

Supporting Information

Synthesis and Mechanism Studies of 1,3-Benzoazolyl Substitued Pyrrolo[2,3-*b*]pyrazine Derivatives as Non-intercalative Topoisomerase II Catalytic Inhibitors

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Topo I-mediated DNA relaxation assay. Topo I-mediated DNA relaxation assay was performed to test whether BPPs act as a dual inhibitor of Topo I and Topo II.^{1,2} The result was presented at Figure S1. All of the synthesized compounds had no Topo I inhibitory activity at 50 μ M.

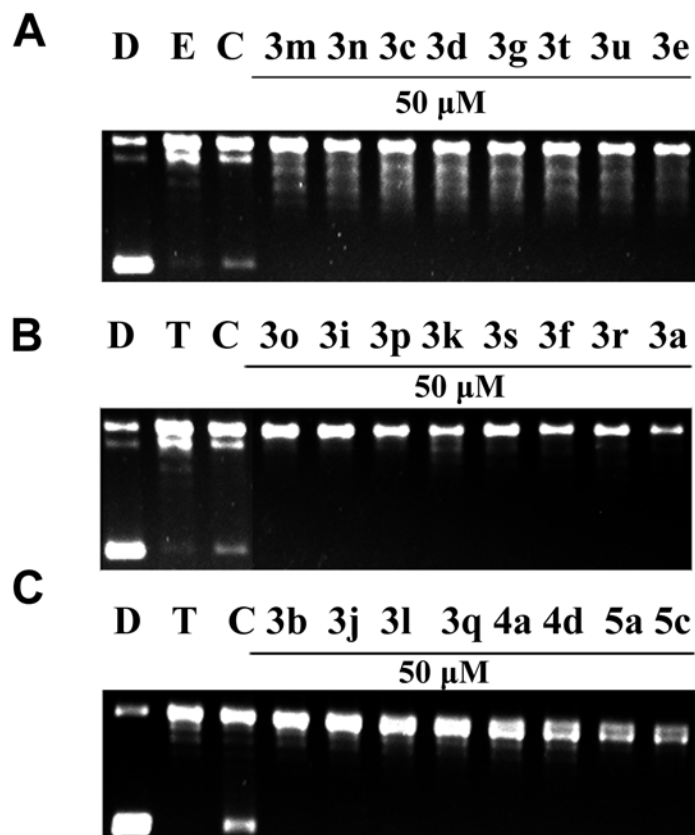


Figure S1. Topo I inhibitory activity of BPPs. (A), (B) and (C) lane **D**: pBR322 DNA; lane **T**: pBR322 DNA + Topo I; lane **C**: pBR322 DNA + Topo I + Camptothecin (100 μ M) other lanes: pBR322 DNA + Topo I + BPPs (50 μ M).

EB displacement assay. The ability of **3t** to interact with DNA was also confirmed by fluorescence-based EB displacement assay (Figure S2). The DNA bound form of EB has a stronger fluorescence emission than free EB, so the displacement of EB from DNA could be monitored by a decrease in the fluorescence signal.⁶ As expected, the addition of the DNA intercalator mAMSA was accompanied by a concomitant decrease in EB fluorescence (Figure S2A). In contrast, the addition of increasing concentration of **3t** did not alter the intensity of EB fluorescence (Figure S2B), indicating that **3t** was incapable of intercalating into DNA.

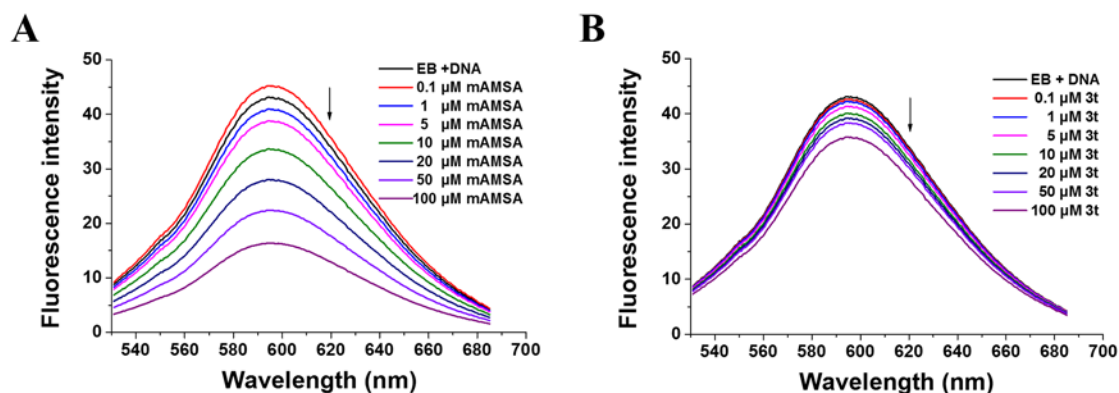


Figure S2. (A) and (B) pBR322 DNA (20 nM) was incubated in the presence of EB (2.5 μM). Arrow indicates the fluorescence intensity change upon increasing concentrations of mAMSA (A) or **3t** (B).

UV-vis titration assay. UV-vis titration was employed to measure the binding affinity of BPPs to CT-DNA. Generally, interaction between compounds and DNA would result in hypochromic effect and red shifts in the absorption spectrum due to the strong stacking interaction between the aromatic chromophore of the compounds and the base pair of DNA, and the electron transfer effect in the process.^{3, 4} As showed in Figure S3A, with the increasing addition of CT-DNA to compound **3t** resulted in a hypochromic effect, but without an obvious red shifts, which was different from the classical intercalation interaction. The apparent binding constant (K_b) to CT-DNA was determined to be $2.8 \times 10^5 \text{ M}^{-1}$ (Figure S3B), means that BPPs showed weak interaction with CT-DNA. This is consistent with the results obtained from the unwinding assay.

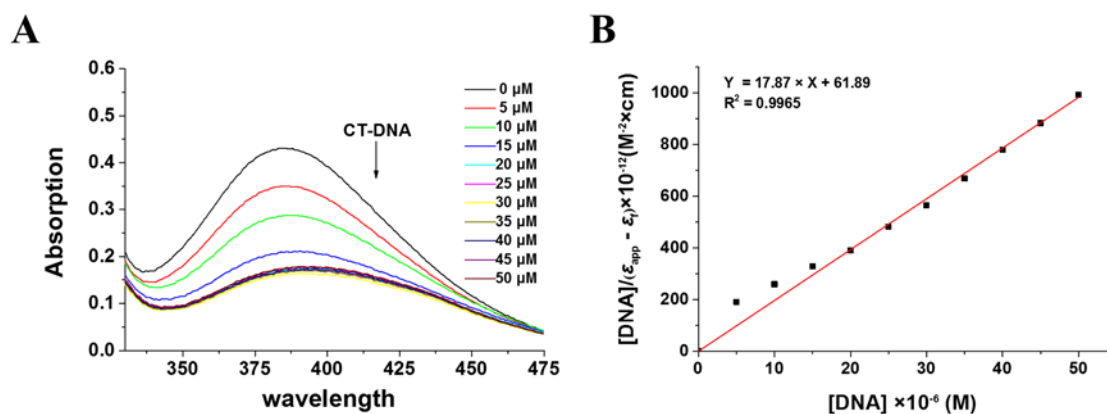
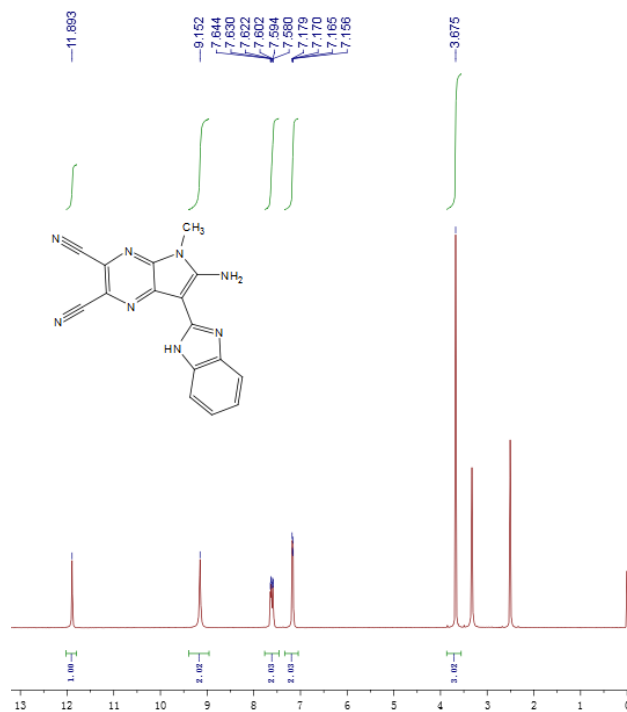
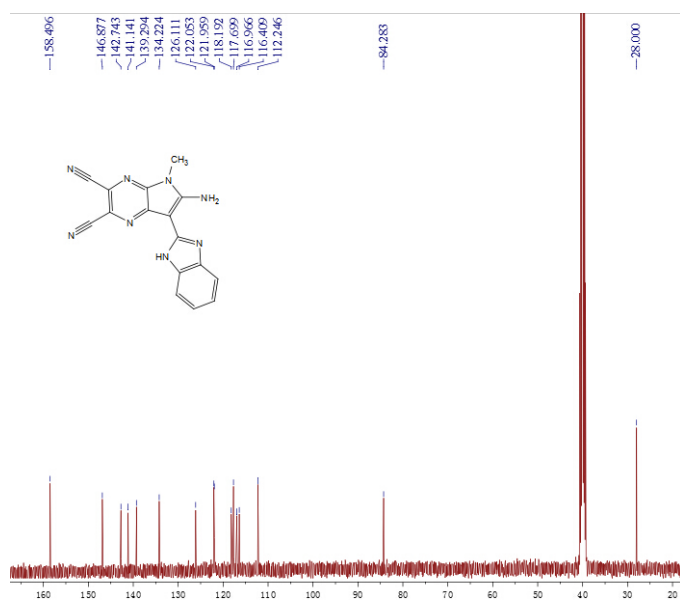


Figure S3. (A) Absorption spectra of compound **3t** upon addition of CT-DNA. [Compound **3t**] = 5 μM, [DNA] = 0 – 50 μM. Arrow indicates the absorption change upon increasing amount of CT-DNA. (B) Graph shows the plot of $[DNA]/(\epsilon_a - \epsilon_f)$ versus [DNA].

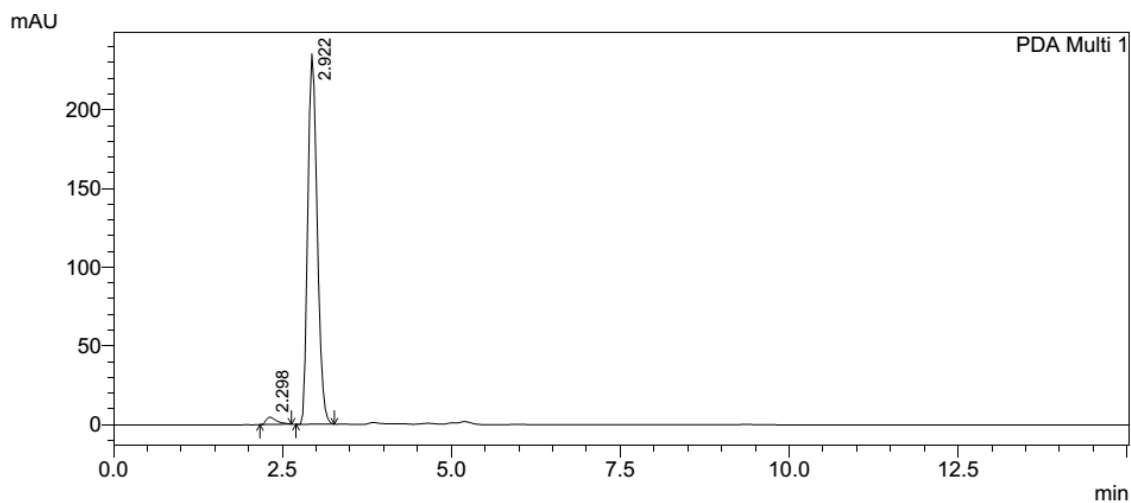
^1H NMR, ^{13}C NMR, HRMS, and HPLC analysis of compounds.



^1H NMR (400 MHz, DMSO- d_6) of **3a**



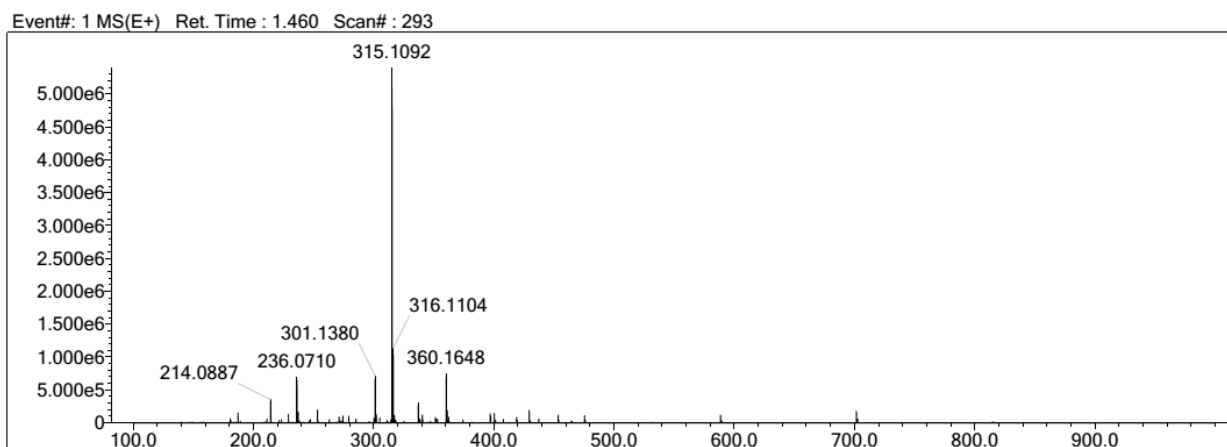
^{13}C NMR (100 MHz, DMSO- d_6) of **3a**



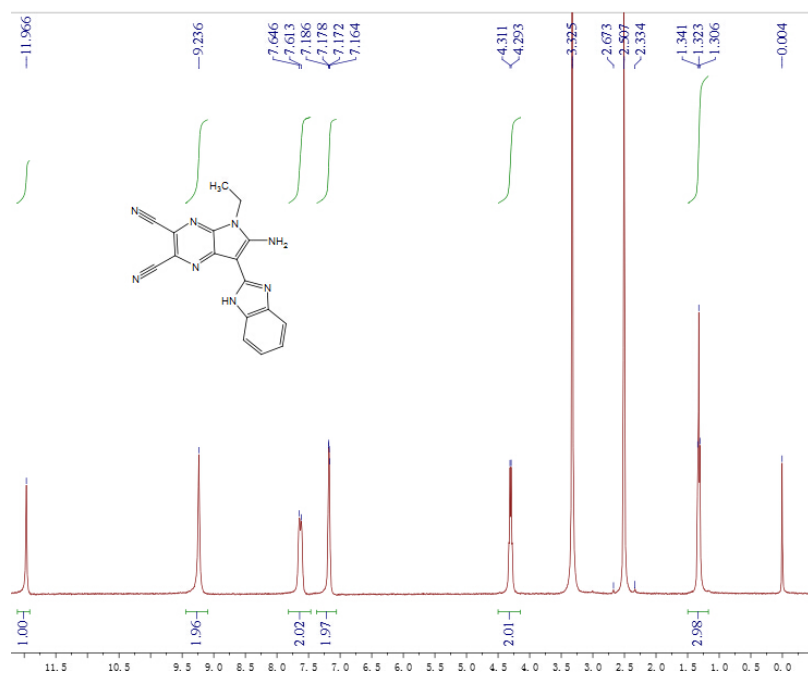
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.298	51581	4682	2.208	1.951
2	2.922	2284804	235341	97.792	98.049
Total		2336385	240023	100.000	100.000

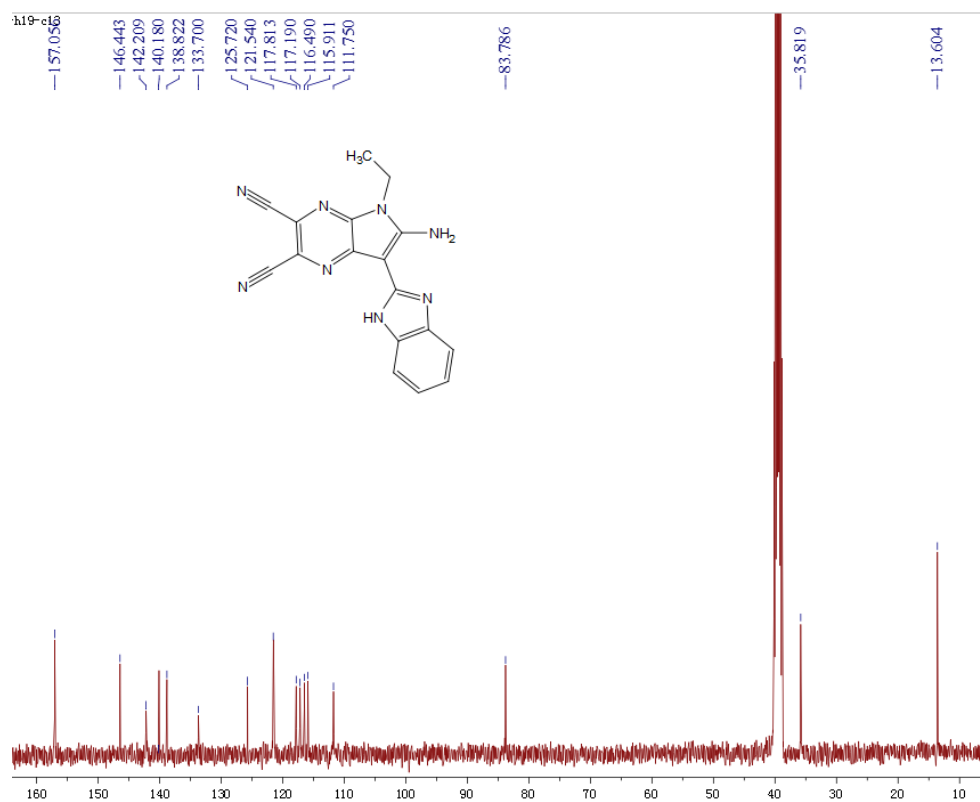
HPLC spectrum of **3a**



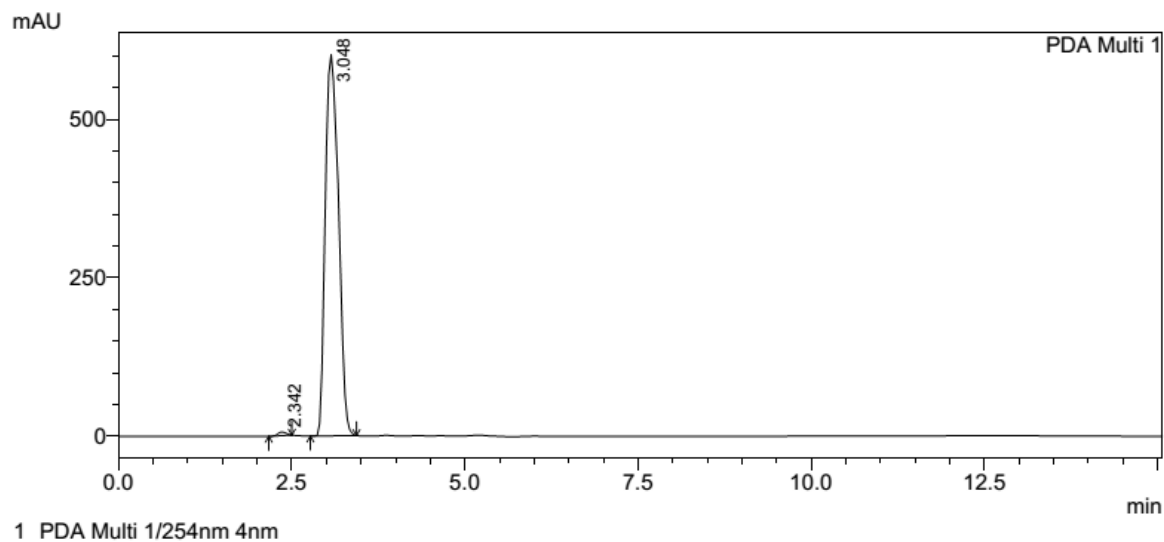
HRMS spectrum of **3a**



¹H NMR (400 MHz, DMSO-*d*₆) of **3b**



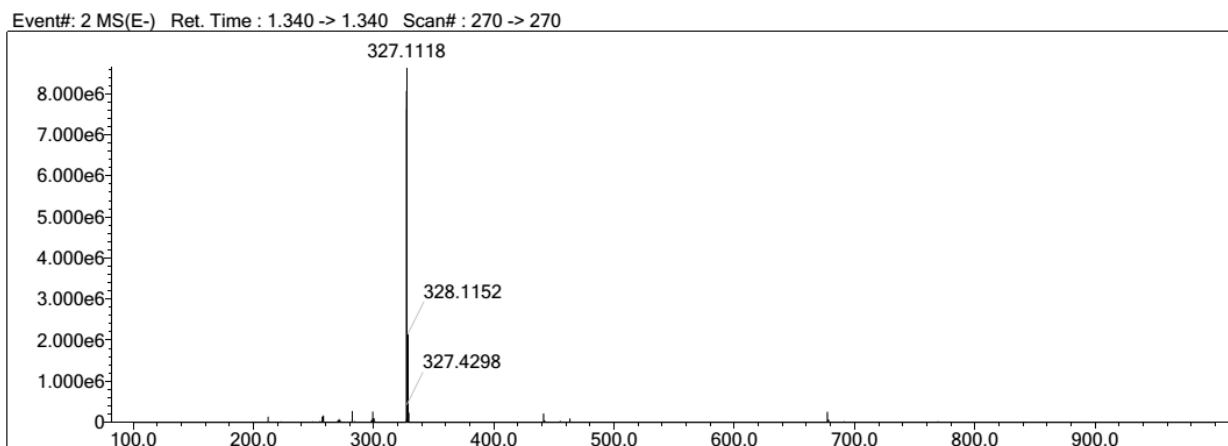
¹³C NMR (100 MHz, DMSO-*d*₆) of **3b**



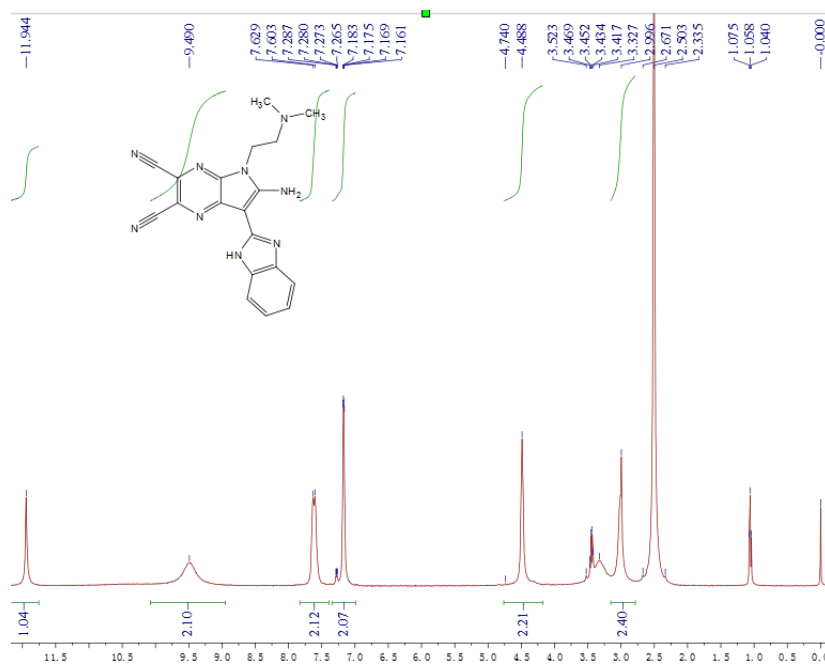
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.342	48688	5864	0.606	0.965
2	3.048	7982812	601737	99.394	99.035
Total		8031500	607601	100.000	100.000

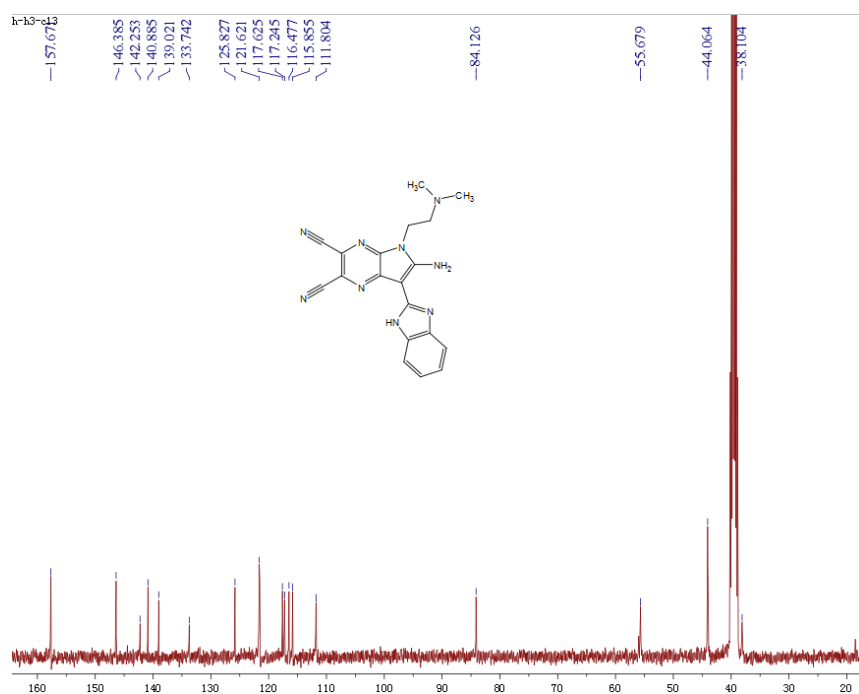
HPLC spectrum of **3b**



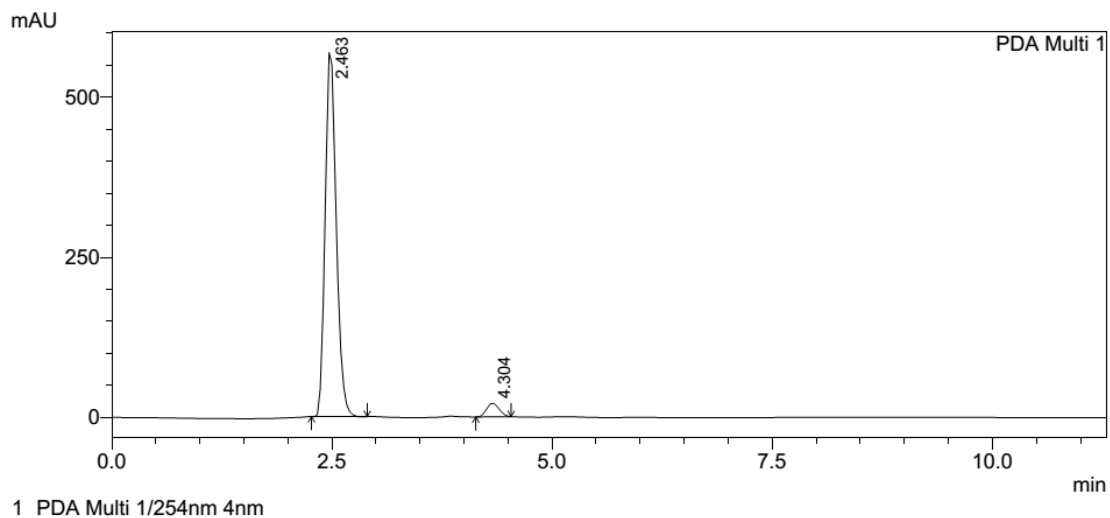
HRMS spectrum of **3b**



¹H NMR (400 MHz, DMSO-*d*₆) of **3c**



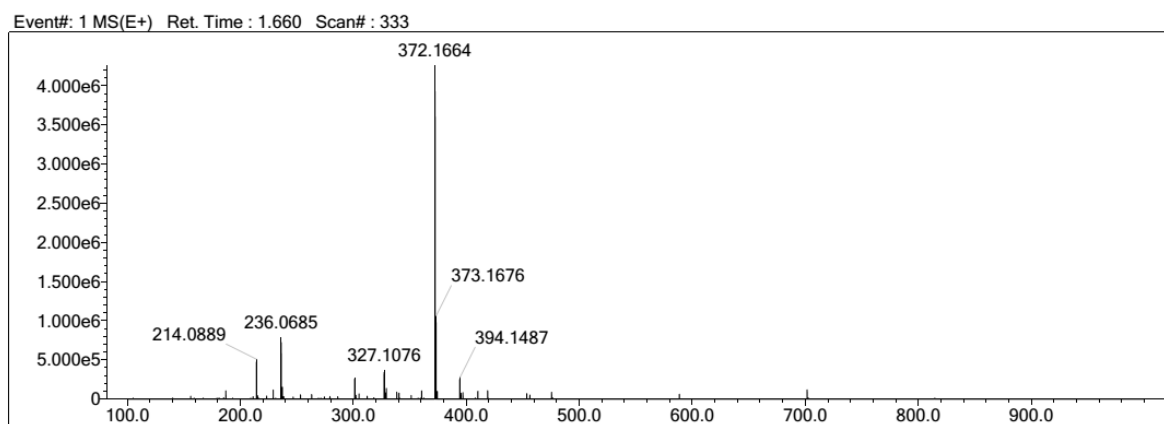
¹³C NMR (100 MHz, DMSO-*d*₆) of **3c**



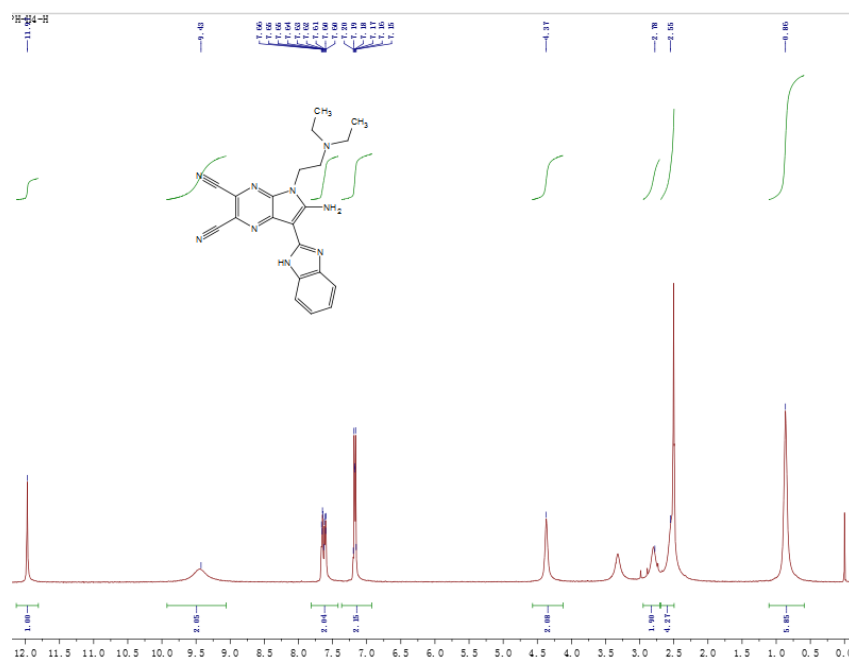
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.463	5002713	568967	95.951	96.419
2	4.304	211085	21133	4.049	3.581
Total		5213799	590100	100.000	100.000

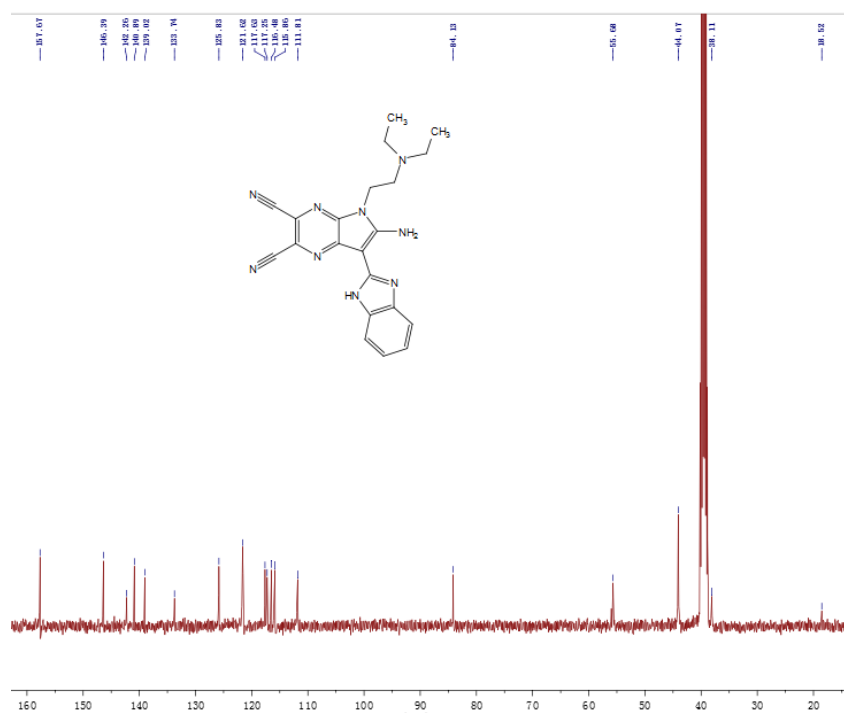
HPLC spectrum of **3c**



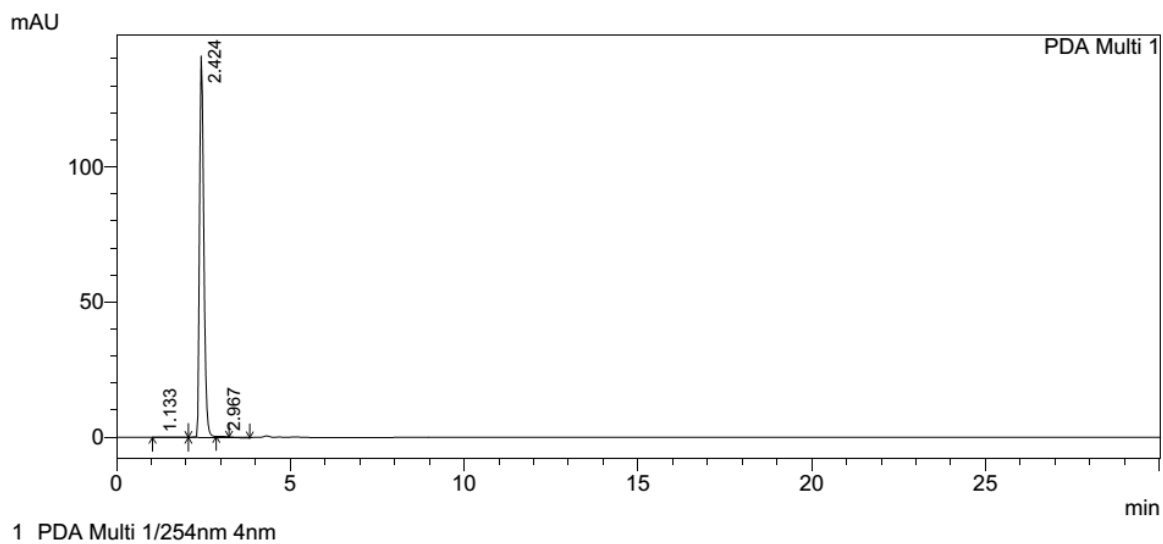
HRMS spectrum of **3c**



¹H NMR (400 MHz, DMSO-*d*₆) of **3d**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3d**

