Electronic Supplementary Material (ESI) for ChemComm.

Diastereoselective addition of redox active esters to azomethine imines by electrosynthesis

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I General information

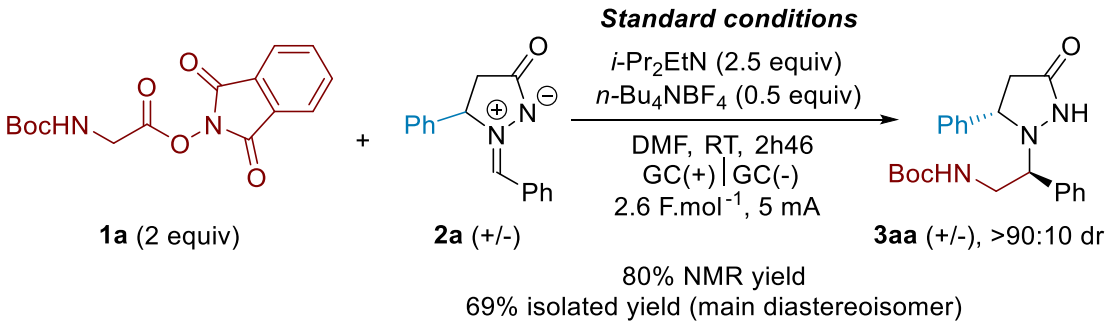
Reactions were performed using oven dried glassware under inert atmosphere of nitrogen. Unless otherwise noted, all reagent-grade chemicals and solvents were obtained from commercial suppliers and were used as received. THF, Toluene, MeCN and CH_2Cl_2 were dried over MBRAUN MB SPS-800 Apparatus. Reactions were monitored by thin-layer chromatography with silica gel 60 F254 pre-coated aluminium plates (0.25 mm). Visualization was performed under UV light, phosphomolybdic acid or $KMnO_4$ oxidation. Chromatographic purification of compounds was achieved with 60 silica gel (40-63 μm). Melting points were measured on a WME Köfler hot-stage (Stuart SMP3) and are uncorrected. Infrared spectra (IR) were recorded on a PerkinElmer Spectrum 100 Series FT-IR spectrometer. Liquids and solids were applied on the Single Reflection Attenuated Total Reflectance (ATR) Accessories. Data are reported in cm^{-1}. Optical rotations were determined with a JASCO P-2000 polarimeter with a water-jacketed 10 cm cell. Specific rotations are reported in 10^{-1} deg cm^2 g^{-1} and concentrations in g per 100 mL. ^1H Spectra (300 MHz) and ^{13}C NMR spectra (75 MHz) were recorded on a Bruker Avance 300. Processing and analysis of the spectra were performed with the Topspin 3.6 software from Bruker on a PC workstation. Data appear in the following order: chemical shifts in ppm which were referenced to the internal solvent signal, number of protons, multiplicity (*s*, singlet; *d*, doublet; *t*, triplet; *q*, quadruplet; *dd*, doublet of doublet, *ddd*, doublet of doublet of doublet, *dt*, doublet of triplet; *ddt*, doublet of doublet of triplet, *td*, triplet of doublet; *tdd*, triplet of doublet of doublet; *m*, multiplet, AB_q, AB system) and coupling constant *J* in Hertz. Accurate Mass measurements (HRMS) were performed by the Mass Spectrometry Laboratory of the University of Rouen and were recorded with a Waters LCP 1er XR spectrometer. Chiral HPLC analyses were carried out on a Dionex Ultimate 3000 equipped with an RS pump, an RS autosampler, and an RS diode array detector for wavelengths monitoring, controlled with Chromoleon. HPLC analyses were performed with Daicel Chiralpak® columns (4.6 mm × 250 mm) and HPLC/MS analyses were performed with Thermo Scientific HPLC Vanquish Horizon/Flex with PDA detector coupling with Thermo Scientific ISQEC Mass Spectrometer, mass range *m/z* 100-1250 with a mass resolution ionization technic heated electrospray ionization (HESI). The electrosynthesis were carried out by means of IKA ElectraSynth® 2.0 apparatus. Cyclic Voltammetry (CV) measurements were carried with an OrigaFlex potentiostat/galvanostat by means of three electrodes. The *N*-(acyloxy)phthalimide

derivatives **1a**[1]**, 1b**[2]**, 1c**[3]**, 1d**[4]**, 1e**[4]**, 1f**[4]**, 1g**[4]**, 1h**[5] **and 1i**[6] as RAE have been synthesized according to literature procedures.

[1] Schwarz, J.; König, B. *Green Chem.* **2016**, *18*, 4743-4749.
[2] Yin, H.; Zheng, M.; Chen, H.; Wang, S.; Zhou, Q.; Zhang, Q.; Wang, P. *J. Am. Chem. Soc.* **2020**, *142*, 14021-14209.
[3] Qin, T.; Malins, L. R.; Edwards, J. T.; Merchant, R. R.; Novak, A. J. E.; Zhong, J. Z.; Mills, R. B.; Yan, M.; Yuan, C.; Eastgate, M. D. *Angew. Chem. Int. Ed.* **2017**, *56*, 260-265.
[4] Yu, L.; Tang, M.-L.; Si, C.-M.; Meng, Z.; Liang, Y.; Han, J.; Sun, X. *Org. Lett.* **2018**, *15*, 4579-4583.
[5] Huang, H.-M.; Koy, M.; Serrano, E.; Pflüger, P. M.; Schwarz, J. L.; Glorius, F. *Nat. Commun.* **2020**, *3*, 393-400.
[6] Cornella, J.; Edwards, J. T.; Qin, T.; Kawamura, S.; Wang, J.; Pan, C.-M.; Gianatassio, R.; Schimdt, M.; Eastgate, M. D.; Baran, P. S. *J. Am. Chem. Soc.* **2016**, *138*, 2174-2177.

II Optimization and mechanistic investigations

II-1 Optimization of the electrosynthesis conditions



This optimization was performed on an IKA ElectraSynth 2.0 apparatus into 5 mL vials.

Entry	Deviation from the standard conditions (Optimization of electrodes, concentration and sacrificial reductant)	yield[a] **3aa** (%)
1	None	80
2	Cgraph(+)/Cgraph(-) instead of GC(+)/GC(-)	27
3	RVC(+)/RVC(-) instead of GC(+)/GC(-)	60
4	$Pt_{foil\ on\ ceramic}$(+)/$Pt_{foil\ on\ ceramic}$ (-) instead of GC(+)/GC(-)	65
5	$Pt_{foil\ on\ ceramic}$(+)/GC (-) instead of GC(+)/GC(-)	69
6	Mg(+)/GC(-)instead of GC(+)/GC(-)	60
7	Al(+)/GC(-)instead of GC(+)/GC(-)	-
8	SS(+)/SS(+) instead of GC(+)/GC(-)	72
9	GC(+)/Ni $_{Foam}$(-) instead of GC(+)/GC(-)	68
10	Au(+)/Au(-) instead of GC(+)/GC(-)	55
11	Boron doped diamond (+)/BDD(-) instead of GC(+)/GC(-)	64
12	0.05 M in DMF instead of 0.1 M	61
13	0.2 M in DMF instead of 0.1 M	75
14	Et_3N (2.5 equiv) instead of *i*-Pr_2EtN (2.5 equiv)	63
15	No *i*-Pr_2EtN	16
16	Et_3N (1.5 equiv) instead of *i*-Pr_2EtN (2.5 equiv)	62
17	Et_3N (3.5 equiv) instead of *i*-Pr_2EtN (2.5 equiv)	73

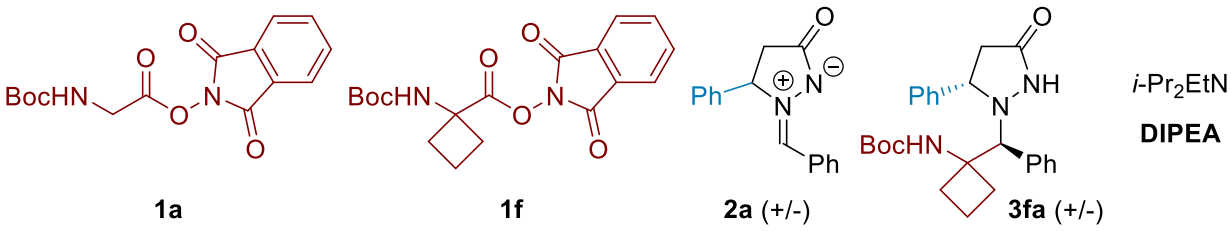
Reaction conditions: carried out with **2a** (0.2 mmol), **1a** (2 equi) in DMF (0.1 M) at RT in an undivided cell with 5 mL vials. Yield of the major diastereoisomer determined on the crude mixture by ^{1}H NMR with Bn_2O as an internal standard.

Entry	Deviation from the standard conditions (Optimization of solvents, NHP ester, supporting electrolyte and current)	yield[a] **3aa** (%)
1	None	80
2	DMA	63
3	CH_3CN	61
4	THF	68
5	CPME	-
6	*i*-PrOH	0
7	NMP	68
8	DMF/CH_3CN (1/1, v/v)	63
9	DMF/THF (1/1, v/v)	69
10	THF/CH_3CN (1/1, v/v)	64
11	DMF/CPME (1/1, v/v)	62
12	Model reaction conditions + H_2O (1.0 equiv)	72
13	NHP ester **1a** (1.5 equiv) instead of 2 equivalents	47
14	NHP ester **1a** (3.5 equiv) instead of 2 equivalents	52
15	*N*-Boc glycine (2.0 equiv) instead of NHP ester **1a**	0
16	Without[a]	58
17	Bu_4NPF_6 instead of Bu_4NBF_4	72
18	Bu_4NBr instead of Bu_4NBF_4	67
19	No current	0
20	Electrolysis carried out for 30 min. (0.47 $F.mol^{-1}$) and the	20
21	2.2 $F.mol^{-1}$ (2h21) at 5 mA	69
22	3.0 $F.mol^{-1}$ (3h13) at 5 mA	70
23	2.2 $F.mol^{-1}$ (4h42) at 2.5 mA	63
24	2.6 $F.mol^{-1}$ (5h34) at 2.5 mA	72
25	3.0 $F.mol^{-1}$ (3h13) at 2.5 mA	67
26	0 °C instead of 21 °C	79
27	50 °C instead of 21 °C	51

Reaction conditions: carried out with **2a** (0.2 mmol), **1a** (2 equi) in DMF (0.1 M) at RT in an undivided cell with 5 mL vials. Yield of the major diastereoisomer determined on the crude mixture by ^1H NMR with Bn_2O as an internal standard. [a] High electrical resistance of the solution was observed without supporting electrolyte leading to a much longer reaction time to deliver 2.6 $F.mol^{-1}$.

II-2 Cyclic Voltammetry experiments

Cyclic voltammetry measurements were recorded using a standard three-electrode setup in 14.0 mL of DMF with Bu_4NBF_4 (0.1 M) as the supporting electrolyte and substrate (0.01 M) at room temperature. The working electrode was a Platinum electrode (200 μm diameter), the counter electrode was a platinum wire, and the reference was a Saturated-Calomel-Electrode (SCE) at a sweep rate of 200 $mV.s^{-1}$.



1a **1f** **2a** (+/-) **3fa** (+/-)

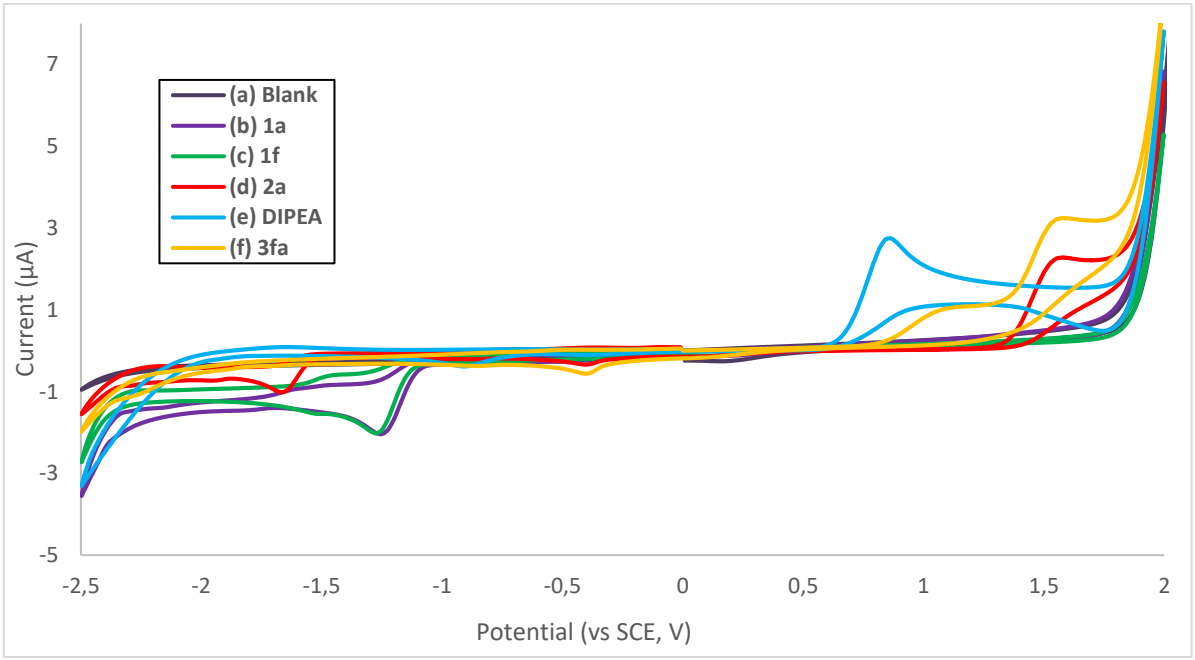


Figure S 1. CV spectra of different compounds.

As shown in Figure S1 (see above), cyclic voltammograms revealed different redox behavior of individual components. An obvious reduction peak of RAE **1a** and **1f** was detected at −1.25 V and -1.27 V respectively (curve b and c), featuring a reductive process at the cathode. Moreover, a reduction peak of azomethine imine **2a** was detected at -1.66 V (curve d), which means that RAEs **1a** and **1f** are reduced before. An obvious oxidation peak of DIPEA was detected at +0.88 V (curve e), indicating an oxidation behavior in the electrochemical cell. Furthermore, it could be noted that an oxidation peak of azomethine imine **2a** was detected

at +1.56 V, and two oxidation peaks of product **3fa** at +1.12 V and +1.56 V, but those oxidative events should be all or part prevented by the oxidation of the Hünig base.CV spectra of various mixtures did not show obvious changes with regard to the redox behaviors (Figure S2).

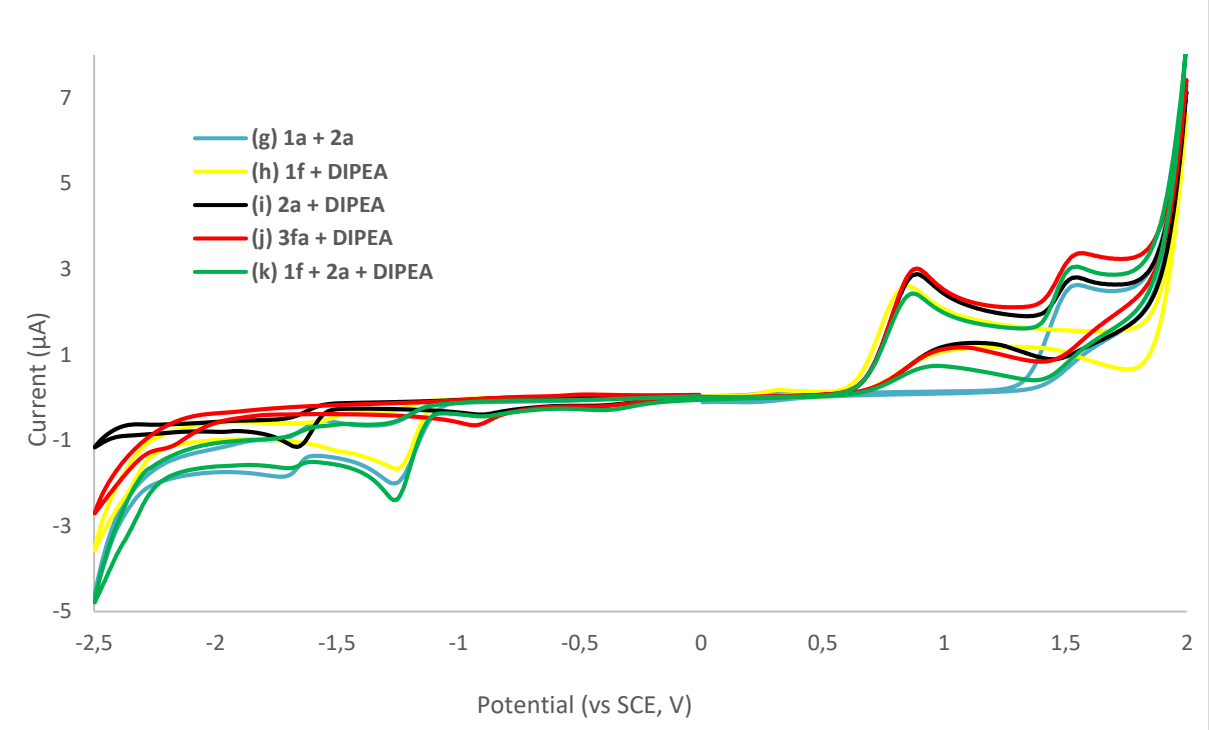
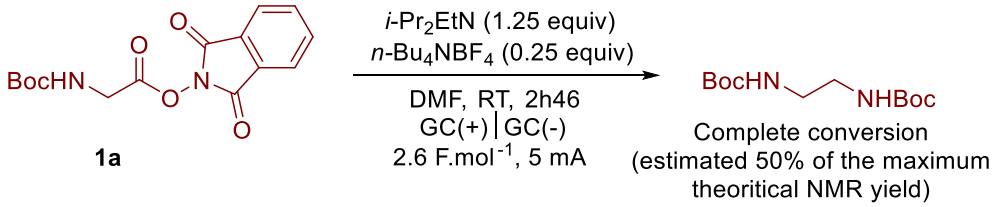


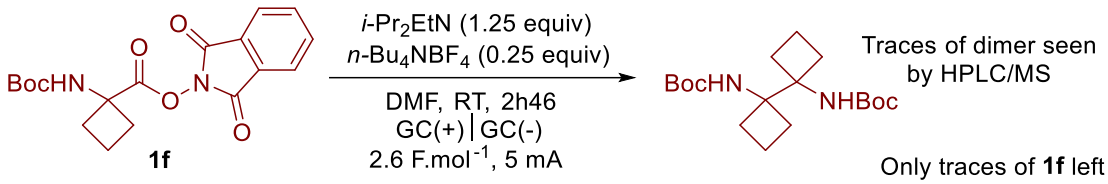
Figure S 2. CV spectra of different mixtures.

II-3 Controlled experiments

The reaction carried out without azomethine imine shows a complete dimerization event of the redox-active ester of *N*-Boc glycine **1a** precursor, likely through the recombination of transient radical species at the cathode. However, only traces of such dimer were detected by HPLC/MS of precursor **1f**. That might be a steric hinderance issue preventing any dimerization to take place.

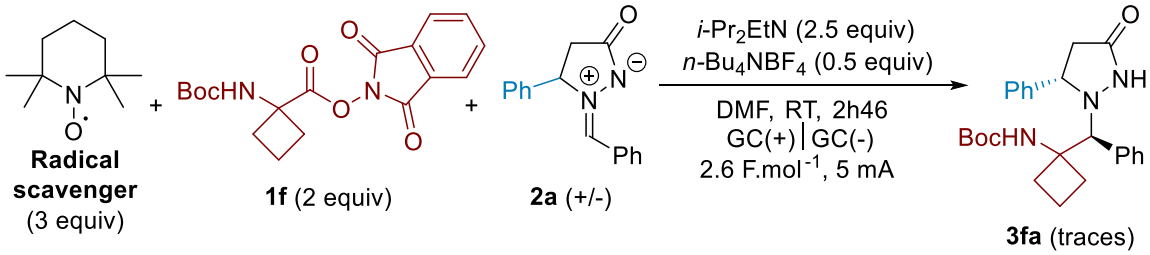


Analyses (^{1}H NMR, HRMS, HPLC/MS) match with litterature: Sukhorukov, A. Y.; Semakin, A. N.; Lesiv, A. V.; Khomutova, Y. A.; Loffe, S. L. *Russ. J. Org. Chem.* **2007**, *43*, 1106-1113.

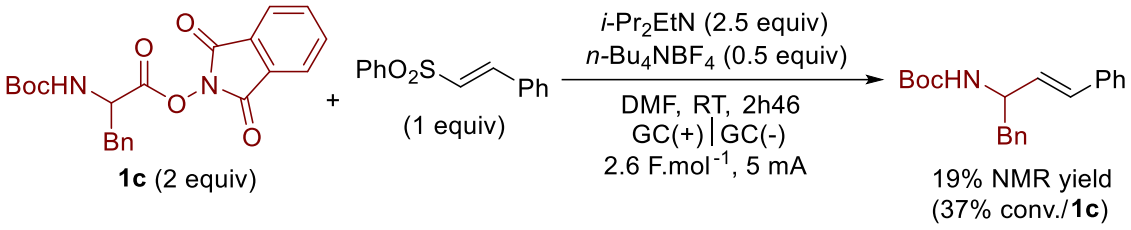


TEMPO inhibited the formation of product **3aa** by quenching likely one of the SET processes.

Standard conditions + a radical scavenger (3 equiv)



A vinyl sulfone as a radical trap was successfully, albeit in moderate yield, used akin to MacMillan *and coll.* achievement in visible-light photoredox reaction,[7] showing *a priori* that a radical species was generated from the REA **1c** under our electrochemical conditions.



[7] Noble, A.; MacMillan, D. W. *J. Am. Chem. Soc.* **2014**, *136*, 11602-5.

II-4 Faraday efficiency

The Faraday efficiency (FE) was calculated for the electrosynthesis of the model product **3fa** which has been performed on both 0.2 mmol (83%, NMR yield, 64% isolated yield) and 1.2 mmol (82%, NMR yield, 72% isolated yield, depicted in Scheme 2 in the manuscript), according to the following equation:

$$FE = \frac{Q_{theo}}{Q_{exp}} \times 100 = \frac{n_e \times n_{Prod} \times F}{i \times t} \times 100 = \frac{n_e \times (n_{Reag} \times Y) \times F}{i \times t} \times 100$$

with n_e is the number of electrons added to or removed from one product molecule (2 in our case), n_{Prod} the amount of product in mol, n_{Reag} the amount of reagent used in mol, Y isolated or NMR yield (%), F the Faraday constant (96485 C), i the current in A (5 mA) and t the time in seconds (9960 and 60720 seconds from 2h46 and 16h52 respectively)

according to : P. Gandeepan, L. H. Finger, T. H. Meyer, L. Ackermann, *Chem. Soc. Rev.,* 2020, **49**, 4254-4272

Calculation details for product **3fa** on 0.2 mmol scale:

$$FE = \frac{2 \times (0{,}0002 \times 0{,}83) \times 96485}{0{,}005 \times 9960} \times 100 = 64.3\% \text{ (based on NMR yield)}$$

$$FE = \frac{2 \times (0{,}0002 \times 0{,}64) \times 96485}{0{,}005 \times 9960} \times 100 = 49.6\% \text{ (based on isolated yield)}$$

Calculation details for product **3fa** on 1.2 mmol scale:

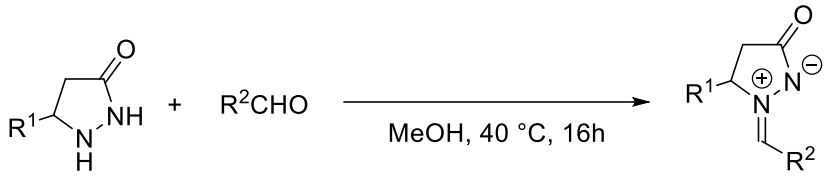
$$FE = \frac{2 \times (0{,}0012 \times 0{,}82) \times 96485}{0{,}005 \times 60720} \times 100 = 62.5\% \text{ (based on NMR yield)}$$

$$FE = \frac{2 \times (0{,}0012 \times 0{,}72) \times 96485}{0{,}005 \times 60720} \times 100 = 54.9\% \text{ (based on isolated yield)}$$

III Experimental procedures

III-1 Synthesis of azomethine imines

The azomethine imines **2a**[8], **2b**[9], **2c**[9], **2d**[9], **2e**[10], **2f**[11], **2g**[9], **2h**[12], **2i**[13], **2j**[14], **2k**[15], **2l**[13], **2m**[13], **2n**[13], **2o**[12], **2p**[16], **2s**[17], **2t**[18], **2u**[18] and benzoyl(3,4-dihydroisoquinolin-2-ium-2-yl)amide **4**[19] have been synthesized according to literature procedures.



2'x (+/-) **2x** (+/-)

General procedure for the synthesis of azomethine imine 2. To a mixture of pyrazolidinone **2'x** (1.2 mmol, 1.0 equiv) and aldehyde (1.44 mmol, 1.2 equiv) into a 10 mL flask under nitrogen was added methanol (2.4 mL). The resulting solution was stirred at 40°C (oil bath temperature) for 16h, then cooled to room temperature and concentrated under reduced pressure. The crude product was purified either by silica gel column chromatography (work-up A) or was dissolved in 2.0 mL of CH_2Cl_2 and poured into 50 mL of cold Et_2O. The resulting precipitate was filtered, washed twice with cold Et_2O (work-up B) and dried over vacuum to give the desired azomethine imine **2**.

[8] Winterton, S. E.; Ready, J. M. *Org. Lett.* **2016**, *18*, 2608-2611.
[9] Zhen, W.; Li, X.-X.; Li, G.-H.; Chen, Z. *Chem. Commun.* **2013**, *49*, 3552-3554.
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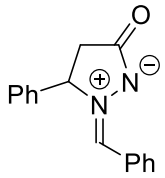
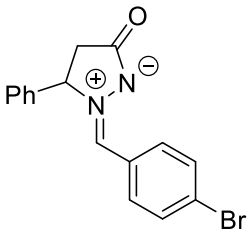
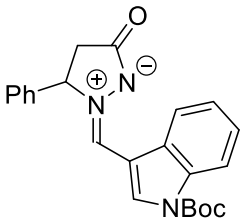
[14] Reddy, T. P.; Krishna, A. V.; Ramachary, D. B. *Org. Lett.* **2018**, *20*, 6979-6983.
[15] Shapiro, N. D.; Shi, Y.; Toste, F. D. *J. Am. Chem. Soc.* **2009**, *131*, 11654-11655.
[16] Ning, L.; Zhaoyan, Z.; Zhengkun, Y. *Org. Lett.* **2011**, *13*, 3394-3387.
[17] Pair, E.; Berini, C.; Noël, R.; Sanselme, M.; Levacher, V.; Brière, J.-F. *Chem. Commun.* **2014**, *50*, 10218-10221.
[18] Qian, Y.; Zavalij, P. J.; Hu, W.; Doyle, M. P. *Org. Lett.* **2013**, *15*, 1564-1567.
[19] Hashimoto, T.; Maeda, Y.; Omote, M.; Nakatsu, H.; Maruoka, K. *J. Am. Chem. Soc.* **2010**, *132*, 4076-4077.



2-benzylidene-5-oxo-3-phenylpyrazolidin-2-ium-1-ide (2a). Following the general procedure with pyrazolidinone **2'a** (1.622 g, 10.0 mmol), the title compound was obtained as a white solid (2.289 g, 91%). R_f = 0.51 (CH_2Cl_2/MeOH: 96/4). ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 8.32 – 8.22 (m, 2H), 7.50 – 7.40 (m, 6H), 7.40 – 7.32 (m, 2H), 6.83 (d, *J* = 1.1 Hz, 1H), 5.55 (ddd, *J* = 9.8, 5.6, 1.1 Hz, 1H), 3.30 (dd, *J* = 16.8, 9.9 Hz, 1H), 2.86 (dd, *J* = 16.8, 5.7 Hz, 1H) ppm. ^{1}H NMR data is in accordance with the literature.[8] Enantioenriched product was obtained by kinetic resolution (*vide infra*).

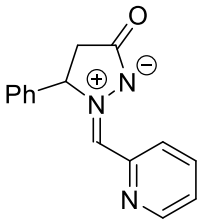


(Z)-2-(4-bromobenzylidene)-5-oxo-3-phenylpyrazolidin-2-ium-1-ide (2g). Following the general procedure with pyrazolidinone **2'a** (194.6 mg, 1.20 mmol), the title compound was obtained as a white-off solid (276.7 mg, 70%). R_f = 0.56 (CH_2Cl_2/MeOH: 95/5). ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 8.21 – 8.05 (m, 2H), 7.64 – 7.52 (m, 2H), 7.51 – 7.41 (m, 3H), 7.35 (m, 2H), 6.76 (s, 1H), 5.53 (ddd, *J* = 9.8, 5.7, 1.1 Hz, 1H), 3.30 (dd, *J* = 16.9, 9.9 Hz, 1H), 2.86 (dd, *J* = 16.9, 5.7 Hz, 1H) ppm. ^{1}H NMR data is in accordance with the literature.[9] The *Z* configuration of the azomethine **2g** was determined by X-Ray analysis (*vide infra*).



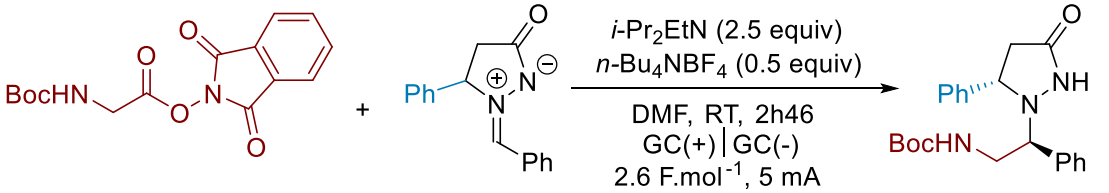
(2-((1-(*tert*-butoxycarbonyl)-1H-indol-3-yl)methylene)-5-oxo-3-phenylpyrazolidin-2-ium-1-ide (2q). Following the general procedure with pyrazolidinone **2'a** (194.6 mg, 1.20 mmol), the title compound was obtained as a white solid (398.2 mg, 85%). %). mp = 287 °C. R_f = 0.63 (CH_2Cl_2/MeOH: 96/4). IR (neat) ν_{max} 2988, 1735, 1661, 1600, 1455, 1375, 1301, 1280, 1229, 1140, 1090, 840, 740, 683 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 9.19 (s, 1H), 8.21 (d, *J* = 8.3 Hz, 1H), 7.52 – 7.18 (m, 8H), 7.16 – 7.04 (m, 1H), 5.67 – 5.50 (m, 1H), 3.36 (dd, *J* = 16.8, 9.9 Hz,

1H), 2.90 (dd, *J* = 16.8, 5.6 Hz, 1H), 1.69 (s, 9H) ppm. ^{13}C NMR (75 MHz; $CDCl_3$): δ_c 182.7 (C), 149.0 (C), 138.6 (C), 135.3 (C), 133.1 (CH), 129.9 (2C, CH), 129.7 (CH), 127.7 (C), 126.9 (2C, CH), 125.7 (CH), 124.8 (CH), 123.7 (CH), 117.4 (CH), 116.0 (CH), 110.5 (C), 85.6 (C), 72.7 (CH), 40.1 (CH_2), 28.2 (3C, CH_3) ppm. HRMS (ESI$^+$): calcd for $C_{23}H_{23}N_3O_3$ [(M+H)$^+$]: 390.1812; Found: 390.1815.



5-oxo-3-phenyl-2-(pyridin-2-ylmethylene)pyrazolidin-2-ium-1-ide (2r). Following the general procedure 2 with pyrazolidinone **2'a** (194.6 mg, 1.20 mmol), the title compound was obtained as a white solid (302.0 mg, 57%). mp = 179 °C. R_f = 0.34 (CH_2Cl_2/MeOH: 96/4). IR (neat) ν_{max} 3171, 3063, 1686, 1592, 1496, 1440, 1312, 1072, 779, 754, 702 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 9.31 (d, *J* = 7.9 Hz, 1H), 8.64 (s, 1H), 7.97 – 7.77 (m, 1H), 7.56 – 7.21 (m, 6H), 7.16 (s, 1H), 5.62 (dd, *J* = 9.9, 5.7 Hz, 1H), 3.35 (dd, *J* = 17.2, 9.9 Hz, 1H), 2.96 (dd, *J* = 17.0, 5.5 Hz, 1H) ppm. Remark: due to very limited solubility no clean ^{13}C NMR was obtained in spite of several solvents were used. HRMS (ESI$^+$): calcd for $C_{15}H_{13}N_3O$ [(M+H)$^+$]: 252.1131; Found: 252.1133.

III-2 Electrosynthesis of addition products

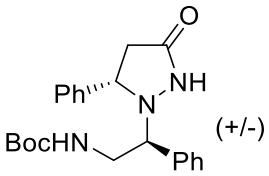


1a (2 equiv) **2a** (+/-) **3aa** (+/-), >90:10 dr

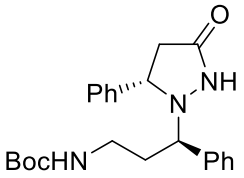
80% NMR yield
69% isolated yield (main diastereoisomer)

Representative procedure for electrosynthesis. To a mixture of azomethine imine **2a** (50.1 mg, 0.20 mmol, 1.0 equiv), *N*-(acyloxy)phthalimide derivative **1a** (128.1 mg, 0.40 mmol, 2.0 equiv) and *n*-Bu_4NBF_4 (0.10 mmol, 0.5 equiv) into an electrochemical cell of 5.0 mL under nitrogen was added DMF (2.0 mL) and *i*-Pr_2EtN (85.0 µL, 0.5 mmol, 2.5 equiv). The electrodes (glassy carbon electrodes as anode and cathode) were installed and the nitrogen was bubbled

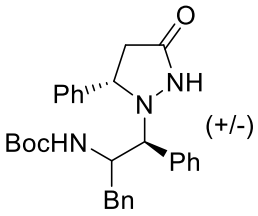
through the solution for 10 minutes. The reaction was carried out at room temperature for 2h47, with a constant current of 5.0 mA and a charge of 2.6 F.mol^{-1}. After completion, the reaction mixture was diluted with EtOAc (10 mL) and washed three times with brine/water solution (1:1, v/v, 3*30 mL). The organic layer was finally dried over anhydrous $MgSO_4$, filtered and concentrated over reduced pressure. The NMR yield was measured by ^{1}H NMR of crude by means of Bn_2O as internal standard (0.5 equiv, 19.5 µL). The diastereoisomeric ratio (dr) was measured by ^{1}H NMR of the crude reaction mixture and by HPLC/MS if required. The residue was purified by silica gel column chromatography (CH_2Cl_2:Et_2O, from 95:5 to 80:20), and, if required, by a second silica gel column chromatography (Pentane:EtOAc:EtOH, from 60:40:0 to 60:36:4) in order to remove small impurity to provide the main diastereoisomer of the desired pyrazolidinone product **3**.



