Supporting Information

Highly Efficient Regio-Selective Ring-Opening Nucleophilic Fluorination of Aziridines and Azetidines: Access to β- or γ-Fluorinated Amino Acid Derivatives

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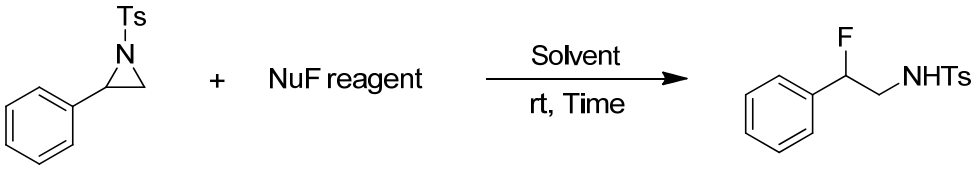
Table of Contents

1. Conditions Optimization

Table S1. Conditions Optimization[a]

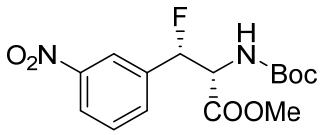


1a **3a**

Entry	NuF Reagent	Solvent	Time (h)	Cover. (%)	Yield[b] (%)
1	CsF	CH_2Cl_2	24	60	< 10
2	KHF_2	CH_2Cl_2	36	10	trace
3	TBAF	CH_2Cl_2	24	0	-
4	$Et_3N.HF$	CH_2Cl_2	24	50	N.D
5	Py.HF[c]	CH_2Cl_2	0.5	100	94 (90[d])
6	Py.HF	Et_2O	5	100	90
7	Py.HF	Tol	0.5	100	78
8	Py.HF	THF	9	60	50
9	Py.HF	1,4-dioxane	9	65	56
10	Py.HF	acetone	9	40	35
11	Py.HF	$CHCl_3$	0.5	100	92
12[e]	Py.HF	CH_2Cl_2	0.5	32	28
13[e]	Py.HF	CH_2Cl_2	9	85	82
14[f]	Py.HF	CH_2Cl_2	0.5	100	90
15[g]	Py.HF	CH_2Cl_2	0.5	100	94

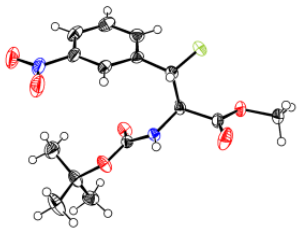
[a]Unless noted, the reaction was conducted with **1a** (0.2 mmol), NuF reagent (3.0 equiv) and 2.0 mL solvent at room temperature for the specified period of time. [b]Yields were determined by ^{19}F NMR using benzotrifluoride as an internal standard. [c]Py.HF = hydrogen fluoride-pyridine (70% HF in pyridine). [d]Isolated yield. [e]Py.HF was added 1.5 equiv. [f]Py.HF was added 5.0 equiv. [g]The reaction was carried out under nitrogen. TBAF = tetrabutylammonium fluoride, N.D. = not detected.

2. X-ray Crystallographic Data of 3v



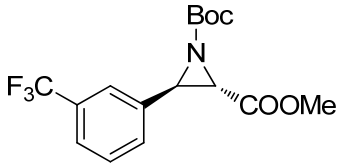
3v

≡



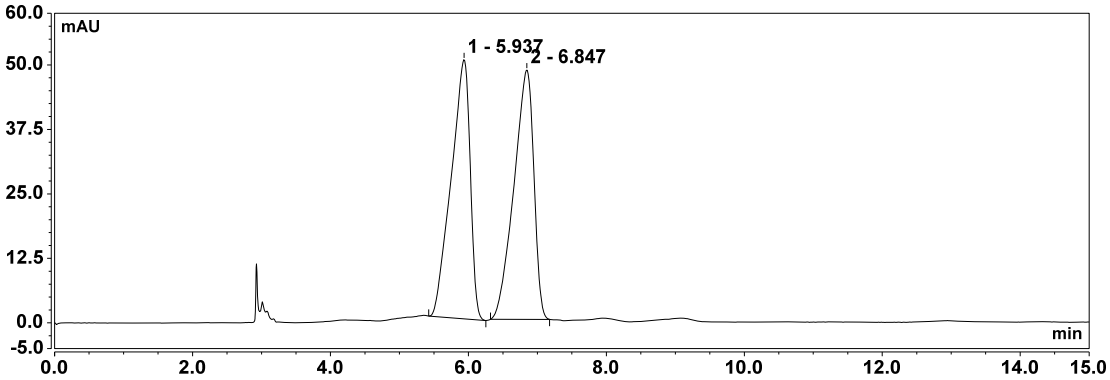
CCDC number	1887355
Empirical formula	$C_{15}H_{19}FN_2O_6$
Formula weight	343.32
Temperature/K	150.00
Crystal system	orthorhombic
Space group	P 1 21 1
a/Å	5.1030(1)
b/Å	24.0246(3)
c/Å	13.7034(2)
α/°	90.0
β/°	98.635
γ/°	90.0
Volume/Å^3	1660.96(5)
Z	4
ρ_{calc}g/cm^3	1.369
μ/mm^{-1}	0.970
F(000)	720.0
Crystal size/mm^3	0.06 × 0.29 × 0.16
Radiation	MoKa(λ = 1.54184)
2Θ range for data collection/°	3.68 to 73.32
Index ranges	-4 ≤ h ≤ 6, -29 ≤ k ≤ 29, -16 ≤ l ≤ 16
Reflections collected	12270
Independent reflections	6438 [R_{int} = 0.0331, R_{sigma} = 0.0395]
Data/restraints/parameters	6438/7/454
Goodness-of-fit on F^2	1.054
Final R indexes [I>=2σ (I)]	R1 = 0.0360, wR2 = 0.0933
Final R indexes [all data]	R1 = 0.0375, wR2 = 0.0954
Largest diff. peak/hole / e Å^{-3}	0.152/-0.199

3. HPLC Results

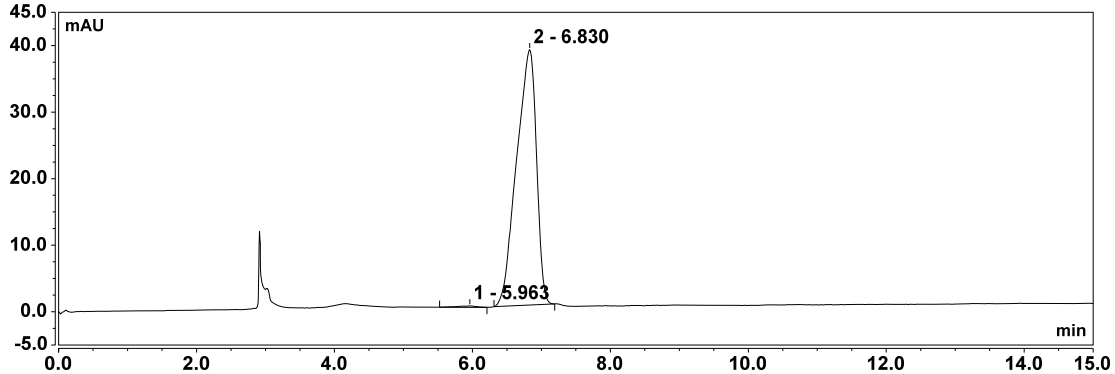


1u

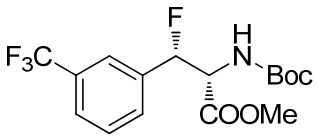
phenomenex Cellulose-1 5um 250x4.6mm (*n*-Hexane/*i*-PrOH = 97/3, flow rate = 1.0 mL/min, λ = 254 nm, 25 °C)



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	5.937	16.0179	50.25	49.73
2	6.847	16.1914	48.39	50.27

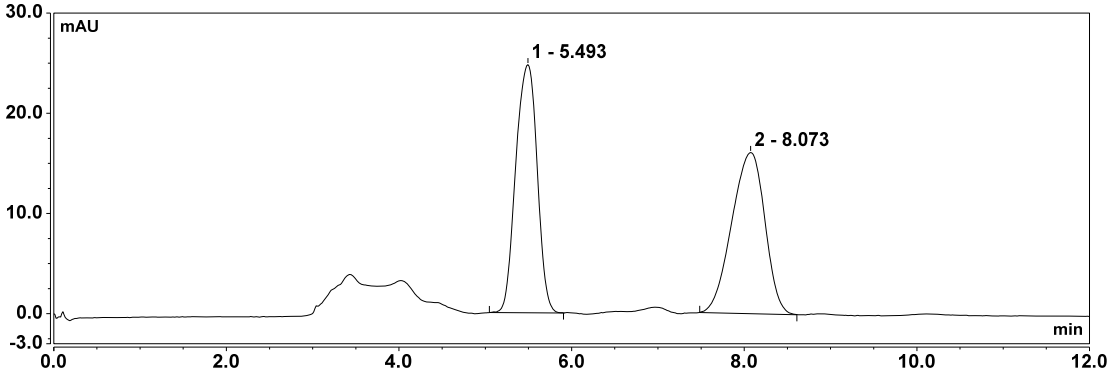


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	5.963	0.0711	0.22	0.55
2	6.830	12.7965	38.38	99.45

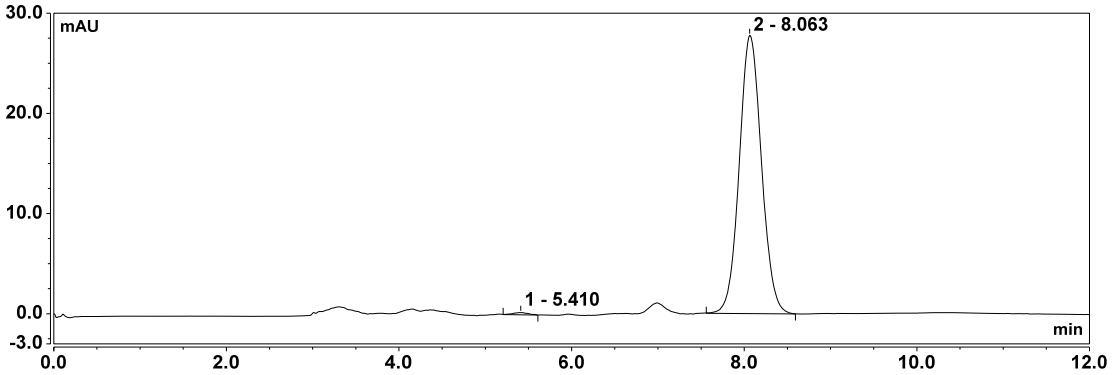


3u

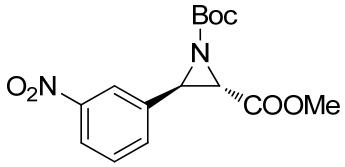
Chiral AD-H Column (*n*-Hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, 25 °C)



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	5.493	7.1322	24.76	49.95
2	8.073	7.1463	16.08	50.05

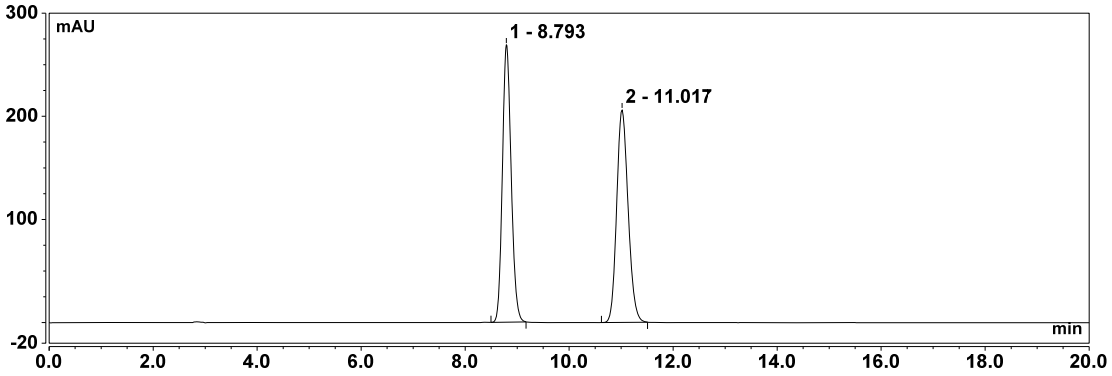


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	5.410	0.0436	0.24	0.53
2	8.063	8.2684	27.78	99.47

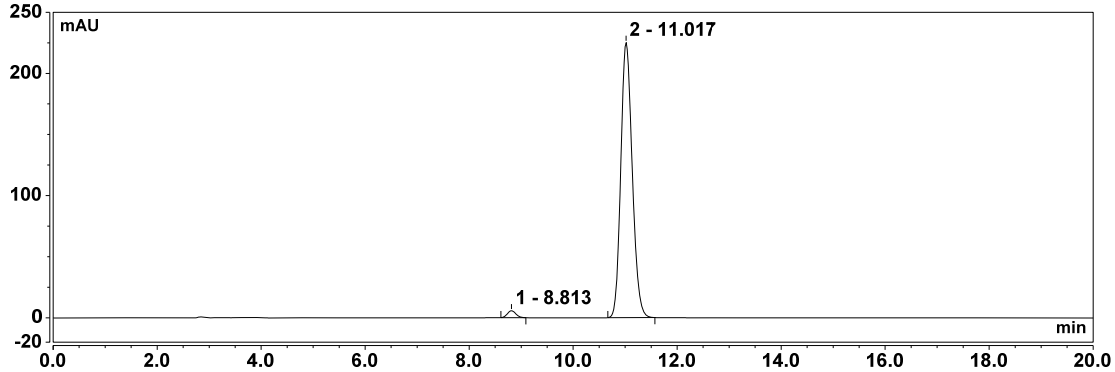


1v

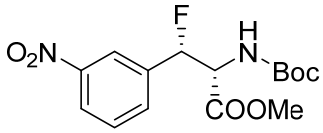
phenomenex Cellulose-1 5um 250x4.6mm (*n*-Hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, 25 °C)



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	8.793	52.6095	269.03	50.05
2	11.017	52.4941	206.30	49.95

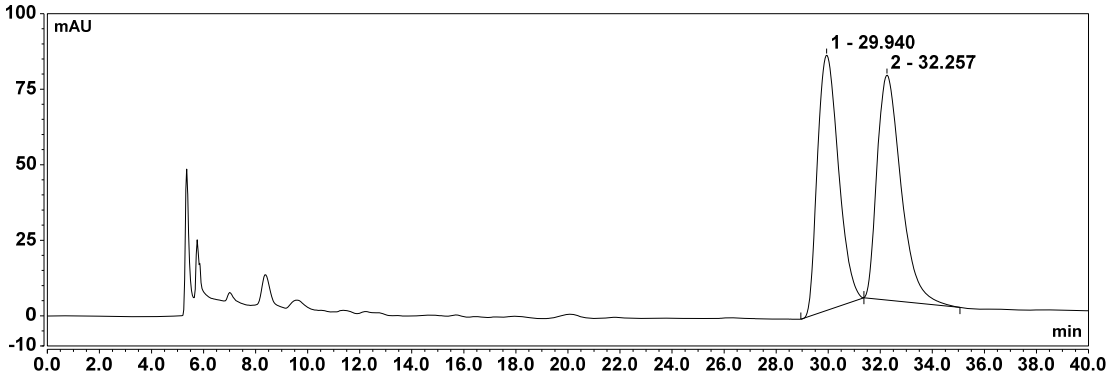


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	8.813	1.0779	5.68	1.85
2	11.017	57.3313	225.21	98.15

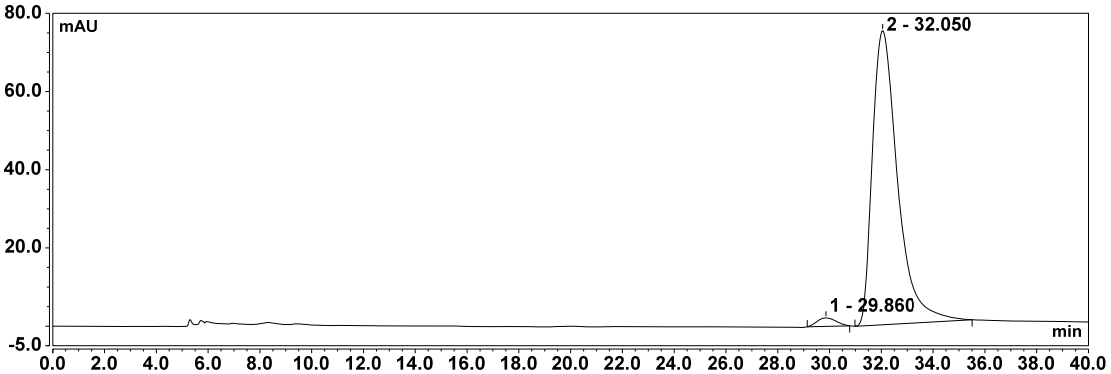


3v

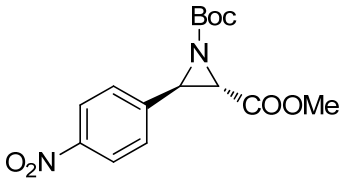
phenomenex Cellulose-1 5um 250x4.6mm (*n*-Hexane/*i*-PrOH = 95/5, flow rate = 0.5 mL/min, λ = 254 nm, 25 °C)



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	29.940	79.1795	84.50	49.76
2	32.257	79.9410	74.46	50.24



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	29.860	1.8325	2.17	2.11
2	32.050	84.9753	75.22	97.89



1w

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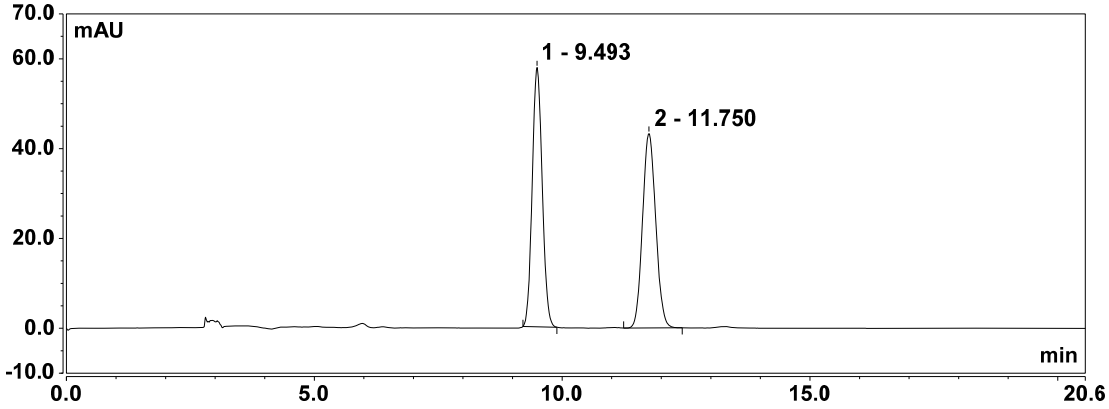
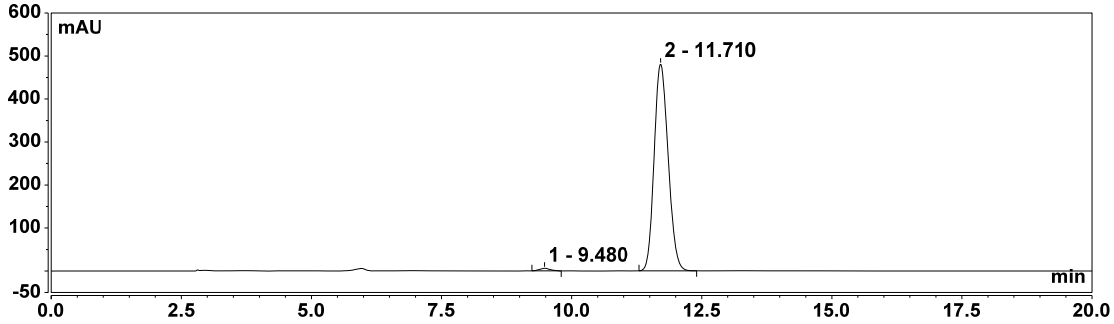
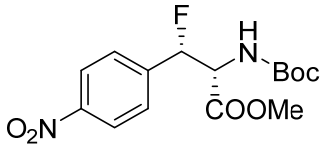


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	9.493	13.4856	57.75	50.26
2	11.750	13.3471	43.35	49.74



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	9.480	1.3857	6.12	0.92
2	11.710	149.6401	480.92	99.08



3w

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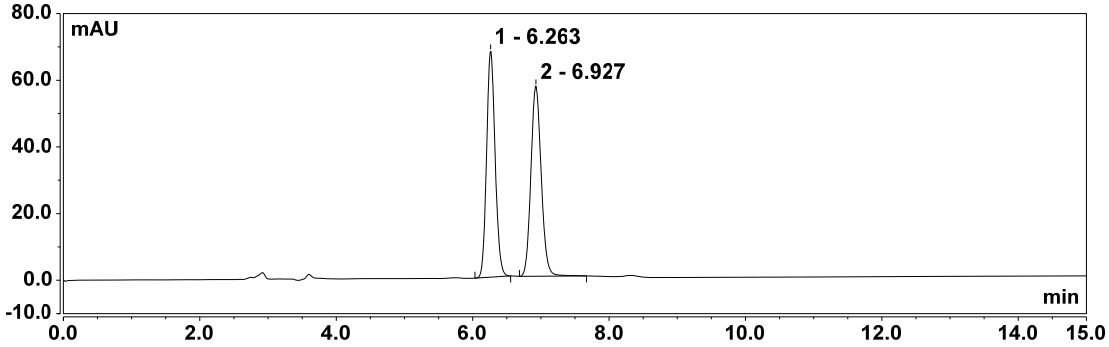
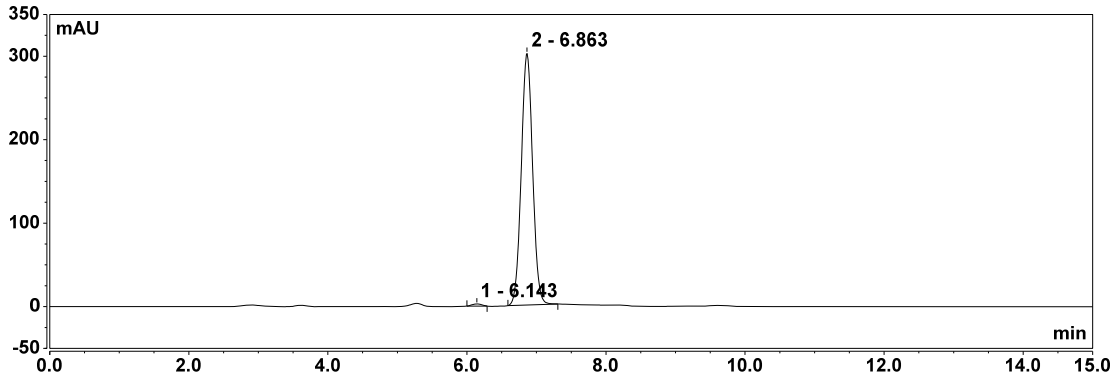
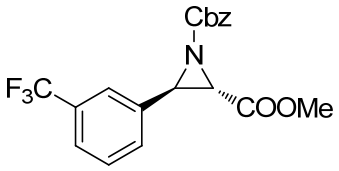


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	6.263	9.8607	67.91	49.70
2	6.927	9.9809	57.07	50.30

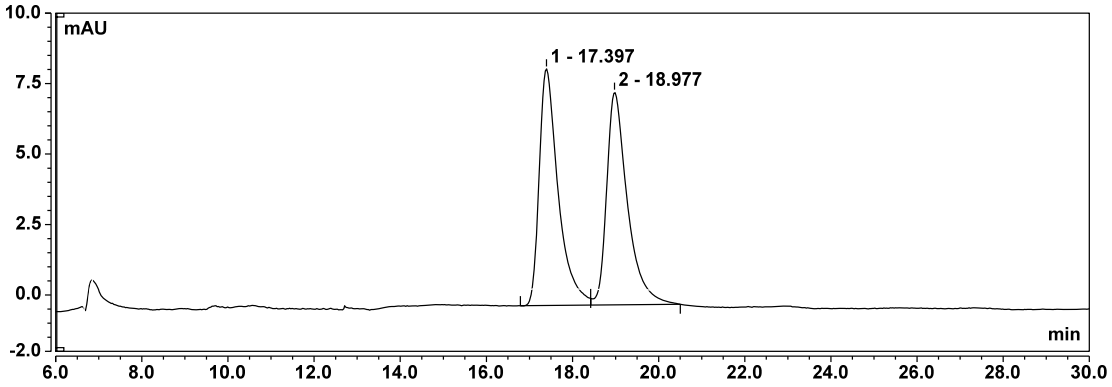


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	6.143	0.4127	2.71	0.72
2	6.863	56.9436	301.61	99.28

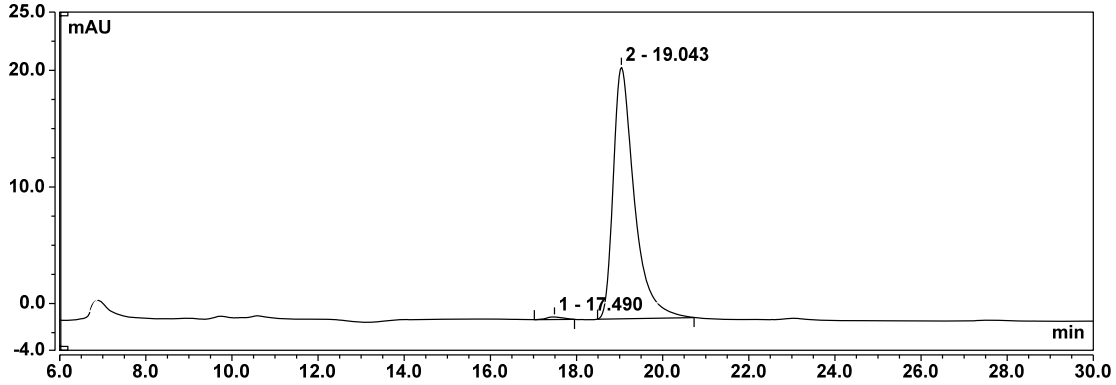


1x

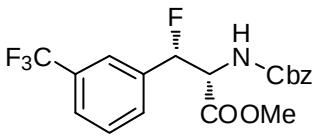
phenomenex Cellulose-1 5um 250x4.6mm (*n*-Hexane/*i*-PrOH = 95/5, flow rate = 0.5 mL/min, λ = 254 nm, 25 °C)



Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	17.397	4.2819	8.40	50.37
2	18.977	4.2191	7.55	49.63

