Supporting Information

Synthesis of Fused Tetramate-Oxazolidine and -Imidazolidine Derivatives and their Antibacterial Activity

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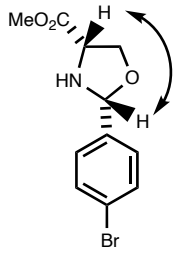
Table of Contents



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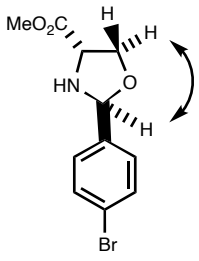

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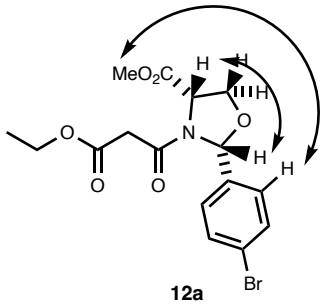

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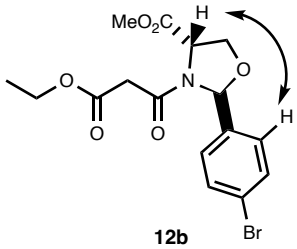

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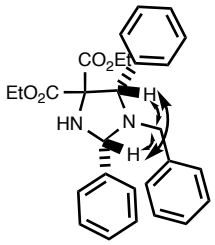

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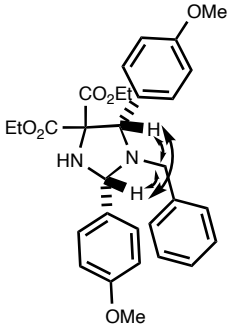

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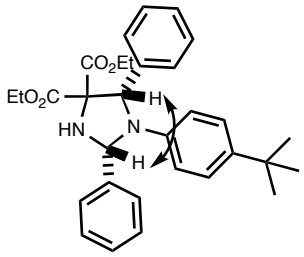

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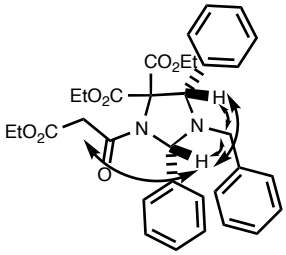

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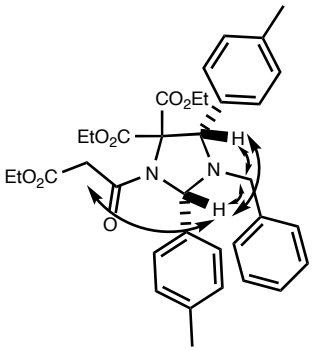

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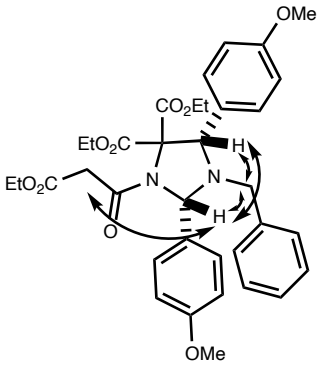

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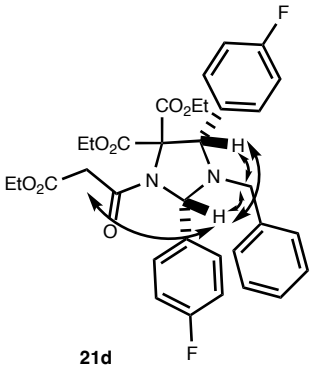

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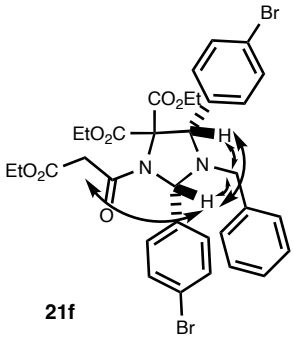

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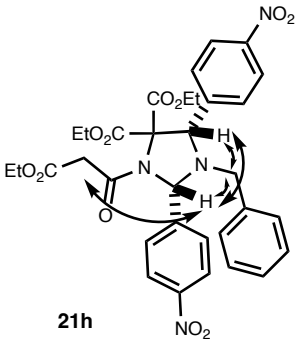

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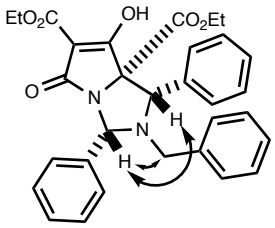

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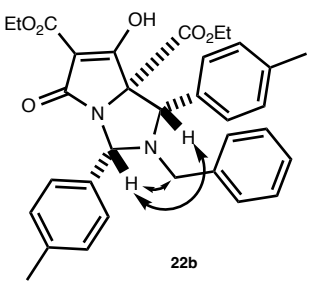

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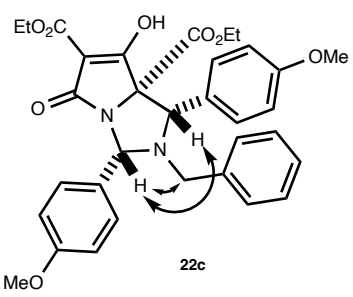

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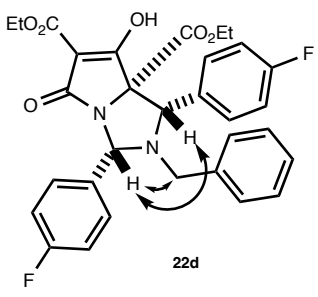

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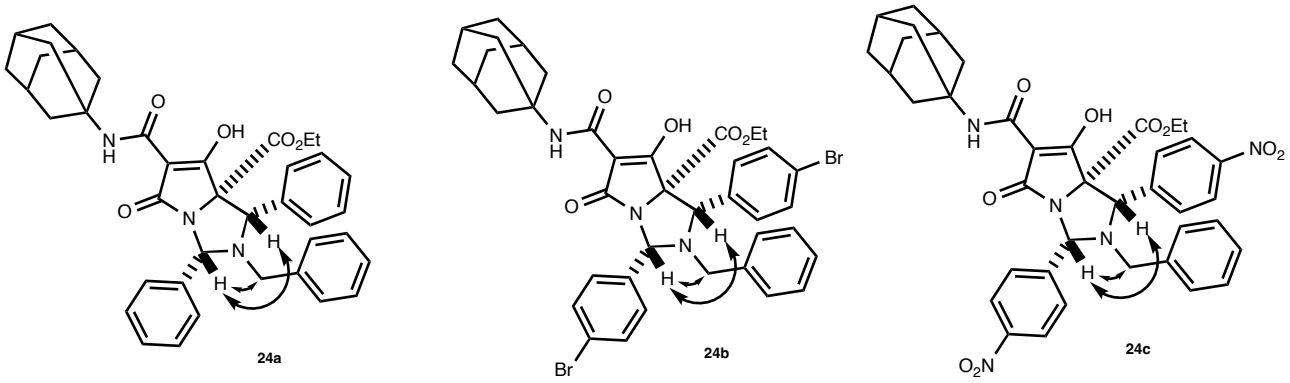
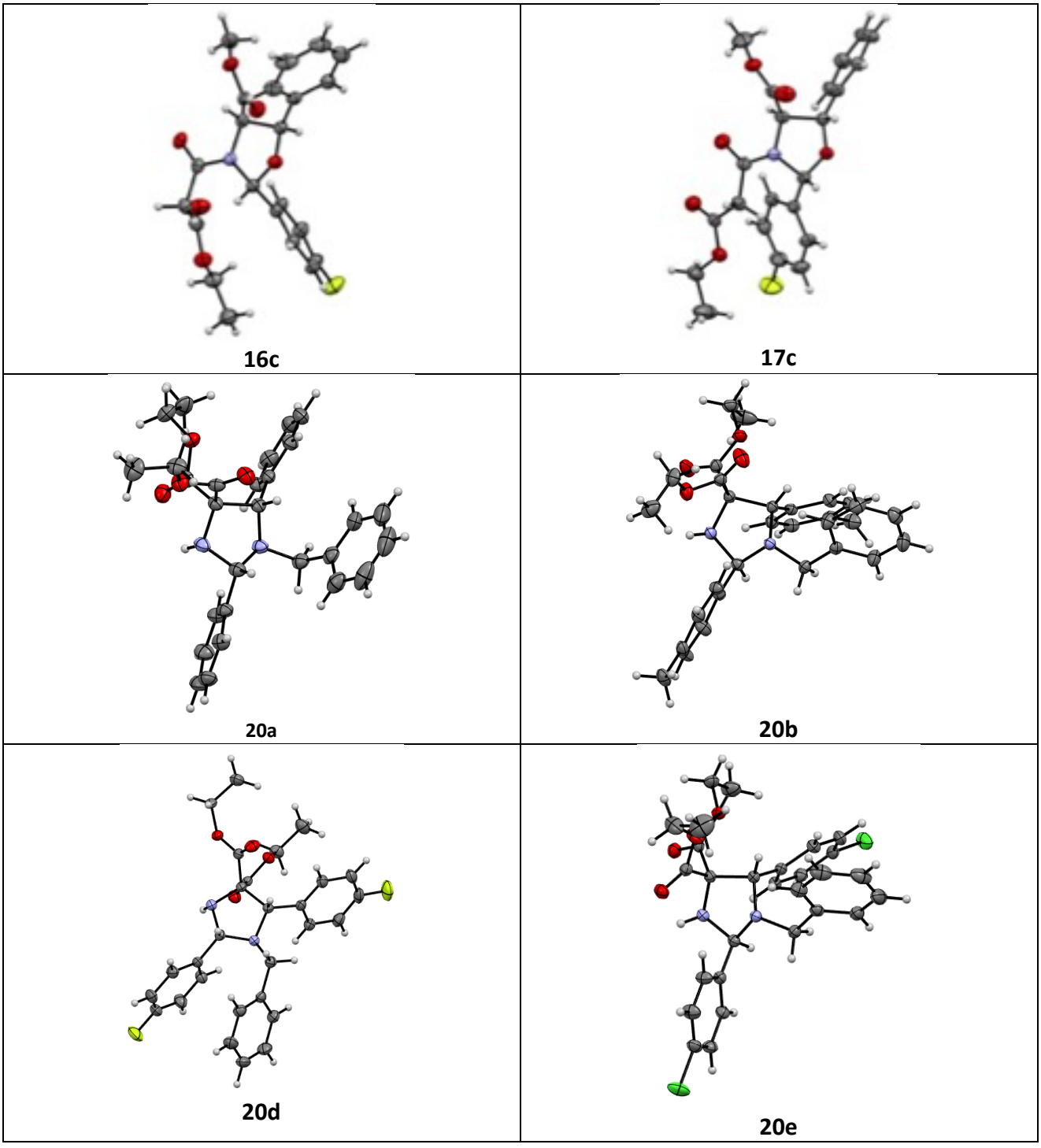


Figure S1: Relative stereochemistry assigned by nOe studies.



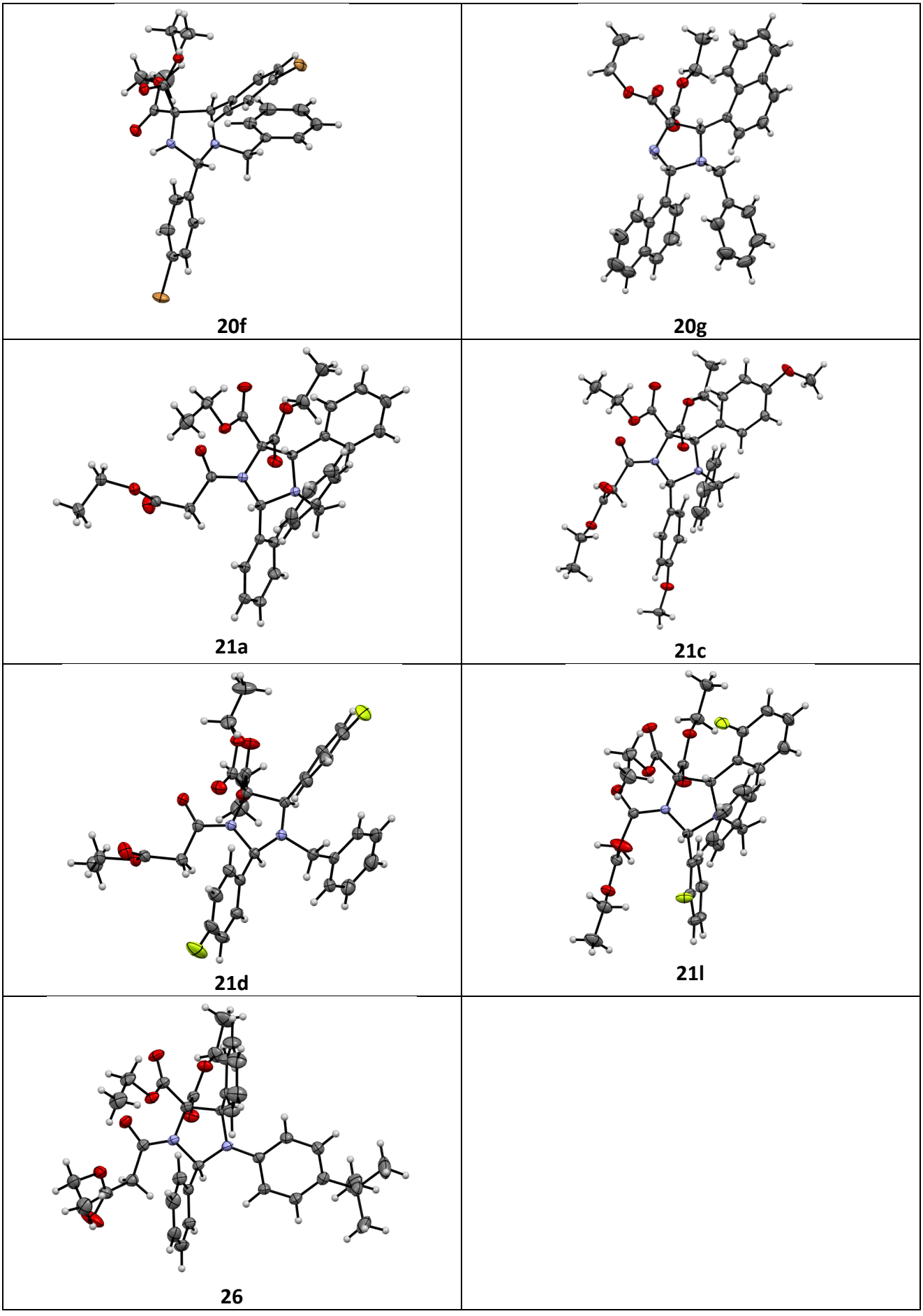


Figure S2: Single-crystal X-ray structures.

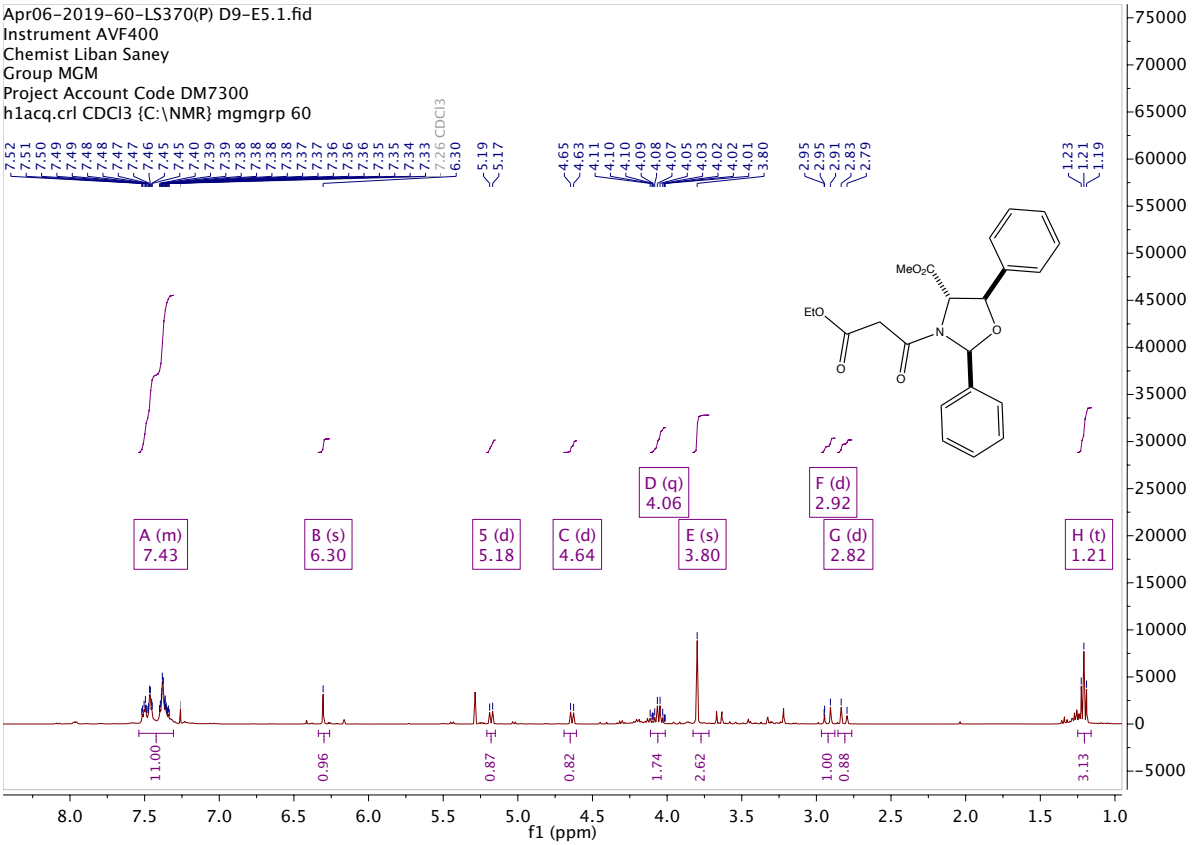


Figure S3: ^{1}H-NMR spectrum of malonamide **17a** at room temperature; $CDCl_3$ solvent, 400 MHz.

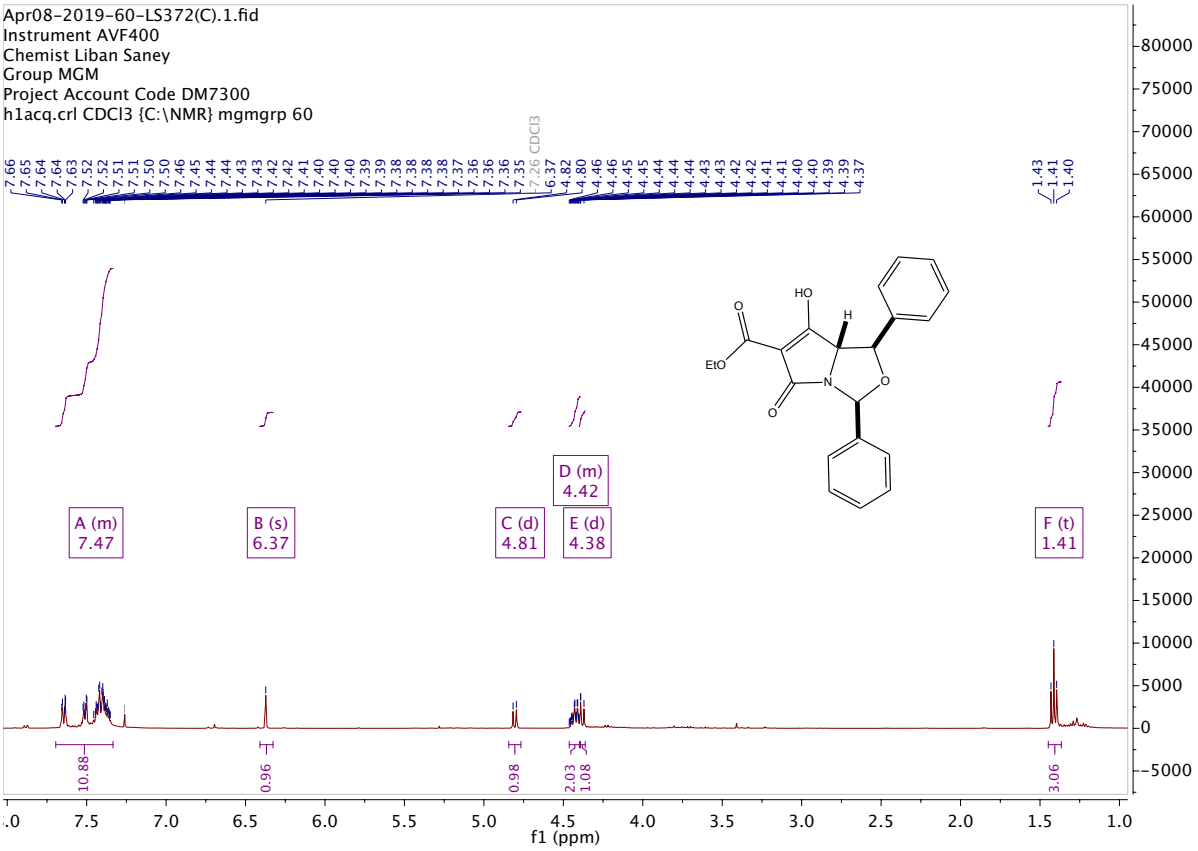


Figure S4: ^{1}H-NMR spectrum of tetramate **18a**, showing the relative purity of the crude material; $CDCl_3$ solvent, 400 MHz.

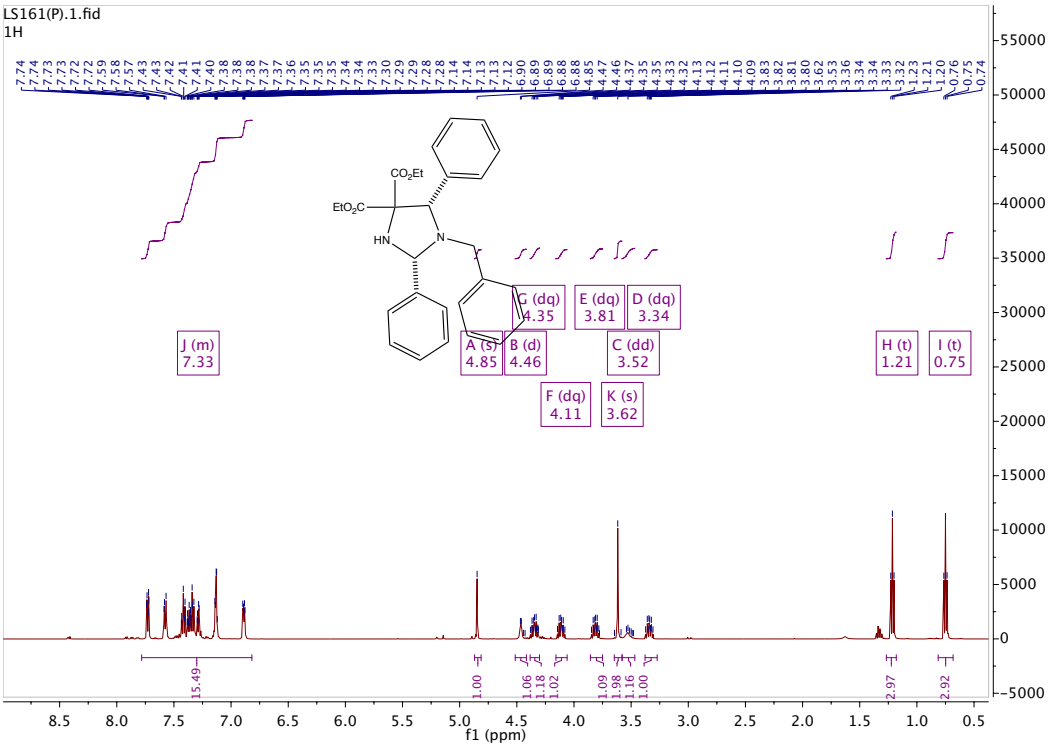


Figure S5: ^{1}H-NMR spectrum of 2,4-*cis* imidazolidine **20a**, showing the distinct diastereotopic methylene protons of the ethyl esters; $CDCl_3$ solution, 500 MHz.

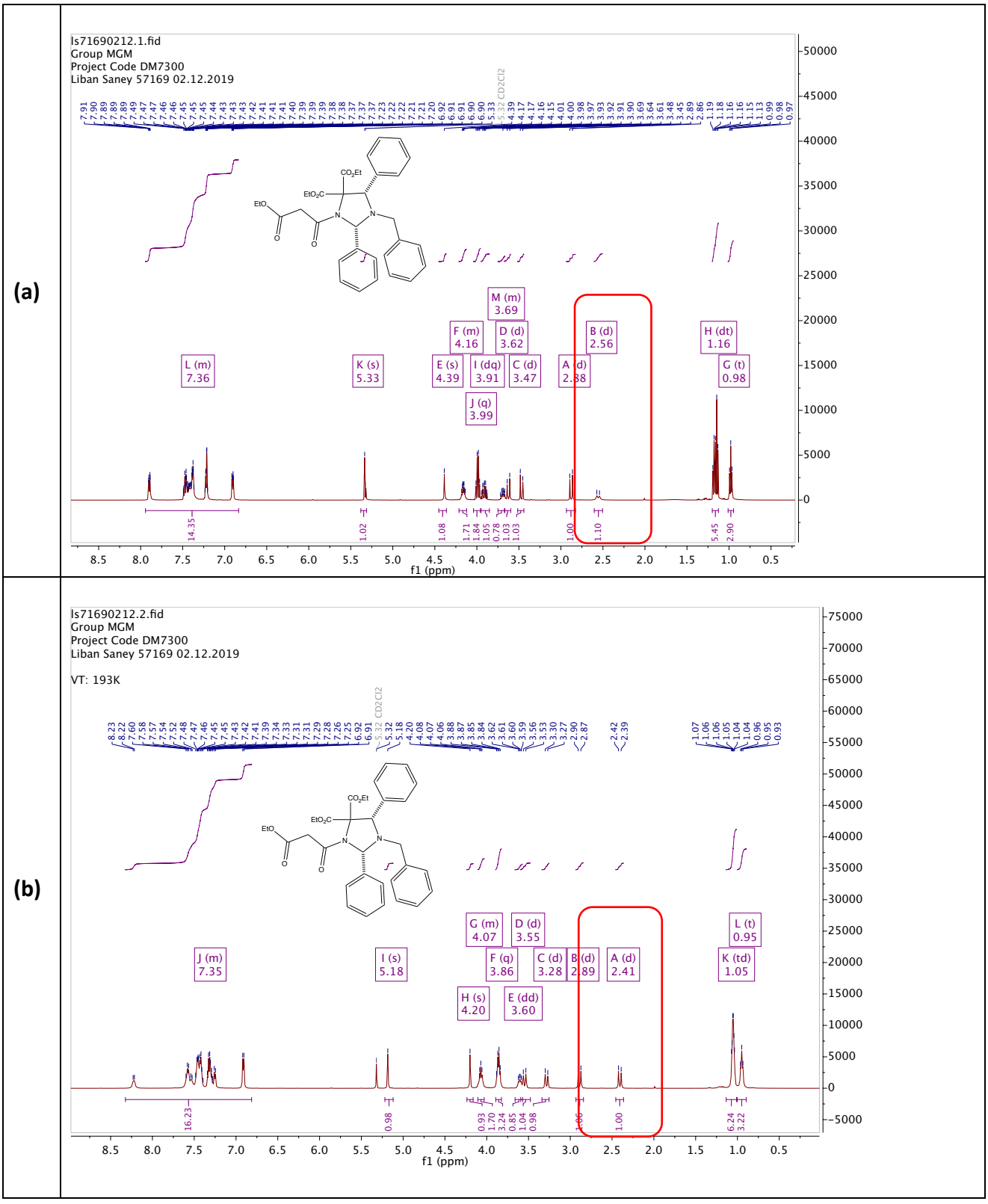


Figure S6: (a) ^{1}H-NMR spectrum of malonamide **21a** at room temperature; **(b)** ^{1}H-NMR spectrum of malonamide **21a** at 193K; with the red rectangle highlighting the diastereotopic H7-methylene protons of interest; CD_2Cl_2 solvent, 500 MHz.

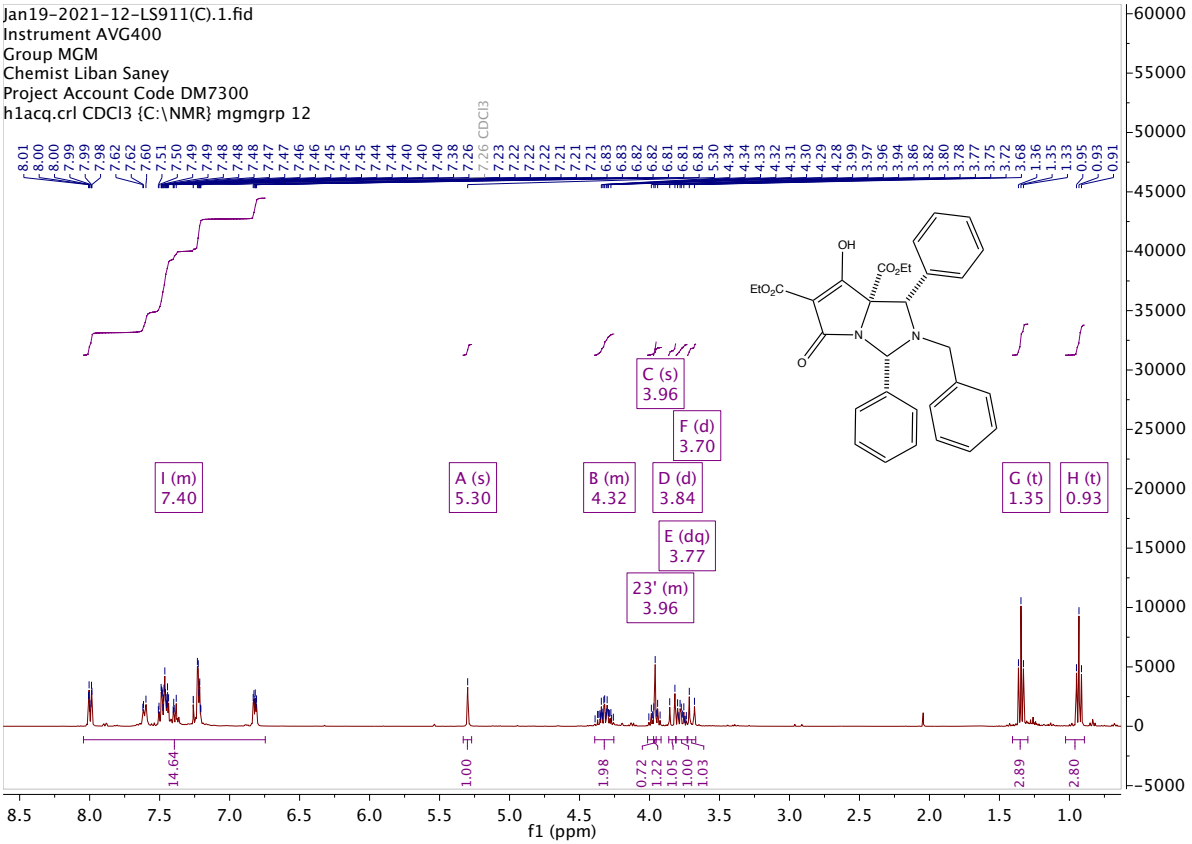


Figure S7: ^{1}H-NMR spectrum of tetramate **22a**, showing the relative purity of the crude material; $CDCl_3$ solution, 400 MHz.

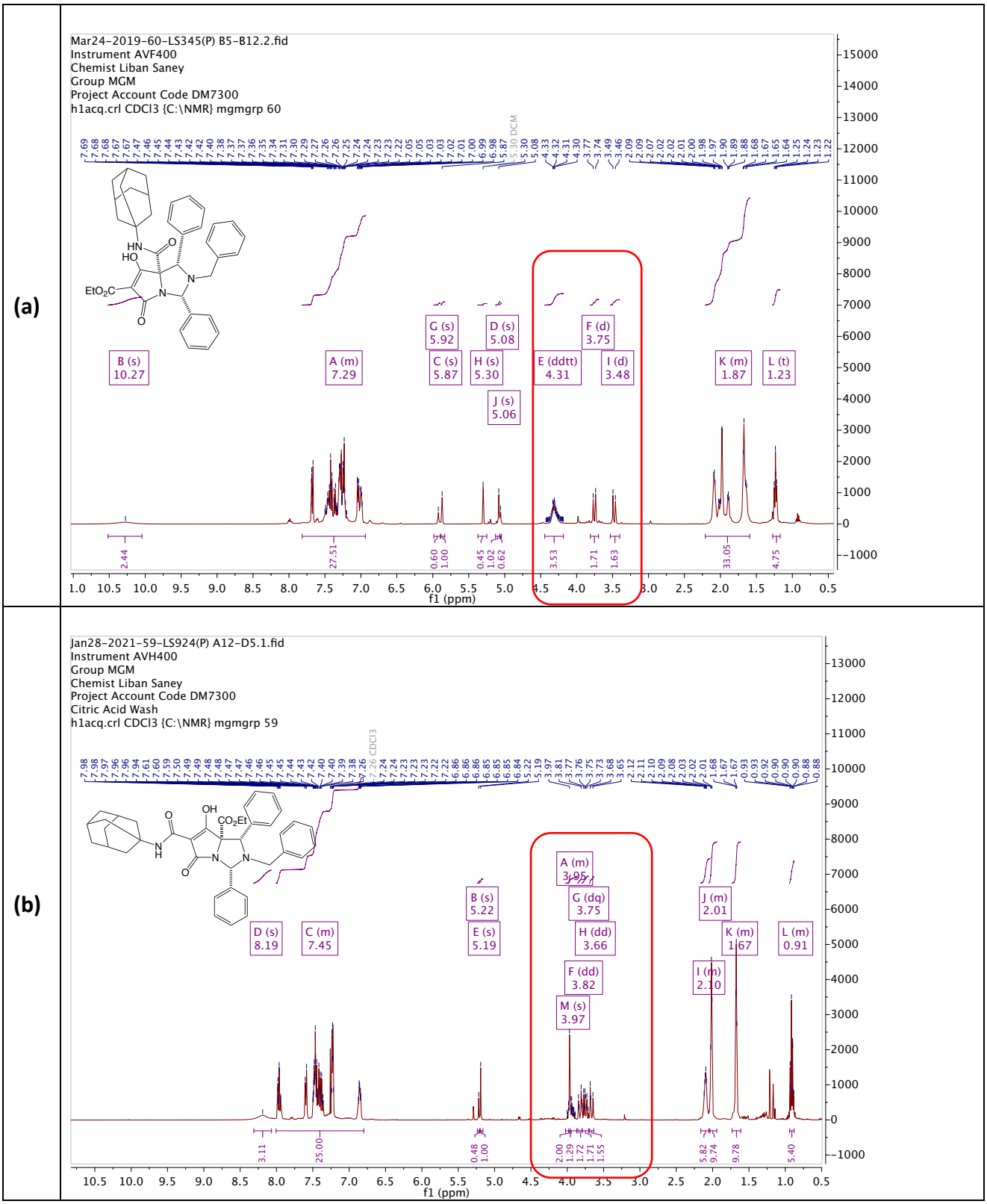


Figure S8: ^{1}H-NMR spectrum post-chromatographic purification after 10% citric acid (aq.) wash; with **(a)** showing the ^{1}H-NMR spectrum of C5-carboxamide **23a** and **(b)** showing the ^{1}H-NMR spectrum of C7-carboxamide **24a**; with the red rectangle highlighting the area of interest within the ^{1}H-NMR spectrum, showing the differences between the two carboxamide products; $CDCl_3$ solvent, 400 MHz.

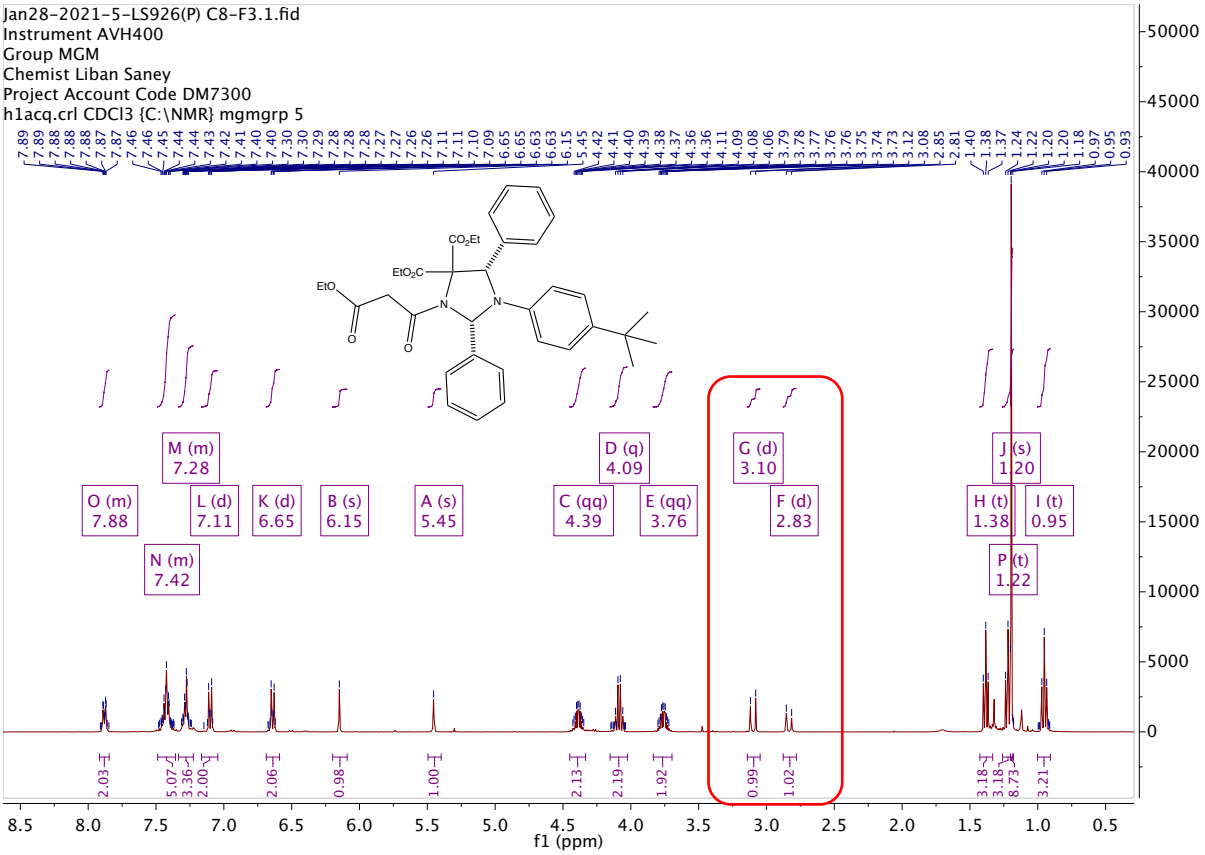


Figure S9: ^{1}H-NMR spectrum of malonamide **26** at room temperature; with the red rectangle highlighting the diastereotopic H7-methylene protons of interest; $CDCl_3$ solvent, 400 MHz.

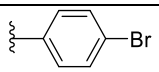
Compound No.	Structure Ar =	δ_H for H-2 (ppm)			10a:11:10b ratio
		Cis 10a	open chain 11	*trans* 10a	
10a,b, 11		5.27	8.28	5.64	1.2:3.3:1

Table S1. Chemical shift values for H-2 and relative population of ring-chain tautomers.

Compound	2,5-*cis* diastereomer δ (ppm) [a]				Compound	2,5-*trans* diastereomer δ (ppm)				dr between 2,5-*cis*/*trans* [b]	Yield (%) [c]
	H2	H4	H5	J_{H4-H5}		H2	H4	H5	J_{H4-H5}		
16a	6.38	5.25	4.81	6.3	**17a**	6.30	5.18	4.64	8.1	1.6:1	14
16b	6.35	5.27	4.81	6.2	**17b**	6.28	5.17	4.63	8.2	1.1:1	43
16c	6.37	5.24	4.82	6.2	**17c**	6.32	5.18	4.65	8.0	1.1:1	49
16d	6.36	5.20	4.80	6.5	**17d**	6.29	5.18	4.64	8.0	1.6:1	25

Table S2: Key chemical shifts (δ), coupling constants (J) and diastereomeric ratio (dr) of 2,5-*cis*/*trans* malonamide diastereomers **16a-d/17a-d**; $CDCl_3$ solvent, 400 MHz; [a] Shown is the ^{1}H-NMR data for the major malonamide rotamer; [b] Determined from ^{1}H-NMR studies of the crude material; [c] Yield includes both diastereomers over two steps from starting amino ester.

Compound	R^1	δ (ppm)				Yield (%)
		H2	H4	H5	J_{H4-H5} (Hz)	
18a	H	6.37	4.81	4.38	8.4	37
18b	Me	6.35	4.80	4.38	8.4	55
18c	F	6.32	4.80	4.37	8.4	64
18d	Br	6.30	4.80	4.35	8.4	62

Table S3: Key chemical shifts (δ), coupling constants (J) and yields of tetramates **18a-d**; $CDCl_3$ solvent, 400 MHz.

Compound	R^1	2,4-*cis* diastereomer δ (ppm)					2,4-*trans* diastereomer δ (ppm)					dr between 2,4-*cis/trans* [a]	Yield (%) [b]
		H2	H4	H6	H6	J_{H6-H6}	H2	H4	H6	H6	J_{H6-H6}		
20a	*p*-H	4.46	4.85	3.62	n.d [c]	n.d [c]	5.19	5.14	2.98	3.50	14.2	2.3:1	65
20b	*p*-Me	4.41	4.76	3.58	n.d[c]	n.d [c]	5.10	5.07	2.95	3.46	14.2	1:1.9	58
20c	*p*-OMe	4.38	4.74	3.56	n.d [c]	n.d. [c]	-	-	-	-	-	>94:6	70 [d]
20d	*p*-F	4.42	4.80	3.53	3.54	14.0	5.12	5.09	2.92	3.45	14.2	2.9:1	Quant.
20e	*p*-Cl	4.42	4.79	3.53	3.57	14.0	5.11	5.08	2.93	3.46	14.2	1:2.3	Quant.
20f	*p*-Br	4.42	4.78	3.53	3.58	14.0	5.10	5.07	2.94	3.46	14.3	1:2.6	96
20g	*o,m*-C_4H_4	5.42	5.98	3.79	3.82	13.8	6.22	6.42	3.31	3.74	14.1	1:3	62
20h	*p*-NO_2	4.62	4.97	3.55	3.59	13.6	5.33	5.25	2.95	3.48	14.3	1:1.1	83
20i	*p*-CF_3	4.55	4.92	3.55	3.61	13.8	5.27	5.21	2.96	3.51	14.3	1:2.4	80
20j	*p*-CN	4.54	4.90	3.52	3.58	13.6	5.25	5.18	2.93	3.49	14.2	1.9:1	77
20k	*m*-Br	4.34	4.77	3.60	n.d [c]	n.d [c]	5.13	5.05	2.98	3.52	14.1	1:2.2	69
20l	*o*-F	4.92	5.30	3.63	n.d [c]	n.d [c]	-	-	-	-	-	>19:1	78 [d]

Table S4: Key chemical shifts, coupling constants, diastereomeric ratio (dr) and yields of imidazolidines **20a-l**; $CDCl_3$ solvent, 400 MHz; [a] Determined from ^{1}H-NMR studies of the crude material; [b] Yields include both diastereomers, however, at times, it was also contaminated with the imine side-product and aldehyde starting material; [c] n.d = not detected as the methylene benzyl protons were not diastereotopic; [d] Yield is only for a single diastereomer.

Compound	R^1	δ (ppm)								Yield (%)
		H2	H4	H6	H6	J_{H6-H6}	H7	H7	J_{H7-H7}	
21a	*p*-H	5.37	4.42	3.63	3.49	14.9	2.89	2.64	15.7	84
21b	*p*-Me	5.29	4.34	3.63	3.46	14.9	2.91	2.63	15.7	67
21c	*p*-OMe	5.28	4.31	3.61	3.46	14.8	2.91	2.64	15.7	56
21d	*p*-F	5.36	4.39	3.58	3.49	14.8	2.87	2.68	15.7	77
21e	*p*-Cl	5.34	4.38	3.57	3.47	14.8	2.88	2.70	15.6	70
21f	*p*-Br	5.34	4.38	3.57	3.49	14.8	2.89	2.72	15.6	76
21g	*o,m*-C_4H_4	6.50	5.55	3.67	3.47	14.9	2.86	2.55	15.8	85
21h	*p*-NO_2	5.55	4.64	3.59	n.d [a]	n.d [a]	2.84	n.d [b]	n.d [b]	Quant.
21i	*p*-CF_3	5.46	4.54	3.58	3.53	14.7	2.87	2.71	15.4	66
21j	*p*-CN	5.45	4.53	3.56	3.51	14.7	2.83	2.72	15.0	69
21k	*m*-Br	5.32	4.38	3.60	3.53	14.7	2.88	2.74	15.7	85
21l	*o*-F	5.89	4.85	3.58	n.d [a]	n.d [a]	3.04	2.72	15.8	79

Table S5: Key chemical shifts, coupling constants and yields of malonamides **21a-l**; $CDCl_3$ solvent, 400 MHz; [a] not detected as the benzyl methylene protons were not diastereotopic; [b] not determined due to a broad multiplet peak.

Compound	R^1	δ (ppm)					Yield (%)
		H2	H4	H9	H9	J_{H9-H9}	
22a	*p*-H	5.30	3.96	3.84	3.70	14.8	77
22b	*p*-Me	5.25	3.90	3.85	3.69	14.7	75
22c	*p*-OMe	5.20	3.88	3.80	3.66	14.8	78
22d	*p*-F	5.26	3.93	3.77	3.67	14.6	77
22e	*p*-Cl	5.27	3.92	3.77	3.66	14.8	75
22f	*p*-Br	5.25	3.91	3.77	3.67	14.6	55
22g	*o,m*-C_4H_4	6.25	4.91	3.81	3.52	14.7	61
22h	*p*-NO_2	5.48	4.15	3.75	n.d [a]	n.d [a]	83
22i	*p*-CF_3	-	-	-	-	-	0
22j	*p*-CN	5.39	4.05	3.72	n.d [a]	n.d [a]	85
22k	*m*-Br	5.18	3.84	3.71	3.63	14.7	70
22l	*o*-F	-	-	-	-	-	0

Table S6: Key chemical shifts, coupling constants and yields of tetramates **22a-l**; $CDCl_3$ solvent, 400 MHz; [a] n.d = not determined as the benzyl methylene protons were not diastereotopic.

21a

C	0.48704400	1.00159000	-0.02972200
N	0.62000900	-0.44173700	-0.23019600
C	-0.54282100	-0.96858000	-0.97365900
N	-1.58915200	0.07499600	-0.83107200
C	-0.77320700	1.29064900	-0.95658100
C	1.89934900	-1.10110500	-0.52958300
C	2.97707000	-0.65682300	0.27466800
O	1.85669300	-1.97144800	-1.40920700
C	4.35932800	-0.94419700	0.12648500
O	5.27065500	-0.48910400	0.84103600
C	-2.39183200	0.00676100	0.40364500
C	0.26879600	1.39609100	1.45056900
O	-0.10353500	2.48886800	1.82930000
O	0.52736300	0.38551200	2.30541800
C	0.85753600	-0.51832500	4.48400600
C	0.43123000	0.71237800	3.70423900
C	-1.52783700	2.61167700	-0.94235800
C	-0.89918700	3.83106900	-0.64847700
C	-1.58021500	5.03973800	-0.78874300
C	-2.90586300	5.06269000	-1.22482300
C	-3.54113100	3.85866000	-1.52580300
C	-2.85616800	2.64964200	-1.39346300
C	-0.97128900	-2.35606900	-0.52318600
C	-1.73400100	-3.15126600	-1.38586200
C	-2.16197900	-4.42078700	-0.99946300
C	-1.82441900	-4.91817100	0.26076200
C	-1.05114500	-4.13780800	1.12192000
C	-0.62571000	-2.86686800	0.73258500
O	4.68096900	-1.79317100	-0.92011600
C	6.20988200	-2.97855000	-2.28622700
C	6.06803800	-2.04076100	-1.09567200
C	-3.76886100	-0.61812900	0.22347800
C	-4.51915800	-0.94930600	1.36024600
C	-5.80918400	-1.46549600	1.24597100
C	-6.37496000	-1.66503000	-0.01577800
C	-5.63411200	-1.34629400	-1.15405800
C	-4.34250700	-0.82817200	-1.03433900
C	1.70023100	1.77397200	-0.62177900
O	1.90757100	1.84208800	-1.81396200
O	2.42599300	2.40584600	0.31719000
C	4.66549500	2.86488600	1.04851300
C	3.68692200	2.98054500	-0.10668300
H	-0.29536300	-1.03292500	-2.04090900
H	-0.31480900	1.22981600	-1.95273000
H	2.75665700	-0.03508200	1.13041900
H	-2.54075000	1.03146500	0.76313600
H	-1.86464900	-0.52263400	1.20752400
H	0.82221800	-0.31090500	5.56013900
H	0.19468200	-1.36396100	4.27260500

H	1.87772000	-0.80862800	4.21535900
H	1.07548600	1.57320100	3.91134200
H	-0.59865800	1.01056300	3.93207200
H	0.11831400	3.84179800	-0.28012000
H	-1.06898100	5.96862700	-0.54706300
H	-3.43562200	6.00703400	-1.32774200
H	-4.57315700	3.85374900	-1.86938400
H	-3.35615900	1.72136400	-1.64576600
H	-1.98681100	-2.77158500	-2.37309400
H	-2.75427600	-5.02377100	-1.68416200
H	-2.15157500	-5.91046400	0.56365000
H	-0.76634100	-4.52435300	2.09810800
H	0.00195100	-2.26651100	1.38333000
H	7.26692100	-3.20914800	-2.47336500
H	5.67404600	-3.91618000	-2.10338500
H	5.78590800	-2.52318700	-3.18764500
H	6.60816100	-1.09923200	-1.26594500
H	6.49698400	-2.48495800	-0.18732200
H	-4.08346900	-0.80178100	2.34700100
H	-6.37163500	-1.71762000	2.14231700
H	-7.37968200	-2.07084000	-0.10870200
H	-6.05967200	-1.50560500	-2.14251400
H	-3.75278900	-0.59457400	-1.91469600
H	5.60234600	3.37073400	0.78216400
H	4.26428800	3.34210200	1.95024000
H	4.88477400	1.81069500	1.25238700
H	4.03354800	2.43706800	-0.98761000
H	3.49671800	4.02251400	-0.39298800

Imaginary Freq = 0
Electronic Energy (EE) = -1914.785005 Hartree
Thermal Free Energy Correction = 0.550704 Hartree
EE + Thermal Free Energy Correction = -1914.234301 Hartree

TS_A

C	0.70544100	0.40504700	0.16331000
N	0.48337800	-1.03665100	0.15256800
C	-0.72549200	-1.39481200	-0.61104700
N	-1.43961300	-0.10582700	-0.80600200
C	-0.30087700	0.82548000	-0.97829000
C	1.62509400	-1.86868100	0.03184300
C	2.77970100	-1.22275700	0.63881500
O	1.52210700	-2.94615800	-0.55307300
C	4.14755900	-1.55281200	0.35227500
O	5.12655700	-1.22576200	1.03256300
C	-2.36856100	0.26409400	0.27765600
C	0.44179400	0.95813300	1.57369600
O	0.47748100	0.30018700	2.59365400
O	0.15235100	2.27990000	1.57882600

C	-0.28585000	4.35653300	2.66493900
C	0.01352200	2.88287900	2.87662000
C	-0.65486000	2.26851000	-1.29849700
C	0.30039700	3.29155300	-1.18538900
C	0.01185700	4.58864800	-1.60611600
C	-1.23512300	4.89930900	-2.15371200
C	-2.18712100	3.88987300	-2.28401500
C	-1.89553400	2.58815300	-1.86870200
C	-1.54176500	-2.49969900	0.03972200
C	-2.39819700	-3.27859200	-0.74638100
C	-3.16347600	-4.29577300	-0.17724500
C	-3.07606800	-4.55191100	1.19262100
C	-2.21470600	-3.78771000	1.98172500
C	-1.44912200	-2.77030200	1.40964500
O	4.32317100	-2.21644700	-0.83933200
C	5.64600000	-3.21022500	-2.53684600
C	5.67395100	-2.47733700	-1.20427700
C	-3.82509600	-0.07436500	-0.00886500
C	-4.74877000	-0.07071300	1.04523100
C	-6.10387500	-0.30544800	0.81501600
C	-6.56215300	-0.55375400	-0.48109100
C	-5.64990200	-0.56847700	-1.53677600
C	-4.29373400	-0.33177200	-1.30164500
C	2.20339700	0.68408000	-0.29155600
O	2.48896800	0.67351200	-1.48802200
O	2.79275700	1.58521100	0.59490000
C	4.95058100	2.10579000	1.50868900
C	4.10844700	2.03825200	0.24444000
H	-0.41702900	-1.75063100	-1.60305800
H	0.24207100	0.46806600	-1.86477300
H	2.62942100	-0.82541400	1.63557600
H	-2.30164200	1.34905000	0.41247400
H	-2.08553600	-0.17603100	1.24284900
H	-0.40314100	4.85808700	3.63299100
H	0.52739300	4.84254500	2.11699500
H	-1.20760900	4.48896300	2.08937200
H	-0.78872200	2.37729700	3.42566900
H	0.94181300	2.72913600	3.43714300
H	1.27050100	3.07343900	-0.75657500
H	0.77032000	5.36183100	-1.50485600
H	-1.45757700	5.91341000	-2.47839300
H	-3.16193700	4.10745700	-2.71517500
H	-2.64019400	1.81050400	-1.99621200
H	-2.45953100	-3.08726700	-1.81515800
H	-3.82376500	-4.89135800	-0.80359600
H	-3.66773900	-5.34811800	1.63914500
H	-2.12901700	-3.98954100	3.04710500
H	-0.75921600	-2.18662900	2.01203000
H	6.66589100	-3.44179700	-2.86993600
H	5.08482400	-4.14652900	-2.44901600

H	5.15876600	-2.59694300	-3.30217200
H	6.23352000	-1.53571700	-1.27770800
H	6.16589900	-3.07704600	-0.42746800
H	-4.39814000	0.11348100	2.05917600
H	-6.80204800	-0.30176800	1.64923500
H	-7.61785600	-0.74115300	-0.66336500
H	-5.99274400	-0.77013500	-2.54939400
H	-3.57409900	-0.36124800	-2.11350100
H	5.93768400	2.52927300	1.28098000
H	4.47252400	2.73849300	2.26634400
H	5.08592900	1.09646400	1.90734600
H	4.54251600	1.35220600	-0.48581900
H	4.02023200	3.02424600	-0.23510000

Imaginary Freq = 1
Electronic Energy (EE) = -1914.772255 Hartree
Thermal Free Energy Correction = 0.551544 Hartree
EE + Thermal Free Energy Correction = -1914.220711 Hartree

TS_B

C	1.24391800	-0.46148400	0.86781400
N	0.33467700	0.57787300	1.32402200
C	-0.96185200	-0.06366600	1.60115100
N	-1.11971200	-1.03912500	0.48913500
C	0.22283400	-1.66160600	0.49947900
C	0.65600800	1.91965700	1.01300700
C	2.08736800	2.04929000	0.78671100
O	-0.21352100	2.78877500	0.92861000
C	2.68108400	3.15509900	0.08008400
O	3.83795700	3.55352700	0.19869500
C	-1.52633800	-0.42901500	-0.78985100
C	2.17913200	0.10286500	-0.26167700
O	3.35732300	-0.24925200	-0.36110600
O	1.40748700	0.37426000	-1.38366200
C	1.17930400	1.35092300	-3.54118100
C	2.15718100	0.76521700	-2.53643800
C	0.47766100	-2.64672400	-0.63585200
C	1.72666900	-2.83976000	-1.24176500
C	1.90049700	-3.83529000	-2.20710300
C	0.84150500	-4.65999200	-2.58473200
C	-0.40396300	-4.48381700	-1.97952500
C	-0.57911800	-3.49416600	-1.01333000
C	-2.21287900	0.72408000	1.97332100
C	-2.88360800	0.28821400	3.12636700
C	-4.08677300	0.86290700	3.53883900
C	-4.65128300	1.89464400	2.79180600
C	-3.99678000	2.34010000	1.64200200
C	-2.79264500	1.76702000	1.23499400
O	1.84063800	3.73883600	-0.85983600

C	1.26093200	5.51342600	-2.33137800
C	2.38545900	4.86704500	-1.53582400
C	-3.00090200	-0.61113300	-1.11909000
C	-3.53072400	0.05264500	-2.23564500
C	-4.86202400	-0.12012700	-2.61117900
C	-5.69588700	-0.96260000	-1.87104700
C	-5.18094300	-1.62265600	-0.75517900
C	-3.84558600	-1.44851900	-0.38375100
C	2.17608300	-0.93928700	2.00111000
O	2.42456800	-0.33251700	3.01887200
O	2.67959300	-2.16861100	1.73854800
C	4.15827600	-3.99171900	2.14708400
C	3.67086800	-2.64918600	2.66215600
H	-0.78050300	-0.70242100	2.47835100
H	0.21817500	-2.28522700	1.40483000
H	2.73432000	1.65940400	1.56301800
H	-0.94487400	-0.89491500	-1.58921000
H	-1.25574700	0.63261900	-0.83466300
H	1.70830500	1.66178400	-4.45084800
H	0.41621600	0.61598700	-3.82282600
H	0.68294100	2.22349600	-3.10592800
H	2.91302600	1.50068700	-2.24433500
H	2.68372500	-0.10729300	-2.94449300
H	2.56787400	-2.21567400	-0.96562500
H	2.87865800	-3.95968900	-2.66652500
H	0.98344100	-5.43040200	-3.33959200
H	-1.24398000	-5.11666300	-2.25752400
H	-1.55125900	-3.36417800	-0.54824800
H	-2.45396700	-0.51859100	3.71618400
H	-4.57524100	0.50417800	4.44206000
H	-5.58773700	2.35205000	3.10378600
H	-4.42146900	3.15027000	1.05430100
H	-2.27392000	2.16720600	0.37740500
H	1.62604300	6.40551900	-2.85642700
H	0.85568800	4.81855200	-3.07543100
H	0.44313700	5.80787100	-1.66546500
H	2.81250200	5.56768700	-0.80865200
H	3.20987700	4.55644000	-2.19312100
H	-2.88787100	0.71325600	-2.81498200
H	-5.25061900	0.40600200	-3.48058500
H	-6.73615000	-1.09684100	-2.15905800
H	-5.82206300	-2.27403000	-0.16479400
H	-3.44257700	-1.94495000	0.49272900
H	4.92013700	-4.39948400	2.82209300
H	3.33288800	-4.70860000	2.08164300
H	4.59686100	-3.88458000	1.15019000
H	4.48062200	-1.91477600	2.72000400
H	3.22557700	-2.73039200	3.66041100

Imaginary Freq = 1

Electronic Energy (EE) = -1914.757302 Hartree

Thermal Free Energy Correction = 0.55107 Hartree
EE + Thermal Free Energy Correction = -1914.206232 Hartree

Product A

C	0.73333900	0.28494800	0.31171100
N	0.39634000	-1.13585700	0.29461200
C	-0.82259200	-1.41229900	-0.49226300
N	-1.36651100	-0.06440100	-0.79988600
C	-0.11916000	0.75300300	-0.90278300
C	1.47424000	-1.99522600	0.27424000
C	2.71163400	-1.18804400	0.63260200
O	1.38419200	-3.18428600	-0.00046200
C	4.01180400	-1.74659700	0.14610300
O	5.06217800	-1.72107700	0.77009500
C	-2.34109400	0.44742300	0.18107300
C	0.46519800	0.85308500	1.69066500
O	0.51336600	0.20673000	2.72296900
O	0.19145500	2.17972700	1.68452400
C	-0.17173800	4.27930800	2.74918000
C	0.15652500	2.81308500	2.97220800
C	-0.30579200	2.21163800	-1.27512800
C	0.73758200	3.12983400	-1.07642200
C	0.62547700	4.44211800	-1.53213200
C	-0.52490000	4.87002100	-2.20049300
C	-1.55999700	3.96231200	-2.41692600
C	-1.44626400	2.64435500	-1.96576300
C	-1.77774900	-2.37759900	0.19014300
C	-2.69255400	-3.10391700	-0.58055600
C	-3.57856800	-3.99887600	0.01812800
C	-3.55531900	-4.18362600	1.40188700
C	-2.63761800	-3.47152800	2.17618000
C	-1.75057400	-2.57687800	1.57527500
O	3.92856000	-2.24409000	-1.10437700
C	4.84309600	-3.14230600	-3.10206500
C	5.15778700	-2.69006000	-1.68645600
C	-3.79400300	0.21946900	-0.21202600
C	-4.79489500	0.32050900	0.76369000
C	-6.14229000	0.18924000	0.42872000
C	-6.51548700	-0.05083600	-0.89580600
C	-5.52674700	-0.16097000	-1.87448500
C	-4.17888000	-0.02764400	-1.53458500
C	2.36570500	0.27103900	-0.02644400
O	2.64055800	0.39206400	-1.25749000
O	2.89708200	1.32365300	0.88529700
C	5.22284500	1.62943500	1.52487100
C	4.12767400	1.91293100	0.49750100
H	-0.51001600	-1.86643300	-1.44250800
H	0.46243400	0.32817800	-1.73576000

H	2.77064900	-1.05968400	1.71545000
H	-2.18356900	1.52738100	0.26381700
H	-2.18011400	0.04602500	1.19090600
H	-0.19372800	4.81057500	3.70842000
H	0.57736300	4.74976600	2.10501100
H	-1.14870300	4.39150000	2.26728200
H	-0.59059100	2.31864100	3.60316000
H	1.13250400	2.68102600	3.45200900
H	1.63254000	2.80459000	-0.56064200
H	1.44738400	5.13524300	-1.36536300
H	-0.60881500	5.89625800	-2.55219800
H	-2.46069000	4.27209500	-2.94303000
H	-2.25258500	1.94521000	-2.15990700
H	-2.70832900	-2.96556900	-1.65897600
H	-4.28392900	-4.55406000	-0.59588800
H	-4.24181000	-4.88459000	1.87161400
H	-2.60329000	-3.61883400	3.25321900
H	-1.01979300	-2.03565600	2.16945200
H	5.75498300	-3.49202200	-3.60168200
H	4.11403200	-3.95920900	-3.09284300
H	4.42018600	-2.31476200	-3.68028500
H	5.88289200	-1.86846800	-1.67357900
H	5.57540800	-3.50374200	-1.08117400
H	-4.51171200	0.49886800	1.79945600
H	-6.90160000	0.26712000	1.20386700
H	-7.56524800	-0.15754400	-1.15955200
H	-5.80395700	-0.35562600	-2.90841600
H	-3.40169000	-0.13151500	-2.28505900
H	6.15454100	2.14396200	1.24863700
H	4.92009900	1.98393500	2.51817400
H	5.42096200	0.55528000	1.58690400
H	4.40057400	1.54574900	-0.49830300
H	3.97558300	3.00226100	0.41119200

Imaginary Freq = 0
Electronic Energy (EE) = -1914.781455 Hartree
Thermal Free Energy Correction = 0.552112 Hartree
EE + Thermal Free Energy Correction = -1914.229343 Hartree

Product B

C	-1.42434600	0.04035800	-0.89930100
N	-0.26440300	0.75010000	-1.41201800
C	0.80916800	-0.20183800	-1.73195200
N	0.63945500	-1.25921500	-0.69963800
C	-0.84183000	-1.41108200	-0.66960200
C	-0.29560900	2.11302800	-1.24055000
C	-1.53120700	2.44586600	-0.40966700
O	0.52333000	2.91132900	-1.67952100
C	-1.32706200	3.60191100	0.52029500
O	-2.13412700	4.48792200	0.73263100

C	1.28058200	-0.98300200	0.59548200
C	-2.01081500	1.03103300	0.28373600
O	-3.24880700	0.92666300	0.55413500
O	-1.06419200	0.77439100	1.40540800
C	-0.61282800	0.62049900	3.73817000
C	-1.60228500	1.08326800	2.67618300
C	-1.37239000	-2.33077200	0.41916900
C	-2.51504300	-2.04112600	1.17749700
C	-2.99928400	-2.97694500	2.09633400
C	-2.36229500	-4.20526700	2.27650500
C	-1.22814200	-4.50241200	1.51818600
C	-0.74572500	-3.57606900	0.59418000
C	2.22650700	0.31470800	-1.90043800
C	3.00201600	-0.27613000	-2.90599400
C	4.33441300	0.08731600	-3.10307400
C	4.91363800	1.06057700	-2.29023600
C	4.14878200	1.66167700	-1.28892500
C	2.81771800	1.29606000	-1.09317900
O	-0.11895800	3.56380100	1.15320300
C	1.56334600	4.48797200	2.55980100
C	0.14432900	4.65386900	2.04252200
C	2.64694700	-1.63180400	0.75758000
C	3.48204800	-1.20915300	1.80195700
C	4.70948400	-1.82678800	2.03867000
C	5.13172500	-2.88232100	1.22660000
C	4.31274500	-3.30620100	0.17943000
C	3.08250800	-2.68677300	-0.05121600
C	-2.55296900	0.02007100	-1.92826000
O	-2.73107800	0.84267000	-2.80392700
O	-3.38549400	-1.02627900	-1.72330300
C	-5.44398000	-2.18889600	-2.00144400
C	-4.63099300	-0.98259700	-2.43706900
H	0.53802000	-0.68695100	-2.68224800
H	-1.06325300	-1.94225000	-1.60844700
H	-2.35814200	2.71064200	-1.07059700
H	0.62670000	-1.38637700	1.37214700
H	1.33482900	0.08788500	0.81820200
H	-0.98424600	0.85946000	4.74360900
H	-0.45870800	-0.46268500	3.67687500
H	0.35895600	1.11109300	3.60468300
H	-1.78070100	2.16626200	2.77813400
H	-2.57564400	0.59585400	2.80606100
H	-3.02205700	-1.08572100	1.04610400
H	-3.88518800	-2.73390000	2.67950300
H	-2.74416700	-4.92438800	2.99853800
H	-0.71822400	-5.45554100	1.64258900
H	0.13691900	-3.81218100	0.00590000
H	2.55364500	-1.03591100	-3.54249500
H	4.91433000	-0.38799900	-3.89081500
H	5.95080200	1.35306500	-2.43791100

H	4.58740600	2.42997600	-0.65706100
H	2.23504700	1.80073500	-0.33391200
H	1.81453600	5.30439600	3.24793600
H	1.67376900	3.53848900	3.09448700
H	2.27913900	4.49902200	1.73113600
H	0.01692700	5.60071600	1.50556700
H	-0.58723900	4.64399300	2.85970900
H	3.16073900	-0.38551700	2.43701600
H	5.34007100	-1.48030400	2.85485000
H	6.09063500	-3.36370200	1.40554800
H	4.63317900	-4.12246000	-0.46500400
H	2.44656800	-3.00153400	-0.87220700
H	-6.41603000	-2.19246800	-2.50926800
H	-4.92236500	-3.12102000	-2.24455600
H	-5.61278600	-2.16521100	-0.92060700
H	-5.13450000	-0.04152300	-2.19374300
H	-4.43463800	-0.98834800	-3.51549400

Imaginary Freq = 0
Electronic Energy (EE) = -1914.773673 Hartree
Thermal Free Energy Correction = 0.552133 Hartree
EE + Thermal Free Energy Correction = -1914.22154 Hartree

Table S7: Cartesian coordinates with the associated energies of their optimized structures. Calculation level: M06-2X/def2-TZVP/SMD(THF)//b3lyp/6-31g(d)/SMD(THF)

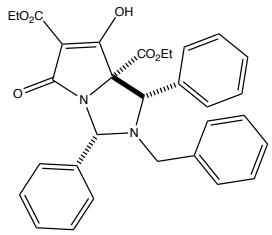
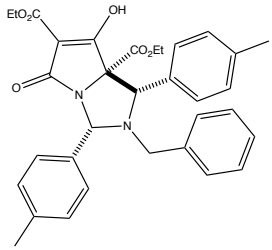
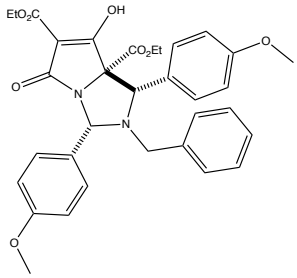
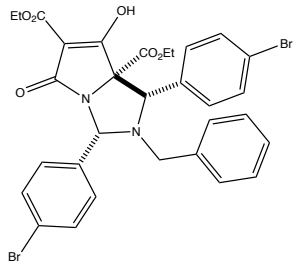
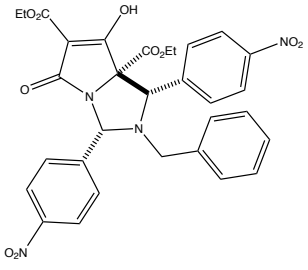
Compound	Structure	M_w (g/mol)	cLogP	PSA (Å²)	MSA (Å²)	rel. PSA (%)	H-donor	H-acceptor	Ro5	MIC (μg/ml)
249a		526.59	5.13	96.38	747.50	12.89	1	5	2/4	0
249b		554.64	6.15	96.38	807.69	11.93	1	5	2/4	31.25
249c		586.64	4.81	114.84	841.76	13.64	1	7	3/4	0
249f		684.38	6.66	96.38	788.37	12.23	1	5	2/4	31.25
249h		616.58	5.00	182.66	819.25	22.30	1	9	3/4	0

Table S8: Physicochemical Properties and MIC values

Experimental

General techniques

Overnight reaction refers to reactions occurring between 15-24 h. All reagents were obtained from commercial sources and was used without further purification. Anhydrous solvents were dried by pre-storing them over activated 3 Å molecular sieves before being passed through an activated alumina column on a solvent tower under N_2 pressure. Solvents were evaporated at 40°C under reduced pressure on a Büchi R-114 rotatory evaporator attached to a Vacuubrand CVC2 pump and a pressure control system, with the exception of water, which was evaporated between 70-80°C. Analytical thin-layer chromatography (TLC) was carried out on Merck aluminium foil backed sheets precoated with 0.2 mm Kielselgel 60 F_{254}. The eluent used is specified in each case. The spots were visualised by UV irradiation (λ=254 nm) and by staining with $KMnO_4$ solution followed by heating. Retention factors (R_f) are quoted to the nearest 0.01. Flash column chromatography was performed on Kielselgel 60 silica gel (230-400 mesh particle size). Melting points were measured using a Stuart Scientific SMP1 melting point instrument and are uncorrected. Infrared spectra were recorded on a Bruker Tensor 27 FT-IR spectrometer equipped with an attached Pike Miracle attenuated total reflectance (ATR) module. Absorption maxima (ν_{max}) are reported in wavenumbers (cm^{-1}) and only selected peaks are reported. ^{1}H-NMR spectra were recorded at 200 MHz, 400 MHz and 500 MHz, ^{13}C-NMR spectra were recorded at 101 MHz or 126 MHz and ^{19}F-NMR spectra were recorded at 377 MHz or 471 MHz using either a Bruker DPX200, AVIIIHD 400 and AVIIIHD 500. Chemical shifts (δ_H, δ_F and δ_C) are reported in parts per million (ppm) upfield from TMS and are referenced to the residual solvent peak (in some cases, it was not possible to reference the chloroform peak in the ^{1}H-NMR spectra due to it being obscured by aromatic protons). Coupling constants (J) are quoted in Hertz (Hz). Data is reported in this format: chemical shift, integration, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, qn = quintet, dd = double doublet, dt = double triplet, dq = double quartet, m = multiplet, br = broad and app = apparent), coupling constant, and assignment. Two-dimensional COSY, HSQC, HMBC and NOESY experiments were recorded at 400 MHz and 500 MHz and nOe experiments were recorded at 500 MHz. Assignments of the spectra were made with ^{1}H, COSY, HSQC, HMBC, ^{13}C and DEPT-135 experiments and

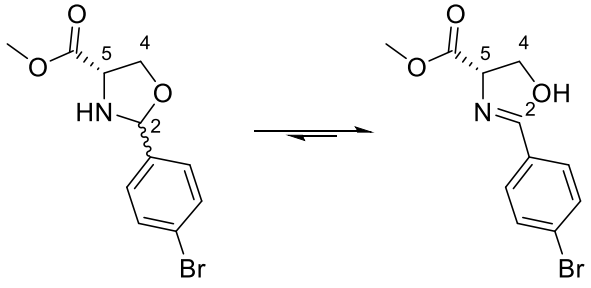
stereochemistry were assigned on the basis of nOe, NOESY or X-ray crystallography. Low resolution mass spectra (*m/z*) were recorded on an Agilent 6120 spectrometer or a Waters LCT Premier XE spectrometer using electrospray ionisation (ESI). Selected peaks are reported in Daltons and their intensities given as percentages of the base peak. High resolution mass spectra (HRMS) were recorded on a Bruker microTOF (ESI) or on an Agilent 7200 Q-TOF (EI or CI). Crystals for X-ray crystallography were grown from slow vapour diffusion of petroleum ether 40:60 into a solution of compound dissolved in minimal EtOAc at room temperature. Low temperature[1] single-crystal X-ray diffraction data were collected using a (Rigaku) Oxford Diffraction SuperNova diffractometer. Raw frame data were collected and reduced using CrysAlisPro and the structures were solved using 'Superflip'[2] before refinement with CRYSTALS[3].

General procedure: Esterification of L-serine and DL-cysteine

To a suspension of the amino acid (1.0 eq) in MeOH (2 mL/mmol) at 0 °C , $SOCl_2$ (1.2 eq) was added drop-wise under continuous stirring and warmed to rt, then refluxed for 1-3 h. The reaction mixture was concentrated *in vacuo* to obtain the respective amino ester.

Methyl (2*RS*,5*S*)-2-(4-bromophenyl)-1,3-oxazolidine-5-carboxylate (A) and Methyl (*S*,*E*)-2-((4-bromobenzylidene)amino)-3-hydroxypropanoate (B), 10a,b, 11

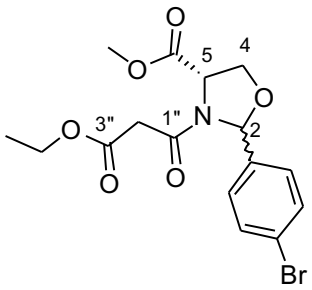
L-Serine methyl ester hydrochloride (1 eq) was dissolved in methanol (5 mL/mmol). Aromatic aldehyde



(1 eq) and Et_3N (2 eq) were then added and the mixture was stirred at rt for 2 h. The solvent was evaporated off and Et_2O (30 mL/mmol) was added to the residue and stirred for 30 min. The mixture was dried over Na_2SO_4, filtered and concentrated *in vacuo* to give oxazolidines in high purity and was used without further purification in the subsequent step. Yield (0.76 g, 98 %); yellow oil; 1:1.5 ring (A) and open chain (B) tautomers. R_f = 0.32 (EtOAc/petrol 1:2); ν_{max}/cm^{-1} (neat) 1733 (C=O); Ring tautomer (A): 1.2:1 *cis* and *trans* diastereomers: δ_H (400 MHz,

CD_2Cl_2) major isomer (*cis*): 2.65 (1H, br. s., NH), 3.76 (3H, s, CO_2CH_3), 3.96 - 4.11 (3H, m, $H4_A$ + $H4_B$ + H5), 5.27 (1H, s, H2), 7.36 - 7.41 (2H, m, Ar-C*H*), 7.47 - 7.54 (2H, m, Ar-C*H*); minor isomer (*trans*): 2.65 (1H, br. s., NH), 3.75 (3H, s, CO_2CH_3), 3.83 (1H, dd, J = 8.0, 5.5 Hz, $H4_A$), 3.96 - 4.03 (1H, m, H5), 4.04 - 4.11 (1H, m, $H4_B$), 5.64 (1H, s, H2), 7.36 - 7.41 (2H, m, Ar-C*H*), 7.47 - 7.54 (2H, m, Ar-C*H*); δ_C (100.6 MHz, CD_2Cl_2) major isomer (*cis*): 53.1 (CO_2CH_3), 60.4 (C5), 69.2 (C4), 93.3 (C2), 122.8, 137.8 (Ar-C), 128.7, 132.1 (Ar-*C*H), 173.3 (CO_2CH_3); minor isomer (*trans*): 52.9 (CO_2CH_3), 59.6 (C5), 68.5 (C4), 92.4 (C2), 123.3, 139.3 (Ar-C), 128.7, 131.9 (Ar-*C*H), 173.3 (CO_2CH_3); Open chain tautomer (B): δ_H (400 MHz, CD_2Cl_2): 2.65 (1H, br. s., OH), 3.73 (3H, s, CO_2CH_3), 3.89 - 4.03 (2H, m, $H4_A$ + $H4_B$), 4.14 (1H, dd, J = 6.1, 4.9 Hz, H5), 7.57 (2H, d, J = 8.6 Hz, H2'), 7.65 (2H, d, J = 8.6 Hz, H3'), 8.28 (1H, s, H2); δ_C (100.6 MHz, CD_2Cl_2): 52.7 (CO_2CH_3), 64.1 (C4), 74.5 (C5), 126.3, 135.1 (Ar-C), 130.5, 132.4 (Ar-*C*H), 164.7 (C2), 171.3 (CO_2CH_3); *m/z* (ESI^+) 286 ($[M+H]^+$ 11 %) and 288 ($[M+H]^+$ 11 %); HRMS (ESI^+); $C_{11}H_{13}O_3NBr$ $[M+H]^+$; found 286.00690 and 288.00482, requires 286.00733 and 288.00529.

Methyl (2*RS*,5*S*)-2-(4-bromophenyl)-1-(3-ethoxy-3-oxopropanoyl)-1,3-oxazolidine-5-carboxylate, 12a,b

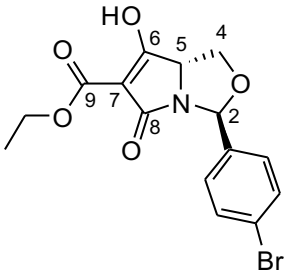


A solution of ethyl hydrogen malonate (1.2 eq) in CH_2Cl_2 (2.5 mL/mmol) was added to a stirred solution of oxazolidine/thiazolidine (1.0 eq), DCC (1.2 eq) and DMAP (0.1 eq) in CH_2Cl_2 (5 mL/mmol) at 0 °C. The mixture was stirred at 0 °C for 15 min and then at rt for 15 h (for thiazolidines) and 4 h (for oxazolidine). The reaction mixture was filtered to remove dicyclohexylurea and the residue was washed with CH_2Cl_2. The combined filtrates were concentrated *in vacuo* and purified by silica gel flash column chromatography (eluent: EtOAc/petrol) to give *N*-acylated oxazolidine **12a,b**. Yield (0.95 g, 51 %); yellow oil; 2.7:1 *cis* and *trans* diastereomers; R_f = 0.31 (*trans*), 0.43 (*cis*) (EtOAc/petrol 1:1); ν_{max}/cm^{-1} (neat) 1666 (C=O), 1741 (C=O); δ_H (400 MHz, $CDCl_3$) major isomer (*cis*, a mixture of two conformers) major conformer: 1.19 - 1.31 (3H, m, OCH_2CH_3), 3.01, 3.04 (2H, ABq, J_{AB} = 15.8 Hz, H2"), 3.80 (3H, s, CO_2CH_3), 4.11 (2H, q, J = 7.1 Hz, OCH_2CH_3), 4.22 - 4.29 (2H, m, H4), 4.86 (1H, app t, J = 5.5 Hz, H5), 6.04 (1H, s, H2), 7.57, 7.60 (4H, ABq, J_{AB} = 8.7 Hz, Ar-

C*H*); minor conformer: 1.19 - 1.31 (3H, m, OCH_2CH_3), 3.39, 3.50 (2H, ABq, J_{AB} = 15.4 Hz, H2"), 3.80 (3H, s, CO_2CH_3), 4.18 (2H, q, J = 7.2 Hz, OCH_2CH_3), 4.22 - 4.29 (1H, m, H4), 4.48 (1H, dd, J = 9.1, 1.8 Hz, H4), 4.77 (1H, dd, J = 6.6, 1.9 Hz, H5), 6.16 (1H, s, H2), 7.40, 7.47 (4H, ABq, J_{AB} = 8.5 Hz, Ar-C*H*); δ_C (100.6 MHz, $CDCl_3$) major isomer (*cis*, a mixture of two conformers) major conformer: 13.9 (OCH_2CH_3), 42.1 (C2"), 52.7 (CO_2CH_3), 58.4 (C5), 61.5 (OCH_2CH_3), 68.5 (C4), 90.6 (C2), 124.4, 135.4 (Ar-C), 129.7, 132.2 (Ar-*C*H), 164.0 (C1"), 166.4 (C3"), 169.9 (C6); minor conformer: 13.9 (OCH_2CH_3), 42.5 (C2"), 53.0 (CO_2CH_3), 58.6 (C5), 61.7 (OCH_2CH_3), 69.6 (C4), 90.8 (C2), 123.1, 135.9 (Ar-C), 129.1, 131.3 (Ar-*C*H), 164.8 (C1"), 166.9 (C3"), 169.9 (CO_2CH_3); δ_H (400 MHz, $CDCl_3$) minor isomer (*trans*, a mixture of two conformers) major conformer: 1.23 (3H, t, J = 7.1 Hz, OCH_2CH_3), 3.04, 3.12 (2H, ABq, J_{AB} = 15.4 Hz, H2"), 3.81 (3H, s, CO_2CH_3), 4.06 - 4.15 (3H, m, OCH_2CH_3 + H4), 4.19 - 4.26 (1H, m, H4), 4.83 (1H, dd, J = 6.7, 2.8 Hz, H5), 6.29 (1H, s, H2), 7.28 (2H, d, J = 8.3 Hz, Ar-C*H*), 7.58 (1H, d, J = 8.3 Hz, Ar-C*H*); minor conformer: 1.31 (3H, t, J = 7.1 Hz, OCH_2CH_3), 3.39 - 3.43 (2H, m, H2"), 3.87 (3H, s, CO_2CH_3), 4.19 - 4.26 (3H, m, OCH_2CH_3 + H4), 4.30 - 4.35 (1H, m, H4), 4.77 (1H, app d, J = 5.6 Hz, H5), 6.42 (1H, s, H2), 7.31 (2H, d, J = 8.3 Hz, Ar-C*H*), 7.50 (1H, d, J = 8.3 Hz, Ar-C*H*); δ_C (100.6 MHz, $CDCl_3$) minor isomer (*trans*, a mixture of two conformers) major conformer: 14.0 (OCH_2CH_3), 42.4 (C2"), 52.8 (CO_2CH_3), 58.7 (C5), 61.6 (OCH_2CH_3), 67.4 (C4), 89.8 (C2), 124.4, 135.4 (Ar-C), 128.7, 132.4 (Ar-*C*H), 163.7 (C1"), 166.0 (C3"), 169.6 (CO_2CH_3); minor conformer: 14.1 (OCH_2CH_3), 42.8 (C2"), 53.4 (CO_2CH_3), 59.0 (C5), 61.8 (OCH_2CH_3), 69.0 (C4), 90.2 (C2), 123.0, 136.3 (Ar-C), 128.2, 131.6 (Ar-*C*H), 164.2 (C1"), 167.1 (C3"), 170.4 (CO_2CH_3); *m/z* (ESI^+) 424 ($[M+Na]^+$ 100%) and 426 ($[M+Na]^+$ 100%); HRMS (ESI^+); $C_{16}H_{19}O_6NBr$ $[M+H]^+$; found 400.03808 and 402.03594, requires 400.03903 and 402.03698.

(2*S*,5*S*)-1-Aza-2-(4-bromophenyl)-7-ethoxycarbonyl-6-hydroxy-8-oxo-3-oxabicyclo[3.3.0]oct-6-ene, 13

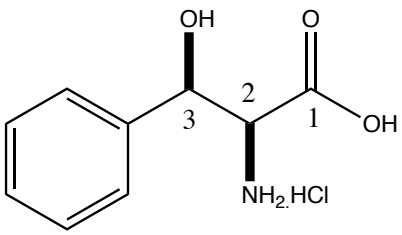
To a solution of the *N*-acylated oxazolidine (1.0 eq) in THF (5 mL/mmol), KO^{t}Bu (1.0 eq) was added and heated at reflux for 3 h. It was then cooled to rt and concentrated *in vacuo*. The crude was purified



directly by silica gel flash column chromatography (eluent; EtOAc/MeOH/1 % Et_3N) to give **13.** Yield (0.19 g, 8 %); yellow solid, mp 136 - 138 °C; R_f = 0.29 (EtOAc/MeOH 9:1); $[\alpha]_D^{25}$ = -13.2, (*c* = 0.33, MeOH); ν_{max}/cm^{-1} (neat) 1639 (C=C), 1697 (C=O), 1738 (C=O); δ_H (400 MHz, Methanol-*d*$_4$): 1.23 - 1.30 (3H, m, OCH_2CH_3), 3.66 - 3.77 (1H, m, $H4_A$), 3.86 - 4.01 (2H, m, $H4_B$ + H5), 4.13 - 4.28 (2H, m, OCH_2CH_3), 6.24 (1H, s, H2), 7.38 (2H, d, *J* = 8.3 Hz, Ar-H), 7.48 (2H, d, *J* = 8.3 Hz, Ar-H); δ_C (100.6 MHz, Methanol-*d*$_4$): 15.2 (OCH_2CH_3), 60.2 (OCH_2CH_3), 65.4 (C5), 67.6 (C4), 89.6 (C2), 92.6 (C7), 123.2, 140.4 (Ar-C), 129.6, 132.5 (Ar-CH), 167.8 (C8), 183.7 (C9), 196.3 (C6); *m/z* (ESI^-) 366.0 and 368.0 ([M-H]$^-$, 100%); HRMS (ESI^-); $C_{15}H_{13}O_5NBr$ [M-H]$^-$; found 365.99948 and 367.99725, requires 365.99826 and 367. 99621.

(2*S,3*R**)-2-Amino-3-hydroxy-3-phenylpropanoic acid hydrochloride salt :**[4,5]

To a stirring solution of 3 M NaOH (aq.) (1.5 eq.) at rt was added glycine (1.0 eq.) and the solution was stirred for 10 min. Benzaldehyde (2.1 eq.) was added and the solution was stirred until a solid condensation cake formed. The solid was broken apart after 48-72 h at rt and 3 M HCl (aq.) was added to acidify the solution to pH 1 and the mixture was stirred until the solid was consumed to give a clear solution. The solution was separated between Et_2O and water and the aqueous layer was reduced to dryness *in-vacuo* to give β-arylserine as a HCl salt that was contaminated with NaCl and was used without further purification.

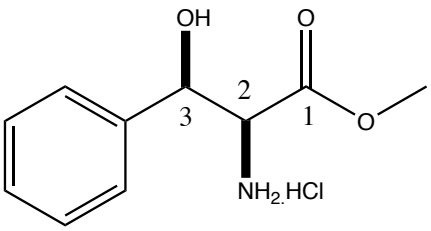


Yield (9.12 g, Quantitative); Off-white solid; m.p. 159-163°C (lit.[4] 150-152°C); ν_{max}/cm^{-1} 3033 (O-H/N-H), 1725 (C=O); Diastereomeric ratio between *threo:erythro* 93:7; $\delta_{H\ (Threo)}$ (400 MHz, D_2O) 4.07 (1H, d, *J*=4.1 Hz, H2), 5.37 (1H, d, *J*=4.0 Hz, H3), 7.28-7.51 (5H, m, Ar-H); $\delta_{c\ (Threo)}$ (101 MHz, D_2O) 60.2 (C2), 71.0 (C3), 125.9 (Ar-C), 128.7 (Ar-C), 129.0 (Ar-C), 138.6 (Ar-C), 171.4 (C1); LRMS (ESI^-) *m/z*: 180.1 ([M – H]$^-$ 96%); HRMS (ESI^-) *m/z*: [M – H]$^-$ calcd. for $C_9H_{10}NO_3$, 180.0666, found 180.0659.

Methyl (2*S,3*R**)-2-amino-3-hydroxy-3-phenylpropanoate hydrochloride salt 1a:**[5,6]

$SOCl_2$ (1.2 eq.) was added dropwise to a stirring solution of amino acid (1.0 eq.) in MeOH at 0°C and left to stir for 15 mins at this temperature. The mixture was then refluxed overnight. The reaction was then stopped and

left to cool to rt and then the solvent was evaporated under reduced pressure to give the methyl ester hydrochloride salt **1a** and was used without further purification.

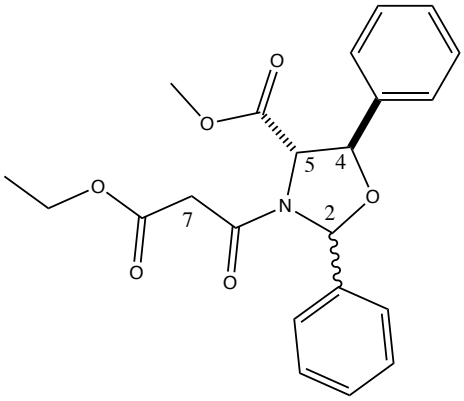


Yield (9.31 g, 96%); Off-white/cream solid; m.p. 168-171°C (lit.[7] 179-180°C); ν_{max}/cm^{-1} 3321 (O-H), 2997 (N-H), 1744 (C=O); $\delta_{H\ (Threo)}$ (400 MHz, D_2O) 3.79 (3H, s, OCH_3), 4.37 (1H, d, *J*=4.0 Hz, H2), 5.40 (1H, d, *J*=4.0 Hz, H3), 7.22-7.46 (5H, m, Ar-H); $\delta_{C\ (Threo)}$ (101 MHz, D_2O) 53.7 (OCH_3), 59.0 (C2), 70.5 (C3), 125.8 (Ar-C), 129.0 (Ar-C), 129.1 (Ar-C), 137.5 (Ar-C), 168.5 (C1); LRMS (ESI^+) *m/z*: 196.1 ($[M + H]^+$ 18%), 218.1 ($[M + Na]^+$ 9%), 391.2 ($[2M + H]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{10}H_{14}NO_3$, 196.0968, found 196.0971.

General procedure for the synthesis of oxazolidines and malonamides:[4, 5,8,9]

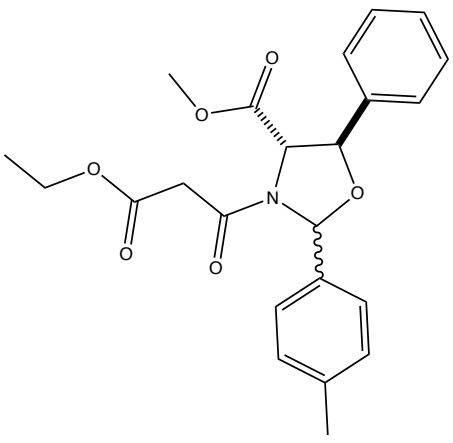
Methyl ester hydrochloride salt **1e** (1 eq.) was suspended in petroleum ether 40:60. The reaction mixture was cooled to 0°C and triethylamine (1.2 eq.) and aromatic aldehyde (1.1 eq.) was added, and the mixture was heated overnight to more than 100°C with continuous removal of water using a Dean-Stark apparatus. The white/brown precipitate was then filtered and washed with Et_2O. The combined filtrates were then concentrated under reduced pressure to furnish the desired oxazolidines **15a-d** as a mixture of diastereomers and was taken on crude into the next reaction sequence. To a stirring solution of oxazolidine **15a-d** (1.0 eq.) in anhydrous DCM at 0°C was added ethyl malonyl chloride (1.1 eq.) and pyridine (1.2 eq.) dropwise. The mixture was stirred at 0°C for 10-20 min and then refluxed overnight. The mixture was then washed with sat. NH_4Cl (aq.), sat. $NaHCO_3$ (aq.), brine, dried over Na_2SO_4, filtered, concentrated under reduced pressure and purified by flash column chromatography to give *N*-acylated oxazolidines **16a-d** and **17a-d**.

Methyl (4*S,5*R**)-3-(3-ethoxy-3-oxopropanoyl)-2,5-diphenyloxazolidine-4-carboxylate 16a, 17a**



Yield (486 mg, 14% over two steps from **1e**); Yellow oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.35(**216a**) and 0.18(**217a**); ν_{max}/cm^{-1} 2933 (C-H), 1742 (C=O), 1663 (C=O); 1.6:1 diastereomeric ratio at the C2-position; **16a** had a mixture of rotamers; δ_H (**216a**, Major rotamer) (400 MHz, $CDCl_3$) 1.23 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.13 (1H, d, *J*=15.6 Hz, H7), 3.16 (1H, d, *J*=15.6 Hz, H7), 3.81 (3H, s, OCH_3), 4.12 (2H, dq, *J*=2.0 Hz, 7.1 Hz, OCH_2CH_3), 4.81 (1H, d, *J*=6.3 Hz, H5), 5.25 (1H, d, *J*=6.3 Hz, H4), 6.38 (1H, s, H2), 7.38-7.81 (10H, m, Ar-H); δ_C (**216a**, Major rotamer) (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.2 (C7), 52.9 (OCH_3), 61.7 (OCH_2CH_3), 64.8 (C5), 80.7 (C4), 90.6 (C2), 126.6 (Ar-C), 127.9 (Ar-C), 129.0 (Ar-C), 129.2 (Ar-C), 129.2 (Ar-C), 130.1 (Ar-C), 136.3 (Ar-C), 136.9 (Ar-C), 164.2 (C=O), 166.5 (C=O), 169.8 (C=O); δ_H (**217a**) (400 MHz, $CDCl_3$) 1.21 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.82 (1H, d, *J*=15.7 Hz, H7), 2.92 (1H, d, *J*=15.7 Hz, H7), 3.80 (3H, s, OCH_3), 4.06 (2H, q, *J*=7.2 Hz, OCH_2CH_3), 4.64 (1H, d, *J*=8.1 Hz, H5), 5.18 (1H, d, *J*=8.1 Hz, H4), 6.30 (1H, s, H2), 7.31-7.54 (10H, m, Ar-H); δ_C (**217a**) (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.3 (C7), 52.8 (OCH_3), 61.5 (OCH_2CH_3), 66.8 (C5), 82.2 (C4), 91.6 (C2), 126.4 (Ar-C), 128.3 (Ar-C), 128.9 (Ar-C), 129.2 (Ar-C), 129.4 (Ar-C), 130.7 (Ar-C), 136.1 (Ar-C), 136.8 (Ar-C), 163.9 (C=O), 166.3 (C=O), 169.6 (C=O); LRMS (**216a**) (ESI$^+$) *m/z*: 420.0 ([M + Na]$^+$ 95%); LRMS (**217a**) (ESI$^+$) *m/z*: 420.0 ([M + Na]$^+$ 95%); HRMS (ESI$^+$) *m/z*: [M + Na]$^+$ calcd. for $C_{22}H_{23}NO_6Na$, 420.1418, found 420.1418.

