

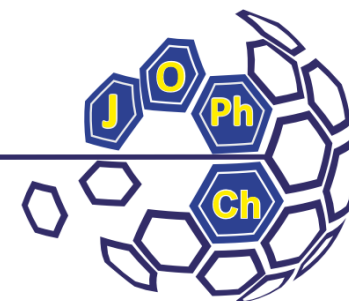
Supporting Information

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The improved synthesis of ROCKYPhos and its application for the asymmetric hydrogenation of dihydroisoquinoline derivatives

V. A. Bilenko,^{1,2} M. V. Gorichko²

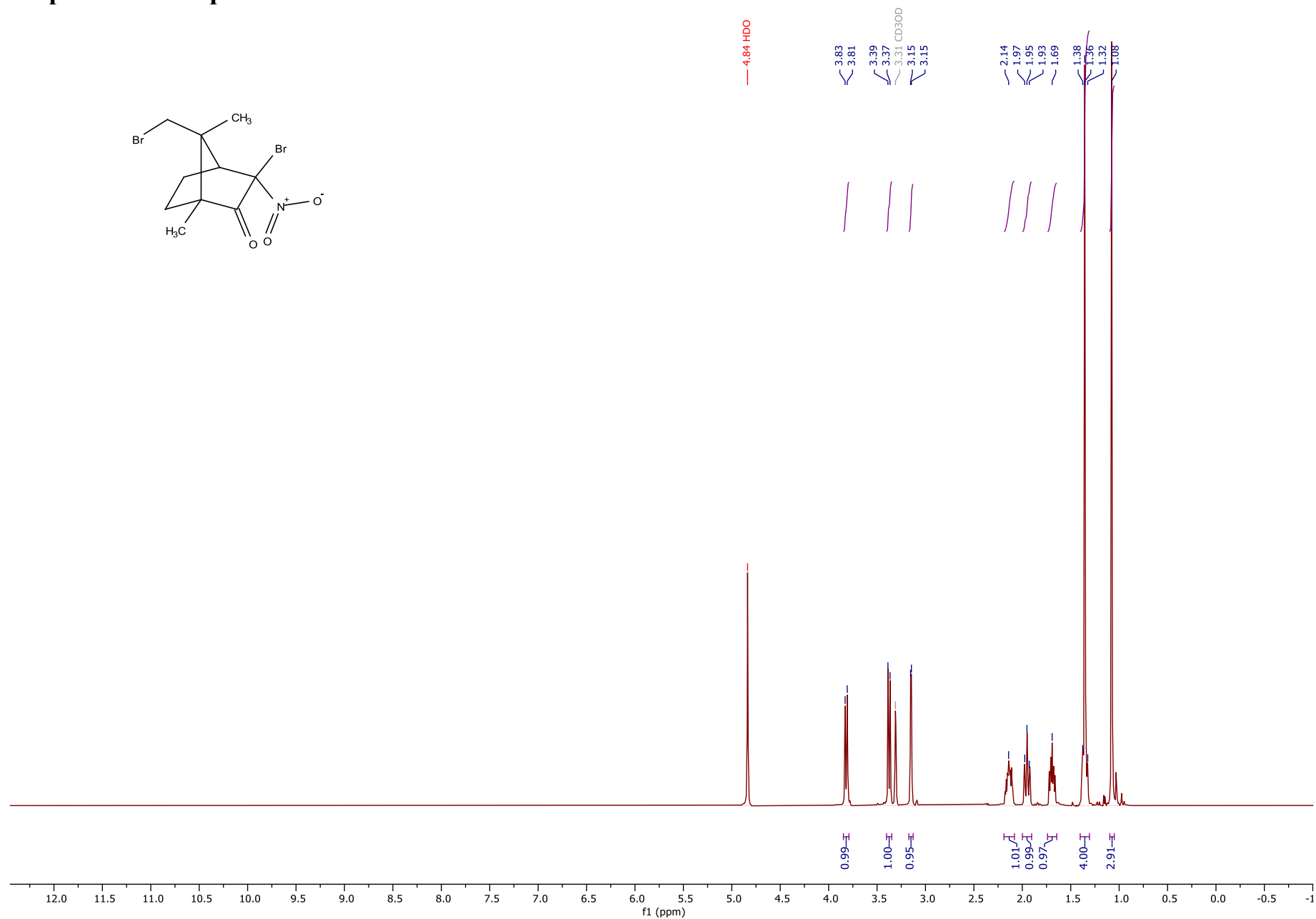
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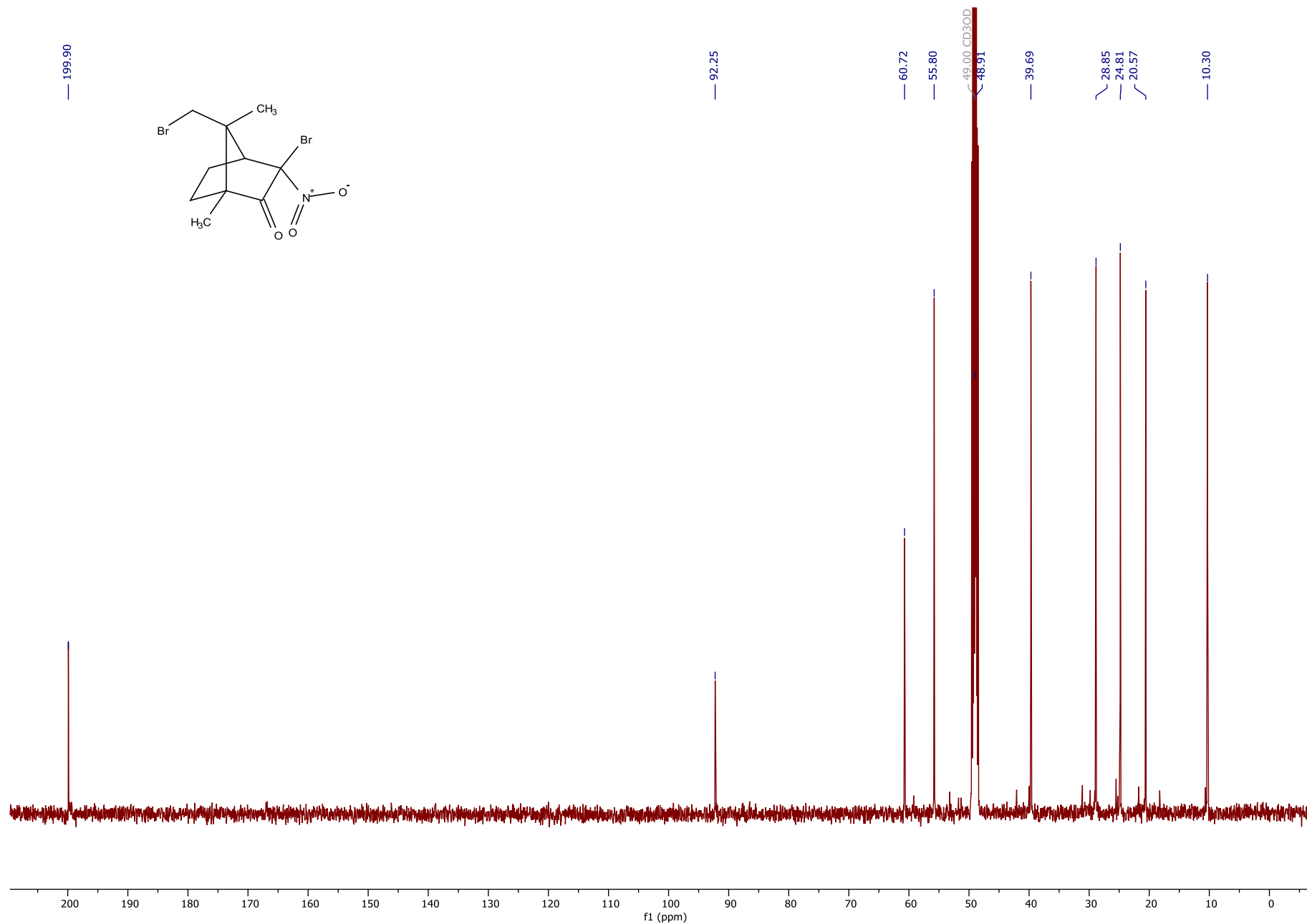
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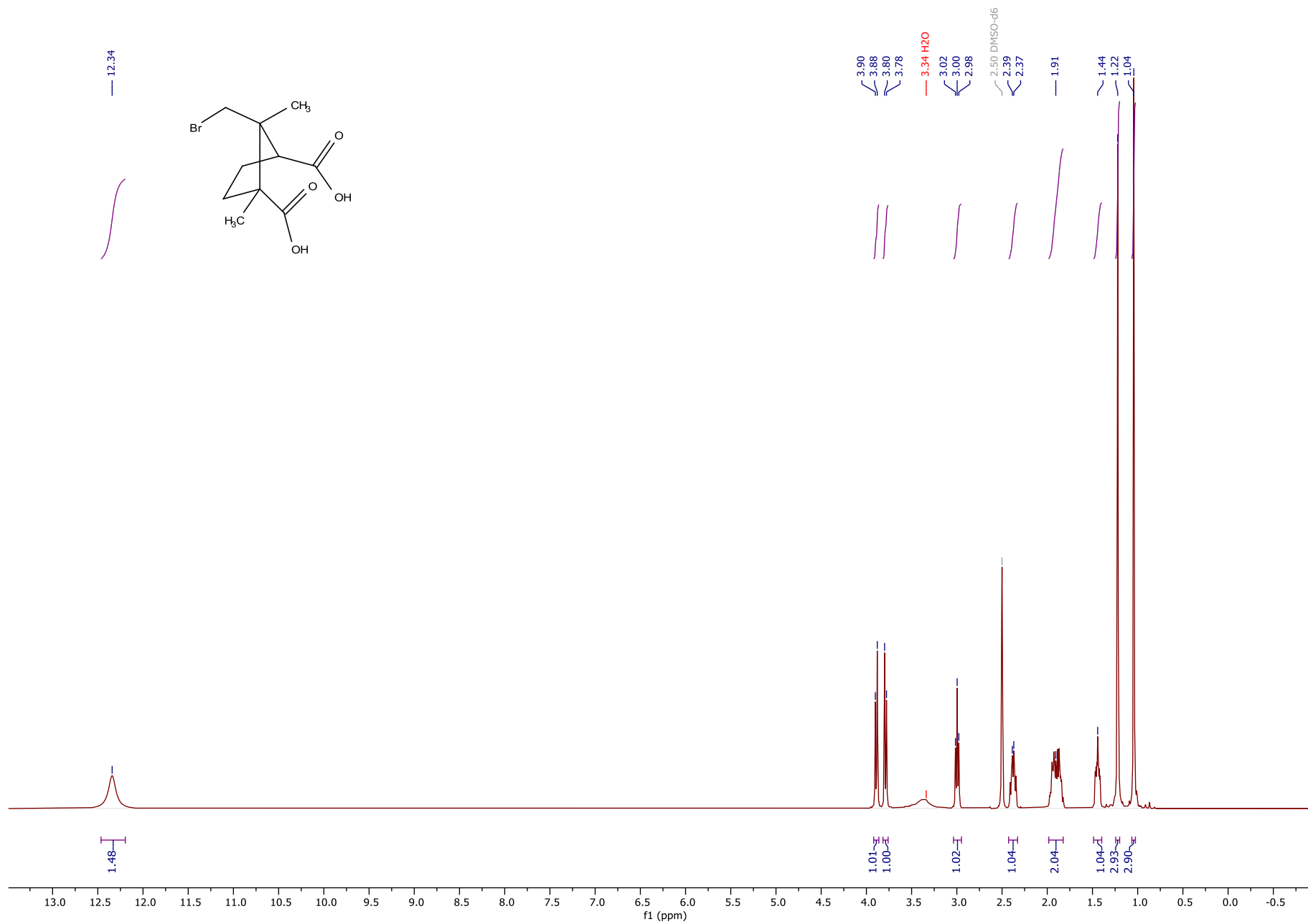
1. Copies of NMR spectra



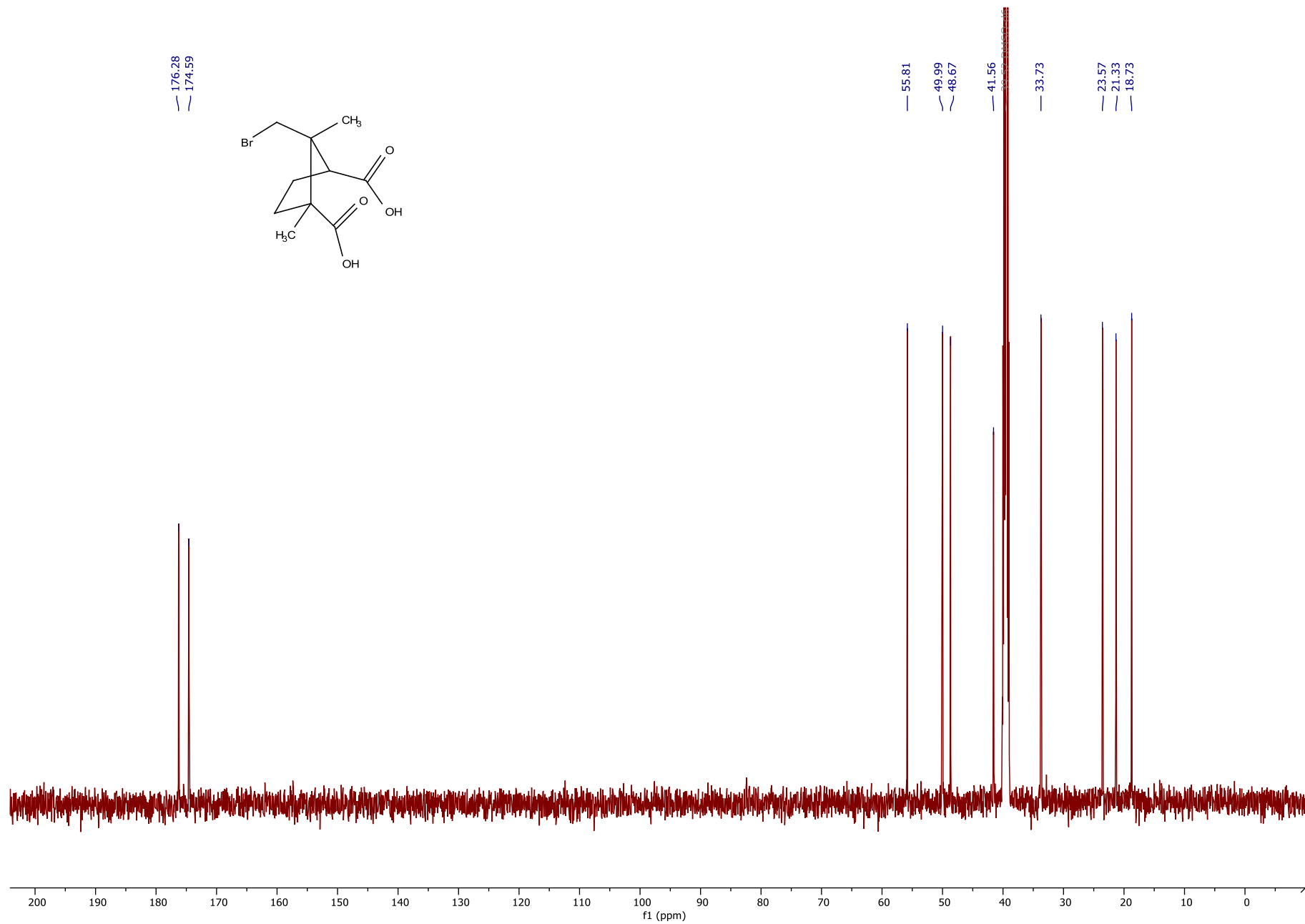
Spectrum S1. (1S,3R,4S,7R)-3-Bromo-7-(bromomethyl)-1,7-dimethyl-3-nitrobicyclo[2.2.1]heptan-2-one 11, ¹H NMR (500 MHz, CD₃OD)