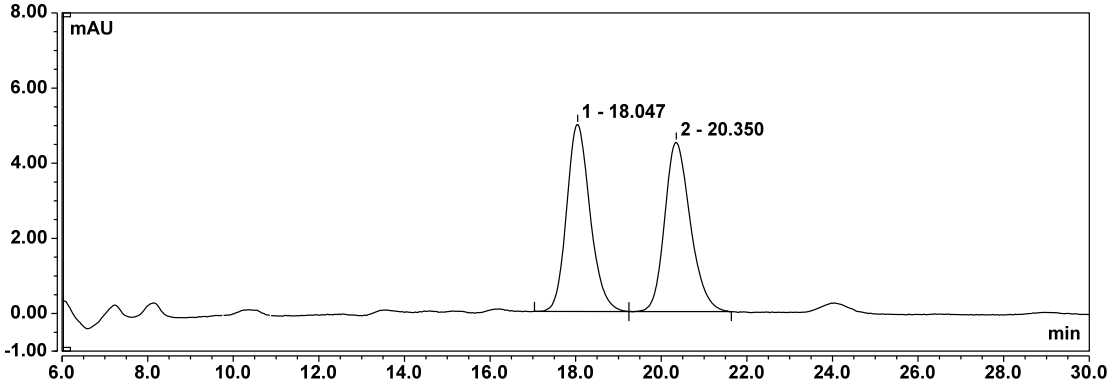


Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	17.490	0.0966	0.23	0.78
2	19.043	12.2387	21.57	99.22

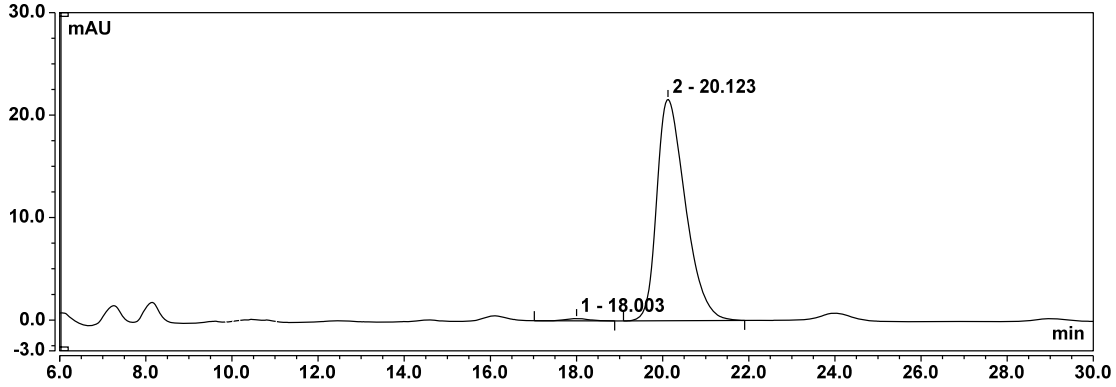


3x

Chiral AD-H Column (*n*-Hexane/*i*-PrOH = 90/10, flow rate = 0.8 mL/min, λ = 254 nm, 25 °C)



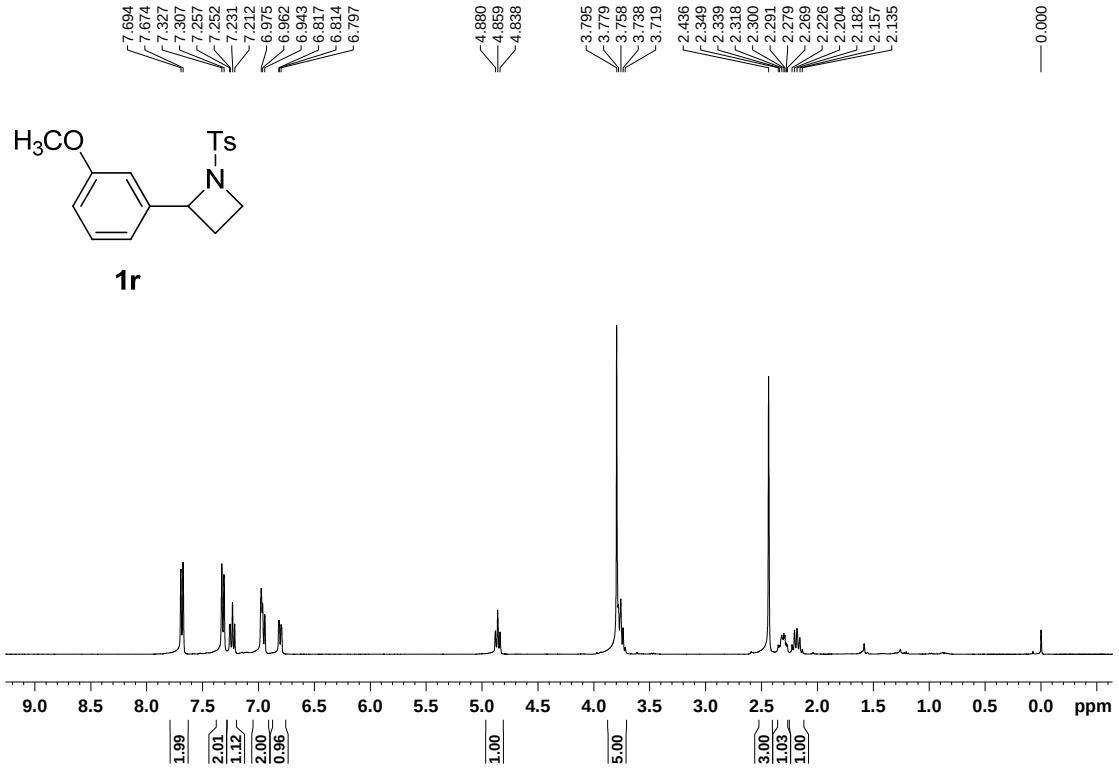
Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	18.047	3.1581	4.98	50.18
2	20.350	3.1348	4.51	49.82



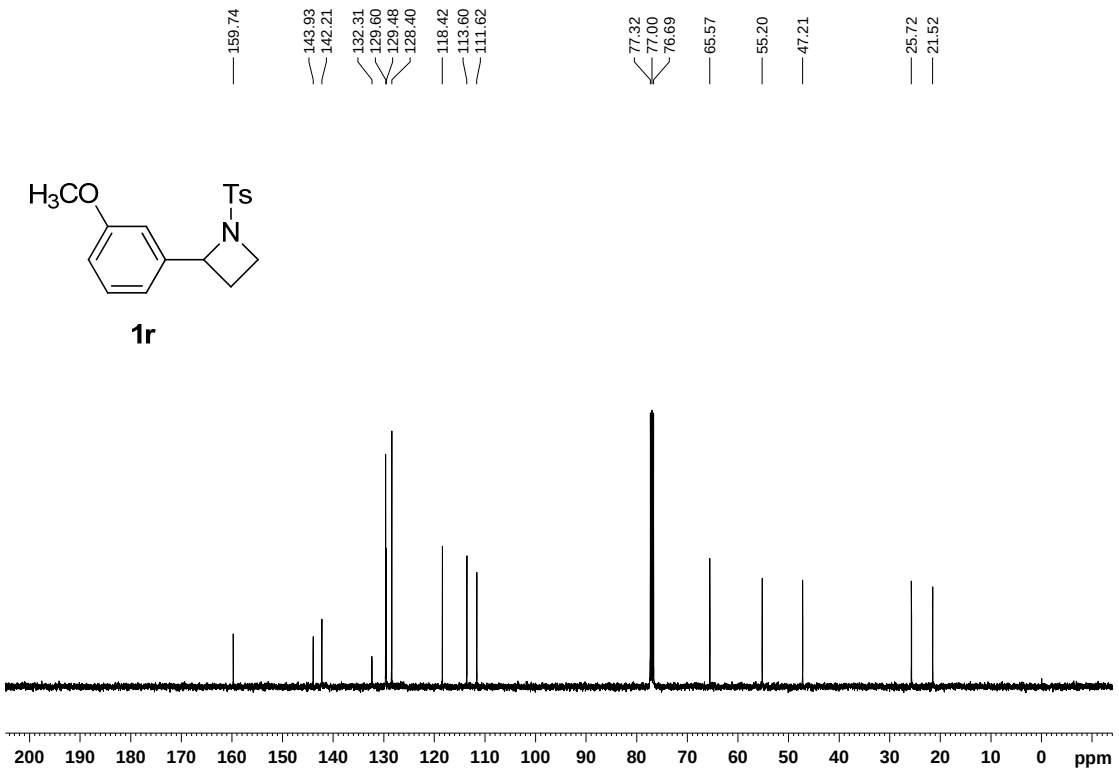
Peak #	RetTime [min]	Area mAU * min	Height [AU]	Area %
1	18.003	0.1340	0.22	0.80
2	20.123	16.6378	21.60	99.20