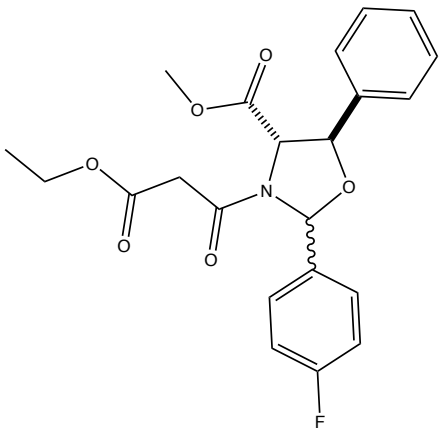
Methyl (4*S,5*R**)-3-(3-ethoxy-3-oxopropanoyl)-5-phenyl-2-(*p*-tolyl)oxazolidine-4-carboxylate 16b, 17b**



Yield (2.32 g, 43% over two steps from **1e**); Pale yellow oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.35(**216b**) and 0.20(**217b**); ν_{max}/cm^{-1} 2985 (C-H), 1742 (C=O), 1662 (C=O); 1.1:1 diastereomeric ratio at the C2-position; **16b** had a mixture of rotamers; δ_H (**216b**, Major rotamer) (400 MHz, $CDCl_3$) 1.23 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.40 (3H, s, CH_3), 3.13 (1H, d, *J*=15.6 Hz, H7), 3.18 (1H, d, *J*=15.6 Hz, H7), 3.82 (3H, s, OCH_3), 4.14 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.81 (1H, d, *J*=6.2 Hz, H5), 5.27 (1H, d, *J*=6.2 Hz, H4), 6.35 (1H, s, H2), 7.27-7.70 (9H, m, Ar-H); δ_C (**216b**, Major rotamer) (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 21.4 (CH_3), 42.2 (C7), 52.8 (OCH_3), 61.7 (OCH_2CH_3), 64.8 (C5), 80.6 (C4), 90.5 (C2), 126.6 (Ar-C), 127.9 (Ar-C), 129.0 (Ar-C), 129.2 (Ar-

C), 129.8 (Ar-C), 133.9 (Ar-C), 136.4 (Ar-C), 140.1 (Ar-C), 164.2 (C=O), 166.6 (C=O), 169.8 (C=O); $\delta_{H\ (\mathbf{217b})}$ (400 MHz, $CDCl_3$) 1.23 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.40 (3H, s, CH_3), 2.84 (1H, d, *J*=15.7 Hz, H7), 2.94 (1H, d, *J*=15.7 Hz, H7), 3.81 (3H, s, OCH_3), 4.08 (2H, q, *J*=7.2 Hz, OCH_2CH_3), 4.63 (1H, d, *J*=8.2 Hz, H5), 5.17 (1H, d, *J*=8.2 Hz, H4), 6.28 (1H, s, H2), 7.26-7.42 (9H, m, Ar-H); $\delta_{C\ (\mathbf{217b})}$ (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 21.5 (CH_3), 42.3 (C7), 52.8 (OCH_3), 61.4 (OCH_2CH_3), 66.8 (C5), 82.1 (C4), 91.5 (C2), 126.4 (Ar-C), 128.2 (Ar-C), 128.9 (Ar-C), 129.2 (Ar-C), 130.1 (Ar-C), 133.8 (Ar-C), 136.2 (Ar-C), 140.9 (Ar-C), 163.9 (C=O), 166.4 (C=O), 169.6 (C=O); LRMS $_{(\mathbf{216b})}$ (ESI^+) *m/z*: 412.7 ($[M + H]^+$ 40%); LRMS $_{(\mathbf{217b})}$ (ESI^+) *m/z*: 412.7 ($[M + H]^+$ 50%); HRMS (ESI^+) *m/z*: $[M + Na]^+$ calcd. for $C_{23}H_{25}NO_6Na$, 434.1574, found 434.1572.

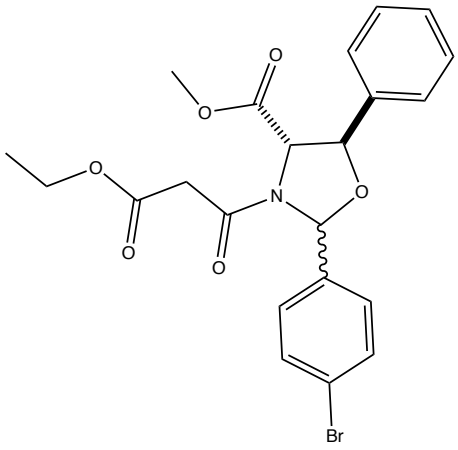
Methyl (4*S,5*R**)-3-(3-ethoxy-3-oxopropanoyl)-2-(4-fluorophenyl)-5-phenyloxazolidine-4-carboxylate 16c,17c**



Yield (2.66 g, 49% over two steps from **1e**); Orange oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.30$_{(\mathbf{216c})}$ and 0.10$_{(\mathbf{217c})}$; ν_{max}/cm^{-1} 2986 (C-H), 1743 (C=O), 1662 (C=O); 1.1:1 diastereomeric ratio at the C2-position; **16c** had a mixture of rotamers; $\delta_{H\ (\mathbf{216c},\ \text{Major rotamer})}$ (400 MHz, $CDCl_3$) 1.23 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 3.14 (1H, d, *J*=15.5 Hz, H7), 3.15 (1H, d, *J*=15.5 Hz, H7), 3.82 (3H, s, OCH_3), 4.14 (2H, m, OCH_2CH_3), 4.82 (1H, d, *J*=6.2 Hz, H5), 5.24 (1H, d, *J*=6.2 Hz, H4), 6.37 (1H, s, H2), 7.05-7.84 (9H, m, Ar-H); $\delta_{C\ (\mathbf{216c},\ \text{Major rotamer})}$ (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.2 (C7), 52.9 (OCH_3), 61.8 (OCH_2CH_3), 64.7 (C5), 80.7 (C4), 89.9 (C2), 116.2 (d, *J*=22.0 Hz, Ar-C), 126.6 (Ar-C), 129.0 (Ar-C), 129.3 (Ar-C), 130.1 (d, *J*=8.4 Hz, Ar-C), 132.8 (d, *J*=3.1 Hz, Ar-C), 136.2 (Ar-C), 163.8 (d, *J*=249.7 Hz, Ar-C), 164.1 (C=O), 166.4 (C=O), 169.9 (C=O); $\delta_{F\ (\mathbf{216c},\ \text{Major rotamer})}$ (377 MHz, $CDCl_3$) -110.93; $\delta_{H\ (\mathbf{217c})}$ (400 MHz, $CDCl_3$) 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.86 (1H, d, *J*=15.6 Hz, H7), 2.94 (1H, d, *J*=15.6 Hz, H7), 3.81 (3H, s, OCH_3), 4.07 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.65 (1H, d, *J*=8.0 Hz, H5), 5.18 (1H, d, *J*=8.0 Hz, H4), 6.32 (1H, s, H2), 7.14-7.53 (9H, m, Ar-H); $\delta_{C\ (\mathbf{217c})}$ (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.3 (C7), 52.9 (OCH_3), 61.6 (OCH_2CH_3), 66.7 (C5), 82.1 (C4), 90.8 (C2), 116.5 (d, *J*=21.6 Hz, Ar-C), 126.4 (Ar-C), 128.9 (Ar-C), 129.3 (Ar-C), 130.3 (d, *J*=8.6 Hz, Ar-C), 132.7 (d, *J*=3.0 Hz, Ar-C), 136.0 (Ar-C), 163.8 (C=O), 163.9 (d,

J=250.6 Hz, Ar-C), 166.2 (C=O), 169.5 (C=O); $\delta_{F\ (\mathbf{217c})}$ (377 MHz, $CDCl_3$) -109.52; LRMS $_{(\mathbf{216c})}$ (ESI^+) *m/z*: 416.6 ([M + H]$^+$ 85%); HRMS (ESI^+) *m/z*: [M + Na]$^+$ calcd. for $C_{22}H_{22}NO_6FNa$, 438.1323, found 438.1322.

Methyl (4*S,5*R**)-2-(4-bromophenyl)-3-(3-ethoxy-3-oxopropanoyl)-5-phenyloxazolidine-4-carboxylate 16d,17d**



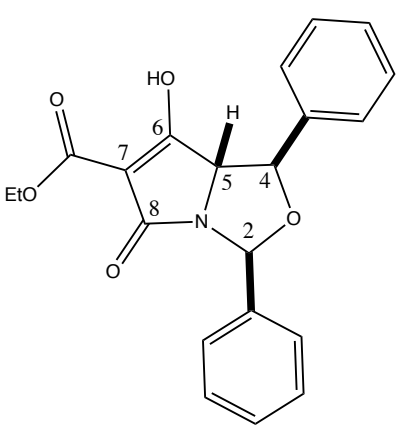
Yield (1.55 g, 25% over two steps from **1e**); Orange oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.28$_{(\mathbf{216d})}$ and 0.13$_{(\mathbf{217d})}$; ν_{max}/cm^{-1} 2983 (C-H), 1744 (C=O), 1664 (C=O); 1.6:1 diastereomeric ratio at the C2-position; **16d** had a mixture of rotamers; $\delta_{H\ (\mathbf{216d},\ Major\ rotamer)}$ (400 MHz, $CDCl_3$) 1.24 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.16 (2H, s, H7), 3.81 (3H, s, OCH_3), 4.14 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.80 (1H, d, *J*=6.5 Hz, H5), 5.20 (1H, d, *J*=6.5 Hz, H4), 6.36 (1H, s, H2), 7.33-7.71 (9H, m, Ar-H); $\delta_{C\ (\mathbf{216d},\ Major\ rotamer)}$ (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.2 (C7), 52.9 (OCH_3), 61.9 (OCH_2CH_3), 64.7 (C5), 80.9 (C4), 89.9 (C2), 124.5 (Ar-C), 126.3 (Ar-C), 126.6 (Ar-C), 129.0 (Ar-C), 129.7 (Ar-C), 132.4 (Ar-C), 135.9 (Ar-C), 136.0 (Ar-C), 164.0 (C=O), 166.4 (C=O), 169.8 (C=O); $\delta_{H\ (\mathbf{217d})}$ (400 MHz, $CDCl_3$) 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.87 (1H, d, *J*=15.6 Hz, H7), 2.95 (1H, d, *J*=15.5 Hz, H7), 3.81 (3H, s, OCH_3), 4.08 (2H, dq, *J*=1.5 Hz, 7.2 Hz, OCH_2CH_3), 4.64 (1H, d, *J*=8.0 Hz, H5), 5.18 (1H, d, *J*=8.0 Hz, H4), 6.29 (1H, s, H2), 7.33-7.89 (9H, m, Ar-H); $\delta_{C\ (\mathbf{217d})}$ (101 MHz, $CDCl_3$) 14.1 (OCH_2CH_3), 42.3 (C7), 52.9 (OCH_3), 61.6 (OCH_2CH_3), 66.7 (C5), 82.3 (C4), 90.9 (C2), 125.0 (Ar-C), 126.3 (Ar-C), 128.9 (Ar-C), 129.3 (Ar-C), 129.9 (Ar-C), 132.6 (Ar-C), 135.9 (Ar-C), 136.0 (Ar-C), 163.7 (C=O), 166.1 (C=O), 169.5 (C=O); LRMS $_{(\mathbf{216d})}$ (ESI^+) *m/z*: 498.0 ([M^{79} + Na]$^+$ 95%), 500.0 ([M^{81} + Na]$^+$ 97%); LRMS $_{(\mathbf{217d})}$ (ESI^+) *m/z*: 498.0 ([M^{79} + Na]$^+$ 94%), 500.0 ([M^{81} + Na]$^+$ 95%); HRMS (ESI^+) *m/z*: [M^{79} + Na]$^+$ calcd. for $C_{22}H_{22}NO_6BrNa$, 498.0523, found 498.0522; [M^{81} + Na]$^+$ calcd. for $C_{22}H_{22}NO_6BrNa$, 500.0504, found 500.0502.

General procedure for the synthesis of tetramates:[5,8,9]

To a solution of malonamide **17a-d** (1.0 eq.) in anhydrous THF was added potassium *tert*-butoxide (1.1 eq.). The mixture was heated at reflux for 3 h. Then the reaction mixture was left to cool to room temperature and then separated between Et_2O and water and the aqueous layer was acidified to pH 1-2 using 3 M HCl solution (aq.)

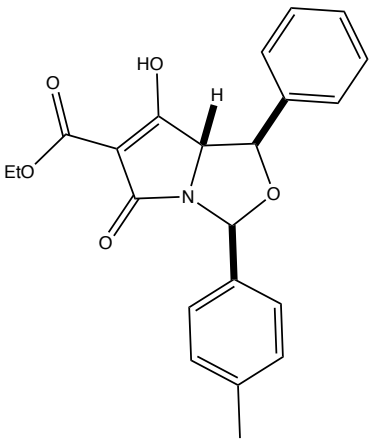
and extracted with EtOAc. The organic layer was washed with brine, dried over Na_2SO_4, filtered and concentrated under reduced pressure to obtain the desired ethyl ester tetramates **18a-d** and was used without further purification.

Ethyl (1*R,3*S**,7a*S**)-7-hydroxy-5-oxo-1,3-diphenyl-5,7a-dihydro-1*H*,3*H*-pyrrolo[1,2-*c*]oxazole-6-carboxylate 18a**



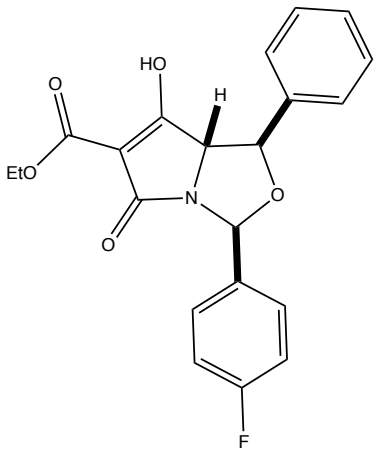
Yield (57 mg, 37%); Orange oil; ν_{max}/cm^{-1} 2983 (C-H), 1700 (C=O), 1661 (C=O), 1614 (C=C); δ_H (400 MHz, $CDCl_3$) 1.41 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 4.38 (1H, d, *J*=8.4 Hz, H5), 4.42 (2H, m, OCH_2CH_3), 4.81 (1H, d, *J*=8.3 Hz, H4), 6.37 (1H, s, H2), 7.36-7.66 (10H, m, Ar-H); δ_C (101 MHz, $CDCl_3$) 14.2 (OCH_2CH_3), 62.0 (OCH_2CH_3), 67.4 (C5), 81.8 (C4), 88.2 (C2), 100.1 (C7), 126.3 (Ar-C), 126.6 (Ar-C), 128.6 (Ar-C), 128.8 (Ar-C), 128.9 (Ar-C), 129.1 (Ar-C), 135.7 (Ar-C), 139.0 (Ar-C), 167.3 (C=O), 175.2 (C8), 185.7 (C6); LRMS (ESI$^-$) *m/z*: 364.0 ([M – H]$^-$ 100%); HRMS (ESI$^-$) *m/z*: [M - H]$^-$ calcd. for $C_{21}H_{18}NO_5$, 364.1191, found 364.1195.

Ethyl (1*R,3*S**,7a*S**)-7-hydroxy-5-oxo-1-phenyl-3-(*p*-tolyl)-5,7a-dihydro-1*H*,3*H*-pyrrolo[1,2-*c*]oxazole-6-carboxylate 18b**



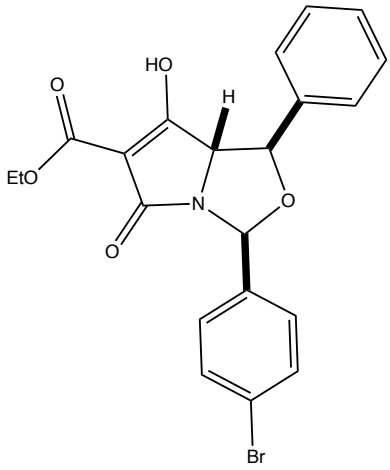
Yield (567 mg, 55%); Orange oil; δ_H (400 MHz, $CDCl_3$) 1.42 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.39 (3H, s, CH_3), 4.38 (1H, d, *J*=8.4 Hz, H5), 4.43 (2H, m, OCH_2CH_3), 4.80 (1H, d, *J*=8.3 Hz, H4), 6.35 (1H, s, H2), 7.23-7.54 (9H, m, Ar-H); δ_C (101 MHz, $CDCl_3$) 14.3 (OCH_2CH_3), 21.3 (CH_3), 62.0 (OCH_2CH_3), 67.5 (C5), 81.8 (C4), 88.3 (C2), 126.3 (Ar-C), 126.6 (Ar-C), 128.9 (Ar-C), 129.1 (Ar-C), 129.3 (Ar-C), 135.8 (Ar-C), 136.2 (Ar-C), 138.6 (Ar-C), 167.4 (C=O), 175.3 (C8), 185.7 (C6).

Ethyl (1*R,3*S**,7a*S**)-3-(4-fluorophenyl)-7-hydroxy-5-oxo-1-phenyl-5,7a-dihydro-1*H*,3*H*-pyrrolo[1,2-*c*]oxazole-6-carboxylate 18c**



Yield (643 mg, 64%); Yellow foamy solid; m.p. 53-58°C; ν_{max}/cm^{-1} 3245 (O-H), 2984 (C-H), 1700 (C=O), 1657 (C=O), 1607 (C=C); δ_H (400 MHz, $CDCl_3$) 1.41 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 4.37 (1H, d, *J*=8.3 Hz, H5), 4.42 (2H, m, OCH_2CH_3), 4.80 (1H, d, *J*=8.4 Hz, H4), 6.32 (1H, s, H2), 7.10 (2H, app t, *J*=8.7 Hz, Ar-H), 7.34-7.50 (5H, m, Ar-H), 7.61 (2H, dd, *J*=5.4 Hz, 8.5 Hz, Ar-H); δ_C (101 MHz, $CDCl_3$) 14.3 (OCH_2CH_3), 62.1 (OCH_2CH_3), 67.4 (C5), 81.8 (C4), 87.8 (C2), 115.5 (d, *J*=21.8 Hz, Ar-C), 126.6 (Ar-C), 128.3 (d, *J*=8.4 Hz, Ar-C), 129.0 (Ar-C), 129.3 (Ar-C), 134.9 (d, *J*=3.1 Hz, Ar-C), 135.6 (Ar-C), 163.1 (d, *J*=247.0 Hz, Ar-C), 167.3 (C=O), 185.8 (C6); δ_F (377 MHz, $CDCl_3$) -113.28.

Ethyl (1*R,3*S**,7a*S**)-3-(4-bromophenyl)-7-hydroxy-5-oxo-1-phenyl-5,7a-dihydro-1*H*,3*H*-pyrrolo[1,2-*c*]oxazole-6-carboxylate 18d**

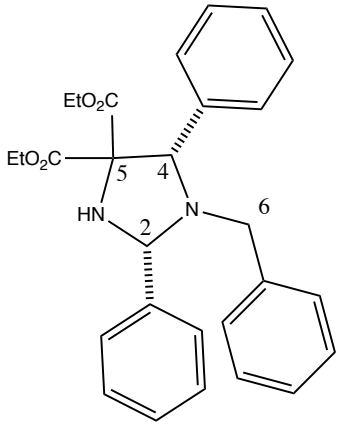


Yield (488 mg, 62%); Red semi-solid/oil; δ_H (400 MHz, $CDCl_3$) 1.41 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 4.35 (1H, d, *J*=8.4 Hz, H5), 4.42 (2H, m, OCH_2CH_3), 4.80 (1H, d, *J*=8.4 Hz, H4), 6.30 (1H, s, H2), 7.40-7.56 (9H, m, Ar-H); δ_C (101 MHz, $CDCl_3$) 14.3 (OCH_2CH_3), 62.1 (OCH_2CH_3), 67.3 (C5), 81.9 (C4), 87.7 (C2), 100.2 (C7), 122.9 (Ar-C), 126.6 (Ar-C), 128.1 (Ar-C), 129.0 (Ar-C), 129.3 (Ar-C), 131.7 (Ar-C), 135.5 (Ar-C), 138.1 (Ar-C), 167.3 (C=O), 171.2 (C8), 185.7 (C6); LRMS (ESI$^-$) *m/z*: 441.9 ([M^{79} – H]$^-$ 95%), 443.9 ([M^{81} – H]$^-$ 97%).

General procedure for the synthesis of Imidazolidine:[5,8-11]

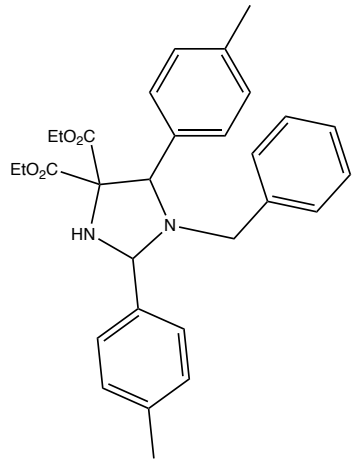
Diethyl aminomalonate hydrochloride salt **19** (1.0 eq.) was suspended in petroleum ether 40:60 and cooled to 0°C. Triethylamine (1.2-1.4 eq.), aldehyde (2.1-2.5 eq.) and amine (1.0-1.2 eq.) were added dropwise, and the mixture was then heated to more than 100°C with continuous removal of water using a Dean-Stark apparatus for 16-24 h. The white/brown precipitate was then filtered and washed with Et_2O. The combined filtrates were then concentrated under reduced pressure and then purified by flash column chromatography to yield the desired imidazolidines **20a-l** and **26**.

Diethyl (2*R,5*S**)-1-benzyl-2,5-diphenylimidazolidine-4,4-dicarboxylate 20a**



Yield (1.64 g, 65%); White solid; m.p. 145-147°C (lit.[10] 147°C); R_f (20% EtOAc in Pet. Ether 40:60) 0.63; ν_{max}/cm^{-1} 3307 (N-H), 3063 (C-H), 3030 (C-H), 2985 (C-H), 1728 (C=O); 2.3:1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.72 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.19 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.32 (1H, dq, *J*=7.2 Hz, 10.6 Hz, OCH_2CH_3), 3.52 (1H, br s, H1 or NH), 3.59 (2H, s, H6), 3.79 (1H, m, OCH_2CH_3), 4.09 (1H, dq, *J*=7.1 Hz, 10.8 Hz, OCH_2CH_3), 4.32 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 4.44 (1H, br s, H2), 4.83 (1H, s, H4), 6.87 (2H, m, Ar-H), 7.10-7.47 (9H, m, Ar-H), 7.56 (2H, m, Ar-H), 7.71 (2H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 52.0 (C6), 61.8 (OCH_2CH_3), 62.1 (OCH_2CH_3), 69.6 (C4), 75.8 (C5), 79.9 (C2), 127.0 (Ar-C), 127.8-127.9 (Ar-C), 128.2 (Ar-C), 128.7 (Ar-C), 129.0 (Ar-C), 130.1 (Ar-C), 134.8 (Ar-C), 138.2 (Ar-C), 138.9 (Ar-C), 169.7 (C=O), 170.2 (C=O); LRMS (ESI^+) *m/z*: 459.2 ($[M + H]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{28}H_{31}N_2O_4$, 459.2278, found 459.2272.

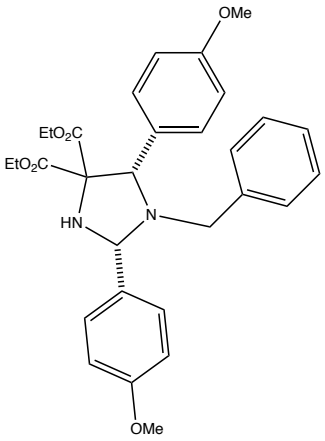
Diethyl 1-benzyl-2,5-bis(4-methylphenyl)imidazolidine-4,4-dicarboxylate 20b



Yield (3.13 g, 58%); Light green oil; R_f (10% EtOAc in Pet. Ether 40:60) 0.38; ν_{max}/cm^{-1} 2982 (C-H), 1729 (C=O); 1:1.9 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.74 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.18 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.35 (3H, s, CH_3), 2.38 (3H, s, CH_3), 3.37 (1H, dq, *J*=7.1 Hz, 10.6 Hz, OCH_2CH_3), 3.52 (1H, br s, H1 or NH), 3.58 (2H, s, H6), 3.80 (1H, m, OCH_2CH_3), 4.08 (1H, m, OCH_2CH_3), 4.30 (1H, m, OCH_2CH_3), 4.41 (1H, m, H2), 4.76 (1H, s, H4), 6.86-7.80 (13H, m, Ar-H); $\delta_{C\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.3 (OCH_2CH_3), 14.0 (OCH_2CH_3), 21.3 (CH_3), 21.4 (CH_3), 51.3 (C6), 61.8 (OCH_2CH_3), 62.1 (OCH_2CH_3), 68.9 (C4), 75.7 (C5), 79.2 (C2), 126.8-138.7 (Ar-C), 169.9 (C=O), 170.3 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.74 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.32 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.34 (6H, s, CH_3, CH_3), 2.95 (1H, d, *J*=14.2 Hz, H6), 3.46 (1H, d, *J*=14.2 Hz, H6), 3.80 (2H, m, OCH_2CH_3), 4.30 (1H, m, OCH_2CH_3), 4.38 (1H, m, OCH_2CH_3), 5.07 (1H, s, H4), 5.10

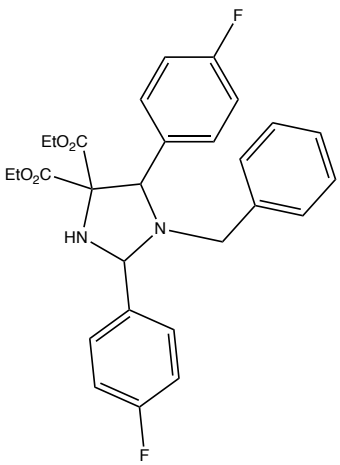
(1H, br s, H2), 6.86-7.80 (13H, m, Ar-H); $\delta_{C\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.3 (OCH_2CH_3), 21.3 (CH_3), 21.3 (CH_3), 49.4 (C6), 61.7 (OCH_2CH_3), 62.4 (OCH_2CH_3), 67.3 (C4), 75.9 (C5), 79.3 (C2), 126.8-138.7 (Ar-C), 168.8 (C=O), 171.0 (C=O); LRMS (ESI^+) *m/z*: 487.2 ($[M + H]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{30}H_{35}O_4N_2$, 487.2591, found 487.2586.

Diethyl (2*R,5*S**)-1-benzyl-2,5-bis(4-methoxyphenyl)imidazolidine-4,4-dicarboxylate 20c**



Yield (2.02 g, 70%); Light green oil; R_f (10% EtOAc in Pet. Ether 40:60) 0.23; ν_{max}/cm^{-1} 2981 (C-H), 1729 (C=O), 1610 (N-H); >94:6 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.79 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.19 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.41 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.56 (2H, s, H6), 3.82 (3H, s, OCH_3), 3.84 (3H, s, OCH_3), 3.85 (1H, m, OCH_2CH_3), 4.08 (1H, m, OCH_2CH_3), 4.31 (1H, m, OCH_2CH_3), 4.38 (1H, s, H2), 4.74 (1H, s, H4), 6.85-7.86 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.0 (OCH_2CH_3), 51.6 (C6), 55.4 (OCH_3), 55.5 (OCH_3), 60.5 (OCH_2CH_3), 61.8 (OCH_2CH_3), 68.8 (C4), 75.5 (C5), 79.1 (C2), 113.7 (Ar-C), 114.1 (Ar-C), 127.0 (Ar-C), 127.8 (Ar-C), 129.9-130.1 (Ar-C), 131.1 (Ar-C), 132.1 (Ar-C), 134.9 (Ar-C), 159.4 (Ar-C), 160.1 (Ar-C), 169.9 (C=O), 170.3 (C=O); LRMS (ESI^+) *m/z*: 519.2 ($[M + H]^+$ 71%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{30}H_{35}O_6N_2$, 519.2490, found 519.2488.

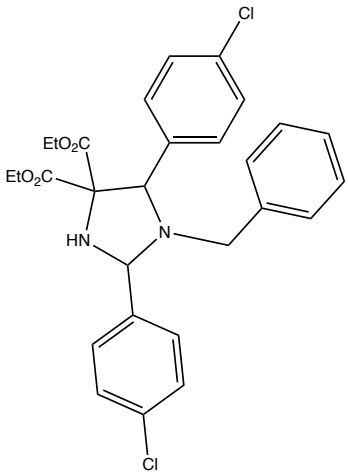
Diethyl 1-benzyl-2,5-bis(4-fluorophenyl)imidazolidine-4,4-dicarboxylate 20d



Yield (6.07 g, Quantitative); Light green oil; R_f (10% EtOAc in Pet. Ether 40:60) 0.30; ν_{max}/cm^{-1} 2984 (C-H), 1729 (C=O), 1603 (N-H); 2.9:1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.78 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.19 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.40 (1H, m, OCH_2CH_3), 3.53 (1H, d, *J*=14.0 Hz, H6), 3.54 (1H, d, *J*=14.0 Hz, H6), 3.81 (1H, m, OCH_2CH_3), 4.09 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.31 (1H, m, OCH_2CH_3), 4.42 (1H, br d, *J*=9.8 Hz, H2), 4.80 (1H, s, H4), 6.80-7.91 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 52.7 (C6), 62.0 (OCH_2CH_3), 62.3 (OCH_2CH_3), 69.5 (C4), 75.7 (C5), 79.8 (C2), 114.9-

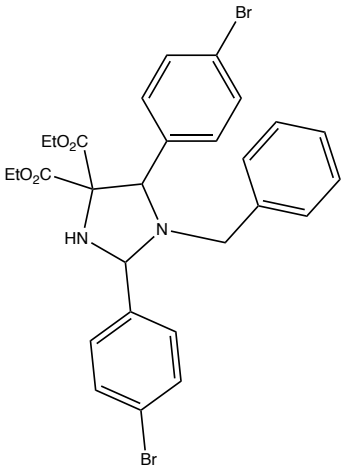
139.3 (Ar-C), 162.6 (d, *J*=246.3 Hz, Ar-C), 163.2 (d, *J*=247.1 Hz, Ar-C), 169.6 (C=O), 170.0 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.78 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.29 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.92 (1H, d, *J*=14.2 Hz, H6), 3.45 (1H, d, *J*=14.3 Hz, H6), 3.82 (2H, m, OCH_2CH_3), 4.32 (2H, m, OCH_2CH_3), 5.09 (1H, s, H4), 5.12 (1H, s, H2), 6.80-7.91 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.2 (OCH_2CH_3), 49.6 (C6), 61.9 (OCH_2CH_3), 62.5 (OCH_2CH_3), 66.9 (C4), 75.7 (C5), 78.7 (C2), 114.9-139.3 (Ar-C), 162.7 (d, *J*=246.8 Hz, Ar-C), 163.0 (d, *J*=246.7 Hz, Ar-C), 168.6 (C=O), 170.7 (C=O); LRMS (ESI^+) *m/z*: 517.2 ($[M + Na]^+$ 6%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{28}H_{29}O_4N_2F_2$, 495.2101, found 495.2089.

Diethyl 1-benzyl-2,5-bis(4-chlorophenyl)imidazolidine-4,4-dicarboxylate 20e



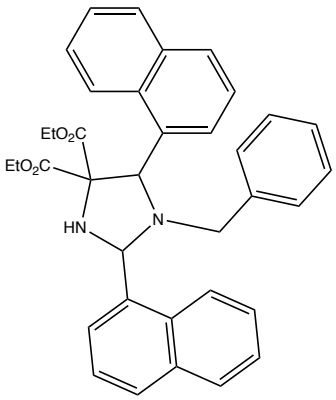
Yield (2.53 g, Quantitative); Colourless oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.65 and 0.78; ν_{max}/cm^{-1} 3304 (N-H), 2983 (C-H), 1730 (C=O); 1:2.3 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.79 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.20 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.42 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.53 (1H, d, *J*=14.0 Hz, H6), 3.57 (1H, d, *J*=14.0 Hz, H6), 3.84 (1H, dq, *J*=7.2 Hz, 10.8 Hz, OCH_2CH_3), 4.11 (1H, m, OCH_2CH_3), 4.32 (1H, m, OCH_2CH_3), 4.42 (1H, br s, H2), 4.79 (1H, s, H4), 6.80-7.62 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 52.7 (C6), 62.1 (OCH_2CH_3), 62.4 (OCH_2CH_3), 69.4 (C4), 75.7 (C5), 79.8 (C2), 127.3 (Ar-C), 128.0 (Ar-C), 128.4 (Ar-C), 129.0 (Ar-C), 130.0 (Ar-C), 130.1 (Ar-C), 130.3 (Ar-C), 133.7 (Ar-C), 134.8 (Ar-C), 134.8 (Ar-C), 136.7 (Ar-C), 137.5 (Ar-C), 169.5 (C=O), 170.0 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.80 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.30 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.93 (1H, d, *J*=14.2 Hz, H6), 3.46 (1H, d, *J*=14.3 Hz, H6), 3.82 (2H, m, OCH_2CH_3), 4.33 (2H, m, OCH_2CH_3), 5.08 (1H, s, H4), 5.11 (1H, br s, H2), 7.10-7.85 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.2 (OCH_2CH_3), 49.7 (C6), 62.0 (OCH_2CH_3), 62.6 (OCH_2CH_3), 67.0 (C4), 75.7 (C5), 78.7 (C2), 127.2-139.5 (Ar-C), 168.6 (C=O), 170.6 (C=O); LRMS (ESI^+) *m/z*: 527.1 ($[M^{35+35} + H]^+$ 100%), 529.1 ($[M^{35+37} + H]^+$ 90%), 531.1 ($[M^{37+37} + H]^+$ 40%); HRMS (ESI^+) *m/z*: $[M^{35+35} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Cl_2$, 527.1475, found 527.1488; $[M^{35+37} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Cl_2$, 529.1448, found 529.1462; $[M^{37+37} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Cl_2$, 531.1428, found 531.1424.

Diethyl 1-benzyl-2,5-bis(4-bromophenyl)imidazolidine-4,4-dicarboxylate 20f



Yield (6.57 g, 96%); Light green oil; R_f (20% EtOAc in Pet. Ether 40:60) 0.38 and 0.35; ν_{max}/cm^{-1} 2981 (C-H), 1729 (C=O), 1645 (N-H); 1:2.6 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.80 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.21 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.46 (1H, m, OCH_2CH_3), 3.53 (1H, d, *J*=14.0 Hz, H6), 3.58 (1H, d, *J*=13.9 Hz, H6), 3.83 (1H, m, OCH_2CH_3), 4.12 (1H, m, OCH_2CH_3), 4.32 (1H, m, OCH_2CH_3), 4.42 (1H, br m, H2), 4.78 (1H, s, H4), 6.81-7.77 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 52.6 (C6), 62.1 (OCH_2CH_3), 62.4 (OCH_2CH_3), 69.5 (C4), 75.7 (C5), 79.8 (C2), 121.8-140.0 (Ar-C), 169.5 (C=O), 169.9 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.80 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.31 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.94 (1H, d, *J*=14.3 Hz, H6), 3.46 (1H, d, *J*=14.3 Hz, H6), 3.83 (2H, m, OCH_2CH_3), 4.32 (2H, m, OCH_2CH_3), 5.07 (1H, s, H4), 5.10 (1H, br s, H2), 6.81-7.77 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.2 (OCH_2CH_3), 49.7 (C6), 62.0 (OCH_2CH_3), 62.6 (OCH_2CH_3), 67.0 (C4), 75.7 (C5), 78.8 (C2), 121.8-140.0 (Ar-C), 168.5 (C=O), 170.6 (C=O); LRMS (ESI^+) *m/z*: 615.8 ($[M^{79+79} + H]^+$ 60%), 617.8 ($[M^{79+81} + H]^+$ 100%), 619.8 ($[M^{81+81} + H]^+$ 62%); HRMS (ESI^+) *m/z*: $[M^{79+79} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Br_2$, 615.0500, found 615.0481; $[M^{79+81} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Br_2$, 617.0479, found 617.0464; $[M^{81+81} + H]^+$ calcd. for $C_{28}H_{29}O_4N_2Br_2$, 619.0459, found 619.0442.

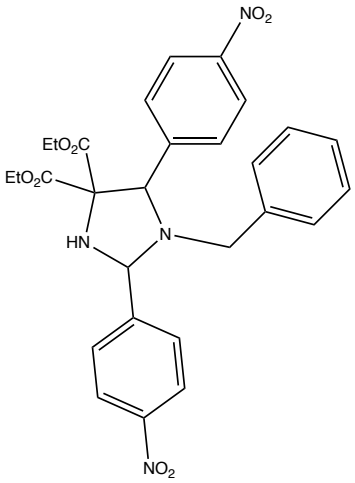
Diethyl 1-benzyl-2,5-di(naphthalen-1-yl)imidazolidine-4,4-dicarboxylate 20g



Yield (1.65 g, 62%); Foamy white solid; m.p. 65-68°C; R_f (20% EtOAc in Pet. Ether 40:60) 0.63 and 0.53; ν_{max}/cm^{-1} 3299 (N-H), 3060 (C-H), 2982 (C-H), 1728 (C=O); 1:3 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.20 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.27 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.84 (1H, dq, *J*=7.2 Hz, 10.6 Hz, OCH_2CH_3), 3.47 (1H, m, OCH_2CH_3), 3.79 (1H, m, H6), 3.82 (1H, d, *J*=13.8 Hz, H6), 4.22 (1H, m, OCH_2CH_3), 4.41 (1H, dq, *J*=7.1 Hz, 10.6 Hz, OCH_2CH_3), 5.42 (1H, d, *J*=11.3 Hz, H2), 5.98 (1H, s, H4), 6.80-8.57 (19H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 12.9 (OCH_2CH_3), 14.0 (OCH_2CH_3), 50.8 (C6), 61.5 (OCH_2CH_3), 62.3 (OCH_2CH_3), 63.8 (C4), 76.4 (C2), 123.6-138.7 (Ar-C),

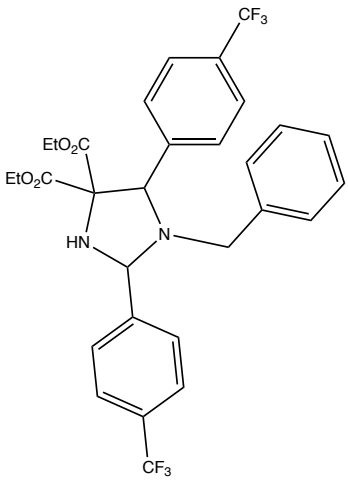
168.3 (C=O), 170.8 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.26 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.11 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.31 (1H, d, *J*=14.1 Hz, H6), 3.47 (2H, m, OCH_2CH_3), 3.58 (1H, br s, NH), 3.74 (1H, d, *J*=14.1 Hz, H6), 4.22 (2H, m, OCH_2CH_3), 6.22 (1H, s, H2), 6.42 (1H, s, H4), 6.80-8.57 (19H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 12.6 (OCH_2CH_3), 14.1 (OCH_2CH_3), 53.3 (C6), 61.2 (C4), 61.6 (OCH_2CH_3), 62.2 (OCH_2CH_3), 76.5 (C2), 123.6-138.7 (Ar-C), 168.6 (C=O), 170.4 (C=O); LRMS (ESI^+) *m/z*: 559.2 ($[M + H]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{36}H_{35}N_2O_4$, 559.2591, found 559.2587.

Diethyl 1-benzyl-2,5-bis(4-nitrophenyl)imidazolidine-4,4-dicarboxylate 20h



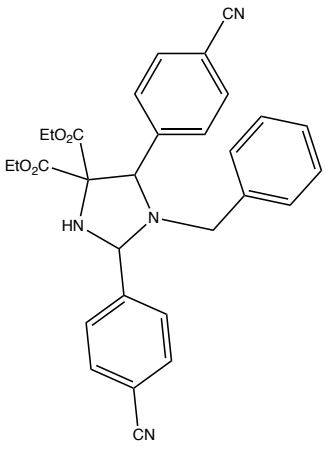
Yield (4.33 g, 83%); Yellow oil; R_f (20% EtOAc in Pet. Ether 40:60) 0.30 and 0.20; ν_{max}/cm^{-1} 3310 (N-H), 2983 (C-H), 1731 (C=O), 1603 (N-H); 1:1.1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.76 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.23 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 3.37 (1H, dq, *J*=7.2 Hz, 10.8 Hz, OCH_2CH_3), 3.48 (1H, br s, NH), 3.55 (1H, d, *J*=13.6 Hz, H6), 3.59 (1H, d, *J*=13.6 Hz, H6), 3.84 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.16 (1H, dq, *J*=7.1 Hz, 10.6 Hz, OCH_2CH_3), 4.36 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.62 (1H, br s, H2), 4.97 (1H, s, H4), 6.81 (2H, m, Ar-H), 7.03 (3H, m, Ar-H), 7.69 (2H, d, *J*=8.7 Hz, Ar-H), 7.82 (2H, d, *J*=8.6 Hz, Ar-H), 8.14 (2H, d, *J*=8.8 Hz, Ar-H), 8.20 (2H, d, *J*=8.8 Hz, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.0 (OCH_2CH_3), 54.5 (C6), 62.6 (OCH_2CH_3), 62.6 (OCH_2CH_3), 70.5 (C4), 76.1 (C5), 80.7 (C2), 123.3 (Ar-C), 123.9 (Ar-C), 127.7 (Ar-C), 128.1 (Ar-C), 129.6 (Ar-C), 129.7 (Ar-C), 129.8 (Ar-C), 134.8 (Ar-C), 145.9 (Ar-C), 146.0 (Ar-C), 147.7 (Ar-C), 148.5 (Ar-C), 168.9 (C=O), 169.5 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.76 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.30 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.95 (1H, d, *J*=14.3 Hz, H6), 3.48 (1H, m, H6), 3.85 (2H, m OCH_2CH_3), 4.33 (2H, m, OCH_2CH_3), 5.25 (1H, s, H4), 5.33 (1H, d, *J*=5.1 Hz, H2), 6.79-8.46 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.1 (C6), 62.4 (OCH_2CH_3), 62.9 (OCH_2CH_3), 67.2 (C4), 75.7 (C5), 78.4 (C2), 123.3-148.5 (Ar-C), 168.2 (C=O), 170.0 (C=O); LRMS (ESI^+) *m/z*: 548.2 ($[M]^+$ 6%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{28}H_{29}O_8N_4$, 549.1980, found 549.1977.

Diethyl 1-benzyl-2,5-bis(4-(trifluoromethyl)phenyl)imidazolidine-4,4-dicarboxylate 20i



Yield (2.25 g, 80%, contaminated with side-products); Colourless oil; R_f (20% EtOAc in Pet. Ether 40:60) 0.78 and 0.53; ν_{max}/cm^{-1} 2986 (C-H), 1732 (C=O), 1620 (N-H); 1:2.4 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.76 (3H, m, OCH_2CH_3), 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.55 (1H, d, *J*=14.1 Hz, H6), 3.55 (1H, m, OCH_2CH_3), 3.61 (1H, d, *J*=13.8 Hz, H6), 3.80 (1H, m, OCH_2CH_3), 4.16 (1H, m, OCH_2CH_3), 4.35 (1H, m, OCH_2CH_3), 4.55 (1H, s, H2), 4.92 (1H, s, H4), 6.80-8.04 (13H, m, Ar-H); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.75 (3H, m, OCH_2CH_3), 1.32 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.96 (1H, d, *J*=14.3 Hz, H6), 3.51 (1H, d, *J*=14.3 Hz, H6), 3.80 (2H, m, OCH_2CH_3), 4.35 (2H, m, OCH_2CH_3), 5.21 (1H, s, H4), 5.27 (1H, s, H2), 6.80-8.04 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.2 (OCH_2CH_3), 49.9 (C6), 62.2 (OCH_2CH_3), 62.7 (OCH_2CH_3), 67.3 (C4), 75.9 (C5), 78.8 (C2), 122.8-144.9 (Ar-C), 168.5 (C=O), 170.4 (C=O); LRMS (ESI^+) *m/z*: 594.2 ($[M]^+$ 30%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{30}H_{29}O_4N_2F_6$, 595.2026, found 595.2021.

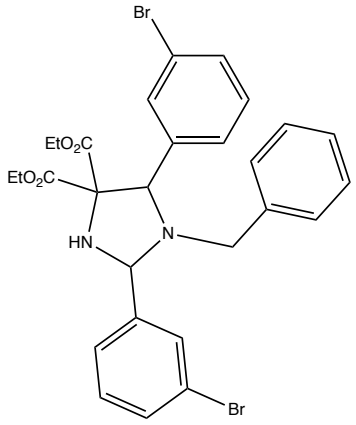
Diethyl 1-benzyl-2,5-bis(4-cyanophenyl)imidazolidine-4,4-dicarboxylate 20j



Yield (945 mg, 77%); White crystals/colourless oil; m.p. 55-58°C; R_f (20% EtOAc in Pet. Ether 40:60) 0.20 and 0.13; ν_{max}/cm^{-1} 3327 (N-H), 2984 (C-H), 2228 (C≡N), 1730 (C=O), 1609 (N-H); 1.9:1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.77 (3H, m, OCH_2CH_3), 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.36 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.52 (1H, d, *J*=13.6 Hz, H6), 3.58 (1H, d, *J*=13.6 Hz, H6), 3.85 (1H, m, OCH_2CH_3), 4.15 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.34 (1H, m, OCH_2CH_3), 4.54 (1H, br d, *J*=9.8 Hz, H2), 4.90 (1H, s, H4), 6.78-7.77 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 54.3 (C6), 62.5 (OCH_2CH_3), 62.6 (OCH_2CH_3), 70.6 (C4), 76.0 (C5), 80.9 (C2), 111.8-146.0 (Ar-C), 169.0 (C=O), 169.5 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.78 (3H, m, OCH_2CH_3), 1.29 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.93 (1H, d, *J*=14.3 Hz, H6), 3.49 (1H, d, *J*=14.2 Hz, H6), 3.84 (2H, m, OCH_2CH_3), 4.34 (2H, m, OCH_2CH_3), 5.18 (1H, s, H4), 5.25 (1H, br d, *J*=5.0 Hz, H2), 6.78-7.77 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.1 (C6), 62.3

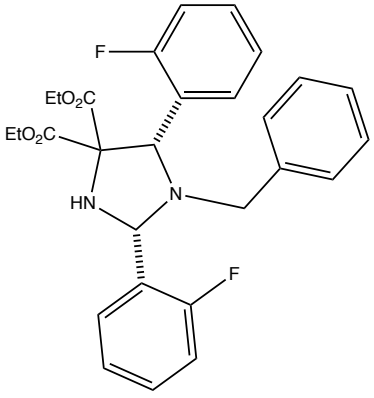
(OCH_2CH_3), 62.8 (OCH_2CH_3), 67.4 (C4), 75.7 (C5), 78.7 (C2), 111.8-146.0 (Ar-C), 168.3 (C=O), 170.1 (C=O); LRMS (ESI^+) *m/z*: 509.2 ($[M + H]^+$ 68%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{30}H_{27}O_4N_4$, 507.2027, found 507.2025.

Diethyl 1-benzyl-2,5-bis(3-bromophenyl)imidazolidine-4,4-dicarboxylate 20k



Yield (1.01 g, 69%); Colourless oil; R_f (20% EtOAc in Pet. Ether 40:60) 0.50; ν_{max}/cm^{-1} 3315 (N-H), 2982 (C-H), 1730 (C=O); 1:2.2 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.85 (3H, m, OCH_2CH_3), 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.45 (1H, m, OCH_2CH_3), 3.60 (2H, m, H6), 3.84 (1H, m, OCH_2CH_3), 4.12 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.34 (1H, m, OCH_2CH_3), 4.34 (1H, underneath OCH_2CH_3 peaks, H2), 4.77 (1H, s, H4), 6.85-7.80 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.0 (OCH_2CH_3), 53.2 (C6), 62.2 (OCH_2CH_3), 62.4 (OCH_2CH_3), 69.8 (C4), 75.8 (C5), 80.2 (C2), 122.5-143.5 (Ar-C), 169.2 (C=O), 169.8 (C=O); $\delta_{H\ (2,4\text{-}trans\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.80 (3H, m, OCH_2CH_3), 1.32 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.98 (1H, d, *J*=14.1 Hz, H6), 3.52 (1H, d, *J*=14.1 Hz, H6), 3.84 (2H, m, OCH_2CH_3), 4.34 (2H, m, OCH_2CH_3), 5.05 (1H, s, H4), 5.13 (1H, br d, *J*=3.2 Hz, H2), 6.85-7.80 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}trans\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.0 (C6), 62.1 (OCH_2CH_3), 62.7 (OCH_2CH_3), 67.3 (C4), 75.8 (C5), 78.9 (C2), 122.5-143.5 (Ar-C), 168.5 (C=O), 170.4 (C=O); LRMS (ESI^+) *m/z*: 616.0 ($[M^{79+81}]^+$ 29%); HRMS (ESI^-) *m/z*: $[M^{79+79} - H]^-$ calcd. for $C_{28}H_{27}O_4N_2Br_2$, 613.0332, found 613.0330; $[M^{79+81} - H]^-$ calcd. for $C_{28}H_{27}O_4N_2Br_2$, 615.0313, found 615.0320; $[M^{81+81} - H]^-$ calcd. for $C_{28}H_{27}O_4N_2Br_2$, 617.0297, found 617.0452.

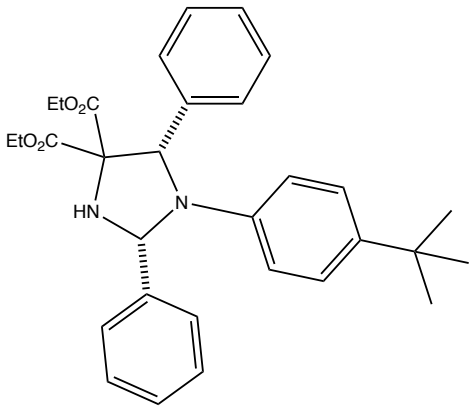
Diethyl (2*R,5*S**)-1-benzyl-2,5-bis(2-fluorophenyl)imidazolidine-4,4-dicarboxylate 20l**



Yield (922 mg, 78%); Pale yellow oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.68; ν_{max}/cm^{-1} 3306 (N-H), 2983 (C-H), 1732 (C=O), 1616 (N-H); >19:1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.81 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.24 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.39 (1H, br s, OCH_2CH_3), 3.63 (2H, s, H6), 3.68 (1H, br d, *J*=10.9 Hz, NH), 3.81 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.18 (1H, m, OCH_2CH_3), 4.37 (1H, dq, *J*=7.2 Hz, 10.8 Hz, OCH_2CH_3),

4.92 (1H, br d, *J*=10.2 Hz, H2), 5.30 (1H, br s, H4), 6.90-7.90 (13H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 54.5 (C6), 62.1 (OCH_2CH_3), 62.3 (OCH_2CH_3), 73.9 (d, *J*=3.4 Hz, C2), 76.0 (C5), 114.9 (d, *J*=21.9 Hz, Ar-C), 115.7 (d, *J*=21.8 Hz, Ar-C), 123.8 (d, *J*=3.5 Hz, Ar-C), 124.7 (d, *J*=3.5 Hz, Ar-C), 125.8 (d, *J*=11.5 Hz, Ar-C), 126.7 (d, *J*=12.1 Hz, Ar-C), 127.0 (Ar-C), 127.8 (Ar-C), 129.1-129.2 (Ar-C), 129.6 (Ar-C), 130.4 (d, *J*=8.4 Hz, Ar-C), 161.5 (d, *J*=248.8 Hz, Ar-C), 161.7 (d, *J*=248.7 Hz, Ar-C), 168.7 (C=O), 169.4 (C=O); $\delta_{F\ (2,4\text{-}cis\ diastereomer)}$ (377 MHz, $CDCl_3$) -116.95, -118.74; LRMS (ESI^+) *m/z*: 495.2 ($[M + H]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{28}H_{29}O_4N_2F_2$, 495.2090, found 495.2086.

Diethyl (2*R,5*S**)-1-(4-(*tert*-butyl)phenyl)-2,5-diphenylimidazolidine-4,4-dicarboxylate 25**



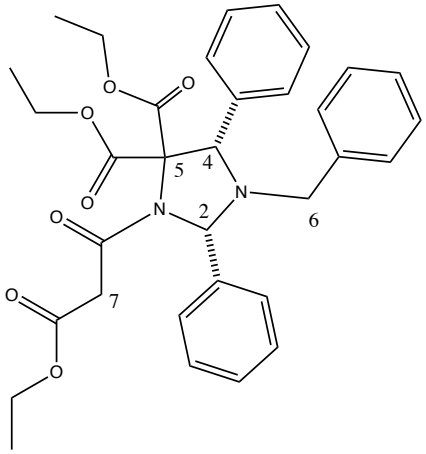
Yield (4.47 g, 56%); Yellow solid; m.p. 61-63°C; R_f (20% EtOAc in Pet. Ether 40:60) 0.68; ν_{max}/cm^{-1} 3314 (N-H), 2962 (C-H), 1734 (C=O), 1614 (N-H); 4:1 mixture of 2,4-*cis/trans* diastereomers; $\delta_{H\ (2,4\text{-}cis\ diastereomer)}$ (400 MHz, $CDCl_3$) 0.94 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.20 (9H, s, $C(CH_3)_3$), 1.28 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.54 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.62 (1H, d, *J*=11.0 Hz, NH), 3.81 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.24 (1H, dq, *J*=7.1 Hz, 10.8 Hz, OCH_2CH_3), 4.41 (1H, dq, *J*=7.1 Hz, 10.8 Hz, OCH_2CH_3), 5.36 (1H, br d, *J*=10.8 Hz, H2), 5.63 (1H, s, H4), 6.46 (2H, d, *J*=8.9 Hz, Ar-H), 7.08 (2H, d, *J*=8.9 Hz, Ar-H), 7.26-7.45 (6H, m, Ar-H), 7.58 (2H, m, Ar-H), 7.69 (2H, m, Ar-H); $\delta_{c\ (2,4\text{-}cis\ diastereomer)}$ (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.1 (OCH_2CH_3), 31.5 ($(CH_3)_3$), 33.9 ($C(CH_3)_3$), 62.2 (OCH_2CH_3), 62.6 (OCH_2CH_3), 70.7 (C4), 77.2 (C5), 78.6 (C2), 114.8 (Ar-C), 125.6 (Ar-C), 127.4 (Ar-C), 128.2 (Ar-C), 128.5 (Ar-C), 128.8 (Ar-C), 129.0 (Ar-C), 139.1 (Ar-C), 140.6 (Ar-C), 141.3 (Ar-C), 144.4 (Ar-C), 166.8 (C=O), 169.2 (C=O); LRMS (ESI^+) *m/z*: 500.2 ($[M]^+$ 35%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{31}H_{37}N_2O_4$, 501.2748, found 501.2737.

General procedure for the synthesis of *N*-acylated imidazolidines:[5,8]

To a stirring solution of imidazolidine **20a-l** and **25** (1.0 eq.) in anhydrous DCM at 0°C was added ethyl malonyl chloride (1.05-1.1 eq.) and pyridine (1.1-1.2 eq.) dropwise. The mixture was stirred at 0°C for 10-20 min and then refluxed overnight. The mixture was then washed with sat. NH_4Cl (aq.), sat. $NaHCO_3$ (aq.), brine, dried over

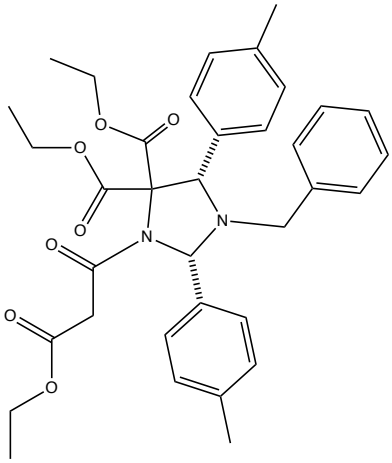
Na_2SO_4, filtered, concentrated under reduced pressure and purified by flash column chromatography to give *N*-acylated imidazolidines **21a-l** and **26**.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-diphenylimidazolidine-4,4-dicarboxylate 21a**



Yield (1.63 g, 84%); Thick sticky colourless oil that crystallised overnight; R_f (30% EtOAc in Pet. Ether 40:60) 0.30; ν_{max}/cm^{-1} 2982 (C-H), 1740 (C=O), 1661 (C=O); δ_H (400 MHz, $CDCl_3$) 0.93 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.18 (6H, m, OCH_2CH_3, OCH_2CH_3), 2.64 (1H, br d, *J*=15.7 Hz, H7), 2.89 (1H, d, *J*=15.7 Hz, H7), 3.49 (1H, d, *J*=14.9 Hz, H6), 3.63 (1H, d, *J*=14.9 Hz, H6), 3.69 (1H, m, OCH_2CH_3), 3.95 (1H, dq, *J*=7.1 Hz, 10.6 Hz, OCH_2CH_3), 4.03 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.21 (2H, dq, *J*=1.1 Hz, 7.2 Hz, OCH_2CH_3), 4.42 (1H, s, H4), 5.37 (1H, s, H2), 6.89 (2H, m, Ar-H), 7.20 (3H, m, Ar-H), 7.30-7.48 (8H, m, Ar-H), 7.91 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.8 (C7), 50.2 (C6), 60.4 (OCH_2CH_3), 61.2 (OCH_2CH_3), 61.8 (OCH_2CH_3), 70.7 (C4), 75.4 (C5), 79.2 (C2), 127.6 (Ar-C), 128.2 (Ar-C), 128.4 (Ar-C), 128.9 (Ar-C), 129.0 (Ar-C), 129.2 (Ar-C), 129.8 (Ar-C), 130.0 (Ar-C), 130.2 (Ar-C), 133.6 (Ar-C), 134.4 (Ar-C), 138.7 (Ar-C), 165.3 (C=O), 165.4 (C=O), 166.6 (C=O), 166.9 (C=O); LRMS (ESI$^+$) *m/z*: 573.2 ([M + H]$^+$ 55%); HRMS (ESI$^+$) *m/z*: [M + H]$^+$ calcd. for $C_{33}H_{37}N_2O_7$, 573.2595, found 573.2594.

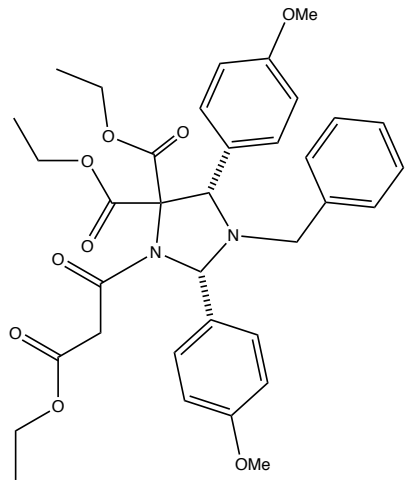
Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis-(4-methylphenyl)imidazolidine-4,4-dicarboxylate 21b**



Yield (5.58 g, 67%); Thick sticky orange oil; R_f (50% EtOAc in Pet. Ether 40:60) 0.63; ν_{max}/cm^{-1} 2983 (C-H), 1743 (C=O), 1663 (C=O); δ_H (400 MHz, $CDCl_3$) 0.97 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.17 (6H, m, OCH_2CH_3, OCH_2CH_3), 2.37 (3H, s, CH_3), 2.42 (3H, s, CH_3), 2.63 (1H, br d, *J*=15.7 Hz, H7), 2.91 (1H, d, *J*=15.7 Hz, H7), 3.46 (1H, d, *J*=14.9 Hz, H6), 3.63 (1H, d, *J*=14.9 Hz, H6), 3.74 (1H, dq, *J*=7.0 Hz, 10.6 Hz, OCH_2CH_3), 3.95 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.03 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.19 (2H, dq, *J*=1.9 Hz, 7.1 Hz, OCH_2CH_3), 4.34

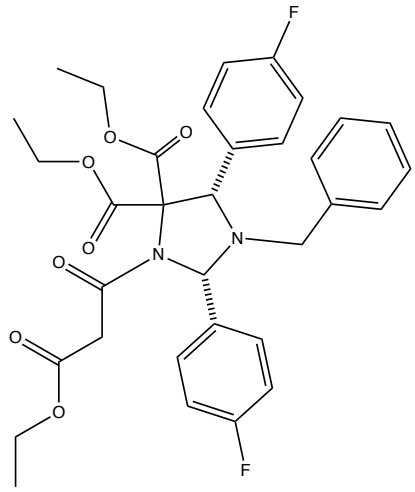
(1H, s, H4), 5.29 (1H, s, H2), 6.91 (2H, m, Ar-H), 7.11-7.38 (9H, m, Ar-H), 7.79 (2H, d, *J*=7.6 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 21.3 (CH_3), 21.5 (CH_3), 42.9 (C7), 49.5 (C6), 61.1 (OCH_2CH_3), 61.7 (OCH_2CH_3), 61.9 (OCH_2CH_3), 70.0 (C4), 75.1 (C5), 78.5 (C2), 127.5 (Ar-C), 128.2 (Ar-C), 129.1 (Ar-C), 129.7 (Ar-C), 130.1-130.2 (Ar-C), 131.2 (Ar-C), 133.3 (Ar-C), 135.5 (Ar-C), 138.7 (Ar-C), 139.8 (Ar-C), 165.3 (C=O), 165.4 (C=O), 166.7 (C=O), 166.9 (C=O); LRMS (ESI^+) *m/z*: 601.3 ($[M + H]^+$ 60%), 623.2 ($[M + Na]^+$ 100%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{35}H_{41}N_2O_7$, 601.2908, found 601.2906.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis-(4-methoxyphenyl)imidazolidine-4,4-dicarboxylate 21c**



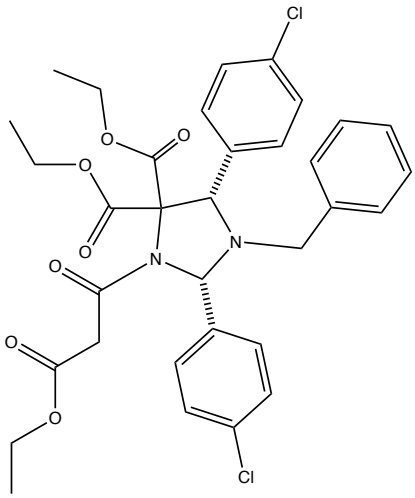
Yield (3.07 g, 56%); Thick sticky orange oil that crystallised overnight; R_f (50% EtOAc in Pet. Ether 40:60) 0.50; ν_{max}/cm^{-1} 2982 (C-H), 1742 (C=O), 1659 (C=O); δ_H (400 MHz, $CDCl_3$) 1.00 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.18 (6H, m, OCH_2CH_3, OCH_2CH_3), 2.64 (1H, br d, *J*=15.7 Hz, H7), 2.91 (1H, d, *J*=15.6 Hz, H7), 3.46 (1H, d, *J*=14.8 Hz, H6), 3.61 (1H, d, *J*=15.1 Hz, H6), 3.77 (1H, m, OCH_2CH_3), 3.82 (3H, s, OCH_3), 3.87 (3H, s, OCH_3), 3.97 (1H, m, OCH_2CH_3), 4.04 (2H, q, *J*=7.2 Hz, OCH_2CH_3), 4.19 (2H, dq, *J*=1.3 Hz, 7.1 Hz, OCH_2CH_3), 4.31 (1H, s, H4), 5.28 (1H, s, H2), 6.85-7.84 (13H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 49.8 (C6), 55.4 (OCH_3), 55.4 (OCH_3), 61.2 (OCH_2CH_3), 61.8 (OCH_2CH_3), 61.9 (OCH_2CH_3), 69.8 (C4), 75.1 (C5), 78.4 (C2), 113.8 (Ar-C), 114.3 (Ar-C), 126.1 (Ar-C), 127.5 (Ar-C), 128.2 (Ar-C), 129.3 (Ar-C), 130.1 (Ar-C), 130.4 (Ar-C), 131.5 (Ar-C), 133.6 (Ar-C), 160.1 (Ar-C), 160.6 (Ar-C), 165.3 (C=O), 165.6 (C=O), 166.8 (C=O), 167.0 (C=O); LRMS (ESI^+) *m/z*: 655.2 ($[M + Na]^+$ 63%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{35}H_{41}N_2O_9$, 633.2807, found 633.2798.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis(4-fluorophenyl)imidazolidine-4,4-dicarboxylate 21d**



Yield (5.78 g, 77%); Thick sticky yellow oil; R_f (50% EtOAc in Pet. Ether 40:60) 0.73; ν_{max}/cm^{-1} 2984 (C-H), 1740 (C=O), 1662 (C=O); δ_H (400 MHz, $CDCl_3$) 0.98 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.17 (3H, t, *J*=7.1 Hz, OCH_2CH_3) 1.21 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.68 (1H, br d, *J*=15.7 Hz, H7), 2.87 (1H, d, *J*=15.6 Hz, H7), 3.49 (1H, d, *J*=14.8 Hz, H6), 3.58 (1H, d, *J*=14.8 Hz, H6), 3.74 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 3.97 (1H, m, OCH_2CH_3), 4.05 (2H, m, OCH_2CH_3), 4.22 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.39 (1H, s, H4), 5.36 (1H, s, H2), 6.84 (2H, m, Ar-H), 7.02-7.28 (7H, m, Ar-H), 7.40 (2H, m, Ar-H), 7.87 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 50.8 (C6), 61.3 (OCH_2CH_3), 62.0 (OCH_2CH_3), 62.2 (OCH_2CH_3), 70.3 (C4), 75.3 (C5), 78.8 (C2), 115.4 (d, *J*=21.5 Hz, Ar-C), 116.0 (br d, *J*=22.0 Hz, Ar-C), 127.7 (Ar-C), 128.3 (Ar-C), 129.8 (Ar-C), 130.0 (d, *J*=3.1 Hz, Ar-C), 130.8 (Ar-C), 132.0 (d, *J*=8.3 Hz, Ar-C), 133.6 (Ar-C), 134.6 (d, *J*=3.2 Hz, Ar-C), 163.1 (d, *J*=247.8 Hz, Ar-C), 163.5 (d, *J*=249.7 Hz, Ar-C), 165.2 (C=O), 165.5 (C=O), 166.4 (C=O), 166.8 (C=O); δ_F (377 MHz, $CDCl_3$) -110.97, -112.77; LRMS (ESI$^+$) *m/z*: 631.2 ([M + Na]$^+$ 95%); HRMS (ESI$^+$) *m/z*: [M + H]$^+$ calcd. for $C_{33}H_{35}N_2O_7F_2$, 609.2407, found 609.2410.

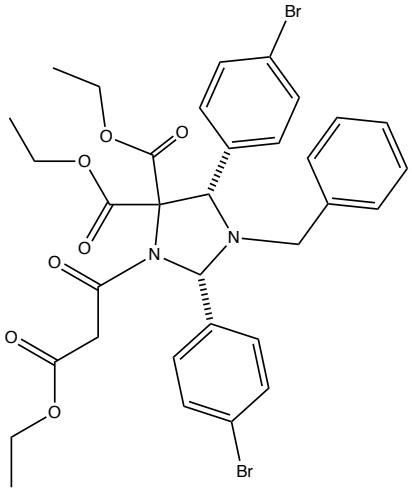
Diethyl (2*S,5*S**)-1-benzyl-2,5-bis(4-chlorophenyl)-3-(3-ethoxy-3-oxopropanoyl)imidazolidine-4,4-dicarboxylate 21d**



Yield (1.57 g, 70%); Thick sticky pale yellow oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.33; ν_{max}/cm^{-1} 2983 (C-H), 1742 (C=O), 1665 (C=O); δ_H (400 MHz, $CDCl_3$) 0.97 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.18 (6H, m, OCH_2CH_3, OCH_2CH_3), 2.70 (1H, br d, *J*=15.8 Hz, H7), 2.88 (1H, d, *J*=15.6 Hz, H7), 3.47 (1H, d, *J*=14.8 Hz, H6), 3.57 (1H, d, *J*=14.8 Hz, H6), 3.74 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 3.96 (1H, m, OCH_2CH_3), 4.03 (2H, dq, *J*=1.3 Hz, 7.2 Hz, OCH_2CH_3), 4.21 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.38 (1H, s, H4), 5.34 (1H, s, H2), 6.83 (2H, m, Ar-H), 7.17-7.22 (3H, m, Ar-H), 7.34 (4H, m, Ar-H), 7.40 (2H, d, *J*=8.6 Hz, Ar-H), 7.80 (2H, d, *J*=8.4 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 50.9 (C6), 61.4 (OCH_2CH_3), 62.1 (OCH_2CH_3), 62.4 (OCH_2CH_3), 70.4 (C4), 75.3 (C5), 78.8 (C2), 127.8 (Ar-C),

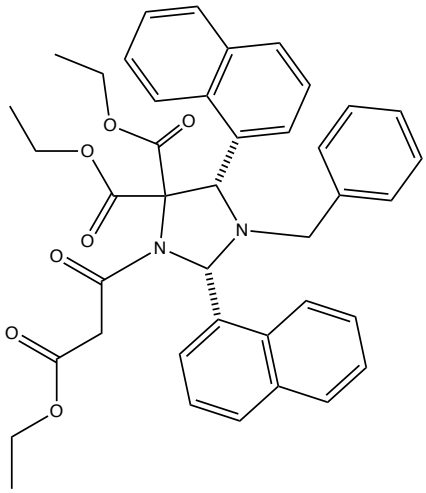
128.4 (Ar-C), 128.7 (Ar-C), 129.3 (Ar-C), 129.9 (Ar-C), 130.5 (Ar-C), 131.5 (Ar-C), 133.0 (Ar-C), 133.4 (Ar-C), 134.9 (Ar-C), 137.3 (Ar-C), 165.1 (C=O), 166.4 (C=O), 166.8 (C=O); LRMS (ESI$^+$) *m/z*: 663.1 ([M^{35+35} + Na]$^+$ 100%), 665.1 ([M^{35+37} + Na]$^+$ 83%), 667.1 ([M^{37+37} + Na]$^+$ 28%); HRMS (ESI$^+$) *m/z*: [M^{35+35} + Na]$^+$ calcd. for $C_{33}H_{34}N_2O_7Cl_2Na$, 663.1635, found 663.1633; [M^{35+37} + Na]$^+$ calcd. for $C_{33}H_{34}N_2O_7Cl_2Na$, 665.1613, found 665.1599; [M^{37+37} + Na]$^+$ calcd. for $C_{33}H_{34}N_2O_7Cl_2Na$, 667.1603, found 667.1555.

Diethyl (2*S,5*S**)-1-benzyl-2,5-bis(4-bromophenyl)-3-(3-ethoxy-3-oxopropanoyl)imidazolidine-4,4-dicarboxylate 21f**



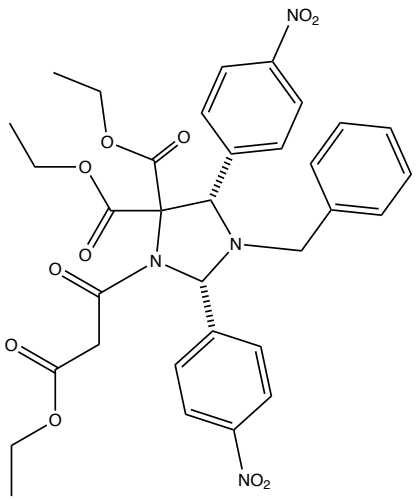
Yield (5.82 g, 76%); Thick sticky orange oil; R_f (50% EtOAc in Pet. Ether 40:60) 0.75; ν_{max}/cm^{-1} 2982 (C-H), 1739 (C=O), 1663 (C=O); δ_H (400 MHz, $CDCl_3$) 0.99 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.19 (6H, m, OCH_2CH_3, OCH_2CH_3), 2.72 (1H, br d, *J*=15.1 Hz, H7), 2.89 (1H, d, *J*=15.6 Hz, H7), 3.49 (1H, d, *J*=14.8 Hz, H6), 3.57 (1H, d, *J*=14.8 Hz, H6), 3.75 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.97 (1H, m, OCH_2CH_3), 4.04 (2H, dq, *J*=1.4 Hz, 7.1 Hz, OCH_2CH_3), 4.22 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.38 (1H, s, H4), 5.34 (1H, s, H2), 6.84 (2H, m, Ar-H), 7.18-7.22 (3H, m, Ar-H), 7.29 (2H, m, Ar-H), 7.50 (2H, d, *J*=8.7 Hz, Ar-H), 7.56 (2H, d, *J*=8.5 Hz, Ar-H), 7.74 (2H, d, *J*=8.4 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 50.9 (C6), 61.4 (OCH_2CH_3), 62.1 (OCH_2CH_3), 62.3 (OCH_2CH_3), 70.5 (C4), 75.2 (C5), 78.9 (C2), 123.1 (Ar-C), 124.0 (Ar-C), 127.8 (Ar-C), 128.4 (Ar-C), 129.8 (Ar-C), 130.7 (Ar-C), 131.7 (Ar-C), 131.8 (Ar-C), 132.2 (Ar-C), 133.4 (Ar-C), 133.5 (Ar-C), 137.9 (Ar-C), 165.0 (C=O), 165.4 (C=O), 166.3 (C=O), 166.8 (C=O); LRMS (ESI$^+$) *m/z*: 751.0 ([M^{79+79} + Na]$^+$ 47%), 753.0 ([M^{79+81} + Na]$^+$ 98%), 755.0 ([M^{81+81} + Na]$^+$ 49%); HRMS (ESI$^+$) *m/z*: [M^{79+79} + H]$^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 729.0806, found 729.0800; [M^{79+81} + H]$^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 731.0785, found 731.0778; [M^{81+81} + H]$^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 733.0765, found 733.0761.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-di(naphthalen-1-yl)imidazolidine-4,4-dicarboxylate 21g**



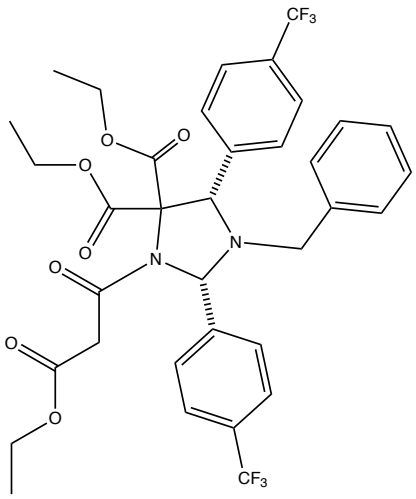
Yield (1.61 g, 85%); Light yellow foamy solid; m.p. 75-78°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.28; ν_{max}/cm^{-1} 3061 (C-H), 2983 (C-H), 1740 (C=O), 1659 (C=O); δ_H (400 MHz, $CDCl_3$) 0.65 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.06 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.16 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.55 (1H, br d, *J*=15.8 Hz, H7), 2.86 (1H, d, *J*=15.8 Hz, H7), 3.41 (1H, m, OCH_2CH_3), 3.47 (1H, d, *J*=14.7 Hz, H6), 3.67 (1H, d, *J*=14.9 Hz, H6), 3.92 (3H, m, OCH_2CH_3, OCH_2CH_3), 4.27 (2H, m, OCH_2CH_3), 5.55 (1H, s, H4), 6.50 (1H, s, H2), 6.57-8.82 (19H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.3 (OCH_2CH_3), 13.9 (OCH_2CH_3), 13.9 (OCH_2CH_3), 42.3 (C7), 51.9 (C6), 61.1 (OCH_2CH_3), 61.6 (OCH_2CH_3), 62.5 (OCH_2CH_3), 66.6 (C4), 73.7 (C2), 76.1 (C5), 121.8-134.4 (Ar-C), 165.5 (C=O), 165.7 (C=O), 166.7 (C=O), 168.2 (C=O); LRMS (ESI^-) *m/z*: 672.1 ($[M]^-$ 100%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{41}H_{39}N_2O_7$, 671.2763, found 671.2776.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis(4-nitrophenyl)imidazolidine-4,4-dicarboxylate 21h**



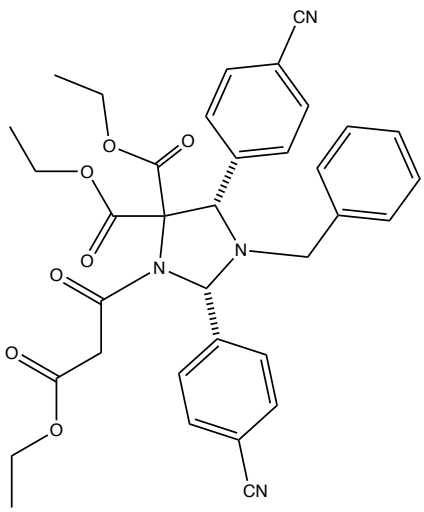
Yield (1.68 g, Quantitative); Yellow foamy solid; m.p. 69-72°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.08; ν_{max}/cm^{-1} 2984 (C-H), 1739 (C=O), 1666 (C=O); δ_H (400 MHz, $CDCl_3$) 0.99 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.18 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.29 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.84 (2H, br m, H7), 3.59 (2H, s, H6), 3.77 (1H, dq, *J*=7.2 Hz, 10.9 Hz, OCH_2CH_3), 4.03 (3H, m, OCH_2CH_3, OCH_2CH_3), 4.31 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 4.64 (1H, s, H4), 5.55 (1H, s, H2), 6.82 (2H, m, Ar-H), 7.15 (3H, m, Ar-H), 7.64 (2H, d, *J*=8.3 Hz, Ar-H), 8.01 (2H, d, *J*=8.8 Hz, Ar-H), 8.23 (4H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 52.9 (C6), 61.6 (OCH_2CH_3), 62.5 (OCH_2CH_3), 63.0 (OCH_2CH_3), 71.6 (C4), 75.6 (C5), 79.6 (C2), 123.5 (Ar-C), 123.9 (Ar-C), 128.1 (Ar-C), 128.5 (Ar-C), 129.5 (Ar-C), 130.1 (Ar-C), 130.9 (Ar-C), 133.4 (Ar-C), 141.9 (Ar-C), 146.1 (Ar-C), 148.4 (Ar-C), 148.6 (Ar-C), 164.9 (C=O), 165.2 (C=O), 165.9 (C=O), 166.6 (C=O); LRMS (ESI^+) *m/z*: 685.2 ($[M + Na]^+$ 95%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{33}H_{35}N_4O_{11}$, 663.2297, found 663.2289.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis(4-(trifluoromethyl)phenyl)imidazolidine-4,4-dicarboxylate 21i**



Yield (1.19 g, 66%); Thick sticky orange oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.30; ν_{max}/cm^{-1} 2986 (C-H), 1742 (C=O), 1667 (C=O); δ_H (400 MHz, $CDCl_3$) 0.91 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.16 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.24 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.71 (1H, br m, H7), 2.87 (1H, d, *J*=15.4 Hz, H7), 3.53 (1H, d, *J*=14.7 Hz, H6), 3.58 (1H, d, *J*=14.7 Hz, H6), 3.70 (1H, m, OCH_2CH_3), 3.94 (1H, m, OCH_2CH_3), 4.02 (2H, dq, *J*=3.1 Hz, 7.1 Hz, OCH_2CH_3), 4.25 (2H, q, *J*=7.2 Hz, OCH_2CH_3), 4.54 (1H, s, H4), 5.46 (1H, s, H2), 6.82 (2H, m, Ar-H), 7.15 (3H, m, Ar-H), 7.56 (2H, d, *J*=8.2 Hz, Ar-H), 7.64 (4H, m, Ar-H), 7.97 (2H, d, *J*=7.9 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.4 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 52.0 (C6), 61.5 (OCH_2CH_3), 62.2 (OCH_2CH_3), 62.6 (OCH_2CH_3), 71.2 (C4), 75.5 (C5), 79.5 (C2), 125.4 (q, *J*=3.5 Hz, Ar-C), 125.9 (Ar-C), 127.9 (Ar-C), 128.4 (Ar-C), 129.5 (Ar-C), 129.6 (Ar-C), 130.5 (Ar-C), 131.2 (Ar-C), 131.5 (Ar-C), 133.4 (Ar-C), 138.8 (Ar-C), 143.0 (Ar-C), 165.0 (C=O), 165.3 (C=O), 166.2 (C=O), 166.8 (C=O); δ_F (377 MHz, $CDCl_3$) -62.74, -62.80; LRMS (ESI$^+$) *m/z*: 709.2 ([M + H]$^+$ 8%); LRMS (ESI$^-$) *m/z*: 707.2 ([M – H]$^-$ 95%); HRMS (ESI$^+$) *m/z*: [M + H]$^+$ calcd. for $C_{35}H_{35}N_2O_7F_6$, 709.2343, found 709.2337.

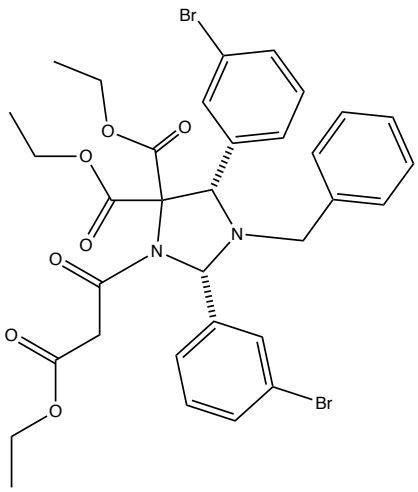
Diethyl (2*S,5*S**)-1-benzyl-2,5-bis(4-cyanophenyl)-3-(3-ethoxy-3-oxopropanoyl)imidazolidine-4,4-dicarboxylate 21j**



Yield (682 mg, 69%); White crystals/colourless oil; R_f (50% EtOAc in Pet. Ether 40:60) 0.33; ν_{max}/cm^{-1} 2984 (C-H), 2229 (C≡N), 1743 (C=O), 1667 (C=O); δ_H (400 MHz, $CDCl_3$) 0.94 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.17 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.24 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.72 (1H, br m, H7), 2.83 (1H, d, *J*=15.0 Hz, H7), 3.51 (1H, d, *J*=14.9 Hz, H6), 3.56 (1H, d, *J*=14.7 Hz, H6), 3.70 (1H, dq, *J*=7.1 Hz, 10.6 Hz, OCH_2CH_3), 3.96 (1H, m, OCH_2CH_3), 4.03 (2H, dq, *J*=1.0 Hz, 7.2 Hz, OCH_2CH_3), 4.26 (2H, q, *J*=7.1 Hz, OCH_2CH_3),

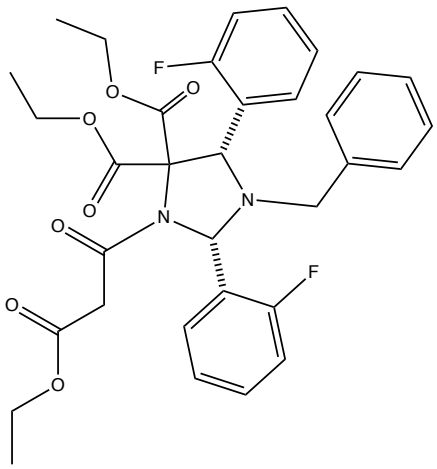
4.53 (1H, s, H4), 5.45 (1H, s, H2), 6.77 (2H, m, Ar-H), 7.14 (3H, m, Ar-H), 7.54 (2H, d, *J*=8.0 Hz, Ar-H), 7.65 (4H, m, Ar-H), 7.92 (2H, d, *J*=8.0 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.8 (C7), 52.7 (C6), 61.6 (OCH_2CH_3), 62.4 (OCH_2CH_3), 62.9 (OCH_2CH_3), 71.7 (C4), 75.5 (C5), 79.8 (C2), 113.0 (Ar-C), 118.4 (C≡N), 128.1 (Ar-C), 128.5 (Ar-C), 129.5 (Ar-C), 129.9 (Ar-C), 130.7 (Ar-C), 132.2 (Ar-C), 132.6 (Ar-C), 133.4 (Ar-C), 140.0 (Ar-C), 144.2 (Ar-C), 164.9 (C=O), 165.3 (C=O), 166.0 (C=O), 166.6 (C=O); LRMS (ESI^+) *m/z*: 623.2 ($[M + H]^+$ 17%); LRMS (ESI^-) *m/z*: 621.2 ($[M – H]^-$ 94%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{35}H_{35}N_4O_7$, 623.2500, found 623.2495.

Diethyl (2*S,5*S**)-1-benzyl-2,5-bis(3-bromophenyl)-3-(3-ethoxy-3-oxopropanoyl)imidazolidine-4,4-dicarboxylate 21k**



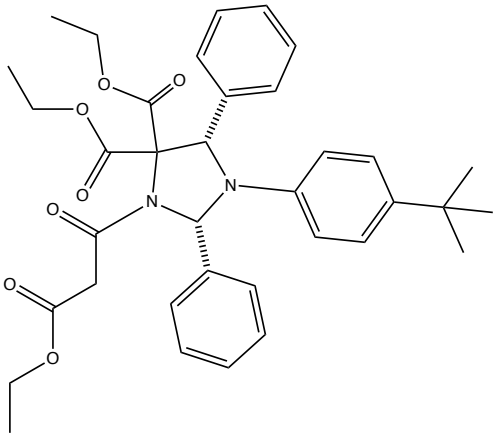
Yield (887 mg, 85%); Thick sticky pale yellow oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.28; ν_{max}/cm^{-1} 2983 (C-H), 1742 (C=O), 1666 (C=O); δ_H (400 MHz, $CDCl_3$) 1.09 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.19 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.24 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.74 (1H, br m, H7), 2.88 (1H, d, *J*=15.7 Hz, H7), 3.53 (1H, d, *J*=14.7 Hz, H6), 3.60 (1H, d, *J*=14.7 Hz, H6), 3.85 (1H, m, OCH_2CH_3), 3.99 (1H, m, OCH_2CH_3), 4.06 (2H, dq, *J*=0.9 Hz, 7.1 Hz, OCH_2CH_3), 4.24 (2H, dq, *J*=2.5 Hz, 7.1 Hz, OCH_2CH_3), 4.38 (1H, s, H4), 5.32 (1H, s, H2), 6.86 (2H, m, Ar-H), 7.18-7.38 (7H, m, Ar-H), 7.48 (1H, m, Ar-H), 7.53 (1H, m, Ar-H), 7.81 (1H, d, *J*=7.7 Hz, Ar-H), 7.93 (1H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.8 (OCH_2CH_3), 14.0 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.9 (C7), 51.6 (C6), 61.4 (OCH_2CH_3), 62.2 (OCH_2CH_3), 62.5 (OCH_2CH_3), 70.8 (C4), 75.3 (C5), 79.2 (C2), 122.6 (Ar-C), 123.0 (Ar-C), 127.9 (Ar-C), 128.4 (Ar-C), 128.8 (Ar-C), 129.7 (Ar-C), 130.1 (Ar-C), 130.6 (Ar-C), 132.2 (Ar-C), 133.0 (Ar-C), 133.6 (Ar-C), 136.8 (Ar-C), 141.1 (Ar-C), 165.1 (C=O), 166.4 (C=O), 166.7 (C=O); LRMS (ESI^-) *m/z*: 727.0 ($[M^{79+79} – H]^-$ 52%), 729.0 ($[M^{79+81} – H]^-$ 100%), 731.0 ($[M^{81+81} – H]^-$ 57%); HRMS (ESI^+) *m/z*: $[M^{79+79} + H]^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 729.0806, found 729.0804; $[M^{79+81} + H]^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 731.0787, found 731.0783; $[M^{81+81} + H]^+$ calcd. for $C_{33}H_{35}N_2O_7Br_2$, 733.0774, found 733.0765.

Diethyl (2*S,5*S**)-1-benzyl-3-(3-ethoxy-3-oxopropanoyl)-2,5-bis(2-fluorophenyl)imidazolidine-4,4-dicarboxylate 21l**



Yield (791 mg, 79%); Thick sticky orange oil; R_f (30% EtOAc in Pet. Ether 40:60) 0.30; ν_{max}/cm^{-1} 2985 (C-H), 1744 (C=O), 1668 (C=O); δ_H (400 MHz, $CDCl_3$) 0.93 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.18 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.20 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.72 (1H, br d, *J*=15.8 Hz, H7), 3.04 (1H, d, *J*=15.8 Hz, H7), 3.56 (1H, d, *J*=14.8 Hz, H6), 3.60 (1H, d, *J*=14.7 Hz, H6), 3.66 (2H, br m, OCH_2CH_3), 4.04 (2H, dq, *J*=1.5 Hz, 7.1 Hz, OCH_2CH_3), 4.20 (2H, m, OCH_2CH_3), 4.85 (1H, s, H4), 5.89 (1H, s, H2), 6.91-8.32 (13H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 13.9 (OCH_2CH_3), 14.1 (OCH_2CH_3), 42.0 (C7), 52.1 (C6), 61.3 (OCH_2CH_3), 62.0 (OCH_2CH_3), 62.3 (OCH_2CH_3), 63.6 (C4), 71.6 (C2), 74.8 (C5), 115.2 (d, *J*=21.8 Hz, Ar-C), 115.7 (d, *J*=21.9 Hz, Ar-C), 122.2 (d, *J*=12.1 Hz, Ar-C), 124.2 (d, *J*=3.5 Hz, Ar-C), 125.6 (Ar-C), 126.1 (d, *J*=8.9 Hz, Ar-C), 127.6 (Ar-C), 128.2 (Ar-C), 129.1 (Ar-C), 129.6 (Ar-C), 130.4 (d, *J*=8.3 Hz, Ar-C), 131.5 (d, *J*=9.3 Hz, Ar-C), 131.9 (Ar-C), 133.4 (Ar-C), 161.3 (d, *J*=247.1 Hz, Ar-C), 161.9 (d, *J*=248.4 Hz, Ar-C), 165.0 (C=O), 165.6 (C=O), 166.2 (C=O), 166.3 (C=O); δ_F (377 MHz, $CDCl_3$) -117.03, -119.42; LRMS (ESI$^-$) *m/z*: 607.2 ([M – H]$^-$ 45%); LRMS (ESI$^+$) *m/z*: 609.2 ([M + H]$^+$ 13%); HRMS (ESI$^+$) *m/z*: [M + H]$^+$ calcd. for $C_{33}H_{35}N_2O_7F_2$, 609.2407, found 609.2402.

Diethyl (2*S,5*S**)-1-(4-(*tert*-butyl)phenyl)-3-(3-ethoxy-3-oxopropanoyl)-2,5-diphenylimidazolidine-4,4-dicarboxylate 26**



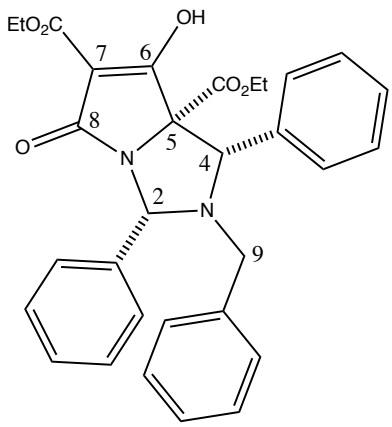
Yield (571 mg, 65%); Yellow foamy solid; m.p. 52-55°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.40; ν_{max}/cm^{-1} 2963 (C-H), 1742 (C=O), 1669 (C=O); δ_H (400 MHz, $CDCl_3$) 0.95 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.20 (9H, s, $C(CH_3)_3$), 1.22 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.38 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 2.83 (1H, br d, *J*=15.5 Hz, H7), 3.10 (1H, d, *J*=15.5 Hz, H7), 3.76 (2H, m, OCH_2CH_3), 4.09 (2H, q, *J*=7.2 Hz, OCH_2CH_3), 4.39 (2H, m, OCH_2CH_3), 5.45 (1H, s, H4), 6.15 (1H, s, H2), 6.65 (2H, d, *J*=8.8 Hz, Ar-H), 7.11 (2H, d, *J*=8.8 Hz, Ar-H), 7.28 (3H, m, Ar-H), 7.42 (5H, m, Ar-H), 7.88 (2H, m, Ar-

H); δ_c (101 MHz, $CDCl_3$) 13.5 (OCH_2CH_3), 14.2 (OCH_2CH_3), 31.4 (($CH_3)_3$), 34.1 ($C(CH_3)_3$), 43.0 (C7), 61.4 (OCH_2CH_3), 62.0 (OCH_2CH_3), 62.8 (OCH_2CH_3), 71.4 (C4), 76.3 (C5), 80.6 (C2), 118.7 (Ar-C), 125.8 (Ar-C), 127.9 (Ar-C), 128.3 (Ar-C), 128.3 (Ar-C), 128.9 (Ar-C), 129.6 (Ar-C), 129.8 (Ar-C), 136.7 (Ar-C), 140.0 (Ar-C), 141.7 (Ar-C), 144.8 (Ar-C), 165.1 (C=O), 165.5 (C=O), 166.4 (C=O), 167.6 (C=O); LRMS (ESI^+) *m/z*: 615.3 ($[M + H]^+$ 25%), 637.2 ($[M + Na]^+$ 54%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{36}H_{43}N_2O_7$, 615.3065, found 615.3066.

General procedure for the synthesis of imidazolidine-derived tetramates:

To a solution of *N*-acylated imidazolidines **21a-l** (1.0 eq.) in anhydrous THF was added DBU (1.1-1.2 eq.). The mixture was stirred overnight at rt. The reaction mixture was then cooled to 0°C, diluted with water, and partitioned between Et_2O and water and the aqueous layer was acidified to pH 1-2 using 3 M HCl solution (aq.) and extracted with EtOAc. The organic layer was washed with brine, then dried over Na_2SO_4, filtered and concentrated under reduced pressure to yield the desired tetramates **22a-l**, which was then used without further purification.