***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-2-phenylethyl)carbamate (3aa).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1a** (128.1 mg, 0.4 mmol, 2.0 equiv), the title compound was obtained as white solid (51.5 mg, 90:10 dr, 69% main diastereoisomer). A bigger scale has been made involving azomethine imine **2a** (250.0 mg, 1.0 mmol, 1.0 equiv) and *N*-(acyloxy)phthalimide derivative **1a** (641.0 mg, 2.0 mmol, 2.0 equiv) for 13h55 using an electrochemical cell of 20.0 mL and DMF (10.0 mL) to afford a white solid (217.2 mg, 90:10 dr, 57%). mp = 76–77 °C. R_f = 0.34 main diastereoisomer (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2974, 1683, 1511, 1494, 1452, 1365, 1249, 1165, 758, 700 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 8.95 (s, 1H), 7.38 – 7.12 (m, 10H), 4.58 – 4.38 (m, 1H), 4.28 (d, *J* = 8.3 Hz, 1H), 4.19 – 3.94 (m, 2H), 3.27 (dd, *J* = 16.5, 8.8 Hz, 1H), 3.09 – 2.88 (m, 1H), 2.24 (d, *J* = 16.7 Hz, 1H), 1.50 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.4 (C), 157.4 (C), 142.4 (C), 138.9 (C), 129.0 (2C, C), 128.5 (2C, C), 128.3 (C), 127.8 (2C, C), 127.2 (C), 126.1 (2C, C), 80.3 (C), 70.6 (CH), 62.7 (CH), 44.1 (CH_2), 37.2 (CH_2), 28.5 (CH_3, 3C) ppm. HRMS (ESI$^+$): calcd for $C_{22}H_{27}N_3O_3$ [(M+H)$^+$]: 382.2131; Found: 382.2125.



***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-3-phenylpropyl)carbamate (3ba).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1b** (134.0 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (13.9 mg, >84:16 dr, 18% main diastereoisomer). mp = 183 °C. R_f = 0.36 main diastereoisomer (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3301, 1683, 1527, 1453, 1367, 1250, 1163, 920, 730, 701 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.65 (s, 1H), 7.44 – 7.10 (m, 10H), 4.67 (s, 1H), 4.31 (d, *J* = 7.5 Hz, 1H), 3.99 (t, *J* = 5.7 Hz, 1H), 3.29 (m, 1H), 3.04 (dd, *J* = 16.8, 8.9 Hz, 1H), 2.88 (td, *J* = 14.0, 7.6 Hz, 1H), 2.27 (dd, *J* = 16.8, 1.7 Hz, 1H), 2.04 (dd, *J* = 12.1, 6.4 Hz, 2H), 1.42 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 174.7 (C), 156.4 (C), 142.1 (C), 139.6 (C), 128.9 (CH, 2C), 128.7 (CH, 2C), 128.2 (CH), 128.1 (CH), 127.4 (CH), 126.3 (CH, 2C), 79.7 (C), 69.4 (CH), 62.7 (CH), 36.6 (CH_2), 34.5 (CH_2), 28.54 (CH_3, 3C) ppm. HRMS (ESI^+): calcd for $C_{23}H_{29}N_3O_3$ [$(M+H)^+$]: 382.2282; Found: 396.2281.



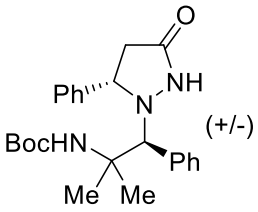
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-1,3-diphenylpropan-2-yl)carbamate (3ca' and 3ca'').** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1c** (164.2 mg, 0.40 mmol, 2.0 equiv), the title compounds were obtained as white solids (29.2 mg (**40**:14:38:8 dr, first main diastereoisomer **3ca'**) and 27.3 mg (40:14:**38**:8 dr, second main diastereoisomer **3ca''**)).

3ca': mp = 182 °C. R_f = 0.65 first main diastereoisomer (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3309, 3200, 1704, 1660, 1538, 1279, 1166, 935, 700, 671 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): 9.06 (s, 1H), 7.44 – 6.99 (m, 15H), 4.70 – 4.43 (m, 1H), 4.22 (dd, *J* = 19.2, 9.4 Hz, 2H), 3.94 (d, *J* = 2.5 Hz, 1H), 3.23 (dd, *J* = 16.9, 8.4 Hz, 1H), 2.65 (dd, *J* = 14.6, 5.7 Hz, 1H), 2.28 – 2.10 (m, 2H), 1.44 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.6 (C), 156.9 (C), 142.5 (C), 137.4 (C), 136.2 (C), 129.1 (2C, CH), 128.9 (2C, CH), 128.8 (2C, CH), 128.7 (2C, CH), 128.7 (CH), 128.4 (2C, CH), 127.1 (CH), 126.7 (CH), 126.1 (2C, CH), 80.3 (C), 73.7 , CH), 62.7 (CH), 51.6 (CH), 38.8 (CH_2), 37.07

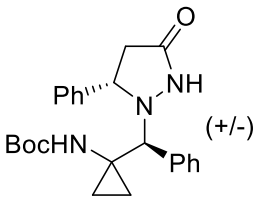
(CH_2), 28.45 (3C, CH_3) ppm. HRMS (ESI^+): calcd for $C_{29}H_{33}N_3O_3$ [$(M+H)^+$]: 472.2595; Found: 472.2613.

3ca'': mp = 86 °C. R_f = 0.27 second main diastereoisomer (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2976, 2927, 1691, 1495, 1366, 1167, 700 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): 7.53 (s, 1H), 7.43 – 7.04 (m, 15H), 4.57 – 4.27 (m, 3H), 4.12 (d, J = 6.9 Hz, 2H), 3.13 (dd, J = 14.3, 4.4 Hz, 1H), 2.81 (m, 1H), 2.36 (m, 1H), 2.10 (d, J = 16.0 Hz, 1H), 1.33 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 175.6 (C), 155.5 (C), 141.8 (C), 137.8 (C), 136.4 (C), 129.6 (CH, 2C), 129.5 (CH, C), 128.8 (CH, 3C), 128.7 (CH, 3C), 128.6 (CH), 128.4 (CH, 2C), 127.4 (CH), 126.4 (CH), 126.3 (CH, 2C), 79.5 (C), 72.5 (CH), 63.1 (CH), 52.7 (CH), 36.8 (CH_2), 36.4 (CH_2), 28.4 (CH_3, 3C) ppm. HRMS (ESI^+): calcd for $C_{29}H_{33}N_3O_3$ [$(M+H)^+$]: 472.2595; Found: 472.2611.

tert-butyl

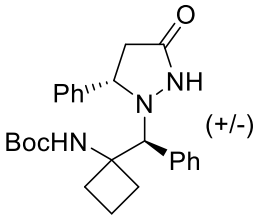


***tert*-butyl (1-((2-methyl-3-oxo-5-phenylpyrazolidin-1-yl)-1-phenylpropan-2-yl)carbamate (3da).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1d** (139.3 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (36.9 mg, >95:5 dr, 45%). mp = 174 °C. R_f = 0.42 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3381, 2980, 1678, 1502, 1366, 1254, 1166, 1067, 767, 711 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.59 (s, 1H), 7.34 – 7.05 (m, 10H), 4.68 (s, 1H), 4.39 (s, 1H), 4.28 (d, J = 7.1 Hz, 1H), 3.13 (dd, J = 16.6, 8.7 Hz, 1H), 2.18 (dd, J = 16.5, 1.7 Hz, 1H), 1.48 (s, 9H), 1.41 (s, 3H), 1.13 (s, 3H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 174.0 (C), 155.3 (C), 142.2 (C), 139.1 (C), 129.3 (2C, CH), 128.4 (CH, 2C), 128.4 (CH, 2C), 128.1 (CH), 127.1 (CH), 126.3 (2C), 79.7 (C), 75.4 (CH), 64.4 (CH), 56.2 (C), 36.7 (CH_2), 28.6 (CH_3, 3C), 28.0 (CH_3), 26.7 (CH_3) ppm. HRMS (ESI^+): calcd for $C_{24}H_{31}N_3O_3$ [$(M+H)^+$]: 410.2438; Found: 410.2459.

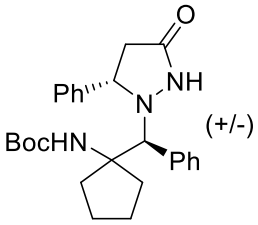


***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclopropyl)carbamate (3ea).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-

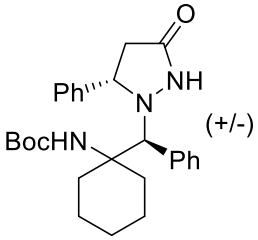
(acyloxy)phthalimide derivative **1e** (138.5 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (46.9 mg, >95:5 dr, 58%). mp = 214 °C. R_f = 0.43 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3381, 2980, 1678, 1502, 1366, 1254, 1166, 1067, 767, 711 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.53 (s, 1H), 7.33 – 7.09 (m, 10H), 4.72 (s, 1H), 4.17 (dd, *J* = 8.8, 1.2 Hz, 1H), 3.22 (ddd, *J* = 16.6, 8.8, 0.7 Hz, 1H), 3.13 (s, 1H), 2.22 (dd, *J* = 16.6, 1.2 Hz, 1H), 1.50 (m, 10H), 1.34 (ddd, *J* = 13.7, 10.1, 5.4 Hz, 1H), 0.65 (ddd, *J* = 9.9, 7.0, 5.4 Hz, 1H), 0.42 (ddd, *J* = 10.1, 6.9, 5.4 Hz, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.0 (C), 157.1 (C), 142.7 (C), 139.0 (C), 128.8 (CH, 2C), 128.4 (CH, 2C), 128.3 (C), 127.7 (CH, 2C), 127.0 (CH), 126.1 (CH, 2C), 80.3 (C), 62.4 (CH), 37.5 (CH_2), 35.6 (C), 28.5 (CH_3), 17.7 (CH_2), 11.9 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{24}H_{29}N_3O_3$ [$(M+H)^+$]: 408.2282; Found: 408.2290.



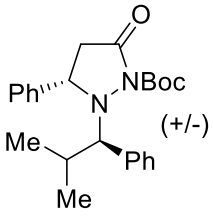
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fa).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (54.0 mg, >95:5 dr, 64%). A bigger scale has been made involving azomethine imine **2a** (300.4 mg, 1.2 mmol, 1.0 equiv) and *N*-(acyloxy)phthalimide derivative **1f** (864.9 mg, 2.4 mmol, 2.0 equiv) for 16h52 using an electrochemical cell of 20.0 mL and DMF (12.0 mL) to afford a white solid (364.0 mg, >95:5 dr, 72%). The reaction was also carried out with the enantioenriched azomethine imine **2a**-(*S*) (99% ee, 0.20 mmol) to provide the corresponding product **3aa** in 57% yield and >98% ee (*vide infra*). mp = 177 °C. R_f = 0.45 (CH_2Cl_2/Et_2O: 8/2). $[\alpha]_D^{25}$ -108 (*c* 1.0, $CHCl_3$). IR (neat) ν_{max} 3301, 2965, 1661, 1528, 1367, 1282, 1253, 1169, 1028, 699 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.14 (s, 1H), 7.28 – 7.12 (m, 10H), 4.42 (s, 1H), 4.16 (d, *J* = 8.5 Hz, 1H), 4.02 (s, 1H), 3.32 (dd, *J* = 16.6, 7.9 Hz, 1H), 3.04 (dd, *J* = 12.9, 7.8 Hz, 1H), 2.46 (dd, *J* = 21.3, 9.7 Hz, 1H), 2.22 (d, *J* = 16.6 Hz, 1H), 2.16 – 1.99 (m, 2H), 1.92 – 1.73 (m, 1H), 1.54 (s, 9H), 1.05 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.3 (C), 142.5 (C), 136.8 (C), 128.5 (CH, 2C), 128.3 (CH, 2C), 128.3 (CH), 126.9 (CH), 126.1 (CH, 2C), 80.0 (C), 78.7 (CH), 63.1 (CH), 60.2 (C), 37.4 (CH_2), 33.5 (CH_2), 31.5 (CH_2), 28.6 (CH_3, 3C), 16.6 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{25}H_{31}N_3O_3$ [$(M+H)^+$]: 422.2438; Found: 422.2438.



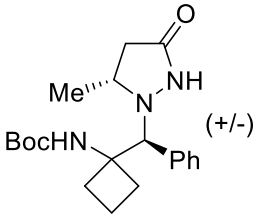
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclopentyl)carbamate (3ga).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1g** (149.8 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (52.0 mg, >95:5 dr, 60%). mp = 117 °C. R_f = 0.52 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3295, 2962, 1668, 1538, 1365, 1277, 1250, 1167, 1104, 770, 702 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.22 (s, 1H), 7.30 – 7.09 (m, 10H), 4.26 – 4.14 (m, 2H), 3.82 (s, 1H), 3.37 – 3.21 (m, 2H), 2.20 (d, *J* = 16.5 Hz, 1H), 1.87 – 1.65 (m, 3H), 1.57 – 1.43 (m, 12H), 0.58 – 0.49 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.2 (C), 156.4 (C), 142.4 (C), 139.8 (C), 128.5 (CH, 2C), 128.2 (CH, 2C), 128.2 (CH), 126.9 (CH), 126.2 (CH, 2C), 79.9 (C), 79.0 (CH), 66.7 (C), 63.5 (CH), 42.9 (CH_2), 37.1 (CH_2), 35.5 (CH_2), 28.6 (CH_3, 3C), 24.3 (CH_2), 20.79 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{33}N_3O_3$ [$(M+H)^+$]: 436.2595; Found: 436.2599.



***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclohexyl)carbamate (3ha).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1h** (155.4 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (53.2 mg, >95:5 dr, 59%). mp = 194 °C. R_f = 0.55 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2935, 1683, 1495, 1451, 1365, 1247, 1168, 1090, 910, 703 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.99 (s, 1H), 7.28 – 7.10 (m, 10H), 4.32 (s, 1H), 4.25 (d, *J* = 7.8 Hz, 1H), 4.03 (s, 1H), 3.13 (m, 2H), 2.15 (dd, *J* = 16.4, 1.4 Hz, 1H), 1.51 (s, 10H), 1.62 – 1.01 (m, 8H), 0.93 – 0.81 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.8 (C), 155.7 (C), 142.1 (C), 139.1 (C), 129.3 (CH), 128.4 (CH, 2C), 128.3 (CH, 2C), 128.0 (CH), 127.0 (C), 126.3 (CH, 2C), 79.58 (C), 77.1 (CH), 64.4 (CH), 58.4 (C), 36.7 (CH_2), 35.2 (CH_2), 34.3 (CH_2), 28.6 (CH_3, 3C), 25.4 (CH_2), 21.5 (CH_2, 2C) ppm. HRMS (ESI^+): calcd for $C_{27}H_{35}N_3O_3$ [$(M+H)^+$]: 450.2751; Found: 450.2740.

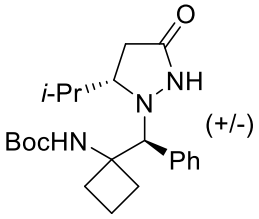


***tert*-butyl 2-(2-methyl-1-phenylpropyl)-5-oxo-3-phenylpyrazolidine-1-carboxylate (3ia).** Following the general procedure with azomethine imine **2a** (50.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1i** (93.3 mg, 0.40 mmol, 2.0 equiv), a crude reaction was obtained and dissolved in 1.0 mL of acetonitrile under a nitrogen atmosphere. Boc_2O (87.3 mg, 0.40 mmol, 2.0 equiv) dissolved in 1.0 mL of acetonitrile was added dropwise *via* a syringe followed by DMAP (2.4 mg, 0.02 mmol, 0.1 equiv) and the reaction was stirred at rt during 16 h. The residue was evaporated under *vacuum* and purified by silica gel column chromatography (CH_2Cl_2:Et_2O, from 95:5 to 80:20), and, if required, by a second silica gel column chromatography (Pentane:EtOAc:EtOH, from 60:40:0 to 60:36:4) in order to remove small impurity to provide the main diastereoisomer of the desired pyrazolidinone product **3ia** as white solid (21.2 mg, >95:5 dr, 27%). mp = 69 °C. R_f = 0.63 (CH_2Cl_2/Et_2O: 9/1). IR (neat) ν_{max} 2927, 1773, 1452, 1368, 1291, 1147, 1132, 1072, 963, 770, 705 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 7.45 – 7.19 (m, 10H), 4.54 (d, *J* = 8.6 Hz, 1H), 3.80 (d, *J* = 10.2 Hz, 1H), 2.32 (m, 1H), 2.03 (dd, *J* = 17.5, 1.3 Hz, 1H), 1.87 (dd, *J* = 17.5, 8.7 Hz, 1H), 1.65 (s, 9H), 1.21 (d, *J* = 6.5 Hz, 3H), 0.88 (d, *J* = 6.5 Hz, 3H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.2 (C), 149.0 (C), 142.1 (C), 136.6 (C), 129.4 (CH, 2C), 129.1 (CH, 2C), 128.8 (CH, 2C), 128.6 (CH), 127.4 (CH), 126.0 (CH, 2C), 83.8 (C), 75.0 (CH), 56.4 (CH), 40.5 (CH_2), 28.6 (CH), 28.5 (CH_3, 3C), 21.3 (CH_3), 21.0 (CH_3) ppm. HRMS (ESI^+): calcd for $C_{24}H_{30}N_2O_3$ [$(M+H)^+$]: 395.2329; Found: 395.2347.

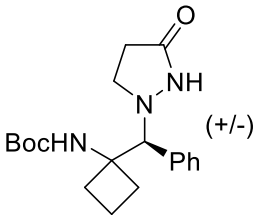


***tert*-butyl (1-((5-methyl-3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fb).** Following the general procedure with azomethine imine **2b** (37.6 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (45.3 mg, >95:5 dr, 63%). mp = 180 °C. R_f = 0.40 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3272, 2977, 1663, 1538, 1364, 1280, 1170, 874, 730,707 cm^{-1}. ^1H NMR (300 MHz;

$CDCl_3$): δ_H 8.89 (s, 1H), 7.43 – 7.19 (m, 5H), 4.36 (s, 1H), 3.80 (s, 1H), 3.13 (m, 1H), 3.06 – 2.87 (m, 2H), 2.42 – 2.29 (m, 1H), 2.13 – 1.94 (m, 2H), 1.86 – 1.72 (m, 2H), 1.50 (s, 9H), 1.02 – 0.95 (m, 1H), 0.99 (d, J = 6.6 Hz, 3H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.4 (C), 156.4 (C), 137.5 (C), 128.5 (CH 3C), 128.2 (CH, 2C), 79.9 (C), 78.2 (CH), 60.2 (C), 56.3 (CH), 35.6 (CH_2), 33.3 (CH_2), 31.3 (CH_2), 28.5 (CH_3, 3C), 21.1 (CH), 16.5 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{20}H_{29}N_3O_3$ [(M+H)$^+$]: 360.2282; Found: 360.2284.

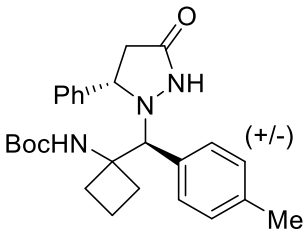


***tert*-butyl (1-((5-isopropyl-3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fc).** Following the general procedure with azomethine imine **2c** (43.2 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (46.5 mg, >95:5 dr, 60%). mp = 177 °C. R_f = 0.44 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3241, 2950, 1671, 1535, 1282, 1166, 1044, 694 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 8.98 (s, 1H), 7.37 – 7.26 (m, 5H), 4.45 (s, 1H), 3.78 (s, 1H), 2.97 (ddd, J = 12.8, 8.1, 3.9 Hz, 1H), 2.89 – 2.71 (m, 2H), 2.41 – 2.27 (m, 1H), 2.12 – 1.88 (m, 3H), 1.82 – 1.68 (m, 1H), 1.59 (m, 1H), 1.49 (s, 9H), 1.04 – 0.91 (m, 1H), 0.71 (d, J = 6.8 Hz, 3H), 0.68 (d, J = 6.8 Hz, 3H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.7 (C), 156.1 (C), 136.9 (C), 129.2 (CH), 128.3 (CH, 2C), 128.2 (CH, 2C), 79.9 (C), 79.2 (CH), 65.7 (CH), 60.1 (C), 33.5 (CH_2), 32.0 (CH), 31.6 (CH_2), 31.0 (CH_2), 28.6 (CH_3, 3C), 18.9 (CH_3), 17.6 (CH_3), 16.6 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{22}H_{33}N_3O_3$ [(M+H)$^+$]: 388.2595; Found: 388.2589.

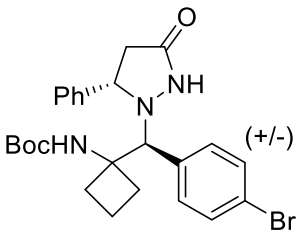


***tert*-butyl (1-((3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fd).** Following the general procedure with azomethine imine **2d** (34.8 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (39.4 mg, >95:5 dr, 57%). mp = 167 °C. R_f = 0.31 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2978, 1665, 1537, 1278, 1365, 1278, 1166, 709 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H

8.88 (s, 1H), 7.43 – 7.24 (m, 5H), 4.48 (s, 1H), 3.72 (s, 1H), 3.27 (dt, *J* = 11.2, 9.1 Hz, 1H), 2.97 (m, 1H), 2.89 – 2.77 (m, 1H), 2.66 (dt, *J* = 17.7, 9.0 Hz, 1H), 2.47 – 2.32 (m, 1H), 2.21 (ddd, *J* = 16.4, 8.8, 5.2 Hz, 1H), 2.12 – 1.96 (m, 2H), 1.81 (m, 1H), 1.51 (s, 9H), 1.22 – 1.06 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 174.7 (C), 156.1 (C), 137.1 (C), 129.0 (CH), 128.5 (CH, 2C), 128.2 (CH, 2C), 80.0 (C), 79.0 (CH), 59.9 (C), 51.2 (CH_2), 33.3 (CH_2), 31.4 (CH_2), 29.9 (CH_2), 28.6 (CH_3, 3C), 16.3 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{19}H_{27}N_3O_3$ [(M+H)$^+$]: 346.2125; Found: 346.2128.

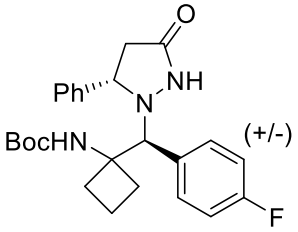


***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(p-tolyl)methyl)cyclobutyl)carbamate (3ff).** Following the general procedure with azomethine imine **2f** (52.9 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (47.9 mg, >95:5 dr, 55%). mp = 166 °C. R_f = 0.46 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3323, 3249, 2964, 1662, 1530, 1283, 1165, 819, 695 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 9.10 (s, 1H), 7.37 – 6.76 (m, 9H), 4.43 (s, 1H), 4.18 (d, *J* = 7.7 Hz, 1H), 3.99 (s, 1H), 3.31 (ddd, *J* = 16.5, 8.6, 0.7 Hz, 1H), 3.12 – 2.93 (m, 1H), 2.51 – 2.37 (m, 1H), 2.27 (s, 3H), 2.22 (d, *J* = 16.6 Hz, 1H), 2.08 (dt, *J* = 14.3, 8.3 Hz, 2H), 1.88 – 1.72 (m, 1H), 1.54 (s, 9H), 1.12 – 0.98 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.3 (C), 142.5 (C), 137.9 (C), 133.7 (C), 129.2 (CH, 2C), 128.6 (CH, 2C), 128.3 (CH, 2C), 126.9 (CH), 126.2 (CH, 2C), 80.0 (C), 78.4 (CH), 63.0 (CH), 60.3 (C), 37.4 (CH_2), 33.5 (CH_2), 31.4 (CH_2), 28.6 (CH_3, 3C), 21.2 (CH_3), 16.6 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{26}H_{33}N_3O_3$ [(M+H)$^+$]: 436.2595; Found: 436.2614.

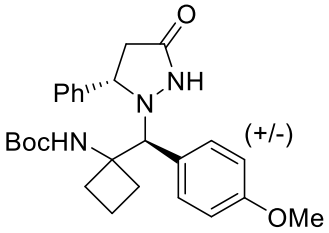


***tert*-butyl (1-((4-bromophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fg).** Following the general procedure with azomethine imine **2g** (65.8 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (59.0 mg, >95:5 dr, 59%). mp = 229 °C. R_f = 0.45 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3240, 1665, 1533, 1279, 1167, 1073, 816, 700 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$):

δ_H 9.12 (s, 1H), 7.35 (d, *J* = 8.4 Hz, 2H), 7.26 – 7.04 (m, 7H), 4.34 (s, 1H), 4.09 (d, *J* = 8.0 Hz, 1H), 3.98 (s, 1H), 3.29 (ddd, *J* = 16.6, 8.7, 0.7 Hz, 1H), 3.07 – 2.93 (m, 1H), 2.52 – 2.35 (m, 1H), 2.21 (d, *J* = 16.7 Hz, 1H), 2.13 – 1.96 (m, 2H), 1.89 – 1.76 (m, 1H), 1.52 (s, 9H), 1.10 – 0.97 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.5 (C), 156.2 (C), 142.2 (C), 135.7 (C), 131.7 (CH, 2C), 130.2 (CH, 2C), 128.4 (CH, 2C), 127.1 (CH), 126.0 (CH, 2C), 122.3 (CH), 80.2 (C), 78.1 (CH), 63.3 (CH), 60.0 (C), 37.5 (CH_2), 33.5 (CH_2), 31.4 (CH_2), 28.6 (CH_3, 3C), 16.6 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{25}H_{30}BrN_3O_3$ [(M+H)$^+$]: 500.1543; Found: 500.1552.

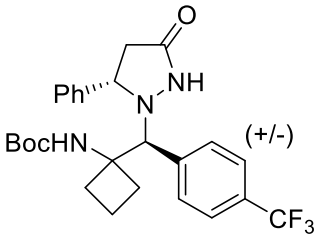


***tert*-butyl (1-((4-fluorophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fh).** Following the general procedure with azomethine imine **2h** (53.6 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (62.3 mg, >95:5 dr, 71%). mp = 204 °C. R_f = 0.45 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3310, 2970, 1660, 1527, 1508, 1282, 1221, 1168, 822, 698 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 9.15 (s, 1H), 7.31 – 7.03 (m, 7H), 6.92 (t, *J* = 8.6 Hz, 2H), 4.37 (s, 1H), 4.11 (d, *J* = 7.9 Hz, 1H), 4.01 (s, 1H), 3.30 (ddd, *J* = 16.6, 8.8, 0.8 Hz, 1H), 3.03 (ddd, *J* = 13.3, 6.7, 3.5 Hz, 1H), 2.57 – 2.35 (m, 1H), 2.22 (d, *J* = 16.9 Hz, 1H), 2.15 – 1.98 (m, 2H), 1.89 – 1.77 (m, 1H), 1.53 (s, 9H), 1.13 – 0.99 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.5 (C), 162.6 (d, *J* = 247.2 Hz, C), 156.2 (C), 142.4 (C), 132.5 (d, *J* = 3.2 Hz, CH), 130.2 (CH, 2C), 128.4 (CH, 2C), 127.1 (CH), 126.1 (CH, 2C), 115.5 (d, *J* = 21.7 Hz, CH), 80.2 (C), 78.0 (CH), 63.2 (CH), 60.2 (C), 37.5 (CH_2), 33.5 (CH_2), 31.4 (CH_2), 28.6 (CH_3, 3C), 16.6 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{25}H_{30}FN_3O_3$ [(M+H)$^+$]: 440.2344; Found: 440.2362.

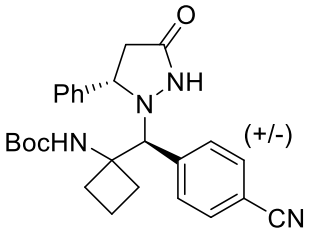


***tert*-butyl (1-((4-methoxyphenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fi).** Following the general procedure with azomethine imine **2i** (56.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound

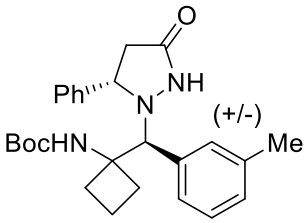
was obtained as white solid (55.7 mg, >95:5 dr, 62%). mp = 196 °C. R_f = 0.41 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3246, 2994, 1669, 1527, 1509, 1277, 1241, 1166, 1039, 822, 696 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.11 (s, 1H), 7.31 – 7.03 (m, 7H), 6.76 (d, *J* = 8.7 Hz, 2H), 4.42 (s, 1H), 4.18 (d, *J* = 8.0 Hz, 1H), 3.97 (s, 1H), 3.74 (s, 3H), 3.31 (ddd, *J* = 16.5, 8.7, 0.7 Hz, 1H), 3.11 – 2.91 (m, 1H), 2.55 – 2.34 (m, 1H), 2.21 (d, *J* = 16.6 Hz, 1H), 2.15 – 1.95 (m, 2H), 1.93 – 1.67 (m, 1H), 1.53 (s, 9H), 1.17 – 0.98 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.6 (C), 159.4 (C), 156.3 (C), 142.6 (C), 129.6 (CH, 2C), 128.8 (CH), 128.3 (CH, 2C), 126.9 (CH), 126.2 (CH, 2C), 113.9 (CH), 80.0 (C), 78.0 (CH), 62.9 (CH), 60.4 (C), 55.3 (CH_3), 37.4 (CH_2), 33.5 (CH_2), 31.4 (CH_2), 28.6 (CH_3, 3C), 16.5 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{33}FN_3O_4$ [$(M+H)^+$]: 452.2544; Found: 452.2560.



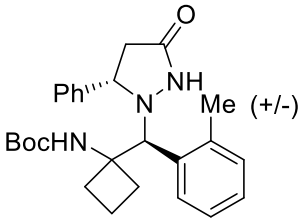
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(4-(trifluoromethyl)phenyl)methyl)cyclobutyl)carbamate (3fj).** Following the general procedure with azomethine imine **2j** (63.6 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (77.8 mg, >95:5 dr, 79%). mp = 201 °C. R_f = 0.49 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3246, 1671, 1322, 1125, 1159, 1066, 695 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.16 (s, 1H), 7.49 (d, *J* = 8.2 Hz, 2H), 7.35 (d, *J* = 8.3 Hz, 2H), 7.28 – 7.08 (m, 6H), 4.35 (s, 1H), 4.09 (s, 1H), 4.06 (d, *J* = 7.6 Hz, 1H), 3.30 (ddd, *J* = 16.6, 8.7, 0.6 Hz, 1H), 3.10 – 2.97 (m, 1H), 2.55 – 2.40 (m, 1H), 2.23 (d, *J* = 17.1 Hz, 1H), 2.17 – 1.99 (m, 2H), 1.92 – 1.77 (m, 1H), 1.54 (s, 9H), 1.12 – 0.97 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.5 (C), 156.2 (C), 142.1 (C), 140.8 (d, *J* = 1.0 Hz, C), 130.5 (q, *J* = 32.6 Hz, C), 129.0 (CH, 2C), 128.5 (CH, 2C), 127.2 (CH), 126.0 (CH, 2C), 125.4 (d, *J* = 3.2 Hz, CH), 124.0 (q, *J* = 272.0 Hz, C), 80.4 (C), 78.4 (CH), 63.5 (CH), 60.1 (C), 37.6 (CH_2), 33.5 (CH_2), 31.5 (CH_2), 28.6 (CH_3, 3C), 16.7 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{30}F_3N_3O_3$ [$(M+H)^+$]: 490.2312; Found: 490.2315.



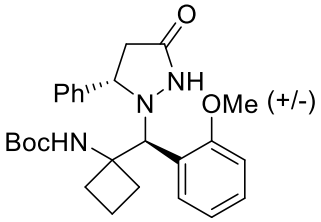
***tert*-butyl (1-((4-cyanophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fk).** Following the general procedure with azomethine imine **2k** (55.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (72.2 mg, >95:5 dr, 81%). mp = 227 °C. R_f = 0.38 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3267, 2964, 1671, 1526, 1281, 1165, 821, 755, 694 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.18 (s, 1H), 7.52 (d, *J* = 8.2 Hz, 2H), 7.34 (d, *J* = 8.6 Hz, 2H), 7.29 – 7.02 (m, 5H), 4.34 (s, 1H), 4.09 (s, 1H), 4.01 (d, *J* = 7.4 Hz, 1H), 3.30 (ddd, *J* = 16.6, 8.8, 0.7 Hz, 1H), 3.03 (ddd, *J* = 13.2, 6.7, 3.7 Hz, 1H), 2.57 – 2.36 (m, 1H), 2.23 (dd, *J* = 16.7, 0.7 Hz, 1H), 2.17 – 2.00 (m, 2H), 1.91 – 1.80 (m, 1H), 1.54 (s, 9H), 1.11 – 1.01 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.4 (C), 156.1 (C), 142.1 (C), 142.0 (C), 132.2 (CH), 129.5 (CH, 2C), 128.5 (CH, 2C), 127.3 (CH), 125.9 (CH, 2C), 118.4 (CH), 112.3 (CH), 80.5 (C), 78.5 (CH), 63.7 (CH), 60.0 (C), 37.6 (CH_2), 33.4 (CH_2), 31.6 (CH_2), 28.5 (CH_3, 2C), 16.7 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{30}N_4O_3$ [$(M+H)^+$]: 447.2391; Found: 447.2408.