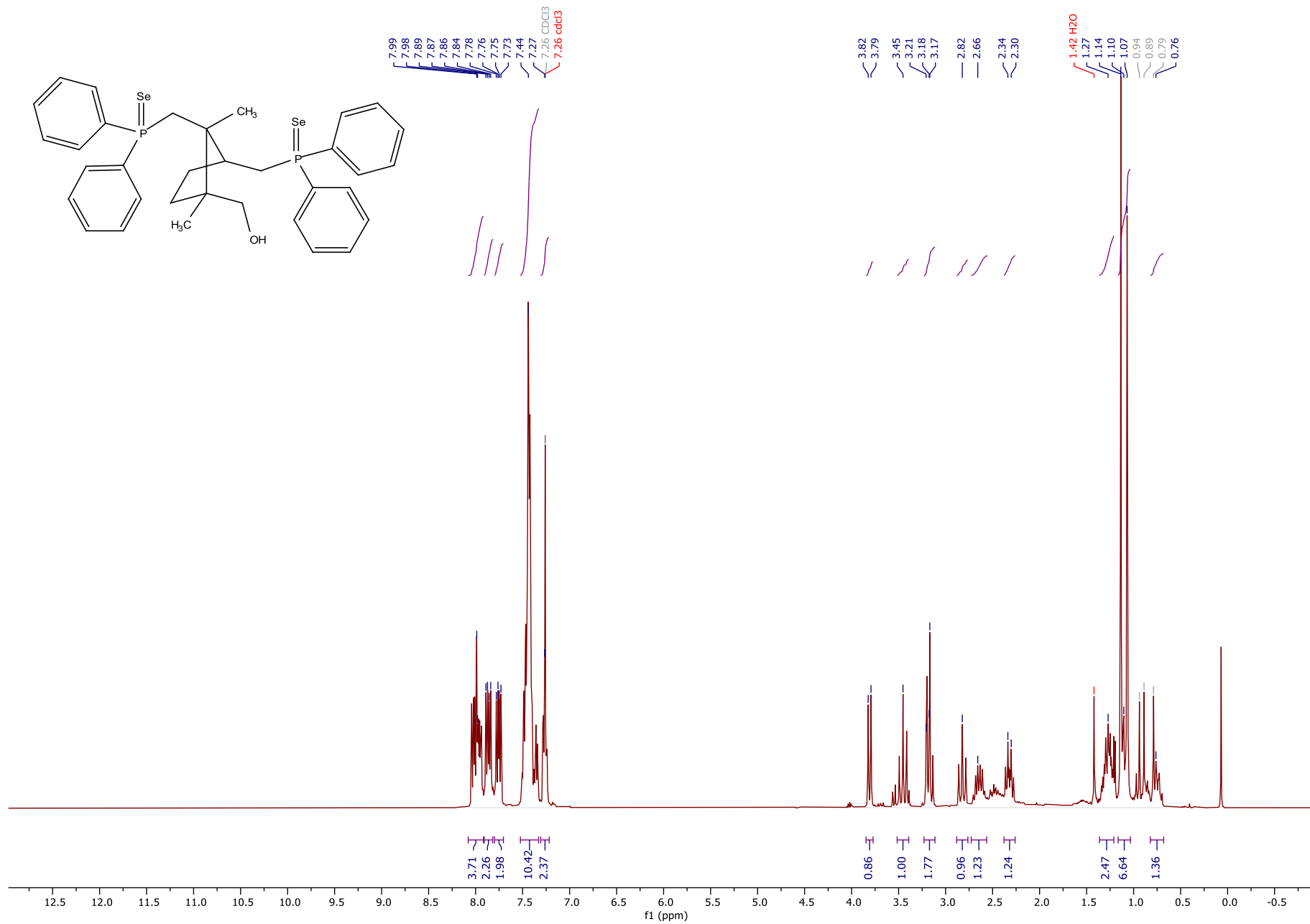
Spectrum S2. (1*S*,3*R*,4*S*,7*R*)-3-Bromo-7-(bromomethyl)-1,7-dimethyl-3-nitrobicyclo[2.2.1]heptan-2-one 11, ¹³C{¹H} NMR (126 MHz, CD₃OD)



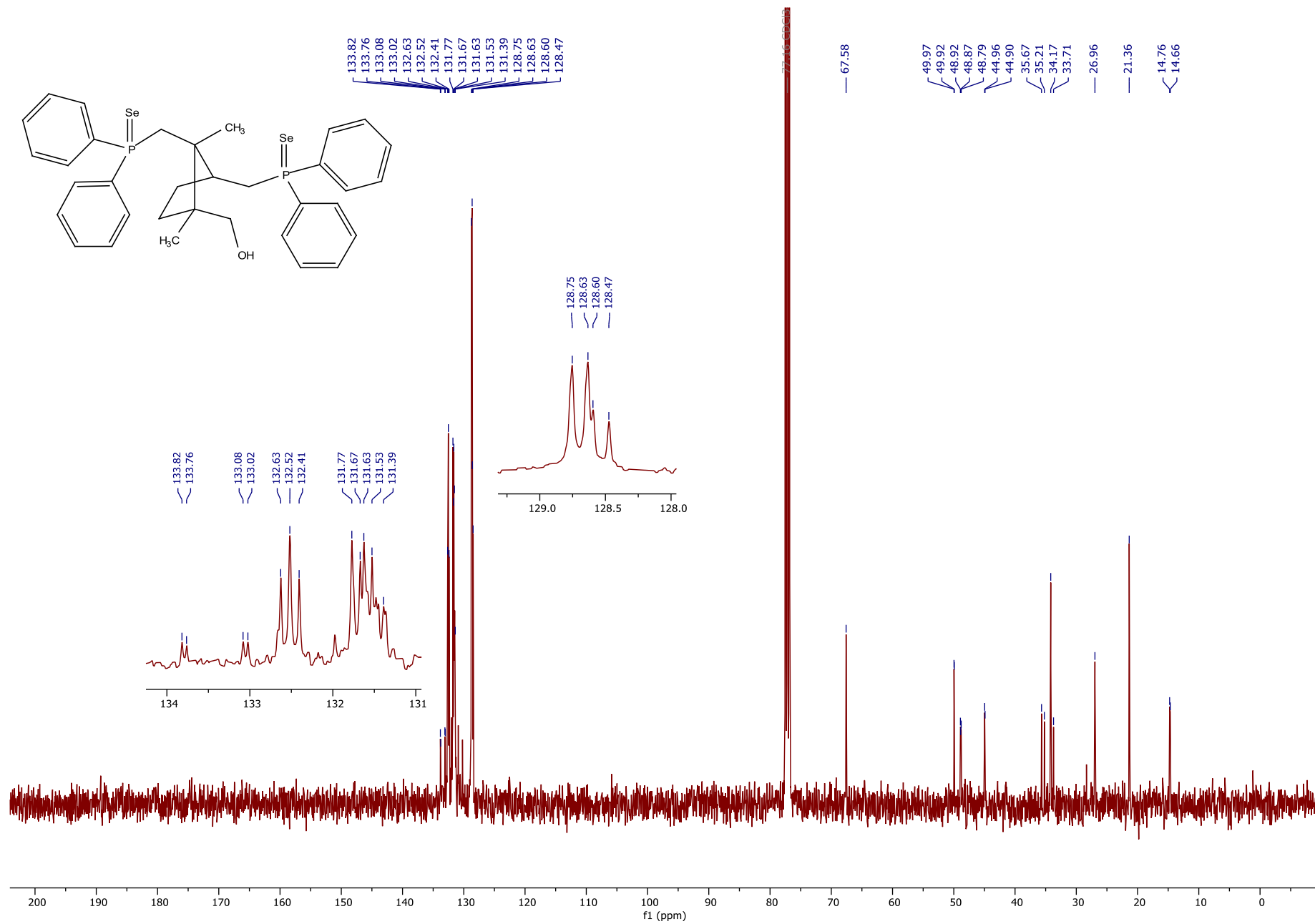
Spectrum S3. (1*S*,2*R*,3*S*)-2-(Bromomethyl)-1,2-dimethylcyclopentane-1,3-dicarboxylic acid 12, ¹H NMR (500 MHz, DMSO-*d*₆)



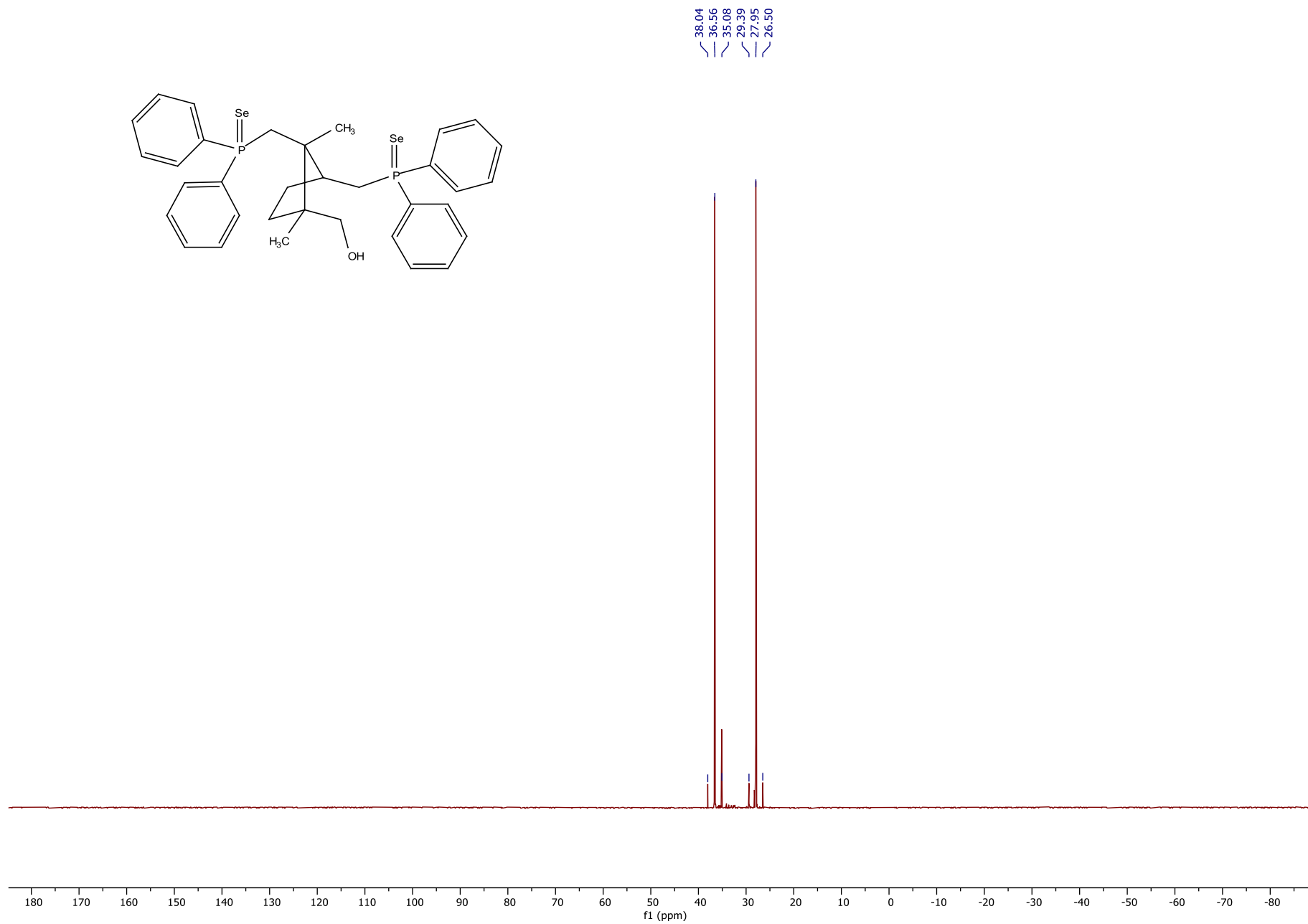
Spectrum S4. (1S,2R,3S)-2-(Bromomethyl)-1,2-dimethylcyclopentane-1,3-dicarboxylic acid 12, $^{13}\text{C}\{^1\text{H}\}$ NMR (126 MHz, DMSO- d_6)



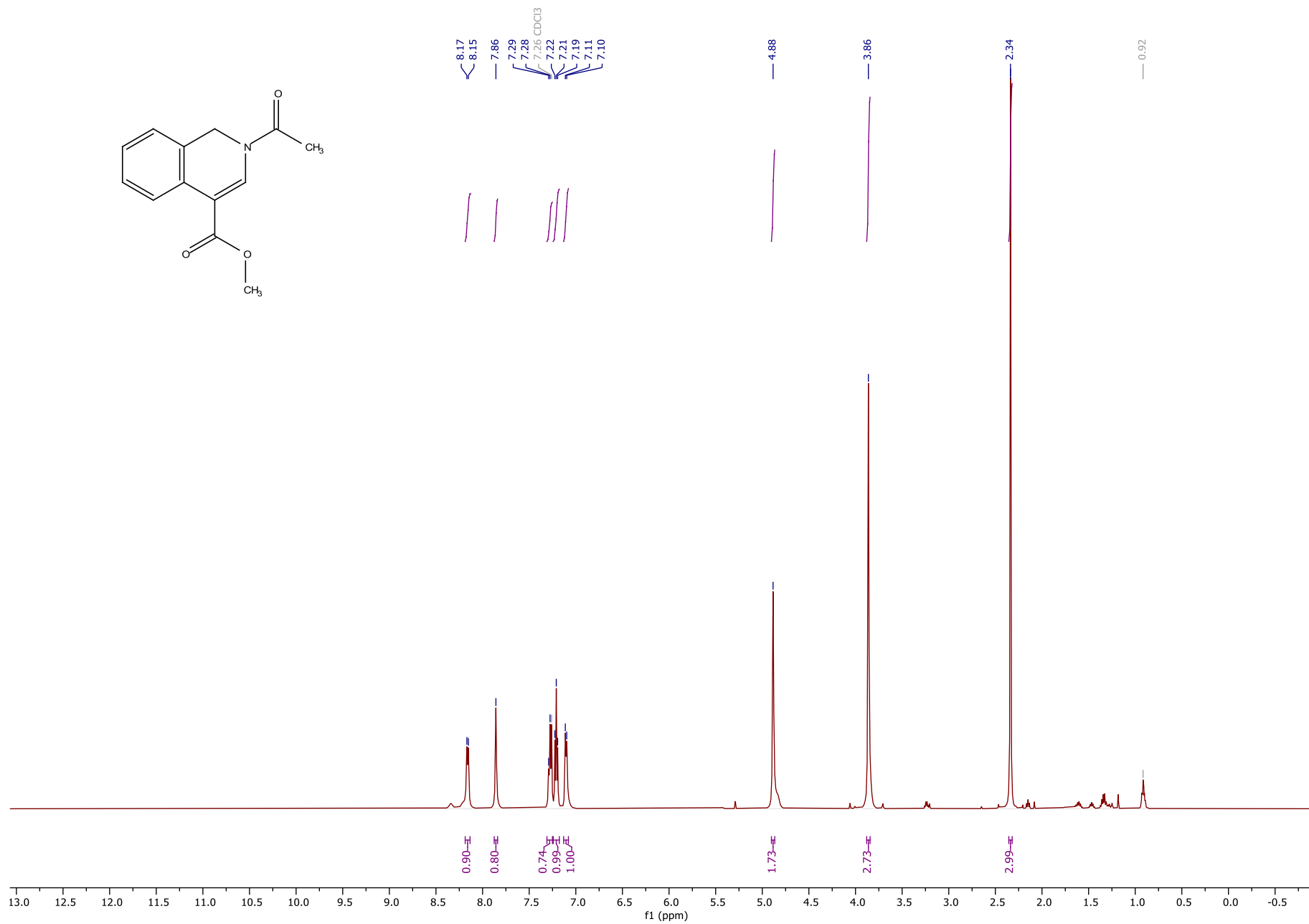
Spectrum S5. $\{(1R,2S,3S)\text{-}2\text{-}\{[\text{Diphenyl}(\text{selanylidene})\text{-}\lambda^5\text{-phosphanyl}]\text{methyl}\}\text{-}3\text{-}(\text{hydroxymethyl})\text{-}2,3\text{-dimethylcyclopentyl}\}\text{methyl}\}\text{diphenyl-}\lambda^5\text{-phosphaneselone 13, } ^1\text{H NMR (400 MHz, } \text{CDCl}_3\text{)}$