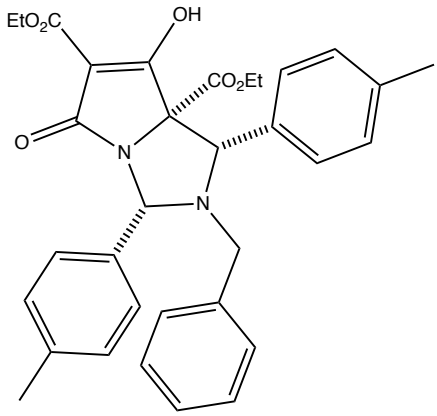
Diethyl (1*S,3*S**,7a*R**)-2-benzyl-7-hydroxy-5-oxo-1,3-diphenyl-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22a**



Yield (2.12 g, 77%); Yellow foamy solid; m.p. 70-74°C; ν_{max}/cm^{-1} 2982 (C-H), 1718 (C=O), 1656 (C=O), 1614 (C=C); δ_H (500 MHz, $CDCl_3$) 0.93 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.35 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.70 (1H, d, *J*=14.9 Hz, H9), 3.78 (1H, dq, *J*=7.2 Hz, 10.5 Hz, OCH_2CH_3), 3.84 (1H, d, *J*=14.8 Hz, H9), 3.96 (1H, m, OCH_2CH_3), 3.96 (1H, s, H4), 4.33 (2H, m, OCH_2CH_3), 5.30 (1H, s, H2), 6.82 (2H, m, Ar-H), 7.22 (3H, m, Ar-H), 7.37-7.51 (6H, m, Ar-H), 7.61 (2H, d, *J*=7.5 Hz, Ar-H), 8.00 (2H, d, *J*=7.1 Hz, Ar-H); δ_c (126 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.1 (C9), 62.0 (OCH_2CH_3), 62.3 (OCH_2CH_3), 69.8 (C4), 75.7 (C5), 76.4 (C2), 127.9 (Ar-C), 128.5 (Ar-C), 128.5 (Ar-C), 128.8 (Ar-C), 128.8 (Ar-C), 129.1 (Ar-C), 129.2 (Ar-C), 129.4 (Ar-C), 130.5 (Ar-C), 132.5 (Ar-C), 133.7 (Ar-C), 138.4 (Ar-C), 164.7 (C=O), 167.6 (C=O), 185.2 (C6); LRMS (ESI^+) *m/z*: 549.2 ($[M + Na]^+$

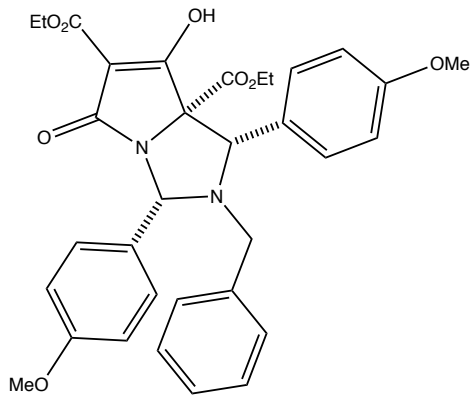
35%); LRMS (ESI^-) *m/z*: 525.2 ([M – H]$^-$ 97%); HRMS (ESI^+) *m/z*: [M + H]$^+$ calcd. for $C_{31}H_{31}N_2O_6$, 527.2177, found 527.2179.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-7-hydroxy-5-oxo-1,3-di-*p*-tolyl-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22b**



Yield (3.76 g, 75%); Yellow foamy solid; m.p. 91-97°C; ν_{max}/cm^{-1} 2982 (C-H), 1723 (C=O), 1656 (C=O), 1614 (C=C); δ_H (400 MHz, $CDCl_3$) 1.00 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.35 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 2.42 (3H, s, CH_3), 2.44 (3H, s, CH_3), 3.69 (1H, d, *J*=14.7 Hz, H9), 3.85 (1H, m, H9), 3.85 (1H, m, OCH_2CH_3), 3.90 (1H, s, H4), 4.01 (1H, dq, *J*=7.1 Hz, 10.7 Hz, OCH_2CH_3), 4.32 (2H, m, OCH_2CH_3), 5.25 (1H, s, H2), 6.83 (2H, m, Ar-H), 7.22-7.36 (7H, m, Ar-H), 7.49 (2H, d, *J*=7.7 Hz, Ar-H), 7.90 (2H, d, *J*=8.1 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.2 (OCH_2CH_3), 21.4 (CH_3), 21.4 (CH_3), 49.5 (C9), 61.8 (OCH_2CH_3), 62.3 (OCH_2CH_3), 69.4 (C4), 76.0 (C2), 127.8 (Ar-C), 128.4 (Ar-C), 129.0 (Ar-C), 129.1 (Ar-C), 129.3 (Ar-C), 129.5 (Ar-C), 130.5 (Ar-C), 132.3 (Ar-C), 135.3 (Ar-C), 138.4 (Ar-C), 139.0 (Ar-C), 164.8 (C=O), 167.5 (C=O), 185.3 (C6); LRMS (ESI^-) *m/z*: 553.2 ([M – H]$^-$ 97%); HRMS (ESI^-) *m/z*: [M – H]$^-$ calcd. for $C_{33}H_{33}N_2O_6$, 553.2344, found 553.2339.

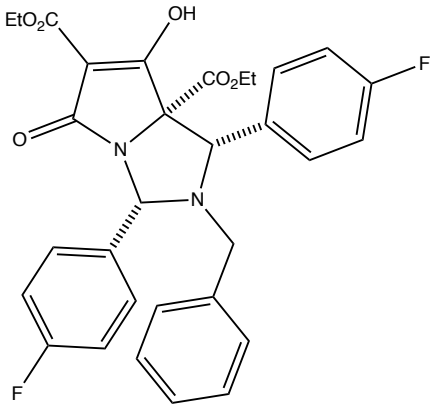
Diethyl (1*S,3*S**,7a*R**)-2-benzyl-7-hydroxy-1,3-bis(4-methoxyphenyl)-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22c**



Yield (2.17 g, 78%); Yellow sticky solid/oil; m.p. 81-85°C; ν_{max}/cm^{-1} 2980 (C-H), 1736 (C=O), 1685 (C=O), 1600 (C=C); δ_H (400 MHz, $CDCl_3$) 1.01 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.34 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.66 (1H, d, *J*=14.8 Hz, H9), 3.80 (1H, d, *J*=14.3 Hz, H9), 3.83 (1H, m, OCH_2CH_3), 3.85 (3H, s, OCH_3), 3.88 (4H, m, OCH_3, H4), 4.01 (1H, m, OCH_2CH_3), 4.30 (2H, m, OCH_2CH_3), 5.20 (1H, s, H2), 6.80 (2H, m, Ar-H), 6.98-7.02 (4H, m, Ar-H), 7.19-7.25 (3H, m, Ar-H), 7.50 (2H, d, *J*=8.2 Hz, Ar-H), 7.91 (2H, d, *J*=8.7 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.8 (OCH_2CH_3), 14.2 (OCH_2CH_3), 49.5 (C9), 55.4

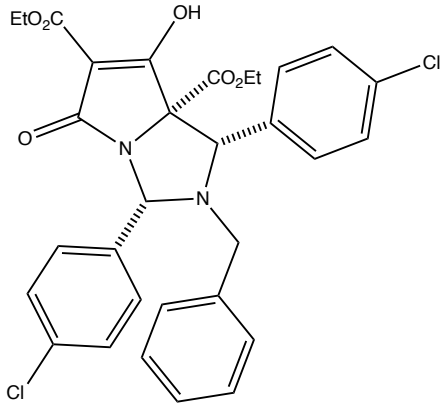
(OCH_3), 61.8 (OCH_2CH_3), 62.3 (OCH_2CH_3), 69.2 (C4), 75.7 (C5), 76.0 (C2), 113.8 (Ar-C), 114.2 (Ar-C), 125.4 (Ar-C), 127.8 (Ar-C), 128.4 (Ar-C), 130.2 (Ar-C), 130.5 (Ar-C), 130.7 (Ar-C), 132.1 (Ar-C), 132.4 (Ar-C), 160.0 (Ar-C), 160.2 (Ar-C), 165.0 (C=O), 167.5 (C=O), 185.4 (C6); LRMS (ESI^-) *m/z*: 585.2 ($[M - H]^-$ 96%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{33}H_{33}N_2O_8$, 585.2231, found 585.2243.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-1,3-bis(4-fluorophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22d**



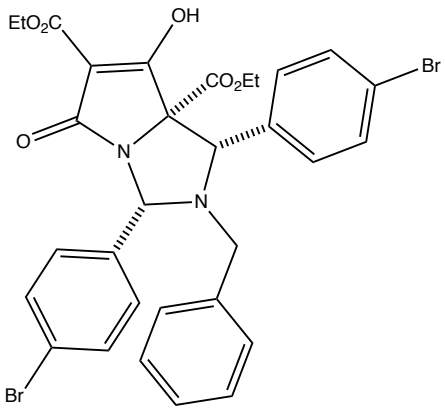
Yield (3.94 g, 77%); Yellow foamy solid; m.p. 95-99°C; ν_{max}/cm^{-1} 2984 (C-H), 1723 (C=O), 1658 (C=O), 1606 (C=C); δ_H (400 MHz, $CDCl_3$) 0.97 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.35 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 3.67 (1H, d, *J*=14.6 Hz, H9), 3.77 (1H, d, *J*=14.6 Hz, H9), 3.82 (1H, m, OCH_2CH_3), 3.93 (1H, s, H4), 3.97 (1H, dq, *J*=7.3 Hz, 10.9 Hz, OCH_2CH_3), 4.33 (2H, m, OCH_2CH_3), 5.26 (1H, s, H2), 6.79 (2H, m, Ar-H), 7.08-7.26 (7H, m, Ar-H), 7.57 (2H, m, Ar-H), 7.94 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.4 (C9), 62.0 (OCH_2CH_3), 62.4 (OCH_2CH_3), 69.2 (C4), 76.0 (C2), 115.3 (d, *J*=21.3 Hz, Ar-C), 115.9 (d, *J*=21.5 Hz, Ar-C), 128.1 (Ar-C), 128.6 (Ar-C), 129.3 (d, *J*=3.3 Hz, Ar-C), 130.3 (Ar-C), 130.8 (Ar-C), 131.1 (d, *J*=8.1 Hz, Ar-C), 132.3 (Ar-C), 134.1 (Ar-C), 163.1 (d, *J*=246.6 Hz, Ar-C), 163.2 (d, *J*=248.2 Hz, Ar-C), 164.7 (C=O), 167.5 (C=O), 185.1 (C6); δ_F (377 MHz, $CDCl_3$) -112.18, -113.71; LRMS (ESI^-) *m/z*: 561.1 ($[M - H]^-$ 100%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{31}H_{27}N_2O_6F_2$, 561.1843, found 561.1832.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-1,3-bis(4-chlorophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22e**



Yield (1.06 g, 75%); Yellow foamy solid; m.p. 88-91°C; ν_{max}/cm^{-1} 2983 (C-H), 1746 (C=O), 1721 (C=O), 1658 (C=O), 1616 (C=C); δ_H (400 MHz, $CDCl_3$) 0.97 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.35 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.66 (1H, d, *J*=14.6 Hz, H9), 3.77 (1H, d, *J*=14.8 Hz, H9), 3.82 (1H, m, OCH_2CH_3), 3.92 (1H, s, H4), 3.98 (1H, m, OCH_2CH_3), 4.32 (2H, m, OCH_2CH_3), 5.27 (1H, s, H2), 6.79 (2H, m, Ar-H), 7.23 (3H, m, Ar-H), 7.41 (2H, d, *J*=8.5 Hz, Ar-H), 7.46 (2H, d, *J*=8.6 Hz, Ar-H), 7.52 (2H, d, *J*=8.2 Hz, Ar-H), 7.88 (2H, d, *J*=8.5 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.6 (C9), 62.0 (OCH_2CH_3), 62.5 (OCH_2CH_3), 69.3 (C4), 75.5 (C5), 75.9 (C2), 128.1 (Ar-C), 128.6 (Ar-C), 128.6 (Ar-C), 129.1 (Ar-C), 130.3 (Ar-C), 130.7 (Ar-C), 132.3 (Ar-C), 134.5 (Ar-C), 135.1 (Ar-C), 137.0 (Ar-C), 164.7 (C=O), 167.4 (C=O), 185.2 (C6); LRMS (ESI$^-$) *m/z*: 593.0 ([M^{35+35} – H]$^-$ 100%), 595.0 ([M^{35+37} – H]$^-$ 69%), 597.1 ([M^{37+37} – H]$^-$ 22%); HRMS (ESI$^+$) *m/z*: [M^{35+35} + H]$^+$ calcd. for $C_{31}H_{29}N_2O_6Cl_2$, 595.1397, found 595.1399; [M^{35+37} + H]$^+$ calcd. for $C_{31}H_{29}N_2O_6Cl_2$, 597.1373, found 597.1362; [M^{37+37} + H]$^+$ calcd. for $C_{31}H_{29}N_2O_6Cl_2$, 599.1360, found 599.1323.

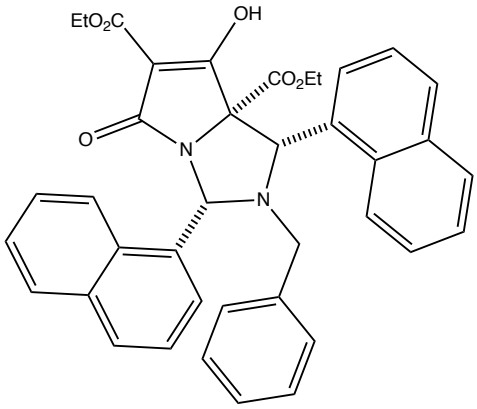
Diethyl (1*S,3*S**,7a*R**)-2-benzyl-1,3-bis(4-bromophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22f**



Yield (2.95 g, 55%); Yellow foamy solid; m.p. 85-90°C; ν_{max}/cm^{-1} 2983 (C-H), 1745 (C=O), 1721 (C=O), 1658 (C=O), 1616 (C=C); δ_H (400 MHz, $CDCl_3$) 0.96 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.35 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.67 (1H, d, *J*=14.6 Hz, H9), 3.77 (1H, d, *J*=14.7 Hz, H9), 3.82 (1H, m, OCH_2CH_3), 3.91 (1H, s, H4), 3.97 (1H, m, OCH_2CH_3), 4.34 (2H, m, OCH_2CH_3), 5.25 (1H, s, H2), 6.79 (2H, m, Ar-H), 7.23 (3H, m, Ar-H), 7.47 (2H, d, *J*=8.1 Hz, Ar-H), 7.56 (2H, d, *J*=8.4 Hz, Ar-H), 7.62 (2H, d, *J*=8.7 Hz, Ar-H), 7.82 (2H, d, *J*=8.5 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.2 (OCH_2CH_3), 50.6 (C9), 62.1 (OCH_2CH_3), 62.5 (OCH_2CH_3), 69.4 (C4), 75.3 (C5), 75.9 (C2), 122.8 (Ar-C), 123.3 (Ar-C), 128.2 (Ar-C), 128.7 (Ar-C), 130.3 (Ar-C), 130.7 (Ar-C), 131.0 (Ar-C), 131.6 (Ar-C), 132.1 (Ar-C), 132.6 (Ar-C), 137.4 (Ar-C), 164.4 (C=O), 167.4 (C=O), 169.2 (C=O), 184.9 (C6); LRMS (ESI$^-$) *m/z*: 681.0 ([M^{79+79} – H]$^-$ 46%), 683.0 ([M^{79+81} – H]$^-$ 95%), 685.0 ([M^{81+81}

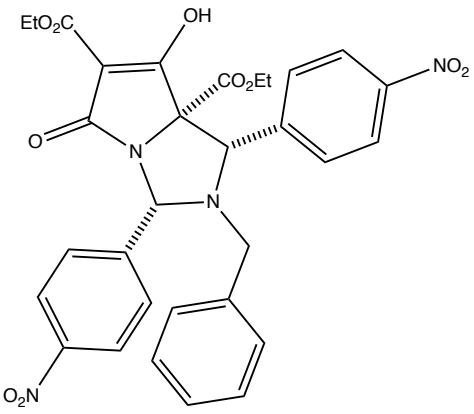
– H]$^-$ 51%); HRMS (ESI$^-$) *m/z*: [M^{79+79} – H]$^-$ calcd. for $C_{31}H_{27}N_2O_6Br_2$, 681.0241, found 681.0242; [M^{79+81} – H]$^-$ calcd. for $C_{31}H_{27}N_2O_6Br_2$, 683.0221, found 683.0225; [M^{81+81} – H]$^-$ calcd. for $C_{31}H_{27}N_2O_6Br_2$, 685.0200, found 685.0996.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-7-hydroxy-1,3-di(naphthalen-1-yl)-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22f**



Yield (851 mg, 61%); Yellow foamy solid; m.p. 108-111°C; ν_{max}/cm^{-1} 3055 (C-H), 2982 (C-H), 1746 (C=O), 1721 (C=O), 1656 (C=O), 1618 (C=C); δ_H (400 MHz, $CDCl_3$) 0.89 (3H, br m, OCH_2CH_3), 1.34 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.52 (1H, d, *J*=14.7 Hz, H9), 3.81 (2H, m, OCH_2CH_3, H9), 4.03 (1H, m, OCH_2CH_3), 4.35 (2H, m, OCH_2CH_3), 4.91 (1H, s, H4), 6.25 (1H, s, H2), 6.55-9.04 (19H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.3 (OCH_2CH_3), 50.1 (C9), 61.8 (OCH_2CH_3), 62.3 (OCH_2CH_3), 64.7 (C4), 71.3 (C2), 123.0-136.8 (Ar-C), 167.4 (C=O); LRMS (ESI$^-$) *m/z*: 625.2 ([M – H]$^-$ 97%); HRMS (ESI$^+$) *m/z*: [M + H]$^+$ calcd. for $C_{39}H_{35}N_2O_6$, 627.2490, found 627.2495.

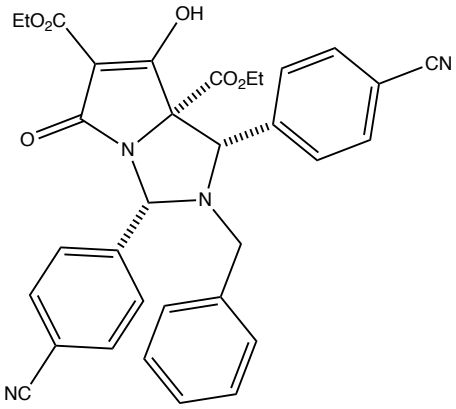
Diethyl (1*S,3*S**,7a*R**)-2-benzyl-7-hydroxy-1,3-bis(4-nitrophenyl)-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22h**



Yield (1.24 g, 83%); Orange foamy solid; m.p. 125-128°C; ν_{max}/cm^{-1} 1723 (C=O), 1608 (C=C); δ_H (400 MHz, $CDCl_3$) 0.90 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.39 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.75 (3H, m, OCH_2CH_3, H9), 3.95 (1H, dq, *J*=7.1 Hz, 10.8 Hz, OCH_2CH_3), 4.15 (1H, s, H4), 4.39 (2H, m, OCH_2CH_3), 5.48 (1H, s, H2), 6.83 (2H, m, Ar-H), 7.21 (3H, m, Ar-H), 7.83 (2H, d, *J*=8.4 Hz, Ar-H), 8.05 (2H, d, *J*=8.8 Hz, Ar-H), 8.25 (2H, d, *J*=8.8 Hz, Ar-H), 8.36 (2H, d, *J*=9.0 Hz, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 14.2 (OCH_2CH_3), 52.9 (C9), 62.4 (OCH_2CH_3), 62.8 (OCH_2CH_3), 70.1 (C4), 75.2 (C5), 76.1 (C2), 123.6 (Ar-C), 124.0 (Ar-C), 128.5 (Ar-C), 128.9 (Ar-C), 129.9 (Ar-C), 130.0 (Ar-C), 130.2 (Ar-C), 132.3 (Ar-C), 140.9 (Ar-C),

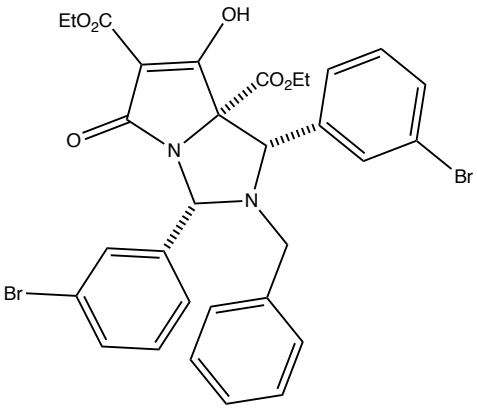
148.1 (Ar-C), 148.6 (Ar-C), 163.9 (C=O), 167.3 (C=O), 184.6 (C6); LRMS (ESI^-) *m/z*: 615.1 ($[M - H]^-$ 98%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{31}H_{27}N_4O_{10}$, 615.1733, found 615.1732.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-1,3-bis(4-cyanophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22j**



Yield (509 mg, 85%); Pale orange oil that solidified overnight; m.p. 79-83°C; ν_{max}/cm^{-1} 2984 (C-H), 2229 (C≡N), 1749 (C=O), 1713 (C=O), 1660 (C=O), 1610 (C=C); δ_H (400 MHz, $CDCl_3$) 0.88 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.37 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.72 (2H, s, H9), 3.77-3.99 (2H, m, OCH_2CH_3), 4.05 (1H, s, H4), 4.36 (2H, m, OCH_2CH_3), 5.39 (1H, s, H2), 6.79 (2H, m, Ar-H), 7.21 (3H, m, Ar-H), 7.68 (2H, m, Ar-H), 7.72 (2H, m, Ar-H), 7.78 (2H, m, Ar-H), 7.98 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.6 (OCH_2CH_3), 14.2 (OCH_2CH_3), 52.6 (C9), 62.3 (OCH_2CH_3), 62.7 (OCH_2CH_3), 70.2 (C4), 76.3 (C2), 112.4 (Ar-C), 113.2 (Ar-C), 118.4 (C≡N), 118.9 (C≡N), 128.5 (Ar-C), 128.8 (Ar-C), 129.7 (Ar-C), 129.8 (Ar-C), 130.2 (Ar-C), 132.2 (Ar-C), 132.3 (Ar-C), 132.6 (Ar-C), 139.2 (Ar-C), 143.8 (Ar-C), 167.3 (C=O), 184.6 (C6); LRMS (ESI^-) *m/z*: 575.2 ($[M - H]^-$ 96%); HRMS (ESI^+) *m/z*: $[M + H]^+$ calcd. for $C_{33}H_{29}N_4O_6$, 577.2082, found 577.2080.

Diethyl (1*S,3*S**,7a*R**)-2-benzyl-1,3-bis(3-bromophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 22k**



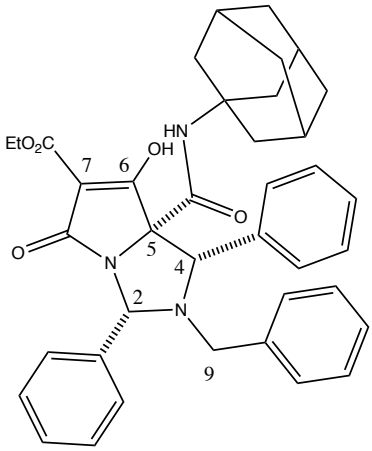
Yield (560 mg, 70%); Yellow foamy solid; m.p. 81-84°C; ν_{max}/cm^{-1} 2983 (C-H), 1747 (C=O), 1720 (C=O), 1658 (C=O), 1617 (C=C); δ_H (400 MHz, $CDCl_3$) 0.97 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.28 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.63 (1H, d, *J*=14.7 Hz, H9), 3.71 (1H, d, *J*=14.6 Hz, H9), 3.79 (1H, m, OCH_2CH_3), 3.84 (1H, s, H4), 3.94 (1H, m, OCH_2CH_3), 4.26 (2H, m, OCH_2CH_3), 5.18 (1H, s, H2), 6.75 (2H, m, Ar-H), 7.15-7.31 (6H, m, Ar-H), 7.42 (2H, m, Ar-H), 7.50 (1H, m, Ar-H), 7.78 (1H, m, Ar-H), 8.00 (1H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.8 (OCH_2CH_3), 14.2 (OCH_2CH_3), 51.2 (C9), 62.1 (OCH_2CH_3), 62.7

(OCH_2CH_3), 69.5 (C4), 75.4 (C5), 76.1 (C2), 122.5 (Ar-C), 123.0 (Ar-C), 128.0 (Ar-C), 128.2 (Ar-C), 128.7 (Ar-C), 130.0 (Ar-C), 130.3 (Ar-C), 130.4 (Ar-C), 131.9 (Ar-C), 132.1 (Ar-C), 132.3 (Ar-C), 132.4 (Ar-C), 136.0 (Ar-C), 140.8 (Ar-C), 164.4 (C=O), 167.3 (C=O), 185.0 (C6); LRMS (ESI^-) *m/z*: 681.0 ($[M^{79+79} - H]^-$ 49%), 683.0 ($[M^{79+81} - H]^-$ 97%), 685.0 ($[M^{81+81} - H]^-$ 51%); HRMS (ESI^+) *m/z*: $[M^{79+79} + H]^+$ calcd. for $C_{31}H_{29}N_2O_6Br_2$, 683.0374, found 683.0392; $[M^{79+81} + H]^+$ calcd. for $C_{31}H_{29}N_2O_6Br_2$, 685.0355, found 685.0364; $[M^{81+81} + H]^+$ calcd. for $C_{31}H_{29}N_2O_6Br_2$, 687.0341, found 687.0342.

General procedure for the synthesis of C5 and C7-carboxamidotetramic acids:[9, 10]

To a solution of tetramic acids **22a-b, f, k** (1.0 eq.) in anhydrous toluene was added 1-adamantylamine (1.2 eq.). The mixture was heated at reflux overnight. Then the reaction mixture was concentrated *in-vacuo* and purified by flash column chromatography to yield tetramates that where chelated with metals. The product was then redissolved in DCM, washed with 10% citric acid solution (aq.), dried over Na_2SO_4, filtered and concentrated under reduced pressure to yield the desired carboxamides **23a-b**, **24a-c**.

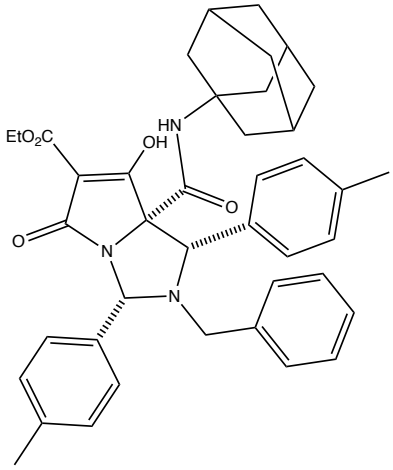
Ethyl (1*S,3*S**,7a*R**)-7a-(adamantan-1-ylcarbamoyl)-2-benzyl-7-hydroxy-5-oxo-1,3-diphenyl-2,3,5,7a-tetrahydro-1*H*-pyrrolo[1,2-*c*]imidazole-6-carboxylate 23a**



Yield (56 mg, 21%); Orange oil; R_f (50% EtOAc in Pet. Ether 40:60) 0.38; ν_{max}/cm^{-1} 2910 (C-H), 2852 (C-H), 1743 (C=O), 1689 (C=O), 1626 (C=C); AB:CD 62:38 by δ_H-NMR; $\delta_{H\ (Major\ tautomer)}$ (400 MHz, $CDCl_3$) 1.23 (3H, t, *J*=7.0 Hz, OCH_2CH_3), 1.64-1.68 (6H, br m, Adamantyl-CH_2), 1.88-2.02 (6H, br m, Adamantyl-CH_2), 2.08 (3H, br m, Adamantyl-H), 3.48 (1H, d, *J*=13.7 Hz, H9), 3.75 (1H, d, *J*=13.6 Hz, H9), 4.31 (2H, m, OCH_2CH_3), 5.08 (1H, s, H4), 5.87 (1H, s, H2), 6.99 (2H, m, Ar-H), 7.04 (2H, m, Ar-H), 7.20-7.50 (9H, m, Ar-H), 7.68 (2H, m, Ar-H), 10.27 (1H, br s, NH/OH); $\delta_{c\ (Major\ tautomer)}$ (101 MHz, $CDCl_3$) 14.2 (OCH_2CH_3), 29.3 (Adamantyl-C), 36.1 (Adamantyl-C), 41.6 (Adamantyl-C), 49.9 (C9), 53.5 (Adamantyl-C), 62.9 (OCH_2CH_3), 65.4 (C4), 77.7 (C2), 79.2 (C5), 95.3 (C7), 127.1 (Ar-C), 128.1 (Ar-C), 128.2 (Ar-C), 128.3 (Ar-C), 128.4 (Ar-C), 128.5 (Ar-C), 128.7 (Ar-C), 128.8 (Ar-C), 129.0 (Ar-C), 134.8 (Ar-C), 137.5 (Ar-C), 139.6 (Ar-C), 165.9 (C=O), 168.1 (C=O), 174.0 (C=O), 186.5

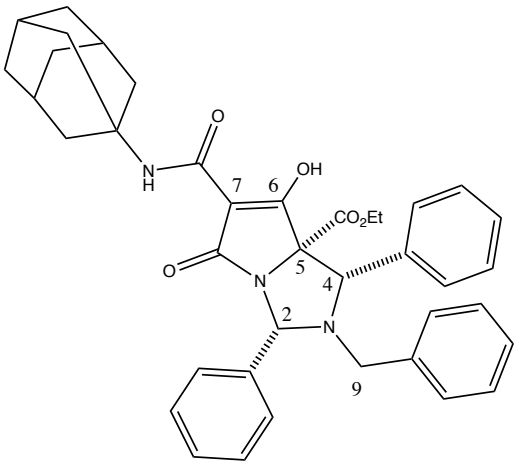
(C6); LRMS (ESI$^-$) *m/z*: 630.2 ([M – H]$^-$ 95%); HRMS (ESI$^-$) *m/z*: [M – H]$^-$ calcd. for $C_{39}H_{40}N_3O_5$, 630.2973, found 630.2967.

Ethyl (1*S,3*S**,7a*R**)-7a-(adamantan-1-ylcarbamoyl)-2-benzyl-7-hydroxy-5-oxo-1,3-di-*p*-tolyl-2,3,5,7a-tetrahydro-1*H*-pyrrolo[1,2-*c*]imidazole-6-carboxylate 23b**



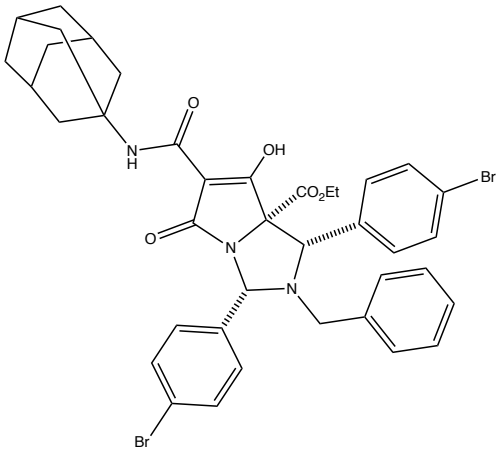
Yield (300 mg, 36%); Brown foamy solid; m.p. 108-111°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.68; ν_{max}/cm^{-1} 3308 (O-H), 2909 (C-H), 2852 (C-H), 1742 (C=O), 1686 (C=O), 1625 (C=C); AB:CD 69:31 by δ_H-NMR; $\delta_{H\ (Major\ tautomer)}$ (400 MHz, $CDCl_3$) 1.25 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.66-1.68 (6H, br m, Adamantyl-CH_2), 1.97-2.01 (6H, br m, Adamantyl-CH_2) 2.09 (3H, br s, Adamantyl-CH), 2.33 (3H, s, CH_3), 2.36 (3H, s, CH_3), 3.40 (1H, d, *J*=13.7 Hz, H9), 3.69 (1H, d, *J*=13.7 Hz, H9), 4.31 (2H, m, OCH_2CH_3), 5.01 (1H, s, H4), 5.77 (1H, s, H2), 6.70 (1H, br s, NH/OH), 6.85 (2H, d, *J*=7.5 Hz, Ar-H), 7.04 (2H, d, *J*=7.2 Hz, Ar-H), 7.08 (2H, d, *J*=7.7 Hz, Ar-H), 7.20-7.25 (5H, m, Ar-H), 7.44 (1H, br s, NH/OH), 7.53 (2H, d, *J*=8.1 Hz, Ar-H); $\delta_{c\ (Major\ tautomer)}$ (101 MHz, $CDCl_3$) 14.2 (OCH_2CH_3), 21.3 (CH_3), 21.3 (CH_3), 29.4 (Adamantyl-C), 36.1 (Adamantyl-C), 41.7 (Adamantyl-C), 49.9 (C9), 53.4 (Adamantyl-C), 62.8 (OCH_2CH_3), 65.1 (C4), 77.5 (C2), 79.2 (C5), 96.0 (C7), 127.1 (Ar-C), 128.2 (Ar-C), 128.2 (Ar-C), 128.4 (Ar-C), 129.0 (Ar-C), 129.2 (Ar-C), 129.3 (Ar-C), 136.6 (Ar-C), 138.6 (Ar-C), 166.0 (C=O), 168.2 (C=O), 174.0 (C=O), 186.1 (C6); LRMS (ESI$^-$) *m/z*: 658.2 ([M – H]$^-$ 97%); HRMS (ESI$^-$) *m/z*: [M – H]$^-$ calcd. for $C_{41}H_{44}N_3O_5$, 658.3286, found 658.3295.

Ethyl (1*S,3*S**,7a*R**)-6-(adamantan-1-ylcarbamoyl)-2-benzyl-7-hydroxy-5-oxo-1,3-diphenyl-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-7a(5*H*)-carboxylate 24a**



Yield (365 mg, 31%); Yellow foamy solid; m.p. 105-108°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.85; ν_{max}/cm^{-1} 3310 (O-H), 2909 (C-H), 2852 (C-H), 1743 (C=O), 1692 (C=O), 1625 (C=C); AB:CD 67:33 by δ_H-NMR; $\delta_{H\ (Major\ tautomer)}$ (400 MHz, $CDCl_3$) 0.92 (3H, t, *J*=7.2 Hz, OCH_2CH_3), 1.67-1.68 (6H, br m, Adamantyl-CH_2), 2.01-2.11 (9H, br m, Adamantyl-CH_2, CH), 3.66 (1H, d, *J*=14.7 Hz, H9), 3.75 (1H, dq, *J*=7.2 Hz, 10.7 Hz, OCH_2CH_3), 3.82 (1H, d, *J*=14.7 Hz, H9), 3.95 (1H, m, OCH_2CH_3), 3.97 (1H, s, H4), 5.19 (1H, s, H2), 6.86 (2H, m, Ar-H), 7.23 (3H, m, Ar-H), 7.36-7.50 (6H, m, Ar-H), 7.60 (2H, d, *J*=7.5 Hz, Ar-H), 7.97 (2H, m, Ar-H); $\delta_{c\ (Major\ tautomer)}$ (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 29.4 (Adamantyl-C), 36.1 (Adamantyl-C), 41.7 (Adamantyl-C), 50.1 (C9), 53.4 (Adamantyl-C), 62.0 (OCH_2CH_3), 69.3 (C4), 76.6 (C2), 79.2 (C5), 94.5 (C7), 127.6-139.1 (Ar-C), 165.3 (C=O), 166.5 (C=O), 174.9 (C=O), 187.6 (C6); LRMS (ESI^-) *m/z*: 630.3 ($[M - H]^-$ 97%); HRMS (ESI^-) *m/z*: $[M - H]^-$ calcd. for $C_{39}H_{40}N_3O_5$, 630.2963, found 630.2980.

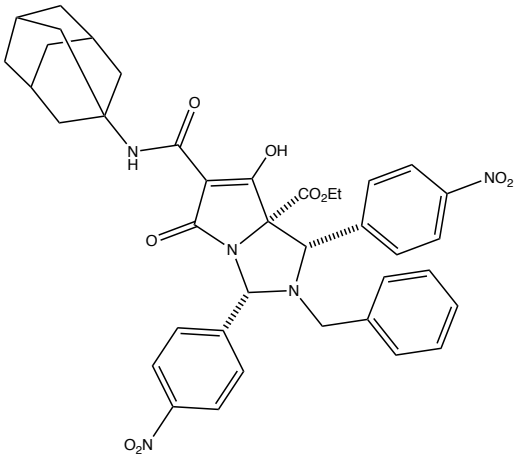
Ethyl (1*S,3*S**,7a*R**)-6-(adamantan-1-ylcarbamoyl)-2-benzyl-1,3-bis(4-bromophenyl)-7-hydroxy-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-7a(5*H*)-carboxylate 24b**



Yield (221 mg, 38%); Orange foamy solid; m.p. 129-133°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.90; ν_{max}/cm^{-1} 3309 (O-H), 2910 (C-H), 2852 (C-H), 1744 (C=O), 1693 (C=O), 1627 (C=C); AB:CD 60:40 by δ_H-NMR; $\delta_{H\ (Major\ tautomer)}$ (400 MHz, $CDCl_3$) 0.95 (3H, t, *J*=6.9 Hz, OCH_2CH_3), 1.67-1.69 (6H, br s, Adamantyl-CH_2), 2.01-2.03 (6H, br s, Adamantyl-CH_2), 2.11 (3H, br s, Adamantyl-CH), 3.65 (1H, d, *J*=14.6 Hz, H9), 3.74-3.83 (2H, m, OCH_2CH_3, H9), 3.92 (1H, s, H4), 3.97 (1H, m, OCH_2CH_3), 5.15 (1H, s, H2), 6.83 (2H, m, Ar-H), 7.23 (2H, m, Ar-H), 7.45 (3H, m, Ar-H), 7.57 (2H, d, *J*=8.4 Hz, Ar-H), 7.61 (2H, m, Ar-H), 7.79 (2H, m, Ar-H); $\delta_{c\ (Major\ tautomer)}$ (101 MHz, $CDCl_3$) 13.7 (OCH_2CH_3), 29.4 (Adamantyl-C), 36.1 (Adamantyl-C), 41.6 (Adamantyl-C), 50.7 (C9), 53.8 (Adamantyl-C), 62.2 (OCH_2CH_3), 68.9 (C4), 76.2 (C2), 93.3 (C7), 122.8-138.1 (Ar-C), 165.1 (C=O), 166.6 (C=O), 174.8 (C=O), 188.2 (C6); LRMS (ESI^-) *m/z*: 786.0 ($[M^{79+79} - H]^-$ 45%), 788.0 ($[M^{79+81} - H]^-$ 100%), 790.0 ($[M^{81+81} - H]^-$ 55%); HRMS (ESI^-) *m/z*: $[M^{79+79} - H]^-$ calcd. for

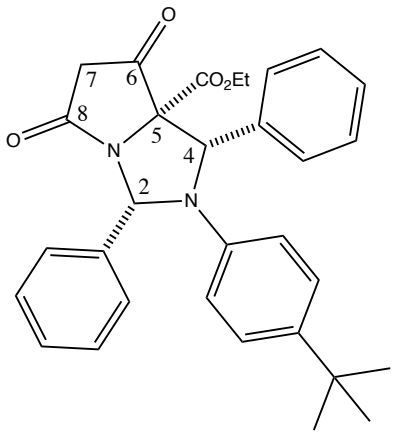
$C_{39}H_{38}N_3O_5Br_2$, 786.1173, found 786.1187; $[M^{79+81} - H]^-$ calcd. for $C_{39}H_{38}N_3O_5Br_2$, 788.1156, found 788.1167; $[M^{81+81} - H]^-$ calcd. for $C_{39}H_{38}N_3O_5Br_2$, 790.1145, found 790.1151.

Ethyl (1*S,3*S**,7a*R**)-6-(adamantan-1-ylcarbamoyl)-2-benzyl-7-hydroxy-1,3-bis(4-nitrophenyl)-5-oxo-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-7a(5*H*)-carboxylate 24c**



Yield (305 mg, 37%); Brown solid; m.p. 156-160°C; R_f (30% EtOAc in Pet. Ether 40:60) 0.58; ν_{max}/cm^{-1} 3307 (O-H), 2911 (C-H), 2852 (C-H), 1742 (C=O), 1693 (C=O), 1629 (C=C); AB:CD 58:42 by δ_H-NMR; $\delta_{H\ (Major\ tautomer)}$ (400 MHz, $CDCl_3$) 0.88 (3H, m, OCH_2CH_3), 1.66-1.70 (6H, br m, Adamantyl-CH_2), 2.04-2.06 (6H, br m, Adamantyl-CH_2), 2.14 (3H, br s, Adamantyl-CH), 3.71-3.81 (3H, m, OCH_2CH_3, H9), 3.95 (1H, m, OCH_2CH_3), 4.14 (1H, s, H4), 5.39 (1H, s, H2), 6.86 (2H, m, Ar-H), 7.19 (3H, m, Ar-H), 7.53 (1H, br s, NH/OH), 7.80 (2H, d, *J*=8.7 Hz, Ar-H), 7.98 (2H, m, Ar-H), 8.22 (2H, d, *J*=8.7 Hz, Ar-H), 8.33 (2H, d, *J*=8.7 Hz, Ar-H); $\delta_{c\ (Major\ tautomer)}$ (101 MHz, $CDCl_3$) 13.8 (OCH_2CH_3), 29.4 (Adamantyl-C), 36.0 (Adamantyl-C), 41.7 (Adamantyl-C), 53.4 (C9), 54.4 (Adamantyl-C), 62.4 (OCH_2CH_3), 69.7 (C4), 76.6 (C2), 90.9 (C7), 123.5-148.3 (Ar-C), 164.8 (C=O), 166.8 (C=O), 174.6 (C=O), 189.2 (C6); LRMS (ESI$^-$) *m/z*: 720.0 ([M – H]$^-$ 98%); HRMS (ESI$^-$) *m/z*: [M – H]$^-$ calcd. for $C_{39}H_{38}N_5O_9$, 720.2675, found 720.2679.

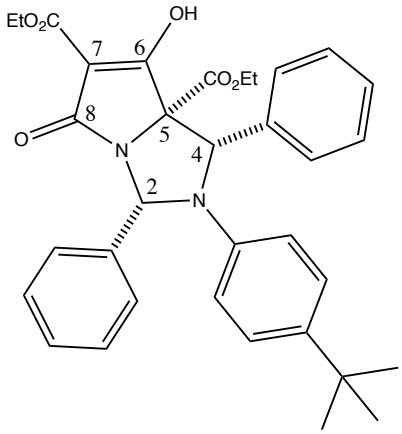
Ethyl (1*S,3*S**,7a*R**)-2-(4-(*tert*-butyl)phenyl)-5,7-dioxo-1,3-diphenyltetrahydro-1*H*-pyrrolo[1,2-*c*]imidazole-7a(5*H*)-carboxylate 27**



Yield not determined; 73:27 mixture of compounds **28:27**; δ_H (400 MHz, $CDCl_3$) 0.54 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.22 (9H, s, $(CH_3)_3$), 3.13 (1H, d, *J*=20.5 Hz, H7), 3.43 (2H, m, OCH_2CH_3), 3.60 (1H, d, *J*=20.5 Hz, H7), 5.17 (1H, s, H4), 6.51 (2H, d, *J*=8.9 Hz, Ar-H), 6.65 (1H, s, H2), 7.14-7.17 (2H, m, Ar-H), 7.31-7.48 (6H, m, Ar-H), 7.70-7.72 (2H, m, Ar-H), 7.82 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.1 (OCH_2CH_3), 31.5 ($(CH_3)_3$), 34.0 ($C(CH_3)_3$), 43.3 (C7), 62.3 (OCH_2CH_3), 68.2 (C4), 76.1 (C5), 77.6 (C2), 114.8 (Ar-C), 126.0 (Ar-C), 127.3

(Ar-C), 127.7 (Ar-C), 128.2 (Ar-C), 128.5 (Ar-C), 128.7 (Ar-C), 128.8 (Ar-C), 136.2 (Ar-C), 140.3 (Ar-C), 142.8 (Ar-C), 144.3 (Ar-C), 164.9 (C=O), 168.4 (C=O), 198.1 (C6).

Diethyl (1*S,3*S**,7a*R**)-2-(4-(*tert*-butyl)phenyl)-7-hydroxy-5-oxo-1,3-diphenyl-2,3-dihydro-1*H*-pyrrolo[1,2-*c*]imidazole-6,7a(5*H*)-dicarboxylate 28**



Yield not determined; 73:27 mixture of compounds **28:27**; δ_H (400 MHz, $CDCl_3$) 0.51 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 1.21 (9H, s, $(CH_3)_3$), 1.42 (3H, t, *J*=7.1 Hz, OCH_2CH_3), 3.43 (2H, m, OCH_2CH_3), 4.44 (2H, q, *J*=7.1 Hz, OCH_2CH_3), 5.05 (1H, s, H4), 6.40 (1H, s, H2), 6.47 (2H, d, *J*=8.9 Hz, Ar-H), 7.13 (2H, d, *J*=8.9 Hz, Ar-H), 7.31-7.48 (6H, m, Ar-H), 7.69 (2H, m, Ar-H), 7.78 (2H, m, Ar-H); δ_c (101 MHz, $CDCl_3$) 13.0 (OCH_2CH_3), 14.3 (OCH_2CH_3), 31.5 ($(CH_3)_3$), 34.0 ($C(CH_3)_3$), 62.0 (OCH_2CH_3), 62.2 (OCH_2CH_3), 69.3 (C4), 76.1 (C5), 77.7 (C2), 114.7 (Ar-C), 125.9 (Ar-C), 127.3 (Ar-C), 127.7 (Ar-C), 128.2 (Ar-C), 128.5 (Ar-C), 128.7 (Ar-C), 128.8 (Ar-C), 136.3 (Ar-C), 141.2 (Ar-C), 142.5 (Ar-C), 144.9 (Ar-C), 164.2 (C=O), 167.6 (C=O), 186.4 (C6); LRMS (ESI^-) *m/z*: 567.2 ($[M - H]^-$ 100%).

References

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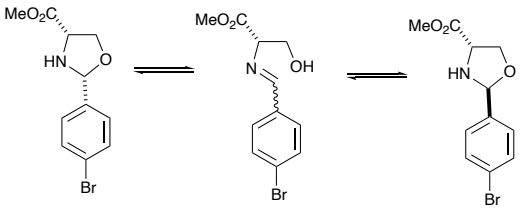

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NMR@CHEM.OX

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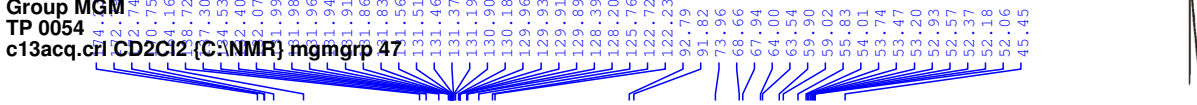

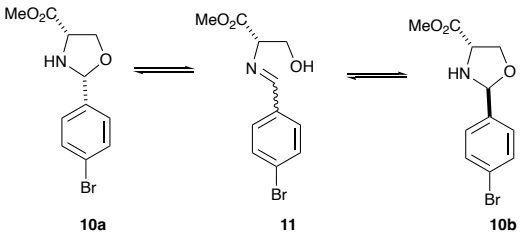

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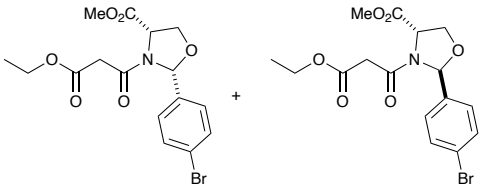

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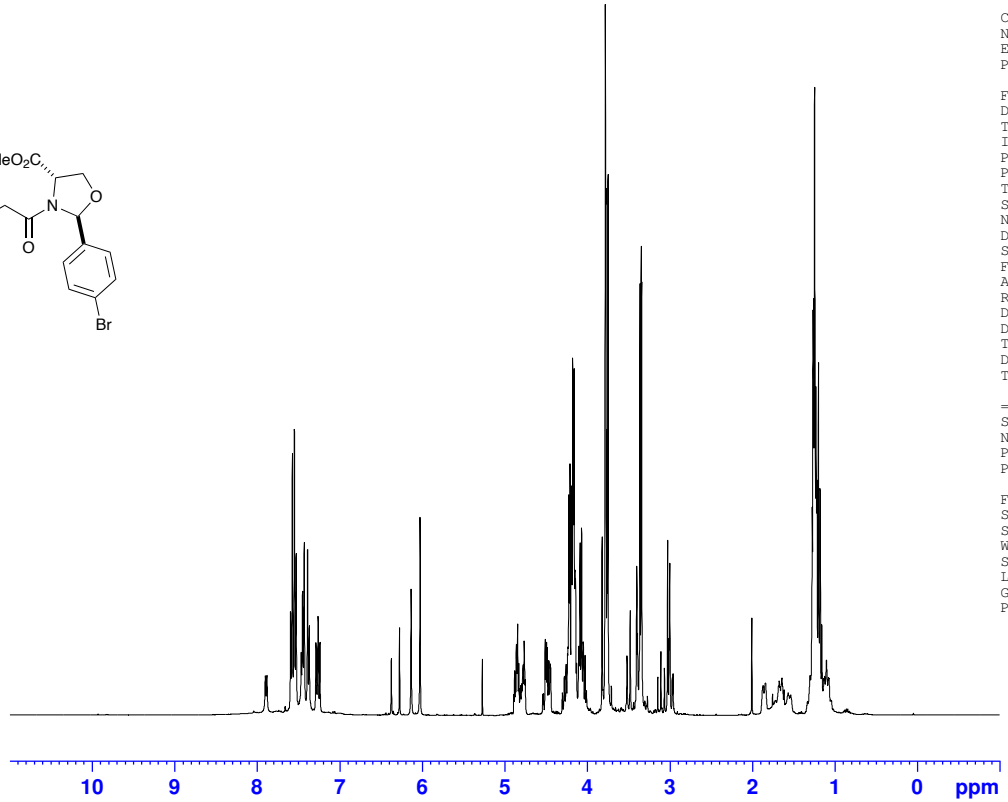

NMR@CHEM.OX

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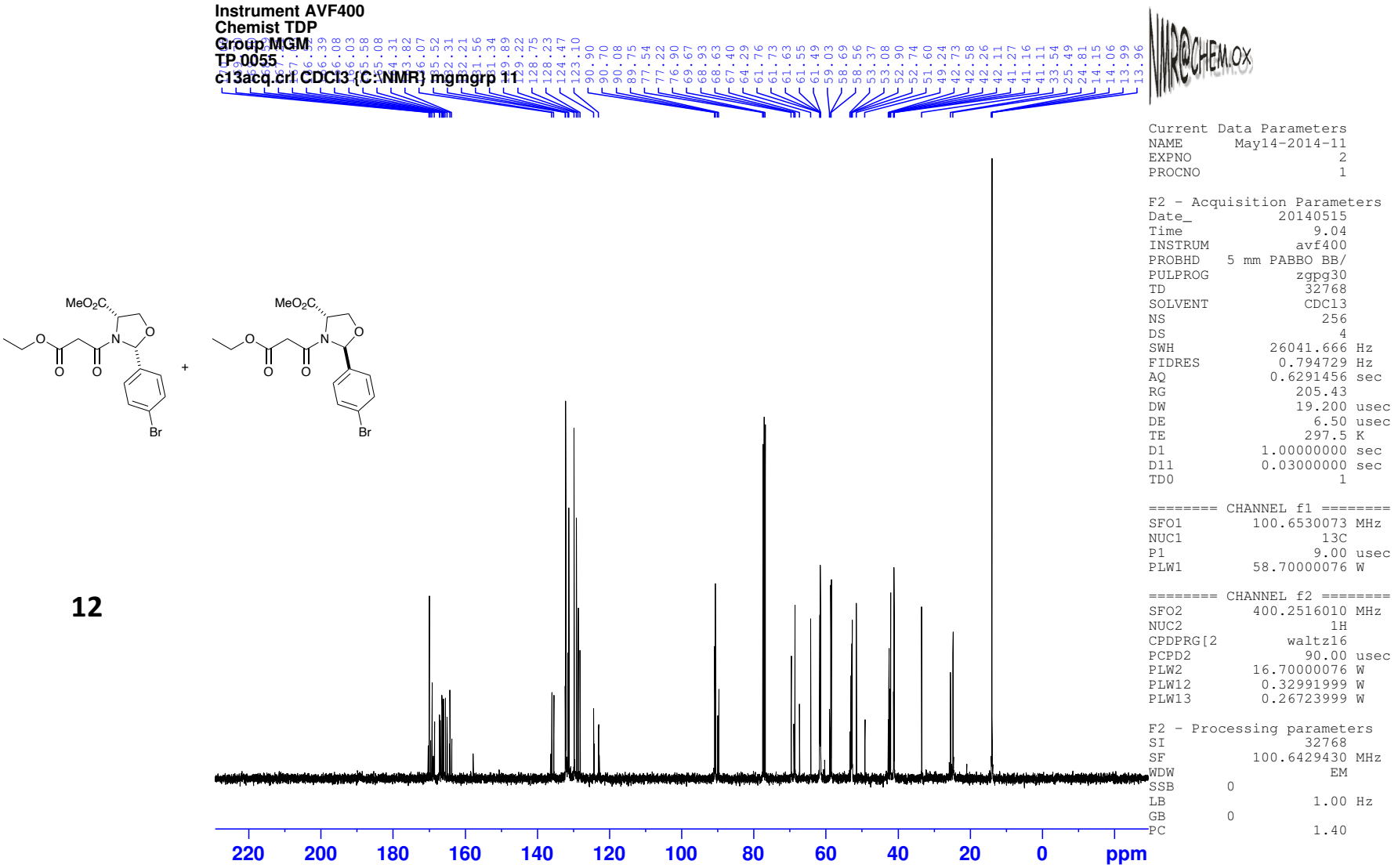
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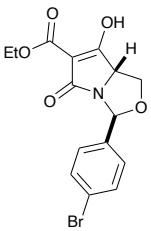

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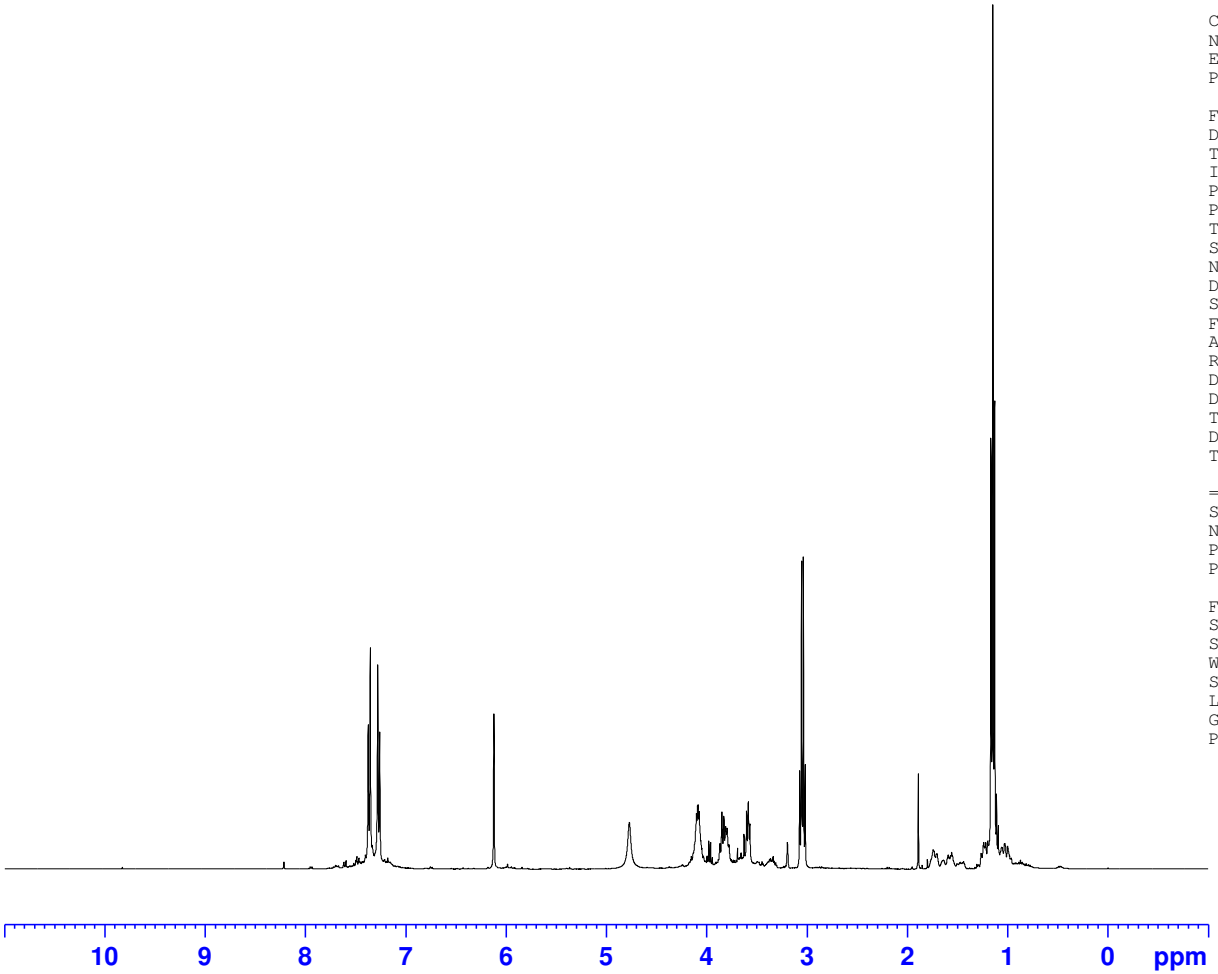

NMR@CHEM.OX

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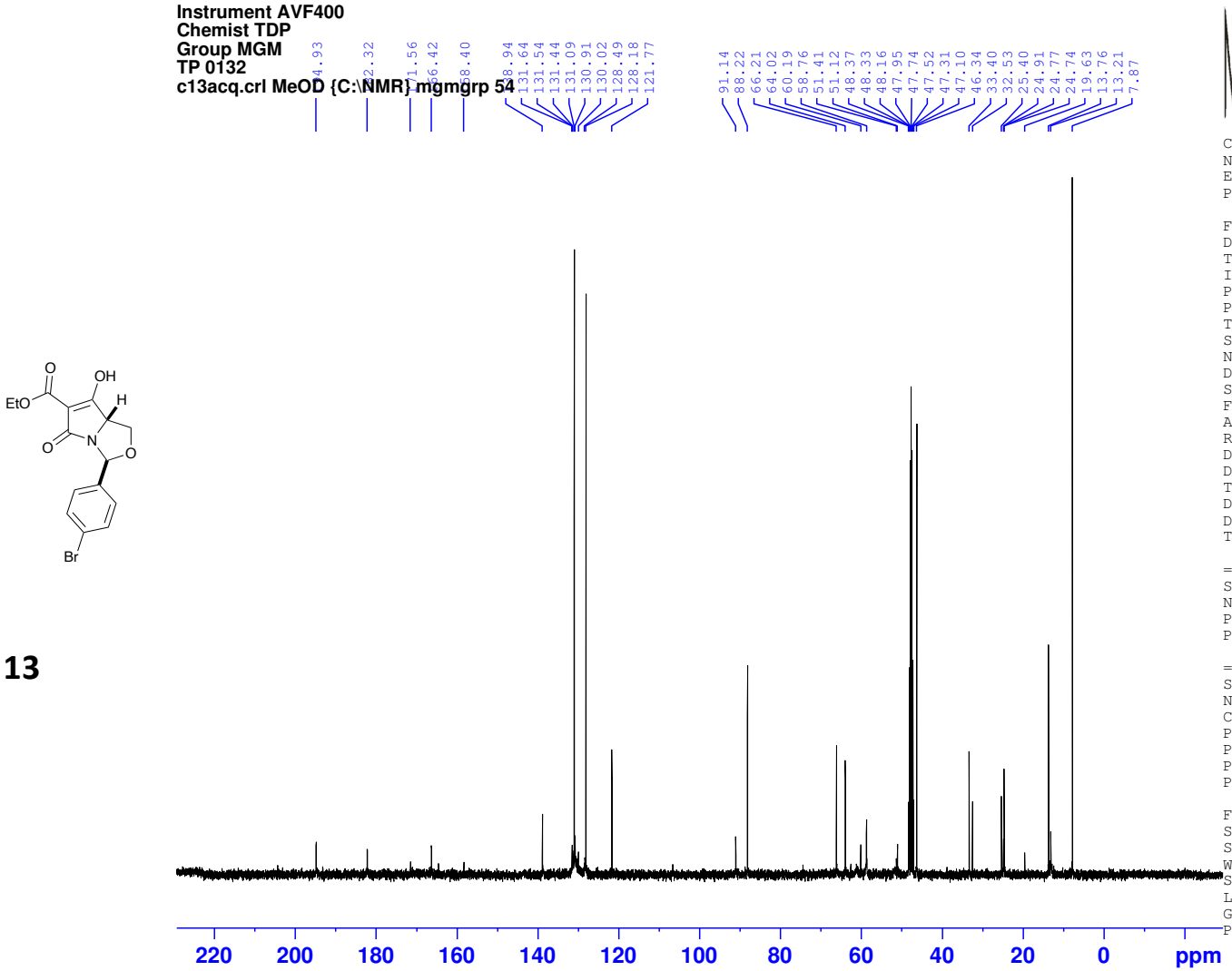

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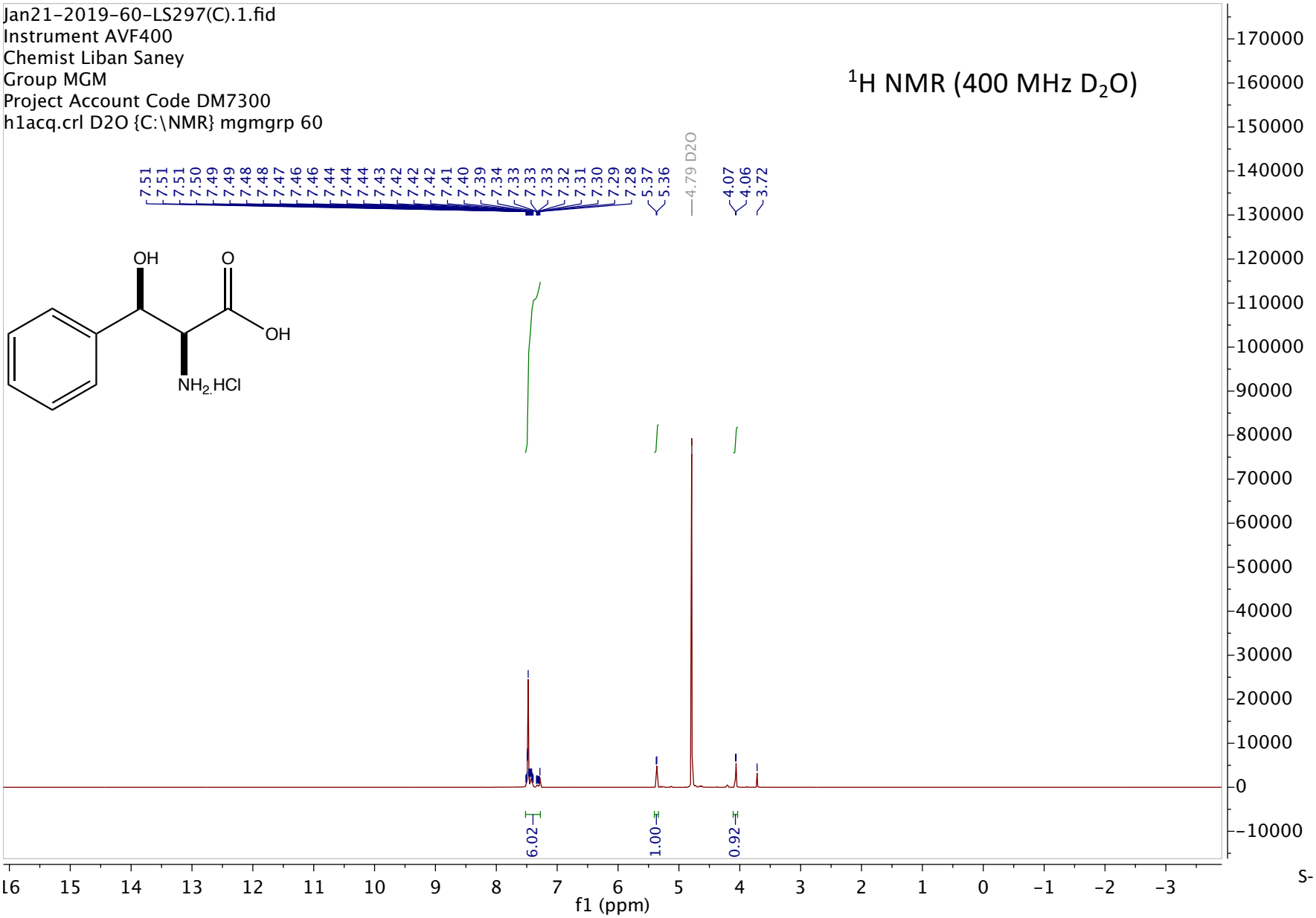
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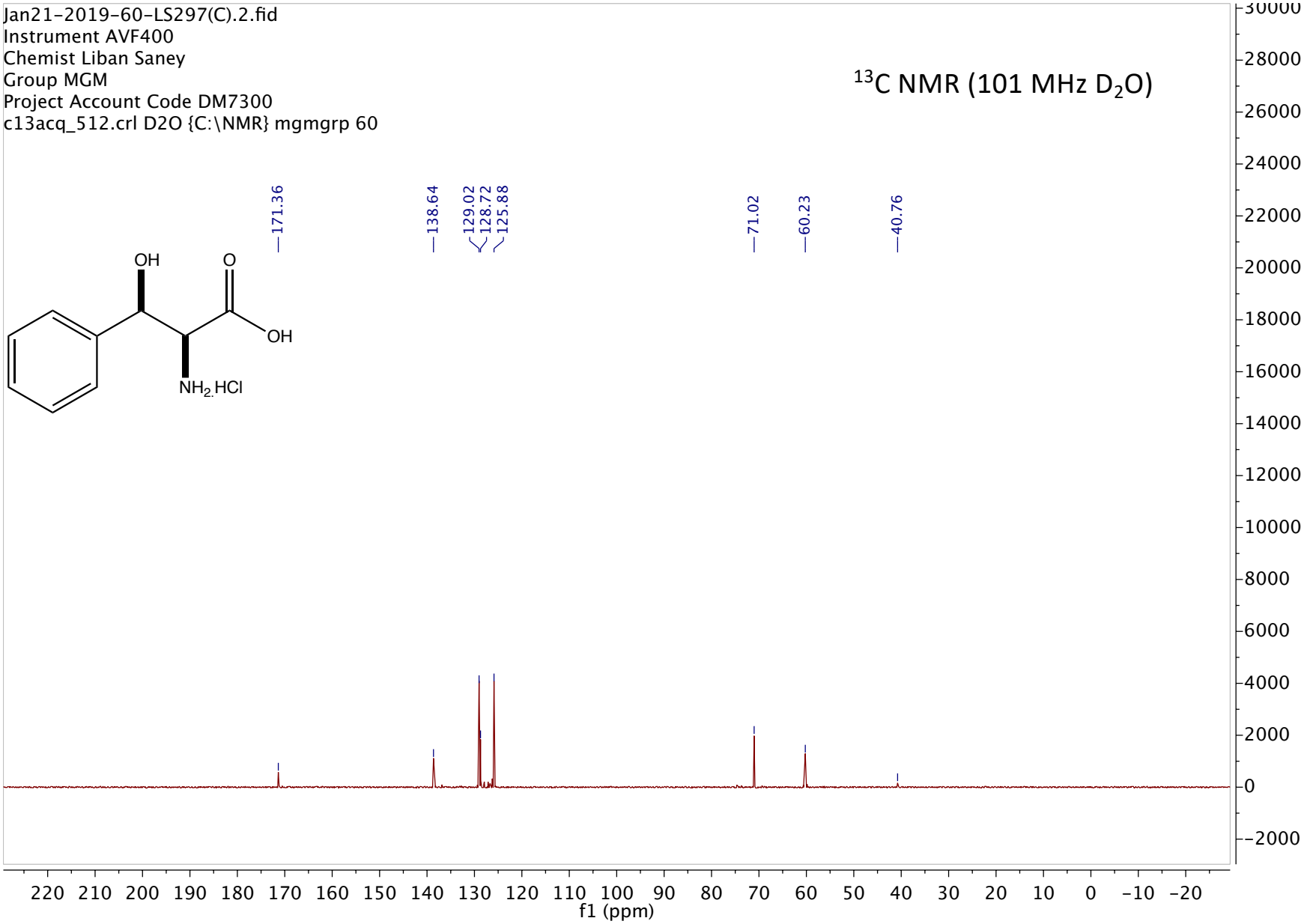
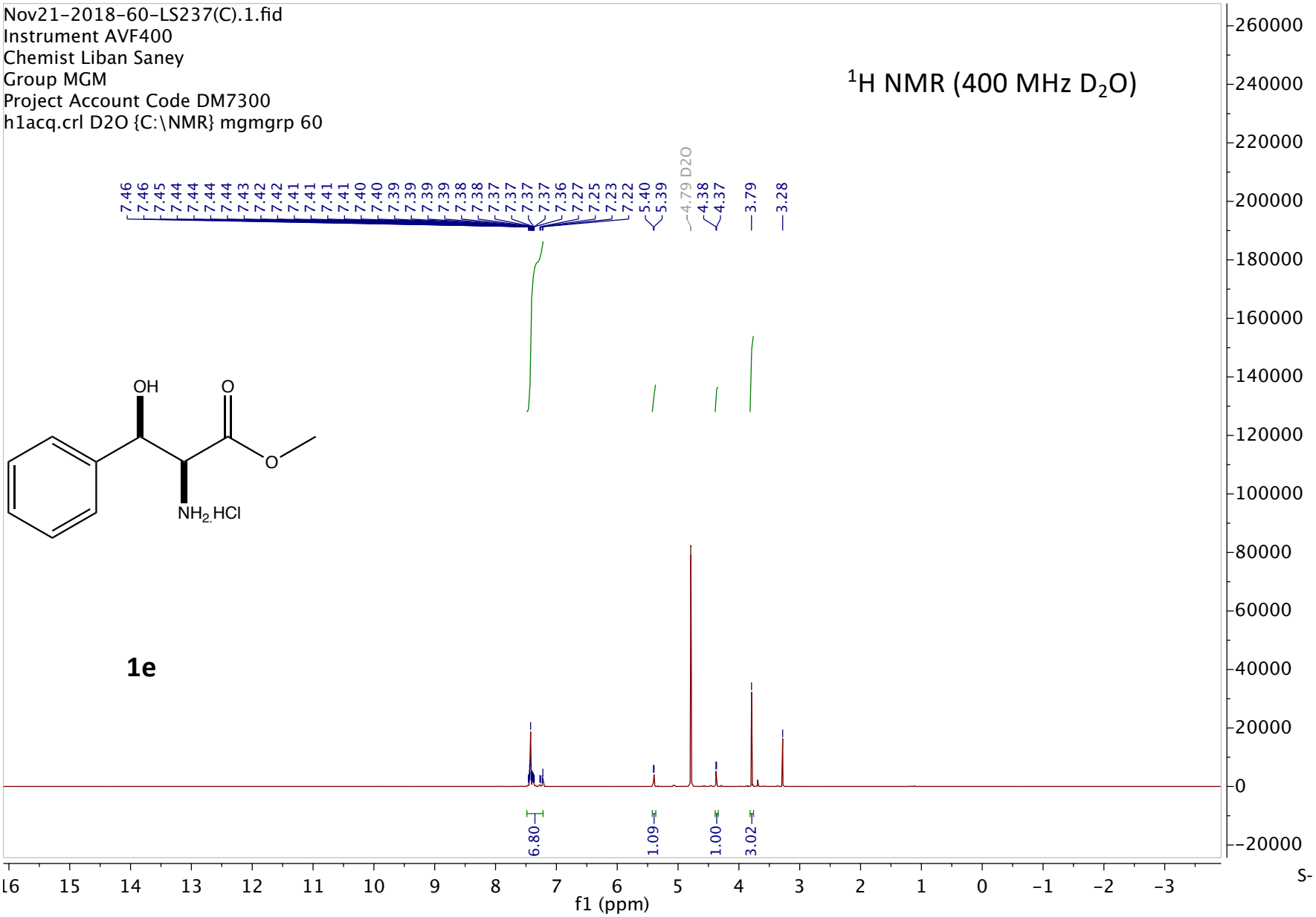
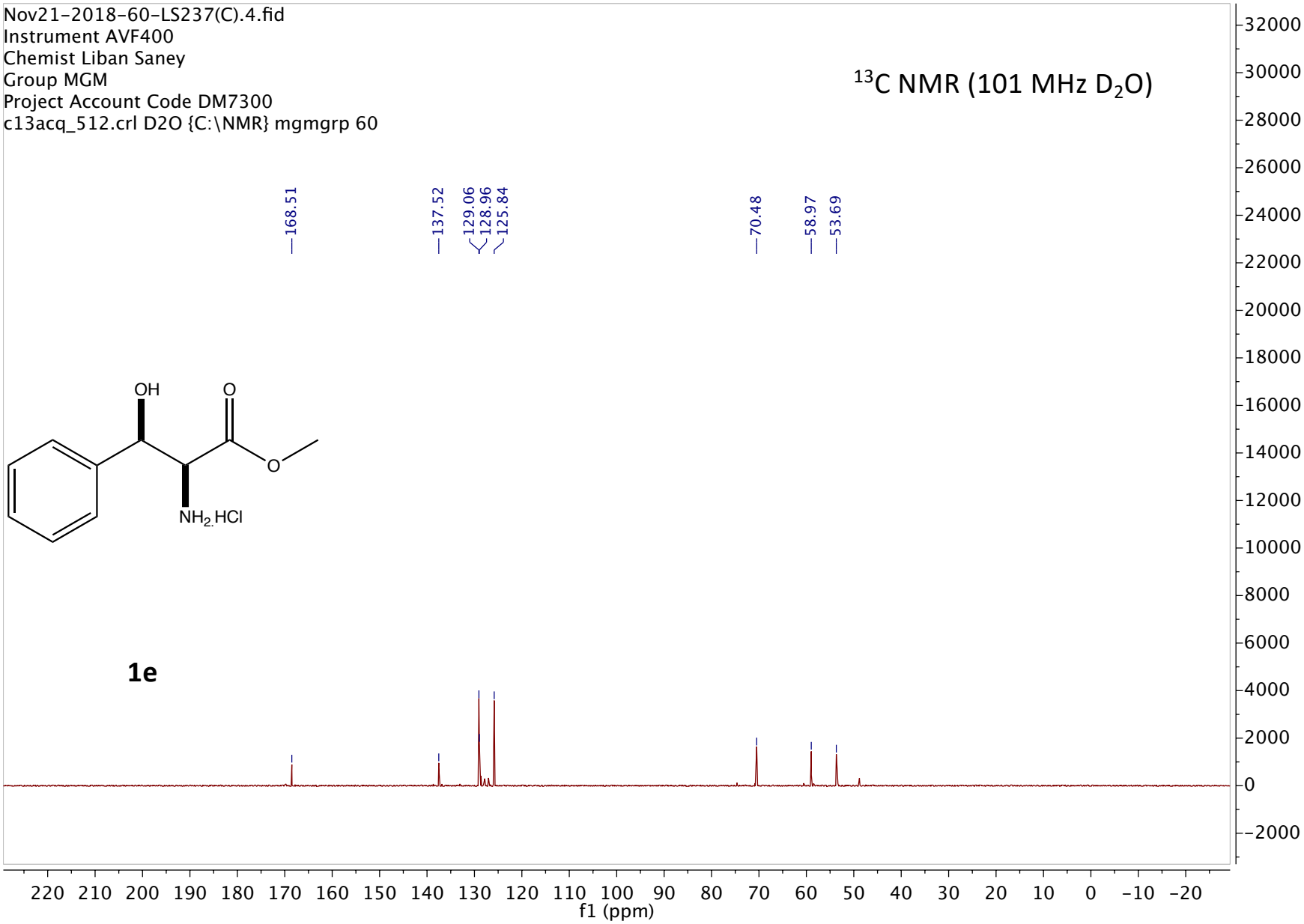
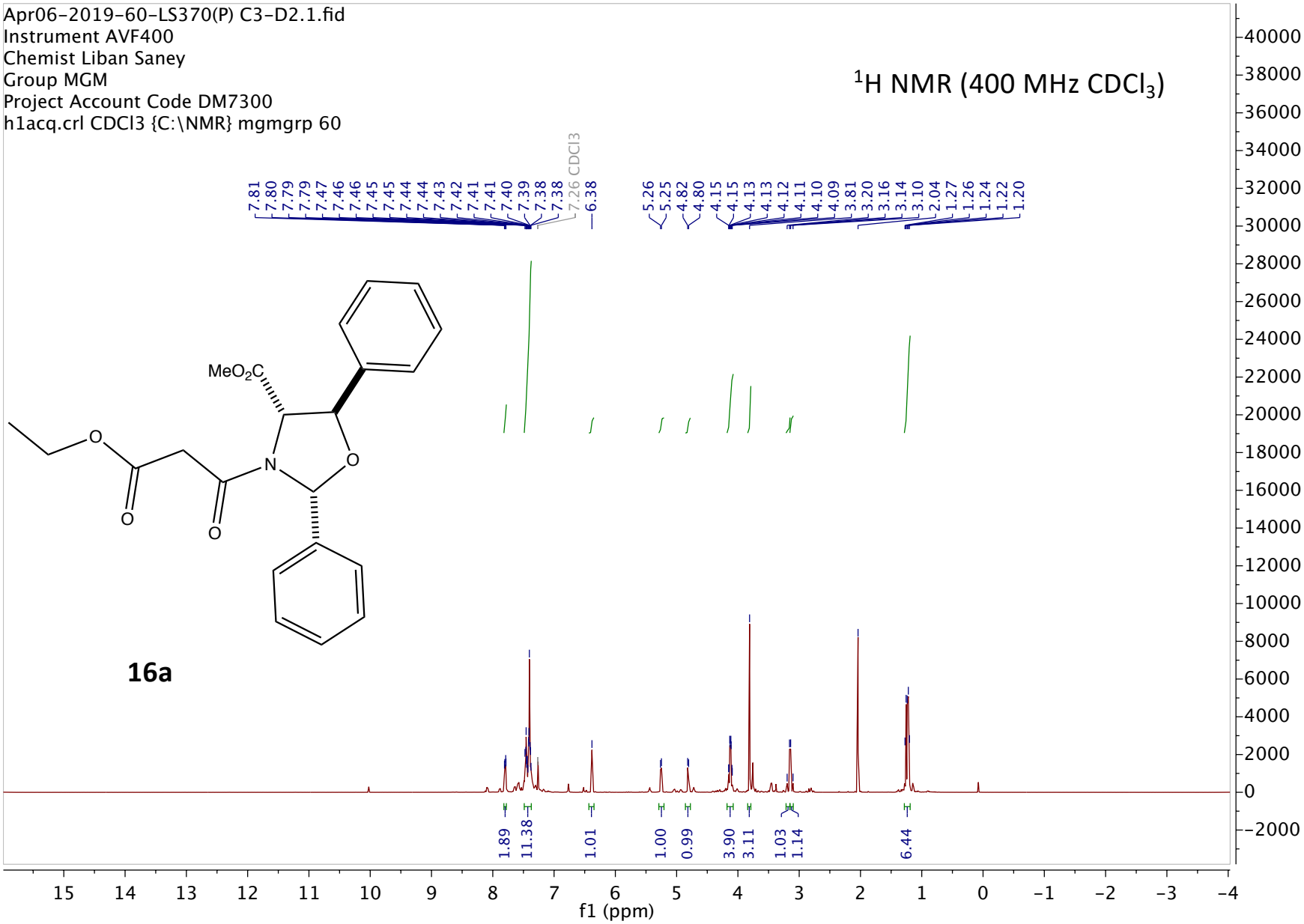
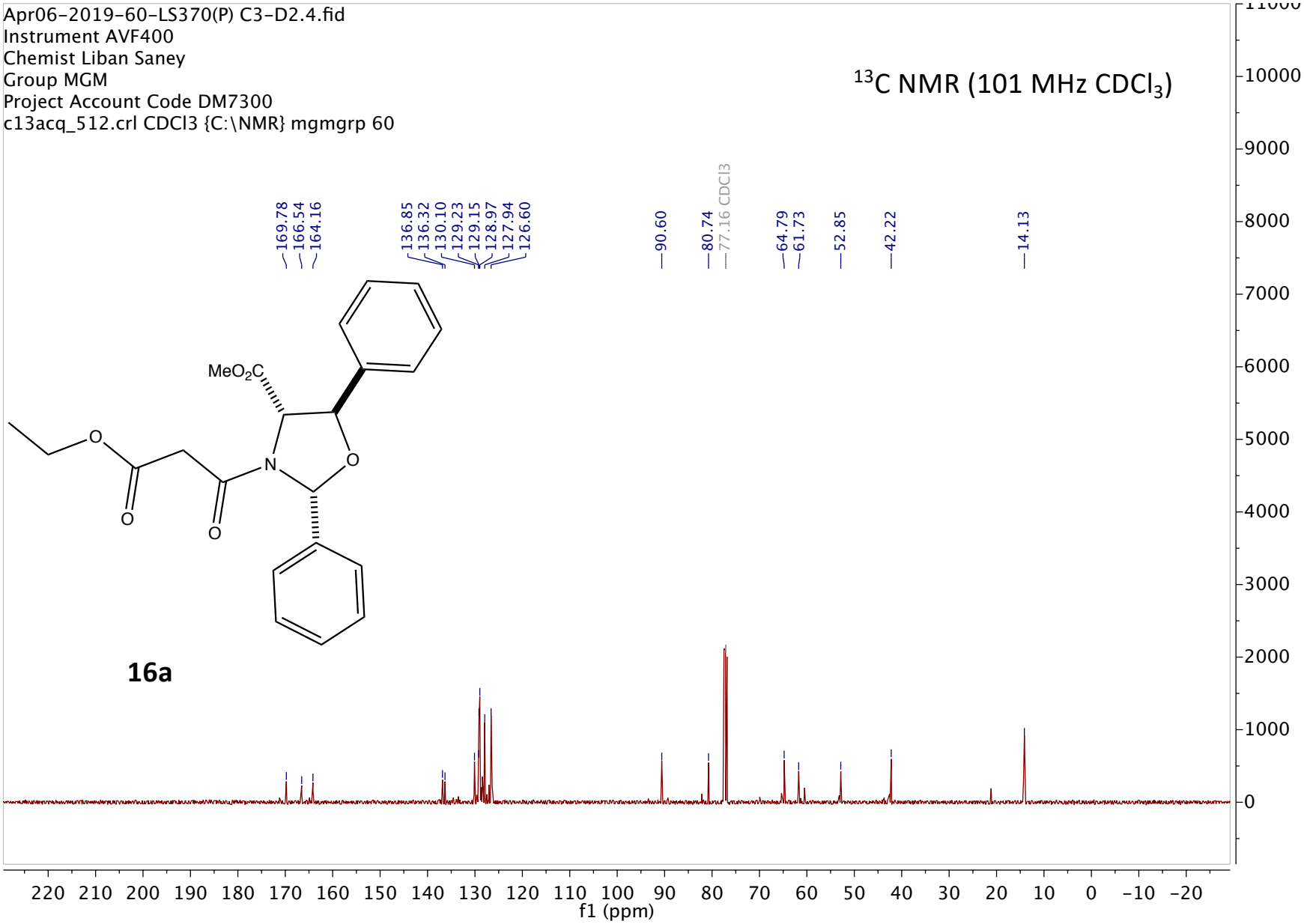
Group MGM
Project Account Code DM7300
h1acq.crl D2O {C:\NMR} mgmgrp 60
1H NMR (400 MHz D2O)
7.51 7.51 7.51 7.50 7.49 7.49 7.48 7.48 7.47 7.46 7.46 7.44 7.44 7.44 7.43 7.42 7.42 7.42 7.41 7.40 7.39 7.34 7.33 7.33 7.33 7.32 7.31 7.30 7.29 7.28 5.37 5.36 4.79 D2O 4.07 4.06 3.72
OH
O
OH
NH2.HCl
6.02
1.00
0.92
f1 (ppm)

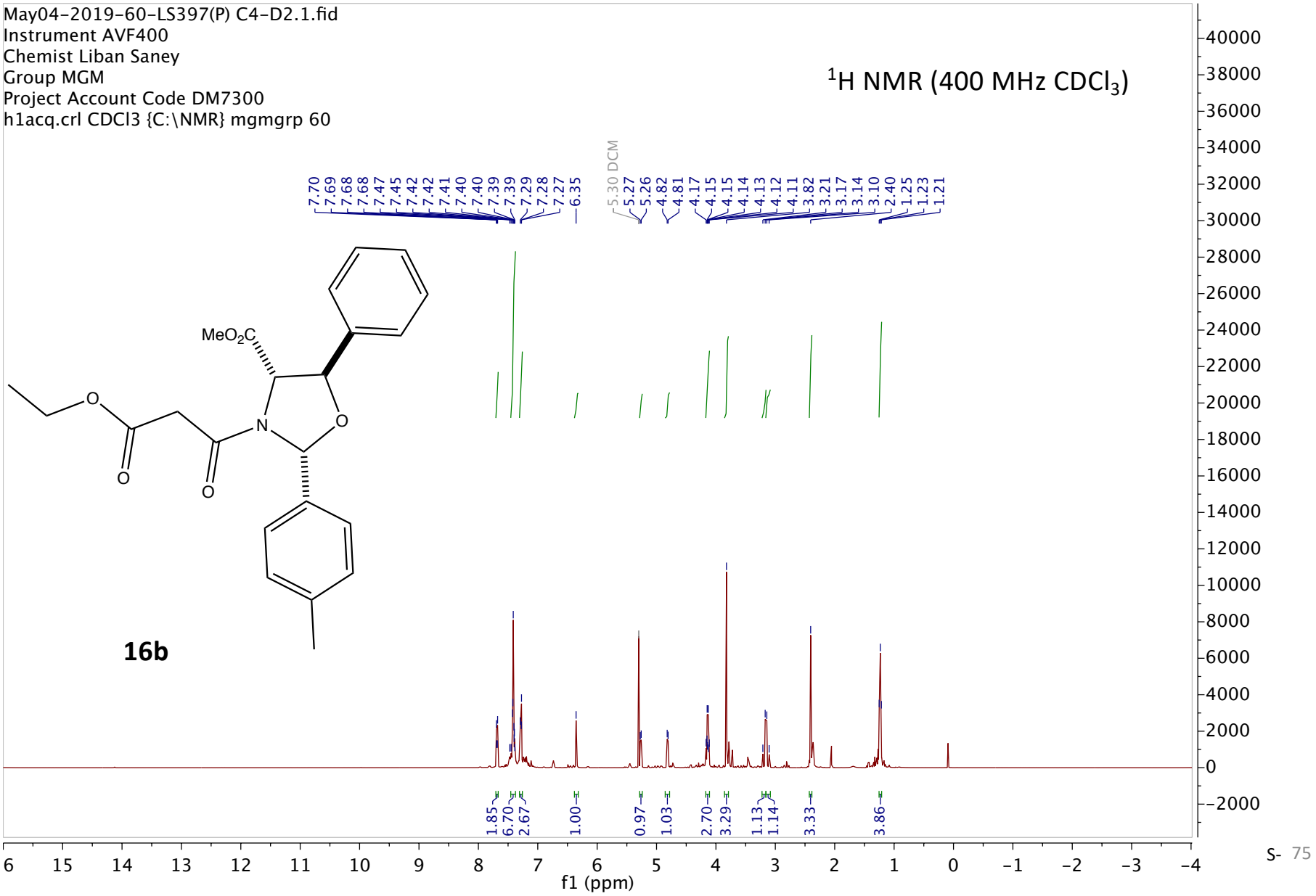

Jan21-2019-60-LS297(C).2.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl D2O {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz D_2O)
171.36
138.64
129.02
128.72
125.88
71.02
60.23
40.76
OH
O
OH
NH2.HCl
f1 (ppm)

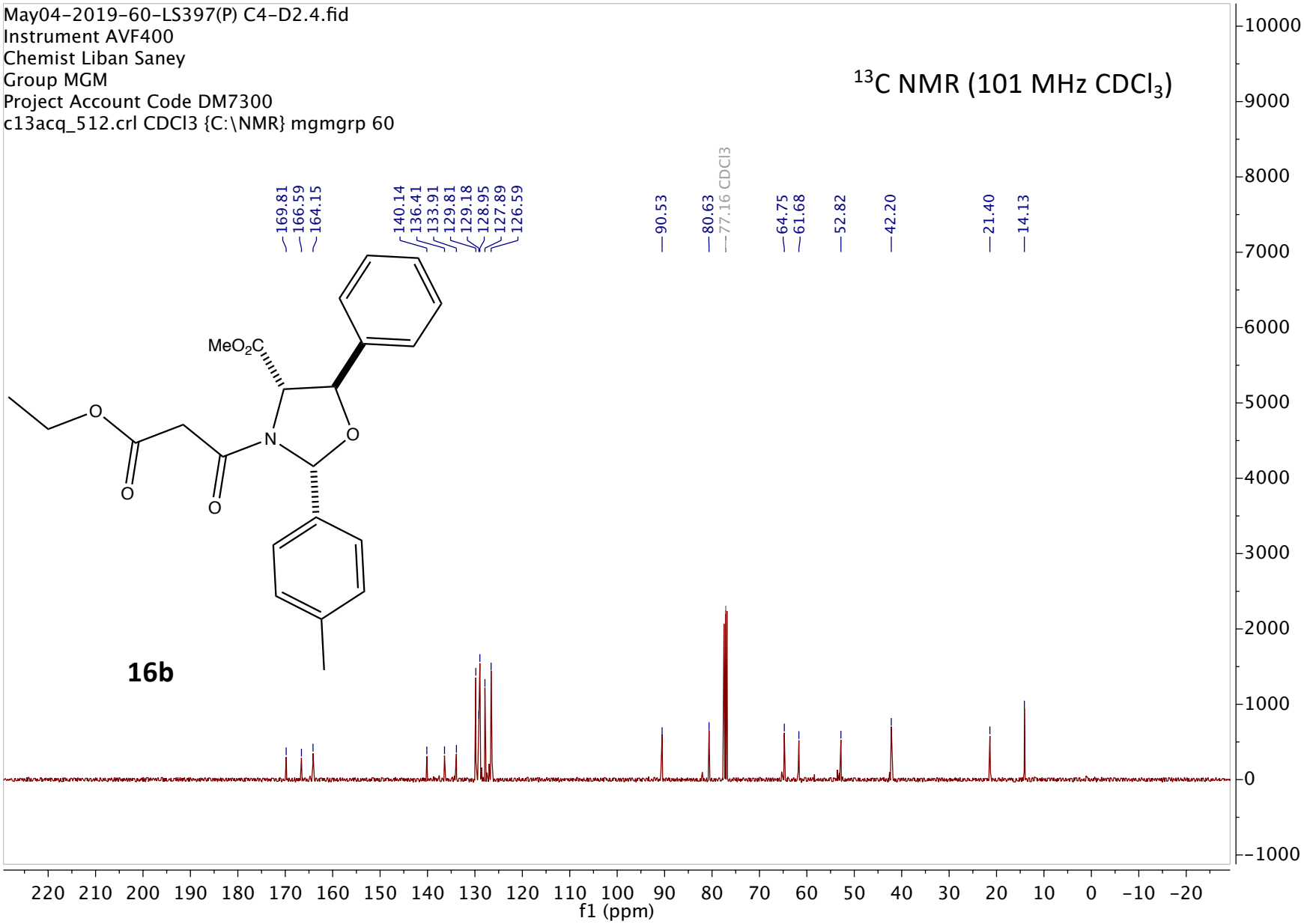

Nov21-2018-60-LS237(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl D2O {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz D_2O)
7.46 7.46 7.45 7.44 7.44 7.44 7.44 7.43 7.42 7.42 7.41 7.41 7.41 7.40 7.40 7.39 7.39 7.39 7.39 7.38 7.38 7.37 7.37 7.37 7.37 7.36 7.27 7.25 7.23 7.22 5.40 5.39 4.79 D2O 4.38 4.37 3.79 3.28
OH
O
O
NH_2.HCl
1e
6.80
1.09
1.00
3.02
260000 240000 220000 200000 180000 160000 140000 120000 100000 80000 60000 40000 20000 0 -20000
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)

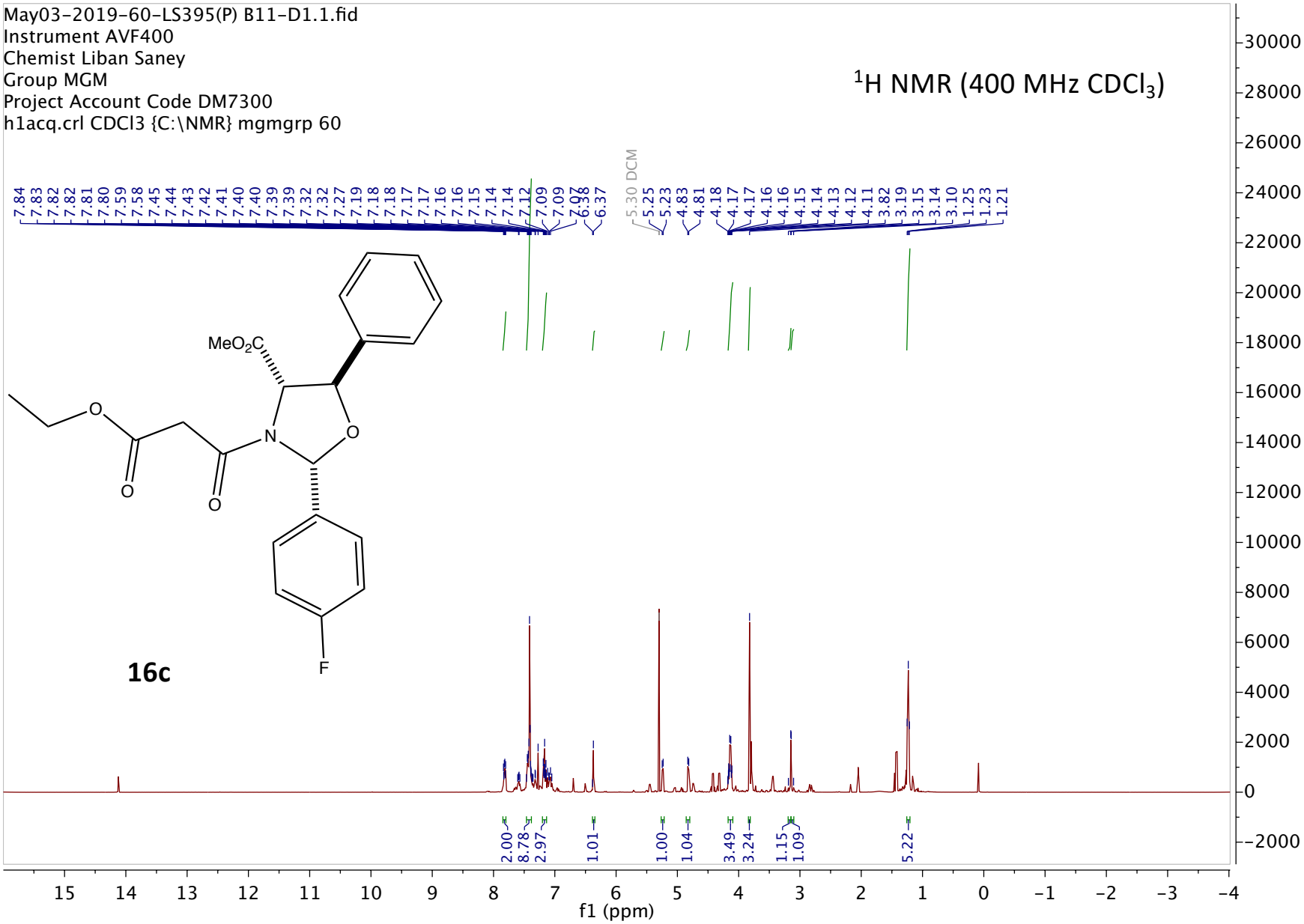

Nov21-2018-60-LS237(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl D2O {C:\NMR} mgmgrp 60
13C NMR (101 MHz D2O)
168.51
137.52
129.06
128.96
125.84
70.48
58.97
53.69
OH
O
O
NH2.HCl
1e
f1 (ppm)