***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(m-tolyl)methyl)cyclobutyl)carbamate (3fl).** Following the general procedure with azomethine imine **2l** (52.9 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (58.6 mg, >95:5 dr, 67%). mp = 153 °C. R_f = 0.47 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3223, 2979, 1669, 1539, 1389, 1365, 1284, 1163, 698 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.06 (s, 1H), 7.29 – 6.96 (m, 9H), 4.42 (s, 1H), 4.14 (d, *J* = 8.1 Hz, 1H), 3.98 (s, 1H), 3.31 (ddd, *J* = 16.6, 8.8, 0.8 Hz, 1H), 3.09 – 2.93 (m, 1H), 2.53 – 2.38 (m, 1H), 2.31 – 1.97 (m, 5H), 1.88 – 1.75 (m, 1H), 1.52 (s, 9H), 1.14 – 0.98 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.4 (C), 142.6 (C), 137.9 (C), 136.6 (C), 129.9 (CH), 128.9 (CH), 128.3 (CH), 128.2 (CH, 2C), 126.9 (CH), 126.2 (CH, 2C), 79.9 (C), 78.8 (CH), 63.2 (CH), 60.2 (C), 37.3 (CH_2), 33.5 (CH_2), 31.4 (CH_2), 28.6 (CH_3, 3C), 21.5 (CH_3), 16.6 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{33}N_3O_3$ [$(M+H)^+$]: 436.2595; Found: 436.2602.

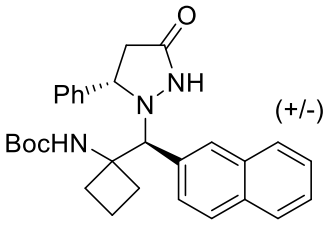


***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(o-tolyl)methyl)cyclobutyl)carbamate (3fm).** Following the general procedure with azomethine imine **2m** (52.9 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (52.2 mg, >95:5 dr, 60%). mp = 199 °C. R_f = 0.47 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3030, 1675, 1604, 1595, 1479, 1371, 1261, 1172, 816, 748, 694 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.25 (s, 1H), 7.30 – 7.24 (m, 1H), 7.22 – 7.06 (m, 7H), 7.01 (td, *J* = 7.6, 1.4 Hz, 1H), 4.64 (s, 1H), 4.44 (s, 1H), 4.04 (d, *J* = 8.2 Hz, 1H), 3.29 (ddd, *J* = 16.5, 8.6, 0.7 Hz, 1H), 3.06 – 2.91 (m, 1H), 2.60 – 2.44 (m, 4H), 2.27 (d, *J* = 16.6 Hz, 1H), 2.13 – 1.98 (m, 1H), 1.94 – 1.77 (m, 2H), 1.54 (s, 9H), 1.33 – 1.16 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.0 (C), 142.4 (C), 136.4 (C), 135.7 (C), 130.8 (CH), 128.2 (CH, 2C), 127.7 (CH), 127.6 (CH), 126.9 (CH), 126.6 (CH), 126.2 (CH, 2C), 80.1 (C), 71.5 (CH), 62.7 (CH), 60.2 (C), 37.6 (CH_2), 32.8 (CH_2), 32.1 (CH_2), 28.6 (CH_3, 3C), 21.0 (CH_3), 16.5 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{33}N_3O_3$ [$(M+H)^+$]: 436.2595; Found: 436.2615.

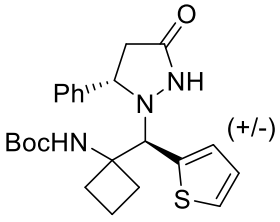


***tert*-butyl (1-((2-methoxyphenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fn).** Following the general procedure with azomethine imine **2n** (56.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (44.3 mg, >95:5 dr, 49%). mp = 176 °C. R_f = 0.42 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3243, 2978, 1665, 1537, 1365, 1278, 1166, 1053, 709 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.18 (s, 1H), 7.35 – 7.07 (m, 7H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.76 (t, *J* = 7.2 Hz, 1H), 4.78 (s, 1H), 4.53 (s, 1H), 4.07 (d, *J* = 8.3 Hz, 1H), 3.88 (s, 3H), 3.35 (dd, *J* = 16.7, 8.5 Hz, 1H), 3.13 – 2.82 (m, 1H), 2.64 – 2.41 (m, 1H), 2.36 – 1.93 (m, 3H), 1.93 – 1.69 (m, 1H), 1.53 (s, 9H), 1.17 – 1.01 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.8 (C), 157.3 (C), 156.2 (C), 142.6 (C), 128.7 (CH), 128.7 (CH), 128.2 (CH, 2C), 126.8 (CH), 126.2 (CH, 2C), 125.4 (CH), 120.9 (CH), 110.5

(CH), 79.9 (C), 68.2 (CH), 62.9 (CH), 60.2 (C), 55.5 (CH_3), 37.6 (CH_2), 32.1 (CH_2), 31.6 (CH_2), 28.6 (CH_3, 3C), 16.5 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{26}H_{33}N_3O_4$ [$(M+H)^+$]: 452.2544; Found: 452.2545.

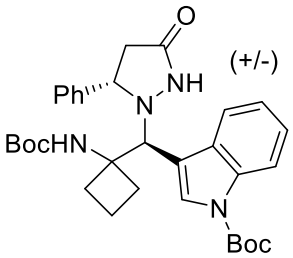


***tert*-butyl (1-(naphthalen-2-yl(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fo).** Following the general procedure with azomethine imine **2o** (60.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (80.2 mg, >95:5 dr, 85%). mp = 189 °C. R_f = 0.46 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3290, 2973, 1678, 1497, 1366, 1247, 1162, 820, 732, 700 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.16 (s, 1H), 7.82 – 7.63 (m, 4H), 7.50 – 7.42 (m, 2H), 7.37 (dd, *J* = 8.6, 1.3 Hz, 1H), 7.22 – 7.11 (m, 5H), 4.44 (s, 1H), 4.21 (s, *J* = 3.9 Hz, 1H), 4.21 (d, *J*= 7.8 Hz, 1H), 3.44 – 3.30 (m, 1H), 3.15 – 3.00 (m, 1H), 2.61 – 2.44 (m, 1H), 2.31 – 2.02 (m, 3H), 1.94 – 1.75 (m, 1H), 1.57 (s, 9H), 1.11 – 0.96 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.4 (C), 142.4 (C), 134.4 (C), 133.3 (C), 133.0 (C), 128.3 (CH, 2C), 128.2 (CH), 128.0 (CH), 127.8 (CH), 127.0 (CH), 126.4 (CH), 126.3 (CH), 126.2 (CH, 2C), 80.1 (C), 78.9 (CH), 63.3 (CH), 60.5 (C), 37.4 (CH_2), 33.6 (CH_2), 31.6 (CH_2), 28.7 (CH_3, 3C), 16.7 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{29}H_{33}N_3O_3$ [$(M+H)^+$]: 472.2595; Found: 452.2604.

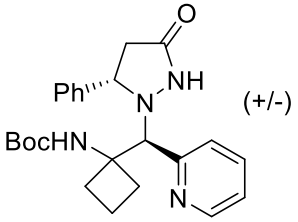


***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(thiophen-2-yl)methyl)cyclobutyl)carbamate (3fp).** Following the general procedure with azomethine imine **2p** (60.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (51.3 mg, >95:5 dr, 68%). mp = 169 °C. R_f = 0.43 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2970, 1658, 1533, 1279, 1168, 1024, 796, 695 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.07 (s, 1H), 7.25 – 7.13 (m, 6H), 7.08 (dd, *J* = 2.9, 1.0 Hz, 1H), 6.92 (dd, *J* = 5.0, 1.2 Hz, 1H), 4.44 (s, 1H), 4.17 (s, 1H), 4.20 – 4.14 (m,1H), 3.29 (ddd, *J* = 16.6, 8.8, 0.7 Hz, 1H), 3.08 – 2.95

(m, 1H), 2.50 – 2.36 (m, 1H), 2.23 (d, *J* = 16.7 Hz, 1H), 2.14 – 1.99 (m, 2H), 1.90 – 1.77 (m, 1H), 1.52 (s, 9H), 1.21 – 1.08 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.5 (C), 156.2 (C), 142.5 (C), 137.6 (C), 128.2 (CH, 2C), 127.4 (CH), 126.9 (CH), 126.0 (CH, 2C), 125.8 (C), 123.1 (C), 79.9 (C), 74.6 (CH), 63.1 (CH), 60.0 (C), 37.4 (CH_2), 33.4 (CH_2), 31.0 (CH_2), 28.5 (CH_3, 3C), 16.4 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{23}H_{29}N_3O_3S$ [(M+H)$^+$]: 428.2002; Found: 428.2016.

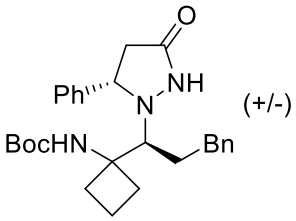


***tert*-butyl 3-((1-((*tert*-butoxycarbonyl)amino)cyclobutyl)(3-oxo-5-phenylpyrazolidin-1-yl) methyl)-1H-indole-1-carboxylate (3fq).** Following the general procedure with azomethine imine **2q** (77.9 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (81.9 mg, >95:5 dr, 73%). mp = 103 °C. R_f = 0.55 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2977, 1735, 1683, 1497, 1452, 1368, 1251, 1159, 1083, 748, 700 cm^{-1}. Remark: due to dynamic exchange phenomenon (as expected from preliminary variable NMR temperature experiments) many broad and split signals were observed and only clear signals are described herewith. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 9.15 (s, 1H), 8.12 (s, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.43 – 6.89 (m, 8H), 4.73 (s, 1H), 4.41 (s, 1H), 4.13 (s, 1H), 3.31 (dd, *J* = 16.8, 9.0 Hz, 1H), 3.14 – 2.92 (m, 1H), 2.57 (s, 1H), 2.26 (d, *J* = 16.9 Hz, 1H), 2.19 – 1.99 (m, 2H), 1.93 – 1.76 (m, 1H), 1.54 (s, 18H), 1.36 – 1.10 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.7 (C), 156.3 (C), 149.2 (C), 143.0 (C), 135.3 (C), 128.2 (CH, 2C), 126.9 (CH), 126.1 (2C), 124.9 (C), 123.0 (CH), 118.6 (C), 116.3 (C), 115.4 (CH), 83.8 (C), 80.0 (C), 70.0 (CH), 63.7 (CH), 60.2 (C), 37.6 (CH_2), 33.4 (CH_2), 31.2 (CH_2), 28.6 (CH_3, 3C), 28.2 (CH_3, 3C), 16.6 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{32}H_{40}N_4O_5$ [(M+H)$^+$]: 561.3071; Found: 561.3076.

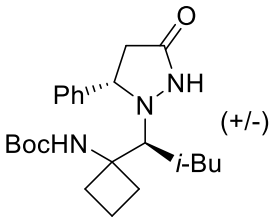


***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(pyridin-2-yl)methyl)cyclobutyl)carbamate (3fr).** Following the general procedure with azomethine imine **2r** (50.2 mg, 0.20 mmol) and *N*-

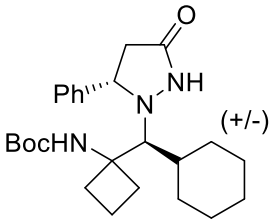
(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (24.9 mg, >95:5 dr, 29%). mp = 183 °C. R_f = 0.27 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3273, 2981, 1661, 1534, 1366, 1290, 1172, 757, 704 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 9.21 (s, 1H), 8.51 (ddd, *J* = 4.9, 1.7, 0.9 Hz, 1H), 7.48 (td, *J* = 7.7, 1.8 Hz, 1H), 7.24 – 7.10 (m, 7H), 4.52 (s, 1H), 4.31 (s, 1H), 4.06 (d, *J* = 7.6 Hz, 1H), 3.34 (dd, *J* = 16.8, 8.7 Hz, 1H), 3.06 – 2.94 (m, 1H), 2.52 (dt, *J* = 12.3, 9.1 Hz, 1H), 2.37 (dt, *J* = 12.0, 9.2 Hz, 1H), 2.23 (dd, *J* = 16.6, 1.1 Hz, 1H), 2.17 – 1.97 (m, 1H), 1.97 – 1.78 (m, 1H), 1.53 (s, 9H), 1.15 – 0.99 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.4 (C), 157.3 (C), 156.2 (C), 149.0 (CH), 142.4 (C), 136.6 (CH), 128.4 (CH, 2C), 127.1 (CH), 126.1 (CH, 2C), 123.2 (CH), 122.7 (CH), 80.2 (C), 79.8 (CH), 63.6 (CH), 59.9 (C), 37.6 (CH_2), 32.7 (CH_2), 31.7 (CH_2), 28.6 (CH_3, 3C), 16.6 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{24}H_{30}N_4O_3$ [$(M+H)^+$]: 423.2391; Found: 423.2397.



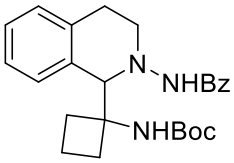
***tert*-butyl (1-(1-(3-oxo-5-phenylpyrazolidin-1-yl)-3-phenylpropyl)cyclobutyl)carbamate (3fs).** Following the general procedure with azomethine imine **2s** (55.7 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (43.2 mg, >95:5 dr, 48%). mp = 149 °C. R_f = 0.48 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 2952, 1658, 1546, 1364, 1295, 1167, 699 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.81 (s, 1H), 7.29 – 7.06 (m, 8H), 7.02 – 6.90 (m, 2H), 4.66 (s, 1H), 4.33 (dd, *J* = 9.1, 2.3 Hz, 1H), 3.11 (dd, *J* = 16.7, 9.1 Hz, 1H), 2.92 (t, *J* = 4.0 Hz, 1H), 2.80 – 2.54 (m, 3H), 2.31 – 1.96 (m, 4H), 1.82 – 1.65 (m, 2H), 1.64 – 1.43 (m, 2H), 1.40 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.1 (C), 155.8 (C), 142.8 (C), 141.3 (C), 128.6 (CH, 2C), 128.5 (CH, 2C), 128.4 (CH, 2C), 127.2 (CH), 126.4 (CH), 126.2 (CH, 2C), 79.8 (C), 71.8 (CH), 62.1 (CH), 61.0 (C), 37.9 (CH_2), 35.5 (CH_2), 32.8 (CH_2), 31.7 (CH_2), 31.1 (CH_2), 28.4 (CH_3, 3C), 16.3 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{27}H_{35}N_3O_3$ [$(M+H)^+$]: 450.2751; Found: 450.2769.



***tert*-butyl (1-(3-methyl-1-(3-oxo-5-phenylpyrazolidin-1-yl)butyl)cyclobutyl)carbamate (3ft).** Following the general procedure with azomethine imine **2t** (46.1 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (37.2 mg, >95:5 dr, 46%). mp = 195 °C. R_f = 0.54 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3279, 2954, 1669, 1550, 1365, 1283, 1171, 1058, 749, 702 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.65 (s, 1H), 7.26 – 7.02 (m, 5H), 4.57 (s, 1H), 4.43 (dd, *J* = 8.9, 2.4 Hz, 1H), 3.12 (dd, *J* = 16.7, 9.0 Hz, 1H), 2.82 (t, *J* = 4.3 Hz, 1H), 2.65 (s, 1H), 2.28 – 1.86 (m, 4H), 1.59 (m, 3H), 1.34 (s, 9H), 1.08 – 0.90 (m, 2H), 0.78 (d, *J* = 4.5 Hz, 3H), 0.76 (d, *J* = 4.4 Hz, 3H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.4 (C), 155.9 (C), 142.9 (C), 128.6 (CH, 2C), 127.3 (CH), 126.4 (CH, 2C), 79.8 (C), 70.0 (CH), 61.8 (CH), 61.3 (C), 38.0 (CH_2), 37.9 (CH_2), 32.8 (CH_2), 31.8 (CH_2), 28.5 (CH_3, 3C), 28.0 (CH), 23.5 (CH_3), 23.0 (CH_3), 16.3 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{23}H_{35}N_3O_3$ [$(M+H)^+$]: 402.2751; Found: 402.2763.

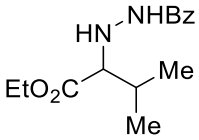


***tert*-butyl (1-(cyclohexyl(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fu).** Following the general procedure with azomethine imine **2u** (51.3 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (42.3 mg, >95:5 dr, 49%). mp = 188 °C. R_f = 0.59 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3242, 2931, 2849, 1661, 1527, 1282, 1166, 921, 730, 708 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.96 (s, 1H), 7.41 – 7.13 (m, 5H), 4.68 (s, 1H), 4.54 (d, *J* = 7.9 Hz, 1H), 3.30 (dd, *J* = 16.5, 8.3 Hz, 1H), 2.87 – 2.70 (m, 2H), 2.35 – 2.18 (m, 2H), 2.18 – 2.02 (m, 2H), 1.50 (s, 9H), 1.86 – 0.75 (m, 12H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 172.1 (C), 156.0 (C), 142.0 (C), 128.4 (CH, 2C), 127.0 (CH), 126.6 (CH, 2C), 80.1 (C), 76.4 (CH), 63.9 (CH), 62.3 (C), 39.4 (CH), 37.4 (CH_2), 36.3 (CH_2), 34.3 (CH_2), 32.0 (CH_2), 29.2 (CH_2), 28.6 (CH_3, 3C), 27.6 (CH_2), 27.3 (CH_2), 26.5 (CH_2), 16.3 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{25}H_{37}N_3O_3$ [$(M+H)^+$]: 428.2908; Found: 428.2895.



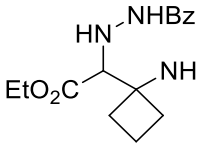
***tert*-butyl (1-(2-benzamido-1,2,3,4-tetrahydroisoquinolin-1-yl)cyclobutyl)carbamate (5).**

Following the general procedure with benzoyl(3,4-dihydroisoquinolin-2-ium-2-yl)amide **4** (32.9 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.40 mmol, 2.0 equiv), the title compound was obtained as white solid (42.8 mg, 51%). mp = 71 °C. R_f = 0.32 (CH_2Cl_2/Et_2O: 8/2). IR (neat) ν_{max} 3274, 2931, 1707, 1644, 1491, 1365, 1251, 1167, 1055, 906, 745, 693, 696 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 8.22 (s, 1H), 7.87 (d, *J* = 7.4 Hz, 2H), 7.54 – 7.37 (m, 3H), 7.29 – 7.08 (m, 3H), 5.37 (s, 1H), 4.47 (s, 1H), 3.56 – 3.41 (m, 1H), 3.27 – 3.06 (m, 2H), 2.79 – 2.65 (m, 1H), 2.40 – 2.27 (m, 1H), 2.25 – 2.12 (m, 1H), 2.10 – 1.81 (m, 2H), 1.40 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 165.4 (C), 155.9 (C), 136.1 (C), 134.1 (C), 133.8 (C), 131.6 (CH), 128.6 (CH), 128.6 (CH, 2C), 128.4 (CH), 127.3 (CH, 2C), 126.8 (CH), 125.7 (CH), 79.4 (C), 68.4 (CH), 63.0 (C), 51.0 (CH_2), 31.0 (CH_2), 30.9 (CH_2), 29.4 (CH_2), 28.5((CH_3, 3C), 16.0 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{25}H_{31}N_3O_3$ [$(M+H)^+$]: 422.2438; Found: 422.2453.



(+/-)

ethyl benzamidovalinate (7ib). Following the general procedure with hydrazone **6b** (44.0 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1i** (93.3 mg, 0.4 mmol, 2 equiv), the title compound was obtained as white solid (24.8 mg, 47%). ^1H NMR (300 MHz; $CDCl_3$) δ_H 7.84 – 7.65 (m, 3H), 7.56 – 7.37 (m,3H), 5.15 – 5.01 (m, 1H), 4.32 – 4.15 (m, 2H), 3.67 – 3.50 (m, 1H), 2.25 – 2.08 (m, 1H), 1.30 (t, *J* = 7.1 Hz, 3H), 1.08 (t, *J* = 7.4 Hz, 6H) ppm. ^1H NMR data is in accordance with the literature.[20]



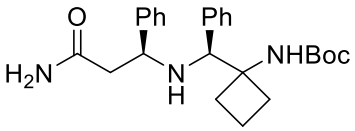
(+/-)

Ethyl 2-(2-benzoylhydrazinyl)-2-(1-((*tert*-butoxycarbonyl)amino)cyclobutyl)acetate (7fb). Following the general procedure with hydrazone **6b** (44.0 mg, 0.20 mmol) and *N*-(acyloxy)phthalimide derivative **1f** (144.1 mg, 0.4 mmol, 2 equiv), the title compound was obtained as white solid (52.8 mg, 67%). mp = 56-58°C. R_f = 0.16 (CH_2Cl_2/Et_2O: 95/5). IR (neat *or solvent or KBr*) ν_{max} 3293, 2976, 1711, 1647, 1367, 1163, 692, 404 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$) δ_H 8.53 (s, 1H), 7.78-7.74 (m, 2H), 7.51-7.37 (m, 3H), 5.27 (brs, 2H), 4.26-4.15 (m, 2H),

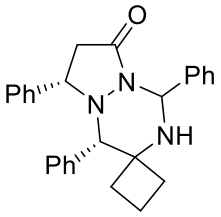
[20] Burk, M. J.; U.S. Patent US5250731, 1993.

4.01 (s, 1H), 2.47-2.29 (m, 4H), 2.07-1.93 (m, 1H), 1.85-1.71 (m, 1H), 1.42 (s, 9H), 1.27 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (75.4 MHz; $CDCl_3$) δ_C 170.9 (C), 167.0 (C), 155.4 (C), 132.7 (C), 131.9 (CH), 128.7 (CH), 127.0 (CH), 79.6 (C), 67.9 (CH), 61.4 (CH_2), 57.9 (C), 30.8 (CH_2), 28.4 (CH_3), 15.4 (CH_2), 14.2 (CH_3, 3C). HRMS (ESI$^+$): calcd for $C_{20}H_{29}N_3O_5$ [(M+H)$^+$]: 392.2180; Found: 392.2171.

III-3 Products transformation



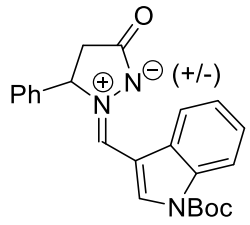
***tert*-butyl (1-(((3-amino-3-oxo-1-phenylpropyl)amino)(phenyl)methyl)cyclobutyl)carbamate (8).** In 7 ml tube flask under nitrogen was introduced 350.0 mg of Raney® Nickel (W.R. Grace and Co. Raney® 2800) and solid was successively washed twice with water and ethanol. A solution of pyrazolidinone **3fa** (42.2 mg, 0.1 mmol, 1.0 equiv) in 2.0 mL of ethanol was added and H_2 was bubbling through the solution during 10 min. The resulting solution was stirred at rt for 24 h and filtered on a pad of celite. The solvent was evaporated under reduced pressure and the residue was purified by silica gel column chromatography (pentane:EtOAc:EtOH, from 80:20:0 to 80:16:4) to provide the desired product **8** as a white solid (25.8 mg, 61%). mp = 168 °C. R_f = 0.27 (pentane:EtOAc:EtOH: 80:20:0). IR (neat) ν_{max} 3269, 2964, 1646, 1621, 1473, 1364, 1257, 1167, 1055, 753, 700 cm^{-1}. ^{1}H NMR (300 MHz; $CDCl_3$): δ_H 7.33 – 7.06 (m, 10H), 6.91 (bs, 1H), 5.27 (bs, 1H), 4.70 (s, 1H), 4.09 (s, 1H), 3.98 (t, *J* = 5.8 Hz, 1H), 2.61 (dd, *J* = 15.0, 6.0 Hz, 1H), 2.52 (dd, *J* = 15.0, 6.0 Hz, 1H), 2.64-2.51 (bs, 1H), 2.40 – 2.25 (m, 2H), 2.24 – 2.14 (m, 1H), 1.95 – 1.88 (m, 2H), 1.57 (brs, 1H), 1.45 (s, 9H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 173.6 (C), 155.3 (C), 142.9 (C), 140.0 (C), 128.5 (CH, 2C), 128.5 (CH, 2C), 128.2 (CH, 2C), 127.5 (CH), 127.2 (CH), 126.9 (CH, 2C), 79.4 (C), 65.8 (CH), 60.3 (C), 57.7 (CH), 42.0 (CH_2, 2C), 30.6 (CH_2), 28.6 (CH_3, 3C), 15.1 (CH_2) ppm. HRMS (ESI$^+$): calcd for $C_{25}H_{33}N_3O_3$ [(M+H)$^+$]: 424.2595; Found: 424.2403.

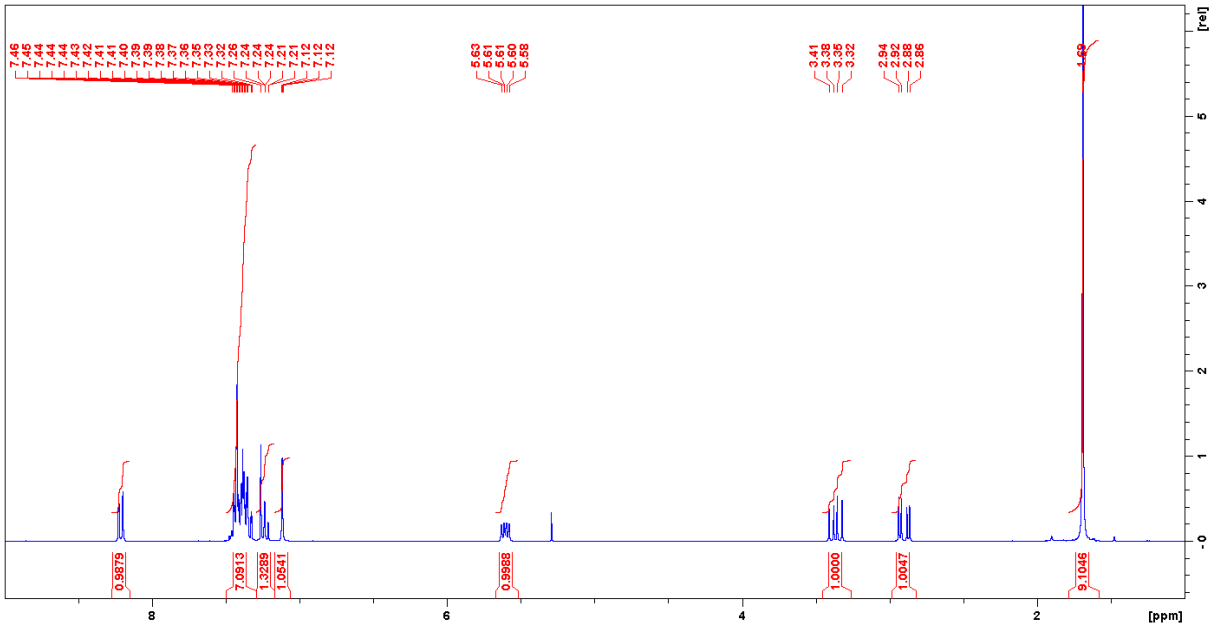


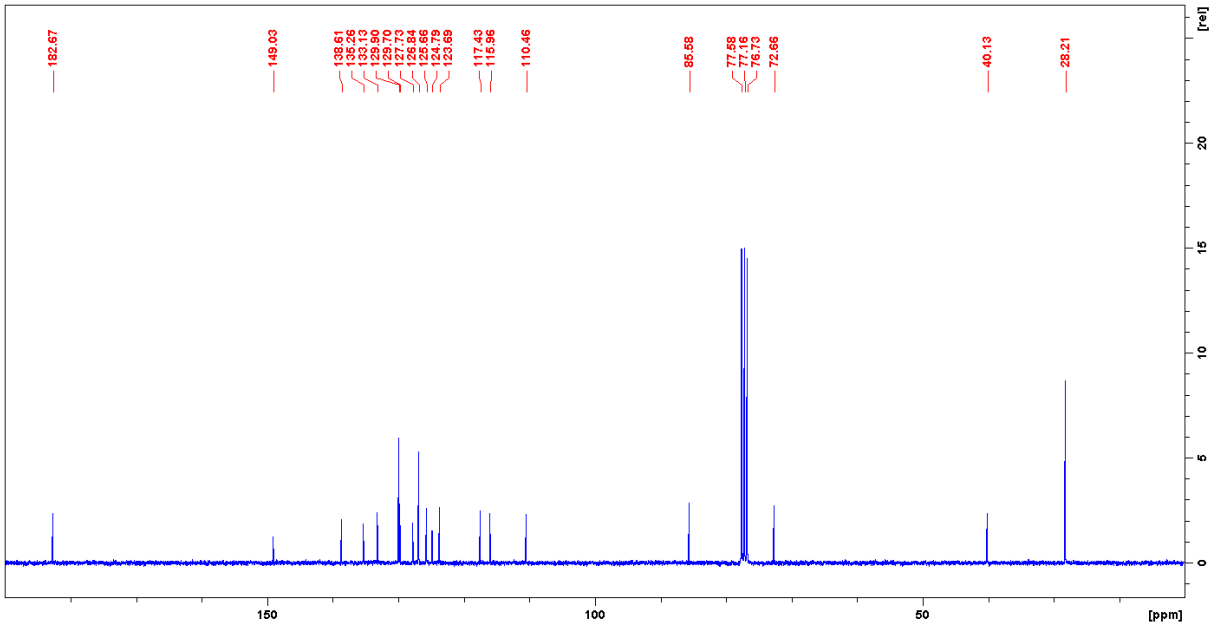
1',4',6'-triphenyltetrahydro-4'*H*,8'*H*-spiro[cyclobutane-1,3'-pyrazolo[1,2-*a*][1,2,4]triazin]-8'-one (9). To a mixture of compound **3fa** (0.071 mmol, 30.0 mg, 1.0 equiv) and $Bi(OTf)_3$ (0.005 mmol, 3.5 mg, 0.075 equiv) into a 6-7 mL tube-flask under nitrogen was added acetonitrile (1.5 mL) followed by benzaldehyde dimethyl acetal (0.142 mmol, 21.4 µL, 2.0 equiv). The resulting solution was sealed and stirred at 85°C (reflux, oil bath temperature) for 24 h, then cooled to room temperature and concentrated under reduced pressure. The crude product was purified by silica gel column chromatography to provide the desired product **9** as a white solid (15 mg, 51%, >95:5 dr). mp = 194 °C. R_f = 0.32 (Pentane/EtOAc: 2/8). IR (neat) ν_{max} 3275, 2934, 1684, 1453, 1391, 965, 807, 702 cm^{-1}. ^1H NMR (300 MHz; $CDCl_3$): δ_H 7.54 – 7.37 (m, 1H), 7.36 – 7.25 (m, 1H), 7.25 – 6.98 (m, 11H), 6.19 (s, 1H), 4.17 (dd, *J* = 9.4, 2.9 Hz, 1H), 3.67 (s, 1H), 3.16 (dd, *J* = 17.4, 9.5 Hz, 1H), 2.64 (dd, *J* = 17.4, 3.1 Hz, 1H), 1.85 (t, *J* = 7.7 Hz, 2H), 1.77 – 1.64 (m, 1H), 1.64 – 1.43 (m, 1H), 1.44 – 1.30 (m, 1H), 0.73 – 0.56 (m, 1H) ppm. ^{13}C NMR (75.4 MHz; $CDCl_3$): δ_C 170.7 (C), 141.9 (C), 139.1 (C), 137.6 (C), 129.2 (CH, 2C), 128.5 (CH, 2C), 128.2 (CH, 3C), 128.0 (CH, 2C), 127.6 (CH), 127.6 (CH), 127.4 (CH, 2C), 127.0 (CH, 2C), 78.5 (CH), 64.3 (CH), 61.2 (CH), 59.1 (C), 36.5 (CH_2), 32.3 (CH_2), 29.0 (CH_2), 15.2 (CH_2) ppm. HRMS (ESI^+): calcd for $C_{27}H_{27}N_3O$ [$(M+H)^+$]: 410.2227; Found: 410.2234.