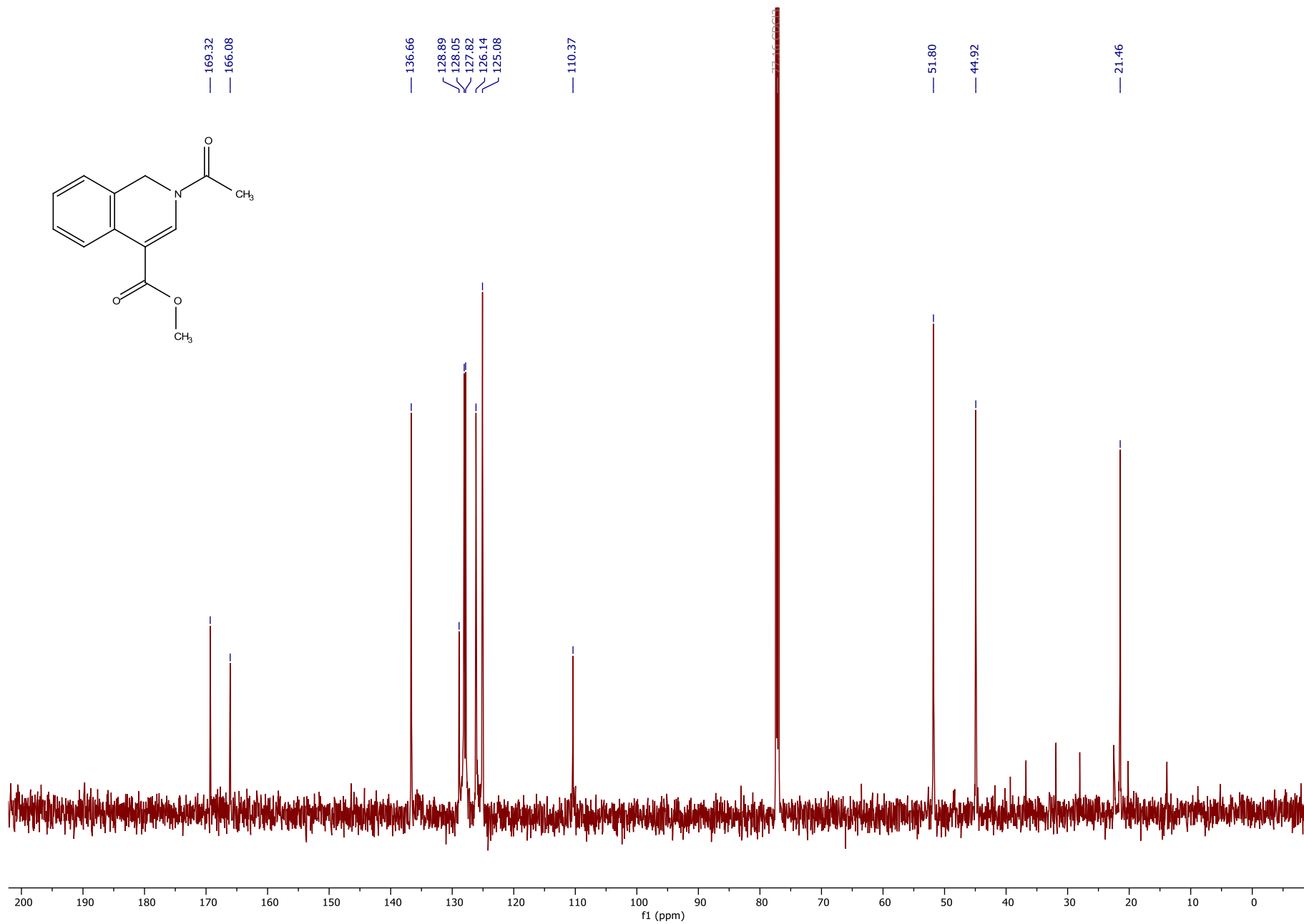
Spectrum S6. $\{[(1R,2S,3S)\text{-}2\text{-}\{[\text{Diphenyl}(\text{selanylidene})\text{-}\lambda^5\text{-phosphanyl}] \text{methyl}\}\text{-}3\text{-}(\text{hydroxymethyl})\text{-}2,3\text{-dimethylcyclopentyl}\} \text{methyl}\} \text{diphenyl-}\lambda^5\text{-phosphaneselone 13, }^{13}\text{C}\{^1\text{H}\} \text{NMR (101 MHz, CDCl}_3\text{)}$



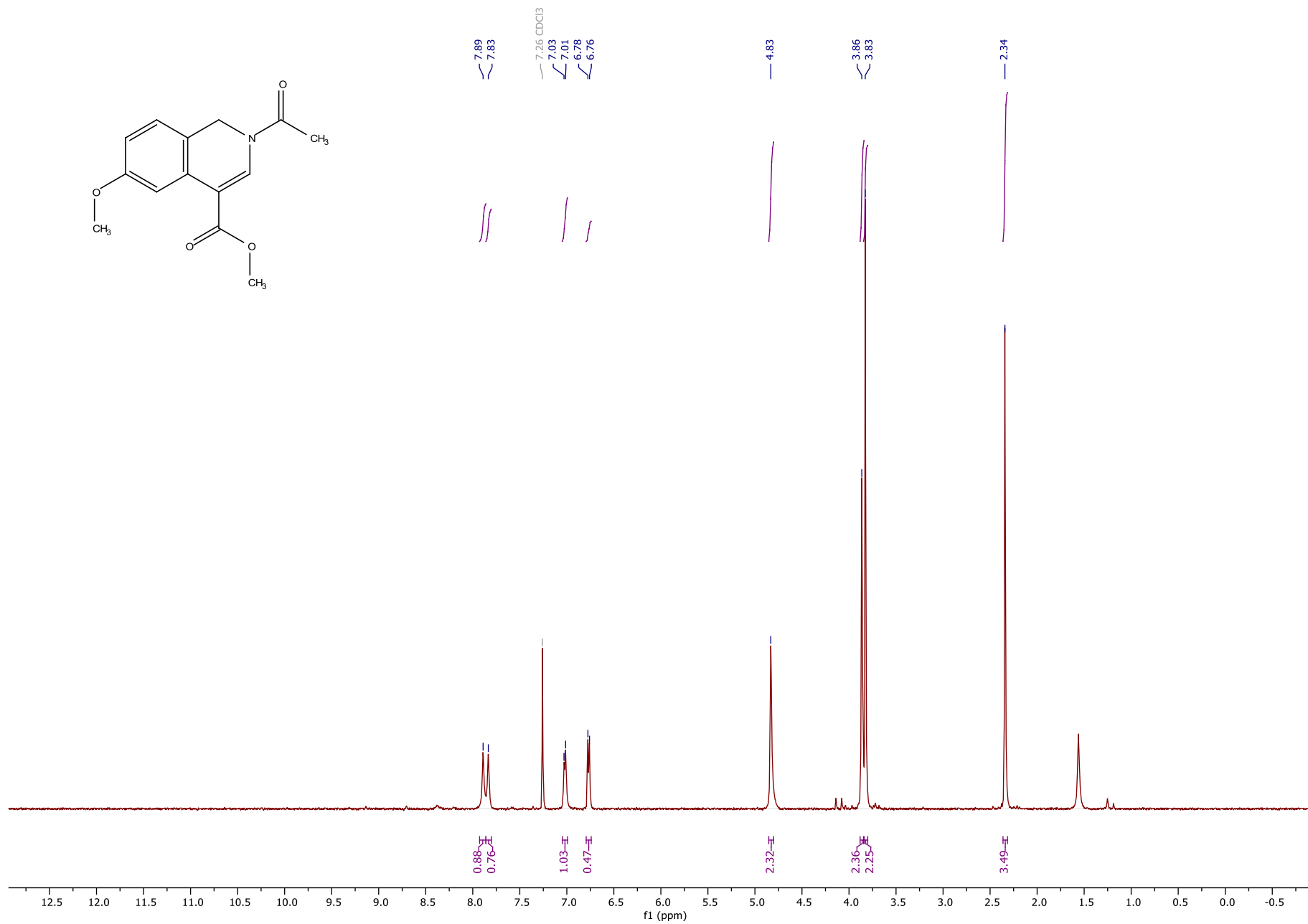
Spectrum S7. $\{(1R,2S,3S)\text{-}2\text{-}\{[\text{Diphenyl}(\text{selanylidene})\text{-}\lambda^5\text{-phosphanyl}]\text{methyl}\}\text{-}3\text{-}(\text{hydroxymethyl})\text{-}2,3\text{-dimethylcyclopentyl}\}\text{methyl}\}$ diphenyl- λ^5 -phosphaneselone 13, $^{31}\text{P}\{^1\text{H}\}$ NMR (243 MHz, CDCl_3)



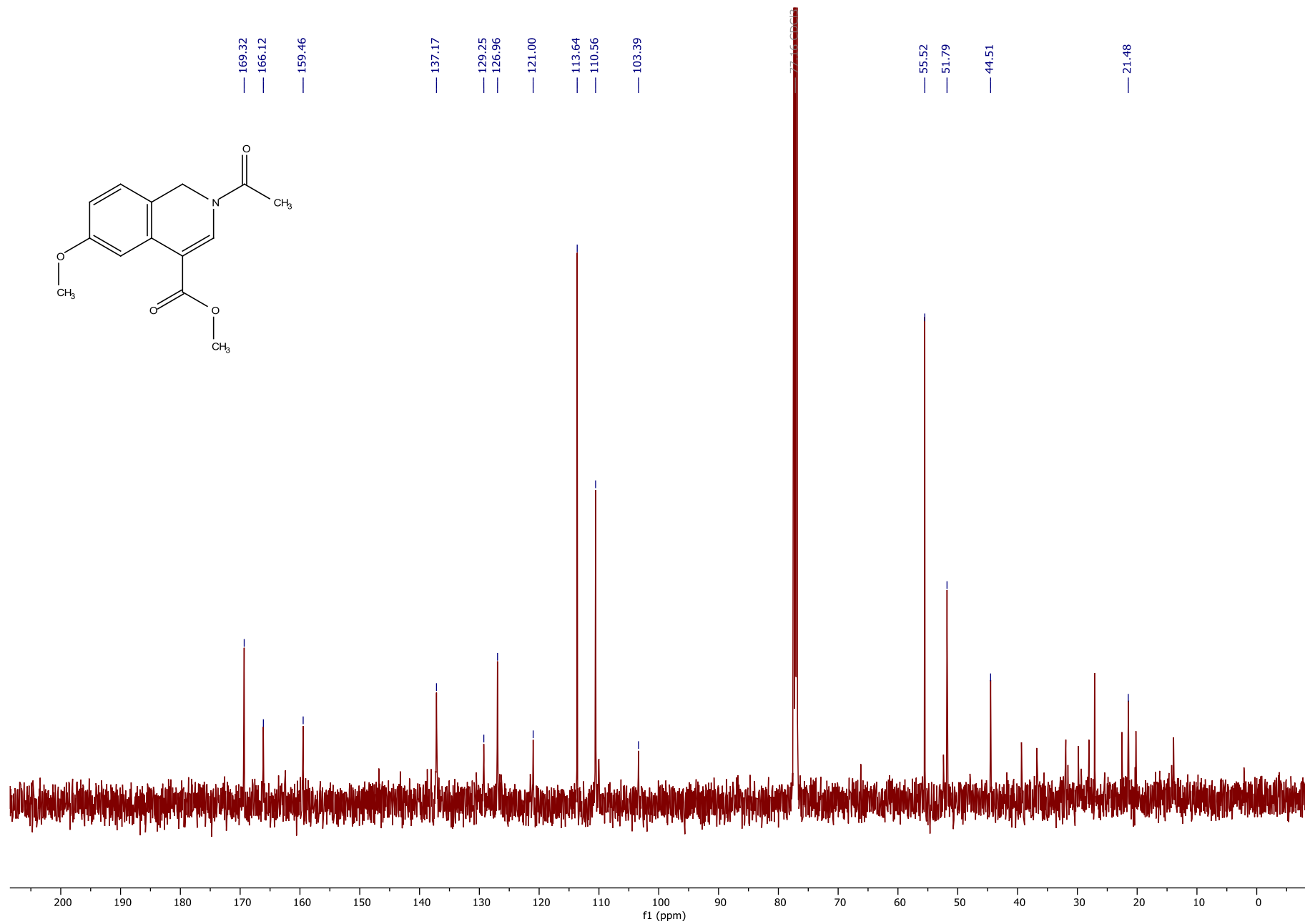
Spectrum S8. Methyl 2-acetyl-1,2-dihydroisoquinoline-4-carboxylate 14a, ¹H NMR (500 MHz, CDCl₃)



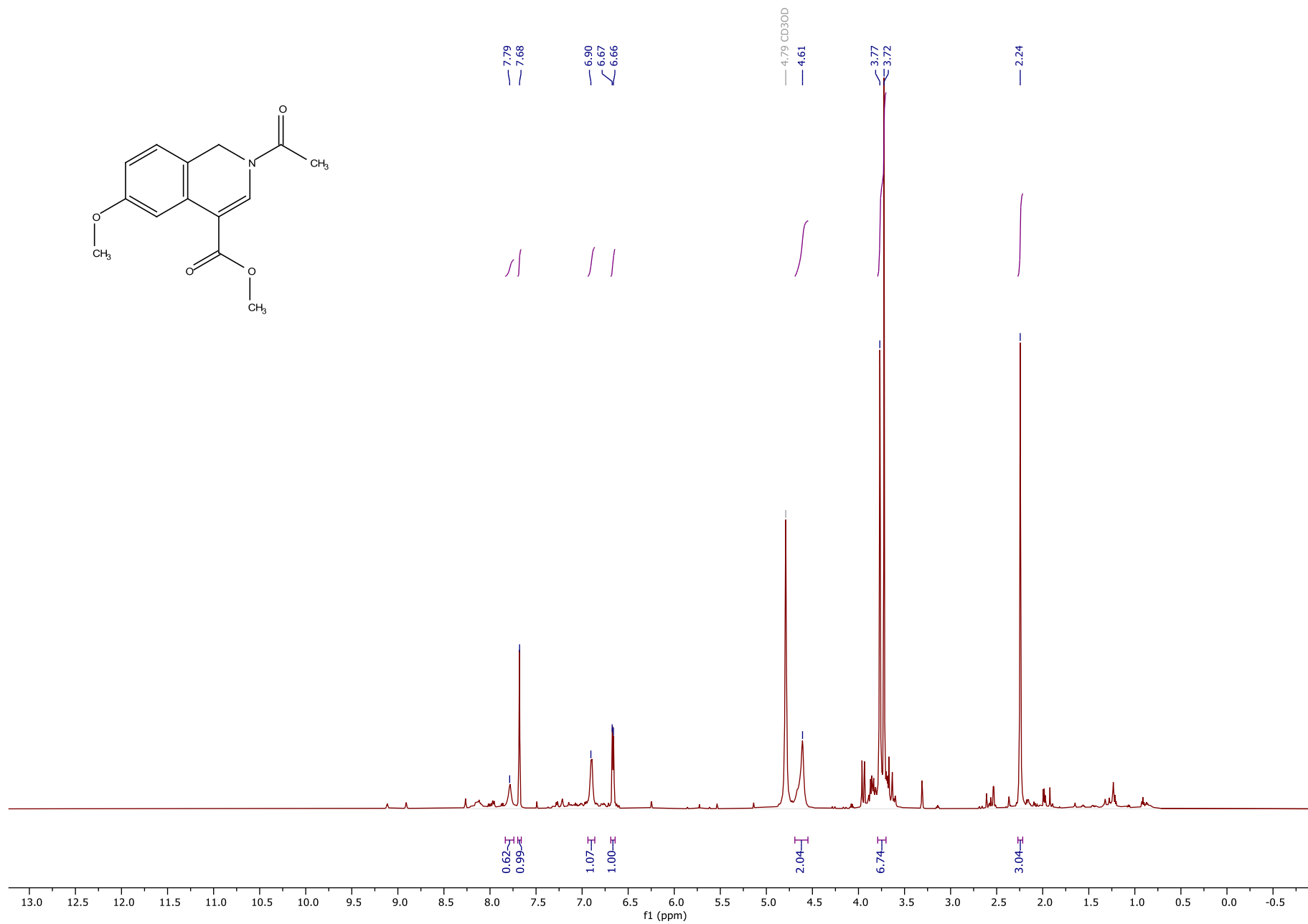
Spectrum S9. Methyl 2-acetyl-1,2-dihydroisoquinoline-4-carboxylate 14a, $^{13}\text{C}\{^1\text{H}\}$ NMR (151 MHz, CDCl_3)



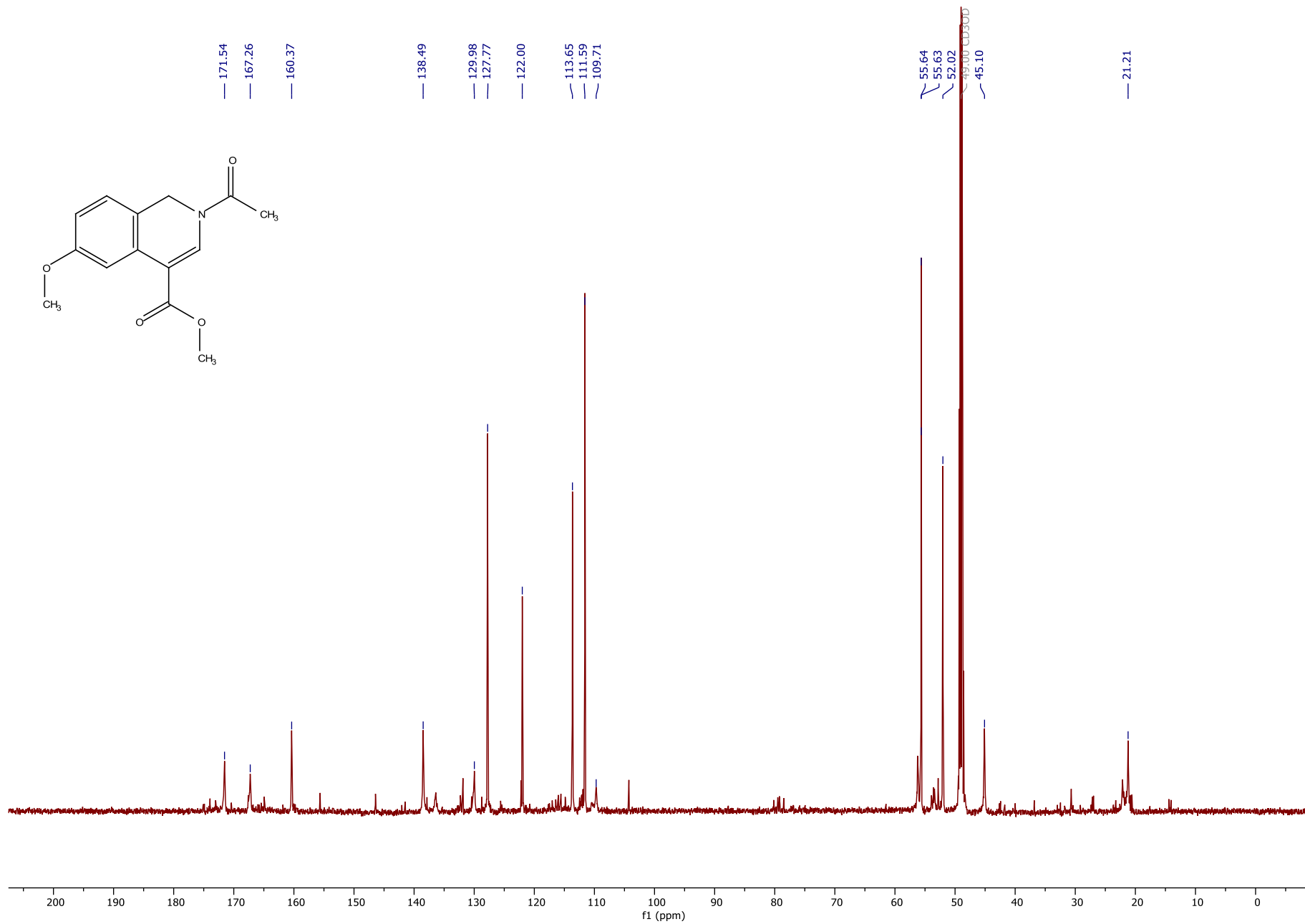
Spectrum S10. Methyl 2-acetyl-6-methoxy-1,2-dihydroisoquinoline-4-carboxylate 14b, ¹H NMR (500 MHz, CDCl₃)