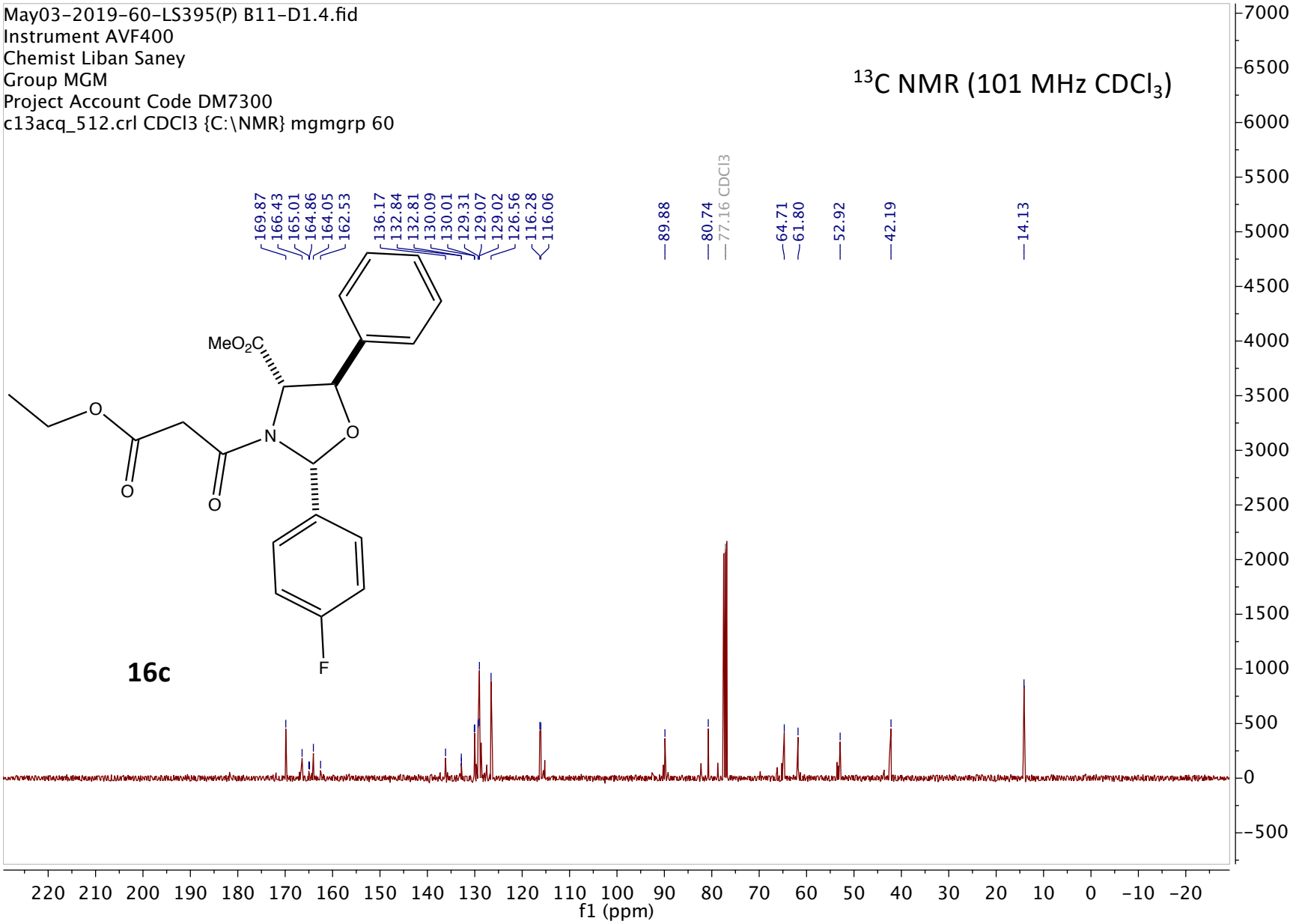

Apr06-2019-60-LS370(P) C3-D2.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.81 7.80 7.79 7.79 7.47 7.46 7.46 7.45 7.45 7.44 7.44 7.43 7.42 7.41 7.41 7.40 7.39 7.38 7.38 7.26 CDCl3 6.38
5.26 5.25 4.82 4.80 4.15 4.15 4.13 4.13 4.12 4.11 4.10 4.09 3.81 3.20 3.16 3.14 3.10 2.04 1.27 1.26 1.24 1.22 1.20
MeO2C
O
O
O
N
O
16a
1.89 11.38 1.01 1.00 0.99 3.90 3.11 1.03 1.14 6.44
f1 (ppm)

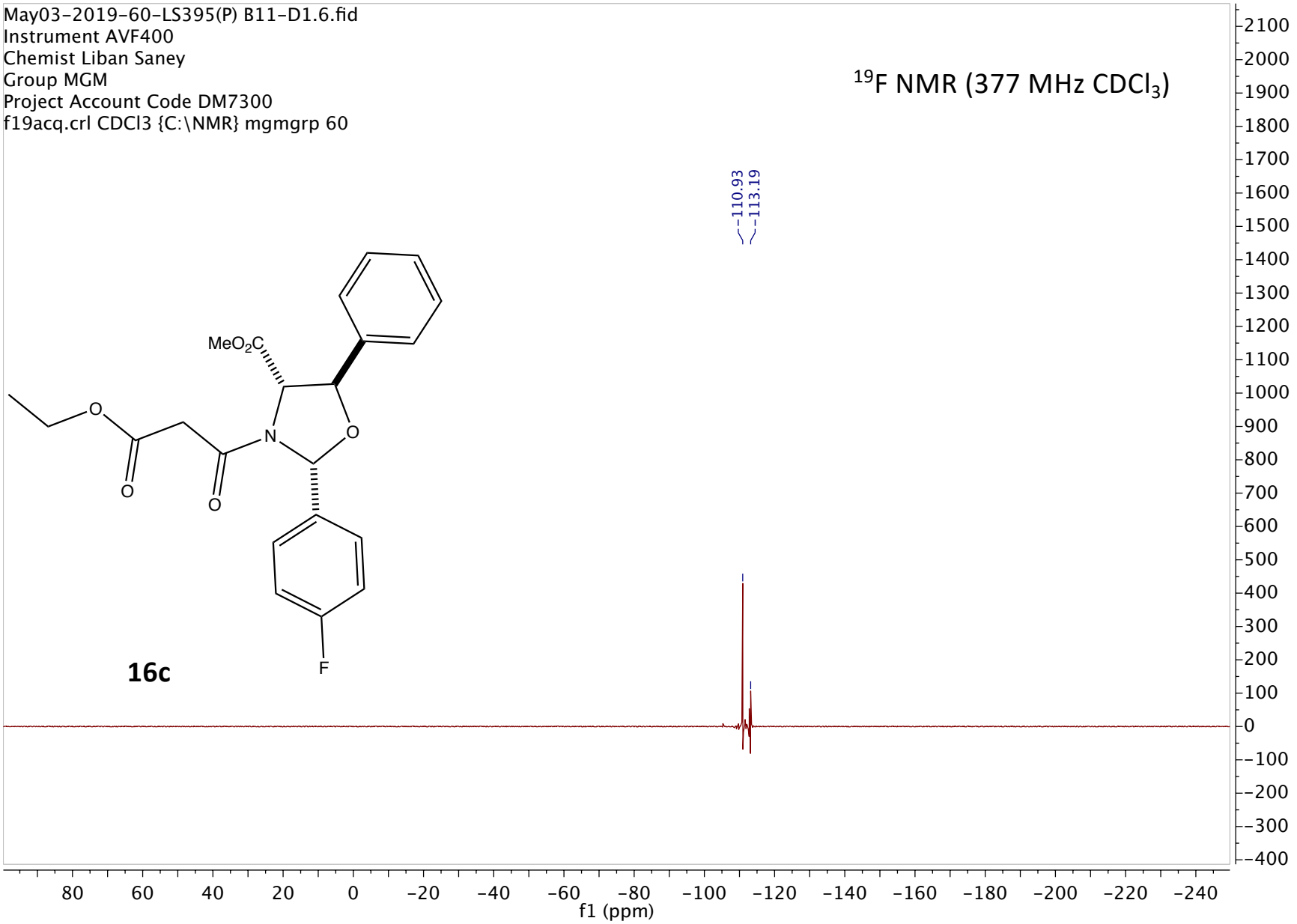

Apr06-2019-60-LS370(P) C3-D2.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
13C NMR (101 MHz CDCl3)
169.78
166.54
164.16
136.85
136.32
130.10
129.23
129.15
128.97
127.94
126.60
90.60
80.74
77.16 CDCl3
64.79
61.73
52.85
42.22
14.13
MeO2C
O
O
N
O
O
O
16a
f1 (ppm)

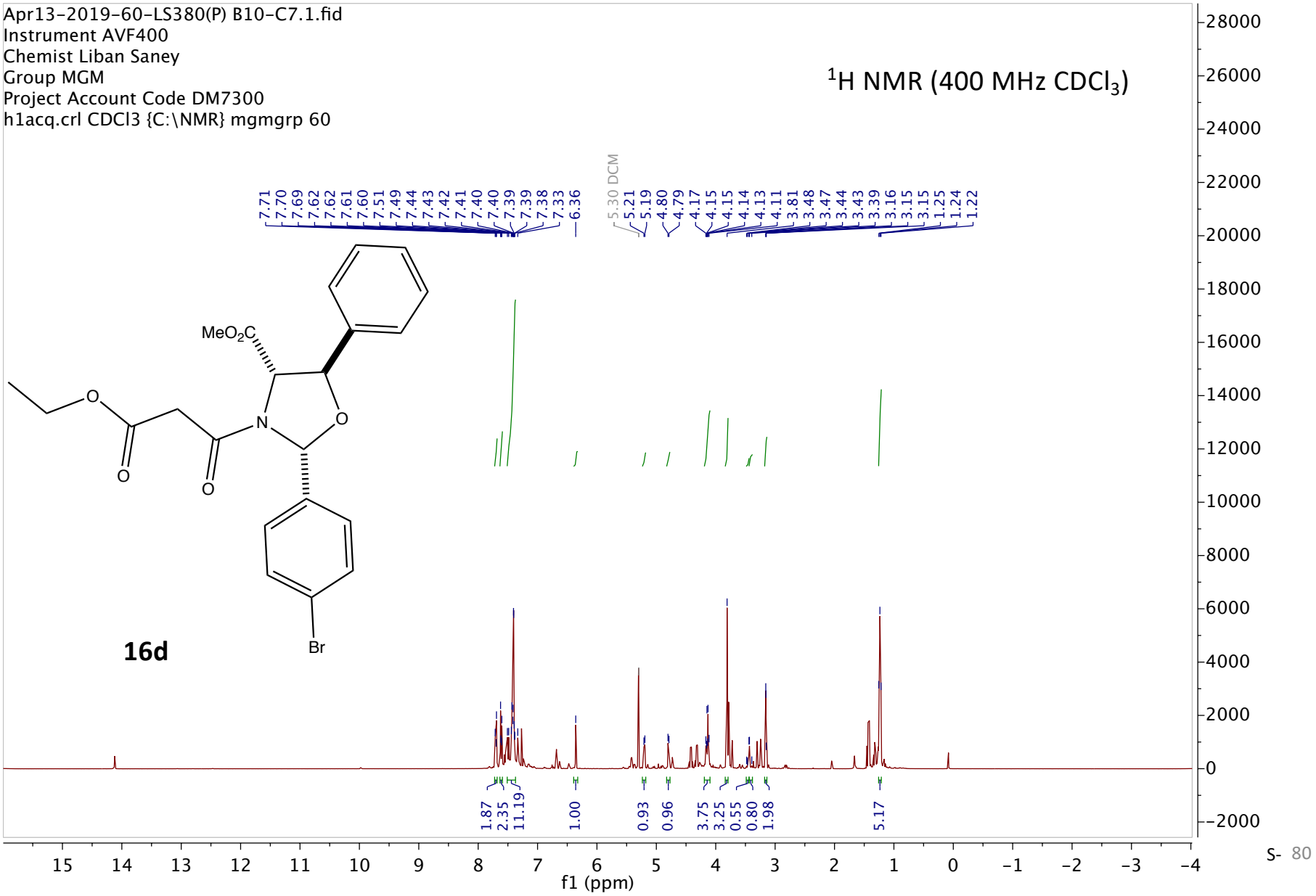

May04-2019-60-LS397(P) C4-D2.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.70 7.69 7.68 7.68 7.47 7.45 7.42 7.42 7.41 7.40 7.40 7.39 7.39 7.29 7.28 7.27 6.35
5.30 DCM
5.27 5.26 4.82 4.81 4.17 4.15 4.15 4.14 4.13 4.12 4.11 3.82 3.21 3.17 3.14 3.10 2.40 1.25 1.23 1.21
MeO2C
O
O
N
O
O
O
16b
1.85 6.70 2.67 1.00 0.97 1.03 2.70 3.29 1.13 1.14 3.33 3.86
40000 38000 36000 34000 32000 30000 28000 26000 24000 22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
6 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

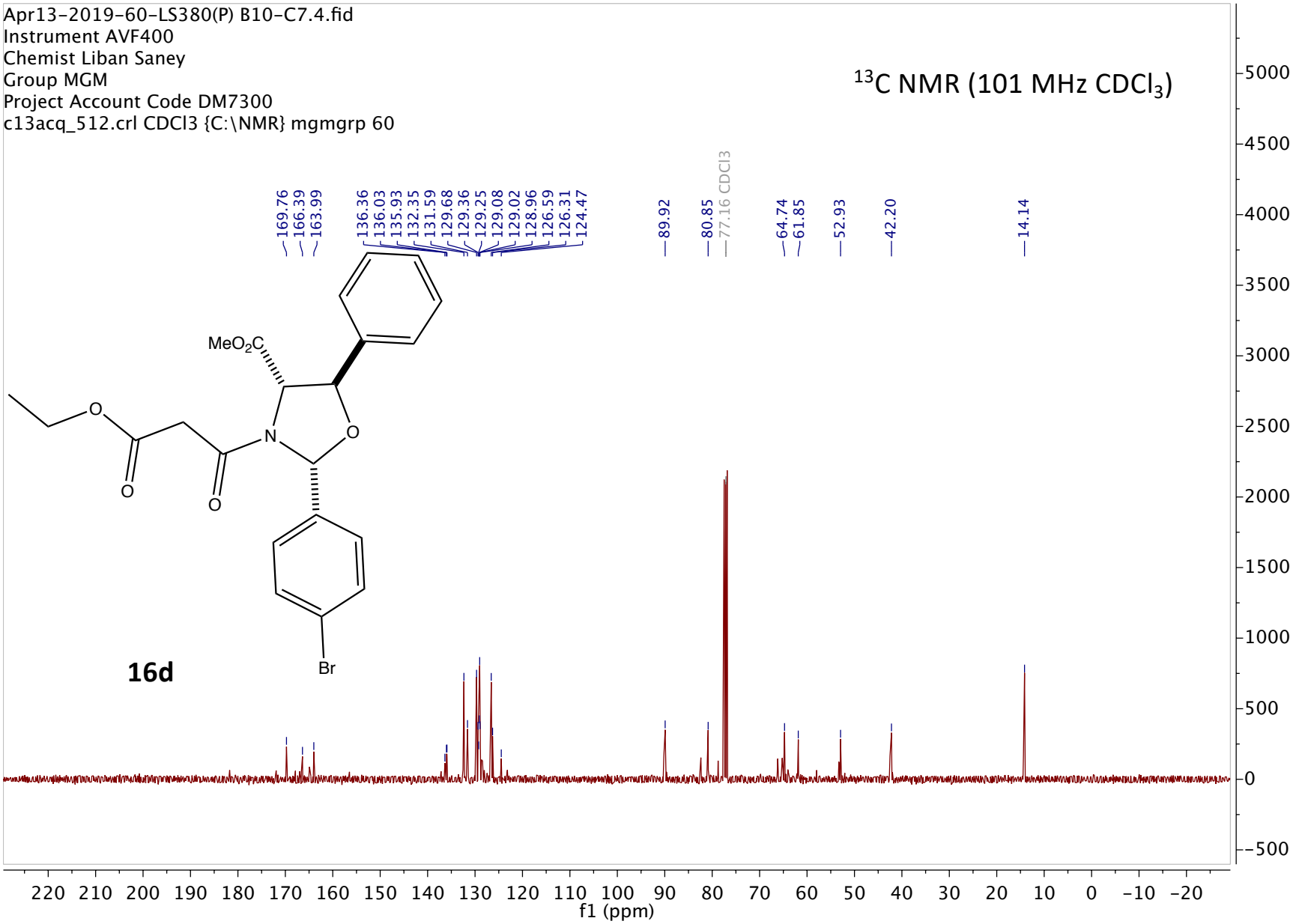

May04-2019-60-LS397(P) C4-D2.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
169.81
166.59
164.15
140.14
136.41
133.91
129.81
129.18
128.95
127.89
126.59
90.53
80.63
77.16 CDCl3
64.75
61.68
52.82
42.20
21.40
14.13
MeO2C
O
O
N
O
O
O
16b
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

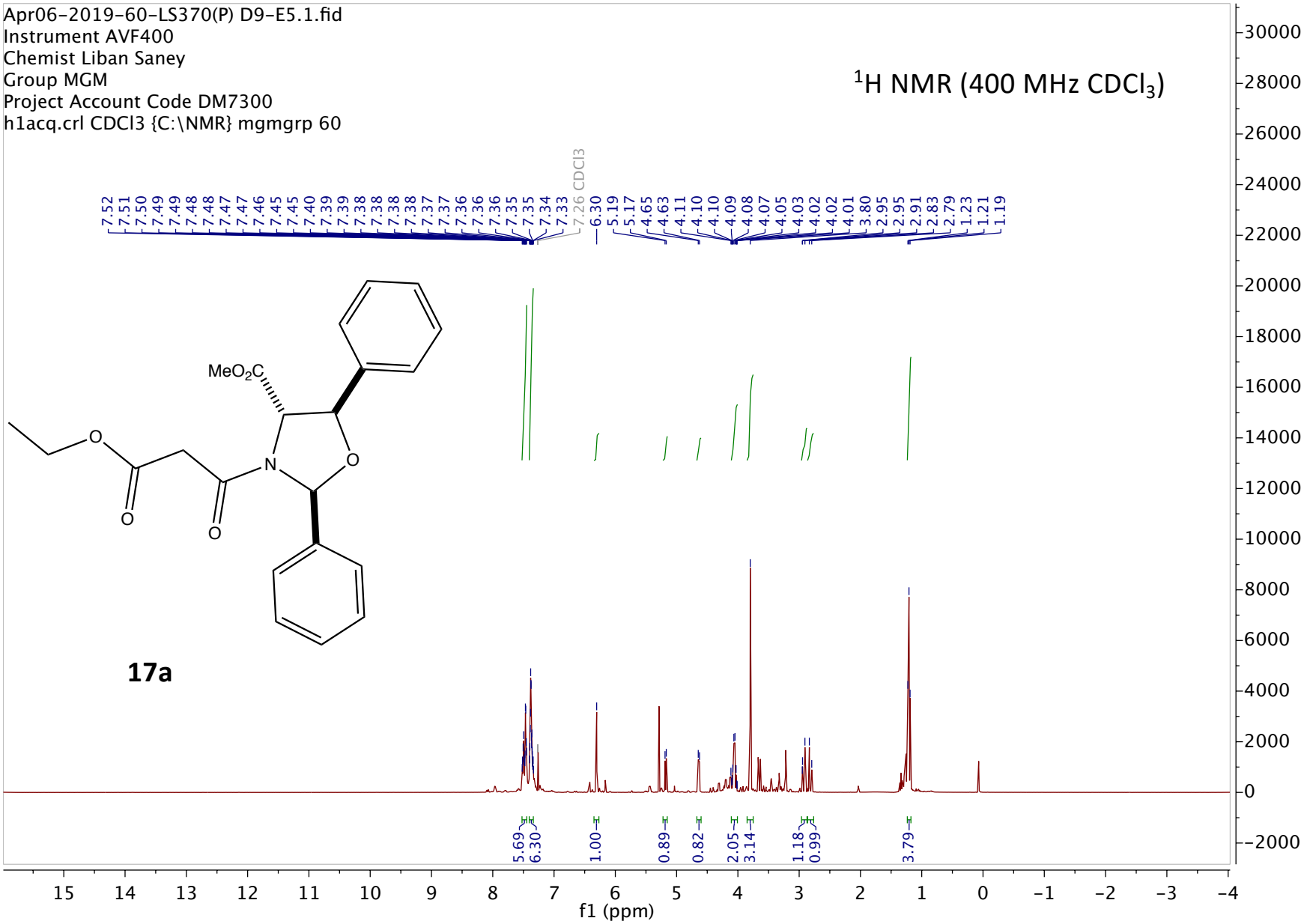

May03-2019-60-LS395(P) B11-D1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.84 7.83 7.82 7.82 7.81 7.80 7.59 7.58 7.45 7.44 7.43 7.42 7.41 7.40 7.40 7.39 7.39 7.32 7.32 7.27 7.19 7.18 7.18 7.17 7.17 7.16 7.16 7.15 7.14 7.14 7.12 7.09 7.09 7.07 6.38 6.37
5.30 DCM
5.25 5.23 4.83 4.81 4.18 4.17 4.17 4.16 4.16 4.15 4.14 4.13 4.12 4.11 3.82 3.19 3.15 3.14 3.10 1.25 1.23 1.21
MeO2C
O
O
O
N
O
F
16c
2.00 8.78 2.97 1.01 1.00 1.04 3.49 3.24 1.15 1.09 5.22
30000 28000 26000 24000 22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

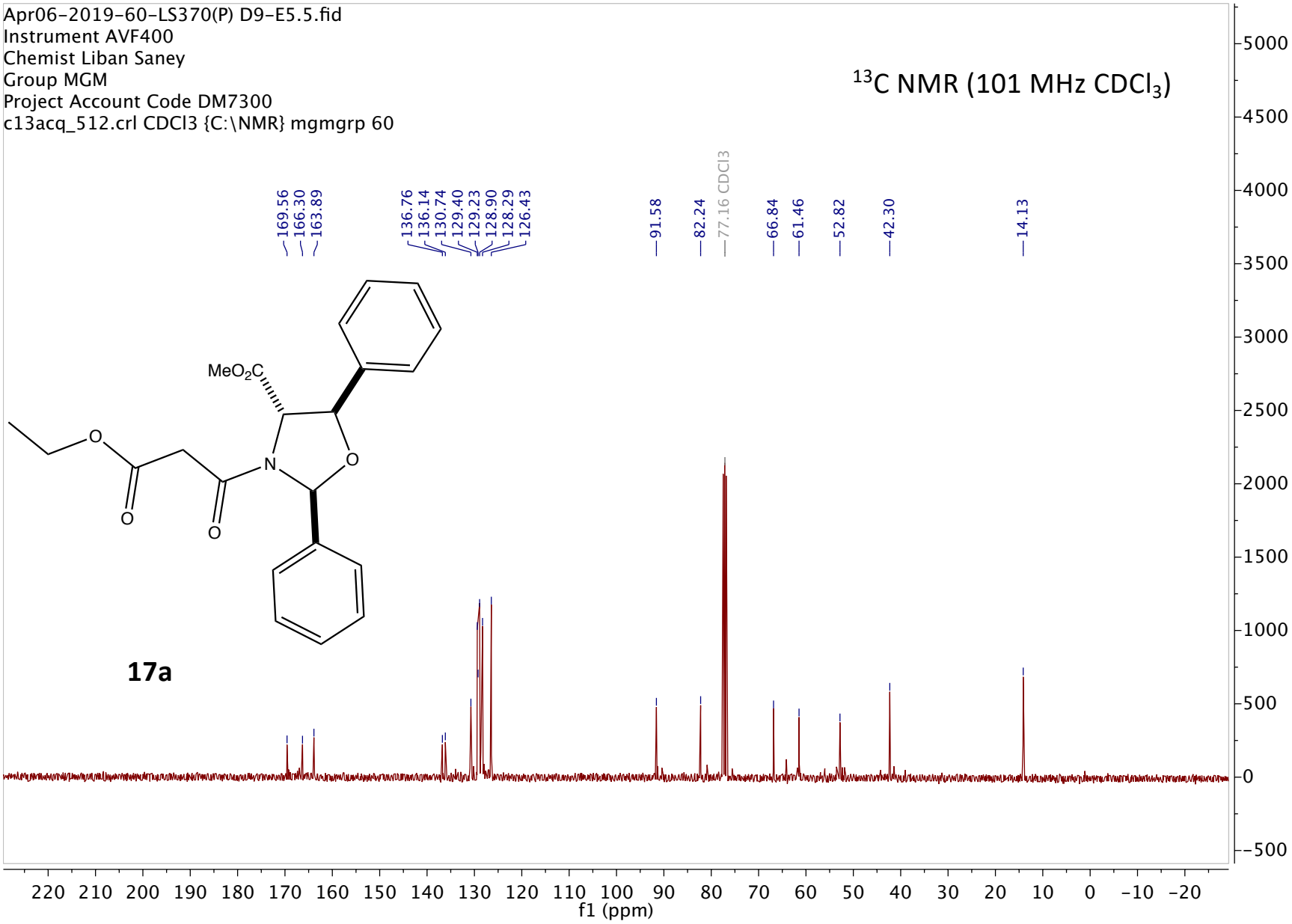

May03-2019-60-LS395(P) B11-D1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
13C NMR (101 MHz CDCl3)
169.87
166.43
165.01
164.86
164.05
162.53
136.17
132.84
132.81
130.09
130.01
129.31
129.07
129.02
126.56
116.28
116.06
89.88
80.74
77.16 CDCl3
64.71
61.80
52.92
42.19
14.13
MeO2C
O
O
O
N
O
F
16c
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

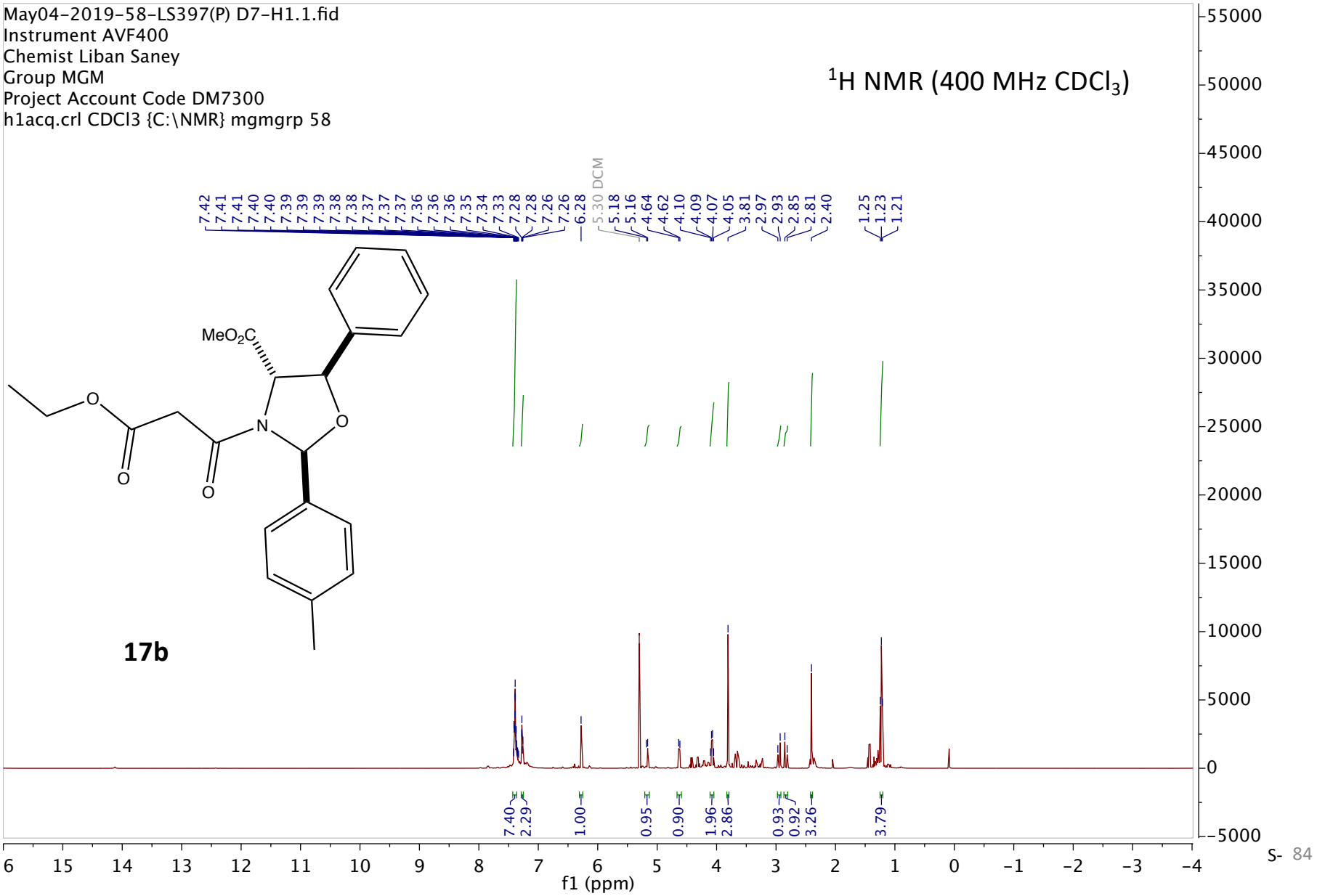

May03-2019-60-LS395(P) B11-D1.6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq.crl CDCl3 {C:\NMR} mgmgrp 60
19F NMR (377 MHz CDCl3)
-110.93
-113.19
MeO2C
O
O
O
N
O
F
16c
f1 (ppm)

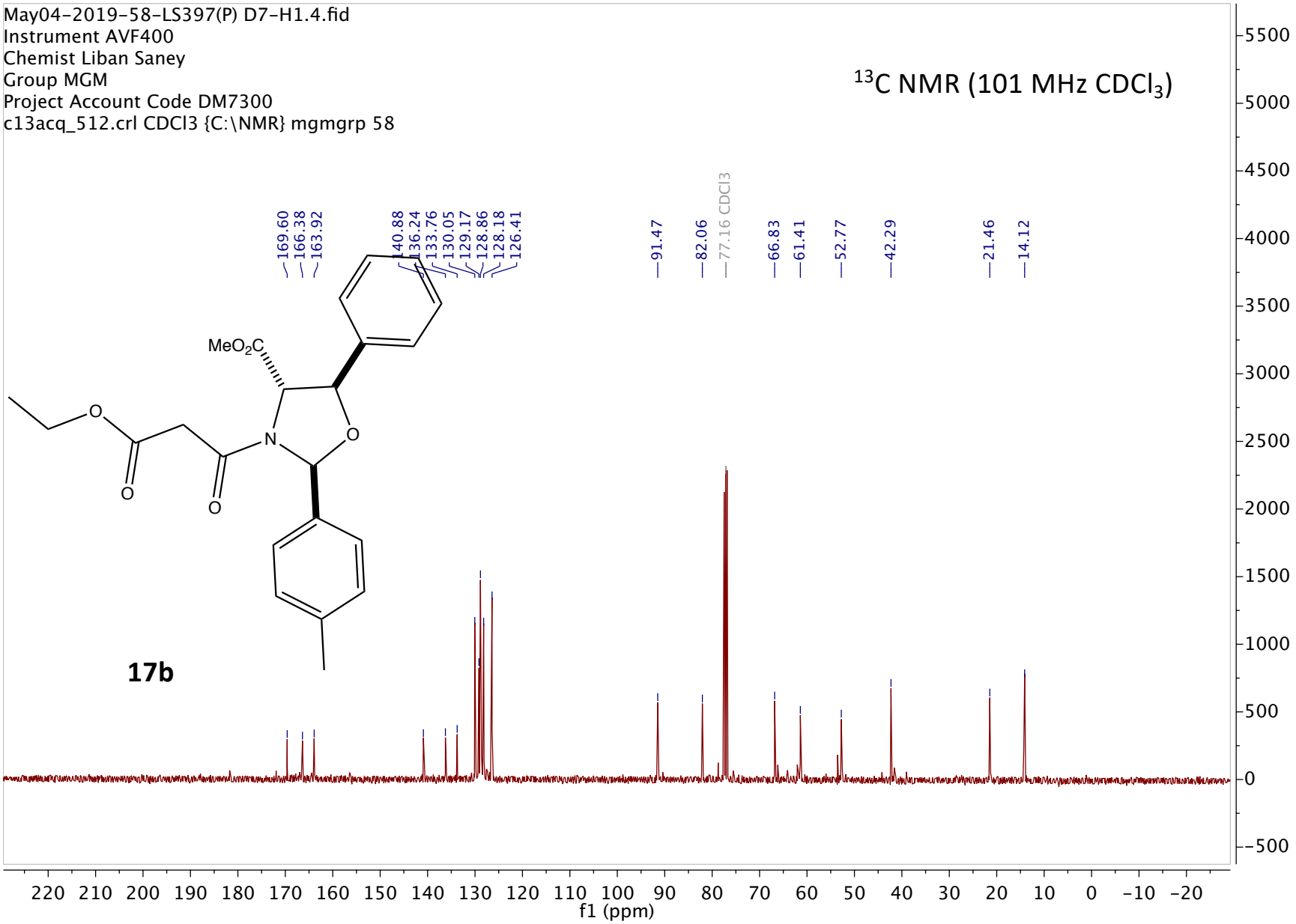

Apr13-2019-60-LS380(P) B10-C7.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.71 7.70 7.69 7.62 7.62 7.61 7.60 7.51 7.49 7.44 7.43 7.42 7.41 7.40 7.40 7.39 7.39 7.38 7.33 6.36
5.30 DCM
5.21 5.19 4.80 4.79 4.17 4.15 4.15 4.14 4.13 4.11 3.81 3.48 3.47 3.44 3.43 3.39 3.16 3.15 3.15 1.25 1.24 1.22
MeO2C
O
O
N
O
O
O
Br
16d
1.87 2.35 11.19 1.00 0.93 0.96 3.75 3.25 0.55 0.80 1.98 5.17
28000 26000 24000 22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

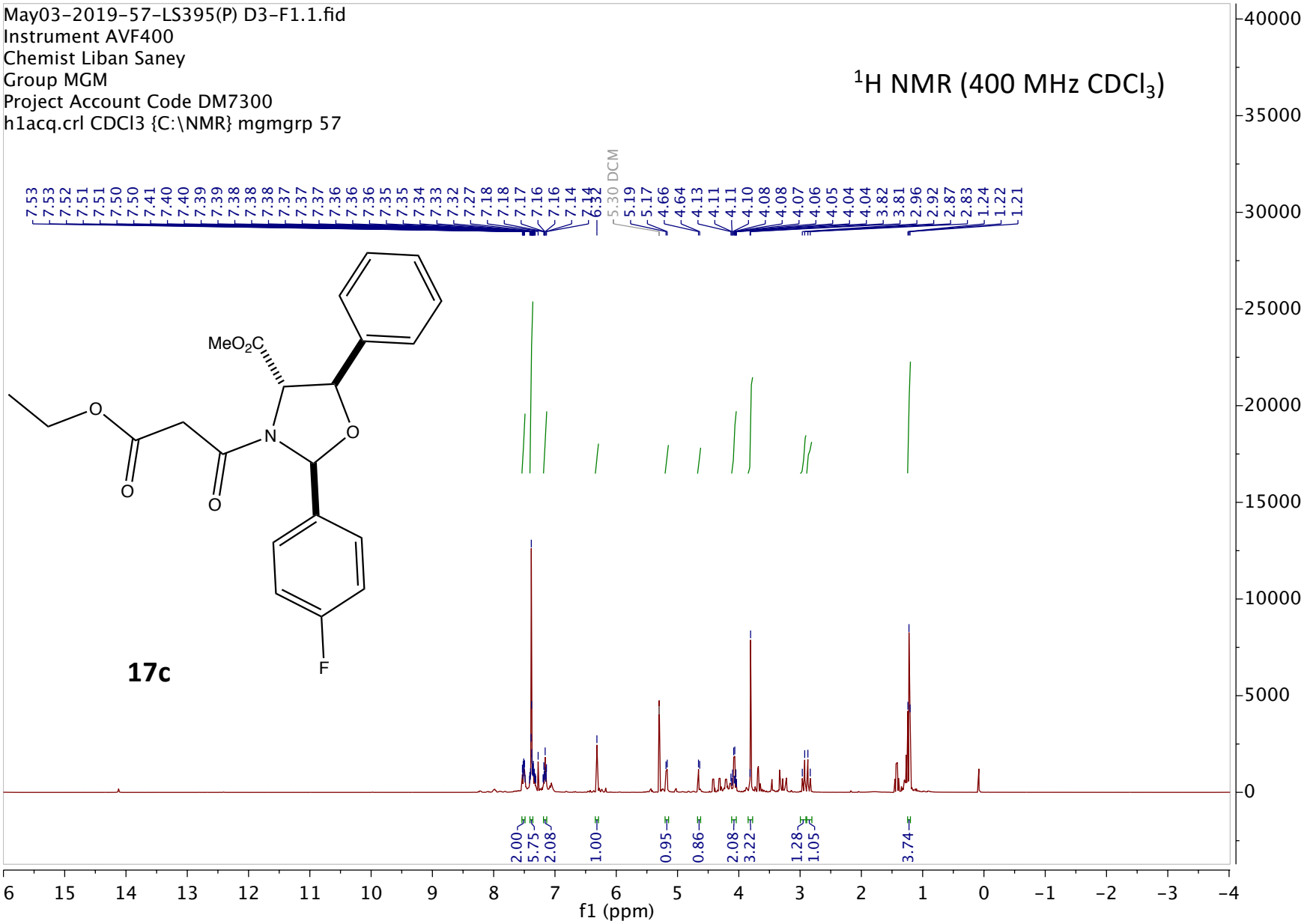

Apr13-2019-60-LS380(P) B10-C7.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
13C NMR (101 MHz CDCl3)
169.76
166.39
163.99
136.36
136.03
135.93
132.35
131.59
129.68
129.36
129.25
129.08
129.02
128.96
126.59
126.31
124.47
89.92
80.85
77.16 CDCl3
64.74
61.85
52.93
42.20
14.14
MeO2C
O
O
O
N
O
Br
16d
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

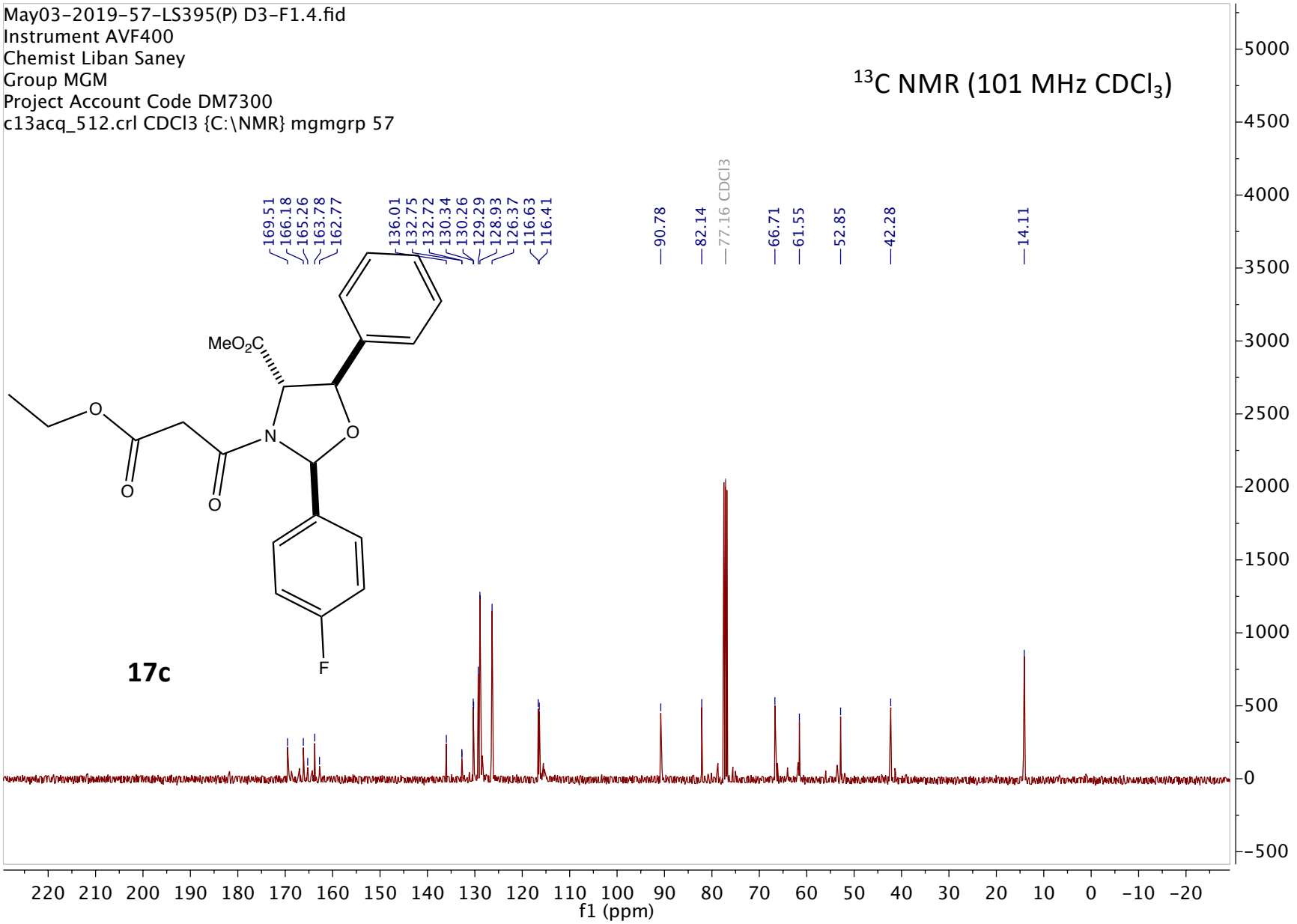

Apr06-2019-60-LS370(P) D9-E5.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.52 7.51 7.50 7.49 7.49 7.48 7.48 7.47 7.47 7.46 7.45 7.45 7.40 7.39 7.39 7.38 7.38 7.38 7.38 7.37 7.37 7.36 7.36 7.36 7.35 7.35 7.34 7.33 7.26 CDCl3 6.30 5.19 5.17 4.65 4.63 4.11 4.10 4.10 4.09 4.08 4.07 4.05 4.03 4.02 4.02 4.01 3.80 2.95 2.95 2.91 2.83 2.79 1.23 1.21 1.19
MeO2C
O
O
O
N
O
17a
5.69 6.30 1.00 0.89 0.82 2.05 3.14 1.18 0.99 3.79
30000 28000 26000 24000 22000 20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 0 -2000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

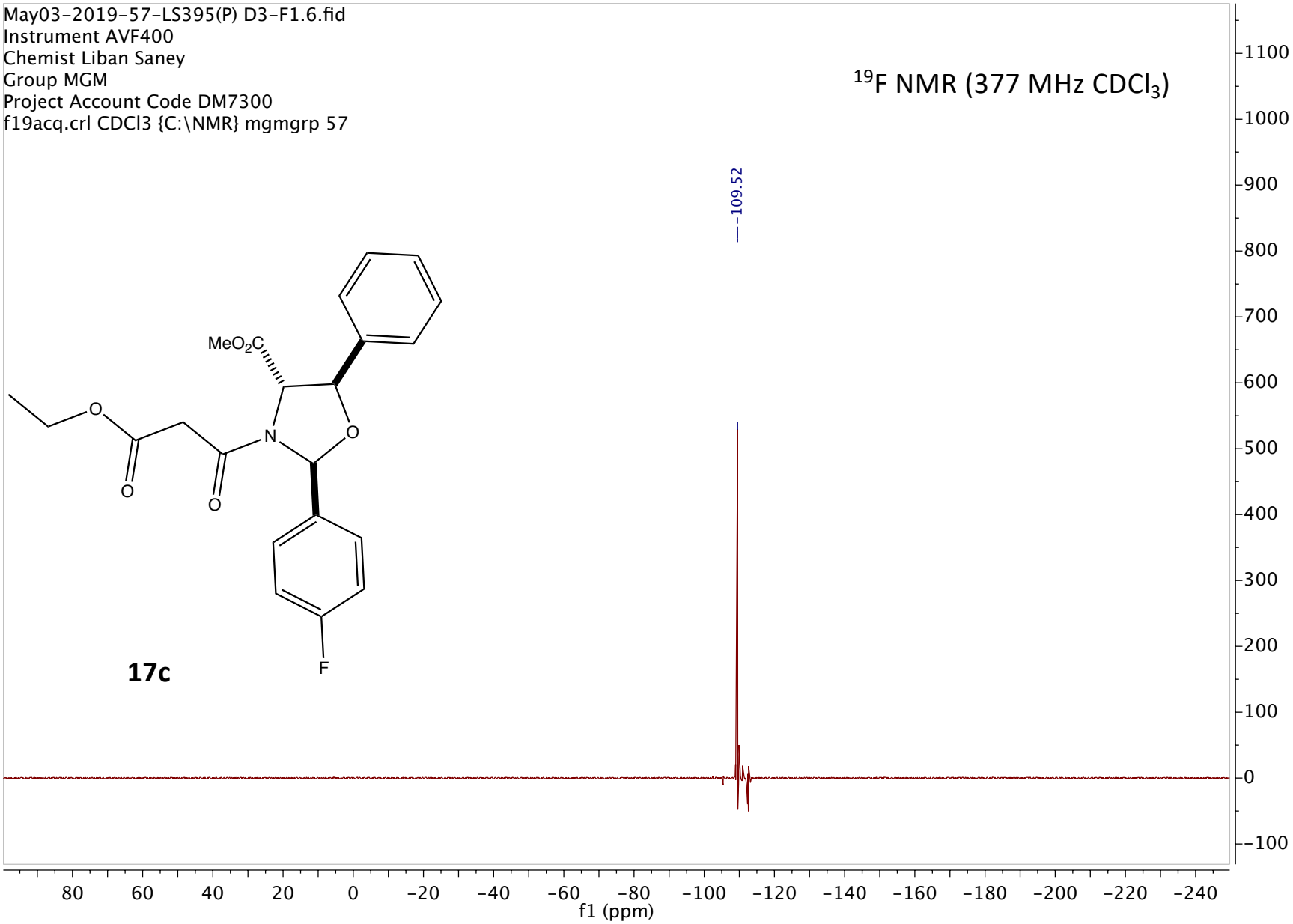

Apr06-2019-60-LS370(P) D9-E5.5.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
169.56
166.30
163.89
136.76
136.14
130.74
129.40
129.23
128.90
128.29
126.43
91.58
82.24
77.16 CDCl3
66.84
61.46
52.82
42.30
14.13
MeO2C
O
O
O
N
O
17a
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

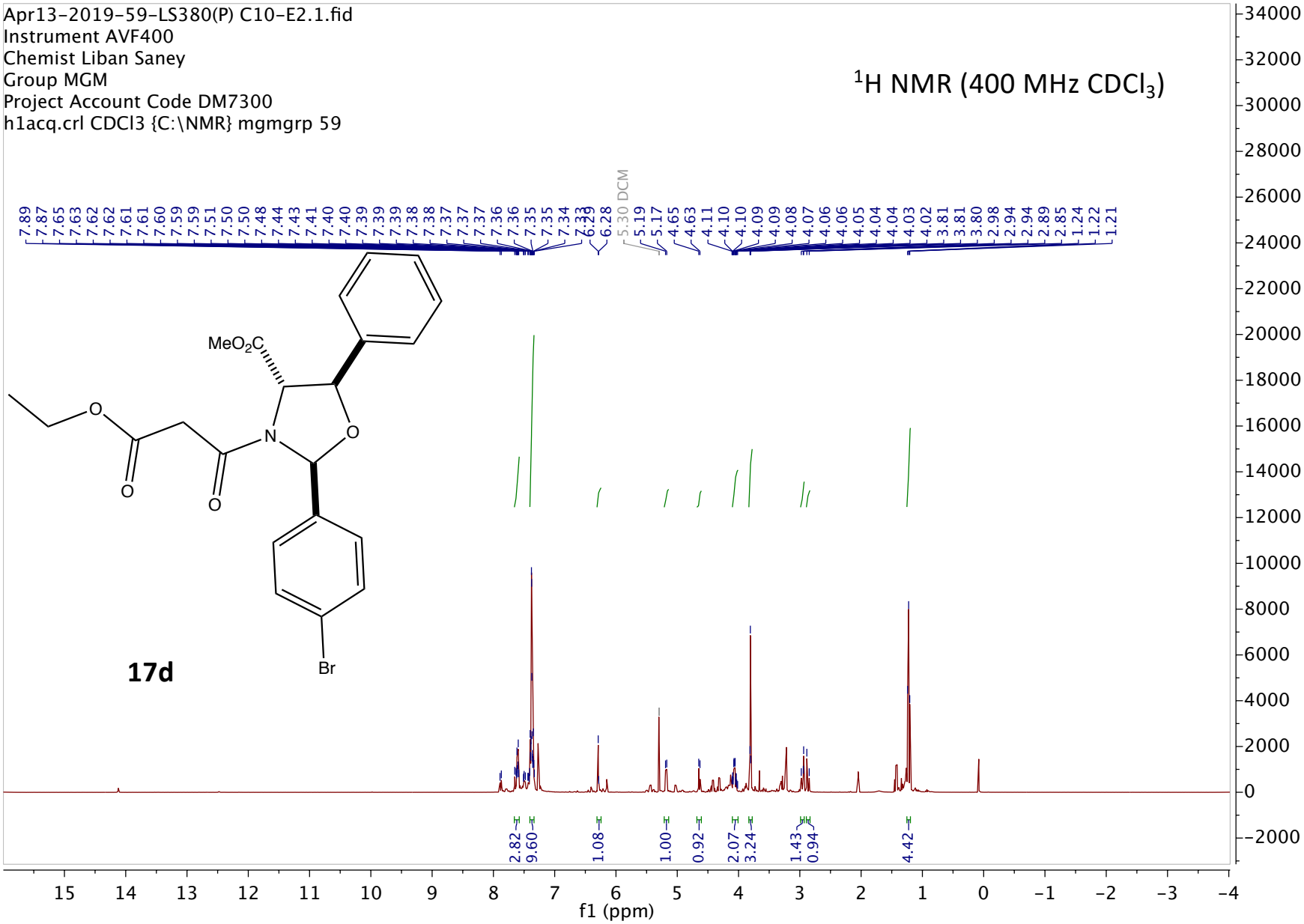

May04-2019-58-LS397(P) D7-H1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 58
^{1}H NMR (400 MHz $CDCl_3$)
7.42 7.41 7.41 7.40 7.40 7.39 7.39 7.39 7.38 7.38 7.37 7.37 7.37 7.36 7.36 7.36 7.35 7.34 7.33 7.28 7.28 7.26 7.26 6.28 5.30 DCM 5.18 5.16 4.64 4.62 4.10 4.09 4.07 4.05 3.81 2.97 2.93 2.85 2.81 2.40 1.25 1.23 1.21
MeO2C
O
O
N
O
O
O
17b
7.40 2.29 1.00 0.95 0.90 1.96 2.86 0.93 0.92 3.26 3.79
55000 50000 45000 40000 35000 30000 25000 20000 15000 10000 5000 0 -5000
6 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

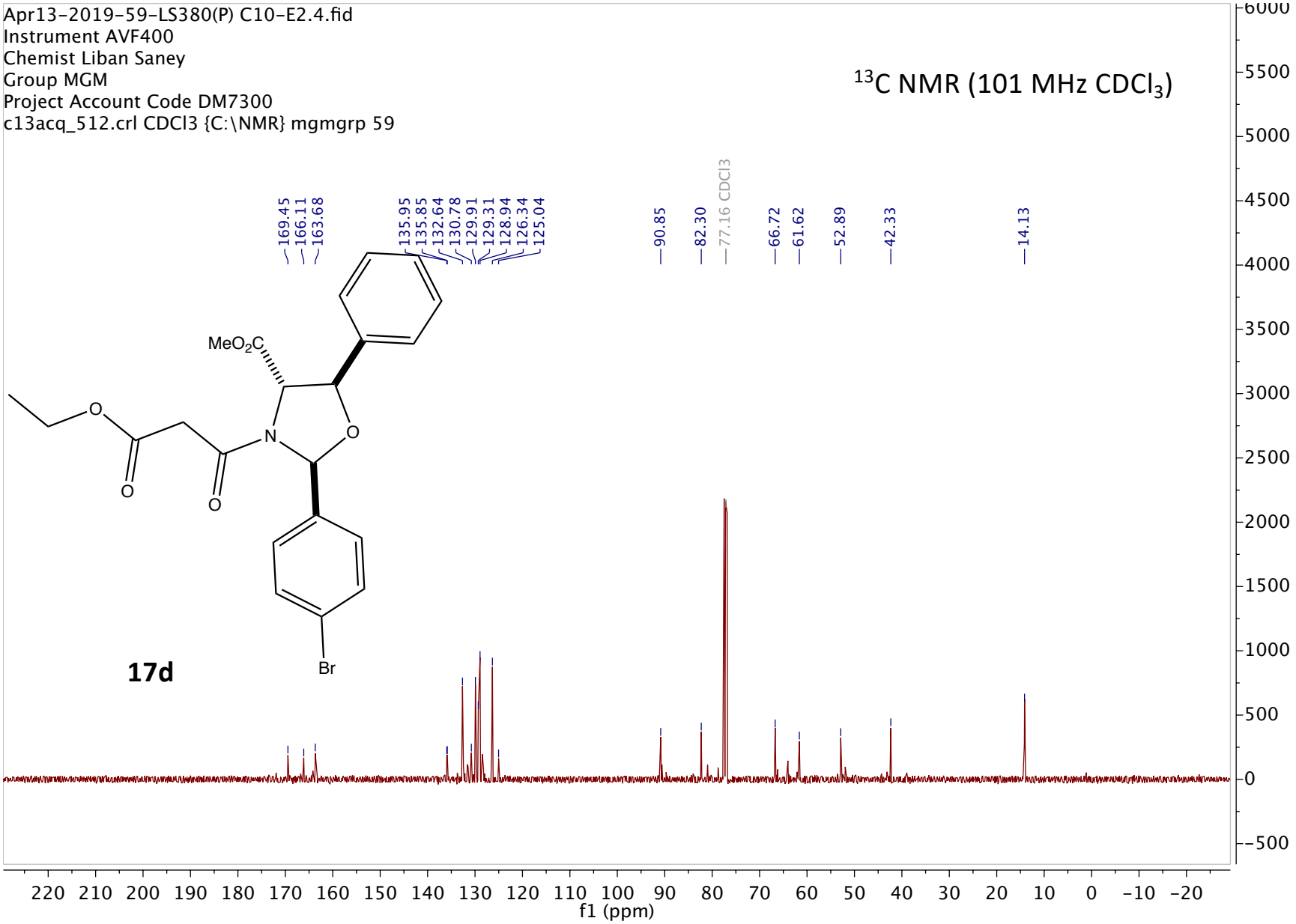

May04-2019-58-LS397(P) D7-H1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 58
^{13}C NMR (101 MHz $CDCl_3$)
169.60
166.38
163.92
140.88
136.24
133.76
130.05
129.17
128.86
128.18
126.41
91.47
82.06
77.16 CDCl3
66.83
61.41
52.77
42.29
21.46
14.12
MeO2C
O
O
O
N
O
17b
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

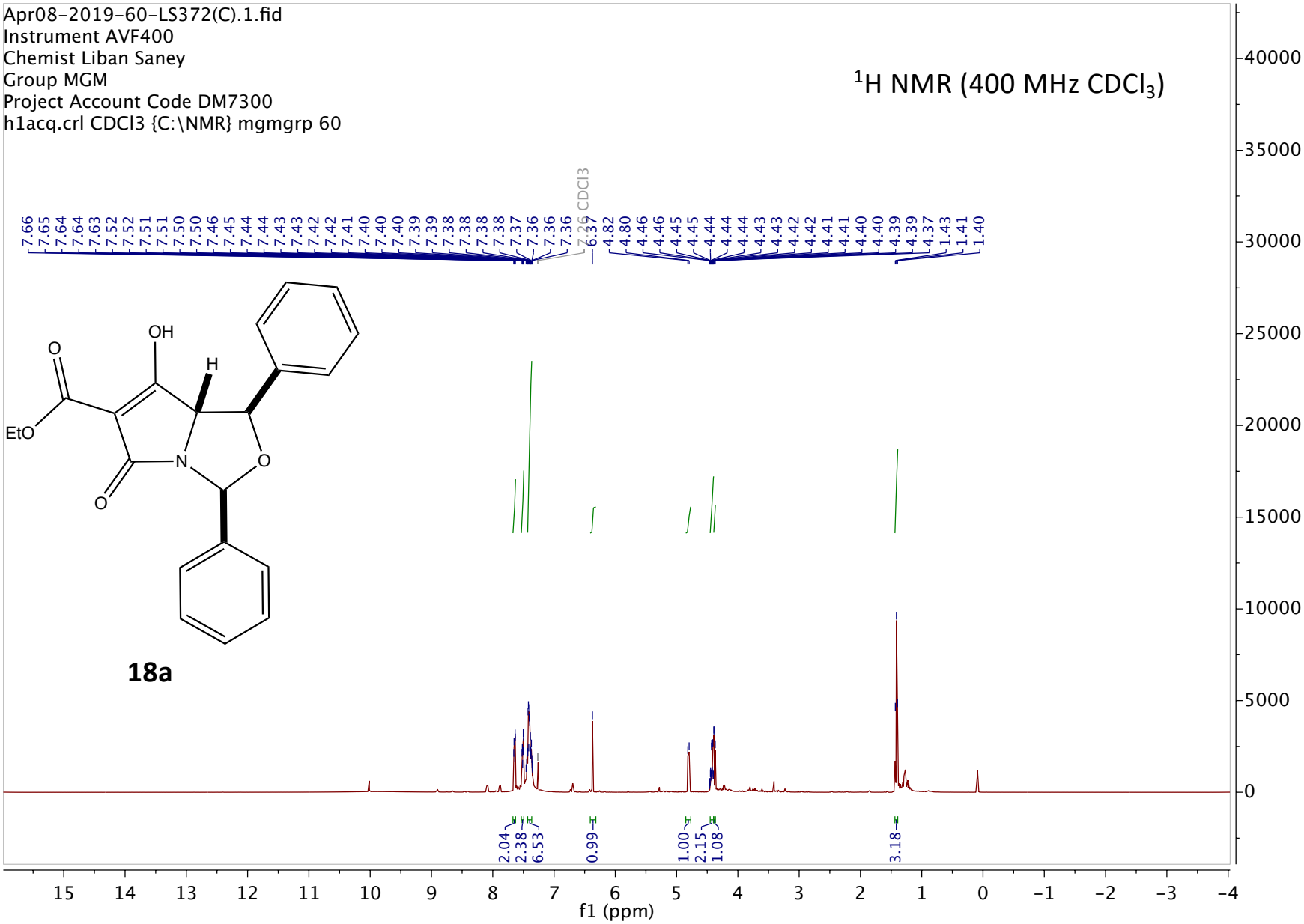

May03-2019-57-LS395(P) D3-F1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 57
^{1}H NMR (400 MHz $CDCl_3$)
7.53 7.53 7.52 7.51 7.51 7.50 7.50 7.41 7.40 7.40 7.39 7.39 7.38 7.38 7.38 7.37 7.37 7.37 7.36 7.36 7.36 7.35 7.35 7.34 7.33 7.32 7.27 7.18 7.18 7.17 7.16 7.16 7.14 7.14 6.32
5.30 DCM
5.19 5.17 4.66 4.64 4.13 4.11 4.11 4.10 4.08 4.08 4.07 4.06 4.05 4.04 4.04 3.82 3.81 2.96 2.92 2.87 2.83 1.24 1.22 1.21
MeO2C
O
O
N
O
O
F
17c
2.00 5.75 2.08 1.00 0.95 0.86 2.08 3.22 1.28 1.05 3.74
40000 35000 30000 25000 20000 15000 10000 5000 0
6 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)

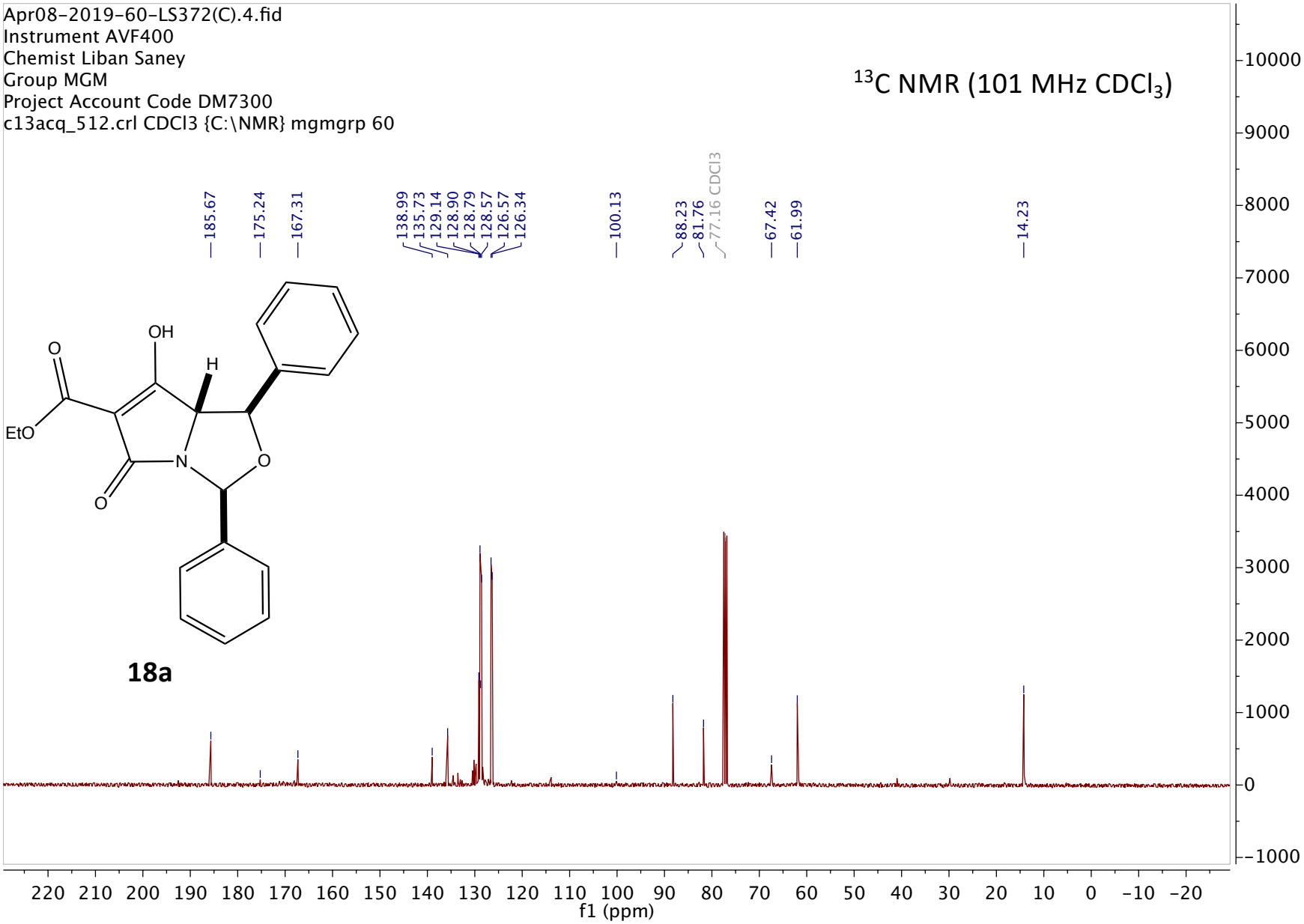

May03-2019-57-LS395(P) D3-F1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 57
^{13}C NMR (101 MHz $CDCl_3$)
169.51
166.18
165.26
163.78
162.77
136.01
132.75
132.72
130.34
130.26
129.29
128.93
126.37
116.63
116.41
90.78
82.14
77.16 CDCl3
66.71
61.55
52.85
42.28
14.11
MeO2C
O
O
O
N
O
F
17c
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

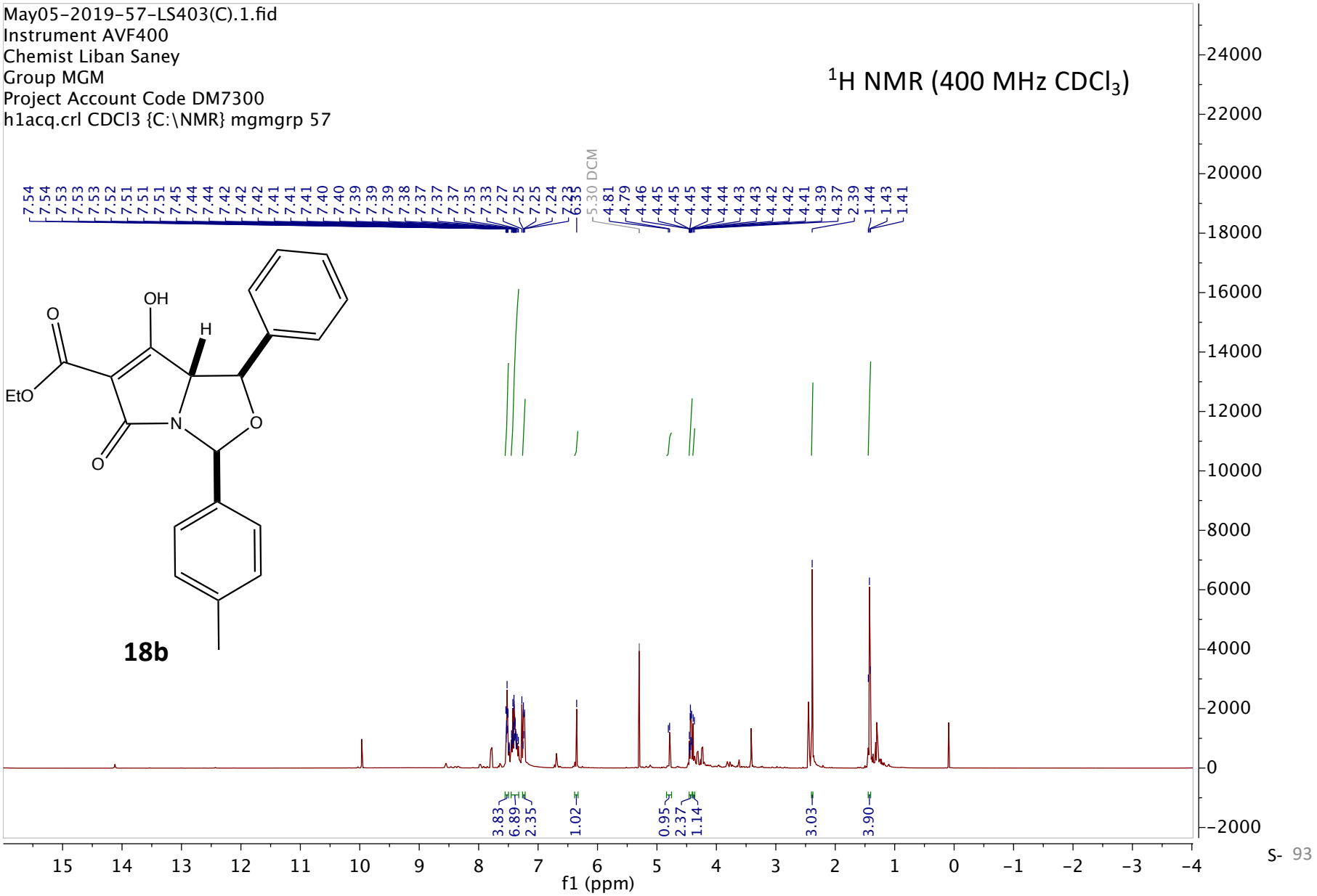

May03-2019-57-LS395(P) D3-F1.6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq.crl CDCl3 {C:\NMR} mgmgrp 57
19F NMR (377 MHz CDCl3)
-109.52
MeO2C
O
O
O
N
O
F
17c
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
f1 (ppm)

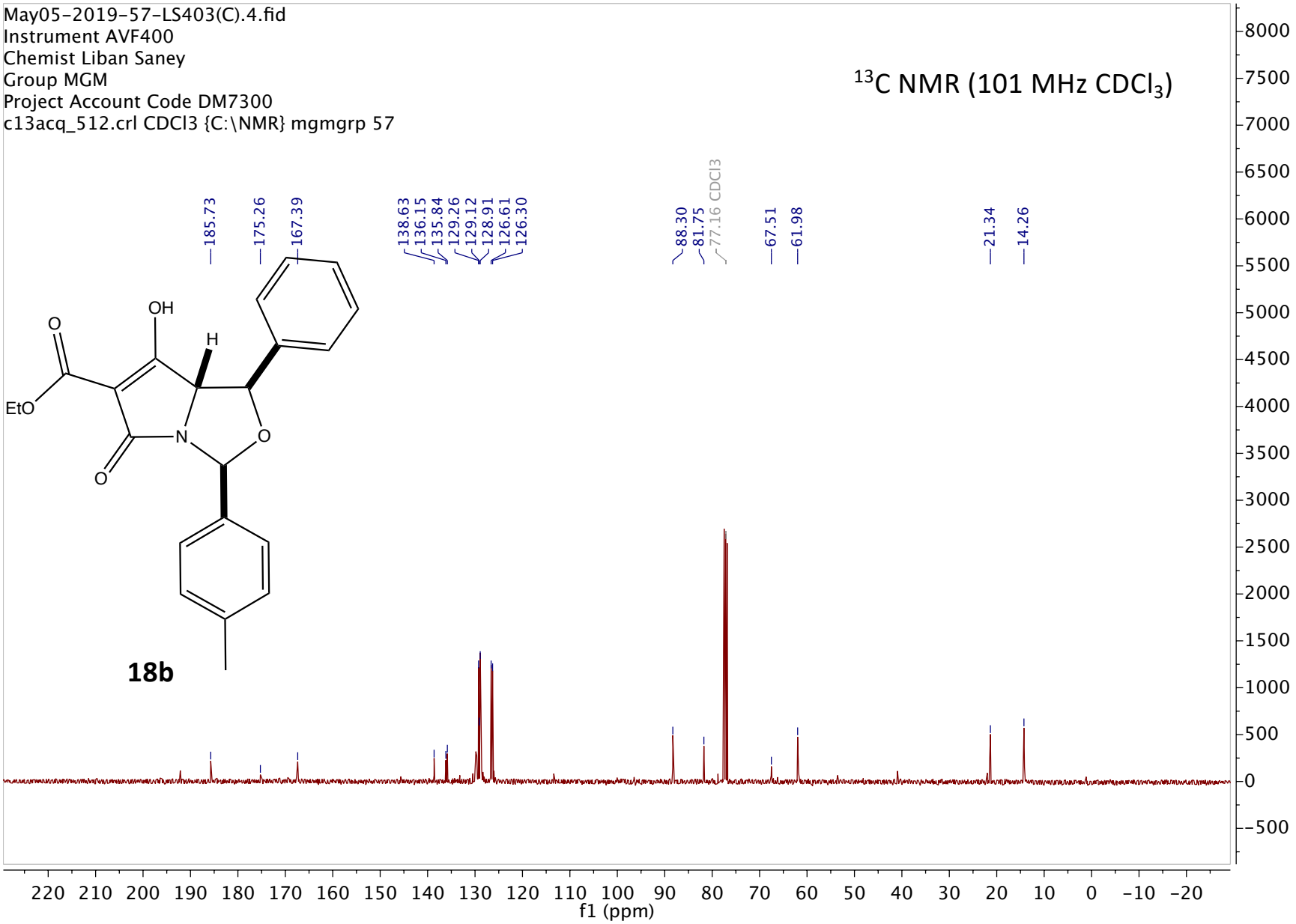

Apr13-2019-59-LS380(P) C10-E2.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
DCM
MeO2C
O
O
N
O
O
Br
17d
f1 (ppm)

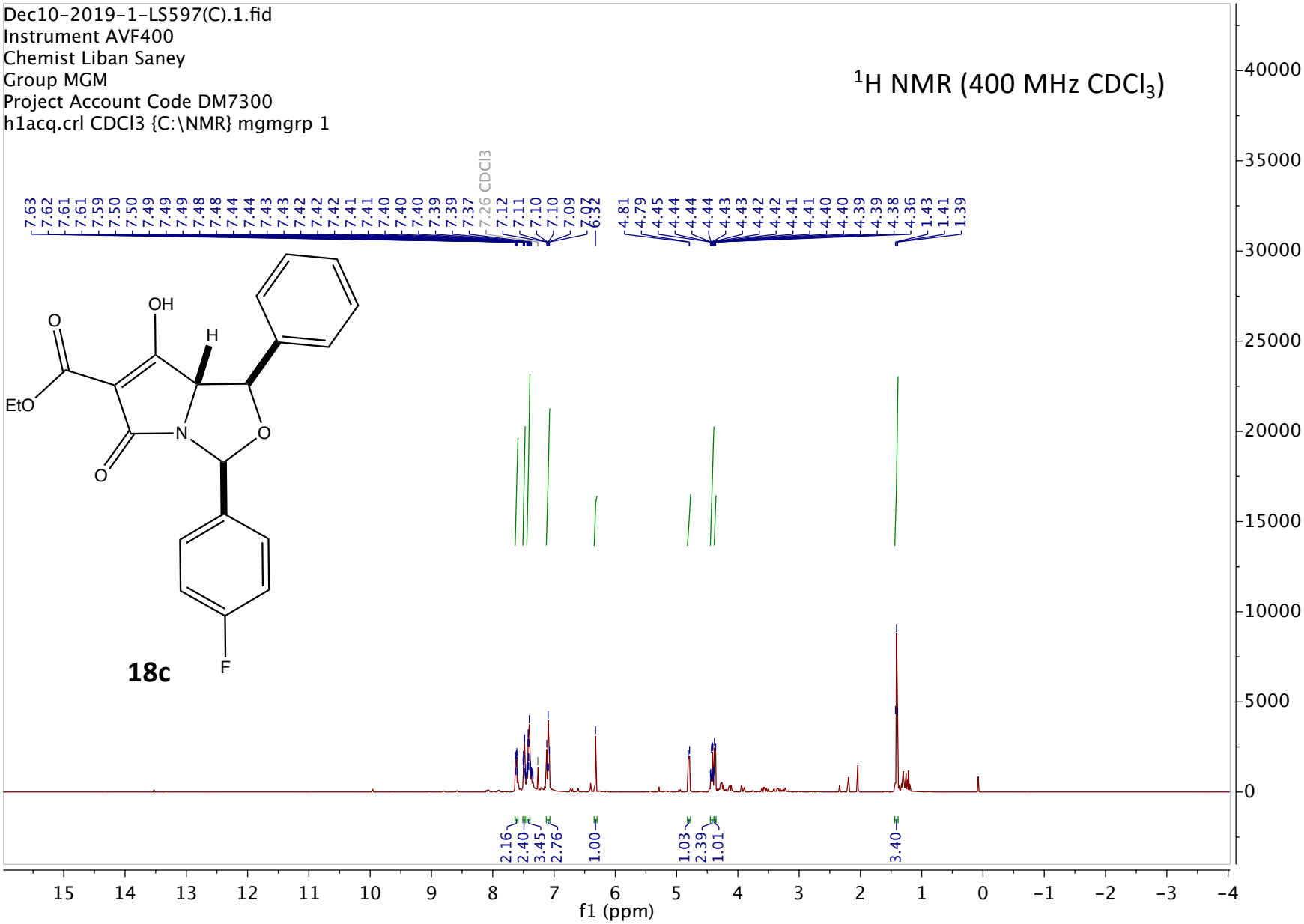

Apr13-2019-59-LS380(P) C10-E2.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
13C NMR (101 MHz CDCl3)
169.45
166.11
163.68
135.95
135.85
132.64
130.78
129.91
129.31
128.94
126.34
125.04
90.85
82.30
77.16 CDCl3
66.72
61.62
52.89
42.33
14.13
MeO2C
O
O
O
N
O
Br
17d
f1 (ppm)

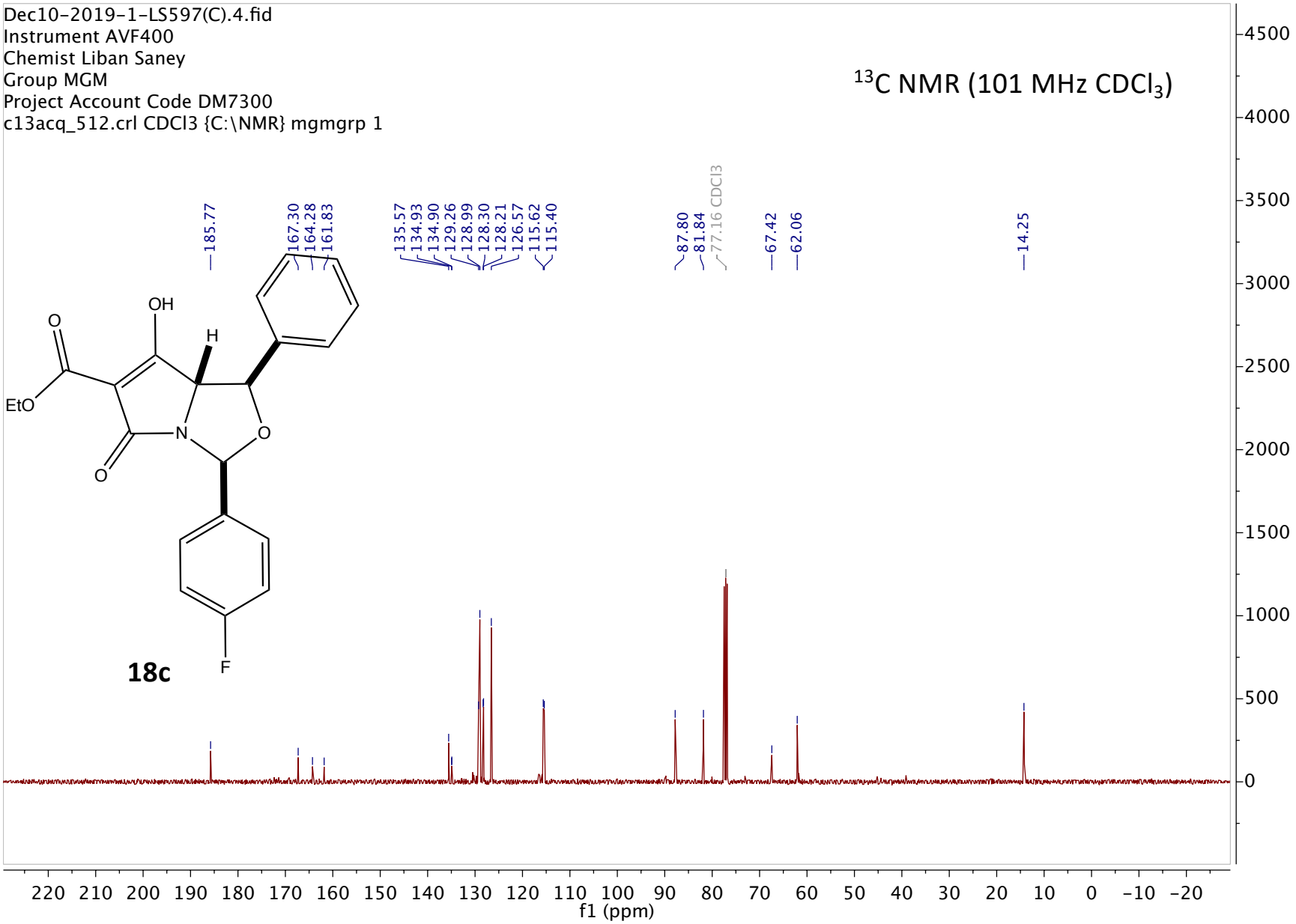

Apr08-2019-60-LS372(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.66 7.65 7.64 7.64 7.63 7.52 7.52 7.51 7.51 7.50 7.50 7.46 7.45 7.44 7.44 7.43 7.43 7.42 7.42 7.41 7.40 7.40 7.40 7.39 7.39 7.38 7.38 7.38 7.38 7.37 7.36 7.36 7.36
7.26 CDCl3
6.37
4.82 4.80 4.46 4.46 4.45 4.45 4.44 4.44 4.44 4.43 4.43 4.42 4.42 4.41 4.41 4.40 4.40 4.39 4.39 4.37 1.43 1.41 1.40
OH
H
O
EtO
N
O
O
18a
2.04 2.38 6.53 0.99 1.00 2.15 1.08 3.18
40000 35000 30000 25000 20000 15000 10000 5000 0
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)


Apr08-2019-60-LS372(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
185.67
175.24
167.31
138.99
135.73
129.14
128.90
128.79
128.57
126.57
126.34
100.13
88.23
81.76
77.16 CDCl3
67.42
61.99
14.23
OH
H
O
EtO
N
O
O
18a
f1 (ppm)


May05-2019-57-LS403(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 57
^{1}H NMR (400 MHz $CDCl_3$)
5.30 DCM
OH
H
O
EtO
N
O
O
18b
3.83
6.89
2.35
1.02
0.95
2.37
1.14
3.03
3.90
f1 (ppm)

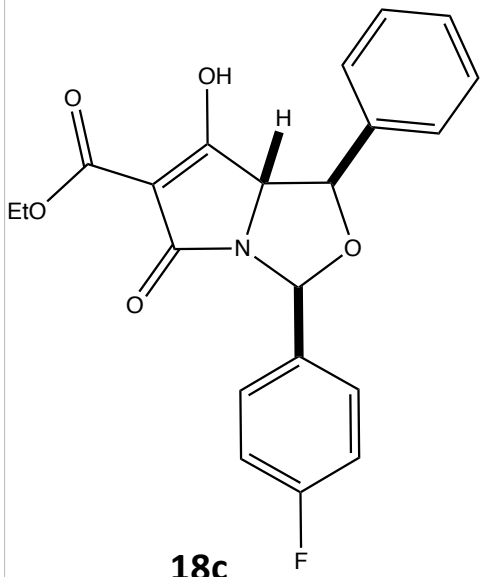

May05-2019-57-LS403(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 57
^{13}C NMR (101 MHz $CDCl_3$)
185.73
175.26
167.39
138.63
136.15
135.84
129.26
129.12
128.91
126.61
126.30
88.30
81.75
77.16 CDCl3
67.51
61.98
21.34
14.26
OH
H
O
EtO
N
O
O
18b
f1 (ppm)


Dec10-2019-1-LS597(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
7.63 7.62 7.61 7.61 7.59 7.50 7.50 7.49 7.49 7.48 7.48 7.44 7.44 7.43 7.43 7.42 7.42 7.42 7.41 7.41 7.40 7.40 7.40 7.39 7.39 7.37 7.26 CDCl3 7.12 7.11 7.10 7.10 7.09 7.07 6.32
4.81 4.79 4.45 4.44 4.44 4.44 4.43 4.43 4.42 4.42 4.41 4.41 4.40 4.40 4.39 4.39 4.38 4.36 1.43 1.41 1.39
OH
H
O
EtO
N
O
O
F
18c
2.16 2.40 3.45 2.76 1.00 1.03 2.39 1.01 3.40
40000 35000 30000 25000 20000 15000 10000 5000 0
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)

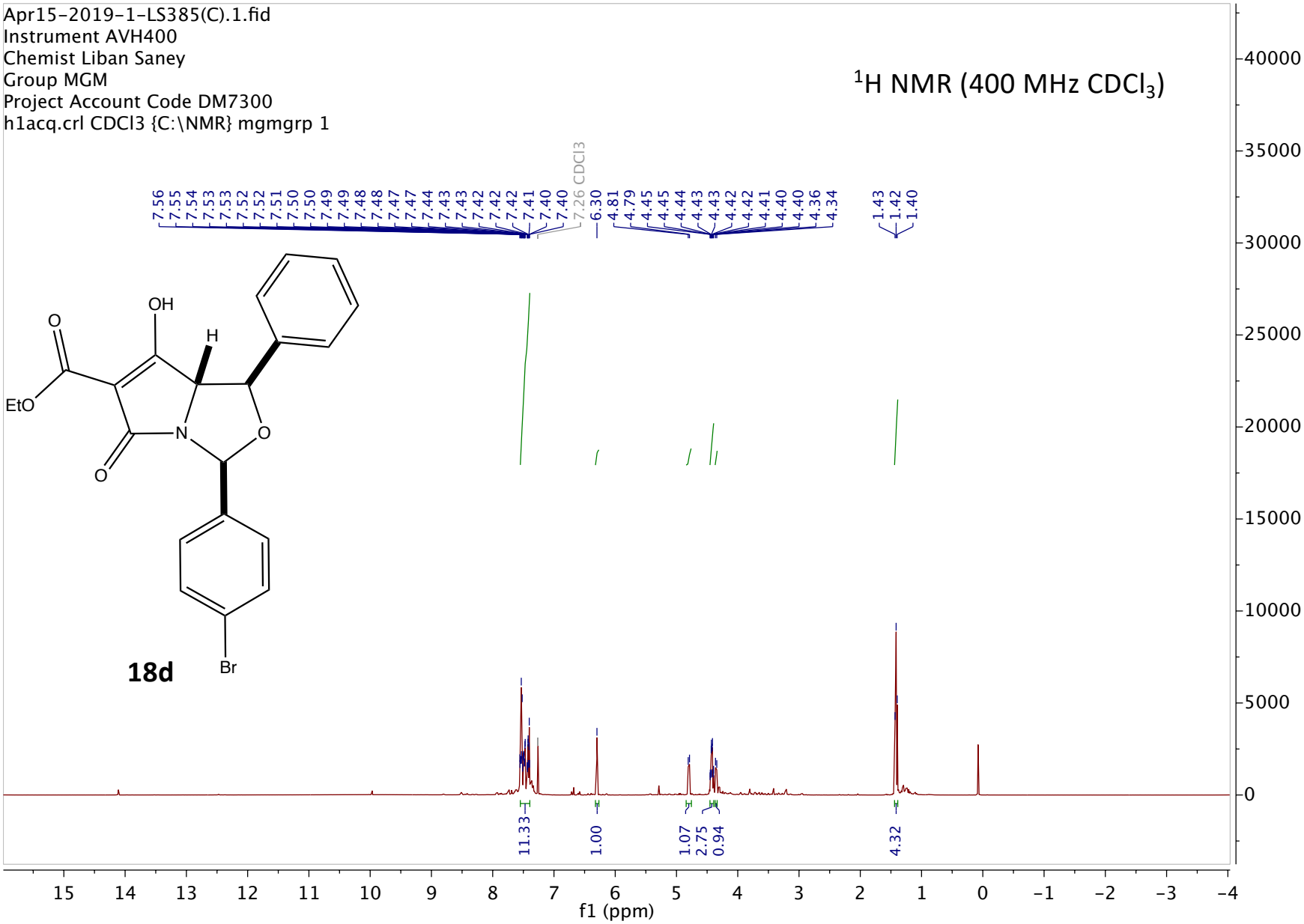

Dec10-2019-1-LS597(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
185.77
167.30
164.28
161.83
135.57
134.93
134.90
129.26
128.99
128.30
128.21
126.57
115.62
115.40
87.80
81.84
77.16 CDCl3
67.42
62.06
14.25
OH
H
O
EtO
N
O
O
F
18c
4500
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

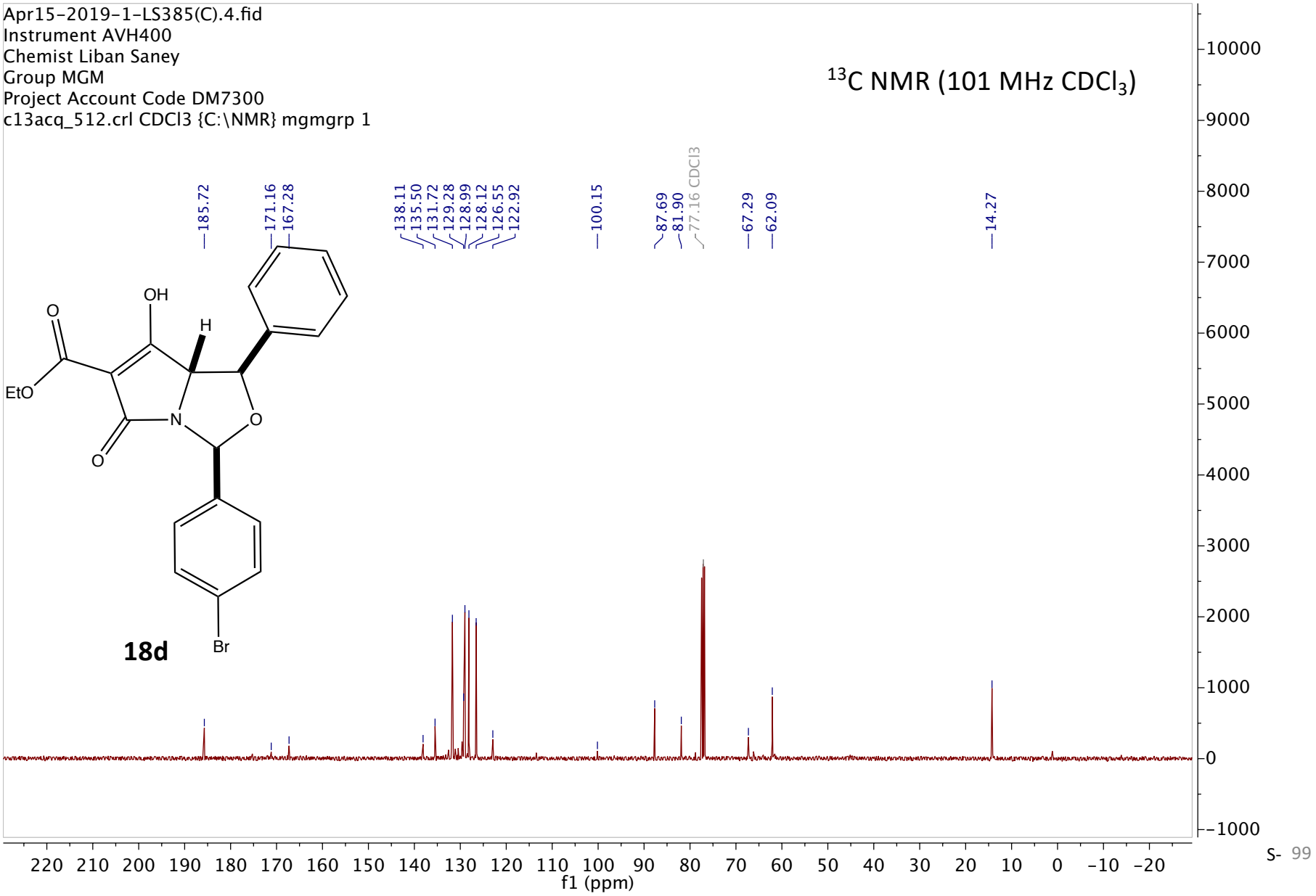
Dec10-2019-1-LS597(C).7.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19dec_256.crl CDCl3 {C:\NMR} mgmgrp 1

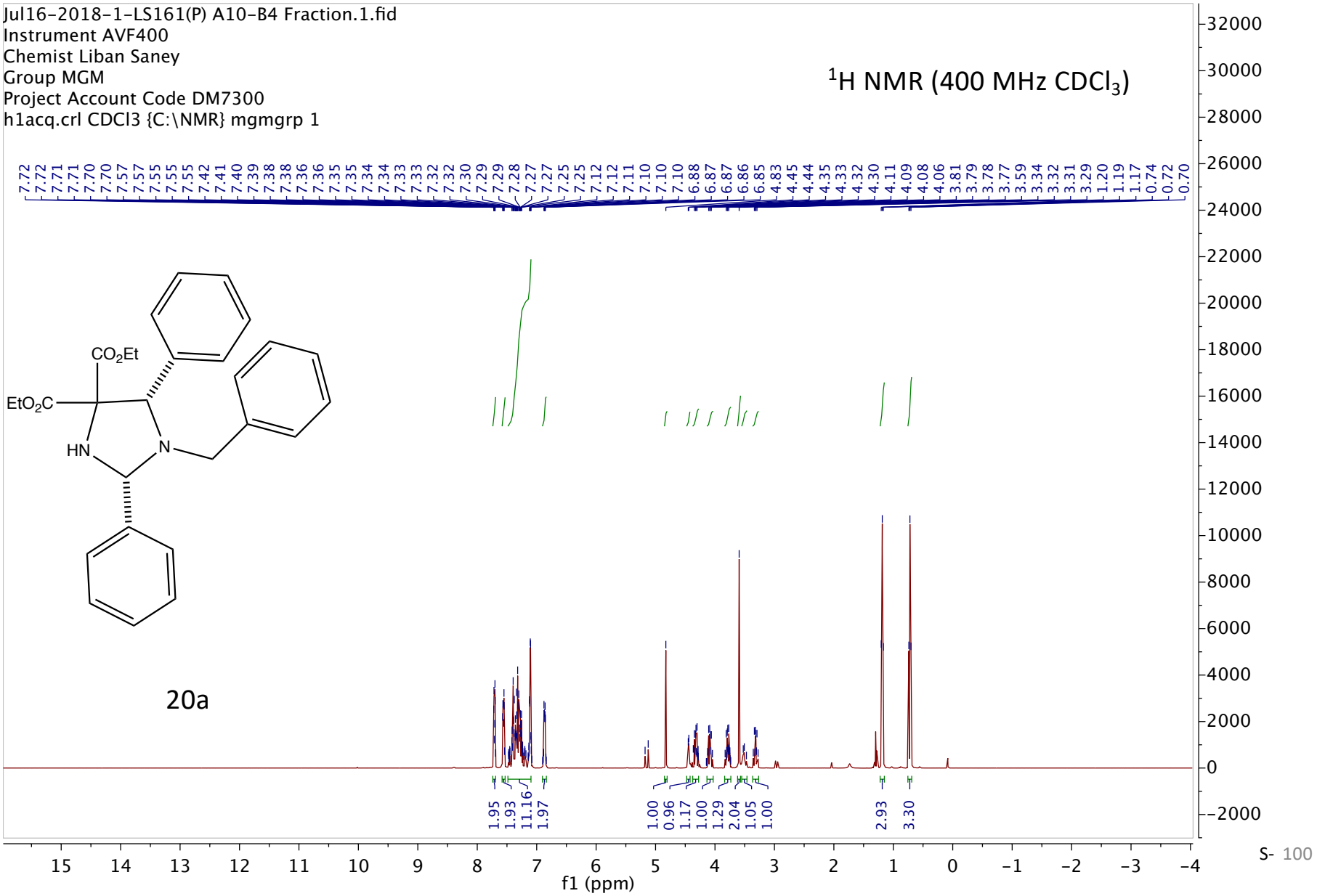
^{19}F NMR (377 MHz $CDCl_3$)