IV NMR spectra

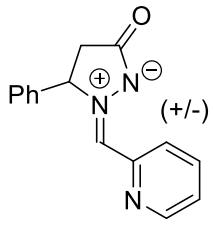
(2-((1-(*tert*-butoxycarbonyl)-1H-indol-3-yl)methylene)-5-oxo-3-phenylpyrazolidin-2-ium-1-ide (2q)

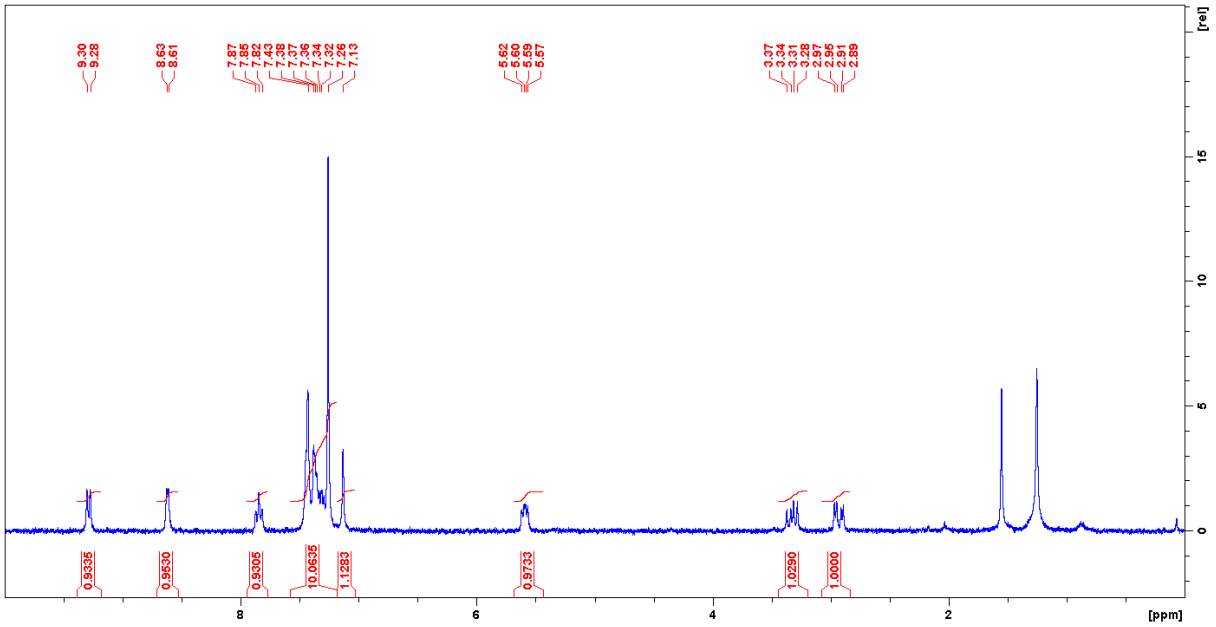




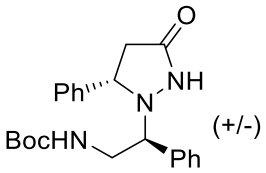


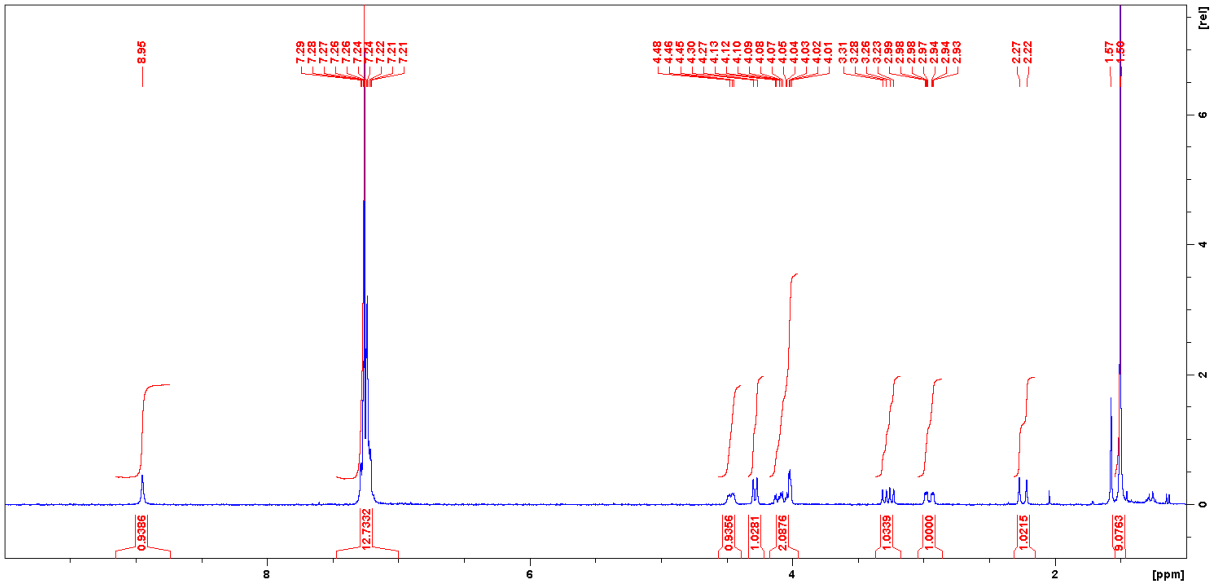
5-oxo-3-phenyl-2-(pyridin-2-ylmethylene)pyrazolidin-2-ium-1-ide (2r)

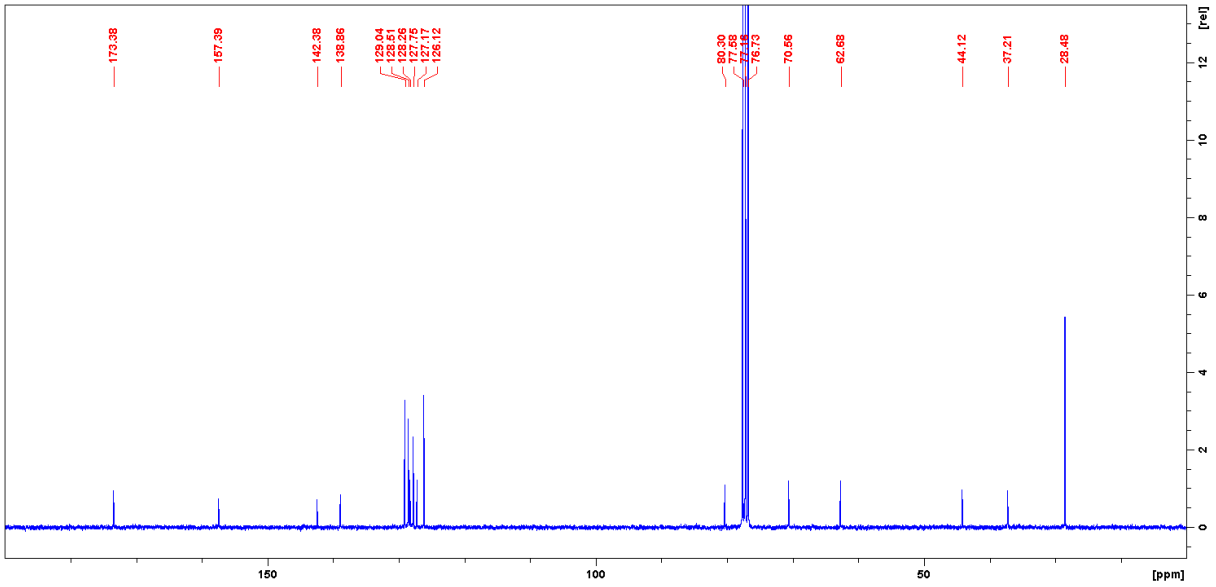




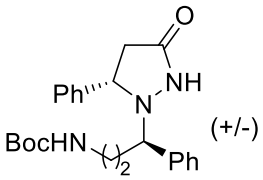
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-2-phenylethyl)carbamate (3aa)**

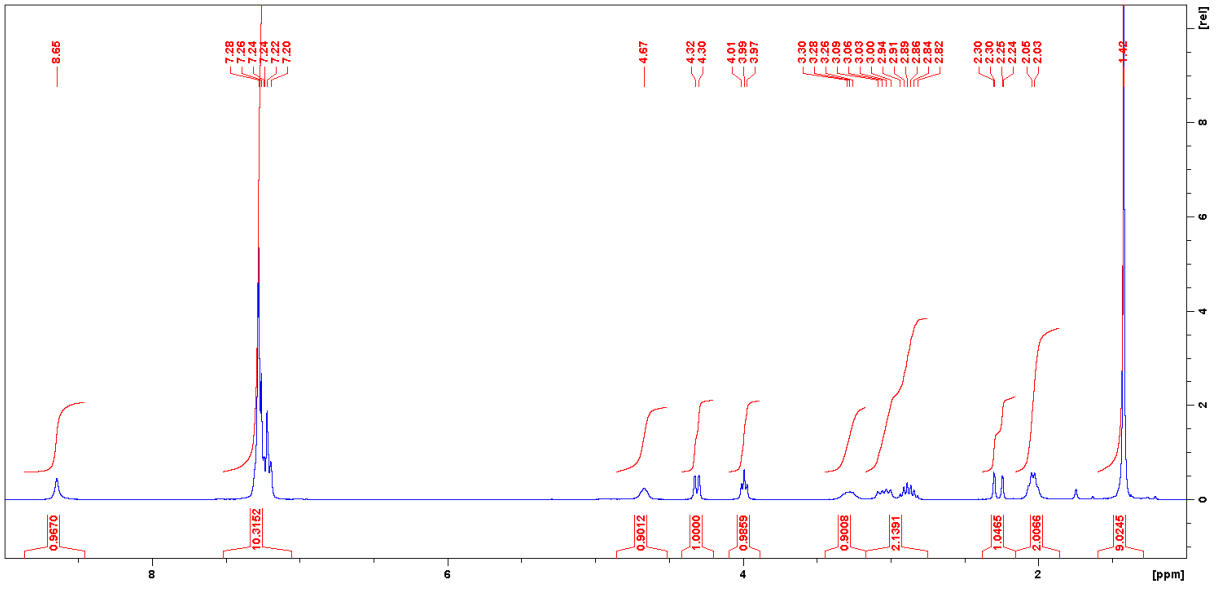


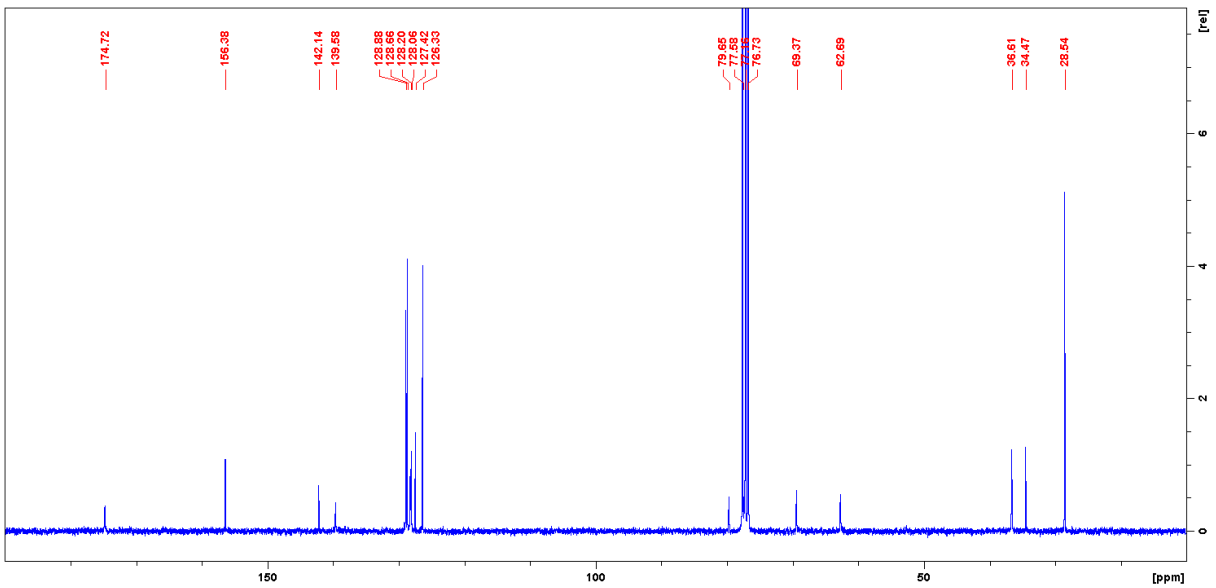




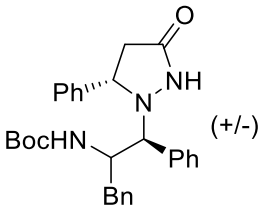
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-3-phenylpropyl)carbamate (3ba)**

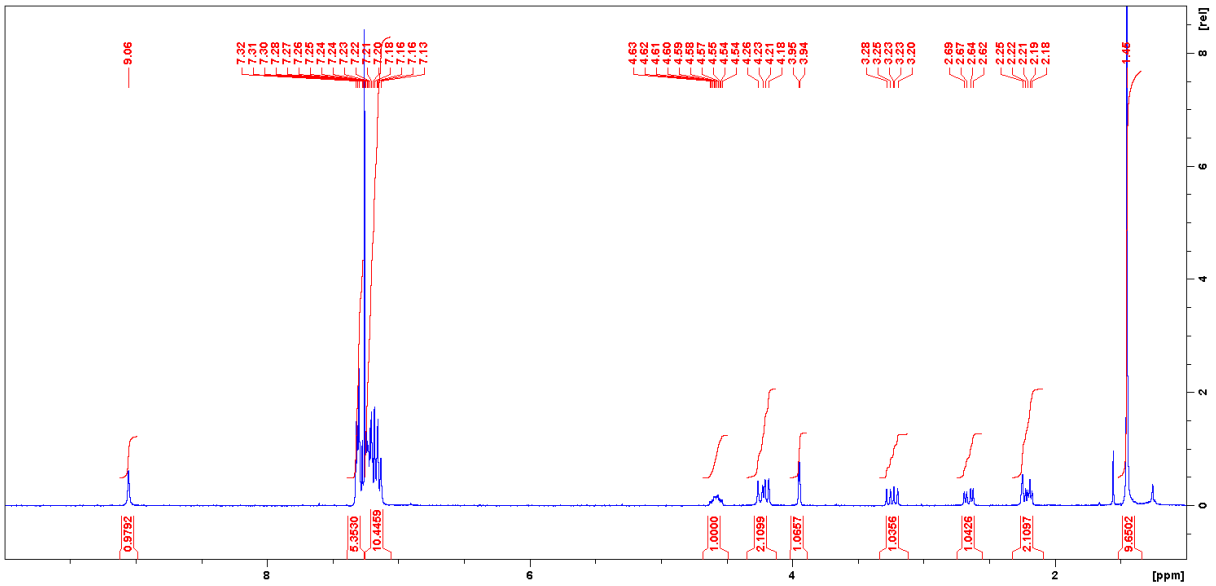


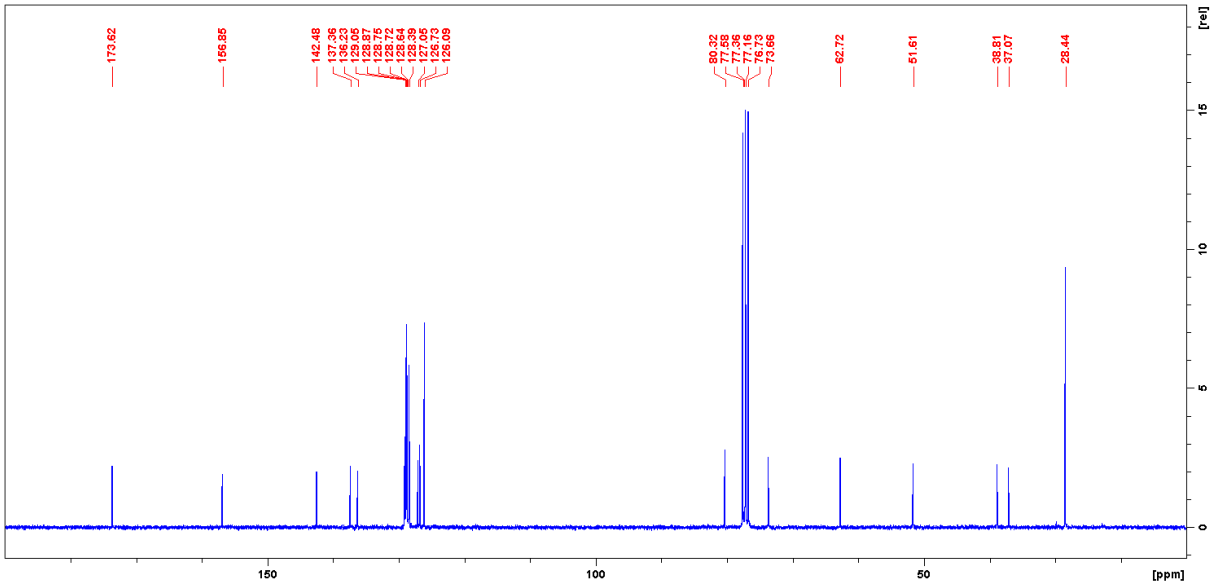




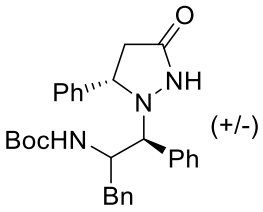
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-1,3-diphenylpropan-2-yl)carbamate (3ca')**

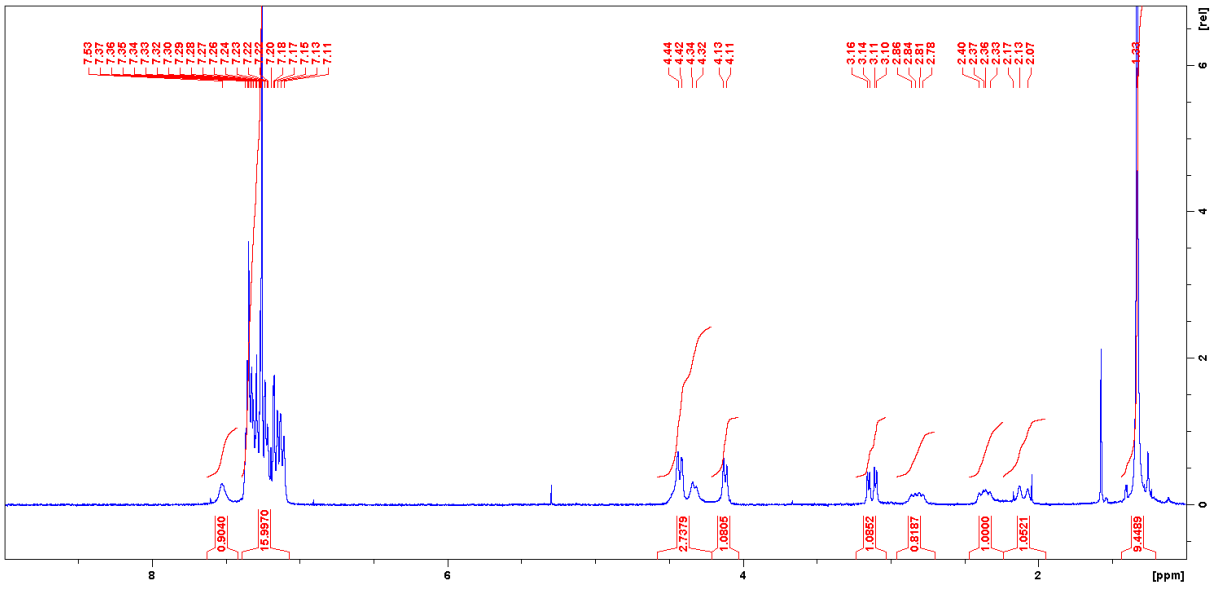


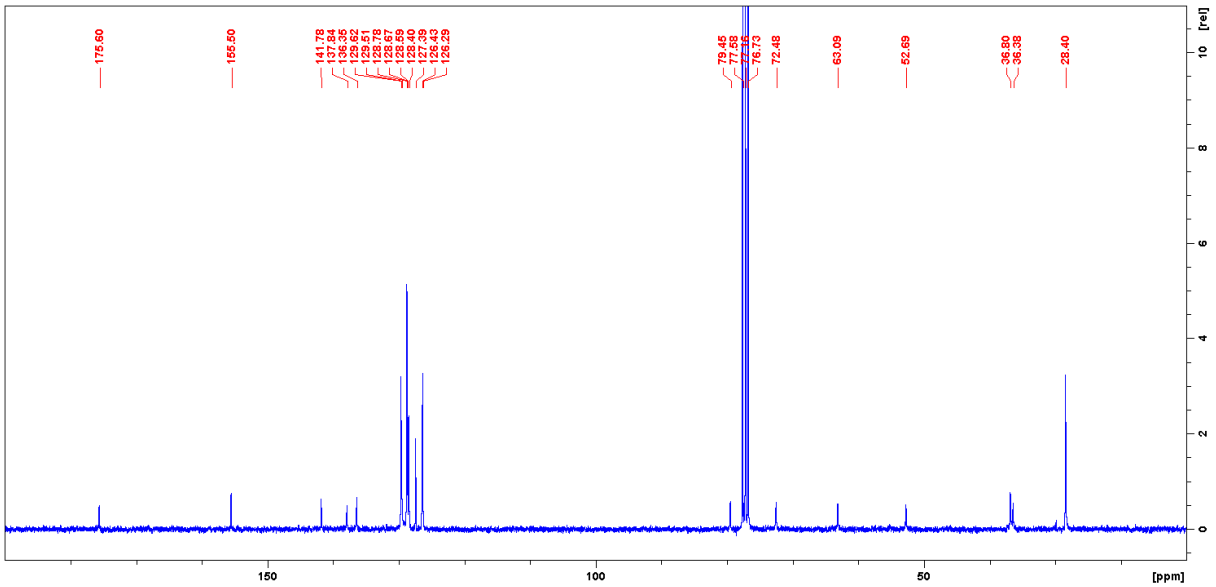




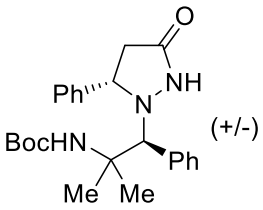
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)-1,3-diphenylpropan-2-yl)carbamate (3ca'')**

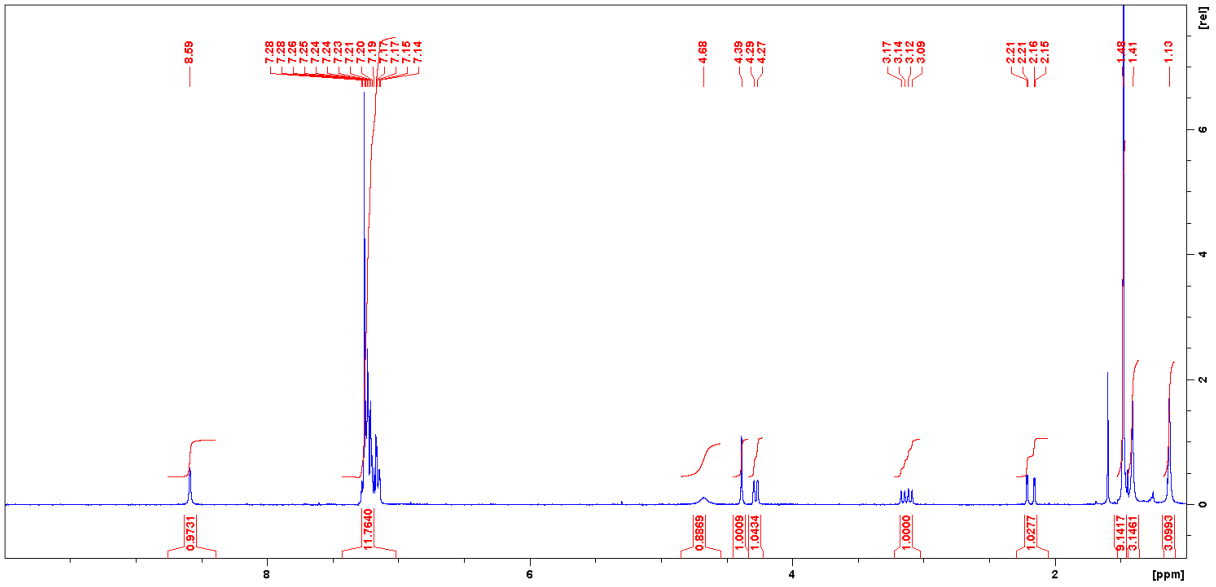


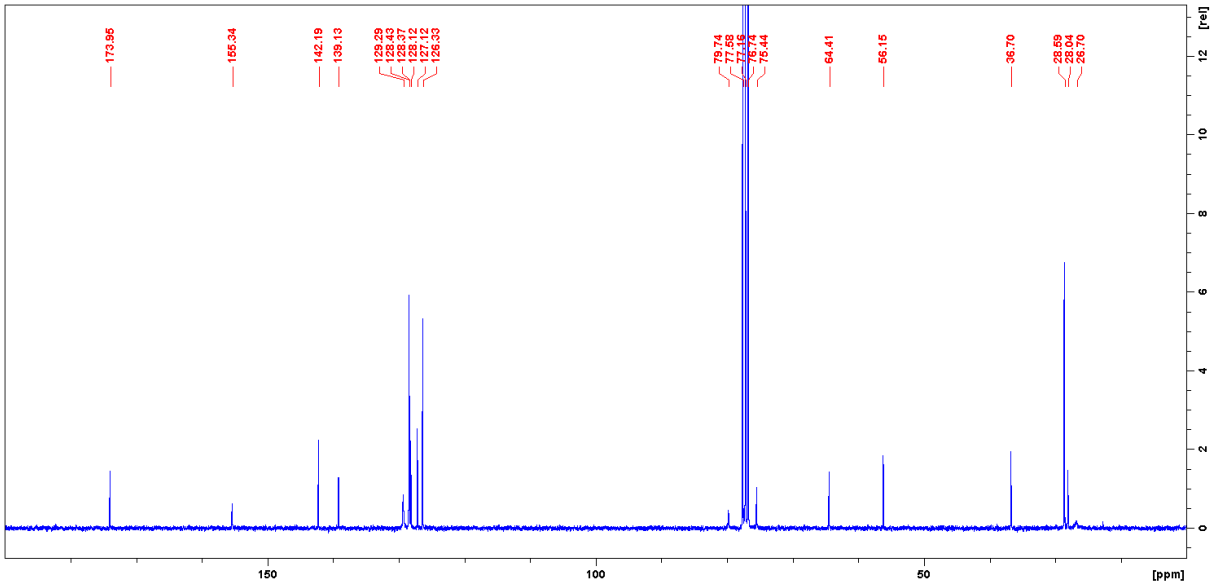




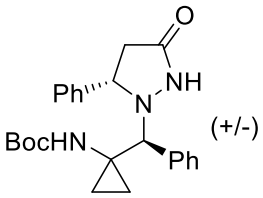
***tert*-butyl (1-((2-methyl-3-oxo-5-phenylpyrazolidin-1-yl)-1-phenylpropan-2-yl)carbamate (3da)**

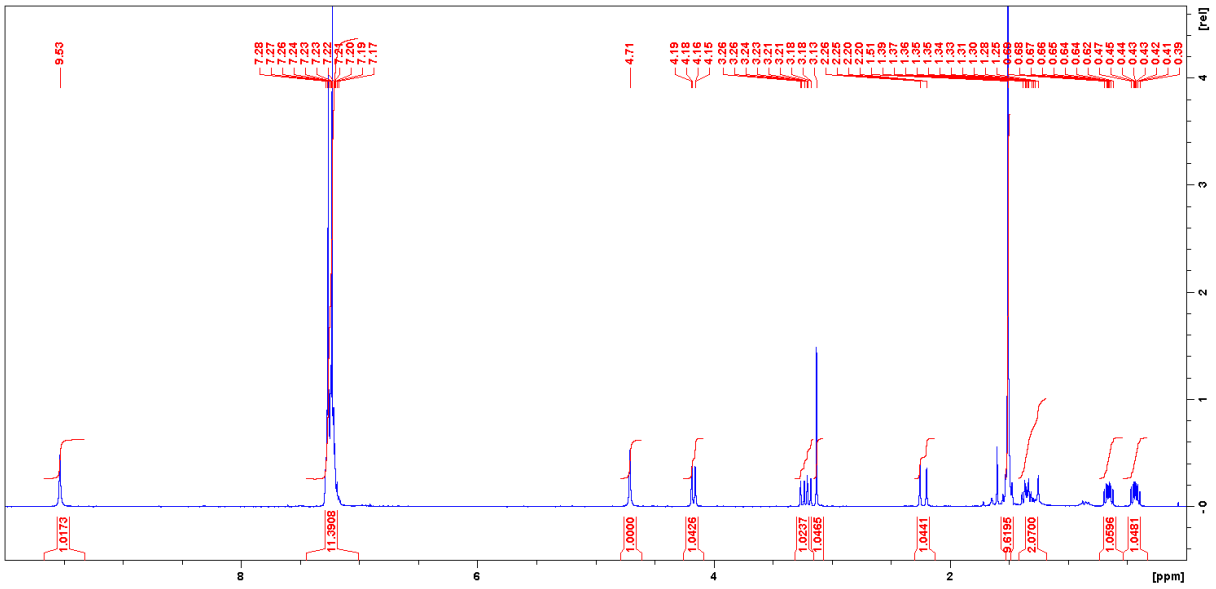


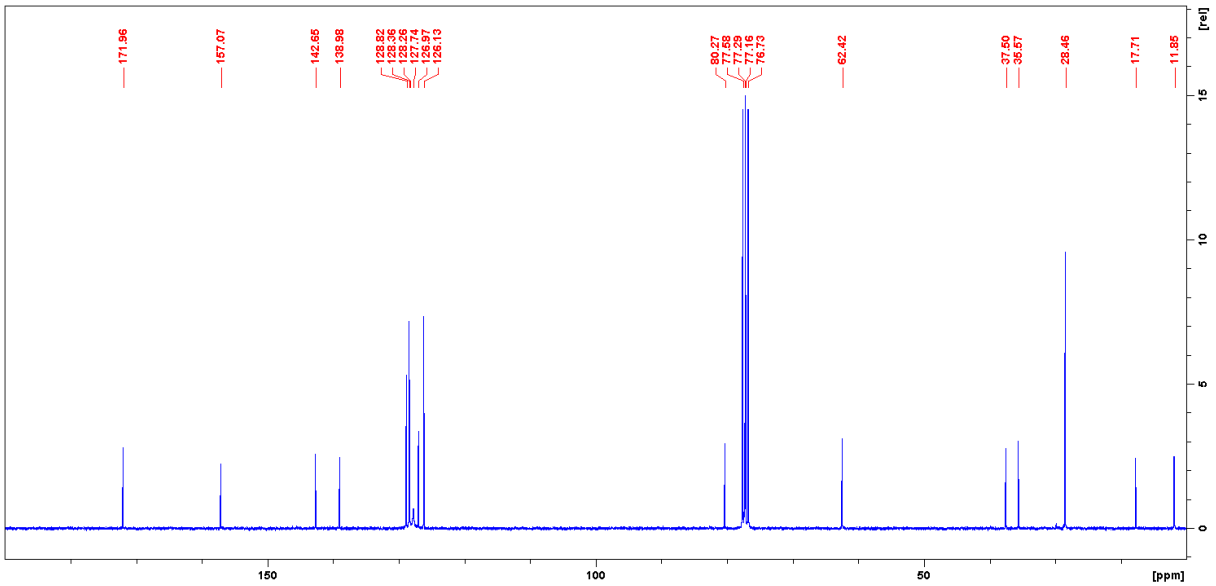




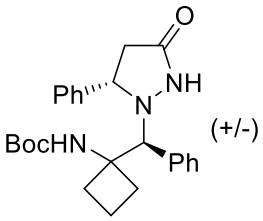
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclopropyl)carbamate (3ea)**

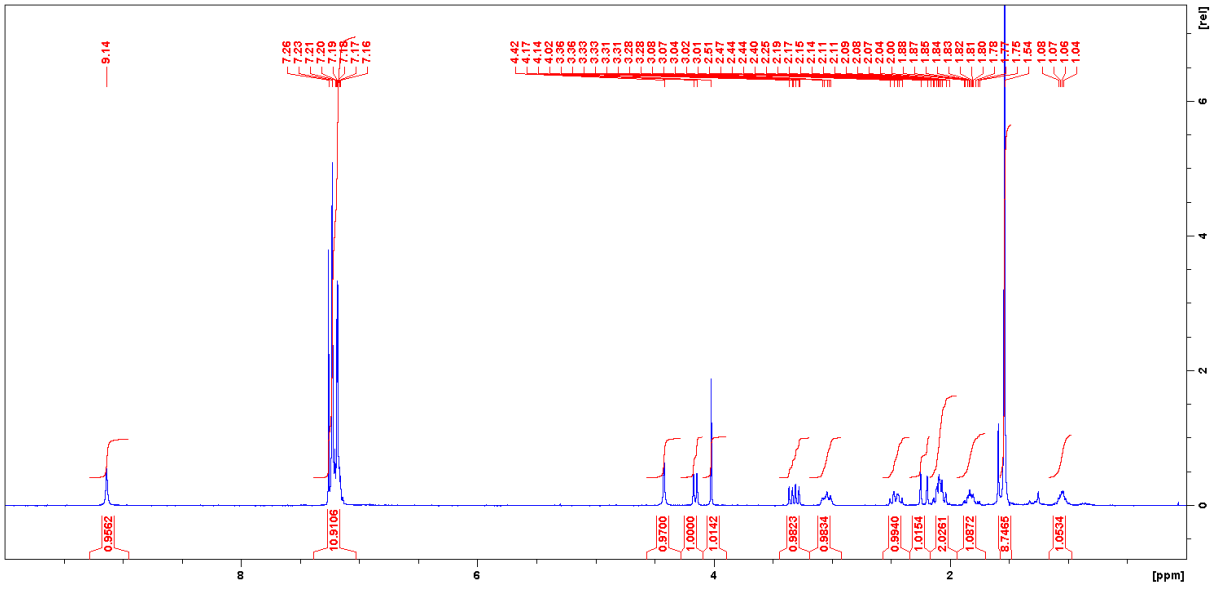


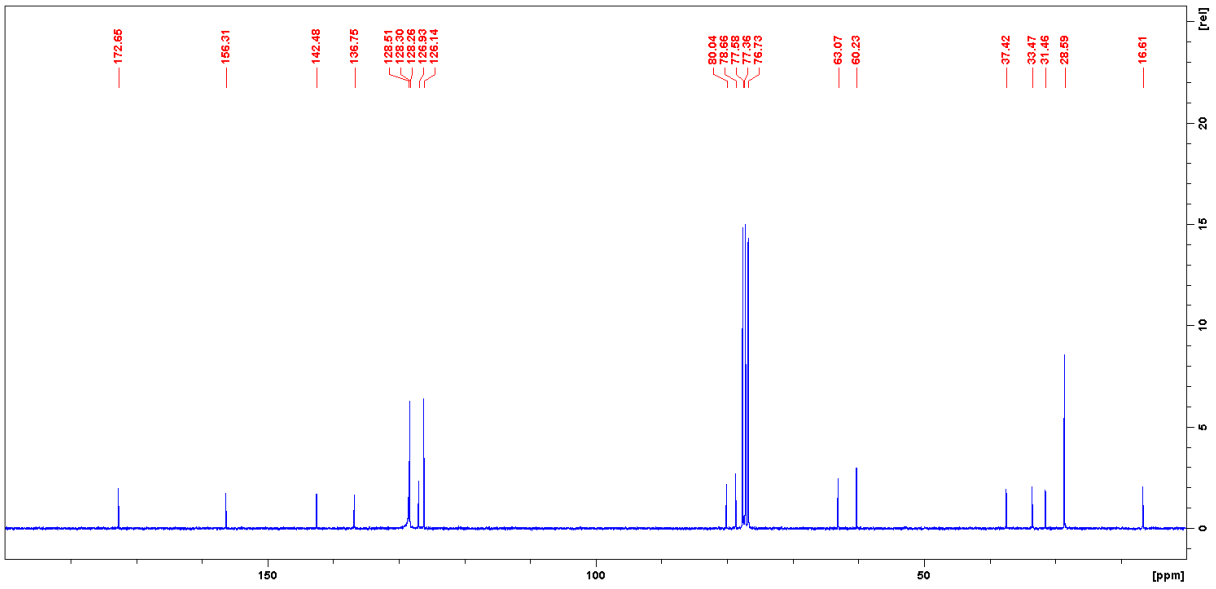




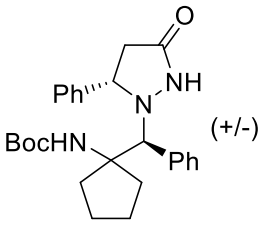
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fa)**