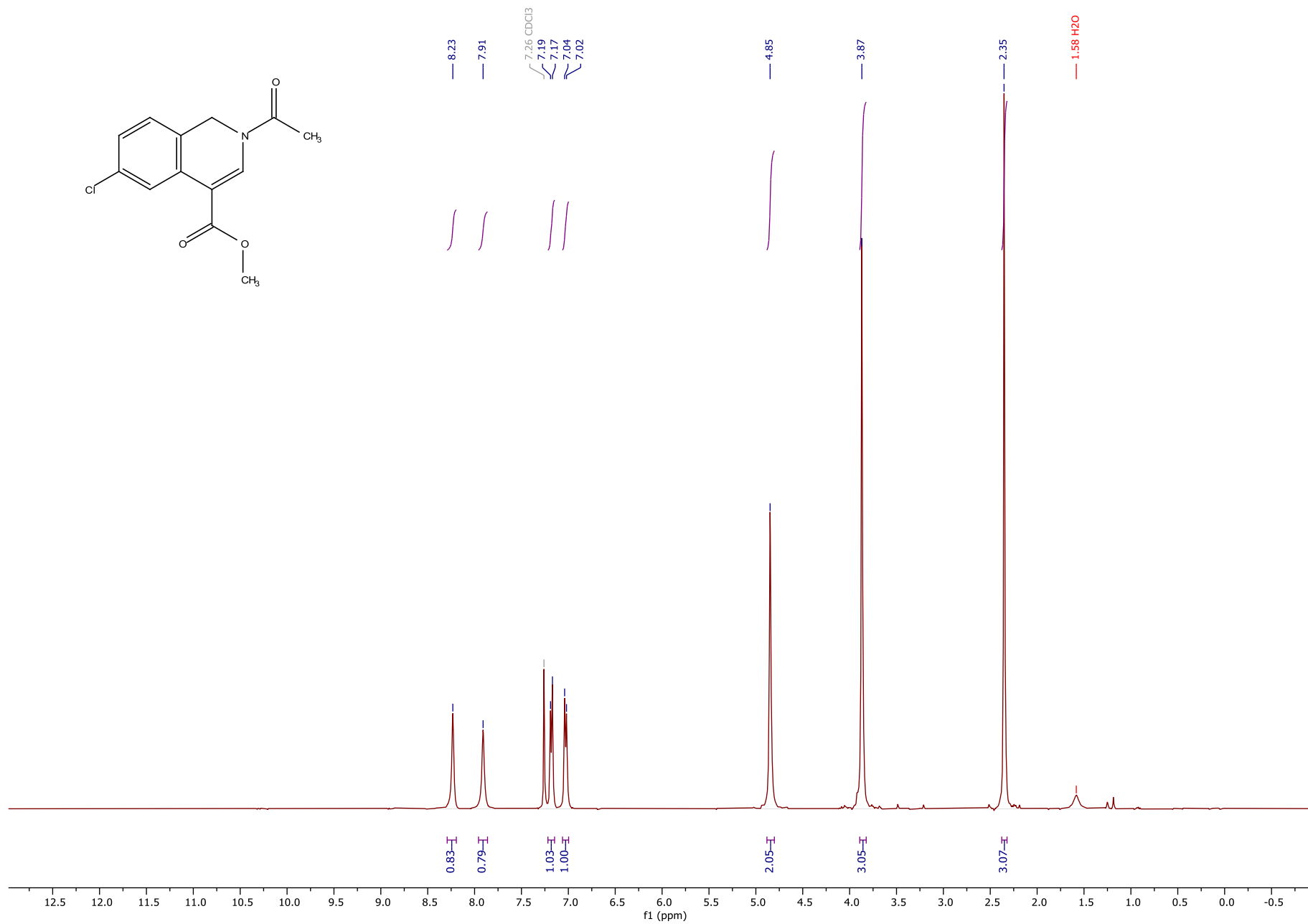
Spectrum S11. Methyl 2-acetyl-6-methoxy-1,2-dihydroisoquinoline-4-carboxylate 14b, $^{13}\text{C}\{^1\text{H}\}$ NMR (126 MHz, CDCl_3)



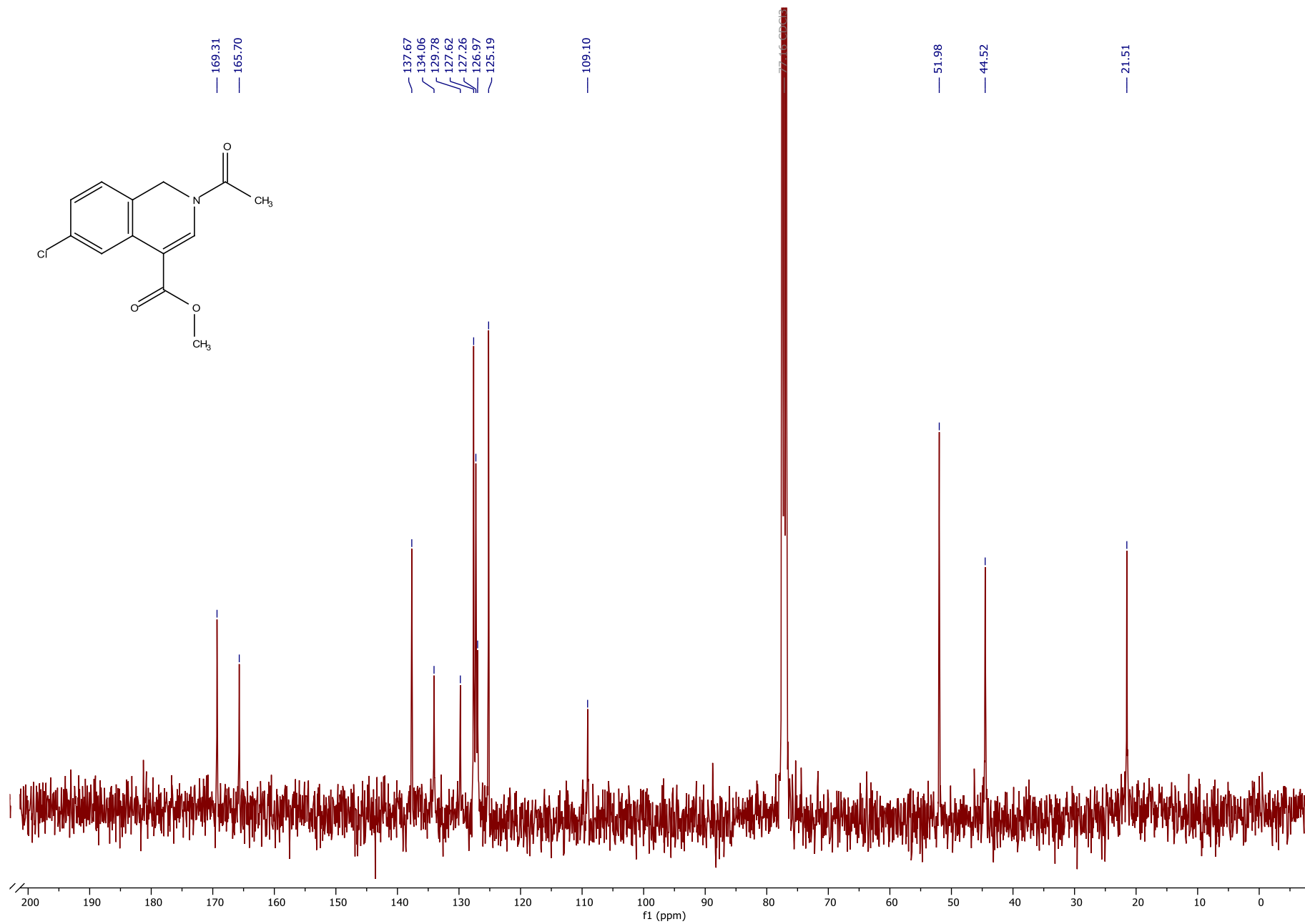
Spectrum S12. Methyl 2-acetyl-6-methoxy-1,2-dihydroisoquinoline-4-carboxylate 14b, ¹H NMR (600 MHz, CD₃OD)



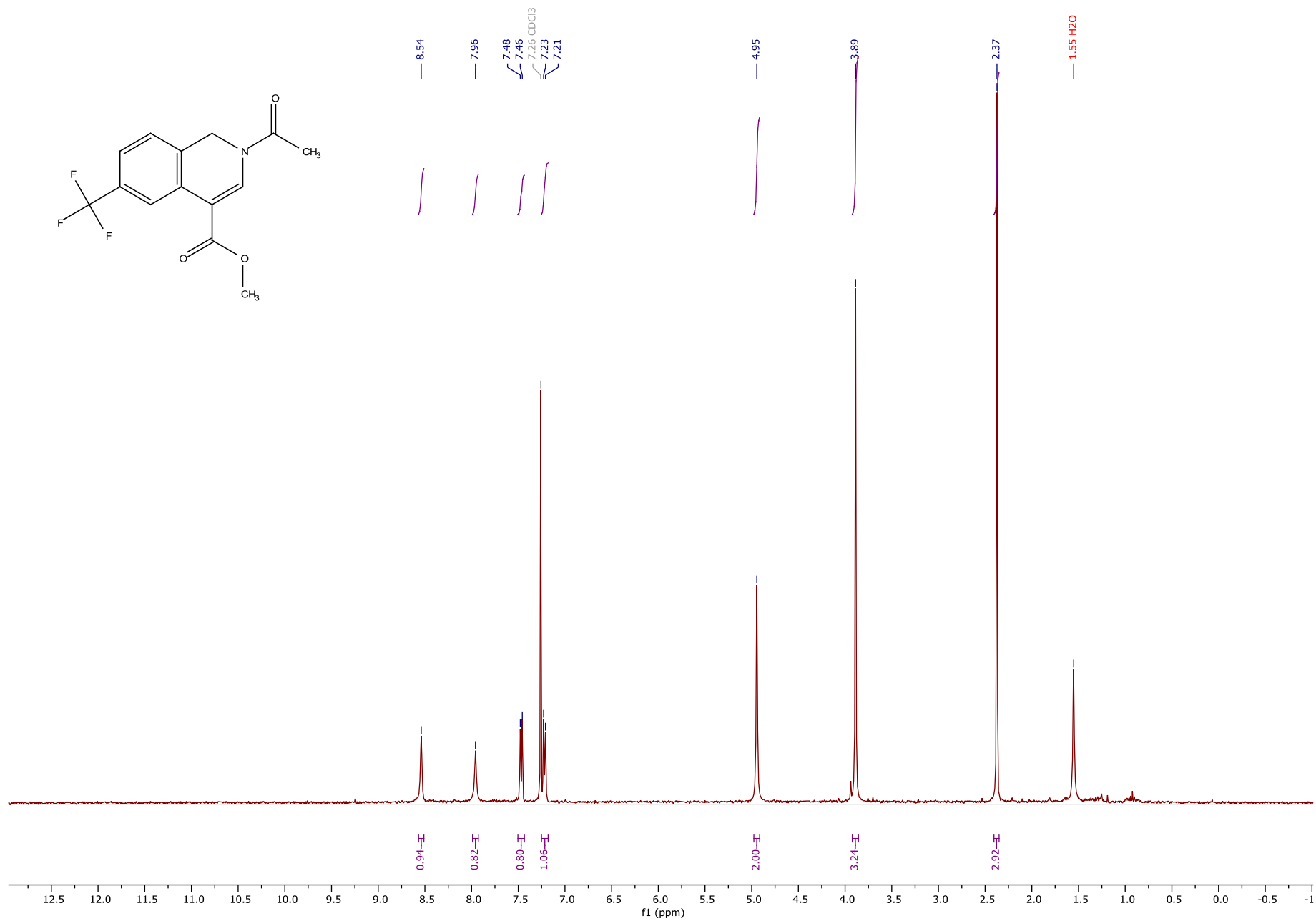
Spectrum S13. Methyl 2-acetyl-6-methoxy-1,2-dihydroisoquinoline-4-carboxylate 14b, $^{13}\text{C}\{^1\text{H}\}$ NMR (151 MHz, CD_3OD)



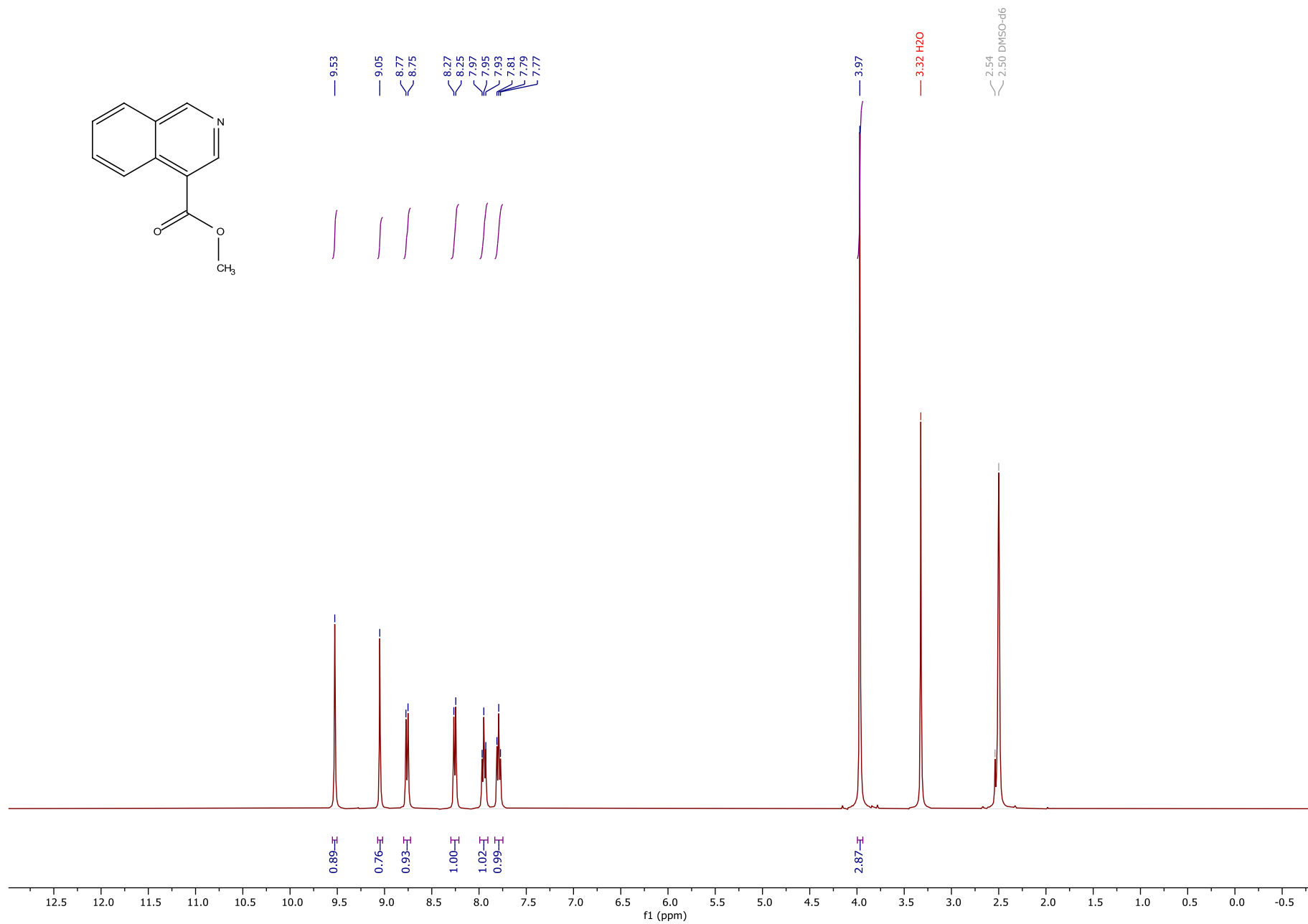
Spectrum S14. Methyl 2-acetyl-6-chloro-1,2-dihydroisoquinoline-4-carboxylate 14c, ¹H NMR (400 MHz, CDCl₃)