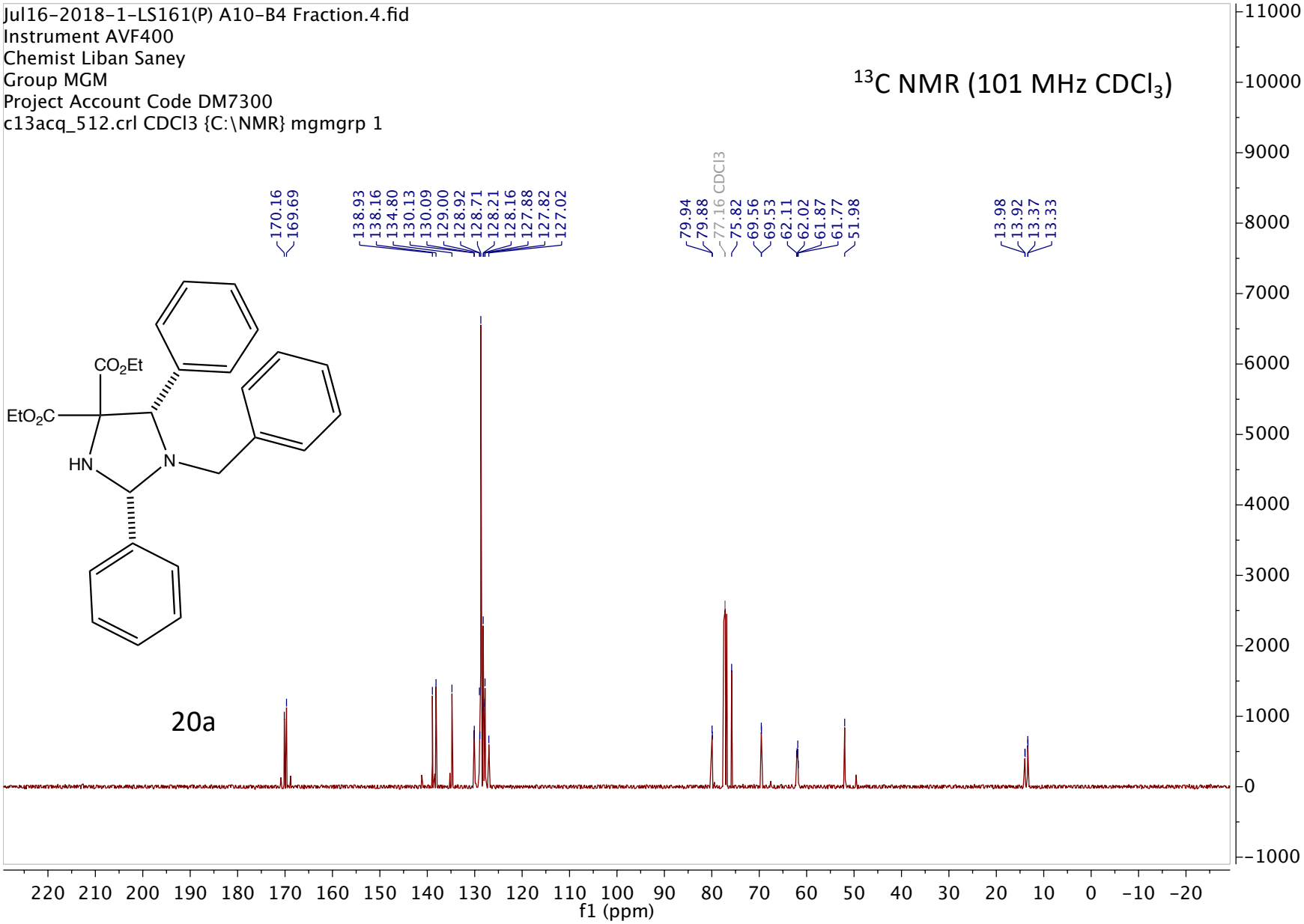


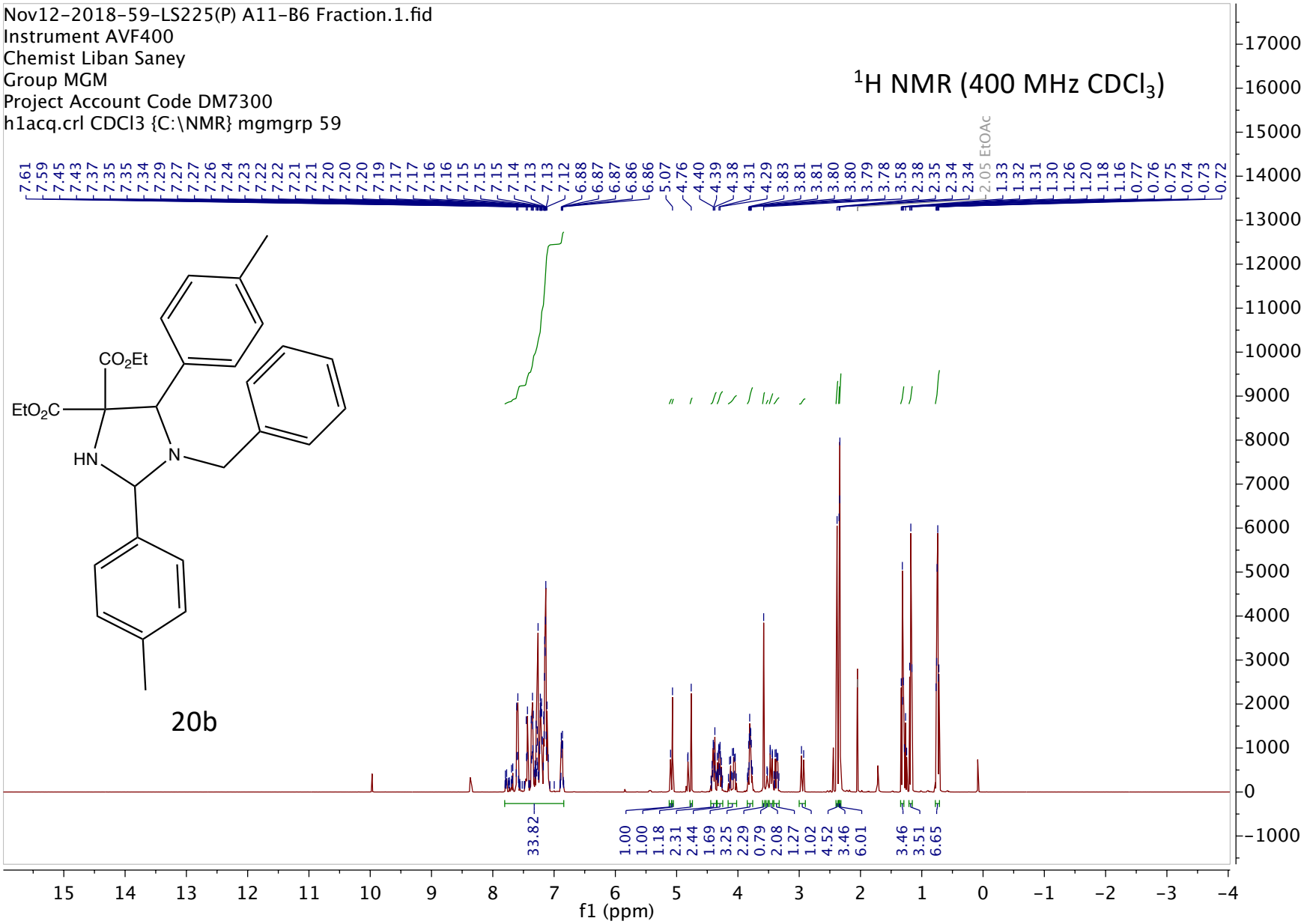
18c

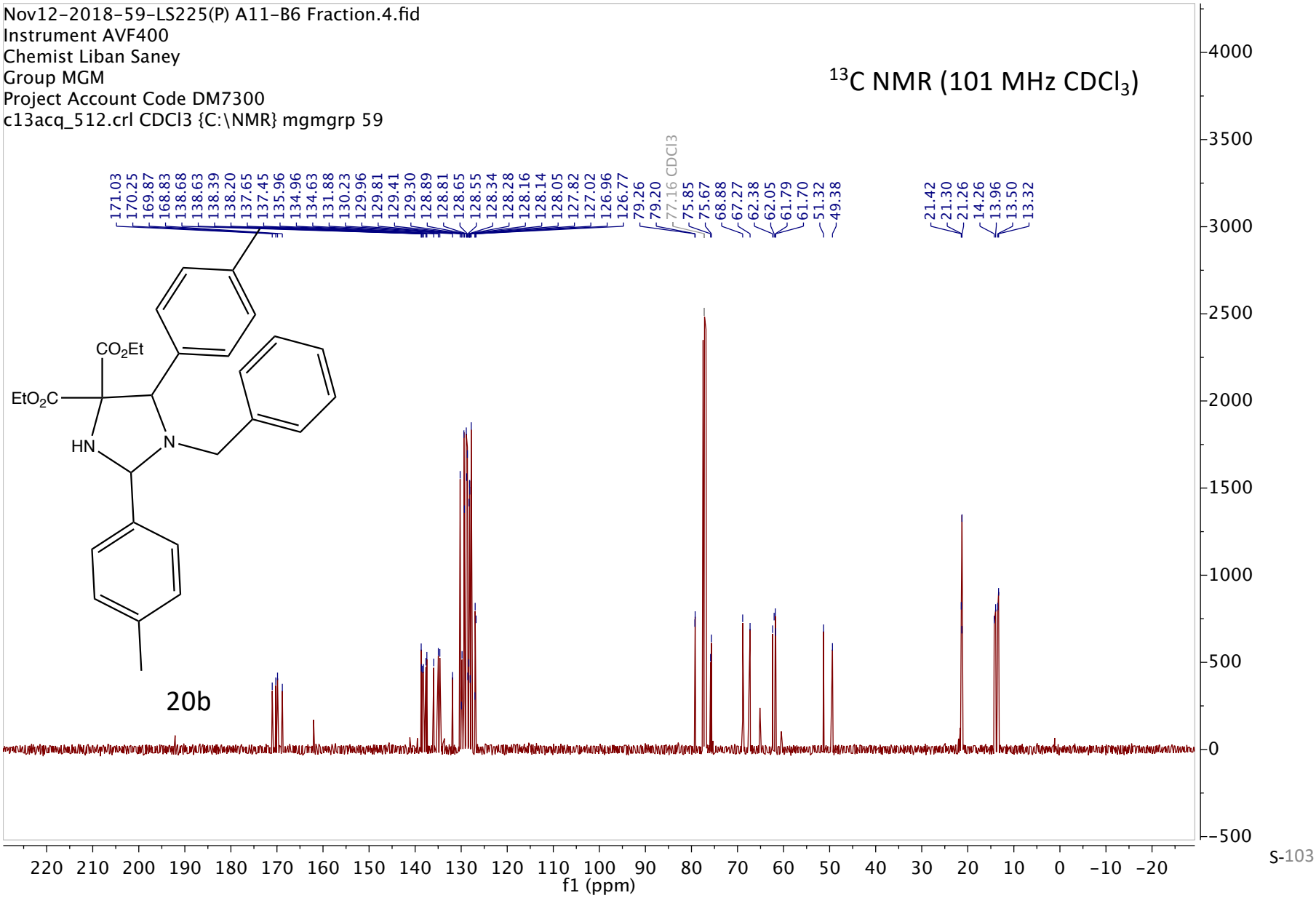

Apr15-2019-1-LS385(C).1.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
7.56 7.55 7.54 7.53 7.53 7.52 7.52 7.51 7.50 7.50 7.49 7.49 7.48 7.48 7.47 7.47 7.44 7.43 7.43 7.42 7.42 7.42 7.41 7.40 7.40 7.26 CDCl3 6.30 4.81 4.79 4.45 4.45 4.44 4.43 4.43 4.42 4.42 4.41 4.40 4.40 4.36 4.34 1.43 1.42 1.40
OH
H
O
EtO
N
O
O
Br
18d
11.33
1.00
1.07
2.75
0.94
4.32
40000
35000
30000
25000
20000
15000
10000
5000
0
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)

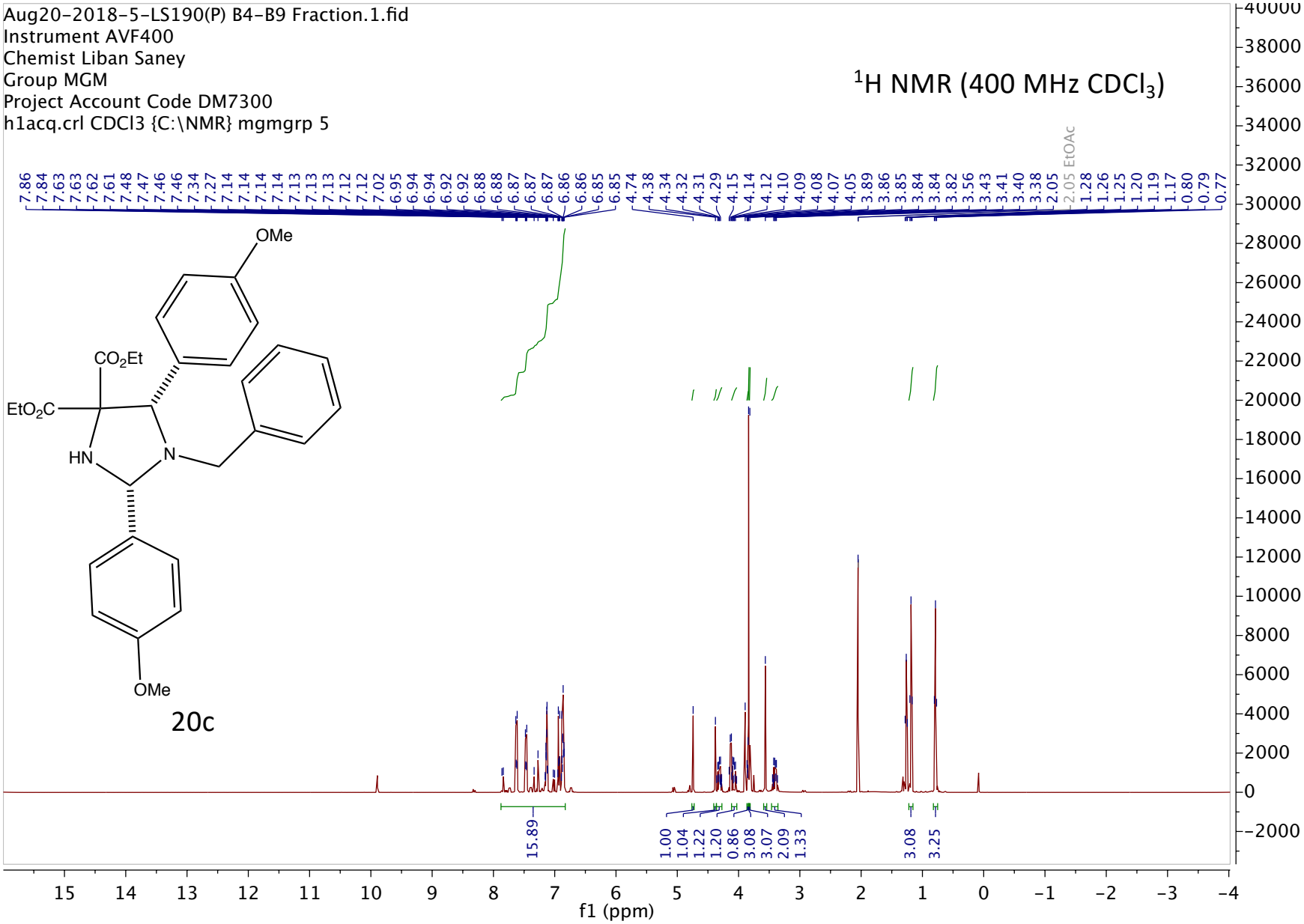

Apr15-2019-1-LS385(C).4.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
185.72
171.16
167.28
138.11
135.50
131.72
129.28
128.99
128.12
126.55
122.92
100.15
87.69
81.90
77.16 CDCl3
67.29
62.09
14.27
OH
H
O
EtO
N
O
O
Br
18d
f1 (ppm)

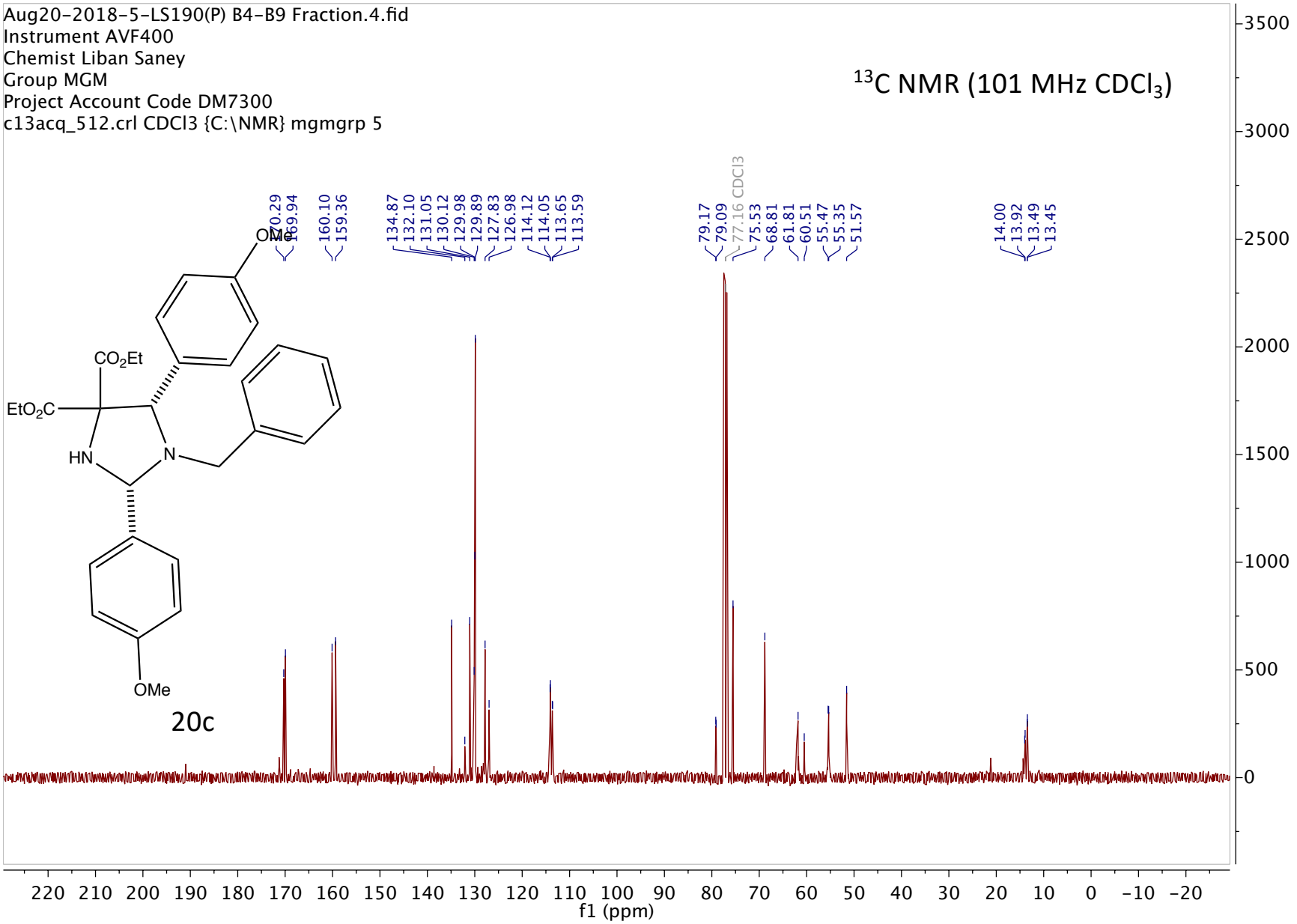

Jul16-2018-1-LS161(P) A10-B4 Fraction.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CO_2Et
EtO_2C
HN
N
20a
f1 (ppm)

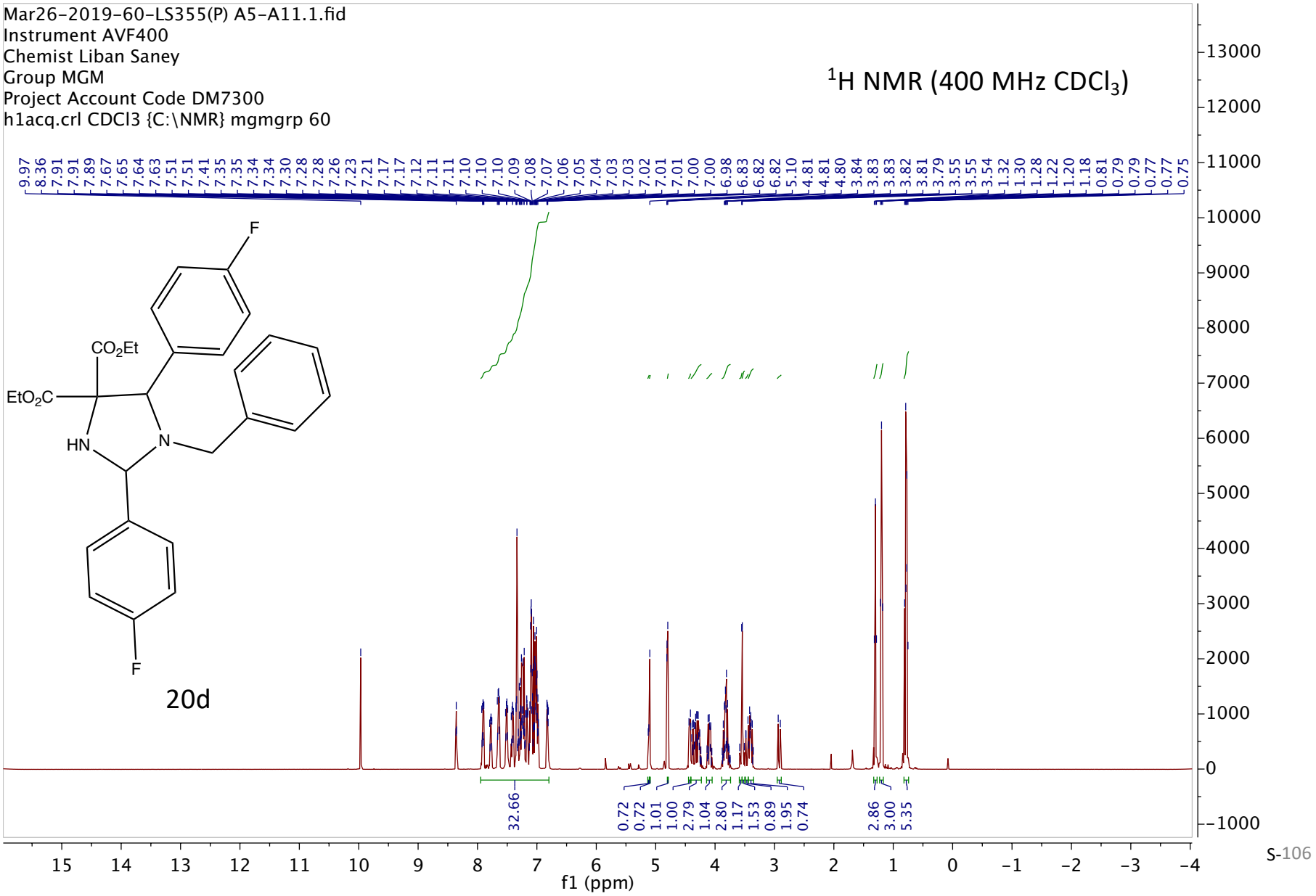

Jul16-2018-1-LS161(P) A10-B4 Fraction.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
170.16
169.69
138.93
138.16
134.80
130.13
130.09
129.00
128.92
128.71
128.21
128.16
127.88
127.82
127.02
79.94
79.88
77.16 CDCl3
75.82
69.56
69.53
62.11
62.02
61.87
61.77
51.98
13.98
13.92
13.37
13.33
CO2Et
EtO2C
HN
N
20a
f1 (ppm)

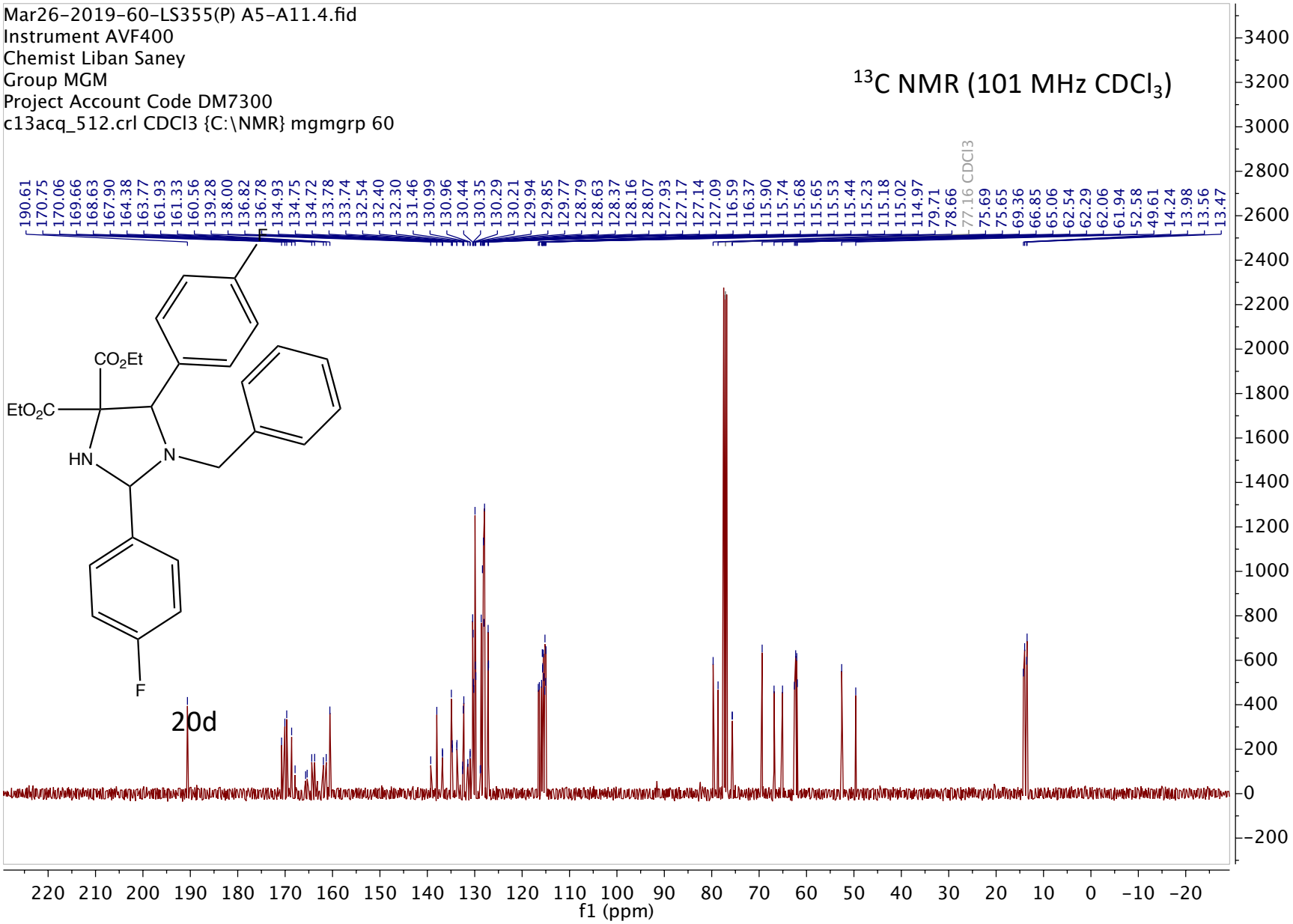

Nov12-2018-59-LS225(P) A11-B6 Fraction.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
EtOAc
CO_2Et
EtO_2C
HN
N
20b
f1 (ppm)

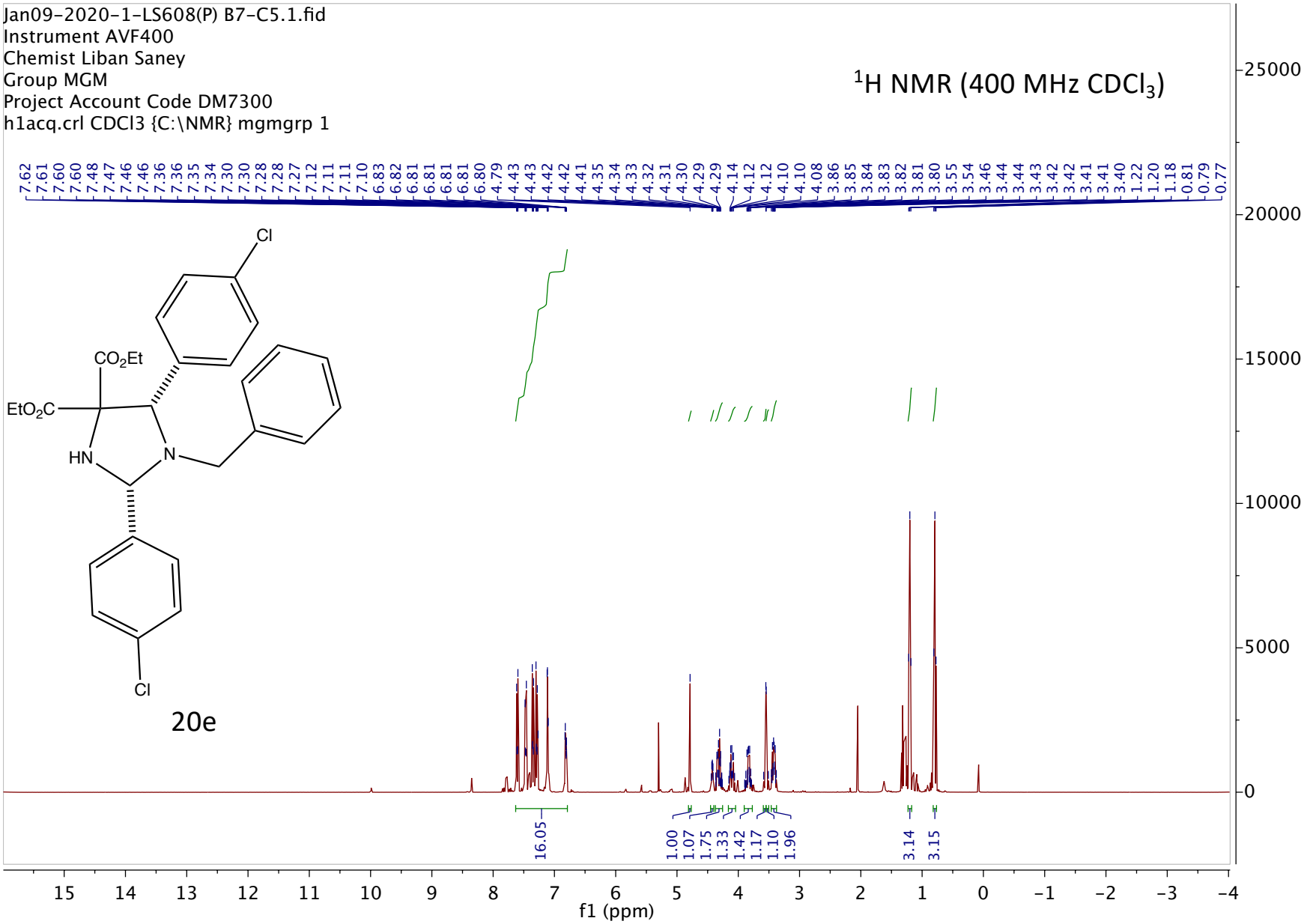

Nov12-2018-59-LS225(P) A11-B6 Fraction.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
^{13}C NMR (101 MHz $CDCl_3$)
171.03
170.25
169.87
168.83
138.68
138.63
138.39
138.20
137.65
137.45
135.96
134.96
134.63
131.88
130.23
129.96
129.81
129.41
129.30
128.89
128.81
128.65
128.55
128.34
128.28
128.16
128.14
128.05
127.82
127.02
126.96
126.77
79.26
79.20
77.16 CDCl3
75.85
75.67
68.88
67.27
62.38
62.05
61.79
61.70
51.32
49.38
21.42
21.30
21.26
14.26
13.96
13.50
13.32
CO_2Et
EtO_2C
HN
N
20b
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

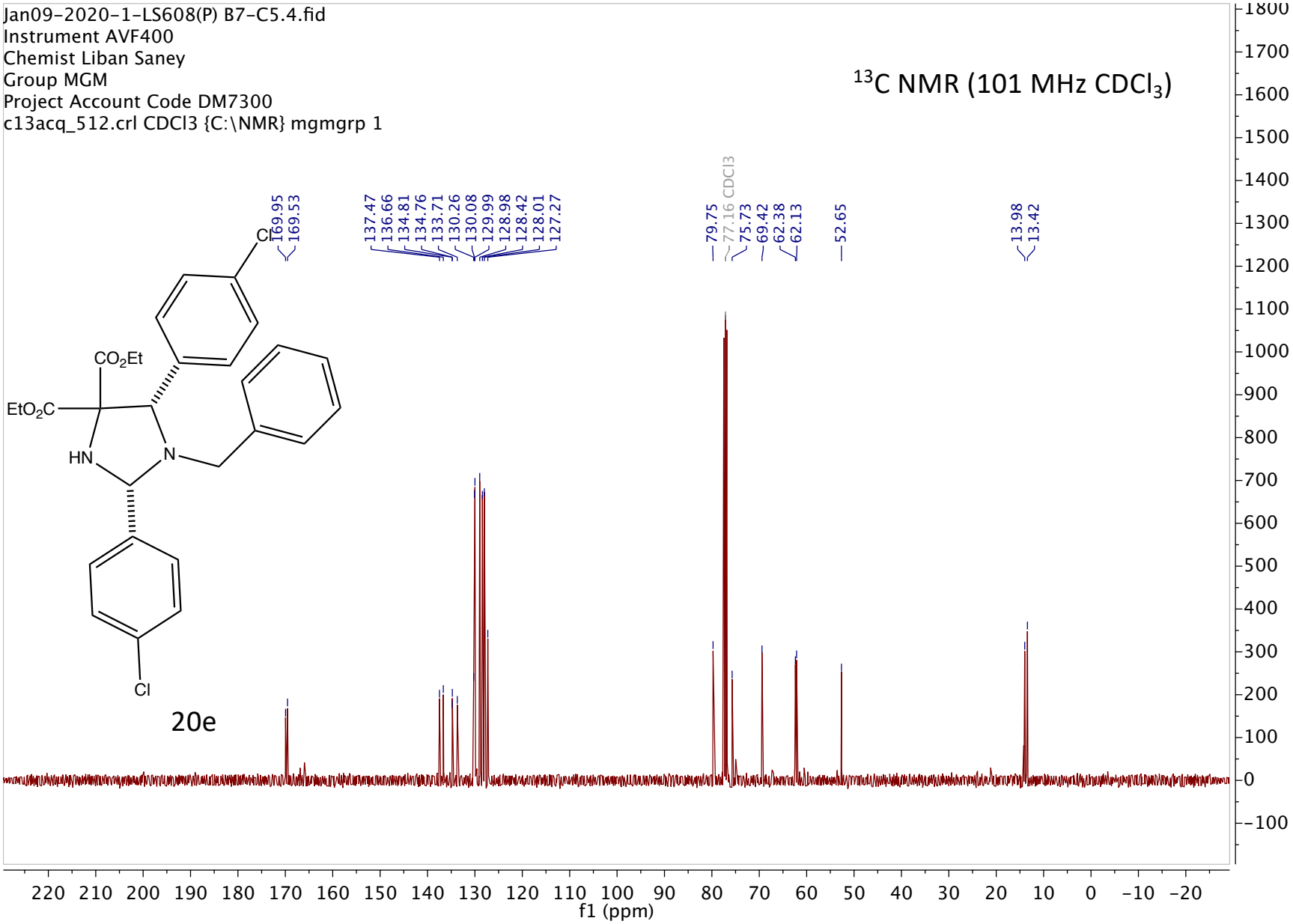

Aug20-2018-5-LS190(P) B4-B9 Fraction.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 5
^{1}H NMR (400 MHz $CDCl_3$)
OMe
CO_2Et
EtO_2C
HN
N
OMe
20c
f1 (ppm)

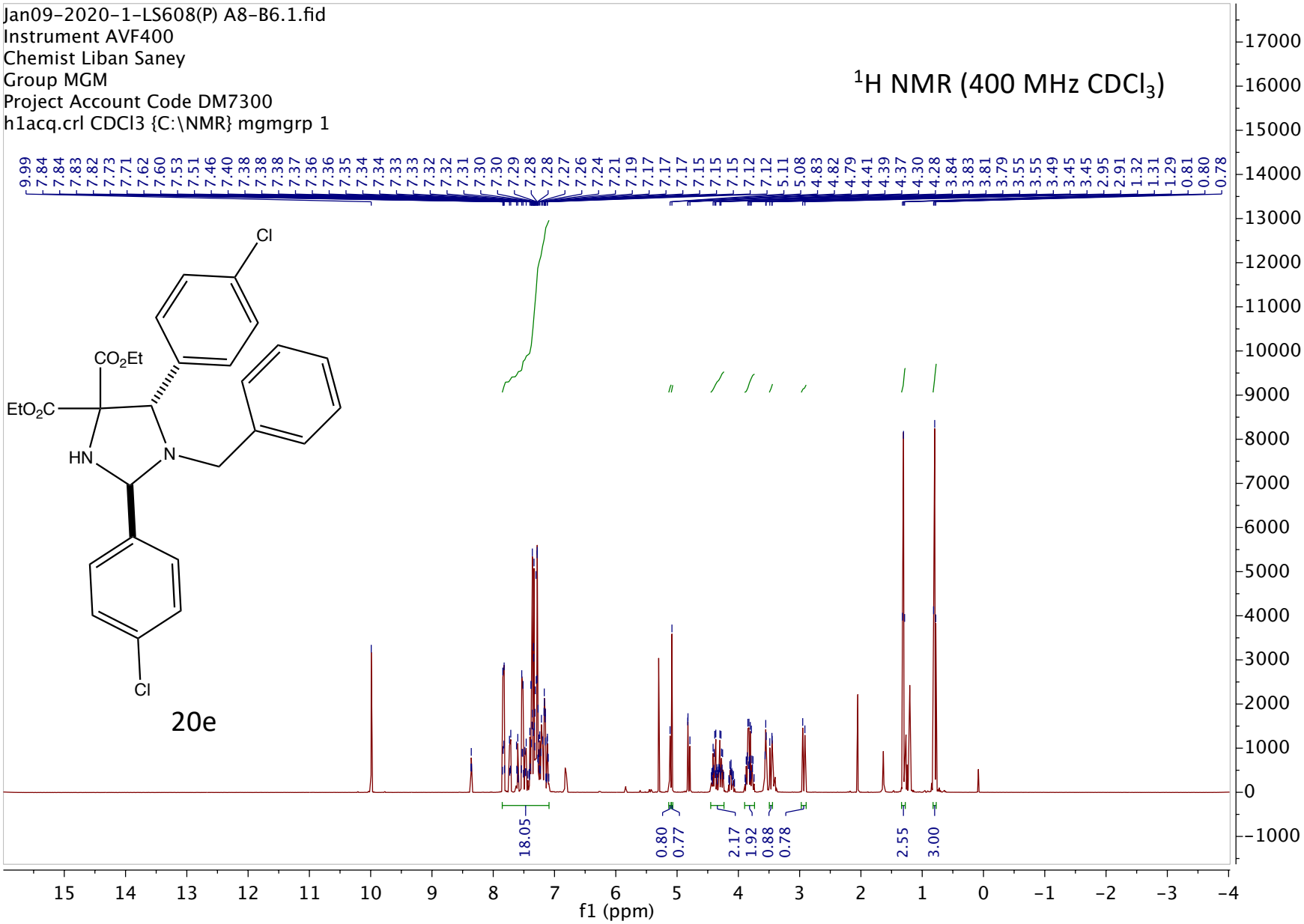

Aug20-2018-5-LS190(P) B4-B9 Fraction.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 5
^{13}C NMR (101 MHz $CDCl_3$)
170.29
169.94
160.10
159.36
134.87
132.10
131.05
130.12
129.98
129.89
127.83
126.98
114.12
114.05
113.65
113.59
79.17
79.09
77.16 CDCl3
75.53
68.81
61.81
60.51
55.47
55.35
51.57
14.00
13.92
13.49
13.45
OMe
CO_2Et
EtO_2C
HN
N
OMe
20c
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

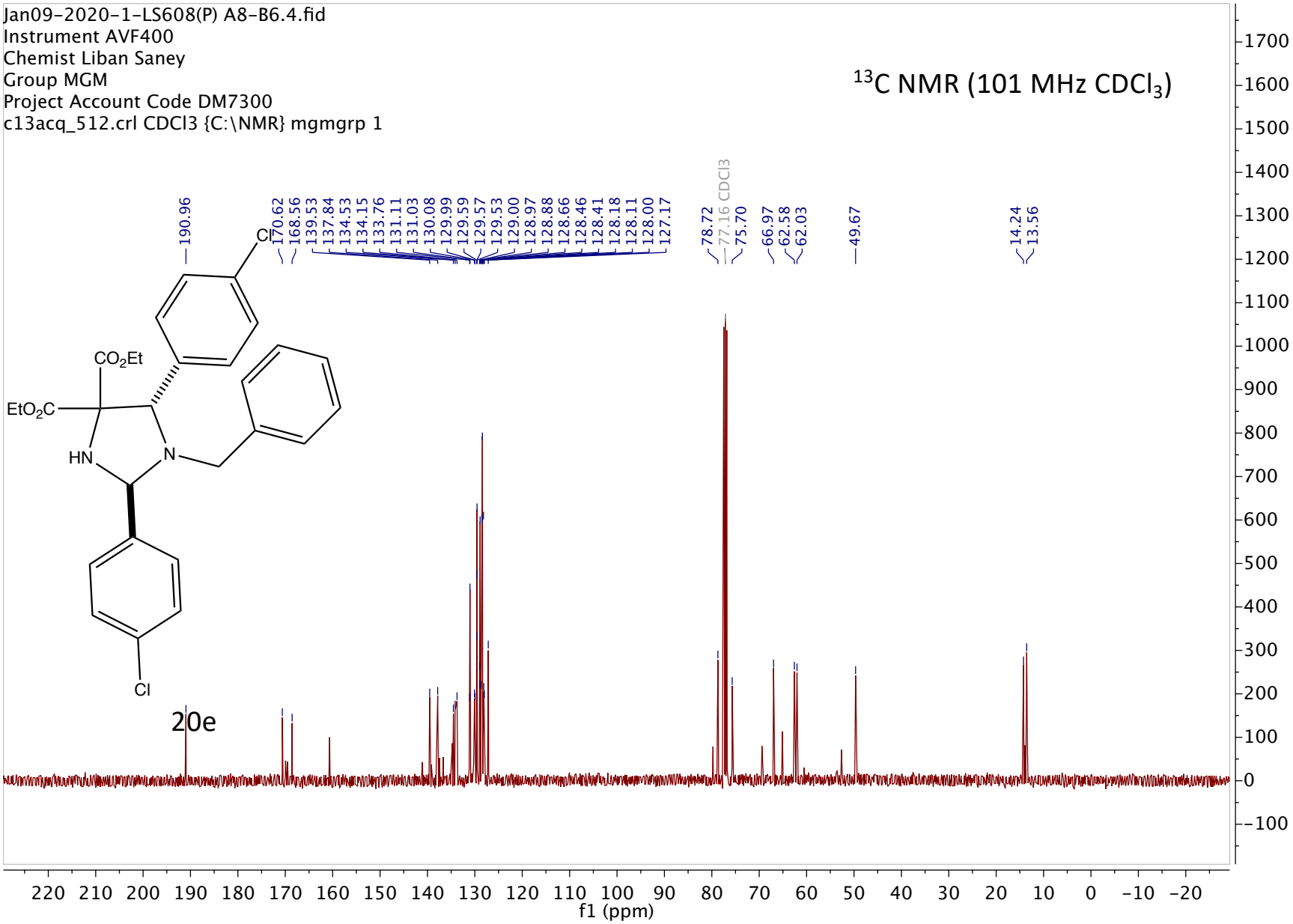

Mar26-2019-60-LS355(P) A5-A11.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
F
CO_2Et
EtO_2C
HN
N
F
20d
f1 (ppm)

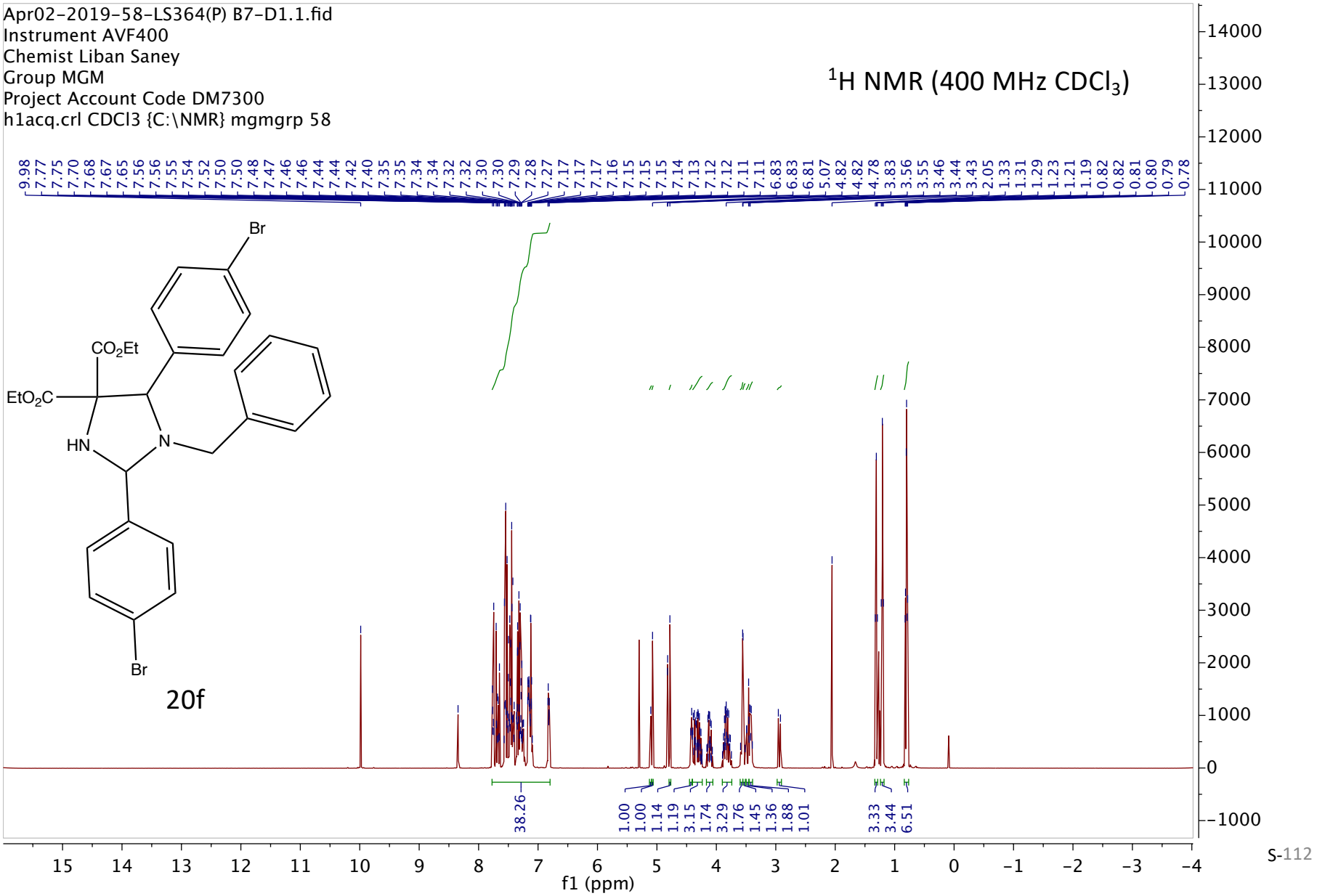

Mar26-2019-60-LS355(P) A5-A11.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
190.61 170.75 170.06 169.66 168.63 167.90 164.38 163.77 161.93 161.33 160.56 139.28 138.00 136.82 136.78 134.93 134.75 134.72 133.78 133.74 132.54 132.40 132.30 131.46 130.99 130.96 130.44 130.35 130.29 130.21 129.94 129.85 129.77 128.79 128.63 128.37 128.16 128.07 127.93 127.17 127.14 127.09 116.59 116.37 115.90 115.74 115.68 115.65 115.53 115.44 115.23 115.18 115.02 114.97 79.71 78.66 77.16 CDCl3 75.69 75.65 69.36 66.85 65.06 62.54 62.29 62.06 61.94 52.58 49.61 14.24 13.98 13.56 13.47
CO_2Et
EtO_2C
HN
N
F
20d
f1 (ppm)

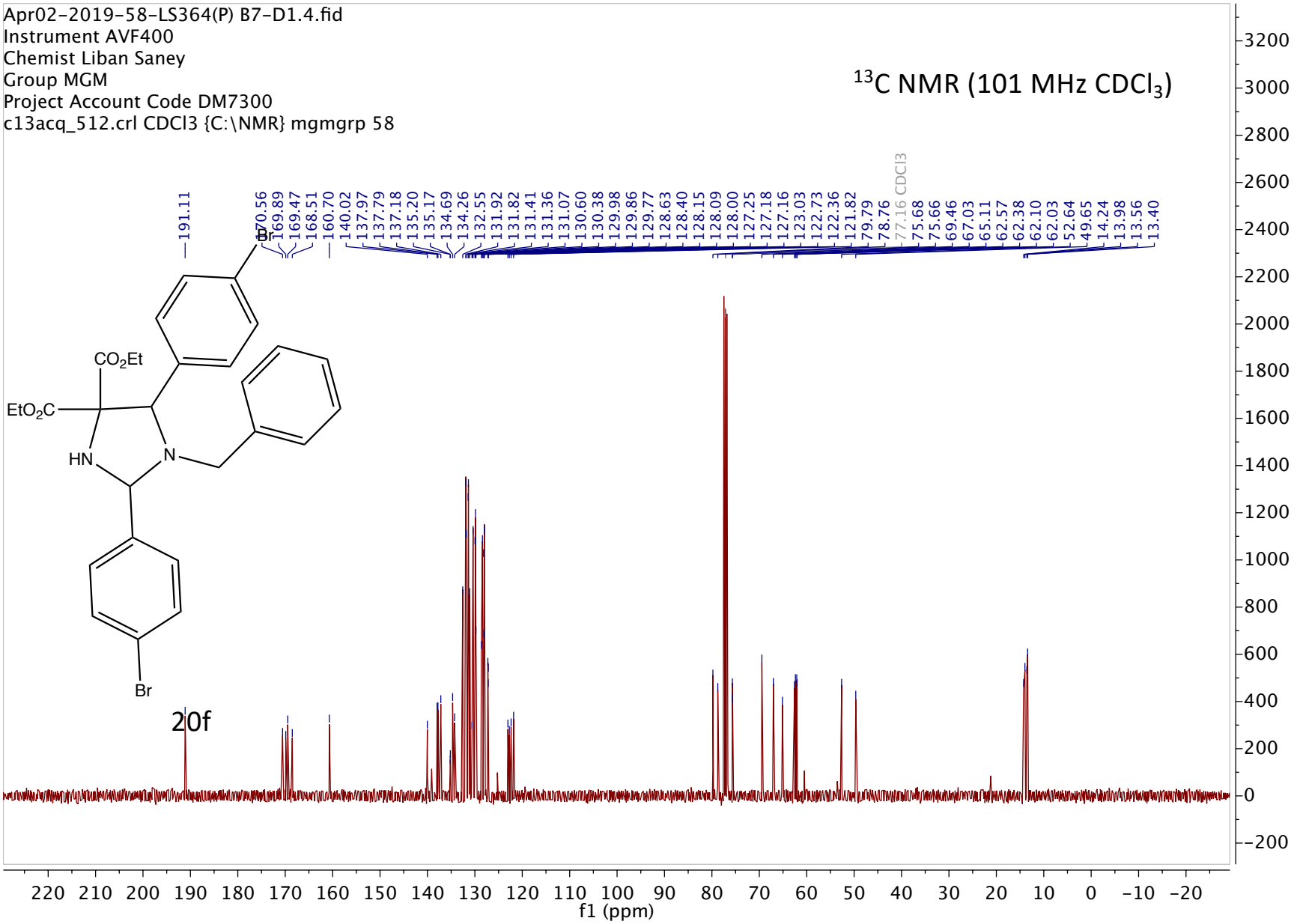

Jan09-2020-1-LS608(P) B7-C5.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
20e
f1 (ppm)

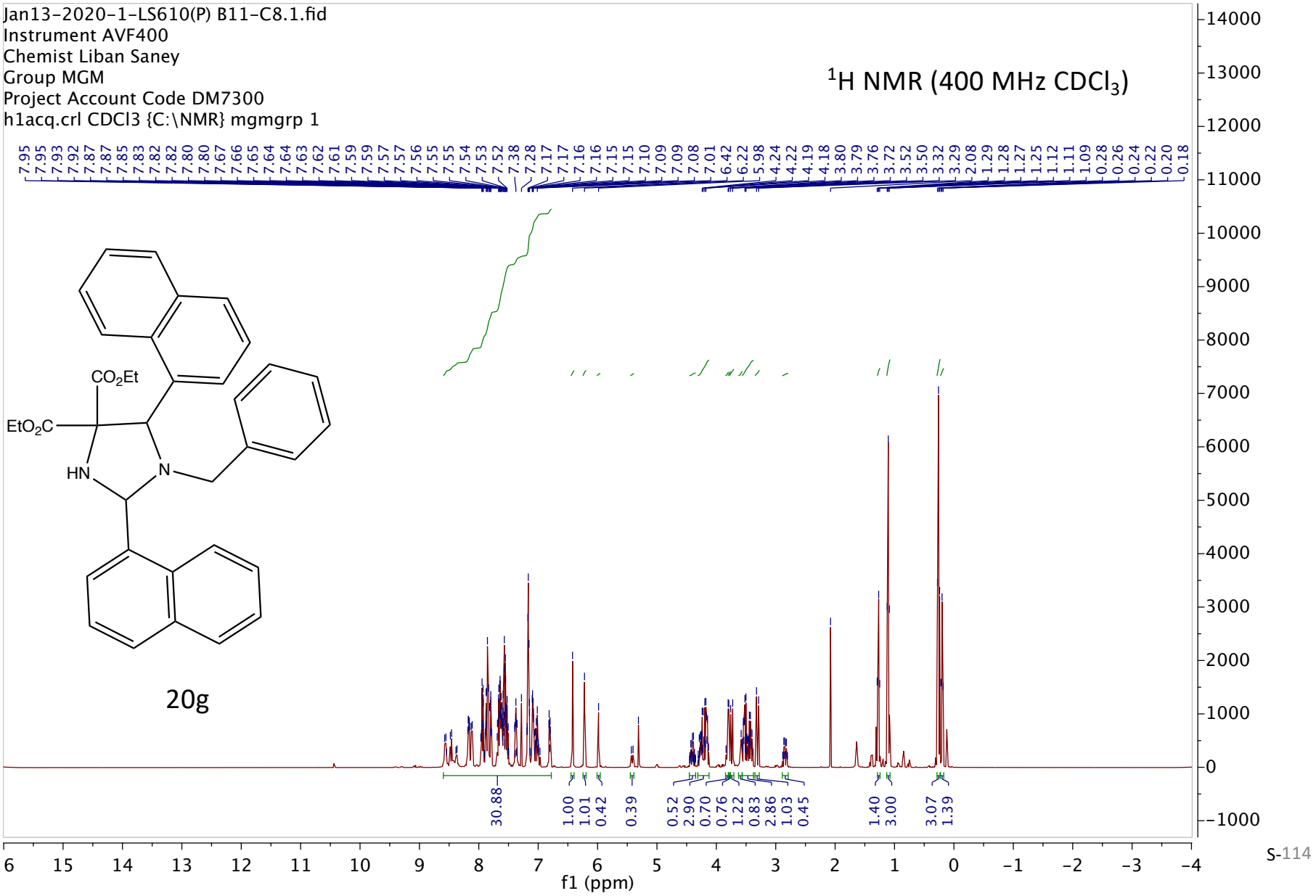

Jan09-2020-1-LS608(P) B7-C5.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
13C NMR (101 MHz CDCl3)
169.95
169.53
137.47
136.66
134.81
134.76
133.71
130.26
130.08
129.99
128.98
128.42
128.01
127.27
79.75
77.16 CDCl3
75.73
69.42
62.38
62.13
52.65
13.98
13.42
CO2Et
EtO2C
HN
N
Cl
Cl
20e
f1 (ppm)

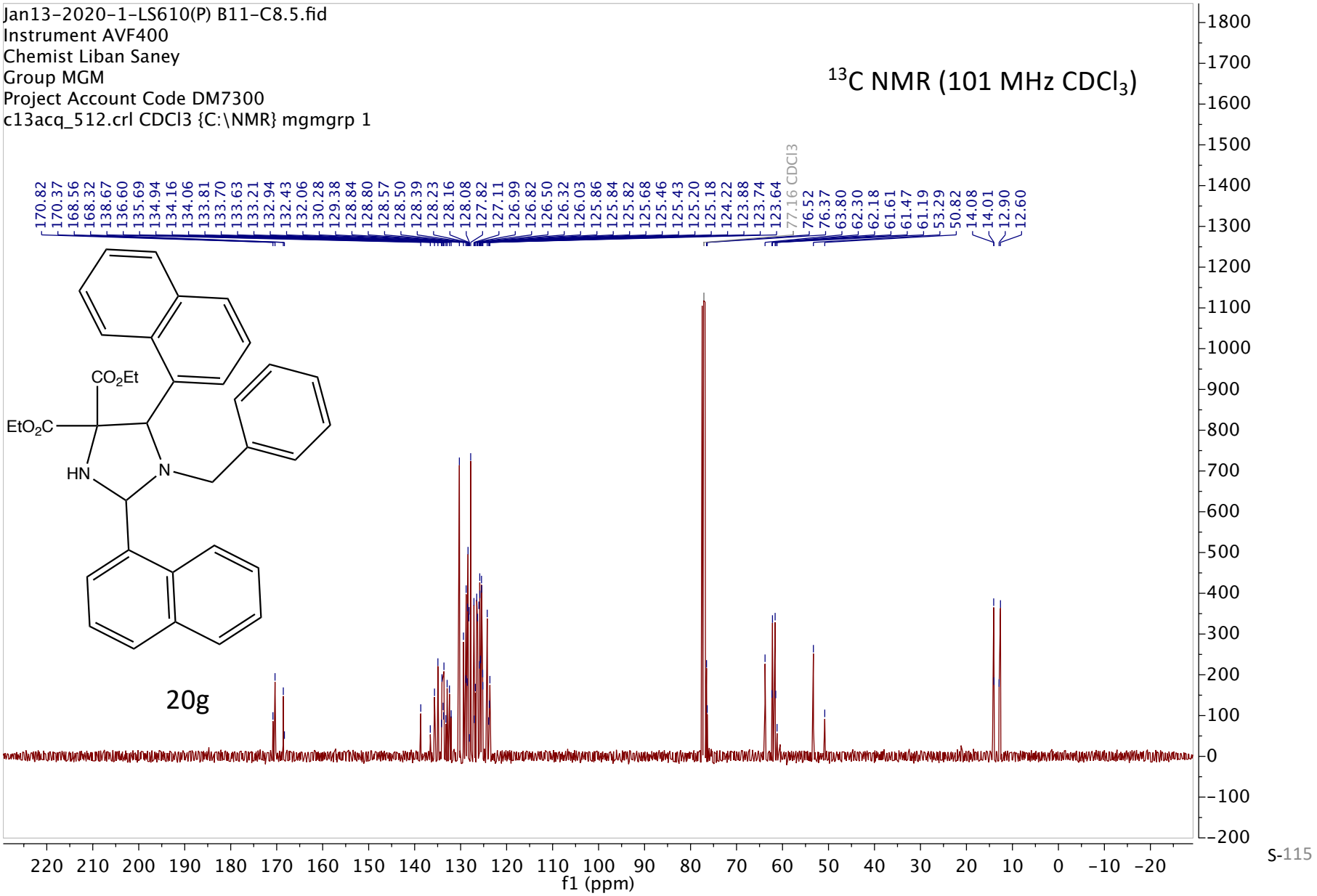

Jan09-2020-1-LS608(P) A8-B6.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
Cl
CO_2Et
EtO_2C
HN
N
Cl
20e
18.05
0.80
0.77
2.17
1.92
0.88
0.78
2.55
3.00
f1 (ppm)

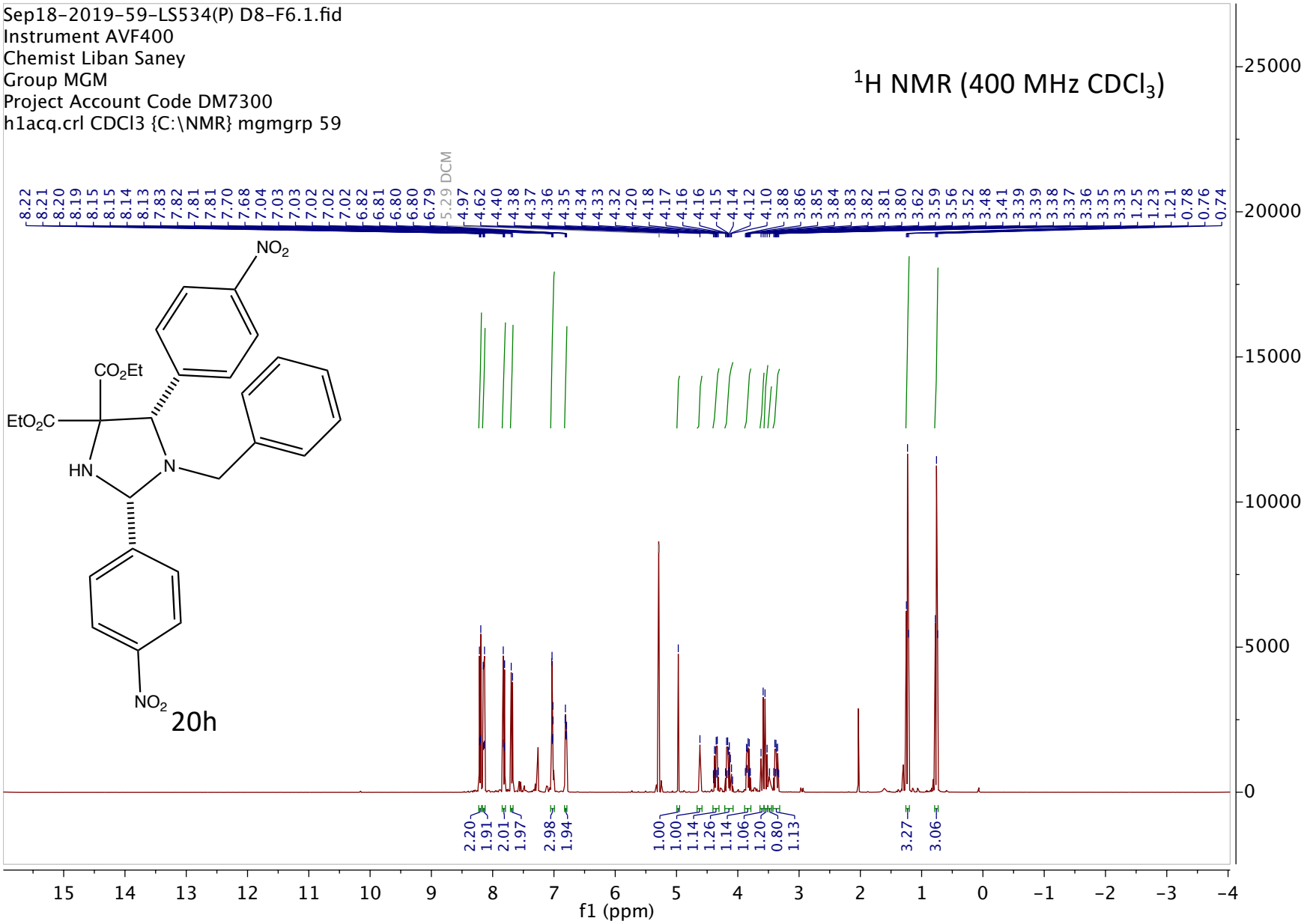

Jan09-2020-1-LS608(P) A8-B6.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
190.96
170.62
168.56
139.53
137.84
134.53
134.15
133.76
131.11
131.03
130.08
129.99
129.59
129.57
129.53
129.00
128.97
128.88
128.66
128.46
128.41
128.18
128.11
128.00
127.17
78.72
77.16 CDCl3
75.70
66.97
62.58
62.03
49.67
14.24
13.56
Cl
CO_2Et
EtO_2C
HN
N
Cl
20e
f1 (ppm)

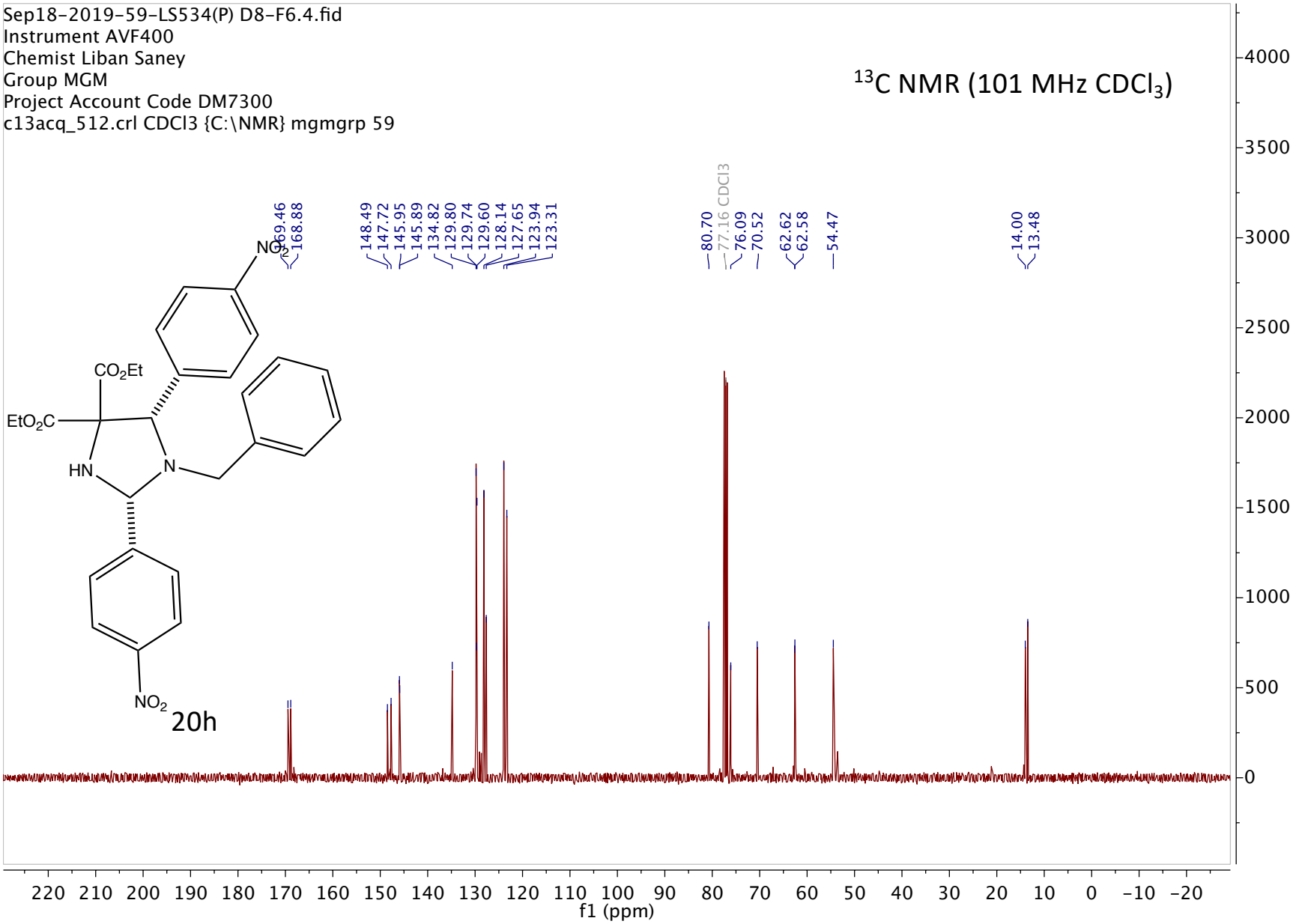

Apr02-2019-58-LS364(P) B7-D1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 58
^{1}H NMR (400 MHz $CDCl_3$)
Br
CO_2Et
EtO_2C
HN
N
Br
20f
f1 (ppm)

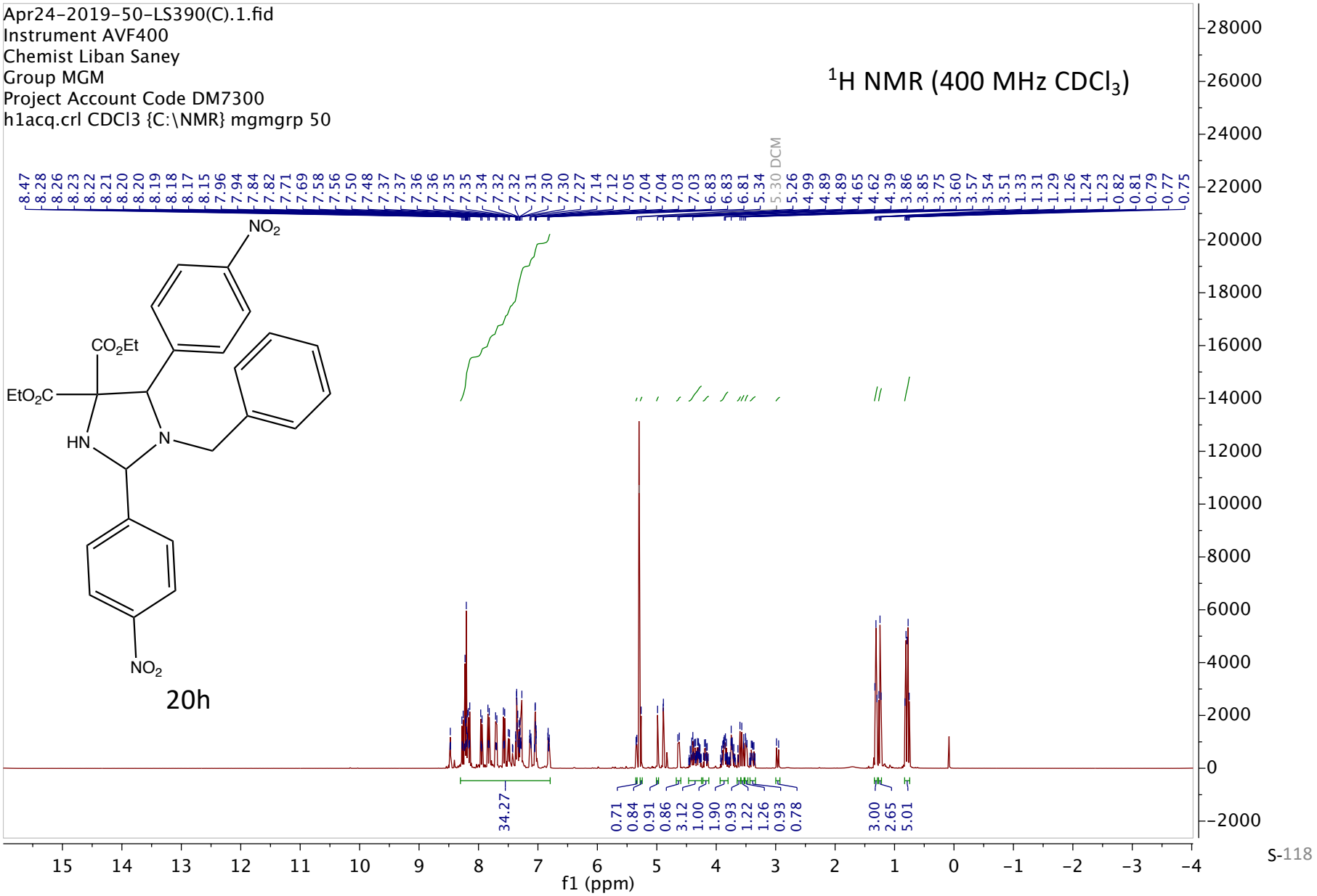

Apr02-2019-58-LS364(P) B7-D1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 58
^{13}C NMR (101 MHz $CDCl_3$)
191.11
170.56
169.89
169.47
168.51
160.70
140.02
137.97
137.79
137.18
135.20
135.17
134.69
134.26
132.55
131.92
131.82
131.41
131.36
131.07
130.60
130.38
129.98
129.86
129.77
128.63
128.40
128.15
128.09
128.00
127.25
127.18
127.16
123.03
122.73
122.36
121.82
79.79
78.76
77.16 CDCl3
75.68
75.66
69.46
67.03
65.11
62.57
62.38
62.10
62.03
52.64
49.65
14.24
13.98
13.56
13.40
Br
CO_2Et
EtO_2C
HN
N
Br
20f
f1 (ppm)

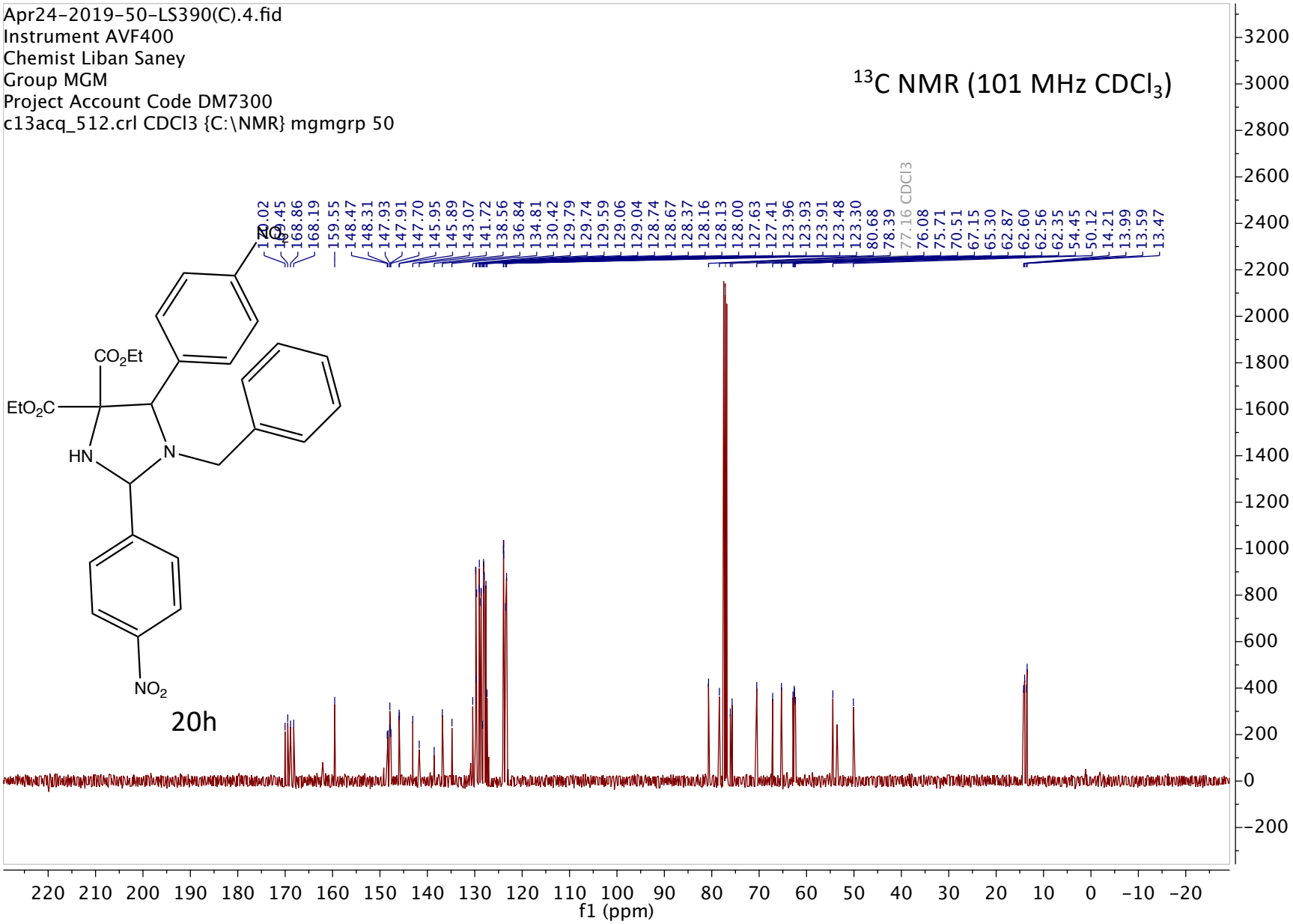

Jan13-2020-1-LS610(P) B11-C8.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CO_2Et
EtO_2C
HN
N
20g
f1 (ppm)

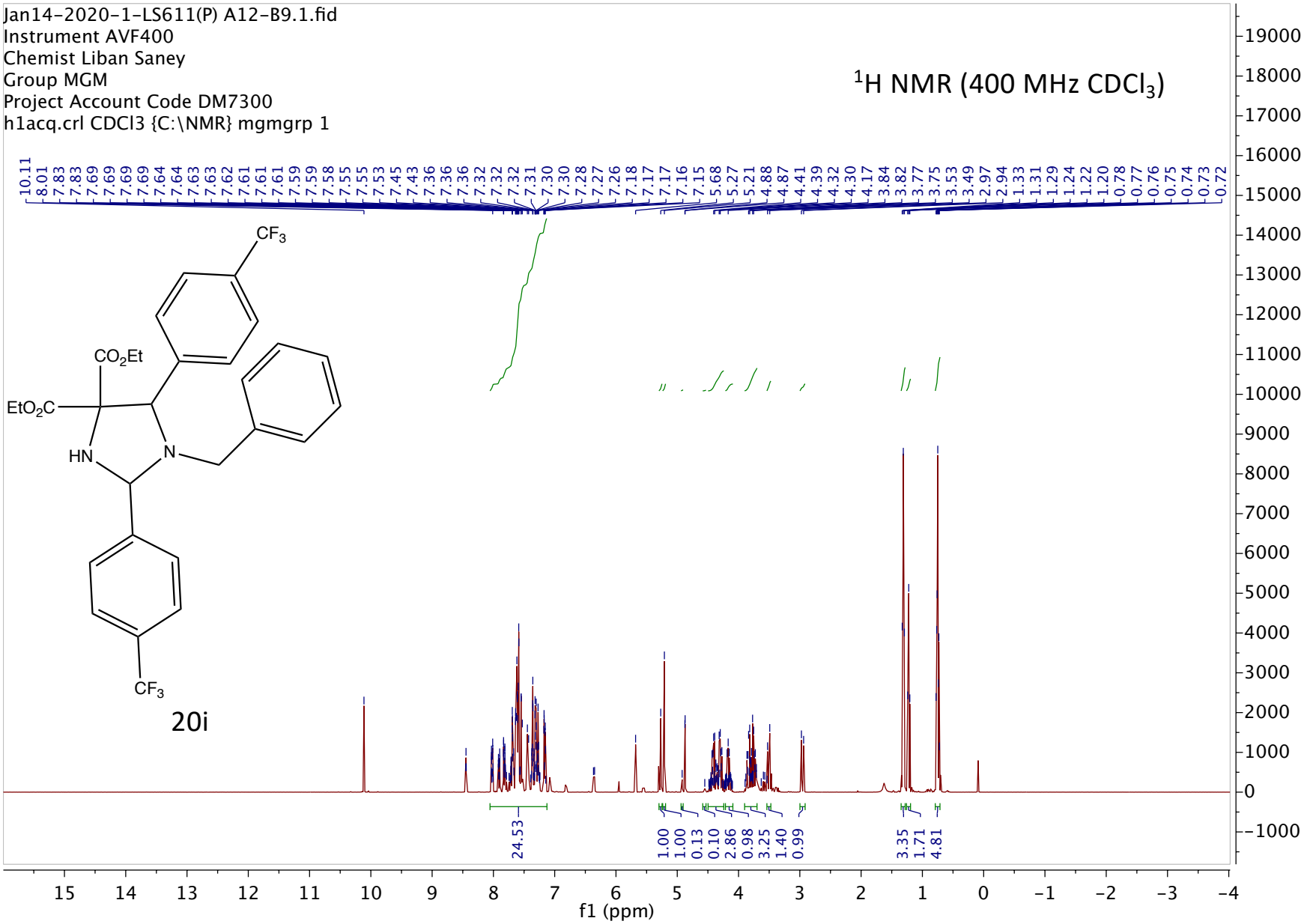

Jan13-2020-1-LS610(P) B11-C8.5.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
170.82 170.37 168.56 168.32 138.67 136.60 135.69 134.94 134.16 134.06 133.81 133.70 133.63 133.21 132.94 132.43 132.06 130.28 129.38 128.84 128.80 128.57 128.50 128.39 128.23 128.16 128.08 127.82 127.11 126.99 126.82 126.50 126.32 126.03 125.86 125.84 125.82 125.68 125.46 125.43 125.20 125.18 124.22 123.88 123.74 123.64 77.16 CDCl3 76.52 76.37 63.80 62.30 62.18 61.61 61.47 61.19 53.29 50.82 14.08 14.01 12.90 12.60
CO_2Et
EtO_2C
HN
N
20g
f1 (ppm)

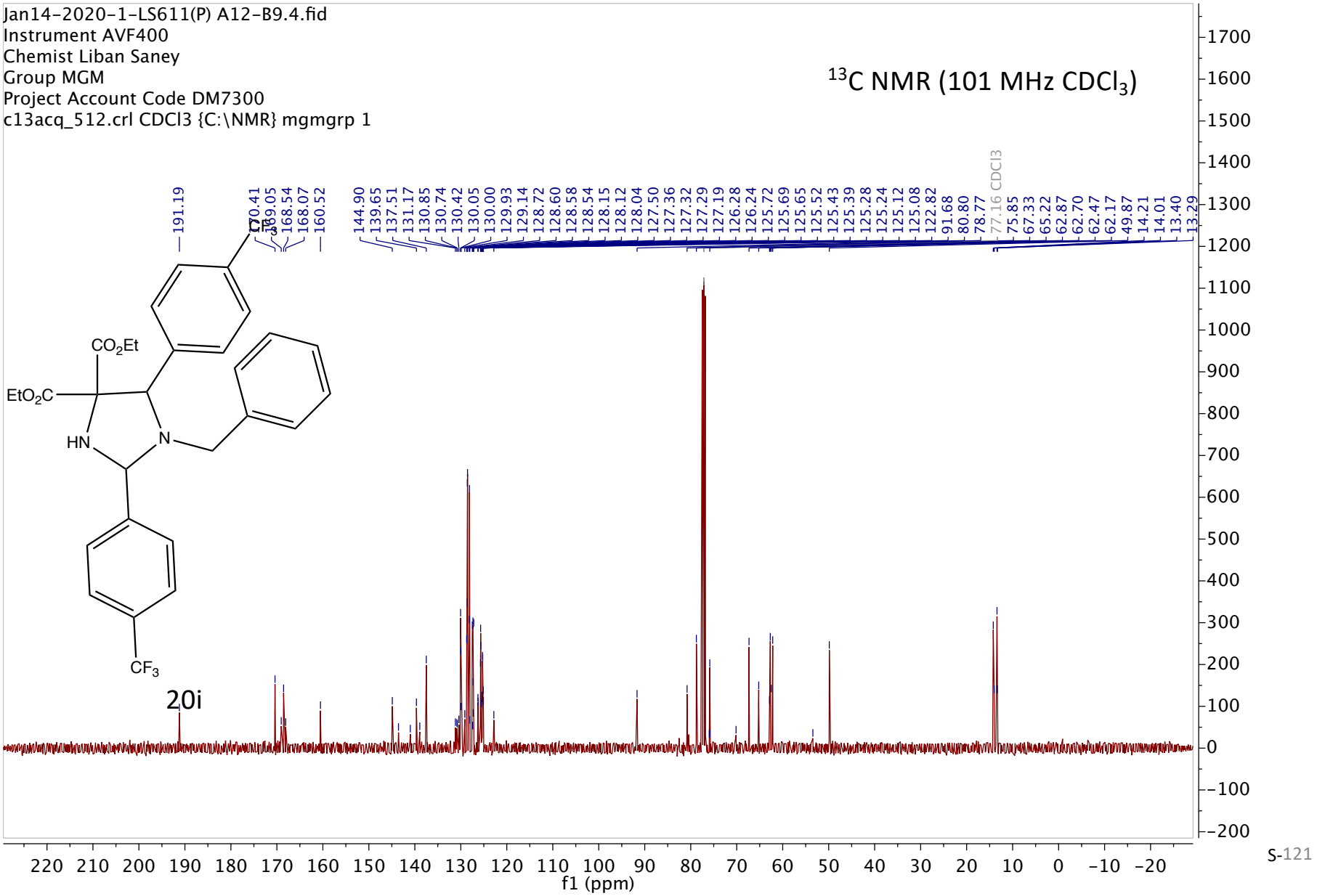

Sep18-2019-59-LS534(P) D8-F6.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
NO_2
CO_2Et
EtO_2C
HN
N
NO_2
20h
f1 (ppm)

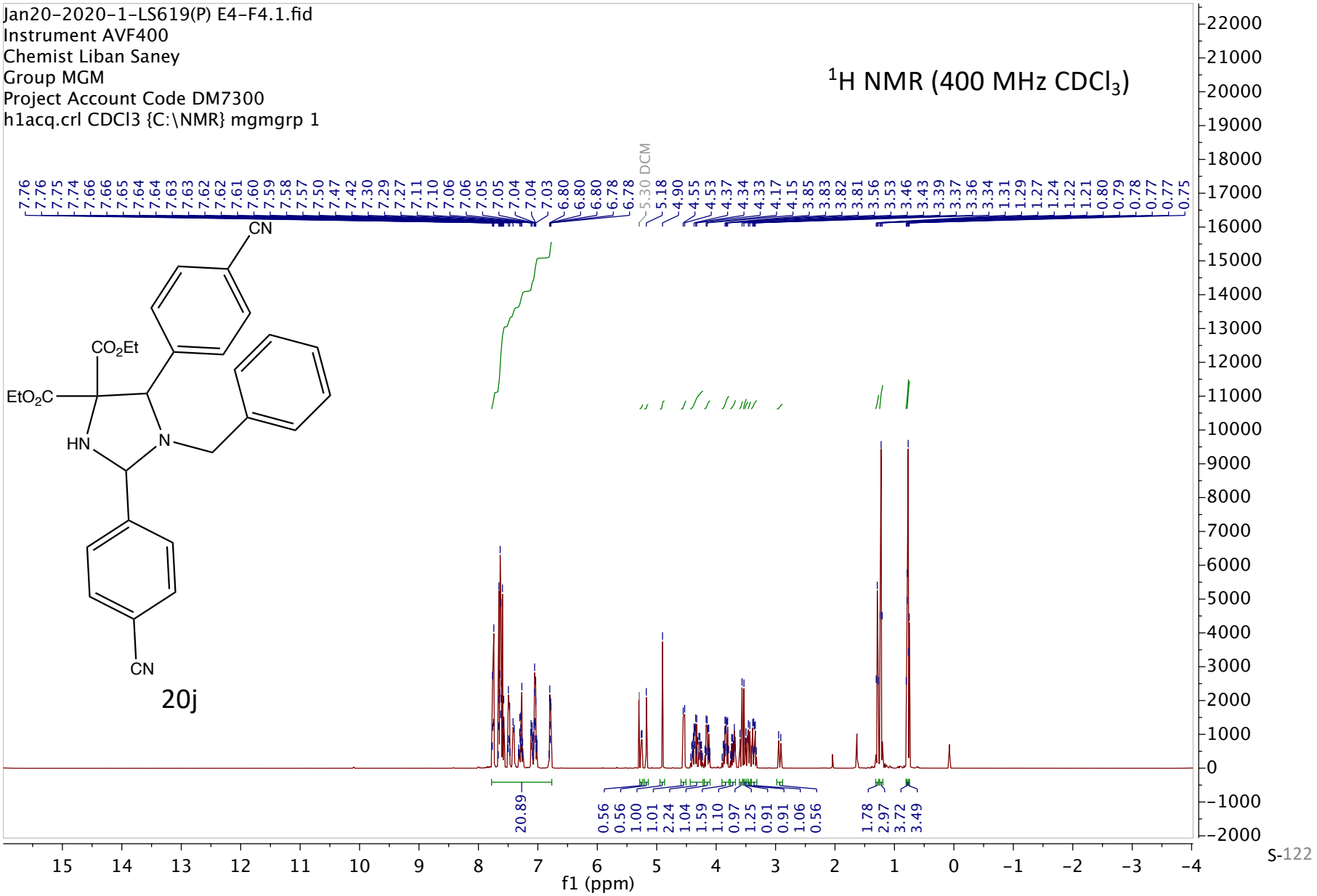

Sep18-2019-59-LS534(P) D8-F6.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
^{13}C NMR (101 MHz $CDCl_3$)
169.46
168.88
148.49
147.72
145.95
145.89
134.82
129.80
129.74
129.60
128.14
127.65
123.94
123.31
80.70
77.16 CDCl3
76.09
70.52
62.62
62.58
54.47
14.00
13.48
NO_2
CO_2Et
EtO_2C
HN
N
NO_2
20h
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

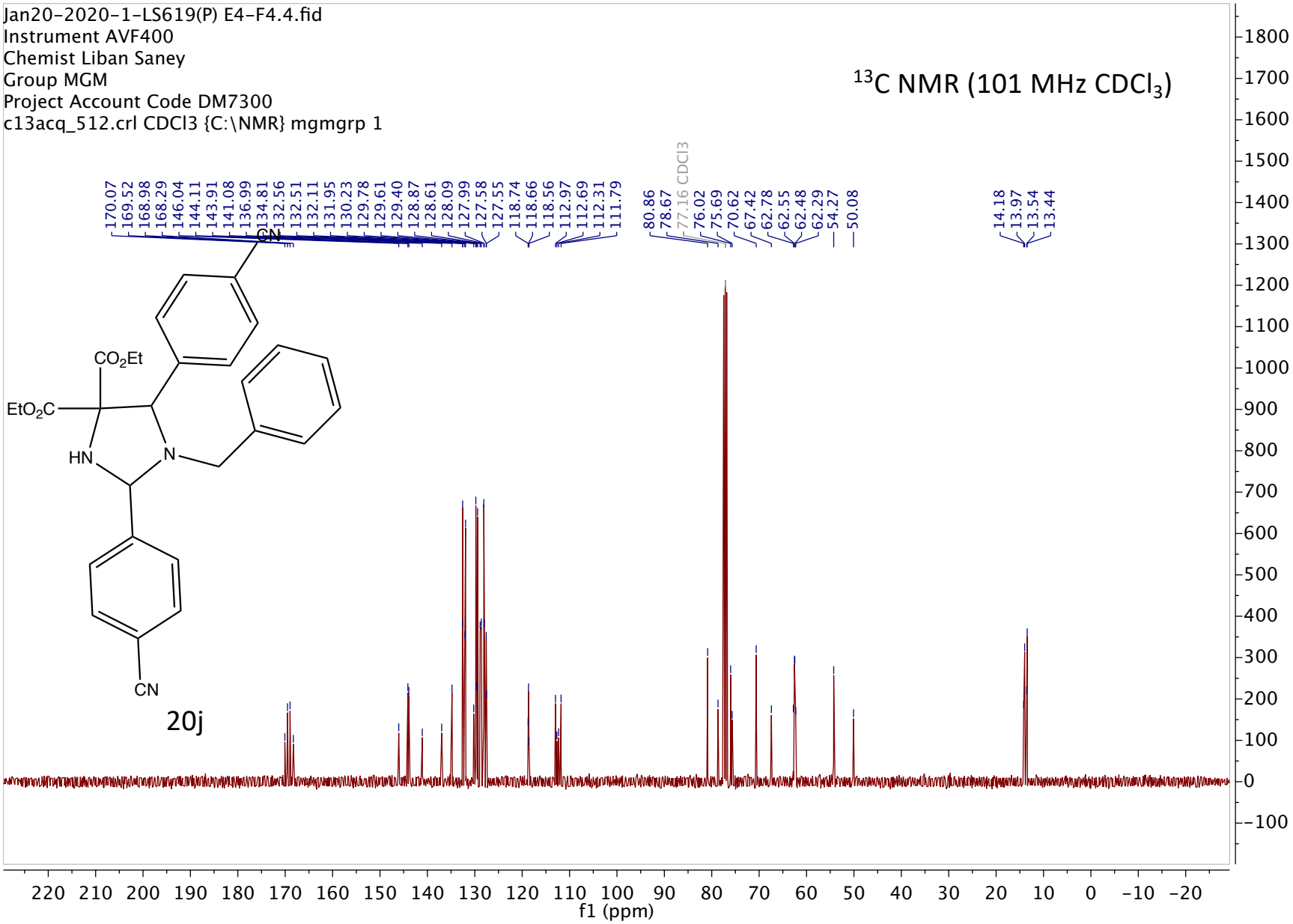

Apr24-2019-50-LS390(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 50
^{1}H NMR (400 MHz $CDCl_3$)
DCM
NO_2
CO_2Et
EtO_2C
HN
N
NO_2
20h
34.27
0.71
0.84
0.91
0.86
3.12
1.00
1.90
0.93
1.22
1.26
0.93
0.78
3.00
2.65
5.01
f1 (ppm)