4. NMR Spectra of Compounds

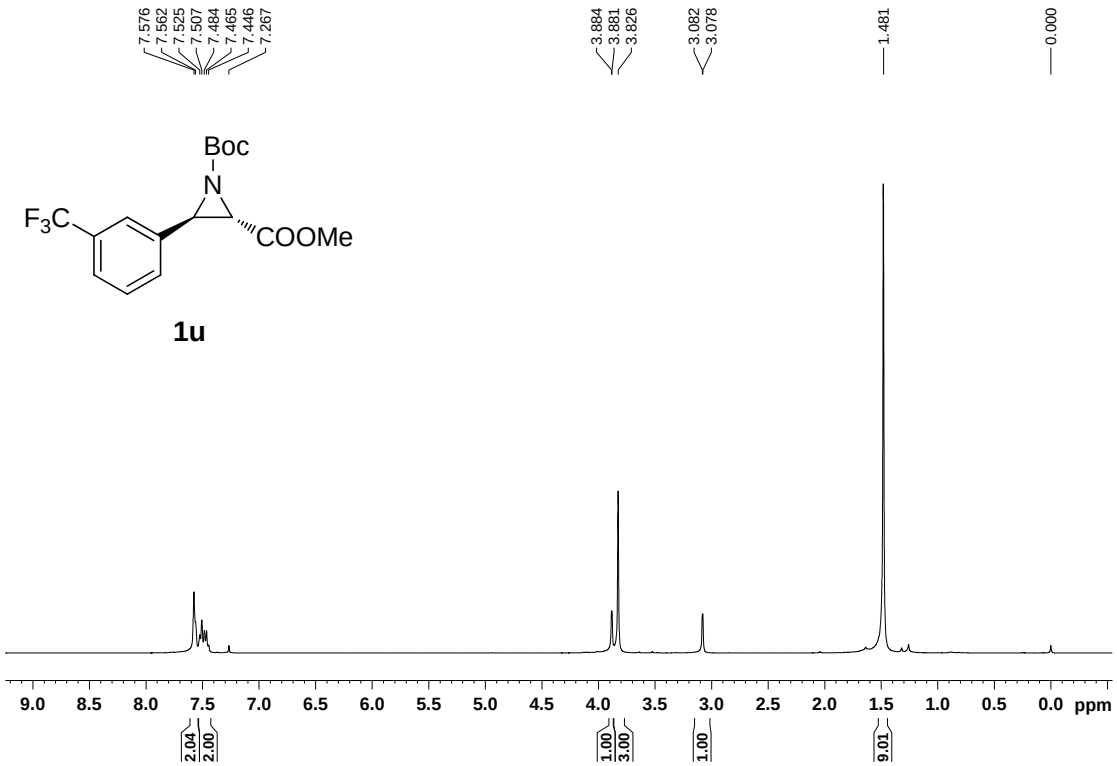
^{1}H NMR spectrum of **1r**



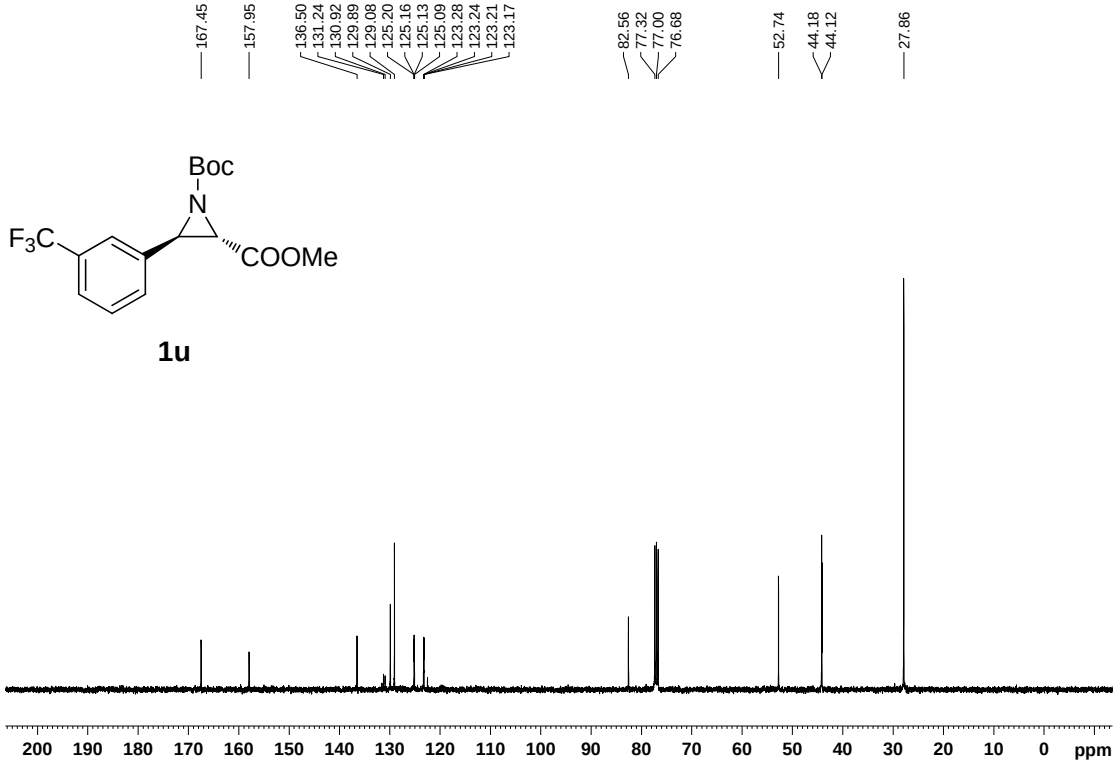
^{13}C NMR spectrum of **1r**



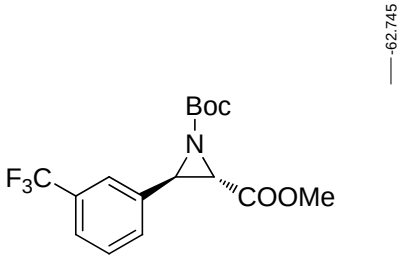
^{1}H NMR spectrum of **1u**



^{13}C NMR spectrum of **1u**

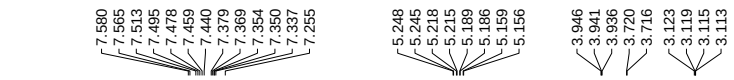


^{1}F NMR spectrum of **1u**



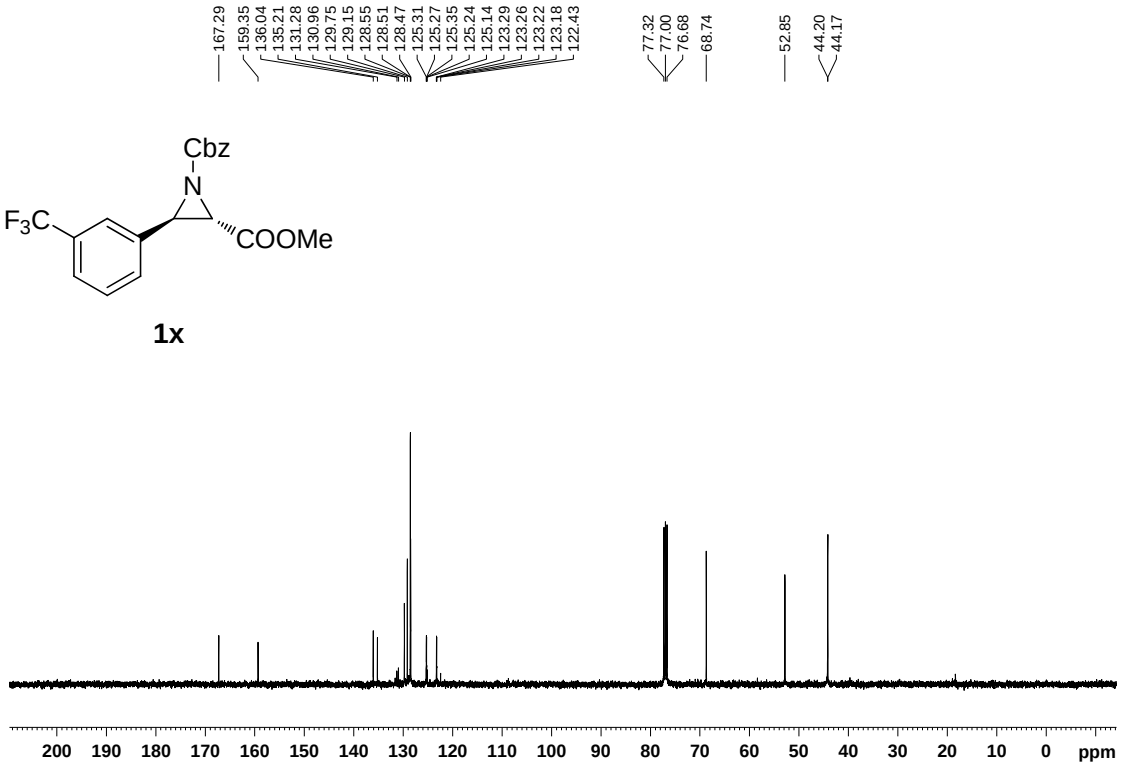
1u

^{1}H NMR spectrum of **1x**



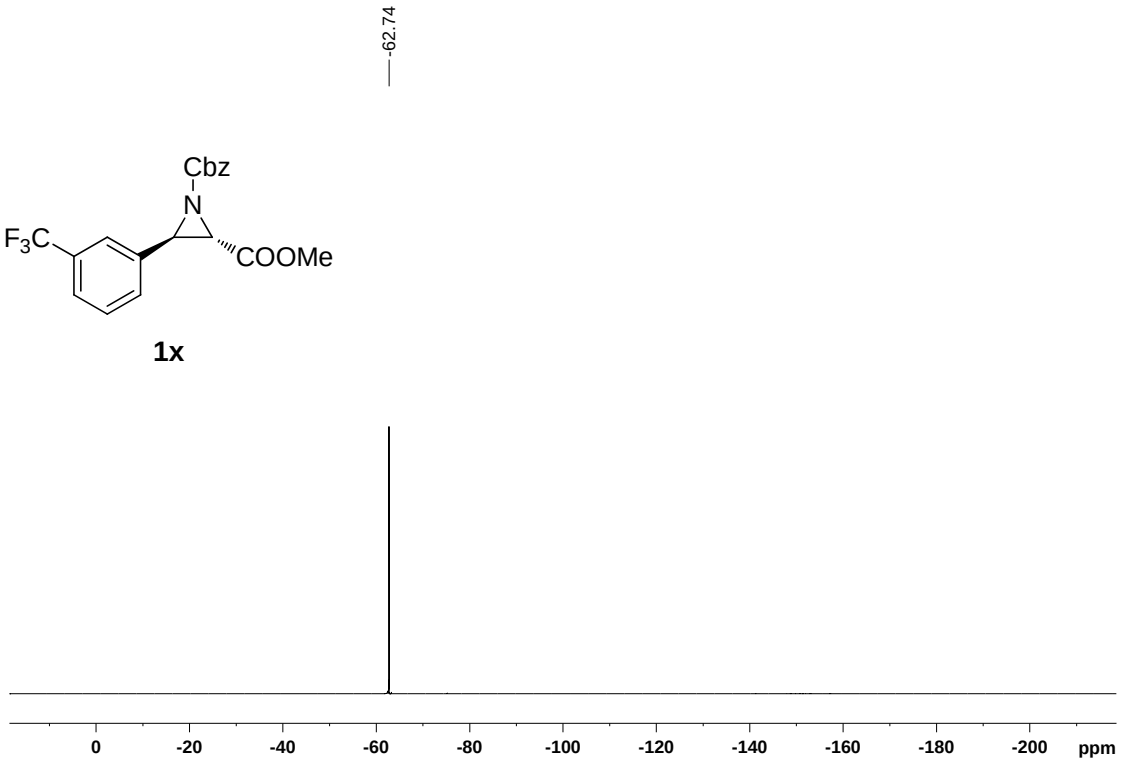
1x

^{13}C NMR spectrum of **1x**



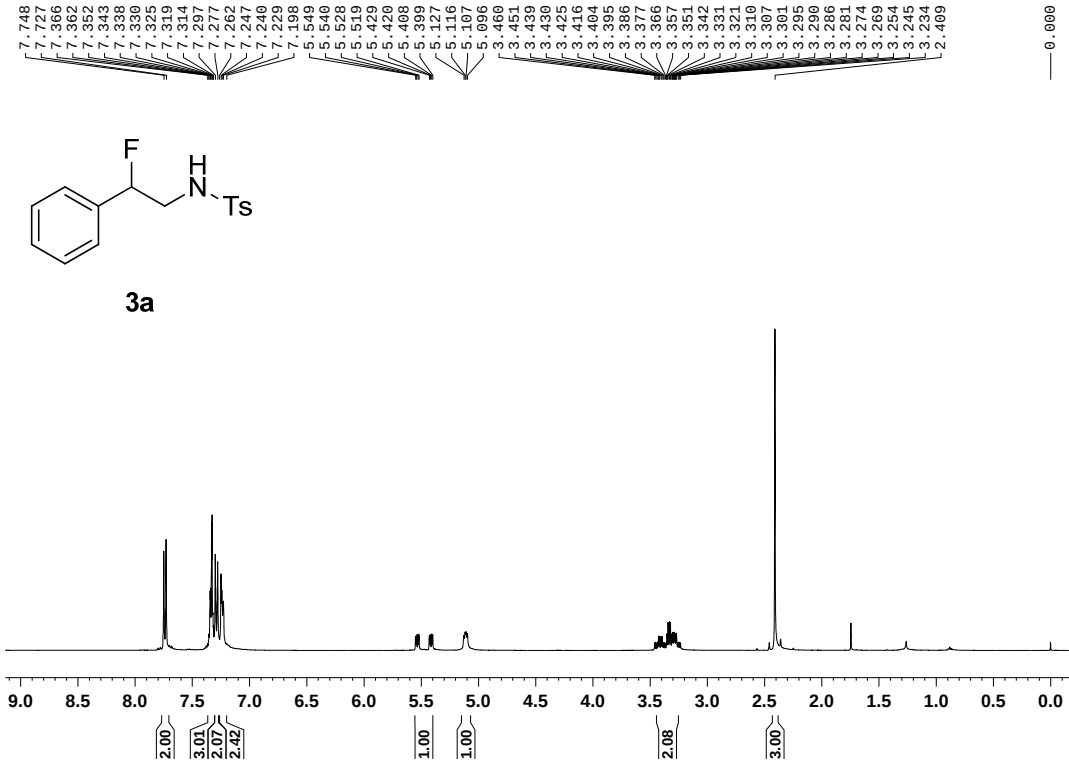
1x

^{1}F NMR spectrum of **1x**

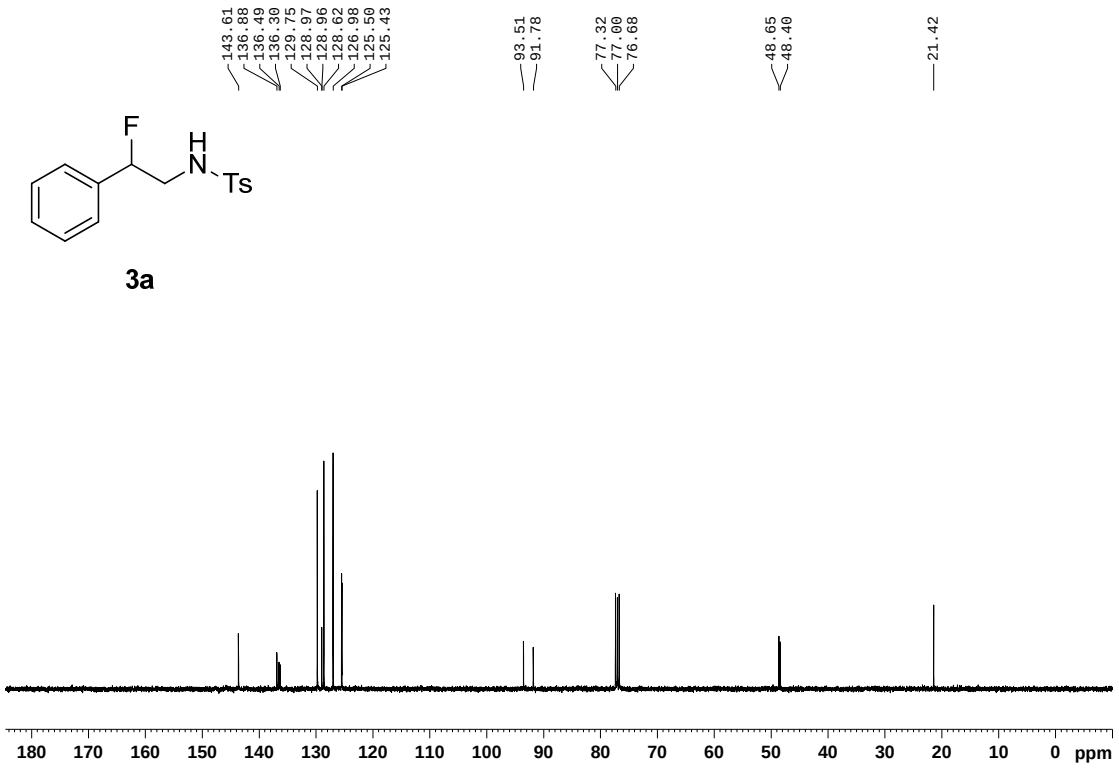


1x

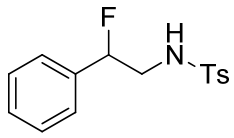
^{1}H NMR spectrum of **3a**



^{13}C NMR spectrum of **3a**

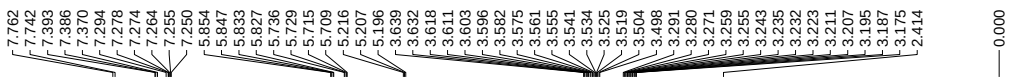


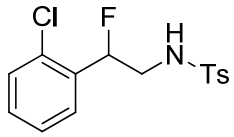
^{19}F NMR spectrum of **3a**



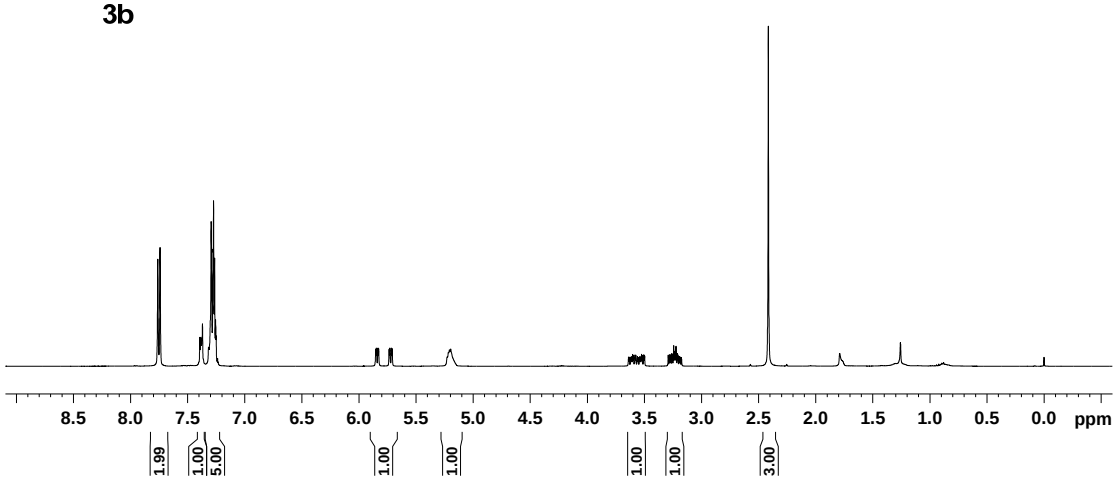
3a

^{1}H NMR spectrum of **3b**

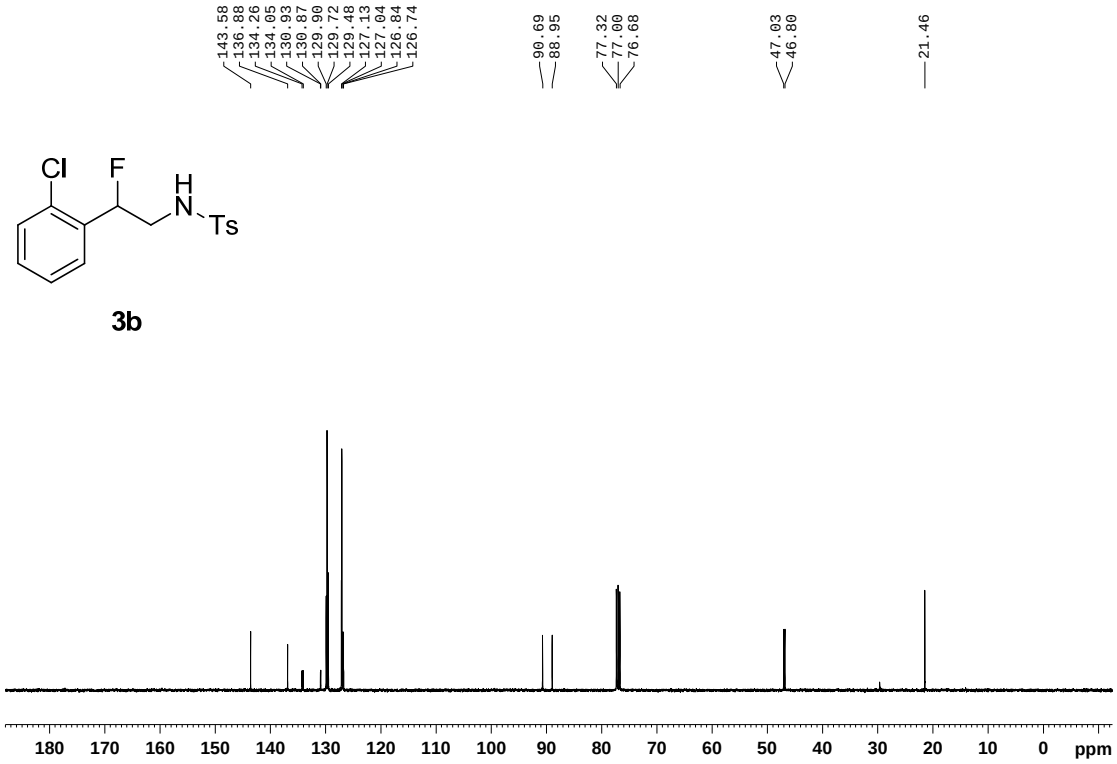




3b

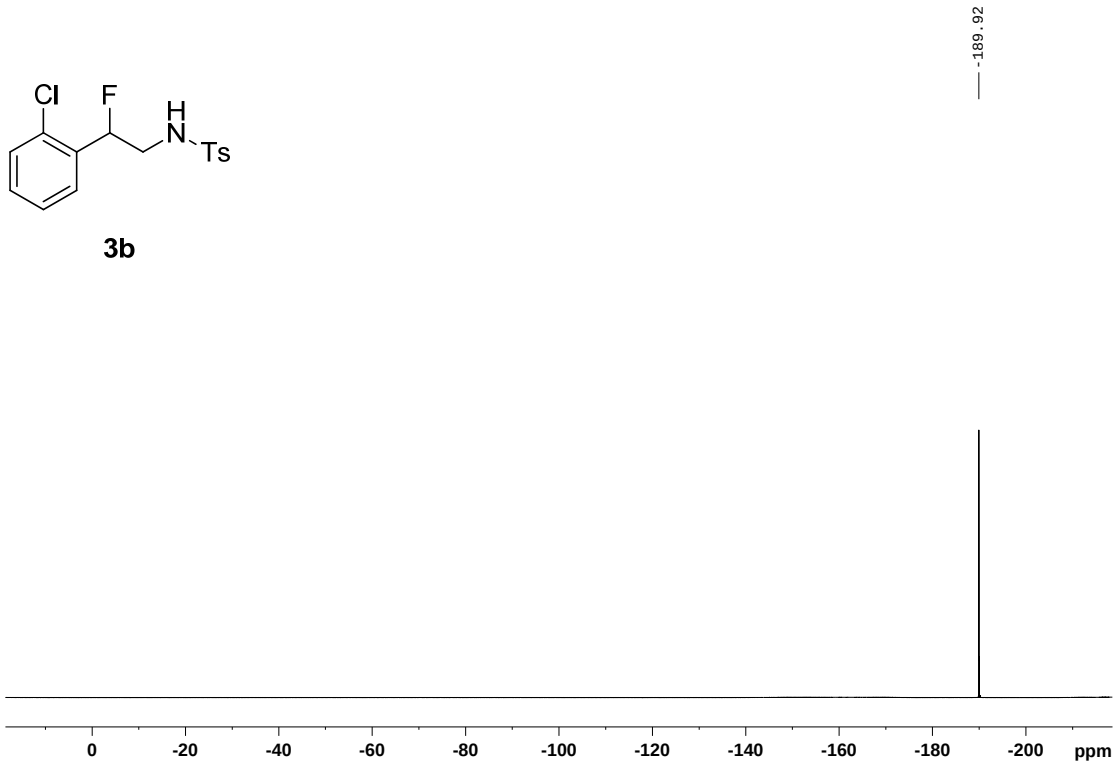


^{13}C NMR spectrum of **3b**



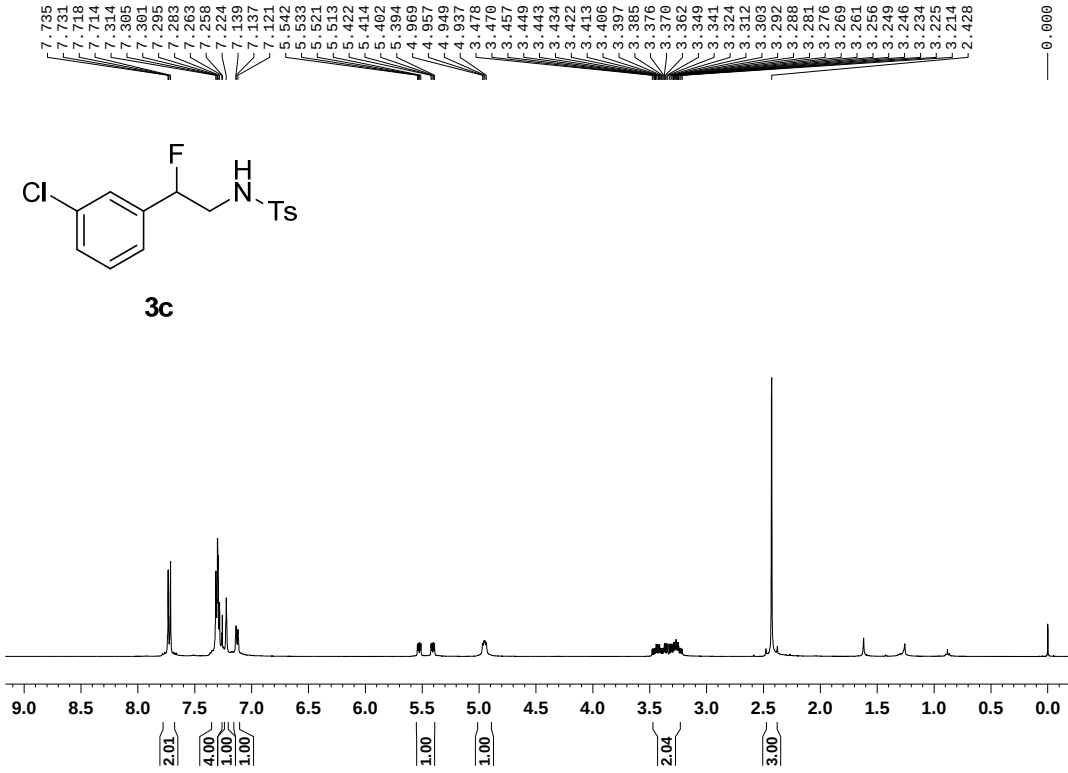
3b