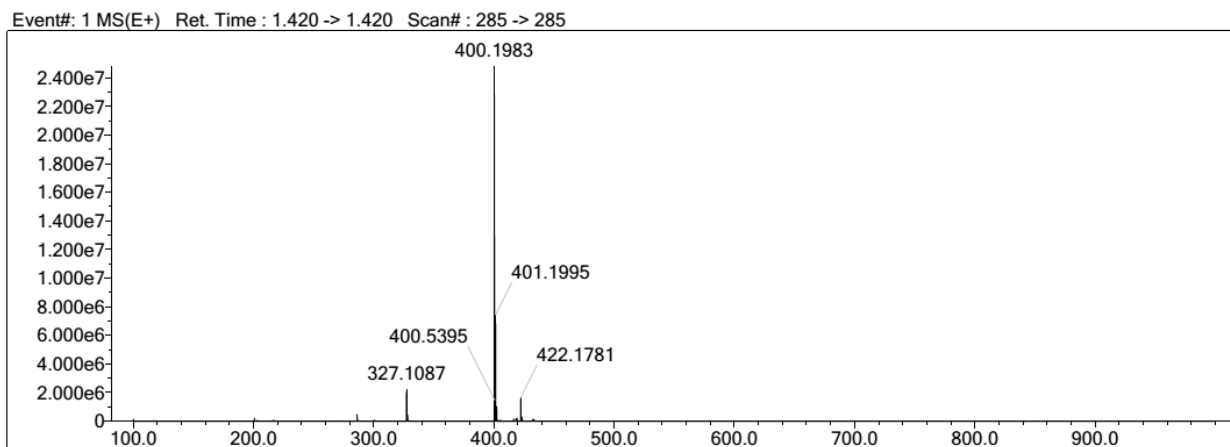


PeakTable

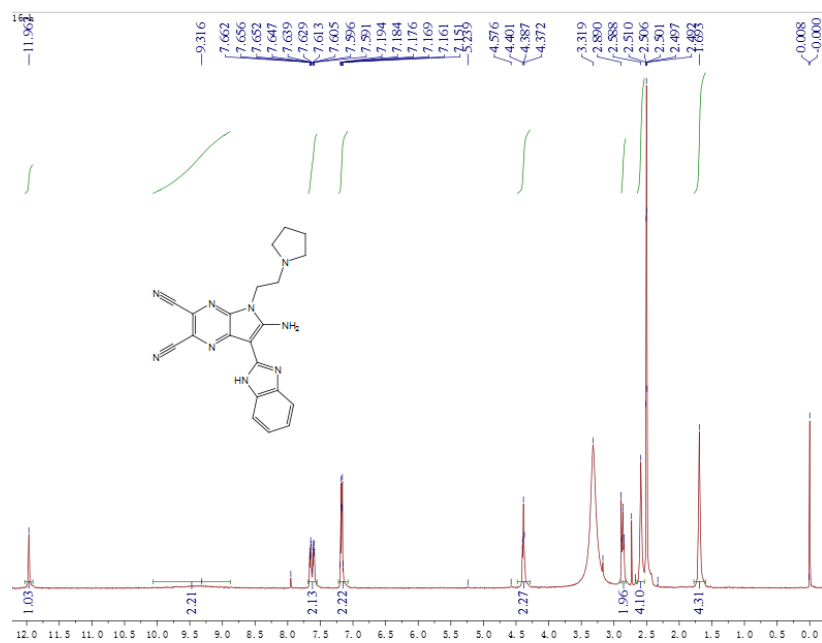
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	1.133	1063	20	0.087	0.014
2	2.424	1225783	141166	99.816	99.891
3	2.967	1199	134	0.098	0.095
Total		1228044	141320	100.000	100.000

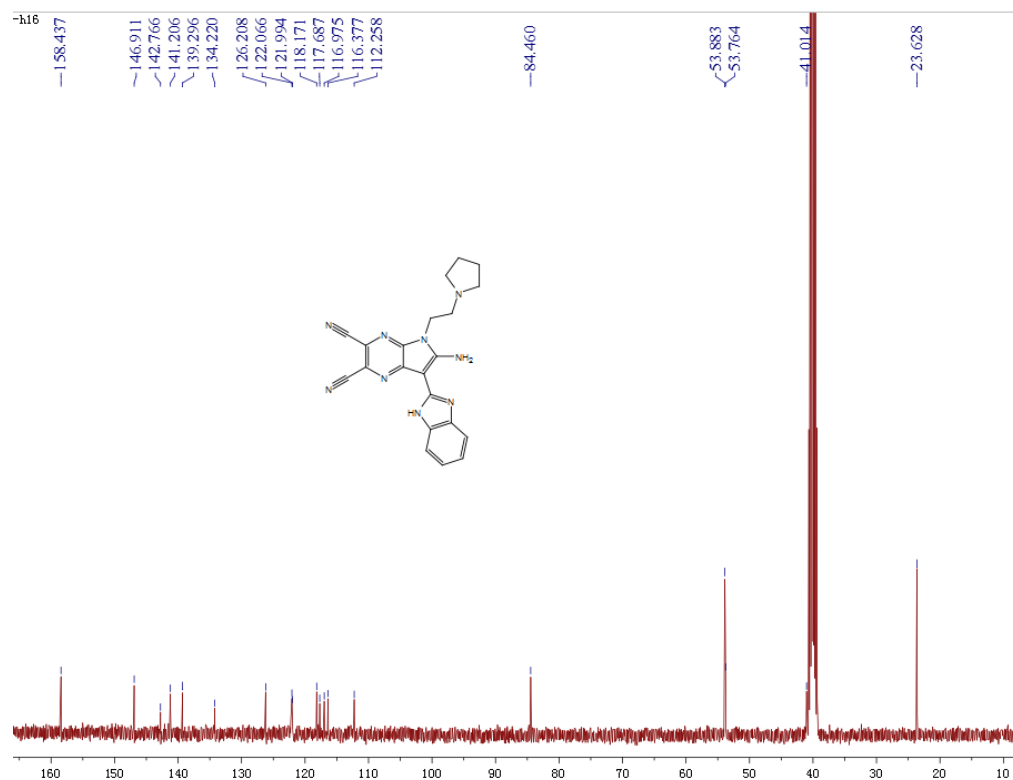
HPLC spectrum of **3d**



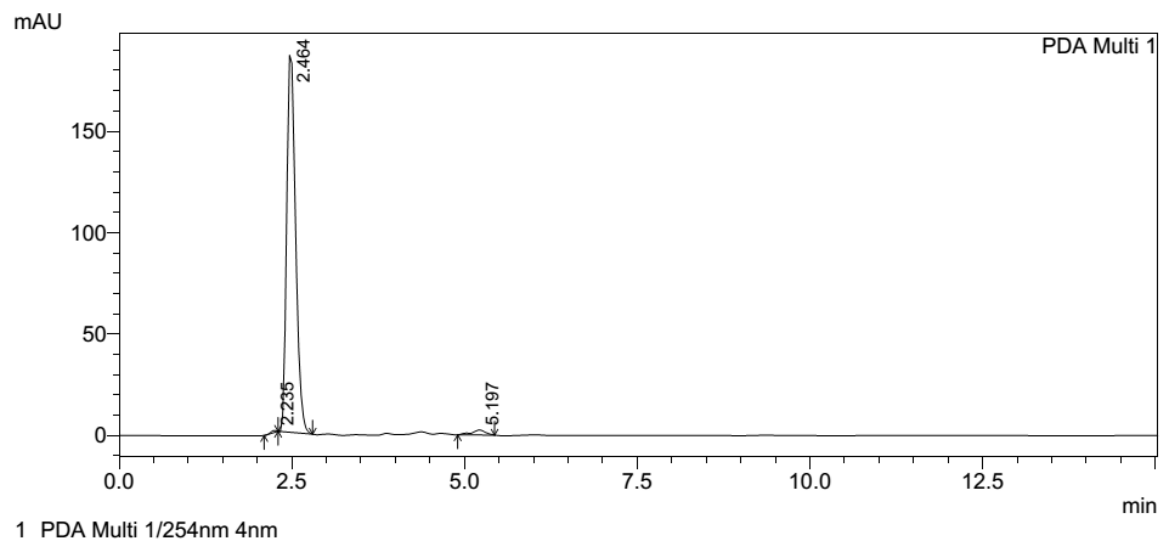
HRMS spectrum of **3d**



¹H NMR (400 MHz, DMSO-*d*₆) of **3e**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3e**

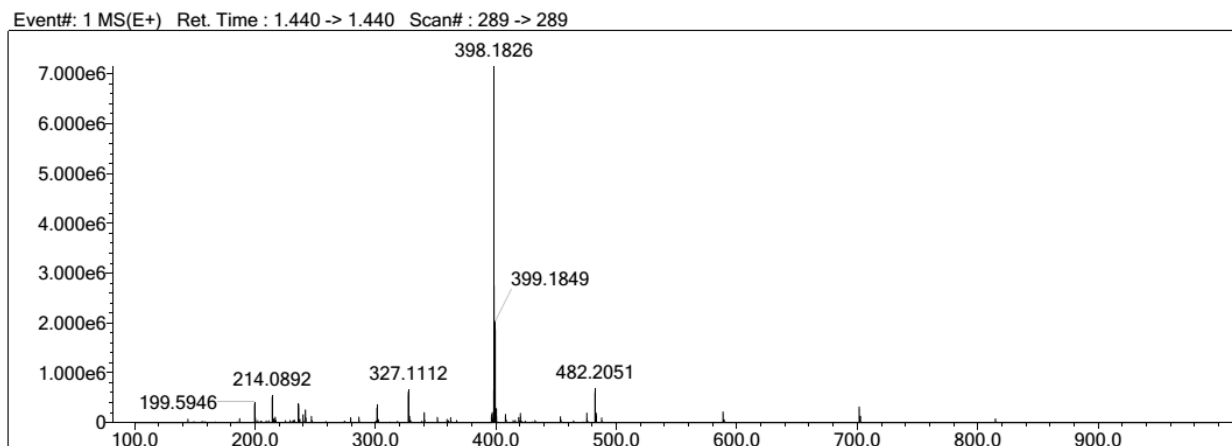


PeakTable

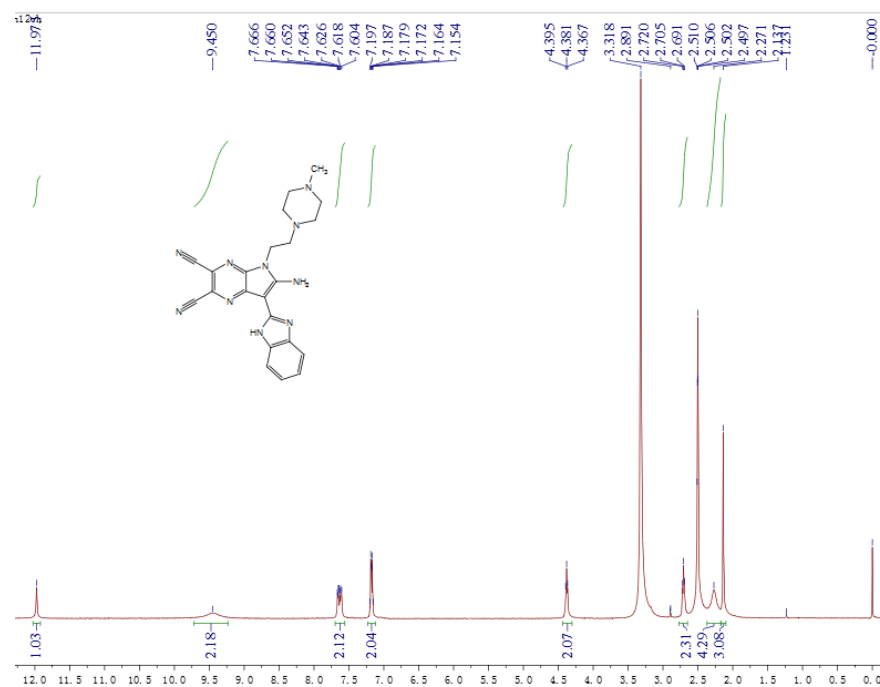
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.235	7490	1099	0.438	0.580
2	2.464	1670709	185942	97.612	98.145
3	5.197	33380	2415	1.950	1.275
Total		1711579	189456	100.000	100.000

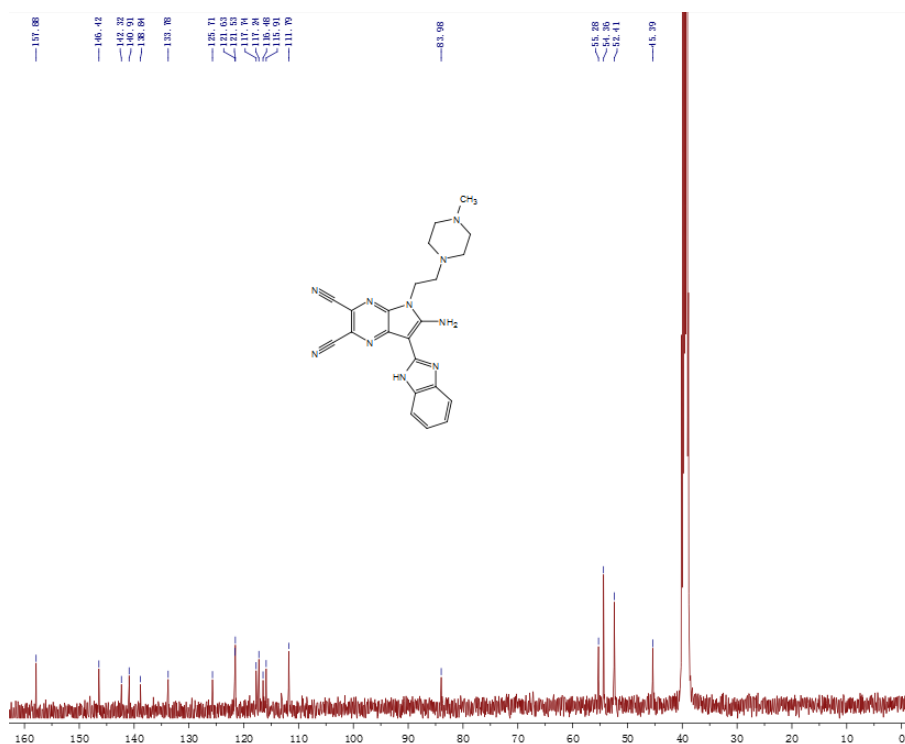
HPLC spectrum of **3e**



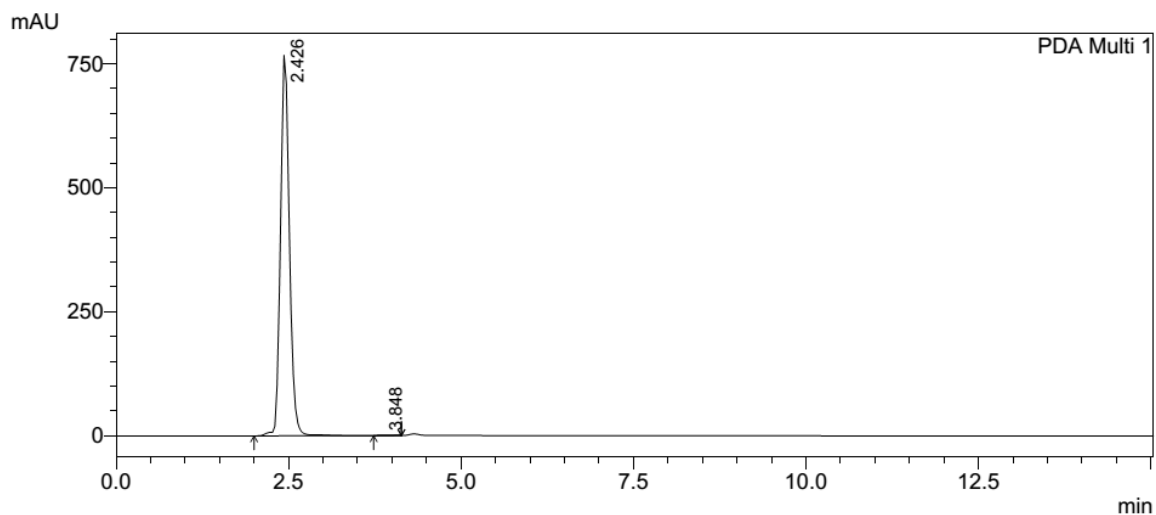
HRMS spectrum of **3e**



¹H NMR (400 MHz, DMSO-*d*₆) of **3f**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3f**



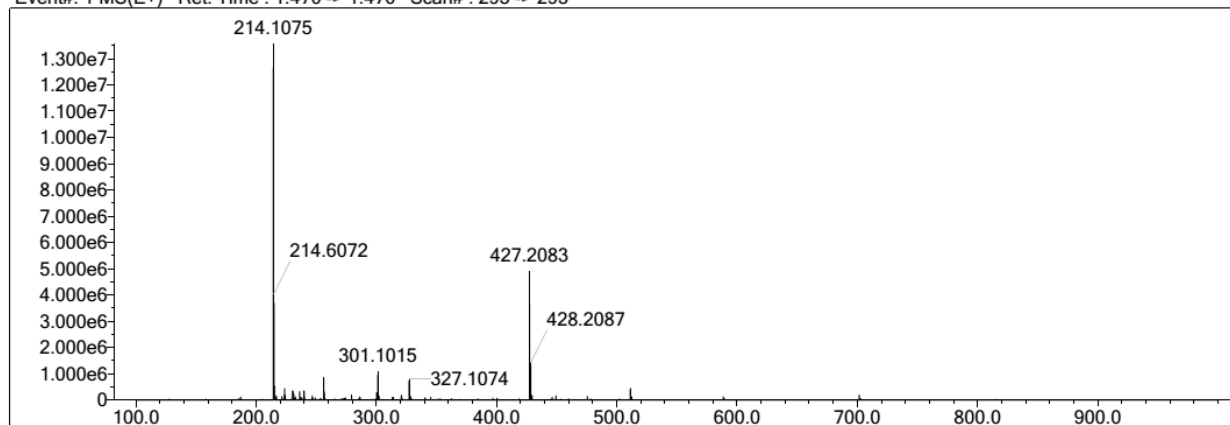
1 PDA Multi 1/254nm 4nm

PeakTable

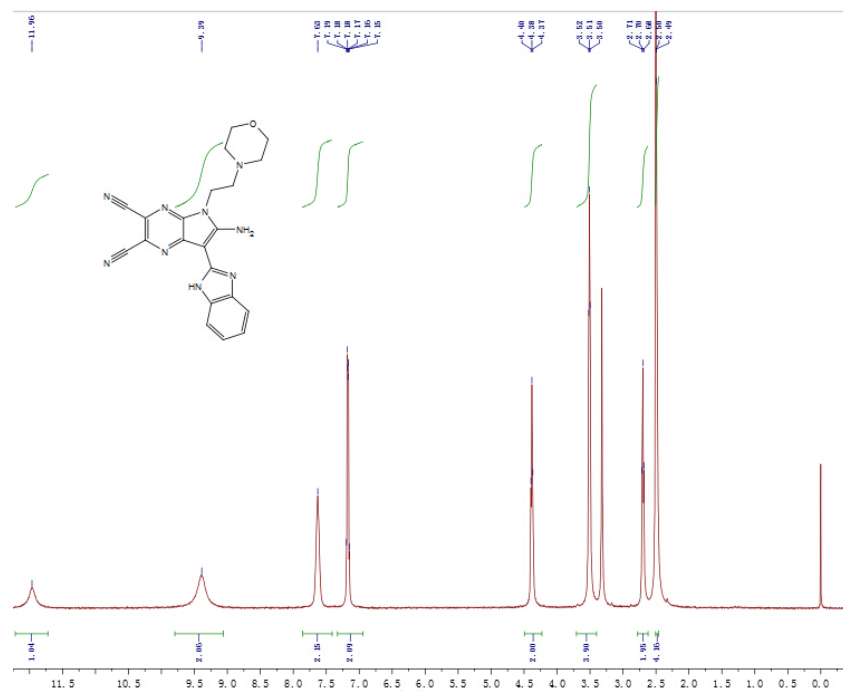
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.426	6912189	767448	99.816	99.882
2	3.848	12720	906	0.184	0.118
Total		6924909	768354	100.000	100.000

HPLC spectrum of **3f**

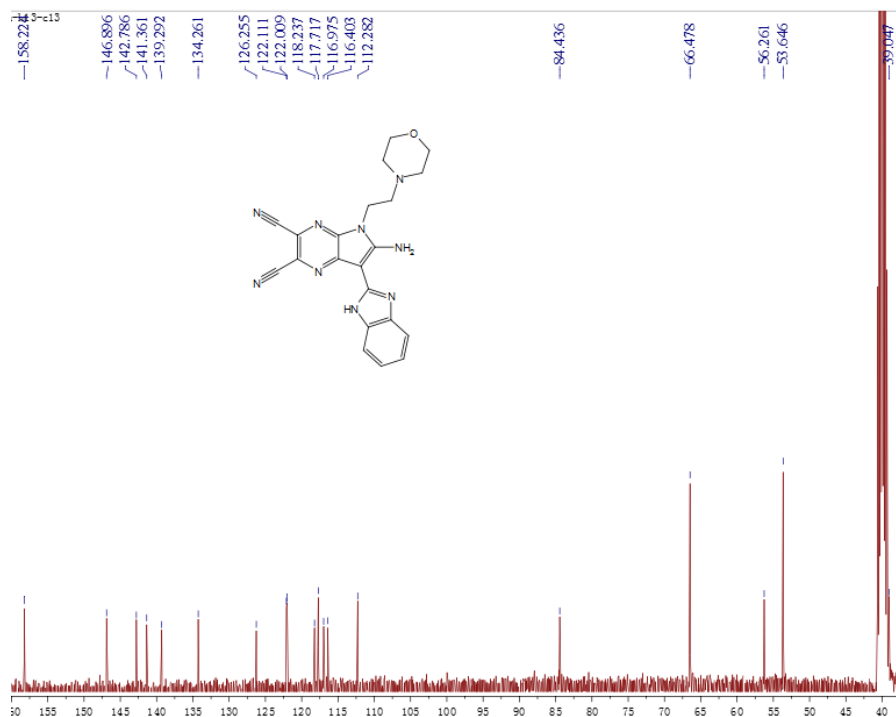
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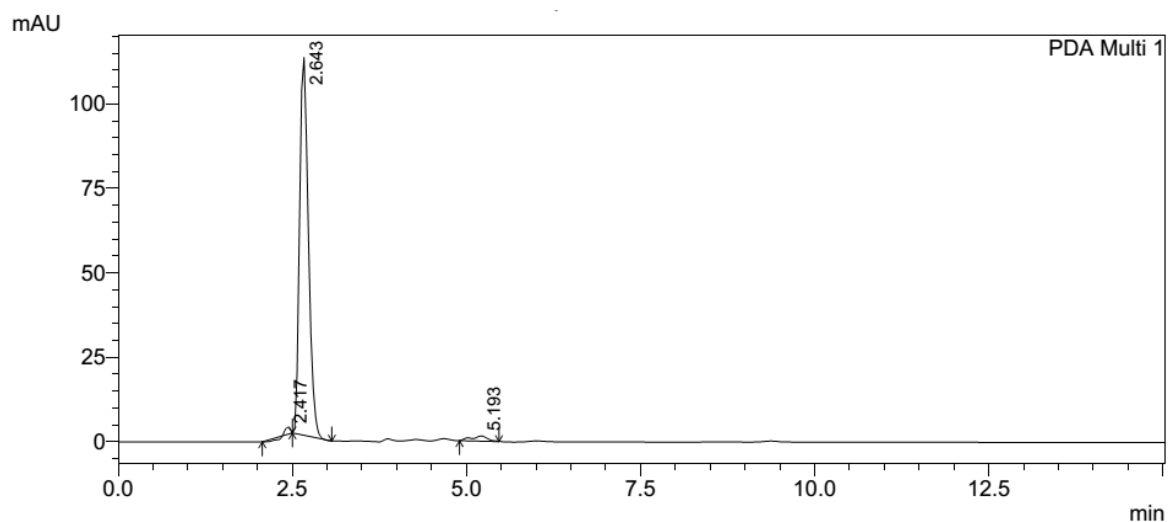
HRMS spectrum of **3f**



¹H NMR (400 MHz, DMSO-*d*₆) of **3g**



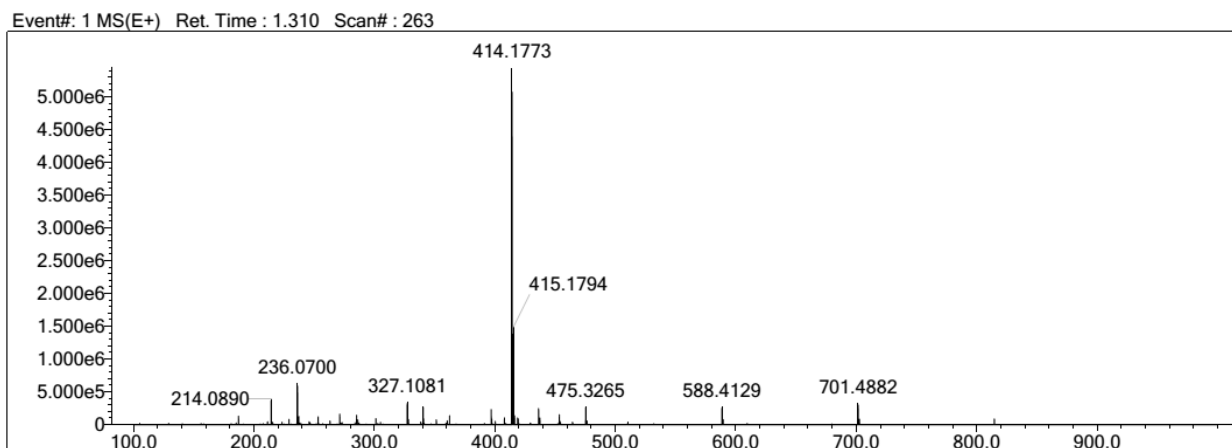
¹³C NMR (100 MHz, DMSO-*d*₆) of **3g**



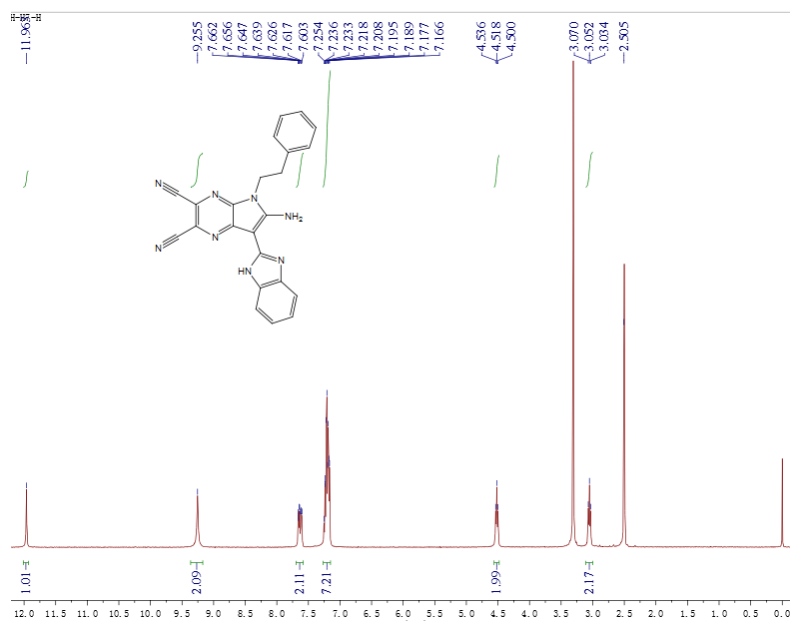
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.417	4789	2177	0.473	1.885
2	2.643	983937	111775	97.094	96.763
3	5.193	24659	1562	2.433	1.352
Total		1013385	115515	100.000	100.000

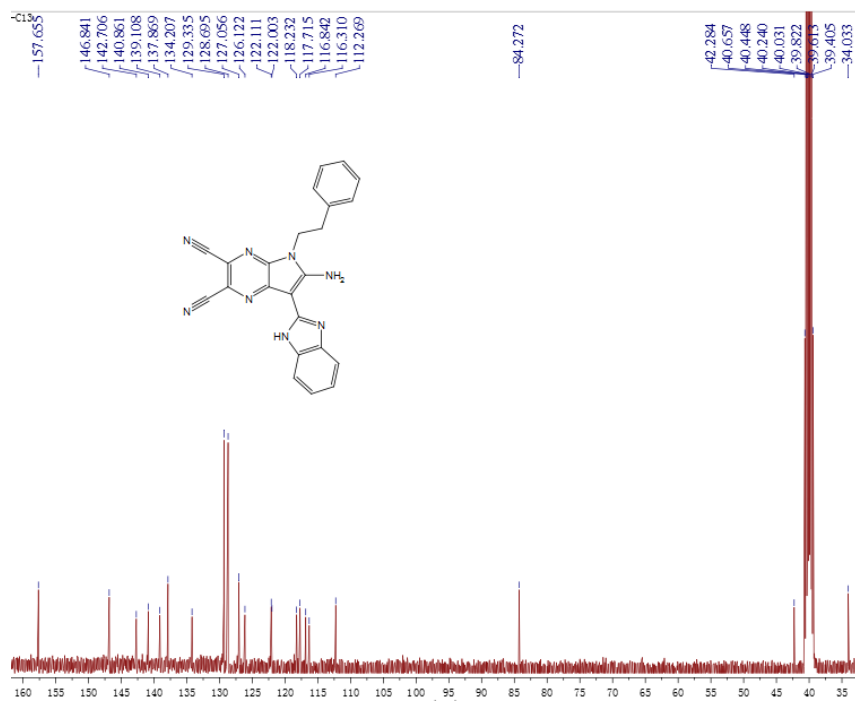
HPLC spectrum of **3g**



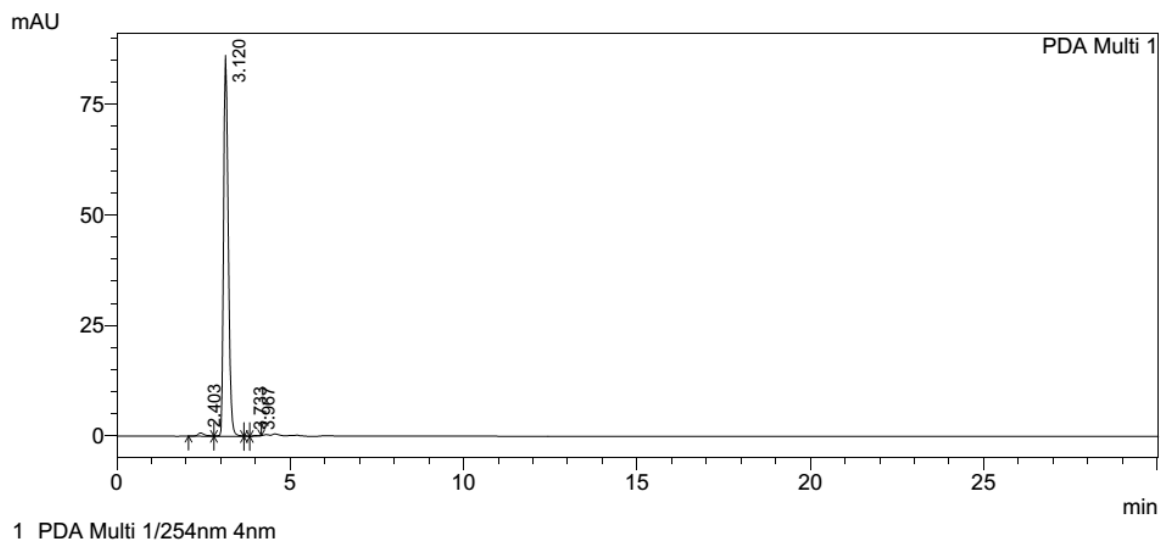
HRMS spectrum of **3g**



¹H NMR (400 MHz, DMSO-*d*₆) of **3h**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3h**

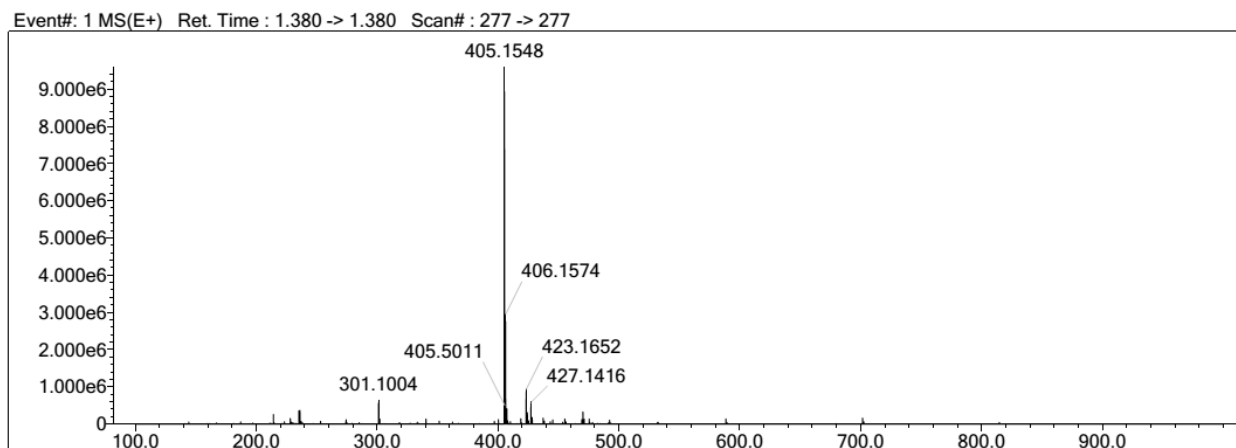


PeakTable

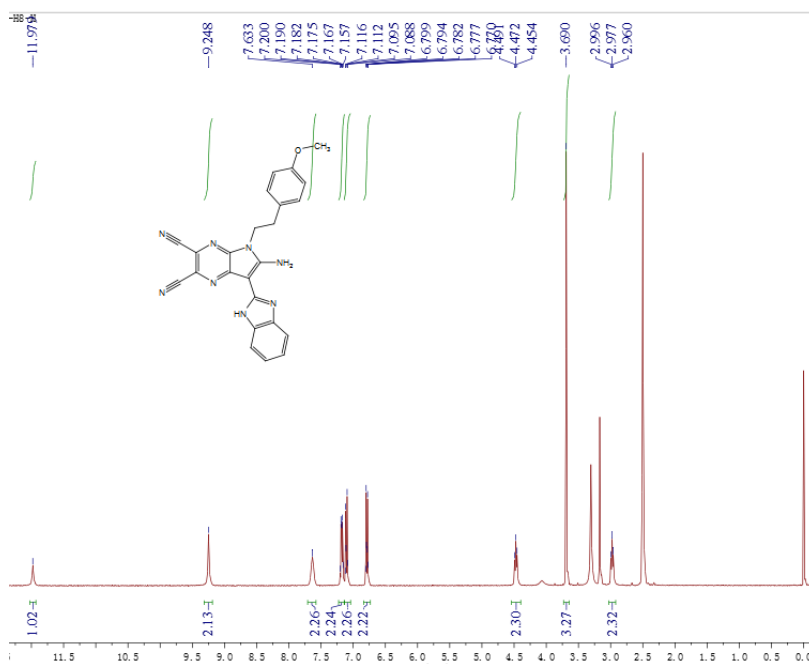
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.403	11289	766	1.369	0.877
2	3.120	810652	86229	98.287	98.718
3	3.733	1146	211	0.139	0.241
4	3.967	1693	143	0.205	0.164
Total		824780	87349	100.000	100.000