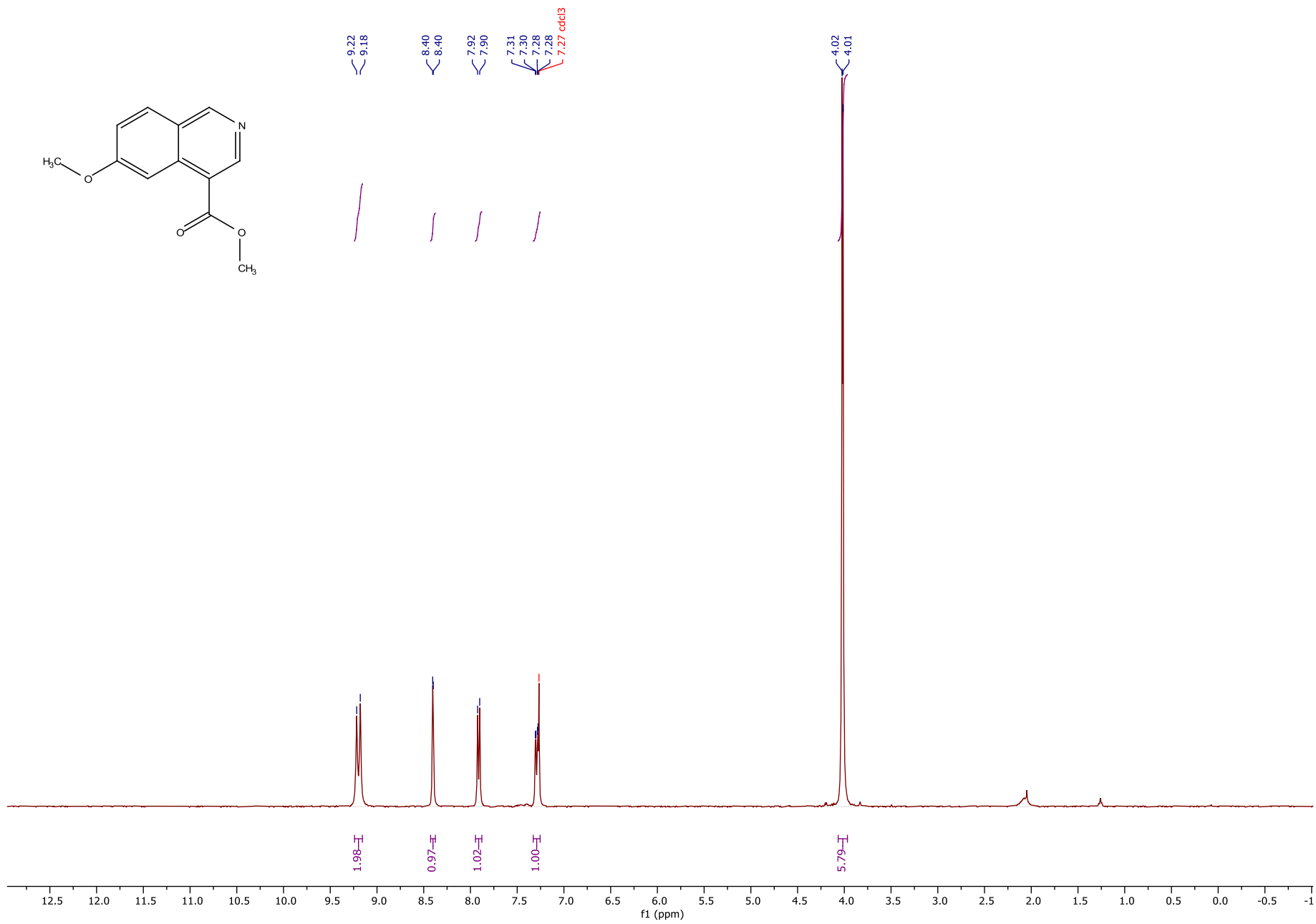
Spectrum S15. Methyl 2-acetyl-6-chloro-1,2-dihydroisoquinoline-4-carboxylate 14c, $^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl₃)



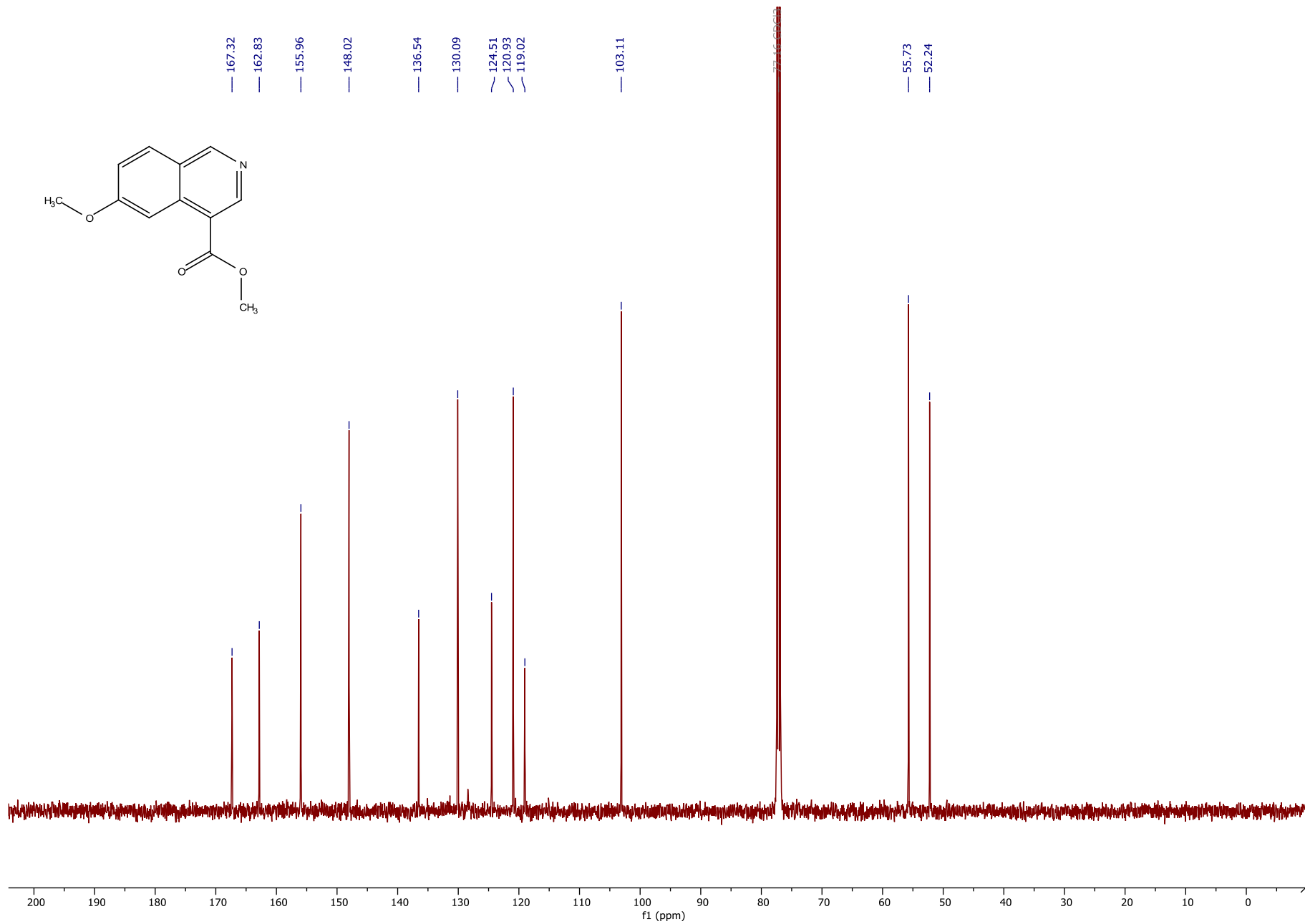
Spectrum S16. Methyl 2-acetyl-6-(trifluoromethyl)-1,2-dihydroisoquinoline-4-carboxylate 14d, ¹H NMR (400 MHz, CDCl₃)



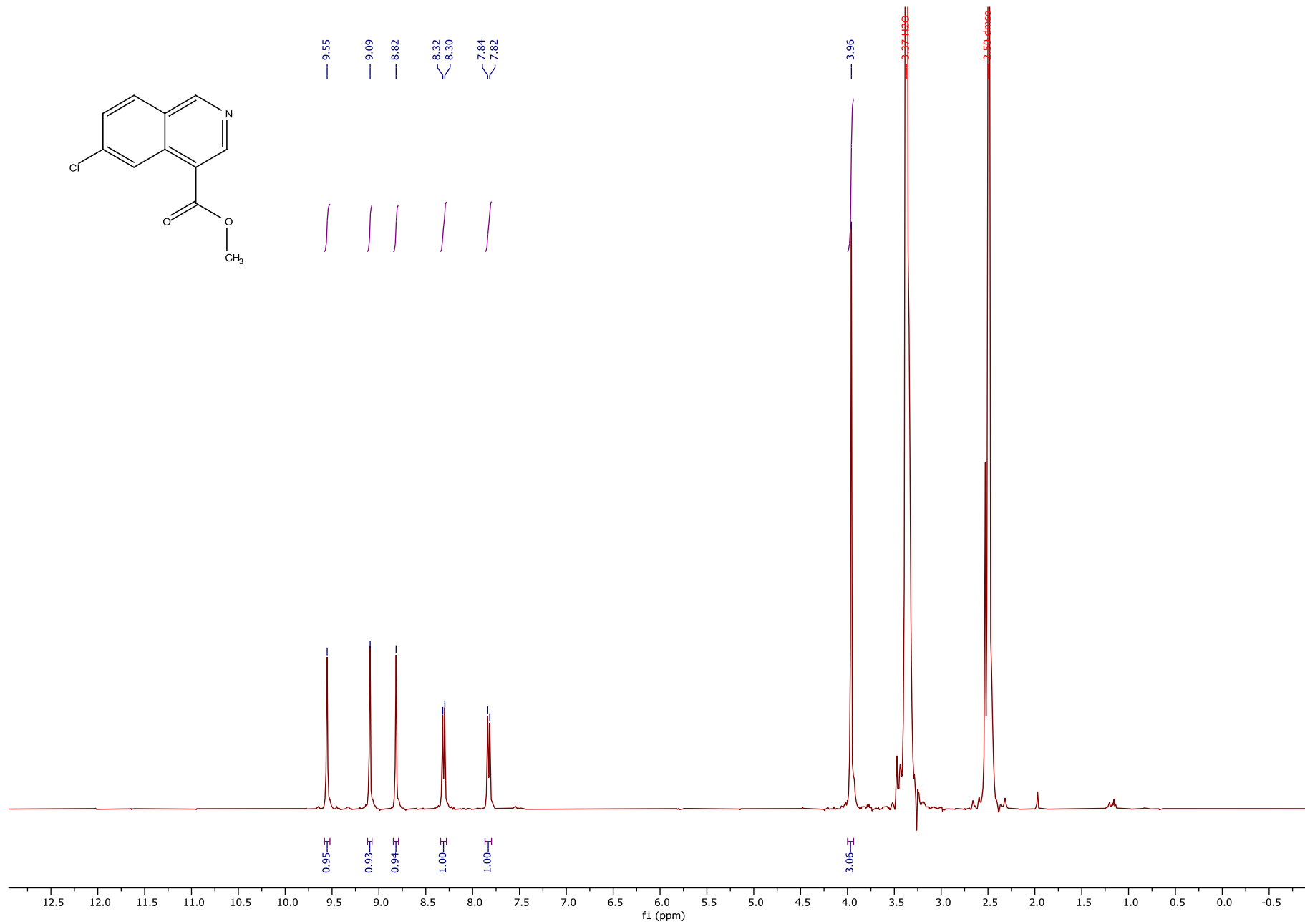
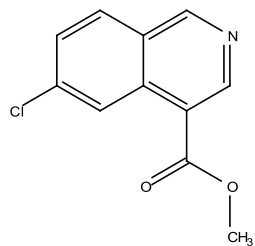
Spectrum S17. Methyl isoquinoline-4-carboxylate 15a, ¹H NMR (400 MHz, DMSO-d₆)



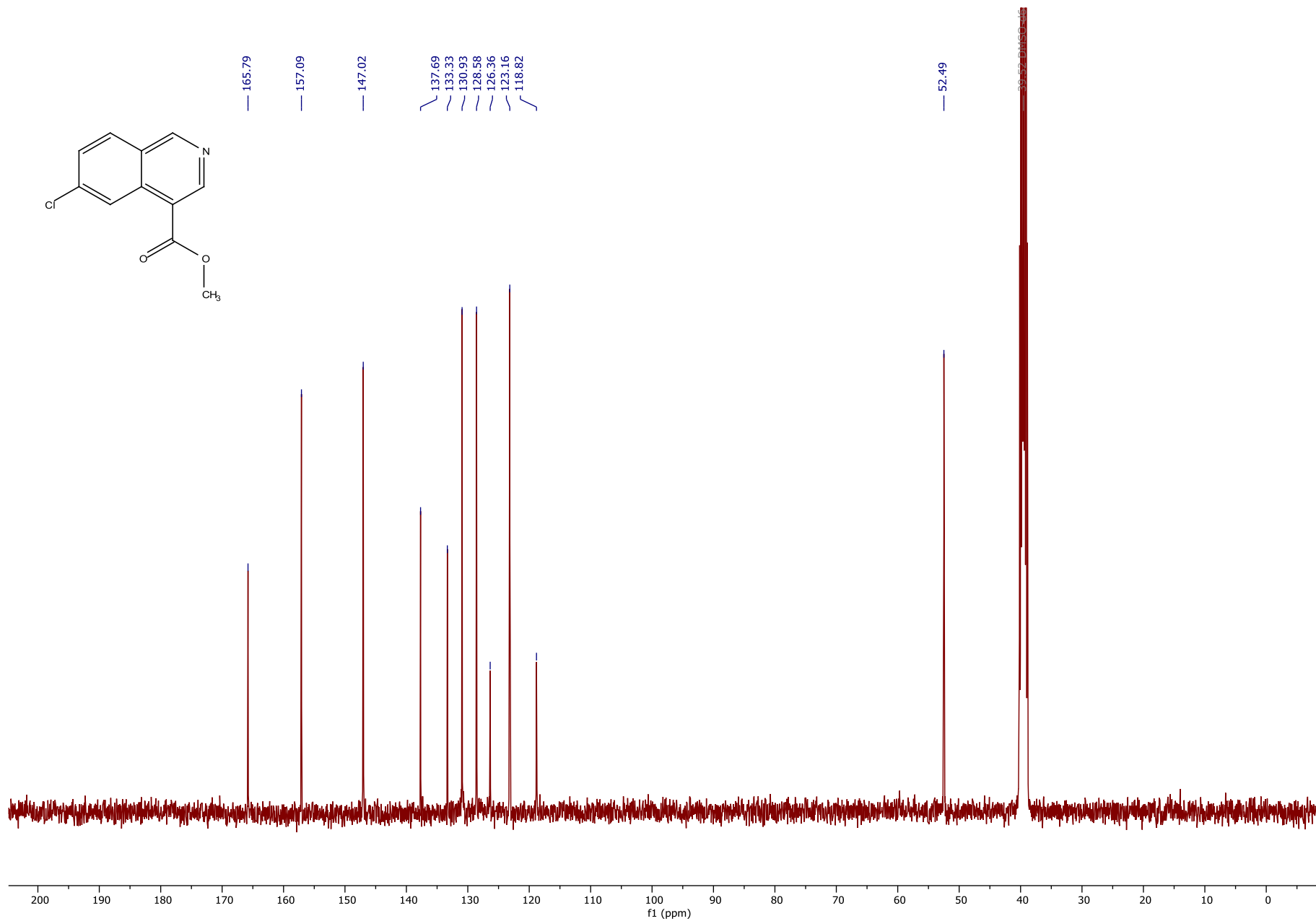
Spectrum S18. Methyl 6-methoxyisoquinoline-4-carboxylate 15b, ¹H NMR (400 MHz, CDCl₃)



