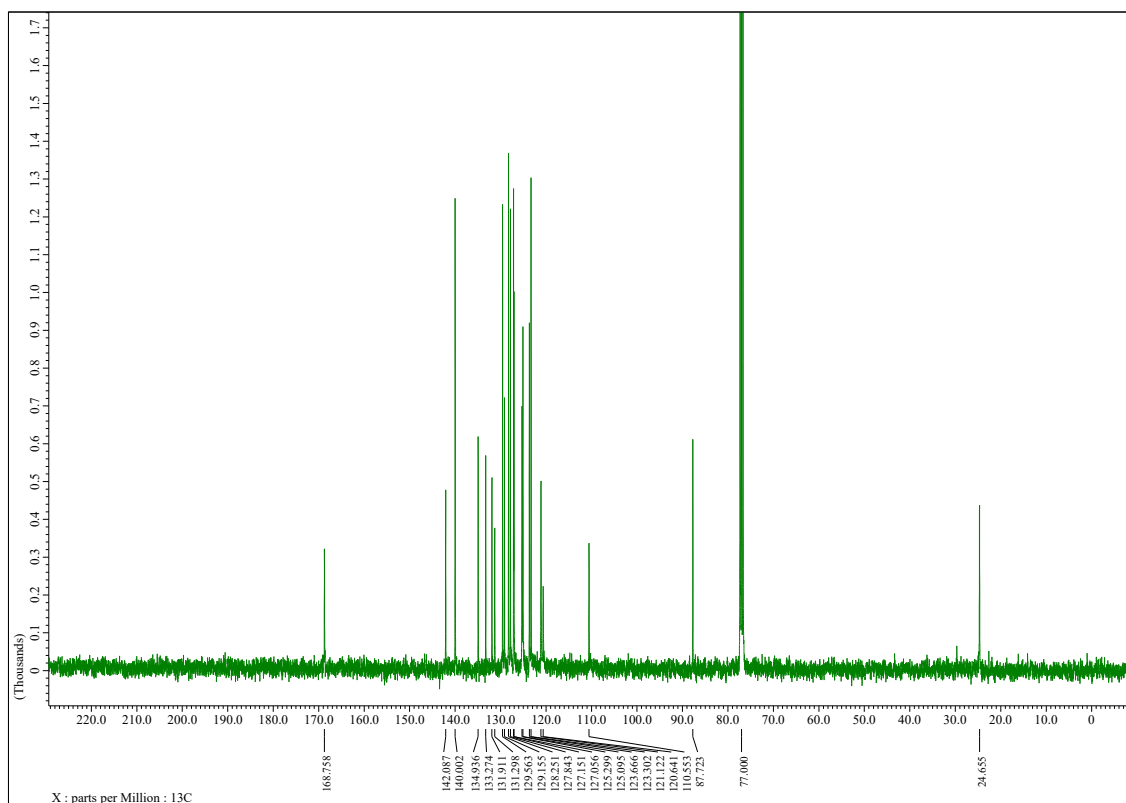
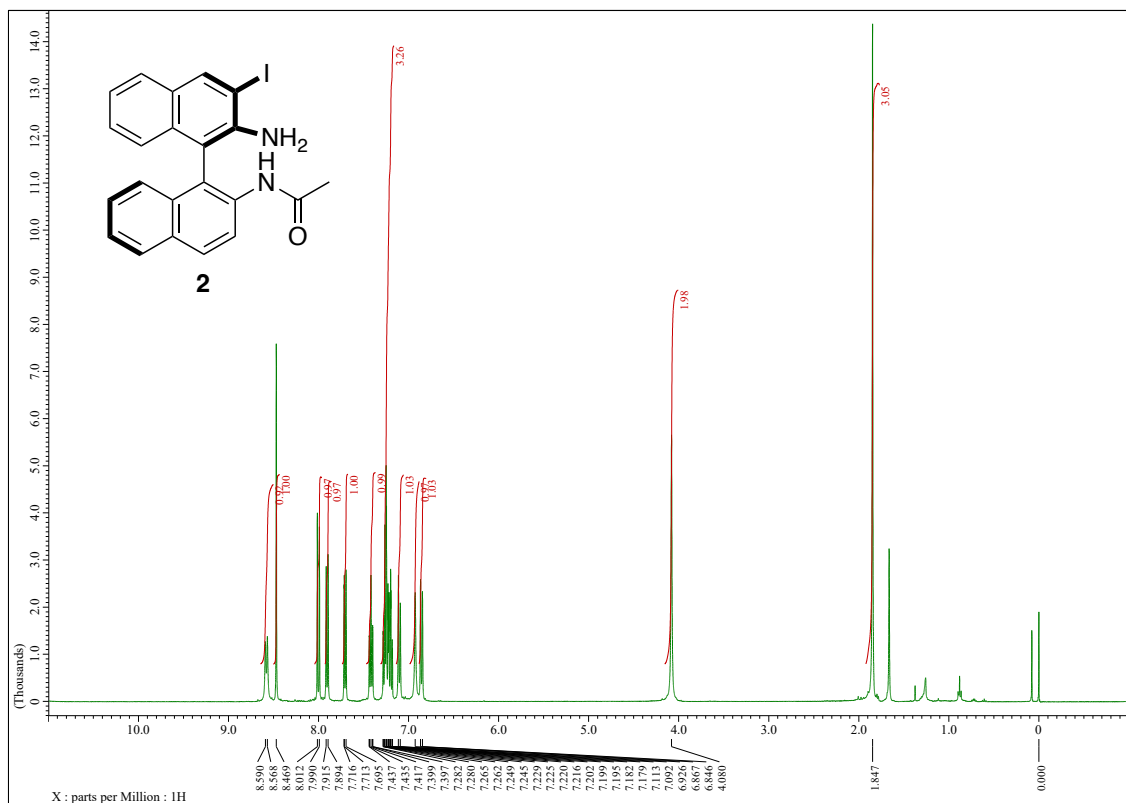


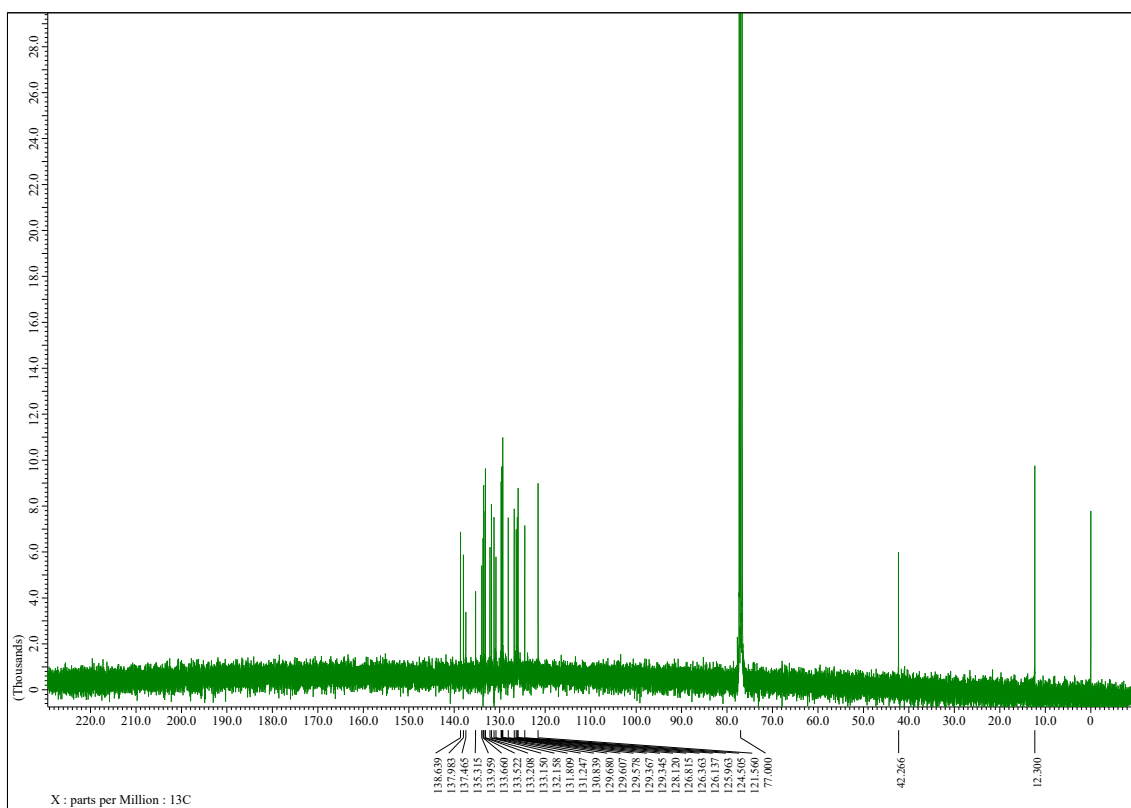
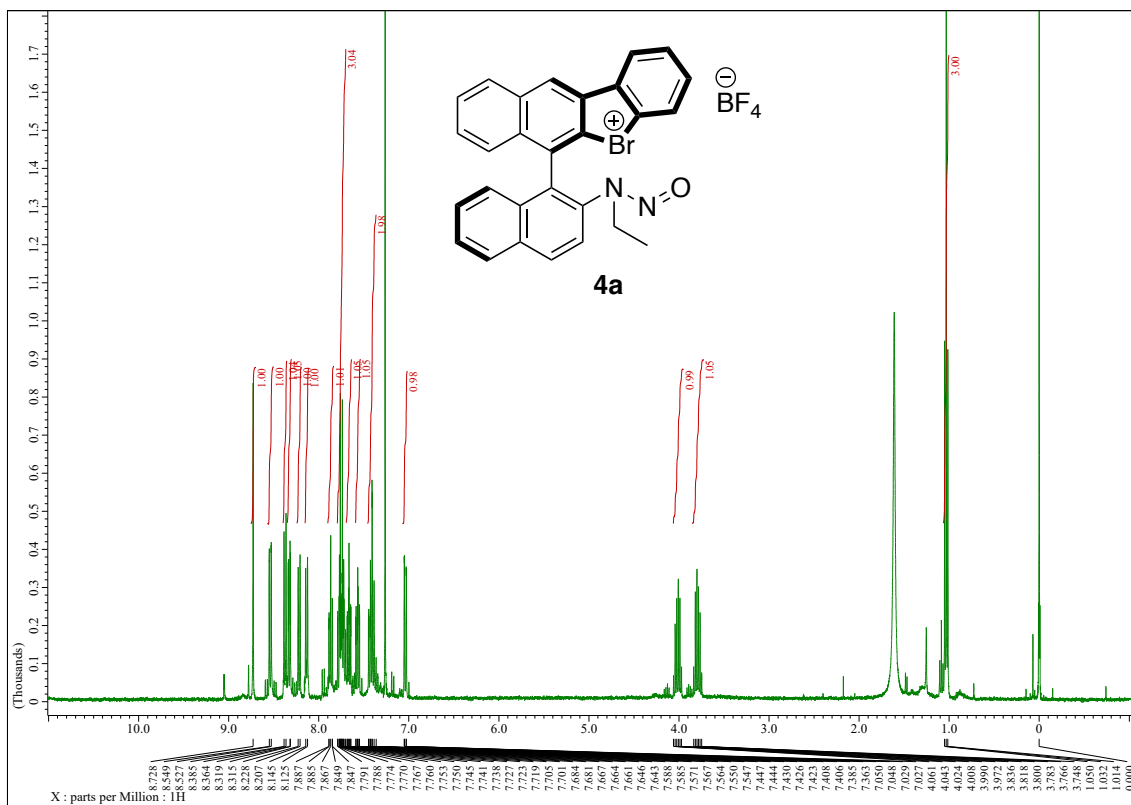
Table S1. Results for the titration reactions shown in Figure 3 and 4.

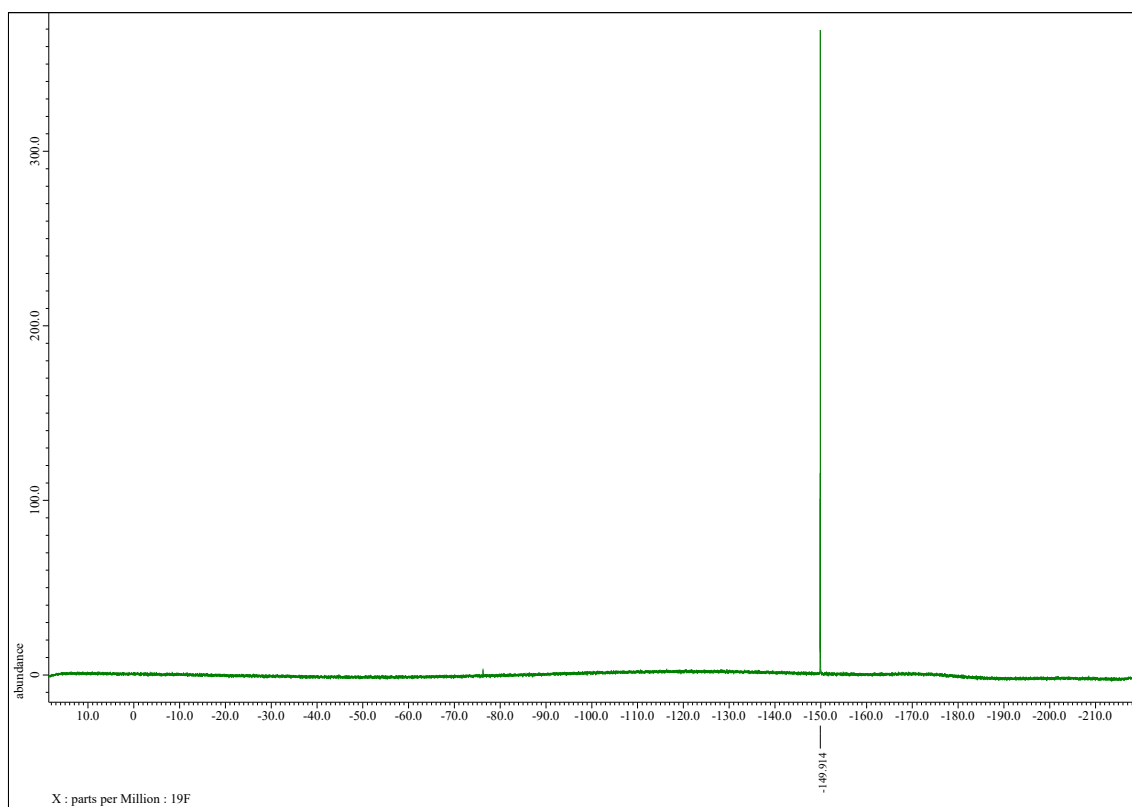
Concentration of 4a / M	Concentration of 5a / M	Equivalent of 5a	Chemical shift for H1	Chemical shift for H4
8.80E-03	0	0	8.693	7.7614
8.80E-03	0.22	25	8.695	7.7609
8.80E-03	0.44	50	8.699	7.7604
8.80E-03	0.66	75	8.701	7.7599
8.80E-03	0.88	100	8.705	7.7594
8.80E-03	1.1	125	8.708	7.7589
8.80E-03	1.32	150	8.712	7.7585
8.80E-03	1.54	175	8.716	7.758
8.80E-03	1.76	200	8.72	7.7575

Concentration of 4a / M	Concentration of 6a / M	Equivalent of 6a	Chemical shift for H1	Chemical shift for H4
8.80E-03	0	0	8.692	7.7621
8.80E-03	0.22	25	8.701	7.76595
8.80E-03	0.44	50	8.703	7.76705
8.80E-03	0.66	75	8.707	7.76835
8.80E-03	0.88	100	8.708	7.7687
8.80E-03	1.1	125	8.71	7.7693
8.80E-03	1.32	150	8.712	7.77
8.80E-03	1.54	175	8.717	7.77125
8.80E-03	1.76	200	8.719	7.7717

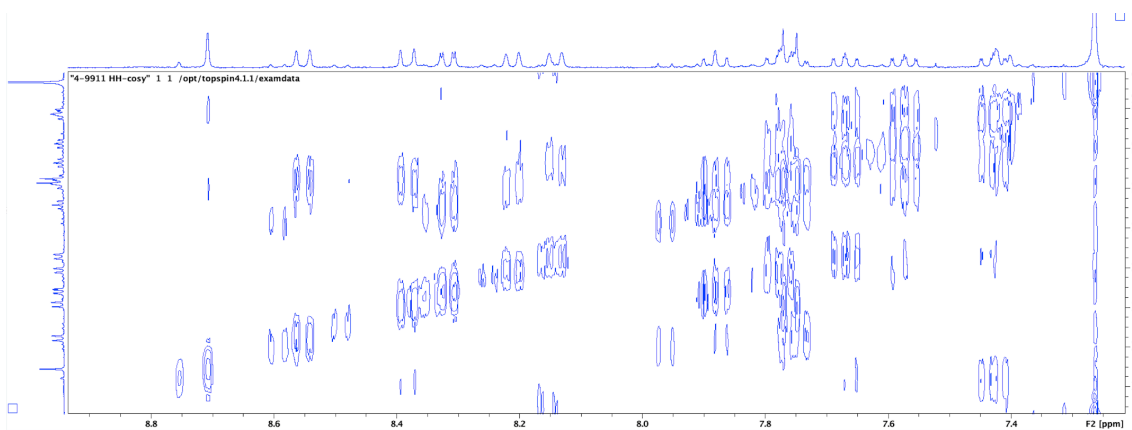
¹H, ¹³C, and ¹⁹F-NMR spectra and HPLC charts.

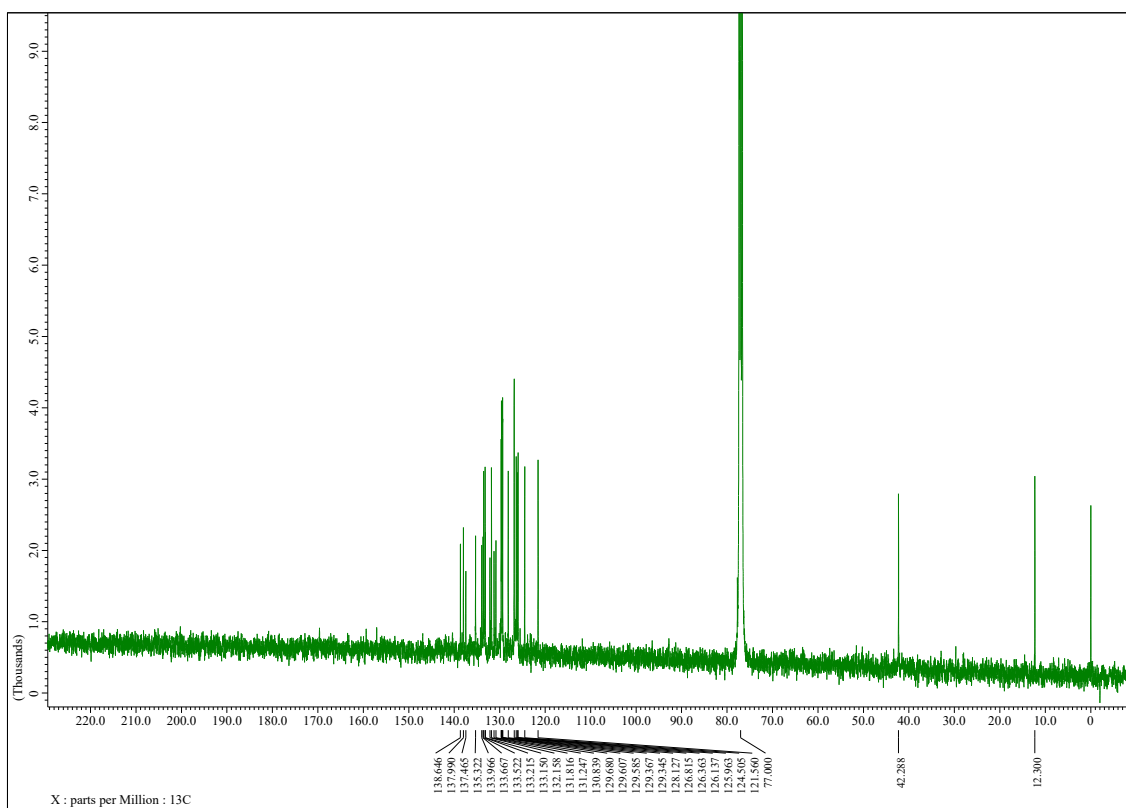
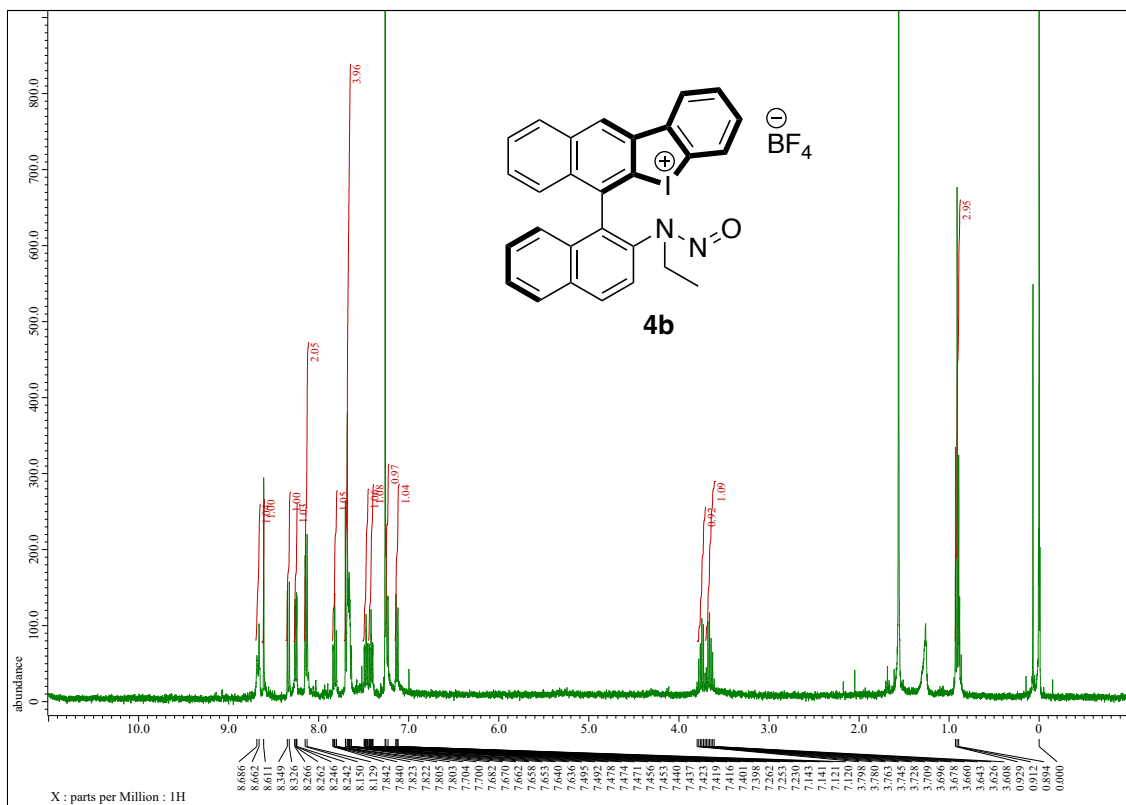


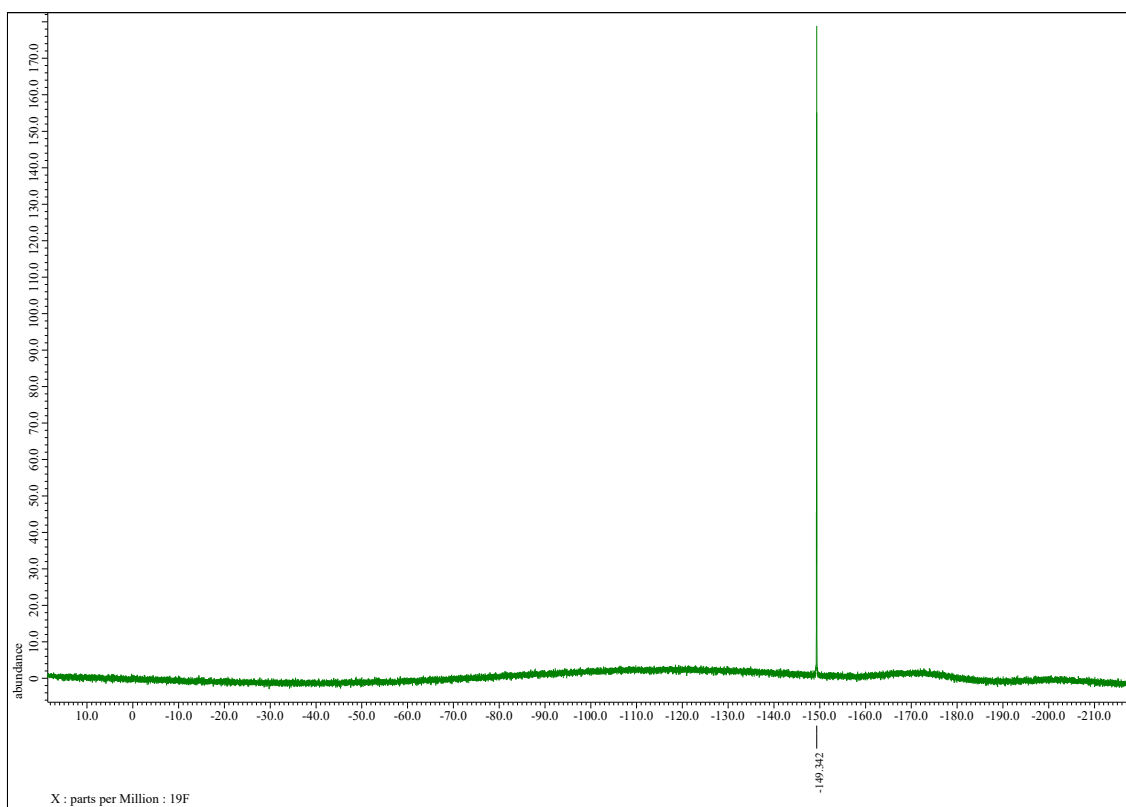


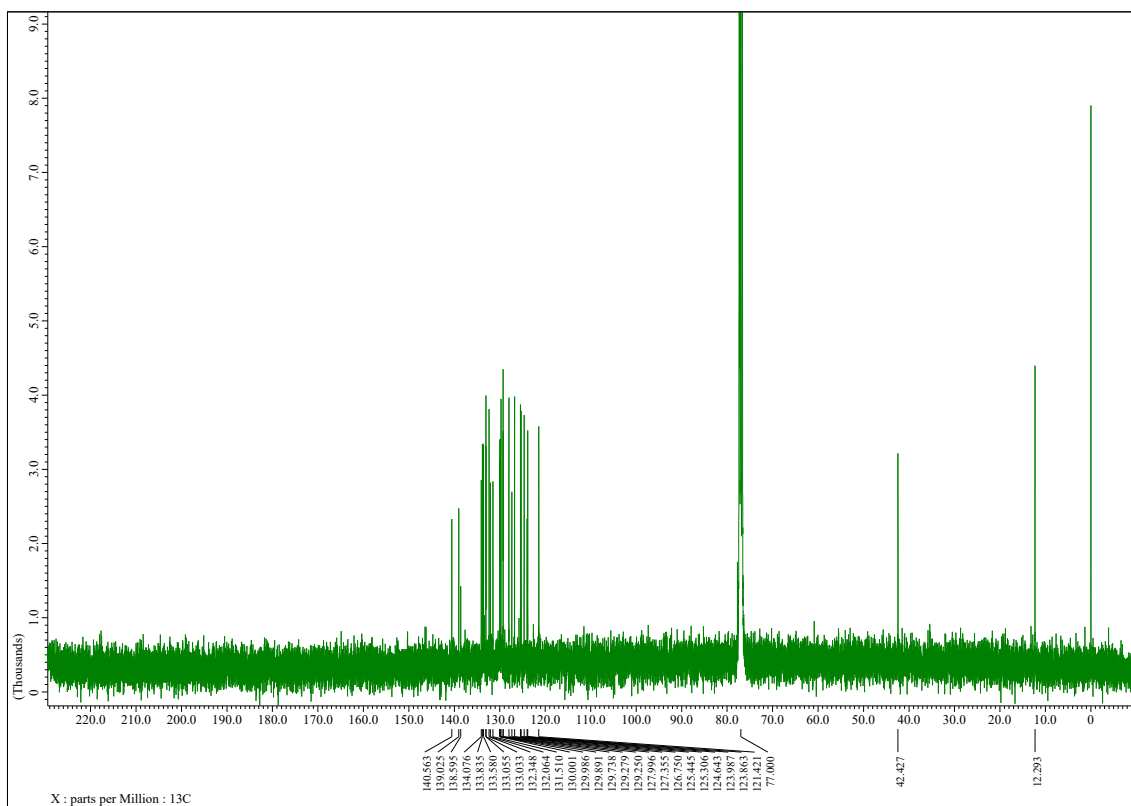
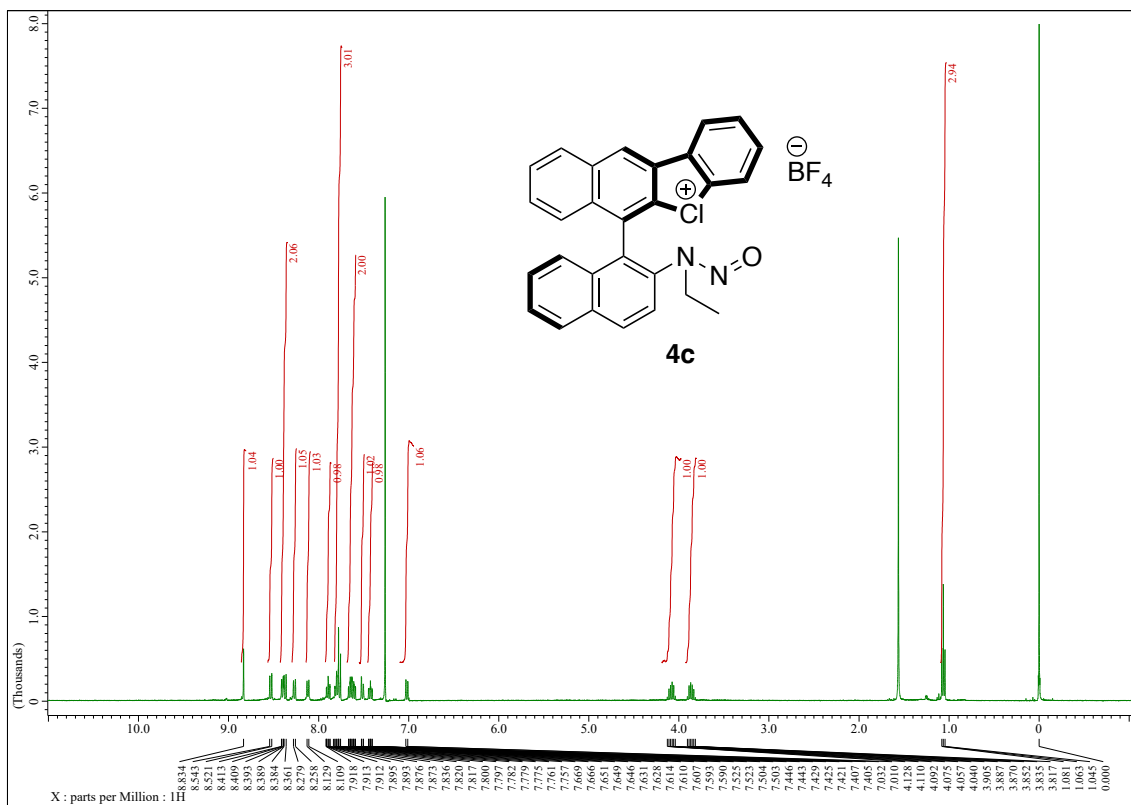