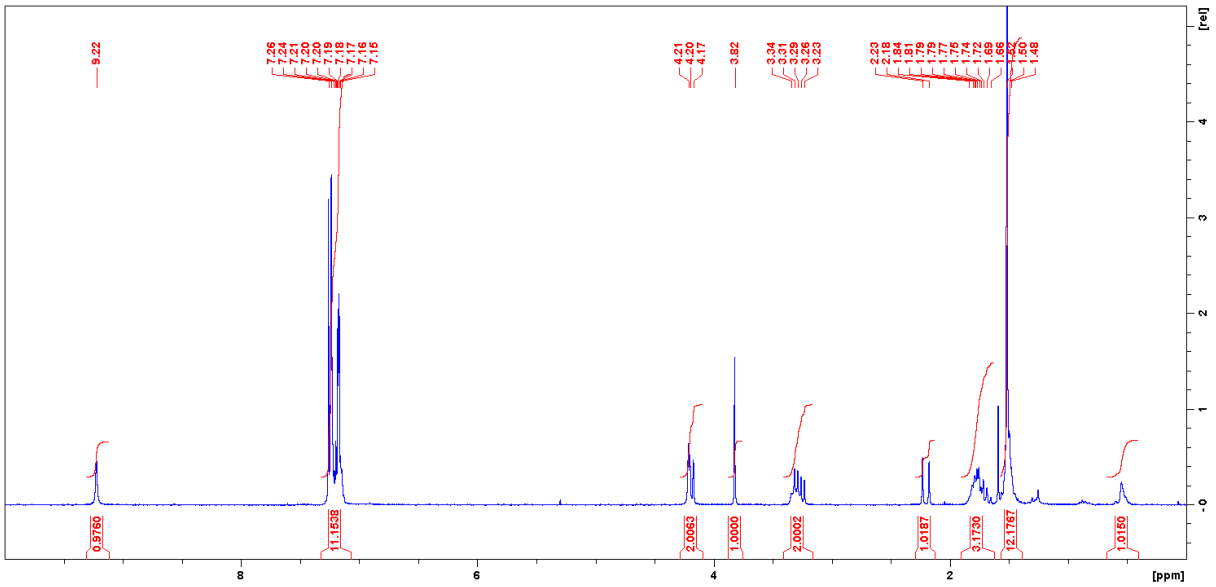


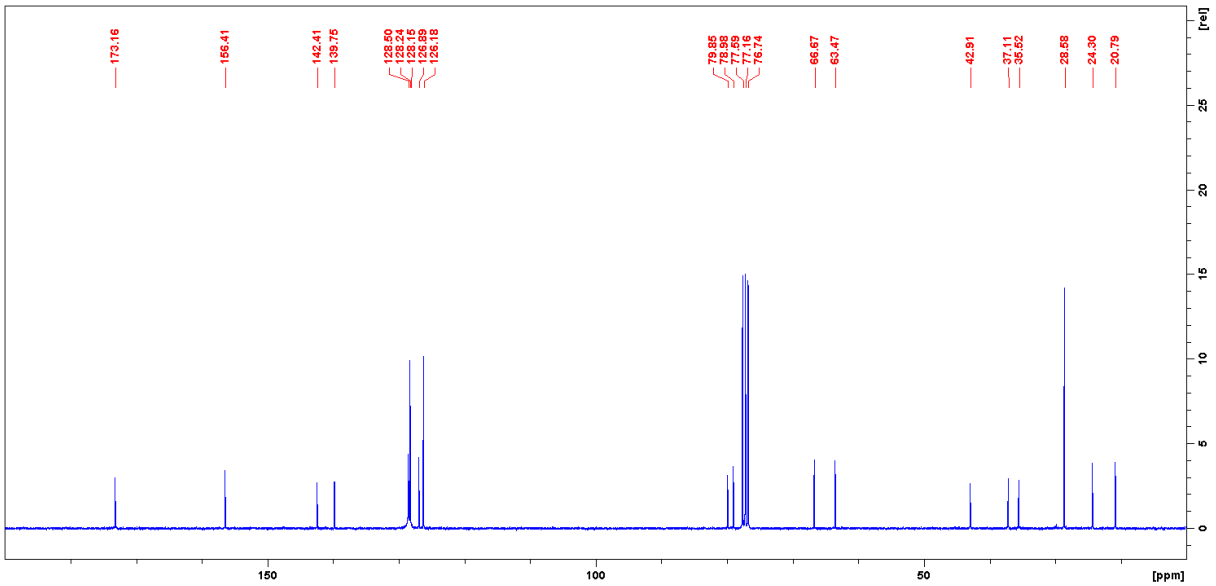




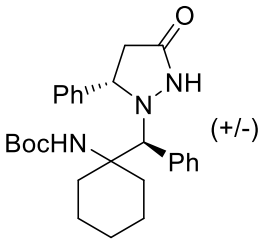
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclopentyl)carbamate (3ga)**

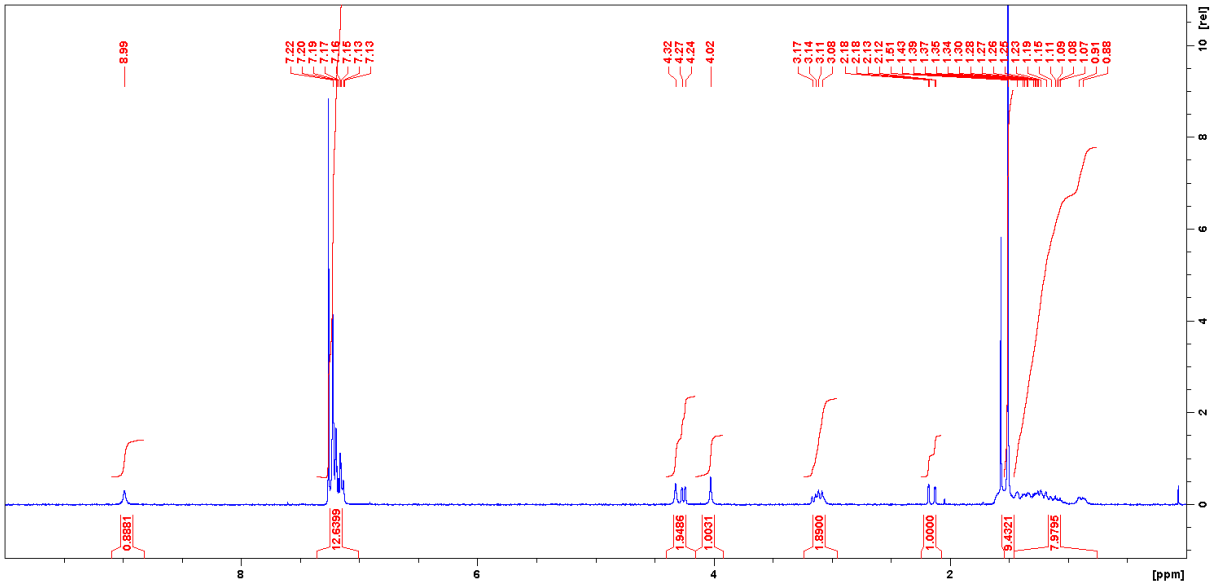


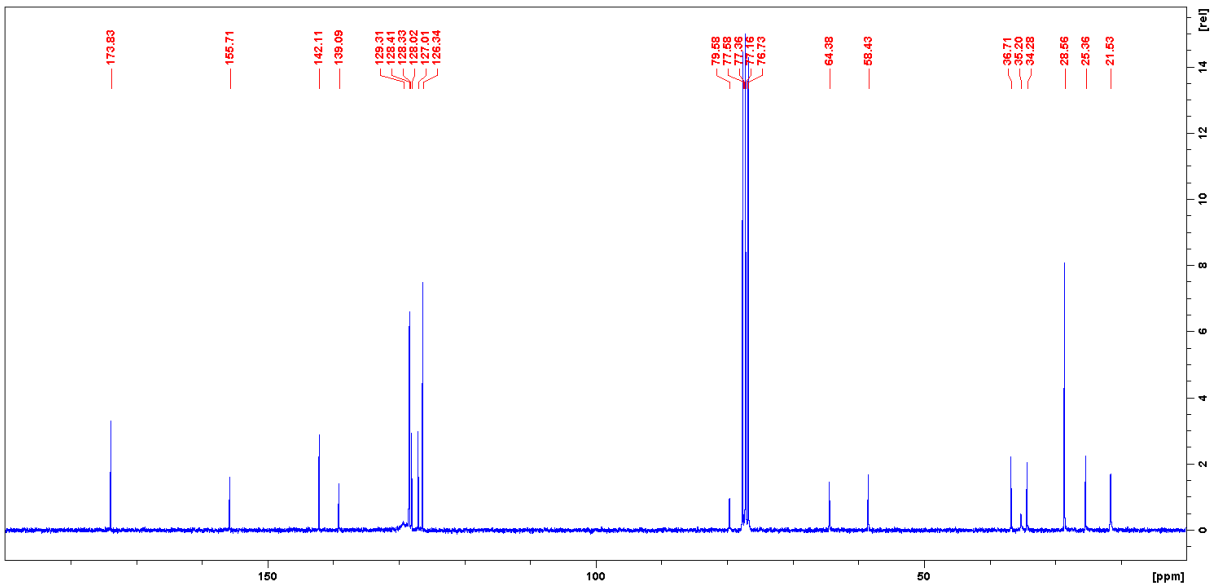




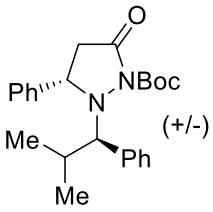
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(phenyl)methyl)cyclohexyl)carbamate (3ha)**

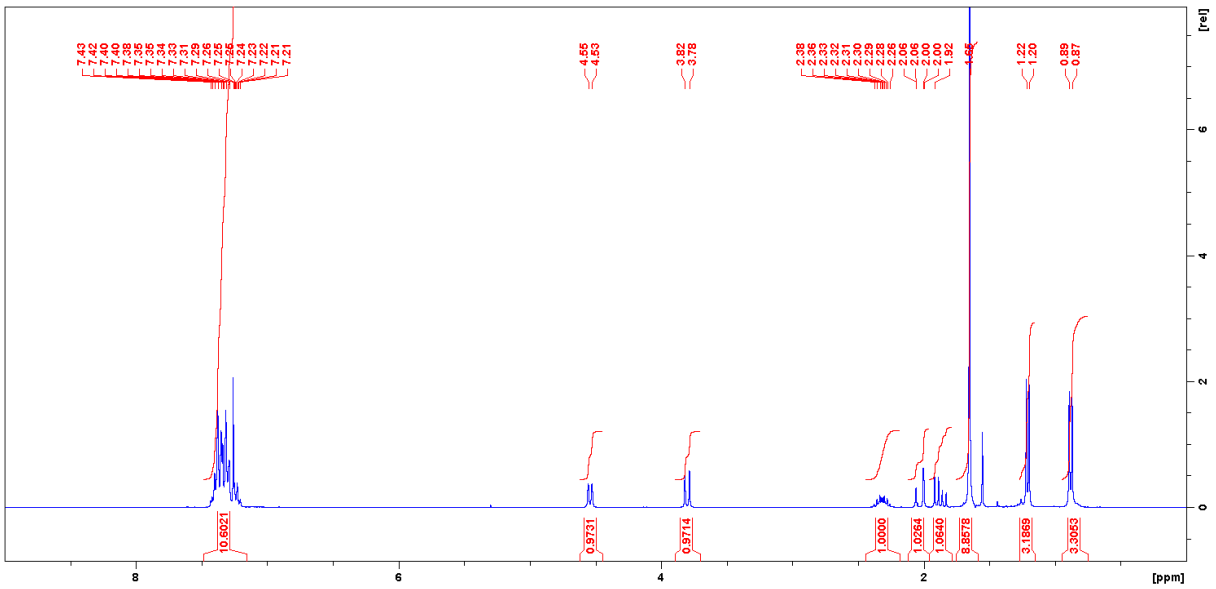


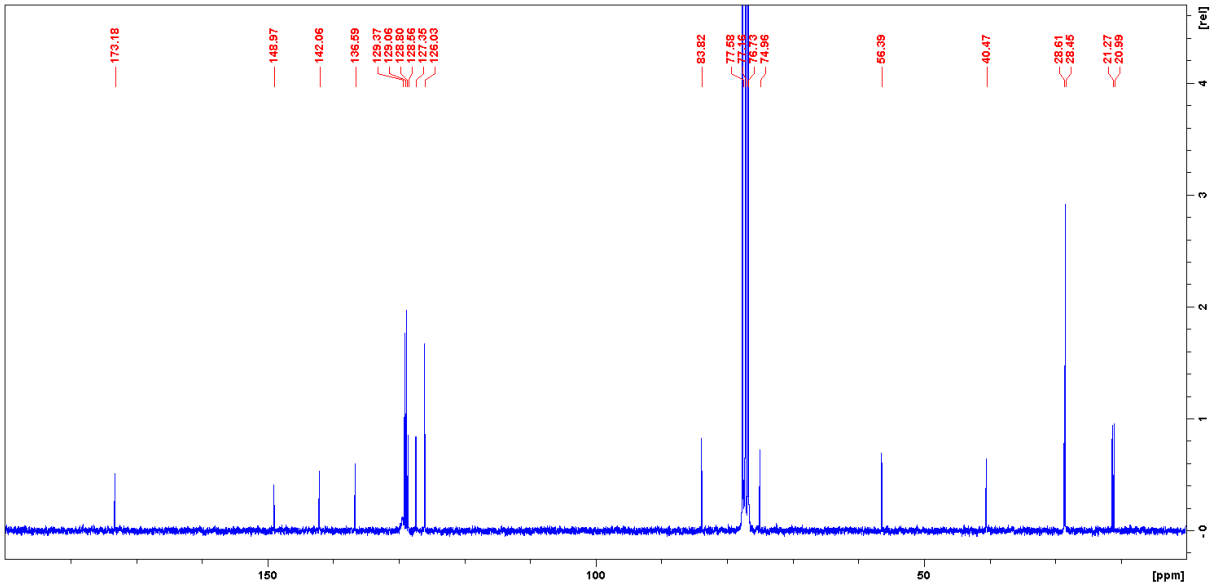




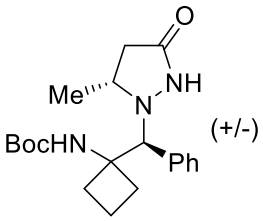
***tert*-butyl 2-(2-methyl-1-phenylpropyl)-5-oxo-3-phenylpyrazolidine-1-carboxylate (3ia)**

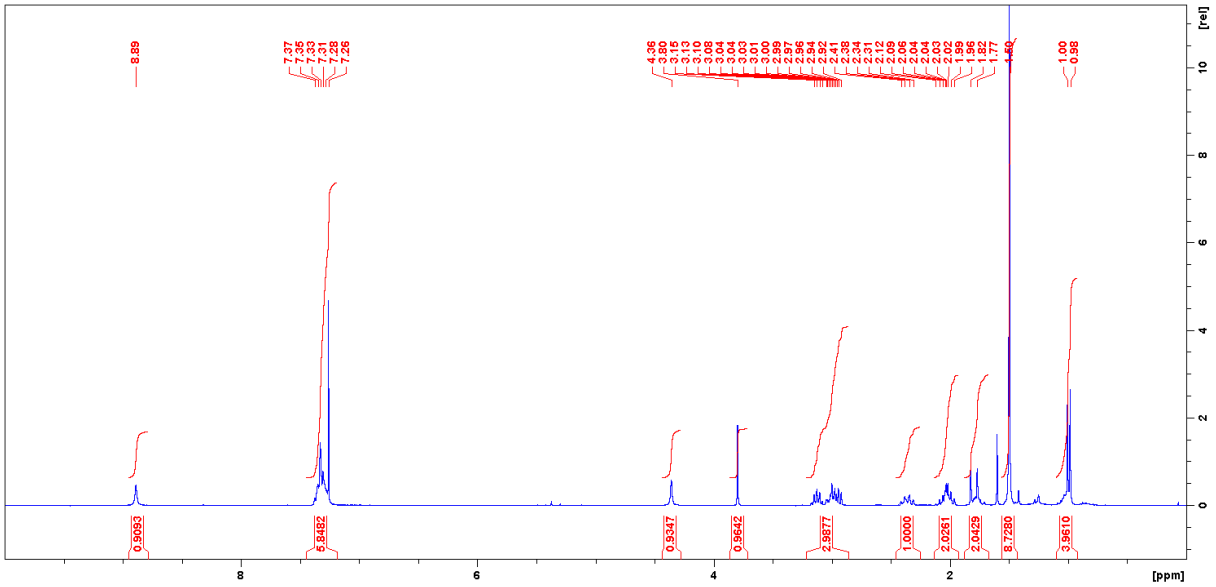


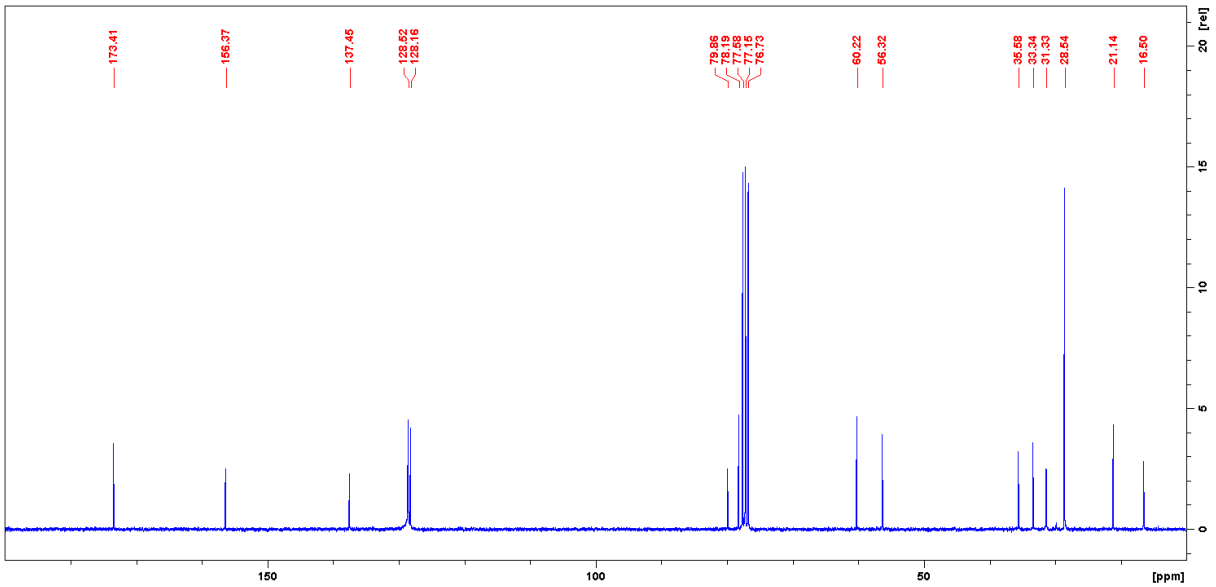




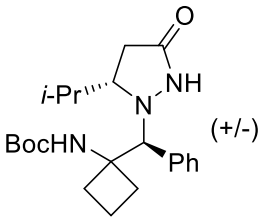
***tert*-butyl (1-((5-methyl-3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fb)**

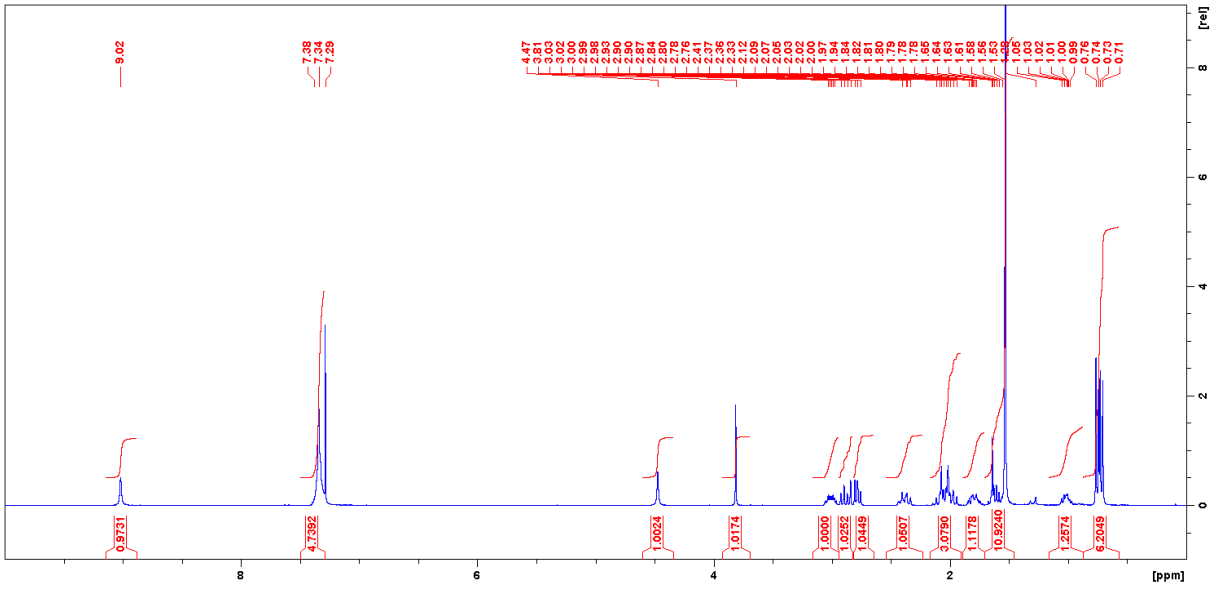


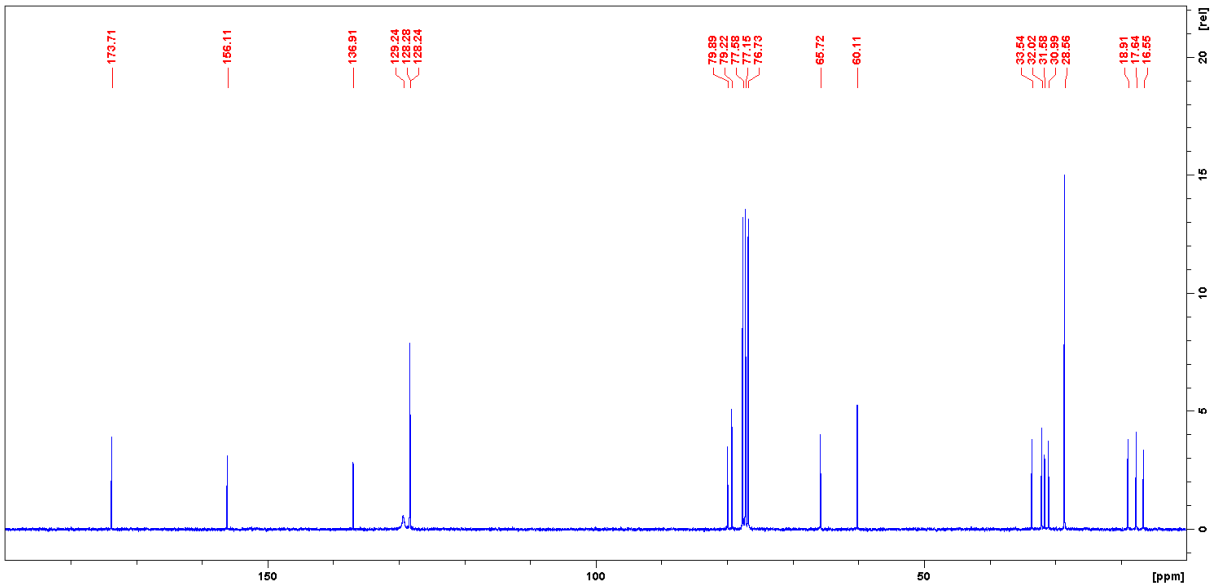




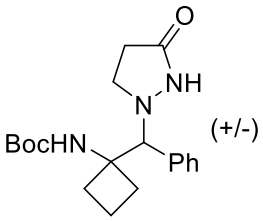
tert-butyl (1-((5-isopropyl-3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fc)

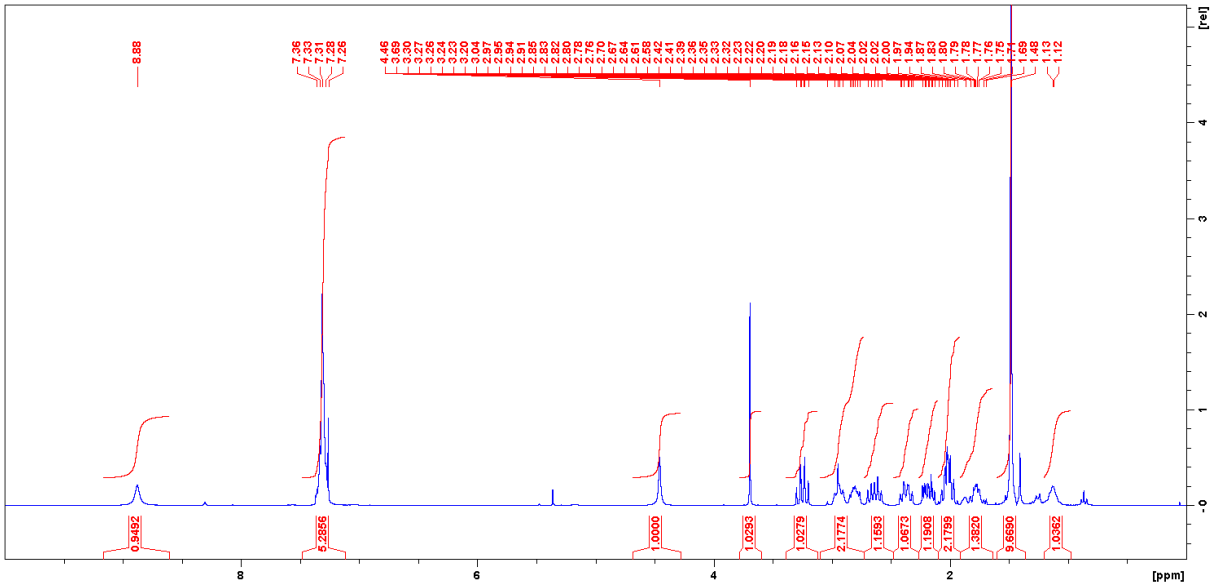


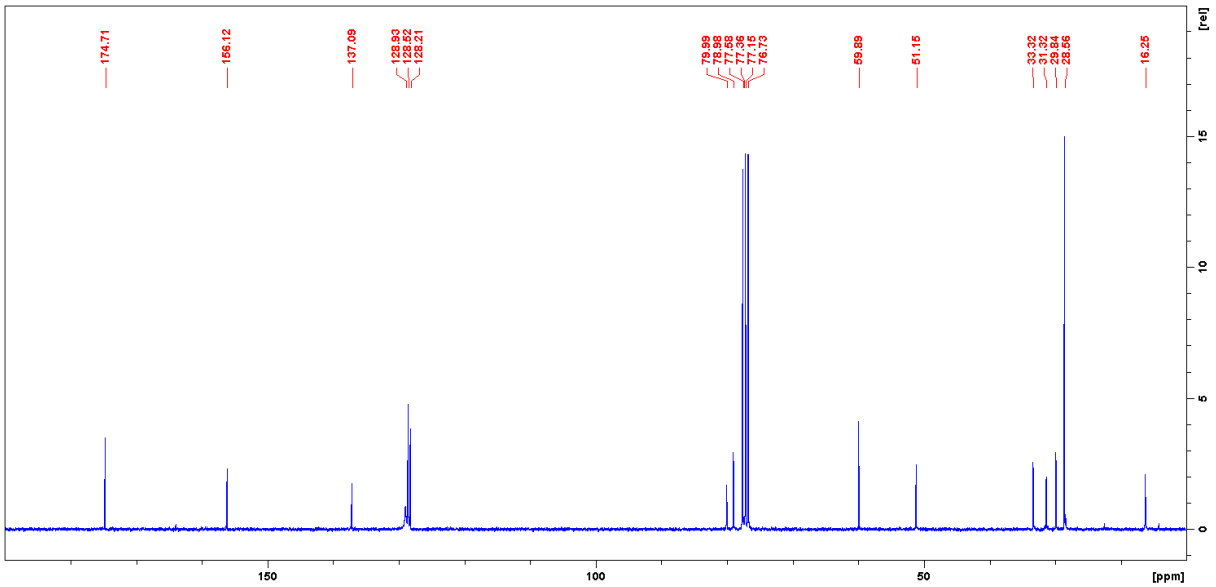




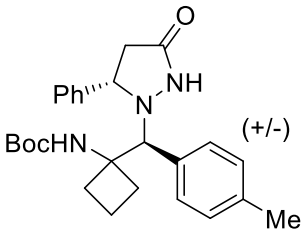
***tert*-butyl (1-((3-oxopyrazolidin-1-yl)(phenyl)methyl)cyclobutyl)carbamate (3fd)**

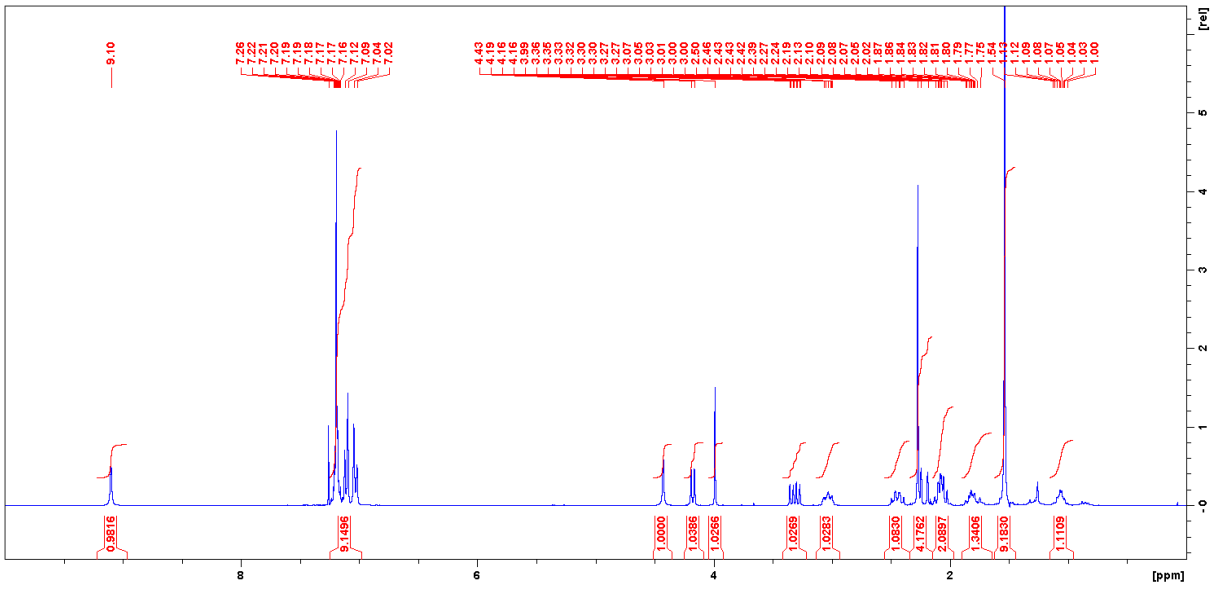


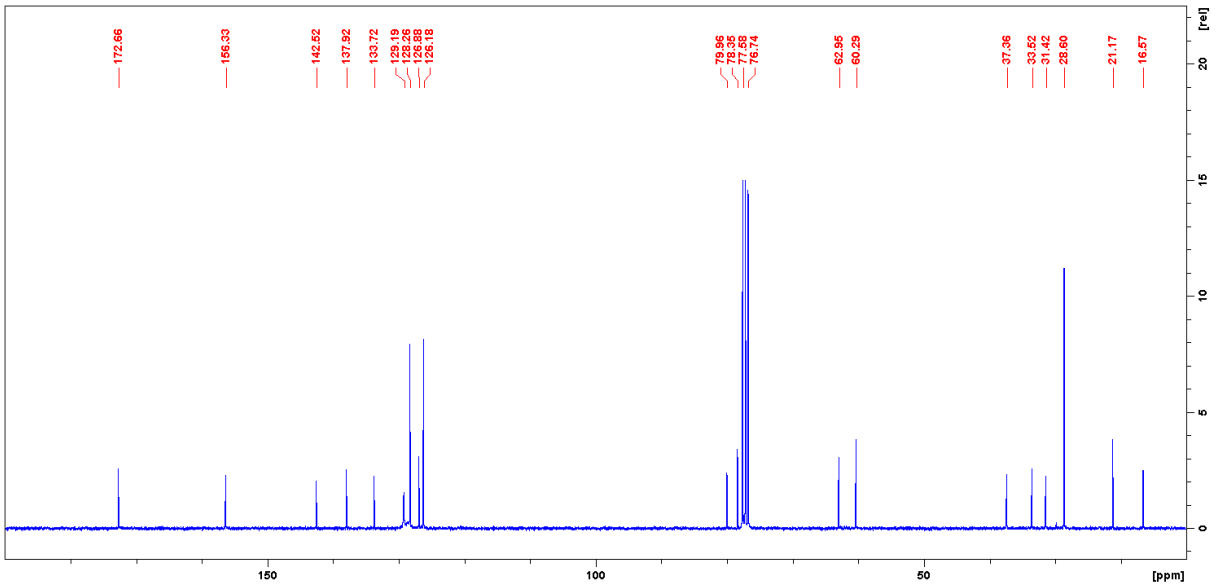




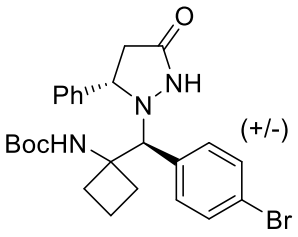
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(p-tolyl)methyl)cyclobutyl)carbamate (3ff)**