PDA Ch1 254nm 4nm

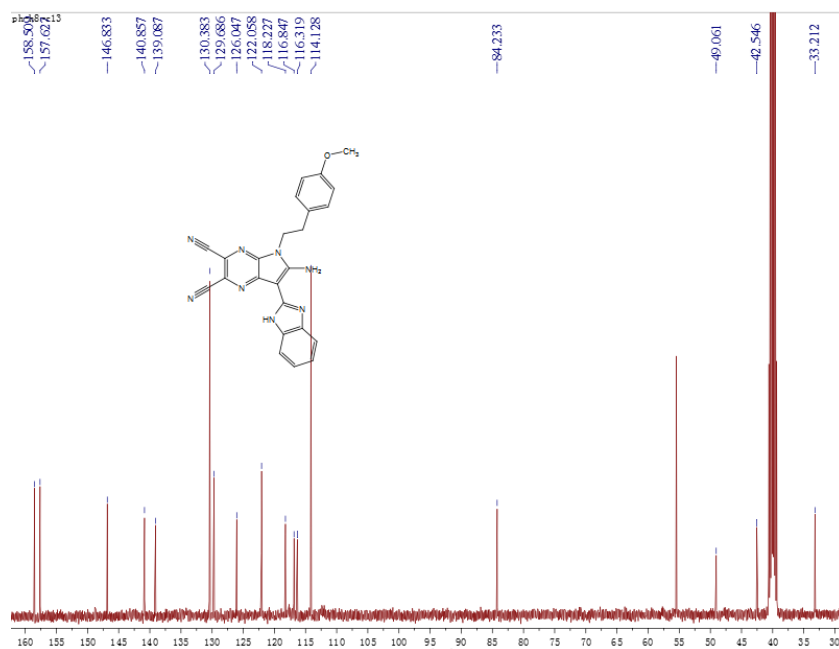
HPLC spectrum of **3h**



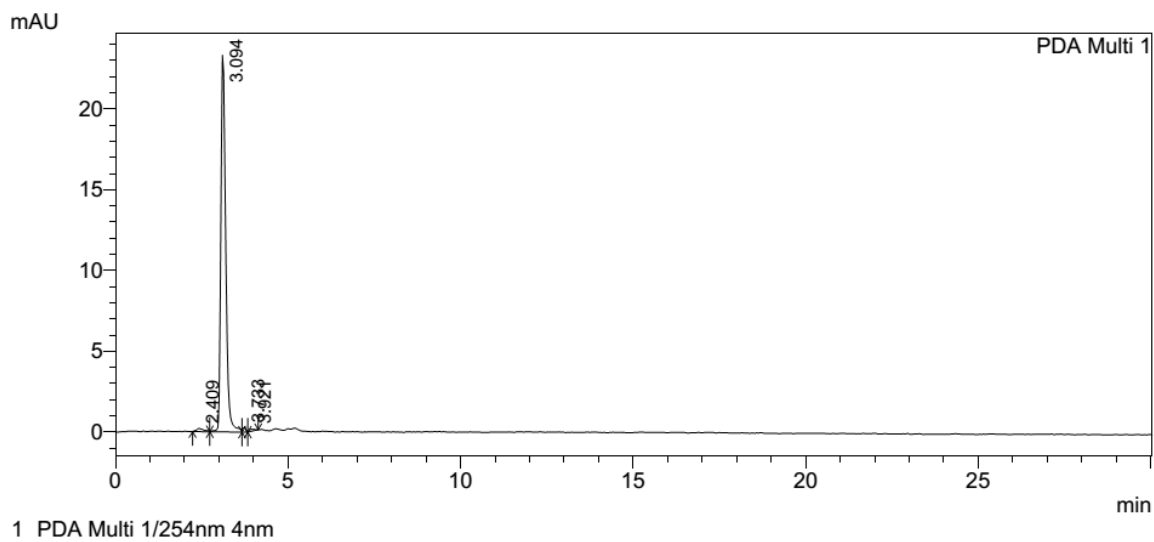
HRMS spectrum of **3h**



¹H NMR (400 MHz, DMSO-*d*₆) of **3i**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3i**

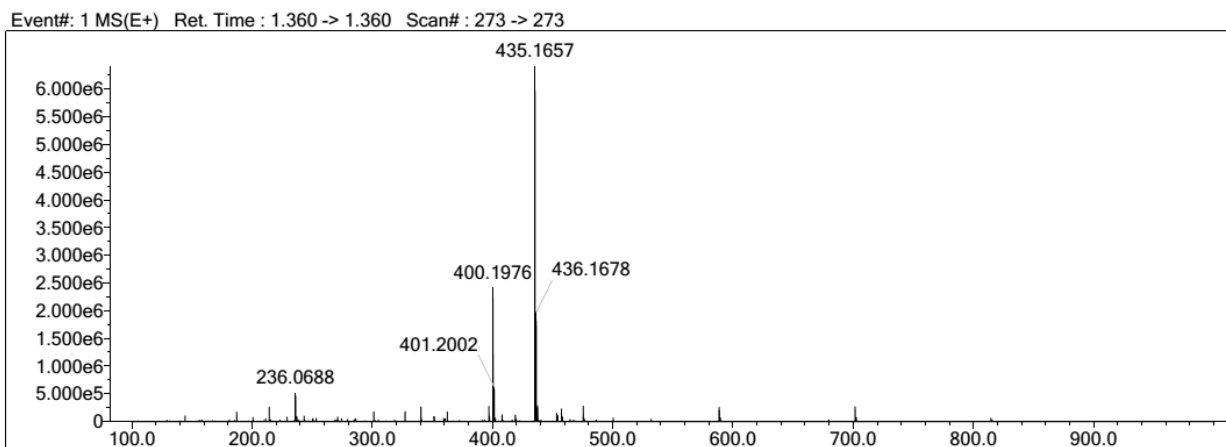


PeakTable

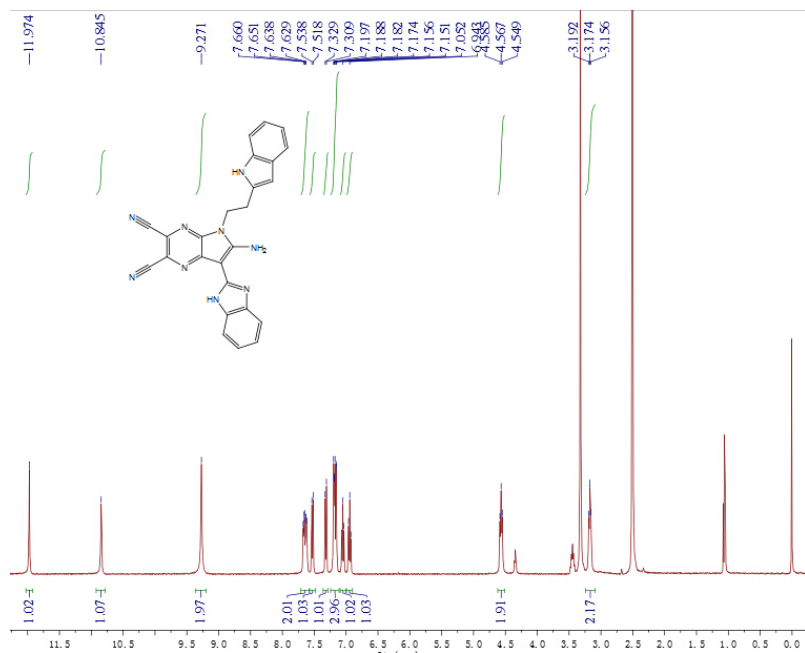
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.409	3074	207	1.301	0.863
2	3.094	230303	23333	97.522	97.411
3	3.733	1428	269	0.605	1.121
4	3.921	1350	145	0.572	0.605
Total		236154	23953	100.000	100.000

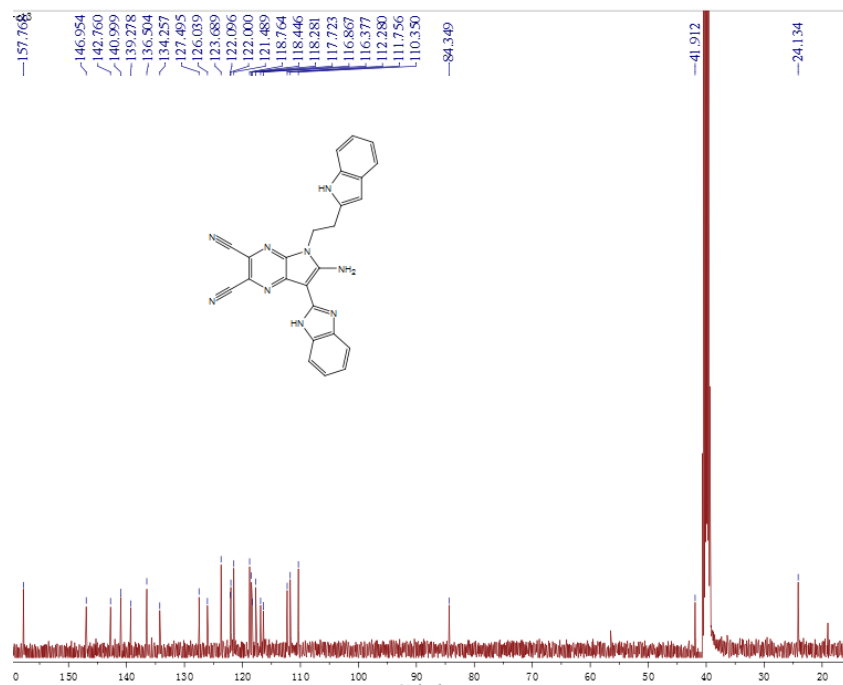
HPLC spectrum of **3i**



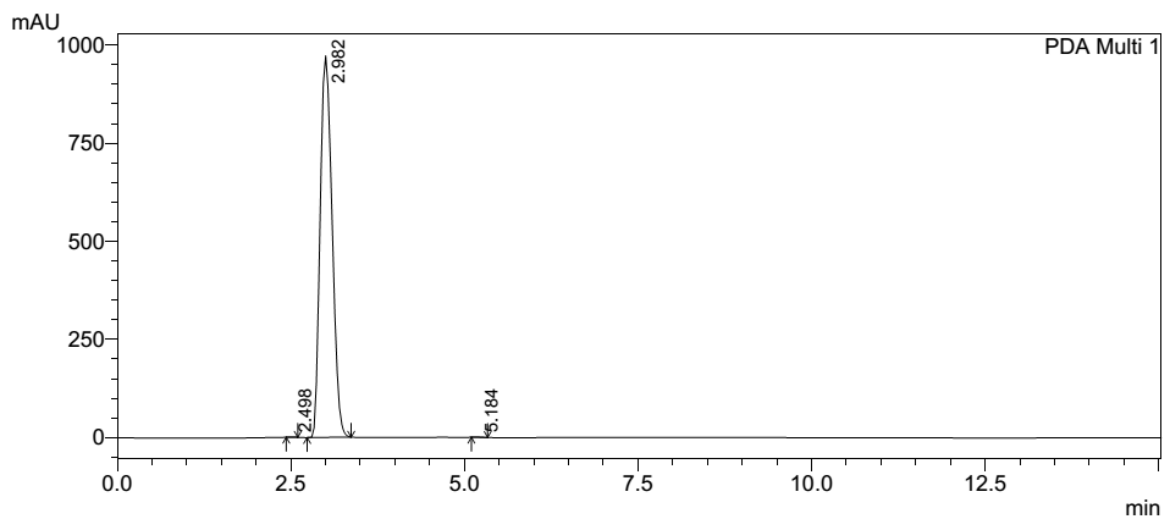
HRMS spectrum of **3i**



¹H NMR (400 MHz, DMSO-*d*₆) of **3j**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3j**



1 PDA Multi 1/254nm 4nm

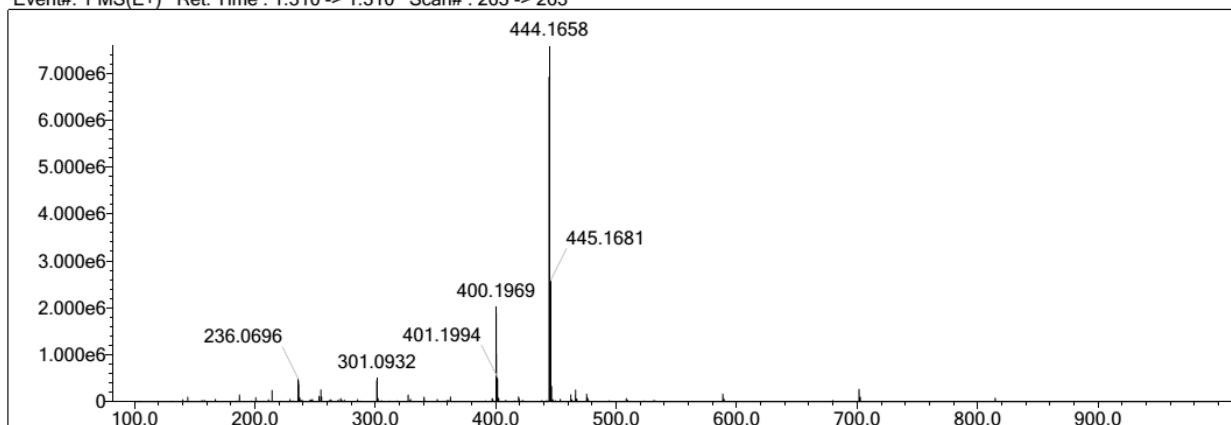
PeakTable

PDA Ch1 254nm 4nm

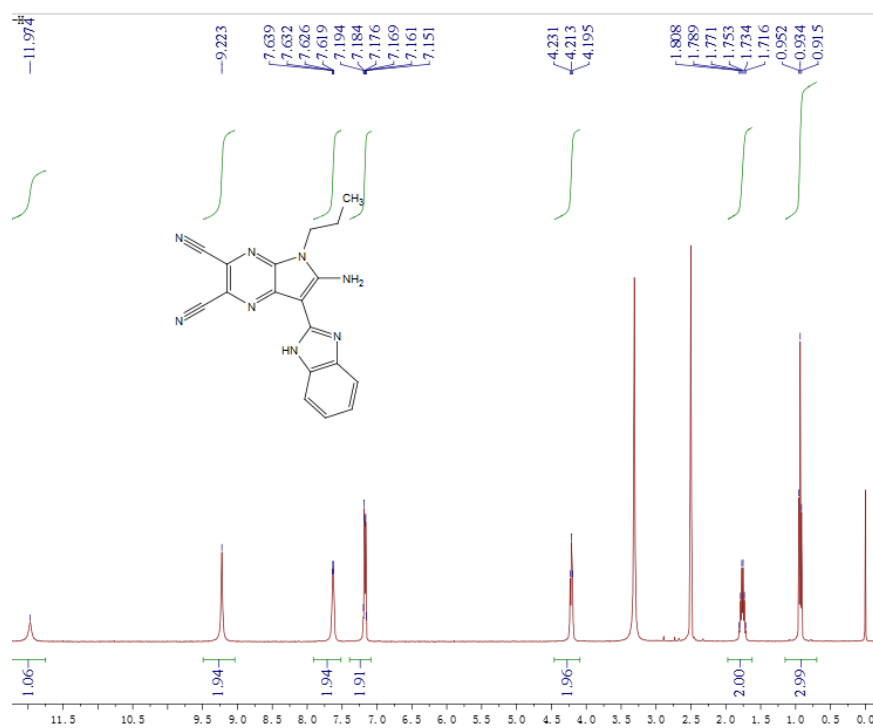
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.498	2473	408	0.021	0.042
2	2.982	11670675	972320	99.925	99.874
3	5.184	6254	822	0.054	0.084
Total		11679402	973550	100.000	100.000

HPLC spectrum of **3j**

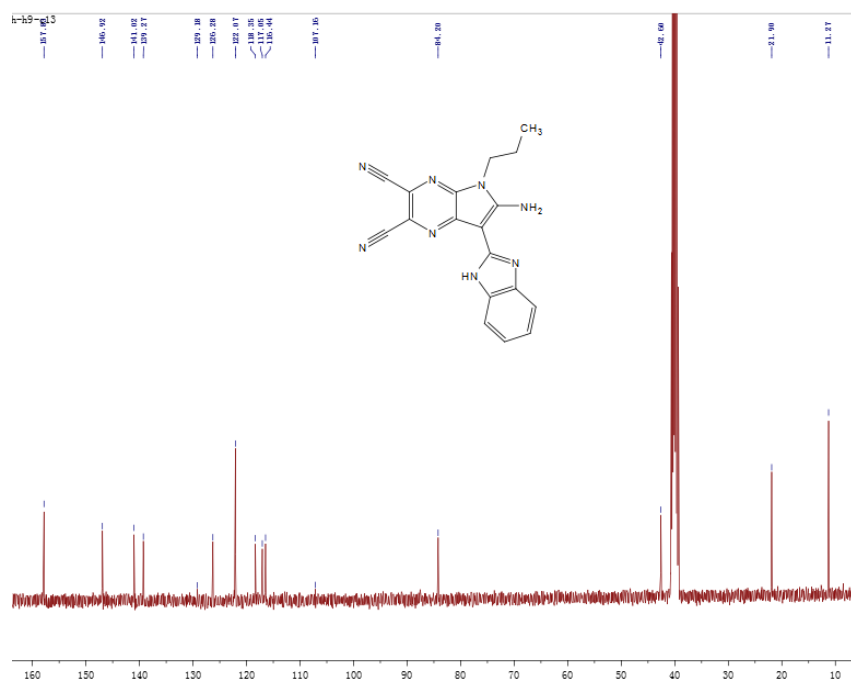
Event#: 1 MS(E+) Ret. Time : 1.310 -> 1.310 Scan#: 263 -> 263



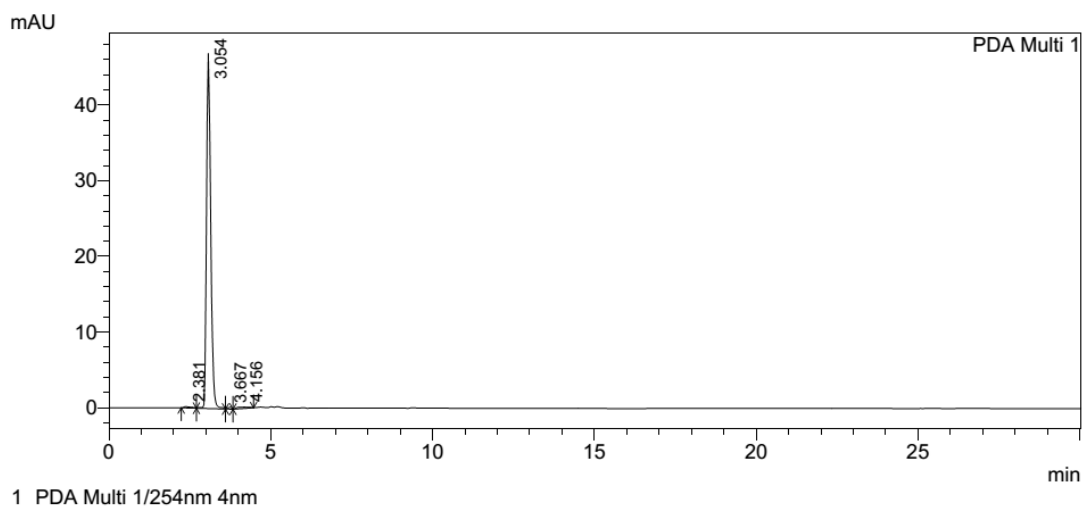
HRMS spectrum of **3j**



¹H NMR (400 MHz, DMSO-*d*₆) of **3k**



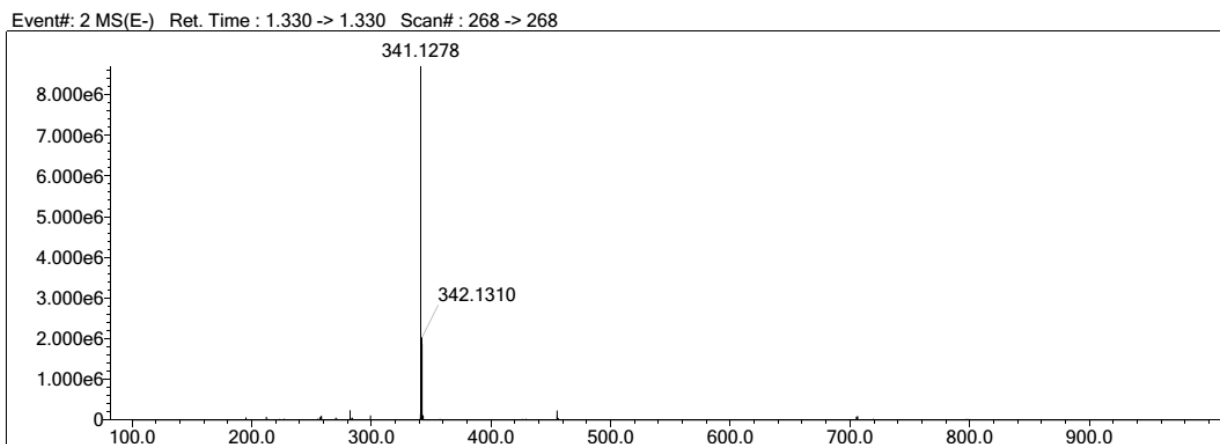
¹³C NMR (100 MHz, DMSO-*d*₆) of **3k**



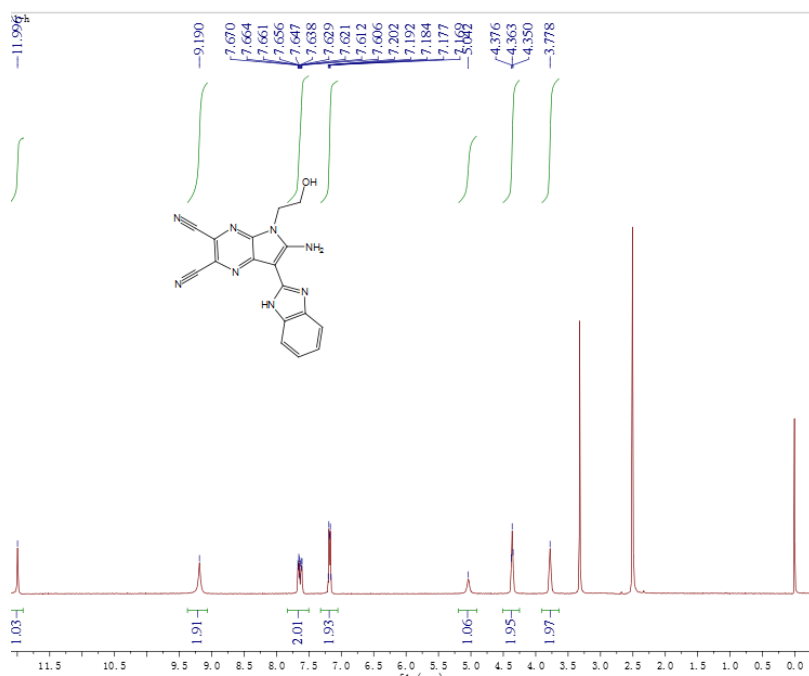
PeakTable

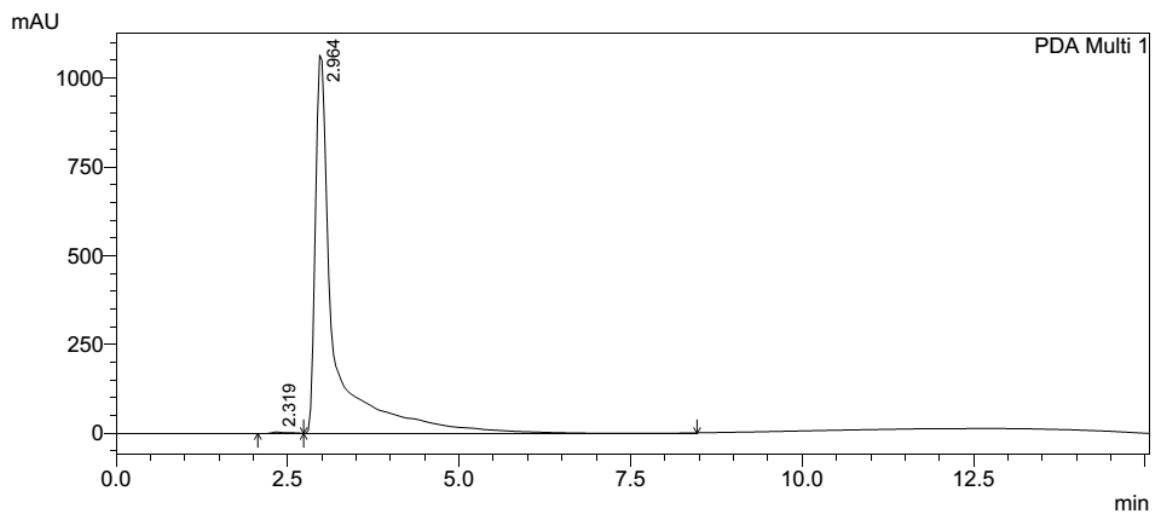
PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.381	3094	168	0.707	0.354
2	3.054	426908	46944	97.607	98.853
3	3.667	2292	186	0.524	0.392
4	4.156	5079	190	1.161	0.401
Total		437373	47489	100.000	100.000

HPLC spectrum of **3k**



HRMS spectrum of **3k**





1 PDA Multi 1/254nm 4nm

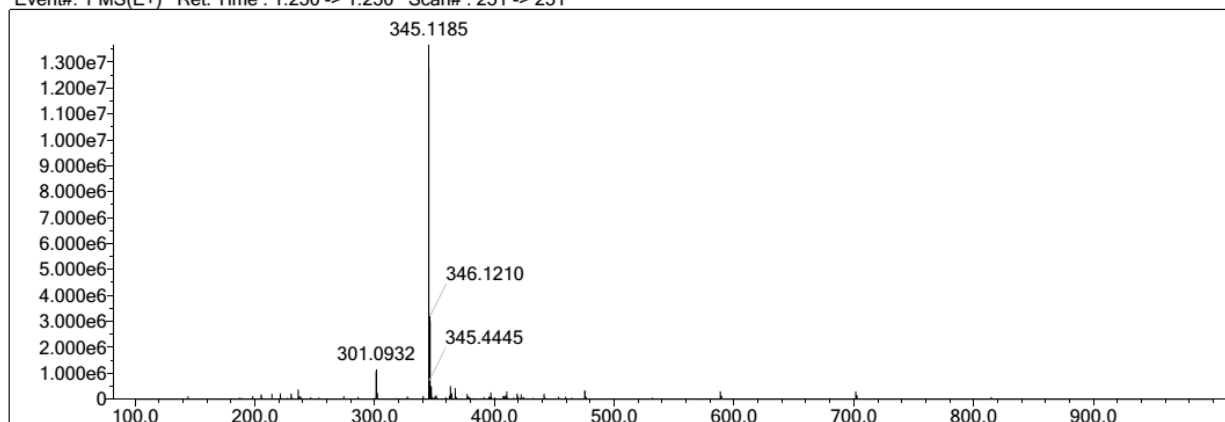
PeakTable

PDA Ch1 254nm 4nm

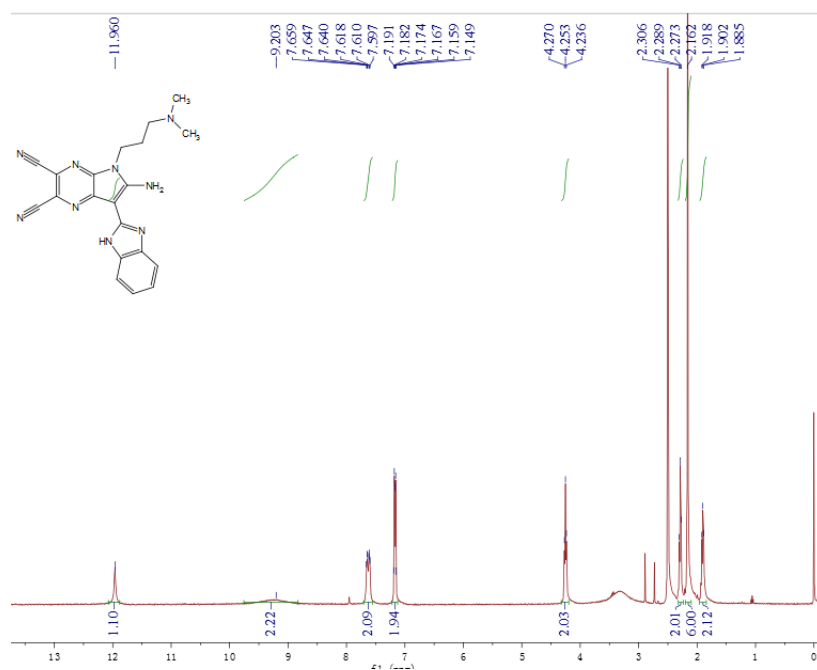
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.319	75854	4656	0.368	0.435
2	2.964	20510840	1065559	99.632	99.565
Total		20586693	1070215	100.000	100.000

HPLC spectrum of **3I**

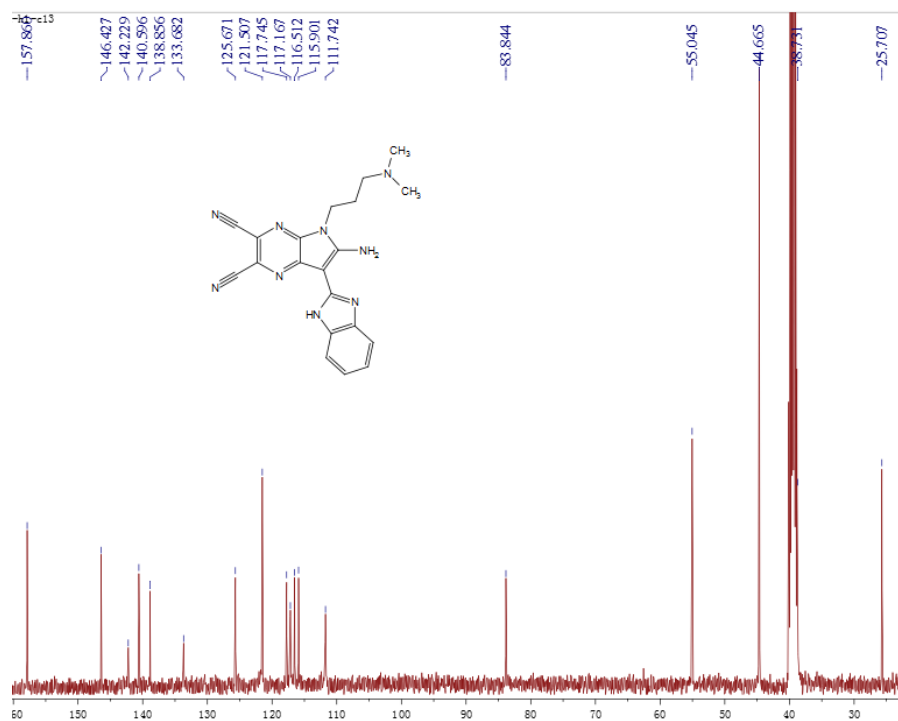
Event#: 1 MS(E+) Ret. Time : 1.250 -> 1.250 Scan#: 251 -> 251



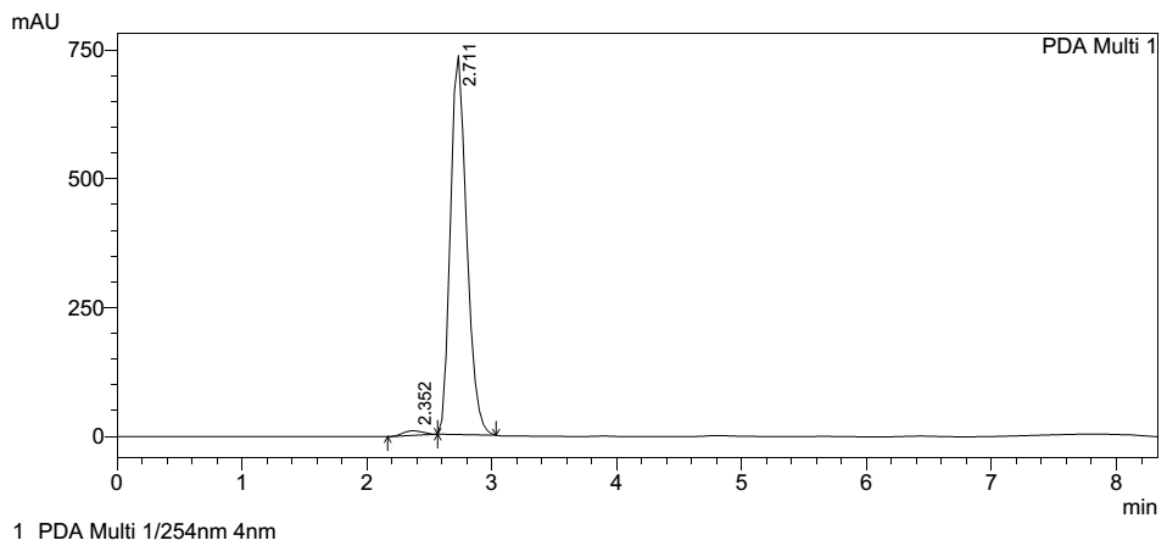
HRMS spectrum of **3I**



¹H NMR (400 MHz, DMSO-*d*₆) of **3m**



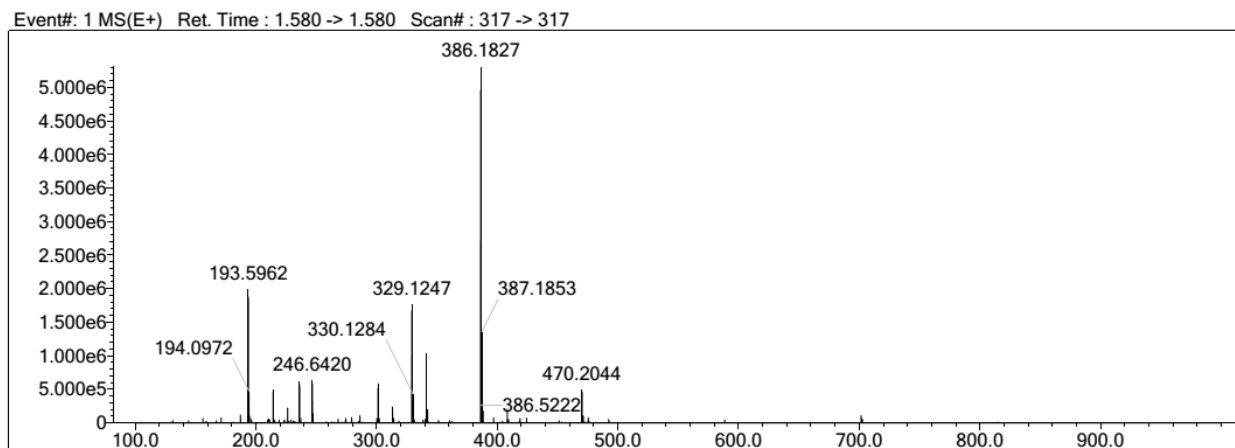
¹³C NMR (100 MHz, DMSO-*d*₆) of **3m**



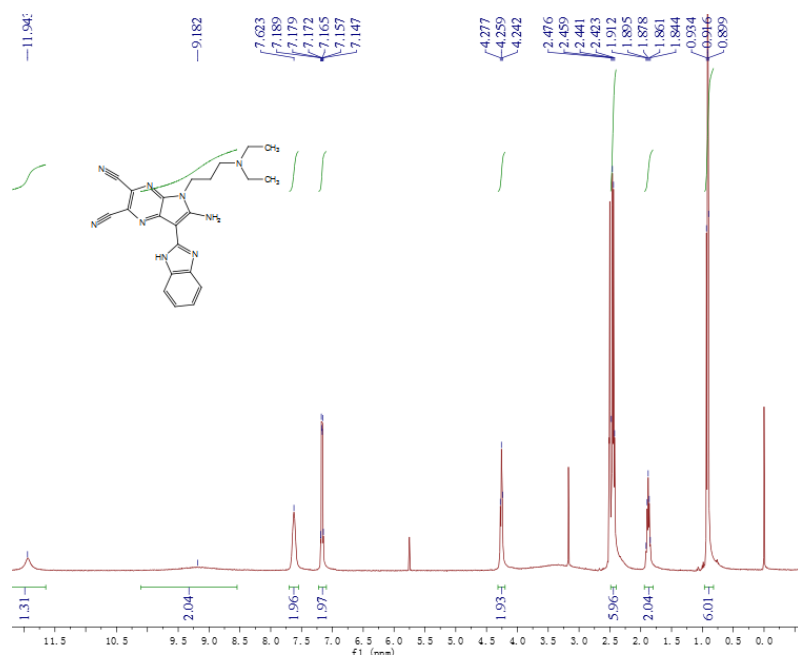
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.352	103081	9181	1.519	1.232
2	2.711	6684290	736173	98.481	98.768
Total		6787372	745354	100.000	100.000