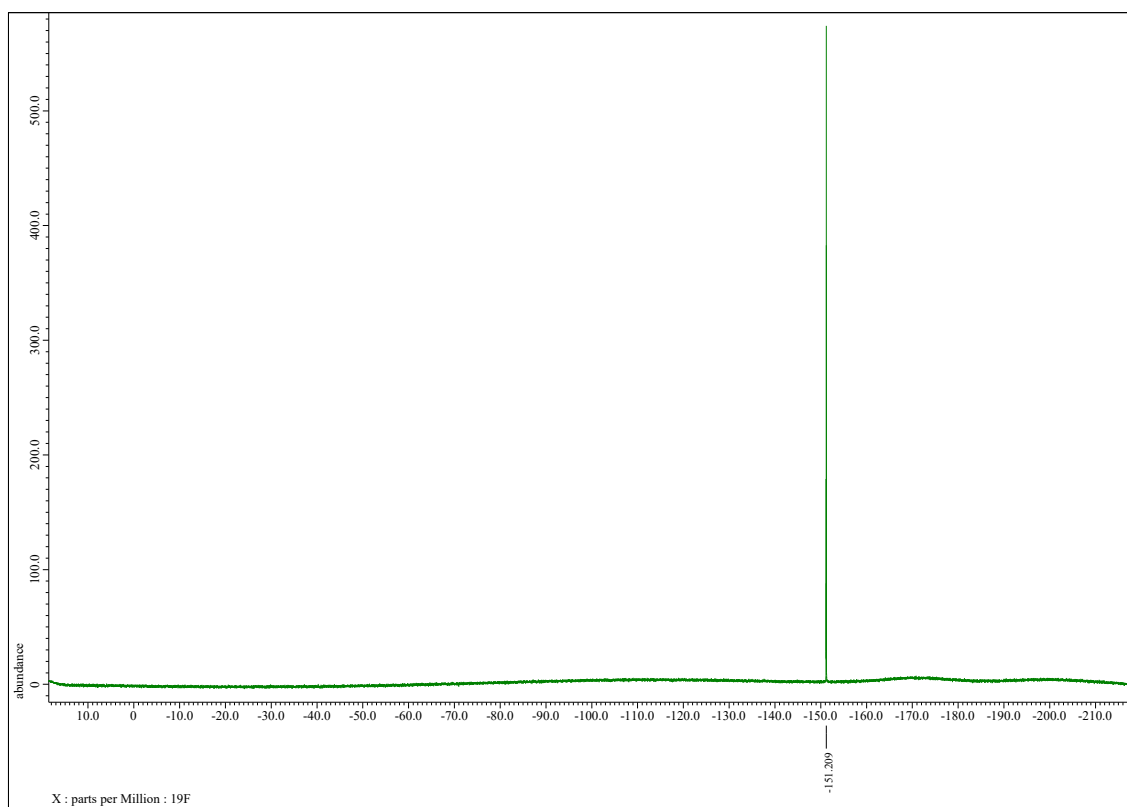
H-H COSY of **4a**

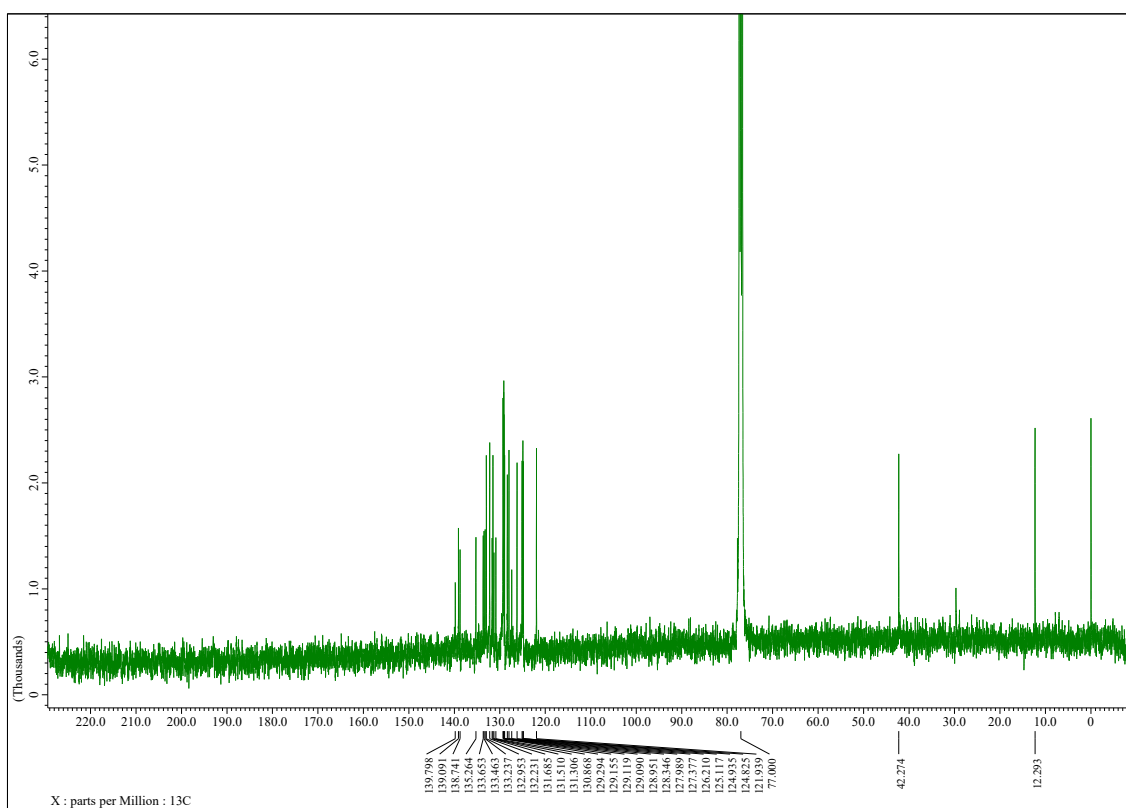
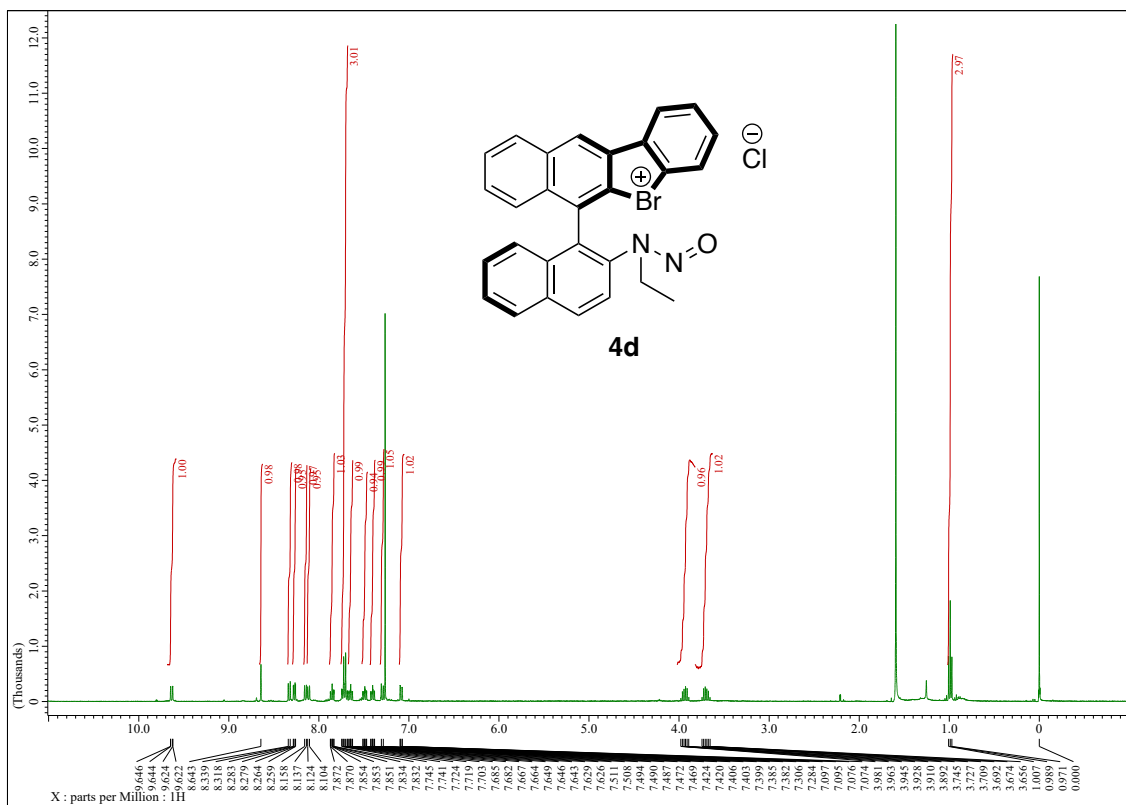






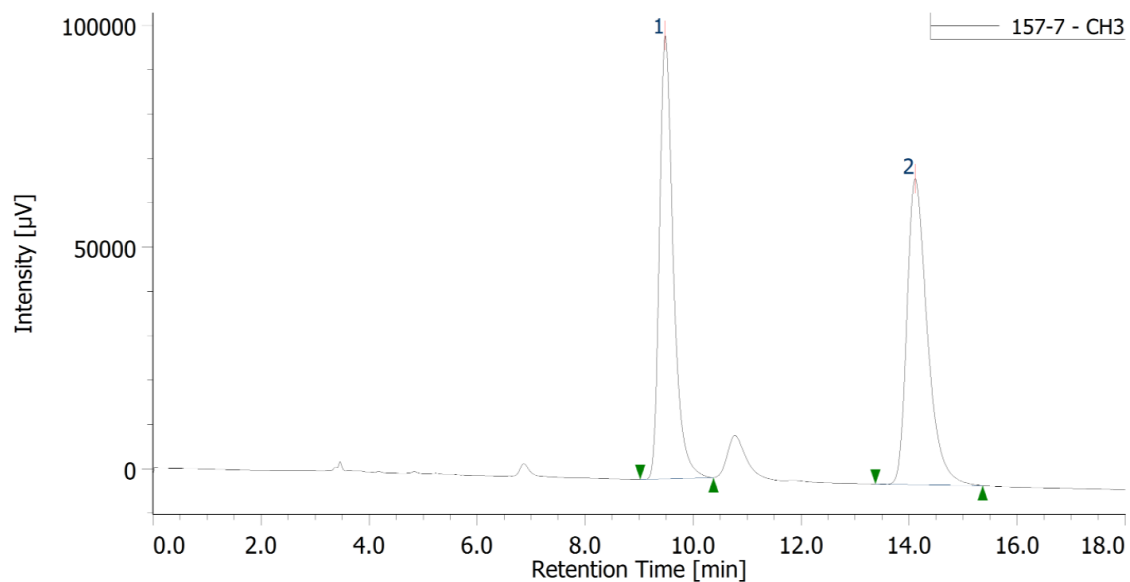






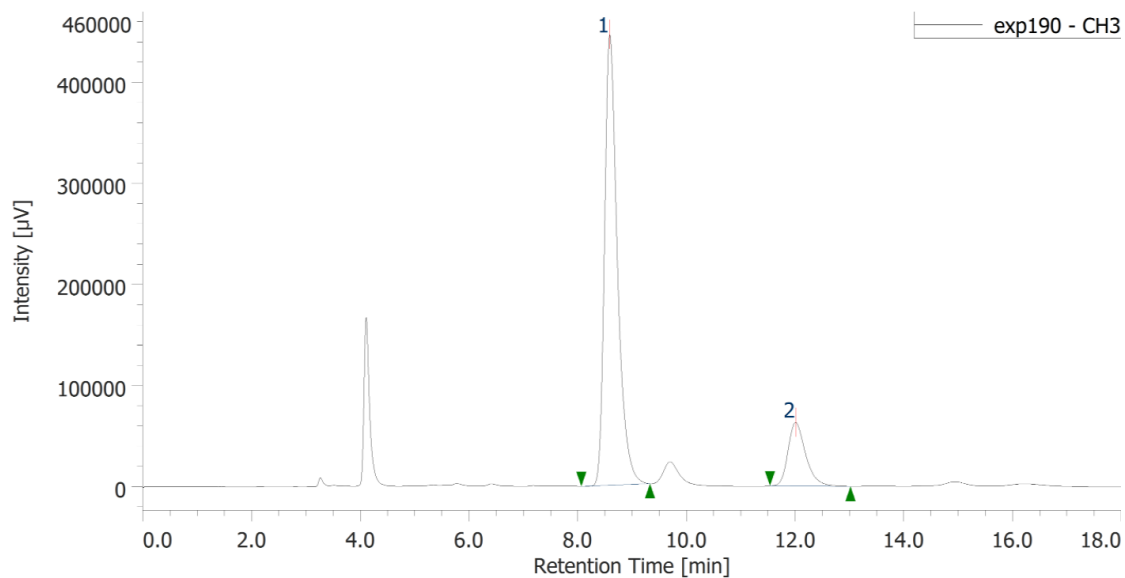
- HPLC charts of **7a** for Scheme 2.

Racemic sample of **7a**



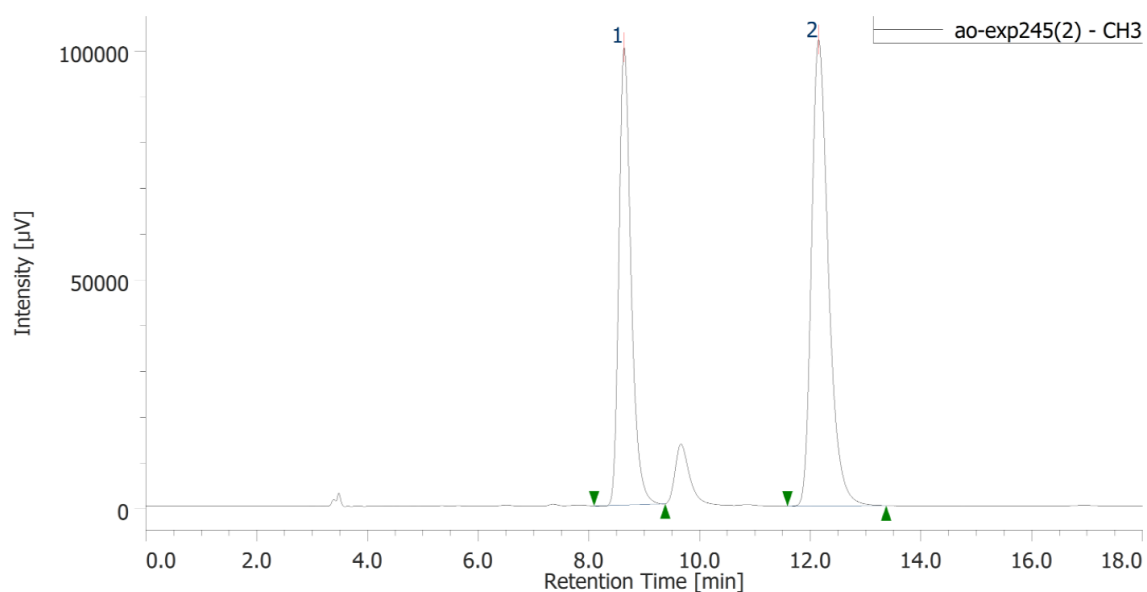
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.48	1775891	99921	49.539	59.170
2	Unknown	3	14.11	1808946	68951	50.461	40.830

Catalyzed by **4a**



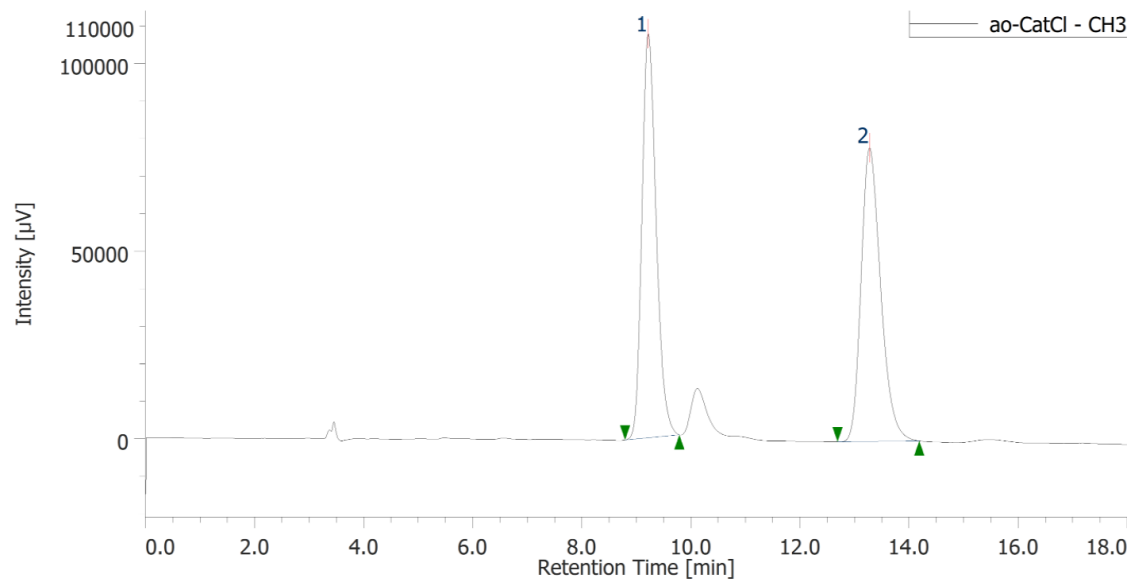
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	8.59	7331298	445910	83.891	87.648
2	Unknown	3	12.01	1407809	62840	16.109	12.352

Catalyzed by **4b**



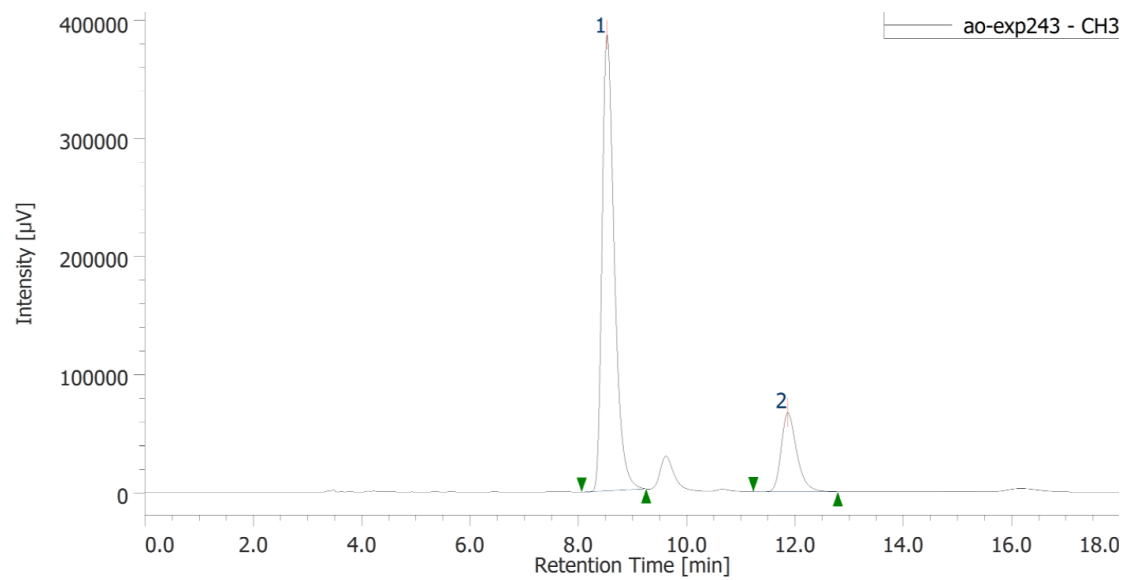
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	8.633	1522932	99893	41.4	49.5
2	Unknown	3	12.150	2157293	101828	58.6	50.5

Catalyzed by **4c**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	9.217	1951692	107727	49.9	57.9
2	Unknown	3	13.275	1957723	78277	50.1	42.1

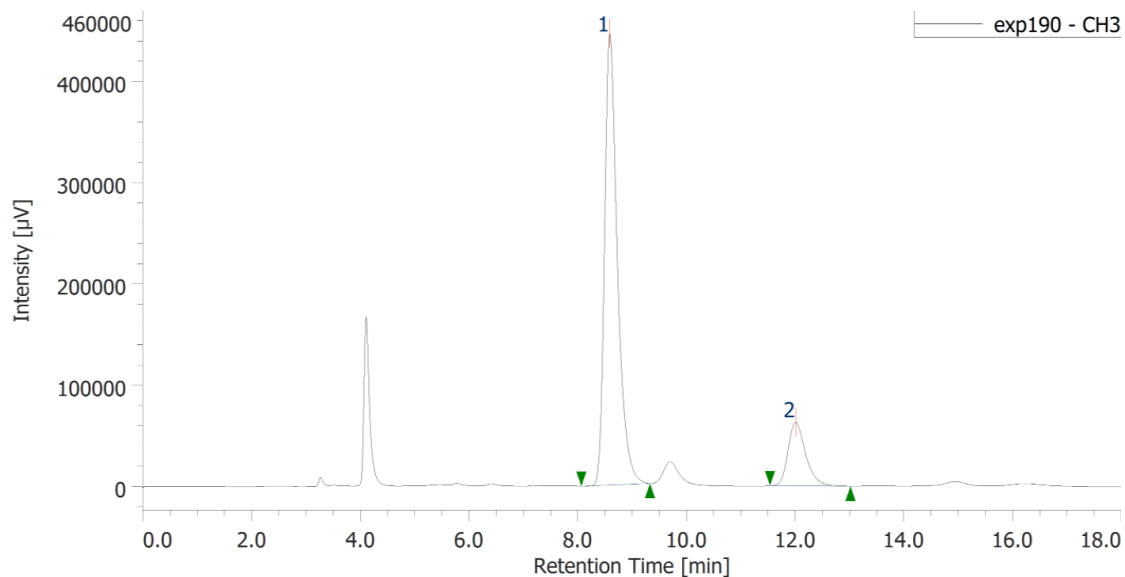
Catalyzed by **4d**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	8.525	6083829	385607	82.1	85.2
2	Unknown	3	11.867	1330858	66772	17.9	14.8

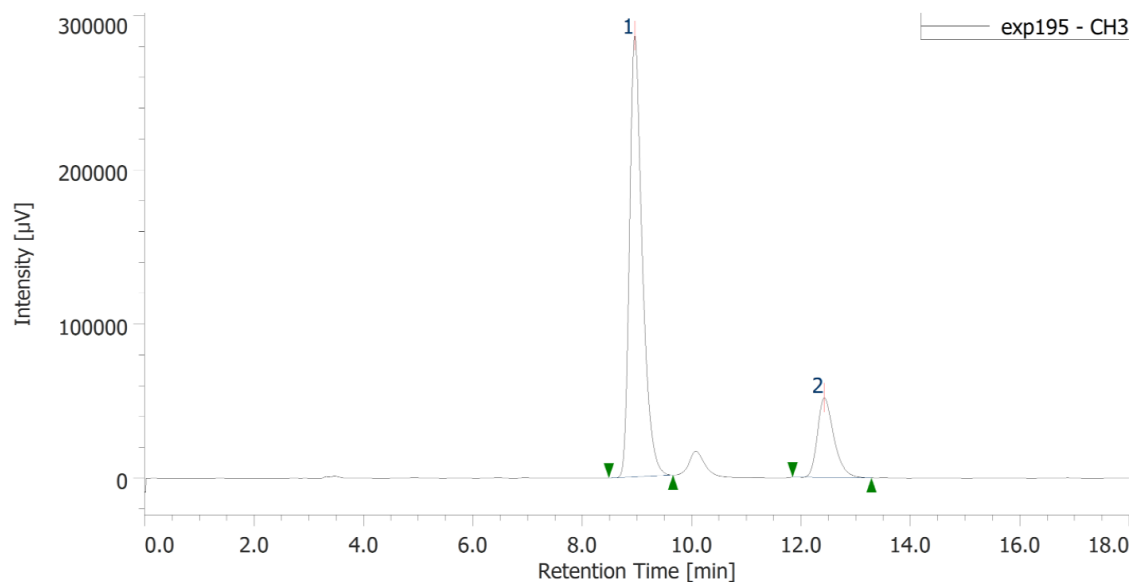
- HPLC charts of **7a** for Table 1.