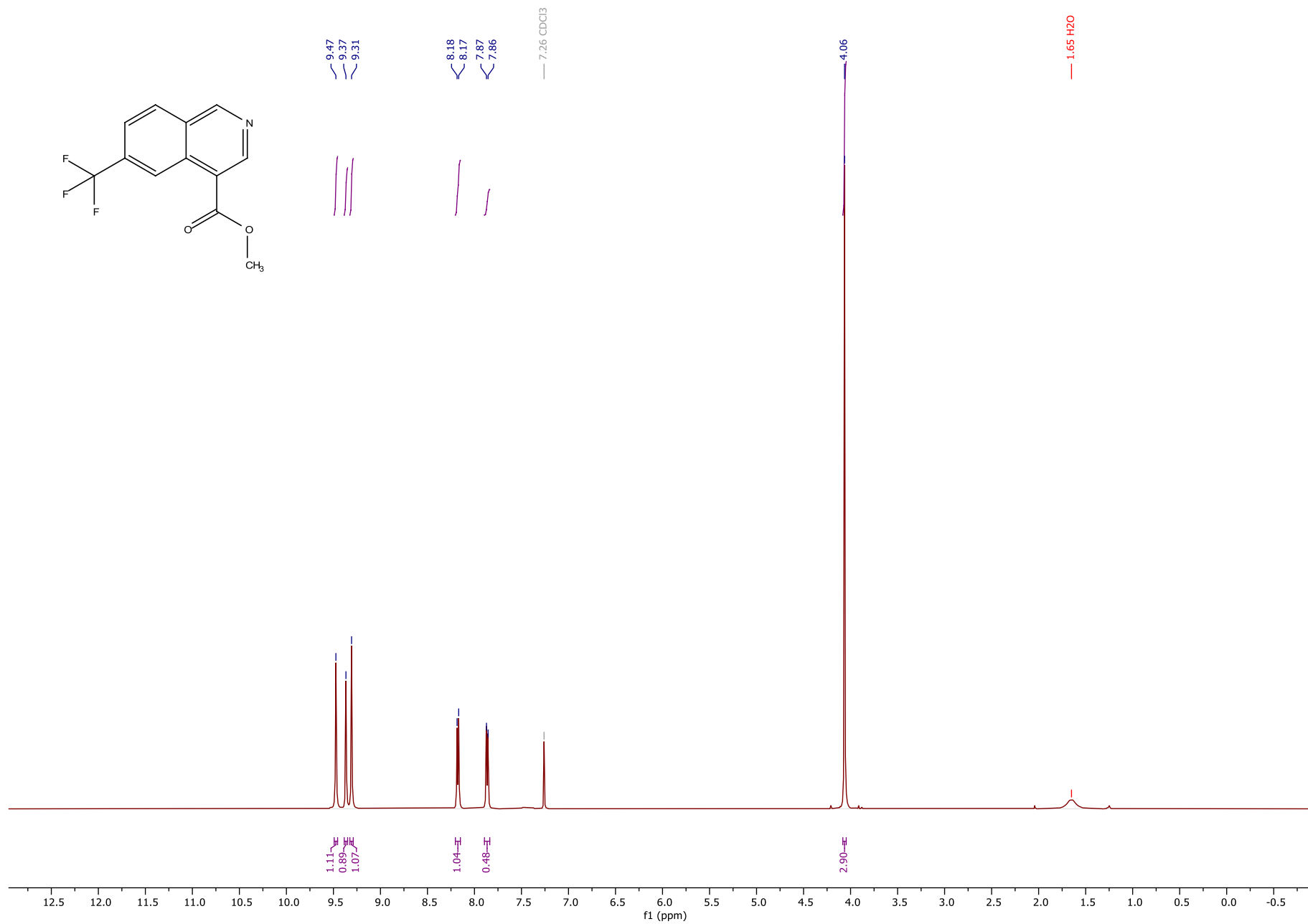
Spectrum S19. Methyl 6-methoxyisoquinoline-4-carboxylate 15b, $^{13}\text{C}\{^1\text{H}\}$ NMR (126 MHz, CDCl_3)



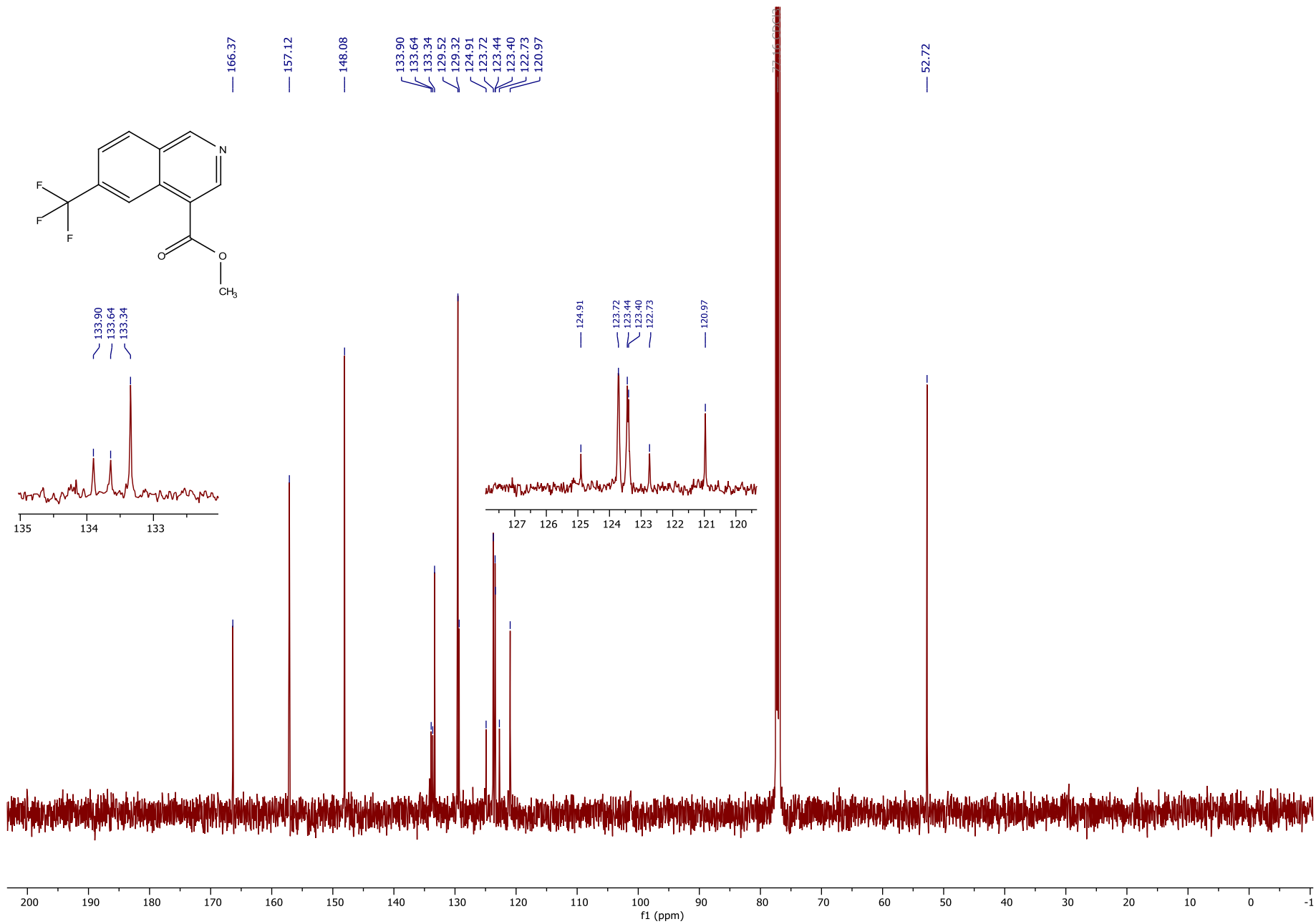
Spectrum S20. Methyl 6-chloroisoquinoline-4-carboxylate 15c, ¹H NMR (400 MHz, DMSO-*d*₆)



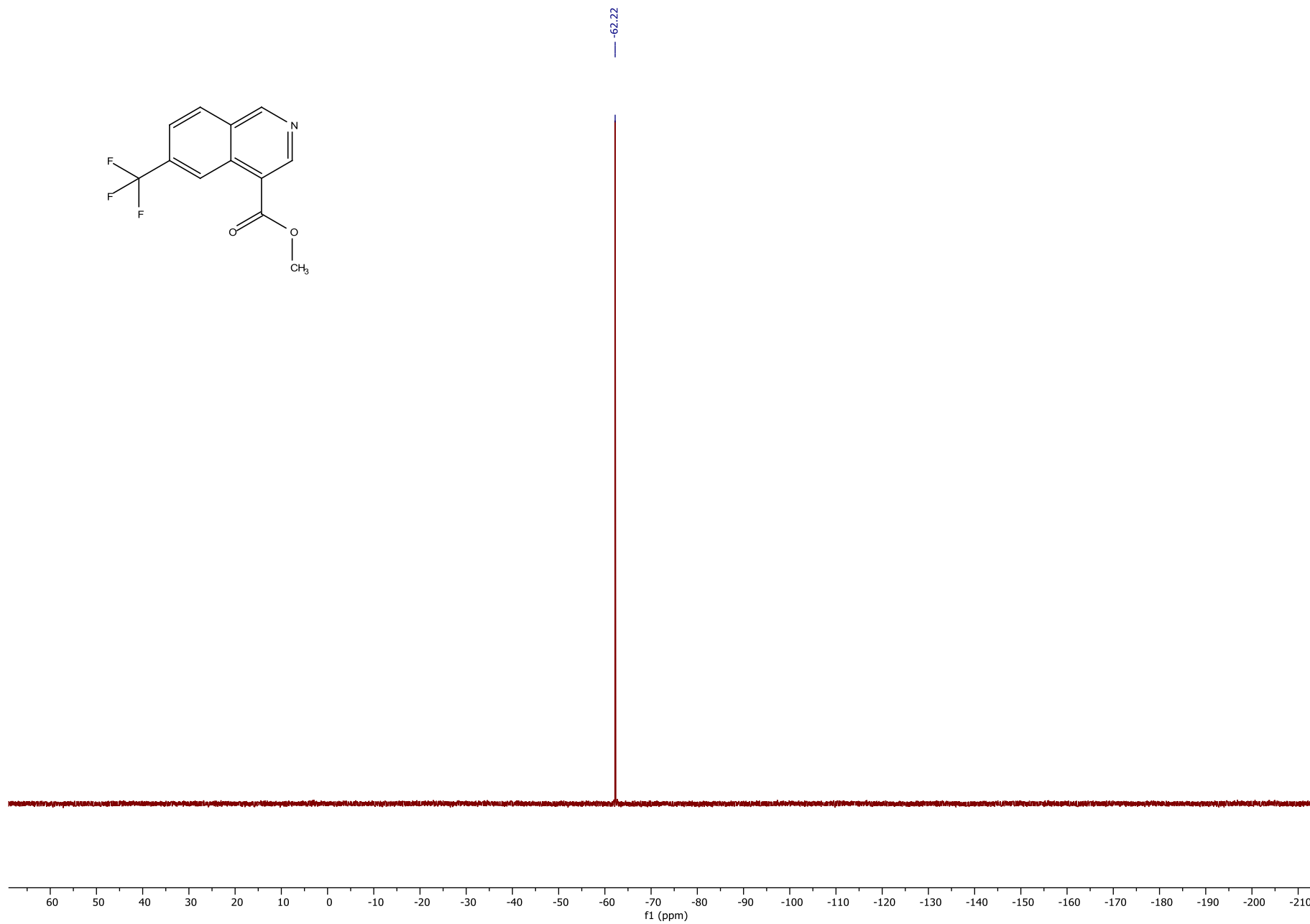
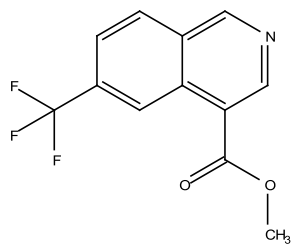
Spectrum S11. Methyl 6-chloroisoquinoline-4-carboxylate 15c, $^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, DMSO- d_6)



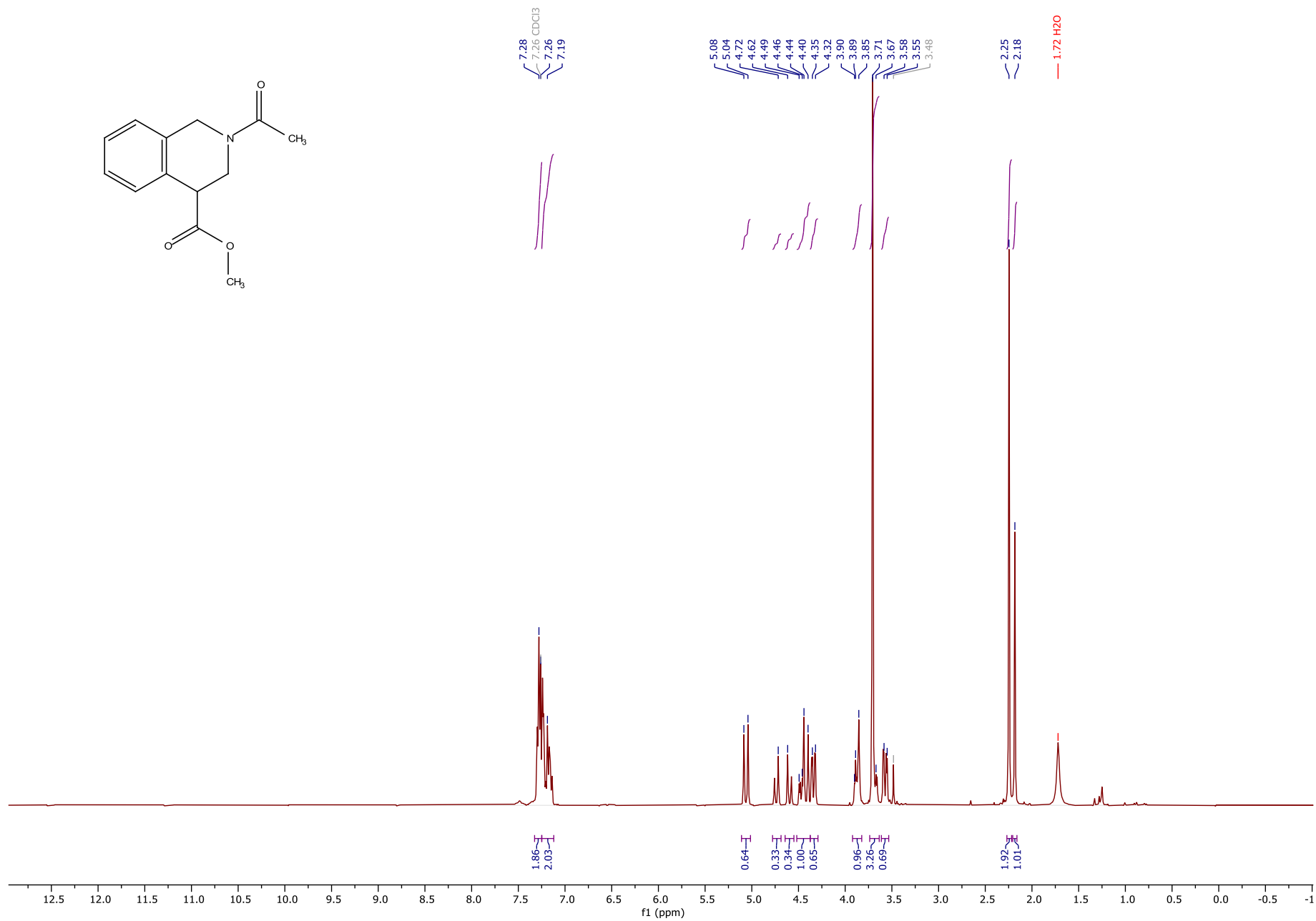
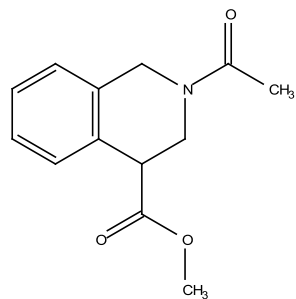
Spectrum S22. Methyl 6-(trifluoromethyl)isoquinoline-4-carboxylate 15d, ¹H NMR (500 MHz, CDCl₃)



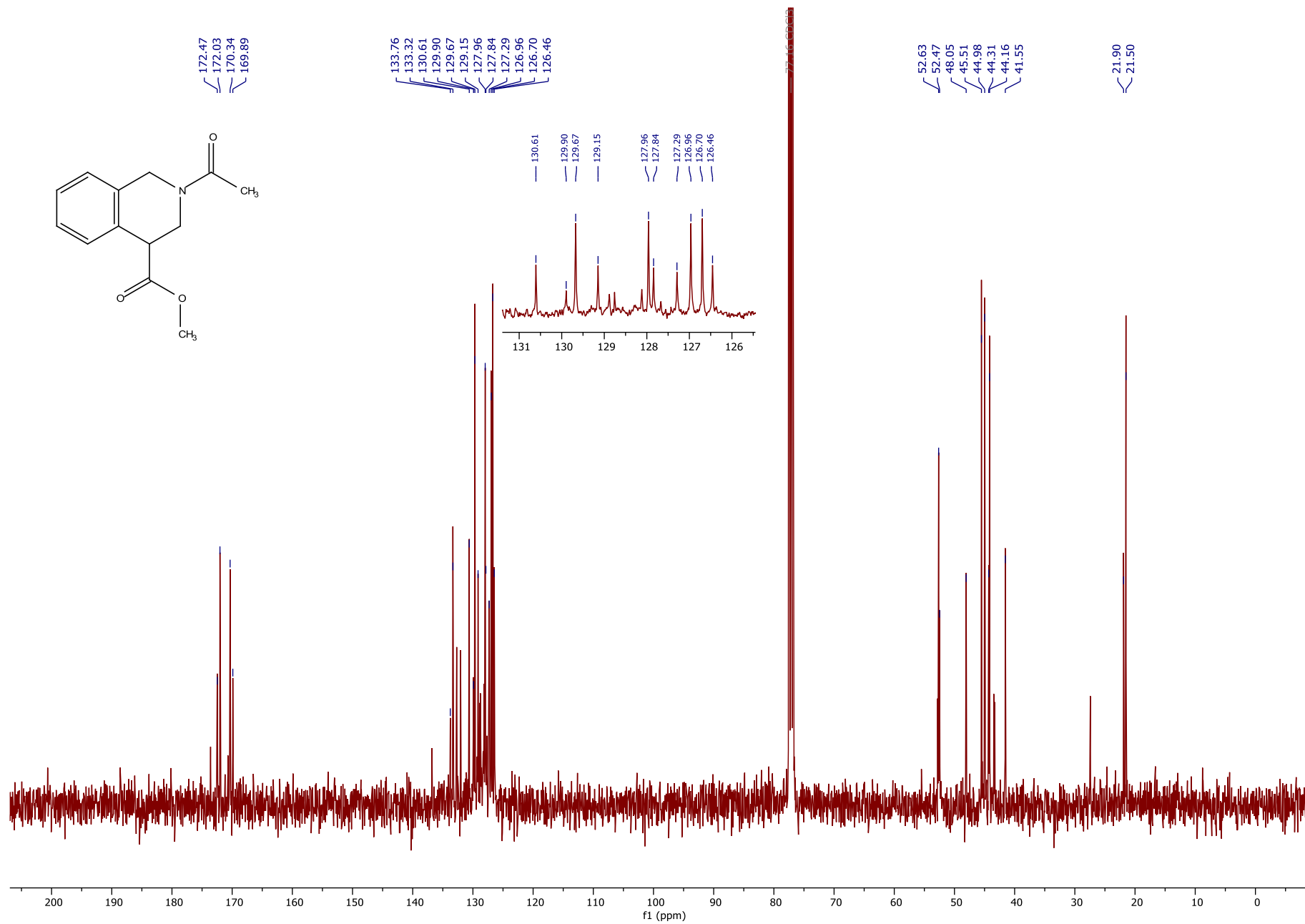
Spectrum S23. Methyl 6-(trifluoromethyl)isoquinoline-4-carboxylate 15d, $^{13}\text{C}\{^1\text{H}\}$ NMR (126 MHz, CDCl_3)