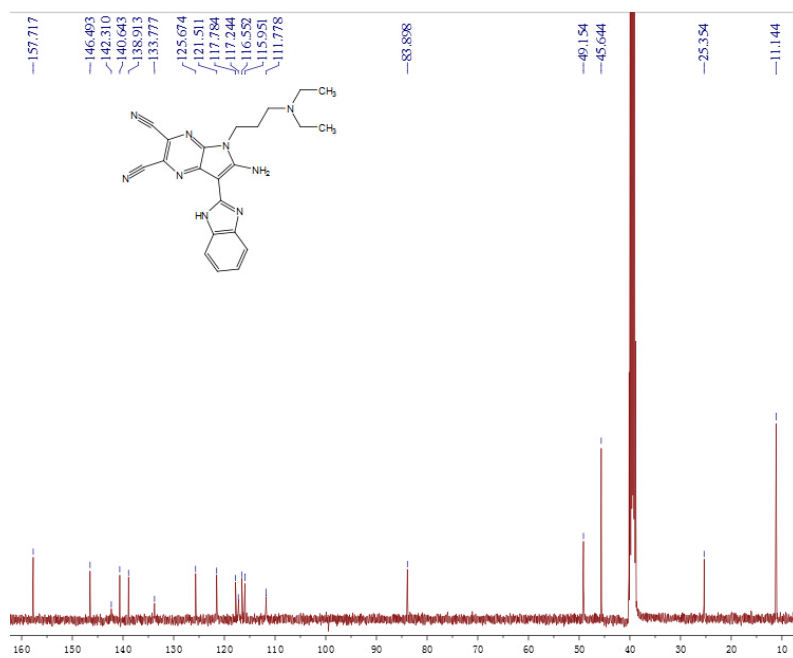
HPLC spectrum of **3m**



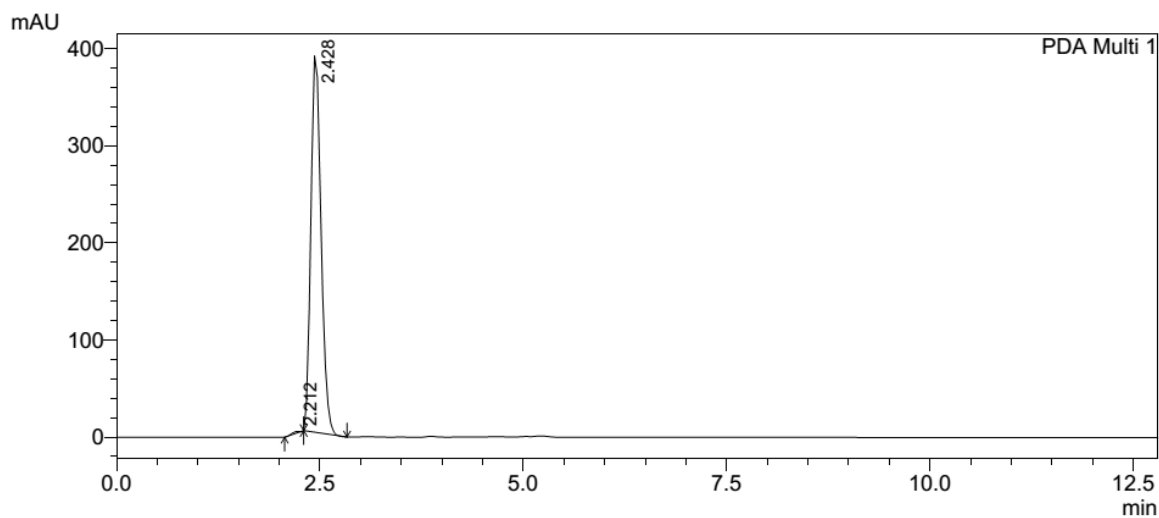
HRMS spectrum of **3m**



¹H NMR (400 MHz, DMSO-*d*₆) of **3n**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3n**



1 PDA Multi 1/254nm 4nm

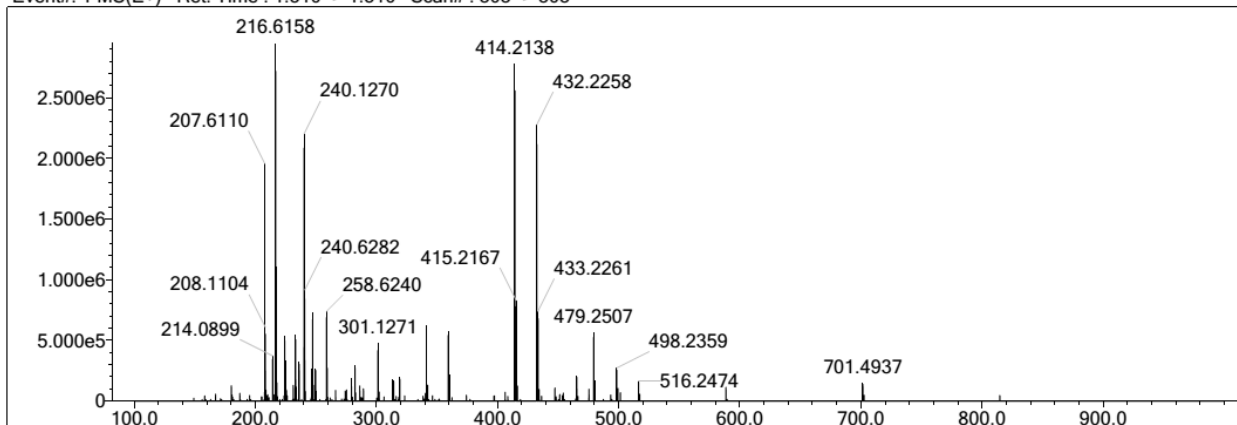
PeakTable

PDA Ch1 254nm 4nm

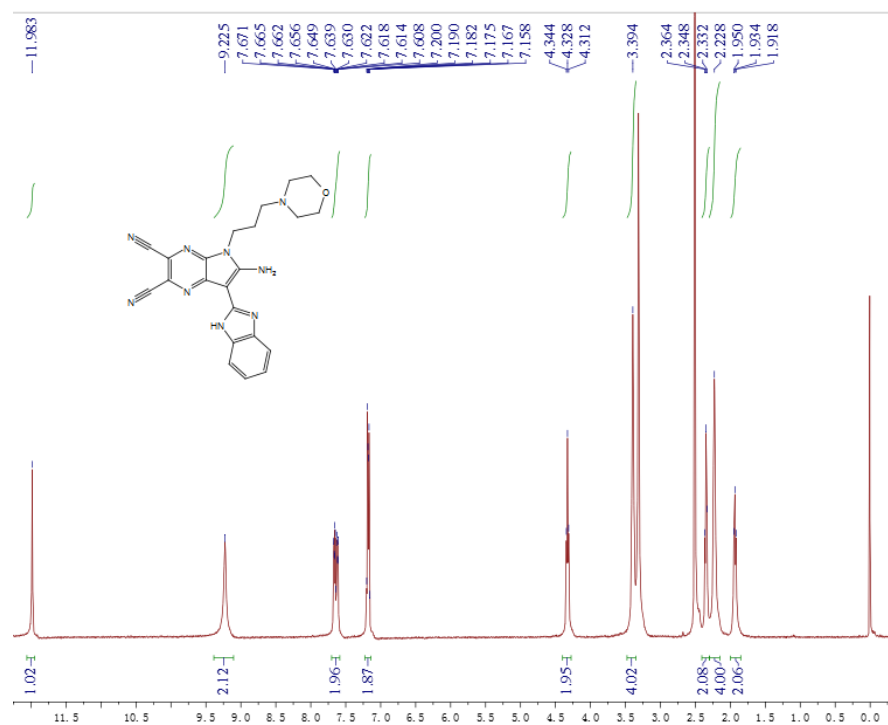
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.212	17235	1812	0.507	0.465
2	2.428	3381663	387697	99.493	99.535
Total		3398898	389509	100.000	100.000

HPLC spectrum of **3n**

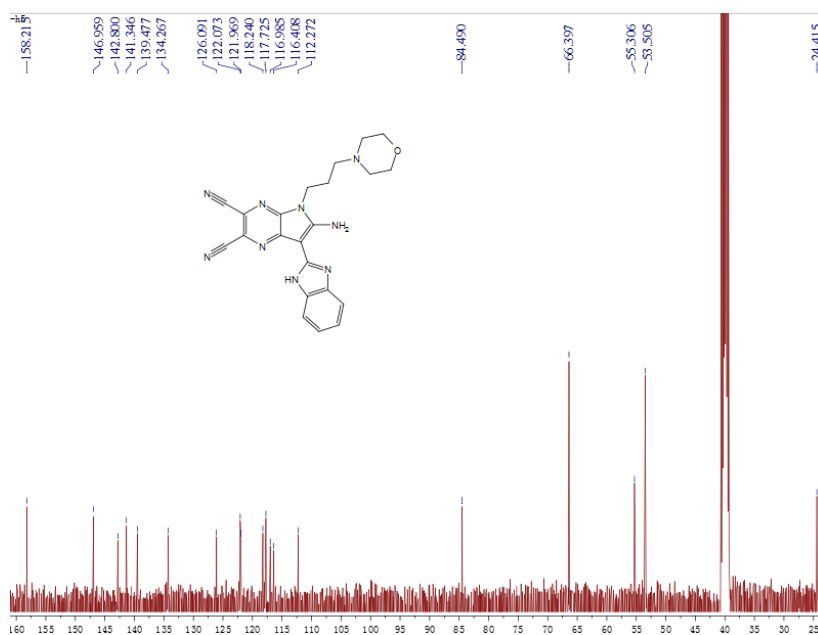
Event#: 1 MS(E+) Ret. Time : 1.510 -> 1.510 Scan#: 303 -> 303



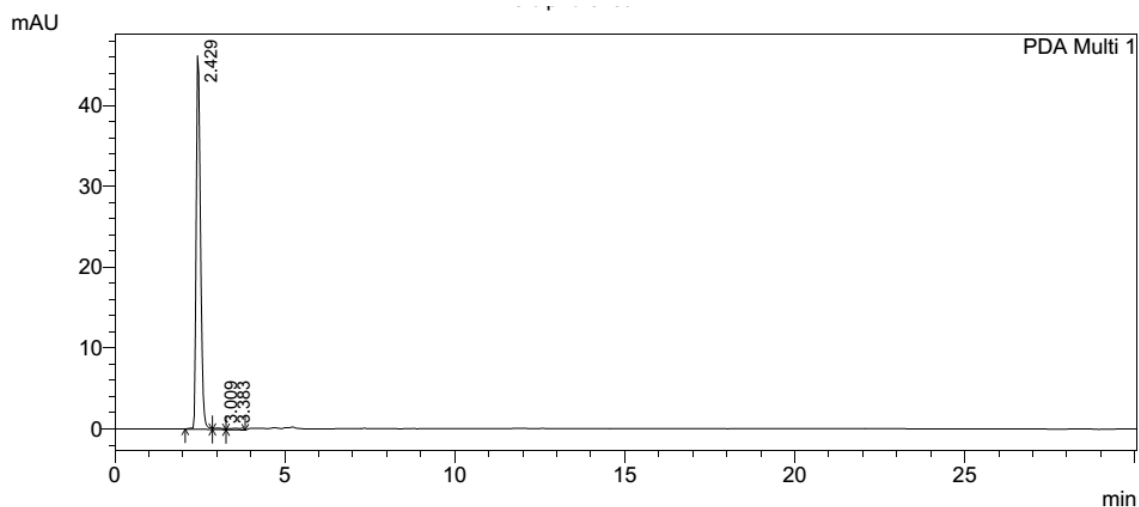
HRMS spectrum of **3n**



¹H NMR (400 MHz, DMSO-*d*₆) of **3o**



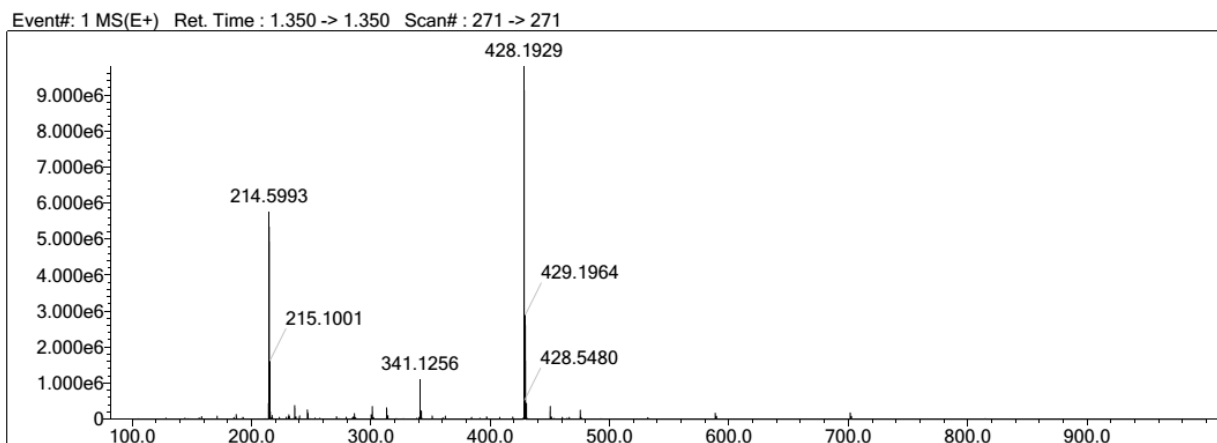
¹³C NMR (100 MHz, DMSO-*d*₆) of **3o**



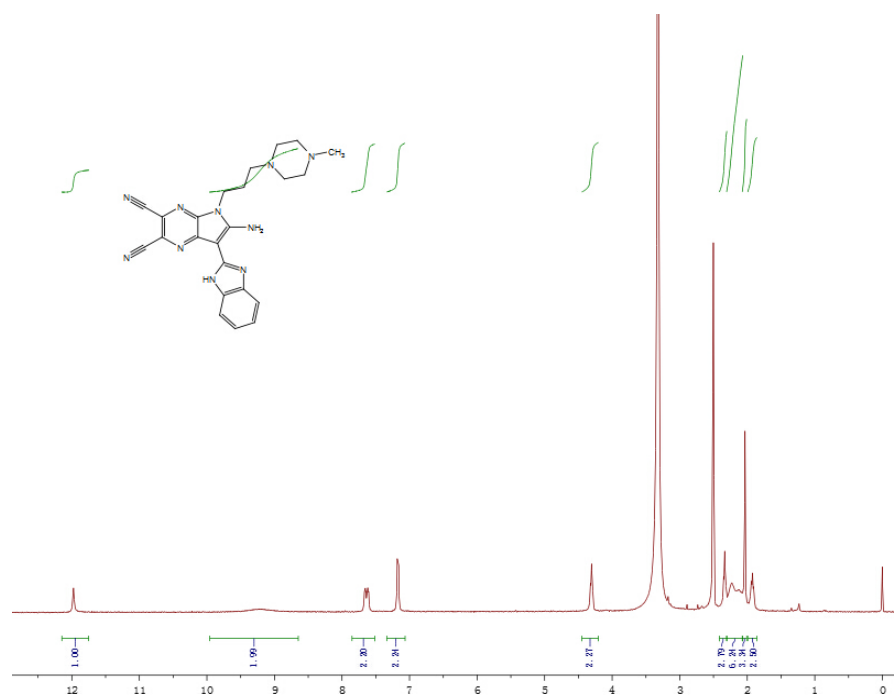
PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.429	408159	46214	97.805	99.191
2	3.009	3630	193	0.870	0.414
3	3.383	5533	184	1.326	0.395
Total		417321	46591	100.000	100.000

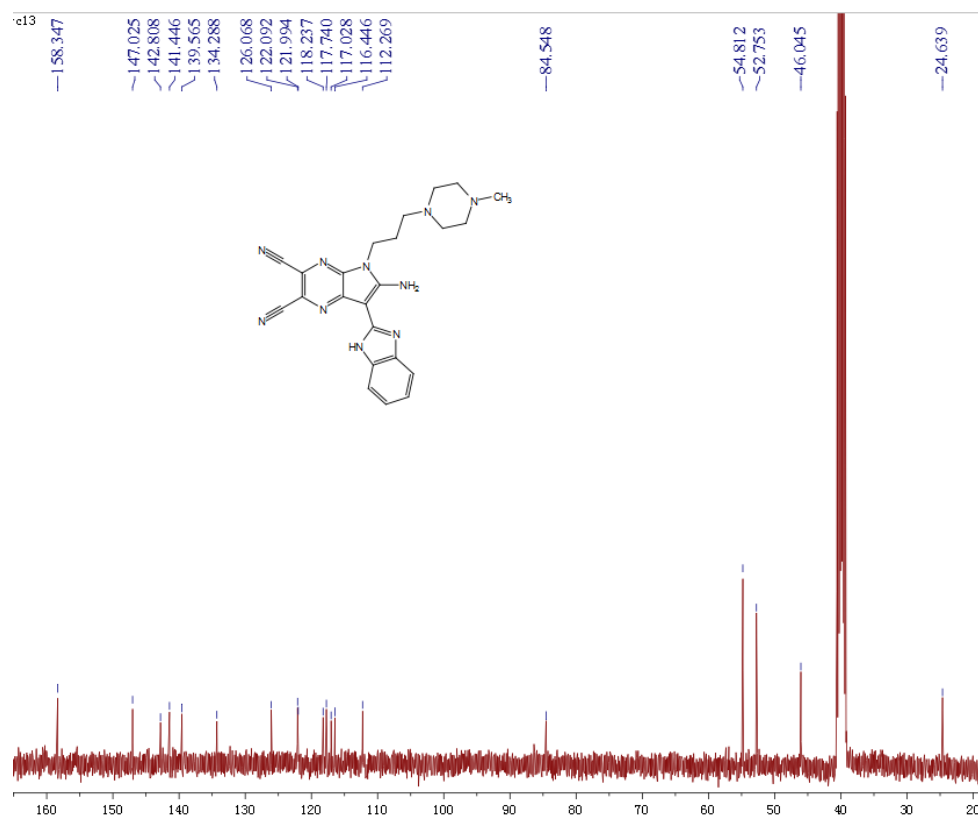
HPLC spectrum of **3o**



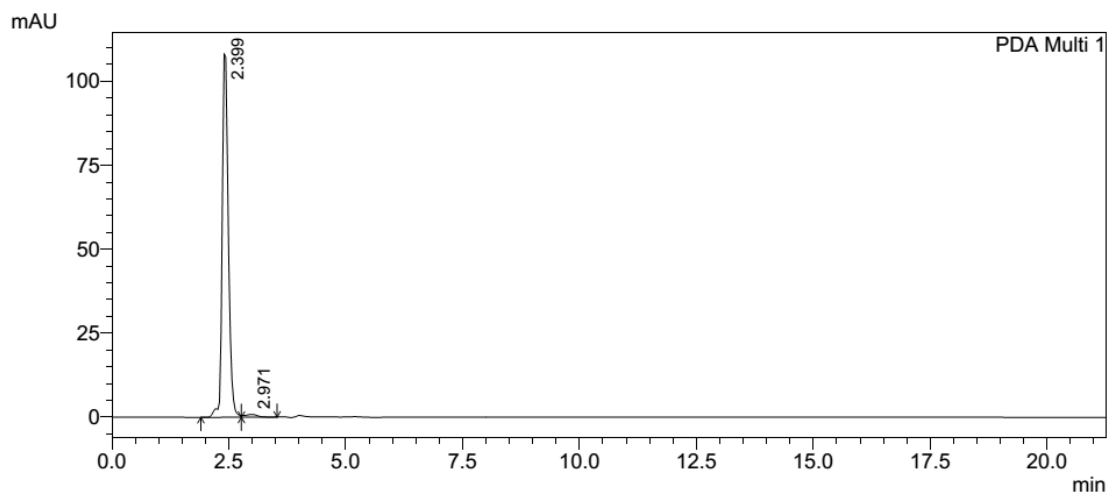
HRMS spectrum of **3o**



¹H NMR (400 MHz, DMSO-*d*₆) of **3p**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3p**



1 PDA Multi 1/254nm 4nm

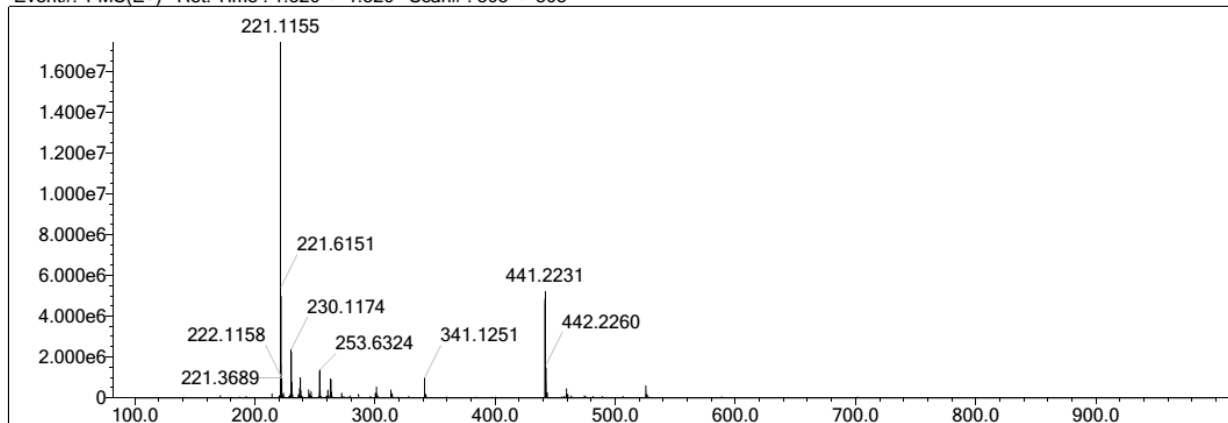
PeakTable

PDA Ch1 254nm 4nm

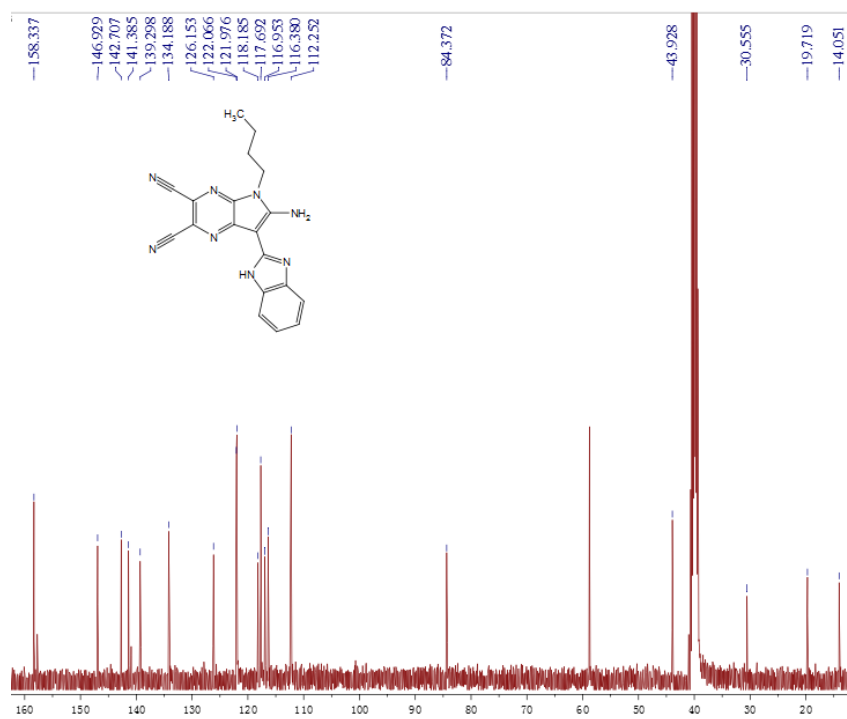
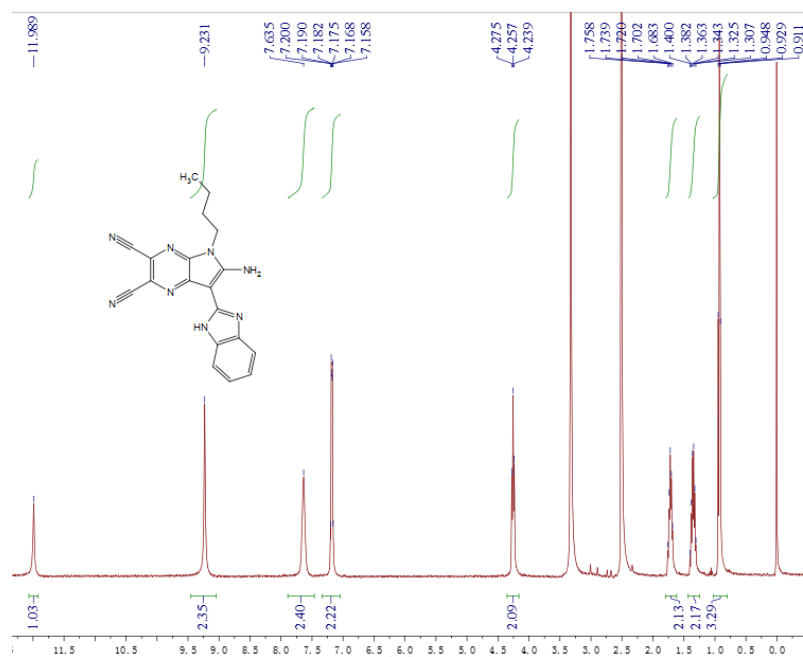
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.399	996891	108355	98.425	99.239
2	2.971	15950	831	1.575	0.761
Total		1012841	109186	100.000	100.000

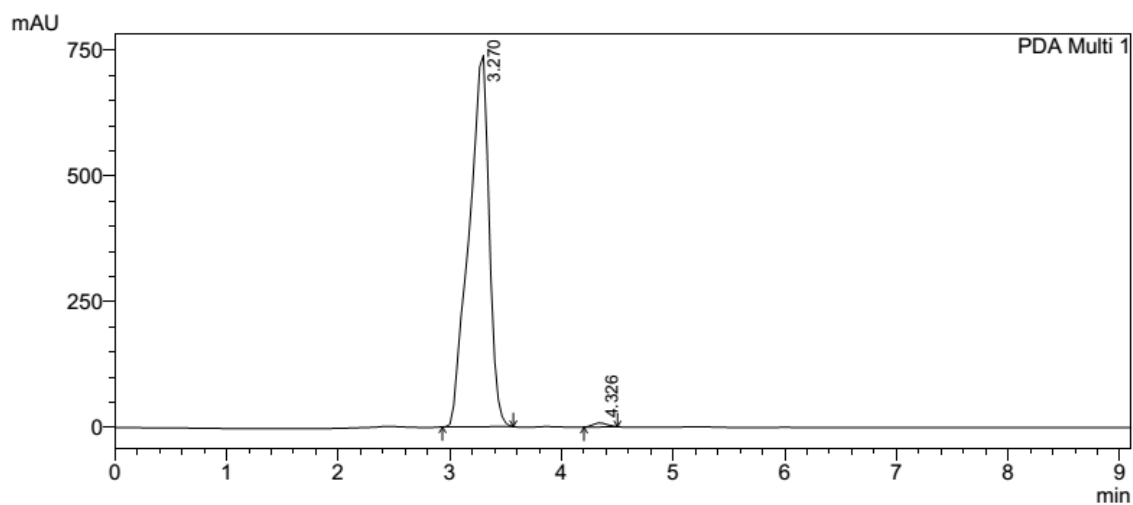
HPLC spectrum of **3p**

Event#: 1 MS(E+) Ret. Time : 1.520 -> 1.520 Scan#: 305 -> 305



HRMS spectrum of **3p**





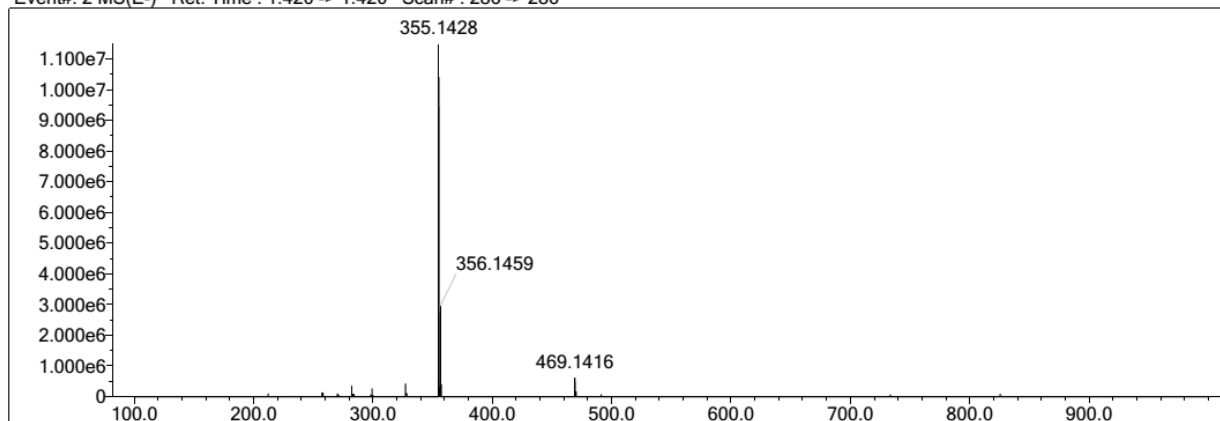
1 PDA Multi 1/254nm 4nm

PeakTable

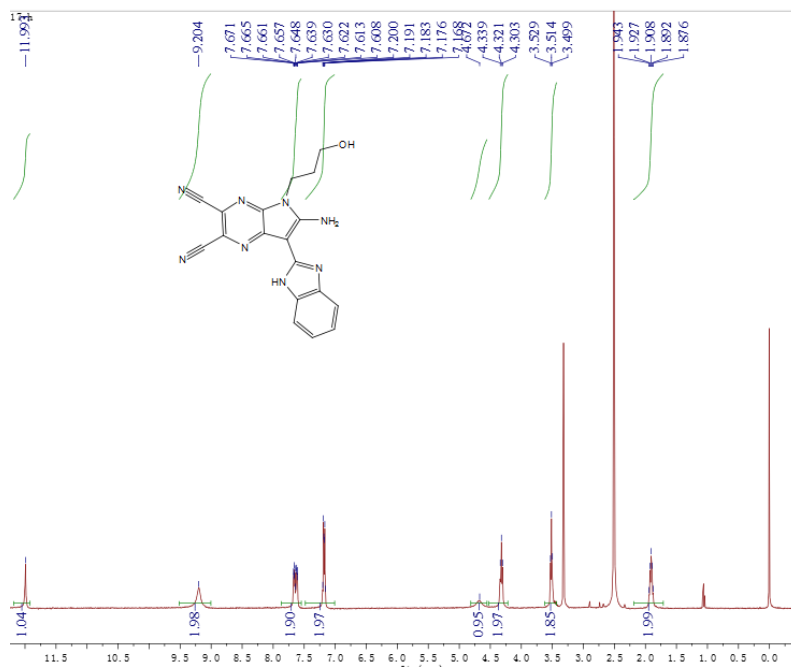
Peak#	Ret. Time	Area	Height	Area %	Height %
1	3.270	9255149	738770	99.234	98.948
2	4.326	71470	7855	0.766	1.052
Total		9326619	746626	100.000	100.000

HPLC spectrum of **3q**

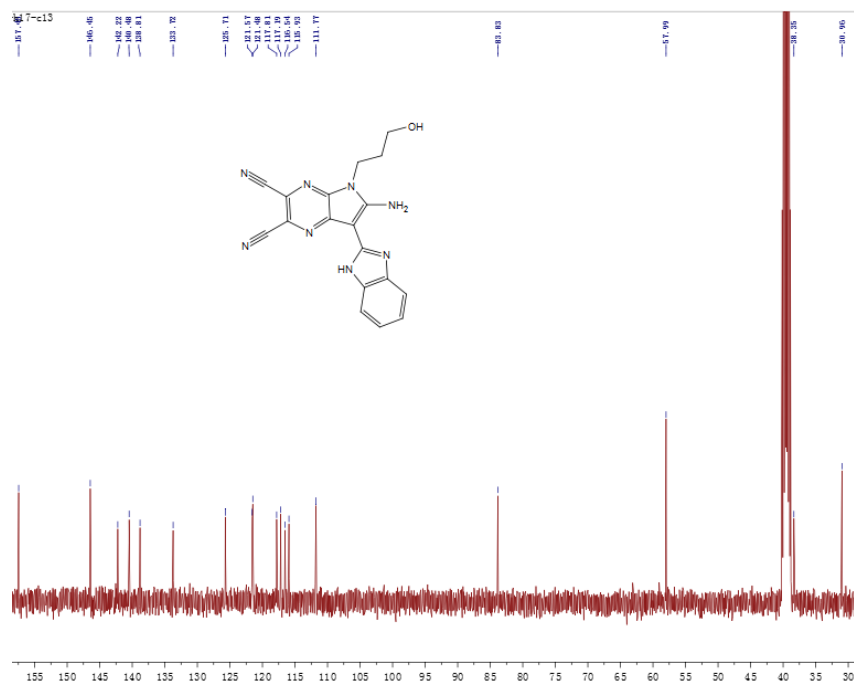
Event#: 2 MS(E-) Ret. Time : 1.420 -> 1.420 Scan# : 286 -> 286



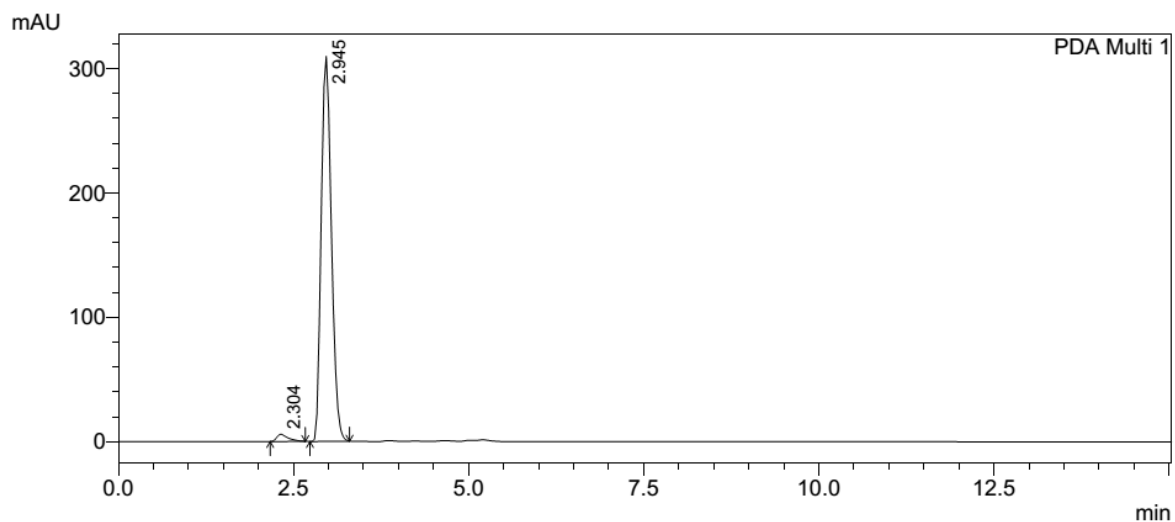
HRMS spectrum of **3q**



¹H NMR (400 MHz, DMSO-*d*₆) of **3r**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3r**