Entry 1 (toluene)



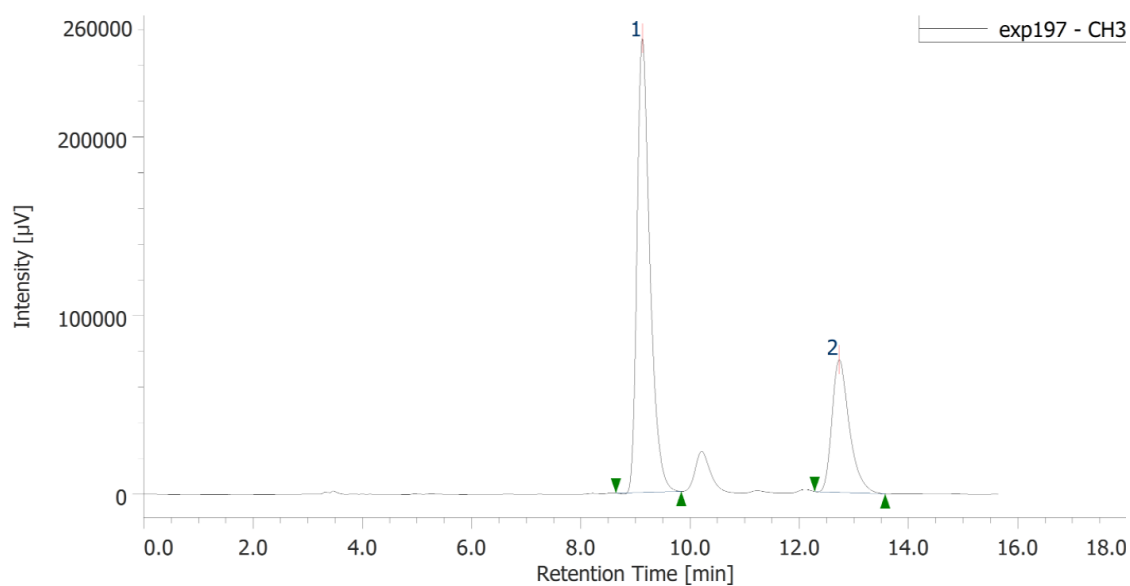
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	8.59	7331298	445910	83.891	87.648
2	Unknown	3	12.01	1407809	62840	16.109	12.352

Entry 2 (THF)



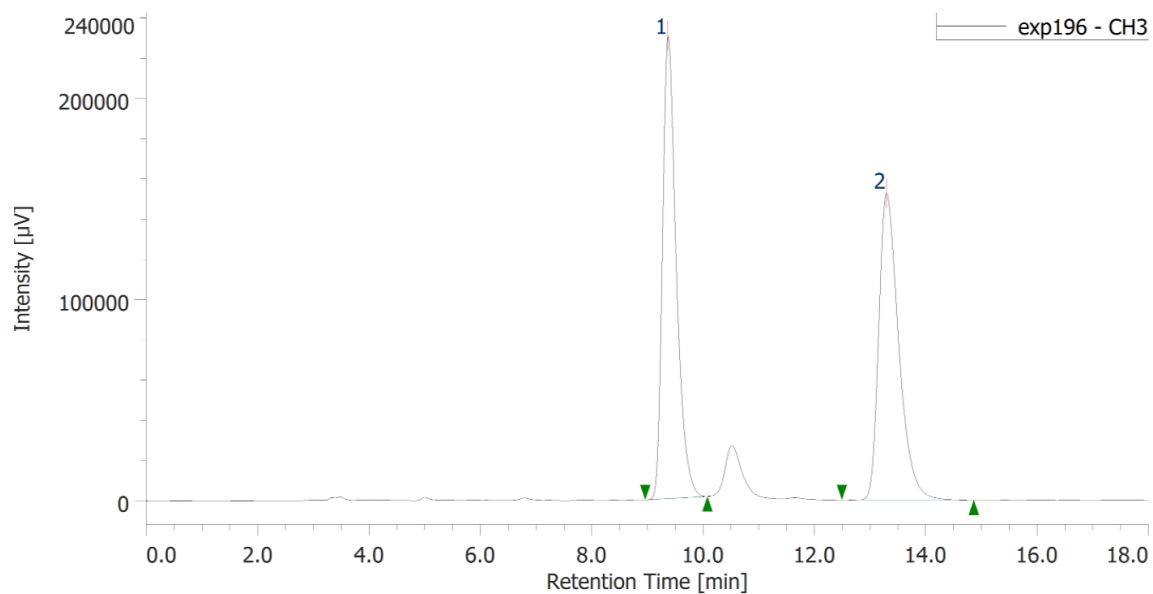
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	8.96	4651974	286067	81.190	84.701
2	Unknown	3	12.43	1077770	51669	18.810	15.299

Entry 3 (CH₂Cl₂)



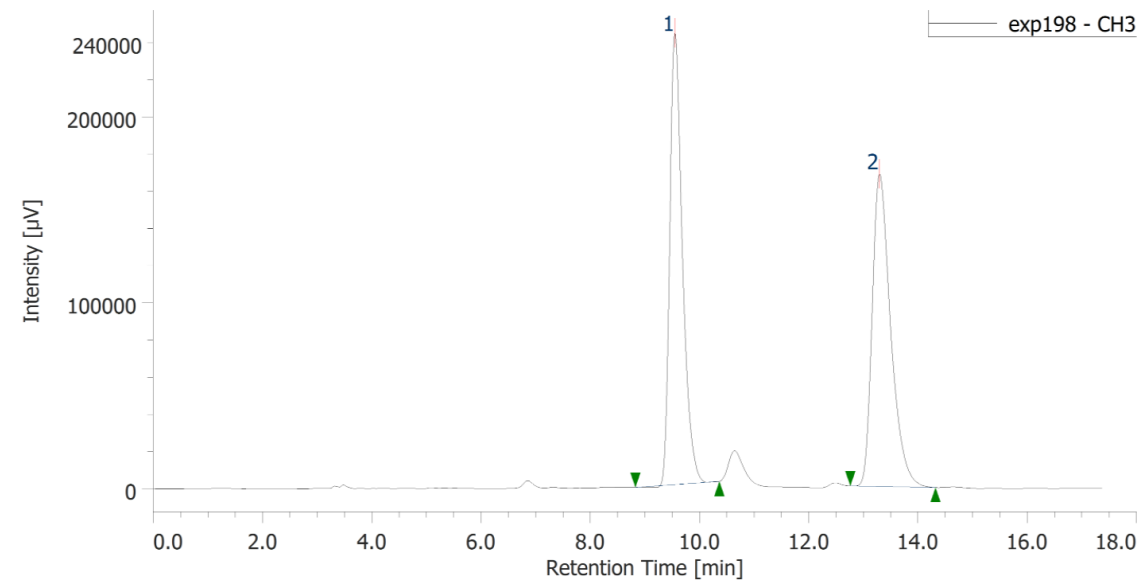
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.13	4156467	254127	71.672	77.397
2	Unknown	3	12.72	1642800	74217	28.328	22.603

Entry 4 (Et₂O)



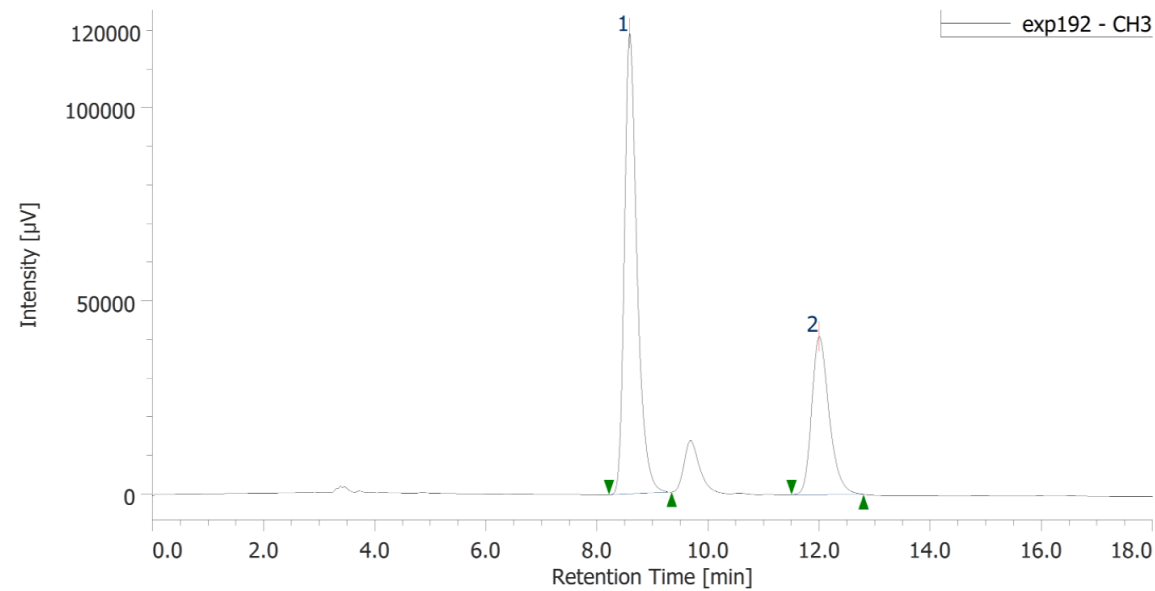
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.37	3953222	229910	51.082	60.151
2	Unknown	3	13.29	3785806	152310	48.918	39.849

Entry 5 (CH₃CN)



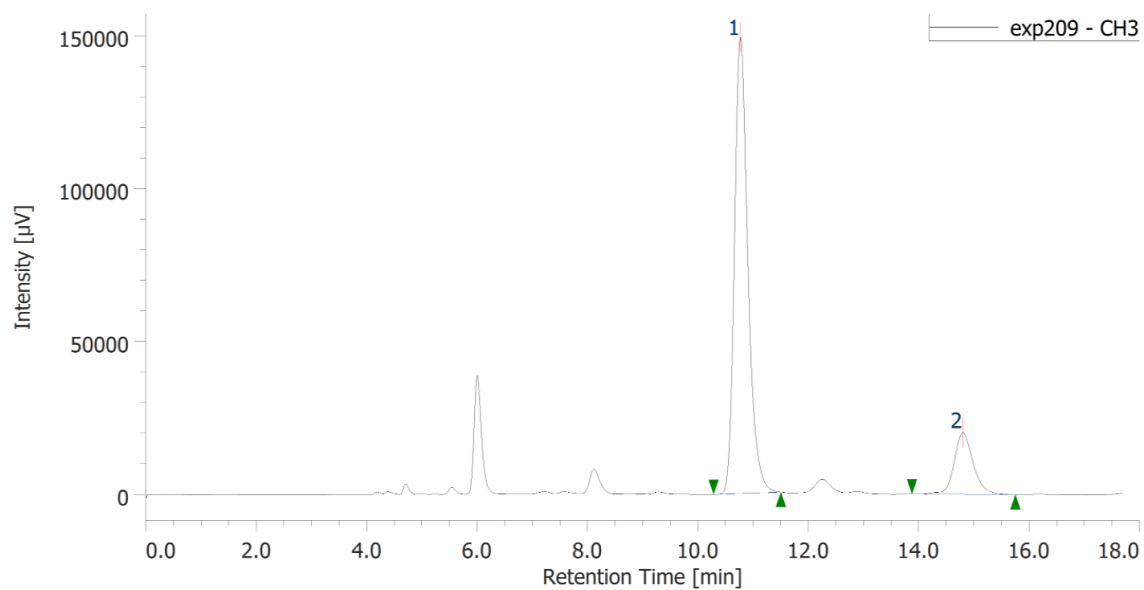
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.55	3911439	242861	49.715	59.100
2	Unknown	3	13.29	3956320	168069	50.285	40.900

Entry 6 (-10 °C)



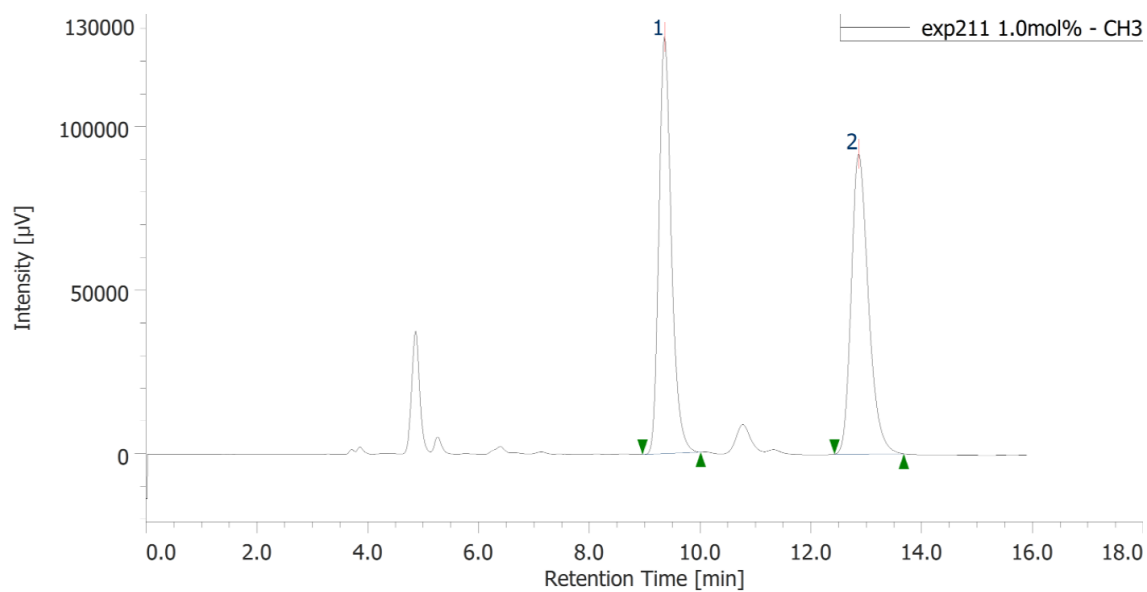
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	8.59	1891690	119256	67.951	74.441
2	Unknown	3	12.00	892200	40946	32.049	25.559

Entry 7 (-30 °C)



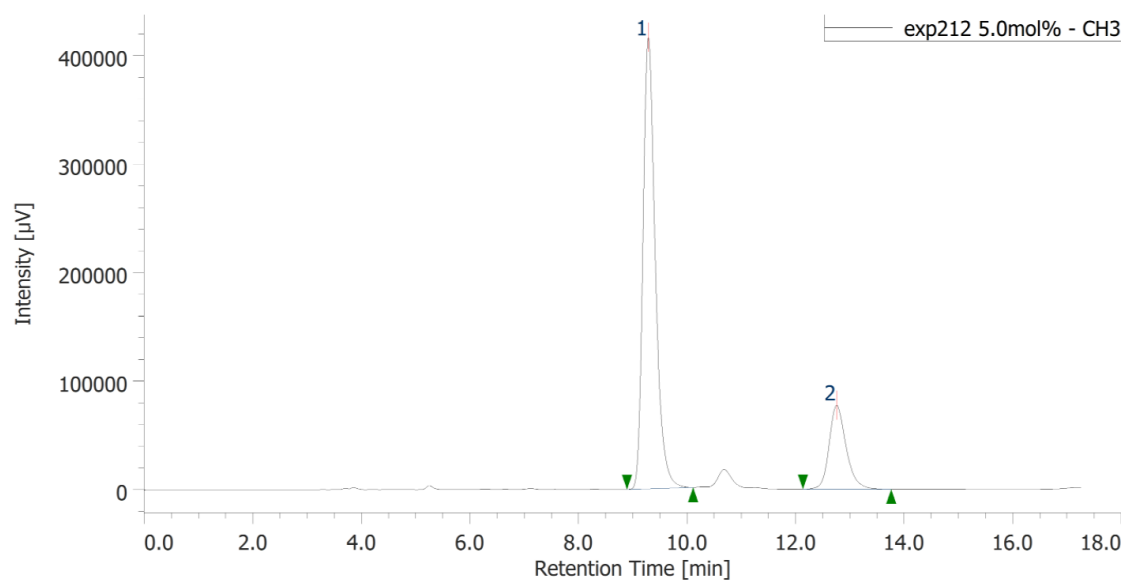
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	10.77	2518823	149219	84.010	88.122
2	Unknown	3	14.80	479416	20113	15.990	11.878

Entry 8 (catalyzed by 1 mol% of **4a**)



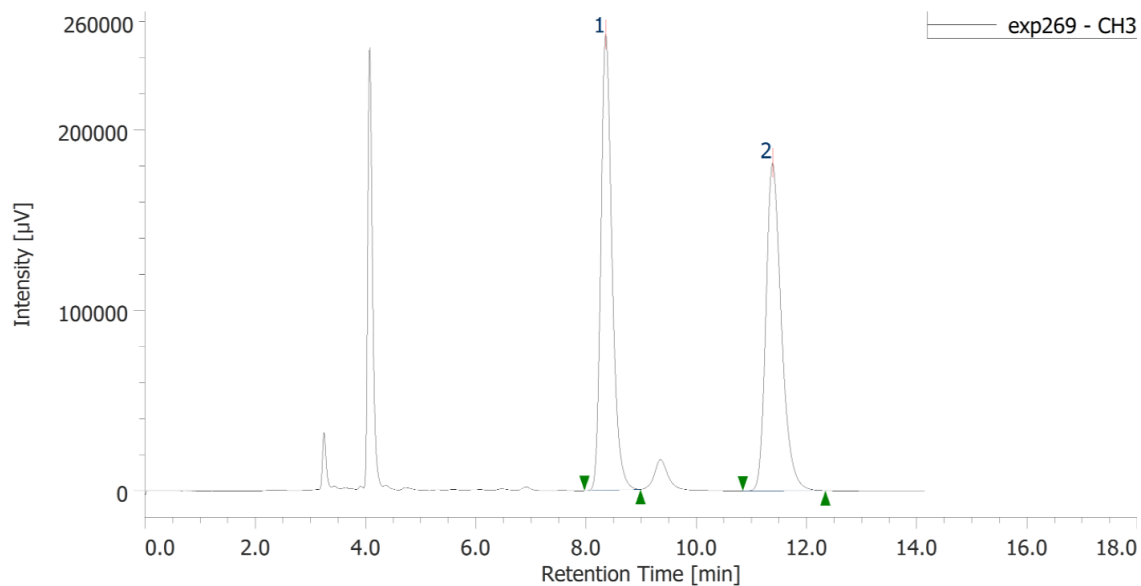
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.36	1995053	127209	50.220	58.117
2	Unknown	3	12.86	1977560	91677	49.780	41.883

Entry 9 (catalyzed by 5 mol% of **4a**)



#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.28	6530331	415943	79.512	84.328
2	Unknown	3	12.75	1682690	77299	20.488	15.672

Entry 10 (no catalyst)



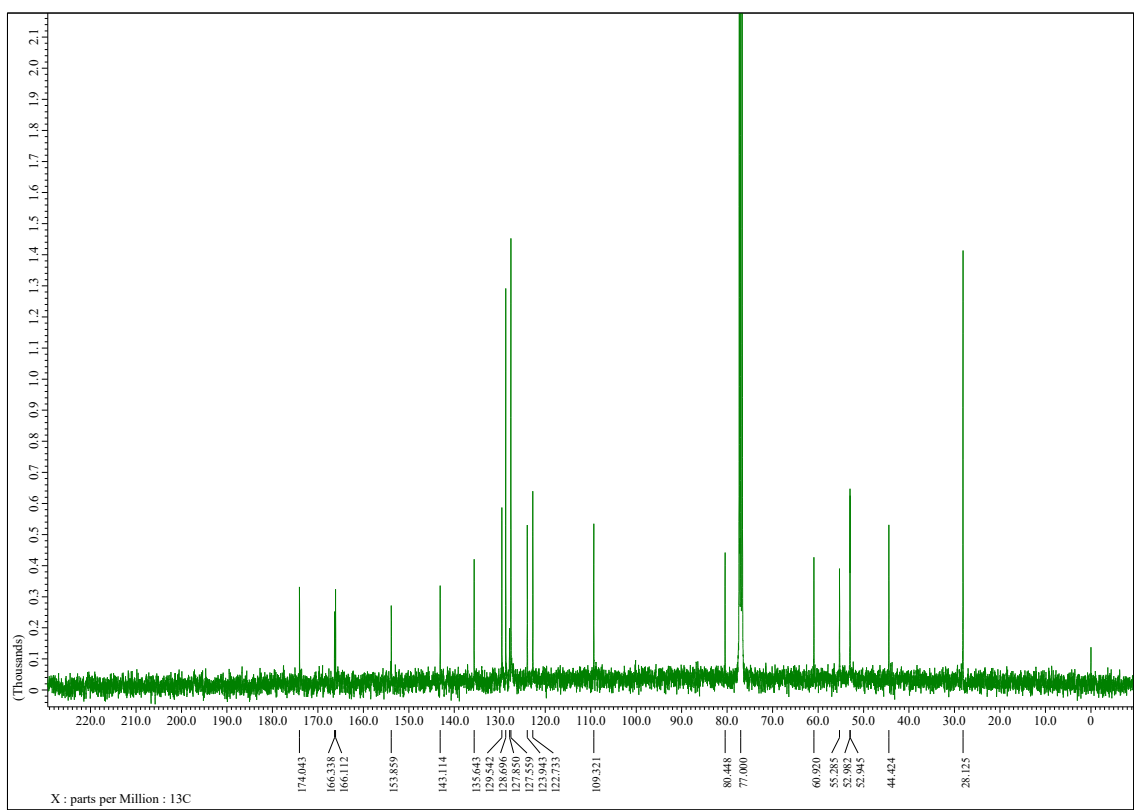
#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	8.36	3540468	252506	49.938	58.152
2	Unknown	3	11.38	3549256	181714	50.062	41.848

Chemical structure of **7a** is shown above the spectrum.

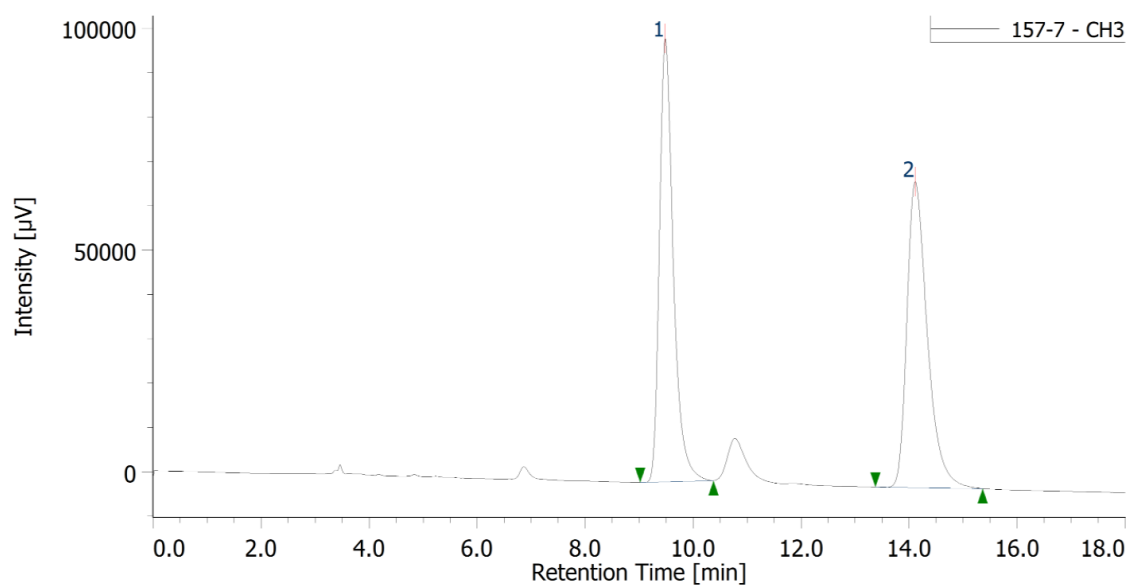
¹H NMR spectrum (CDCl₃) of compound **7a**. The x-axis represents chemical shift (δ) in ppm, ranging from 0 to 8. The y-axis represents intensity. Integration values are provided for several peaks.

Chemical shifts (δ) and integration values (from left to right):

- 7.428, 7.424, 7.421, 7.406, 7.378, 7.376, 7.360, 7.357, 7.343, 7.347, 7.342, 7.339, 7.325, 7.314, 7.310, 7.284, 7.280, 7.277, 7.268, 7.261, 7.254, 7.247, 7.244, 7.236, 7.204, 7.187, 7.181, 7.168, 7.165, 7.008, 7.006, 6.990, 6.987, 6.983, 6.968, 6.715, 6.695, 6.423, 5.026, 4.987, 4.886, 4.884, 3.695, 3.686, 1.306, 0.000
- Integration values: 3.07, 3.05, 1.09, 0.99, 1.00, 0.99, 0.95, 4.03, 0.98, 0.97, 8.96