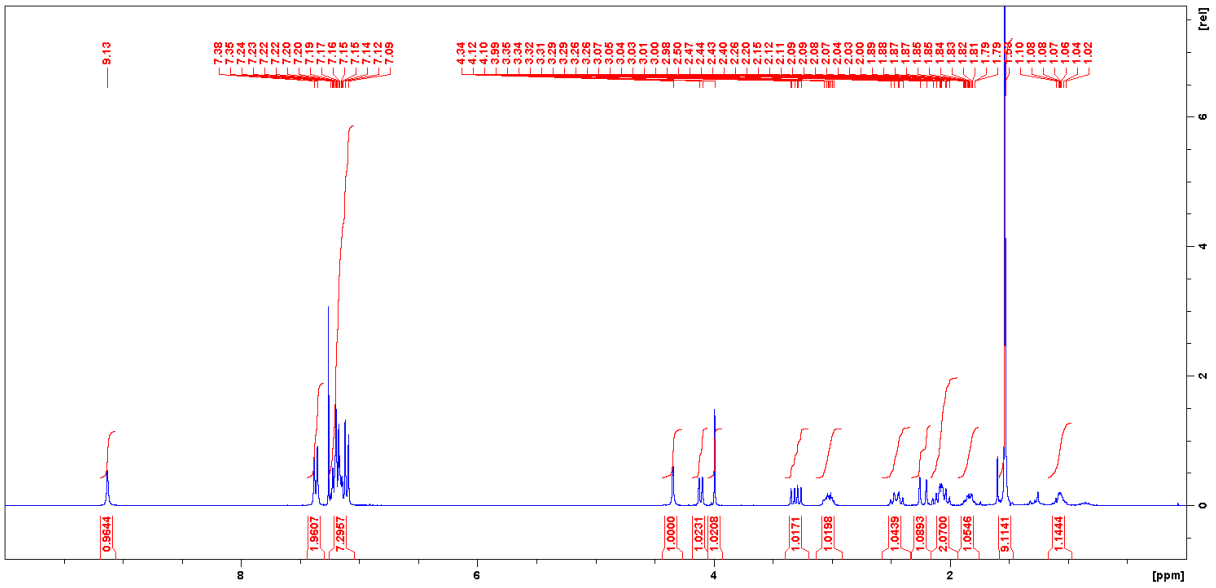


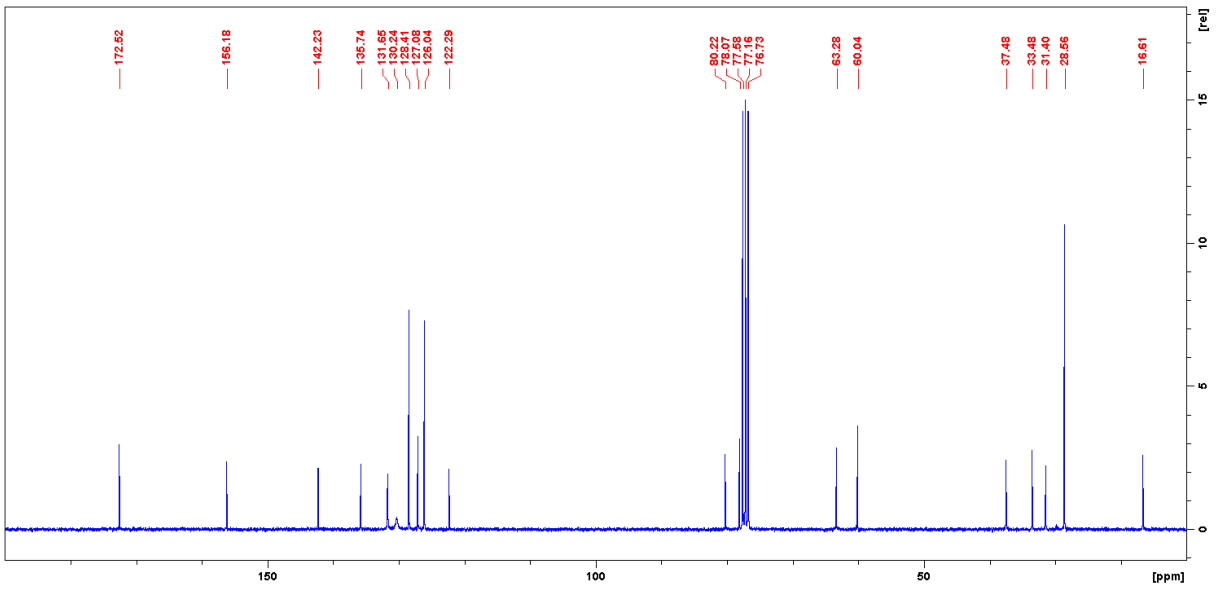




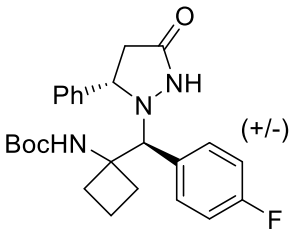
***tert*-butyl (1-((4-bromophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fg)**

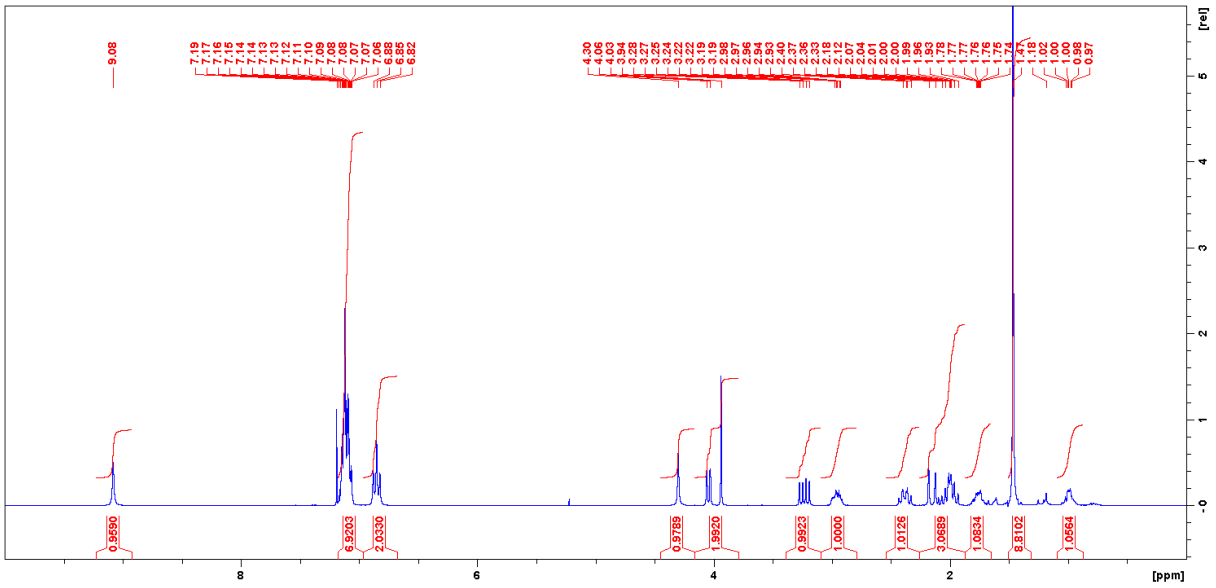


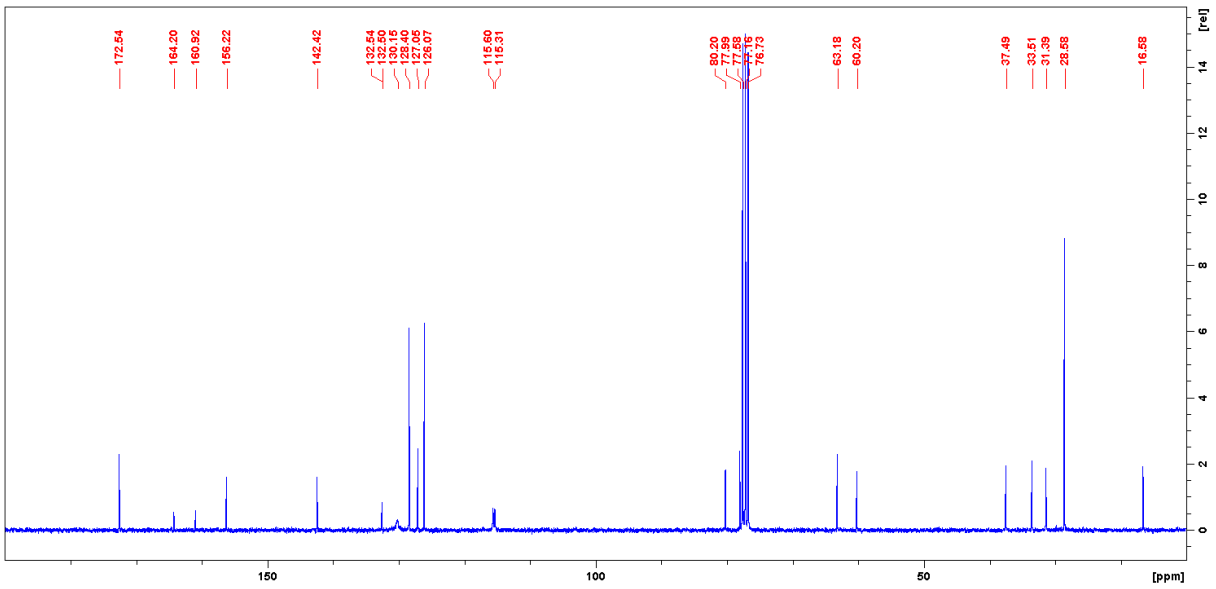




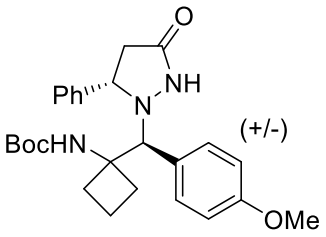
***tert*-butyl (1-((4-fluorophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fh)**

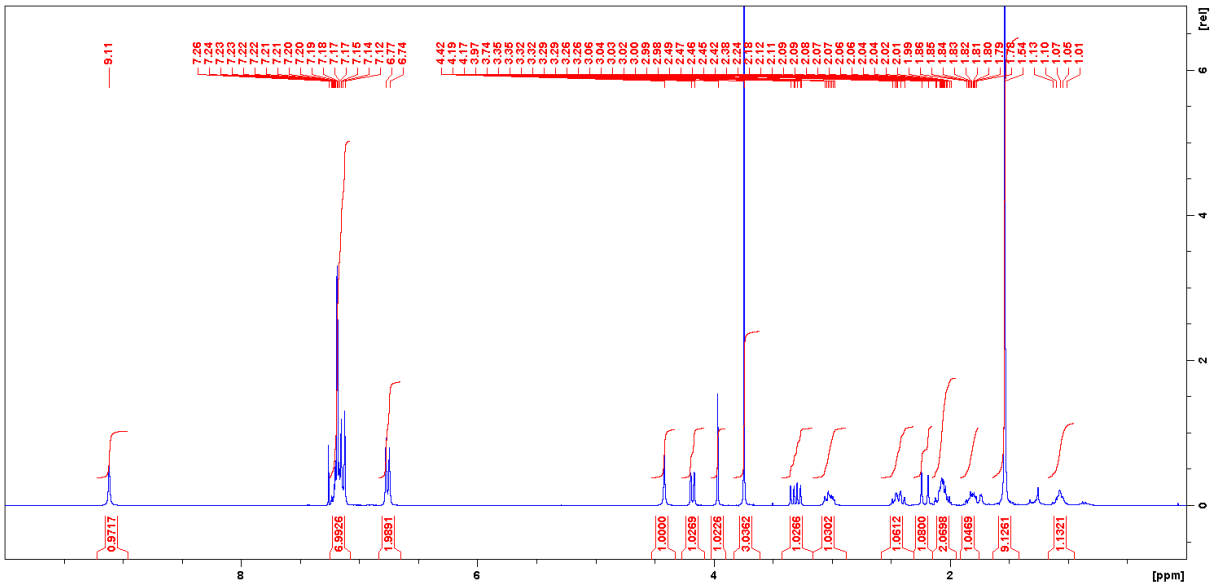


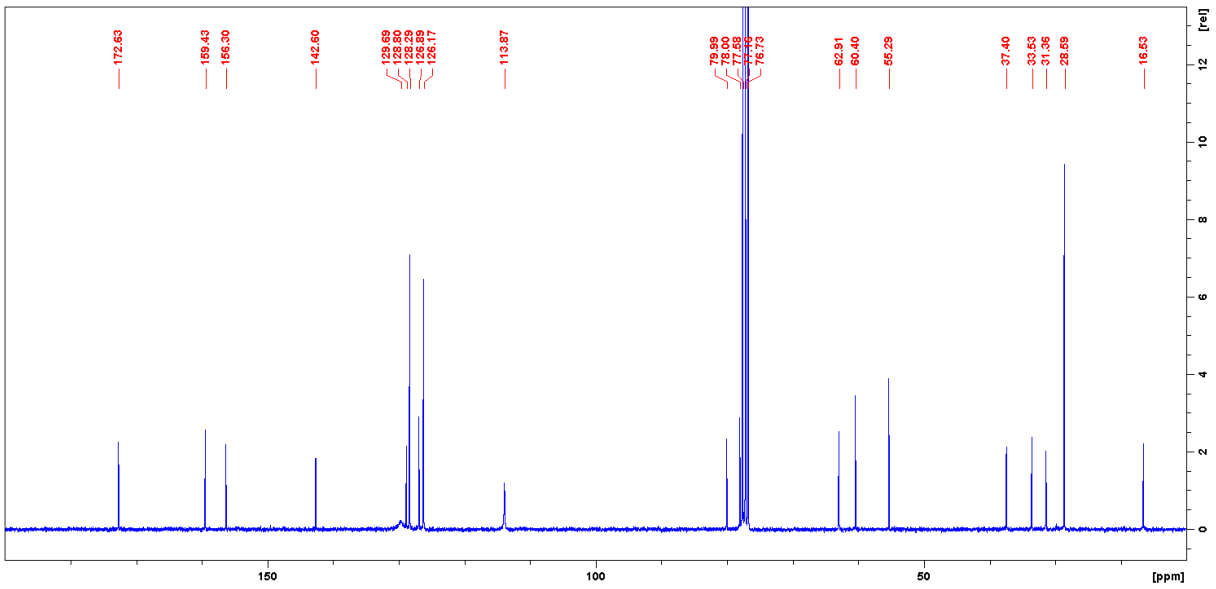




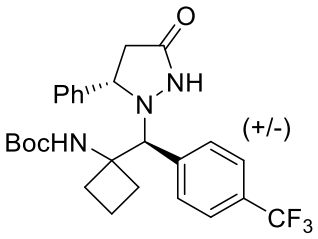
***tert*-butyl (1-((4-methoxyphenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fi)**

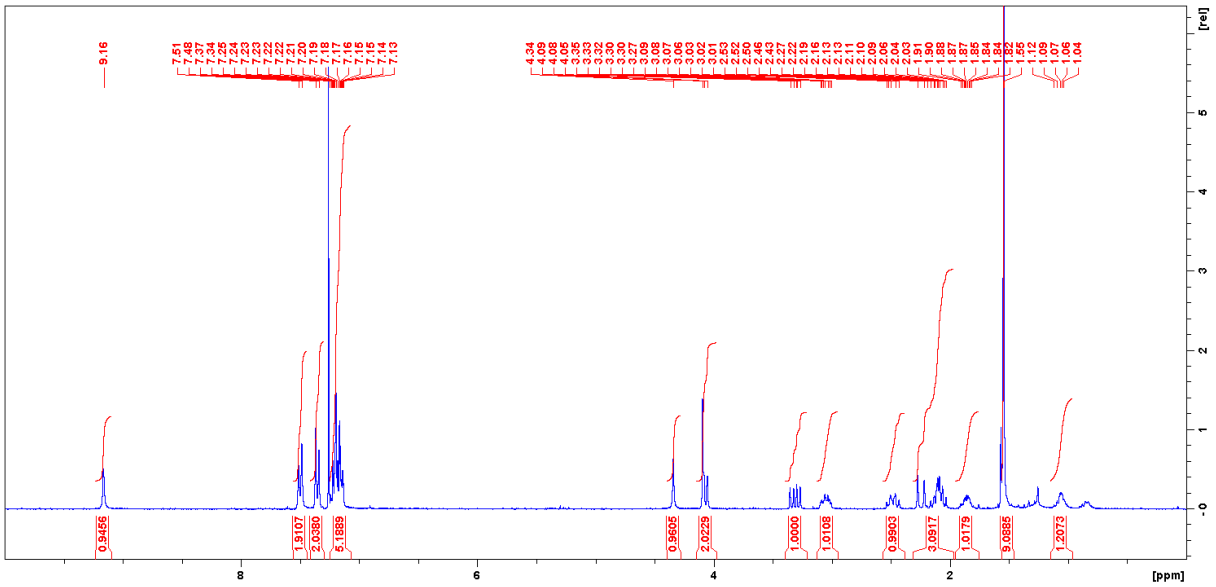


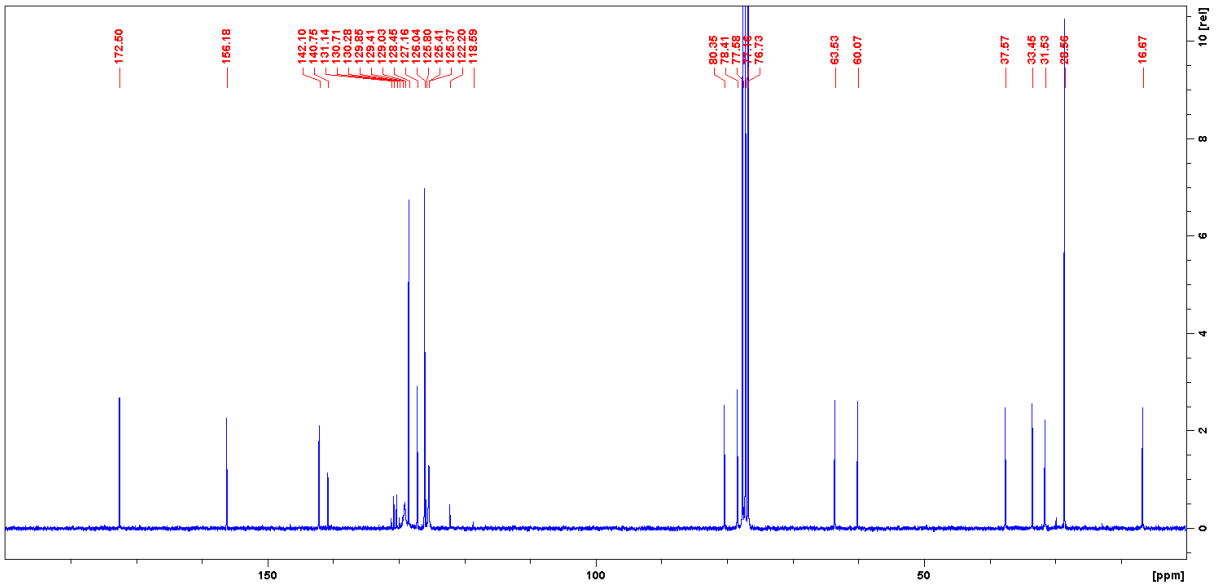




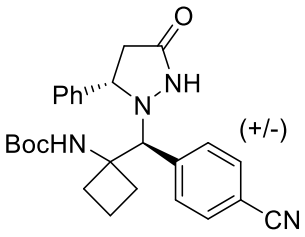
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(4-(trifluoromethyl)phenyl)methyl)cyclobutyl)carbamate (3fj)**

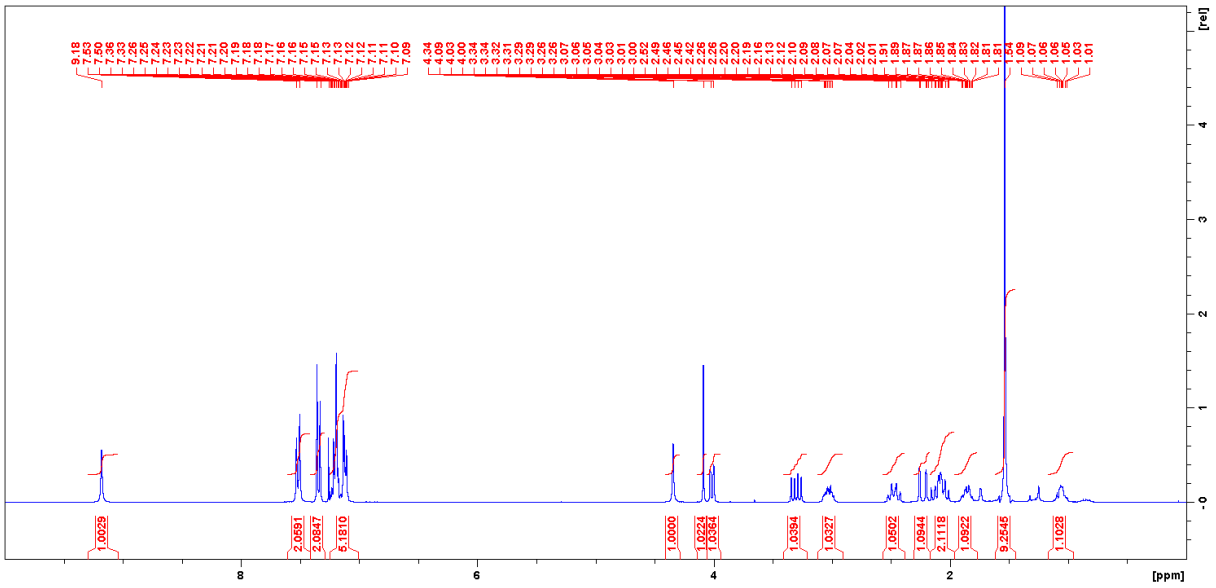


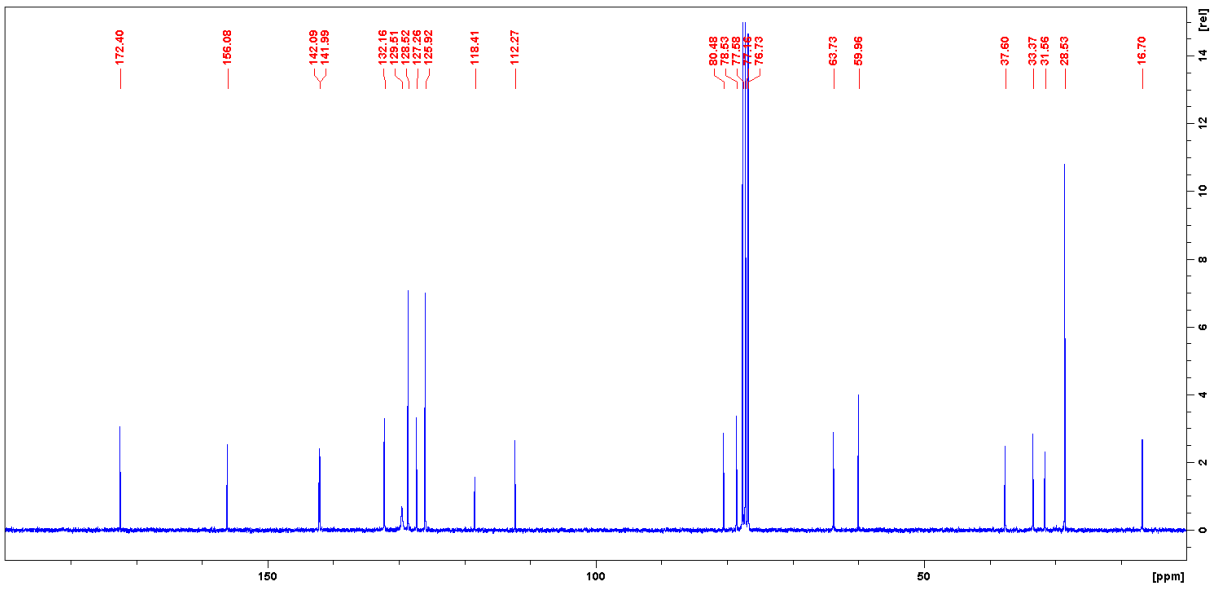




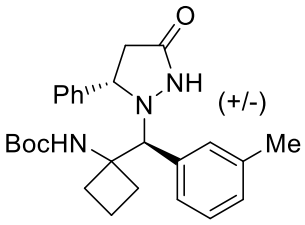
***tert*-butyl (1-((4-cyanophenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fk)**

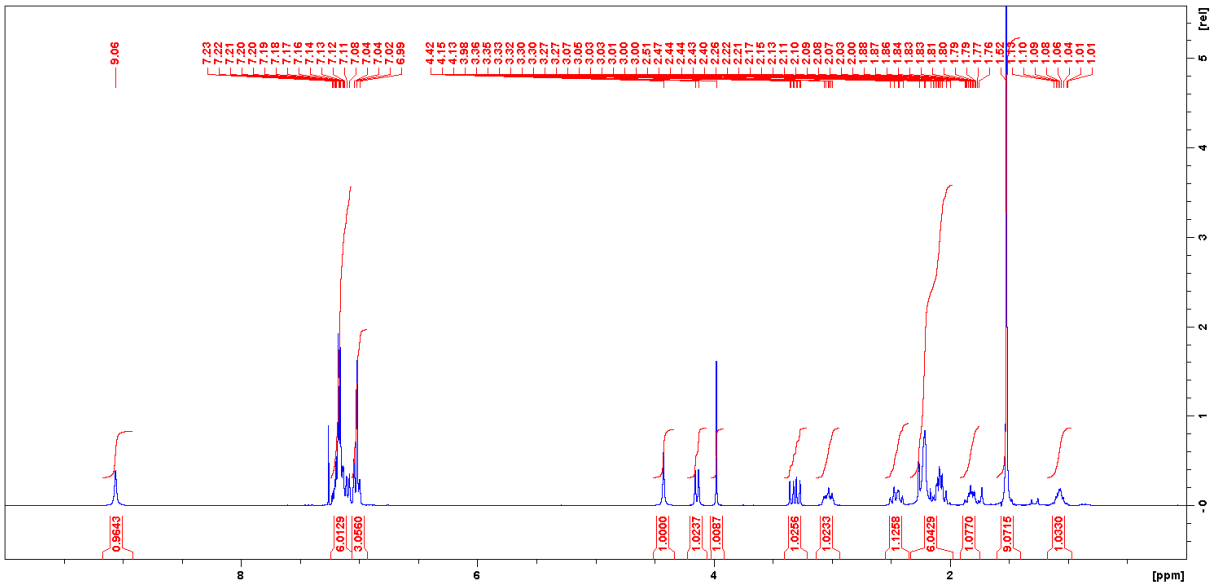


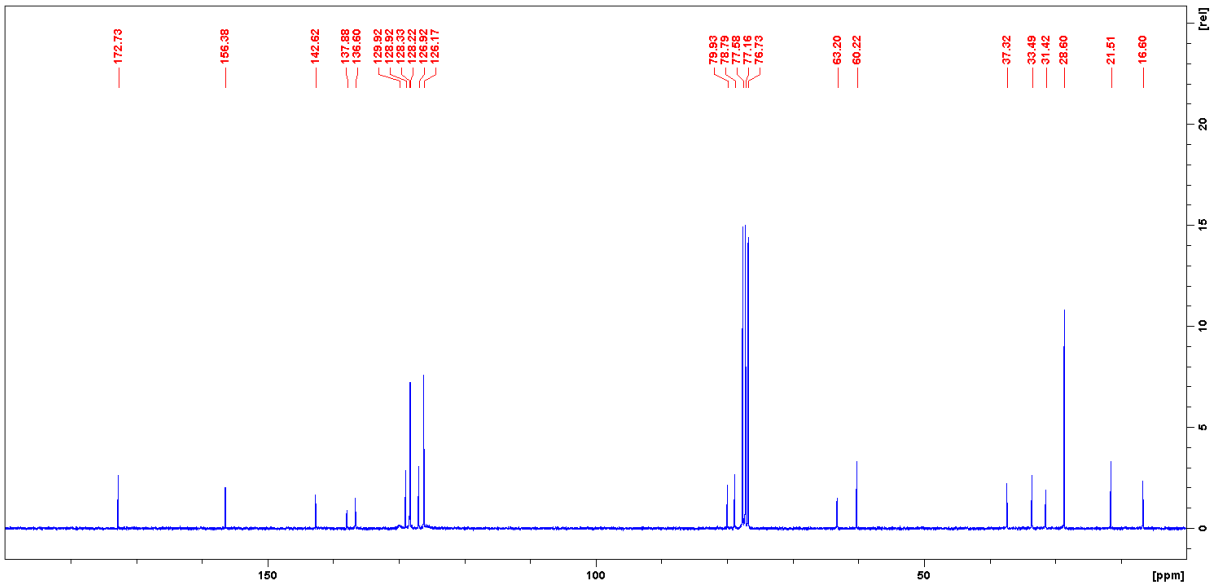




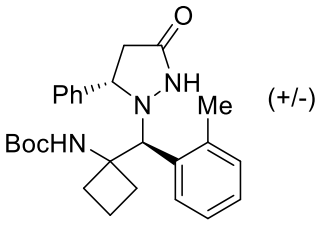
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(m-tolyl)methyl)cyclobutyl)carbamate (3fl)**

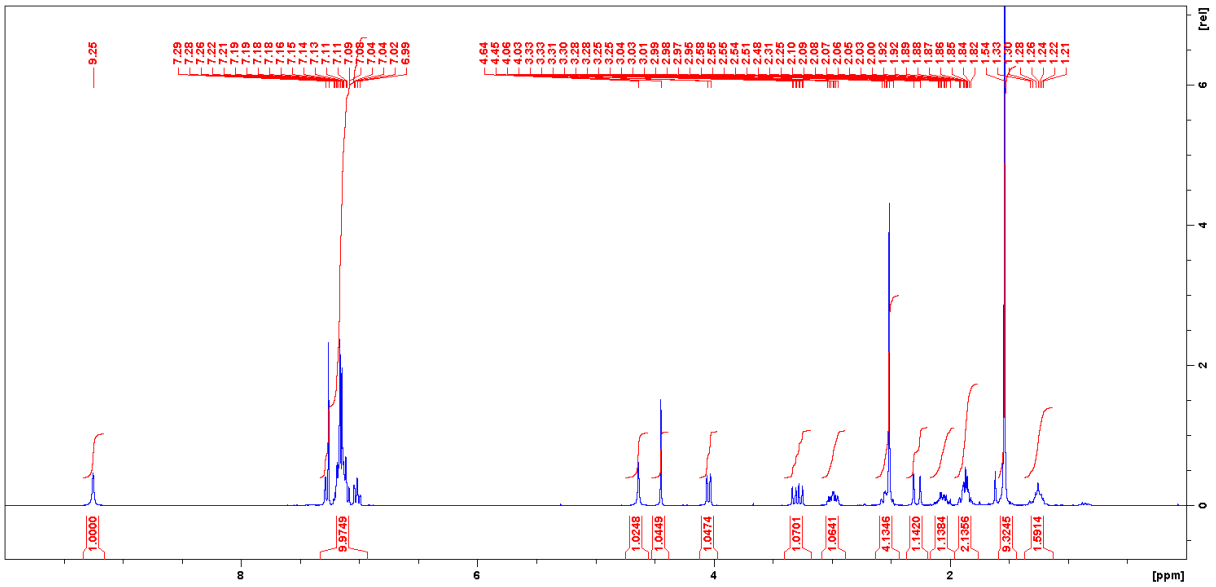


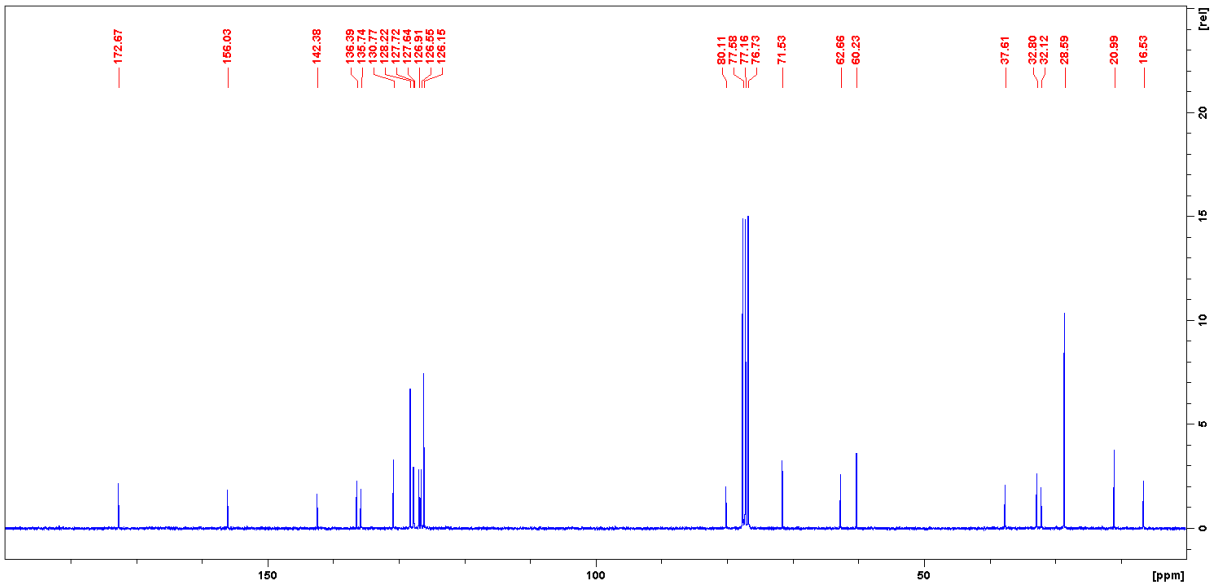




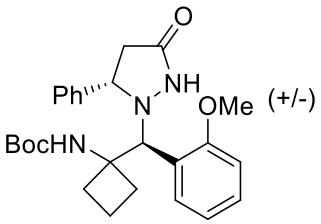
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(o-tolyl)methyl)cyclobutyl)carbamate (3fm)**