^{19}F NMR spectrum of **3b**



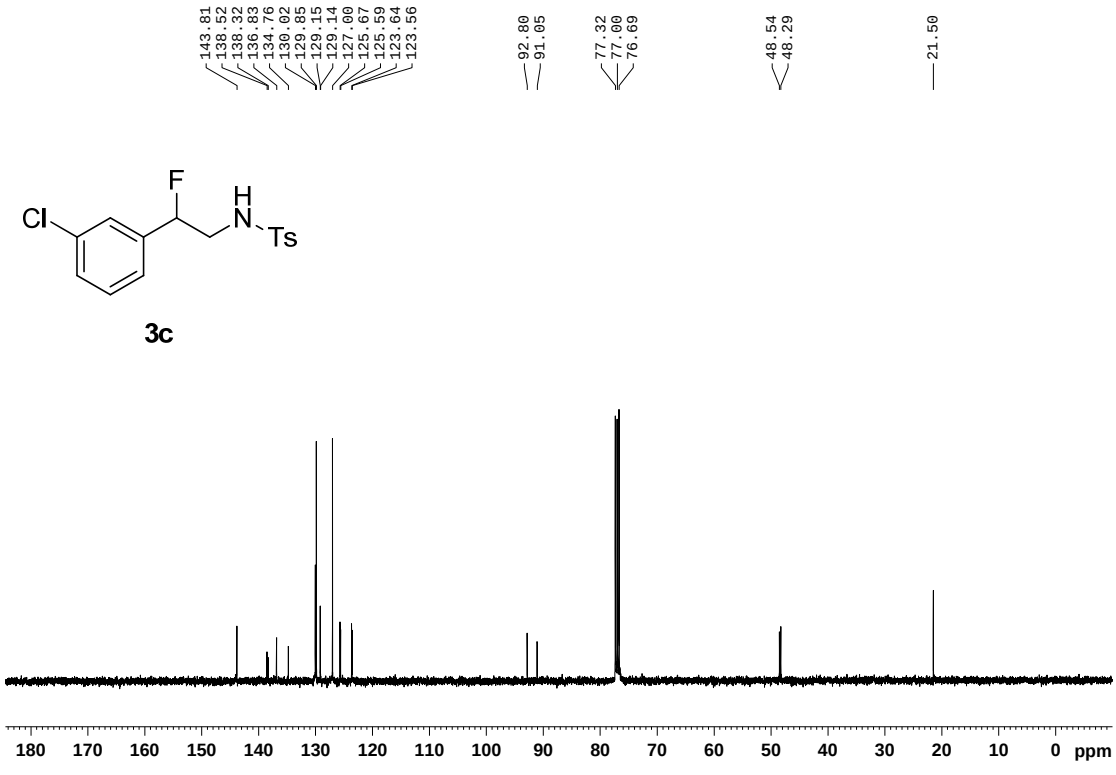
3b

^{1}H NMR spectrum of **3c**



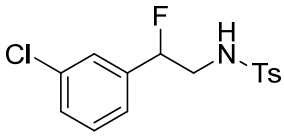
3c

^{13}C NMR spectrum of **3c**



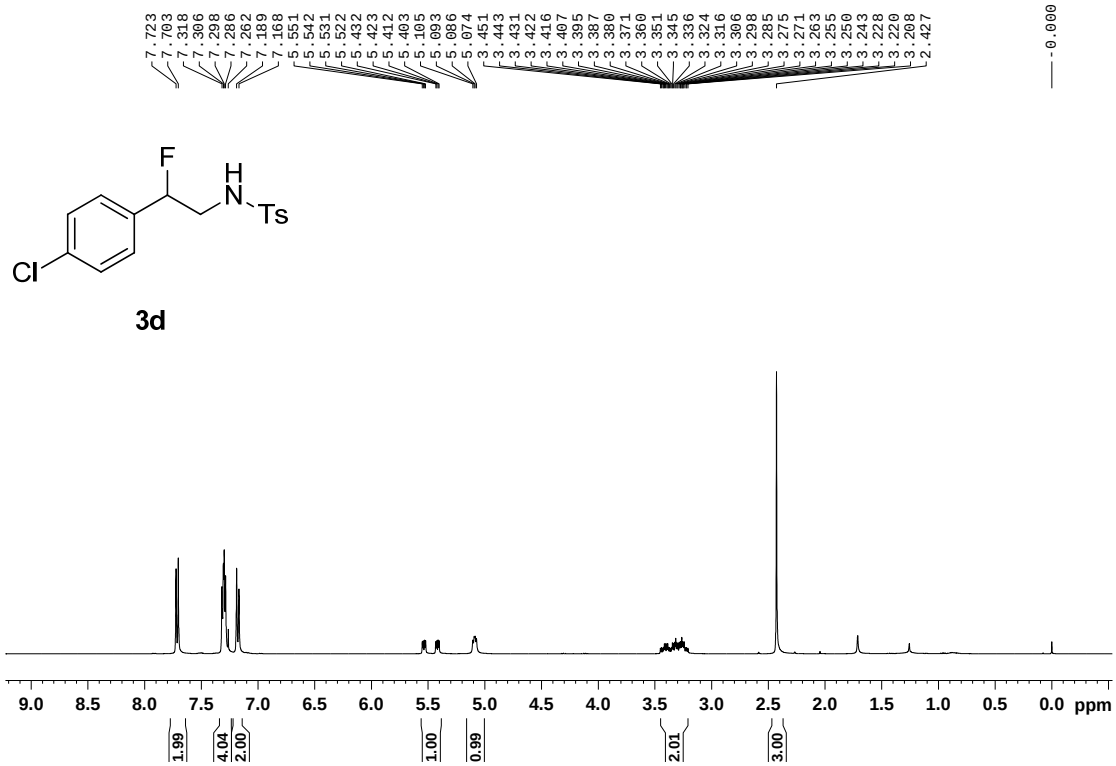
3c

^{19}F NMR spectrum of **3c**



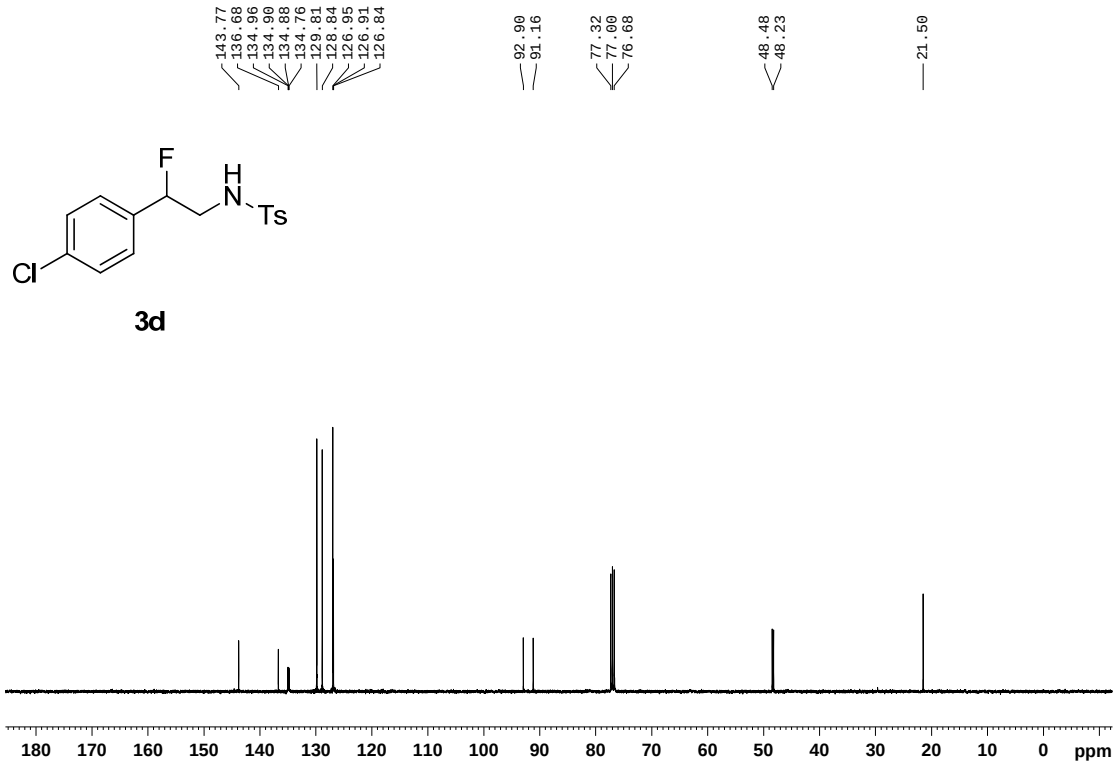
3c

^{1}H NMR spectrum of **3d**



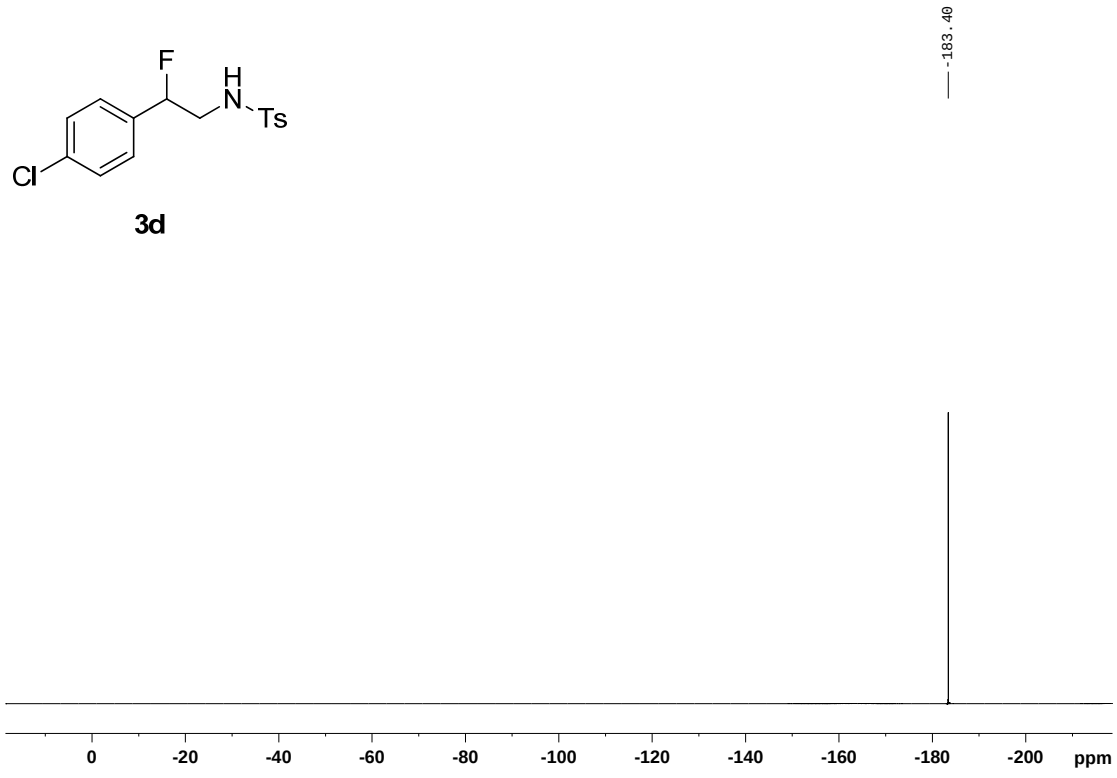
3d

^{13}C NMR spectrum of **3d**



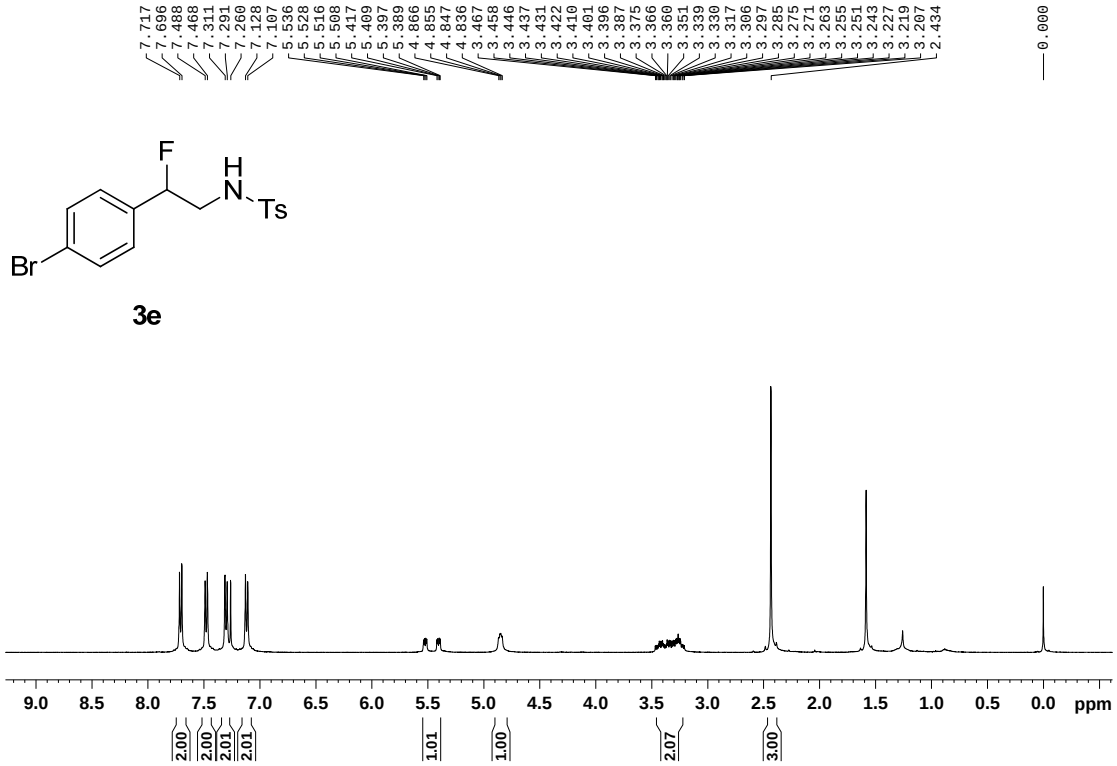
3d

^{19}F NMR spectrum of **3d**



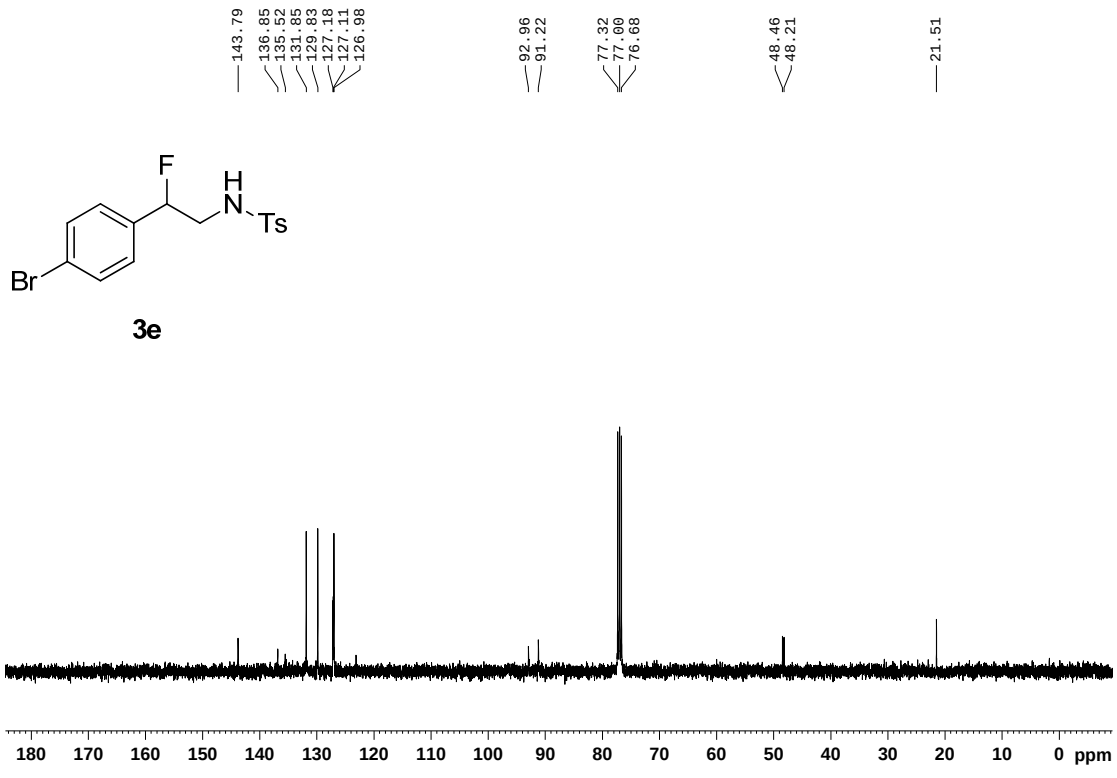
3d

^{1}H NMR spectrum of **3e**



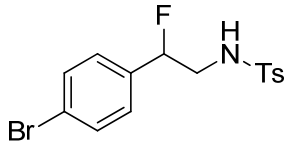
3e

^{13}C NMR spectrum of **3e**



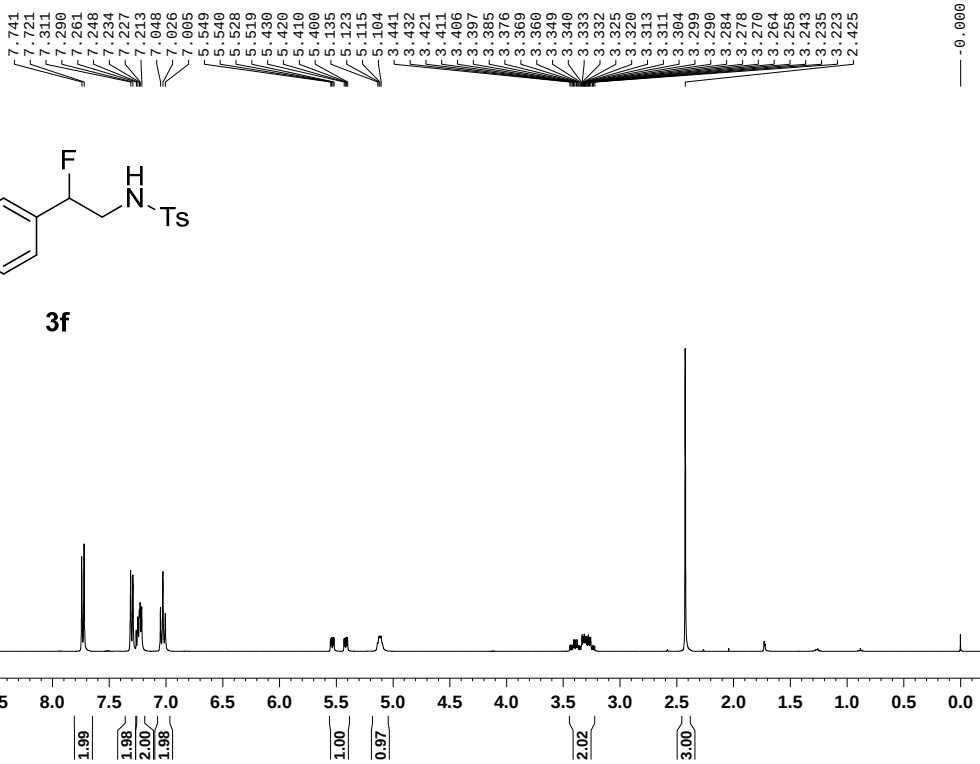
3e

^{19}F NMR spectrum of **3e**



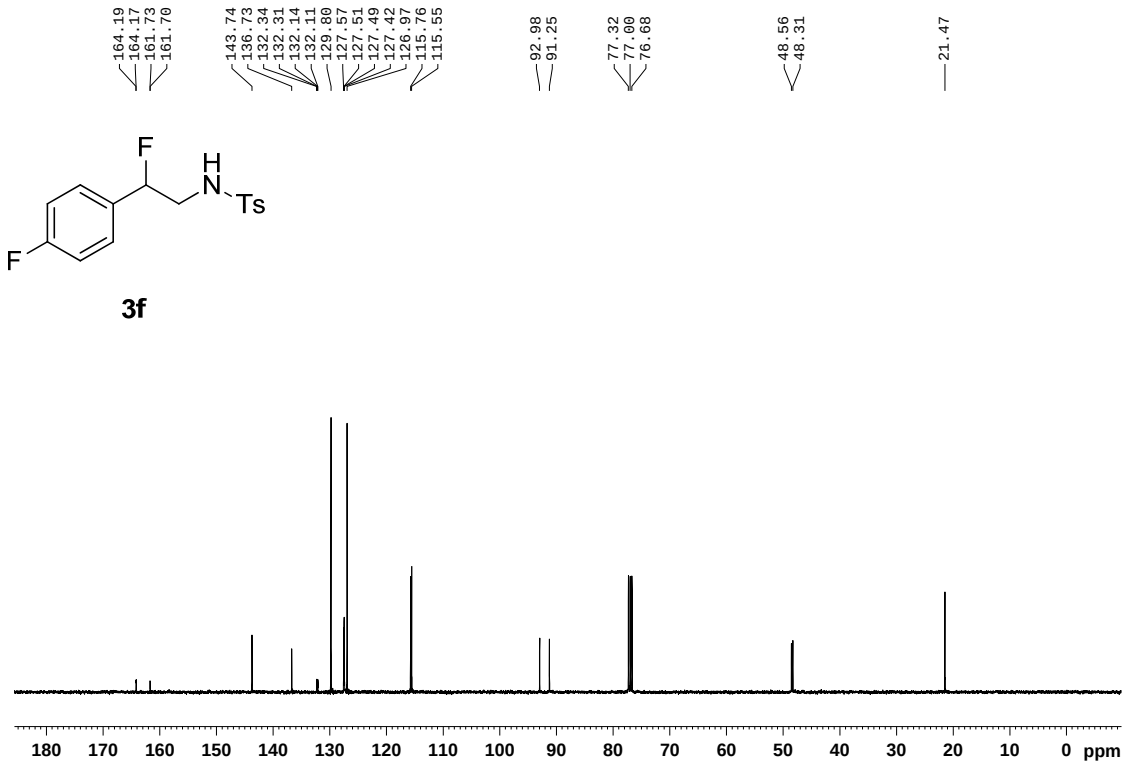
3e

^{1}H NMR spectrum of **3f**

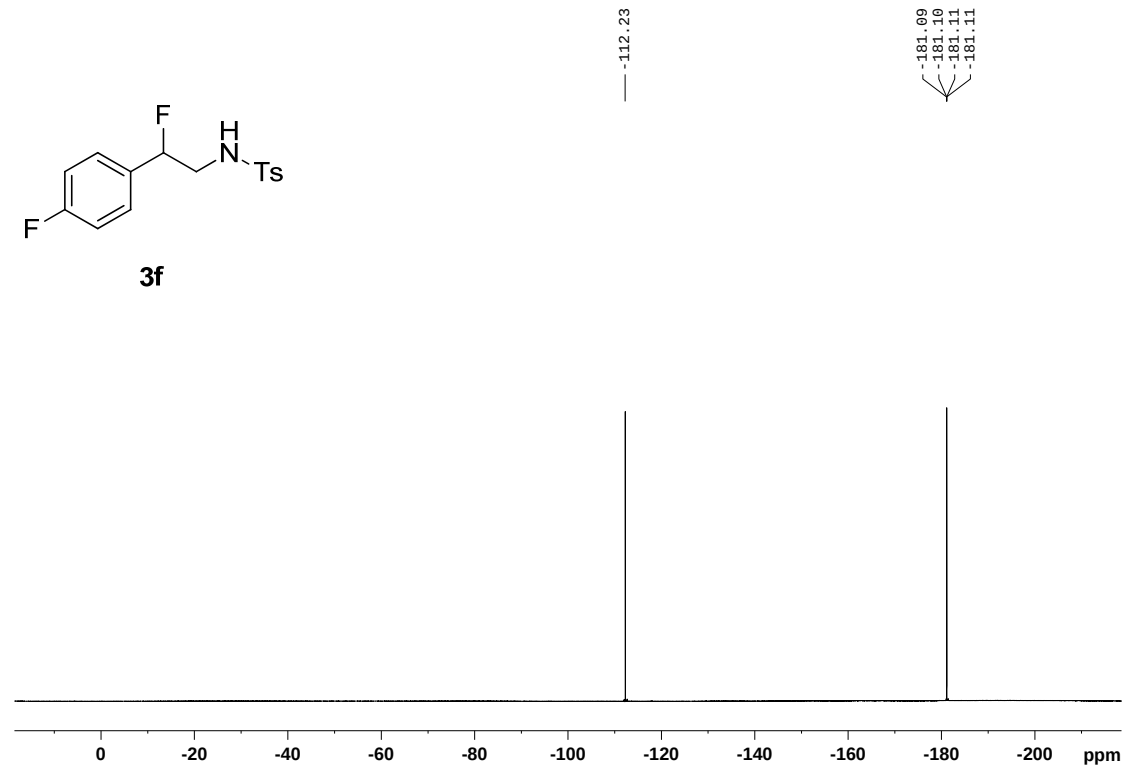


3f

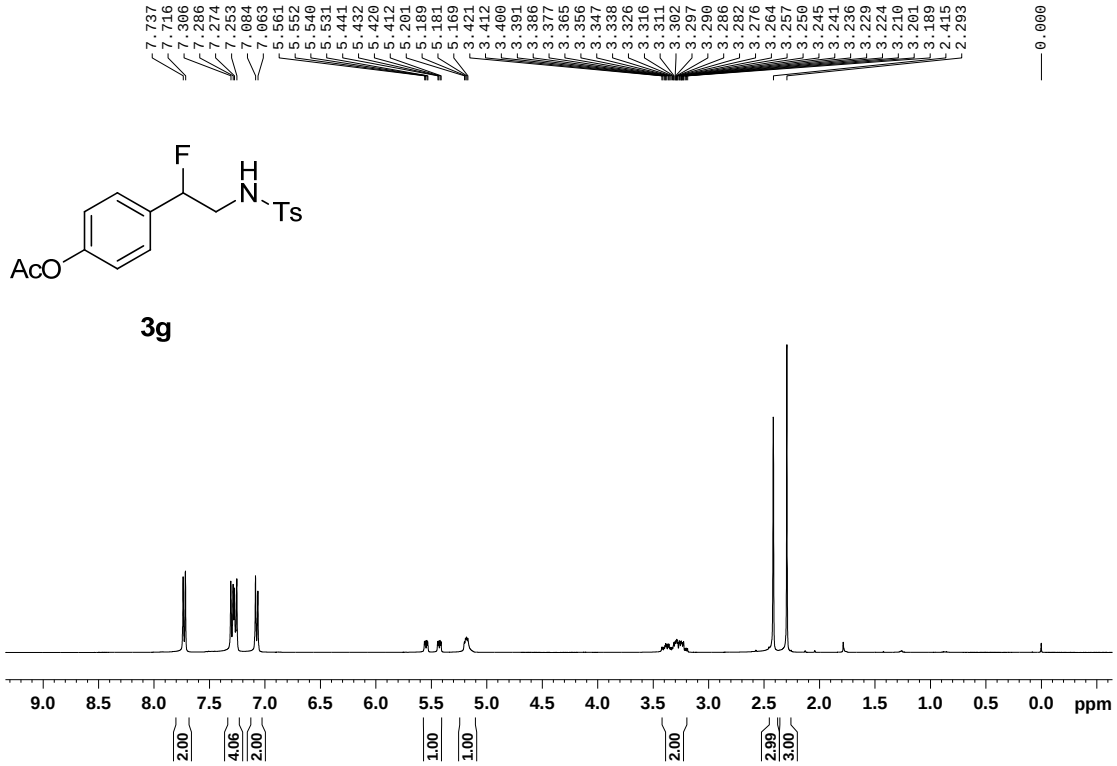
^{13}C NMR spectrum of **3f**



^{19}F NMR spectrum of **3f**

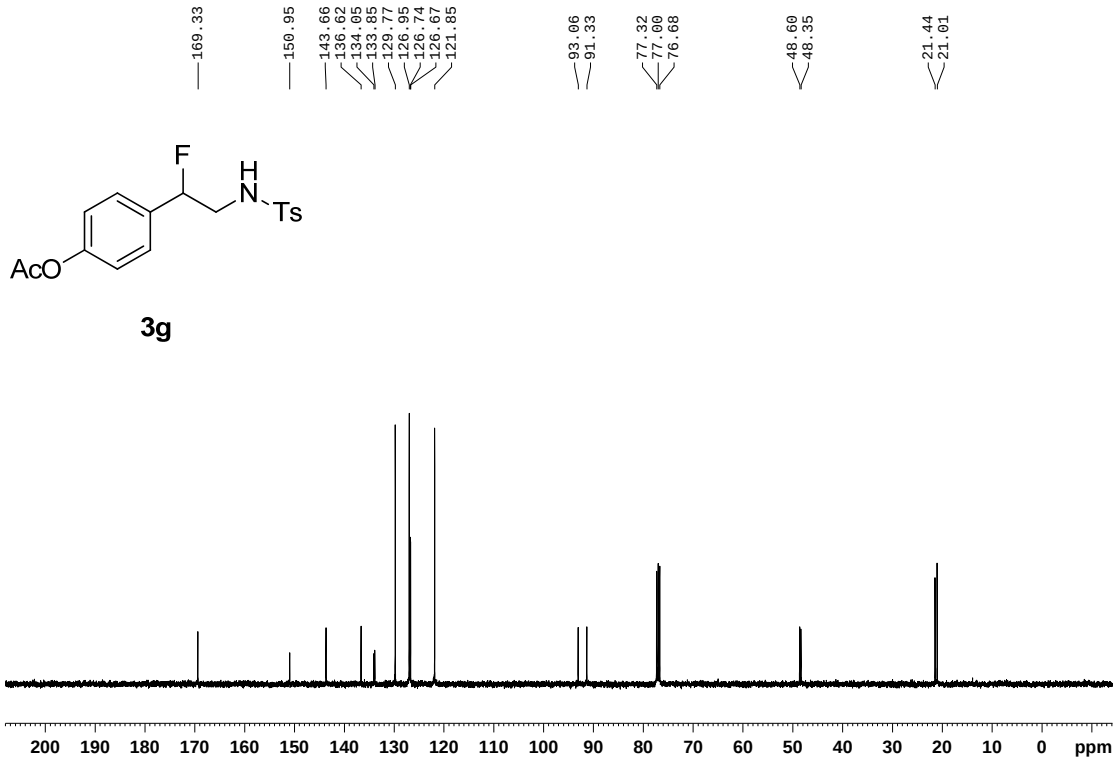


^{1}H NMR spectrum of **3g**



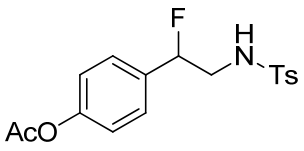
3g

^{13}C NMR spectrum of **3g**