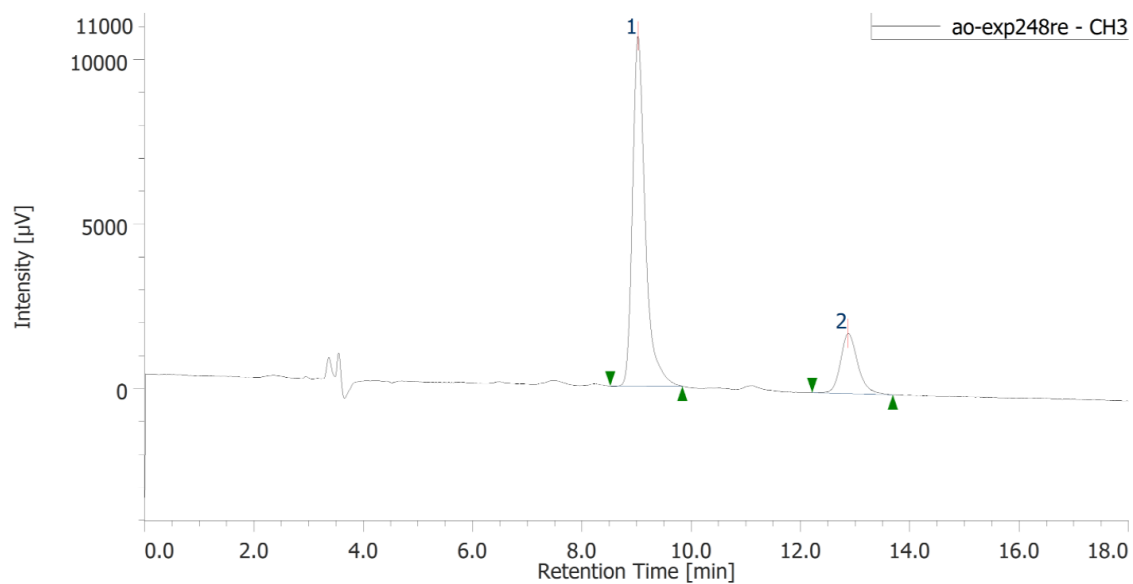


Racemic sample of **7a**

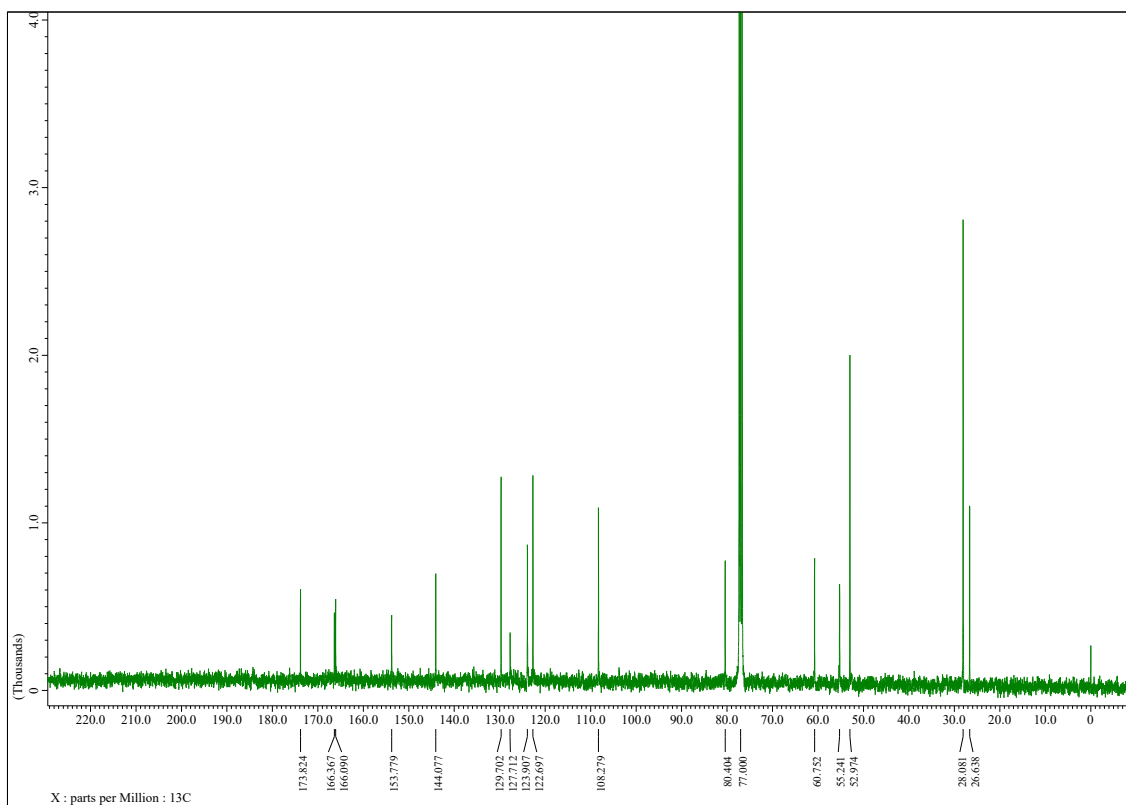
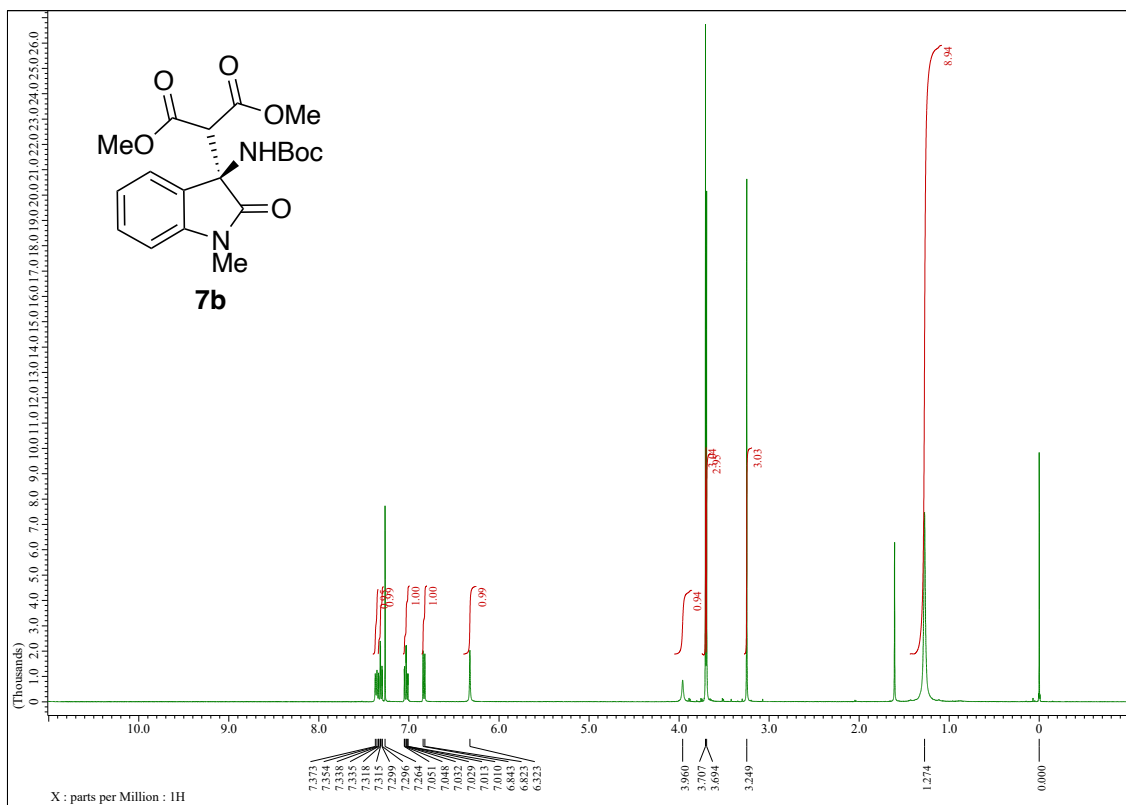


#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	9.48	1775891	99921	49.539	59.170
2	Unknown	3	14.11	1808946	68951	50.461	40.830

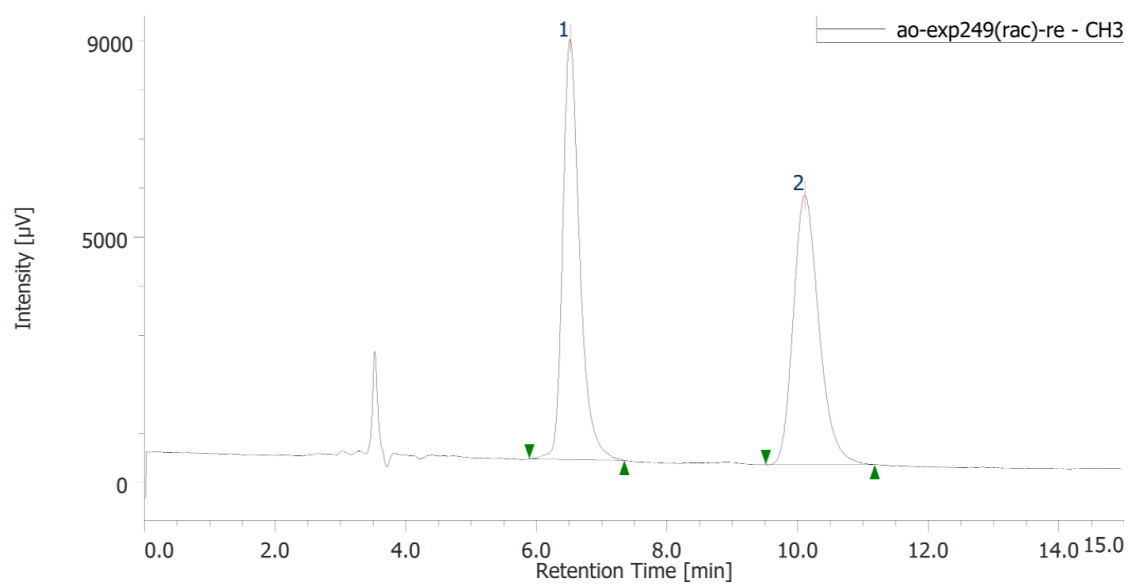
7a catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	9.025	172319	10641	81.1	85.3
2	Unknown	3	12.867	40037	1829	18.9	14.7

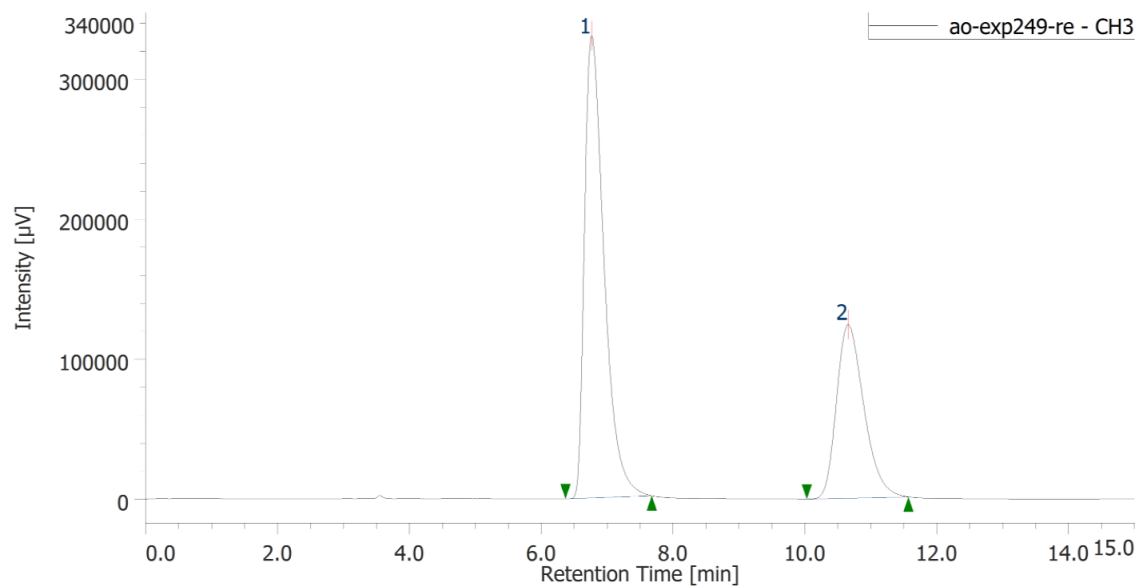


Racemic sample of **7b**

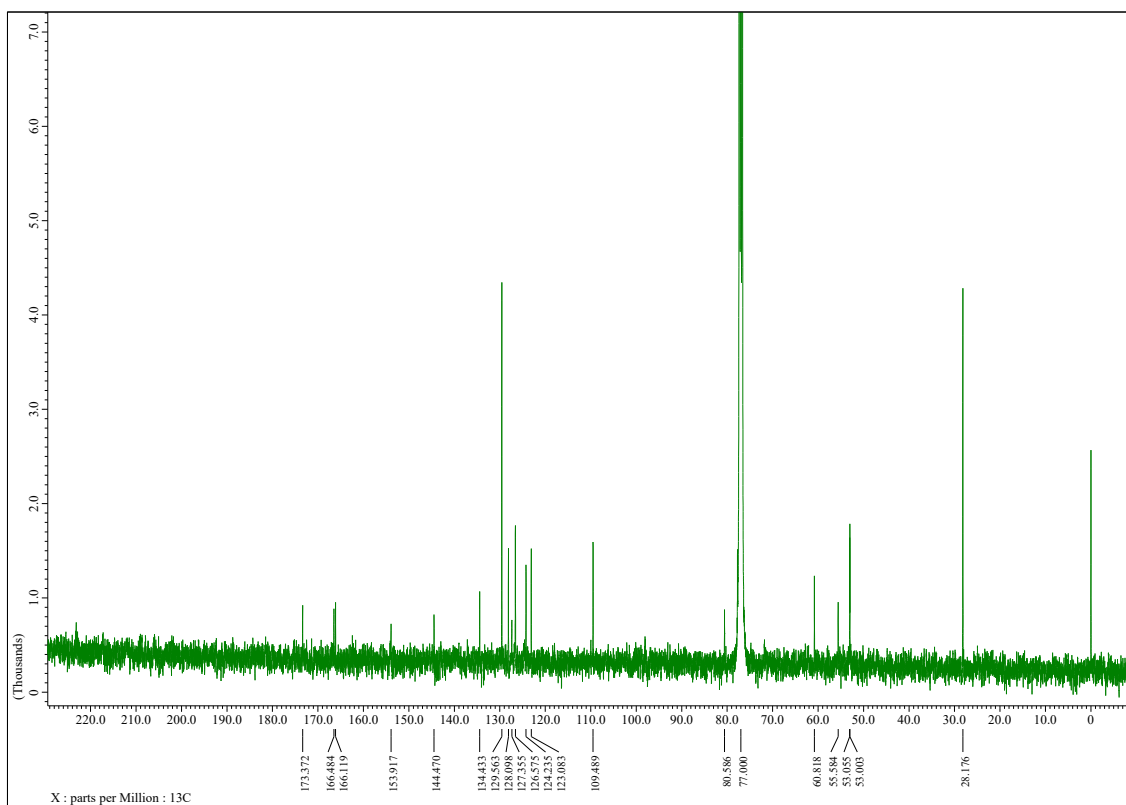
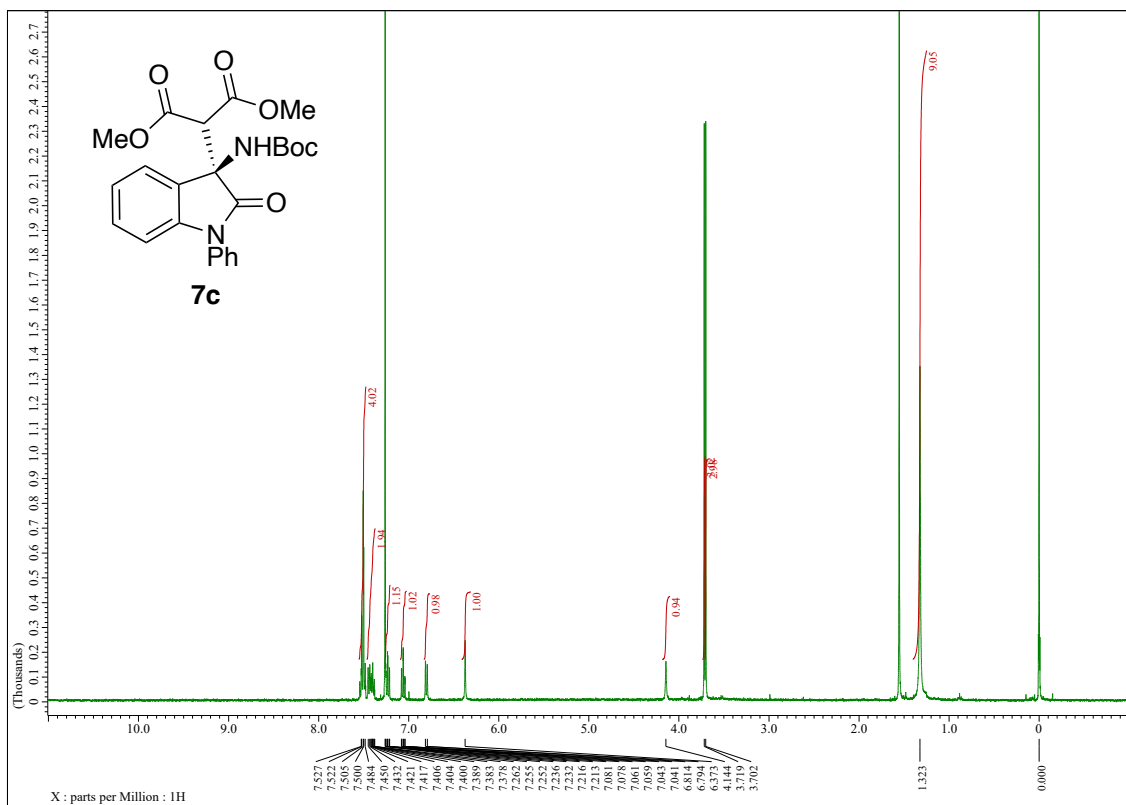


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	6.517	154628	8579	50.8	60.9
2	Unknown	3	10.108	150023	5500	49.2	39.1

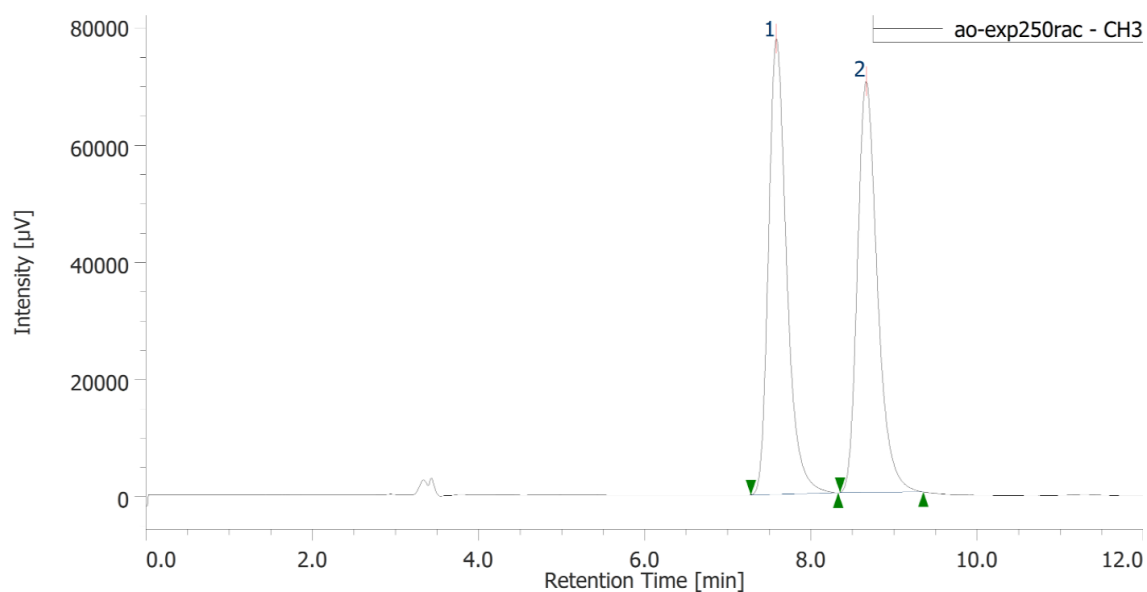
7b catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	6.767	6798246	329619	65.6	72.7
2	Unknown	3	10.658	3564843	123669	34.4	27.3

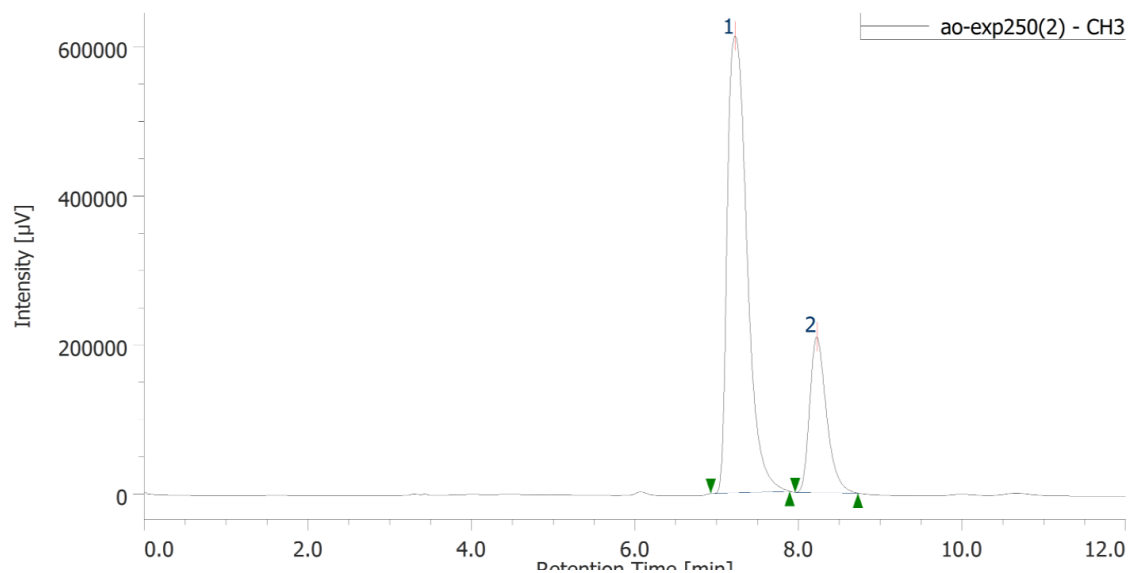


Racemic sample of **7c**

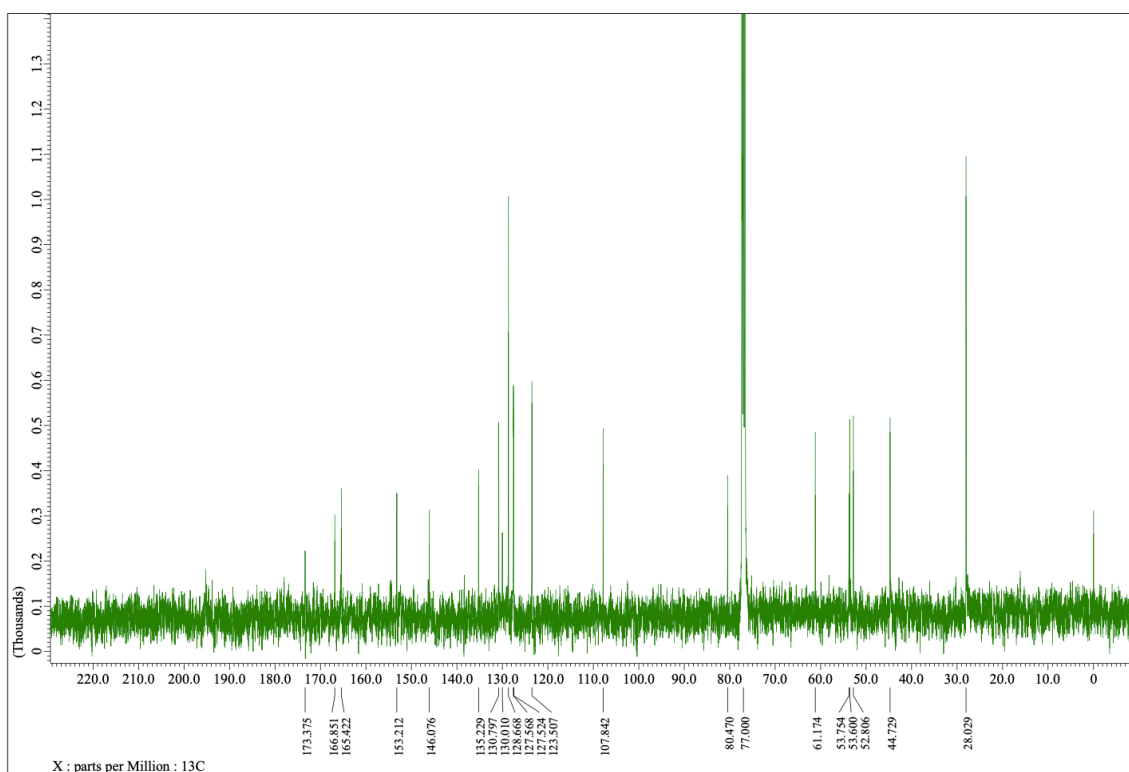
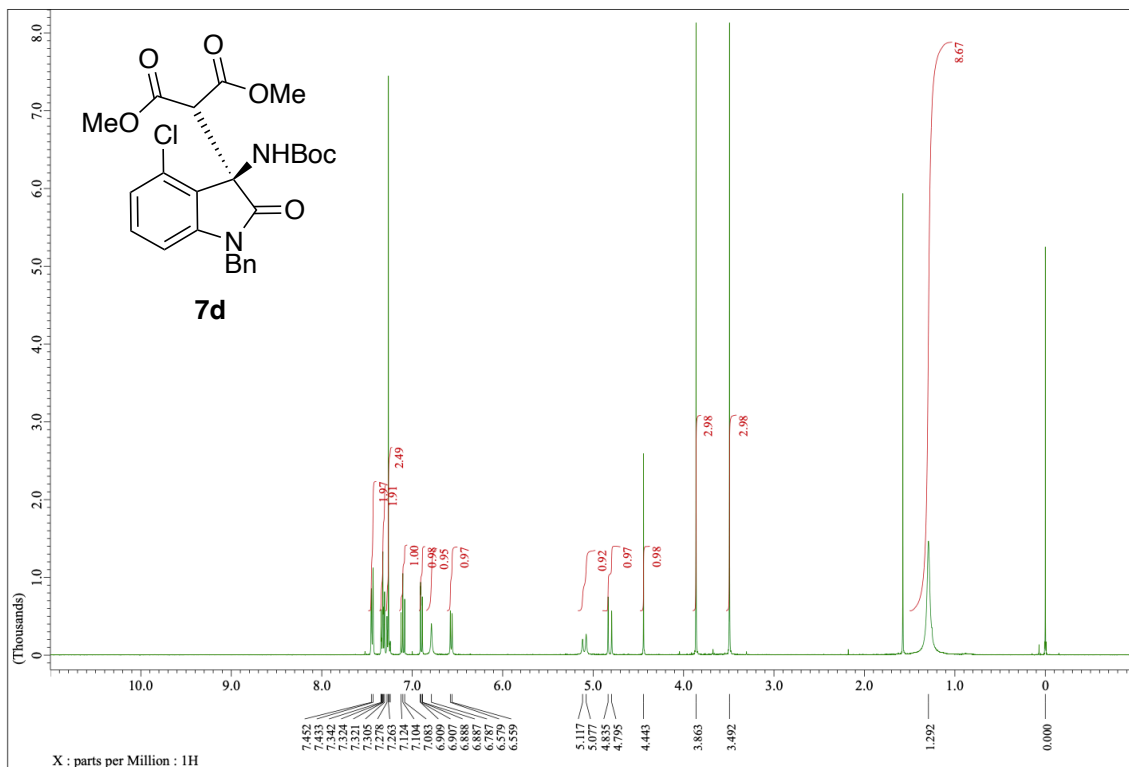


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.583	1178795	77792	50.3	52.6
2	Unknown	3	8.667	1166613	70149	49.7	47.4

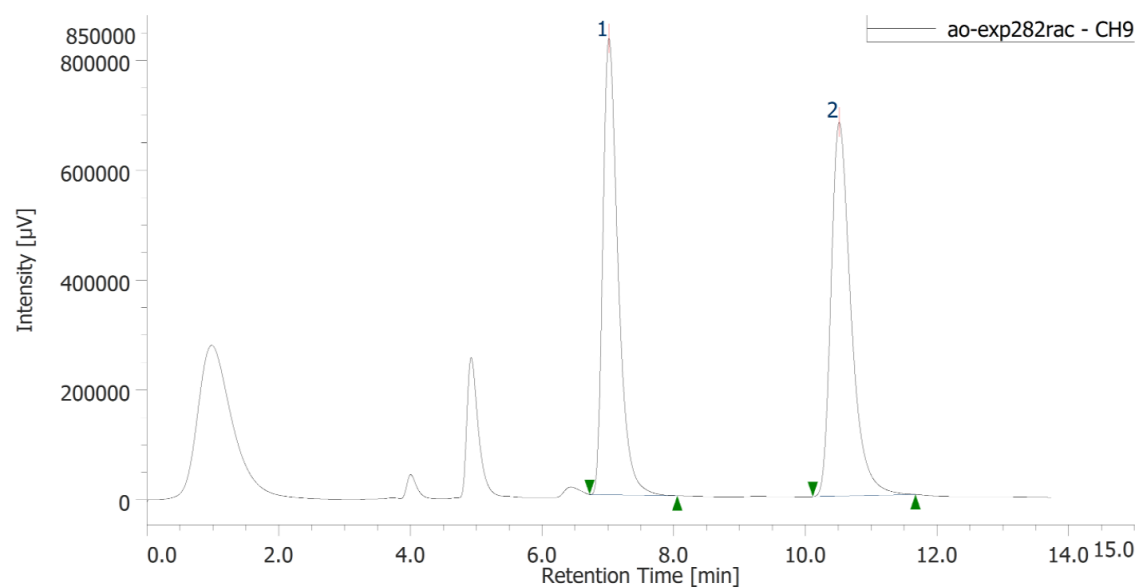
7c catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.225	10291138	612648	77.5	74.6
2	Unknown	3	8.225	2987784	208907	22.5	25.4