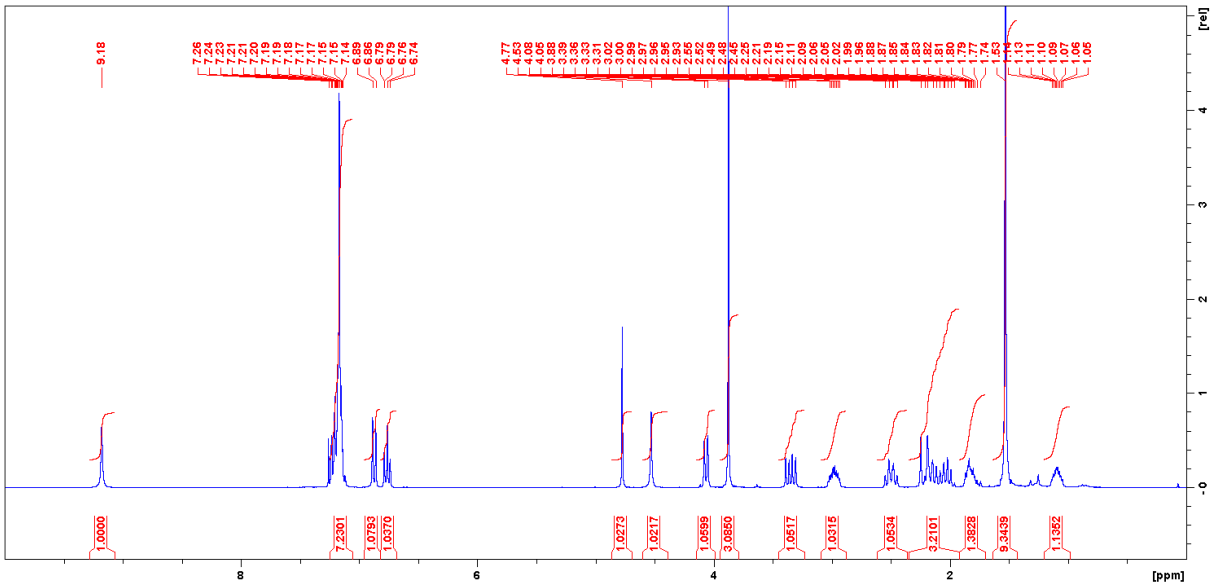


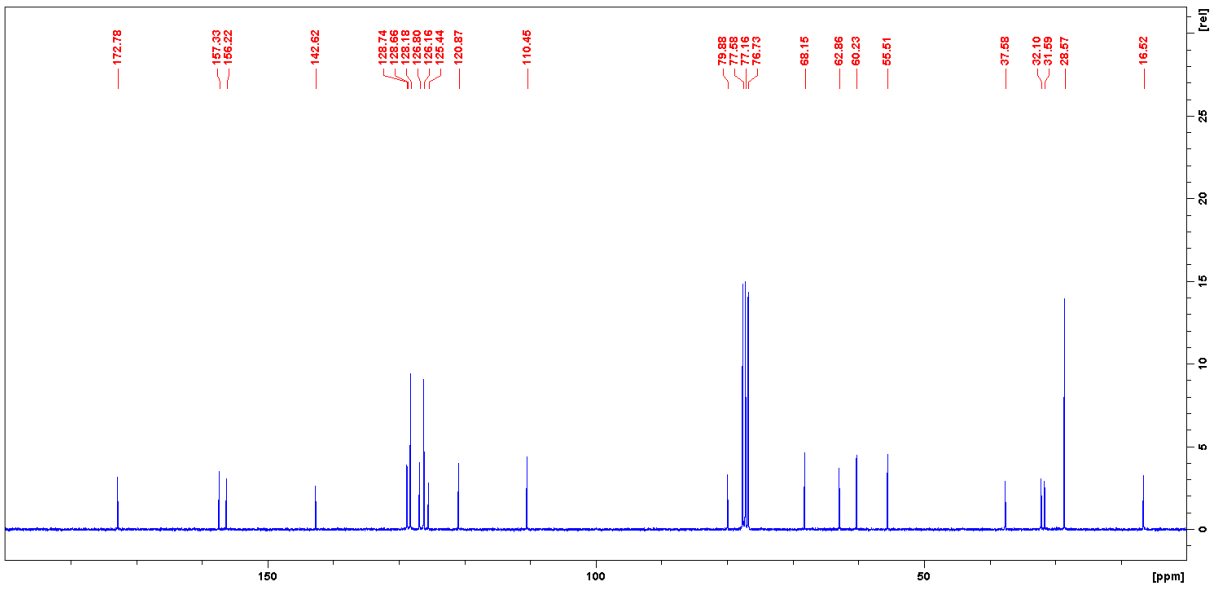




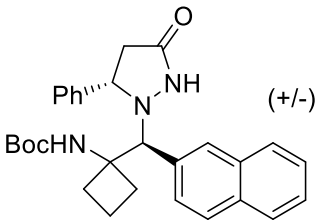
***tert*-butyl (1-((2-methoxyphenyl)(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fn)**

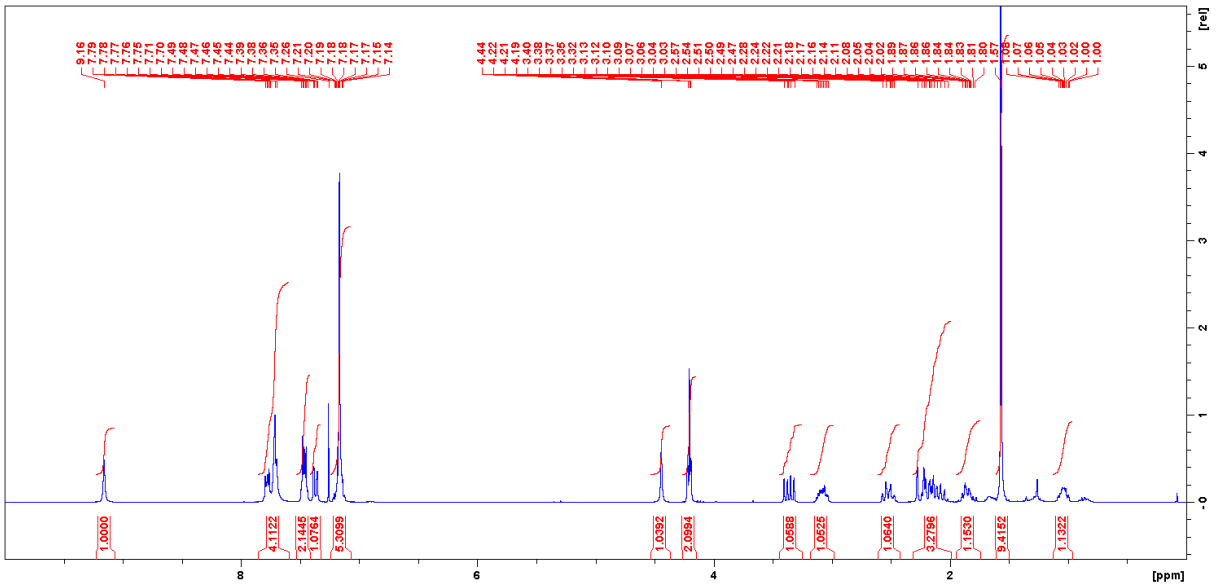


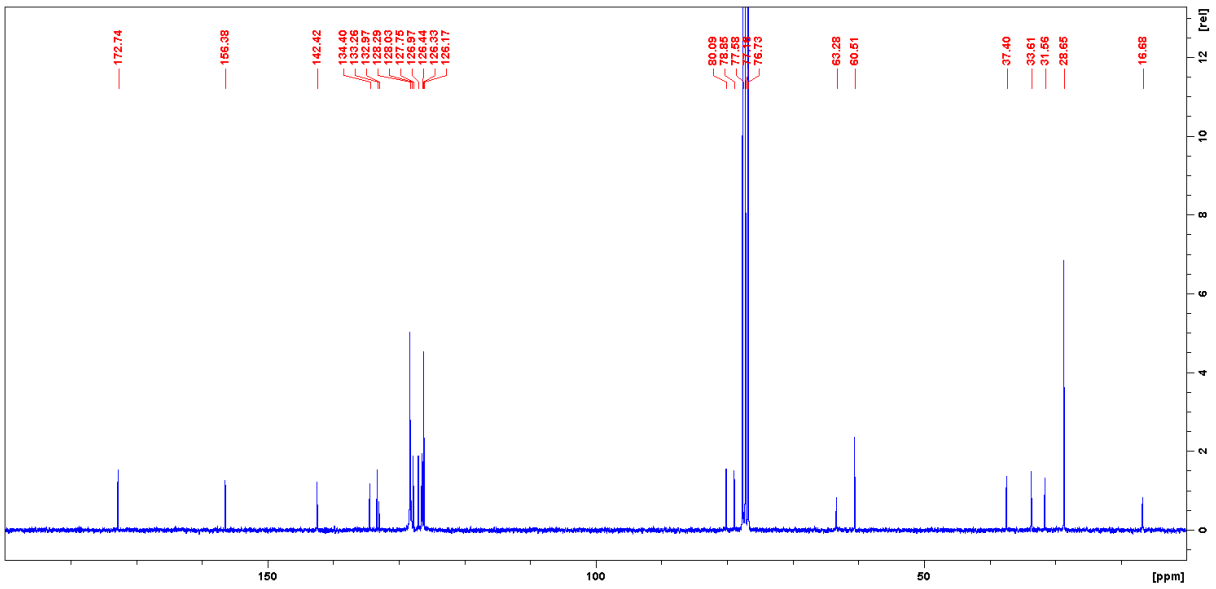




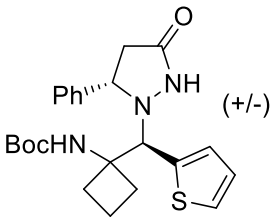
***tert*-butyl (1-(naphthalen-2-yl(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fo)**

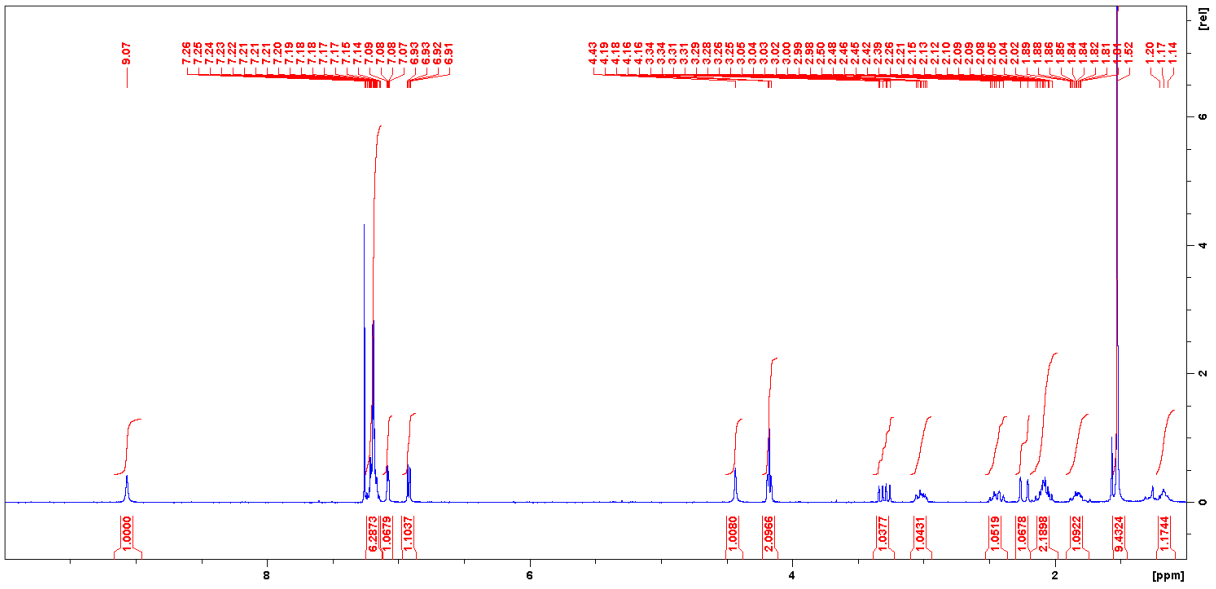


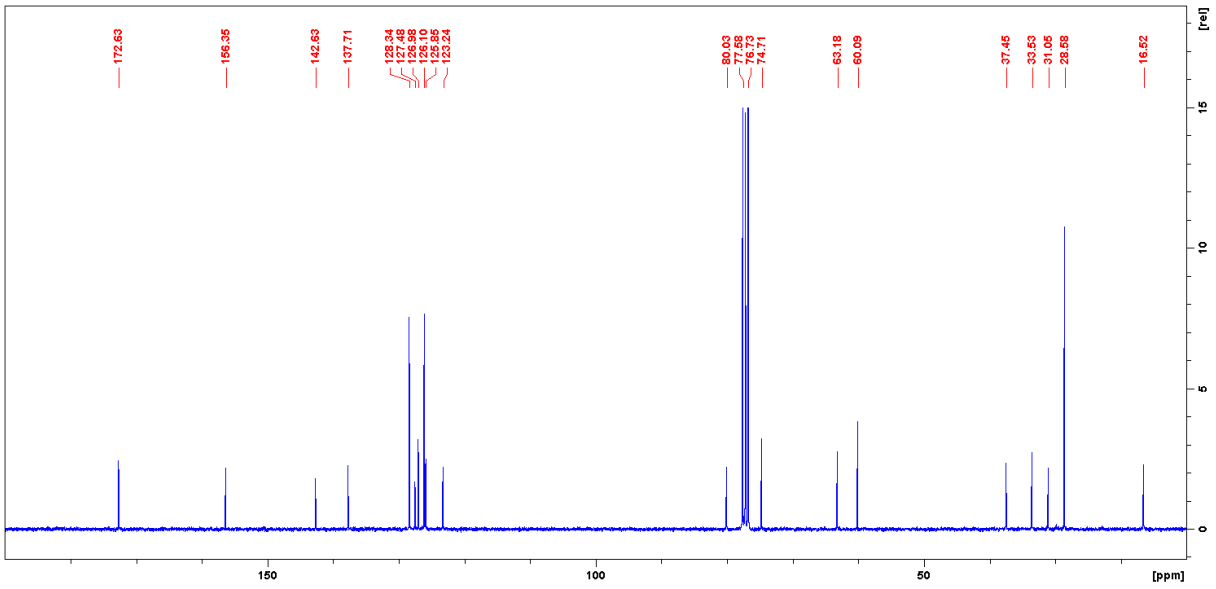




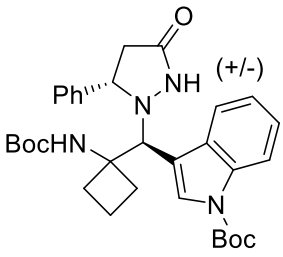
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(thiophen-2-yl)methyl)cyclobutyl)carbamate (3fp)**

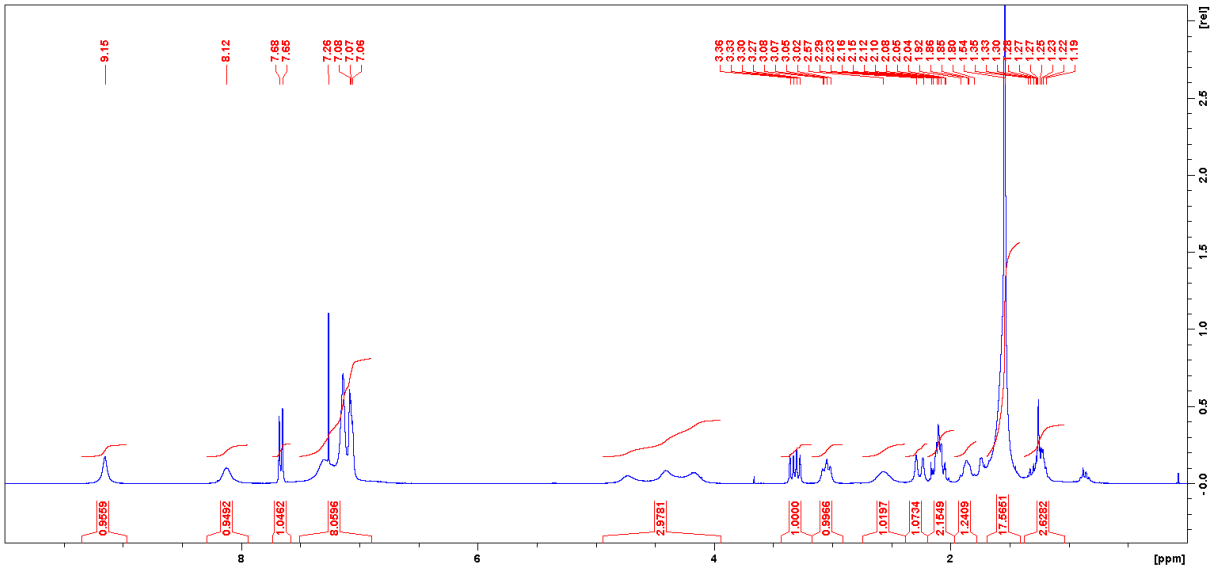


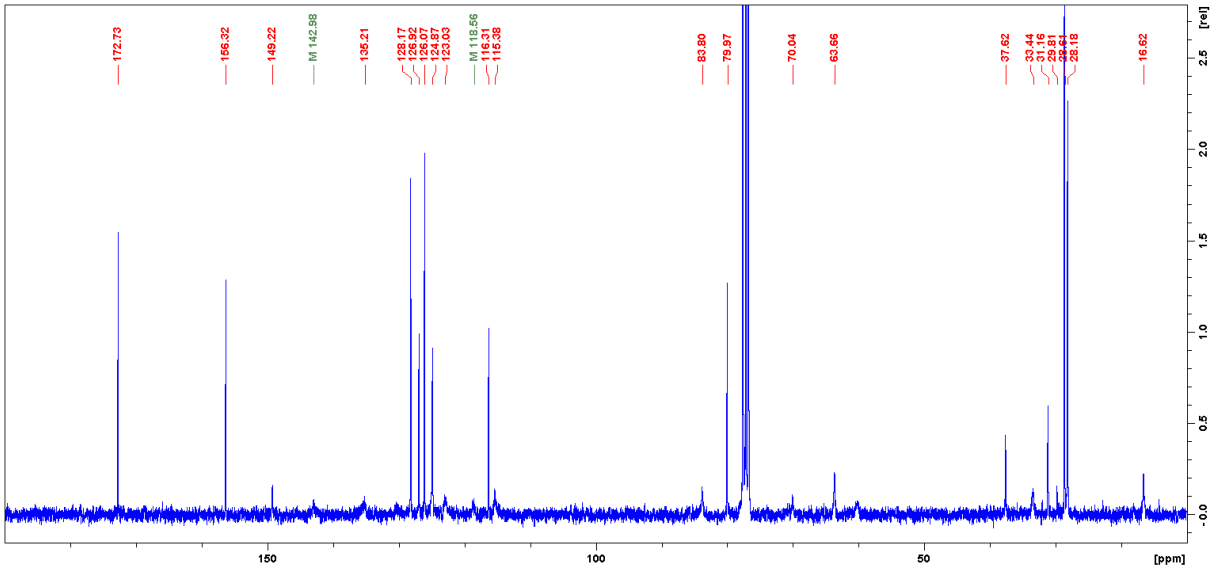




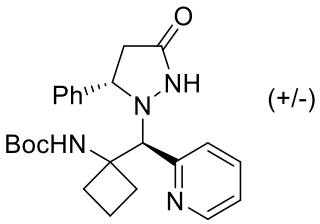
***tert*-butyl 3-((1-((*tert*-butoxycarbonyl)amino)cyclobutyl)(3-oxo-5-phenylpyrazolidin-1-yl) methyl)-1H-indole-1-carboxylate (3fq)**

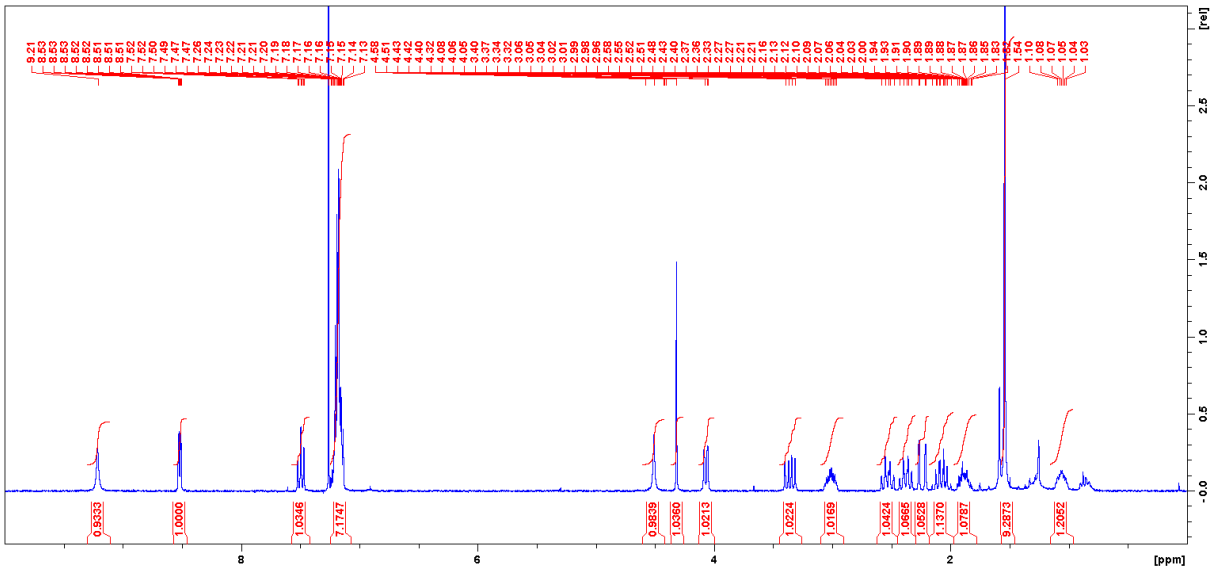


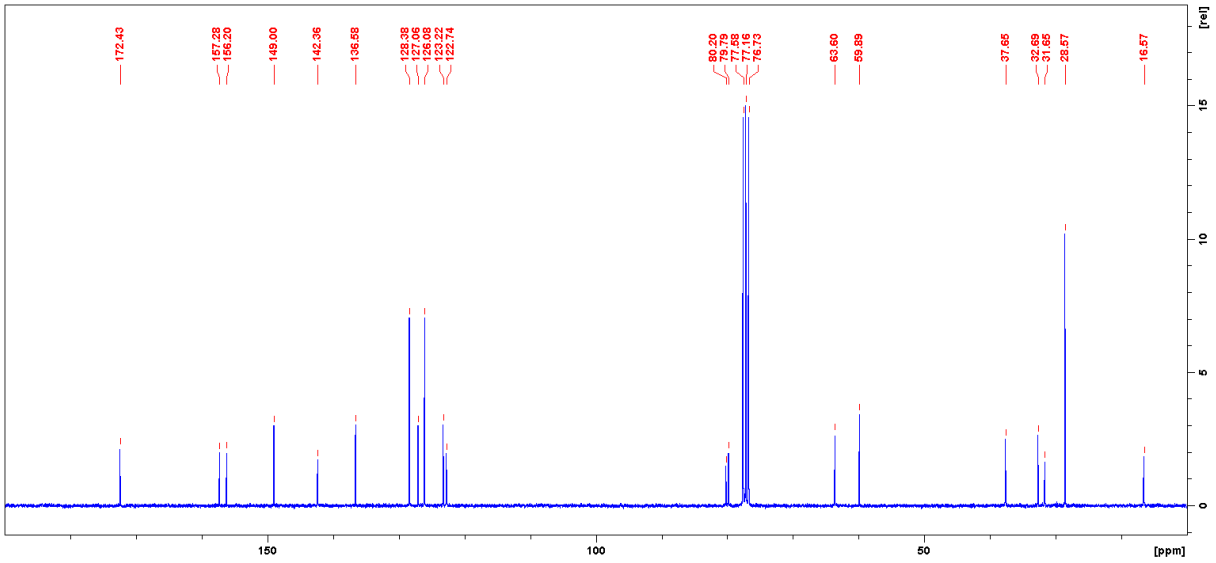




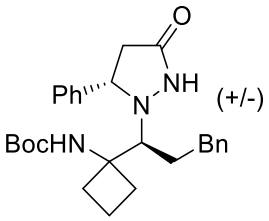
***tert*-butyl (1-((3-oxo-5-phenylpyrazolidin-1-yl)(pyridin-2-yl)methyl)cyclobutyl)carbamate (3fr)**

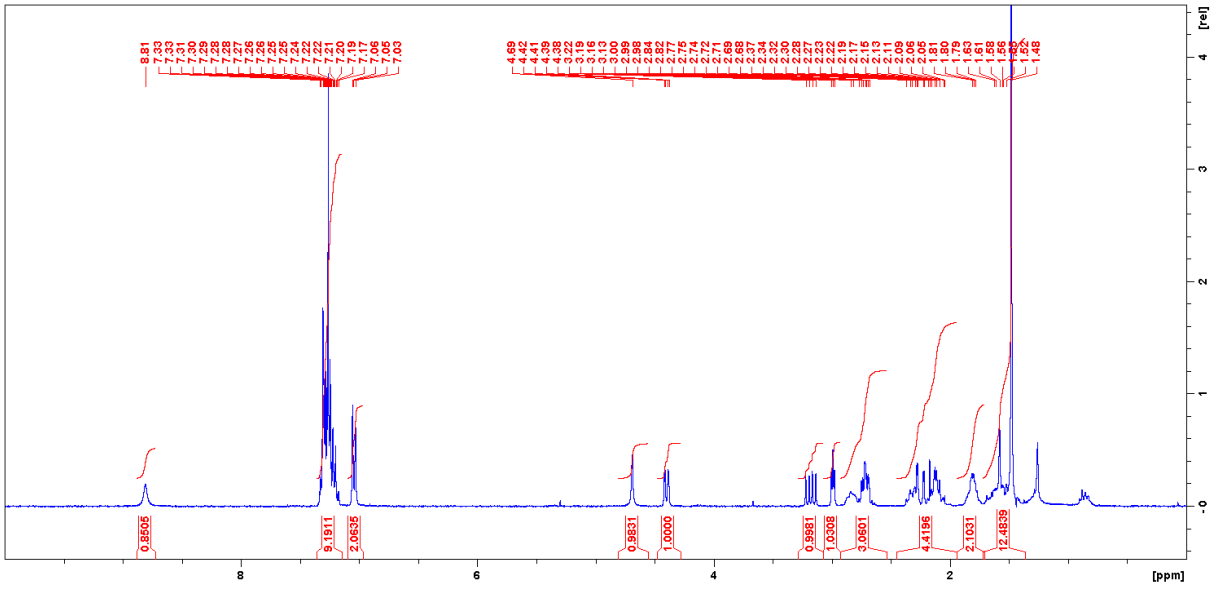


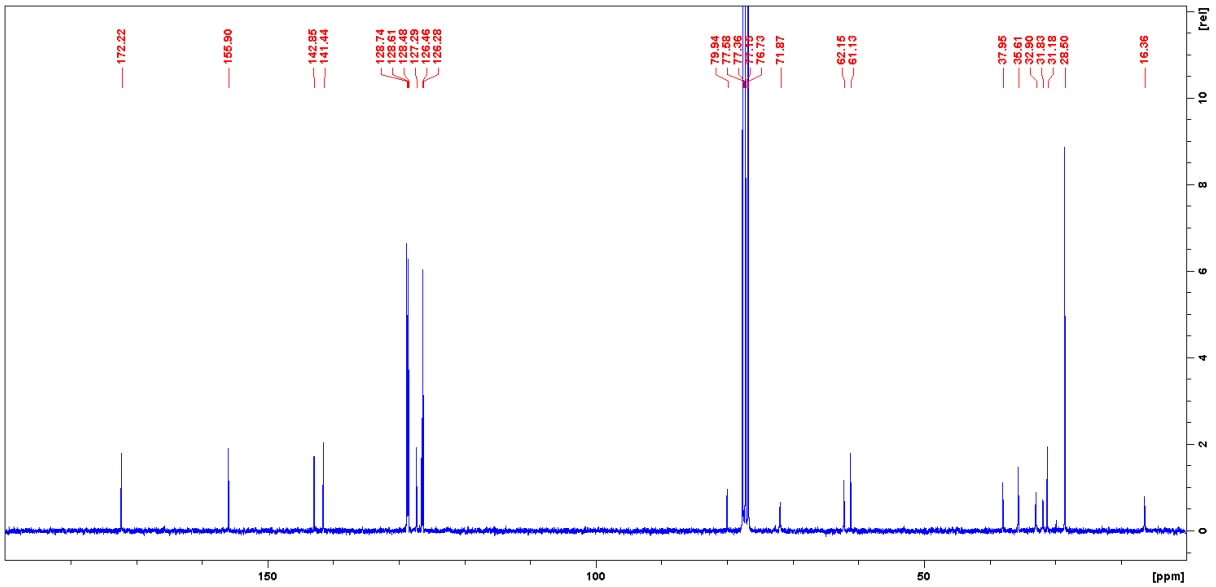




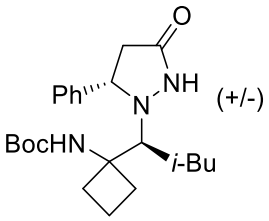
***tert*-butyl (1-(1-(3-oxo-5-phenylpyrazolidin-1-yl)-3-phenylpropyl)cyclobutyl)carbamate (3fs)**

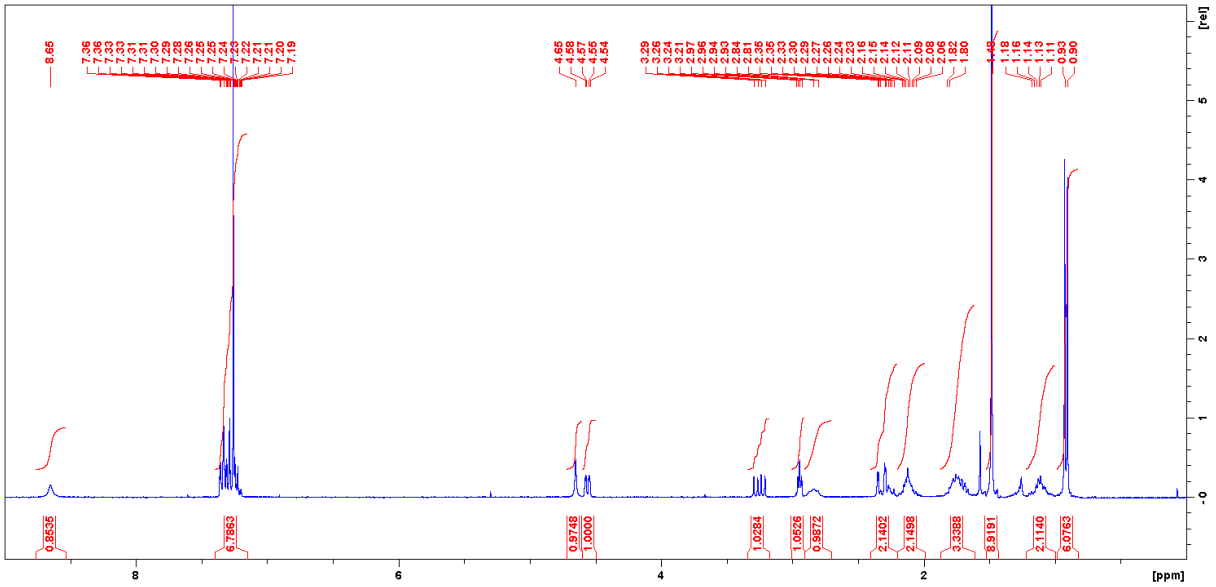


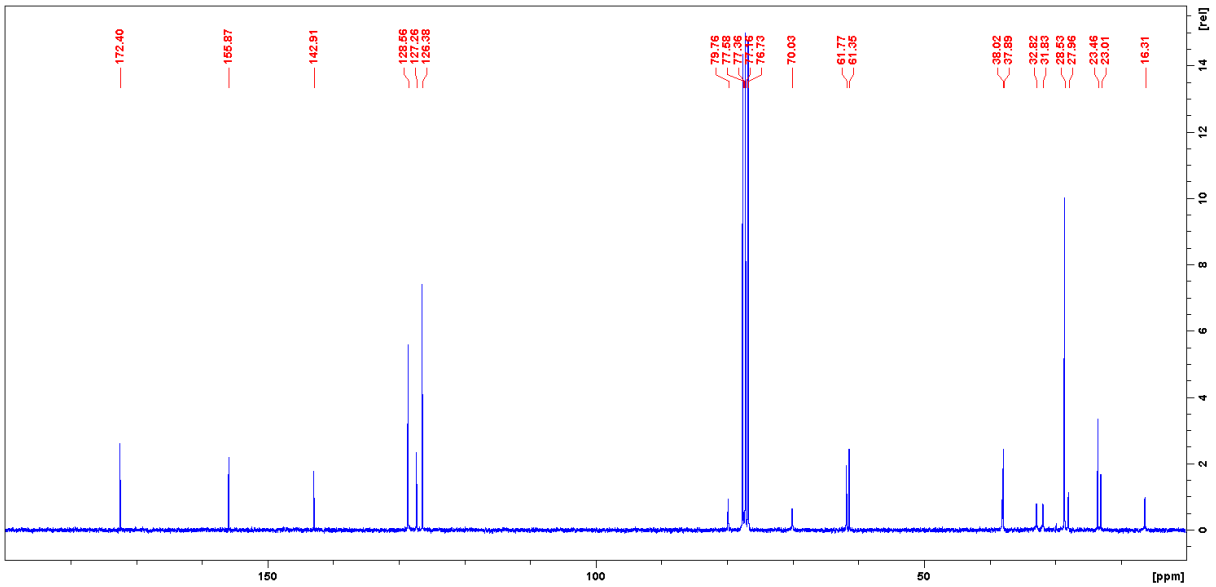




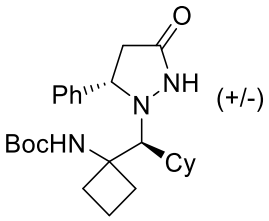
***tert*-butyl (1-(3-methyl-1-(3-oxo-5-phenylpyrazolidin-1-yl)butyl)cyclobutyl)carbamate (3ft)**