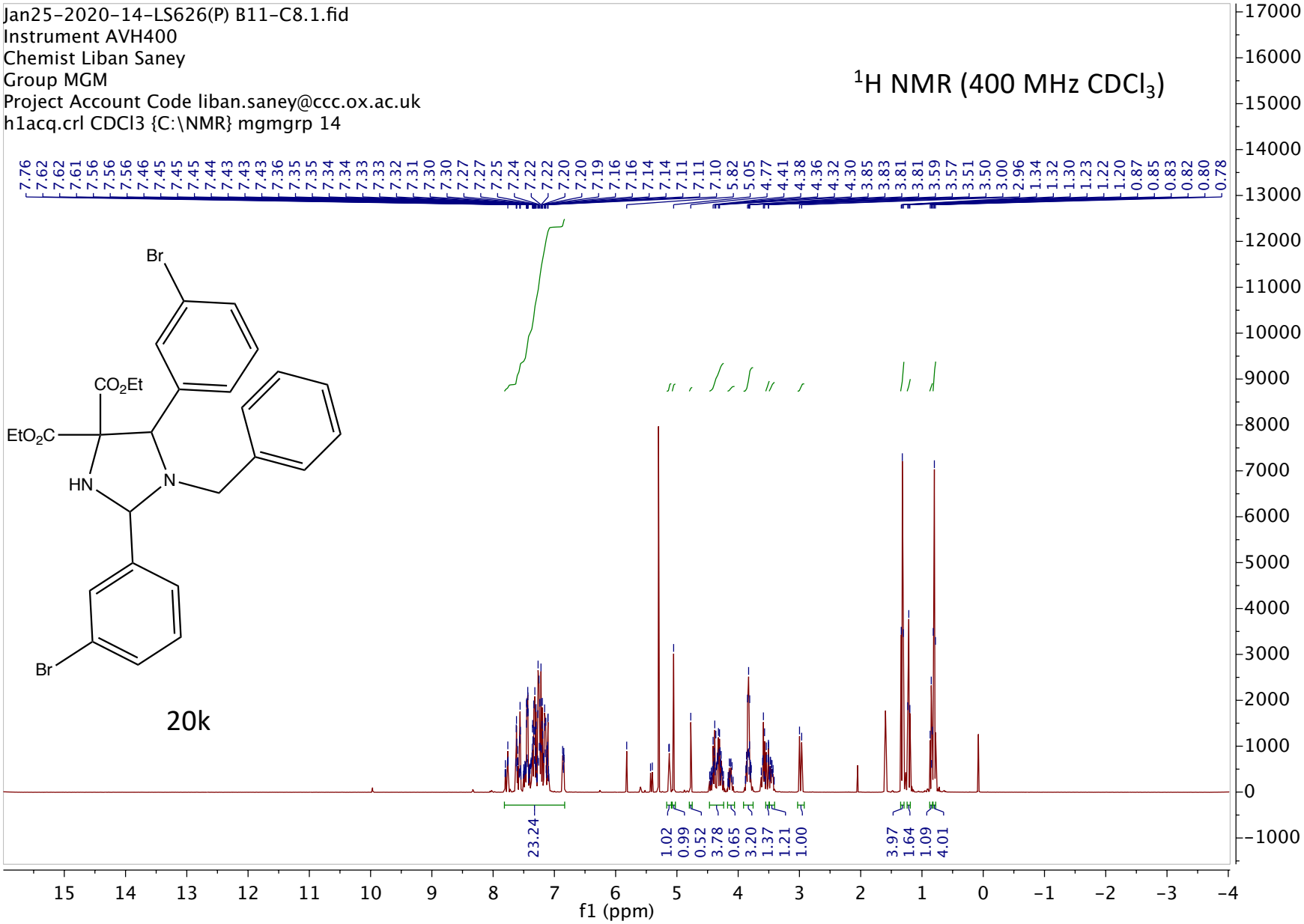

Apr24-2019-50-LS390(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 50
^{13}C NMR (101 MHz $CDCl_3$)
170.02
169.45
168.86
168.19
159.55
148.47
148.31
147.93
147.91
147.70
145.95
145.89
143.07
141.72
138.56
136.84
134.81
130.42
129.79
129.74
129.59
129.06
129.04
128.74
128.67
128.37
128.16
128.13
128.00
127.63
127.41
123.96
123.93
123.91
123.48
123.30
80.68
78.39
77.16 CDCl3
76.08
75.71
70.51
67.15
65.30
62.87
62.60
62.56
62.35
54.45
50.12
14.21
13.99
13.59
13.47
CO_2Et
EtO_2C
HN
N
NO_2
20h
f1 (ppm)

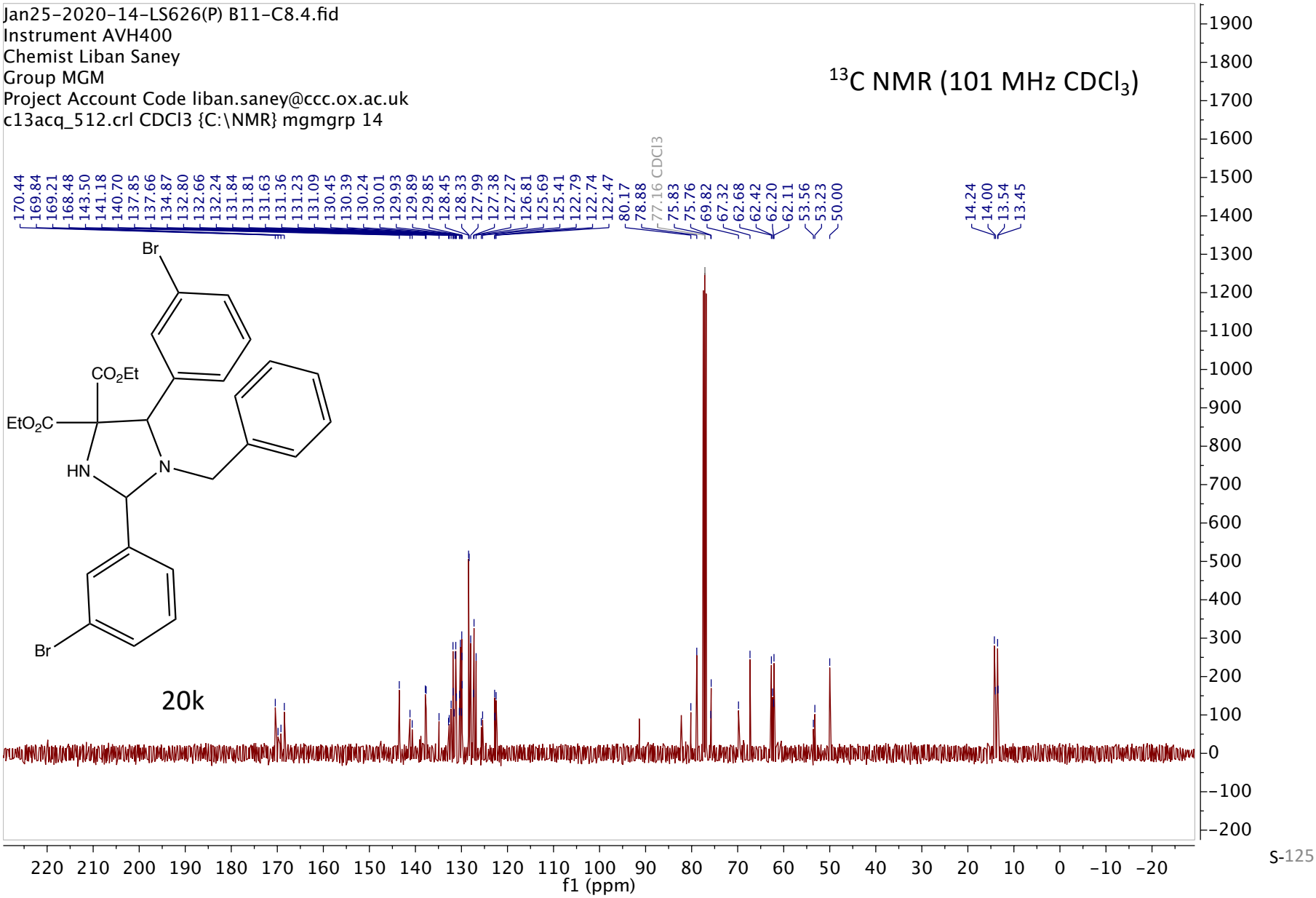

Jan14-2020-1-LS611(P) A12-B9.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CF_3
CO_2Et
EtO_2C
HN
N
CF_3
20i
f1 (ppm)

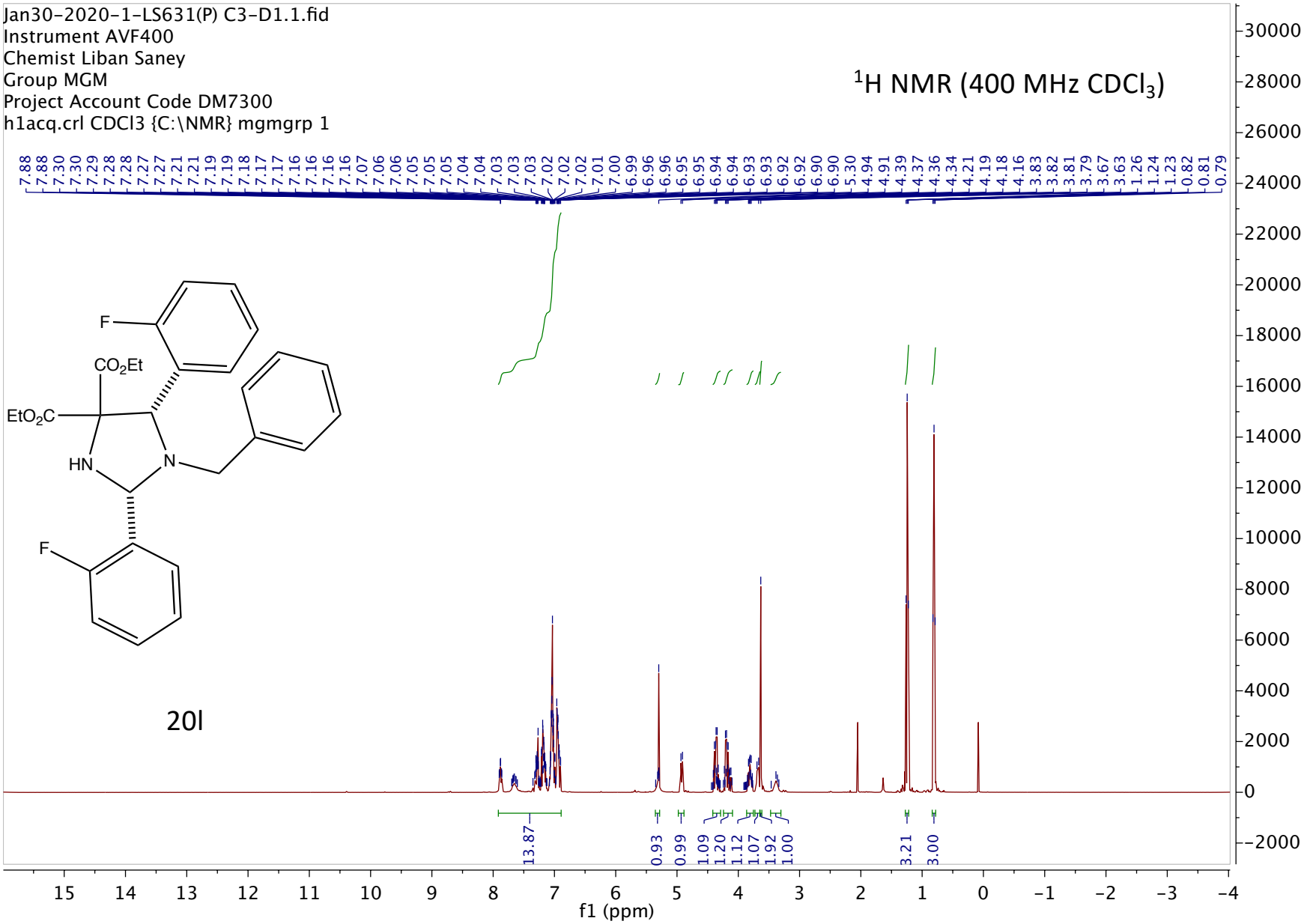

Jan14-2020-1-LS611(P) A12-B9.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
191.19
170.41
169.05
168.54
168.07
160.52
144.90
139.65
137.51
131.17
130.85
130.74
130.42
130.05
130.00
129.93
129.14
128.72
128.60
128.58
128.54
128.15
128.12
128.04
127.50
127.36
127.32
127.29
127.19
126.28
126.24
125.72
125.69
125.65
125.52
125.43
125.39
125.28
125.24
125.12
125.08
122.82
91.68
80.80
78.77
77.16 CDCl3
75.85
67.33
65.22
62.87
62.70
62.47
62.17
49.87
14.21
14.01
13.40
13.29
CO_2Et
EtO_2C
HN
N
CF_3
20i
f1 (ppm)

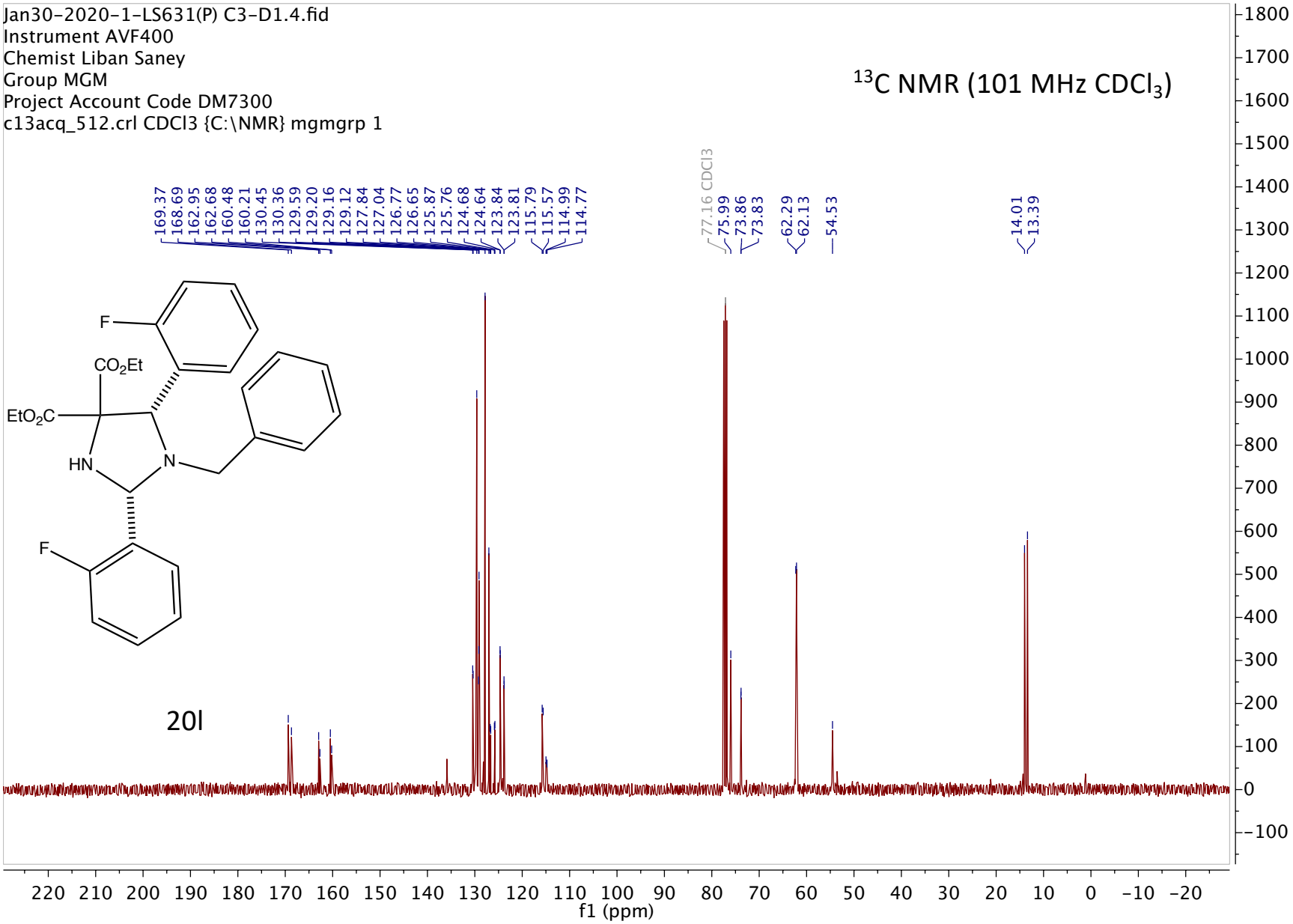

Jan20-2020-1-LS619(P) E4-F4.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
DCM
CN
CO_2Et
EtO_2C
HN
N
CN
20j
f1 (ppm)

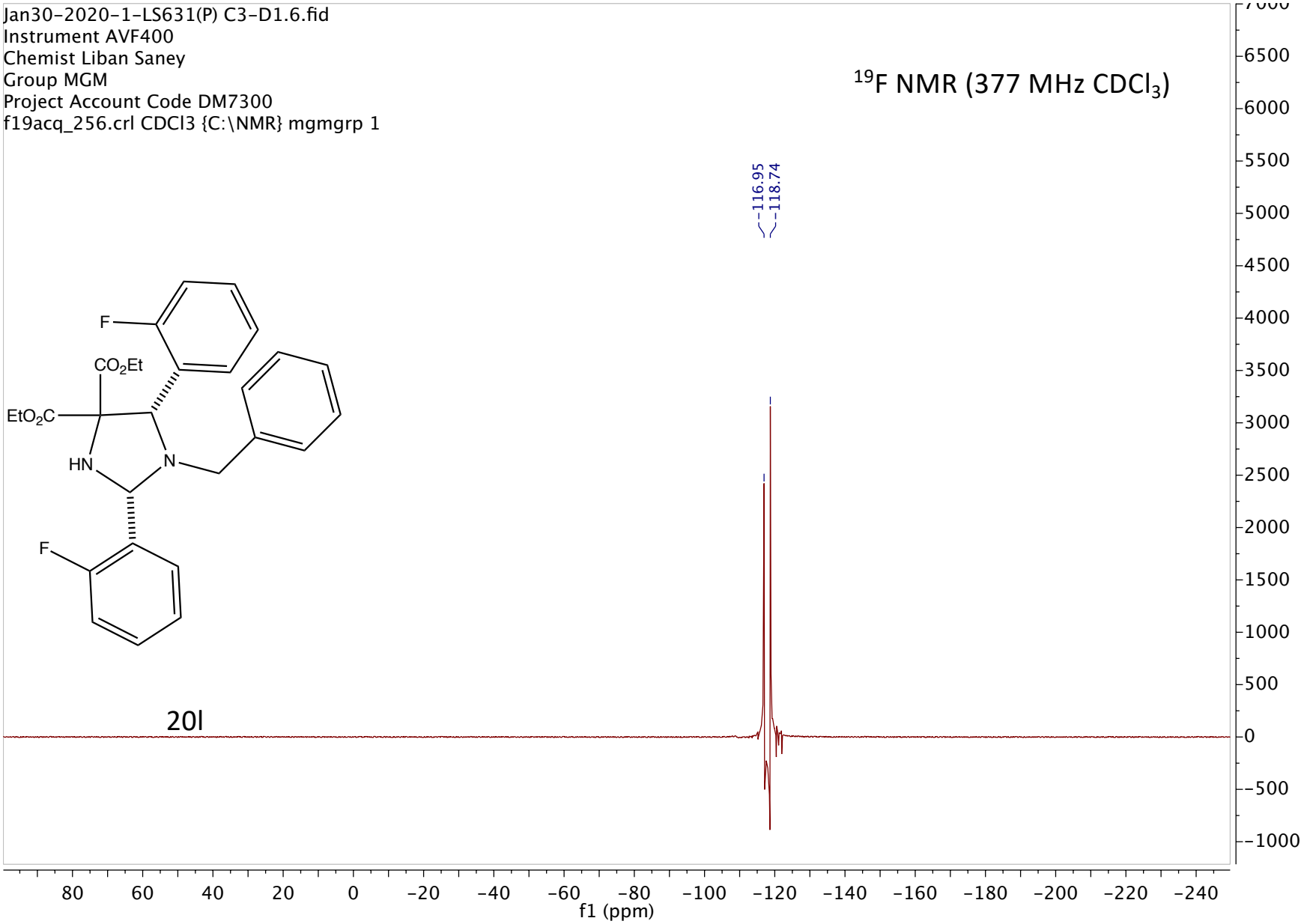

Jan20-2020-1-LS619(P) E4-F4.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
170.07
169.52
168.98
168.29
146.04
144.11
143.91
141.08
136.99
134.81
132.56
132.51
132.11
131.95
130.23
129.78
129.61
129.40
128.87
128.61
128.09
127.99
127.58
127.55
118.74
118.66
118.56
112.97
112.69
112.31
111.79
80.86
78.67
77.16 CDCl3
76.02
75.69
70.62
67.42
62.78
62.55
62.48
62.29
54.27
50.08
14.18
13.97
13.54
13.44
CN
CO_2Et
EtO_2C
HN
N
CN
20j
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

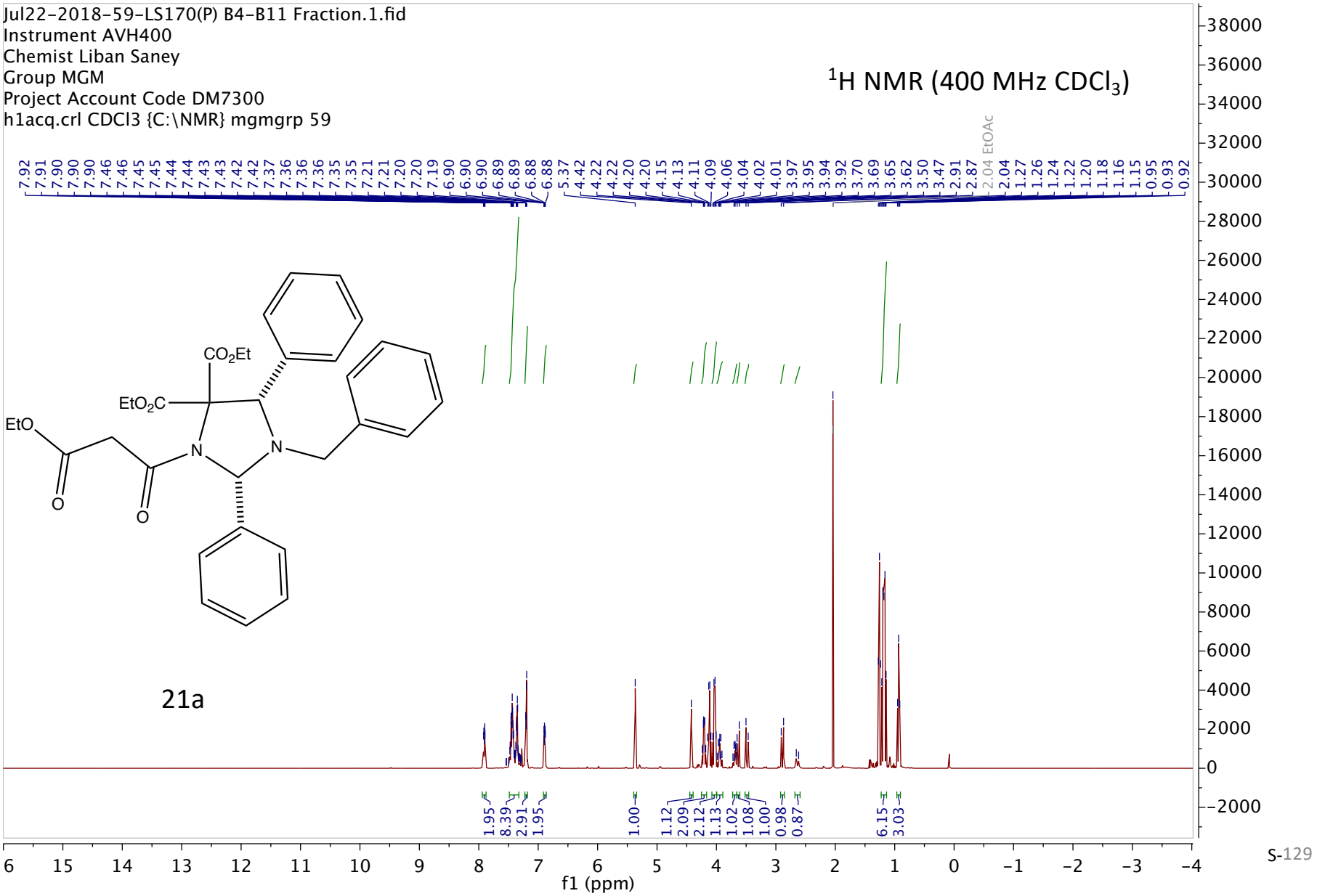

Jan25-2020-14-LS626(P) B11-C8.1.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code liban.saney@ccc.ox.ac.uk
h1acq.crl CDCl3 {C:\NMR} mgmgrp 14
^{1}H NMR (400 MHz $CDCl_3$)
Br
CO_2Et
EtO_2C
HN
N
Br
20k
f1 (ppm)

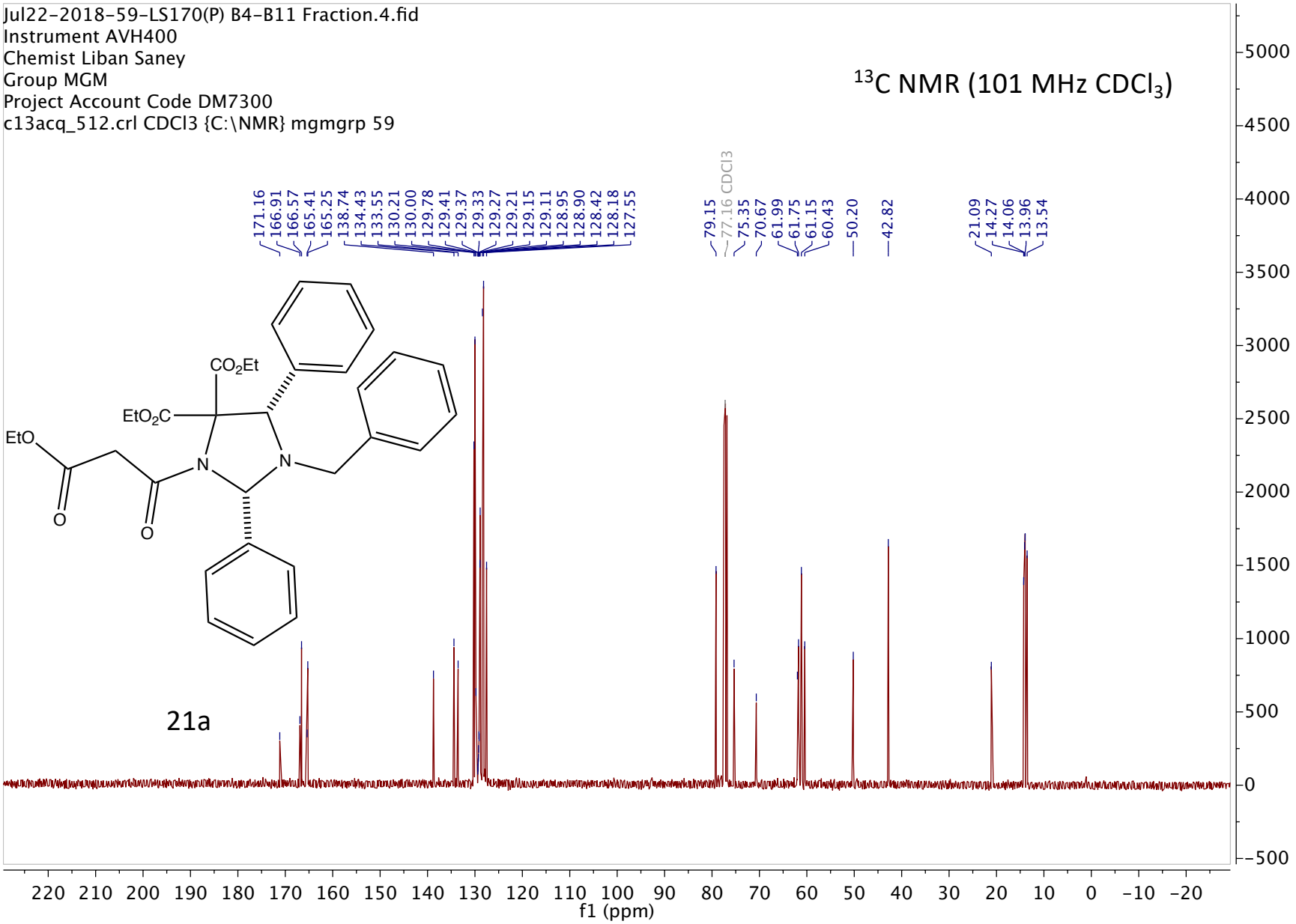

Jan25-2020-14-LS626(P) B11-C8.4.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code liban.saney@ccc.ox.ac.uk
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 14
^{13}C NMR (101 MHz $CDCl_3$)
170.44 169.84 169.21 168.48 143.50 141.18 140.70 137.85 137.66 134.87 132.80 132.66 132.24 131.84 131.81 131.63 131.36 131.23 131.09 130.45 130.39 130.24 130.01 129.93 129.89 129.85 128.45 128.33 127.99 127.38 127.27 126.81 125.69 125.41 122.79 122.74 122.47 80.17 78.88 77.16 CDCl3 75.83 75.76 69.82 67.32 62.68 62.42 62.20 62.11 53.56 53.23 50.00 14.24 14.00 13.54 13.45
Br
CO_2Et
EtO_2C
HN
N
Br
20k
f1 (ppm)

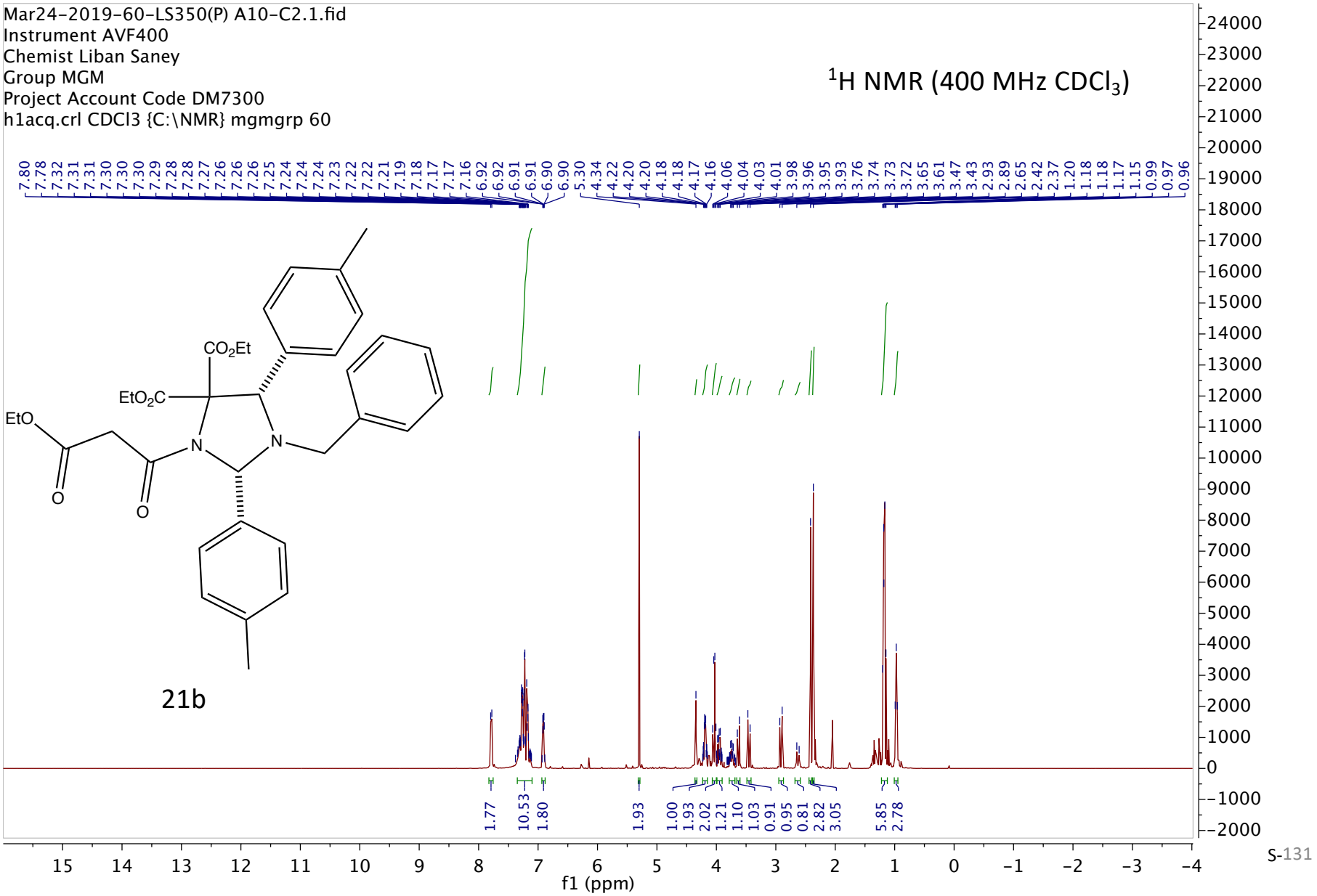

Jan30-2020-1-LS631(P) C3-D1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
F
CO_2Et
EtO_2C
HN
N
F
20l
13.87
0.93
0.99
1.09
1.20
1.12
1.07
1.92
1.00
3.21
3.00
f1 (ppm)

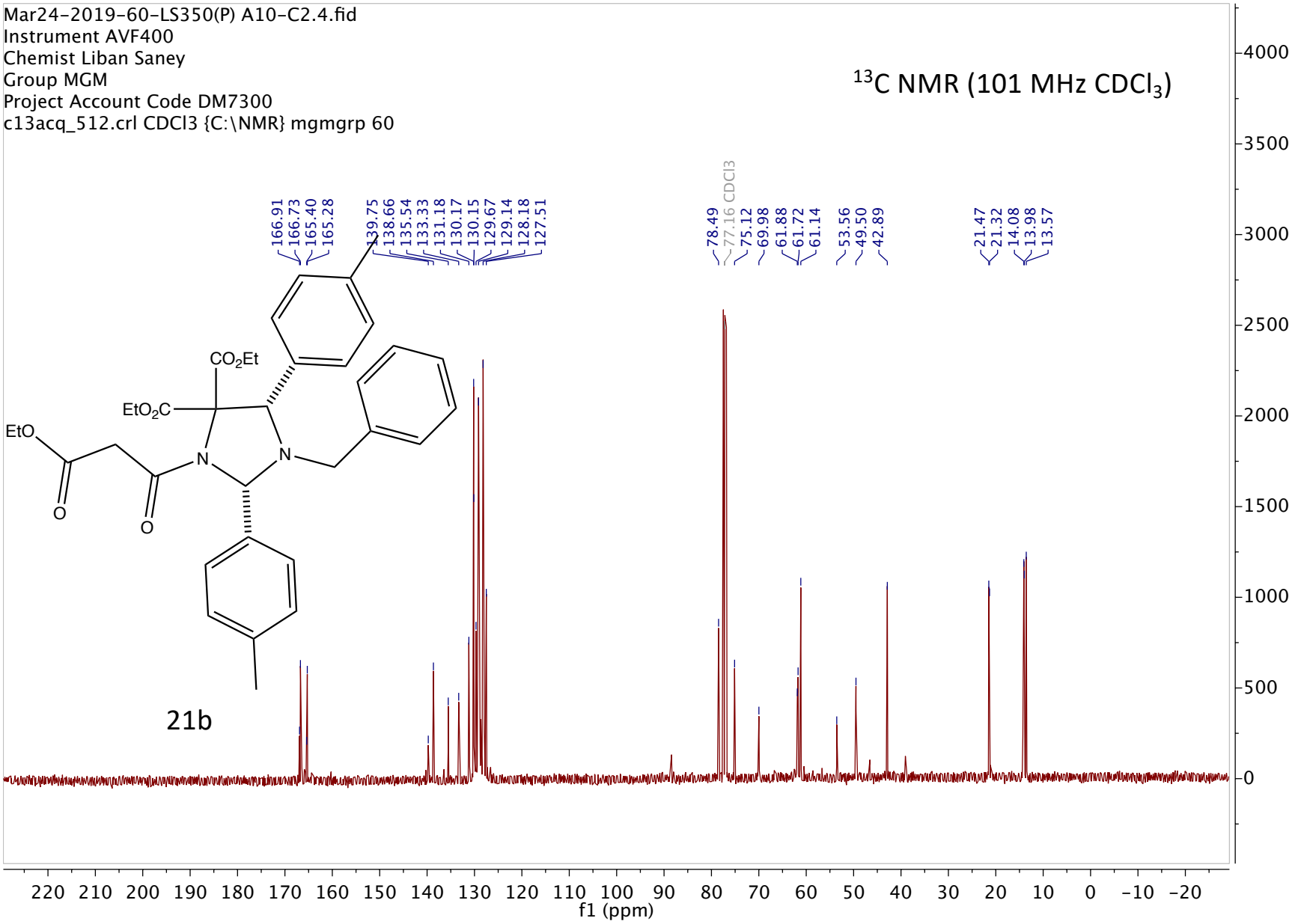

Jan30-2020-1-LS631(P) C3-D1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
169.37
168.69
162.95
162.68
160.48
160.21
130.45
130.36
129.59
129.20
129.16
129.12
127.84
127.04
126.77
126.65
125.87
125.76
124.68
124.64
123.84
123.81
115.79
115.57
114.99
114.77
77.16 CDCl3
75.99
73.86
73.83
62.29
62.13
54.53
14.01
13.39
F
CO2Et
EtO2C
HN
N
F
20l
f1 (ppm)

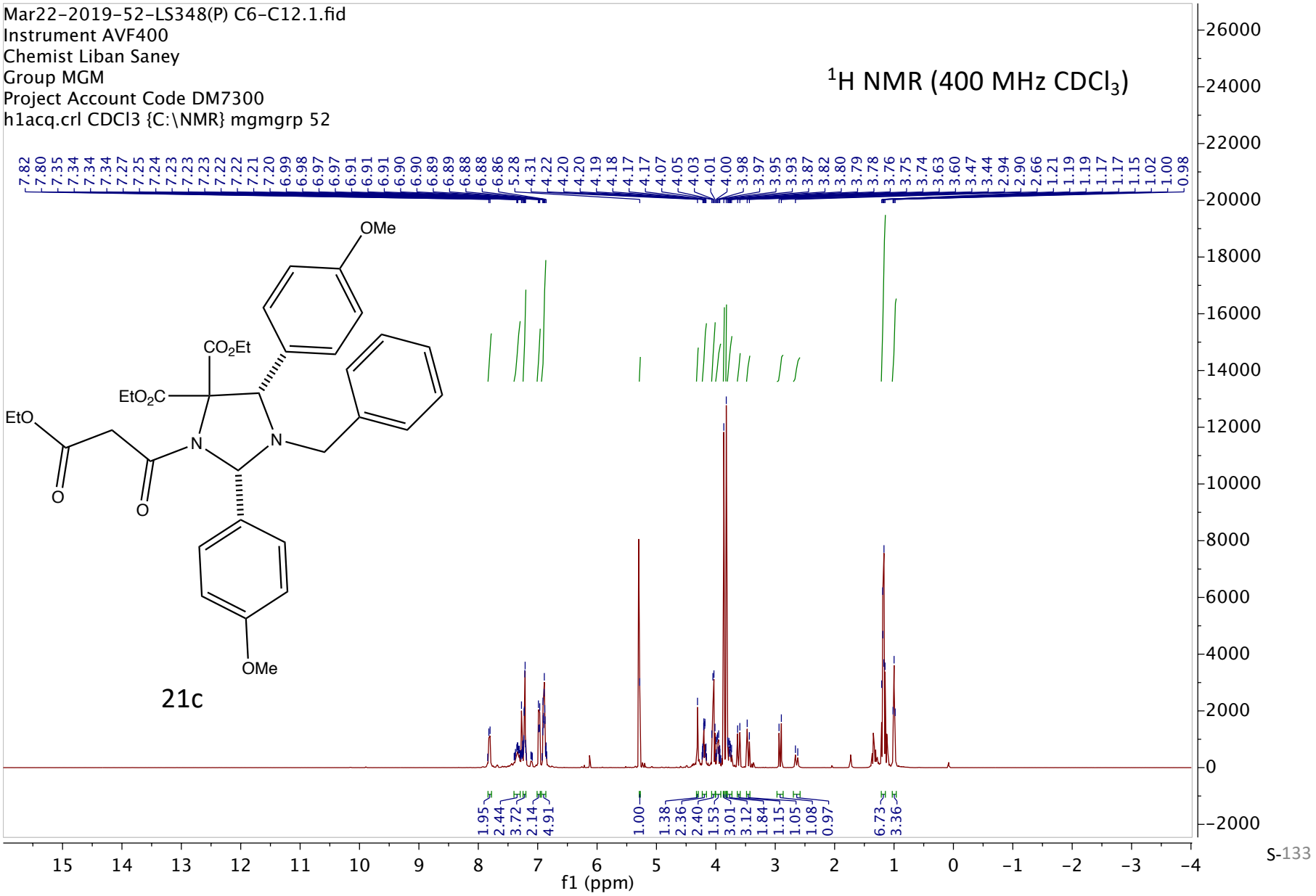

Jan30-2020-1-LS631(P) C3-D1.6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq_256.crl CDCl3 {C:\NMR} mgmgrp 1
19F NMR (377 MHz CDCl3)
-116.95
-118.74
F
CO2Et
EtO2C
HN
N
F
20l
f1 (ppm)

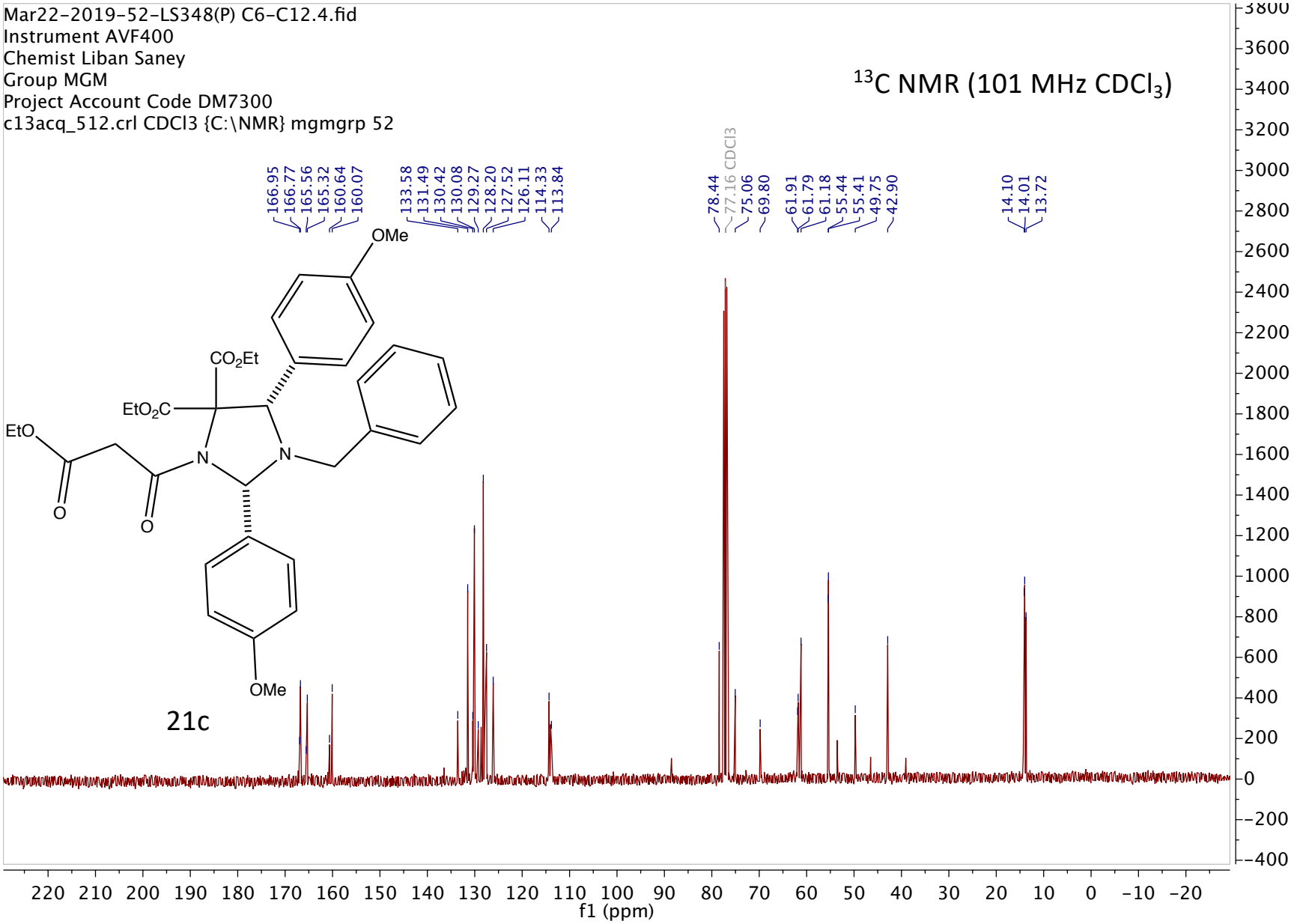

Jul22-2018-59-LS170(P) B4-B11 Fraction.1.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
EtOAc
CO_2Et
EtO_2C
EtO
N
N
O
O
21a
f1 (ppm)

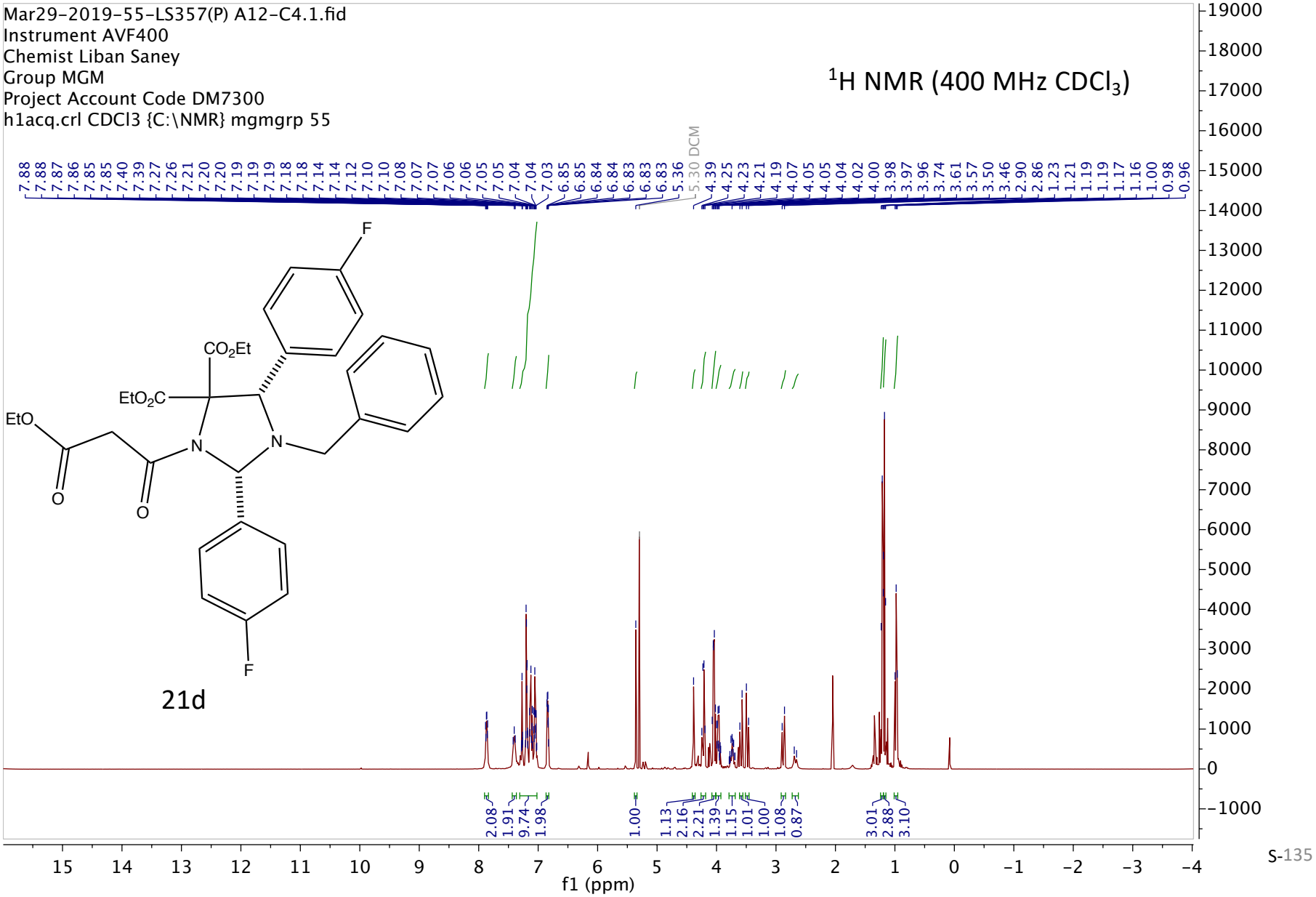

Jul22-2018-59-LS170(P) B4-B11 Fraction.4.fid
Instrument AVH400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
^{13}C NMR (101 MHz $CDCl_3$)
171.16
166.91
166.57
165.41
165.25
138.74
134.43
133.55
130.21
130.00
129.78
129.41
129.37
129.33
129.27
129.21
129.15
129.11
128.95
128.90
128.42
128.18
127.55
79.15
77.16 CDCl3
75.35
70.67
61.99
61.75
61.15
60.43
50.20
42.82
21.09
14.27
14.06
13.96
13.54
CO_2Et
EtO_2C
EtO
N
N
O
O
21a
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

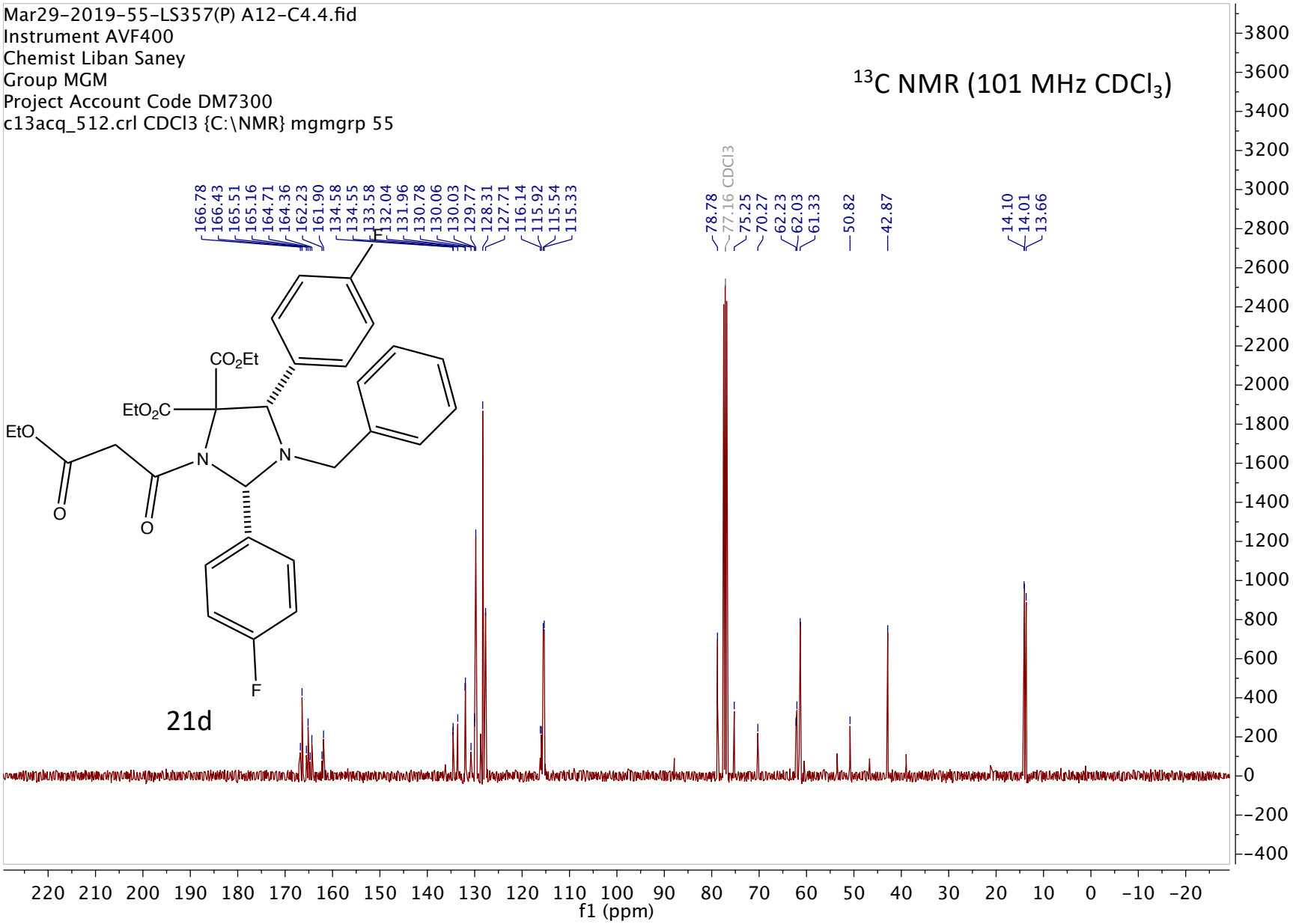

Mar24-2019-60-LS350(P) A10-C2.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
21b
f1 (ppm)

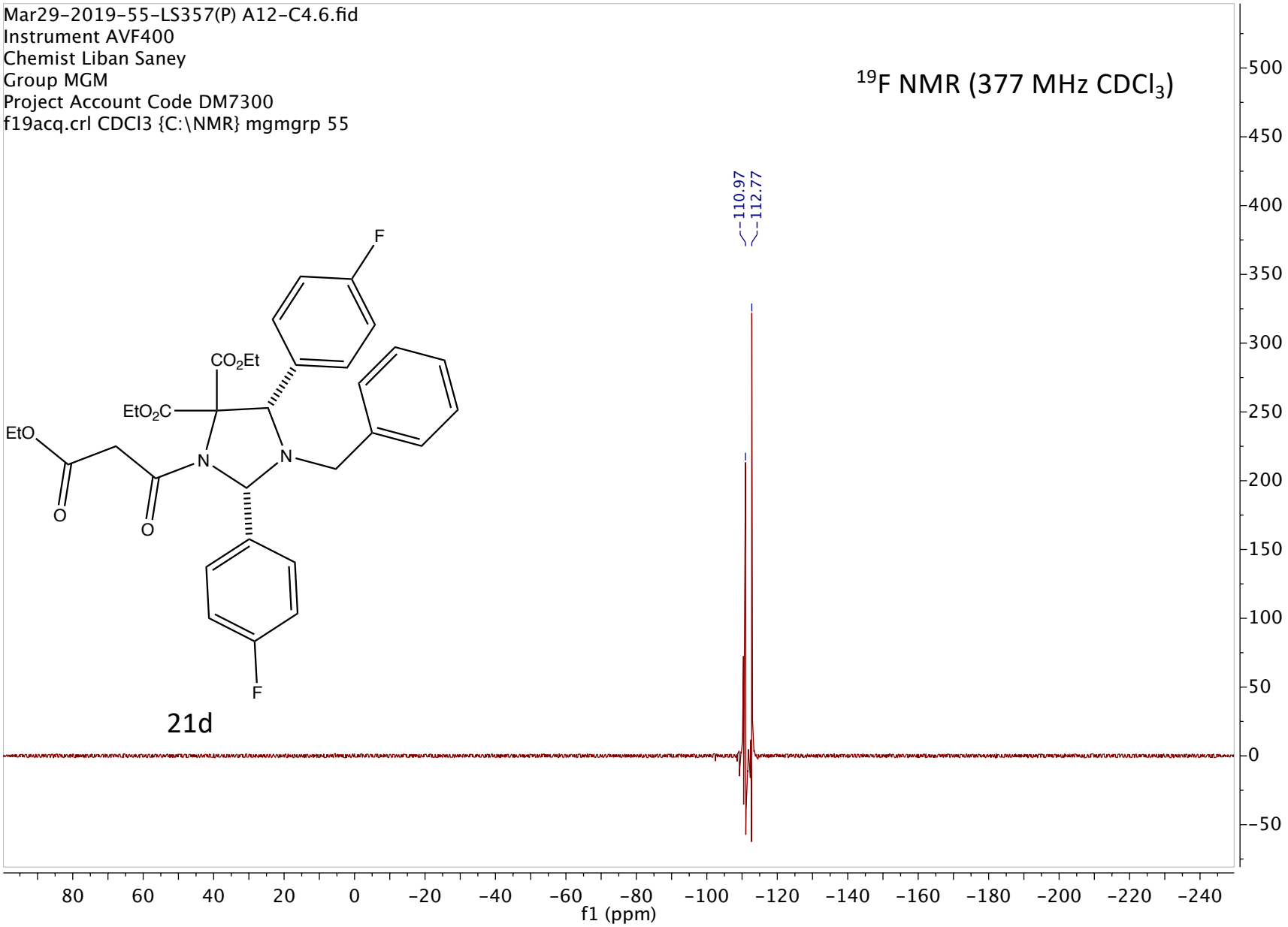

Mar24-2019-60-LS350(P) A10-C2.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
166.91
166.73
165.40
165.28
139.75
138.66
135.54
133.33
131.18
130.17
130.15
129.67
129.14
128.18
127.51
78.49
77.16 CDCl3
75.12
69.98
61.88
61.72
61.14
53.56
49.50
42.89
21.47
21.32
14.08
13.98
13.57
CO_2Et
EtO_2C
EtO
O
O
N
N
21b
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

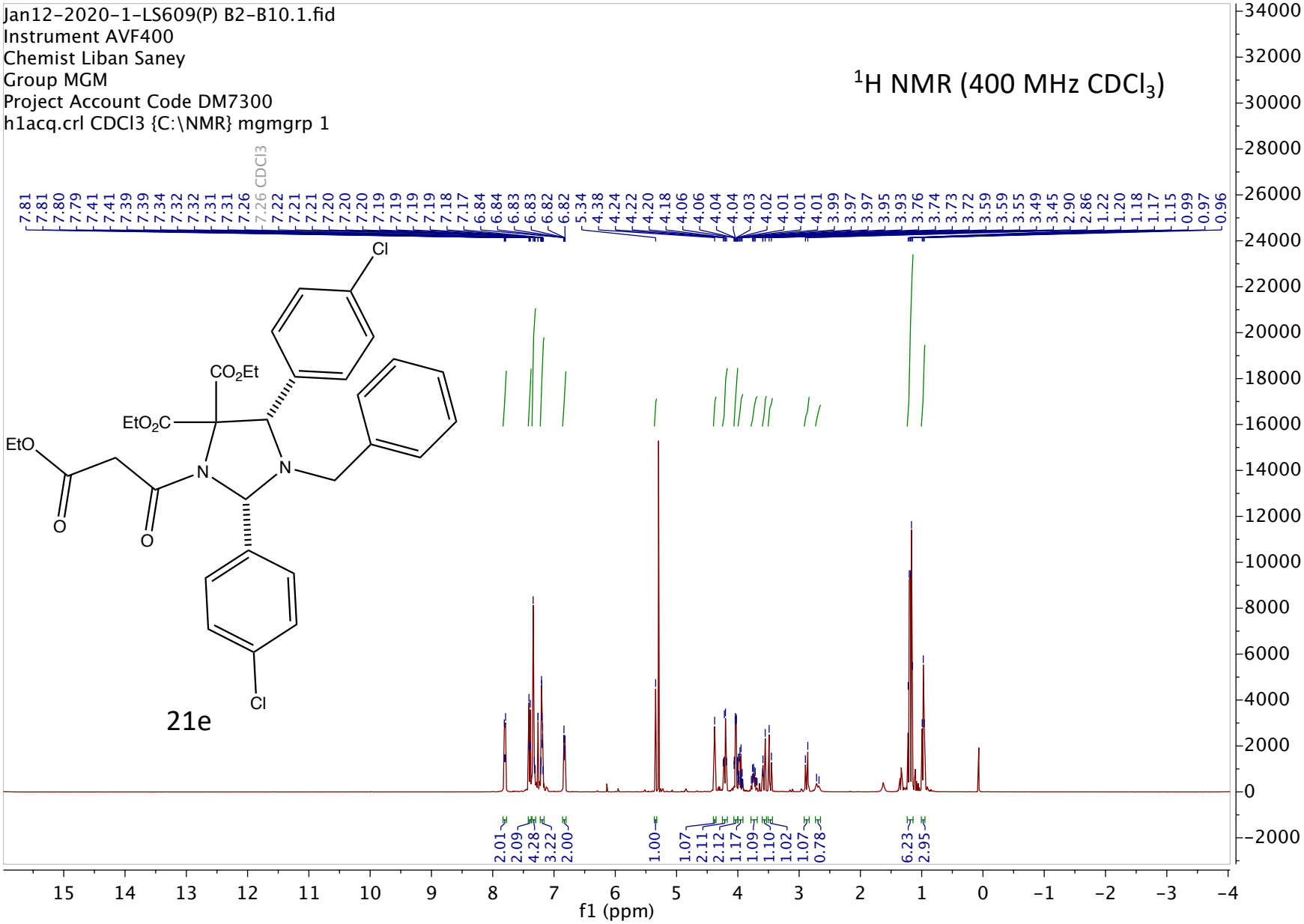

Mar22-2019-52-LS348(P) C6-C12.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 52
1H NMR (400 MHz CDCl3)
OMe
CO2Et
EtO2C
EtO
N
N
O
O
OMe
21c
f1 (ppm)

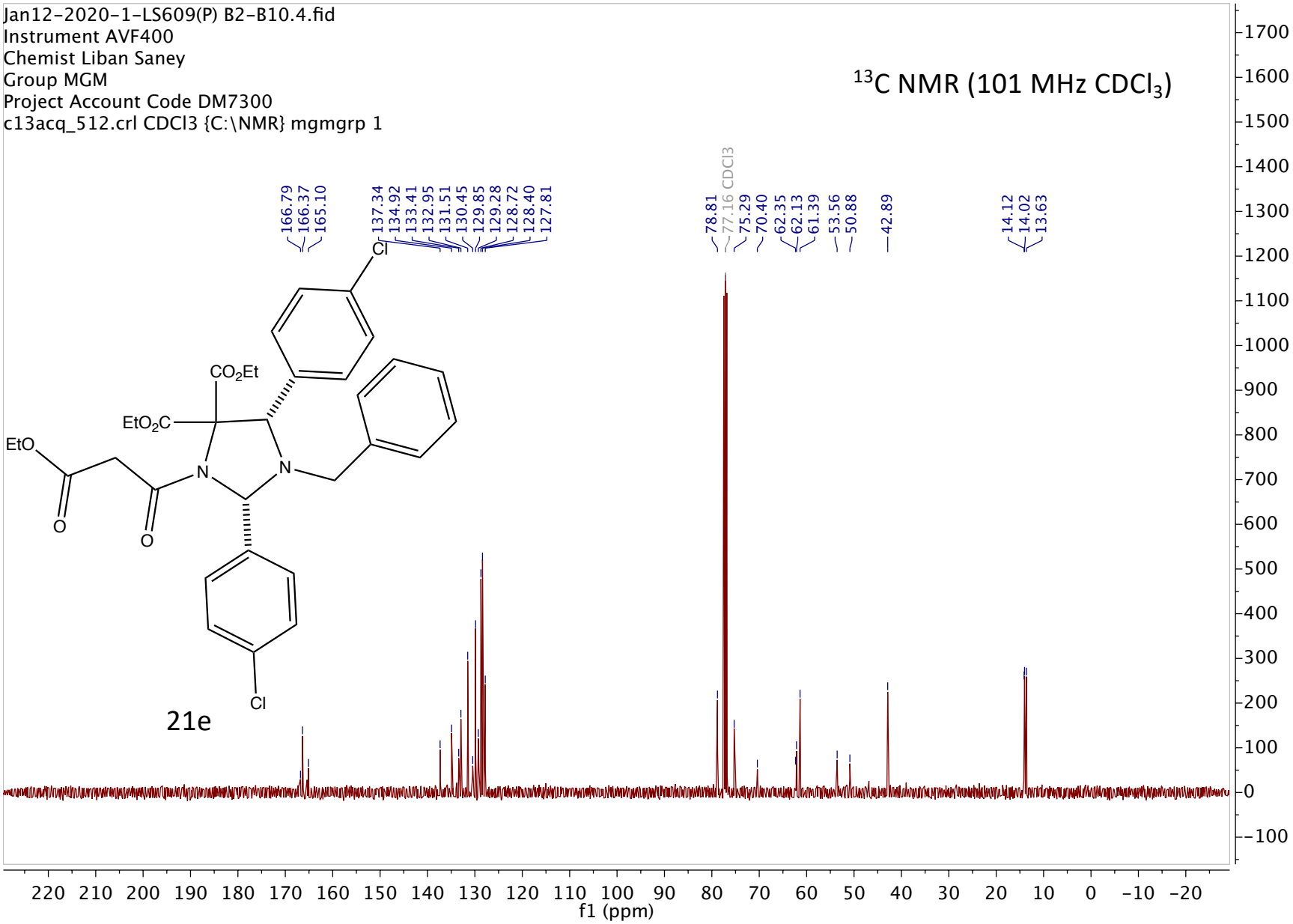

Mar22-2019-52-LS348(P) C6-C12.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 52
13C NMR (101 MHz CDCl3)
166.95
166.77
165.56
165.32
160.64
160.07
133.58
131.49
130.42
130.08
129.27
128.20
127.52
126.11
114.33
113.84
78.44
77.16 CDCl3
75.06
69.80
61.91
61.79
61.18
55.44
55.41
49.75
42.90
14.10
14.01
13.72
OMe
CO2Et
EtO2C
EtO
N
N
O
O
OMe
21c
f1 (ppm)

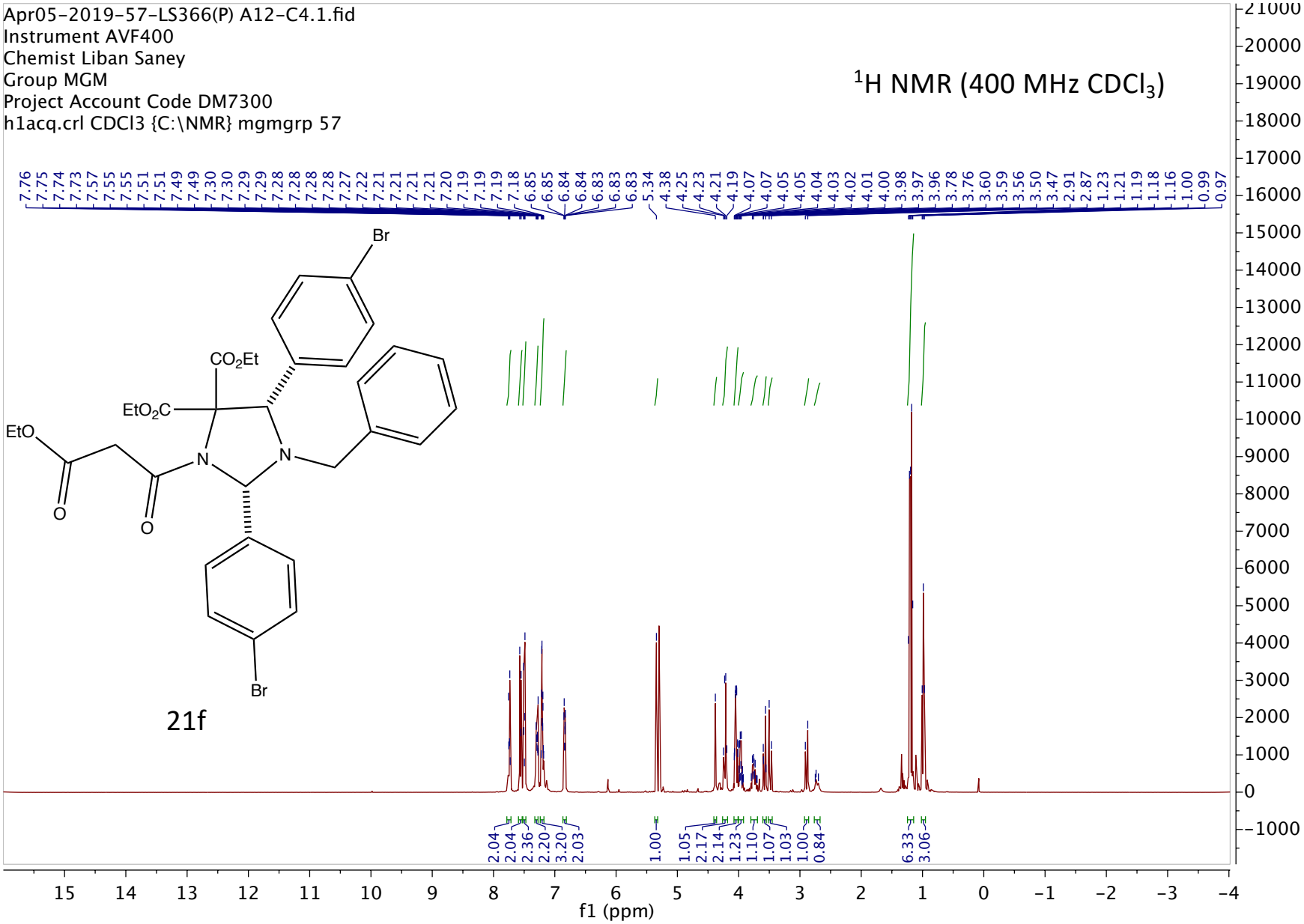

Mar29-2019-55-LS357(P) A12-C4.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 55
^{1}H NMR (400 MHz $CDCl_3$)
21d
f1 (ppm)

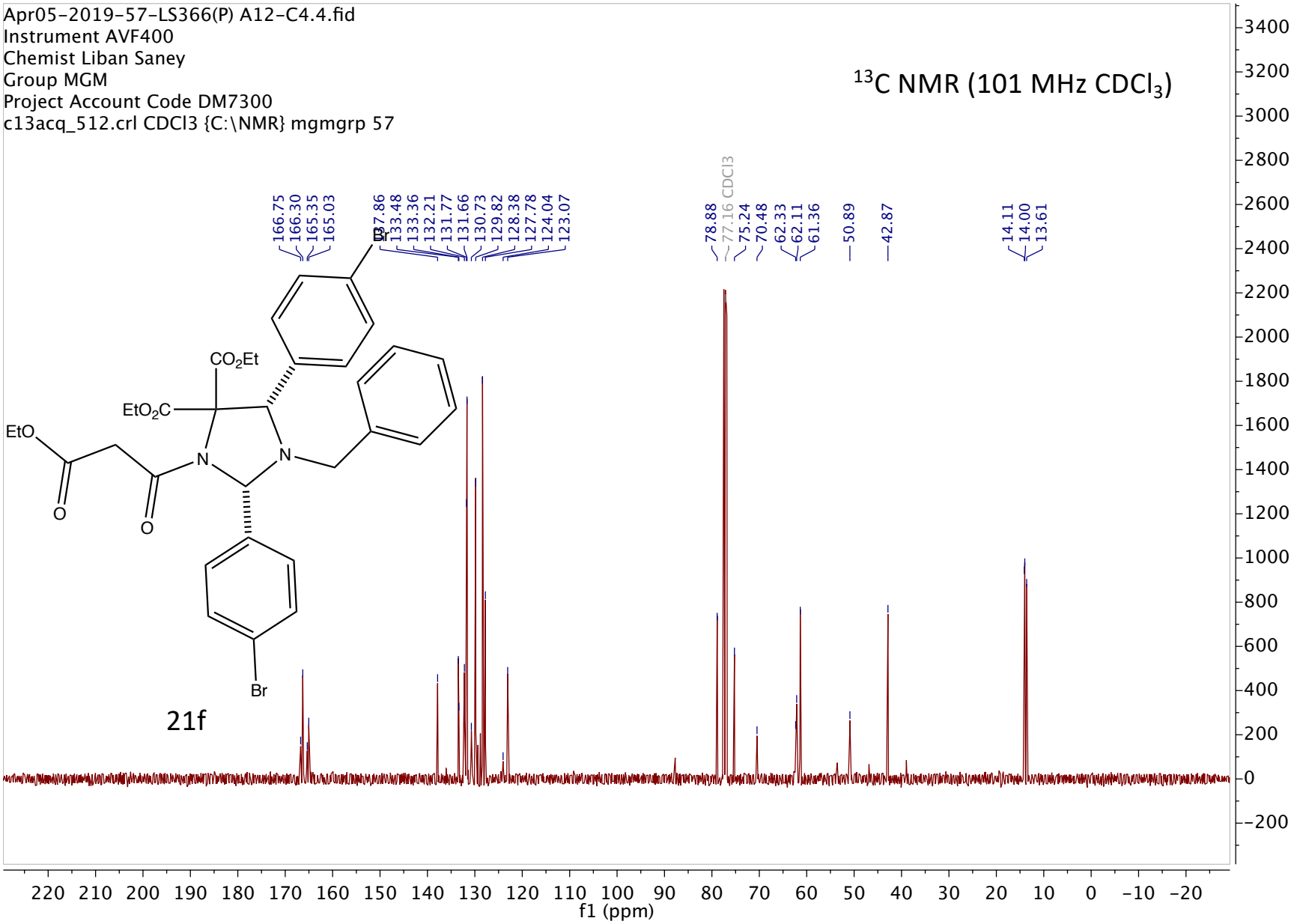

Mar29-2019-55-LS357(P) A12-C4.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 55
^{13}C NMR (101 MHz $CDCl_3$)
166.78
166.43
165.51
165.16
164.71
164.36
162.23
161.90
134.58
134.55
133.58
132.04
131.96
130.78
130.06
130.03
129.77
128.31
127.71
116.14
115.92
115.54
115.33
78.78
77.16 CDCl3
75.25
70.27
62.23
62.03
61.33
50.82
42.87
14.10
14.01
13.66
CO_2Et
EtO_2C
EtO
N
N
O
O
F
21d
f1 (ppm)

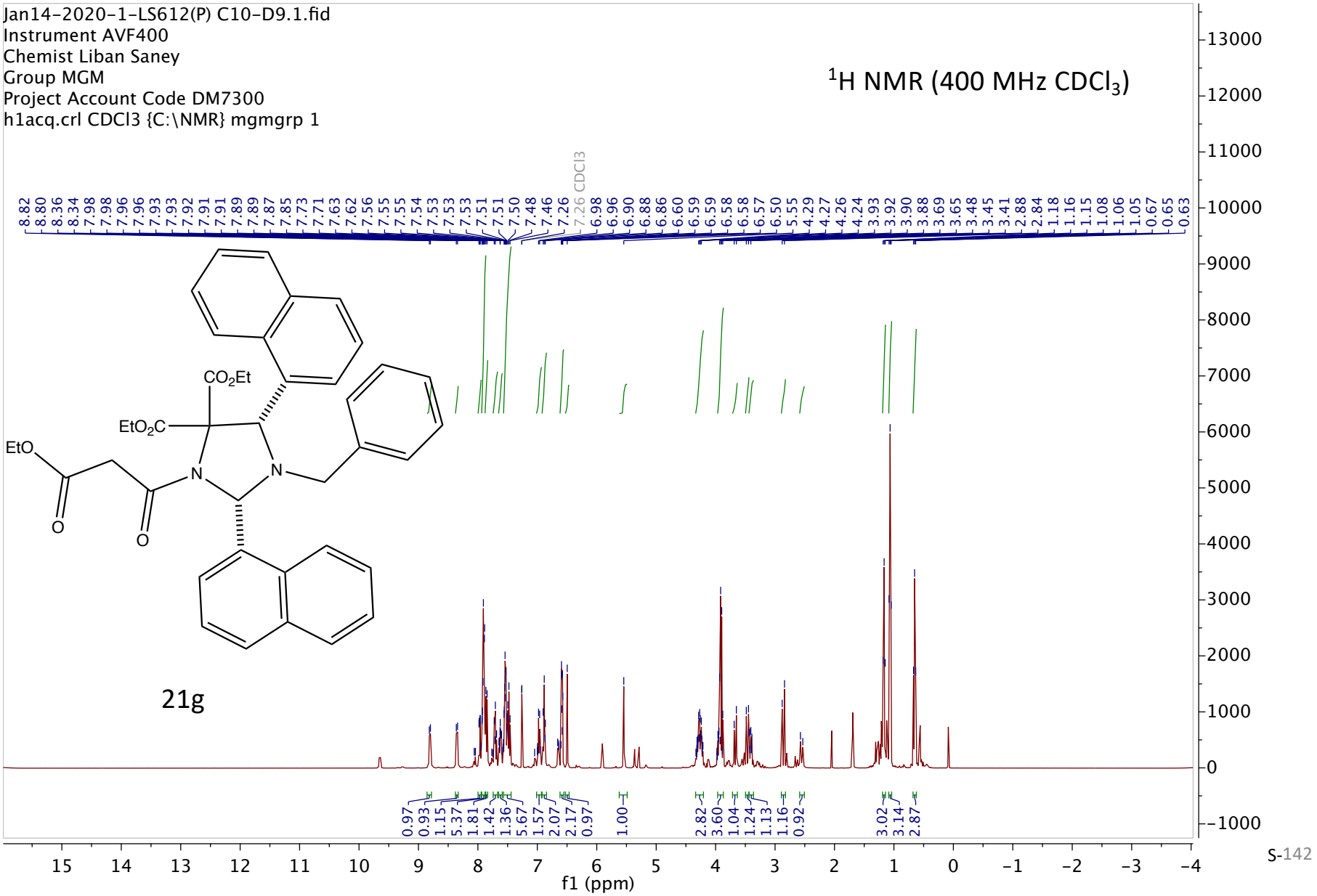

Mar29-2019-55-LS357(P) A12-C4.6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq.crl CDCl3 {C:\NMR} mgmgrp 55
19F NMR (377 MHz CDCl3)
-110.97
-112.77
CO2Et
EtO2C
EtO
N
N
O
O
F
F
21d
f1 (ppm)

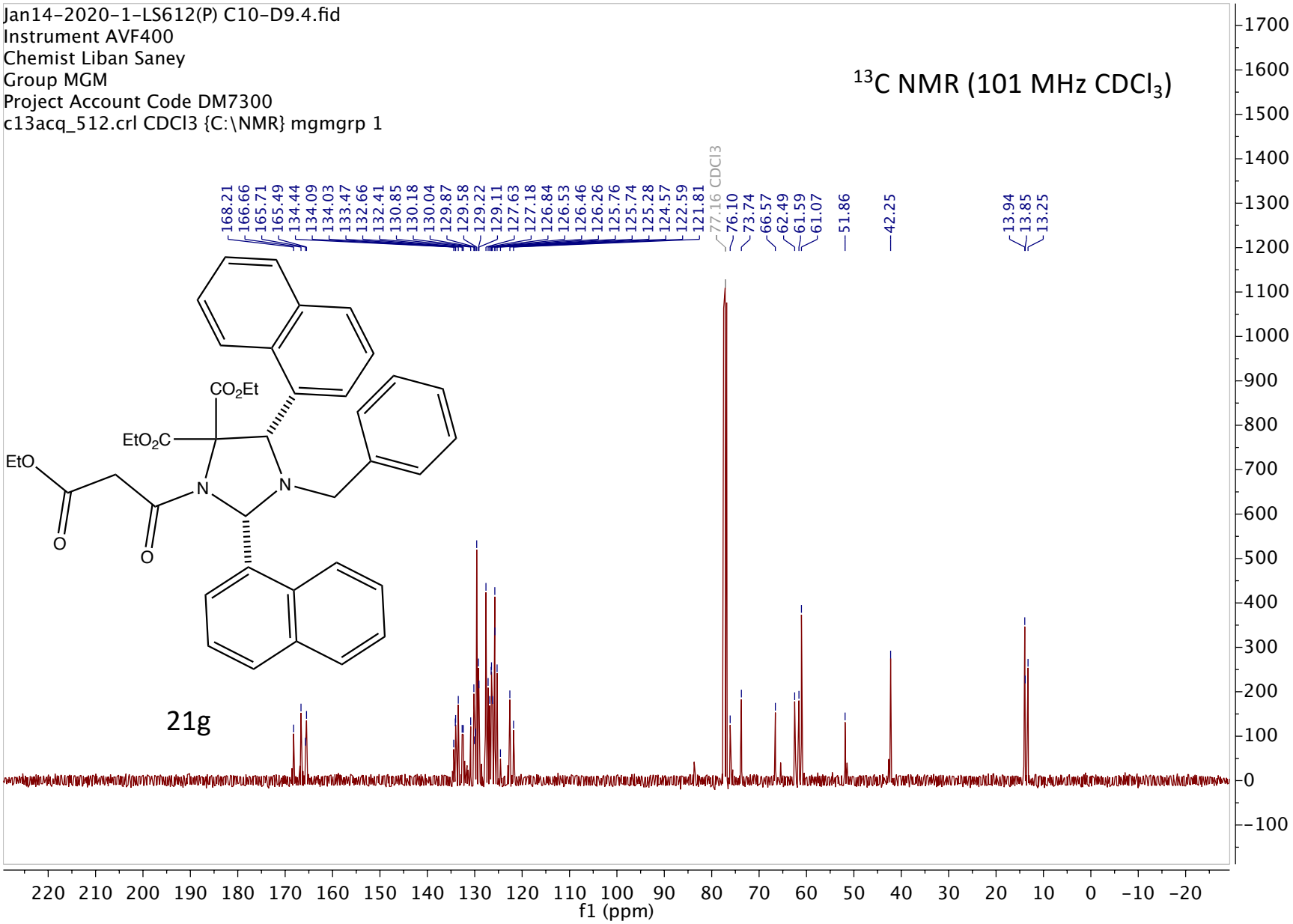

Jan12-2020-1-LS609(P) B2-B10.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
21e
f1 (ppm)

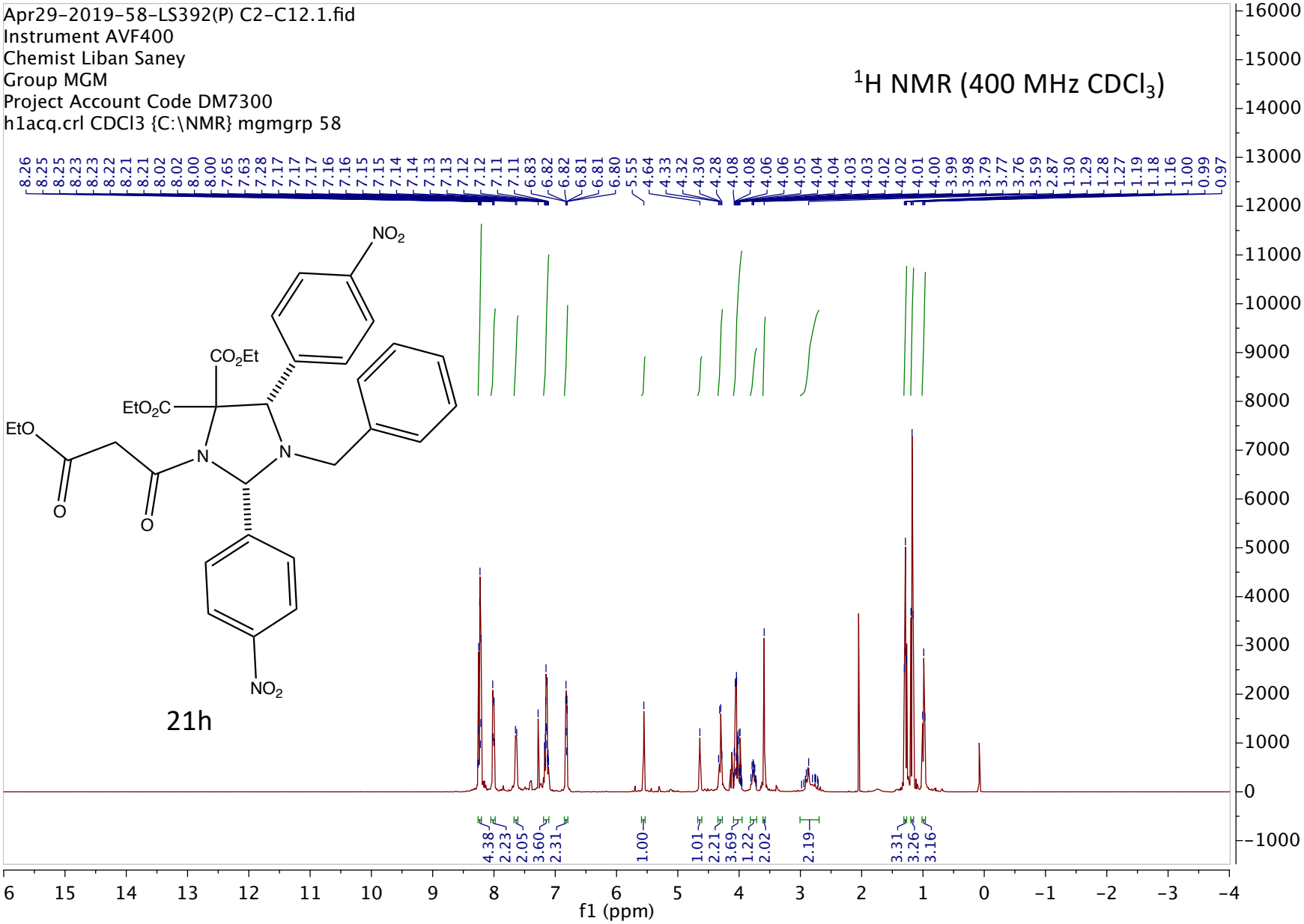

Jan12-2020-1-LS609(P) B2-B10.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
166.79
166.37
165.10
137.34
134.92
133.41
132.95
131.51
130.45
129.85
129.28
128.72
128.40
127.81
78.81
77.16 CDCl3
75.29
70.40
62.35
62.13
61.39
53.56
50.88
42.89
14.12
14.02
13.63
Cl
CO_2Et
EtO_2C
EtO
N
N
O
O
Cl
21e
f1 (ppm)

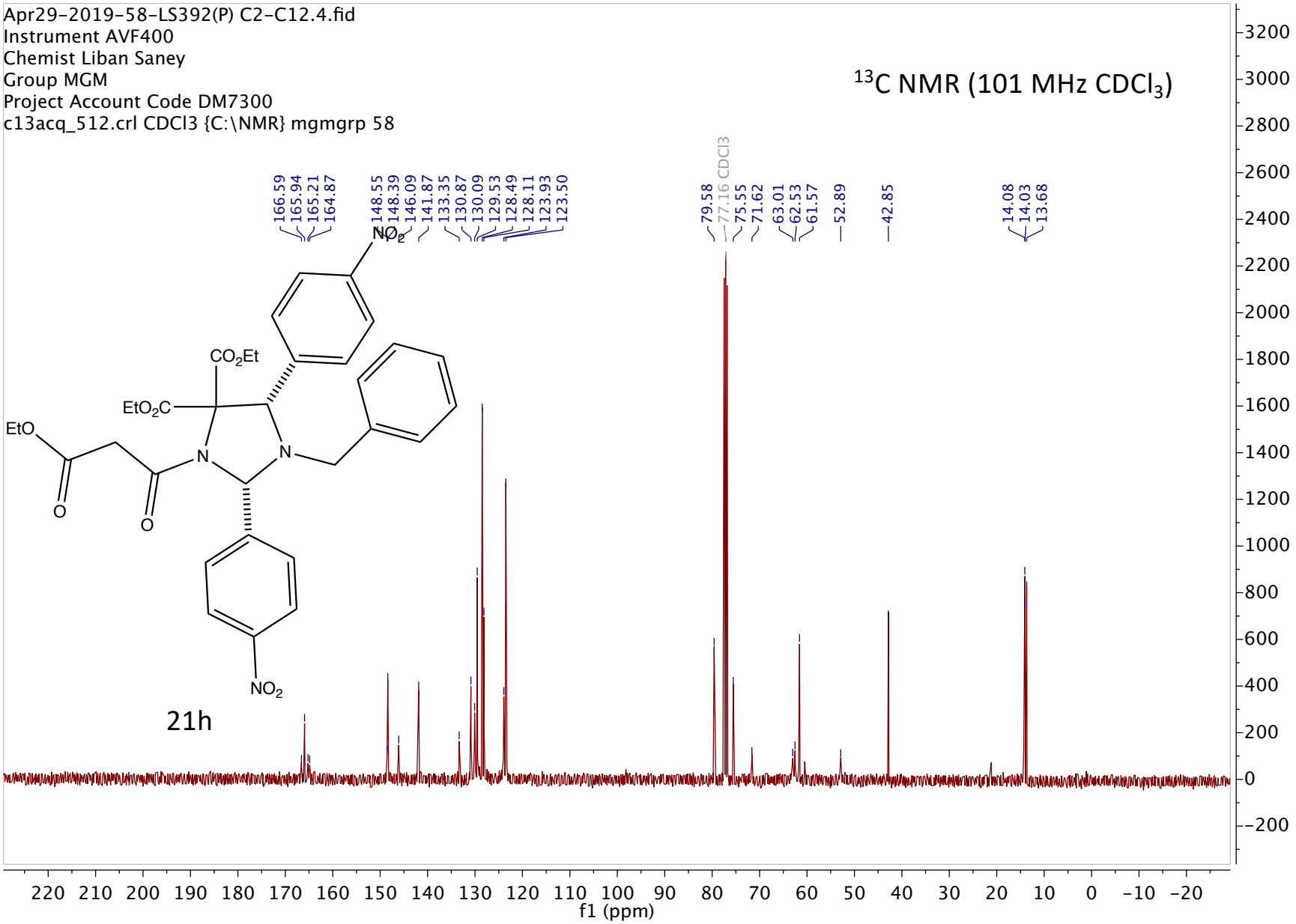

Apr05-2019-57-LS366(P) A12-C4.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 57
^{1}H NMR (400 MHz $CDCl_3$)
Br
CO_2Et
EtO_2C
EtO
N
N
O
O
Br
21f
f1 (ppm)

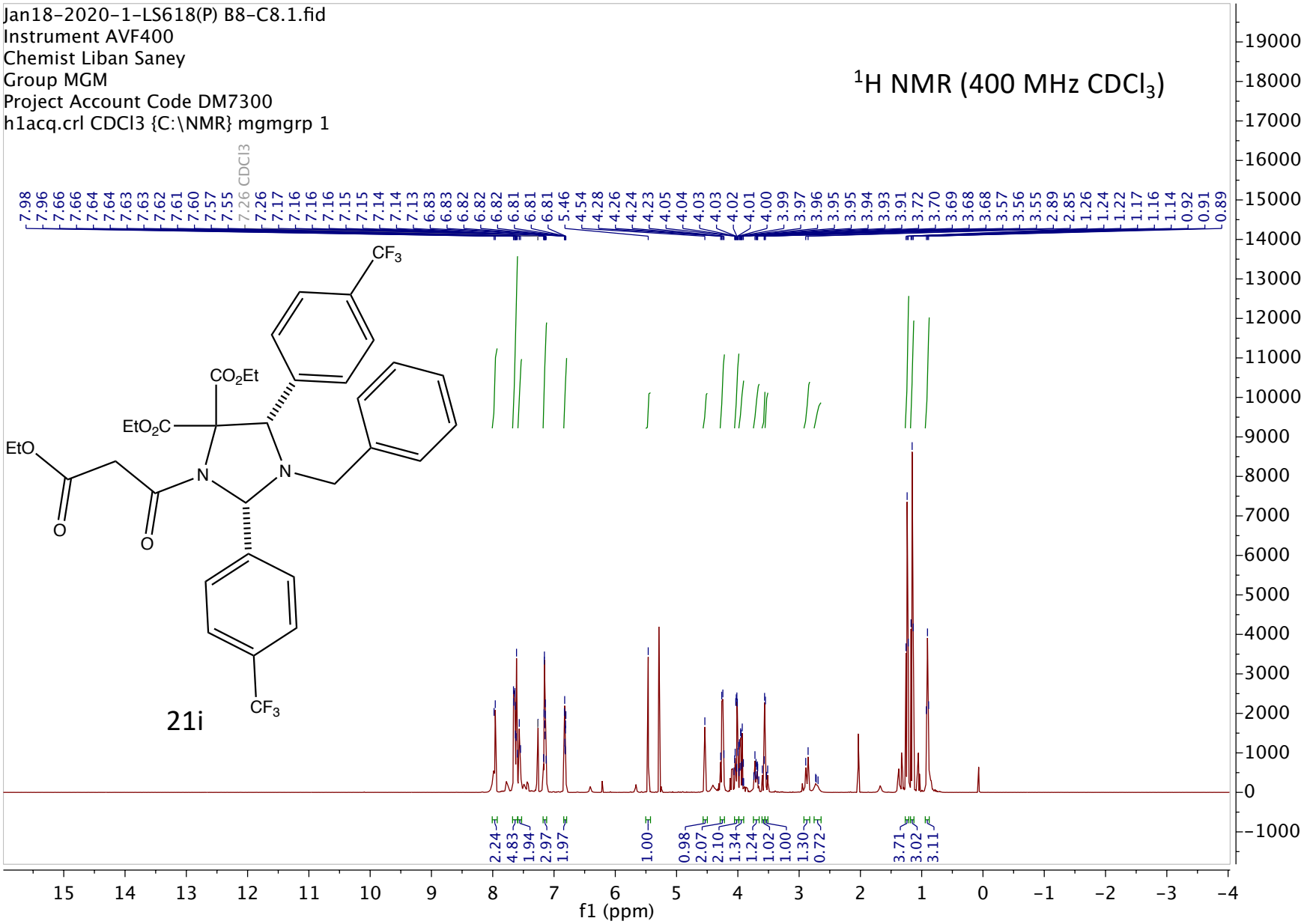

Apr05-2019-57-LS366(P) A12-C4.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 57
^{13}C NMR (101 MHz $CDCl_3$)
166.75
166.30
165.35
165.03
137.86
133.48
133.36
132.21
131.77
131.66
130.73
129.82
128.38
127.78
124.04
123.07
78.88
77.16 CDCl3
75.24
70.48
62.33
62.11
61.36
50.89
42.87
14.11
14.00
13.61
CO2Et
EtO2C
EtO
N
N
O
O
Br
Br
21f
f1 (ppm)