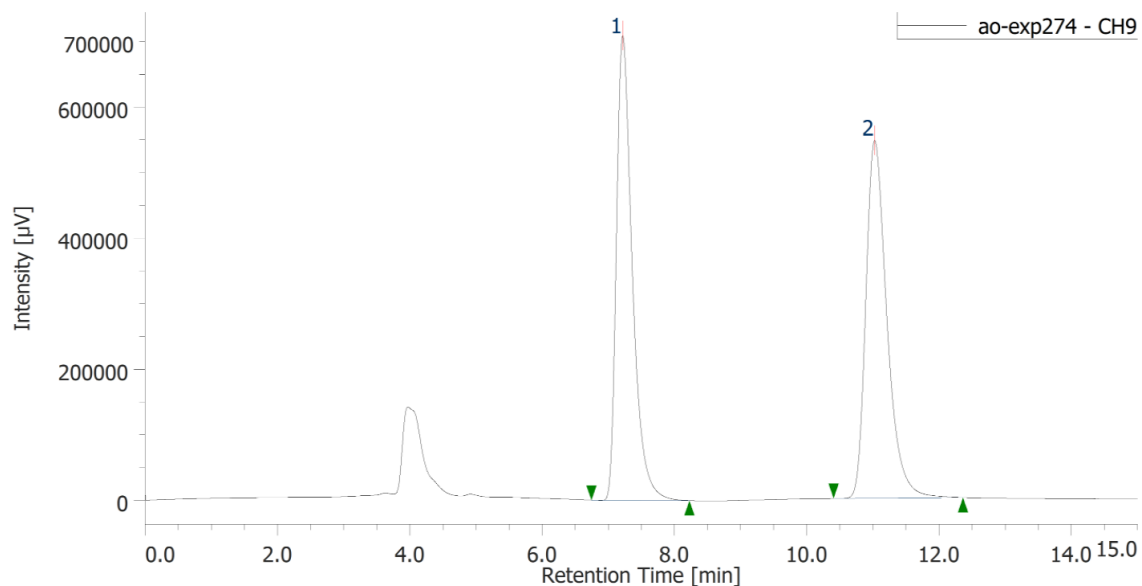


Racemic sample of **7d**

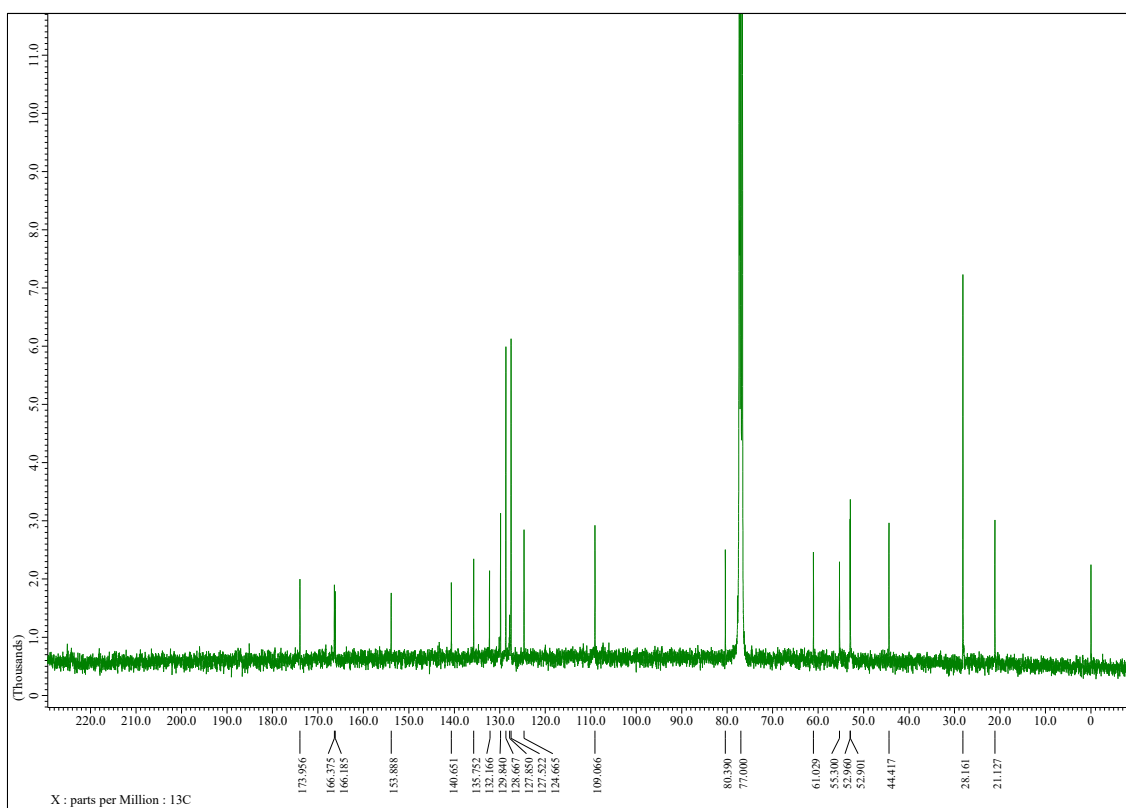
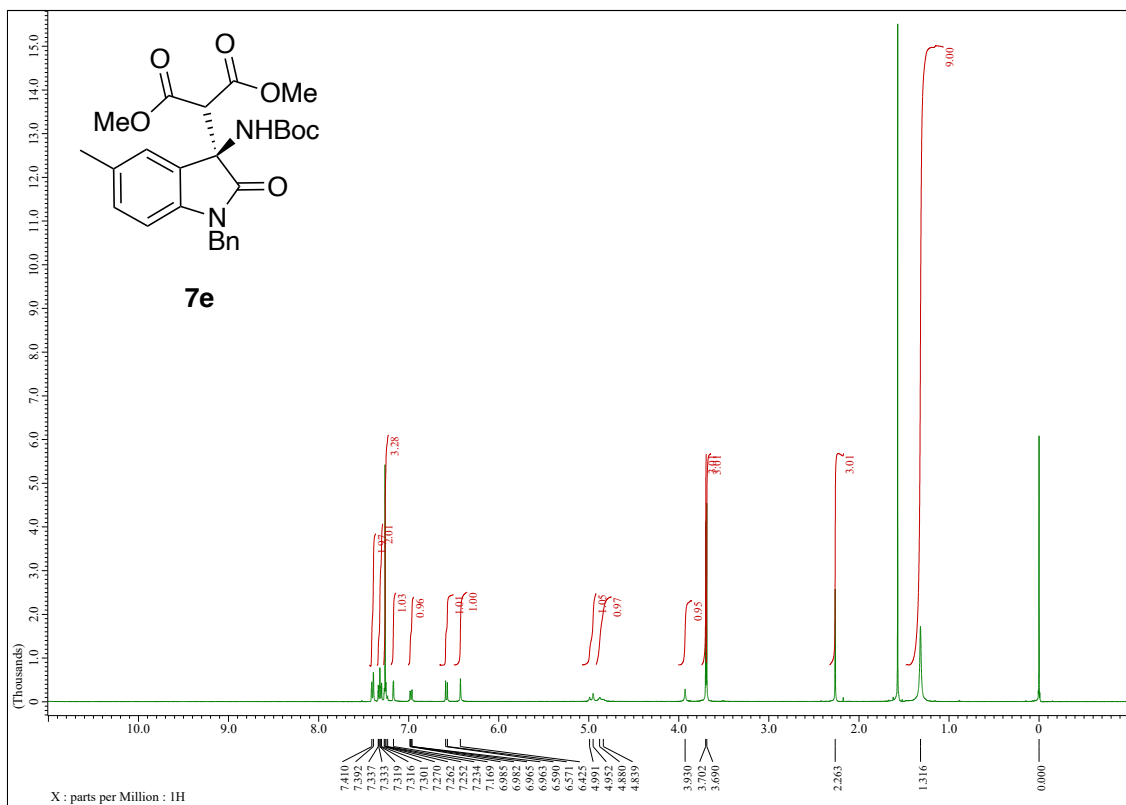


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	9	7.013	13387672	830499	48.2	55.0
2	Unknown	9	10.512	14376635	680124	51.8	45.0

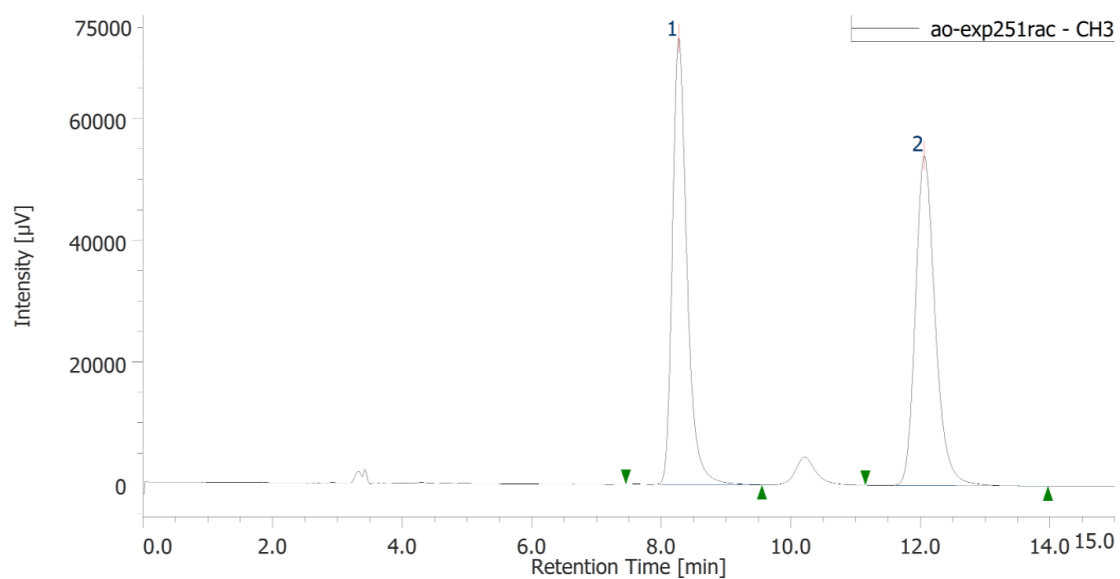
7d catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	9	7.217	11804115	708841	49.4	56.5
2	Unknown	9	11.025	12071694	545843	50.6	43.5

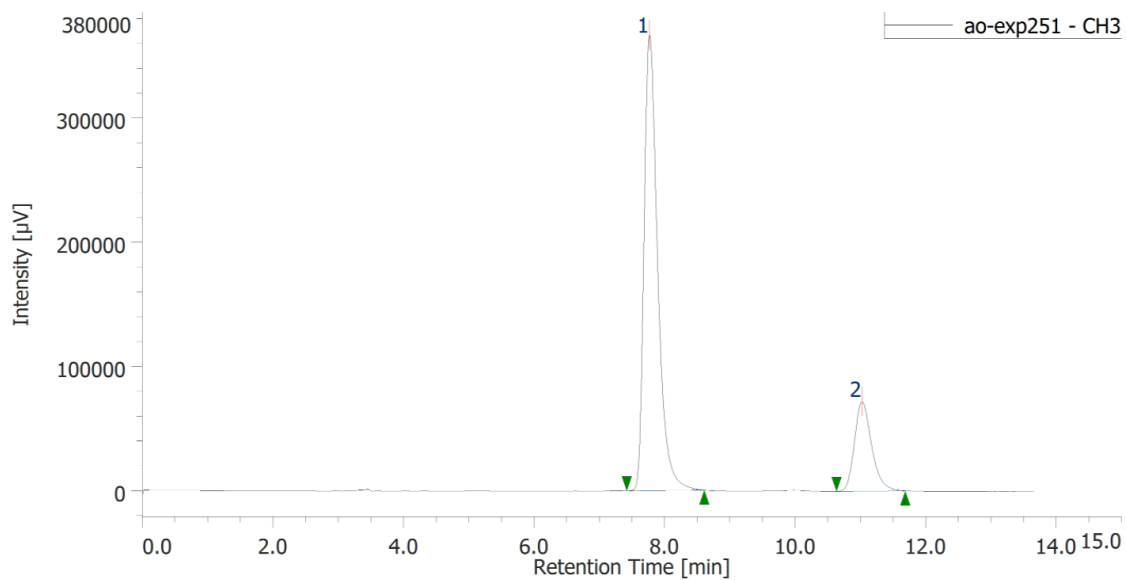


Racemic sample of **7e**

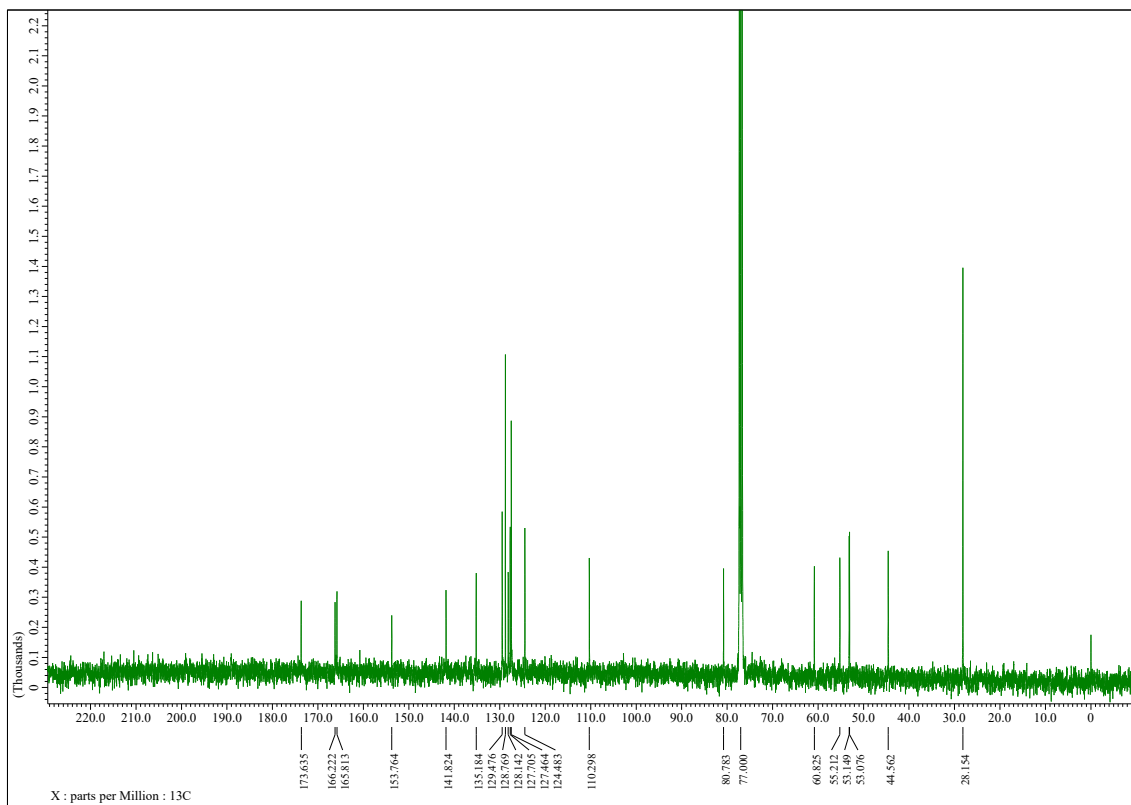
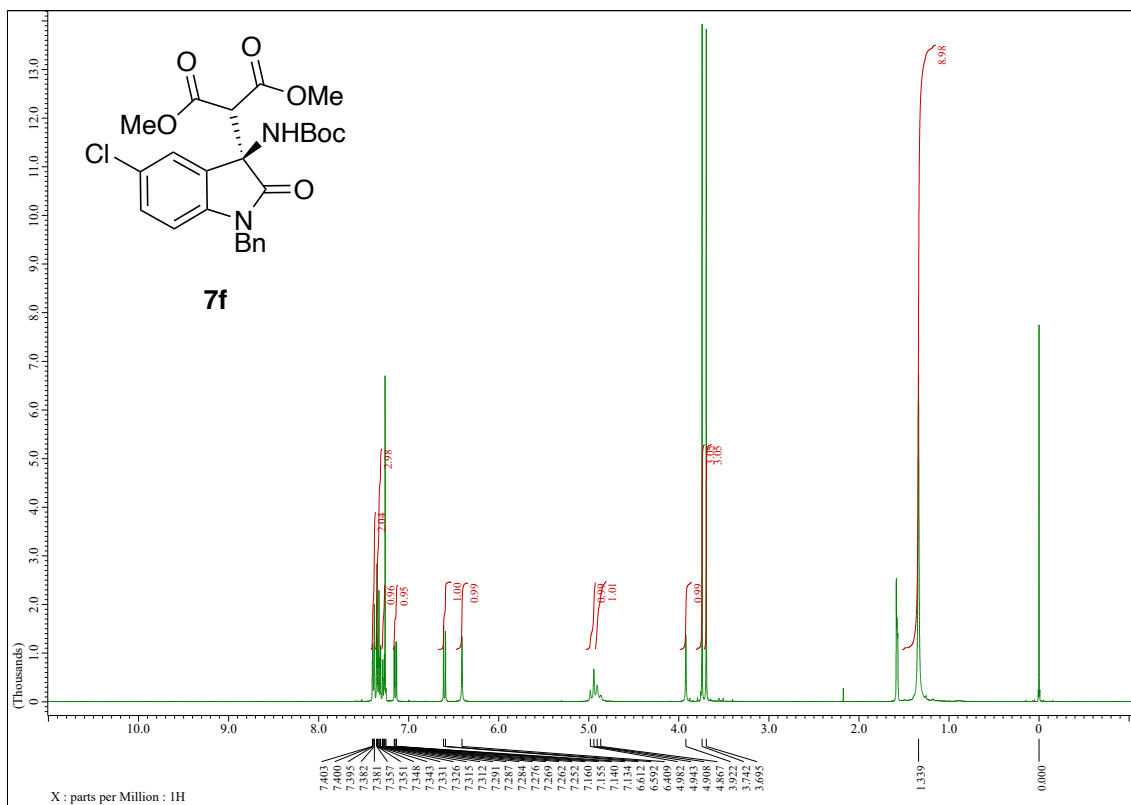


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	8.267	1141384	73322	49.9	57.5
2	Unknown	3	12.058	1146791	54163	50.1	42.5

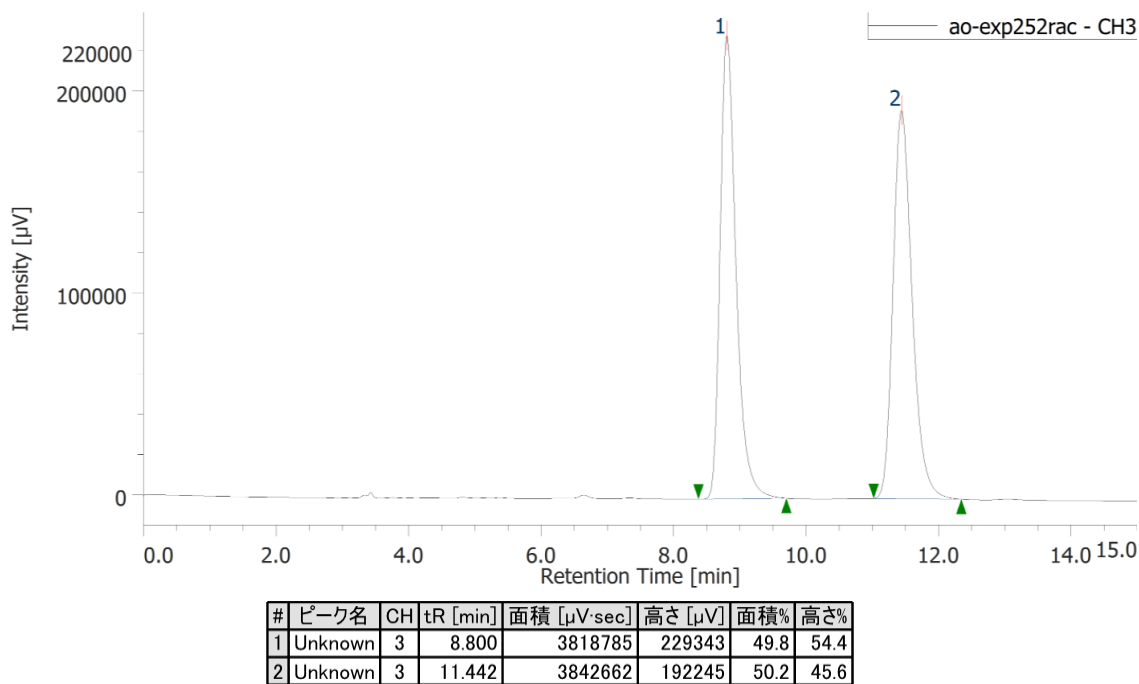
7e catalyzed by **4a**



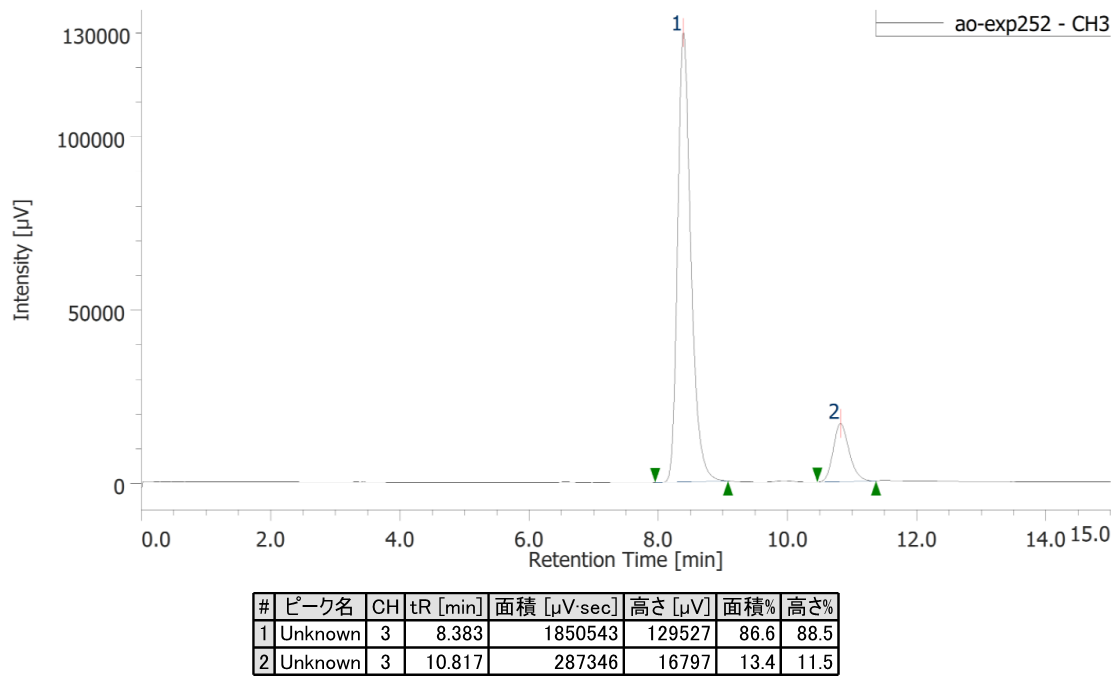
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.767	5311506	366736	80.2	83.6
2	Unknown	3	11.025	1311860	72001	19.8	16.4

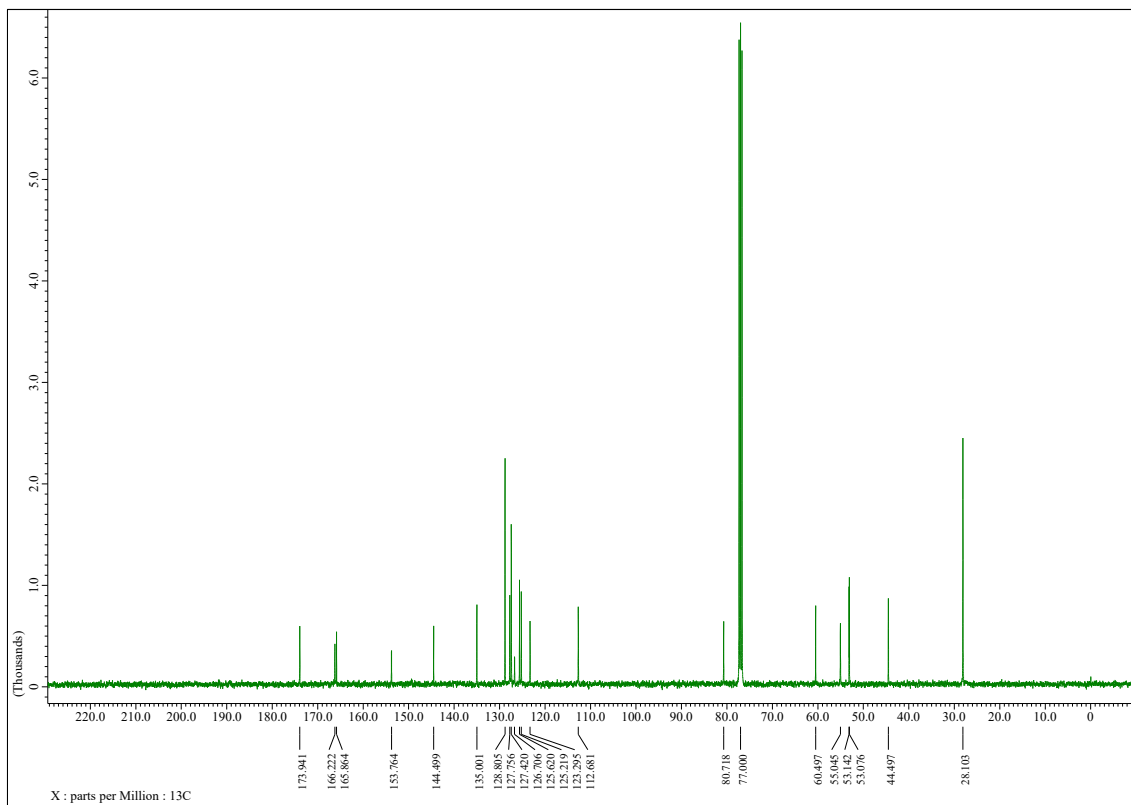
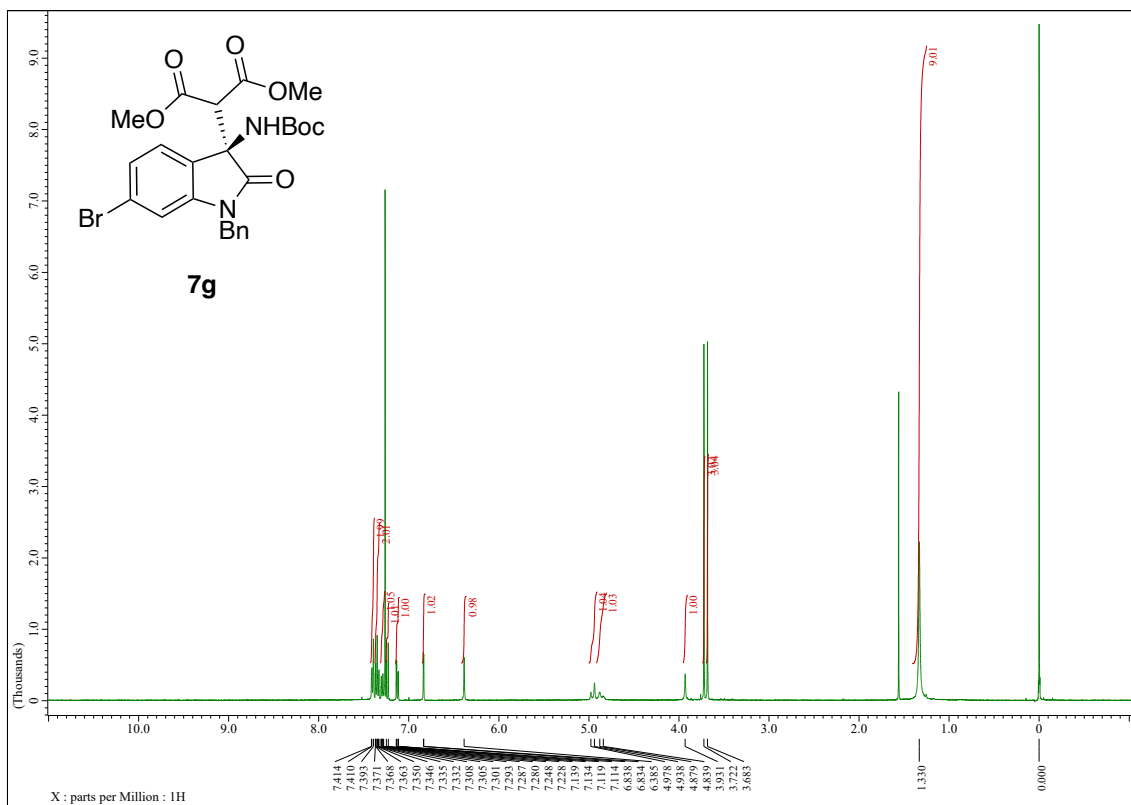