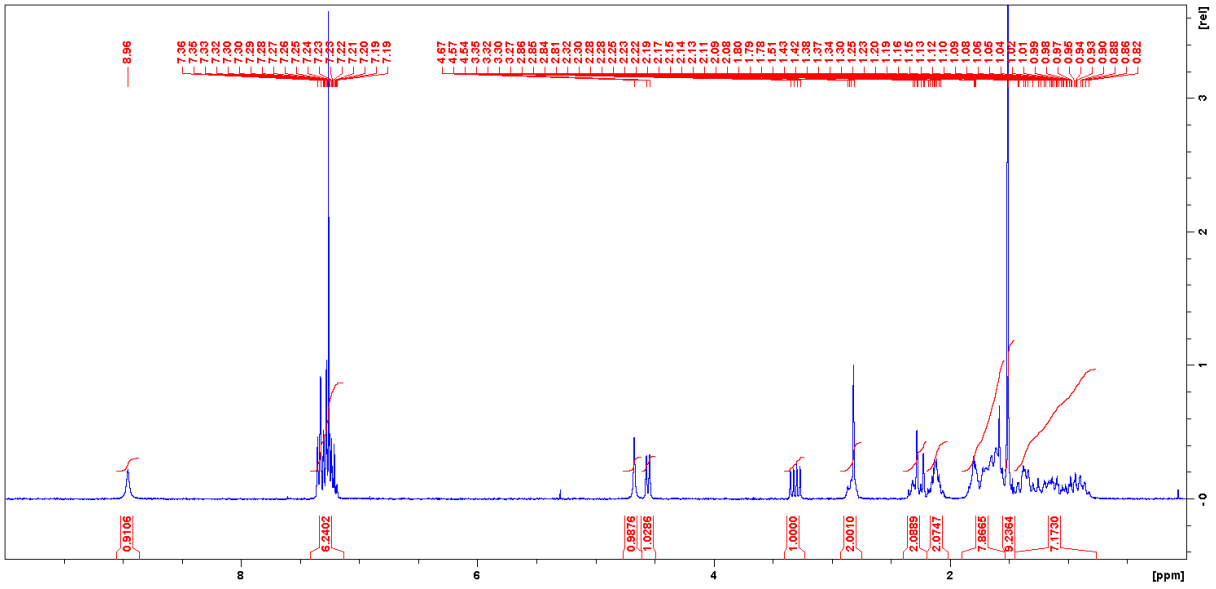


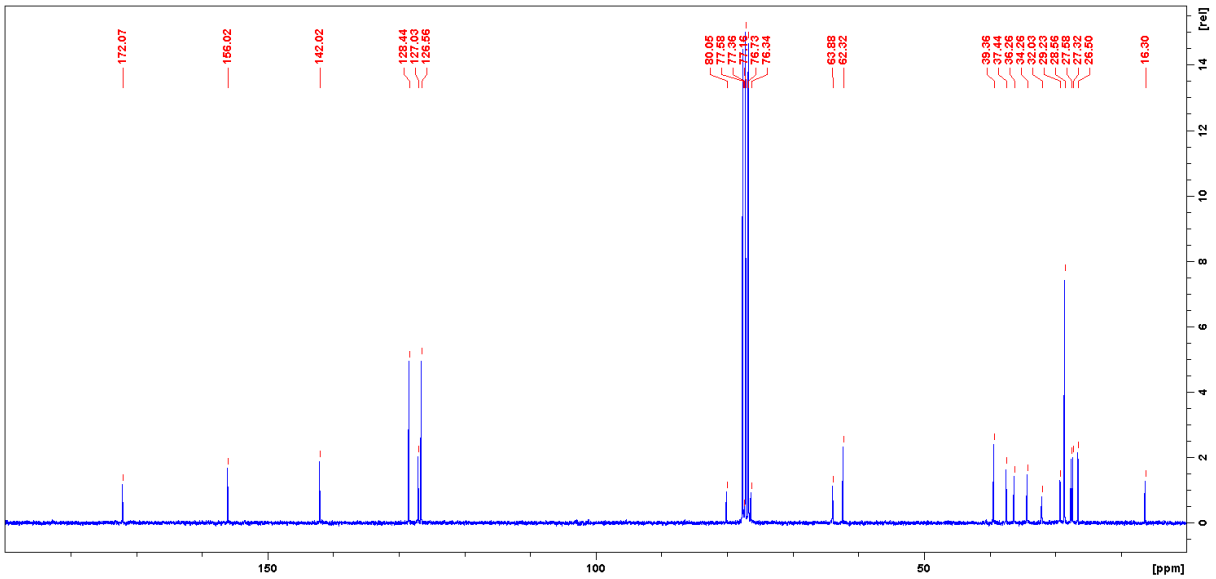




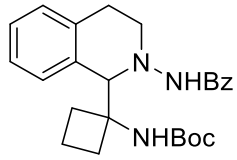
***tert*-butyl (1-(cyclohexyl(3-oxo-5-phenylpyrazolidin-1-yl)methyl)cyclobutyl)carbamate (3fu)**

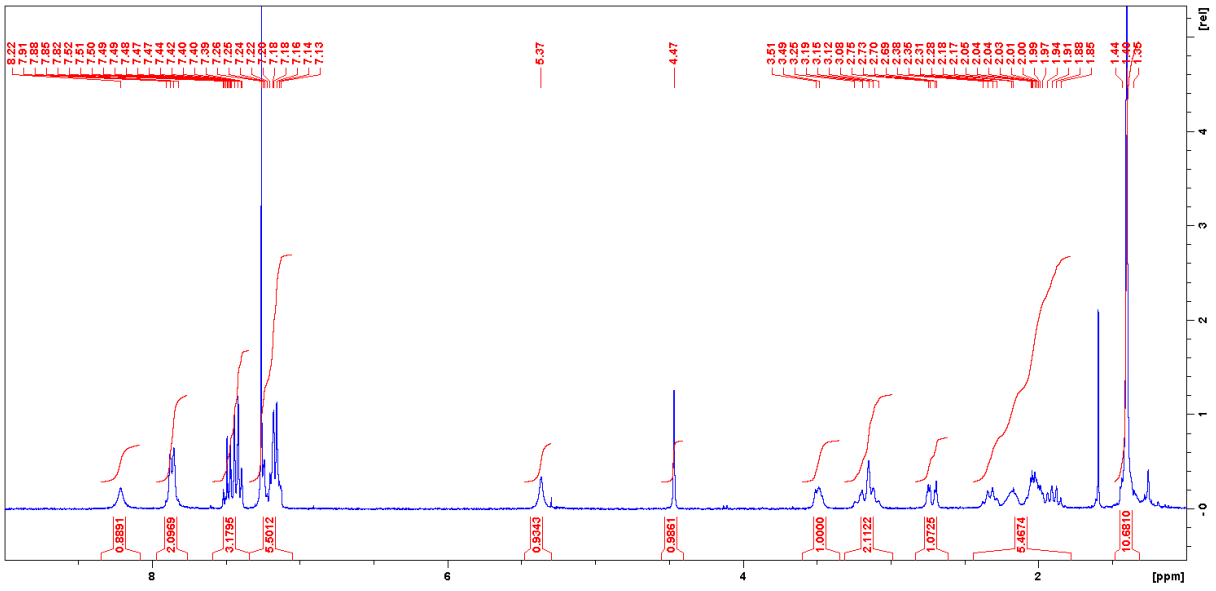


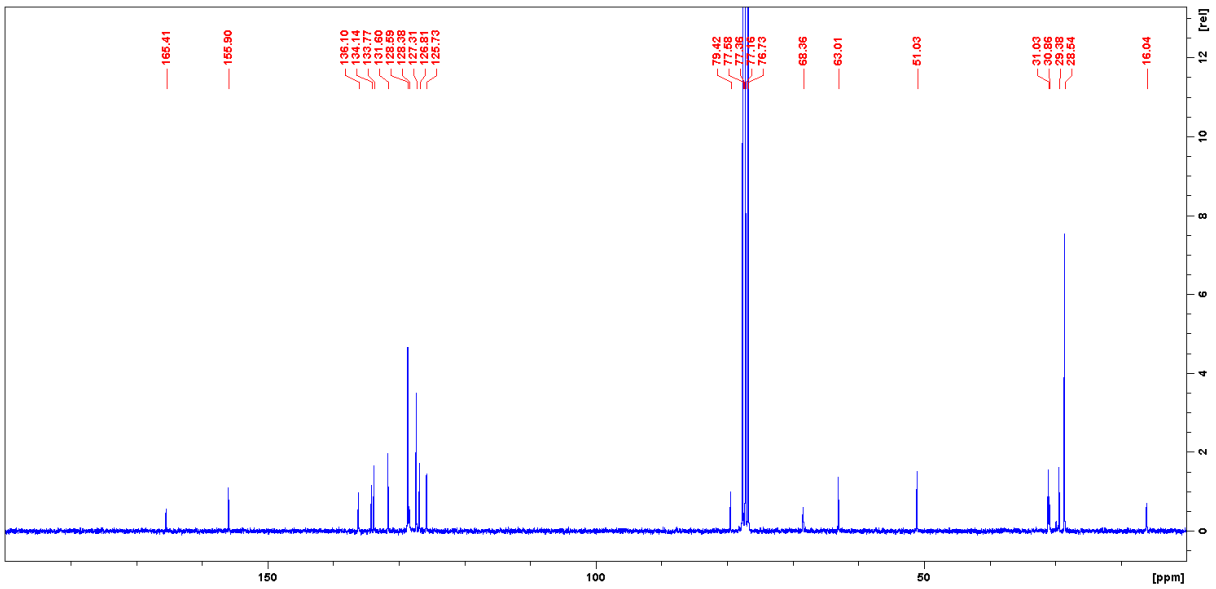




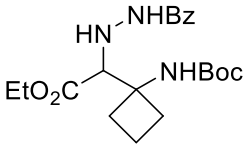
***tert*-butyl (1-(2-benzamido-1,2,3,4-tetrahydroisoquinolin-1-yl)cyclobutyl)carbamate (5)**

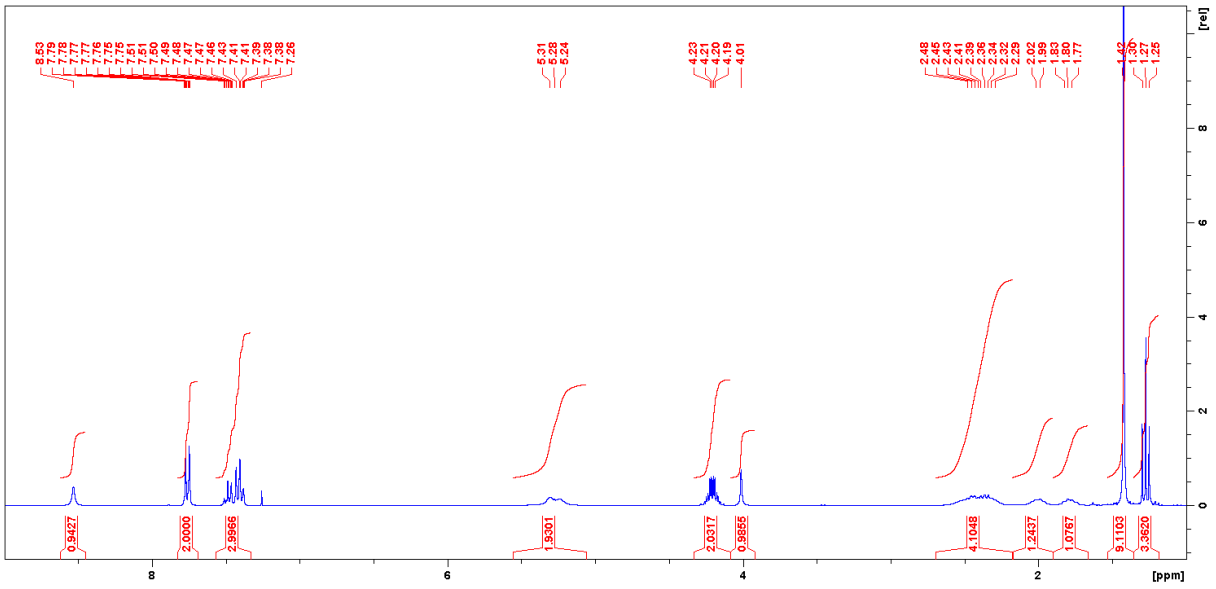


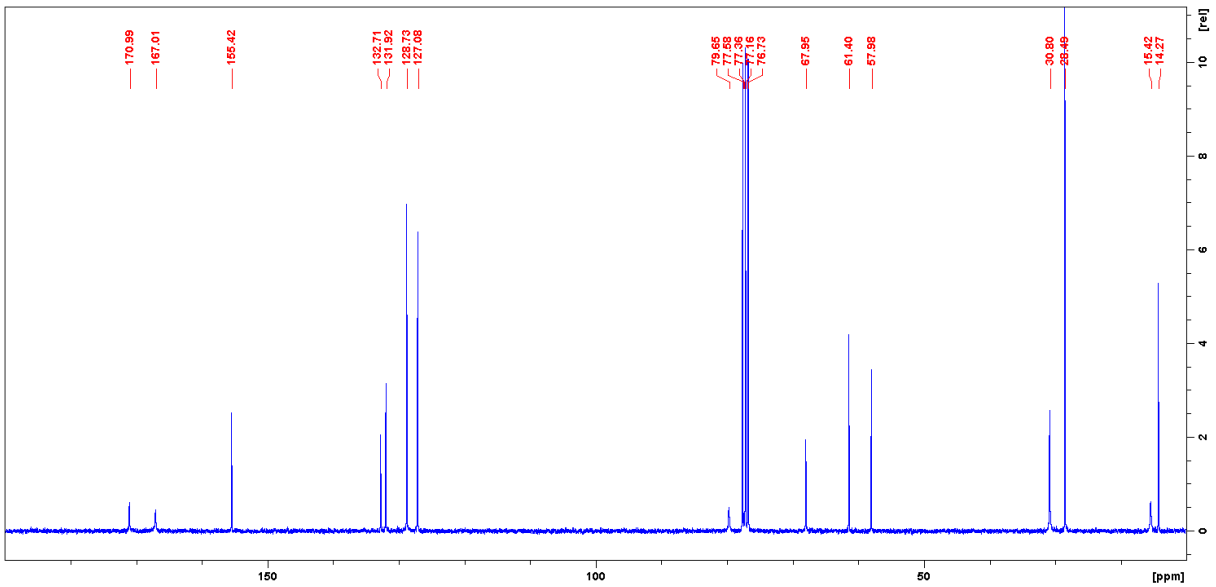




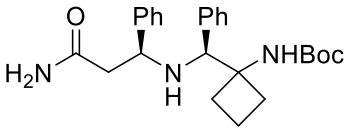
Ethyl 2-(2-benzoylhydrazinyl)-2-(1-((*tert*-butoxycarbonyl)amino)cyclobutyl)acetate (7fb)

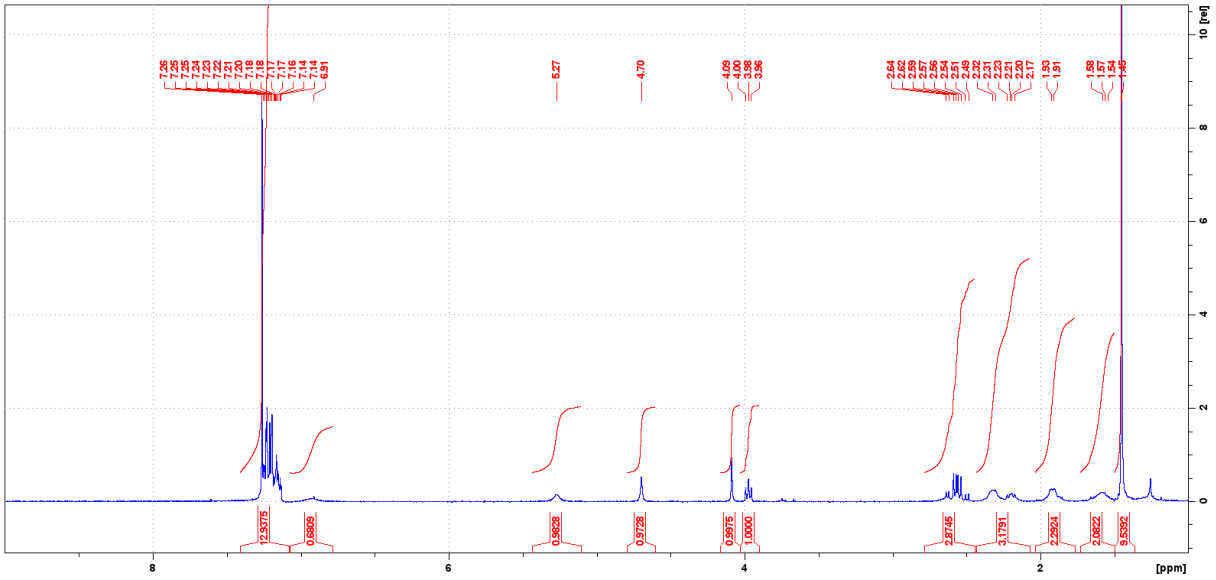


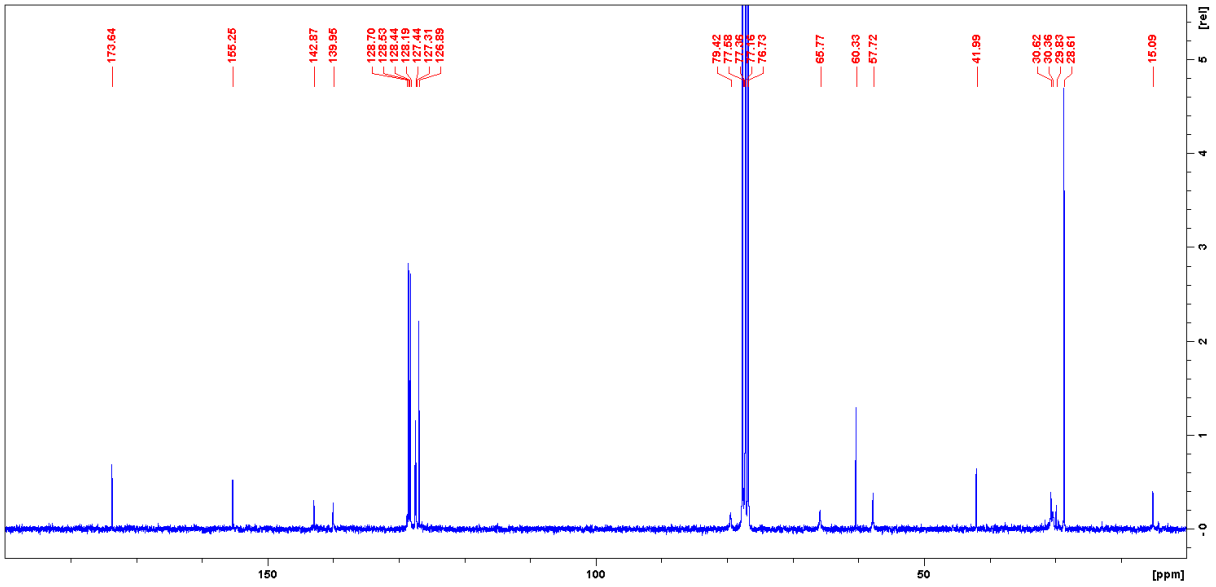




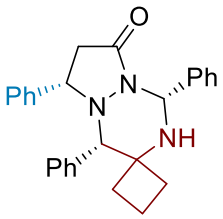
***tert*-butyl (1-(((3-amino-3-oxo-1-phenylpropyl)amino)(phenyl)methyl)cyclobutyl)carbamate (8)**

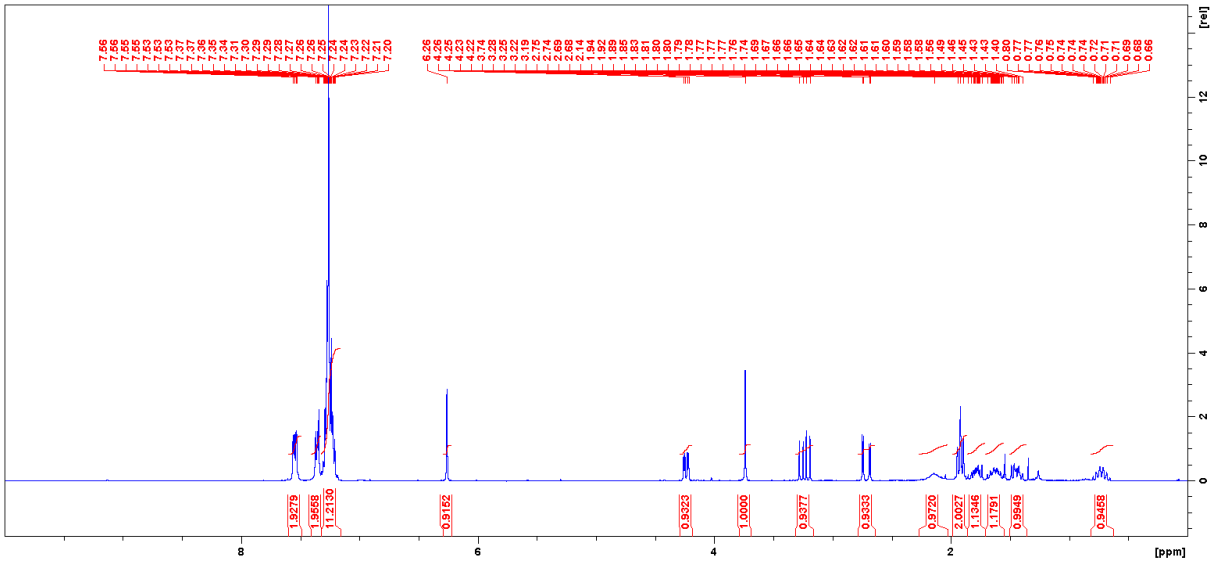


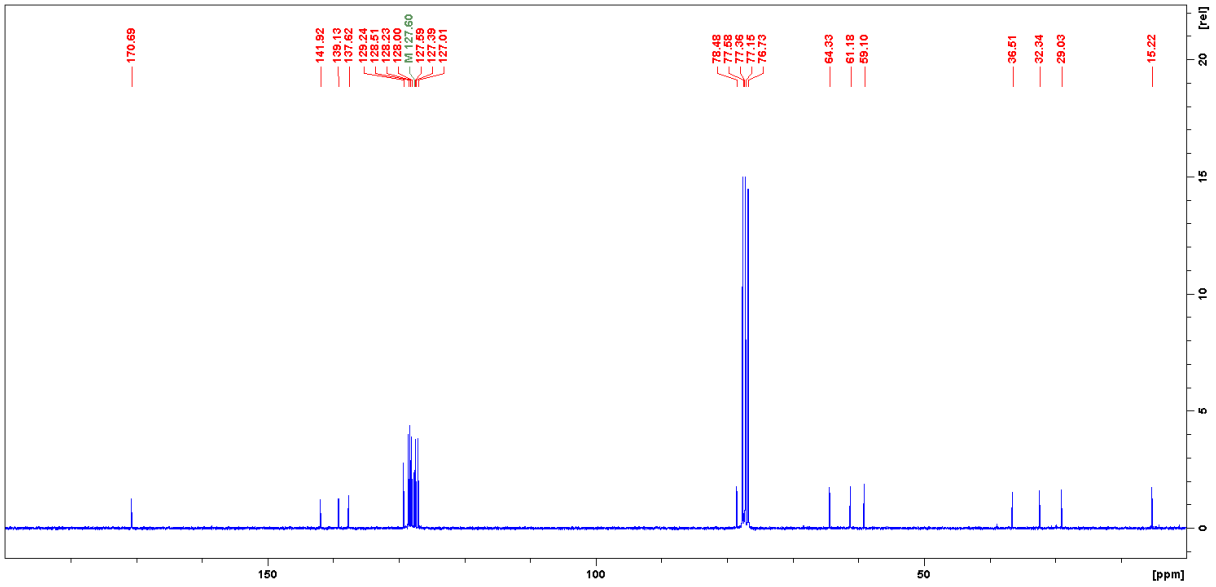




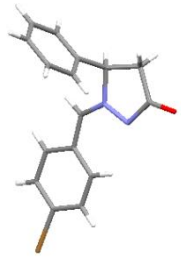
1',4',6'-triphenyltetrahydro-4'*H*,8'*H*-spiro[cyclobutane-1,3'-pyrazolo[1,2-*a*][1,2,4]triazin]-8'-one (9)



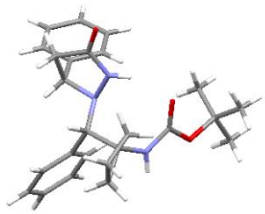




V X-Ray analyses



Crystal structure determination of **2g-(Z)**. $C_{16}H_{13}BrN_2O$, M= 329.19g.mol-1, monoclinic, $P2_1/a$ (Nr 14), a=11.589(2) Å, b=12.259(2) Å, c=11.867(2) Å, β=110.793(3)°, V=1576.1(5)Å^3, Z=4. A total of 9510 reflections were collected at room temperature using a three-circle goniometer of a Bruker SMART APEX diffractometer equipped with a CCD area detector and Mo Ka radiation (λ=0.71073Å). The cell parameters and the orientation matrix of the crystal were preliminary determined by using SMART Software[1]. Data integration and global cell refinement were performed with SAINT Software[2]. Intensities were corrected for Lorentz polarisation, decay and absorption effects (SAINT and SADABS Softwares[2]) and reduced to F_O^2. The structure was solved by direct methods (SHEL-XS[3]). Anisotropic displacement parameters were refined for all non-hydrogen atoms using SHEL-XL[4] available with the WinGX[5] package. Hydrogen atoms were located by Fourier-difference synthesis and fixed geometrically according to their environment with a common isotropic factor. Due to highly disordered electronic densities located in between the molecules within the packing, The program Squeeze from platon[6] was used to remove these. The final cycle of full matrix least square refinement on Fo^2 was based on 2262 observed reflections and 182 variable parameters and converged with unweighted and weighted agreement factors of R1=0.0326, wR2=0.0626 for 1413 reflections with I>2σI and R1=0.0543 , wR2=0.0658 for all data. The data have been deposited to the Cambridge Crystallographic Data Centre (Nr CCDC 2154729).

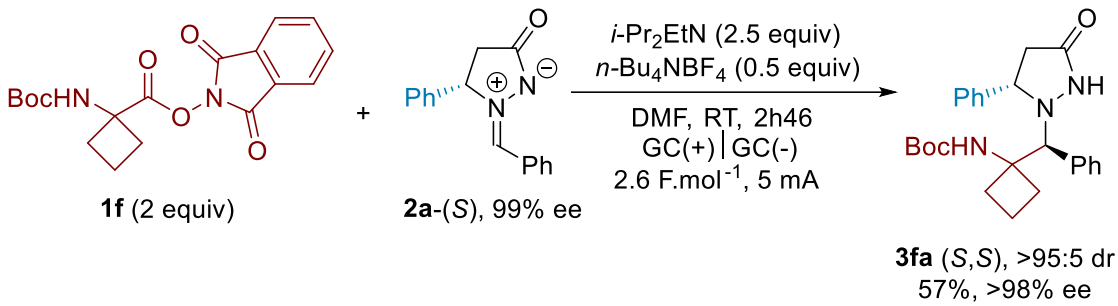


Crystal structure determination of **3fa**. $C25H_{31}N_3O$, M= 421.53g.mol-1, monoclinic, $P2_1/n$ (Nr 14), a=10.242(1)(2) Å, b=18.554(3) Å, c=12.255(1) Å, β=91.745(3)°, V=2328.0(6)Å^3, Z=4. A total of 10371 reflections were collected at room temperature using a three-circle goniometer of a Bruker SMART APEX diffractometer equipped with a CCD area detector and Mo Ka radiation (λ=0.71073Å). The cell parameters and the orientation matrix of the crystal were preliminary determined by using SMART Software[1]. Data integration and global cell refinement were performed with SAINT Software[2]. Intensities were corrected for Lorentz polarisation, decay and absorption effects (SAINT and SADABS Softwares[2]) and reduced to F_O^2. The structure was solved by direct methods (SHEL-XS[3]). Anisotropic displacement parameters

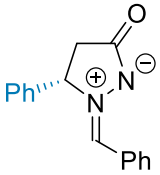
were refined for all non-hydrogen atoms using SHEL-XL[4] available with the WinGX[5] package. Hydrogen atoms were located by Fourier-difference synthesis and fixed geometrically according to their environment with a common isotropic factor. The final cycle of full matrix least square refinement on Fo^2 was based on 3350 observed reflections and 283 variable parameters and converged with unweighted and weighted agreement factors of R1=0.0521, wR2=0.1099 for 1645 reflections with $I>2\sigma I$ and R1=0.1074, wR2=0.1295 for all data. The data have been deposited to the Cambridge Crystallographic Data Centre (Nr CCDC 2154728).

(1)- SMART for WNT/2000 V5.622 (2001), Smart software reference manual, Bruker Advanced X Ray Solutions, Inc., Madison, Wisconsin, USA.
(2)- SAINT+ V6.02 (1999), Saint software reference manual, Bruker Advanced X Ray Solutions, Inc., Madison, Wisconsin, USA.
(3). SHELXS-97: Sheldrick, G. M. Acta Crystallogr. 1990, A46, 467e473.
(4). Sheldrick, G. M. SHELXL-97dA Program for Crystal Structure Refinement; University of Gottingen: Gottingen, Germany, 1997; release 97-2.
(5). Farrugia, L. J. WinGX: Version 1.70.01dAn Integrated System of Windows Programs for the Solution, Refinement and Analysis of Single Crystal X-ray Diffraction Data. Dept. of chemistry, University of Glasgow.
(6) Anthony L. Spek , acta Cryst (2015), C71, 9-18, PLATON SQUEEZE: a tool for the calculation of the disordered solvent contribution to the calculated structure factors

VI Reaction with enantioenriched starting material and HPLC analyses

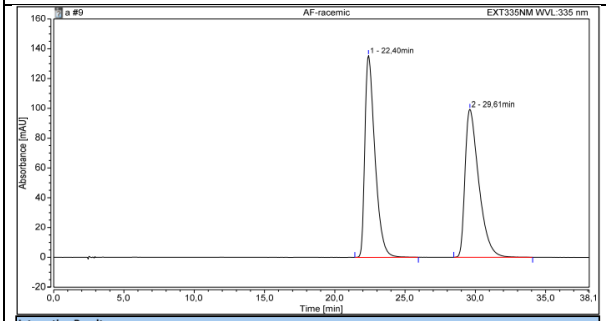


In order to evaluate the non-racemizing issue of the diastereoselective addition of REA **1f** to **2a**, the enantioenriched azomethine imine **2a**-(*S*) (99% ee, after precipitation in pentane) was synthesized by the straightforward kinetic resolution sequence under reduction condition of **2a**-(+/-) reported by Beauchemin and co-workers.[21] Then, our electrosynthesis conditions led to the corresponding hydrazine **3fa** in 57% yield (>95:5 dr) and >98% ee as shown by HPLC analyses (*vide infra*).



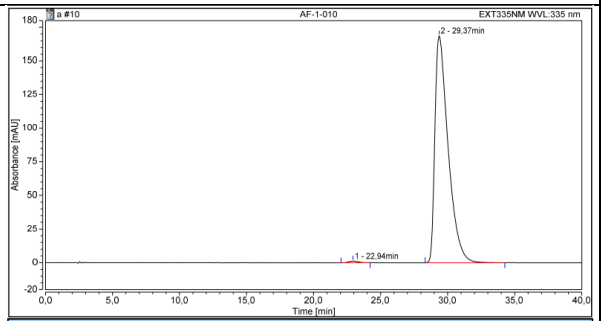
Column Daicel Chiralpak ID 250*4.6 5µm, Heptane/*i*-PrOH (+1% Diethylamine) = 70/30, flow rate 1.2 mL/min, 30 °C, UV 335 nm.

Racemic	99% ee (*S*)



Integration Results

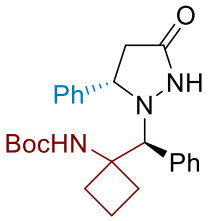
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %
1		22,40	112,458	135,500	49,99	57,68
2		29,61	112,501	99,409	50,01	42,32
Total:			224,959	234,909	100,00	100,00



Integration Results

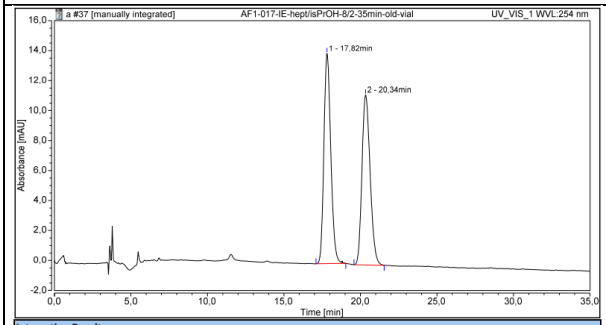
No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %
1		22,94	1,050	1,280	0,54	0,75
2		29,37	192,953	168,755	99,46	99,25
Total:			194,003	170,035	100,00	100,00

[21] Bongers, A.; Moon, P. J.; Beauchemin, A. M. *Angew. Chem. Int. Ed.* **2015**, *54*, 15516.



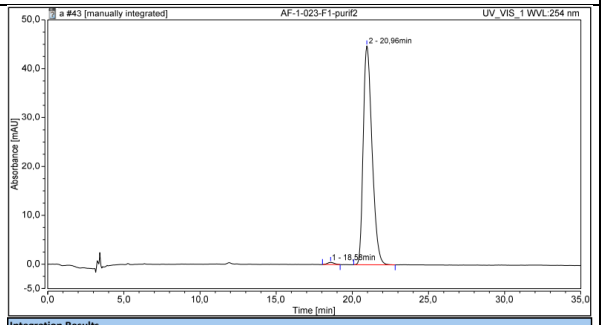
Column Daicel Chiralpak IE, Heptane/*i*-PrOH = 80/20, flow rate 1 mL/min, 20 °C, UV 254 nm.

Racemic	>98% ee



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %
1		17,82	7,343	14,038	51,11	55,27
2		20,34	7,023	11,359	48,89	44,73
Total:			14,365	25,397	100,00	100,00



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %
1		18,58	0,227	0,446	0,75	0,99
2		20,96	30,102	44,817	99,25	99,01
Total:			30,329	45,264	100,00	100,00