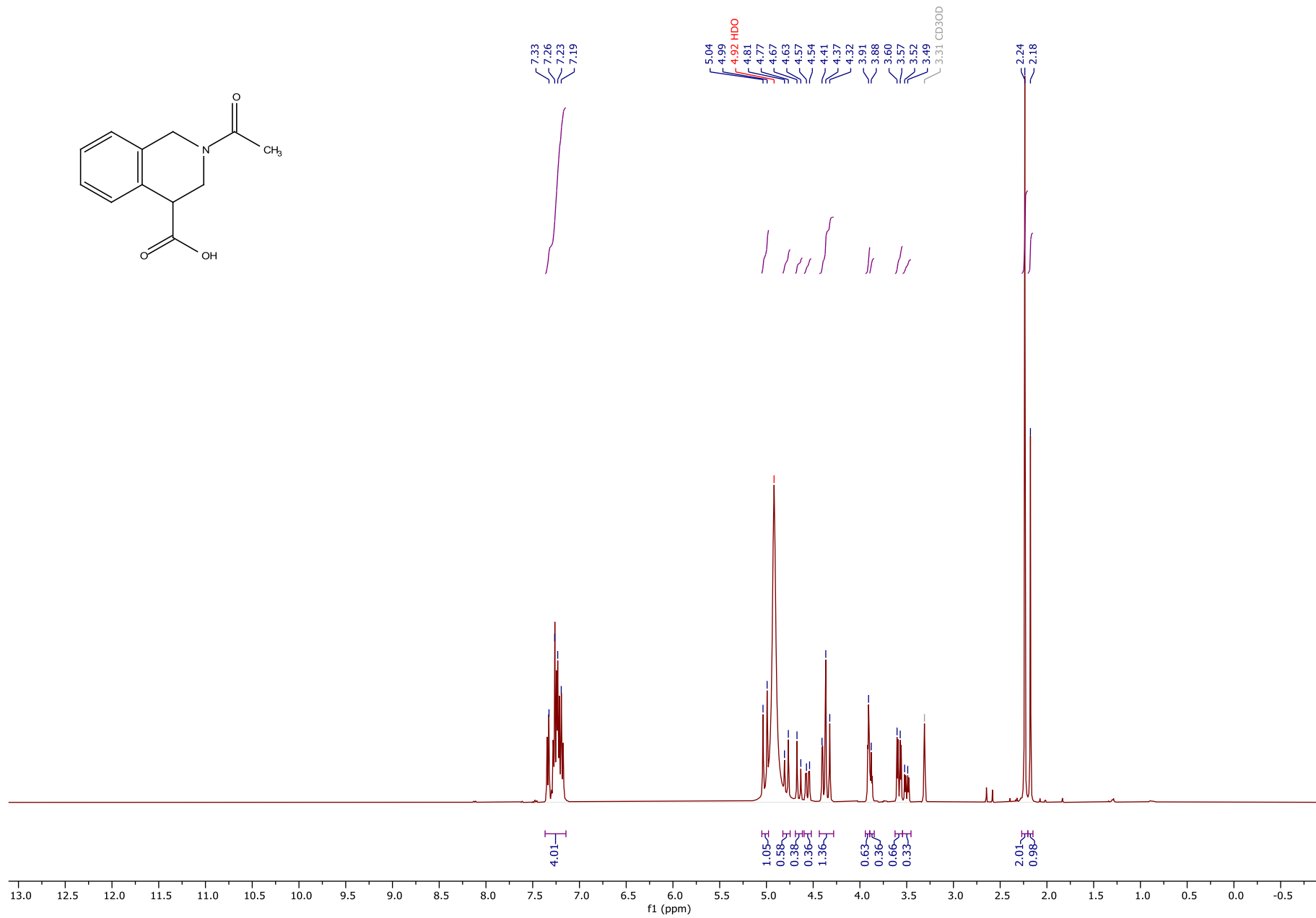
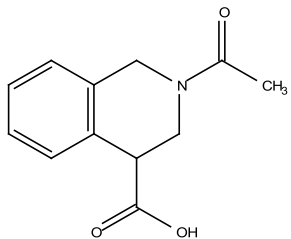
Spectrum S3. Methyl 6-(trifluoromethyl)isoquinoline-4-carboxylate 15d, ¹⁹F{¹H} NMR (376 MHz, CDCl₃)



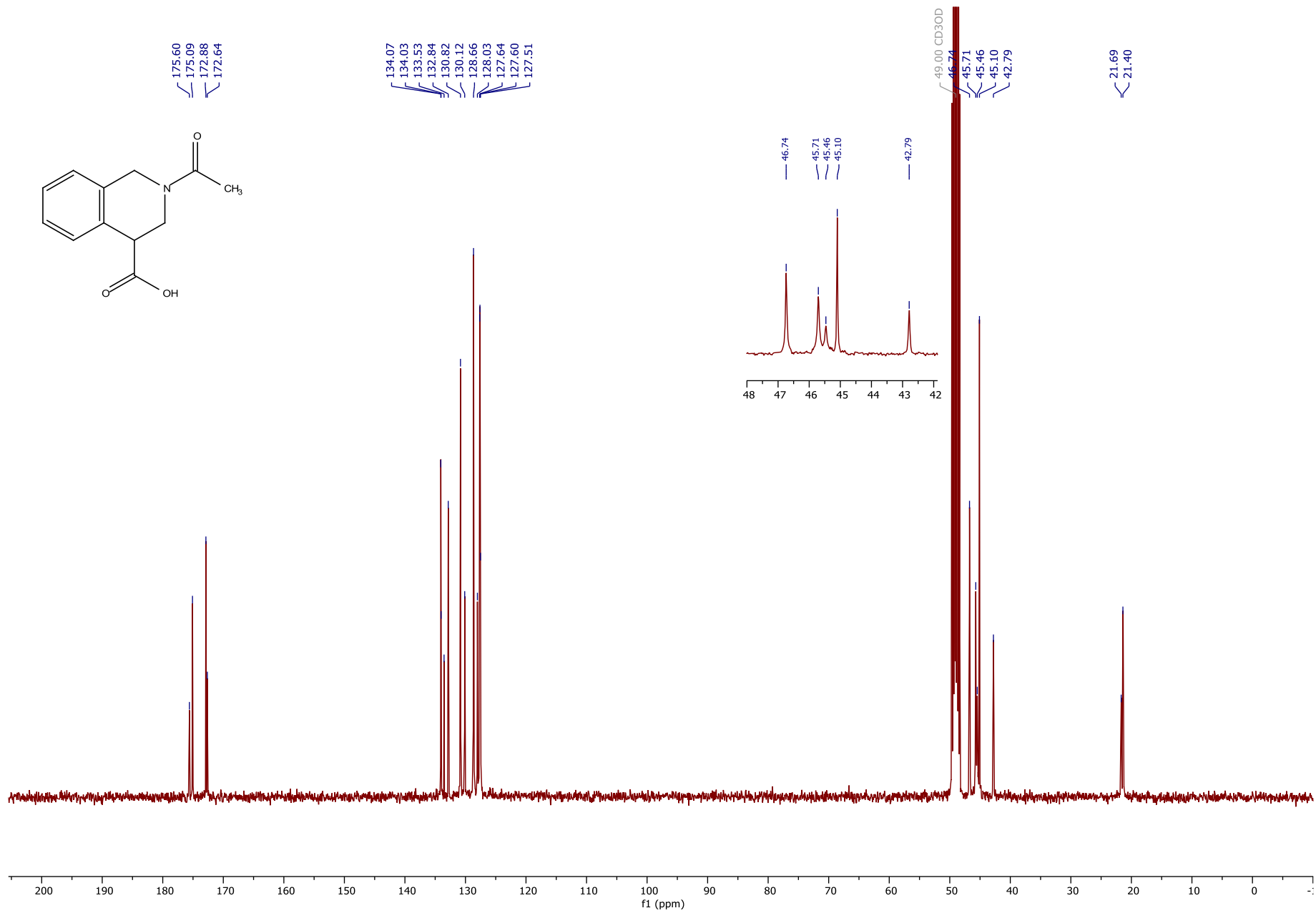
Spectrum S25. Methyl 2-acetyl-1,2,3,4-tetrahydroisoquinoline-4-carboxylate 17a, ¹H NMR (400 MHz, CDCl₃)



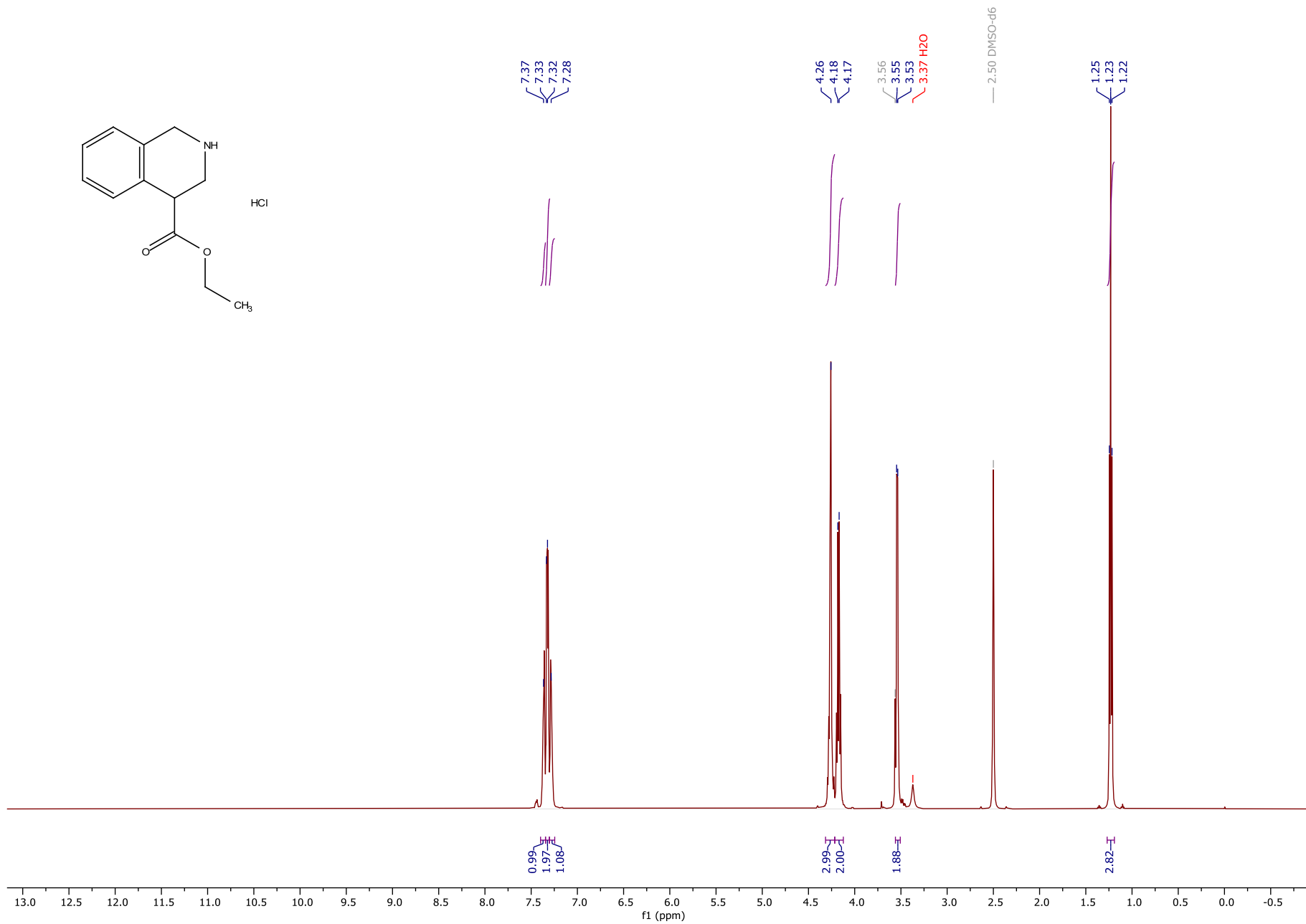
Spectrum S46. Methyl 2-acetyl-1,2,3,4-tetrahydroisoquinoline-4-carboxylate 17a, $^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CDCl_3)



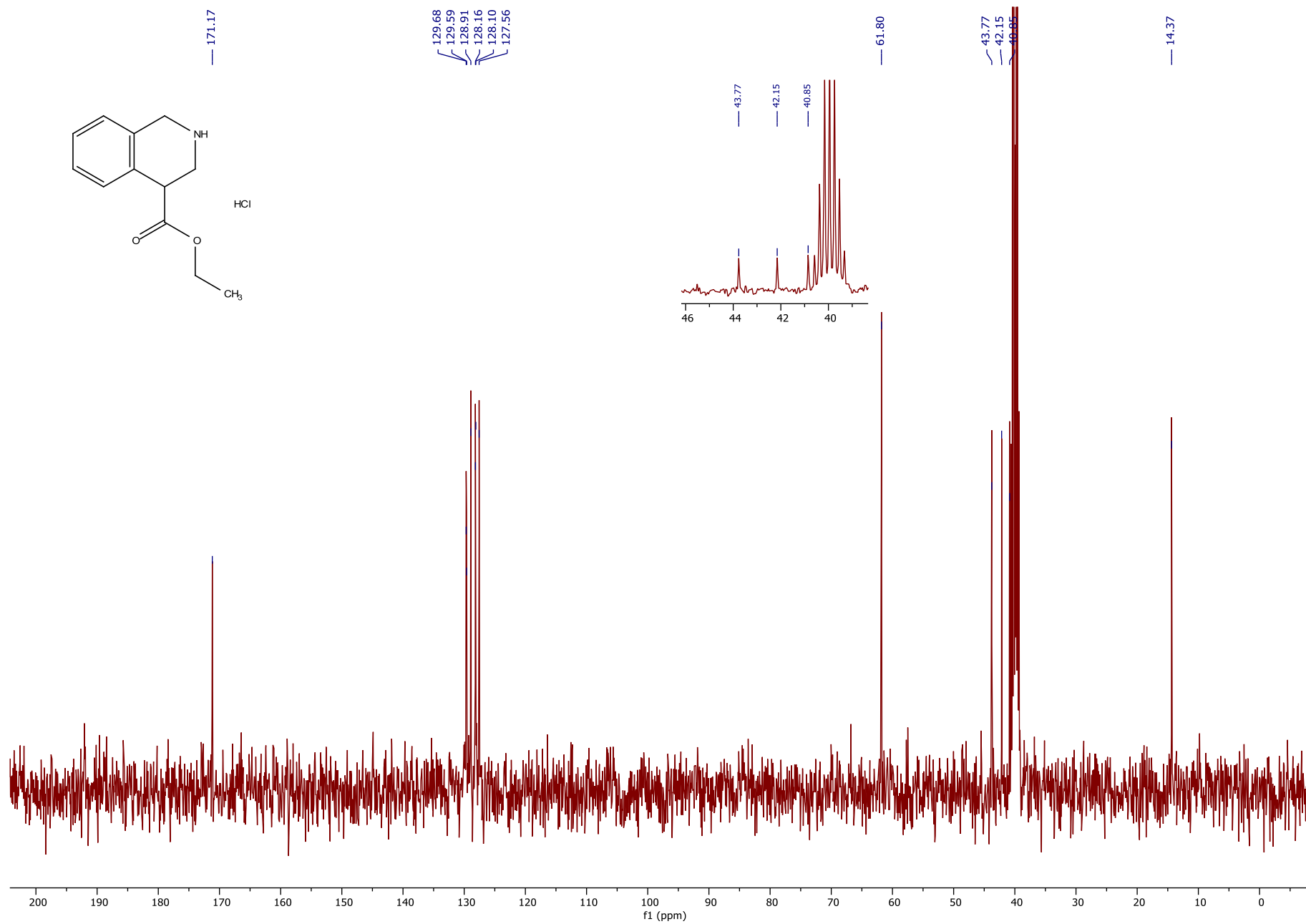
Spectrum S27. 2-Acetyl-1,2,3,4-tetrahydroisoquinoline-4-carboxylic acid 19, ¹H NMR (400 MHz, CD₃OD)