Racemic sample of **7f**

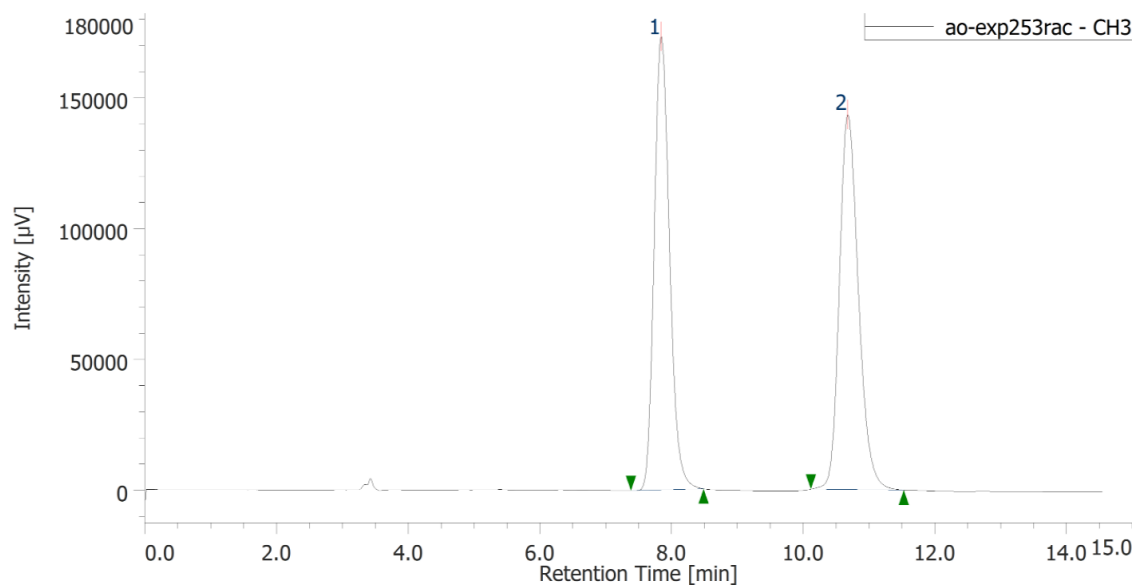


7f catalyzed by **4a**



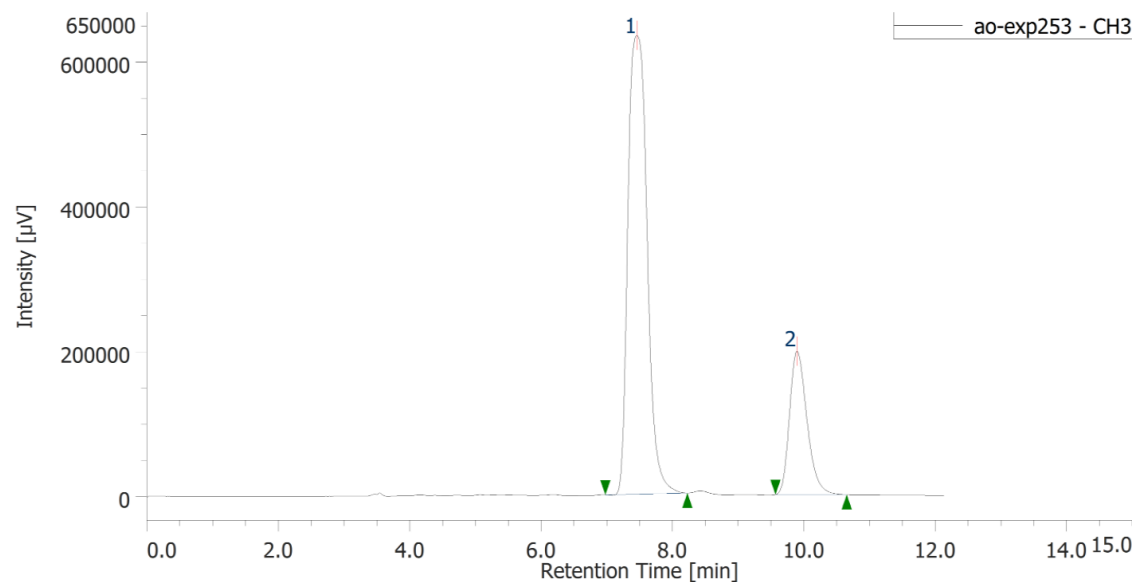


Racemic sample of **7g**

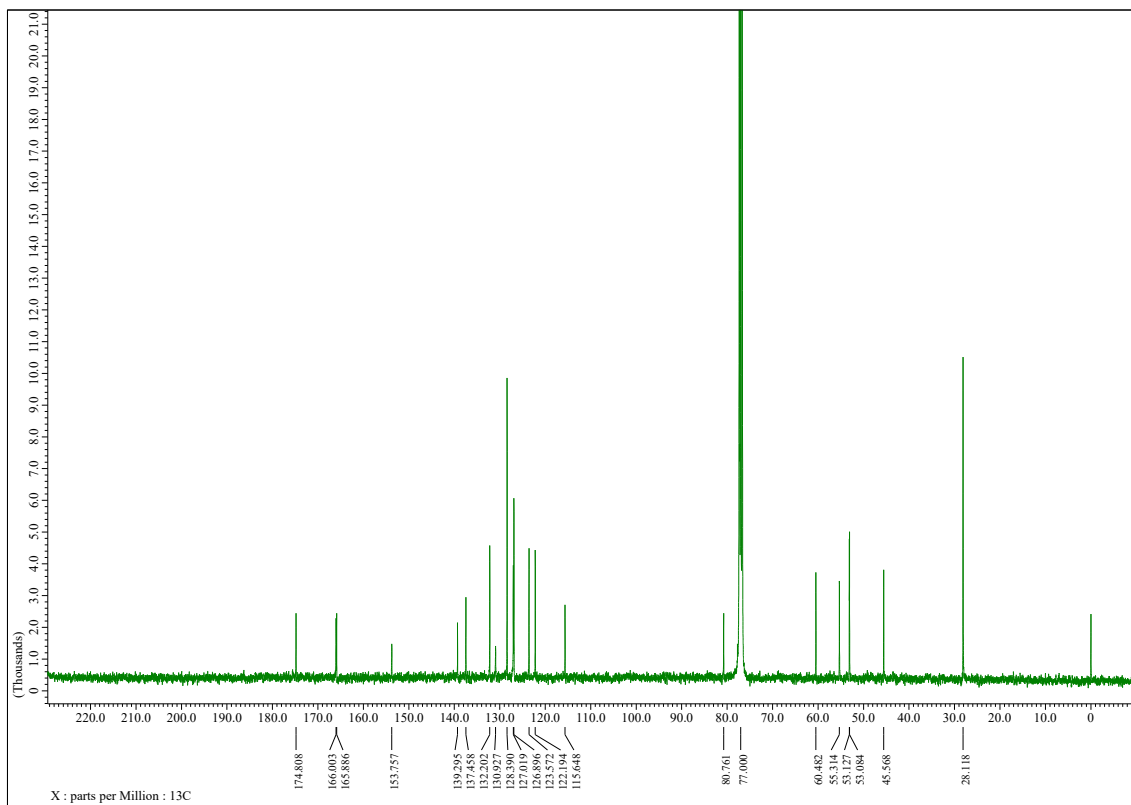
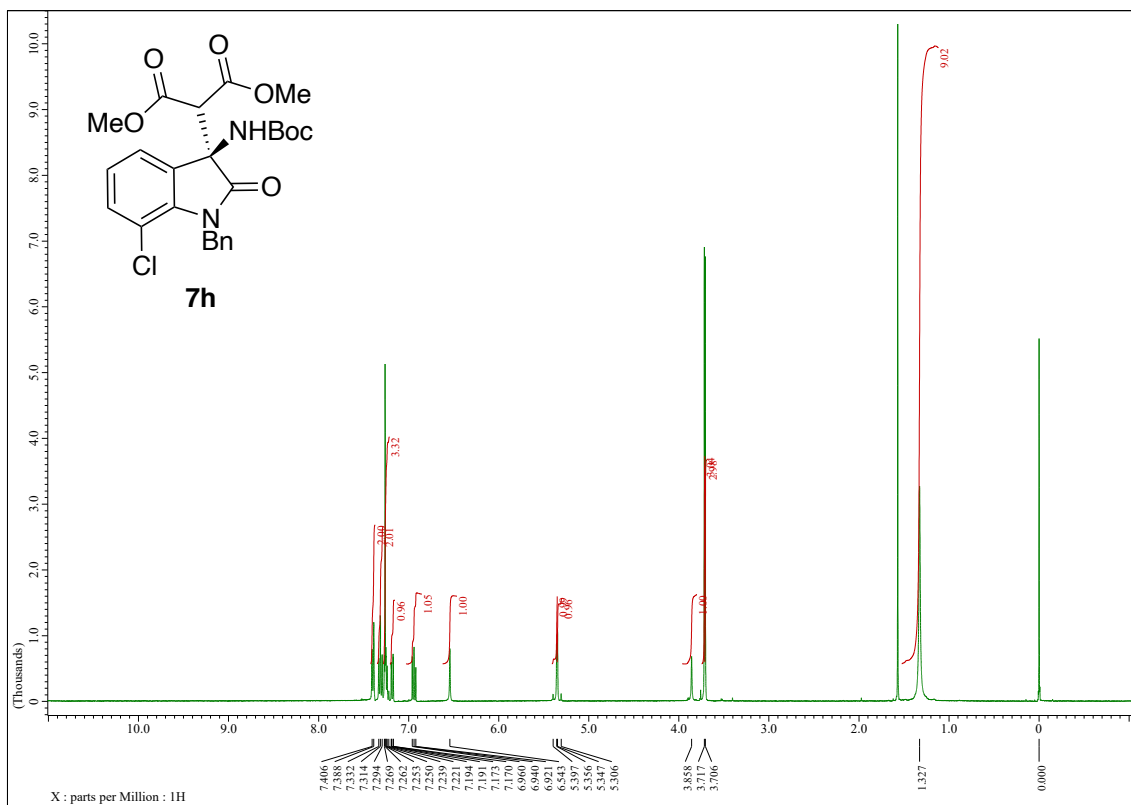


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.842	2808773	173331	49.3	54.7
2	Unknown	3	10.675	2886473	143286	50.7	45.3

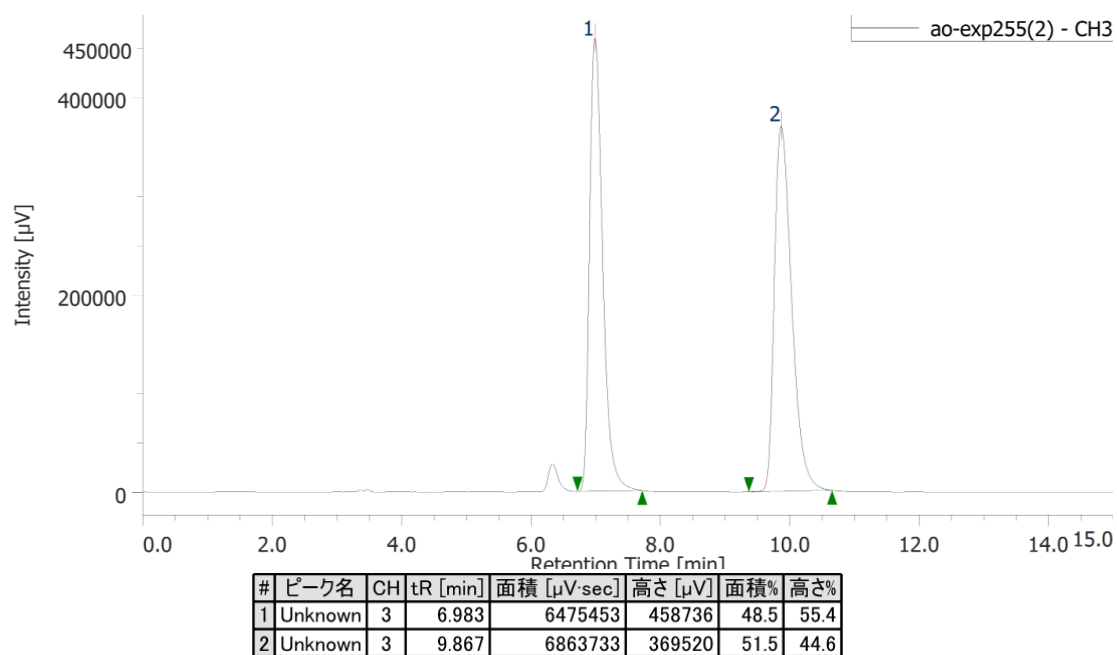
7g catalyzed by **4a**



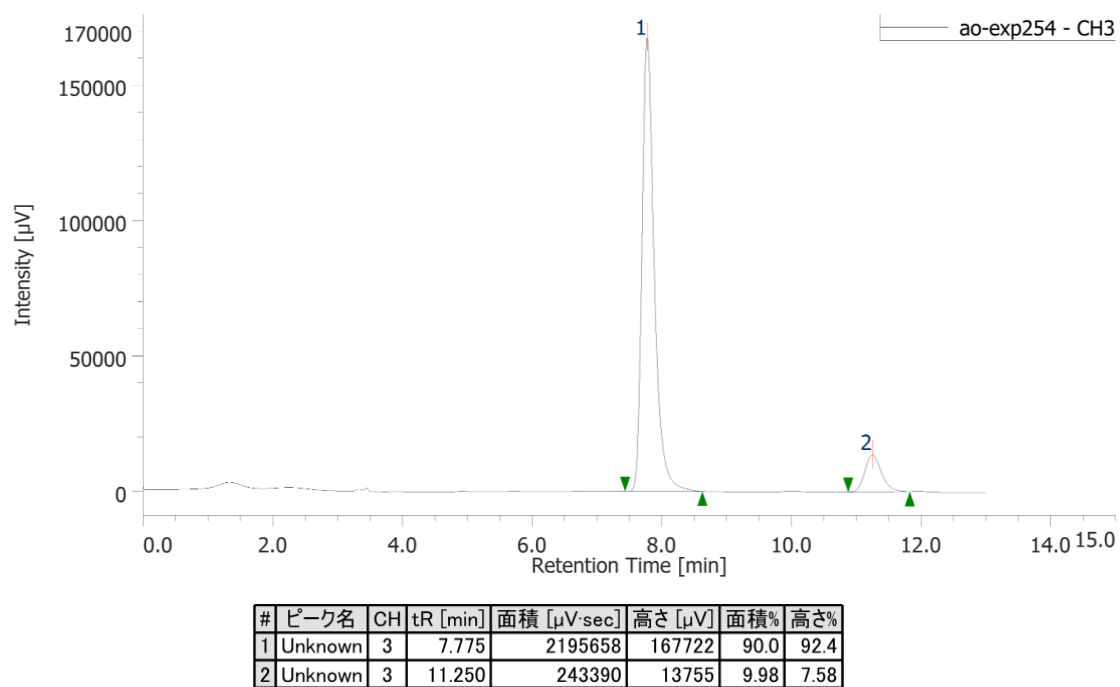
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.458	12827146	633069	77.9	76.2
2	Unknown	3	9.892	3647570	197759	22.1	23.8

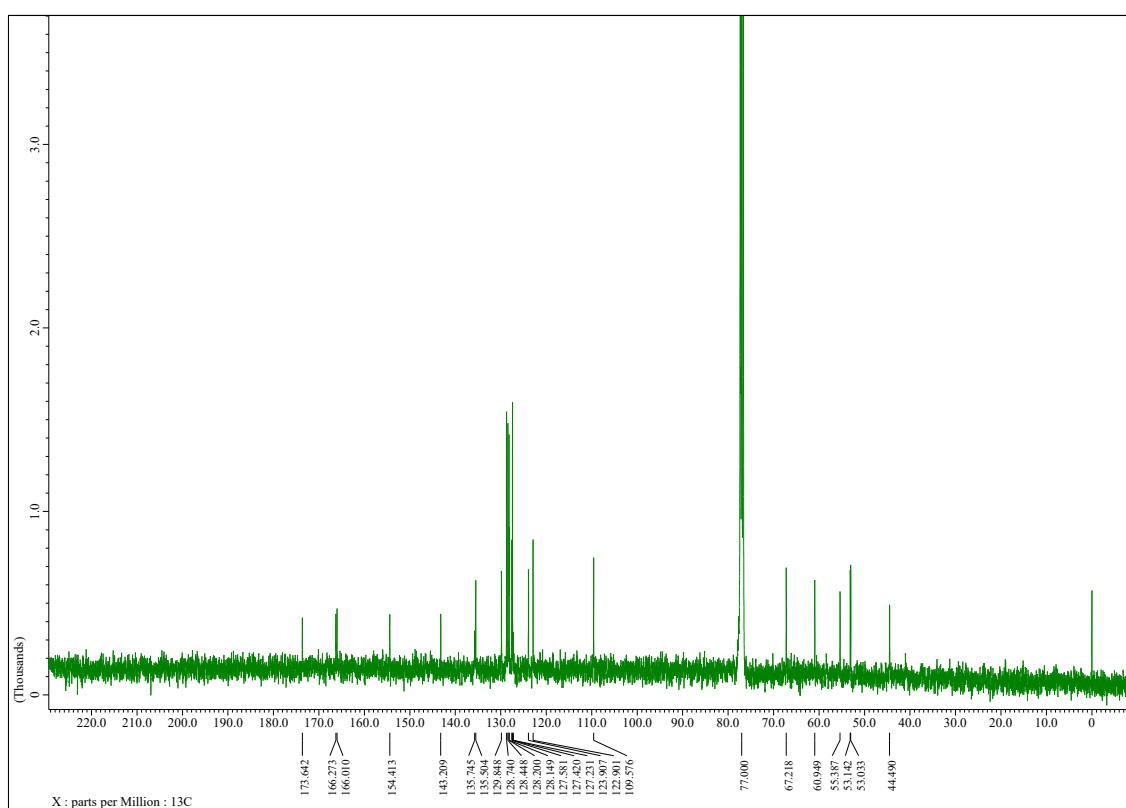
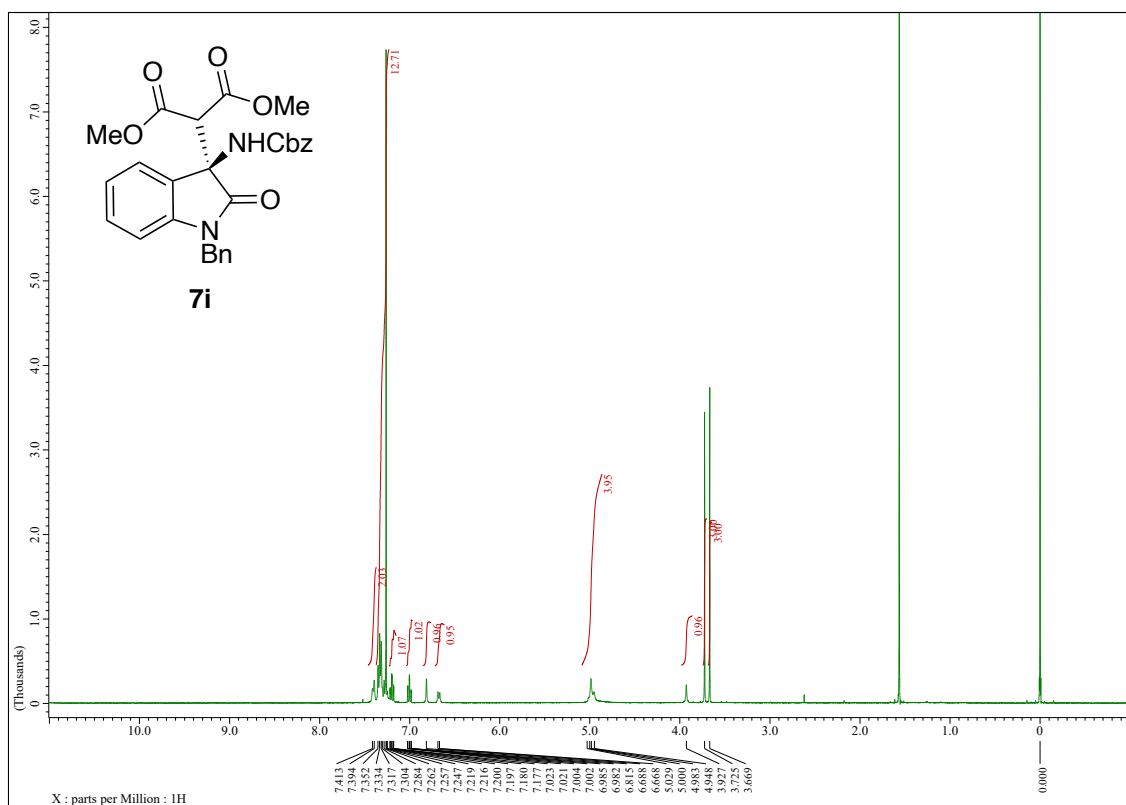


Racemic sample of **7h**

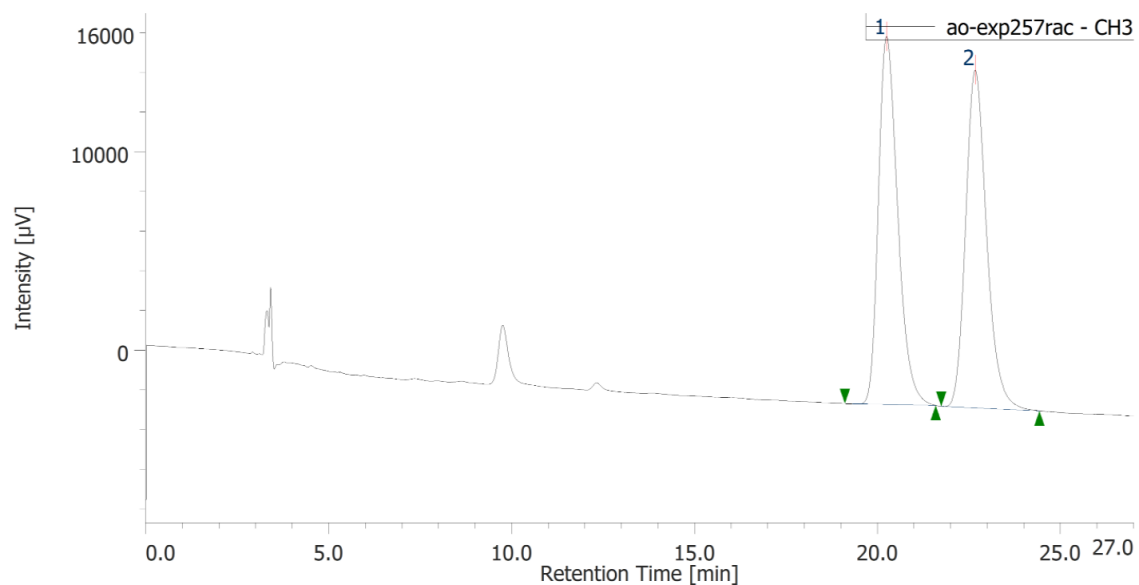


7h catalyzed by **4a**



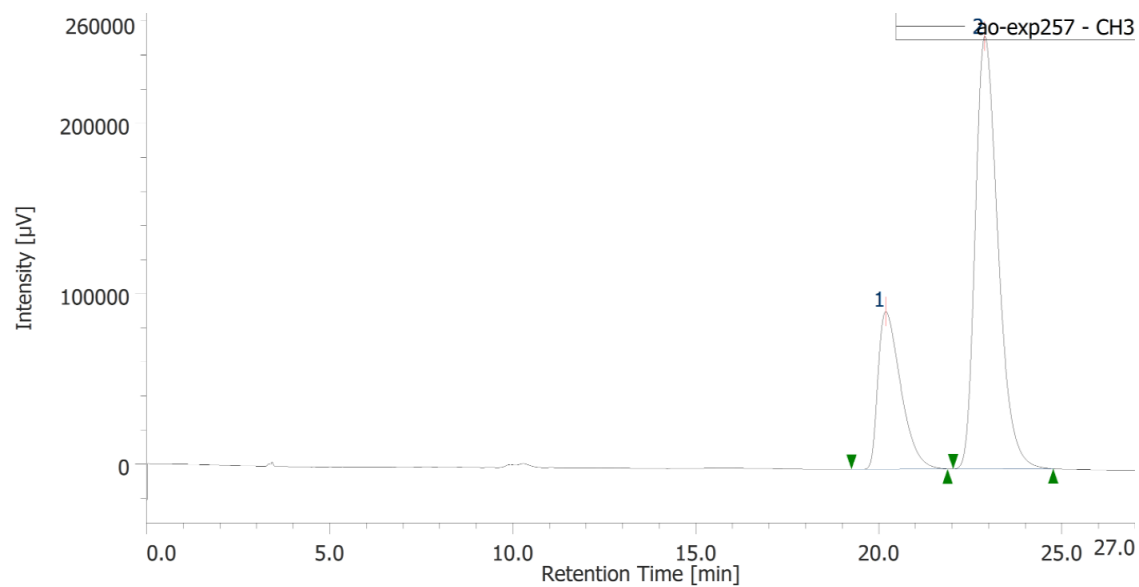


Racemic sample of **7i**

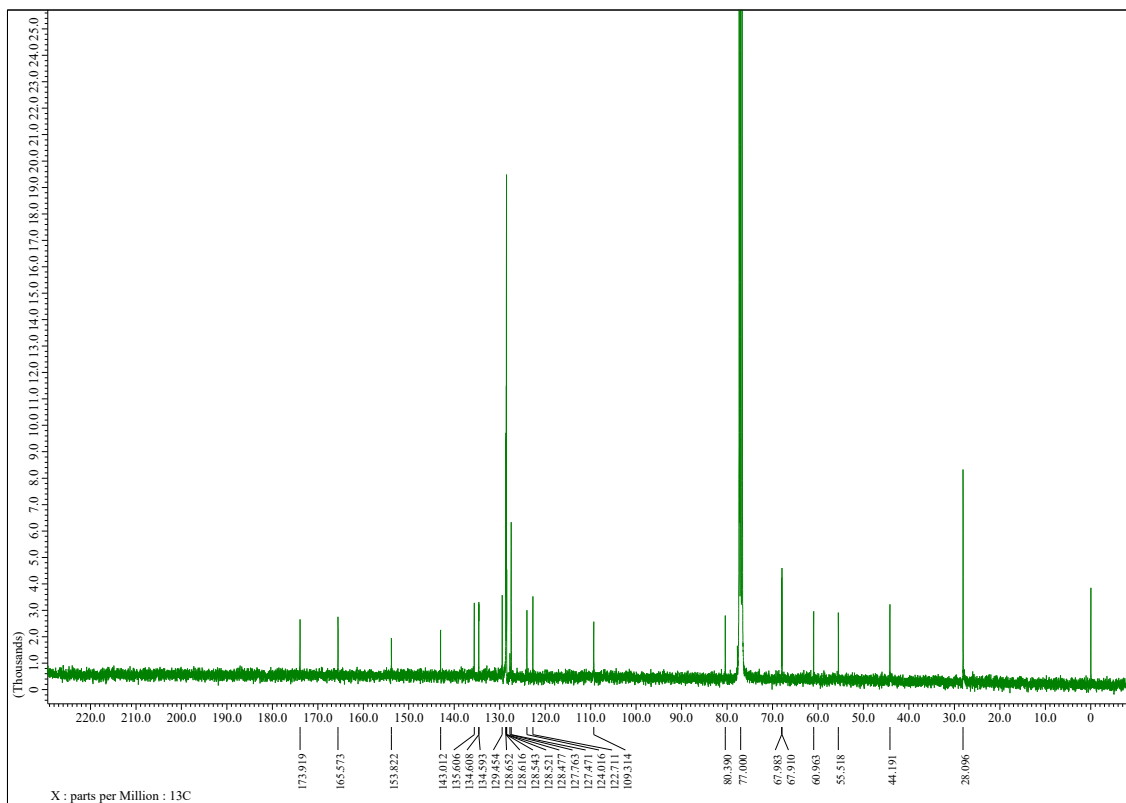
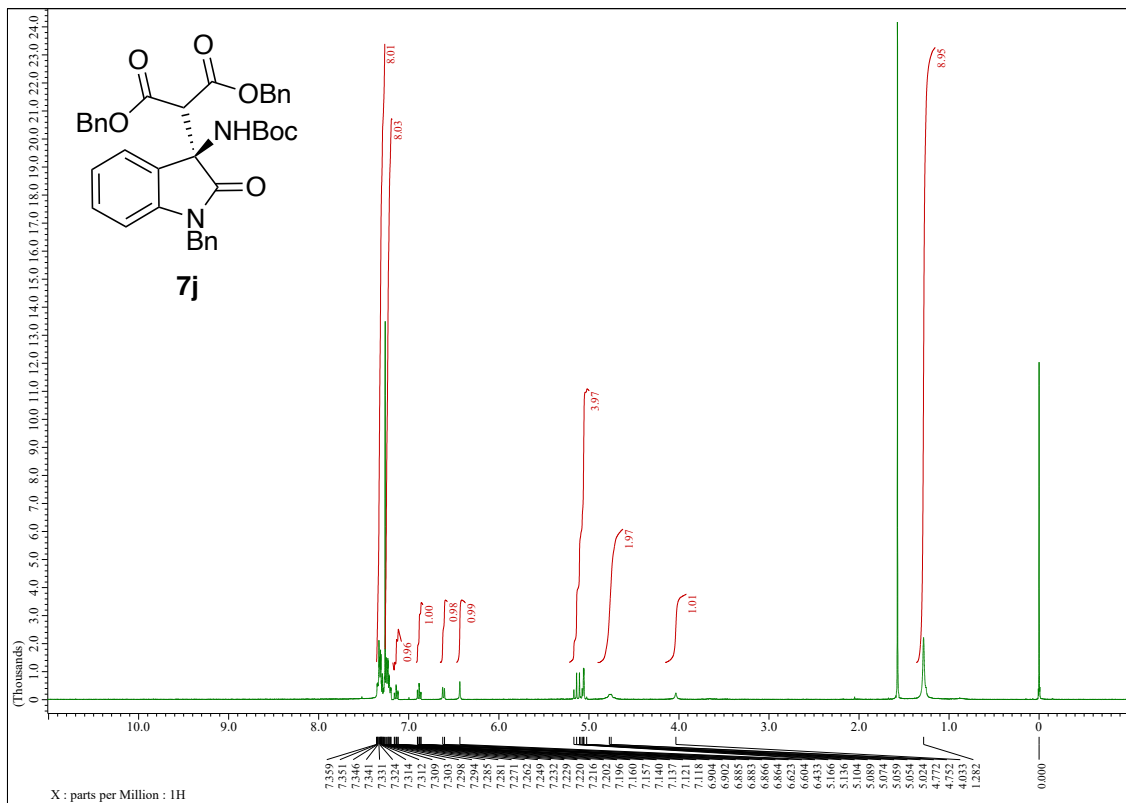