1 PDA Multi 1/254nm 4nm

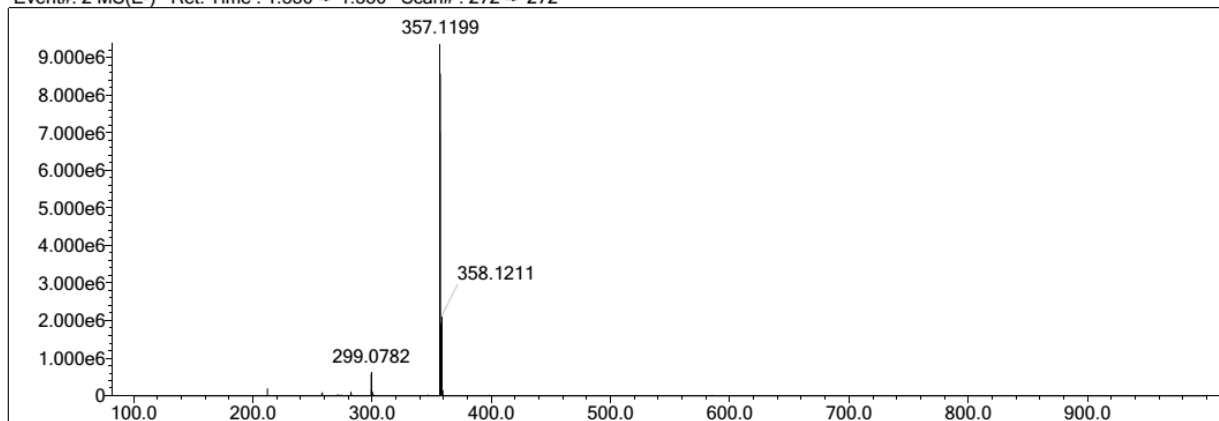
PeakTable

PDA Ch1 254nm 4nm

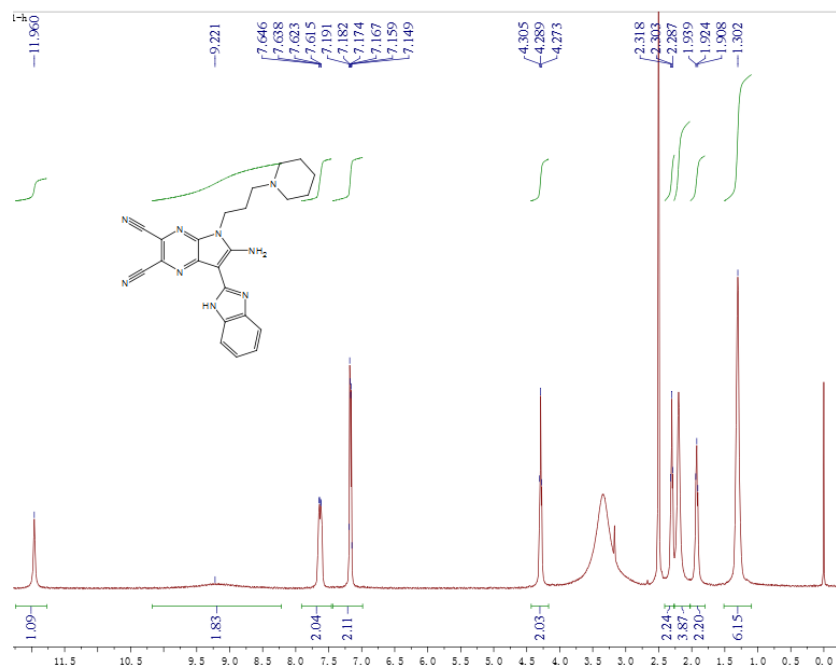
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.304	67001	5820	2.084	1.843
2	2.945	3147952	309961	97.916	98.157
Total		3214953	315781	100.000	100.000

HPLC spectrum of **3r**

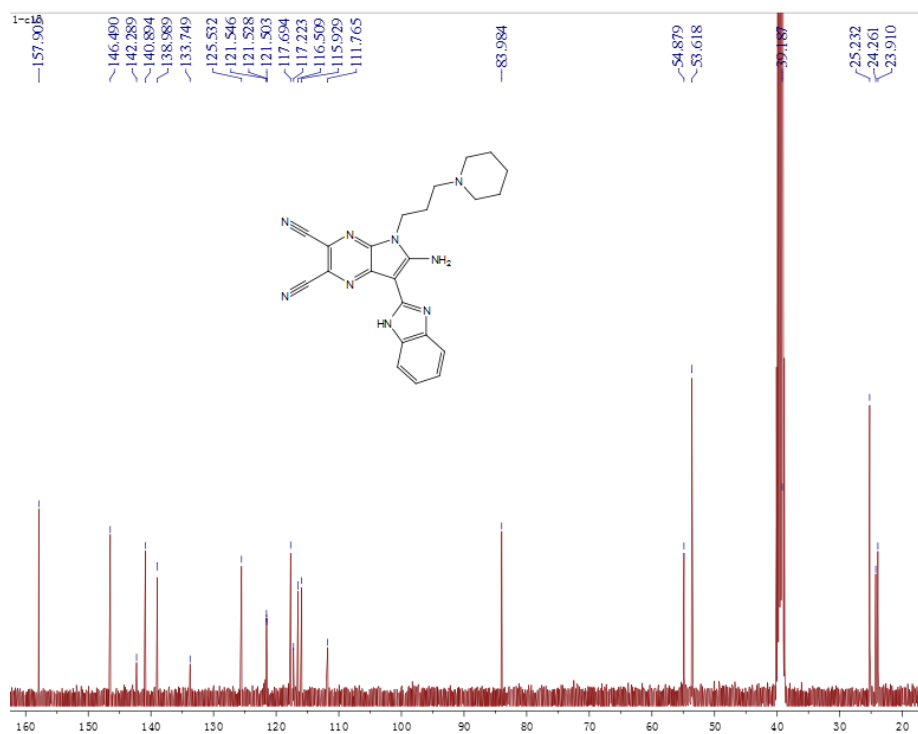
Event#: 2 MS(E-) Ret. Time : 1.350 -> 1.350 Scan#: 272 -> 272



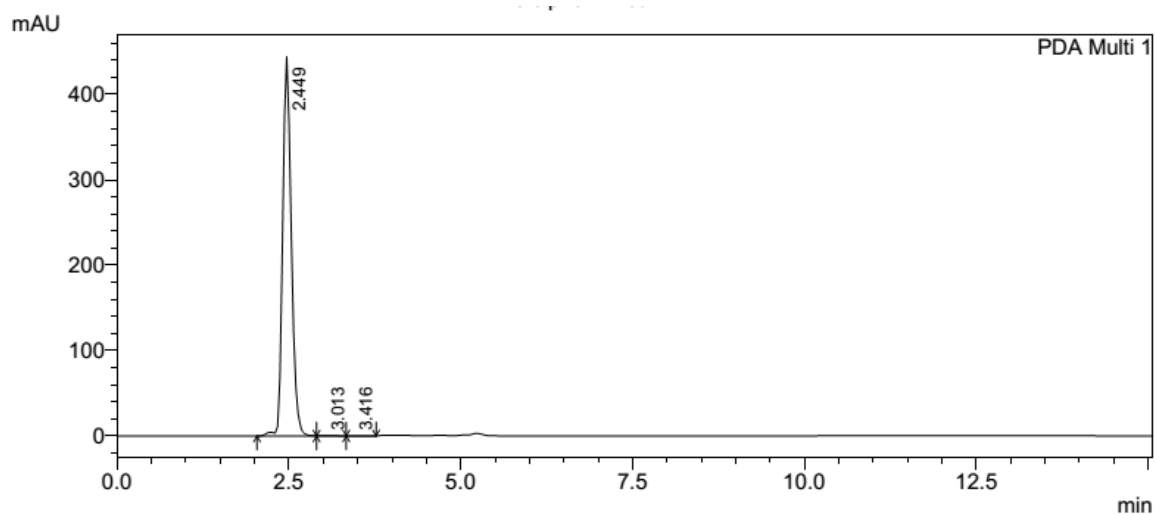
HRMS spectrum of **3r**



¹H NMR (400 MHz, DMSO-*d*₆) of **3s**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3s**

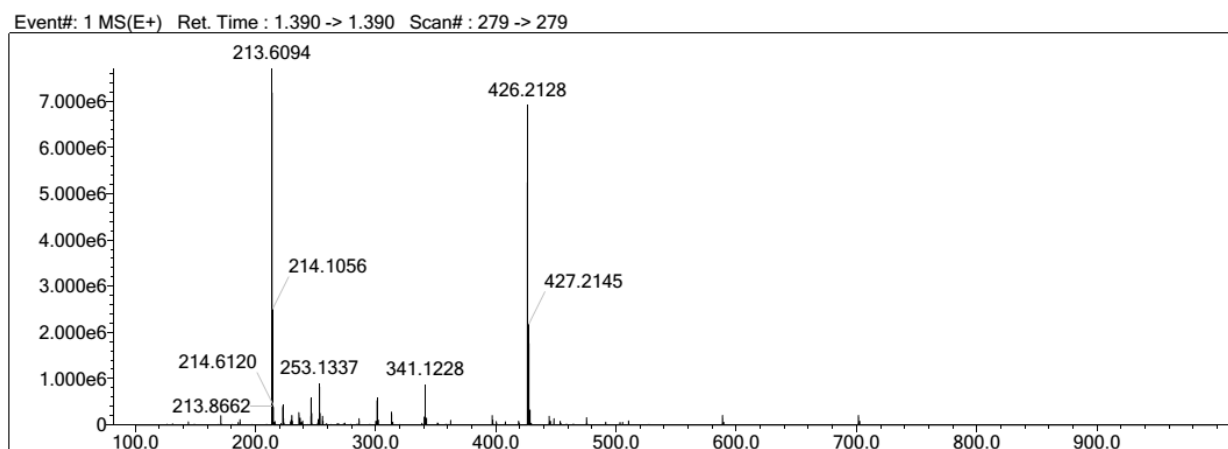


1 PDA Multi 1/254nm 4nm

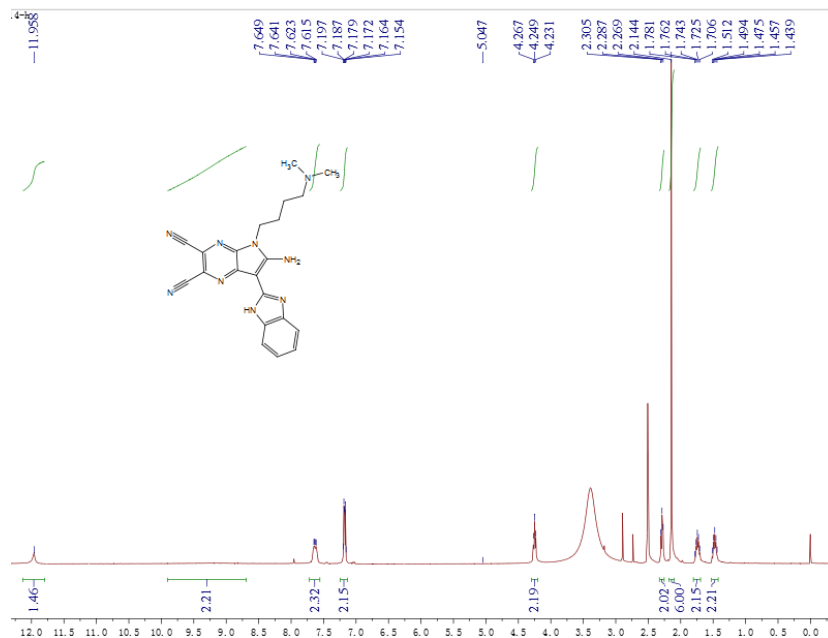
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.449	3890856	444573	99.647	99.786
2	3.013	9613	630	0.246	0.141
3	3.416	4158	322	0.106	0.072
Total		3904627	445525	100.000	100.000

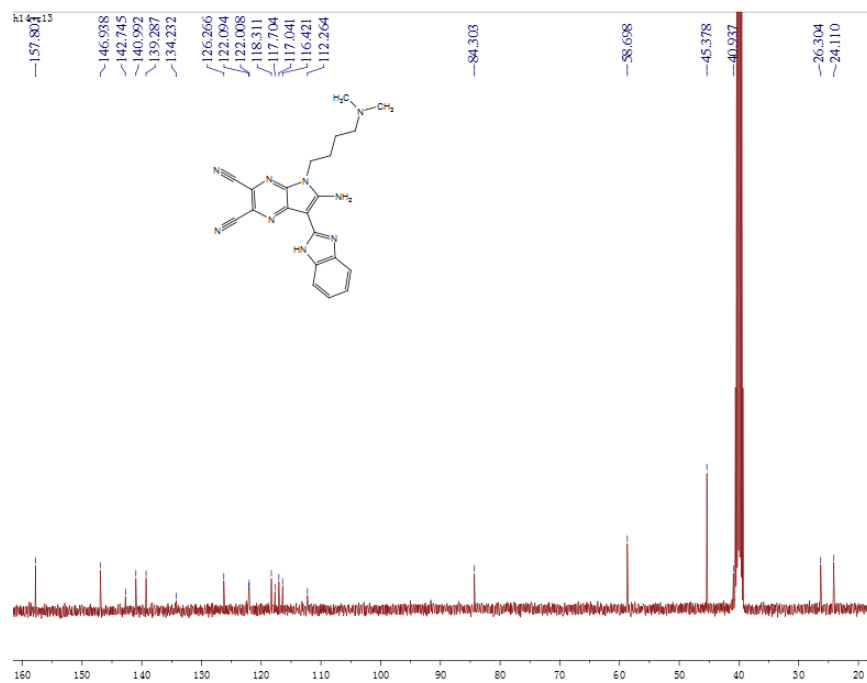
HPLC spectrum of **3s**



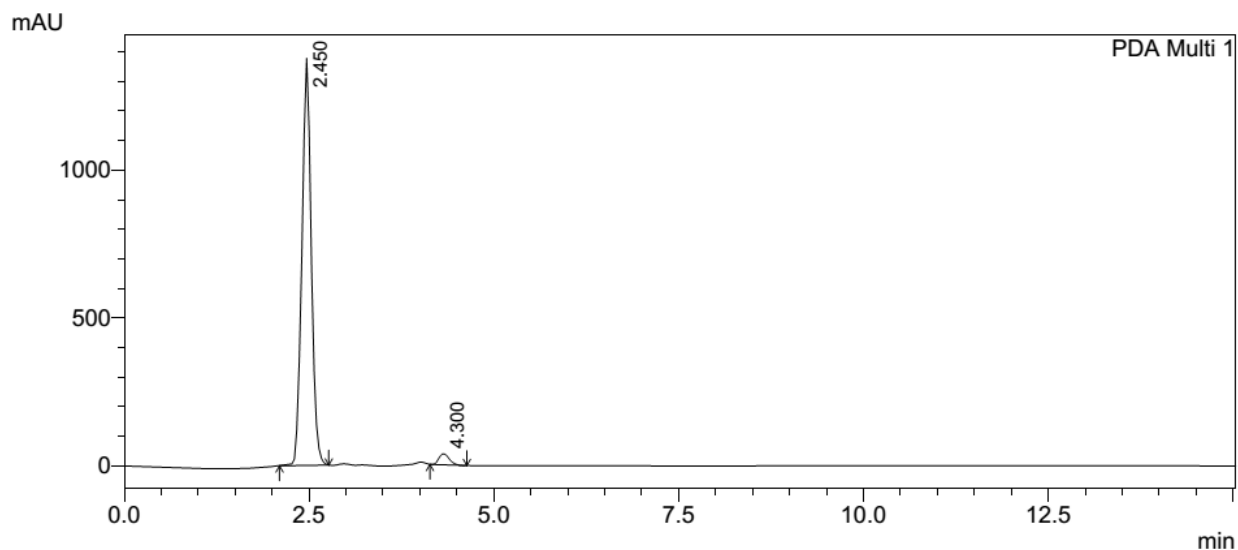
HRMS spectrum of **3s**



¹H NMR (400 MHz, DMSO-*d*₆) of **3t**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3t**



1 PDA Multi 1/254nm 4nm

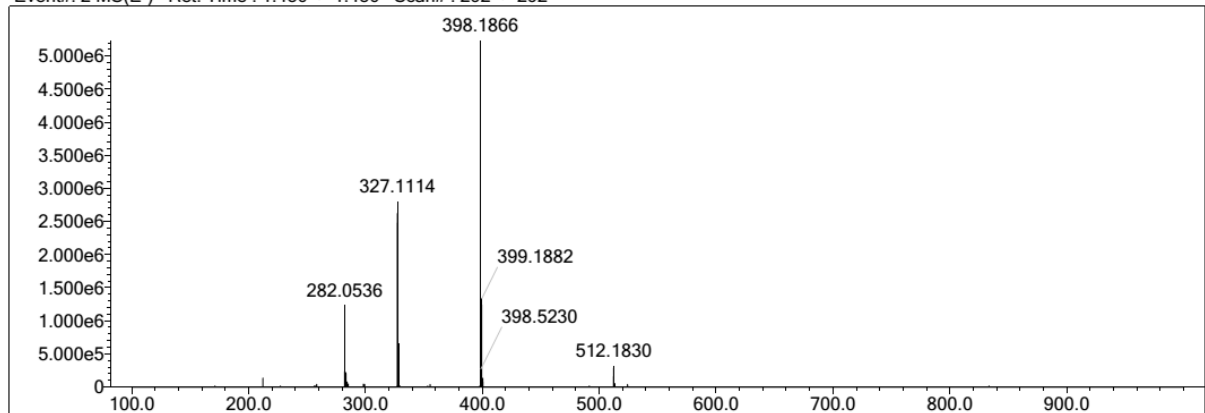
PeakTable

PDA Ch1 254nm 4nm

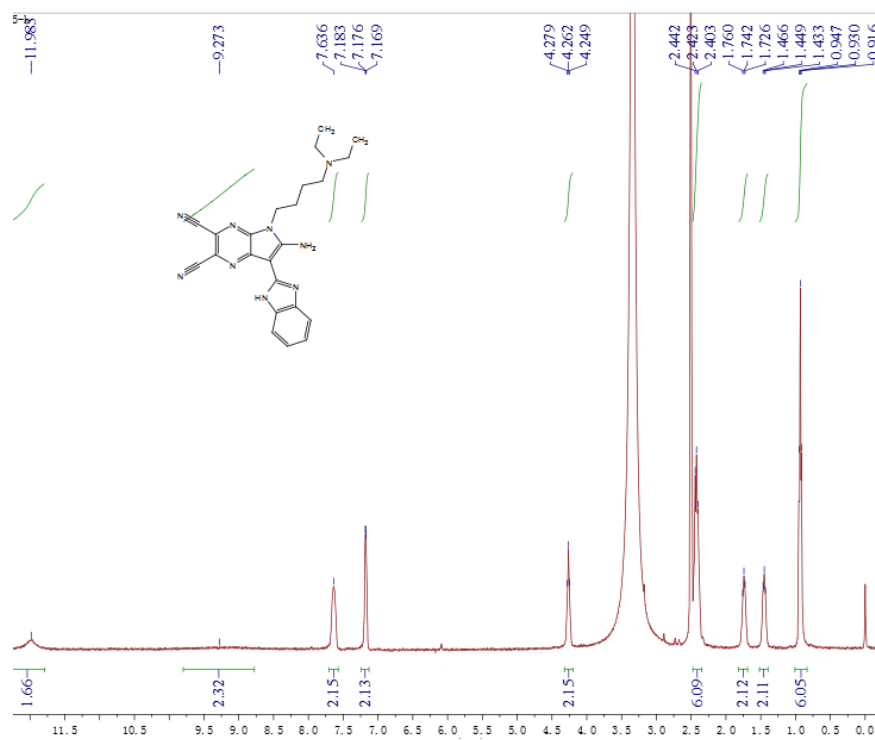
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.450	12089458	1376805	97.099	97.391
2	4.300	361205	36882	2.901	2.609
Total		12450663	1413687	100.000	100.000

HPLC spectrum of **3t**

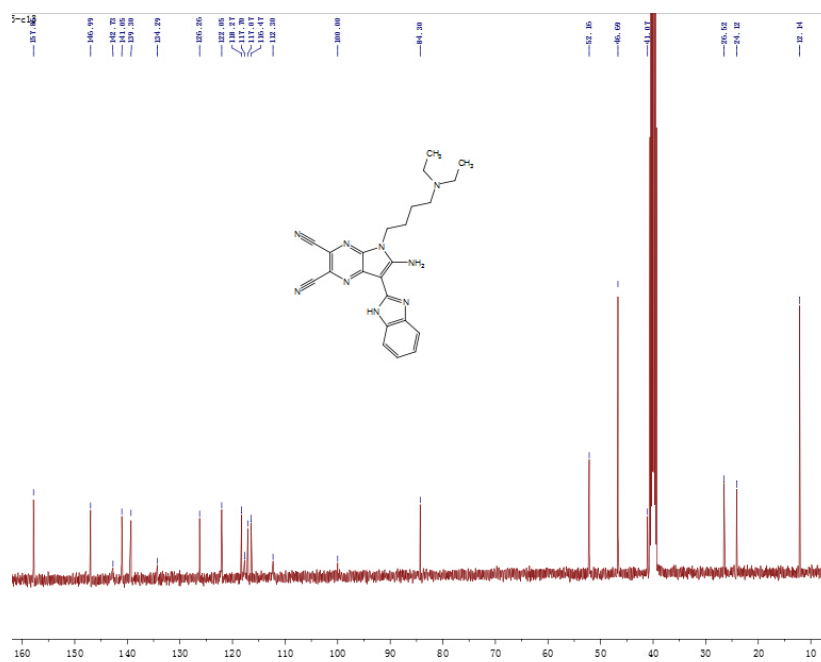
Event#: 2 MS(E-) Ret. Time : 1.450 -> 1.450 Scan#: 292 -> 292



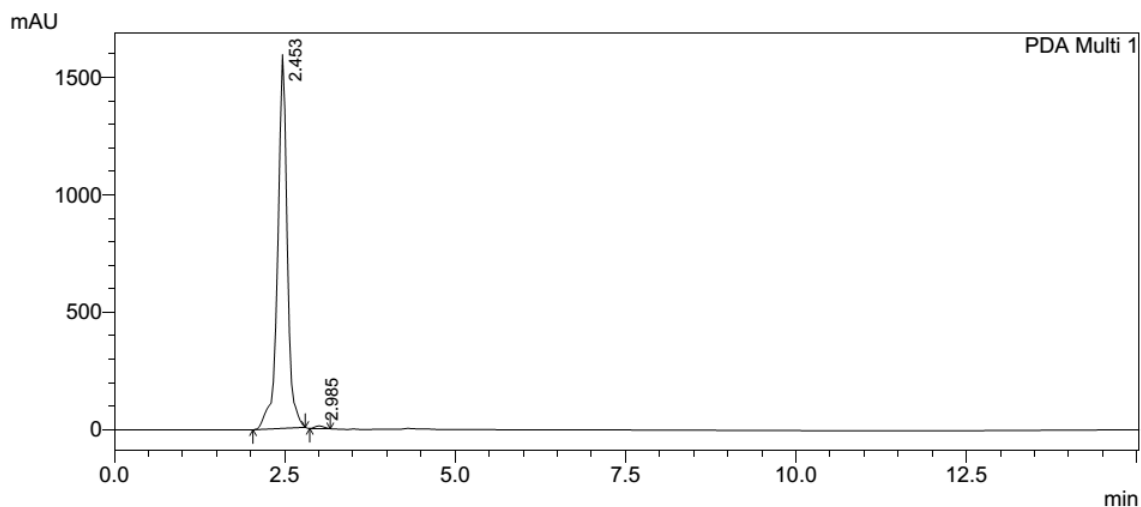
HRMS spectrum of **3t**



¹H NMR (400 MHz, DMSO-*d*₆) of **3u**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3u**



1 PDA Multi 1/254nm 4nm

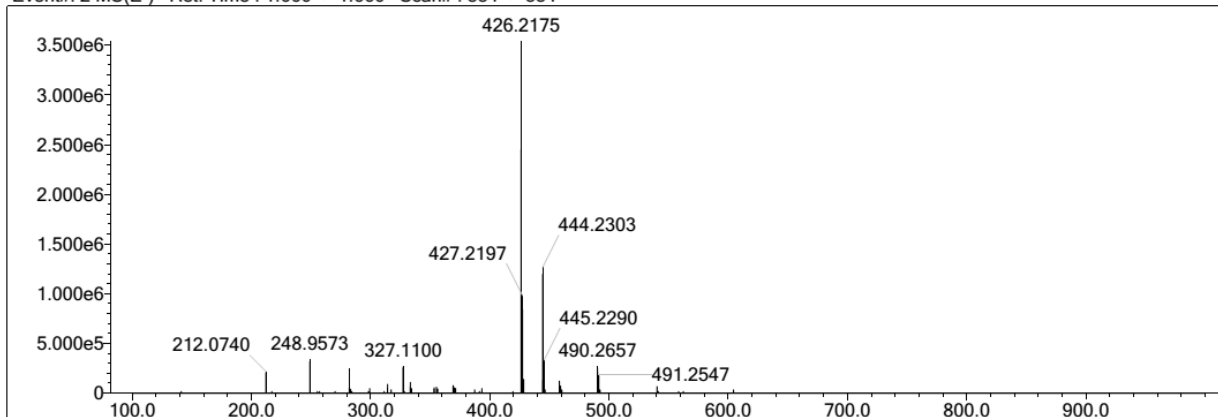
PeakTable

PDA Ch1 254nm 4nm

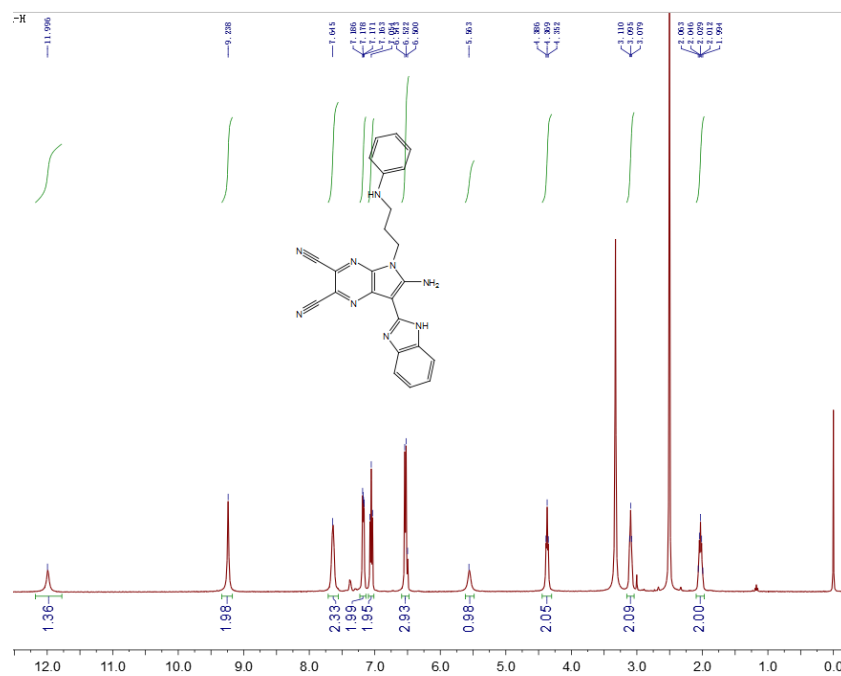
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.453	15463068	1592643	99.308	99.280
2	2.985	107775	11550	0.692	0.720
Total		15570843	1604193	100.000	100.000

HPLC spectrum of **3u**

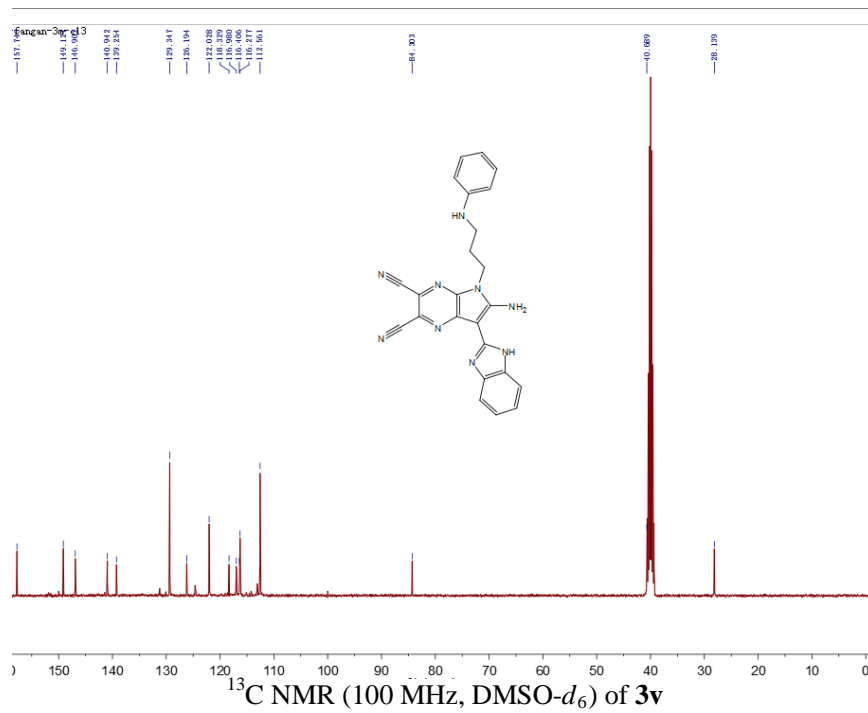
Event#: 2 MS(E-) Ret. Time : 1.660 -> 1.660 Scan#: 334 -> 334



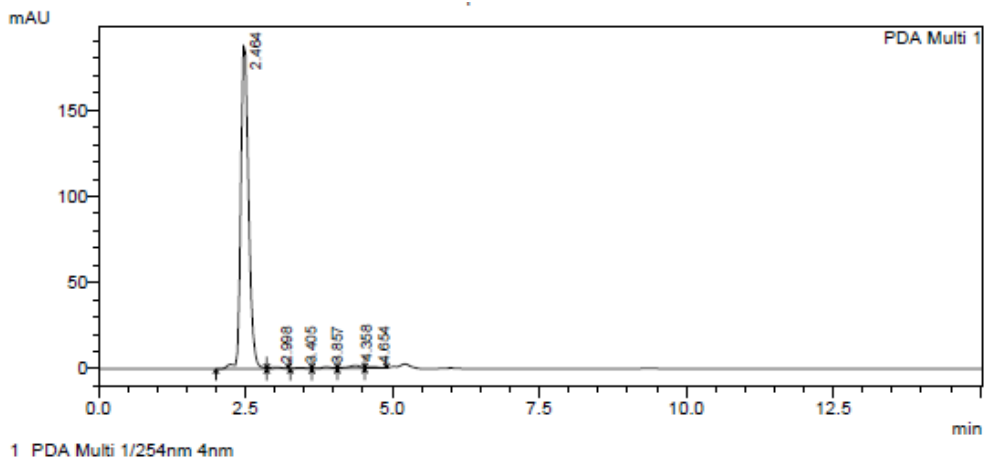
HRMS spectrum of **3u**



¹H NMR (400 MHz, CDCl₃) of **3v**



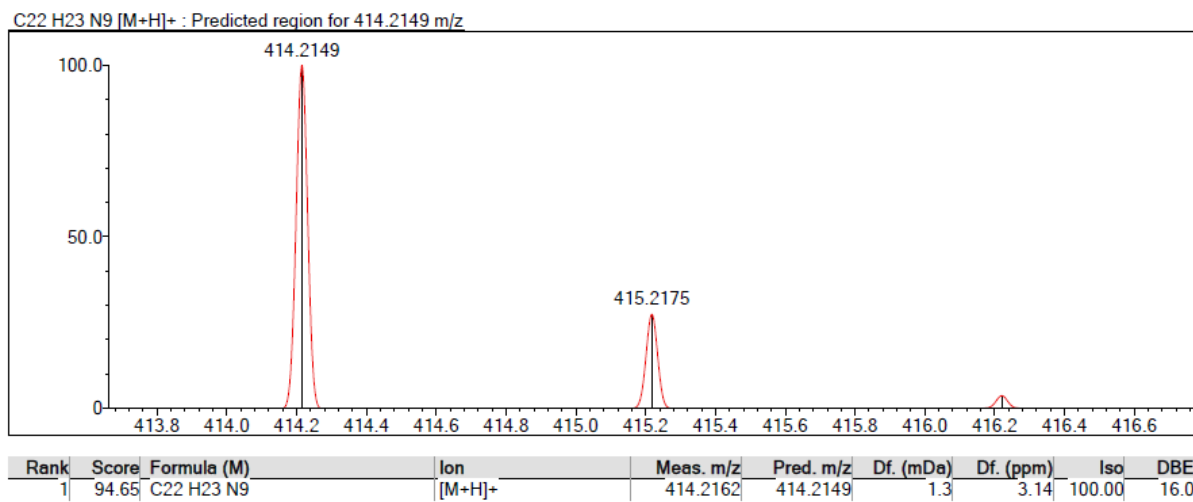
¹³C NMR (100 MHz, DMSO-*d*₆) of **3v**



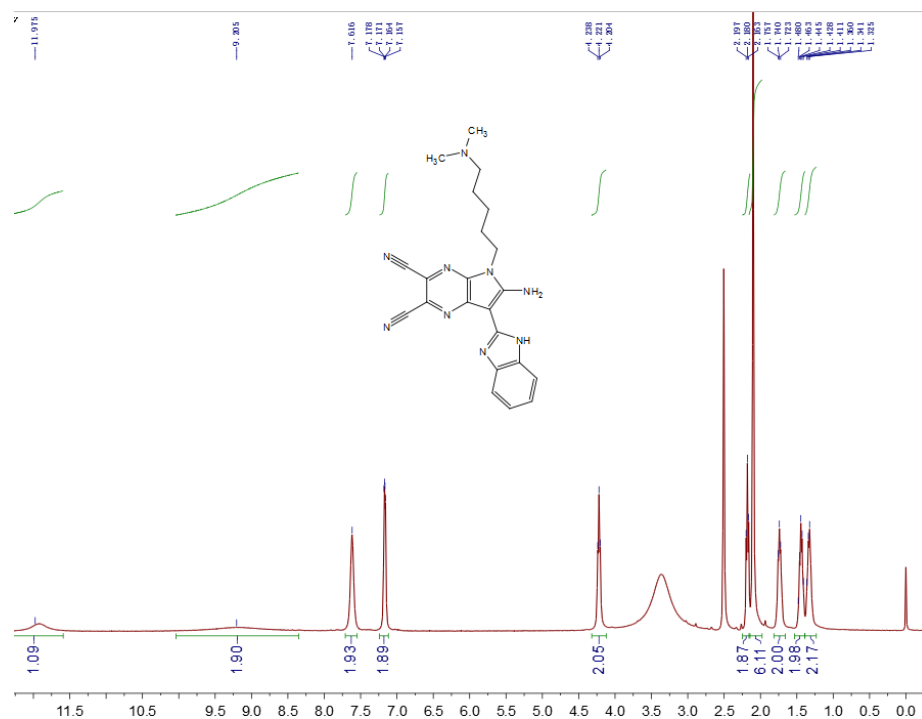
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.464	1734937	187589	97.007	97.694
2	2.998	9145	706	0.511	0.368
3	3.405	3902	392	0.218	0.204
4	3.857	8535	948	0.477	0.494
5	4.358	23072	1613	1.290	0.840
6	4.654	8876	768	0.496	0.400
Total		1788467	192016	100.000	100.000