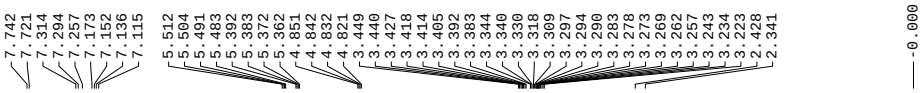
3g

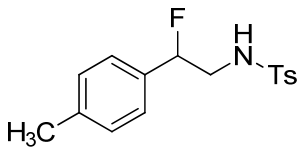
^{19}F NMR spectrum of **3g**



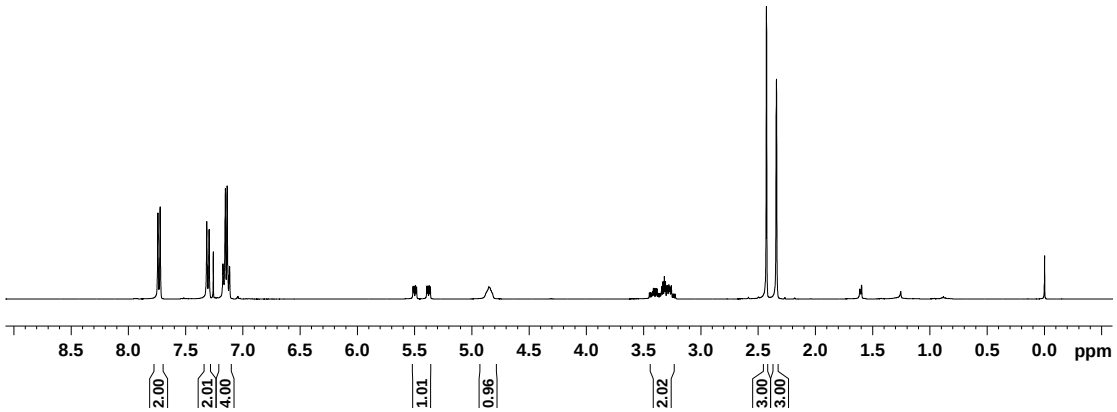
3g

^{1}H NMR spectrum of **3h**

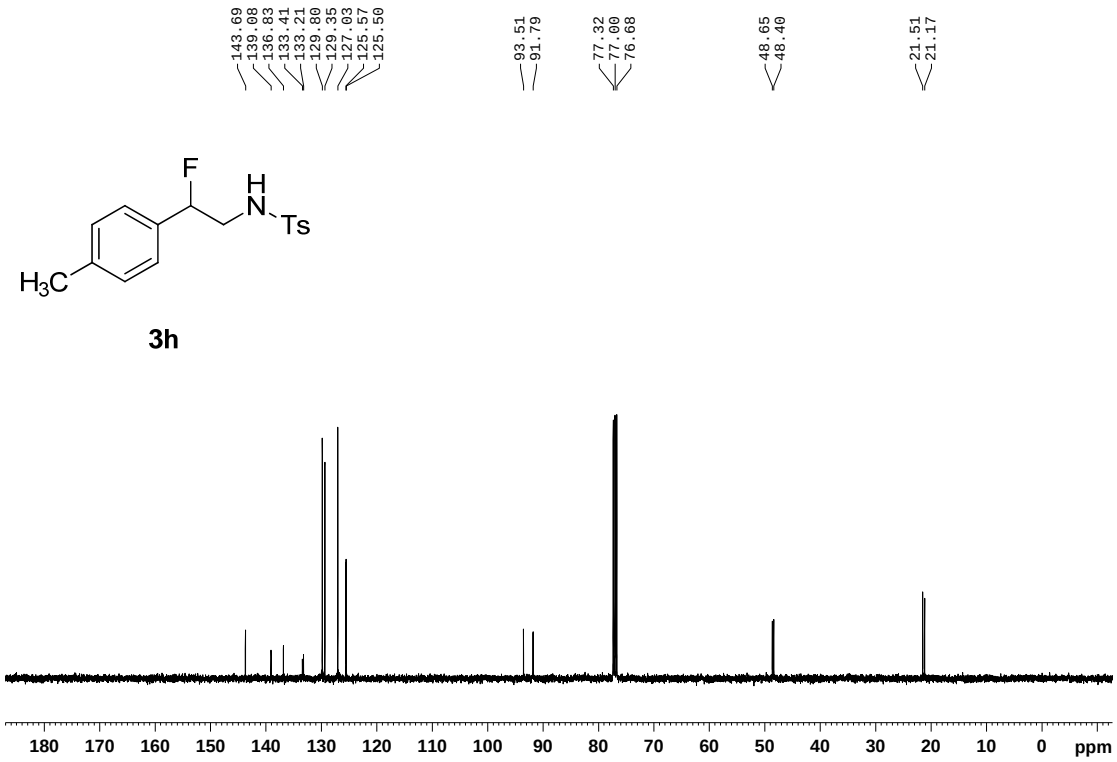




3h

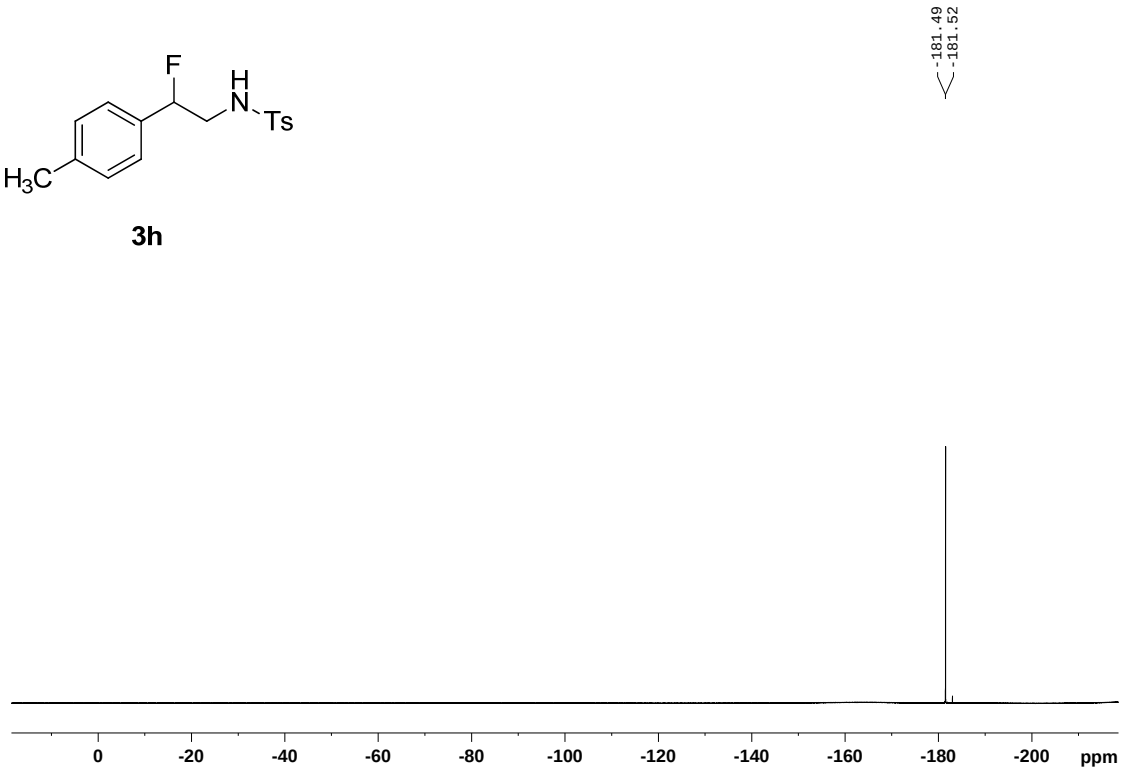


^{13}C NMR spectrum of **3h**



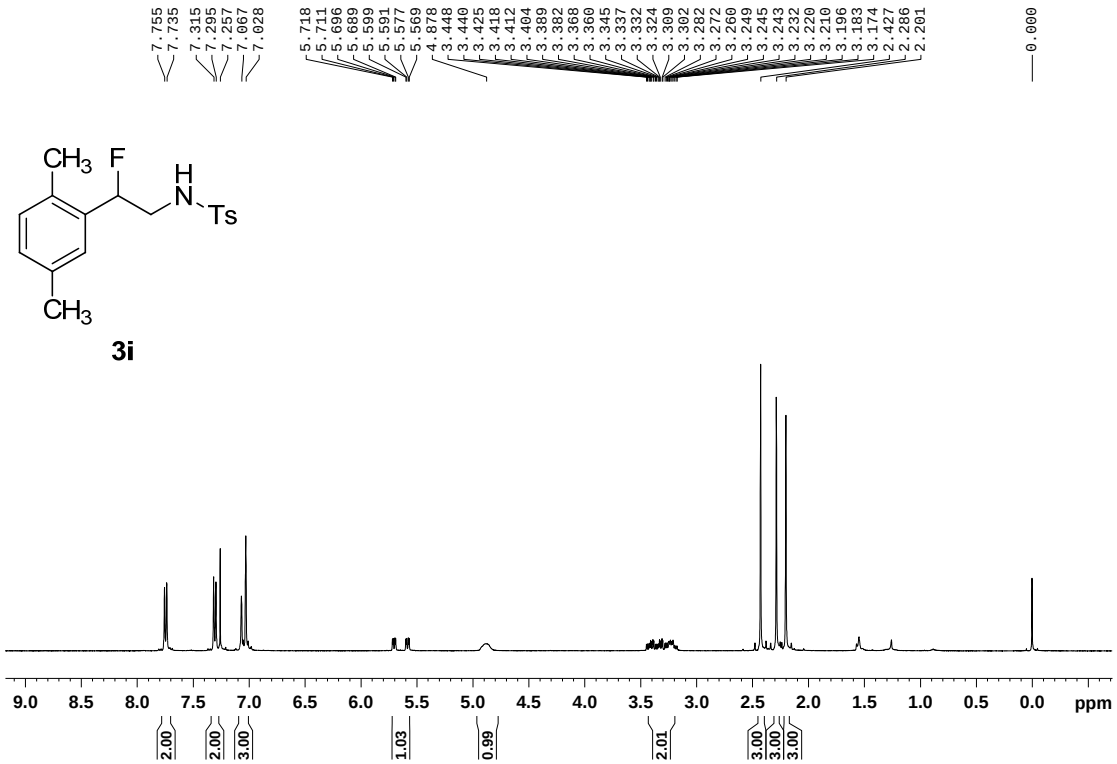
3h

^{19}F NMR spectrum of **3h**

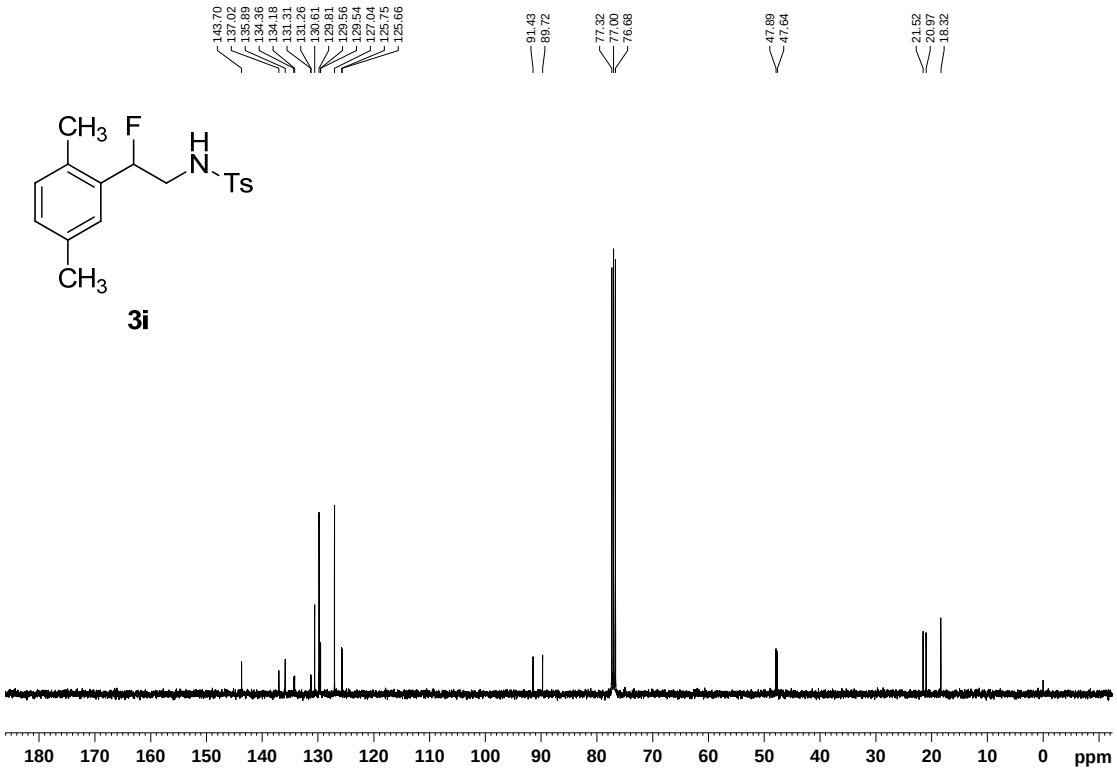


3h

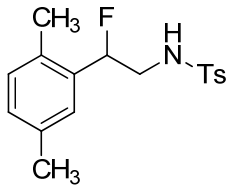
^{1}H NMR spectrum of **3i**



^{13}C NMR spectrum of **3i**

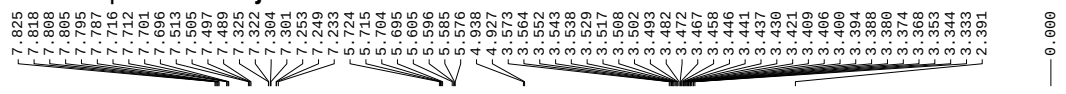


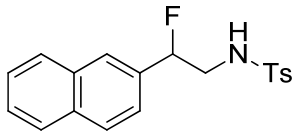
^{19}F NMR spectrum of **3i**



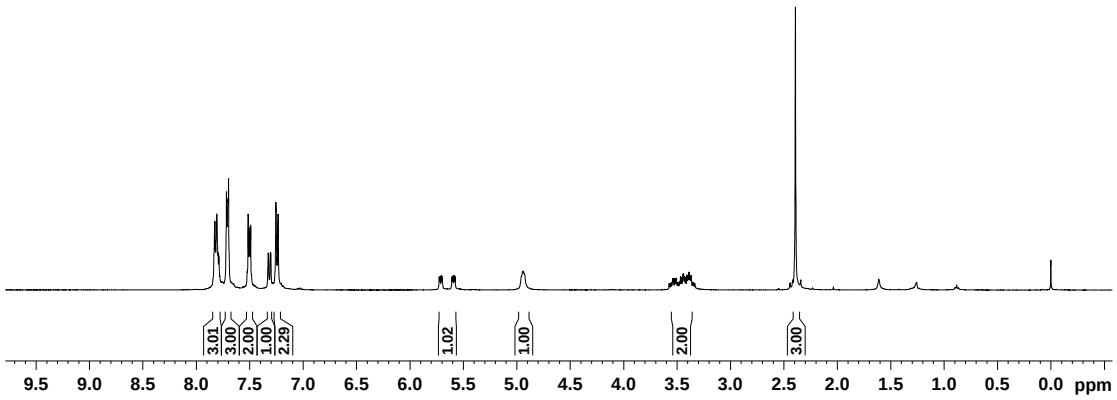
3i

^{1}H NMR spectrum of **3j**

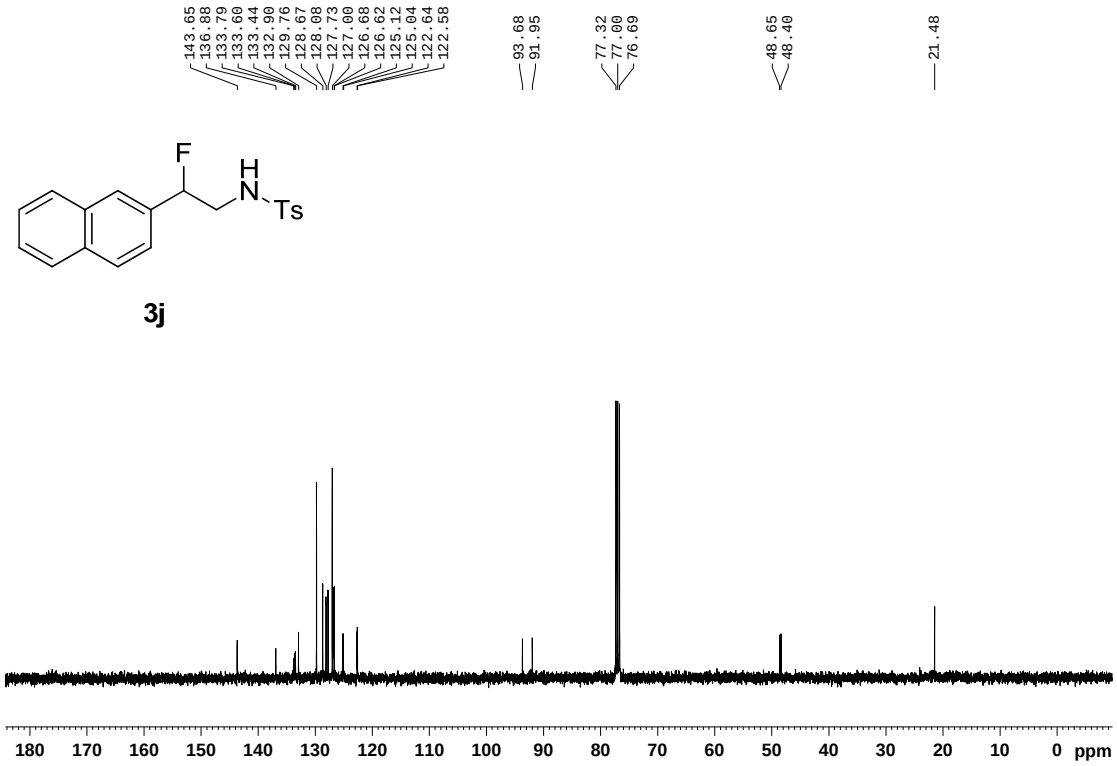




3j

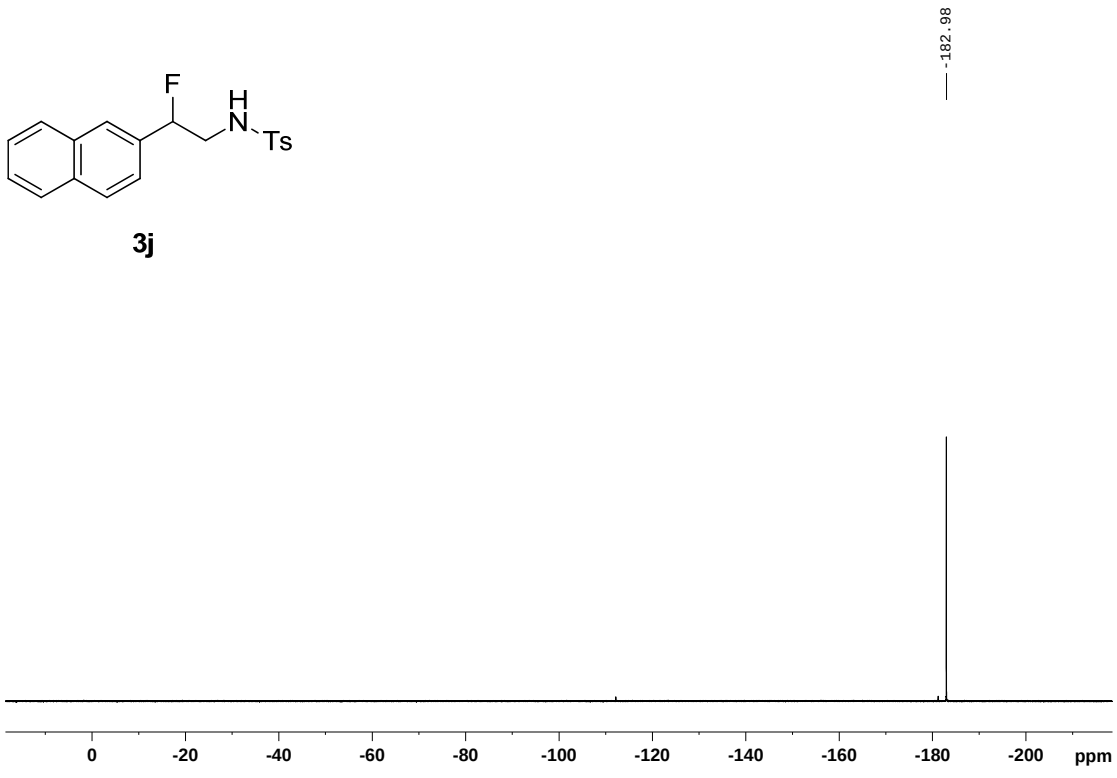


^{13}C NMR spectrum of **3j**



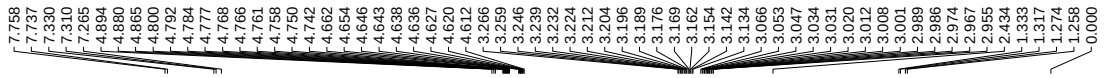
3j

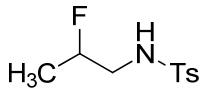
^{19}F NMR spectrum of **3j**



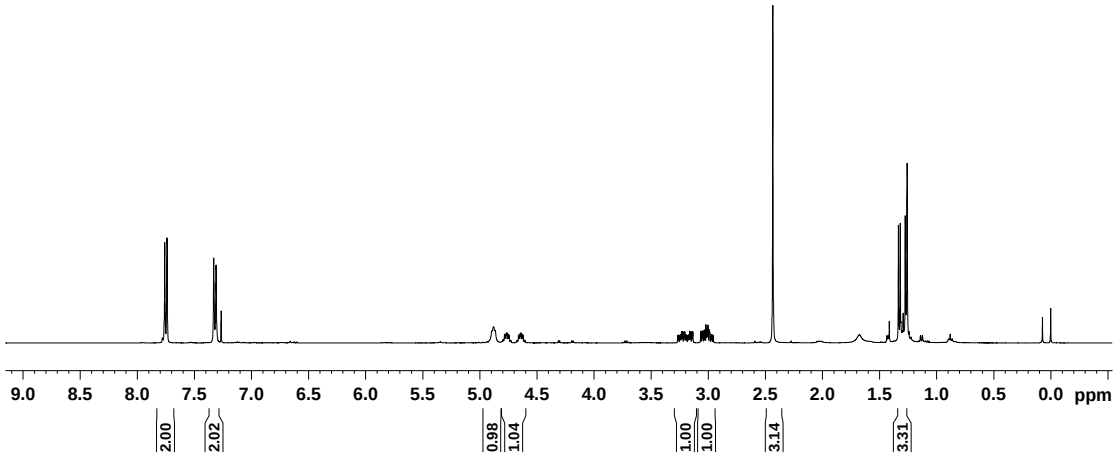
3j

^{19}H NMR spectrum of **3k**

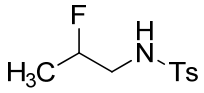