Spectrum S58. 2-Acetyl-1,2,3,4-tetrahydroisoquinoline-4-carboxylic acid 19, $^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, CD₃OD)



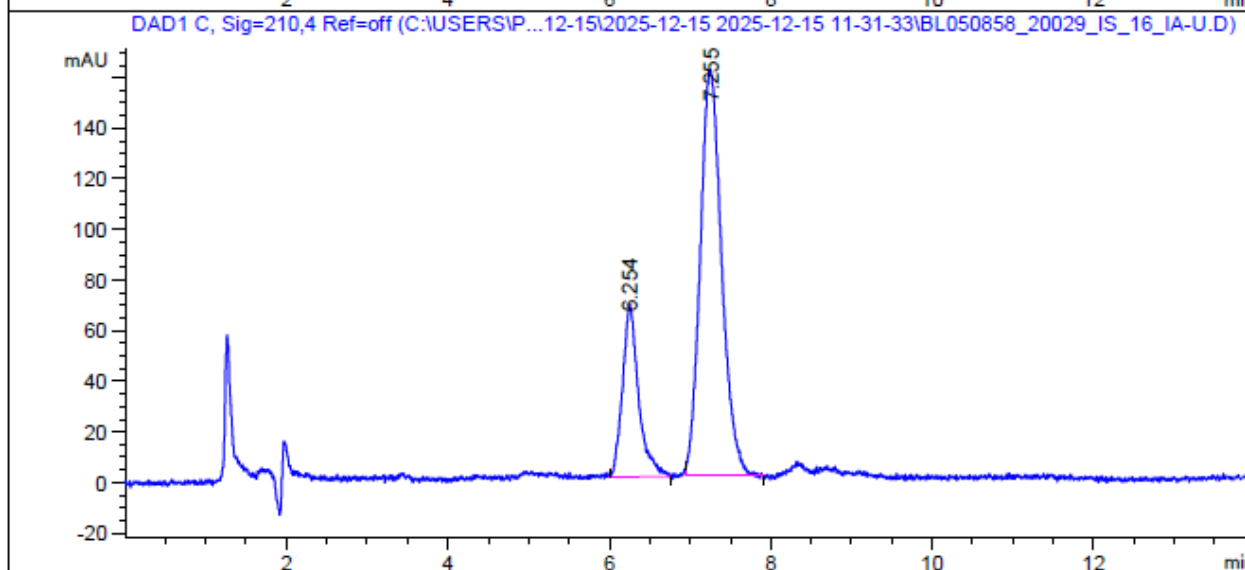
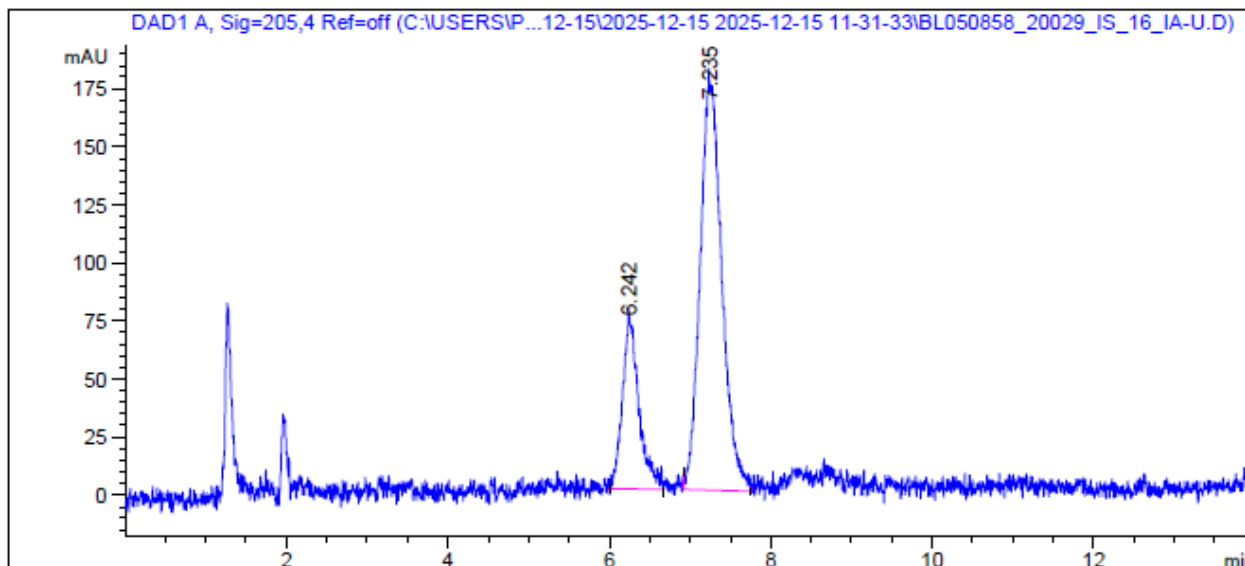
Spectrum S29. Ethyl 1,2,3,4-tetrahydroisoquinoline-4-carboxylate hydrochloride 20a·HCl, ¹H NMR (500 MHz, DMSO-*d*₆)



Spectrum S30. Ethyl 1,2,3,4-tetrahydroisoquinoline-4-carboxylate hydrochloride 20a·HCl, $^{13}\text{C}\{^1\text{H}\}$ NMR (101 MHz, DMSO- d_6)

2. Copies of the HPLC analysis chromatograms on chiral stationary phase of compounds 17a, 19 and 20·HCl

Injection Volume: 1.00 mkl
 Column: Chiralpak IA-U (100x3.0 mm, 1.6 mkm)--IAU0CH-EP003--16
 Mobile Phase: Hexane:IPA:MeOH, 90:5:5
 Flow Rate: 0.35 ml/min



Signal: DAD1 A, Sig=205,4 Ref=off

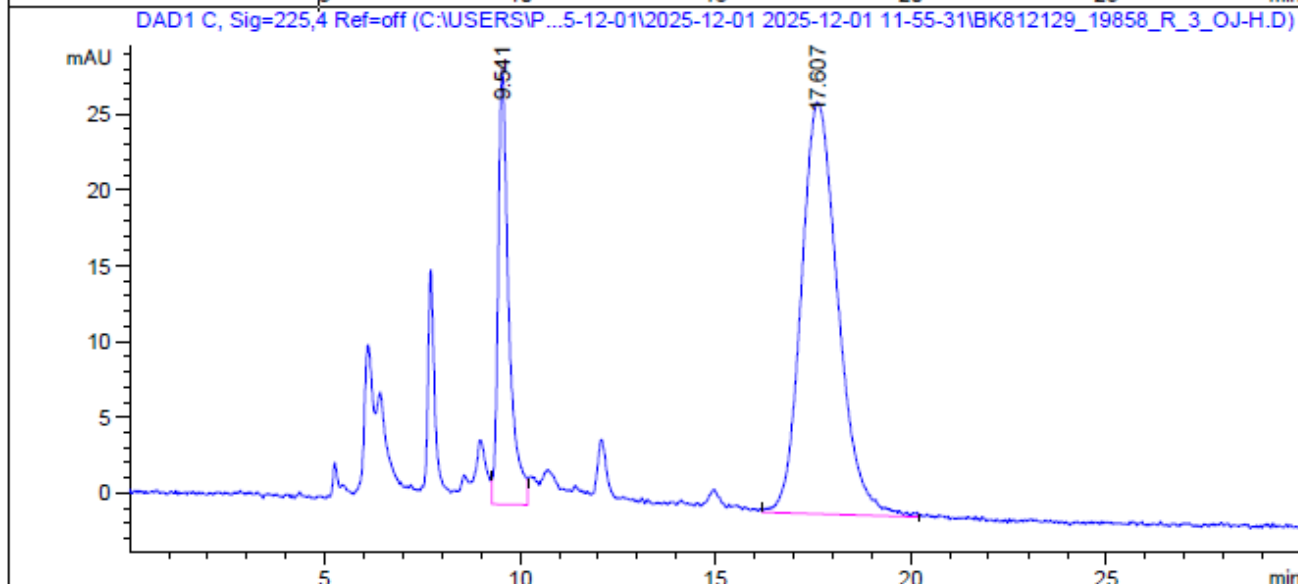
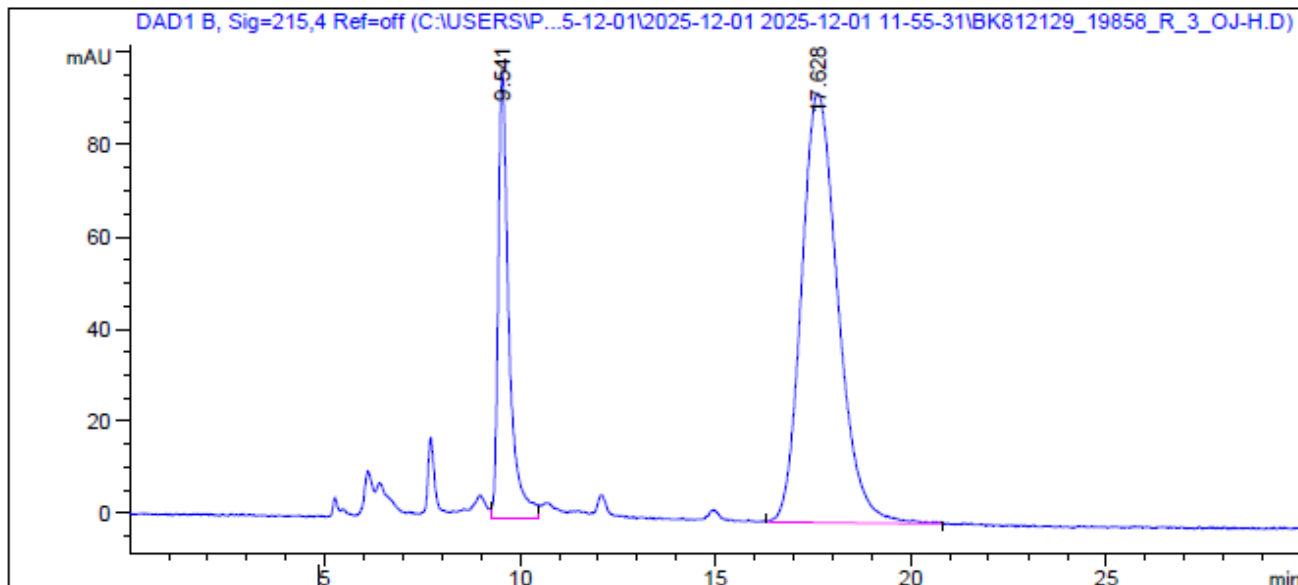
RetTime (min)	Area, %	Area	Resolution	Selectivity	14.002
6.2422	24.22	1063			
7.2352	75.78	3328	2.45	1.16	

Signal: DAD1 C, Sig=210,4 Ref=off

RetTime (min)	Area, %	Area	Resolution	Selectivity	14.002
6.2542	24.16	946			
7.2552	75.84	2970	2.44	1.16	

Spectrum S31. Chiral analysis data for 17a, Chiralpak IA-U (100x3.0 mm, 1.6 mkm; hexanes : 2 – propanol : MeOH, 90:5:5 v/v/v, 0.35 mL/min)

Injection Date : 12:28:22 01.12.2025
 Injection Volume: 7.0 µl
 Column: Chiralcel OJ-H (250x4.6 mm, 5 µm) --OJH0CE-UF008--3
 Mobile Phase: Hexane:IPA, 70:30
 Flow Rate: 0.6 ml/min



Signal: DAD1 B, Sig=215,4 Ref=off

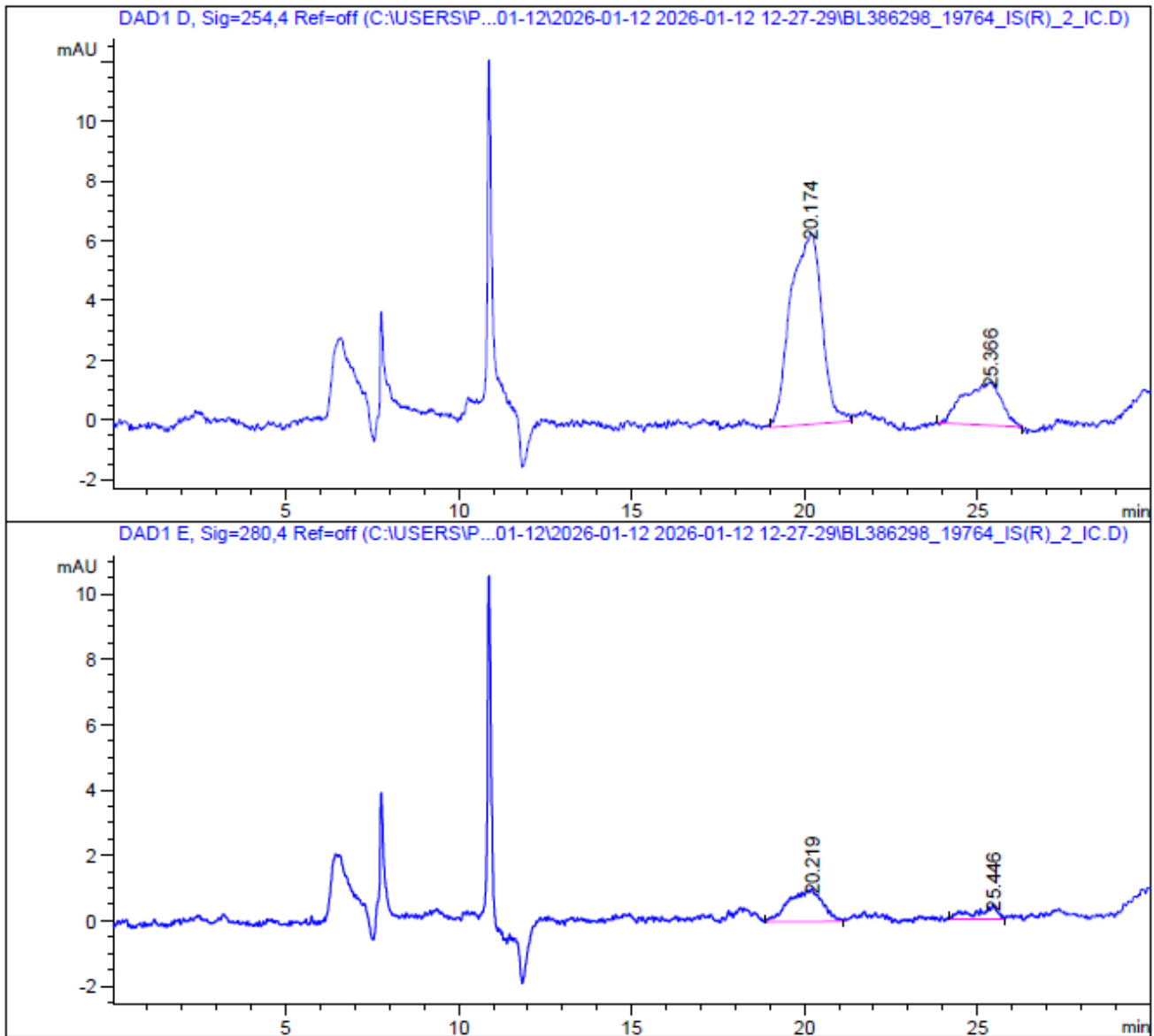
RetTime (min)	Area, %	Area	Resolution	Selectivity	
9.5412	23.71	1876			30.000
17.6282	76.29	6035	7.70	1.85	

Signal: DAD1 C, Sig=225,4 Ref=off

RetTime (min)	Area, %	Area	Resolution	Selectivity	
9.5412	23.77	552			30.000
17.6072	76.23	1772	7.66	1.85	

**Spectrum S32. Chiral analysis data for 19, Chiralcel OJ-H (250x4.6 mm, 5 µm; hexanes :
 2 - propanol, 70:30 v/v, 0.6 mL/min)**

Injection Volume: 10.0 mkl
 Column: Chiralpak IC (250x4.6 mm, 5 mkm)--IC00CE-AV106--2
 Mobile Phase: Hexane(0.1%EDA):IPA(0.1%DEA):MeOH(0.1%DEA), 95:2.5:2.5
 Flow Rate: 0.6 ml/min



Signal: DAD1 D, Sig=254,4 Ref=off

RetTime (min)	Area, %	Area	Resolution	Selectivity	
20.1742	78.79	402			30.004
25.3662	21.21	108	2.51	1.35	

Signal: DAD1 E, Sig=280,4 Ref=off

RetTime (min)	Area, %	Area	Resolution	Selectivity	
20.2192	78.65	66			30.004
25.4462	21.35	18	4.24	1.35	

Spectrum S33. Chiral analysis data for 20, (250x4.6 mm, 5 mkm; hexanes (0.1% ethylenediamine) : 2 - propanol (0.1% diethylamine) : MeOH(0.1% diethylamine), 95:2.5:2.5 v/v/v, 0.6 mL/min)