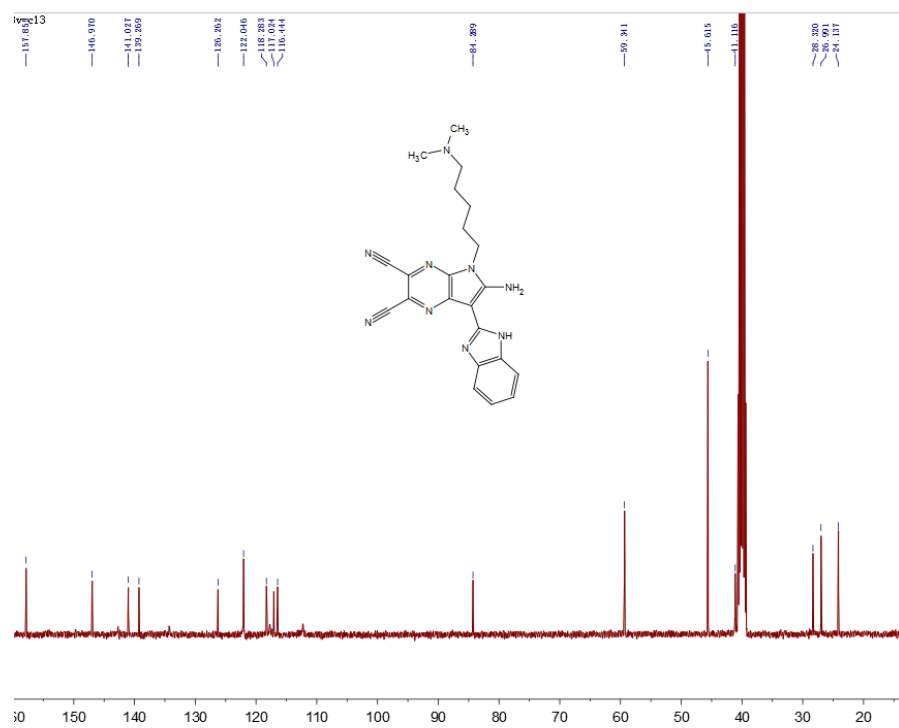
HPLC spectrum of **3v**



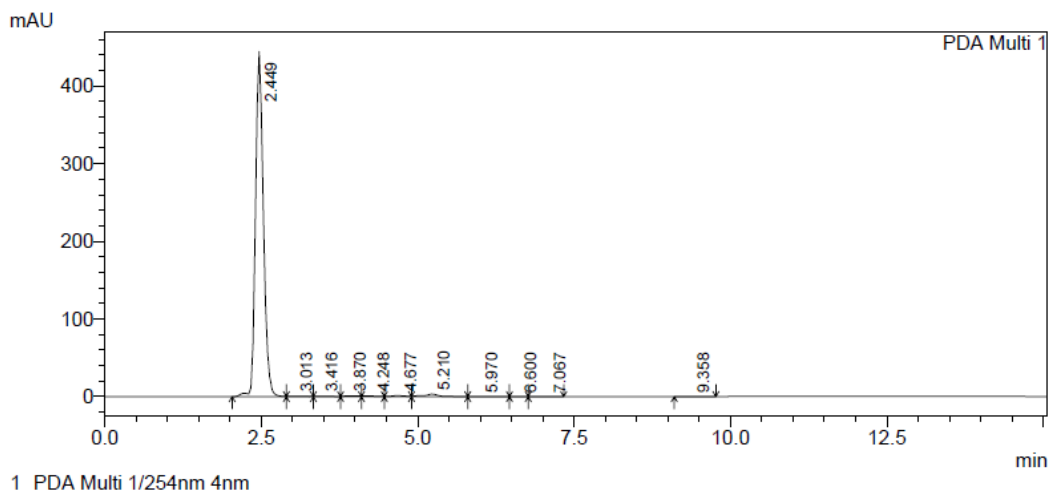
HRMS spectrum of **3v**



¹H NMR (400 MHz, CDCl₃) of **3w**



¹³C NMR (100 MHz, DMSO-*d*₆) of **3w**

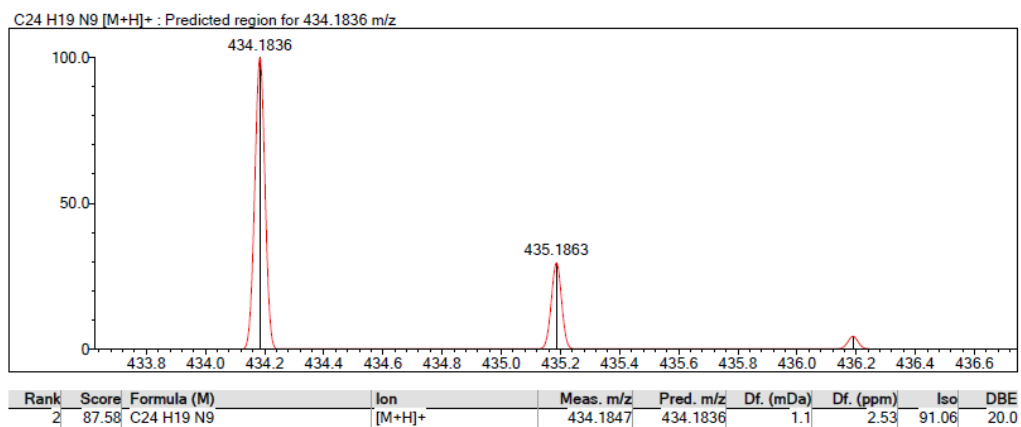


PeakTable

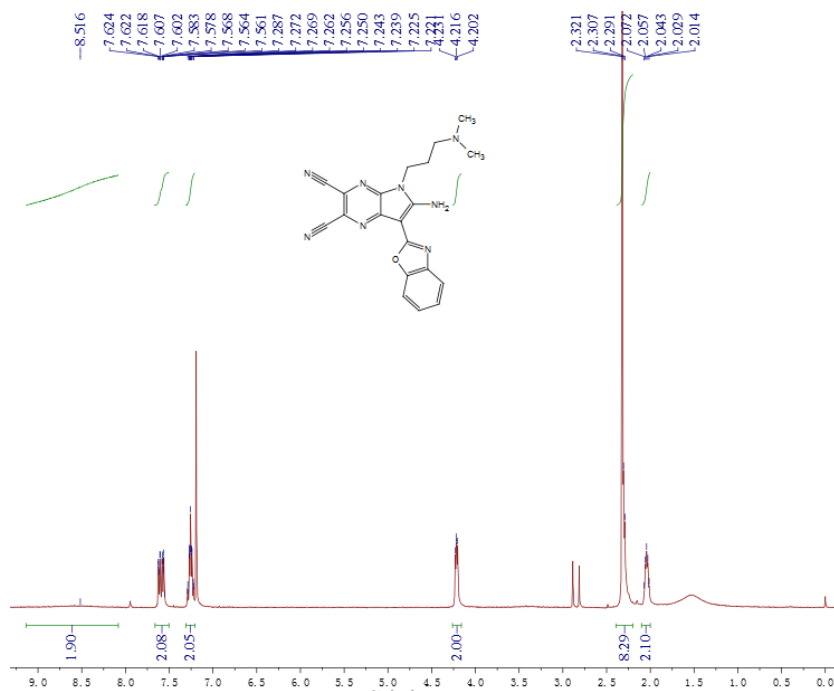
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.449	3892143	444597	96.900	98.236
2	3.013	11222	686	0.279	0.152
3	3.416	6412	401	0.160	0.089
4	3.870	13162	1085	0.328	0.240
5	4.248	12897	786	0.321	0.174
6	4.677	18664	1156	0.465	0.255
7	5.210	50522	3193	1.258	0.705
8	5.970	4559	234	0.113	0.052
9	6.600	1607	139	0.040	0.031
10	7.067	2102	88	0.052	0.019
11	9.358	3364	217	0.084	0.048
Total		4016654	452581	100.000	100.000

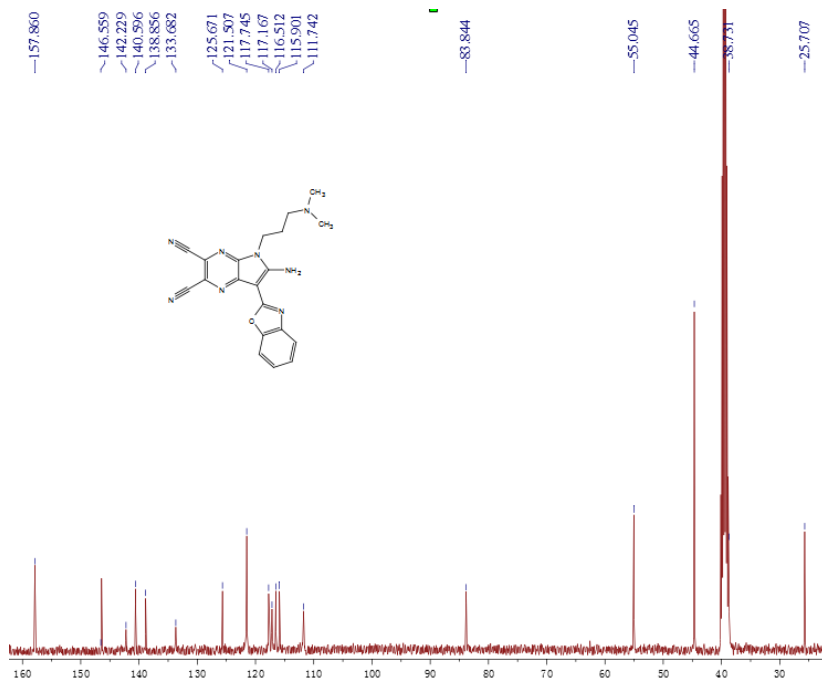
HPLC spectrum of **3w**



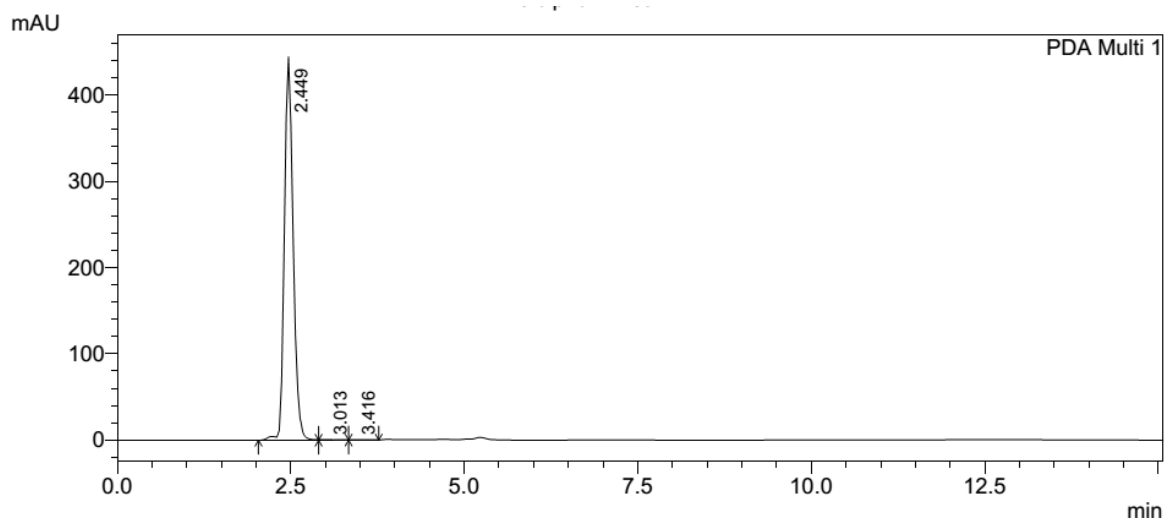
HRMS spectrum of **3w**



¹H NMR (400 MHz, CDCl₃) of **4m**



¹³C NMR (100 MHz, DMSO-*d*₆) of **4m**

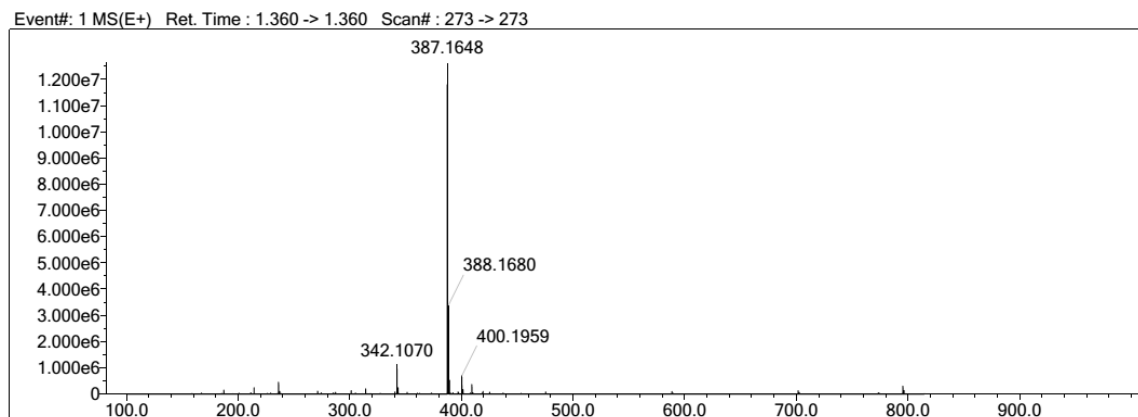


1 PDA Multi 1/254nm 4nm

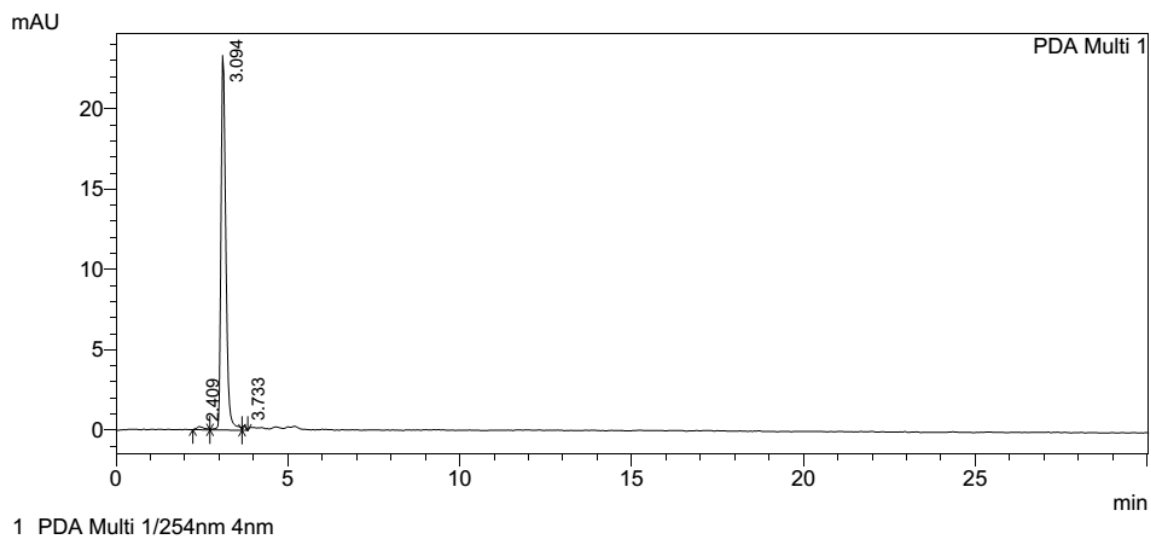
PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.449	3890856	444573	99.647	99.786
2	3.013	9613	630	0.246	0.141
3	3.416	4158	322	0.106	0.072
Total		3904627	445525	100.000	100.000

HPLC spectrum of **4m**



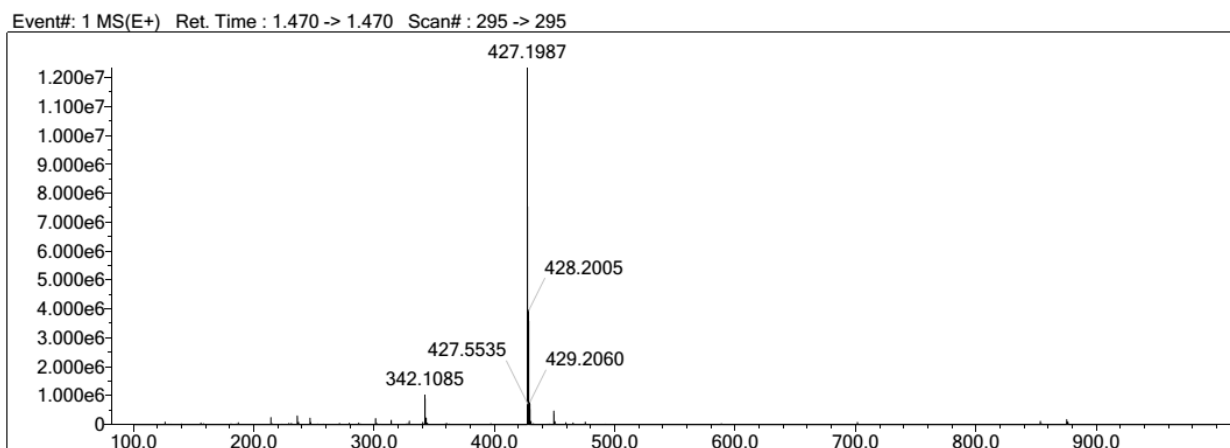
HRMS spectrum of **4m**



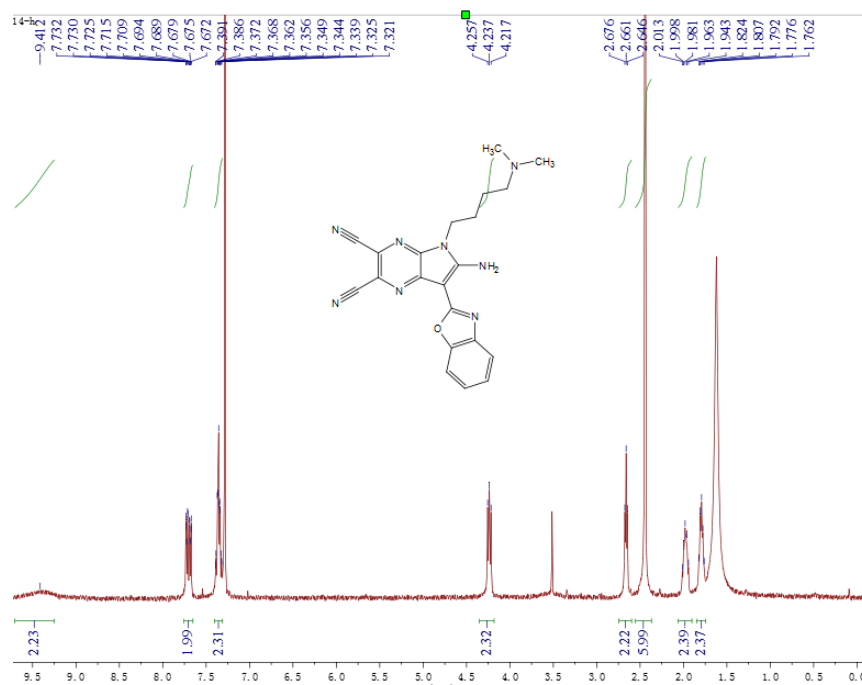
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.409	3074	207	1.309	0.868
2	3.094	230303	23333	98.083	98.004
3	3.733	1428	269	0.608	1.128
Total		234804	23808	100.000	100.000

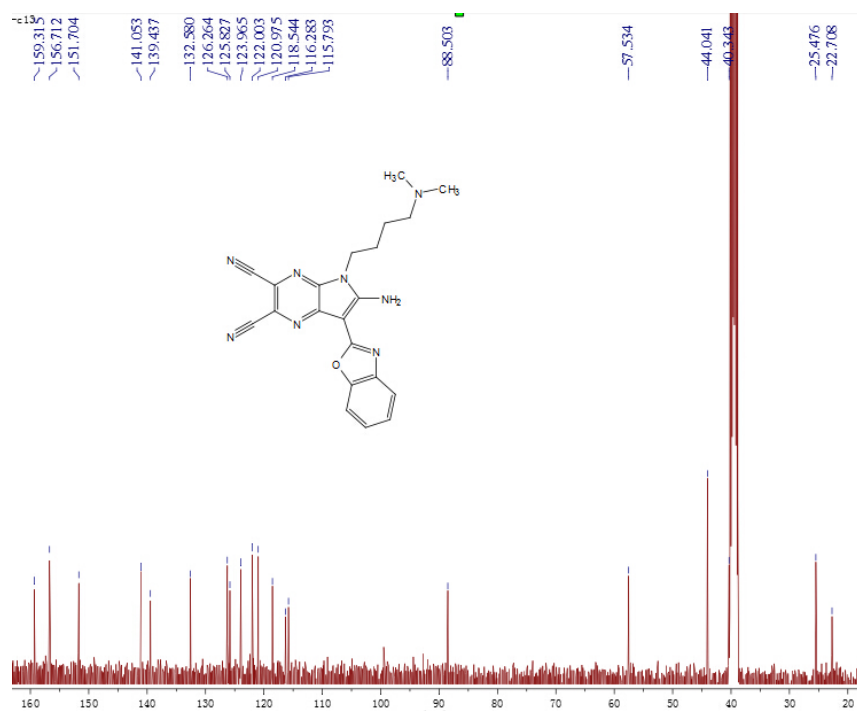
HPLC spectrum of **4s**



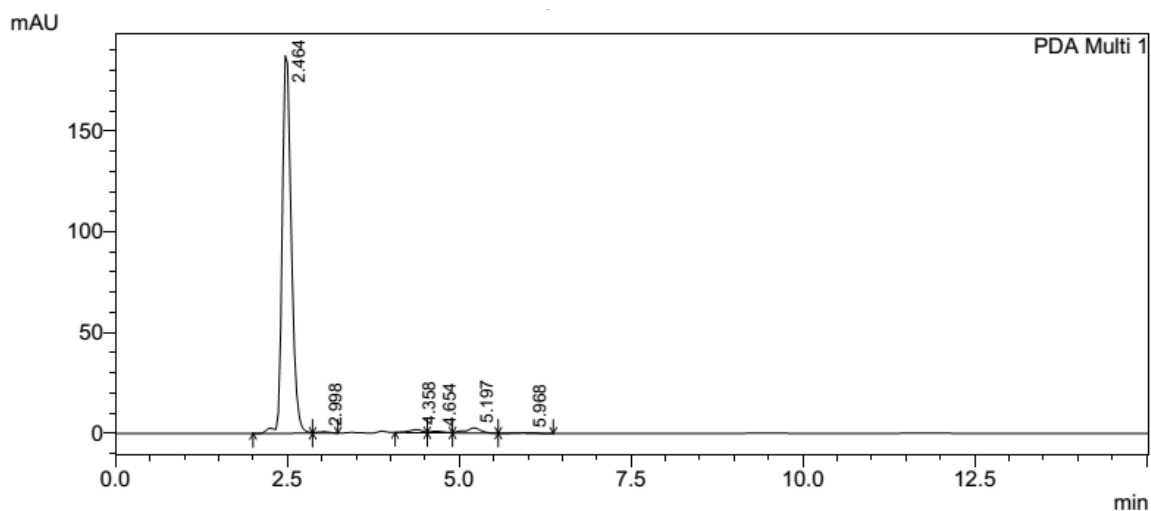
HRMS spectrum of **4s**



¹H NMR (400 MHz, CDCl₃) of **4t**



¹³C NMR (100 MHz, DMSO-*d*₆) of **4t**



1 PDA Multi 1/254nm 4nm

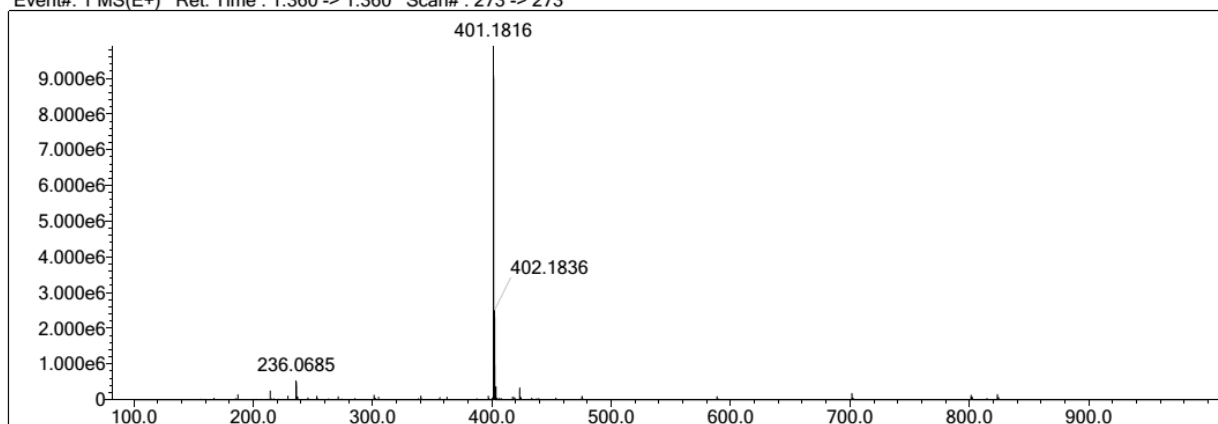
PeakTable

PDA Ch1 254nm 4nm

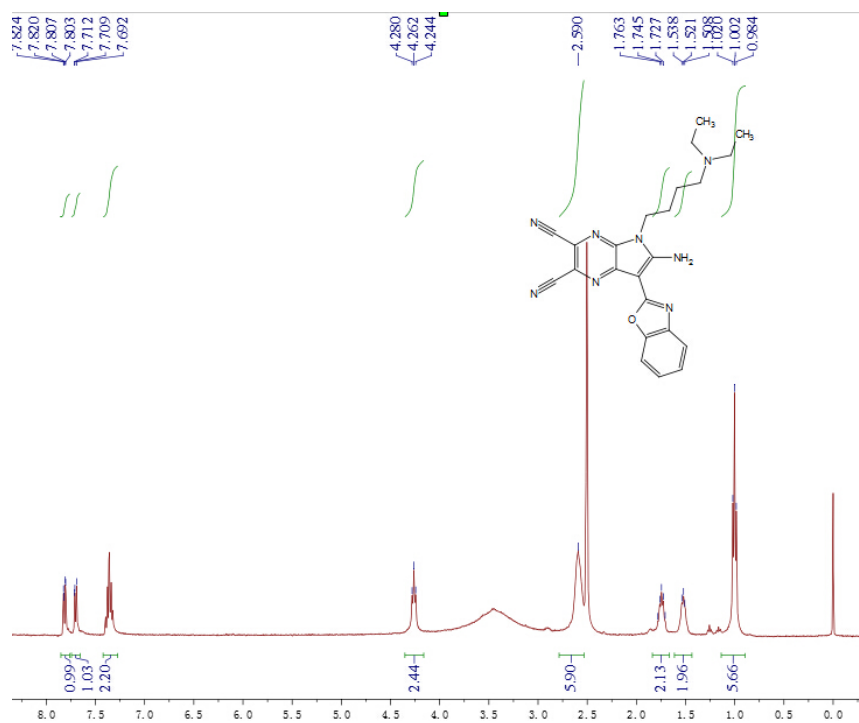
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.464	1734937	187589	95.334	96.871
2	2.998	9145	706	0.502	0.365
3	4.358	20626	1550	1.133	0.801
4	4.654	10929	834	0.601	0.431
5	5.197	38972	2581	2.142	1.333
6	5.968	5234	387	0.288	0.200
Total		1819842	193648	100.000	100.000

HPLC spectrum of **4t**

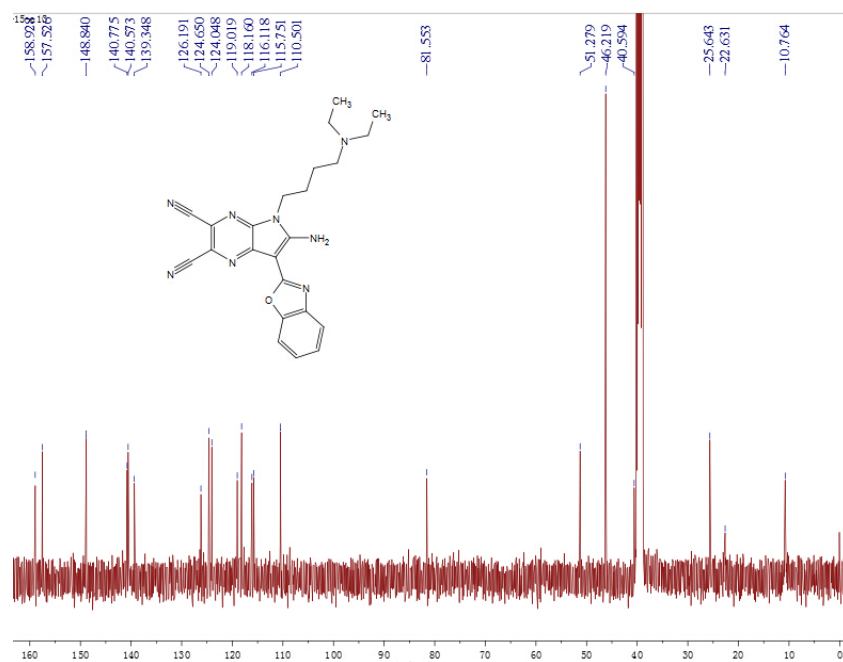
Event#: 1 MS(E+) Ret. Time : 1.360 -> 1.360 Scan#: 273 -> 273



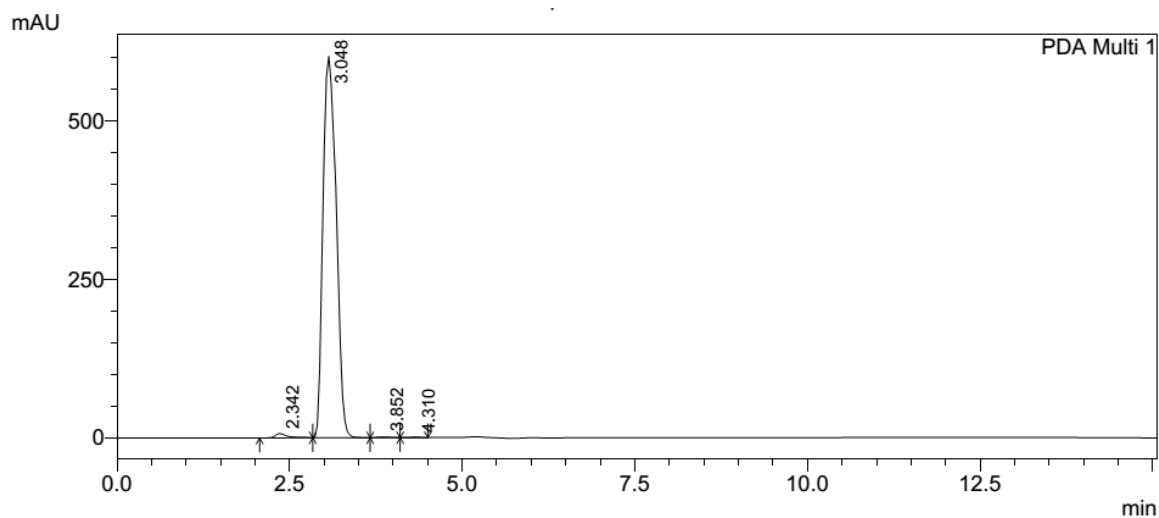
HRMS spectrum of **4t**



¹H NMR (400 MHz, DMSO-*d*₆) of **4u**



¹³C NMR (100 MHz, DMSO-*d*₆) of **4u**



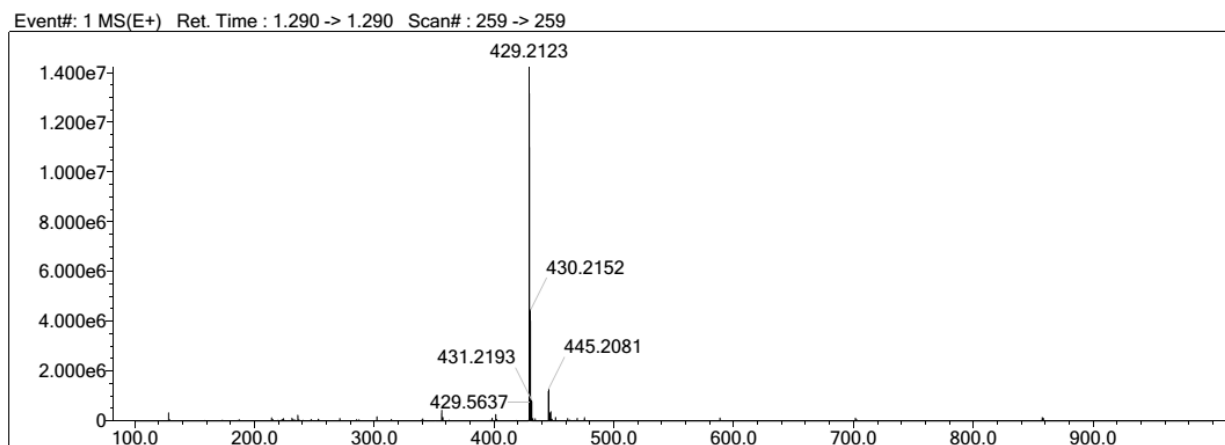
1 PDA Multi 1/254nm 4nm

PeakTable

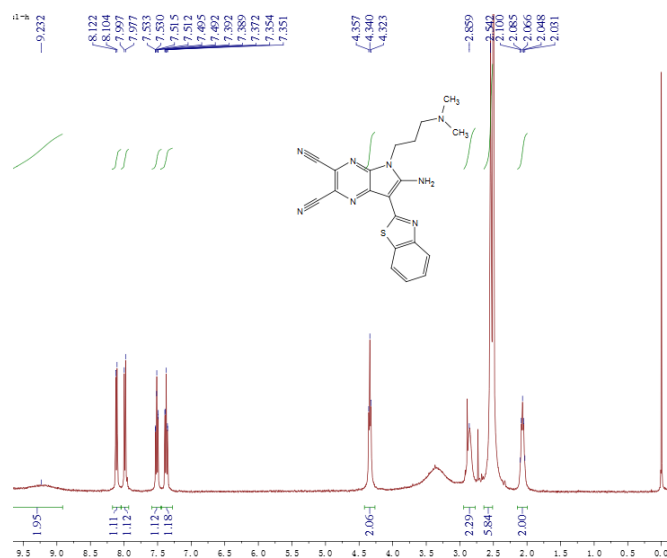
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.342	84960	6950	1.045	1.136
2	3.048	8018747	602527	98.603	98.452
3	3.852	16423	1472	0.202	0.241
4	4.310	12259	1055	0.151	0.172
Total		8132389	612004	100.000	100.000

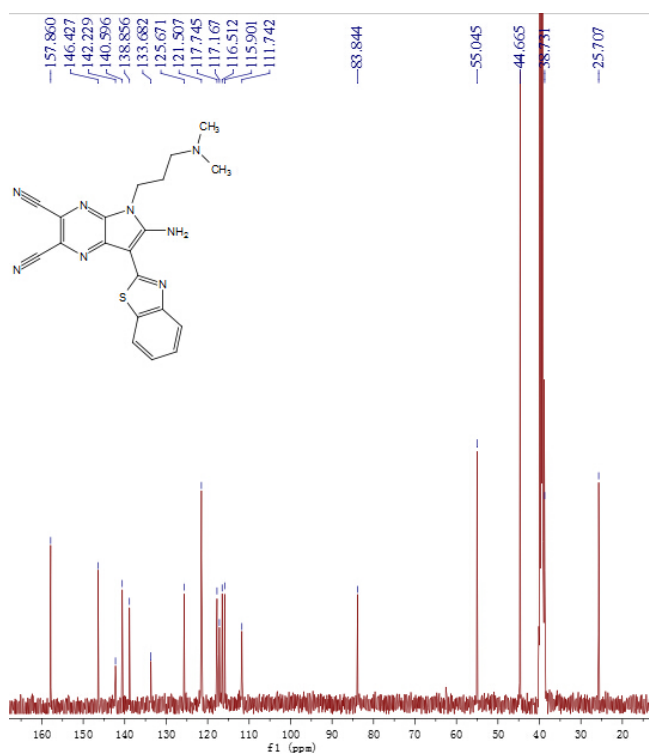
^1H NMR (400 MHz, $\text{DMSO}-d_6$) of **4u**