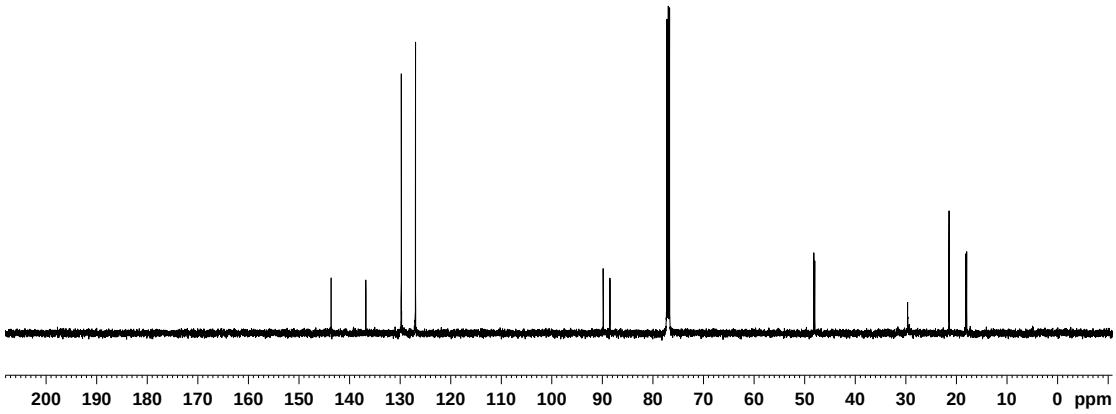
3k



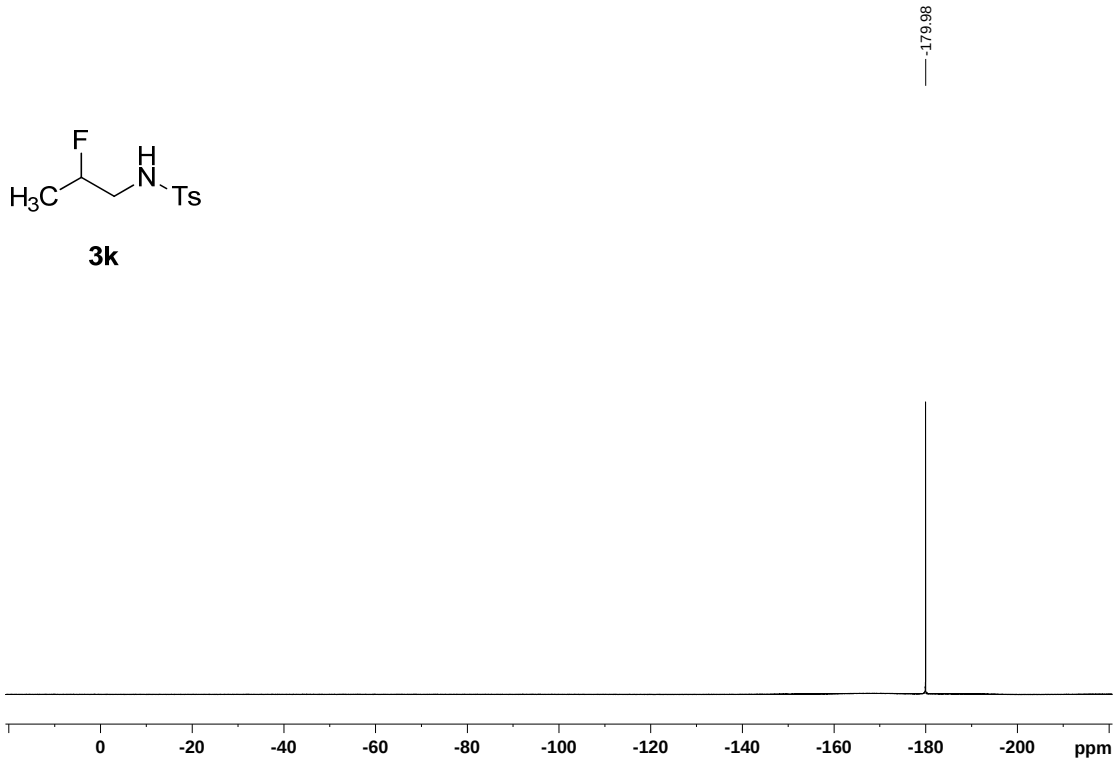
^{13}C NMR spectrum of **3k**



3k

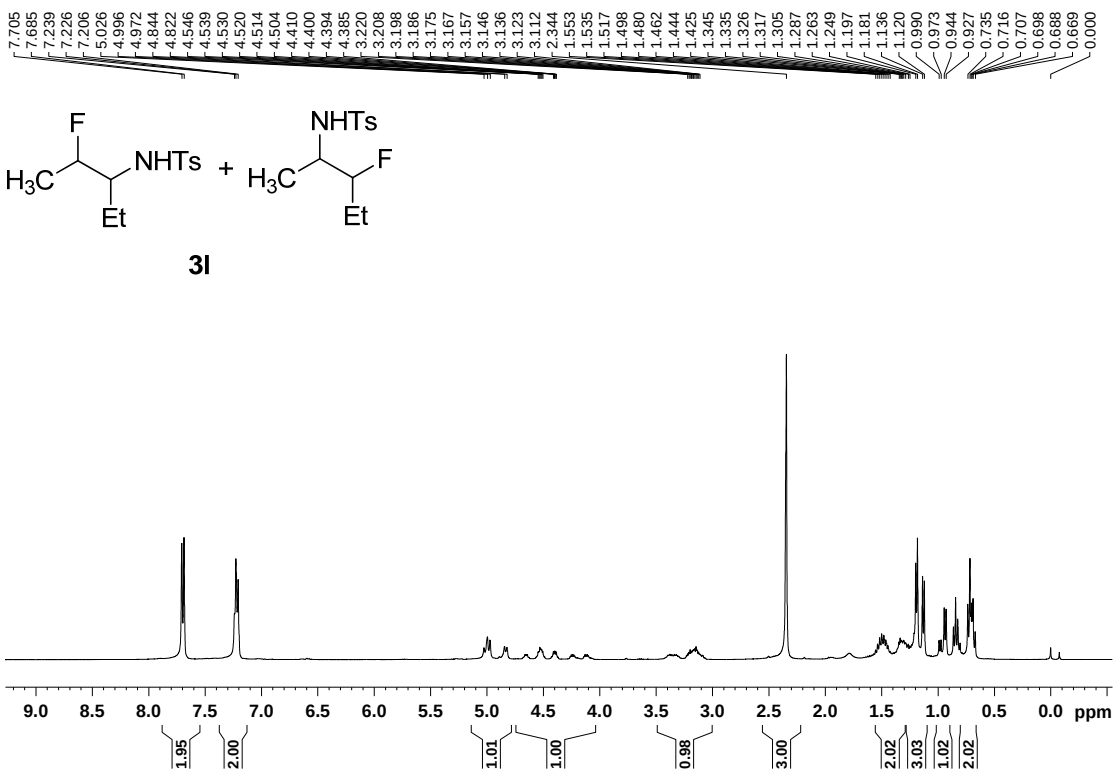


^{19}F NMR spectrum of **3k**



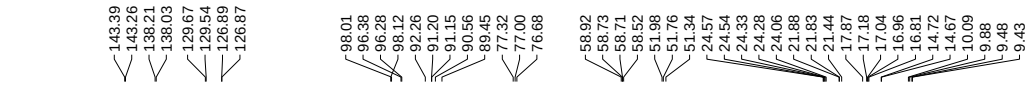
3k

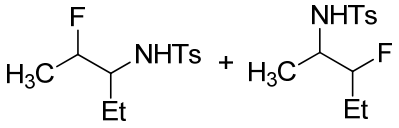
^{19}H NMR spectrum of **3l**



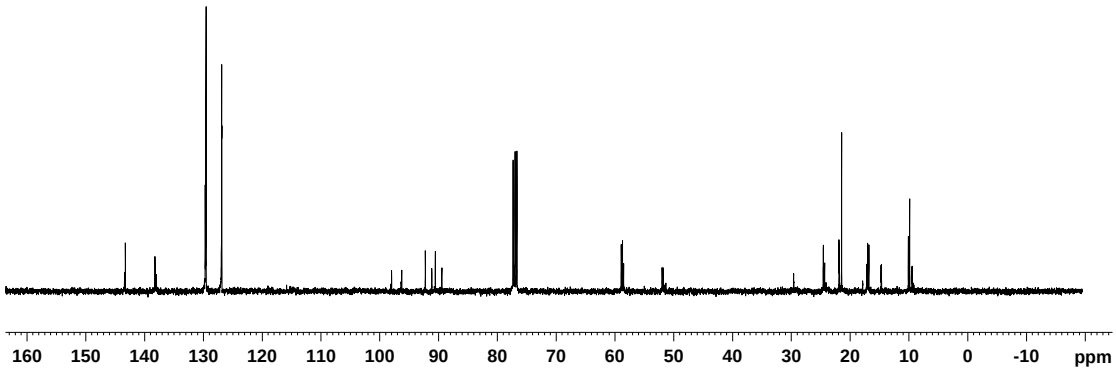
3l

^{13}C NMR spectrum of **3l**

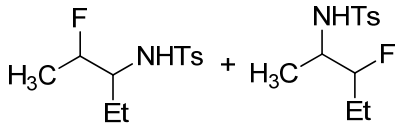




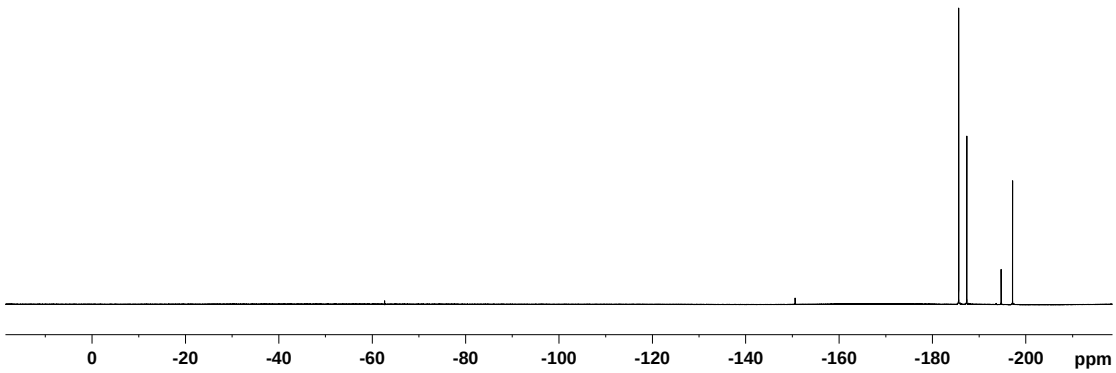
3l



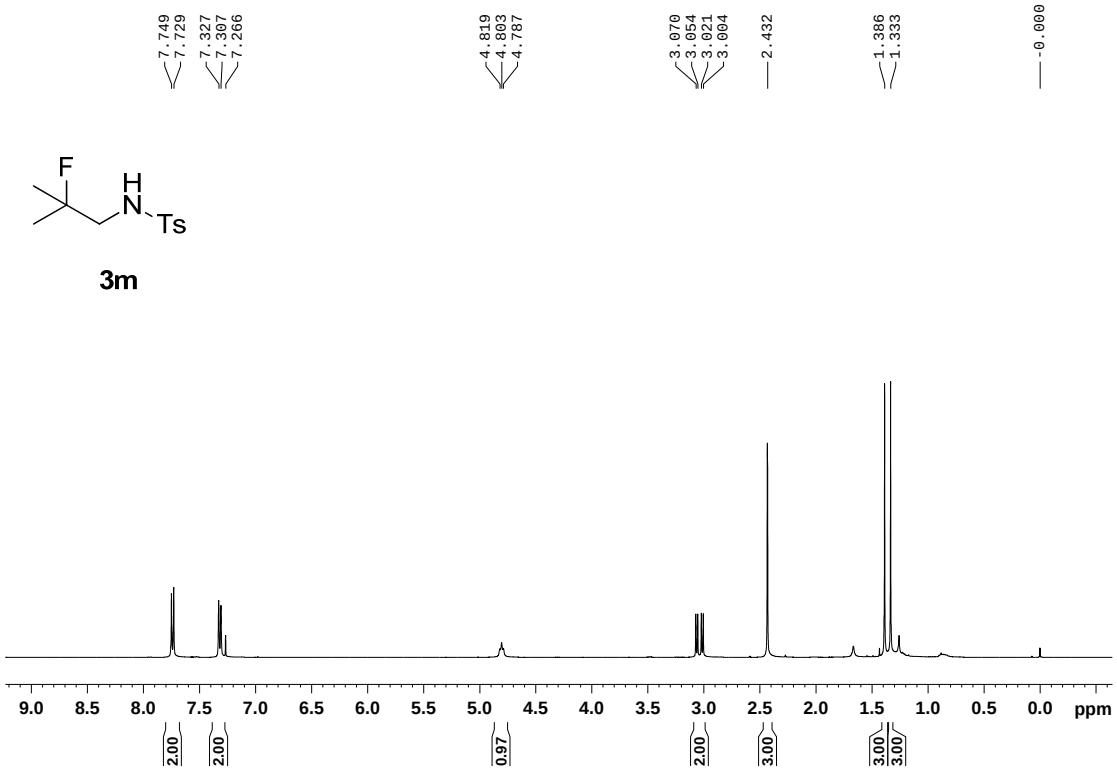
^{19}F NMR spectrum of **3l**



3l

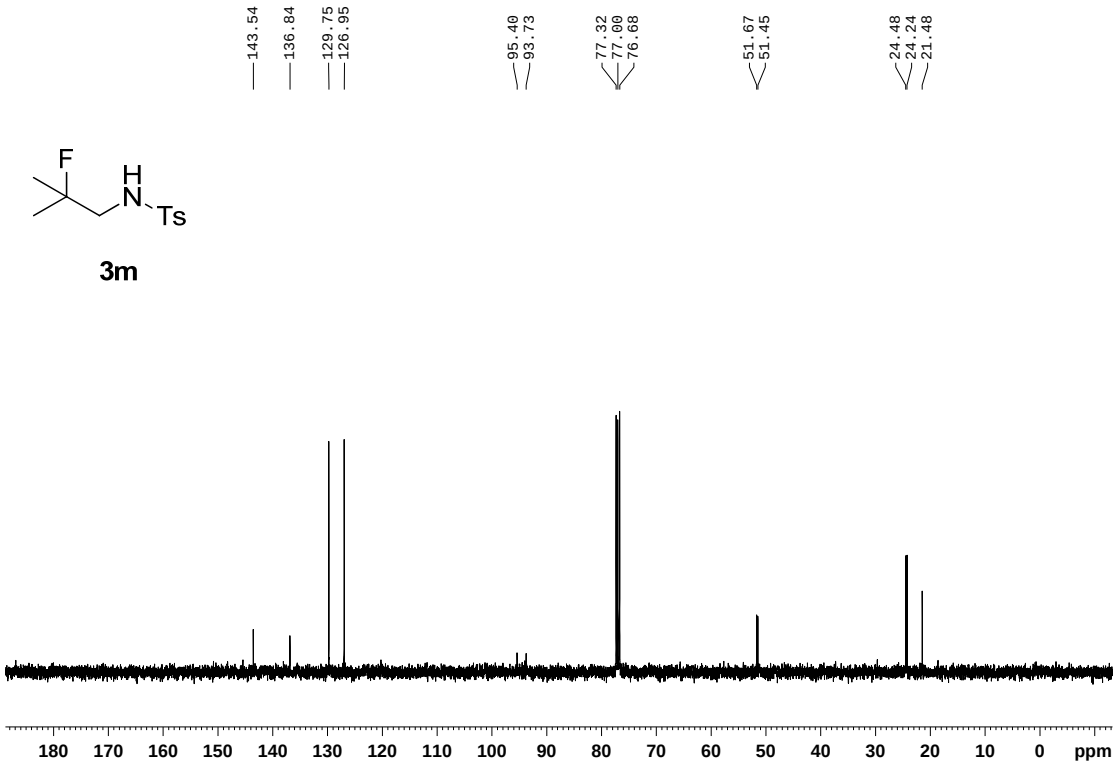


^{1}H NMR spectrum of **3m**



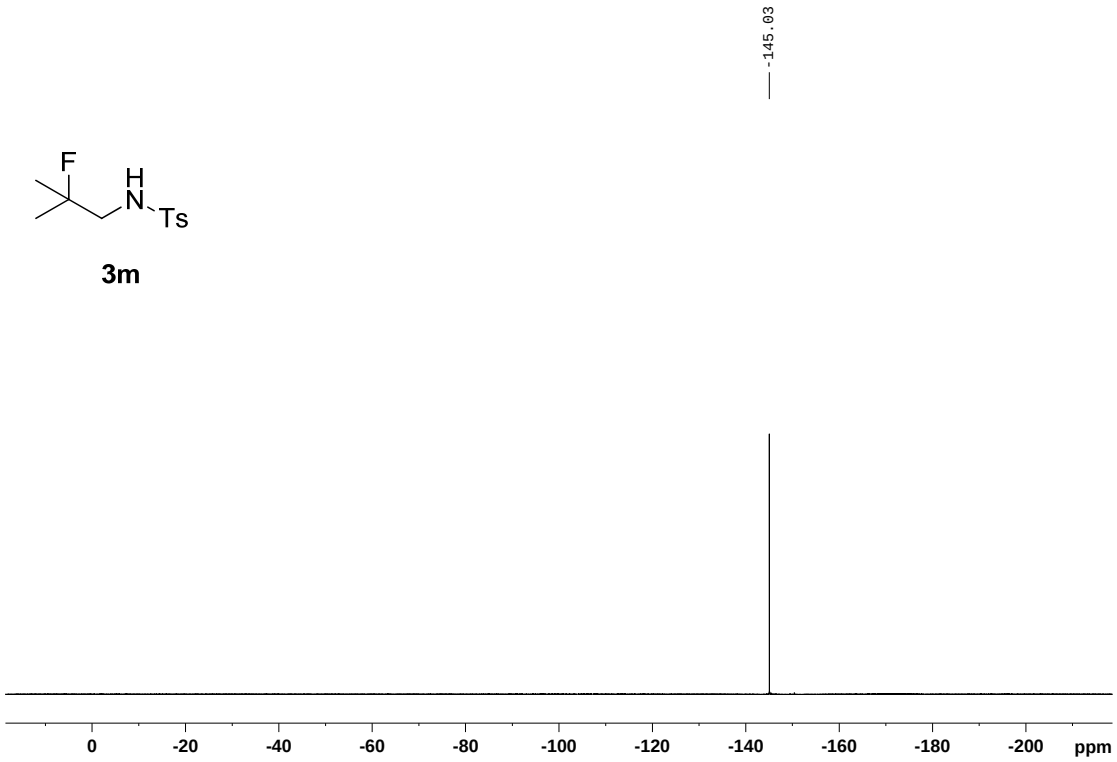
3m

^{13}C NMR spectrum of **3m**

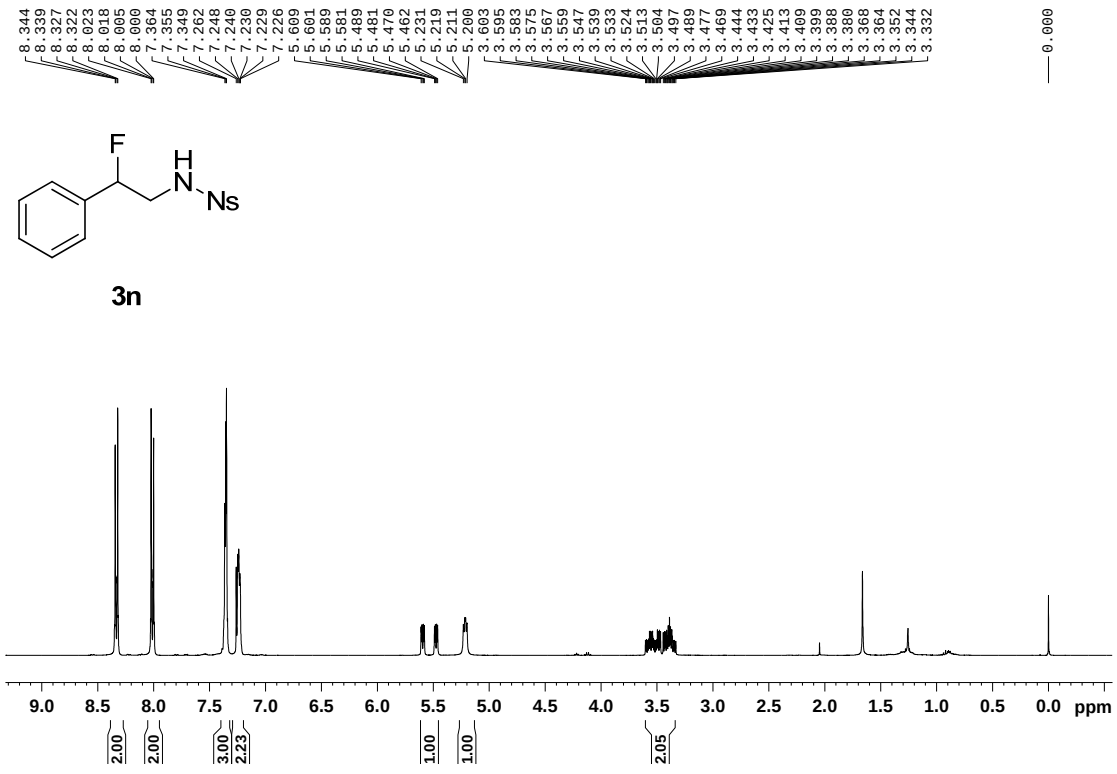


3m

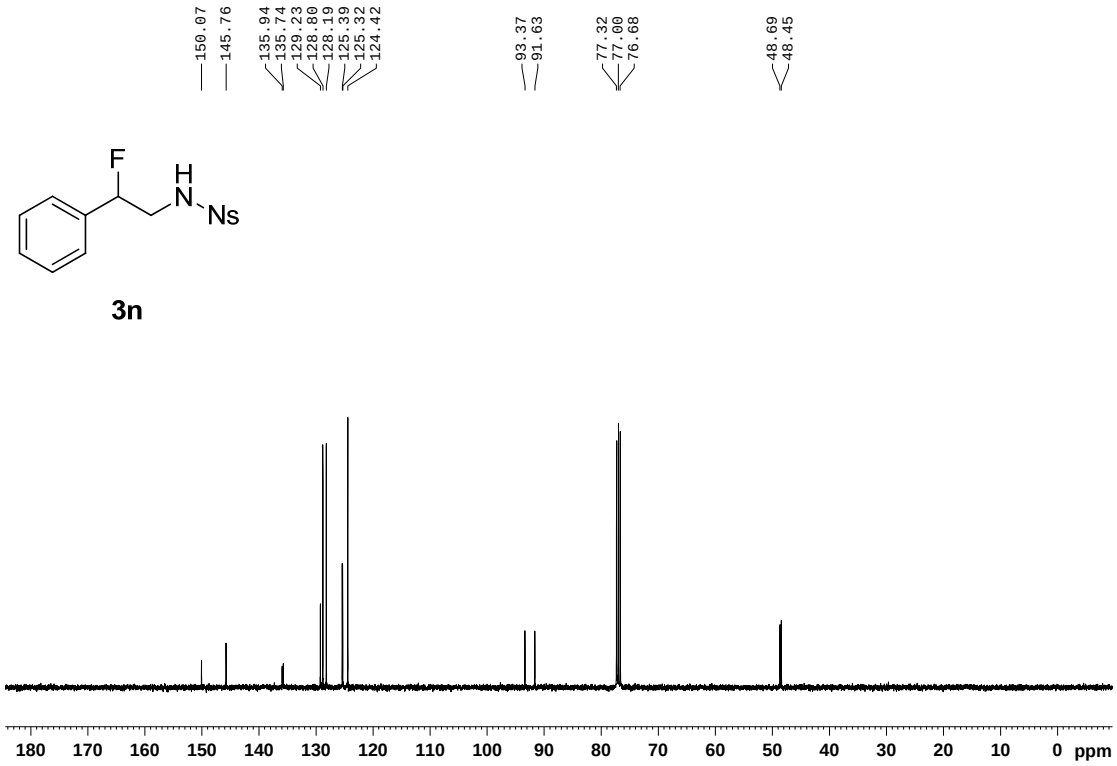
^{19}F NMR spectrum of **3m**



^{1}H NMR spectrum of **3n**

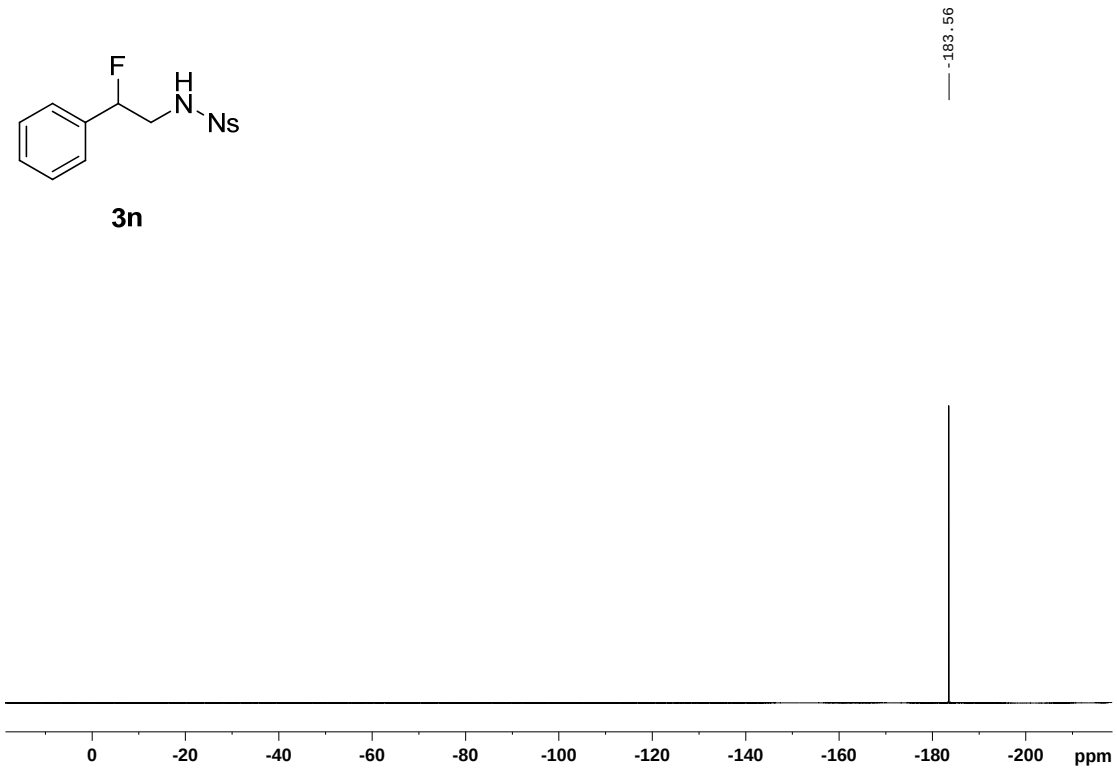


^{13}C NMR spectrum of **3n**



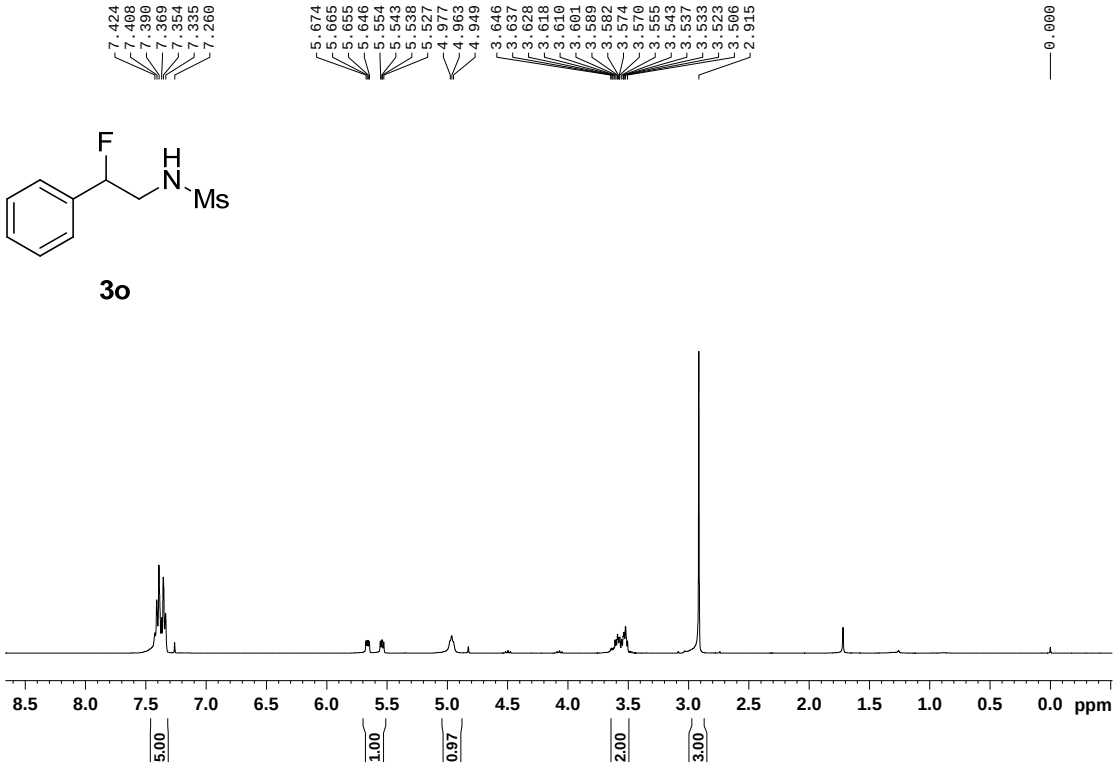
3n

^{13}F NMR spectrum of **3n**



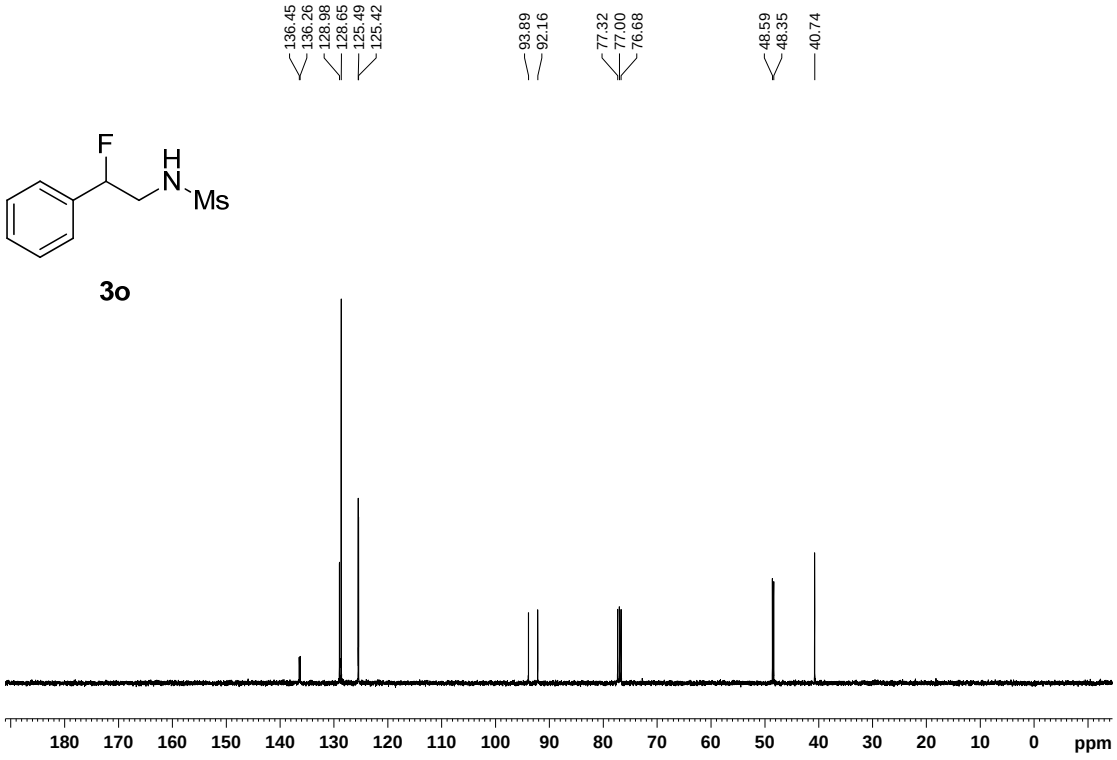
3n

^{1}H NMR spectrum of **3o**