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	20.242	678230	18537	50.1	52.1
2	Unknown	3	22.667	674899	17018	49.9	47.9

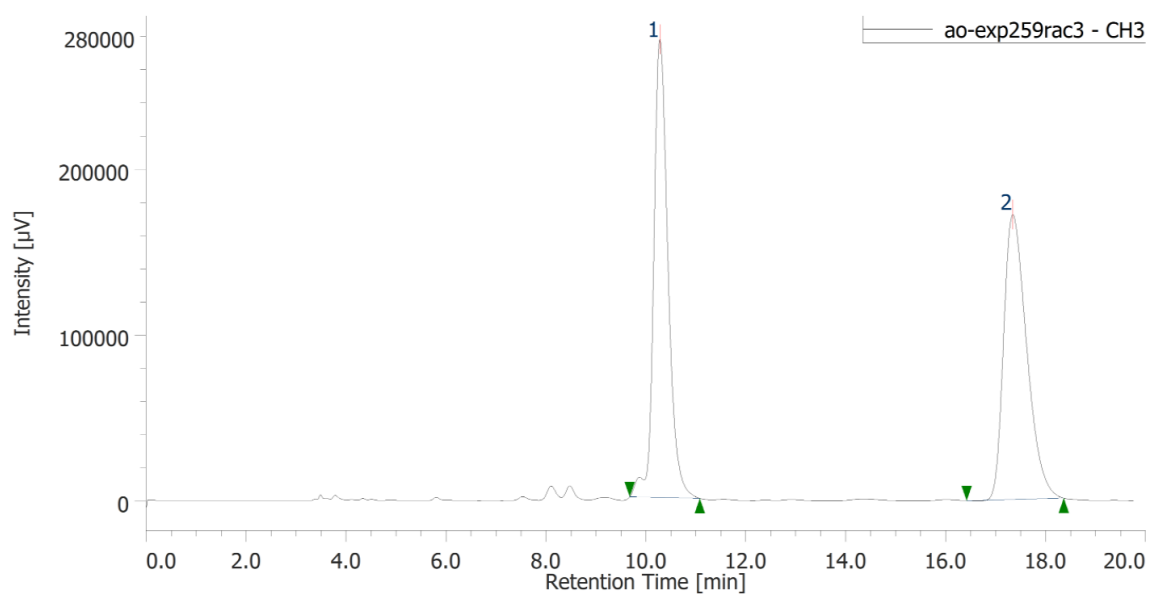
7i catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	20.183	3985252	92517	26.7	26.7
2	Unknown	3	22.883	10921682	253860	73.3	73.3

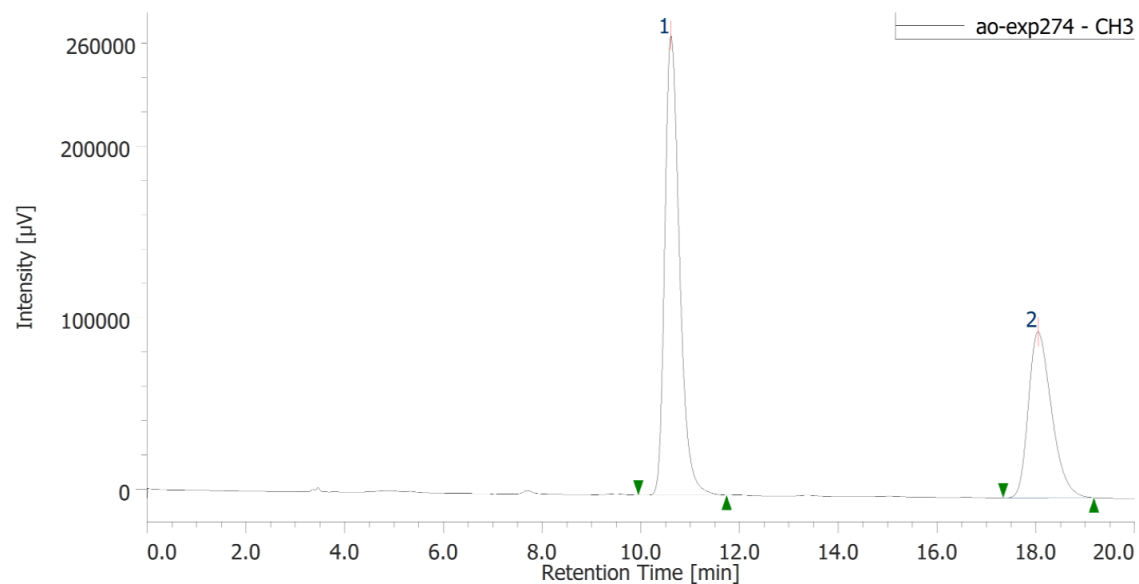


Racemic sample of **7j**

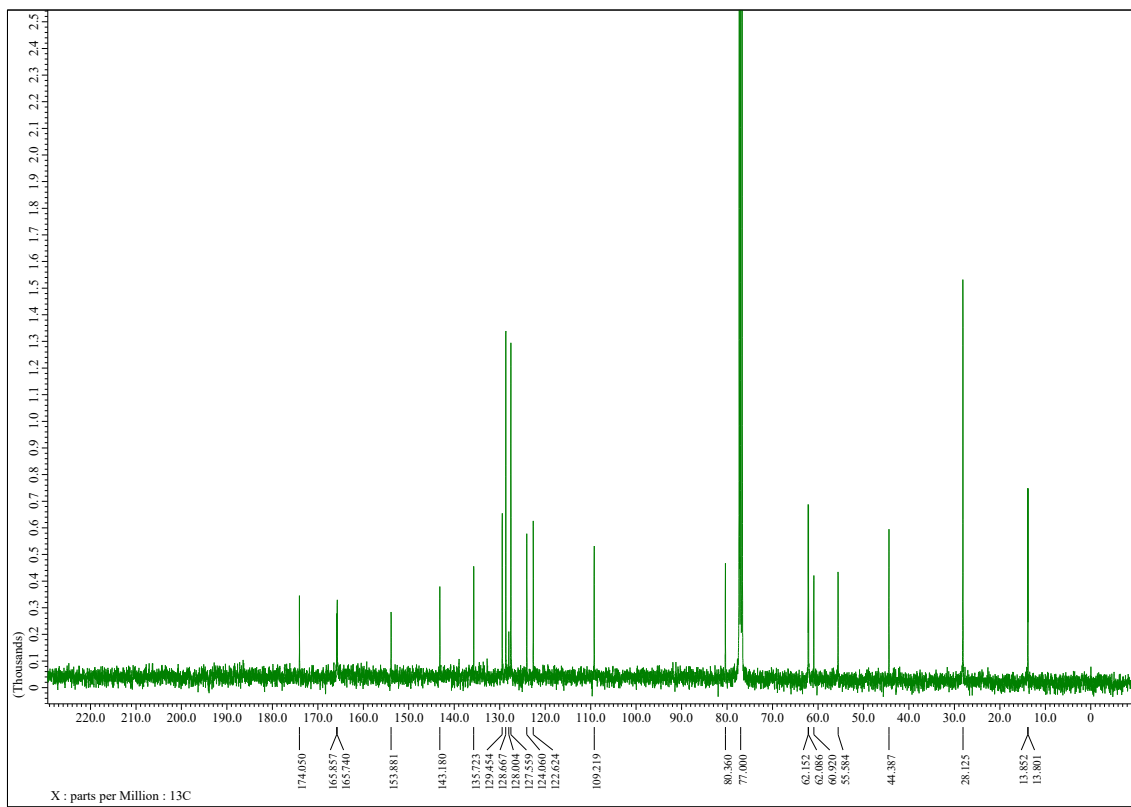
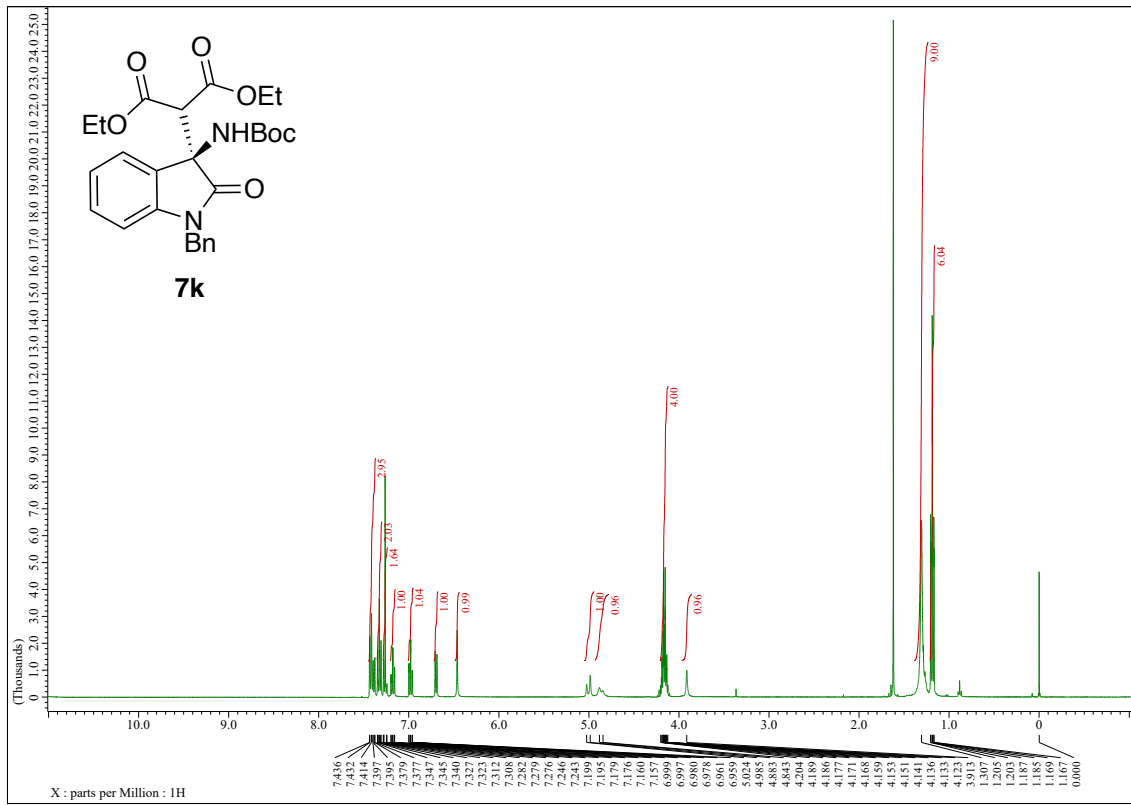


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	10.283	5506445	276038	50.1	61.7
2	Unknown	3	17.342	5494019	171610	49.9	38.3

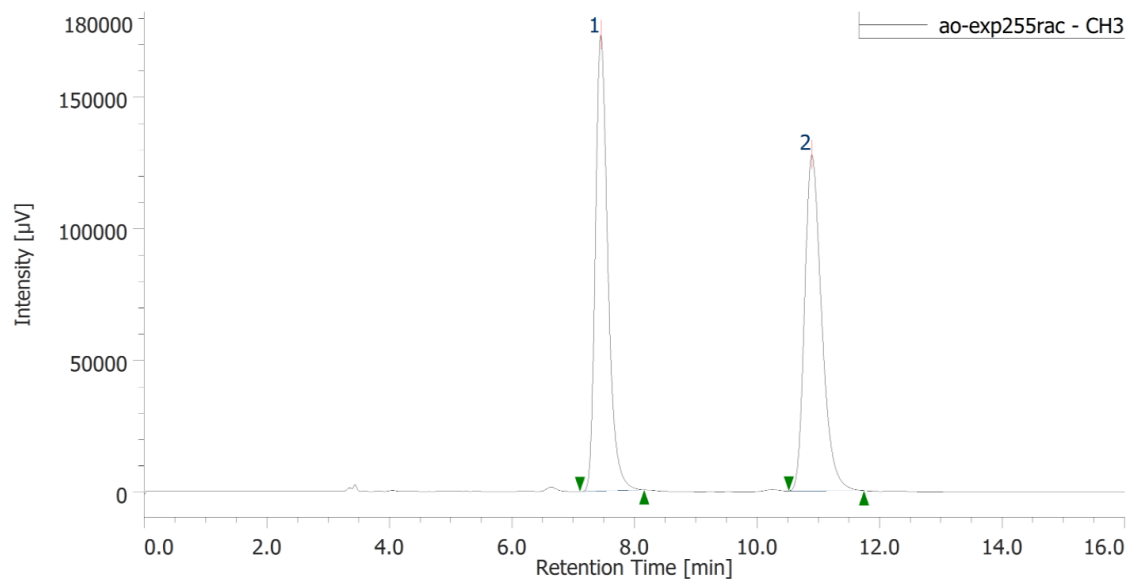
7j catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	10.608	5541817	267545	63.8	73.5
2	Unknown	3	18.042	3149248	96697	36.2	26.5

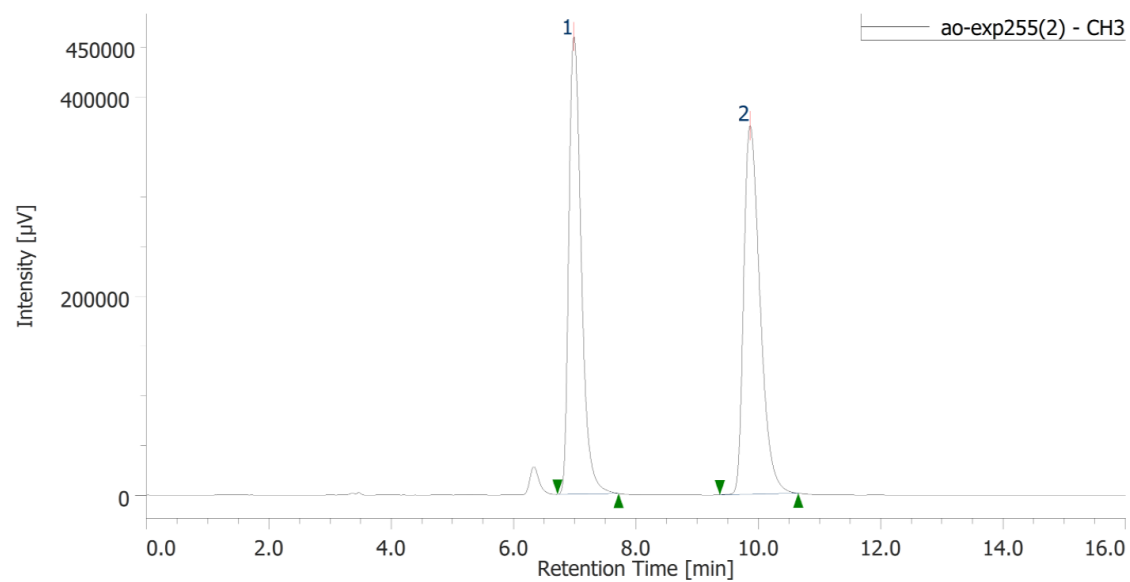


Racemic sample of **7k**

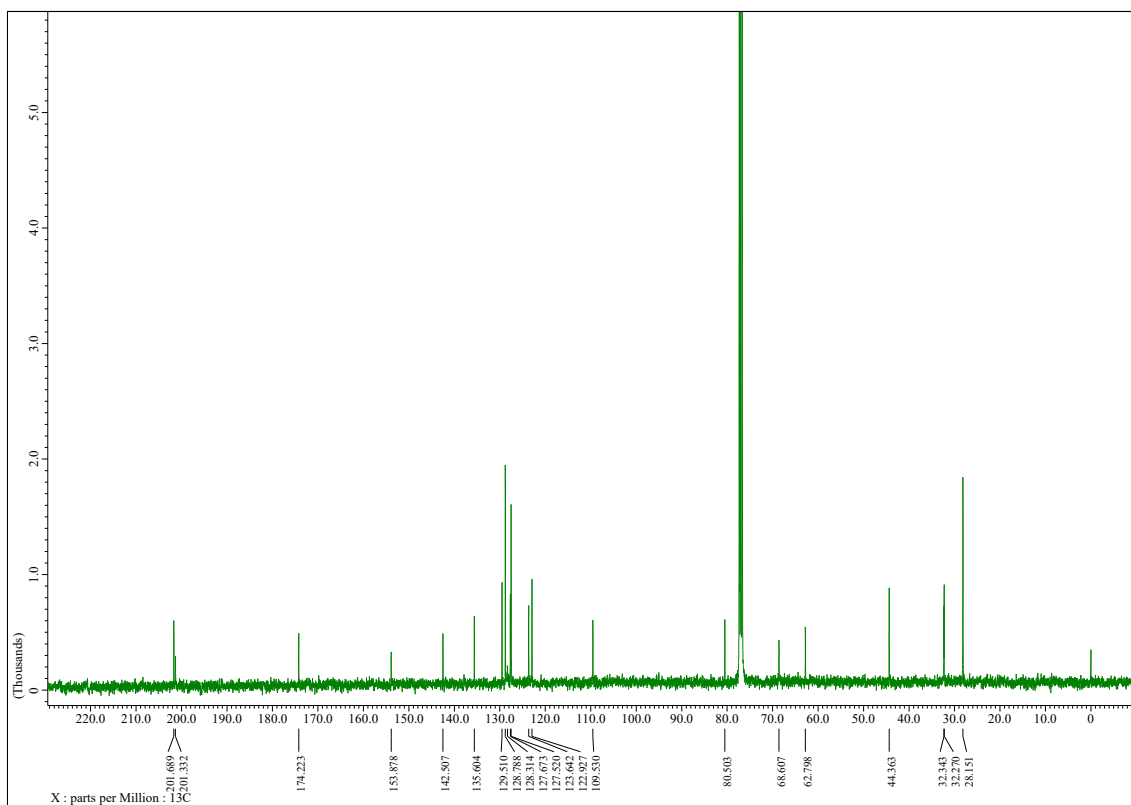
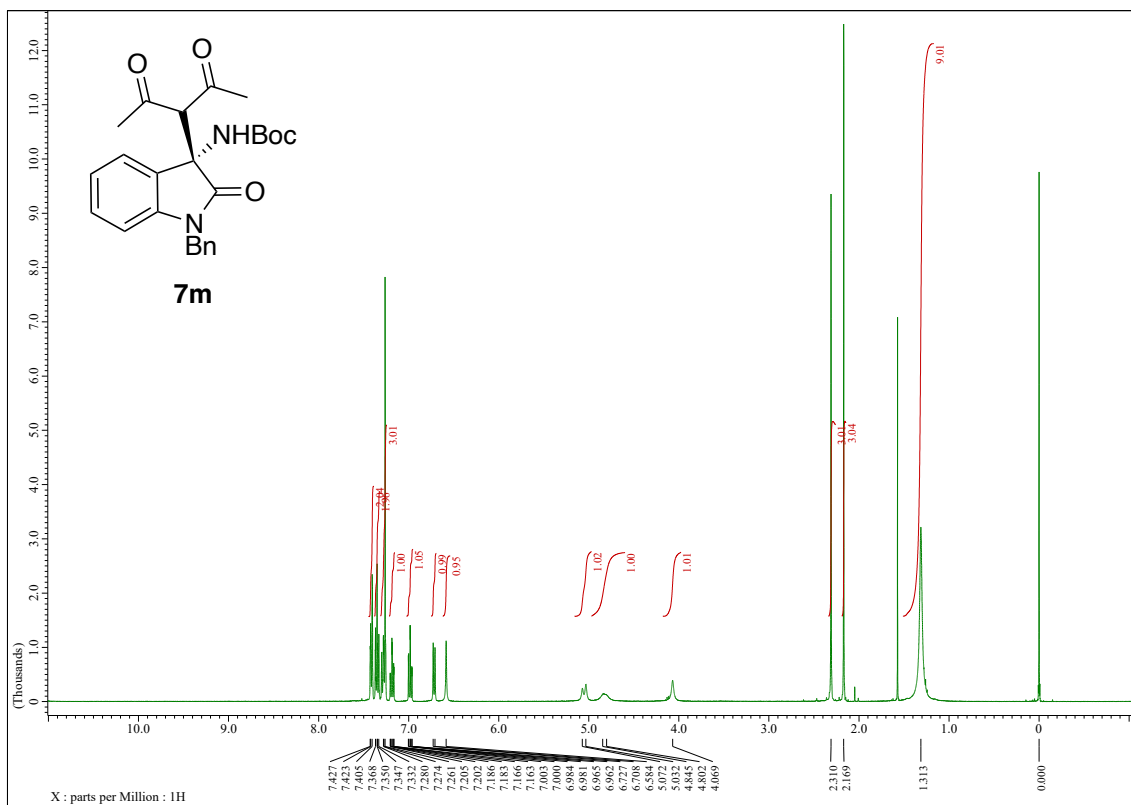


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.450	2450724	173241	49.8	57.6
2	Unknown	3	10.892	2467709	127557	50.2	42.4

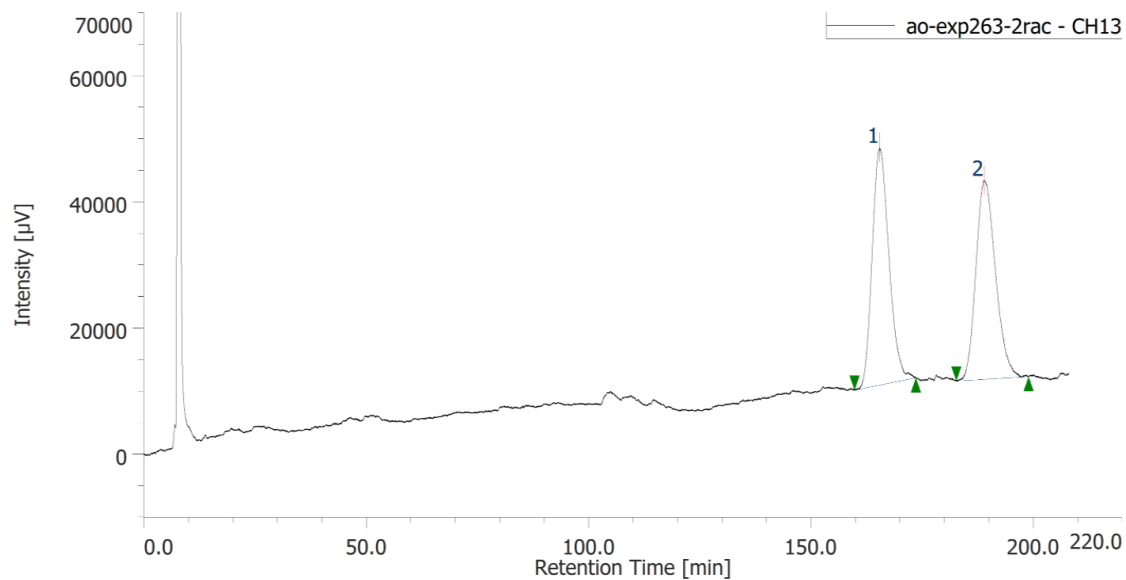
7k catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	6.983	6475453	458736	48.5	55.4
2	Unknown	3	9.867	6863733	369520	51.5	44.6

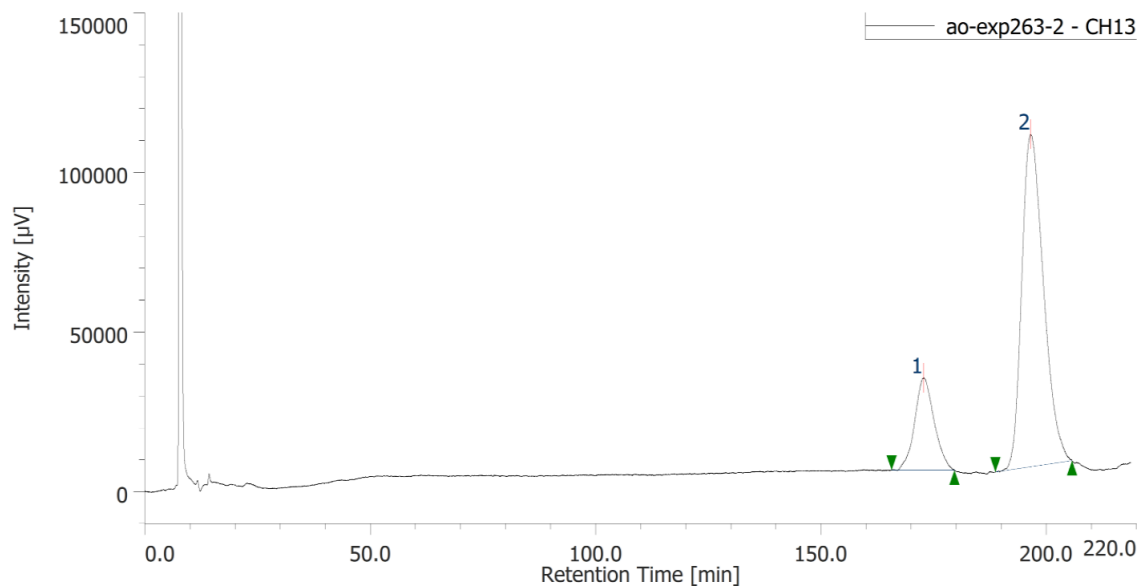


Racemic sample of **7m**; HPLC (CHIRALPAK IC column, hexane/2-propanol = 95/5, flow rate 1.0 mL/min, 25 °C, 210 nm)