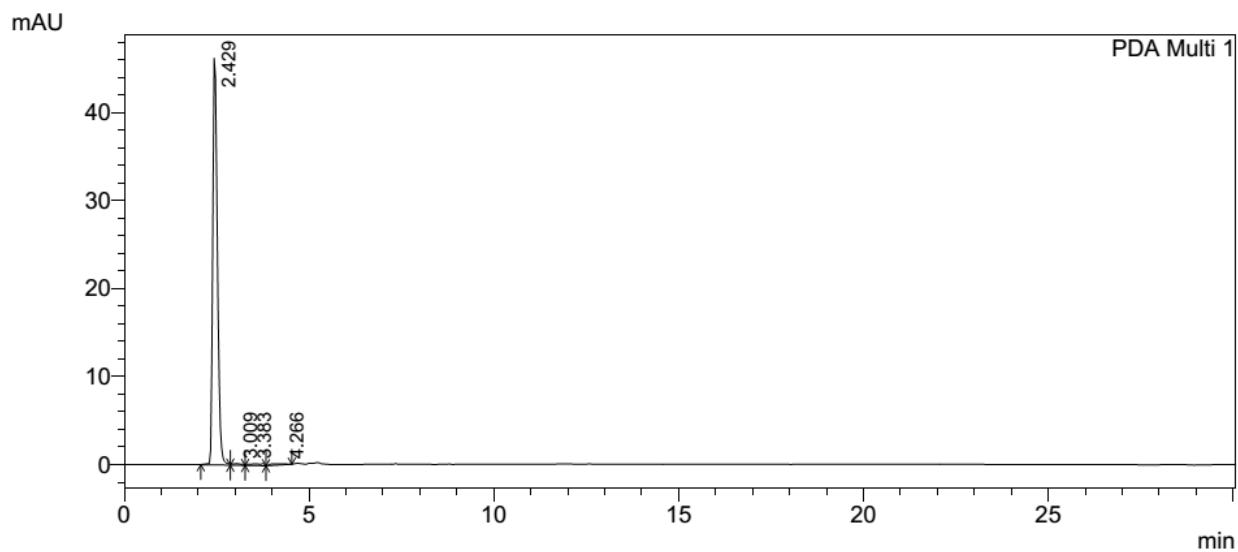
HRMS spectrum of **4u**



¹H NMR (400 MHz, DMSO-*d*₆) of **5m**



¹³C NMR (100 MHz, DMSO-*d*₆) of **5m**



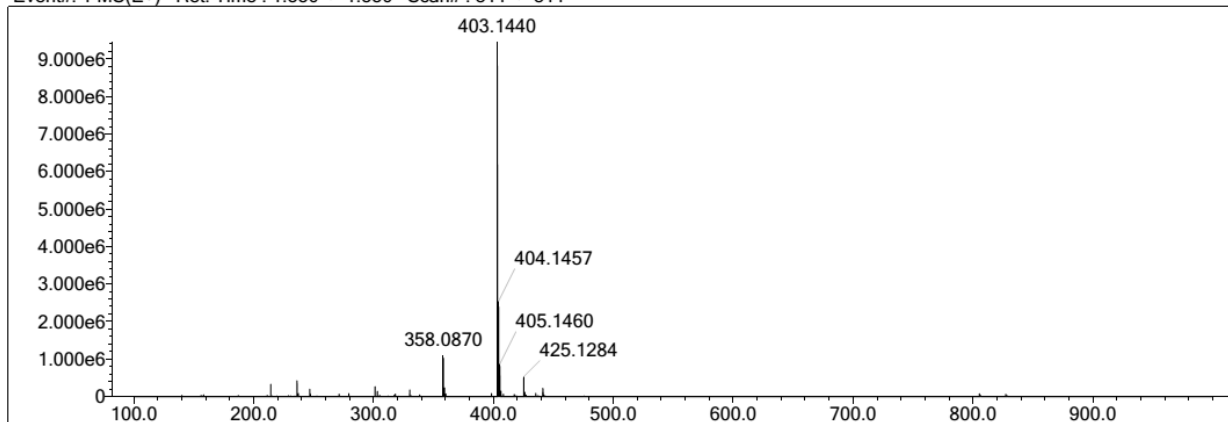
PDA Ch1 254nm 4nm

PeakTable

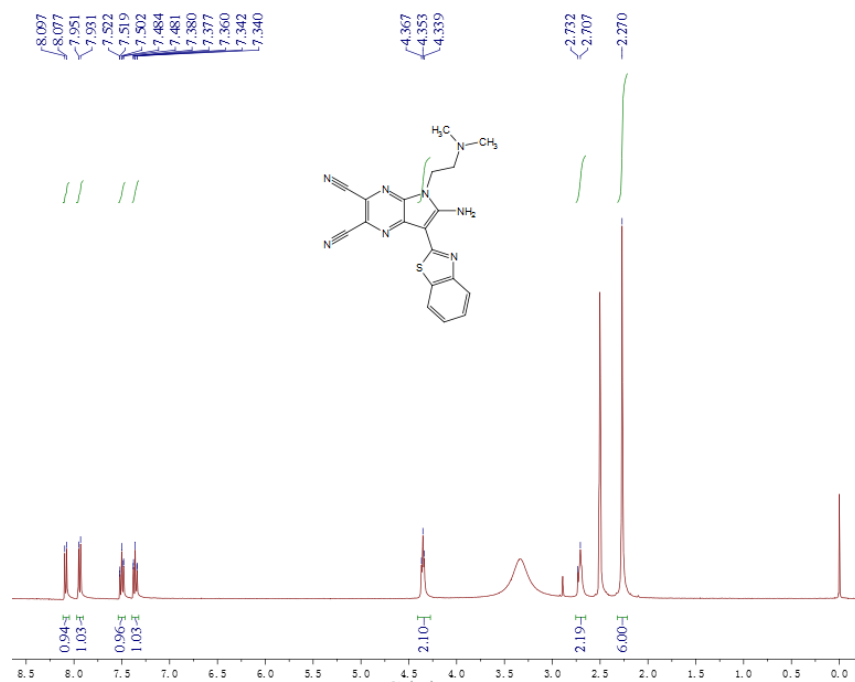
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.429	408159	46214	96.806	98.926
2	3.009	3630	193	0.861	0.413
3	3.383	5533	184	1.312	0.394
4	4.266	4304	125	1.021	0.267
Total		421625	46716	100.000	100.000

HPLC spectrum of **5m**

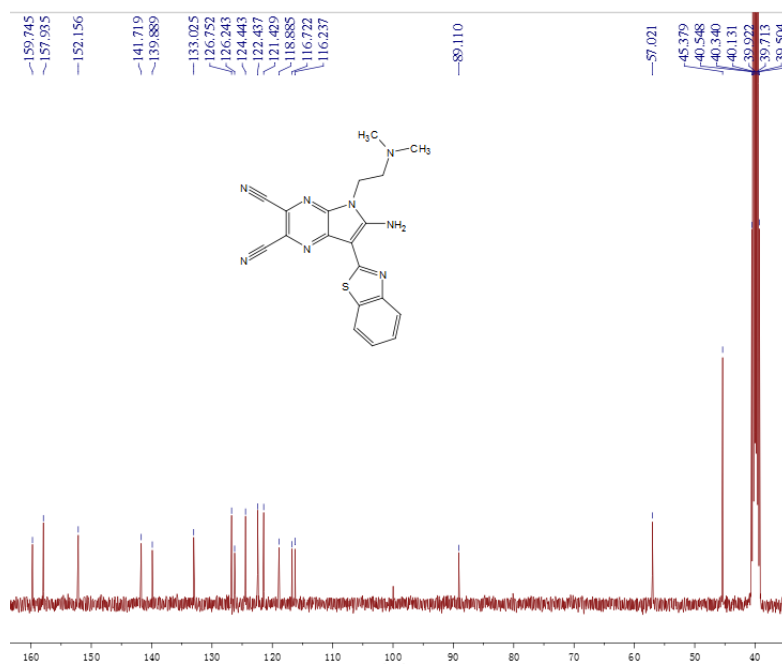
Event#: 1 MS(E+) Ret. Time : 1.550 -> 1.550 Scan#: 311 -> 311



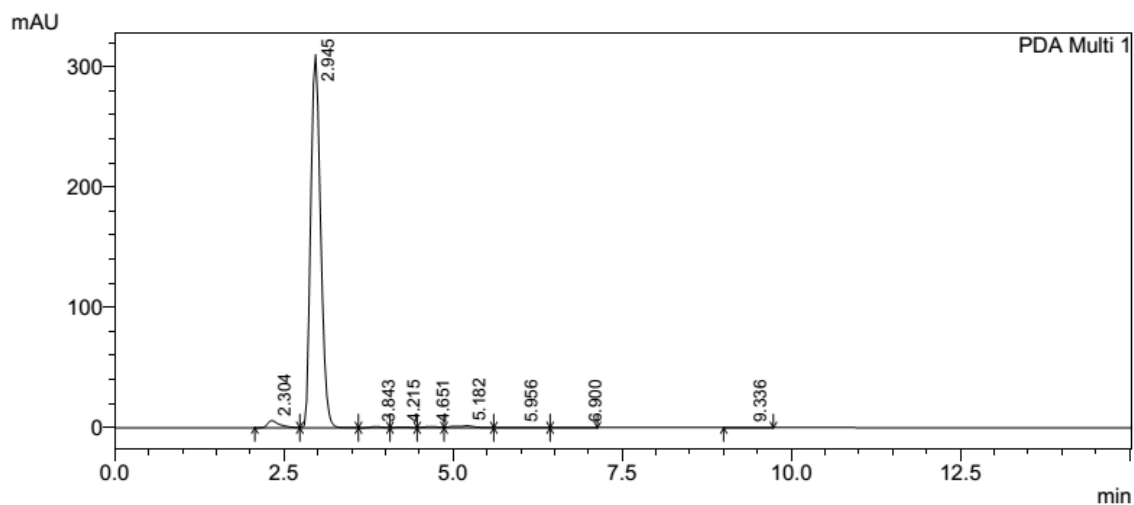
HRMS spectrum of **5m**



¹H NMR (400 MHz, DMSO-*d*₆) of **5c**



¹³C NMR (100 MHz, DMSO-*d*₆) of **5c**

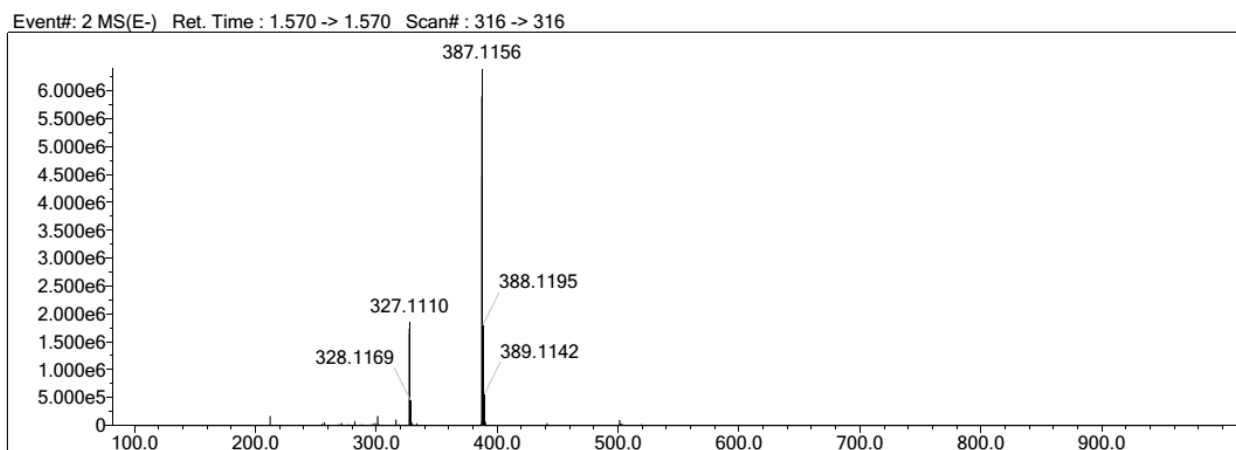


PeakTable

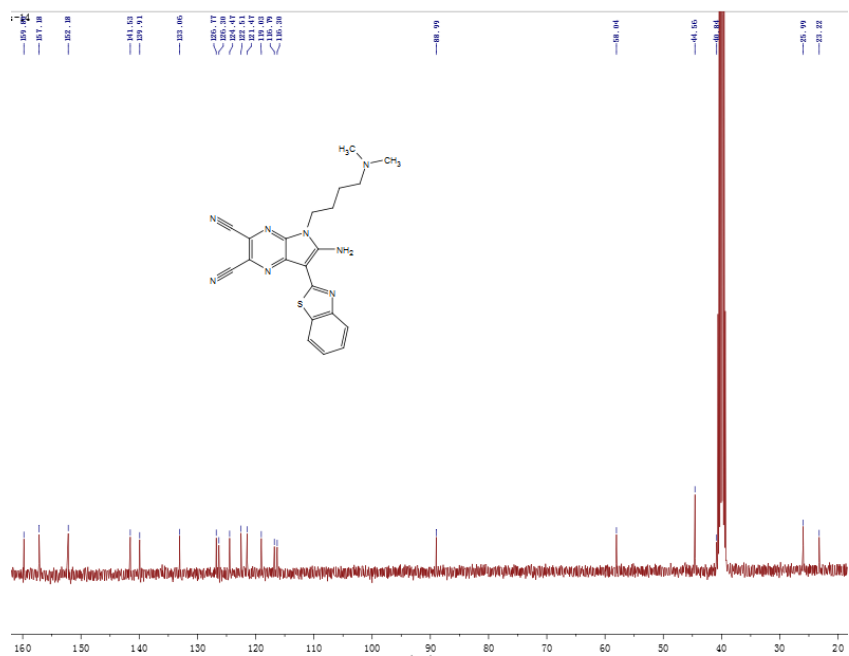
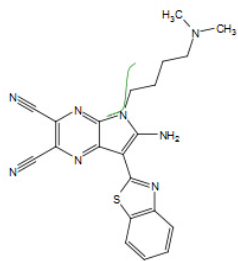
PDA Ch1 254nm 4nm

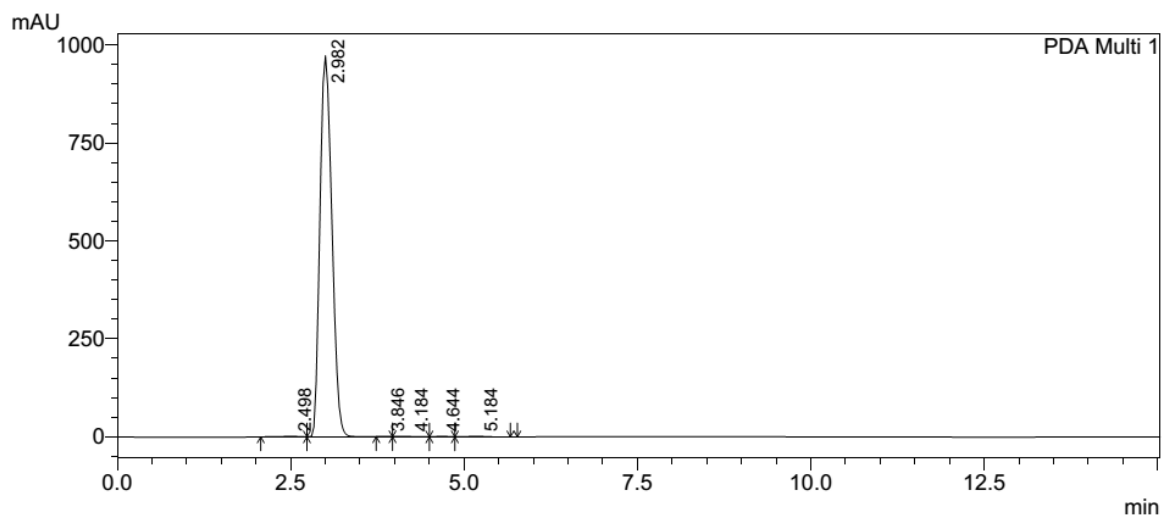
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.304	73831	5963	2.226	1.857
2	2.945	3164434	310263	95.387	96.639
3	3.843	12101	1093	0.365	0.340
4	4.215	8685	512	0.262	0.159
5	4.651	14401	950	0.434	0.296
6	5.182	32280	1661	0.973	0.517
7	5.956	4226	218	0.127	0.068
8	6.900	1836	62	0.055	0.019
9	9.336	5685	331	0.171	0.103
Total		3317480	321054	100.000	100.000

HPLC spectrum of **5c**



HRMS spectrum of **5c**



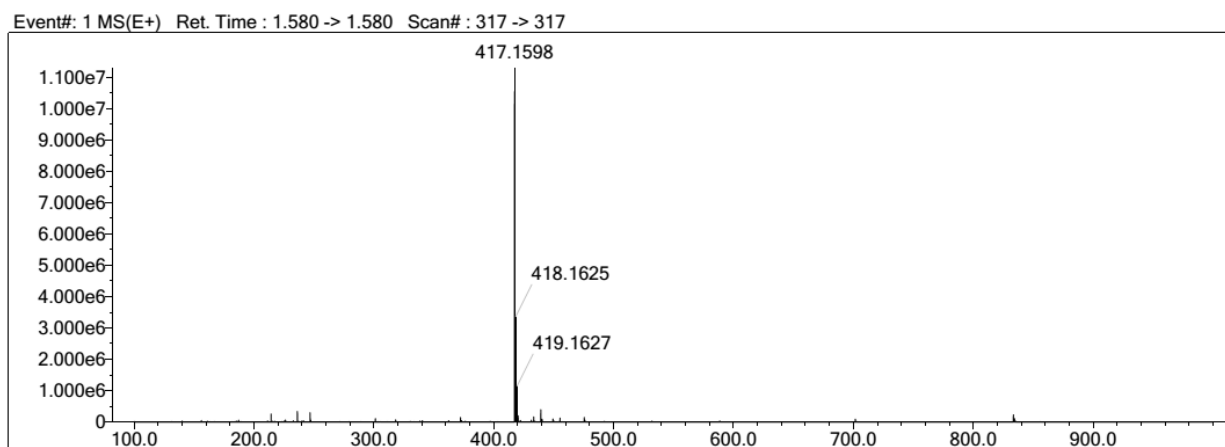


PeakTable

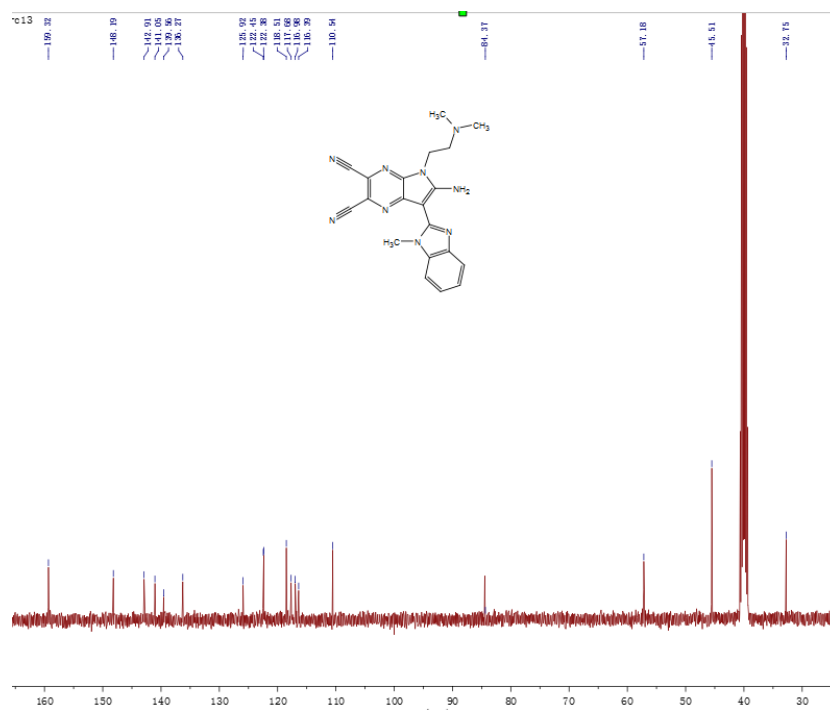
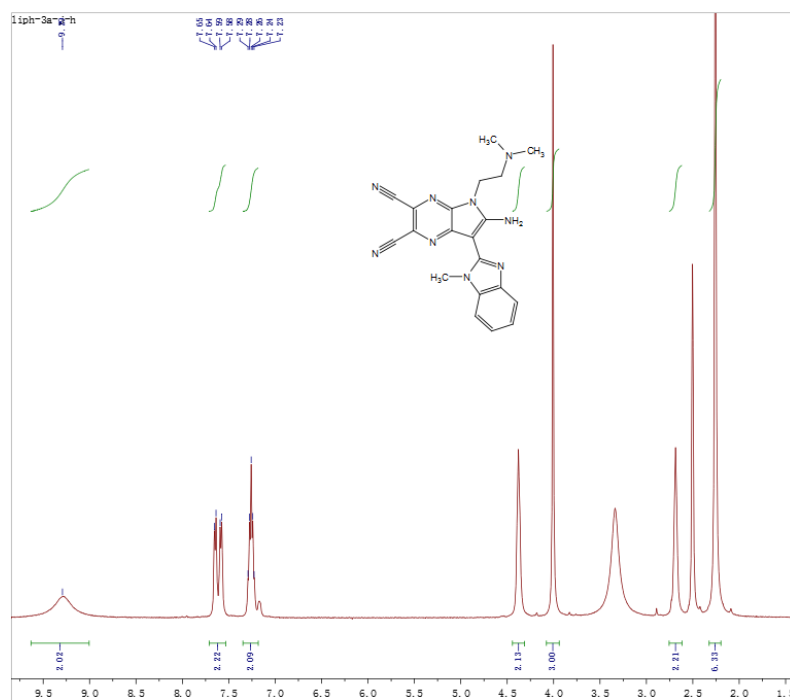
PDA Ch1 254nm 4nm

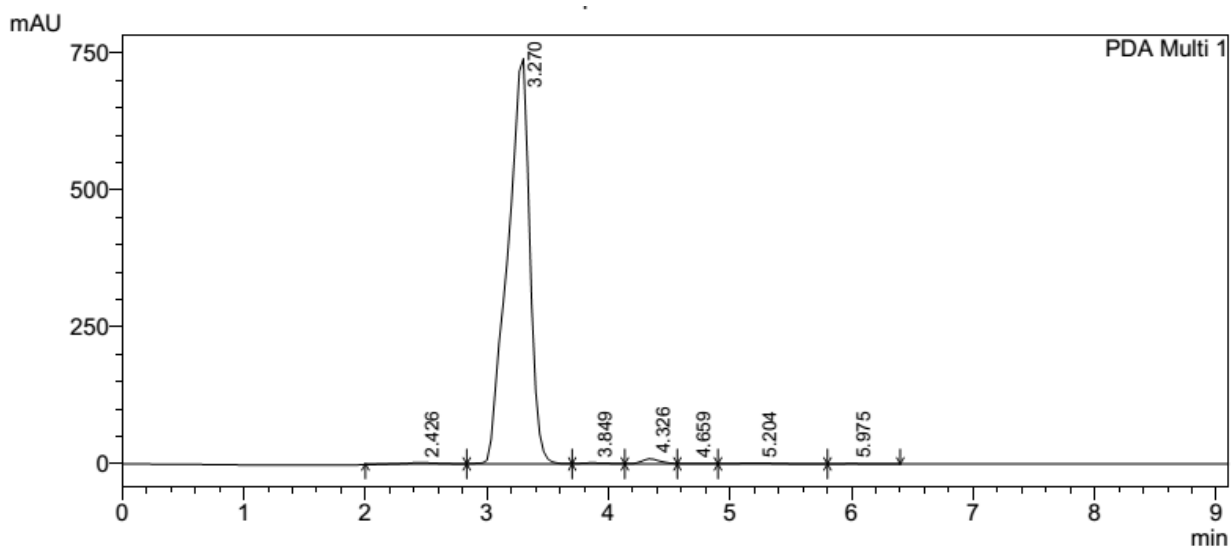
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.498	29389	1521	0.248	0.155
2	2.982	11737626	973178	99.162	99.408
3	3.846	9695	1053	0.082	0.108
4	4.184	19081	733	0.161	0.075
5	4.644	12833	926	0.108	0.095
6	5.184	28148	1558	0.238	0.159
Total		11836772	978969	100.000	100.000

HPLC spectrum of **5t**



HRMS spectrum of **5t**





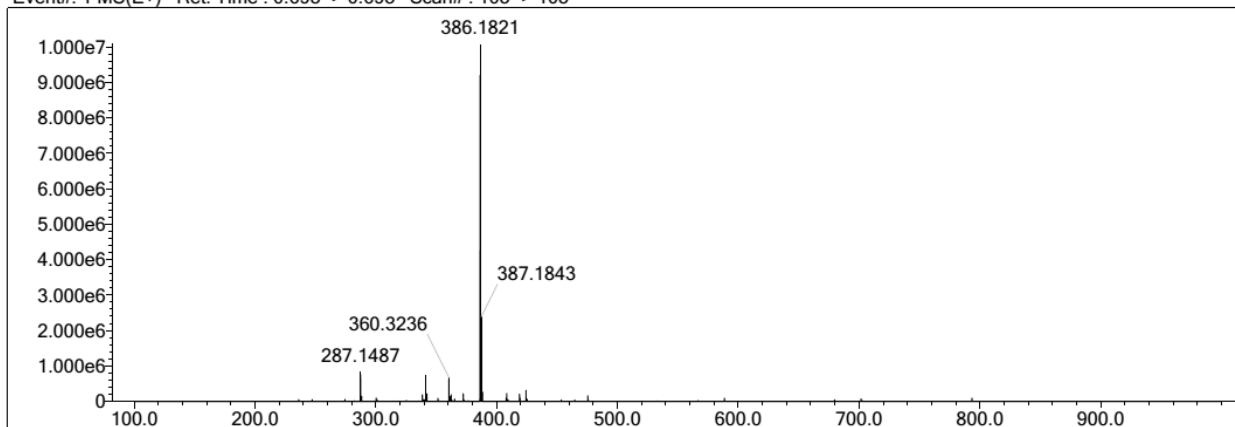
PeakTable

PDA Ch1 254nm 4nm

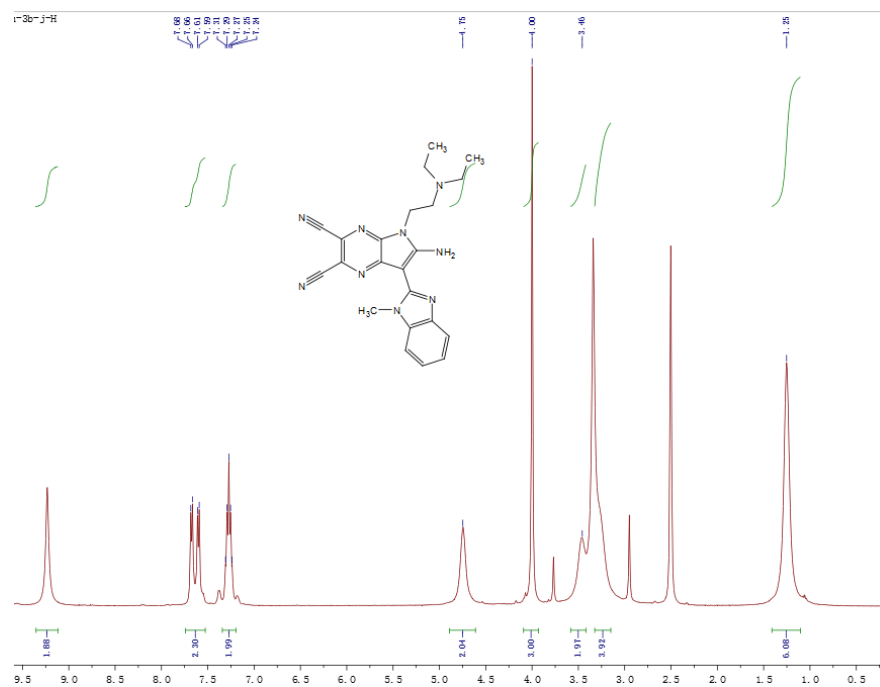
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.426	41024	2562	0.429	0.338
2	3.270	9328333	740436	97.556	97.702
3	3.849	33990	2352	0.355	0.310
4	4.326	101766	9085	1.064	1.199
5	4.659	15929	1131	0.167	0.149
6	5.204	33863	1748	0.354	0.231
7	5.975	7119	539	0.074	0.071
Total		9562024	757853	100.000	100.000

HPLC spectrum of **6c**

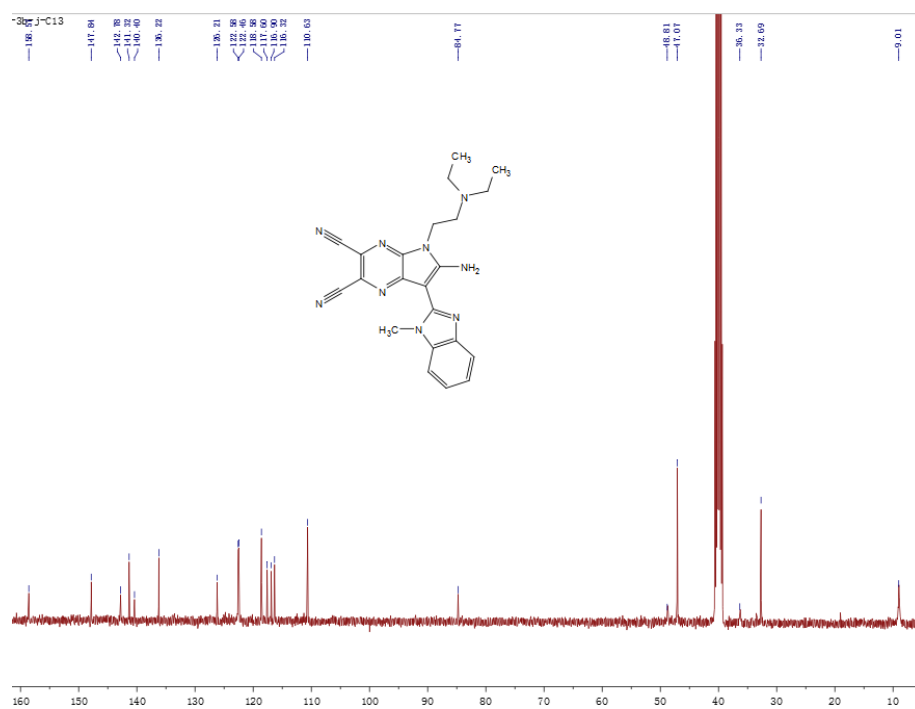
Event#: 1 MS(E+) Ret. Time : 0.693 -> 0.693 Scan#: 105 -> 105



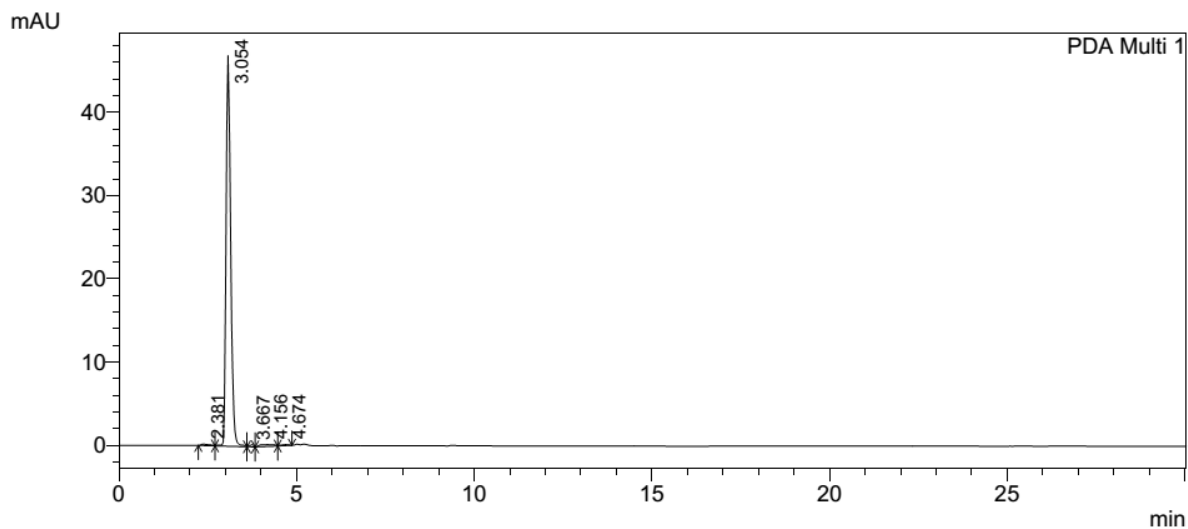
HRMS spectrum of **6c**



¹H NMR (400 MHz, DMSO-*d*₆) of **6d**



¹³C NMR (100 MHz, DMSO-*d*₆) of **6d**



1 PDA Multi 1/254nm 4nm

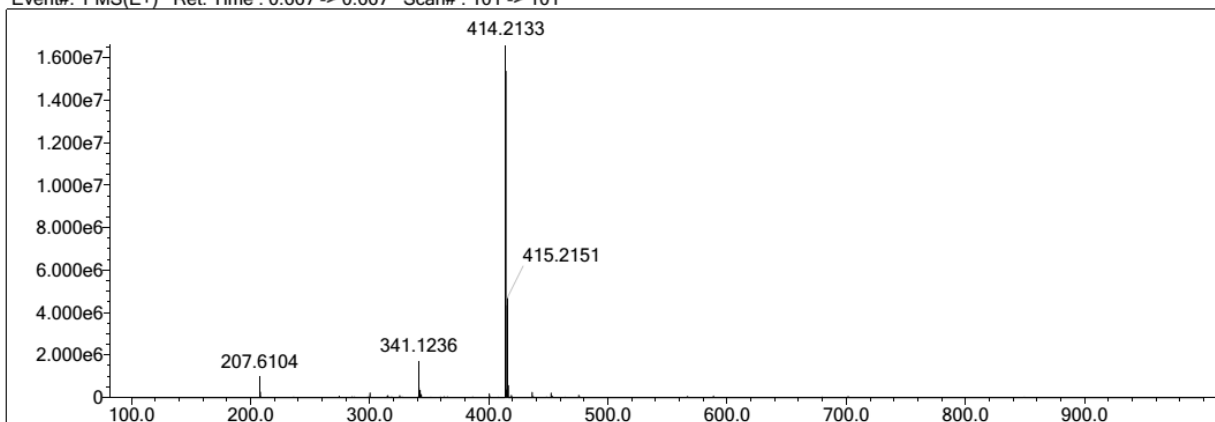
PeakTable

PDA Ch1 254nm 4nm

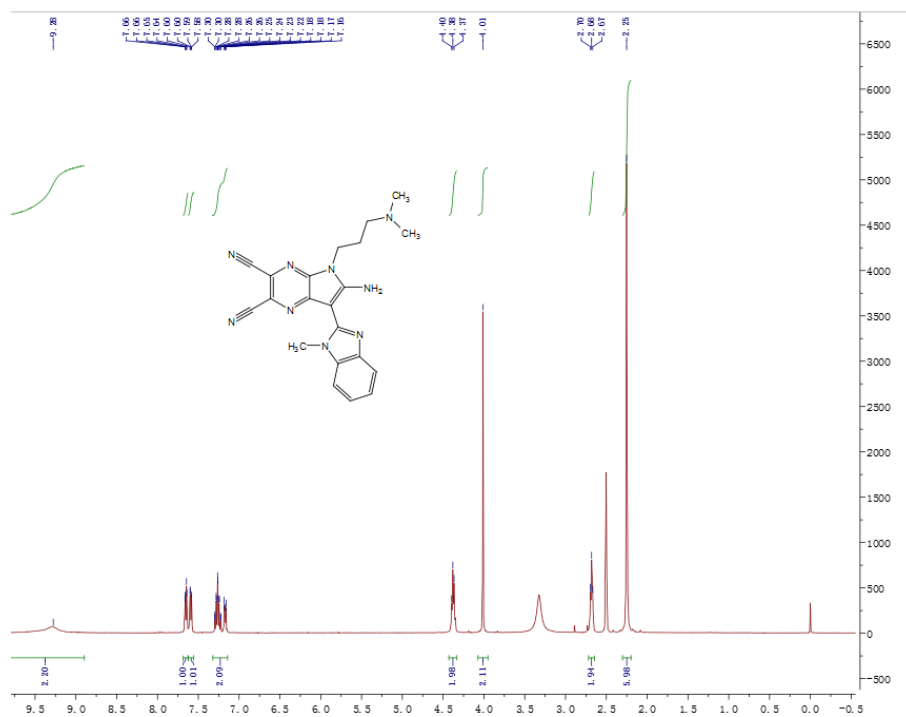
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.381	3094	168	0.702	0.353
2	3.054	426908	46944	96.880	98.508
3	3.667	2292	186	0.520	0.391
4	4.156	6389	226	1.450	0.473
5	4.674	1973	131	0.448	0.275
Total		440657	47655	100.000	100.000