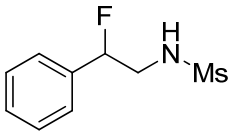
3o

^{13}C NMR spectrum of **3o**



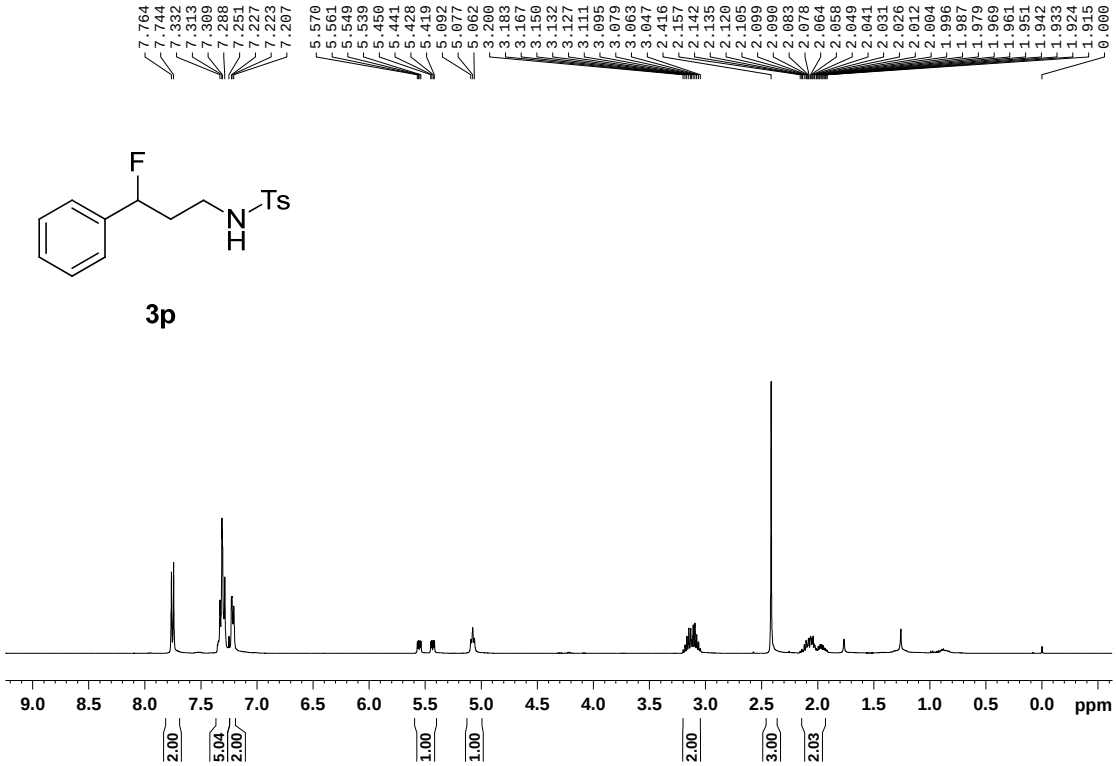
3o

^{19}F NMR spectrum of **3o**



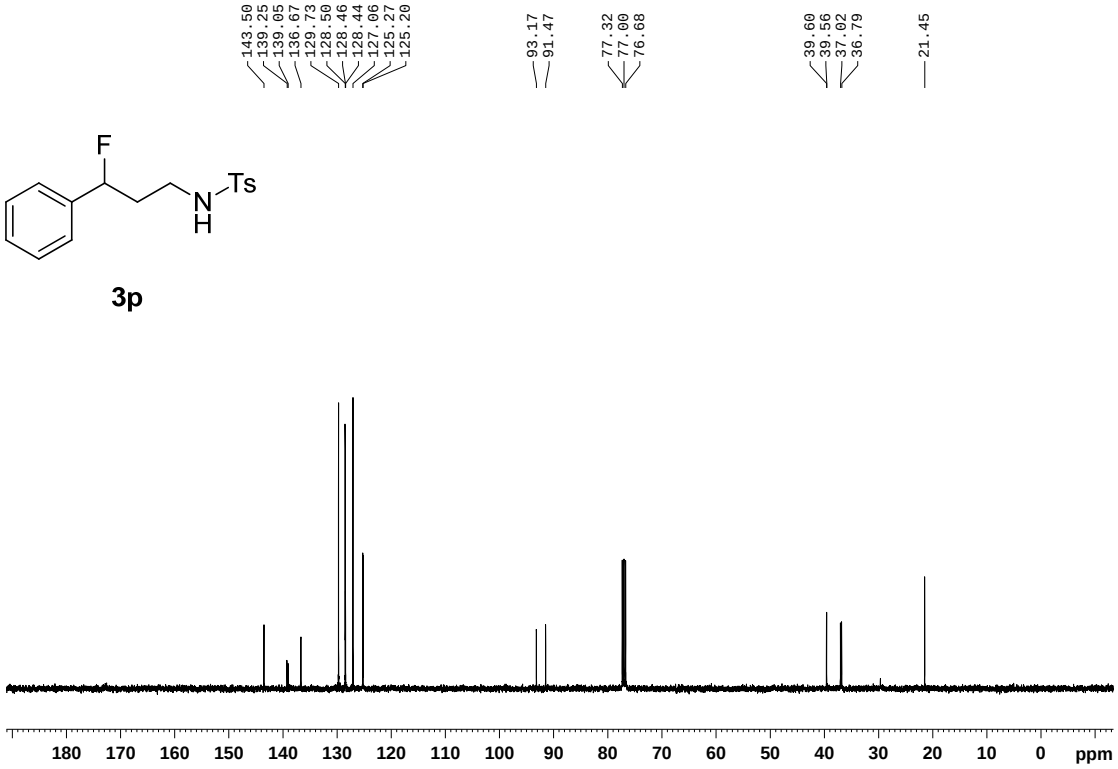
3o

^{1}H NMR spectrum of **3p**



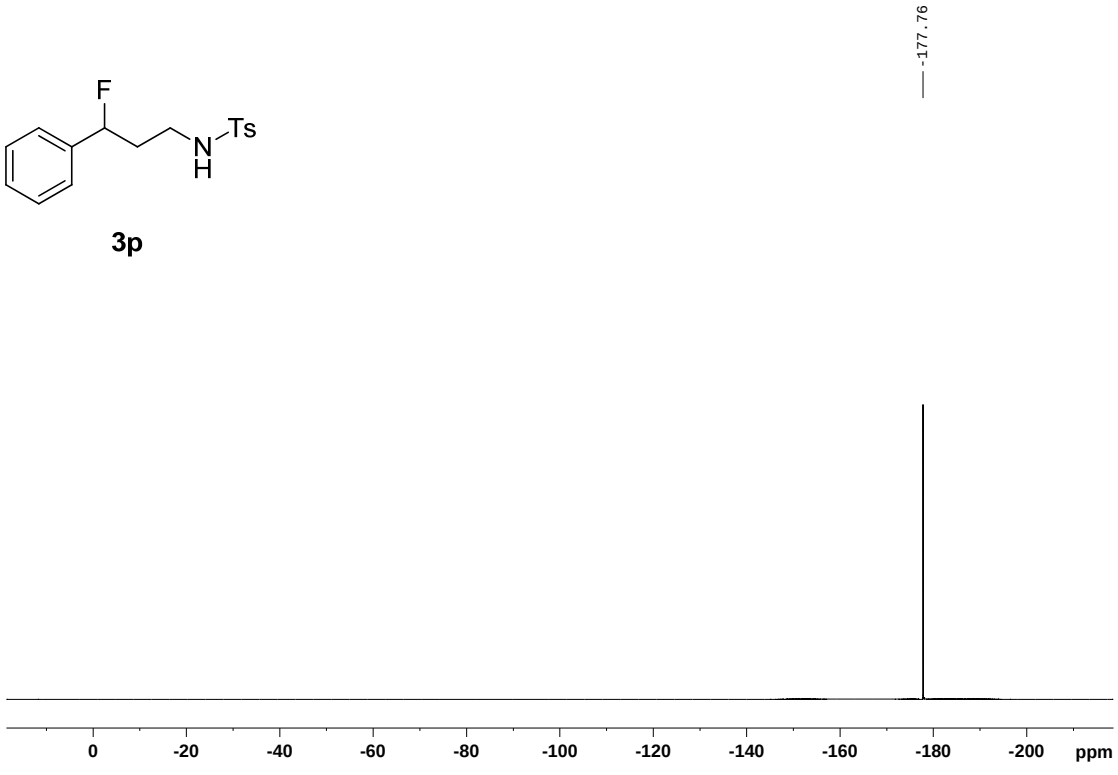
3p

^{13}C NMR spectrum of **3p**



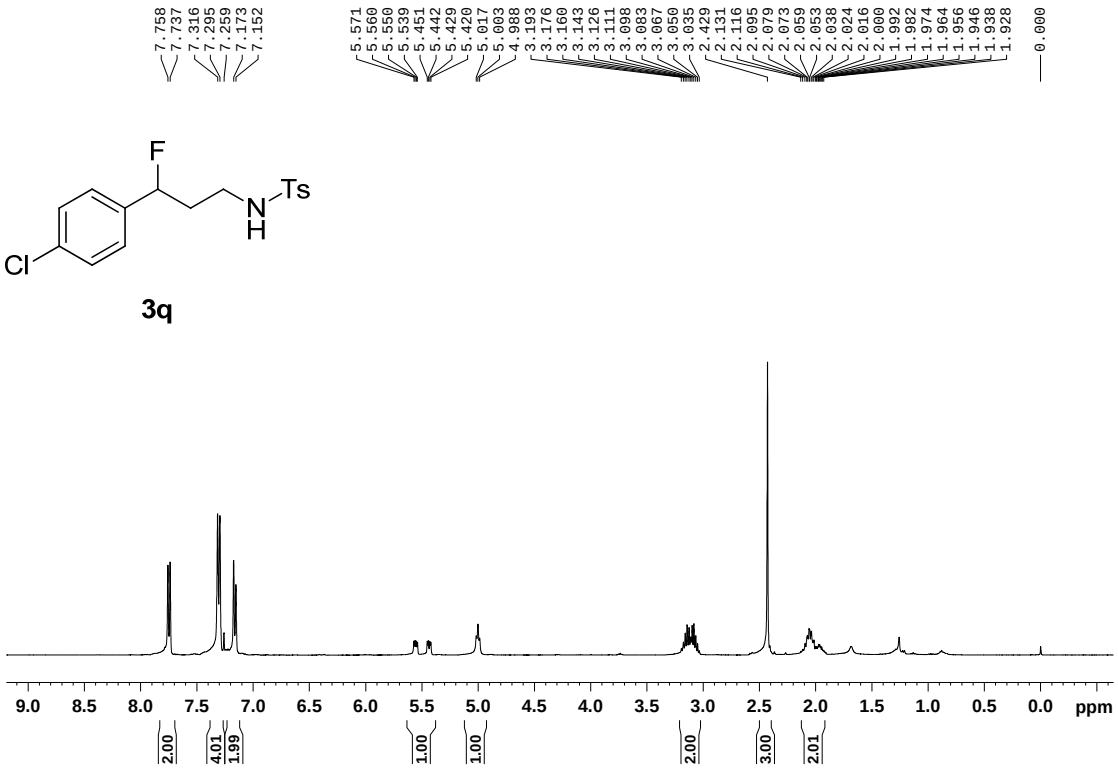
3p

^{19}F NMR spectrum of **3p**

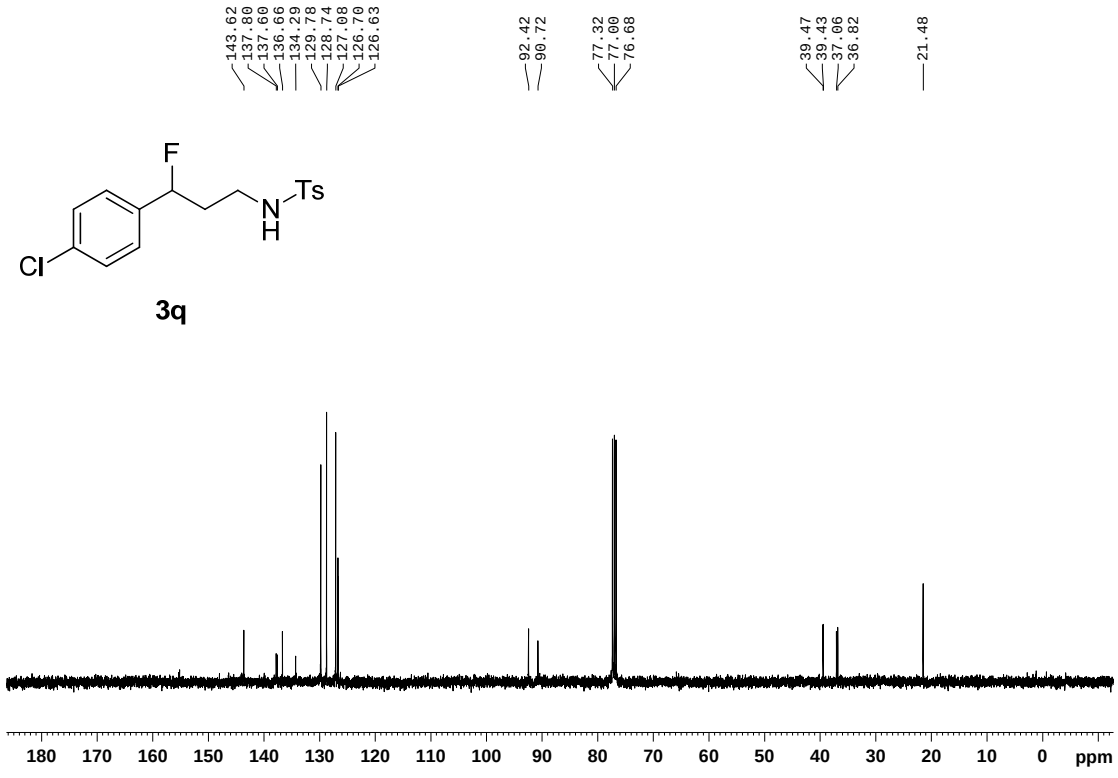


3p

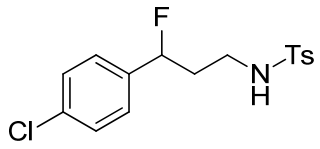
^{1}H NMR spectrum of **3q**



^{13}C NMR spectrum of **3q**

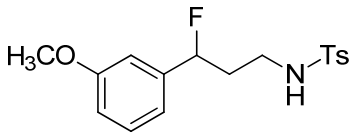


^{19}F NMR spectrum of **3q**

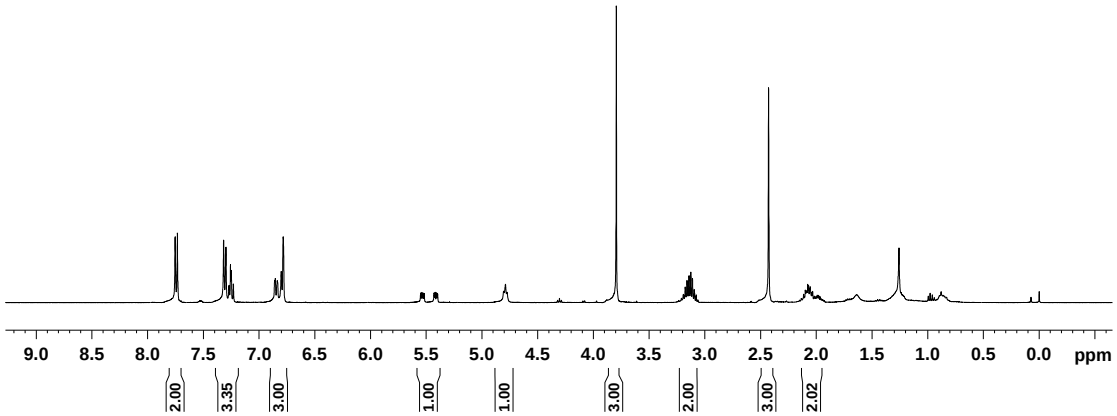


3q

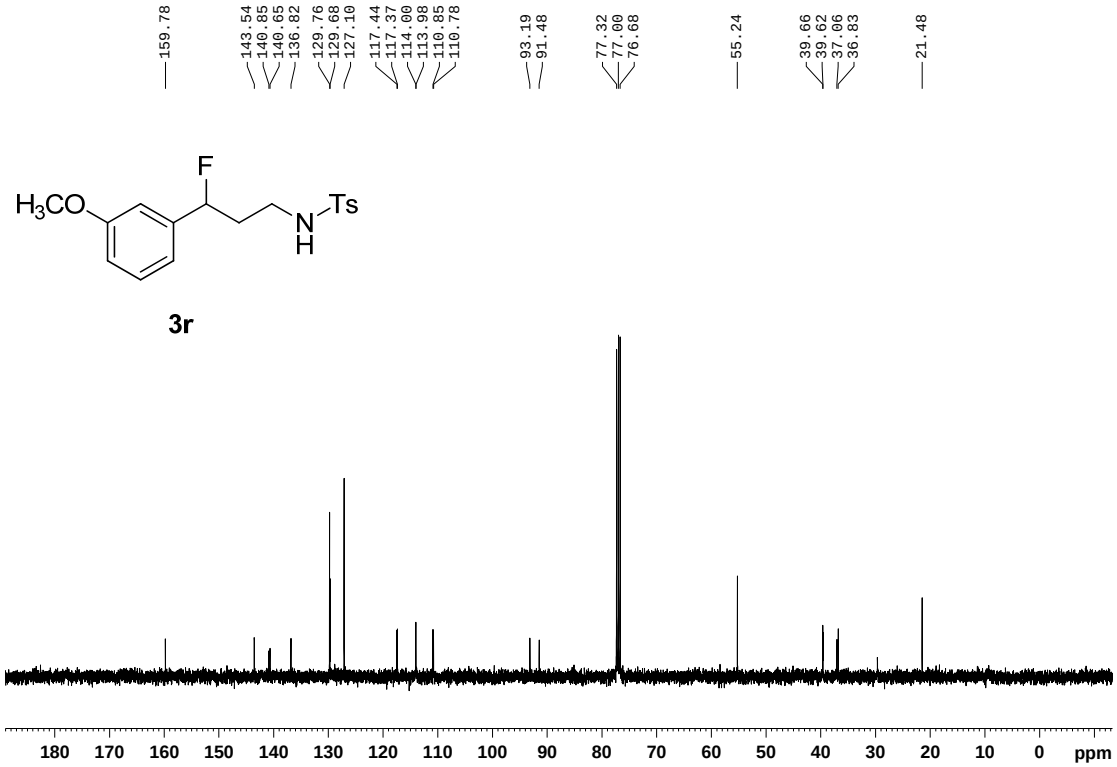
^{1}H NMR spectrum of **3r**



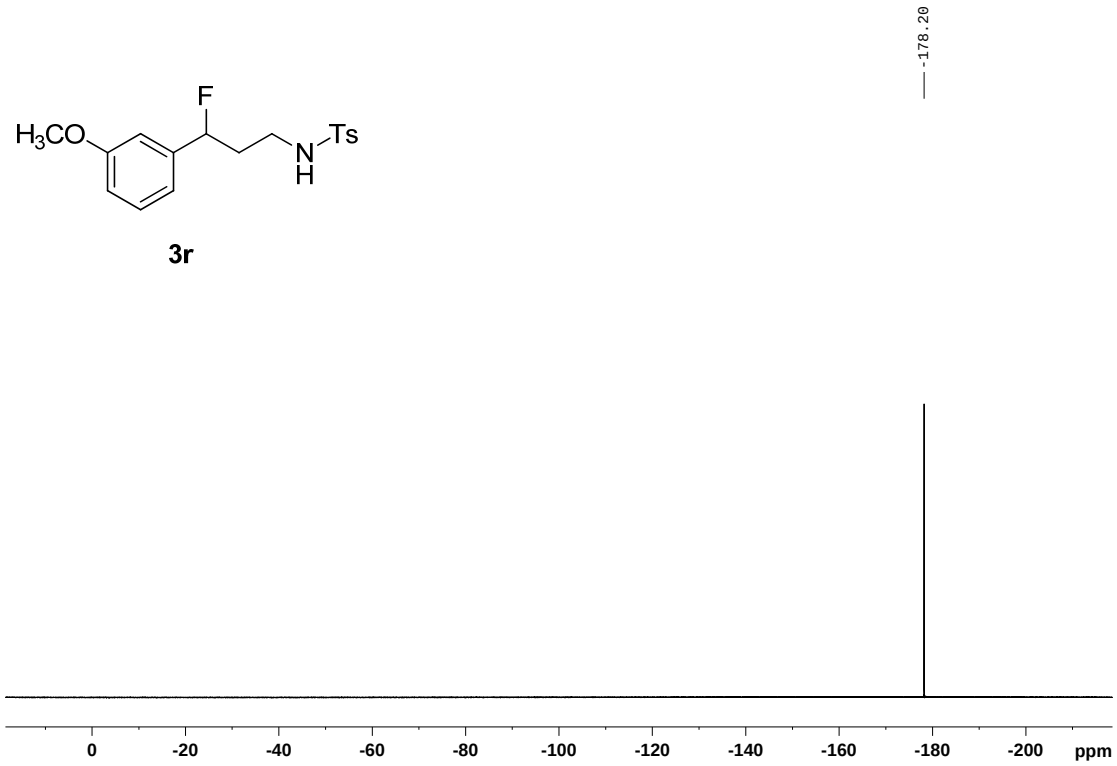
3r



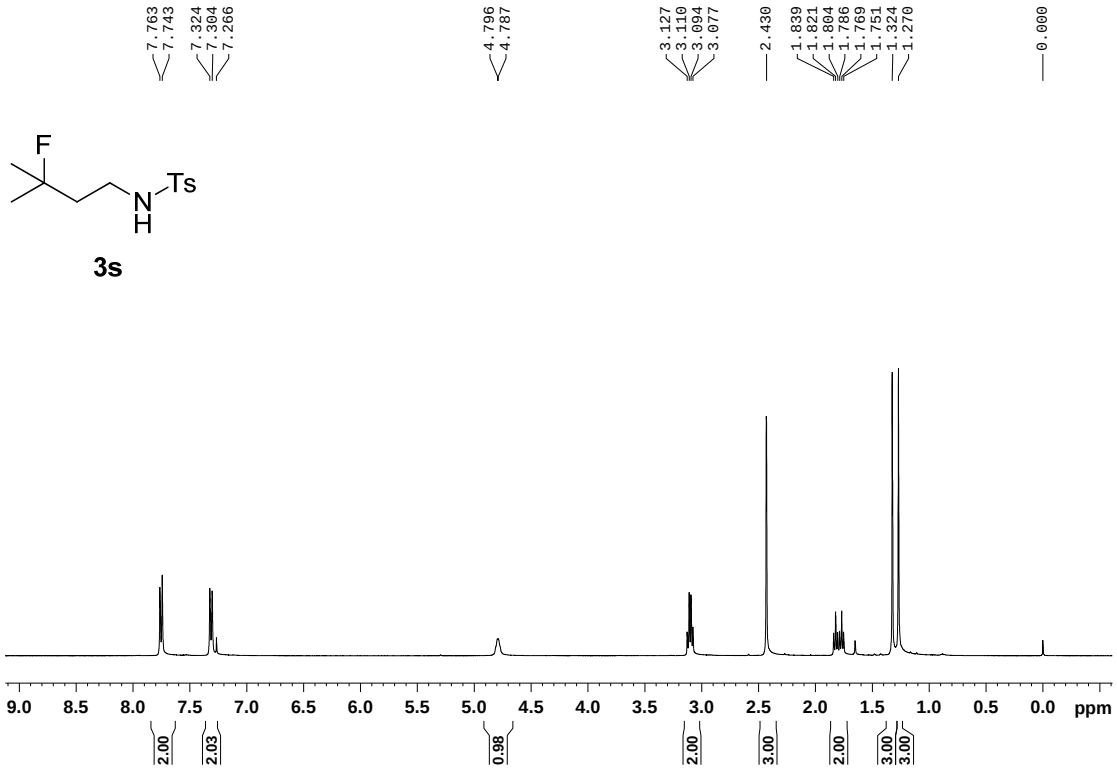
^{13}C NMR spectrum of **3r**



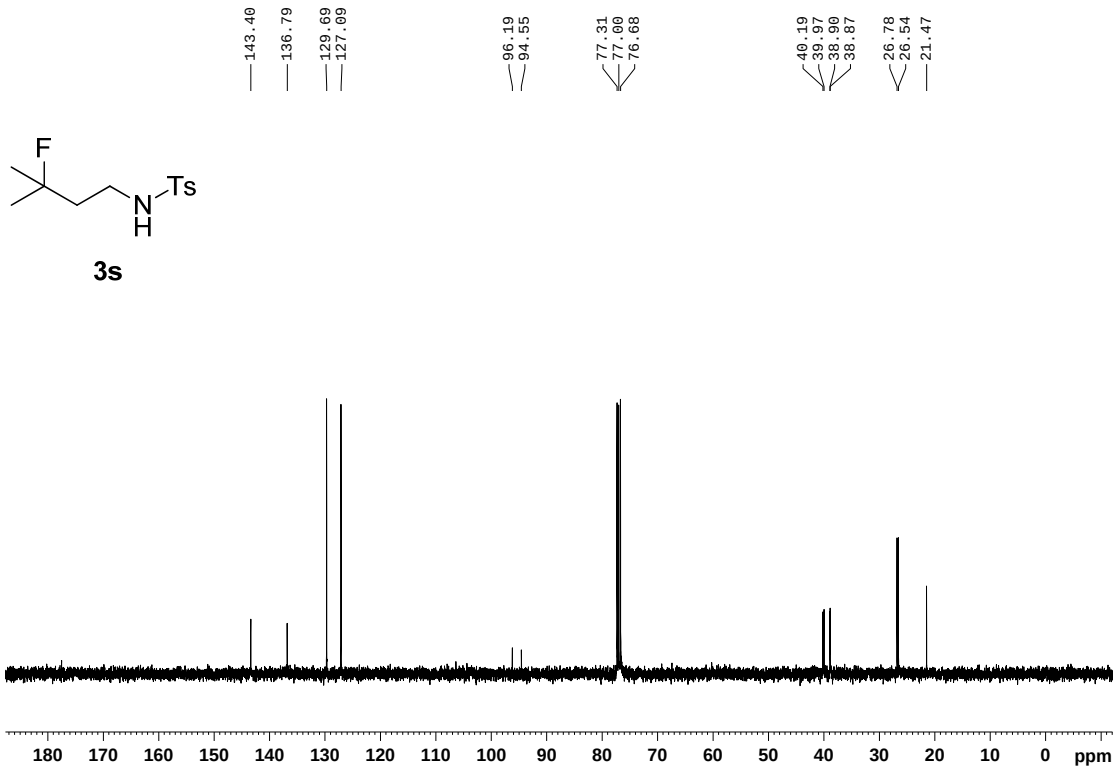
^{13}F NMR spectrum of **3r**



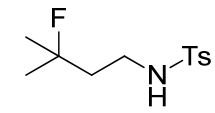
^{1}H NMR spectrum of **3s**



^{13}C NMR spectrum of **3s**

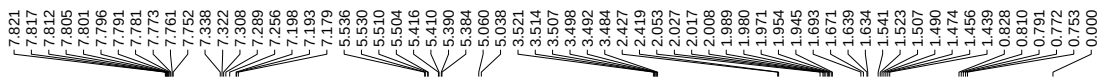


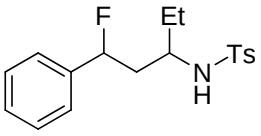