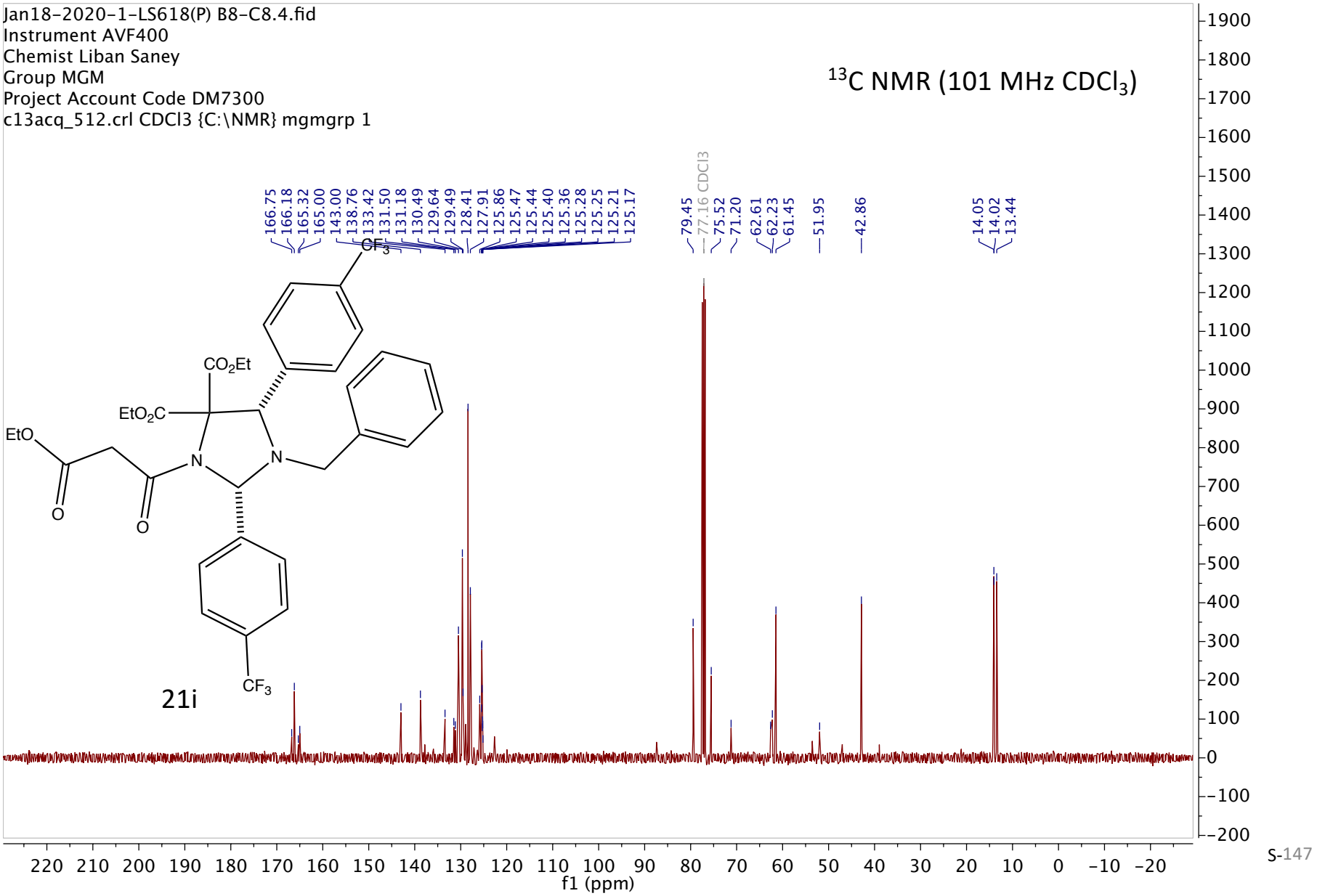

Jan14-2020-1-LS612(P) C10-D9.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CDCl3
CO_2Et
EtO_2C
EtO
N
N
O
O
21g
f1 (ppm)


Jan14-2020-1-LS612(P) C10-D9.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
13C NMR (101 MHz CDCl3)
168.21
166.66
165.71
165.49
134.44
134.09
134.03
133.47
132.66
132.41
130.85
130.18
130.04
129.87
129.58
129.22
129.11
127.63
127.18
126.84
126.53
126.46
126.26
125.76
125.74
125.28
124.57
122.59
121.81
77.16 CDCl3
76.10
73.74
66.57
62.49
61.59
61.07
51.86
42.25
13.94
13.85
13.25
CO2Et
EtO2C
EtO
N
N
O
O
21g
f1 (ppm)


Apr29-2019-58-LS392(P) C2-C12.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 58
^{1}H NMR (400 MHz $CDCl_3$)
NO_2
CO_2Et
EtO_2C
EtO
N
N
O
O
NO_2
21h
f1 (ppm)

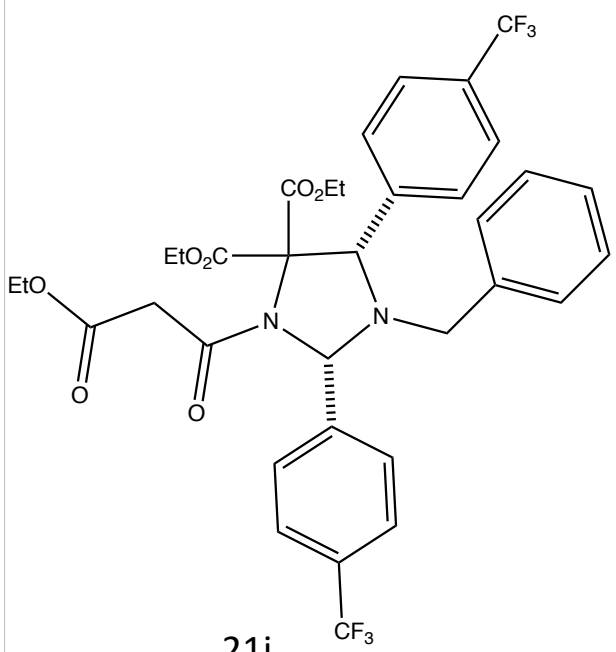

Apr29-2019-58-LS392(P) C2-C12.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 58
^{13}C NMR (101 MHz $CDCl_3$)
166.59
165.94
165.21
164.87
148.55
148.39
146.09
141.87
133.35
130.87
130.09
129.53
128.49
128.11
123.93
123.50
79.58
77.16 CDCl3
75.55
71.62
63.01
62.53
61.57
52.89
42.85
14.08
14.03
13.68
NO_2
CO_2Et
EtO_2C
EtO
N
N
O
O
NO_2
21h
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


Jan18-2020-1-LS618(P) B8-C8.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CDCl3
7.98 7.96 7.66 7.66 7.64 7.64 7.63 7.63 7.62 7.61 7.60 7.57 7.55 7.26 7.17 7.16 7.16 7.16 7.15 7.15 7.14 7.14 7.13 6.83 6.83 6.82 6.82 6.82 6.81 6.81 6.81 5.46 4.54 4.28 4.26 4.24 4.23 4.05 4.04 4.03 4.03 4.02 4.01 4.00 3.99 3.97 3.96 3.95 3.95 3.94 3.93 3.91 3.72 3.70 3.69 3.68 3.68 3.57 3.56 3.55 2.89 2.85 1.26 1.24 1.22 1.17 1.16 1.14 0.92 0.91 0.89
CF3
CO2Et
EtO2C
EtO
N
N
O
O
CF3
21i
2.24 4.83 1.94 2.97 1.97 1.00 0.98 2.07 2.10 1.34 1.24 1.02 1.00 1.30 0.72 3.71 3.02 3.11
19000 18000 17000 16000 15000 14000 13000 12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 0 -1000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

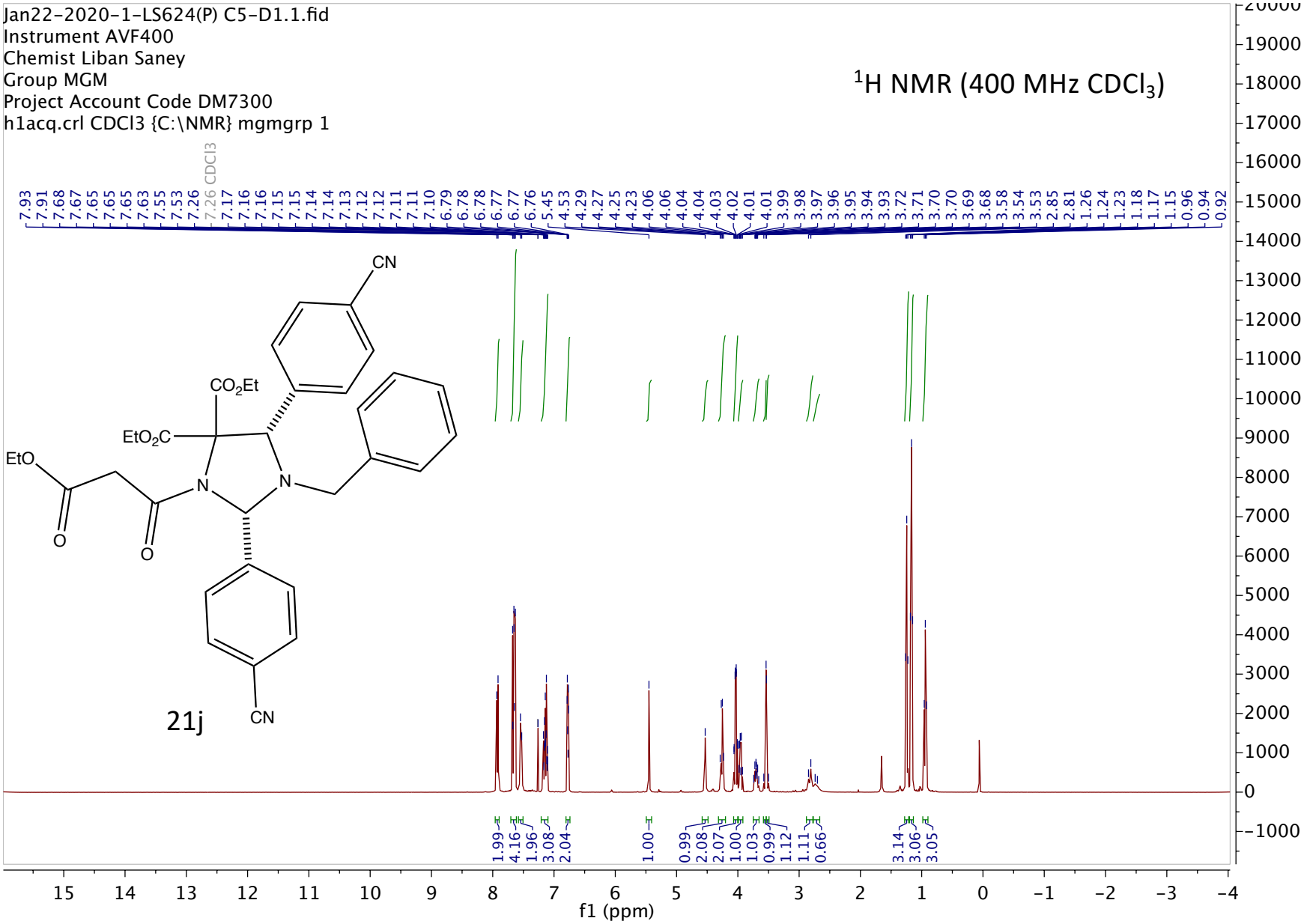

Jan18-2020-1-LS618(P) B8-C8.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
166.75
166.18
165.32
165.00
143.00
138.76
133.42
131.50
131.18
130.49
129.64
129.49
128.41
127.91
125.86
125.47
125.44
125.40
125.36
125.28
125.25
125.21
125.17
79.45
77.16 CDCl3
75.52
71.20
62.61
62.23
61.45
51.95
42.86
14.05
14.02
13.44
CF_3
CO_2Et
EtO_2C
EtO
O
O
N
N
CF_3
21i
f1 (ppm)

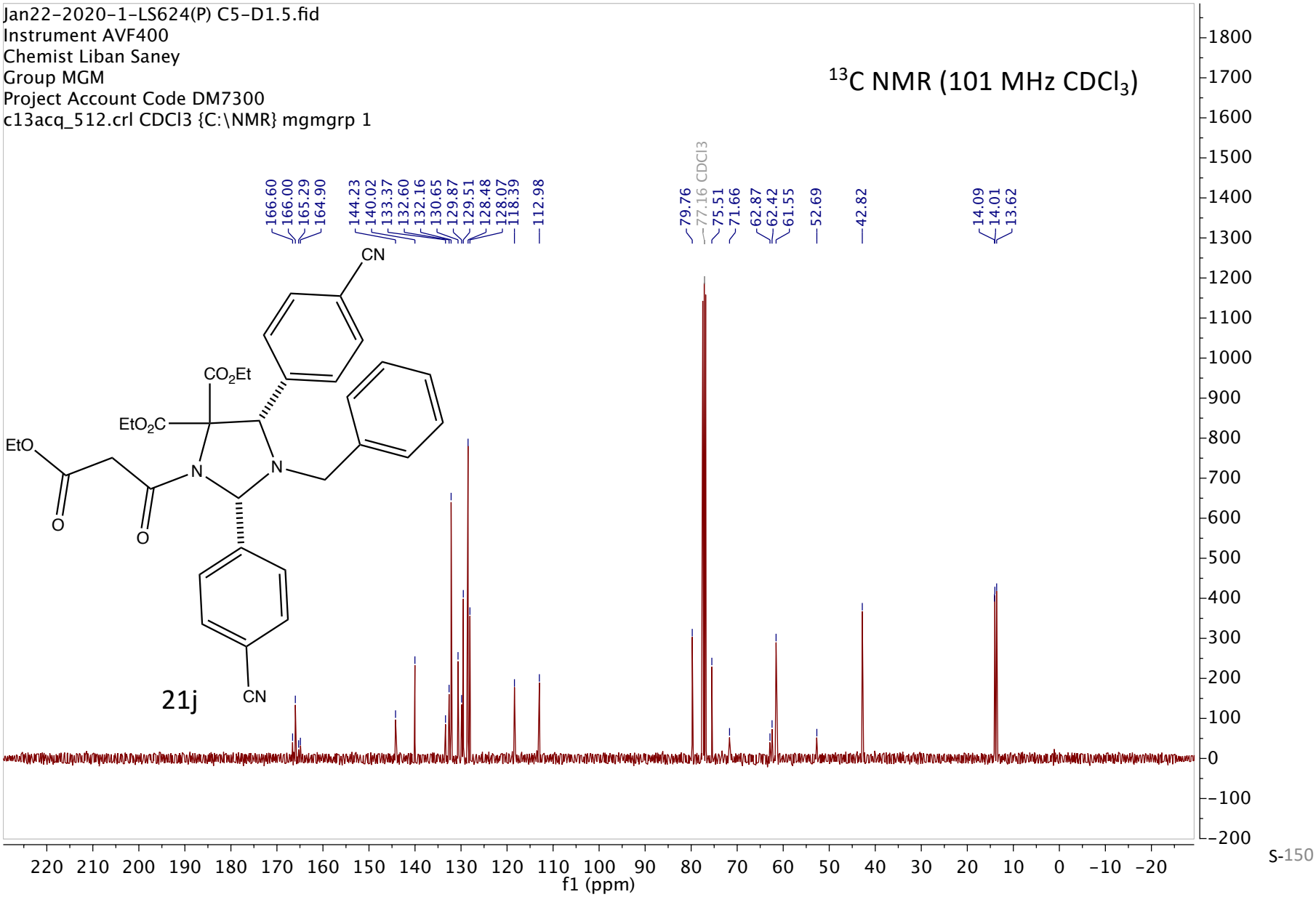
Jan18-2020-1-LS618(P) B8-C8.7.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq_256.crl CDCl3 {C:\NMR} mgmgrp 1

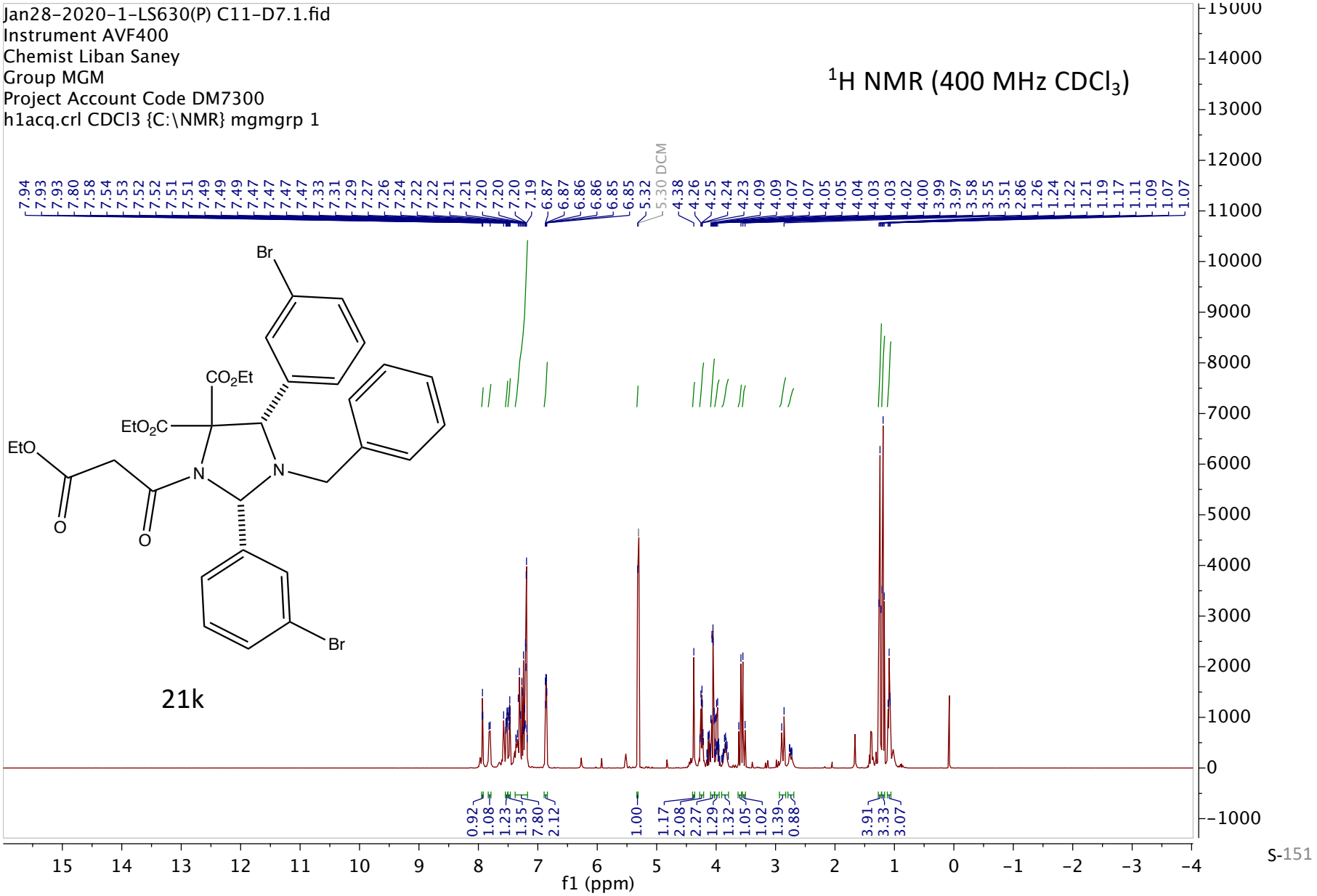
^{19}F NMR (377 MHz $CDCl_3$)

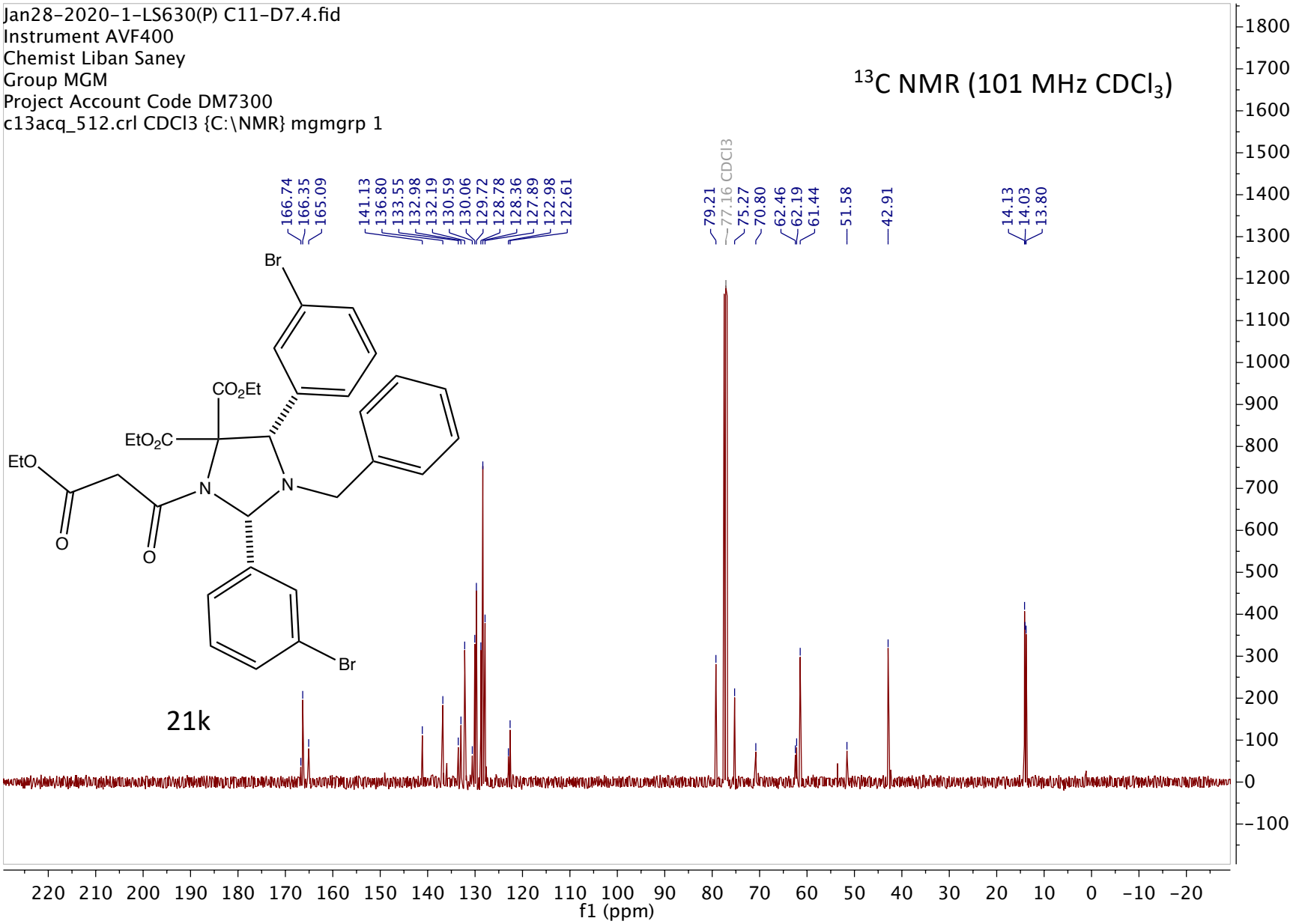


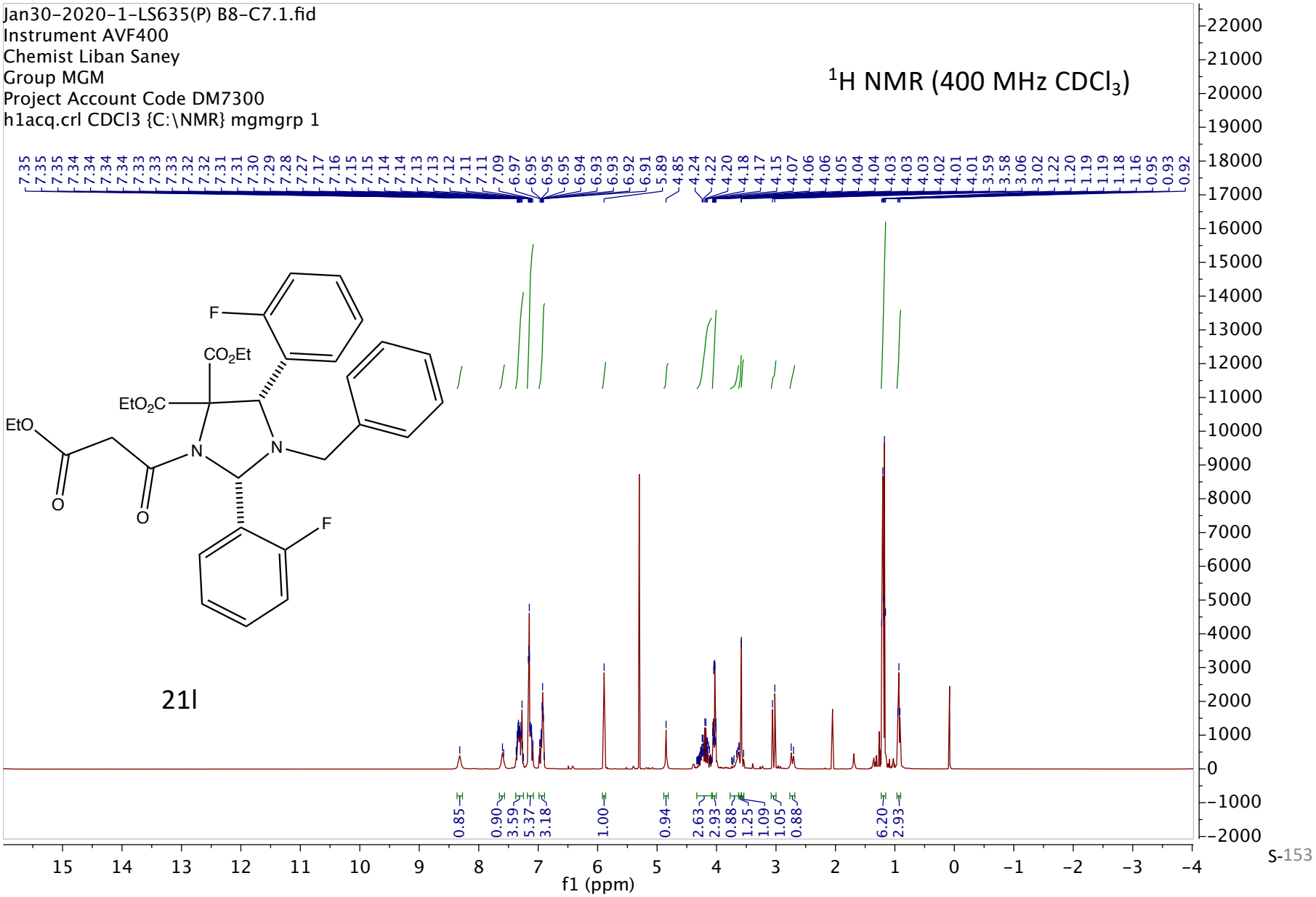
21i

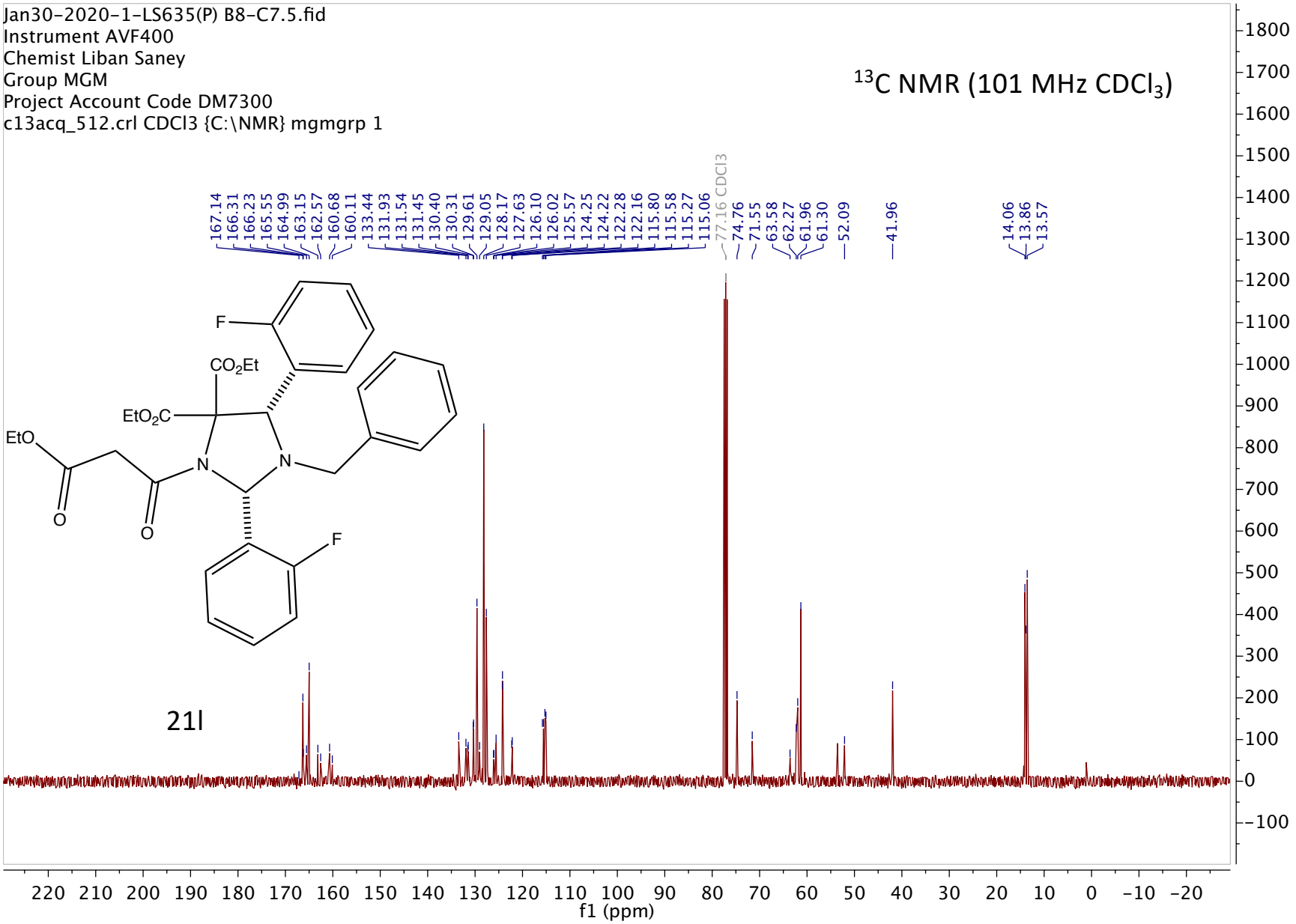

Jan22-2020-1-LS624(P) C5-D1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
CDCl3
7.93 7.91 7.68 7.67 7.65 7.65 7.65 7.63 7.55 7.53 7.26 7.26 7.17 7.16 7.16 7.15 7.15 7.14 7.14 7.13 7.12 7.12 7.11 7.11 7.10 6.79 6.78 6.78 6.77 6.77 6.76 5.45 4.53 4.29 4.27 4.25 4.23 4.06 4.06 4.04 4.04 4.03 4.02 4.01 4.01 3.99 3.98 3.97 3.96 3.95 3.94 3.93 3.72 3.71 3.70 3.70 3.69 3.68 3.58 3.54 3.53 2.85 2.81 1.26 1.24 1.23 1.18 1.17 1.15 0.96 0.94 0.92
CN
CO_2Et
EtO_2C
EtO
N
N
O
O
21j
CN
1.99 4.16 1.96 3.08 2.04 1.00 0.99 2.08 2.07 1.00 1.03 0.99 1.12 1.11 0.66 3.14 3.06 3.05
20000 19000 18000 17000 16000 15000 14000 13000 12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 0 -1000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)

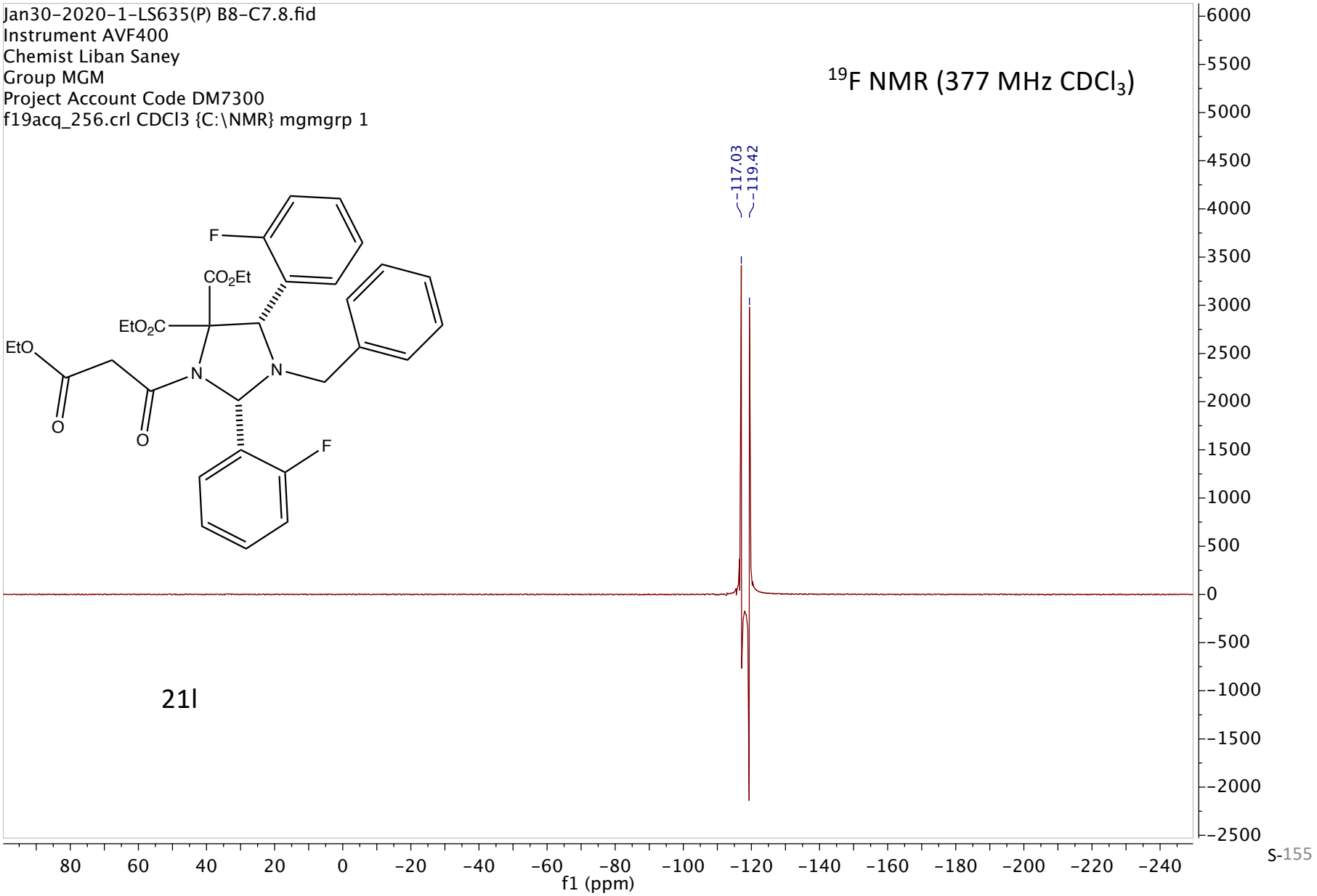

Jan22-2020-1-LS624(P) C5-D1.5.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
166.60
166.00
165.29
164.90
144.23
140.02
133.37
132.60
132.16
130.65
129.87
129.51
128.48
128.07
118.39
112.98
79.76
77.16 CDCl3
75.51
71.66
62.87
62.42
61.55
52.69
42.82
14.09
14.01
13.62
CN
CO_2Et
EtO_2C
EtO
N
N
O
O
CN
21j
f1 (ppm)

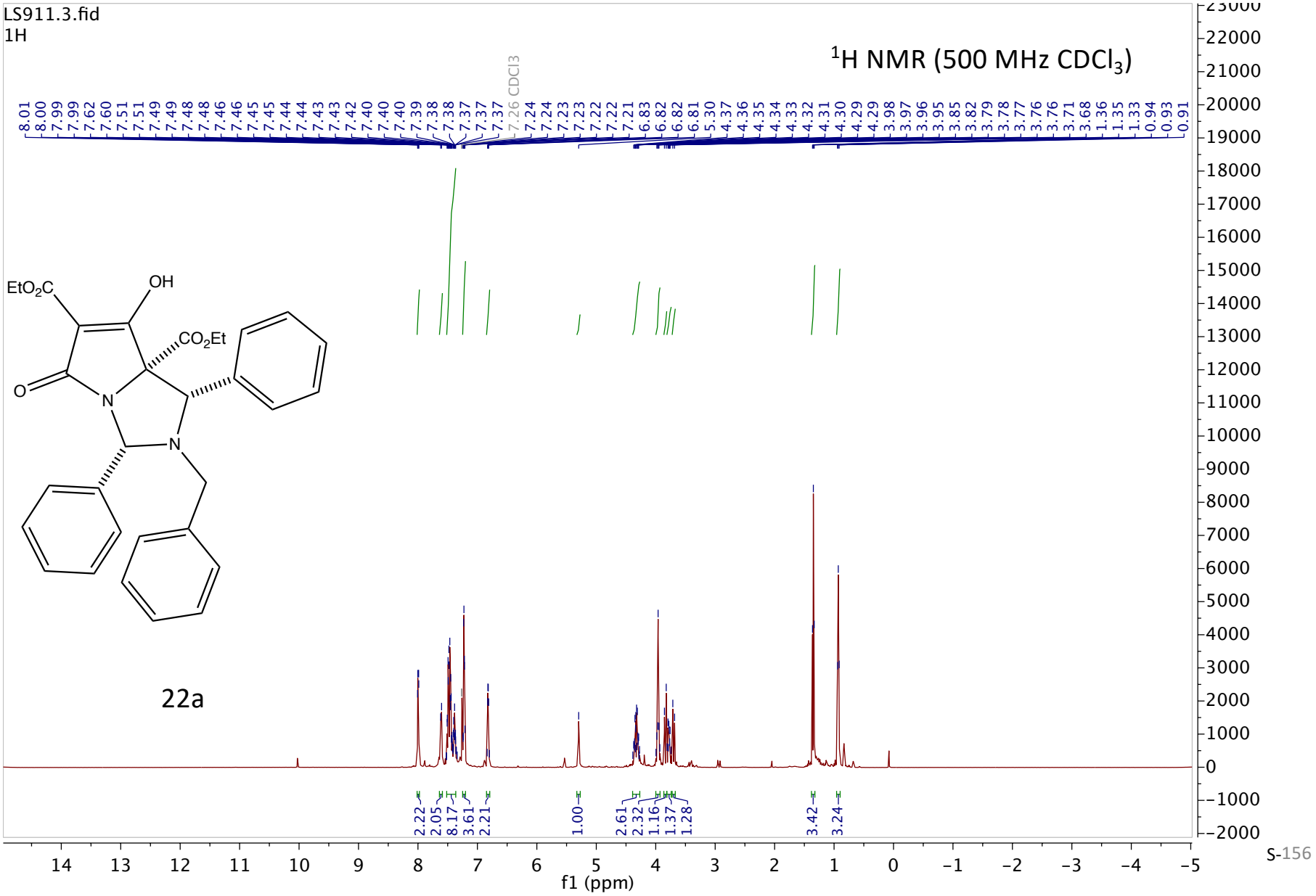

Jan28-2020-1-LS630(P) C11-D7.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
5.30 DCM
Br
CO_2Et
EtO_2C
EtO
N
N
O
O
Br
21k
f1 (ppm)

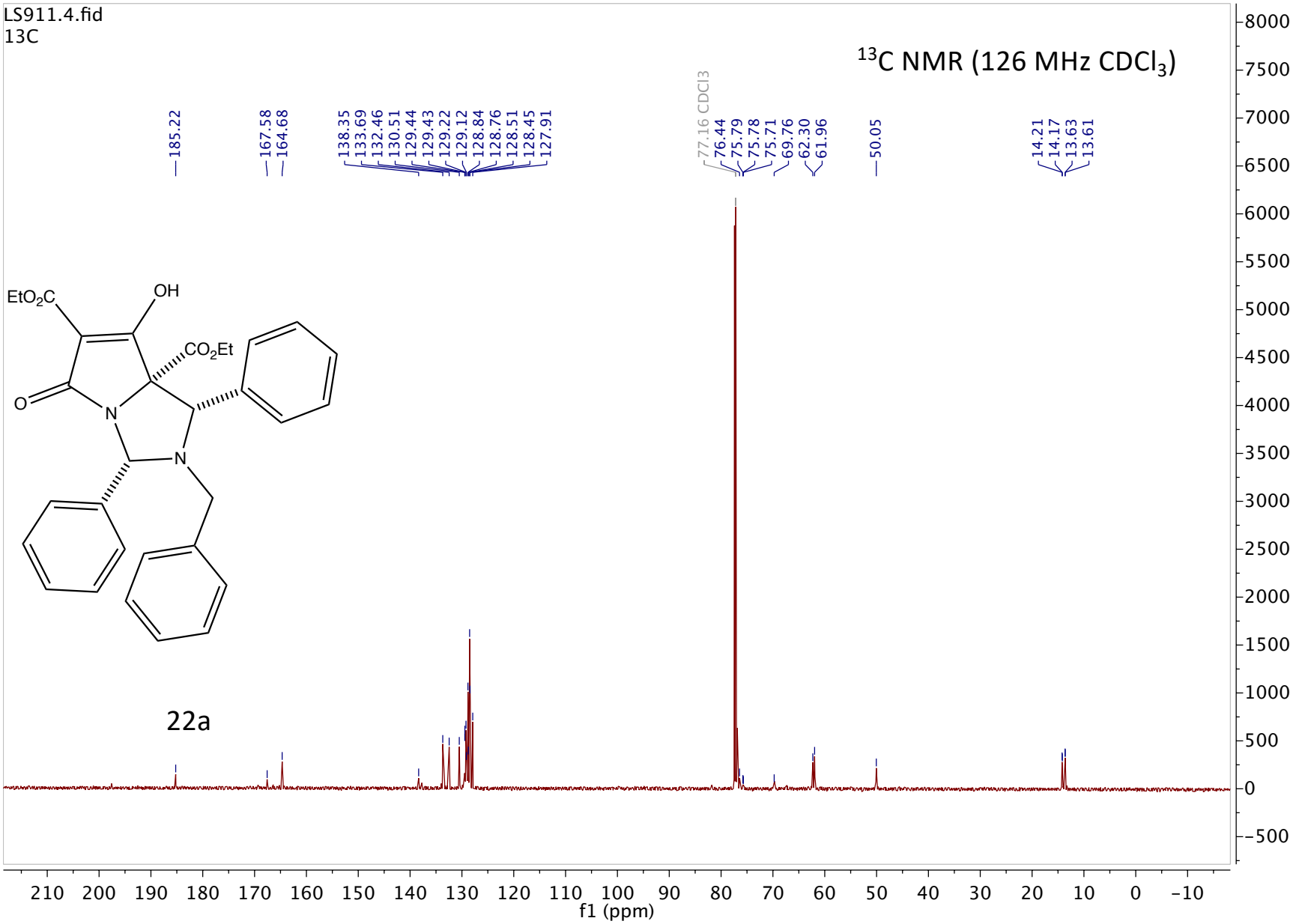

Jan28-2020-1-LS630(P) C11-D7.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
13C NMR (101 MHz CDCl3)
166.74
166.35
165.09
141.13
136.80
133.55
132.98
132.19
130.59
130.06
129.72
128.78
128.36
127.89
122.98
122.61
79.21
77.16 CDCl3
75.27
70.80
62.46
62.19
61.44
51.58
42.91
14.13
14.03
13.80
Br
CO2Et
EtO2C
EtO
N
N
O
O
Br
21k
f1 (ppm)

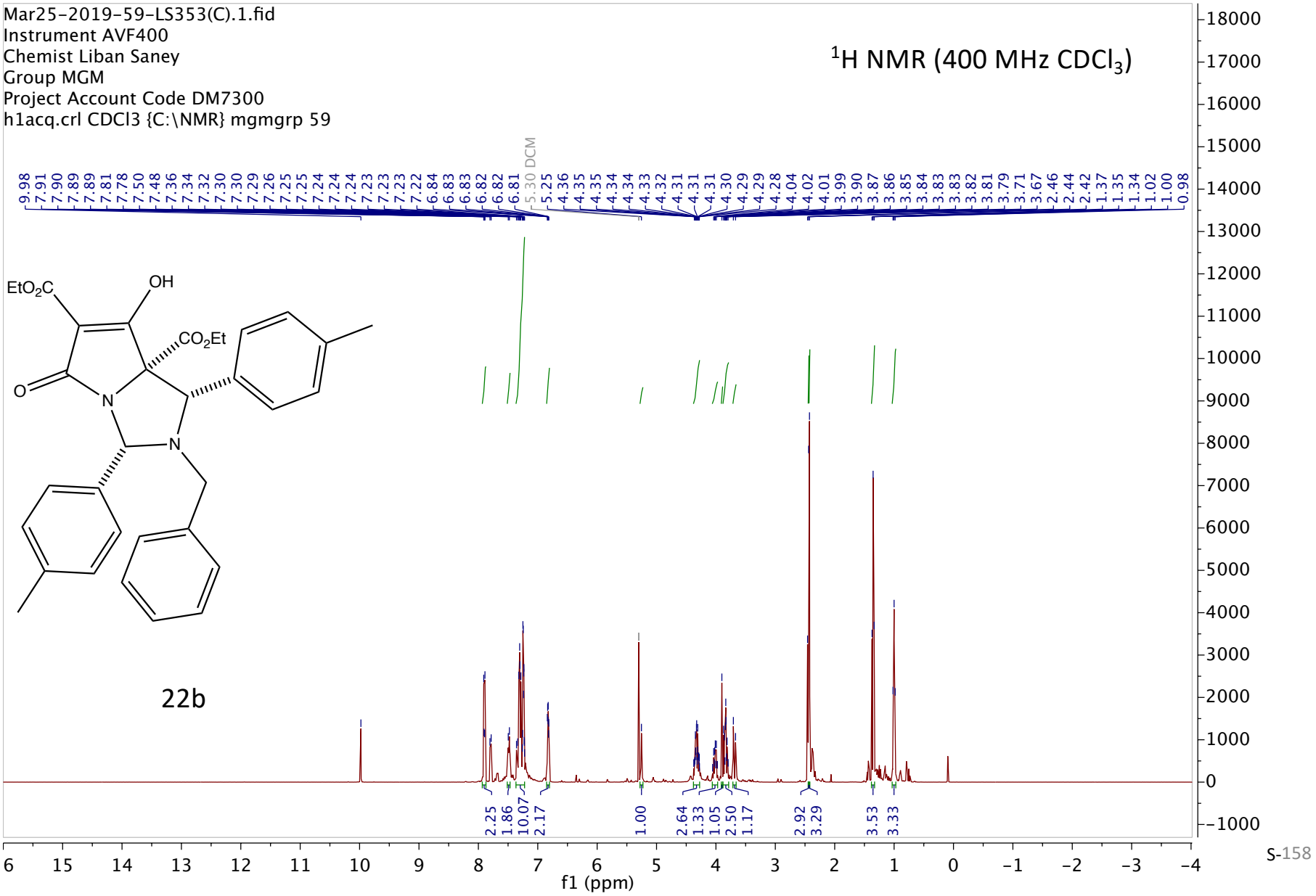

Jan30-2020-1-LS635(P) B8-C7.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
F
CO_2Et
EtO_2C
EtO
N
N
O
O
F
21l
f1 (ppm)

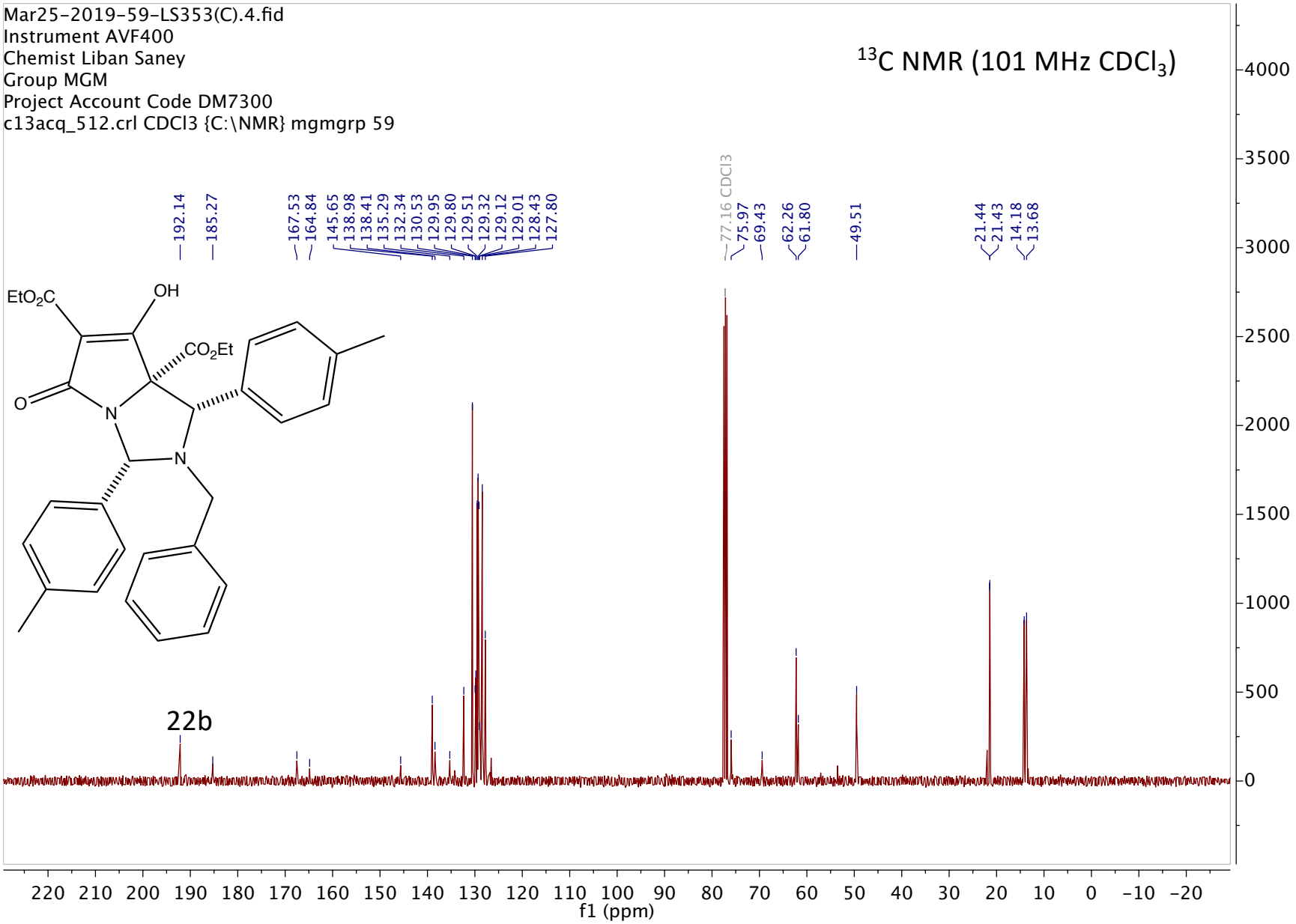

Jan30-2020-1-LS635(P) B8-C7.5.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
167.14
166.31
166.23
165.55
164.99
163.15
162.57
160.68
160.11
133.44
131.93
131.54
131.45
130.40
130.31
129.61
129.05
128.17
127.63
126.10
126.02
125.57
124.25
124.22
122.28
122.16
115.80
115.58
115.27
115.06
77.16 CDCl3
74.76
71.55
63.58
62.27
61.96
61.30
52.09
41.96
14.06
13.86
13.57
F
CO_2Et
EtO_2C
EtO
N
N
O
O
F
21l
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

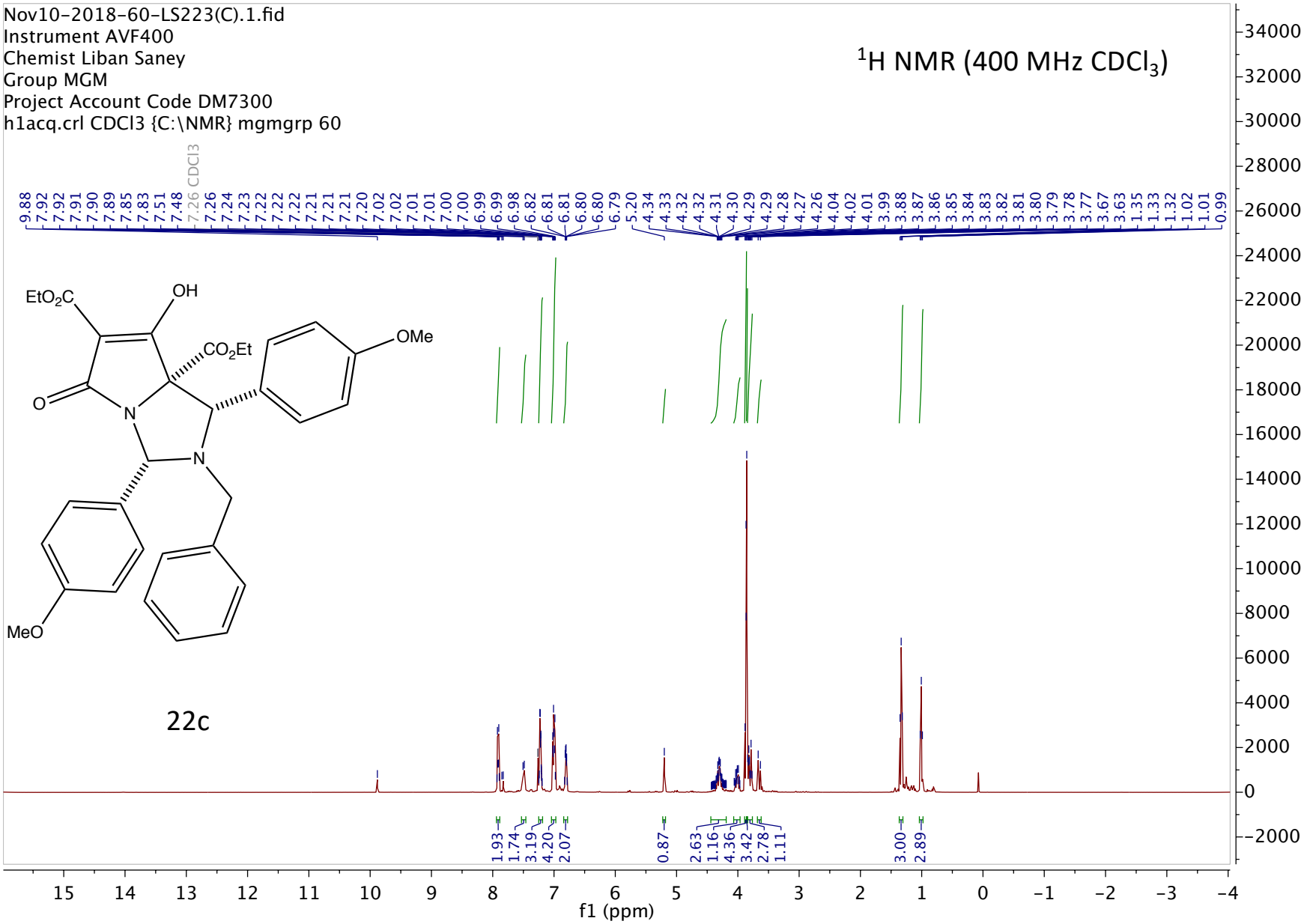

Jan30-2020-1-LS635(P) B8-C7.8.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq_256.crl CDCl3 {C:\NMR} mgmgrp 1
^{19}F NMR (377 MHz $CDCl_3$)
-117.03
-119.42
F
CO_2Et
EtO_2C
EtO
O
O
N
N
F
21l
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
f1 (ppm)

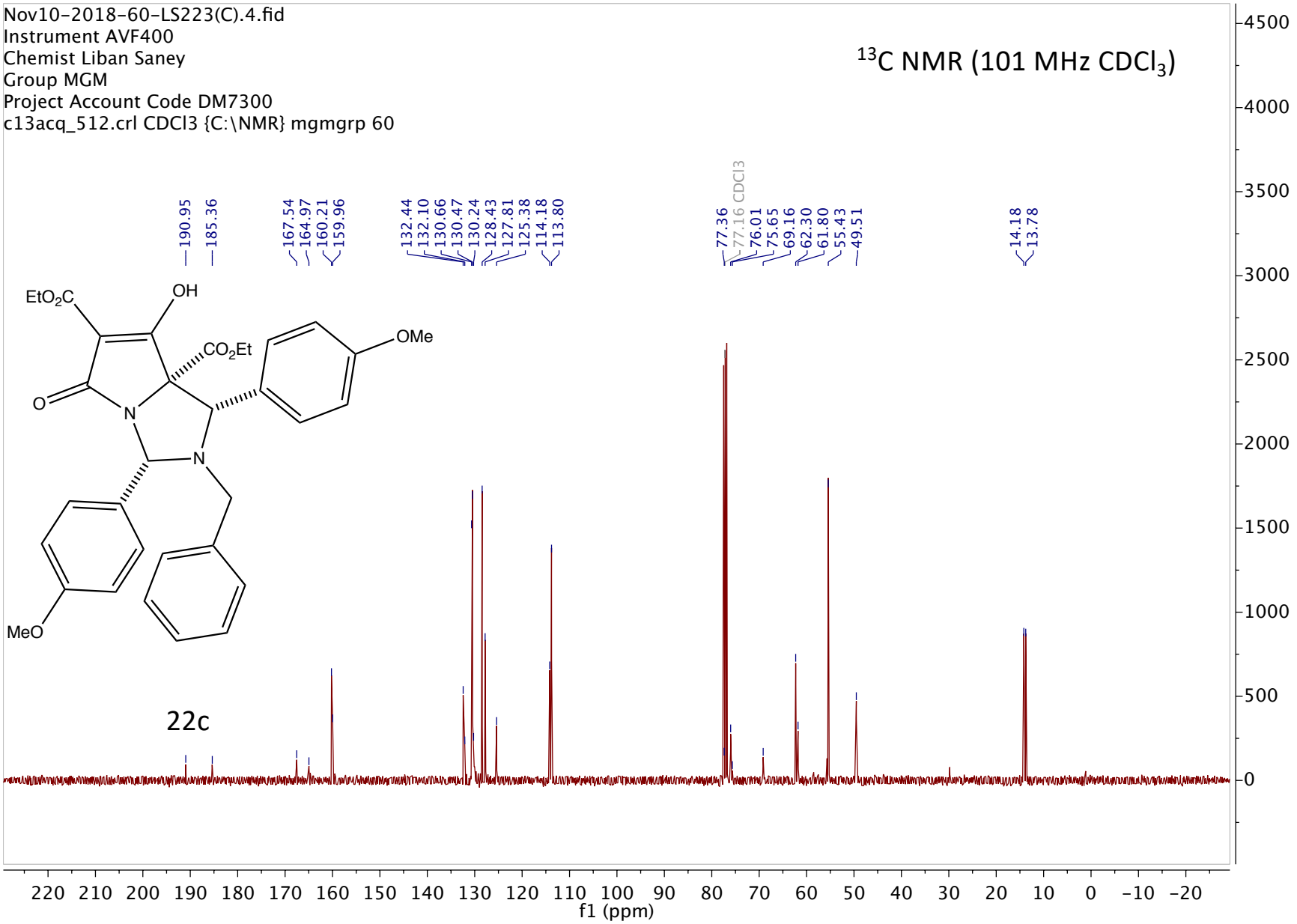

LS911.3.fid
1H
^{1}H NMR (500 MHz $CDCl_3$)
EtO2C
OH
CO2Et
O
N
N
22a
f1 (ppm)

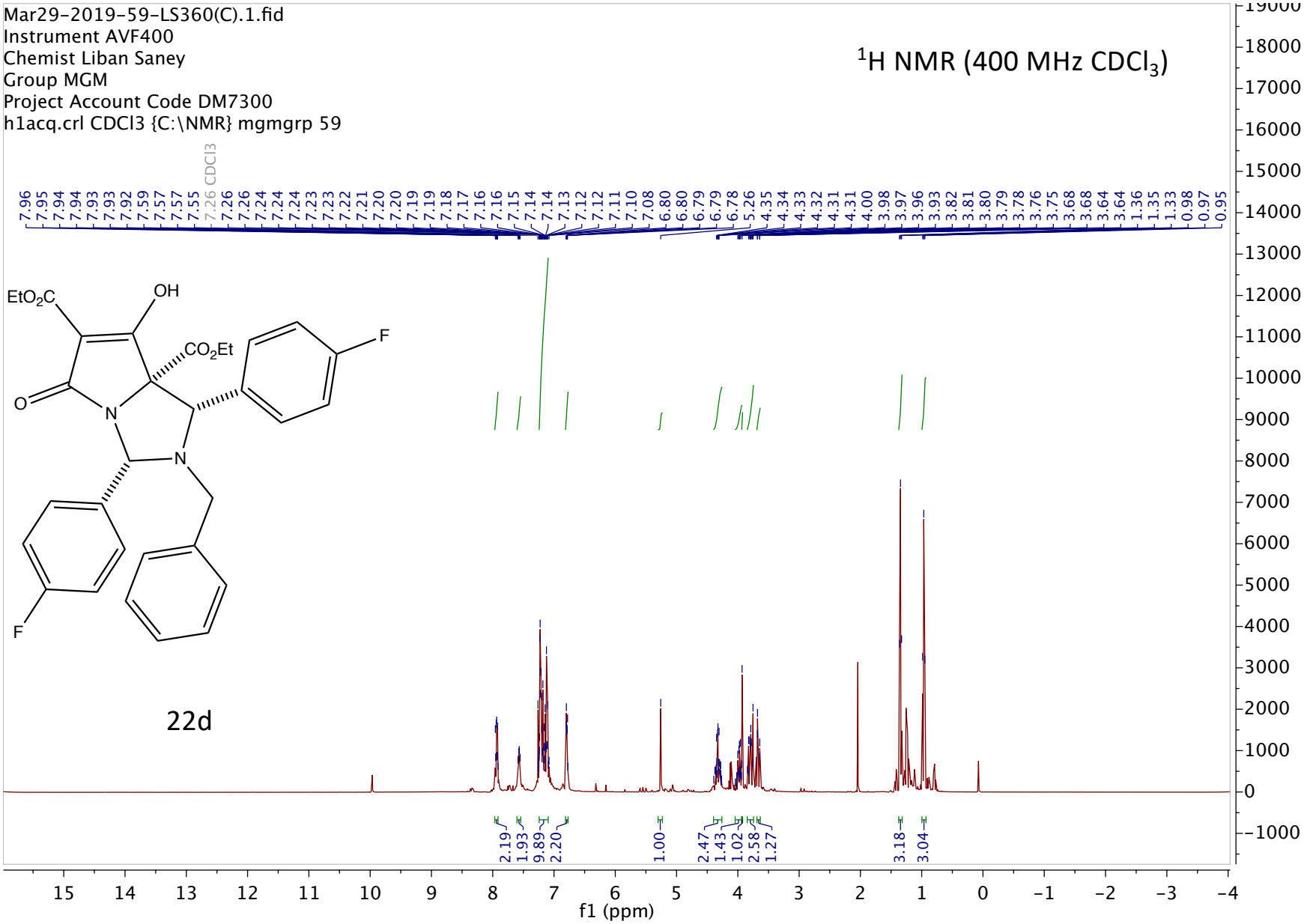

LS911.4.fid
13C
^{13}C NMR (126 MHz $CDCl_3$)
185.22
167.58
164.68
138.35
133.69
132.46
130.51
129.44
129.43
129.22
129.12
128.84
128.76
128.51
128.45
127.91
77.16 CDCl3
76.44
75.79
75.78
75.71
69.76
62.30
61.96
50.05
14.21
14.17
13.63
13.61
EtO2C
OH
CO2Et
O
N
N
22a
f1 (ppm)

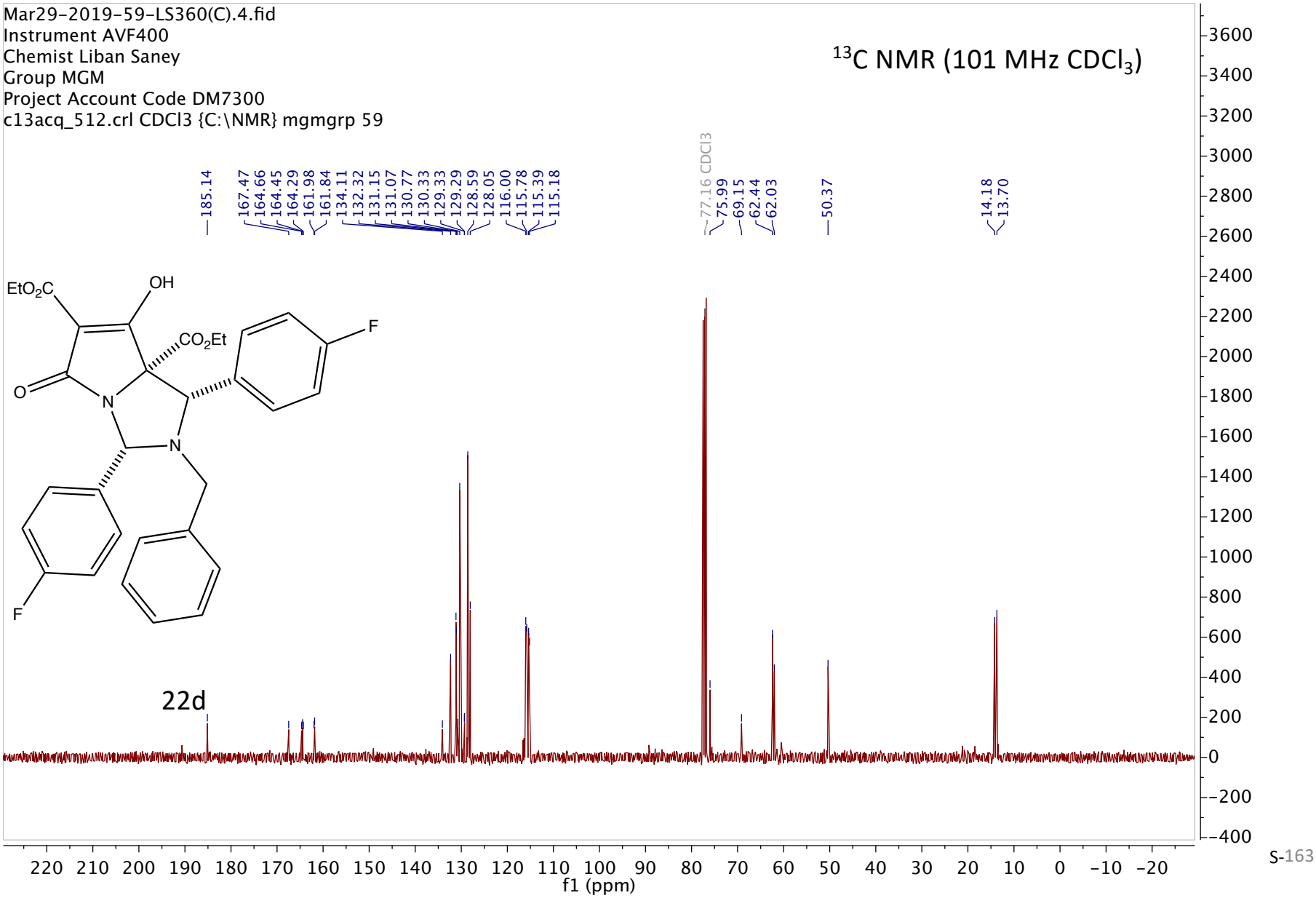

Mar25-2019-59-LS353(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
9.98 7.91 7.90 7.89 7.89 7.81 7.78 7.50 7.48 7.36 7.34 7.32 7.30 7.30 7.29 7.26 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.23 7.22 6.84 6.83 6.83 6.82 6.82 6.81 5.30 DCM 5.25 4.36 4.35 4.35 4.34 4.34 4.33 4.32 4.31 4.31 4.31 4.30 4.29 4.29 4.28 4.04 4.02 4.01 3.99 3.90 3.87 3.86 3.85 3.84 3.83 3.83 3.82 3.81 3.79 3.71 3.67 2.46 2.44 2.42 1.37 1.35 1.34 1.02 1.00 0.98
EtO2C
OH
CO2Et
O
N
N
22b
2.25 1.86 10.07 2.17 1.00 2.64 1.33 1.05 2.50 1.17 2.92 3.29 3.53 3.33
18000 17000 16000 15000 14000 13000 12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 0 -1000
6 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)


Mar25-2019-59-LS353(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
13C NMR (101 MHz CDCl3)
192.14
185.27
167.53
164.84
145.65
138.98
138.41
135.29
132.34
130.53
129.95
129.80
129.51
129.32
129.12
129.01
128.43
127.80
77.16 CDCl3
75.97
69.43
62.26
61.80
49.51
21.44
21.43
14.18
13.68
EtO2C
OH
CO2Et
O
N
N
22b
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


Nov10-2018-60-LS223(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
7.26 CDCl3
9.88 7.92 7.92 7.91 7.90 7.89 7.85 7.83 7.51 7.48 7.26 7.24 7.23 7.22 7.22 7.22 7.21 7.21 7.21 7.20 7.02 7.02 7.01 7.01 7.00 7.00 6.99 6.99 6.98 6.82 6.81 6.81 6.80 6.80 6.79 5.20 4.34 4.33 4.32 4.32 4.31 4.30 4.29 4.29 4.28 4.27 4.26 4.04 4.02 4.01 3.99 3.88 3.87 3.86 3.85 3.84 3.83 3.82 3.81 3.80 3.79 3.78 3.77 3.67 3.63 1.35 1.33 1.32 1.02 1.01 0.99
EtO2C
OH
CO2Et
OMe
O
N
N
MeO
22c
1.93 1.74 3.19 4.20 2.07 0.87 2.63 1.16 4.36 3.42 2.78 1.11 3.00 2.89
f1 (ppm)

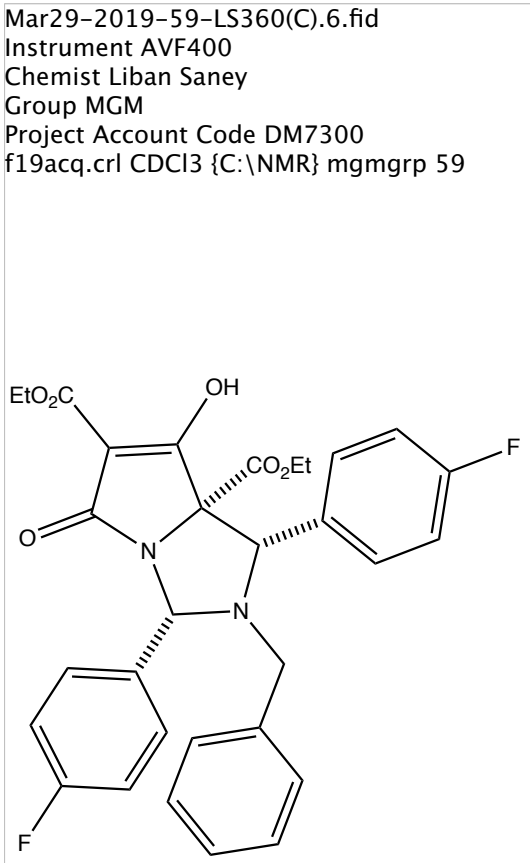

Nov10-2018-60-LS223(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
190.95
185.36
167.54
164.97
160.21
159.96
132.44
132.10
130.66
130.47
130.24
128.43
127.81
125.38
114.18
113.80
77.36
77.16 CDCl3
76.01
75.65
69.16
62.30
61.80
55.43
49.51
14.18
13.78
EtO2C
OH
CO2Et
OMe
O
N
N
MeO
22c
4500
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


Mar29-2019-59-LS360(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 59
^{1}H NMR (400 MHz $CDCl_3$)
CDCl3
7.96 7.95 7.94 7.94 7.93 7.93 7.92 7.59 7.57 7.57 7.55 7.26 7.26 7.26 7.24 7.24 7.24 7.23 7.23 7.22 7.21 7.20 7.20 7.19 7.19 7.18 7.17 7.16 7.16 7.15 7.14 7.14 7.13 7.12 7.12 7.11 7.10 7.08 6.80 6.80 6.79 6.79 6.78 5.26 4.35 4.34 4.33 4.32 4.31 4.31 4.00 3.98 3.97 3.96 3.93 3.82 3.81 3.80 3.79 3.78 3.76 3.75 3.68 3.68 3.64 3.64 1.36 1.35 1.33 0.98 0.97 0.95
EtO2C
OH
CO2Et
O
N
N
F
F
22d
2.19 1.93 9.89 2.20 1.00 2.47 1.43 1.02 2.58 1.27 3.18 3.04
f1 (ppm)

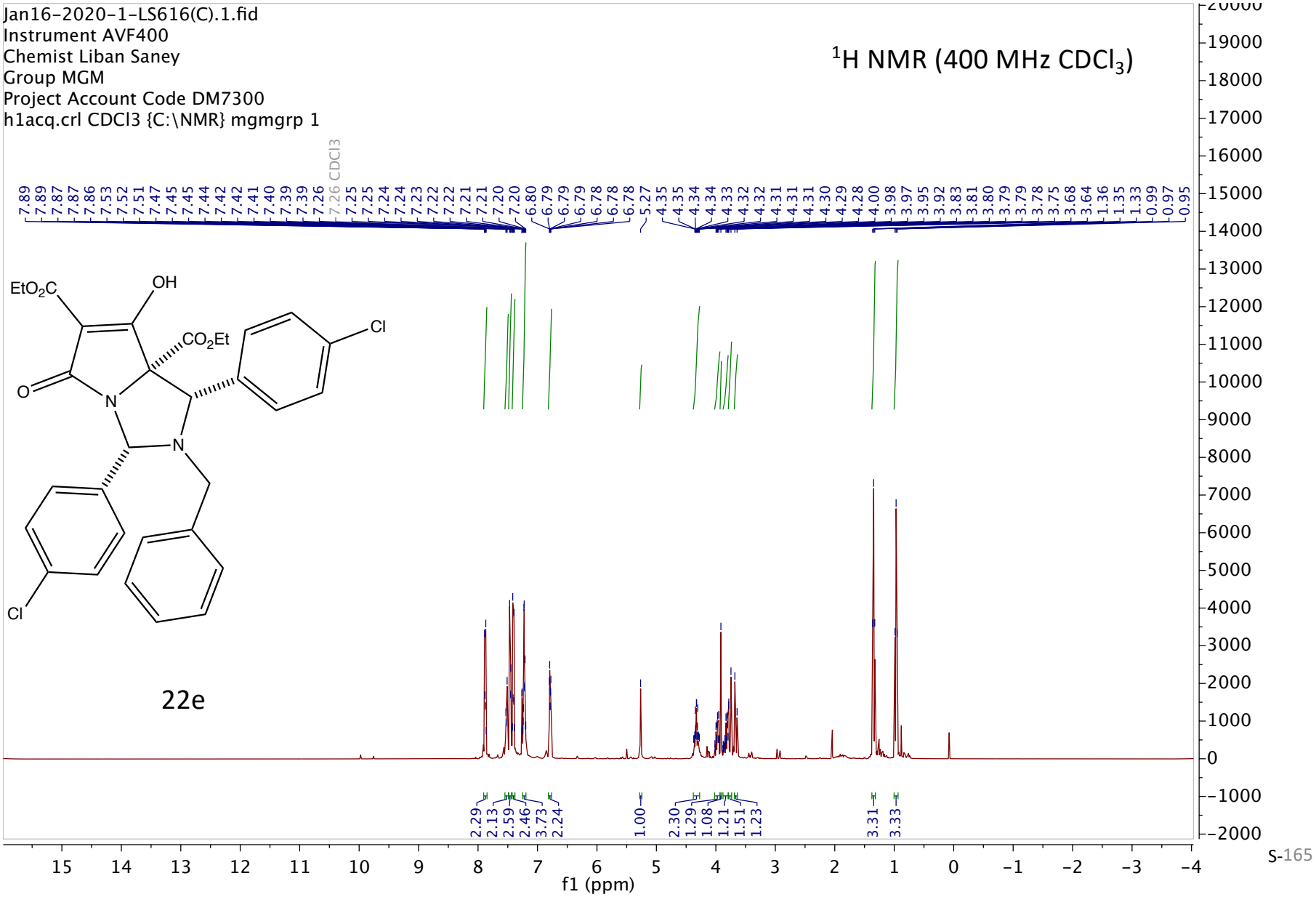

Mar29-2019-59-LS360(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 59
^{13}C NMR (101 MHz $CDCl_3$)
185.14
167.47
164.66
164.45
164.29
161.98
161.84
134.11
132.32
131.15
131.07
130.77
130.33
129.33
129.29
128.59
128.05
116.00
115.78
115.39
115.18
77.16 CDCl3
75.99
69.15
62.44
62.03
50.37
14.18
13.70
EtO2C
OH
CO2Et
F
O
N
N
F
22d
f1 (ppm)

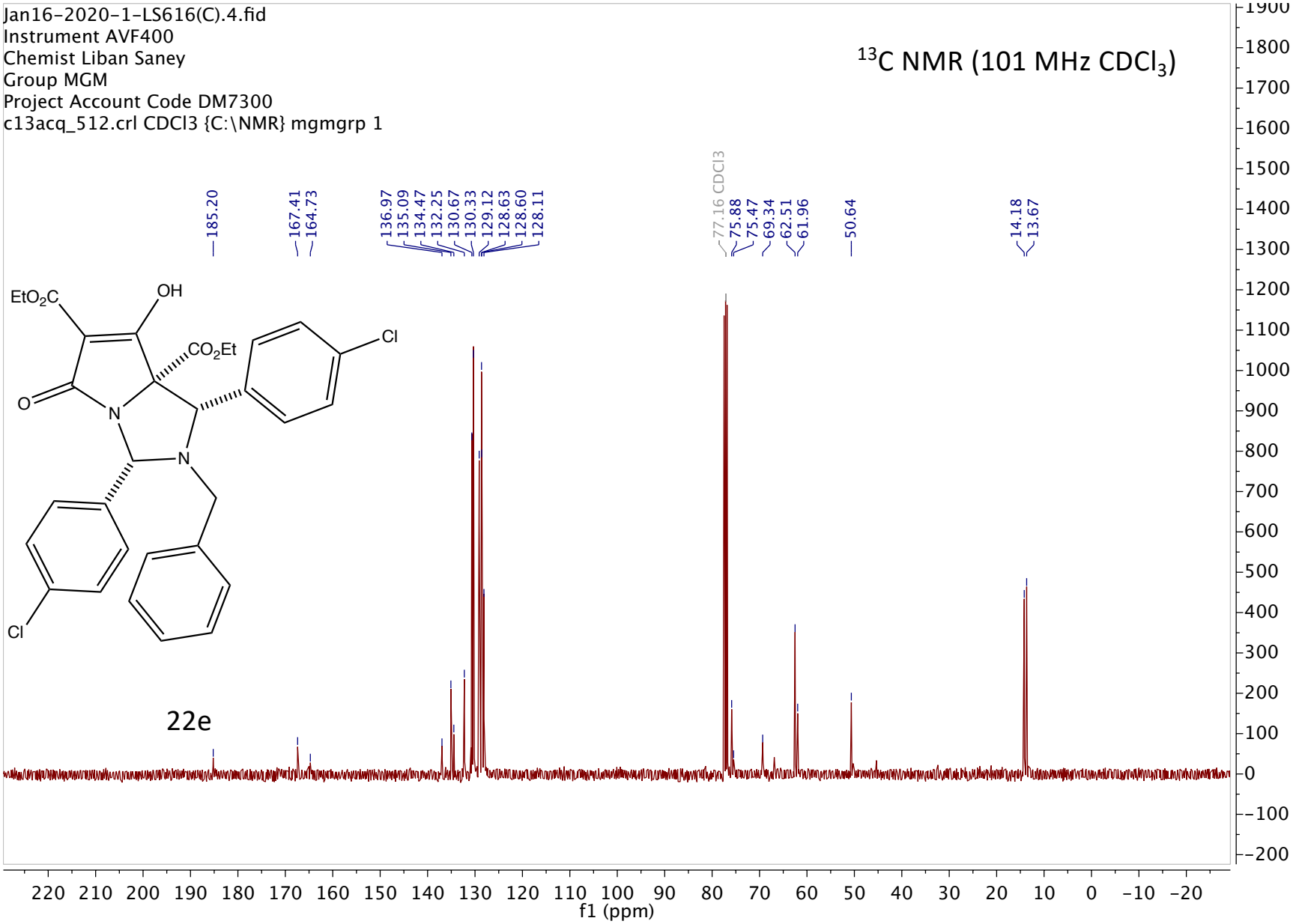
Mar29-2019-59-LS360(C).6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
f19acq.crl CDCl3 {C:\NMR} mgmgrp 59

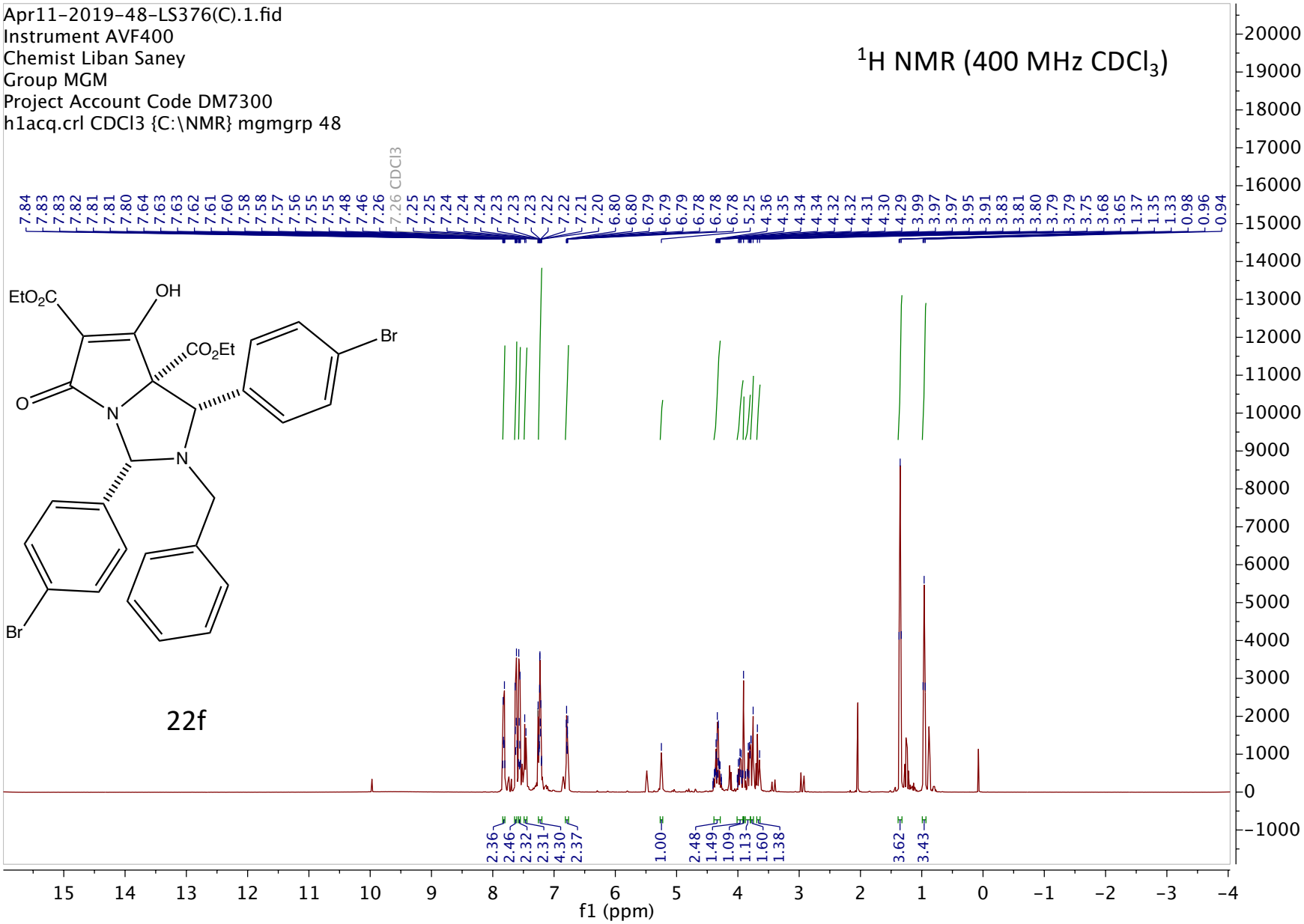
^{19}F NMR (377 MHz $CDCl_3$)

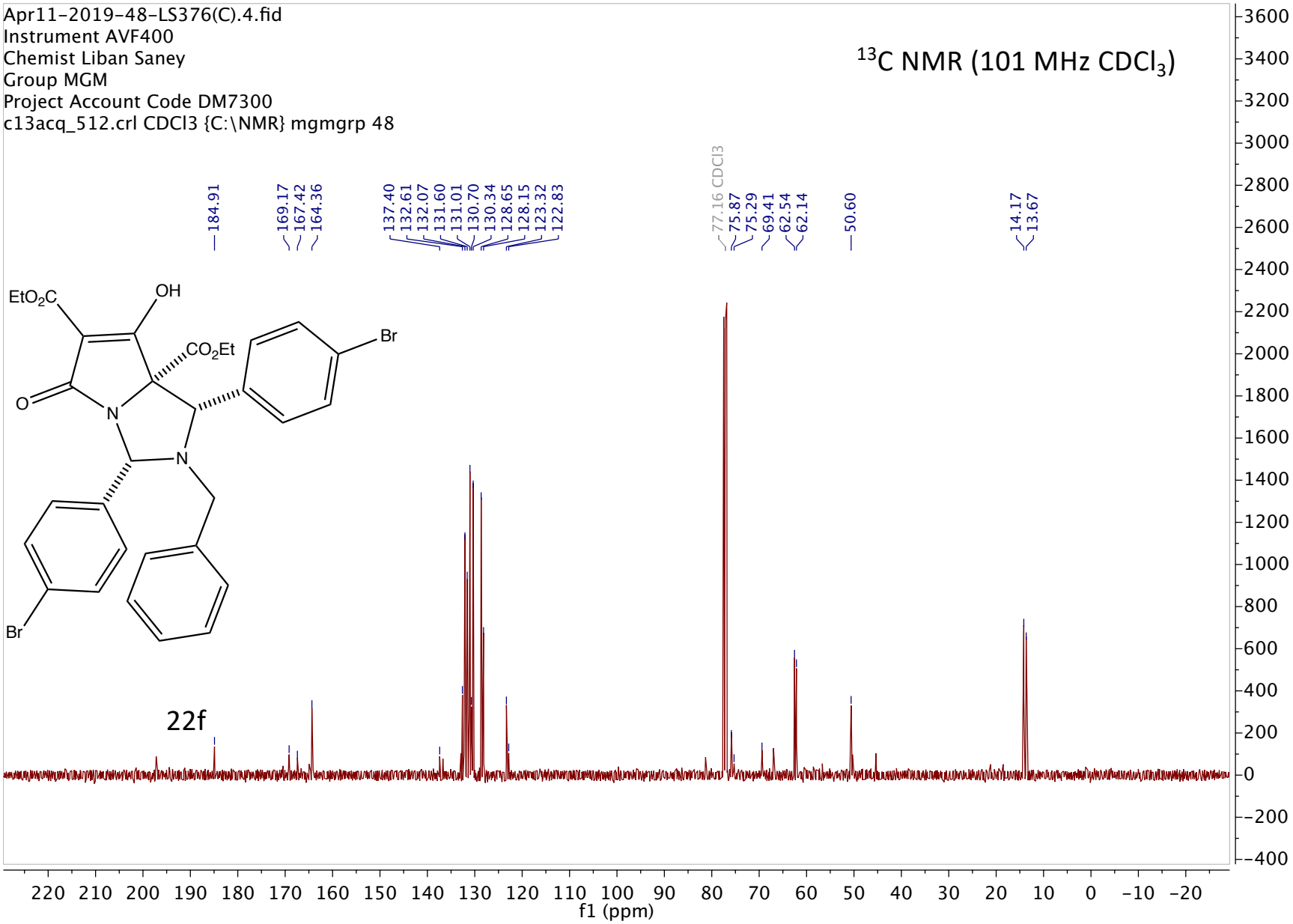


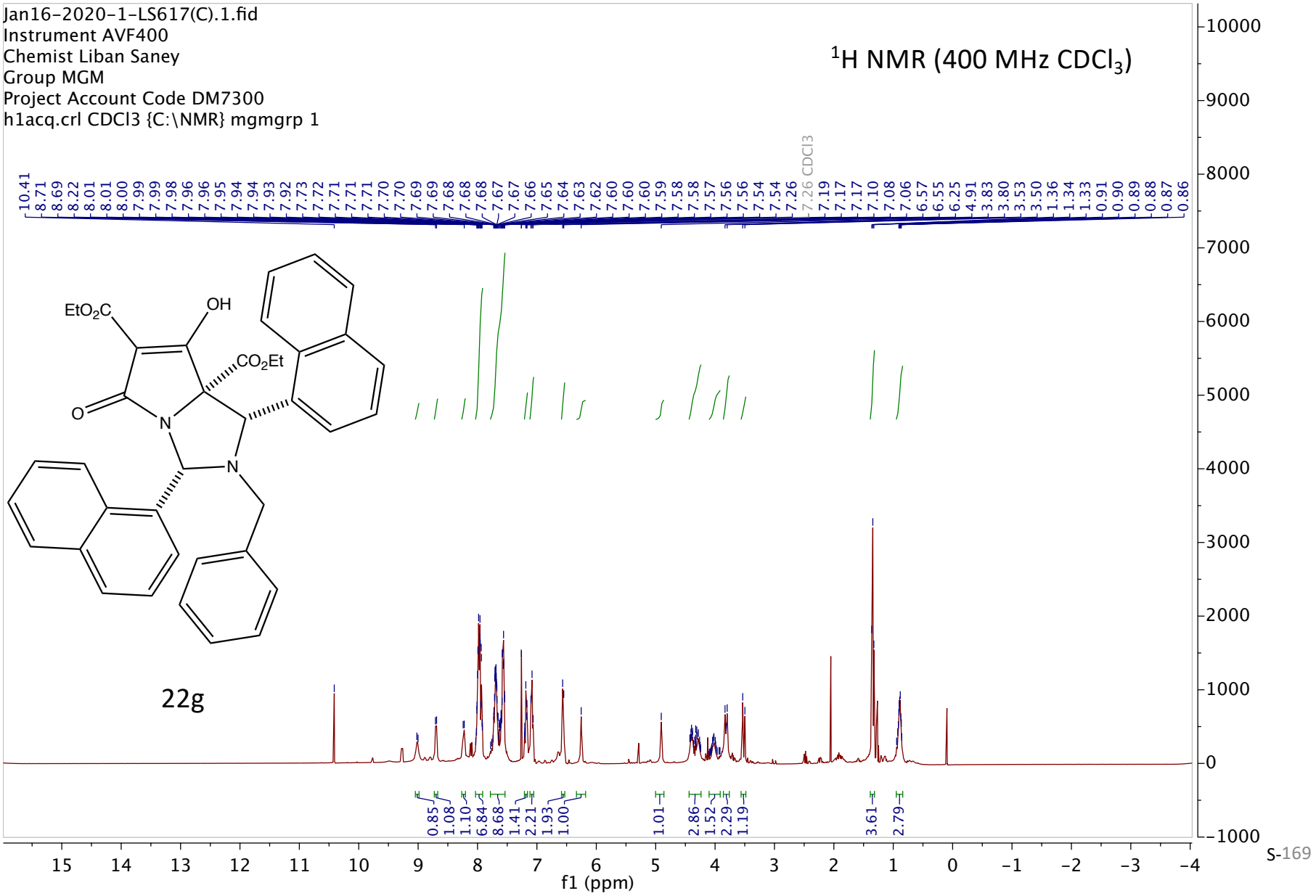
22d

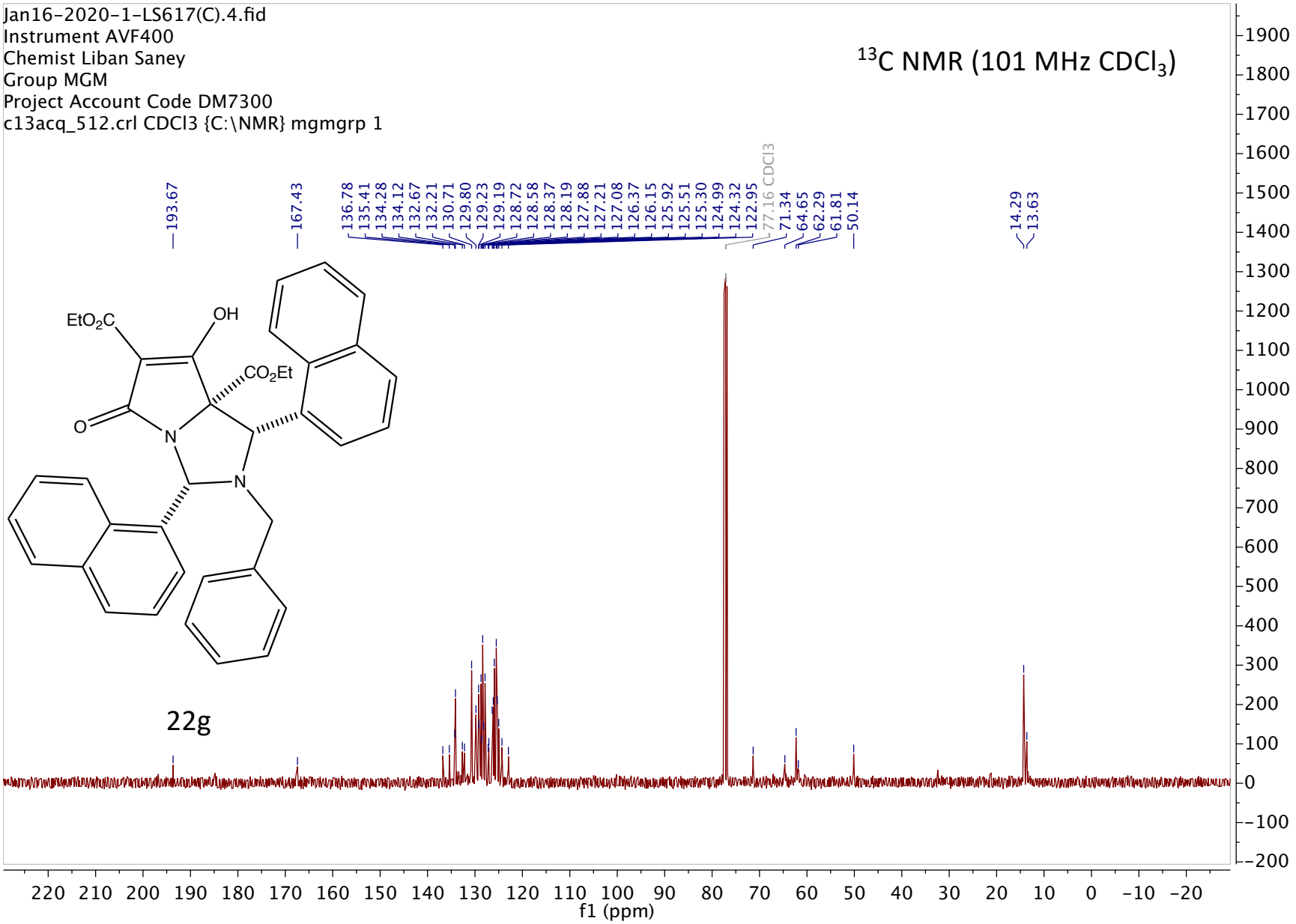

Jan16-2020-1-LS616(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
22e
f1 (ppm)