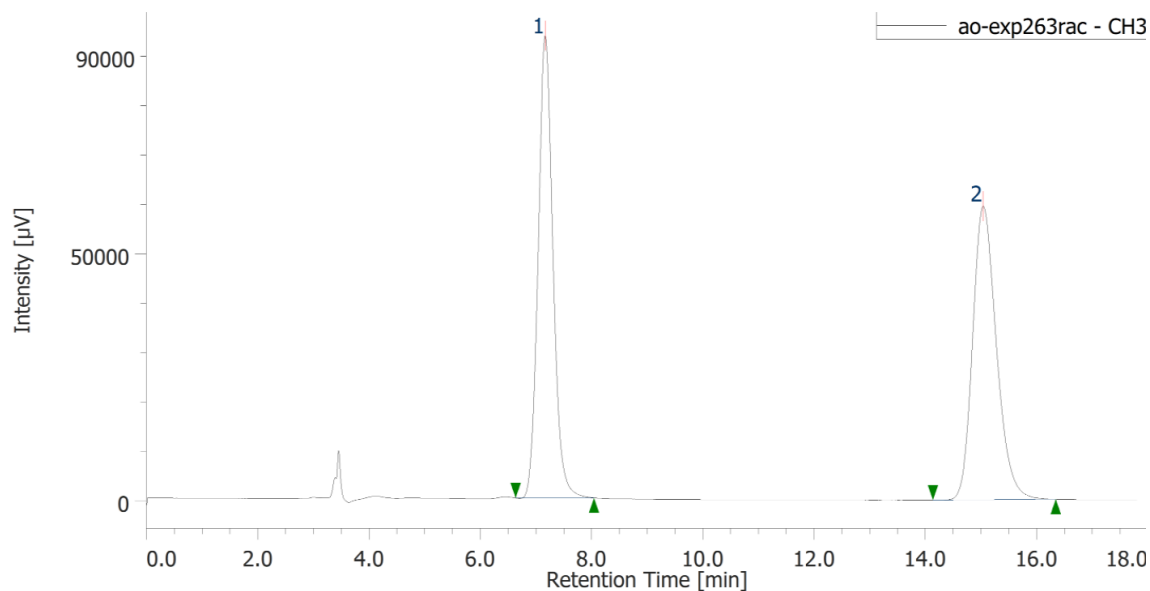
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	13	165.415	9866216	37638	50.5	54.4
2	Unknown	13	188.908	9658658	31514	49.5	45.6

7m catalyzed by **4a**



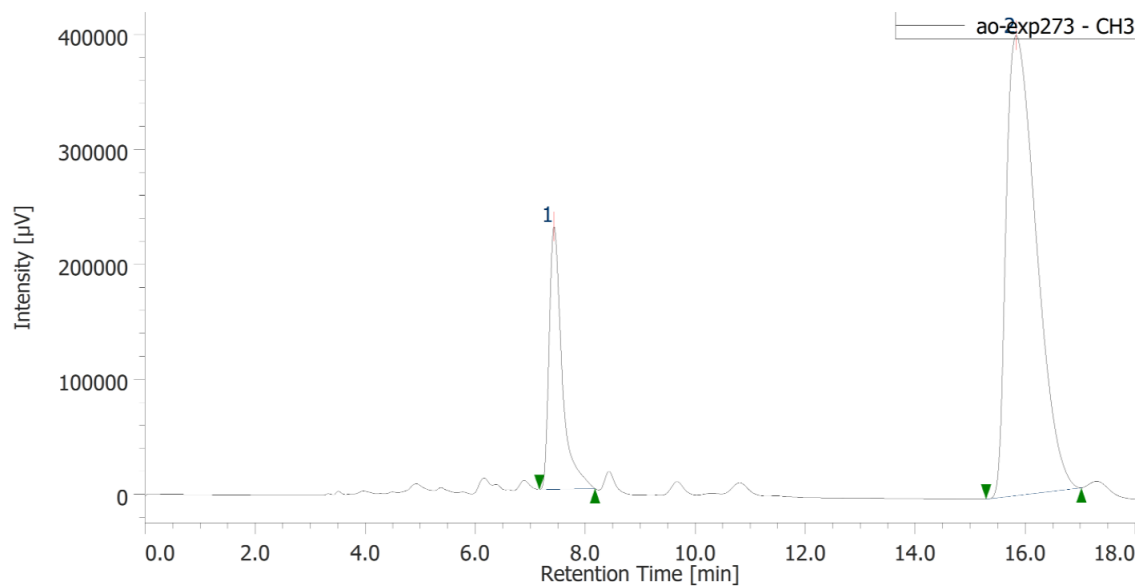
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	13	172.718	8618129	28868	19.8	21.7
2	Unknown	13	196.508	34916305	104057	80.2	78.3

Racemic sample of **7m**; HPLC (CHIRALPAK IA column, hexane/2-propanol = 80/20, flow rate 1.0 mL/min, 25 °C, 254 nm)

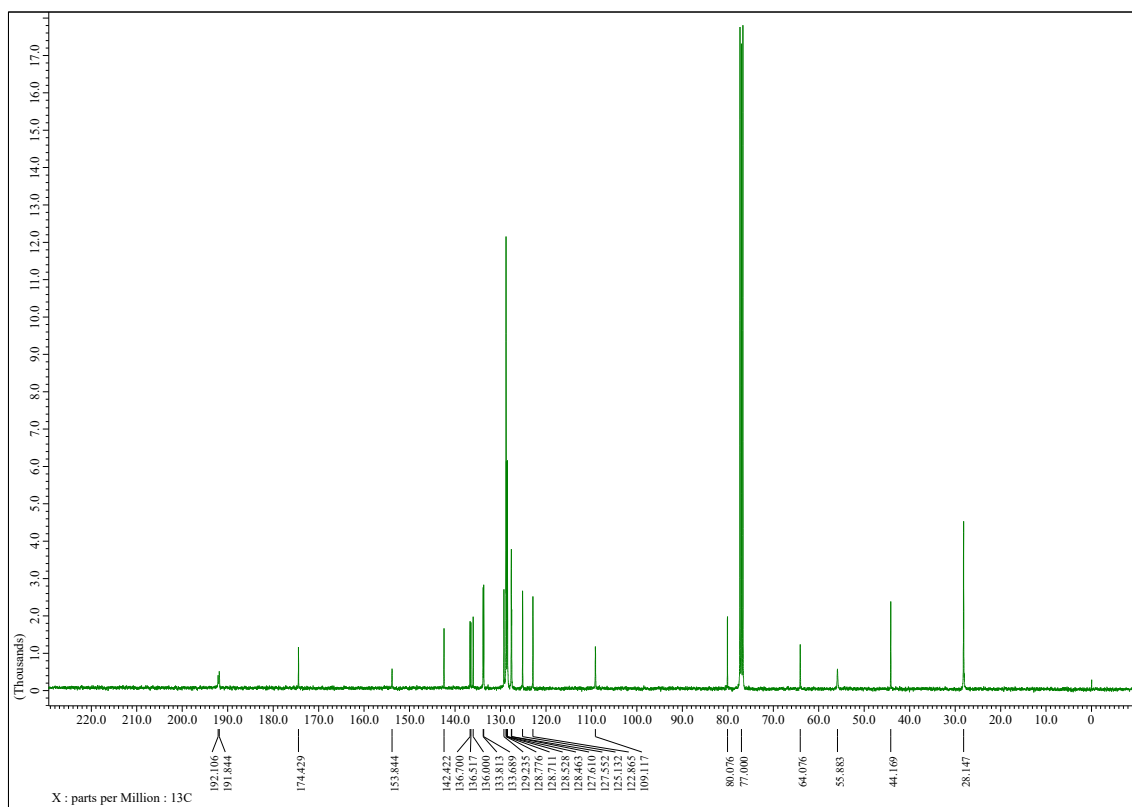
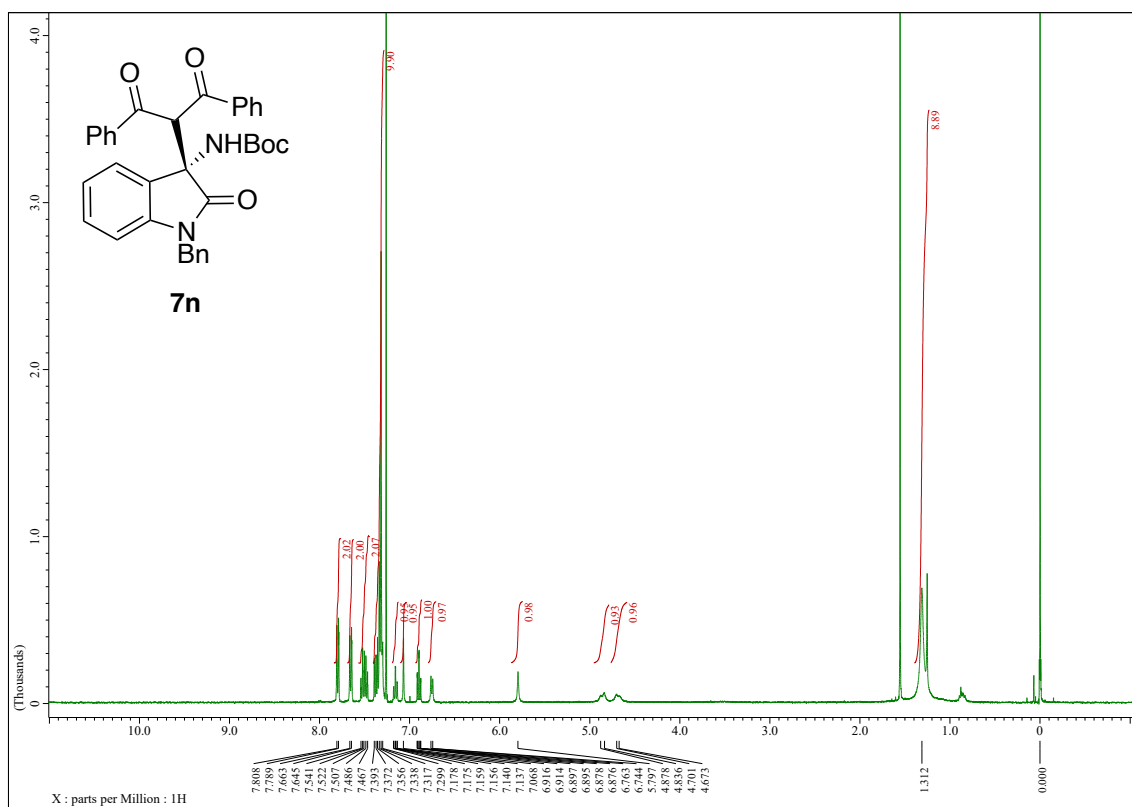


#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.167	1734570	93567	49.6	61.2
2	Unknown	3	15.033	1760787	59373	50.4	38.8

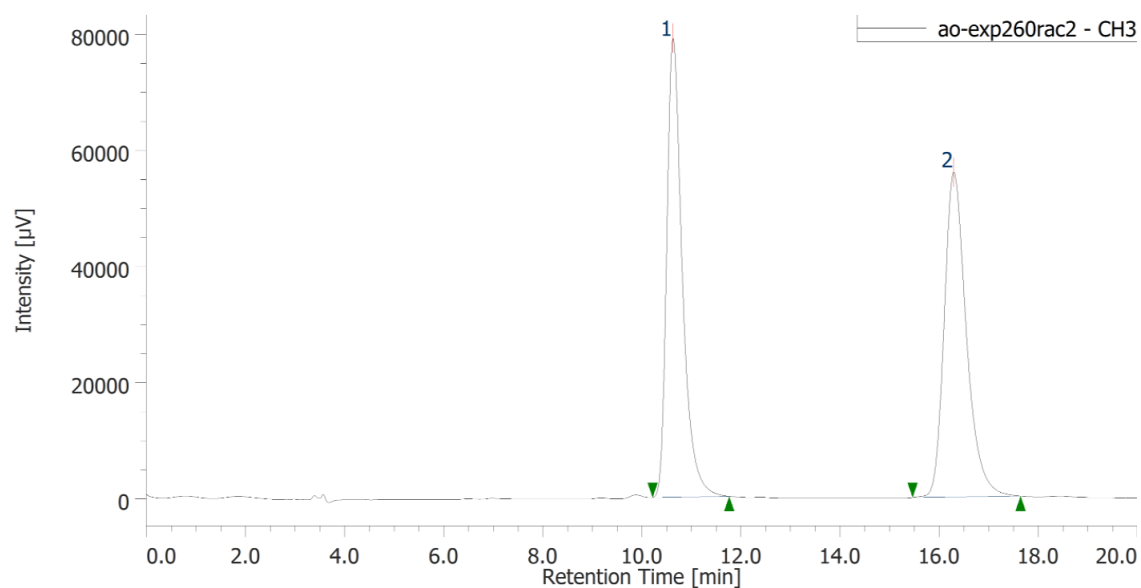
7m catalyzed by **4a**



#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	7.433	3741533	228637	19.7	36.4
2	Unknown	3	15.833	15226451	400186	80.3	63.6

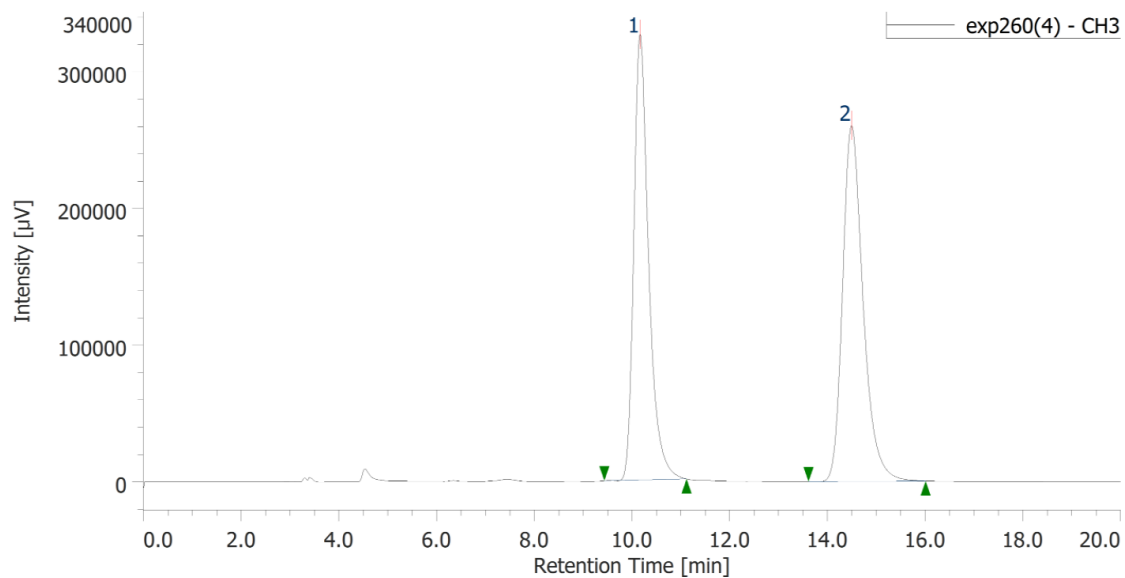


Racemic sample of **7n**

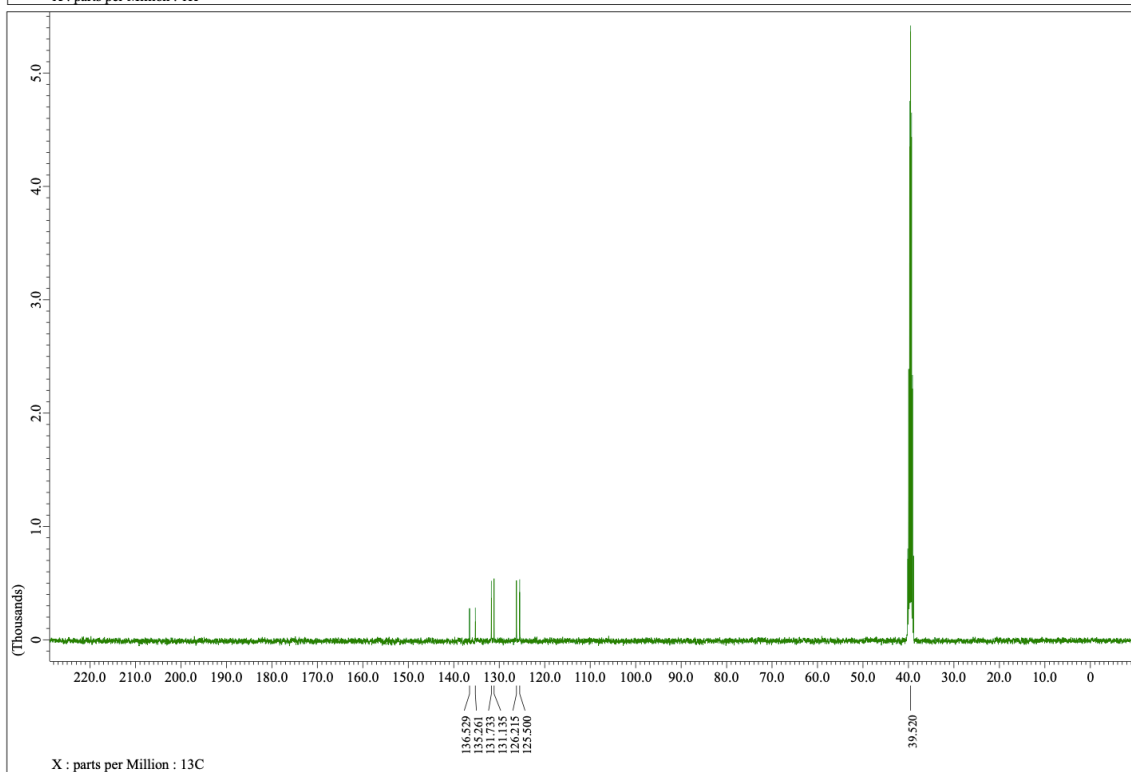
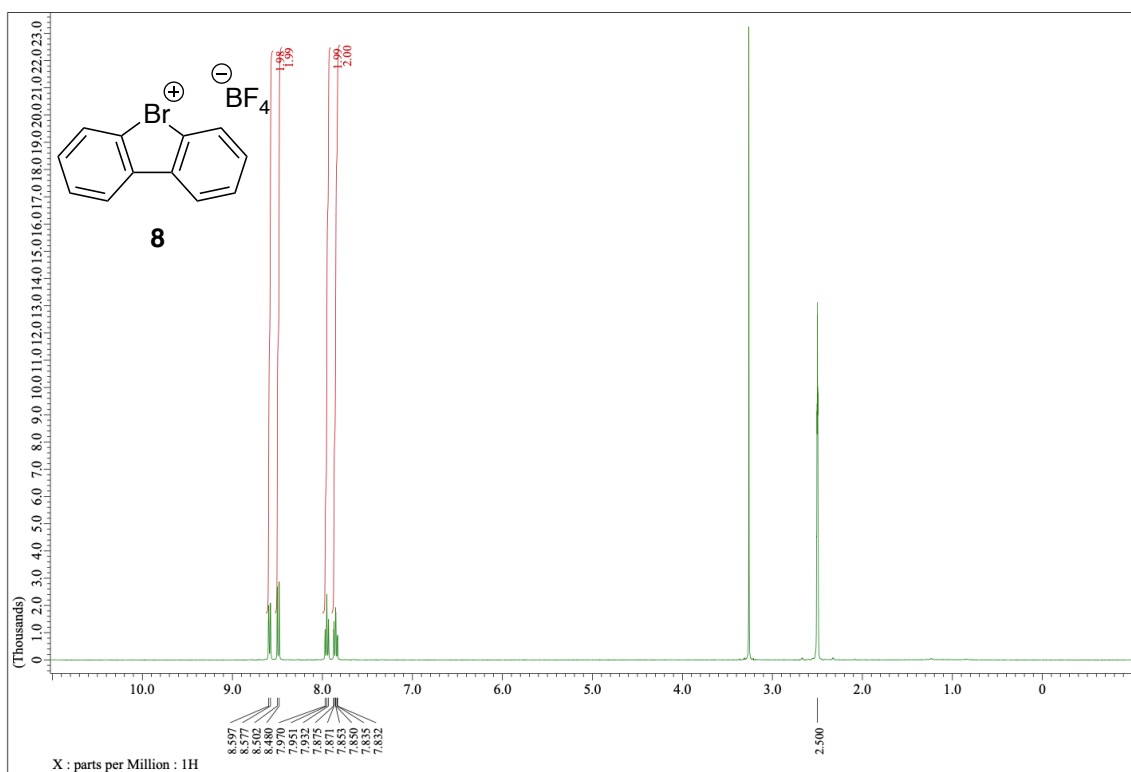


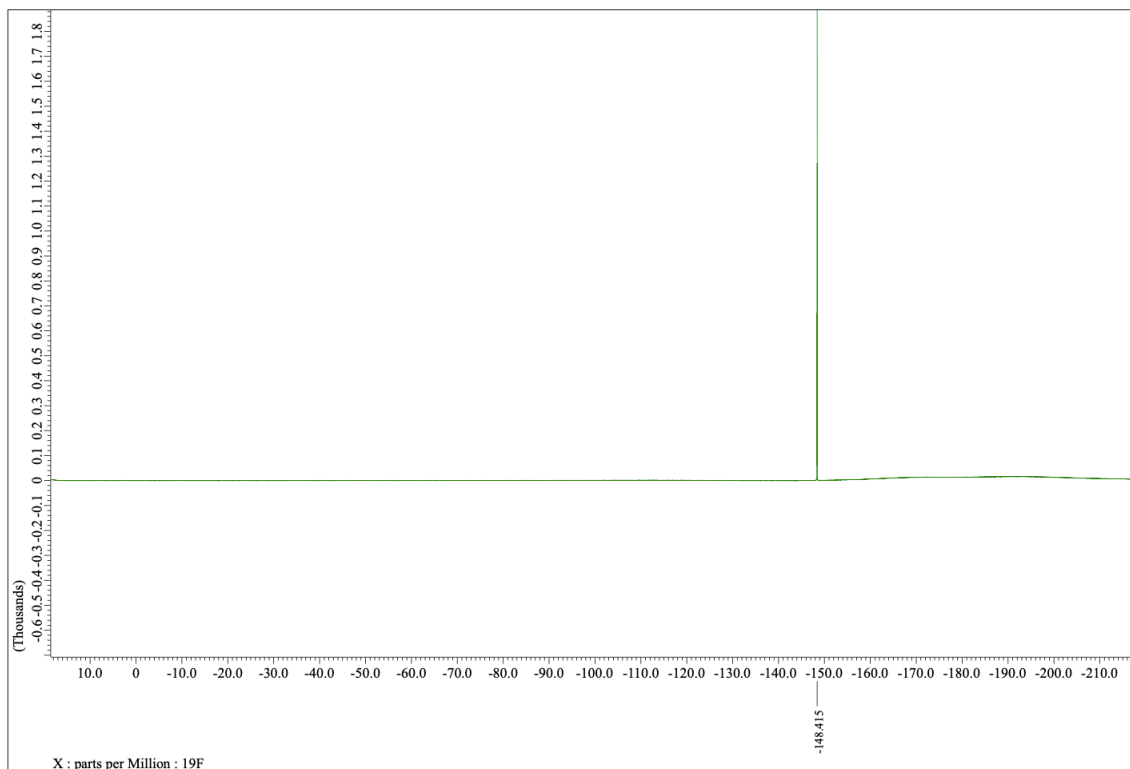
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%	高さ%
1	Unknown	3	10.625	1718643	79049	49.7	58.6
2	Unknown	3	16.292	1737799	55939	50.3	41.4

Racemic sample of **7n**

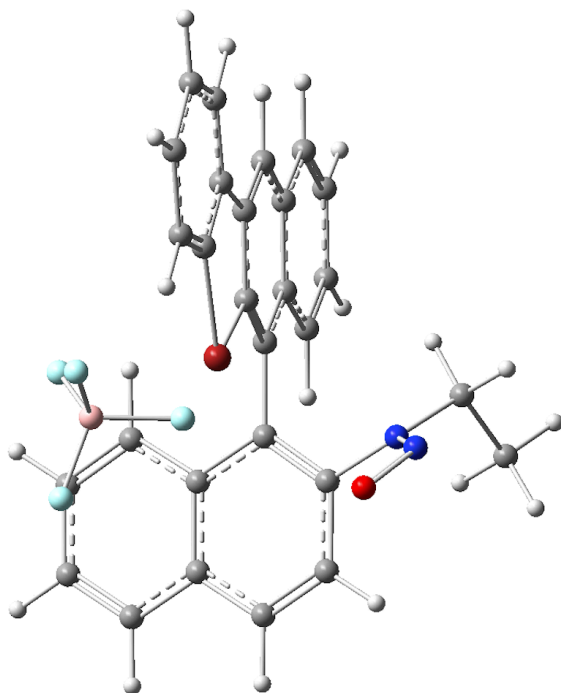


#	ピーク名	CH	tR [min]	Area [μV·sec]	Height [μV]	Area%	Height%
1	Unknown	3	10.17	6873655	325893	47.565	55.592
2	Unknown	3	14.49	7577525	260333	52.435	44.408





Optimized structure of **4a**.



E(RM062X) = -4259.202216 Hartree

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	4.130674	3.760648	-0.945786
2	6	0	4.578837	2.440055	-0.697811
3	6	0	3.681010	1.435511	-0.443777
4	6	0	2.285711	1.702871	-0.424601
5	6	0	1.831700	3.035125	-0.663726
6	6	0	2.792129	4.049155	-0.928284
7	6	0	1.330455	0.672963	-0.151911
8	6	0	0.016464	1.043108	-0.131149
9	6	0	-0.473942	2.348883	-0.364874
10	6	0	0.447005	3.333627	-0.631231
11	6	0	1.713930	-0.740613	0.113789
12	6	0	2.170565	-1.580068	-0.953689
13	6	0	2.473308	-2.941885	-0.675657
14	6	0	2.309018	-3.437455	0.645972
15	6	0	1.872696	-2.624835	1.652750

16	6	0	1.577339	-1.263997	1.383552
17	6	0	2.313062	-1.105735	-2.284521
18	6	0	2.745788	-1.943636	-3.281052
19	6	0	3.056890	-3.294384	-3.001848
20	6	0	2.920880	-3.780874	-1.727425
21	6	0	-2.616843	1.272940	-0.034828
22	6	0	-1.929775	2.457129	-0.301375
23	6	0	-3.985398	1.143517	0.065707
24	6	0	-4.714886	2.317080	-0.124930
25	6	0	-4.083169	3.532056	-0.393510
26	6	0	-2.699344	3.608692	-0.482368
27	7	0	1.179952	-0.422776	2.470928
28	1	0	4.853984	4.543762	-1.148171
29	1	0	5.642082	2.223518	-0.710941
30	1	0	4.023903	0.421915	-0.258881
31	1	0	2.440759	5.060232	-1.114027
32	1	0	0.124420	4.353506	-0.822119
33	1	0	2.533850	-4.481473	0.844071
34	1	0	1.734552	-2.998203	2.661369
35	1	0	2.067377	-0.073281	-2.511724
36	1	0	2.843557	-1.569312	-4.294909
37	1	0	3.394519	-3.945143	-3.801794
38	1	0	3.145022	-4.819882	-1.502886
39	1	0	-4.472230	0.194354	0.256648
40	1	0	-5.796703	2.267240	-0.067263
41	1	0	-4.678184	4.427455	-0.538651
42	1	0	-2.211378	4.555115	-0.693602
43	5	0	-3.973368	-2.000666	-0.592377
44	9	0	-3.284830	-1.278186	-1.583335
45	9	0	-5.293984	-1.568369	-0.522996
46	9	0	-3.855791	-3.351590	-0.770715
47	9	0	-3.350015	-1.621387	0.664929
48	35	0	-1.389483	-0.203977	0.198871
49	8	0	-0.567576	-1.632223	2.837419
50	7	0	0.115685	-0.718935	3.240072
51	6	0	2.078339	0.600145	3.002236

52	1	0	2.236296	1.368119	2.238213
53	1	0	1.532330	1.055819	3.831509
54	6	0	3.408239	0.019216	3.466227
55	1	0	3.249288	-0.729562	4.247509
56	1	0	3.940790	-0.454513	2.635855
57	1	0	4.043127	0.812980	3.868596