^{19}F NMR spectrum of **3s**



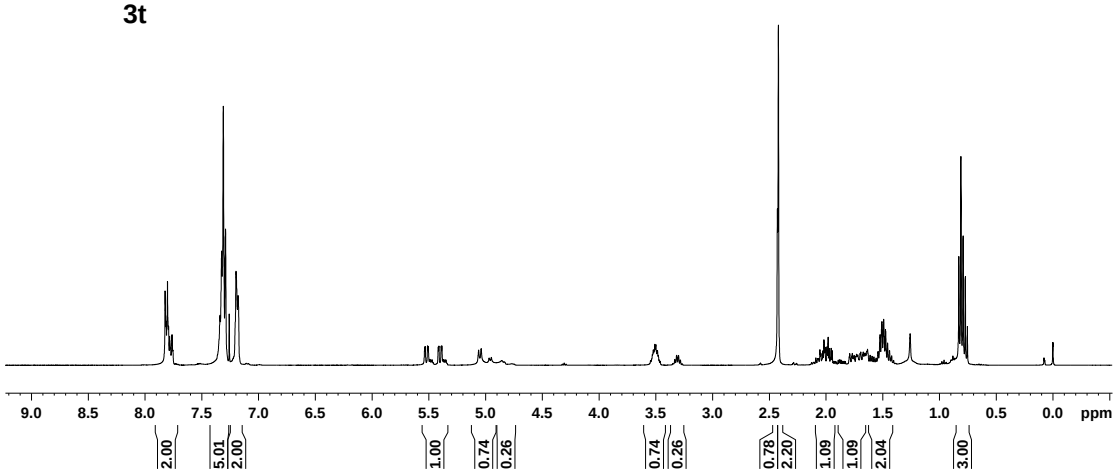
3s

^{1}H NMR spectrum of **3t**

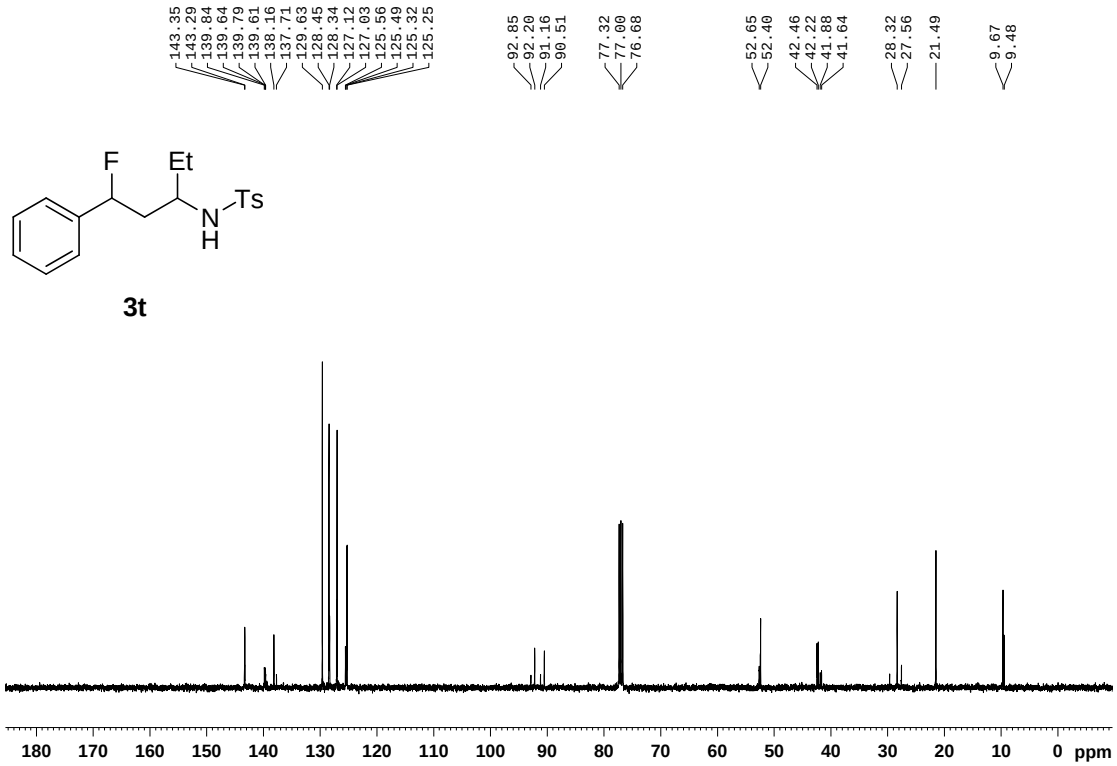




3t

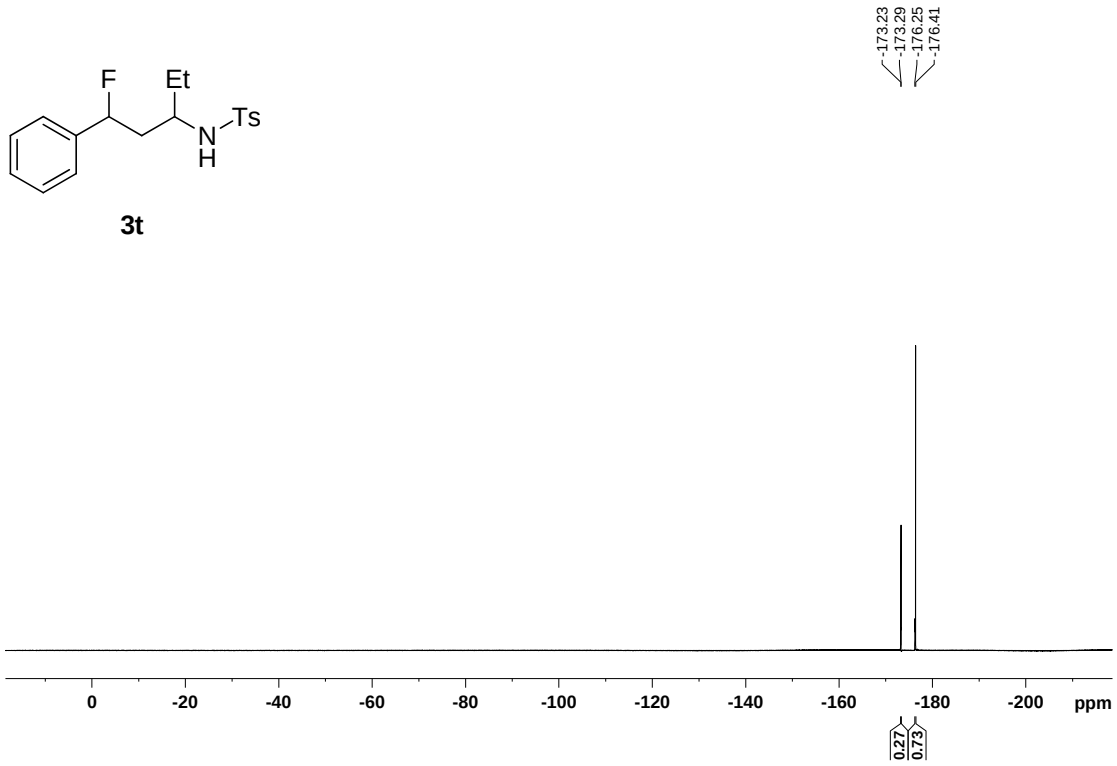


^{13}C NMR spectrum of **3t**



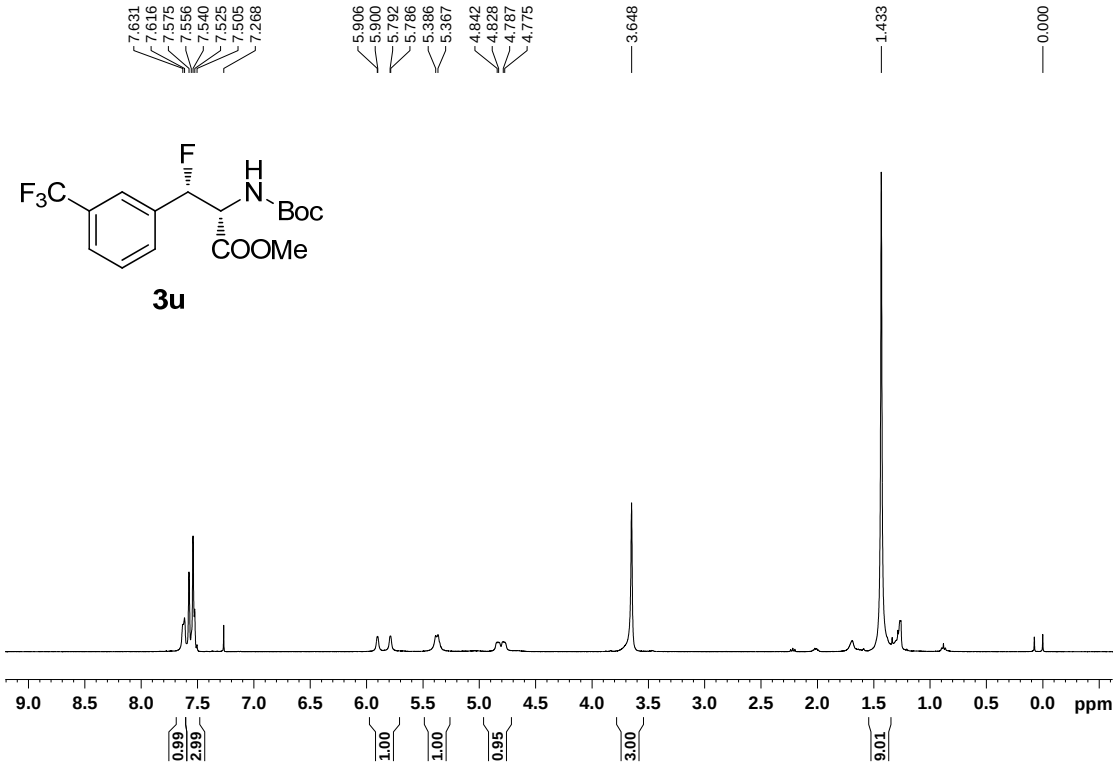
3t

^{19}F NMR spectrum of **3t**

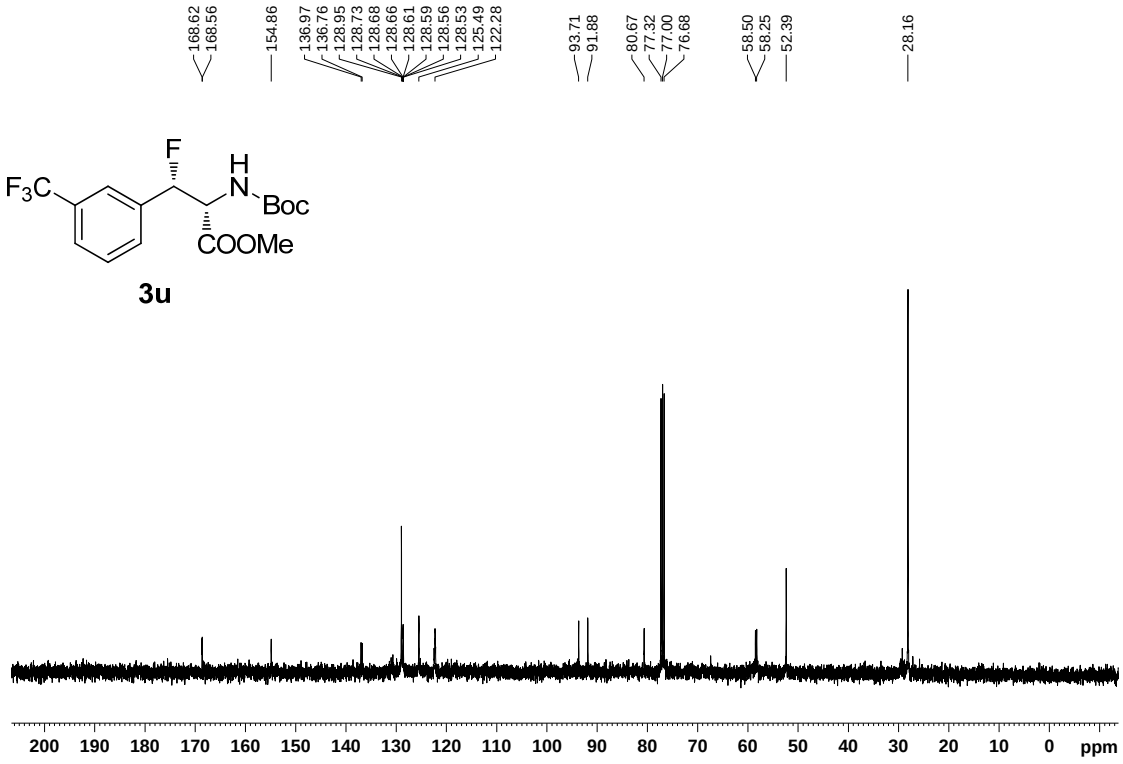


3t

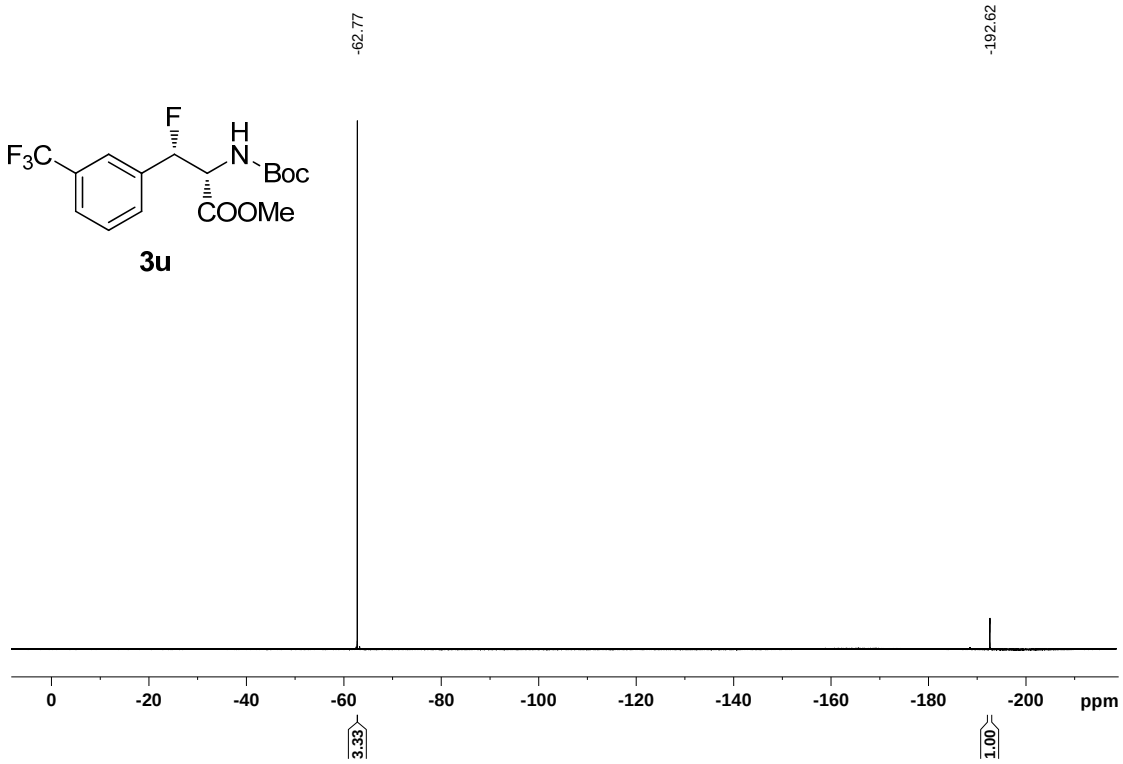
^{1}H NMR spectrum of **3u**



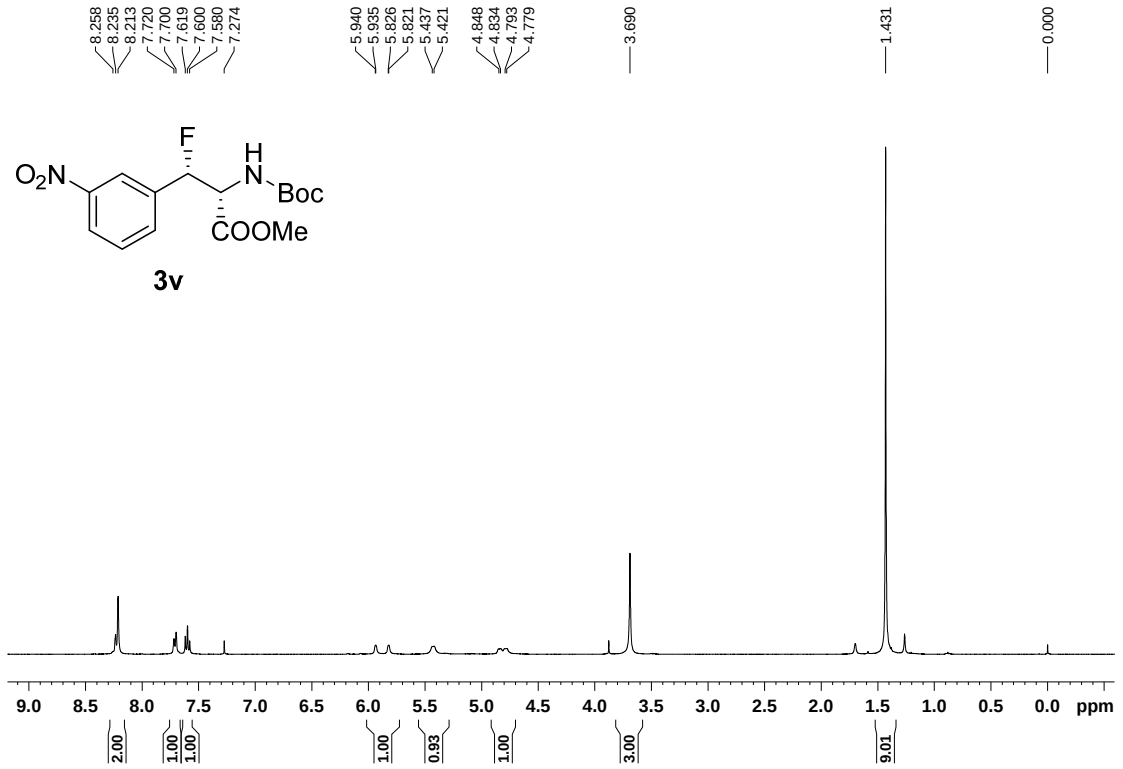
^{13}C NMR spectrum of **3u**



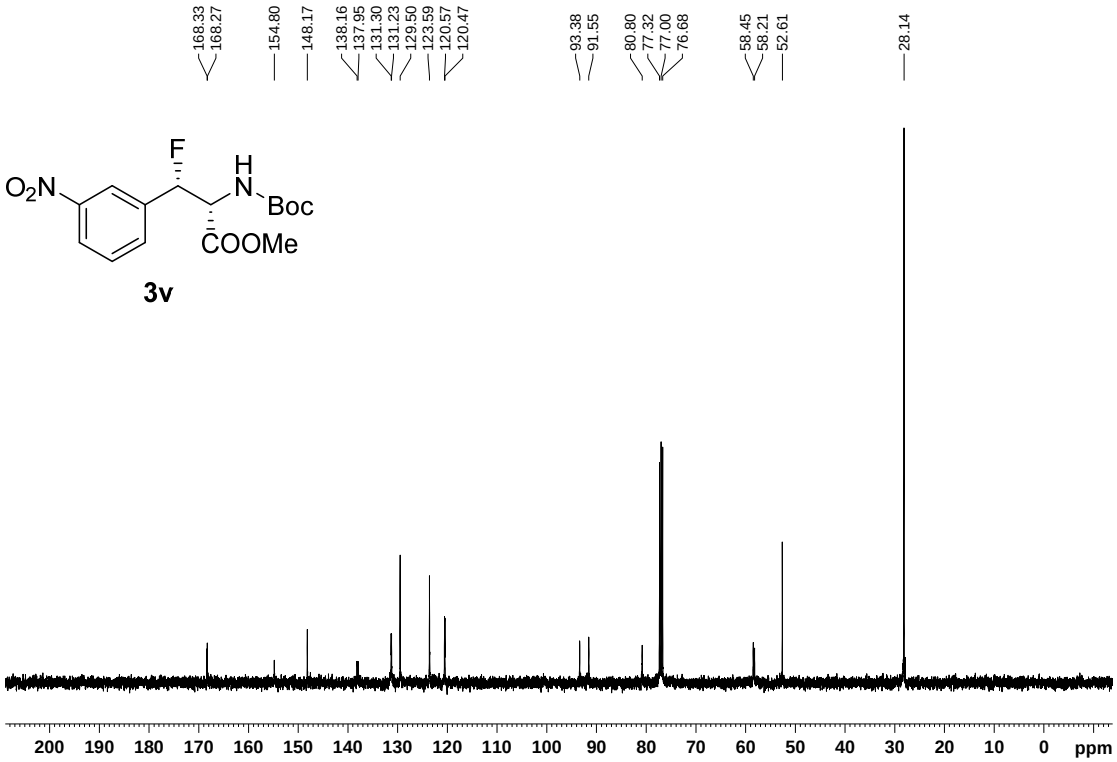
^{19}F NMR spectrum of **3u**



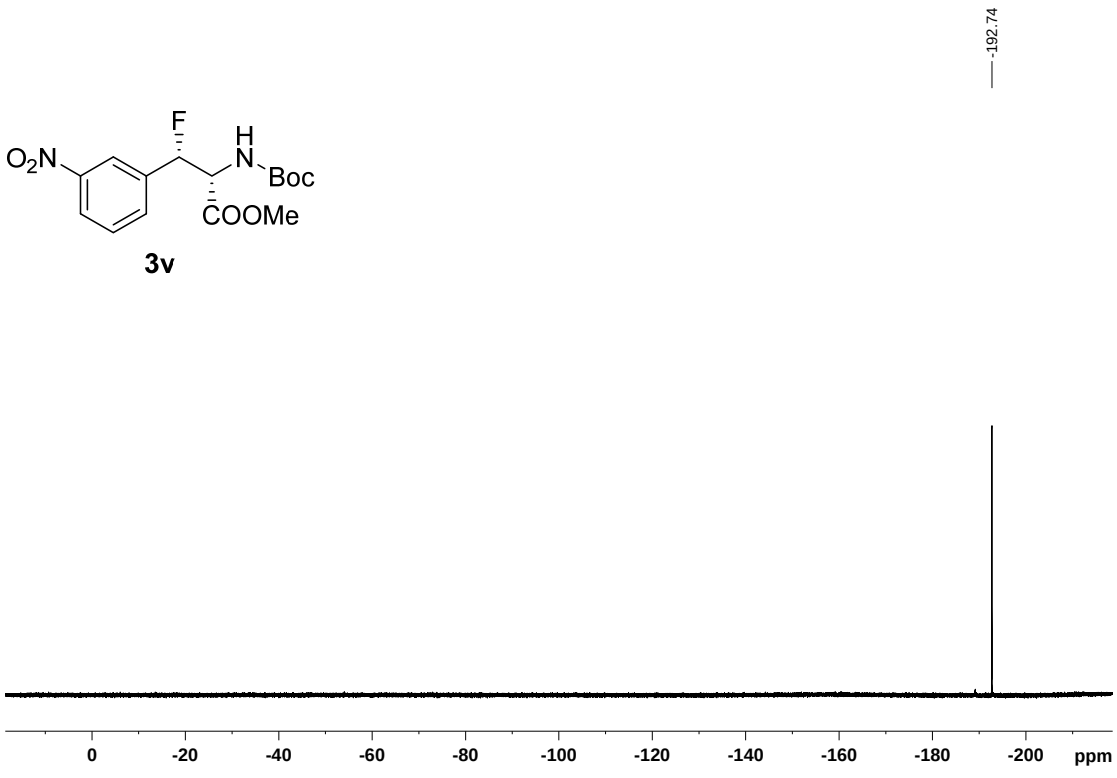
^{1}H NMR spectrum of **3v**



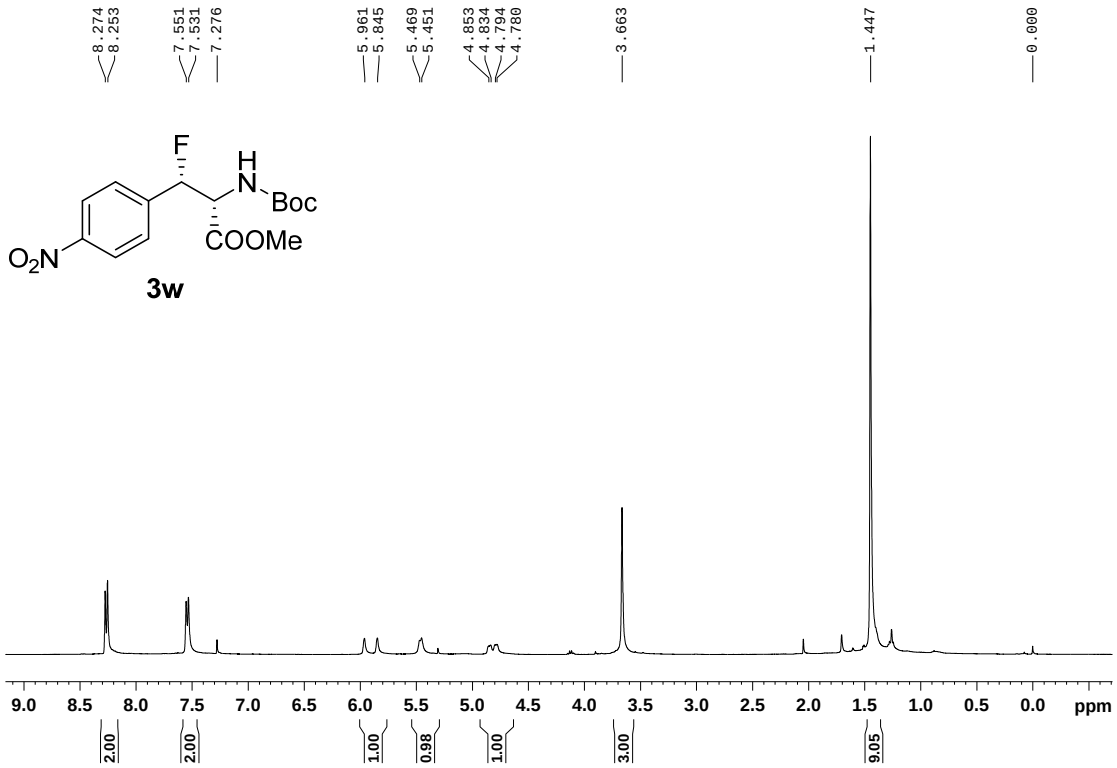
^{13}C NMR spectrum of **3v**



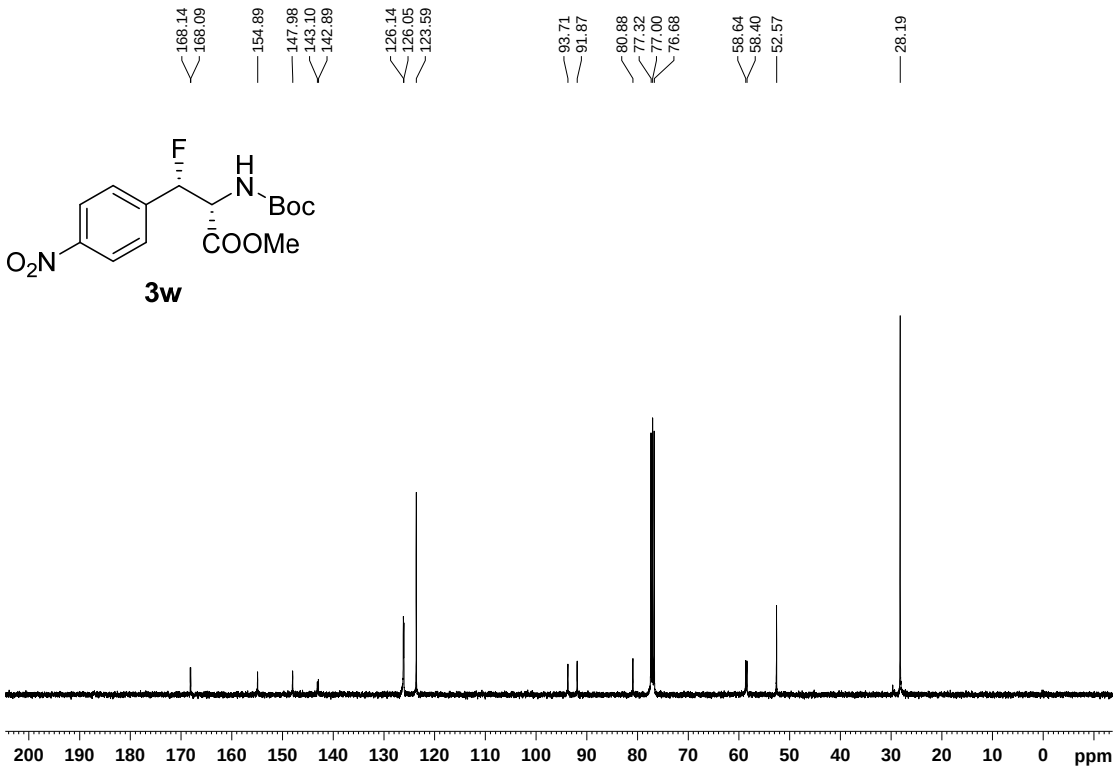
^{19}F NMR spectrum of **3v**



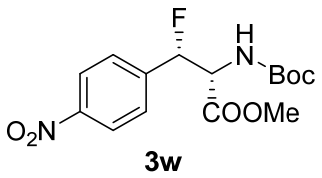
^{1}H NMR spectrum of **3w**



^{13}C NMR spectrum of **3w**

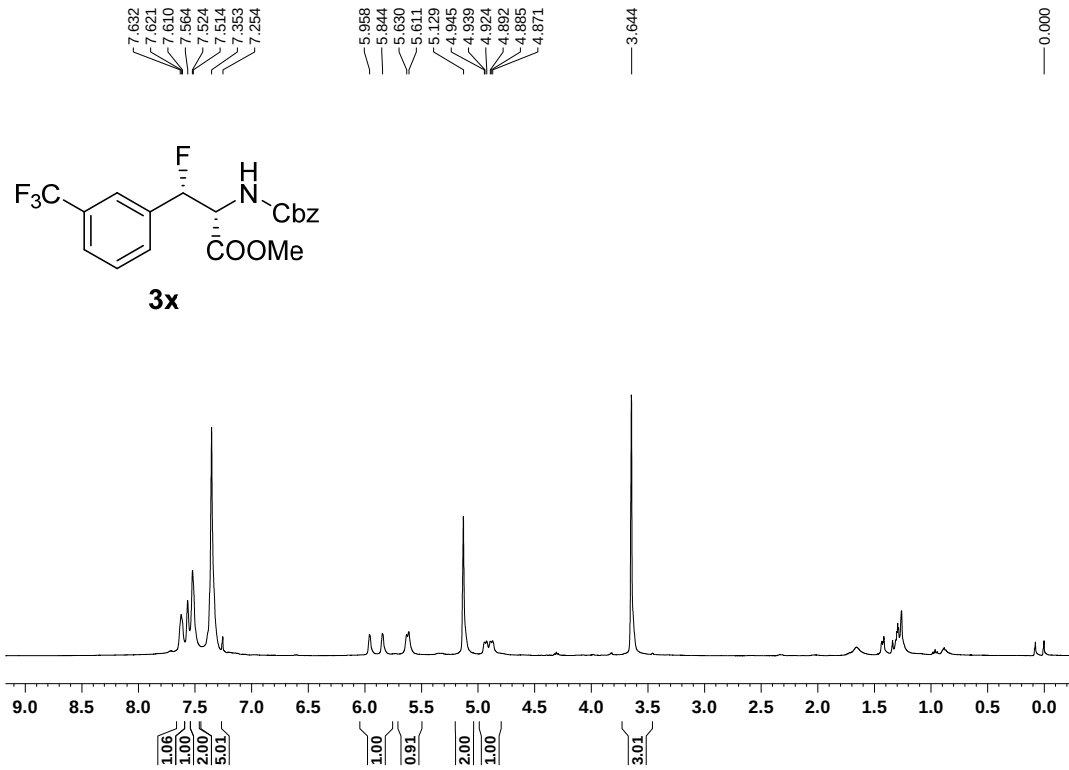


^{19}F NMR spectrum of **3w**



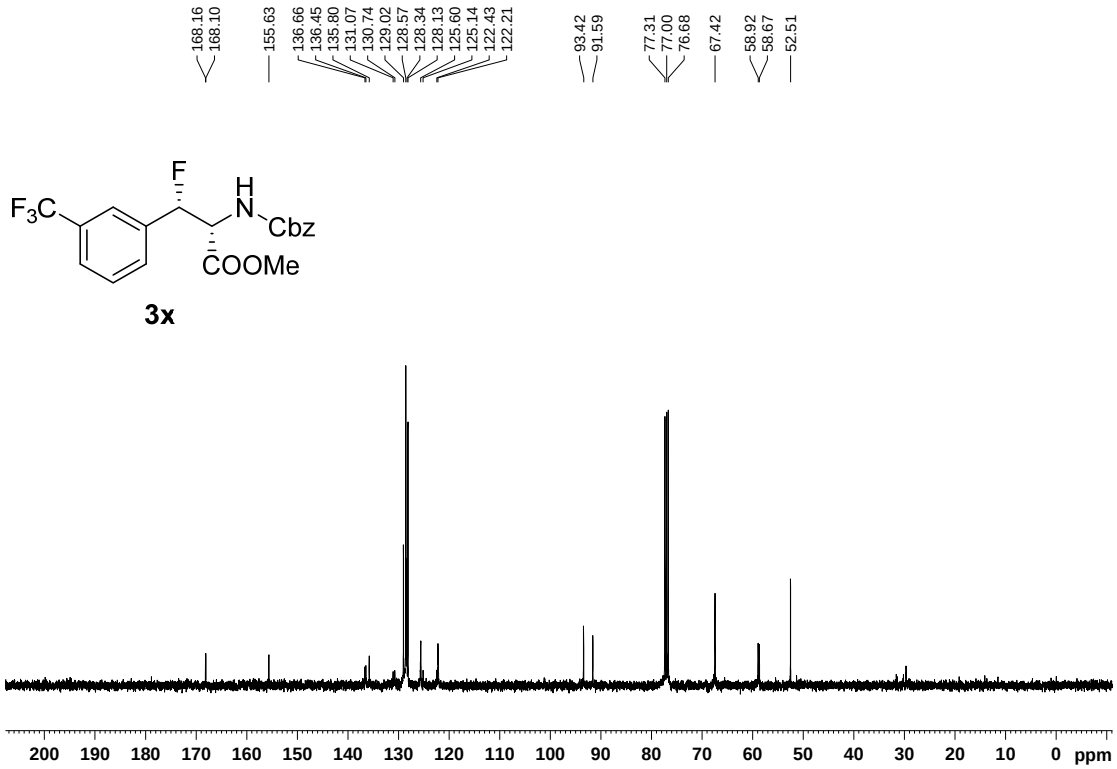
3w

^{1}H NMR spectrum of **3x**



3x

^{13}C NMR spectrum of **3x**



^{19}F NMR spectrum of **3x**