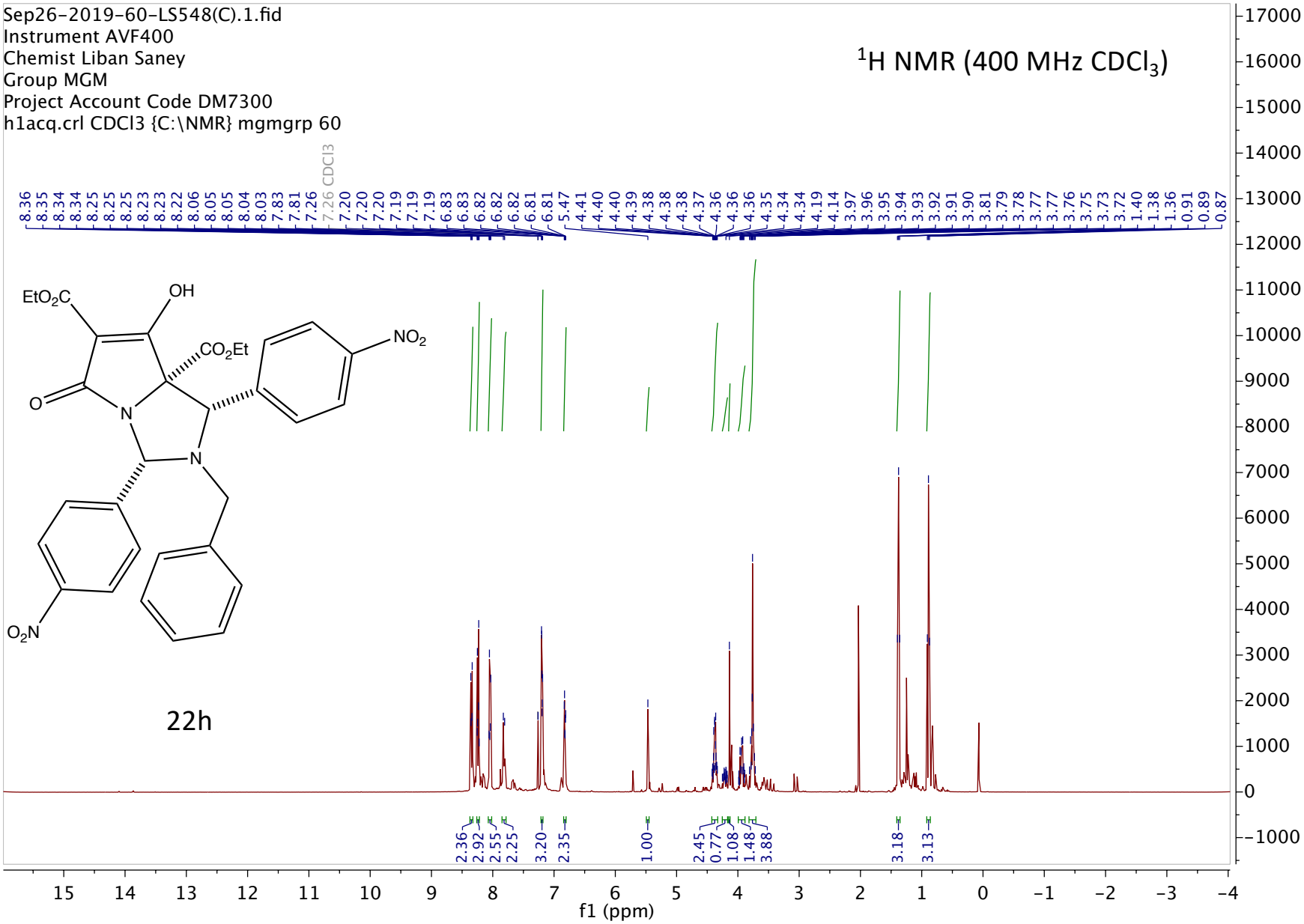

Jan16-2020-1-LS616(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
185.20
167.41
164.73
136.97
135.09
134.47
132.25
130.67
130.33
129.12
128.63
128.60
128.11
77.16 CDCl3
75.88
75.47
69.34
62.51
61.96
50.64
14.18
13.67
EtO2C
OH
CO2Et
Cl
O
N
N
Cl
22e
f1 (ppm)

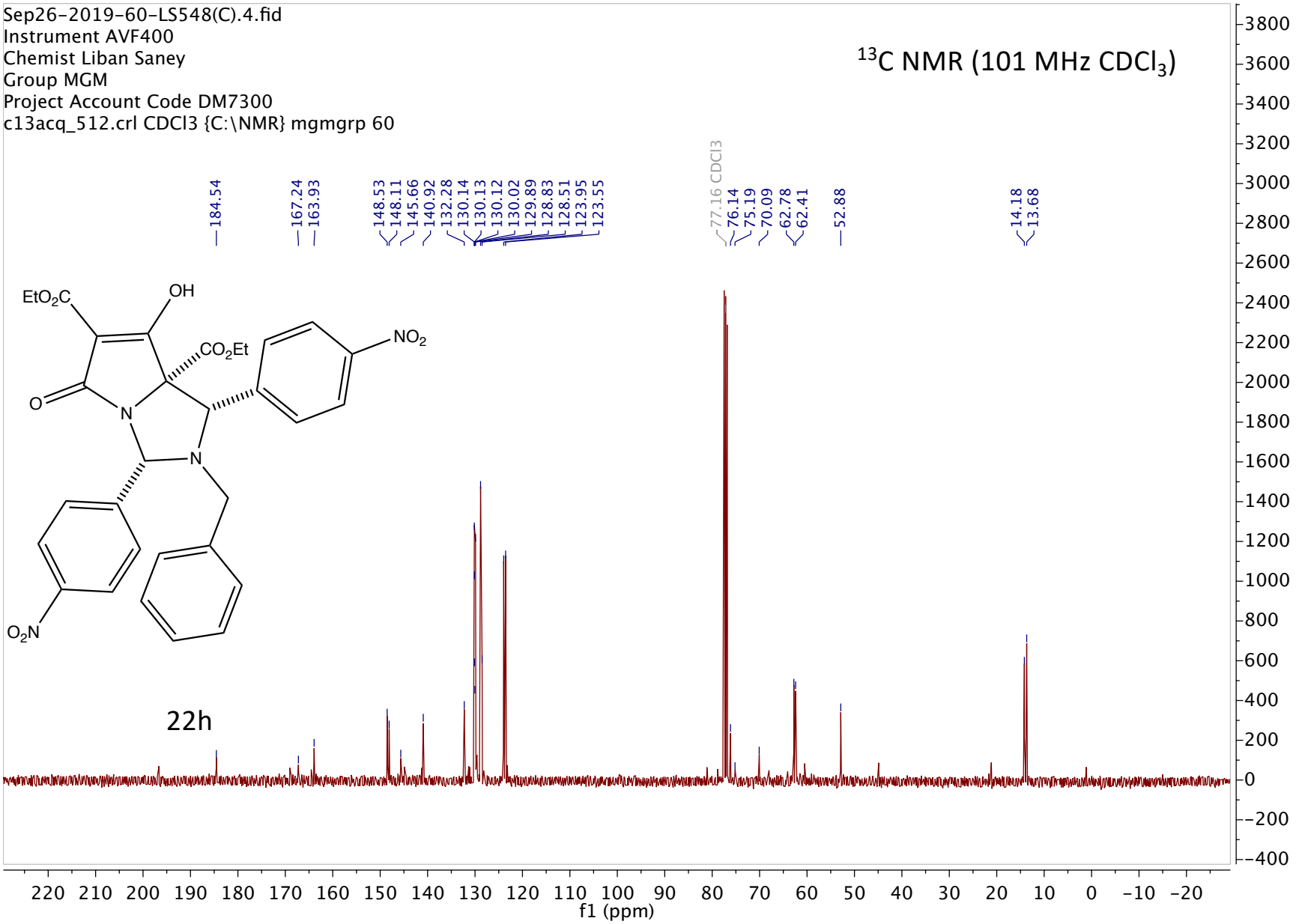

Apr11-2019-48-LS376(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 48
^{1}H NMR (400 MHz $CDCl_3$)
7.26 CDCl3
EtO2C
OH
CO2Et
Br
O
N
N
Br
22f
2.36
2.46
2.32
2.31
4.30
2.37
1.00
2.48
1.49
1.09
1.13
1.60
1.38
3.62
3.43
f1 (ppm)

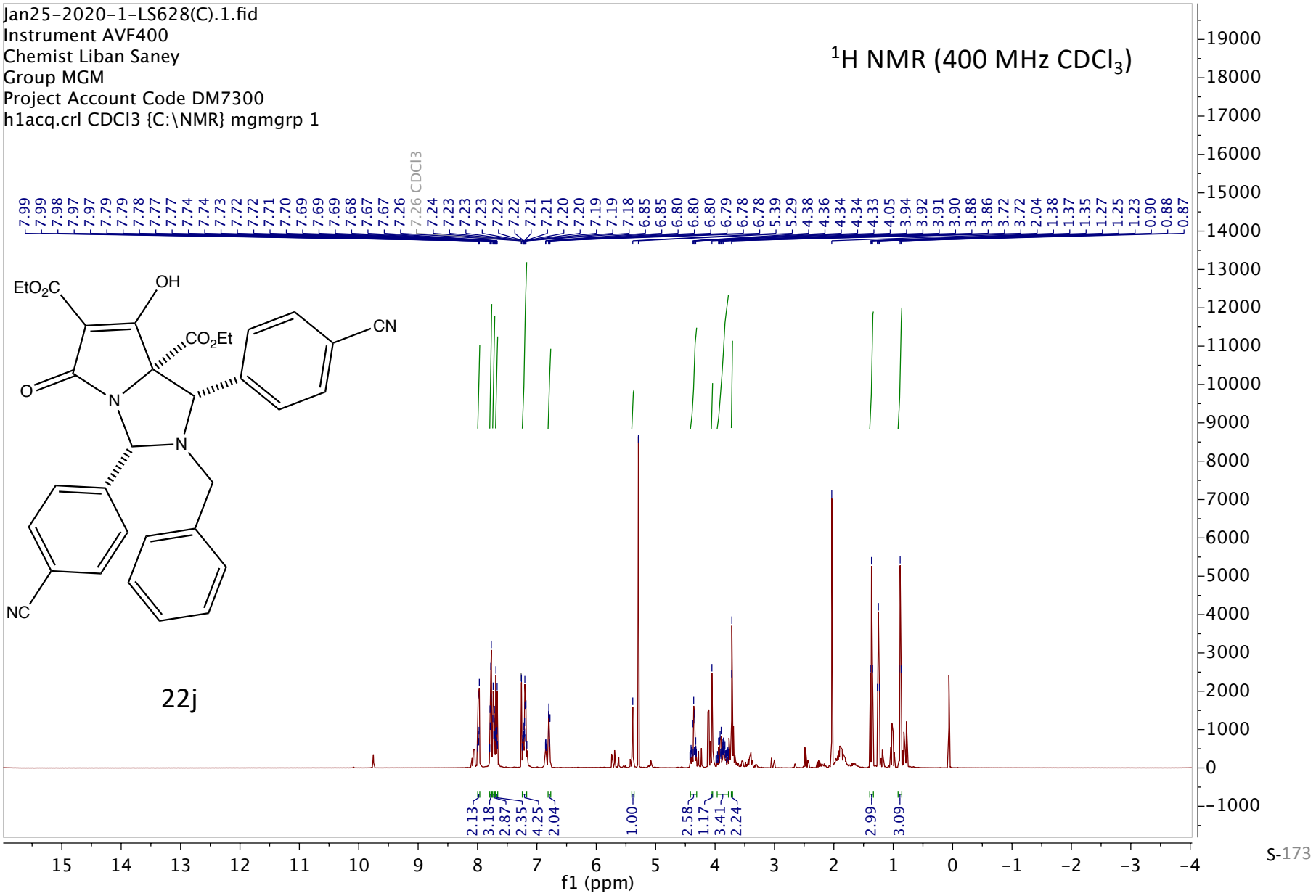

Apr11-2019-48-LS376(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 48
^{13}C NMR (101 MHz $CDCl_3$)
184.91
169.17
167.42
164.36
137.40
132.61
132.07
131.60
131.01
130.70
130.34
128.65
128.15
123.32
122.83
77.16 CDCl3
75.87
75.29
69.41
62.54
62.14
50.60
14.17
13.67
EtO2C
OH
CO2Et
Br
O
N
N
Br
22f
f1 (ppm)

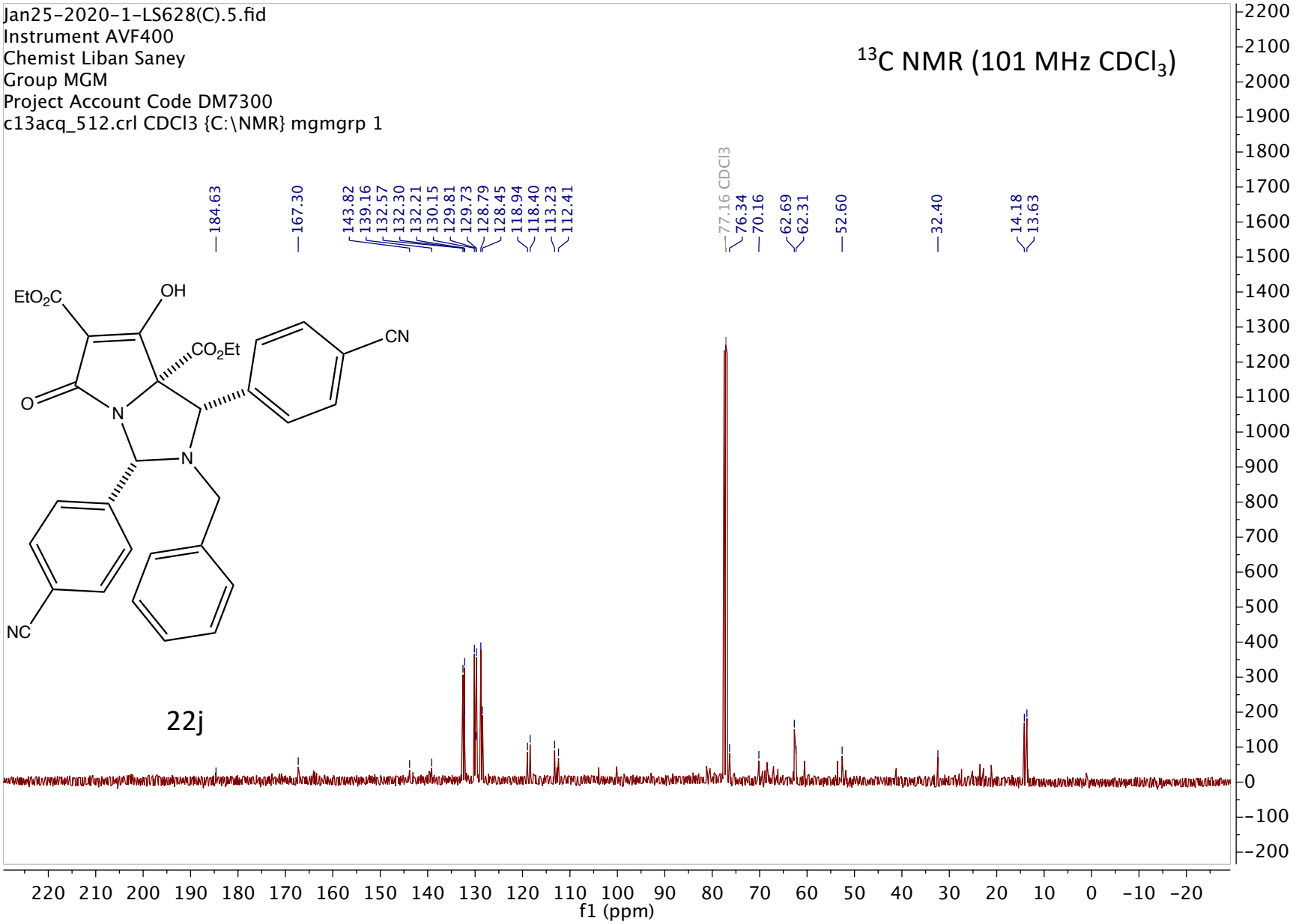

Jan16-2020-1-LS617(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
22g
f1 (ppm)

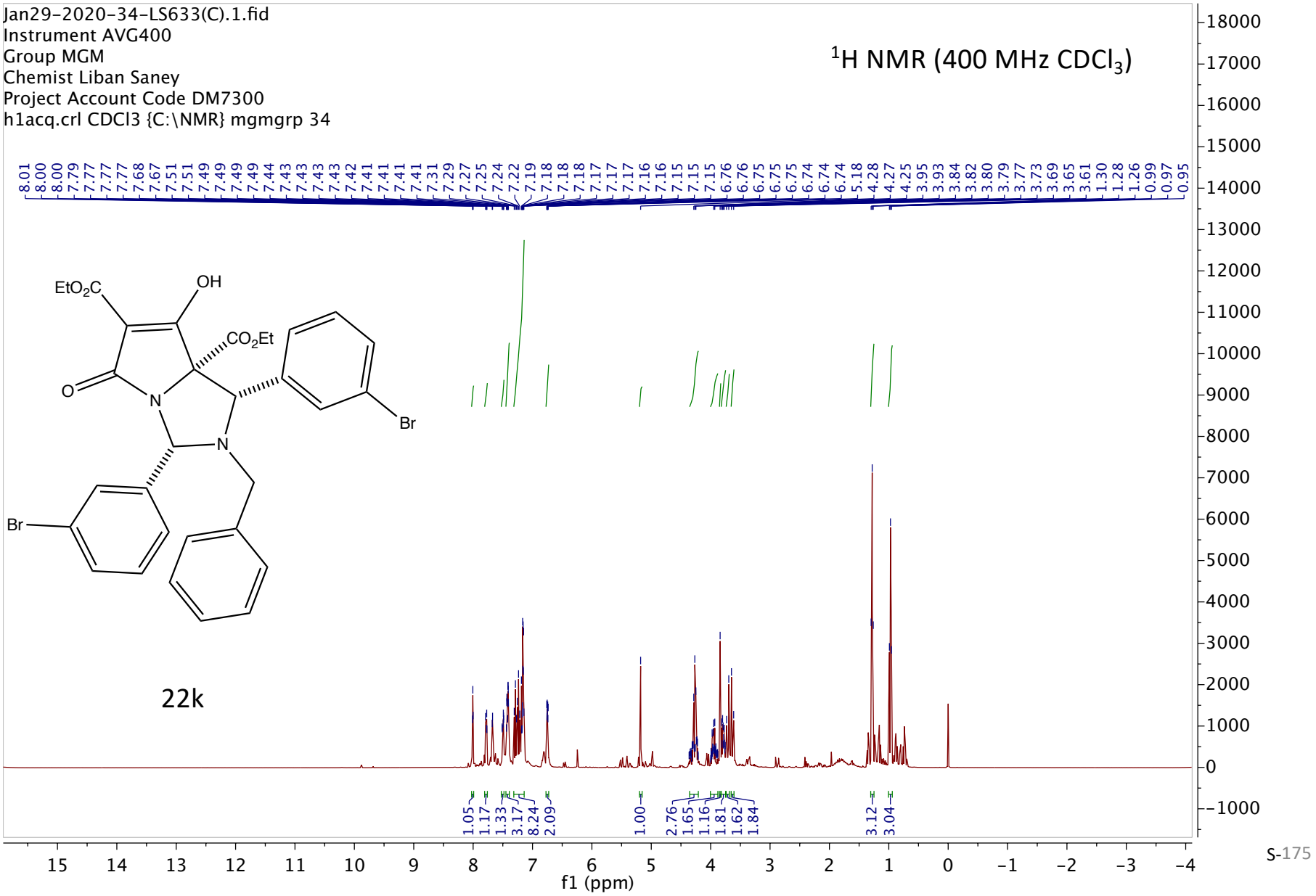

Jan16-2020-1-LS617(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
193.67
167.43
136.78
135.41
134.28
134.12
132.67
132.21
130.71
129.80
129.23
129.19
128.72
128.58
128.37
128.19
127.88
127.21
127.08
126.37
126.15
125.92
125.51
125.30
124.99
124.32
122.95
77.16 CDCl3
71.34
64.65
62.29
61.81
50.14
14.29
13.63
EtO2C
OH
CO2Et
O
N
N
22g
f1 (ppm)

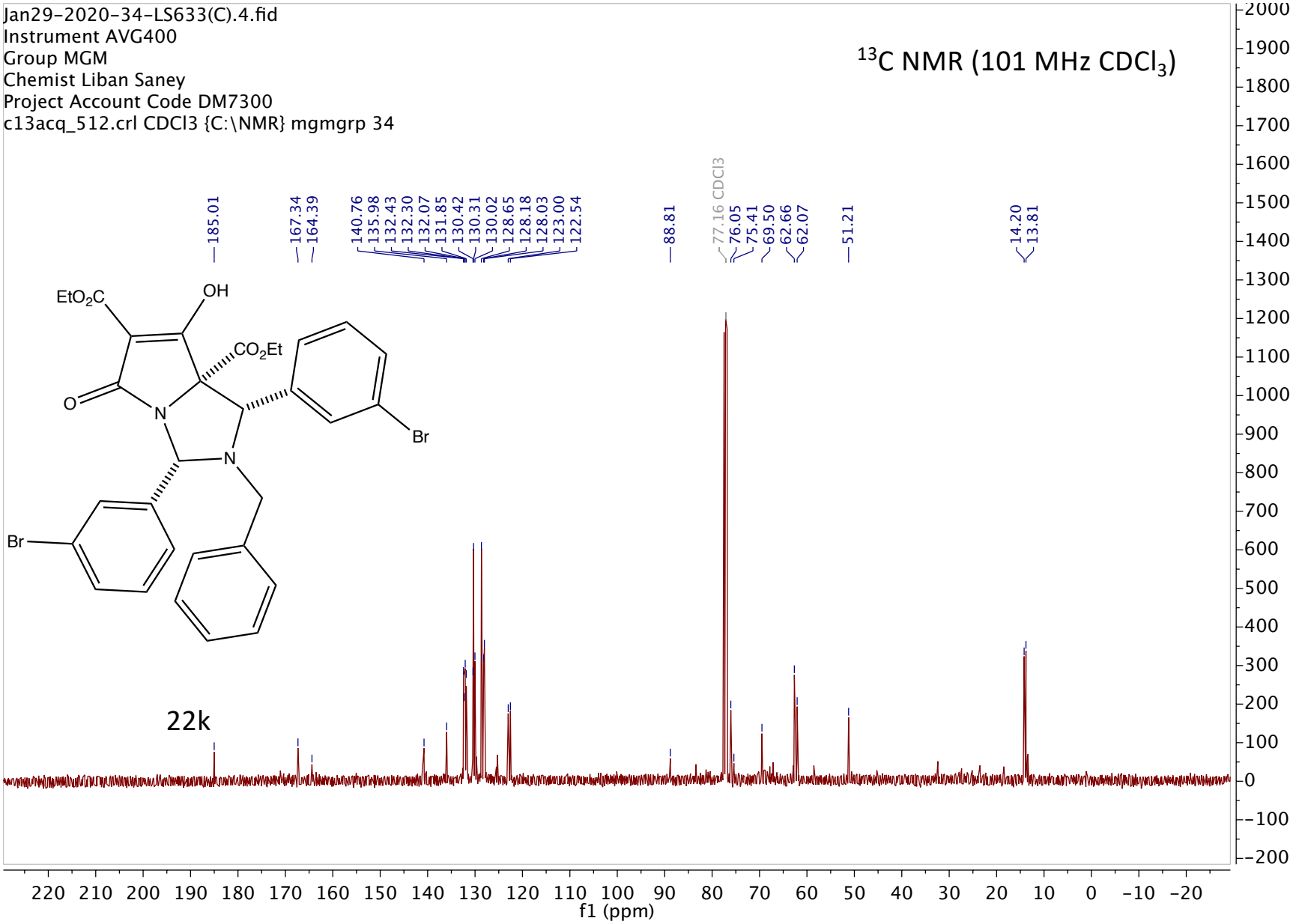

Sep26-2019-60-LS548(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
22h
f1 (ppm)

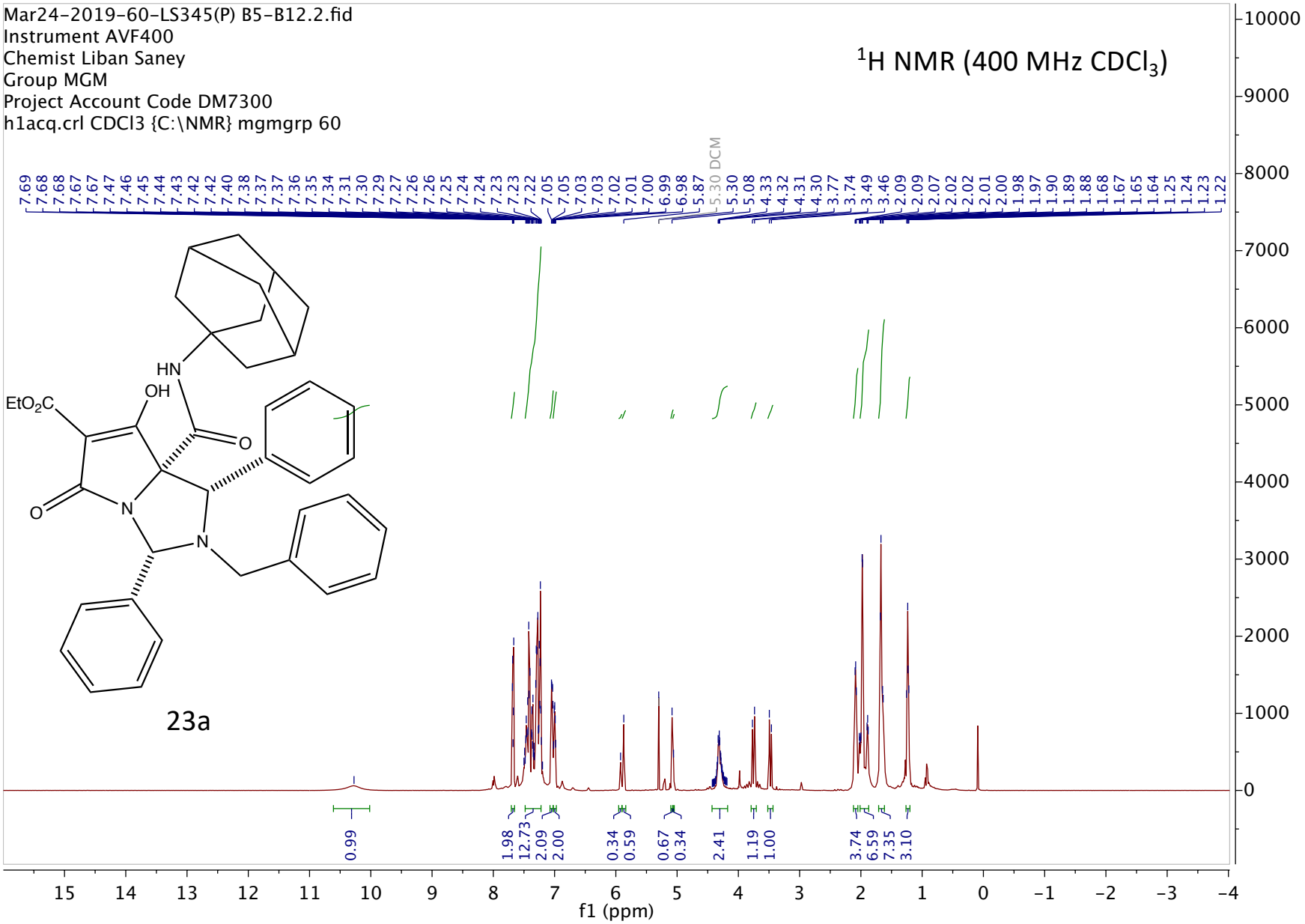

Sep26-2019-60-LS548(C).4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
184.54
167.24
163.93
148.53
148.11
145.66
140.92
132.28
130.14
130.13
130.12
130.02
129.89
128.83
128.51
123.95
123.55
77.16 CDCl3
76.14
75.19
70.09
62.78
62.41
52.88
14.18
13.68
EtO_2C
OH
CO_2Et
NO_2
O
N
N
O_2N
22h
f1 (ppm)

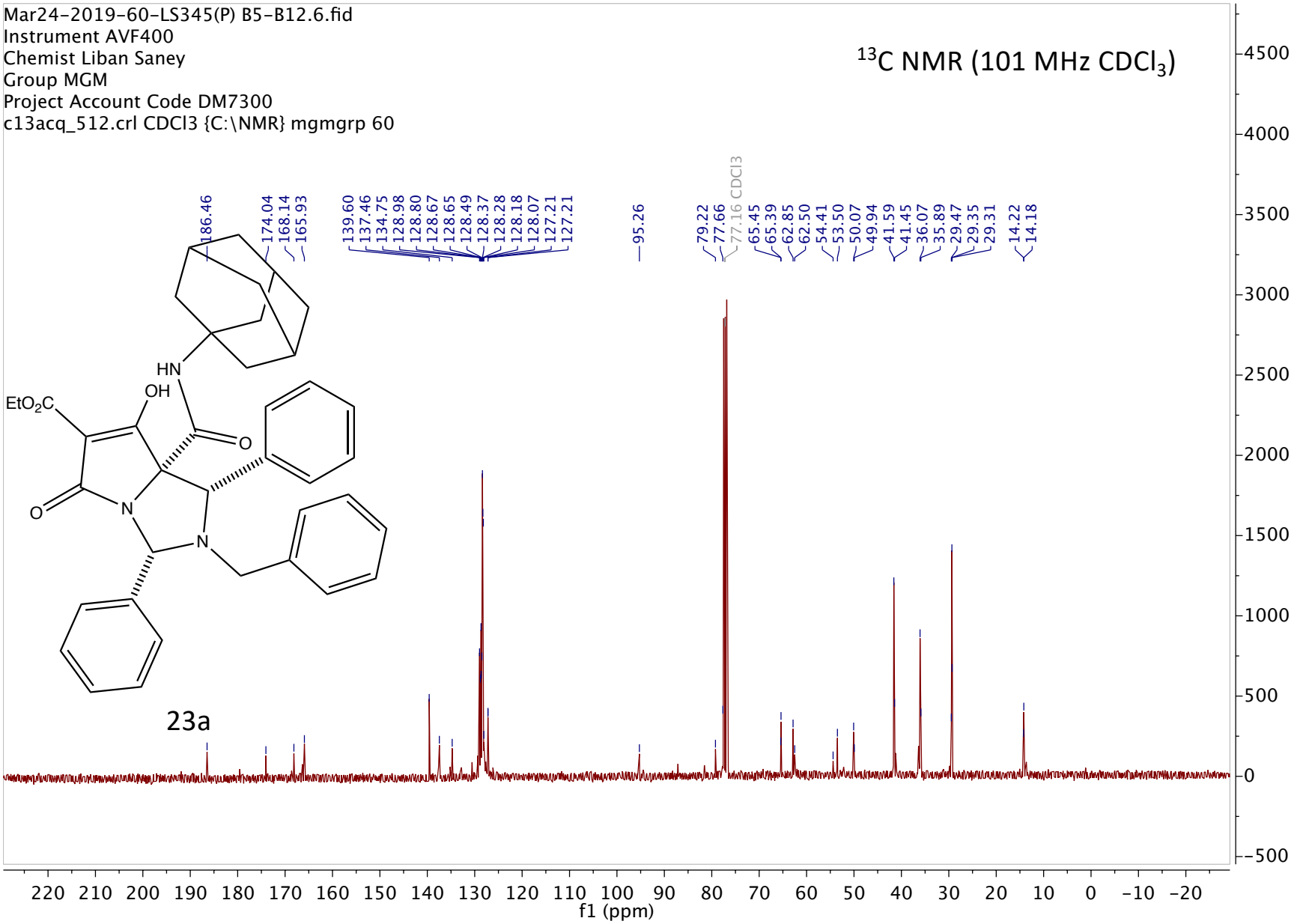

Jan25-2020-1-LS628(C).1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 1
^{1}H NMR (400 MHz $CDCl_3$)
7.26 CDCl3
EtO2C
OH
CO2Et
CN
O
N
N
NC
22j
2.13
3.18
2.87
2.35
4.25
2.04
1.00
2.58
1.17
3.41
2.24
2.99
3.09
f1 (ppm)

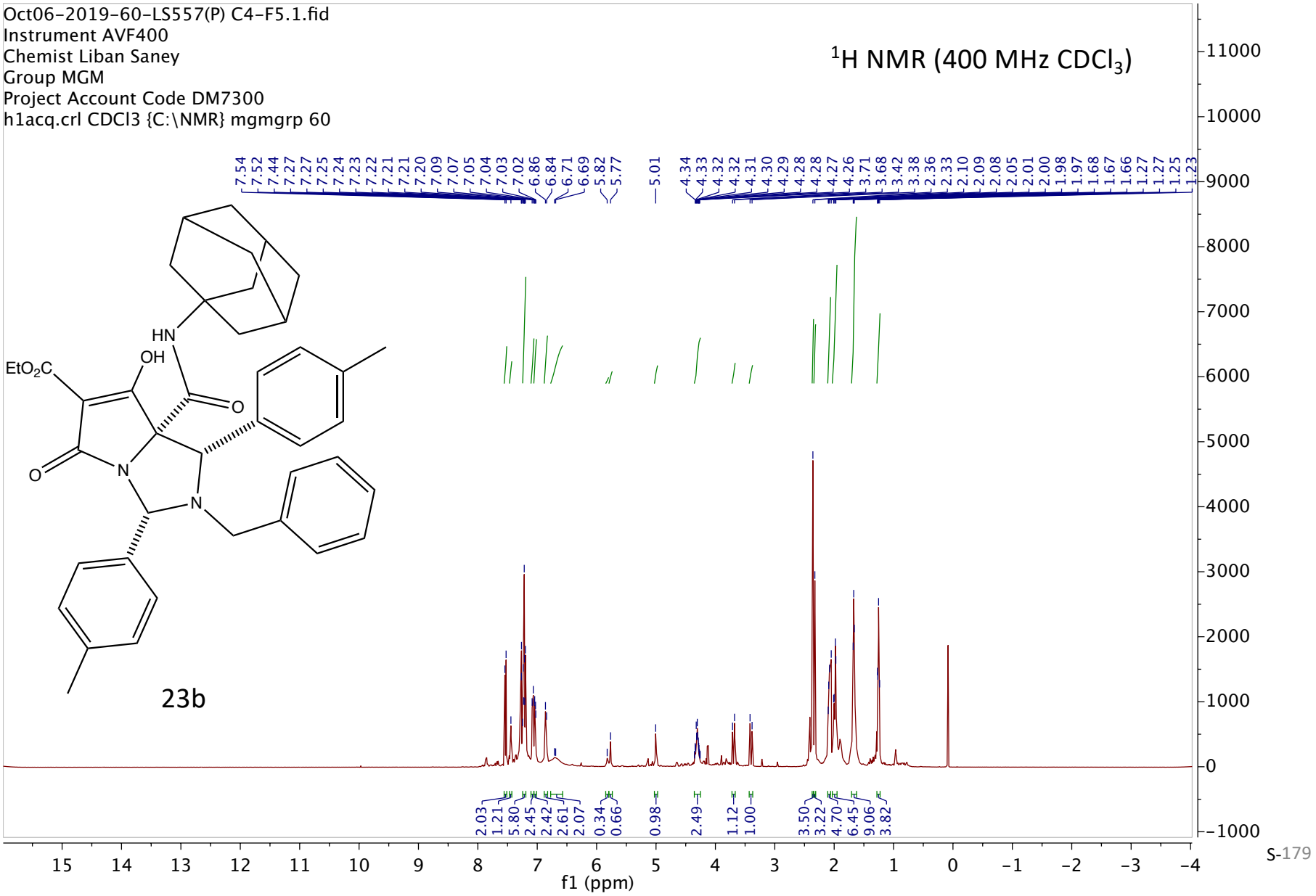

Jan25-2020-1-LS628(C).5.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 1
^{13}C NMR (101 MHz $CDCl_3$)
184.63
167.30
143.82
139.16
132.57
132.30
132.21
130.15
129.81
129.73
128.79
128.45
118.94
118.40
113.23
112.41
77.16 CDCl3
76.34
70.16
62.69
62.31
52.60
32.40
14.18
13.63
EtO2C
OH
CO2Et
CN
O
N
N
NC
22j
f1 (ppm)

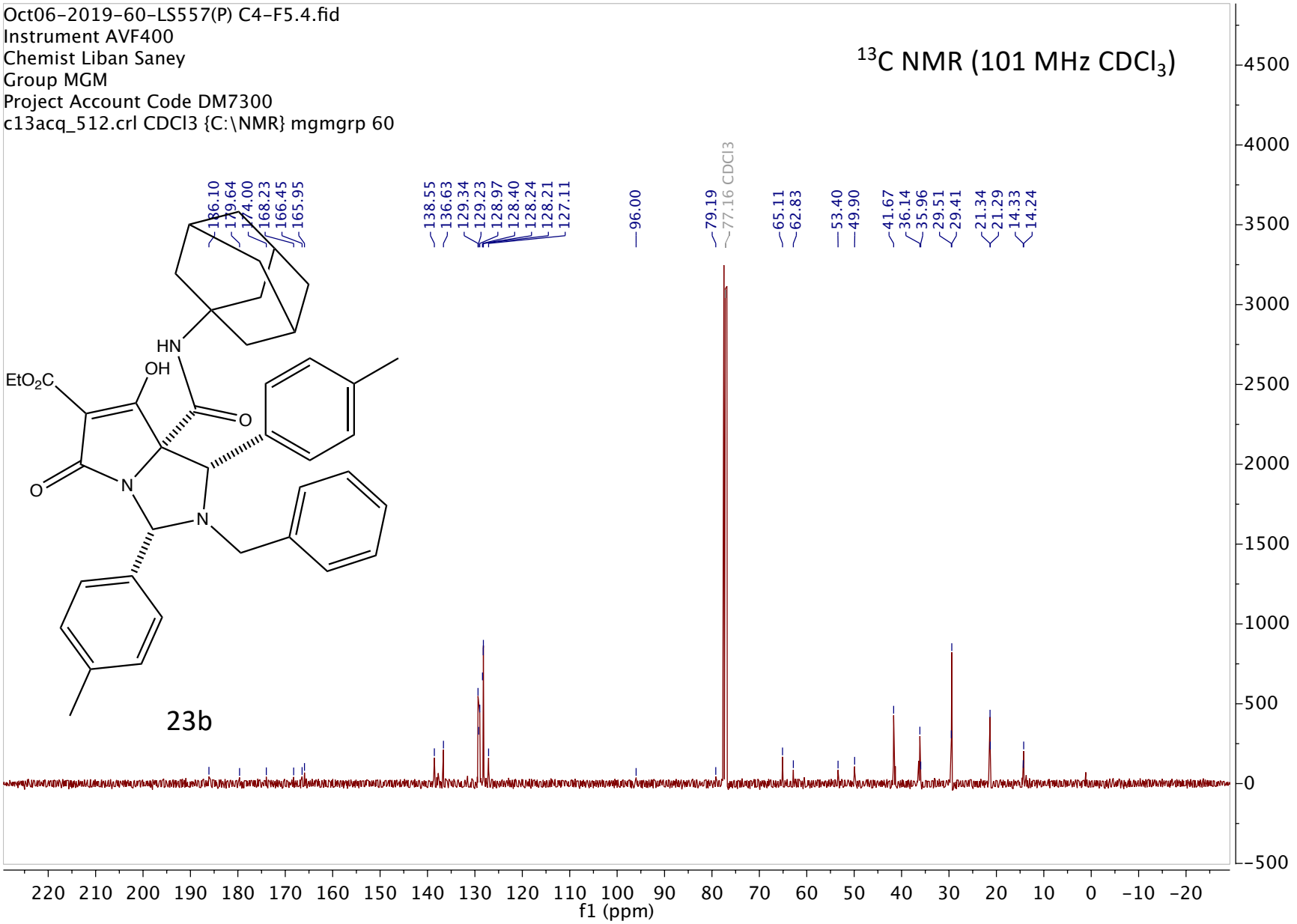

Jan29-2020-34-LS633(C).1.fid
Instrument AVG400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 34
^{1}H NMR (400 MHz $CDCl_3$)
22k
f1 (ppm)

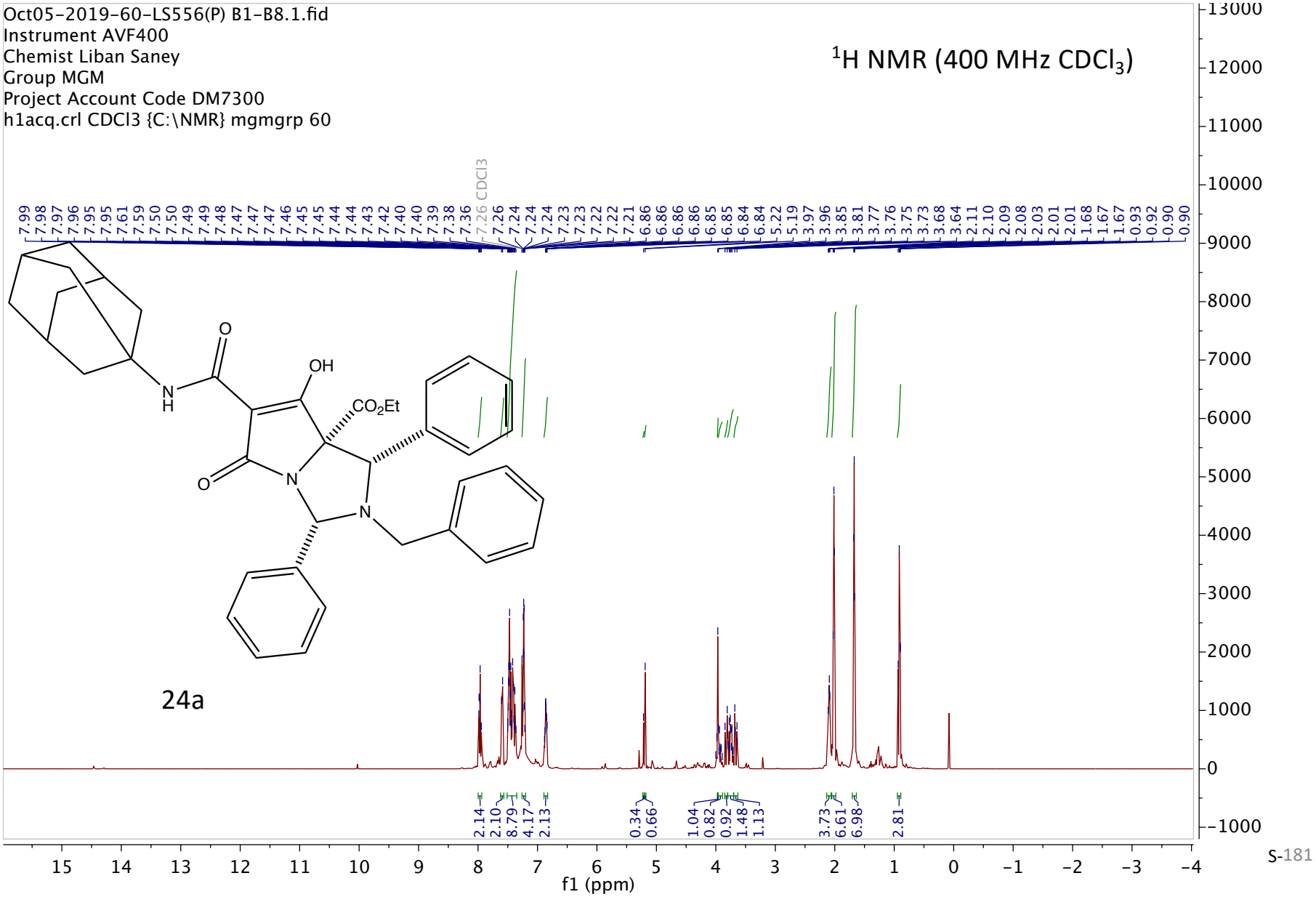

Jan29-2020-34-LS633(C).4.fid
Instrument AVG400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 34
^{13}C NMR (101 MHz $CDCl_3$)
185.01
167.34
164.39
140.76
135.98
132.43
132.30
132.07
131.85
130.42
130.31
130.02
128.65
128.18
128.03
123.00
122.54
88.81
77.16 CDCl3
76.05
75.41
69.50
62.66
62.07
51.21
14.20
13.81
EtO2C
OH
CO2Et
O
N
N
Br
Br
22k
f1 (ppm)

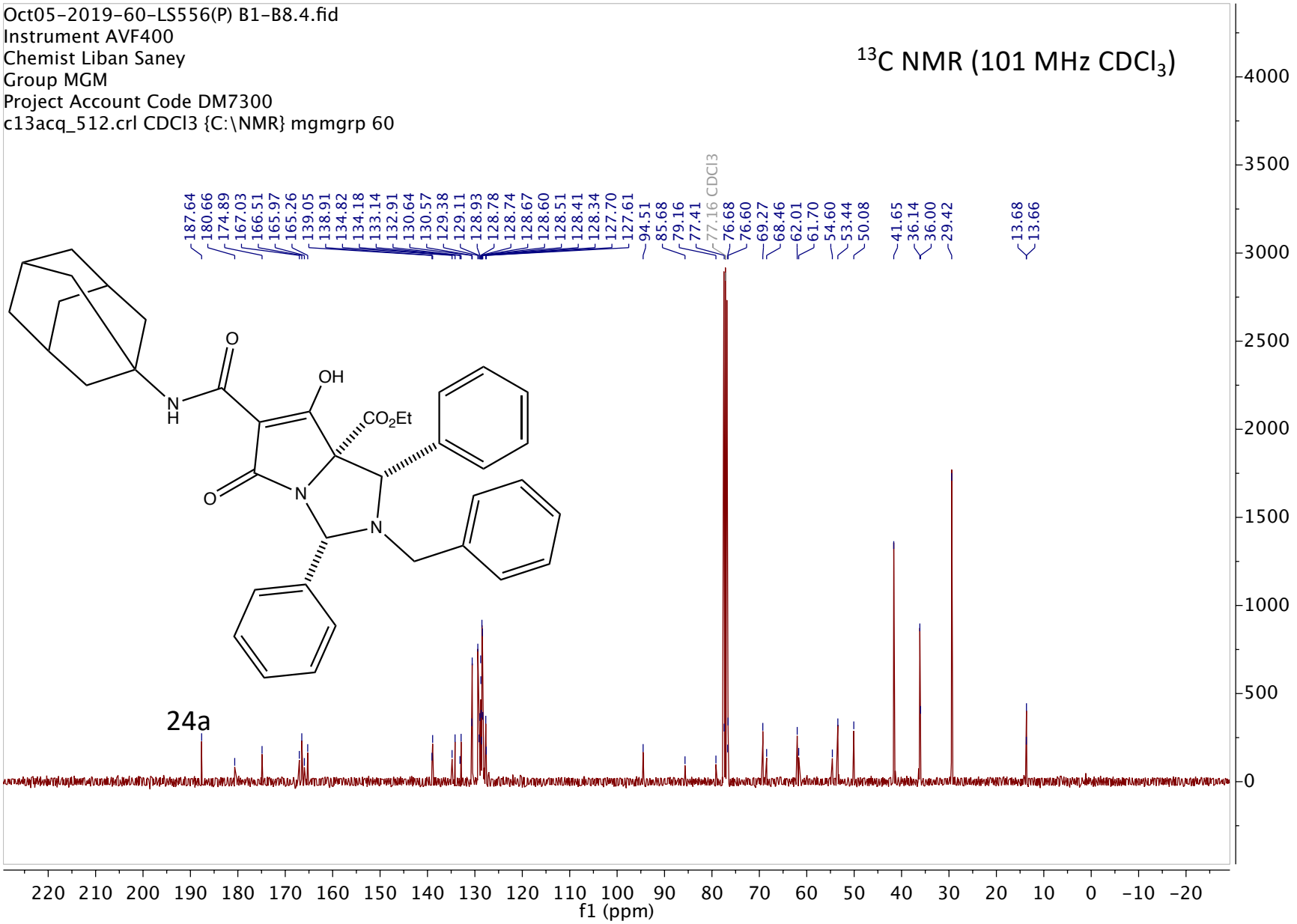

Mar24-2019-60-LS345(P) B5-B12.2.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
DCM
HN
OH
EtO_2C
O
O
N
N
23a
f1 (ppm)

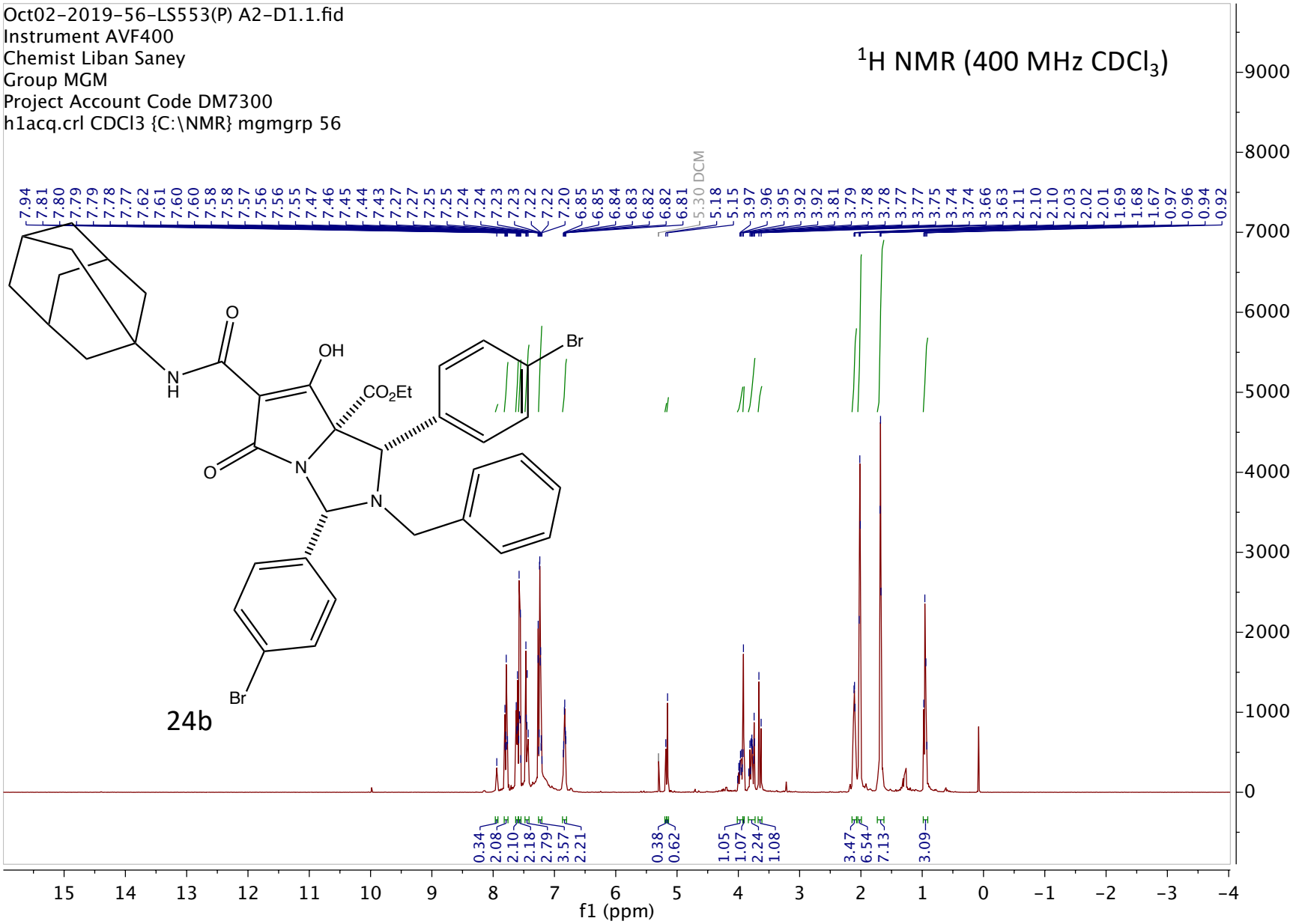

Mar24-2019-60-LS345(P) B5-B12.6.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
186.46
174.04
168.14
165.93
139.60
137.46
134.75
128.98
128.80
128.67
128.65
128.49
128.37
128.28
128.18
128.07
127.21
127.21
95.26
79.22
77.66
77.16 CDCl3
65.45
65.39
62.85
62.50
54.41
53.50
50.07
49.94
41.59
41.45
36.07
35.89
29.47
29.35
29.31
14.22
14.18
HN
OH
EtO_2C
O
O
N
N
23a
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

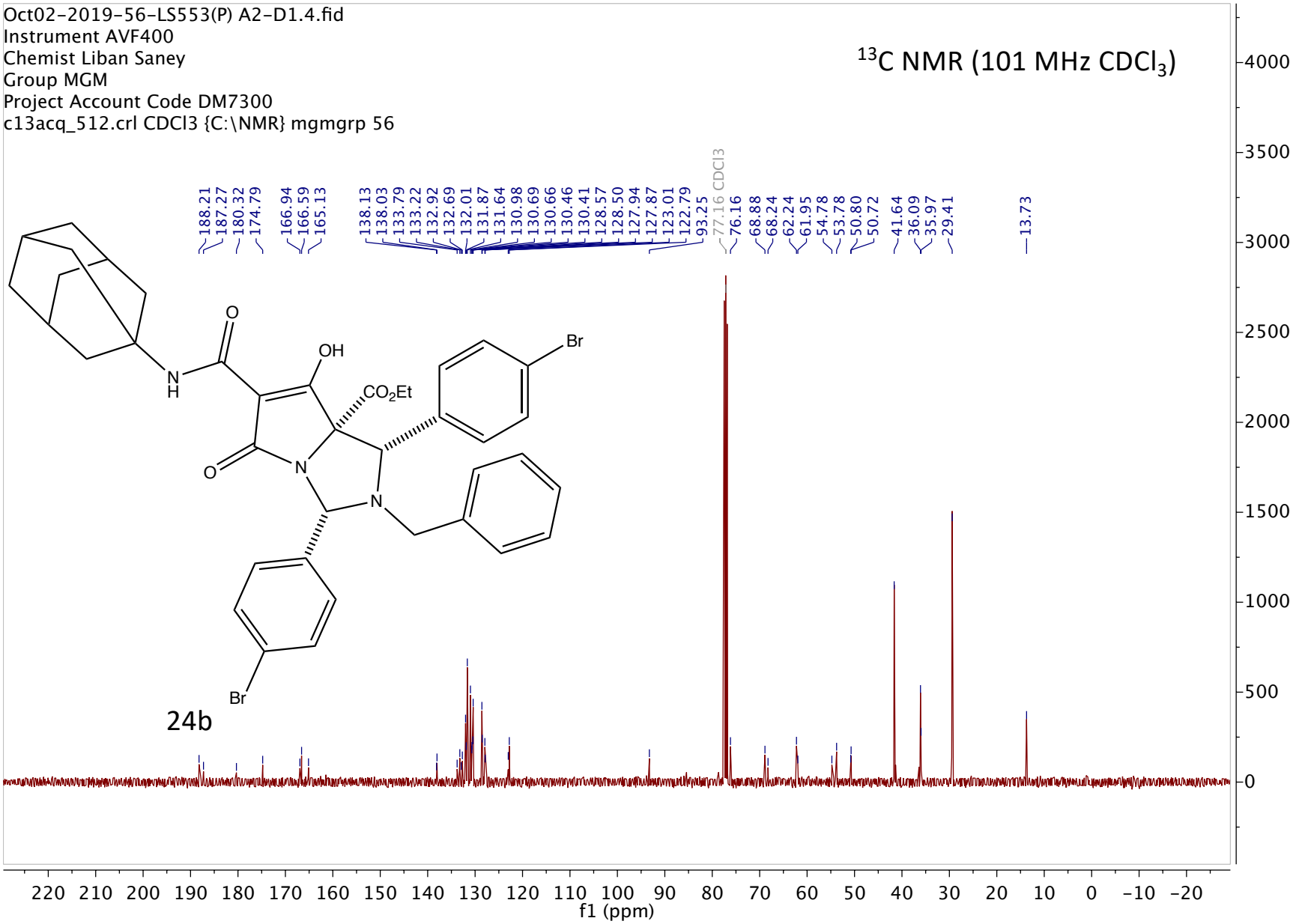

Oct06-2019-60-LS557(P) C4-F5.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
23b
f1 (ppm)

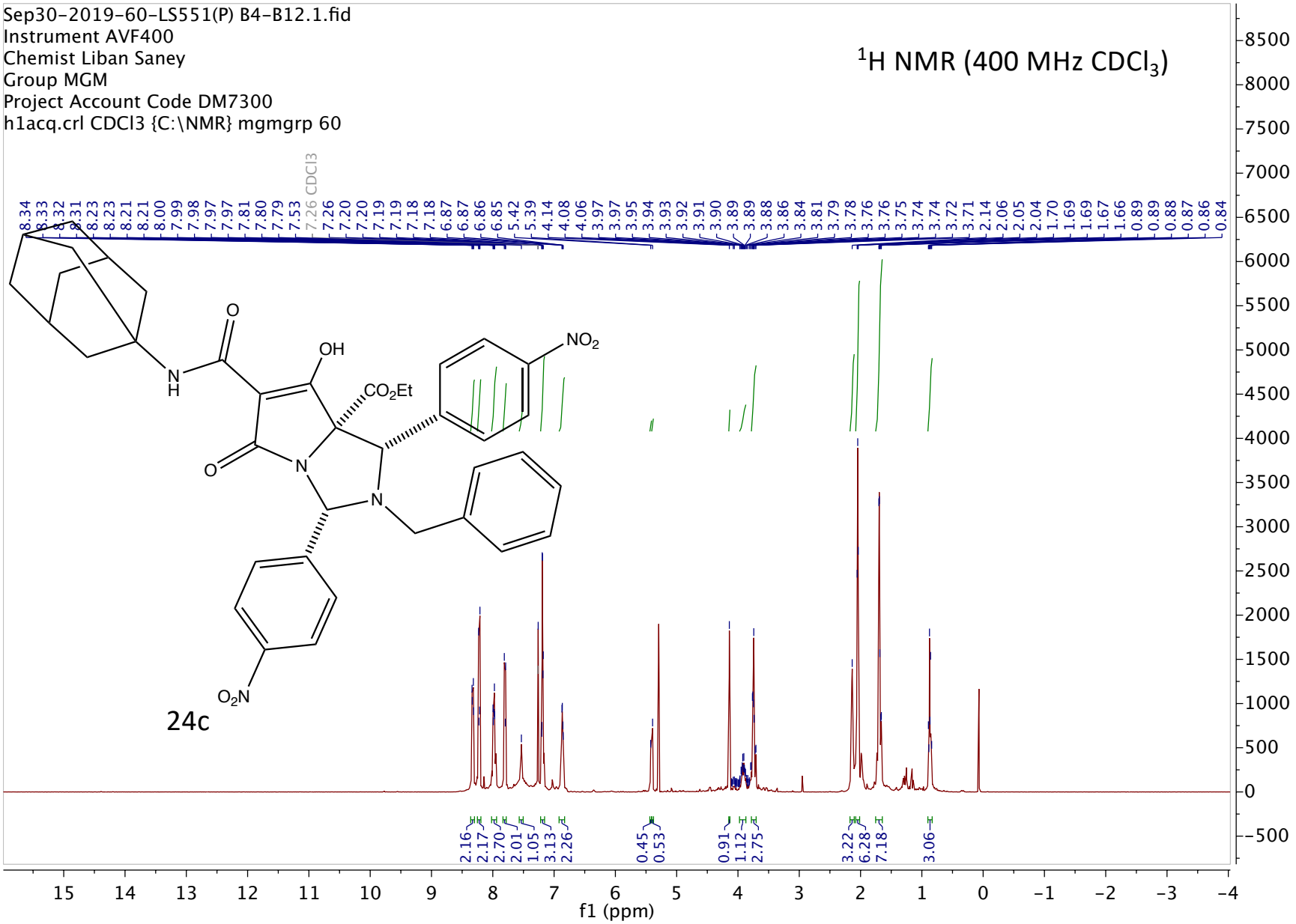

Oct06-2019-60-LS557(P) C4-F5.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
13C NMR (101 MHz CDCl3)
186.10
179.64
174.00
168.23
166.45
165.95
138.55
136.63
129.34
129.23
128.97
128.40
128.24
128.21
127.11
96.00
79.19
77.16 CDCl3
65.11
62.83
53.40
49.90
41.67
36.14
35.96
29.51
29.41
21.34
21.29
14.33
14.24
HN
OH
EtO2C
O
O
N
N
23b
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

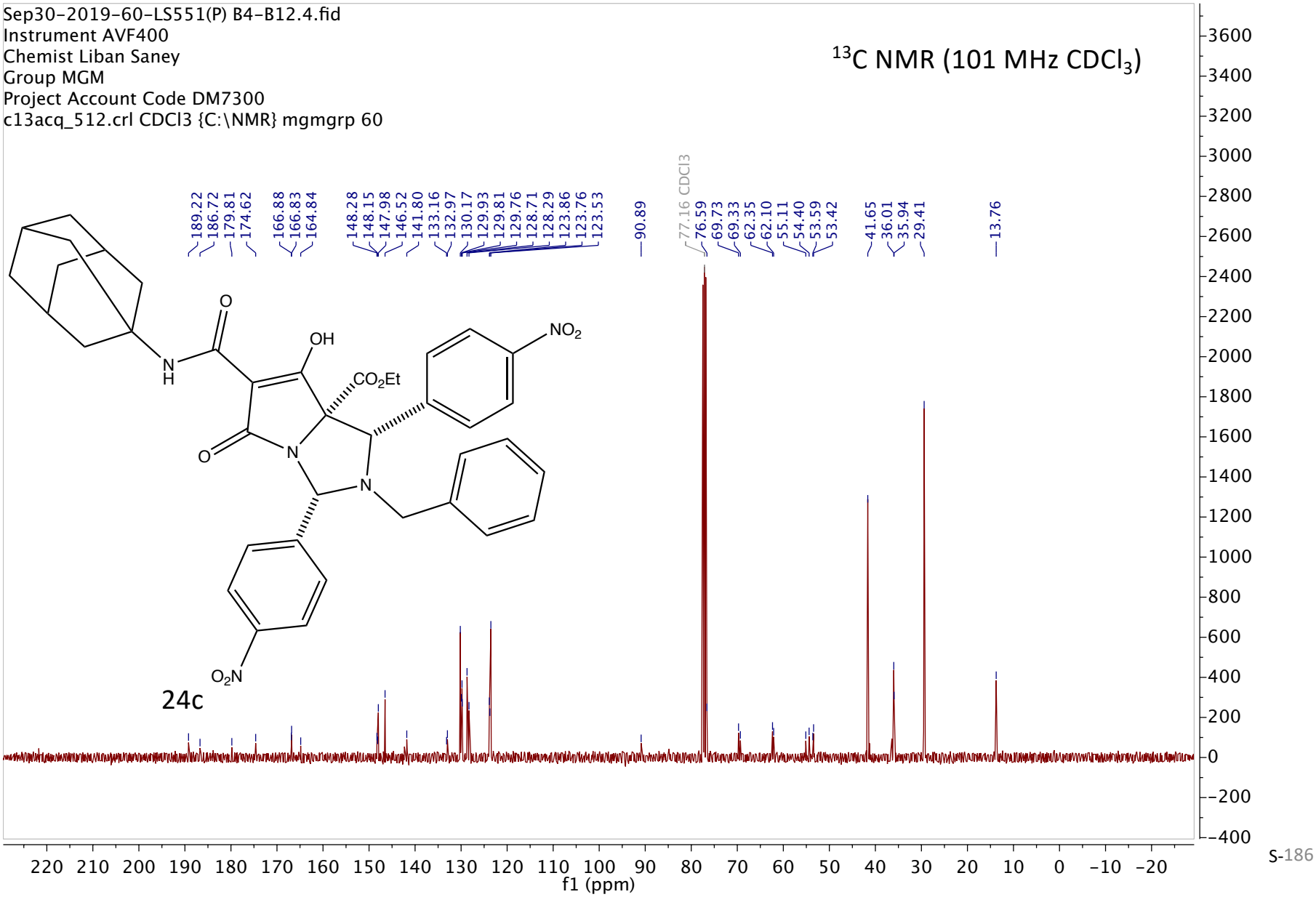

Oct05-2019-60-LS556(P) B1-B8.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
CDCl3
OH
CO_2Et
24a
f1 (ppm)

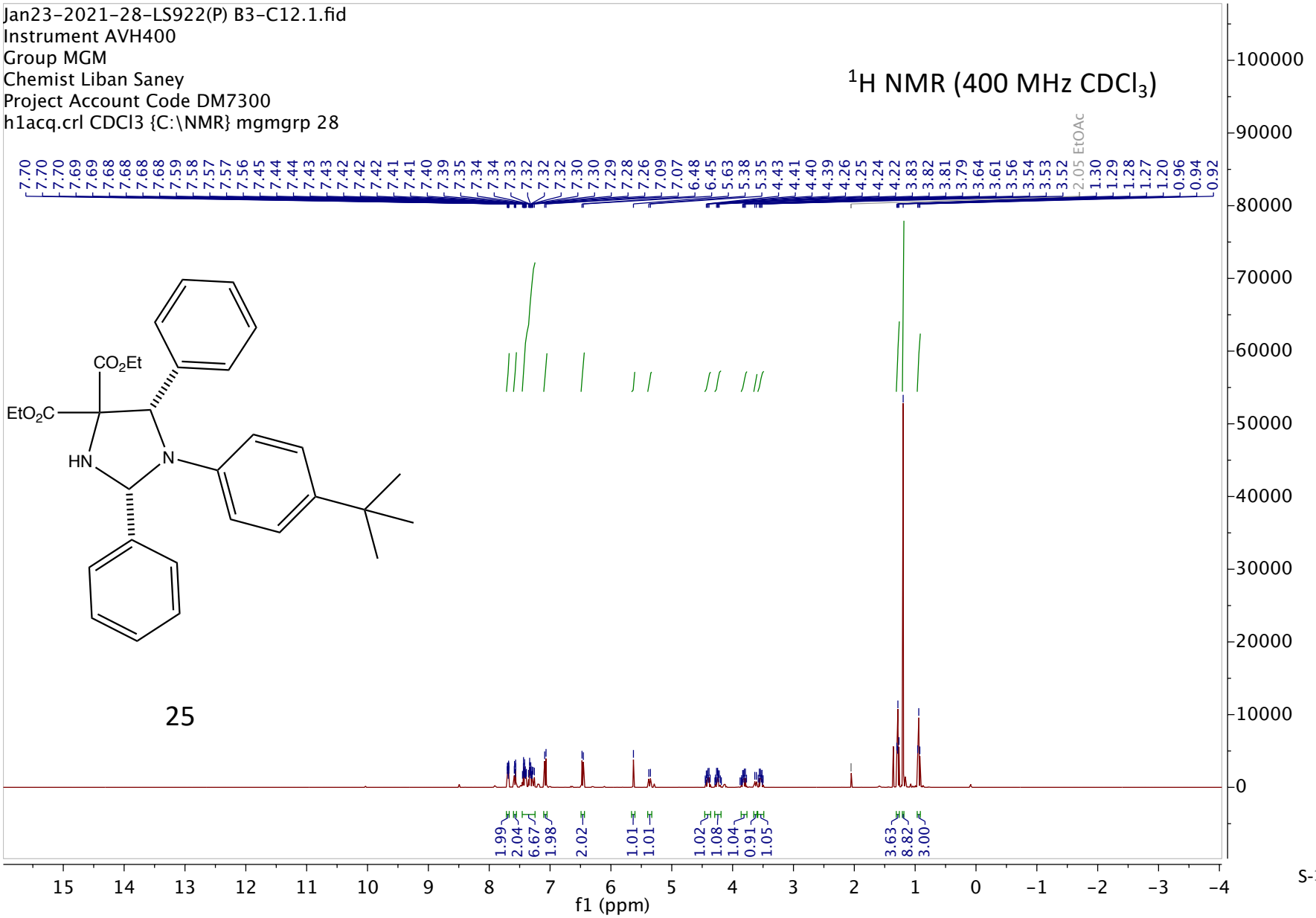

Oct05-2019-60-LS556(P) B1-B8.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
^{13}C NMR (101 MHz $CDCl_3$)
187.64
180.66
174.89
167.03
166.51
165.97
165.26
139.05
138.91
134.82
134.18
133.14
132.91
130.64
130.57
129.38
129.11
128.93
128.78
128.74
128.67
128.60
128.51
128.41
128.34
127.70
127.61
94.51
85.68
79.16
77.41
77.16 CDCl3
76.68
76.60
69.27
68.46
62.01
61.70
54.60
53.44
50.08
41.65
36.14
36.00
29.42
13.68
13.66
OH
CO_2Et
N
H
O
O
N
N
24a
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

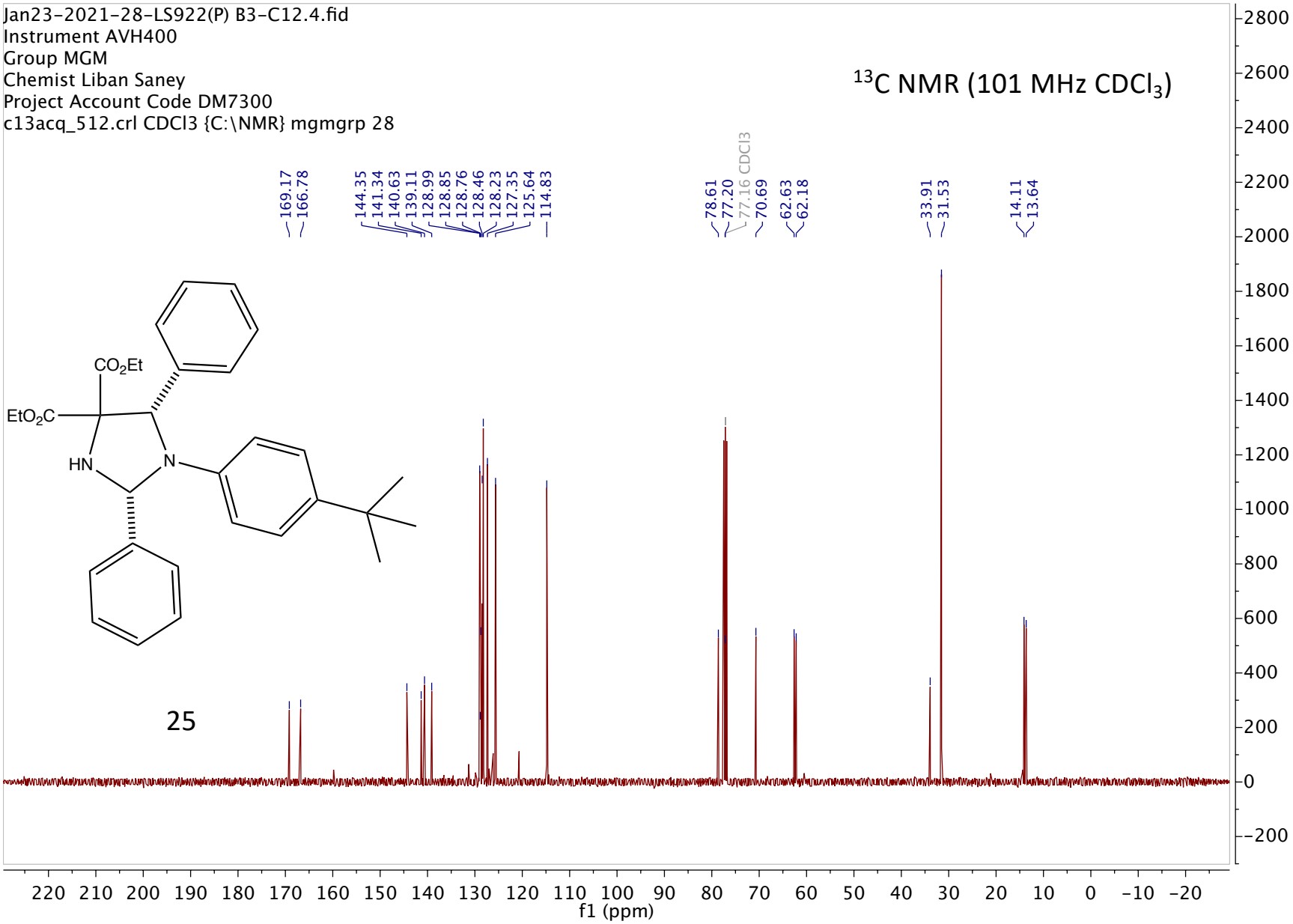

Oct02-2019-56-LS553(P) A2-D1.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 56
^{1}H NMR (400 MHz $CDCl_3$)
24b
f1 (ppm)

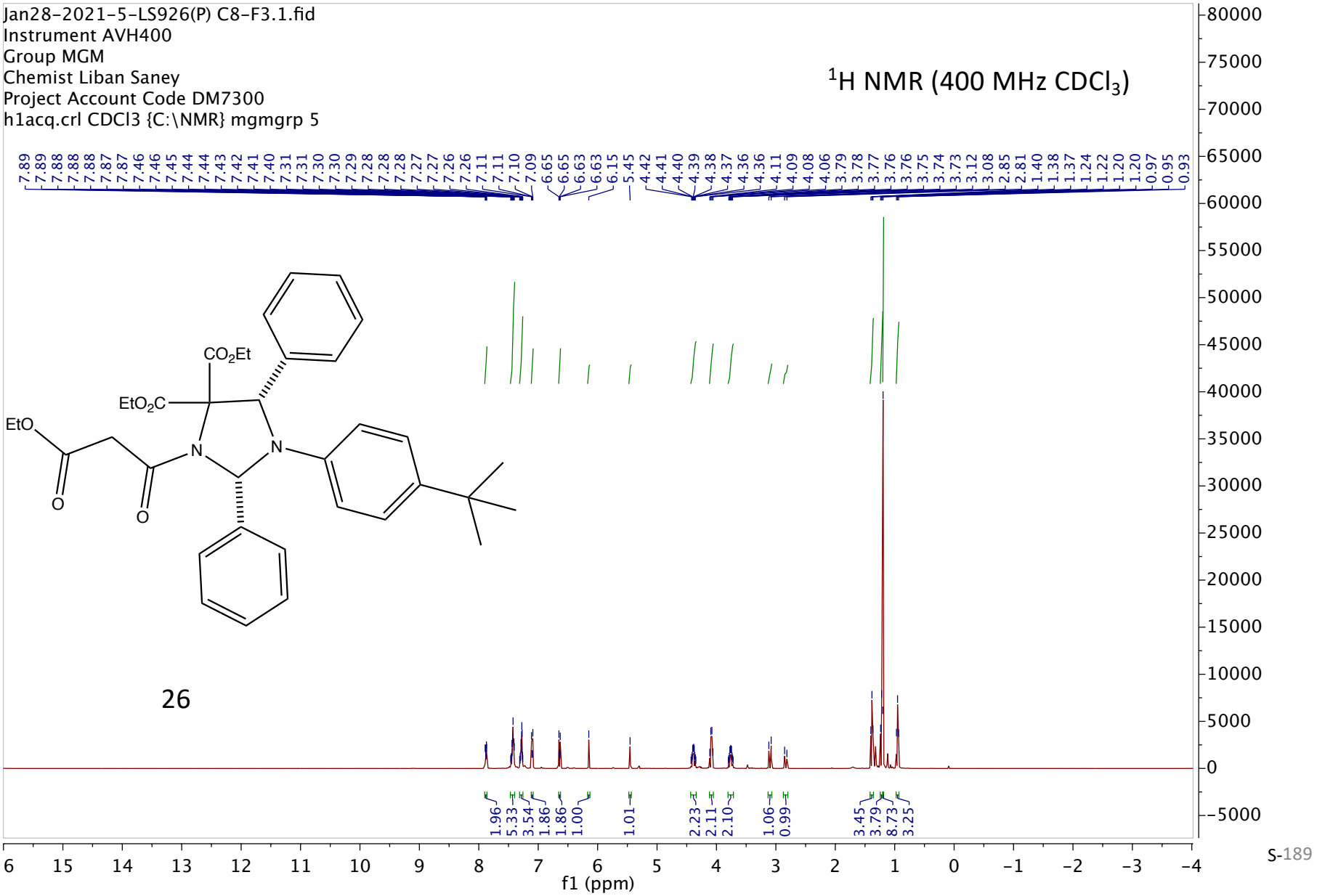

Oct02-2019-56-LS553(P) A2-D1.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 56
^{13}C NMR (101 MHz $CDCl_3$)
188.21
187.27
180.32
174.79
166.94
166.59
165.13
138.13
138.03
133.79
133.22
132.92
132.69
132.01
131.87
131.64
130.98
130.69
130.66
130.46
130.41
128.57
128.50
127.94
127.87
123.01
122.79
93.25
77.16 CDCl3
76.16
68.88
68.24
62.24
61.95
54.78
53.78
50.80
50.72
41.64
36.09
35.97
29.41
13.73
O
OH
N
H
CO_2Et
Br
O
N
N
Br
24b
4000
3500
3000
2500
2000
1500
1000
500
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

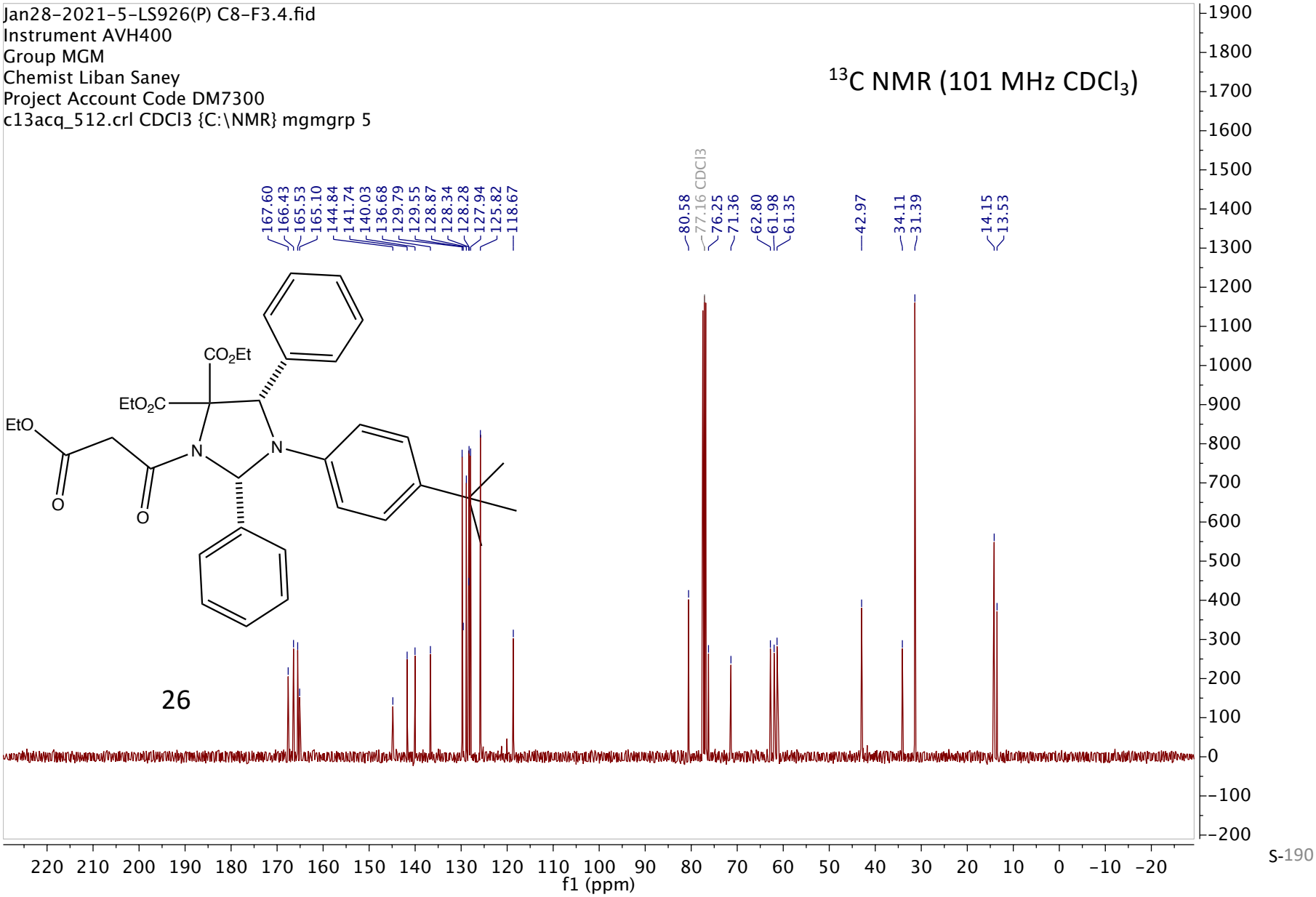

Sep30-2019-60-LS551(P) B4-B12.1.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 60
^{1}H NMR (400 MHz $CDCl_3$)
24c
f1 (ppm)

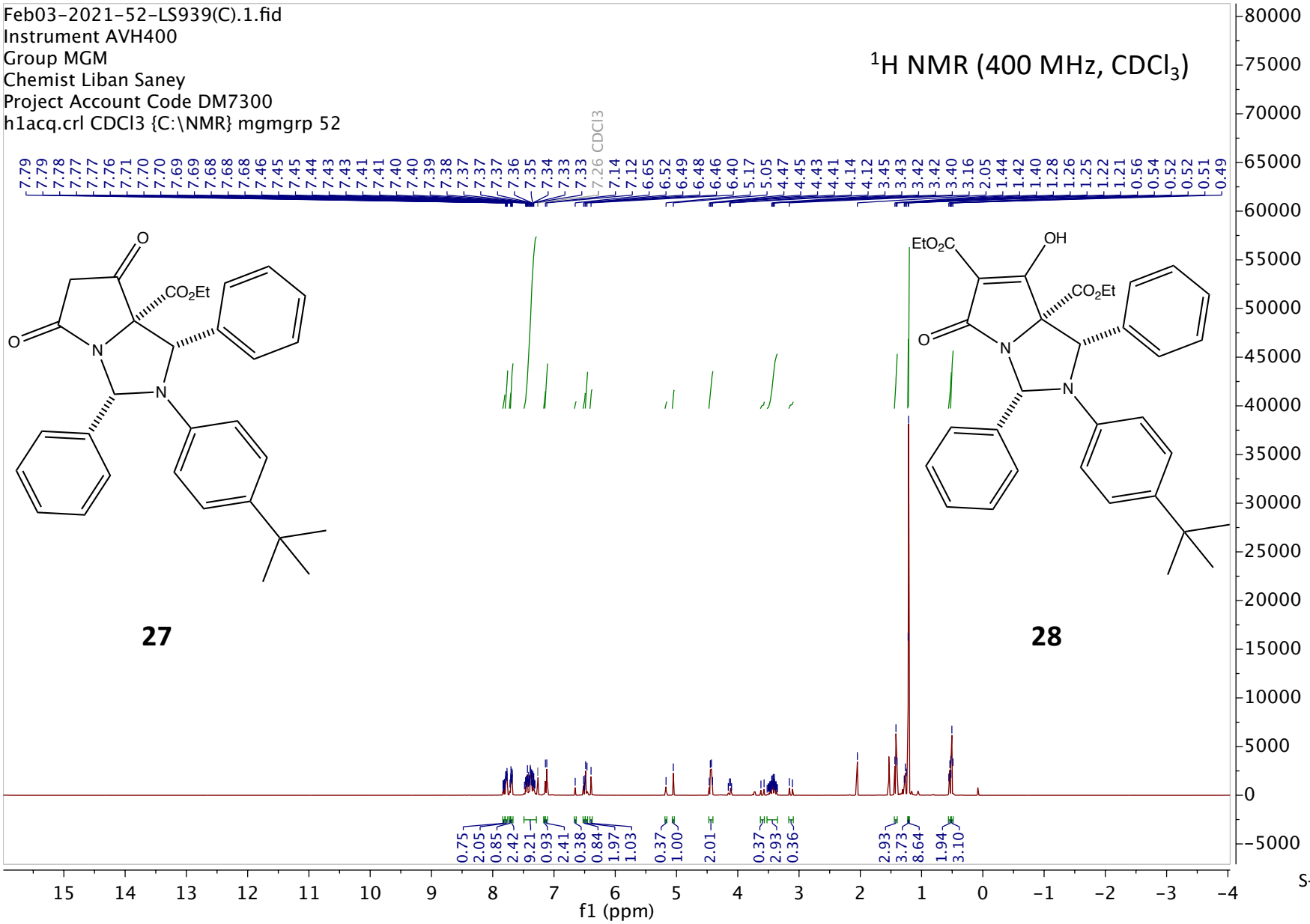

Sep30-2019-60-LS551(P) B4-B12.4.fid
Instrument AVF400
Chemist Liban Saney
Group MGM
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 60
13C NMR (101 MHz CDCl3)
189.22
186.72
179.81
174.62
166.88
166.83
164.84
148.28
148.15
147.98
146.52
141.80
133.16
132.97
130.17
129.93
129.81
129.76
128.71
128.29
123.86
123.76
123.53
90.89
77.16 CDCl3
76.59
69.73
69.33
62.35
62.10
55.11
54.40
53.59
53.42
41.65
36.01
35.94
29.41
13.76
O
OH
NO2
CO2Et
N
H
O
N
N
O2N
24c
f1 (ppm)

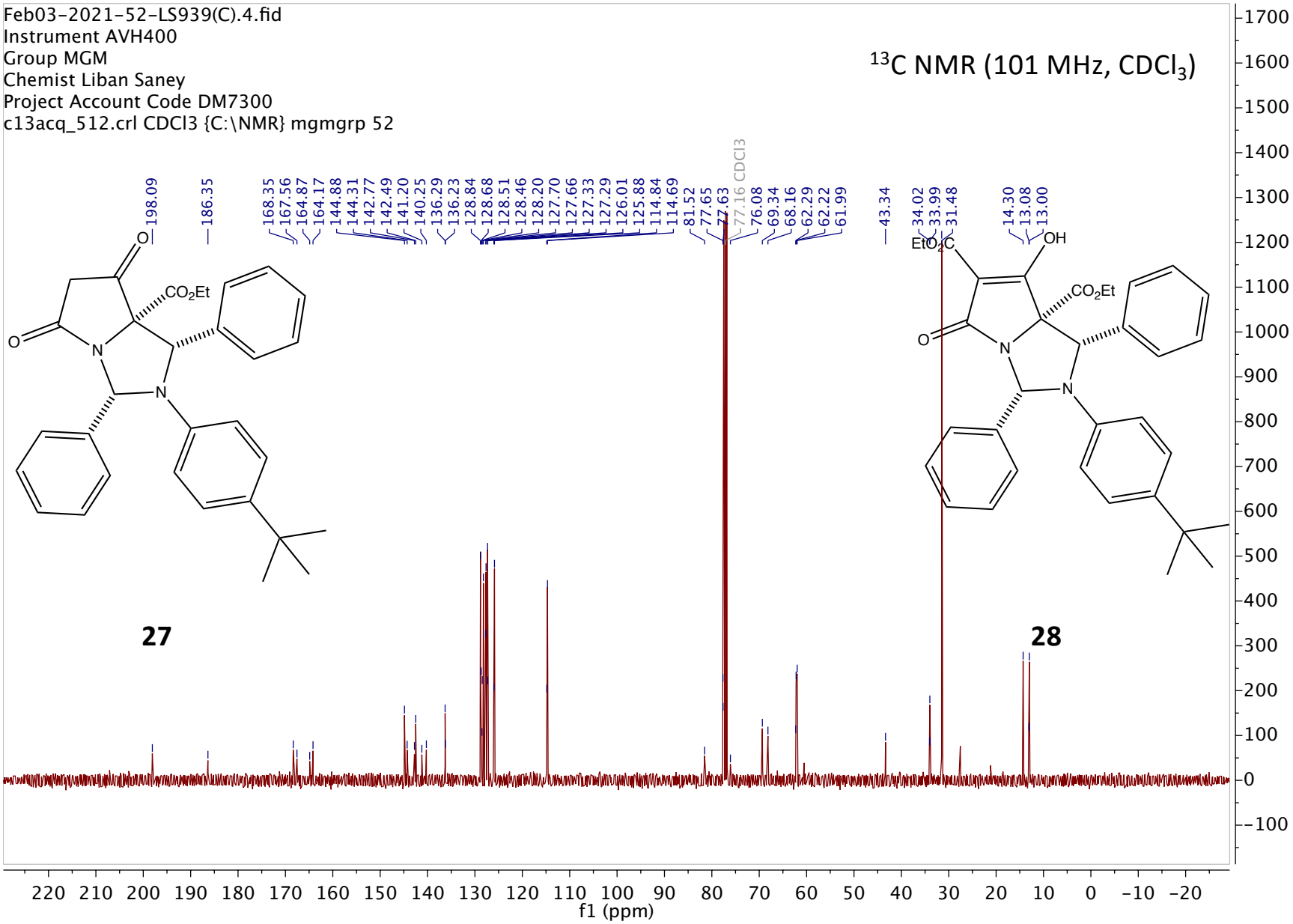

Jan23-2021-28-LS922(P) B3-C12.1.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 28
^{1}H NMR (400 MHz $CDCl_3$)
CO_2Et
EtO_2C
HN
N
25
f1 (ppm)


Jan23-2021-28-LS922(P) B3-C12.4.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 28
^{13}C NMR (101 MHz $CDCl_3$)
169.17
166.78
144.35
141.34
140.63
139.11
128.99
128.85
128.76
128.46
128.23
127.35
125.64
114.83
78.61
77.20
77.16 CDCl3
70.69
62.63
62.18
33.91
31.53
14.11
13.64
CO_2Et
EtO_2C
HN
N
25
f1 (ppm)


Jan28-2021-5-LS926(P) C8-F3.1.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 5
^{1}H NMR (400 MHz $CDCl_3$)
7.89 7.89 7.88 7.88 7.87 7.87 7.46 7.46 7.45 7.44 7.44 7.43 7.42 7.41 7.40 7.31 7.31 7.30 7.30 7.29 7.28 7.28 7.28 7.27 7.27 7.26 7.26 7.11 7.11 7.10 7.09 6.65 6.65 6.63 6.63 6.15 5.45 4.42 4.41 4.40 4.39 4.38 4.37 4.36 4.36 4.11 4.09 4.08 4.06 3.79 3.78 3.77 3.76 3.75 3.74 3.73 3.12 3.08 2.85 2.81 1.40 1.38 1.37 1.24 1.22 1.20 1.20 0.97 0.95 0.93
CO_2Et
EtO_2C
EtO
N
N
O
O
26
1.96 5.33 3.54 1.86 1.86 1.00 1.01 2.23 2.11 2.10 1.06 0.99 3.45 3.79 8.73 3.25
80000 75000 70000 65000 60000 55000 50000 45000 40000 35000 30000 25000 20000 15000 10000 5000 0 -5000
6 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)


Jan28-2021-5-LS926(P) C8-F3.4.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 5
^{13}C NMR (101 MHz $CDCl_3$)
167.60
166.43
165.53
165.10
144.84
141.74
140.03
136.68
129.79
129.55
128.87
128.34
128.28
127.94
125.82
118.67
80.58
77.16 CDCl3
76.25
71.36
62.80
61.98
61.35
42.97
34.11
31.39
14.15
13.53
CO2Et
EtO2C
EtO
O
O
N
N
26
f1 (ppm)


Feb03-2021-52-LS939(C).1.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
h1acq.crl CDCl3 {C:\NMR} mgmgrp 52
^{1}H NMR (400 MHz, $CDCl_3$)
CDCl3
7.79 7.79 7.78 7.77 7.77 7.76 7.71 7.70 7.70 7.69 7.69 7.68 7.68 7.68 7.46 7.45 7.45 7.44 7.43 7.43 7.41 7.41 7.40 7.40 7.39 7.38 7.37 7.37 7.37 7.36 7.35 7.34 7.33 7.33 7.26 7.14 7.12 6.65 6.52 6.49 6.48 6.46 6.40 5.17 5.05 4.47 4.45 4.43 4.41 4.14 4.12 3.45 3.43 3.42 3.40 3.16 2.05 1.44 1.42 1.40 1.28 1.26 1.25 1.22 1.21 0.56 0.54 0.52 0.52 0.51 0.49
O
O
N
N
CO_2Et
27
EtO_2C
OH
O
N
N
CO_2Et
28
0.75 2.05 0.85 2.42 9.21 0.93 2.41 0.38 0.84 1.97 1.03 0.37 1.00 2.01 0.37 2.93 0.36 2.93 3.73 8.64 1.94 3.10
80000 75000 70000 65000 60000 55000 50000 45000 40000 35000 30000 25000 20000 15000 10000 5000 0 -5000
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)


Feb03-2021-52-LS939(C).4.fid
Instrument AVH400
Group MGM
Chemist Liban Saney
Project Account Code DM7300
c13acq_512.crl CDCl3 {C:\NMR} mgmgrp 52
^{13}C NMR (101 MHz, $CDCl_3$)
198.09
186.35
168.35
167.56
164.87
164.17
144.88
144.31
142.77
142.49
141.20
140.25
136.29
136.23
128.84
128.68
128.51
128.46
128.20
127.70
127.66
127.33
127.29
126.01
125.88
114.84
114.69
81.52
77.65
77.63
77.16 CDCl3
76.08
69.34
68.16
62.29
62.22
61.99
43.34
34.02
33.99
31.48
14.30
13.08
13.00
CO_2Et
EtO_2C
OH
27
28
f1 (ppm)