HPLC spectrum of **6d**

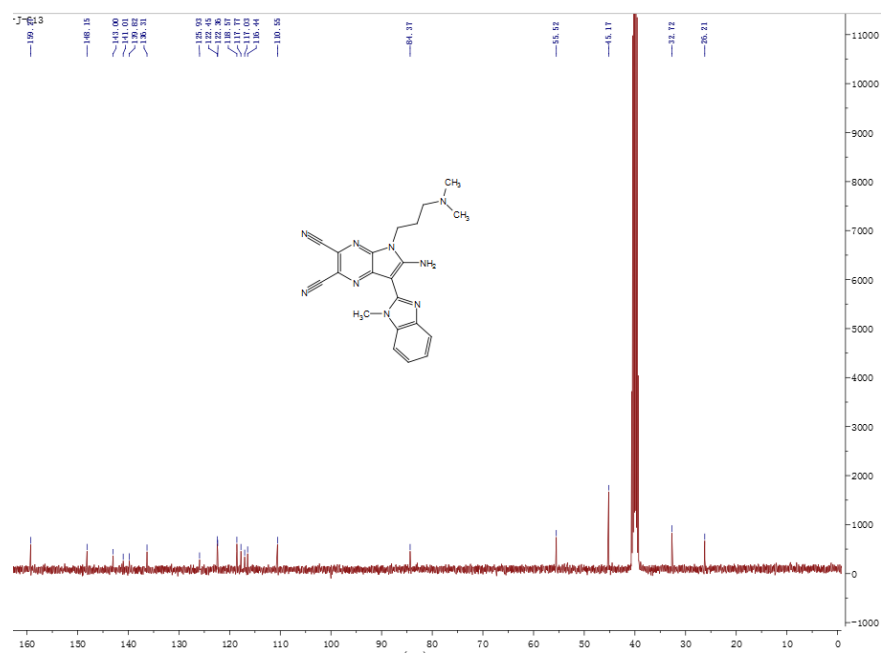
Event#: 1 MS(E+) Ret. Time : 0.667 -> 0.667 Scan# : 101 -> 101



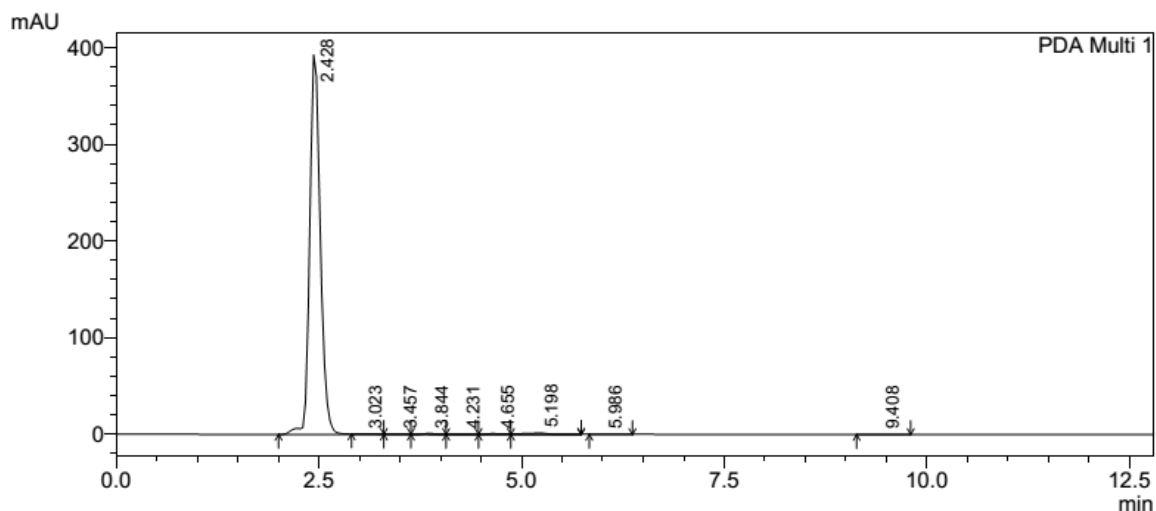
HRMS spectrum of **6d**



¹H NMR (400 MHz, DMSO-*d*₆) of **6m**



¹³C NMR (100 MHz, DMSO-*d*₆) of **6m**

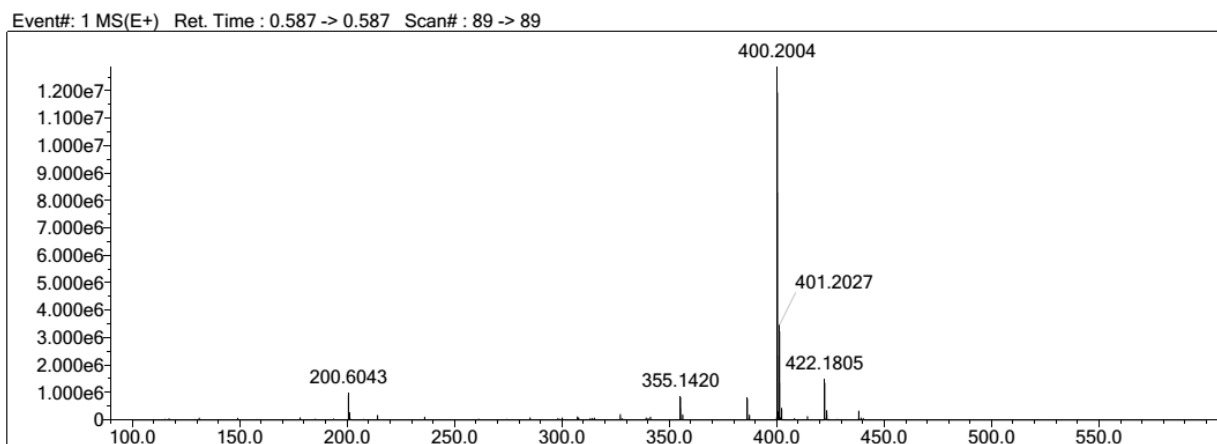


1 PDA Multi 1/254nm 4nm

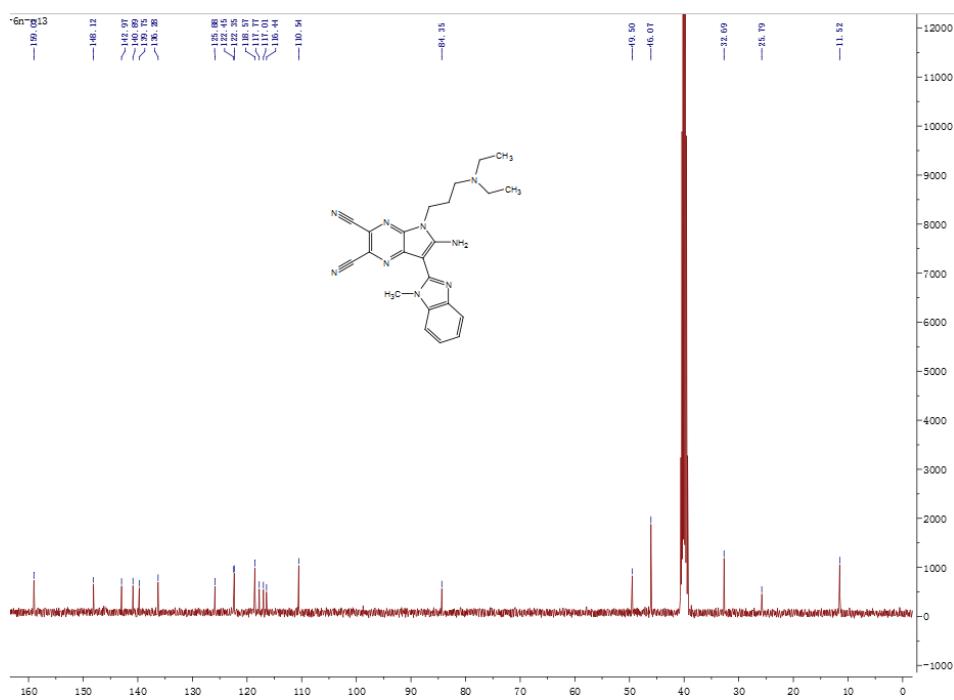
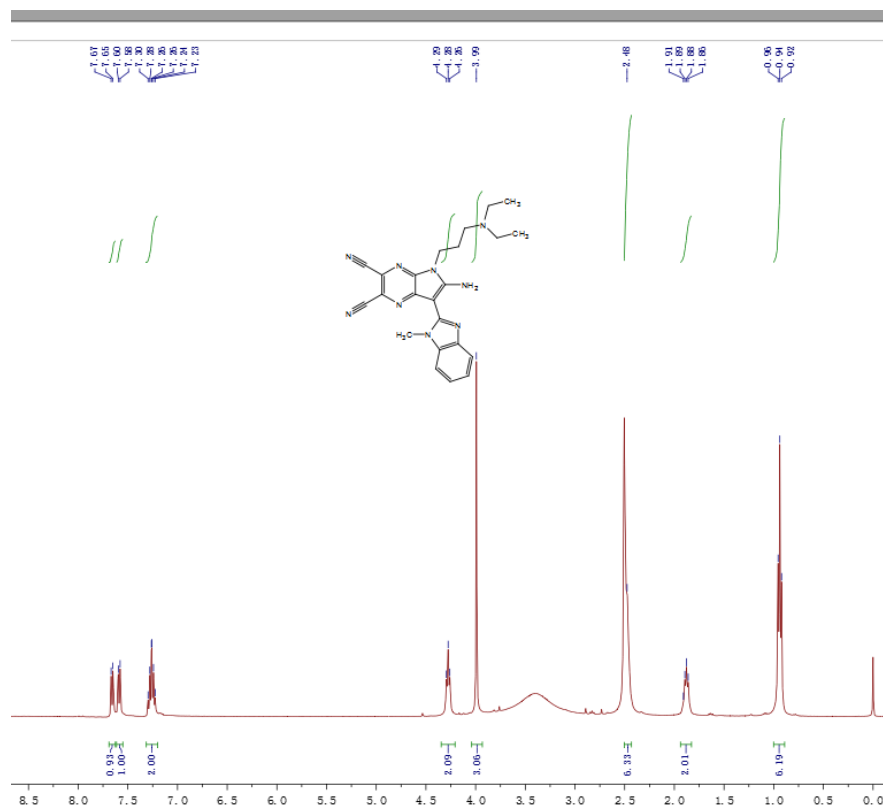
PeakTable

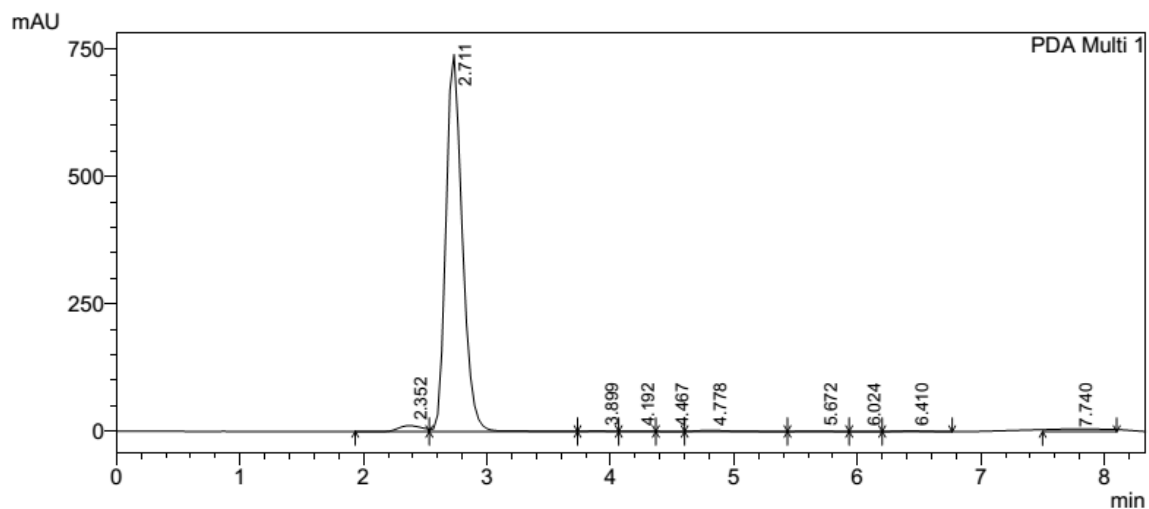
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.428	3588432	393141	98.049	98.765
2	3.023	4612	273	0.126	0.068
3	3.457	1937	175	0.053	0.044
4	3.844	9251	1141	0.253	0.287
5	4.231	6626	414	0.181	0.104
6	4.655	13461	903	0.368	0.227
7	5.198	28810	1521	0.787	0.382
8	5.986	3554	287	0.097	0.072
9	9.408	3151	204	0.086	0.051
Total		3659834	398058	100.000	100.000

HPLC spectrum of **6m**



HRMS spectrum of **6m**





1 PDA Multi 1/254nm 4nm

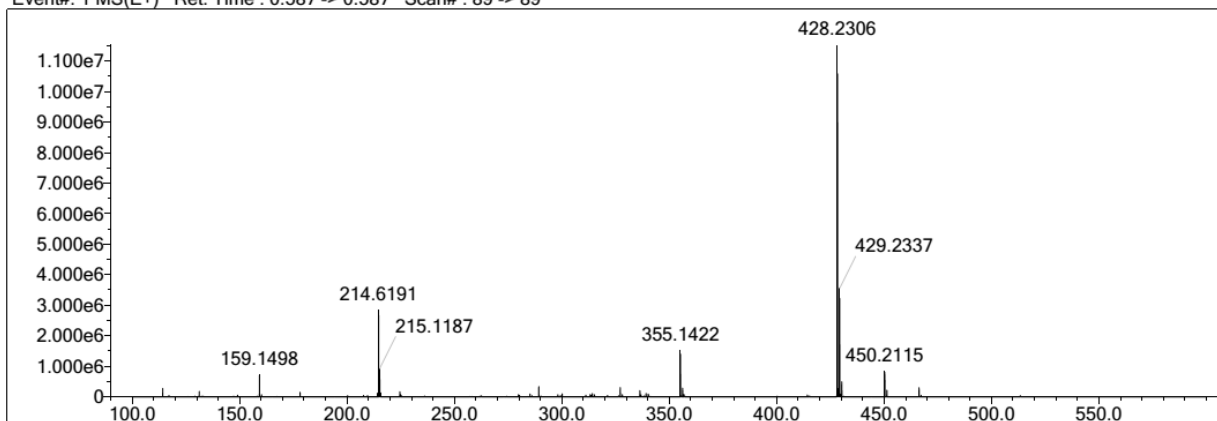
PeakTable

PDA Ch1 254nm 4nm

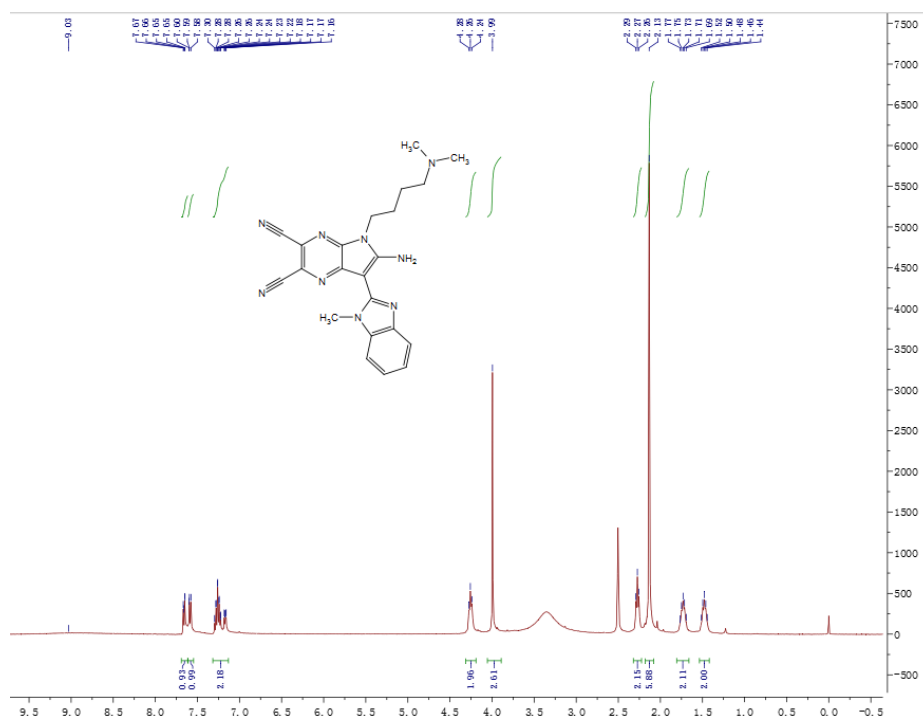
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.352	153924	11518	2.172	1.518
2	2.711	6838316	740524	96.490	97.592
3	3.899	15755	1416	0.222	0.187
4	4.192	4827	362	0.068	0.048
5	4.467	3319	295	0.047	0.039
6	4.778	40815	2411	0.576	0.318
7	5.672	9379	708	0.132	0.093
8	6.024	1571	152	0.022	0.020
9	6.410	17720	1332	0.250	0.176
10	7.740	1424	80	0.020	0.011
Total		7087052	758798	100.000	100.000

HPLC spectrum of **6n**

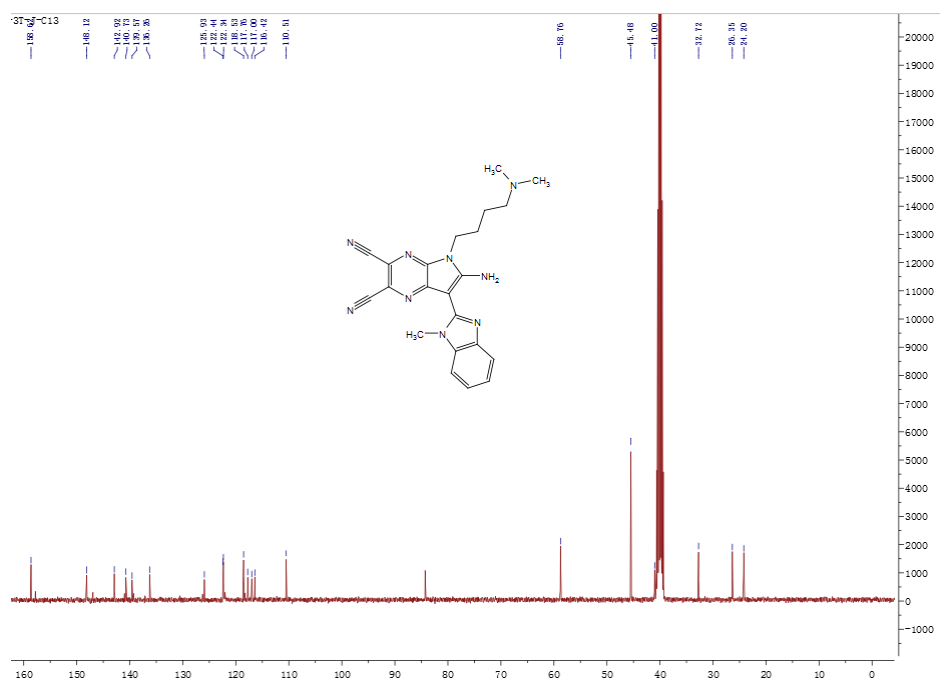
Event#: 1 MS(E+) Ret. Time : 0.587 -> 0.587 Scan#: 89 -> 89



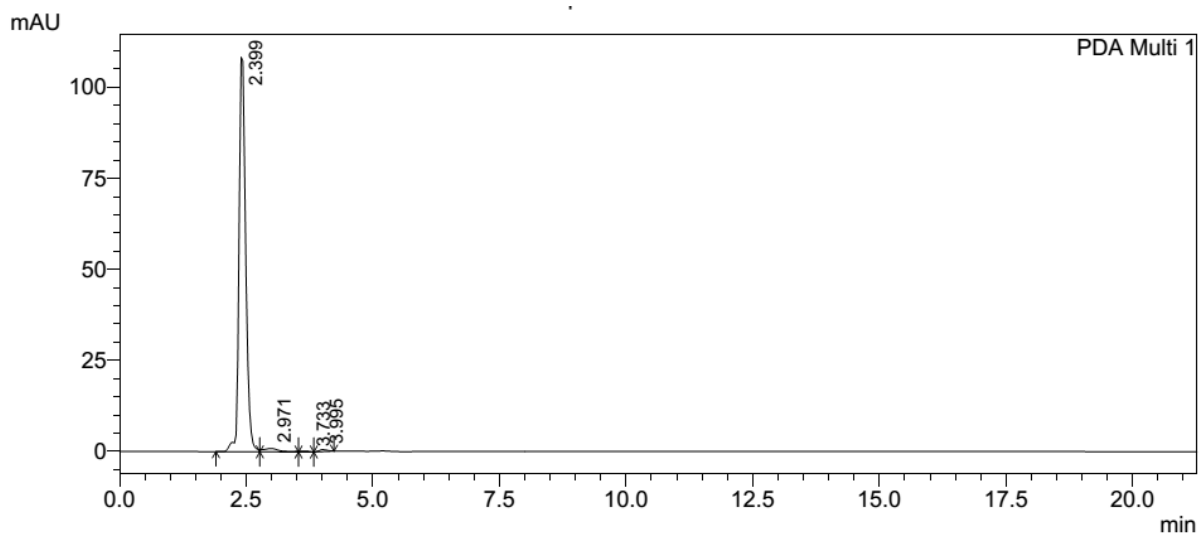
HRMS spectrum of **6n**



¹H NMR (400 MHz, DMSO-*d*₆) of **6t**



¹³C NMR (100 MHz, DMSO-*d*₆) of **6t**



1 PDA Multi 1/254nm 4nm

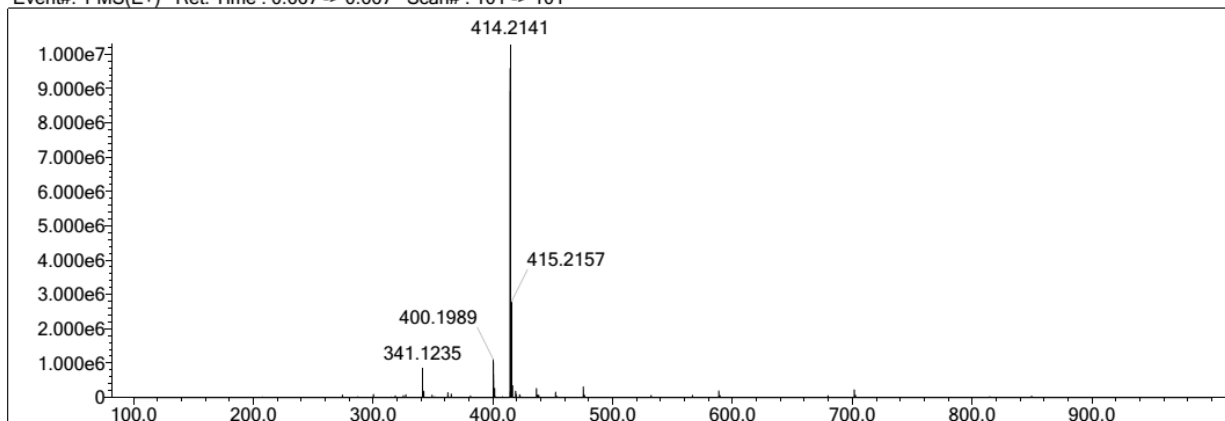
PeakTable

PDA Ch1 254nm 4nm

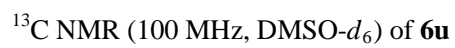
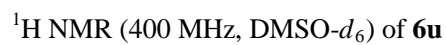
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.399	998863	108398	97.109	98.411
2	2.971	20982	925	2.040	0.840
3	3.733	2509	248	0.244	0.225
4	3.995	6249	577	0.608	0.524
Total		1028603	110149	100.000	100.000

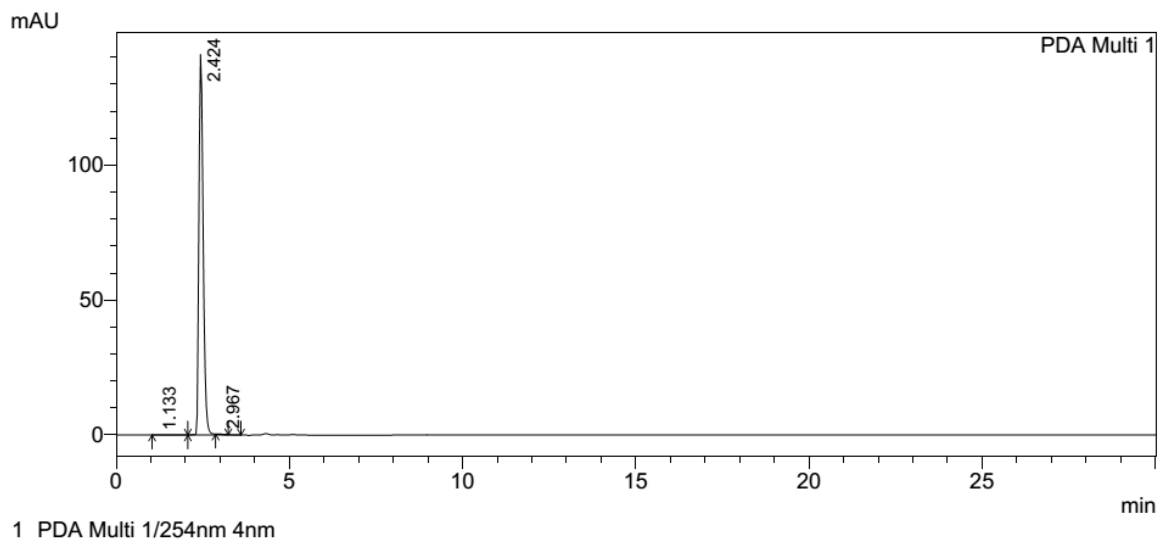
HPLC spectrum of **6t**

Event#: 1 MS(E+) Ret. Time : 0.667 -> 0.667 Scan#: 101 -> 101



HRMS spectrum of **6t**



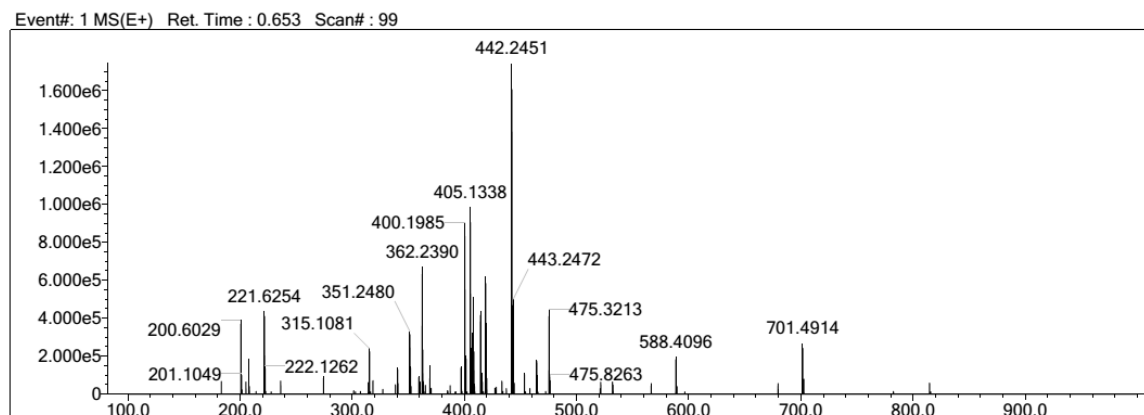


PeakTable

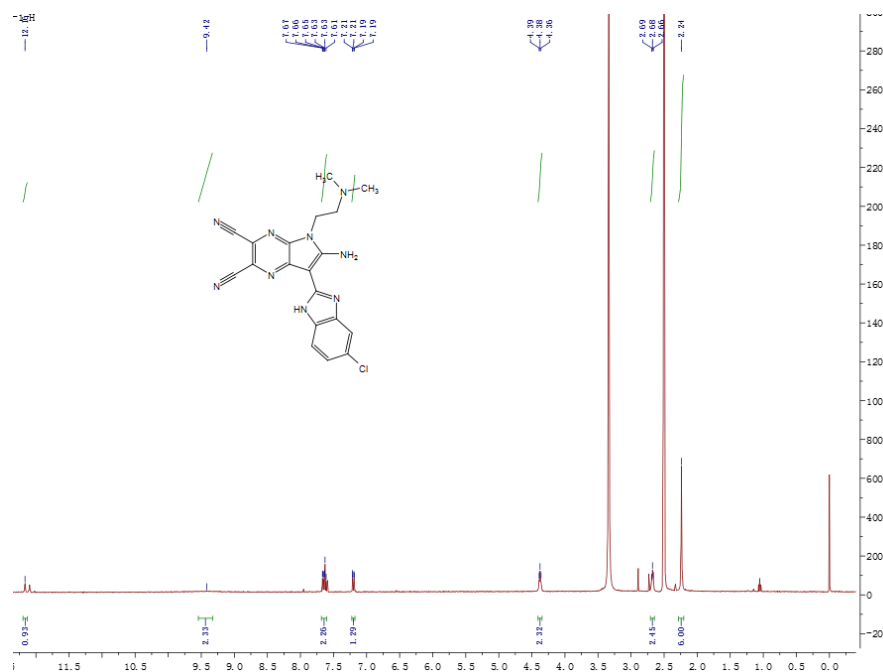
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	1.133	1063	20	0.087	0.014
2	2.424	1216952	141127	99.815	99.891
3	2.967	1199	134	0.098	0.095
Total		1219213	141282	100.000	100.000

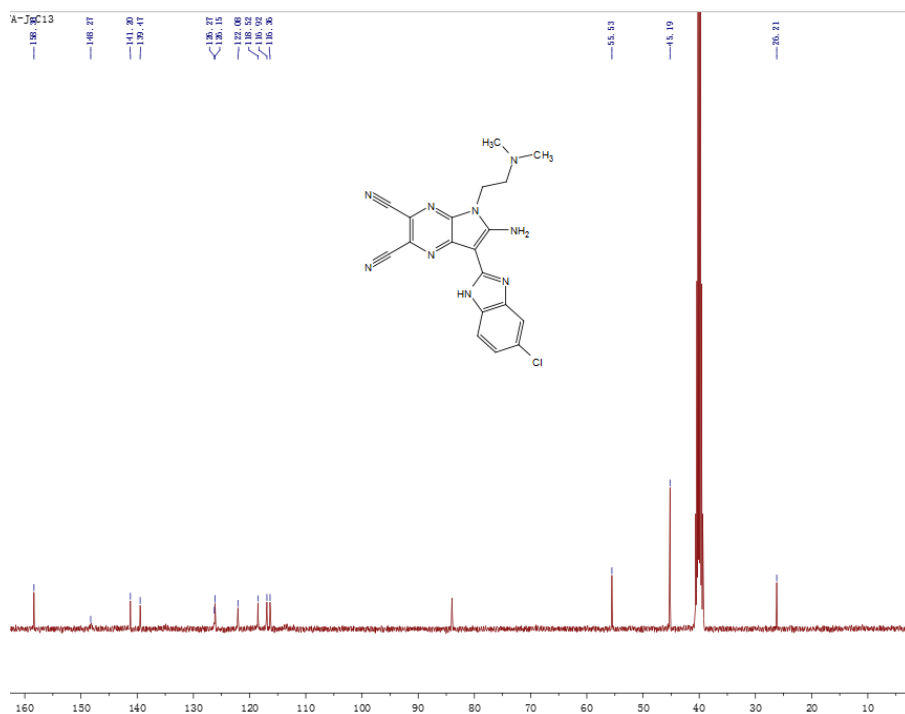
HPLC spectrum of **6u**



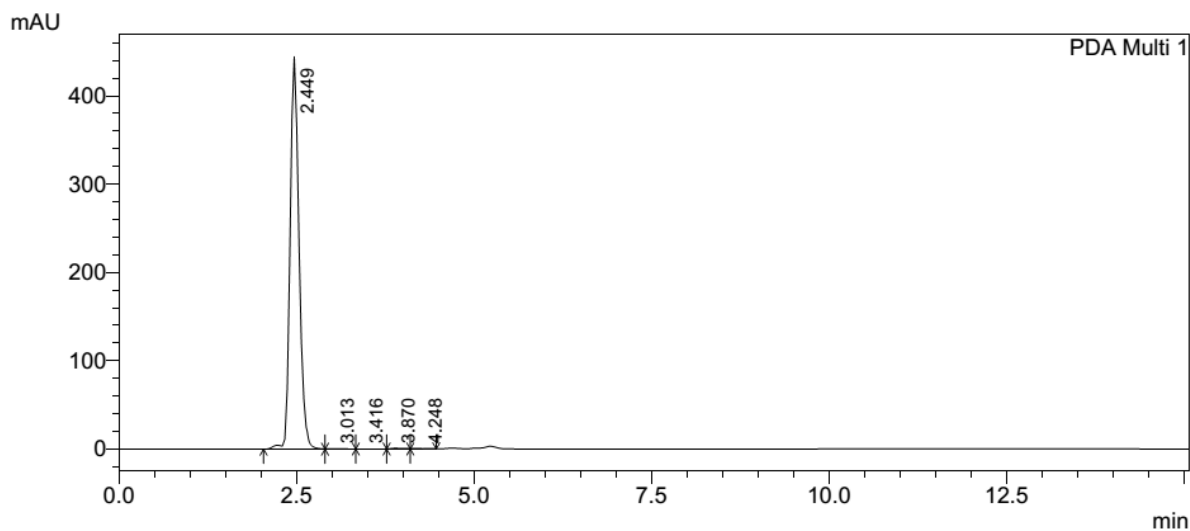
HRMS spectrum of **6u**



¹H NMR (400 MHz, DMSO-*d*₆) of **7c**



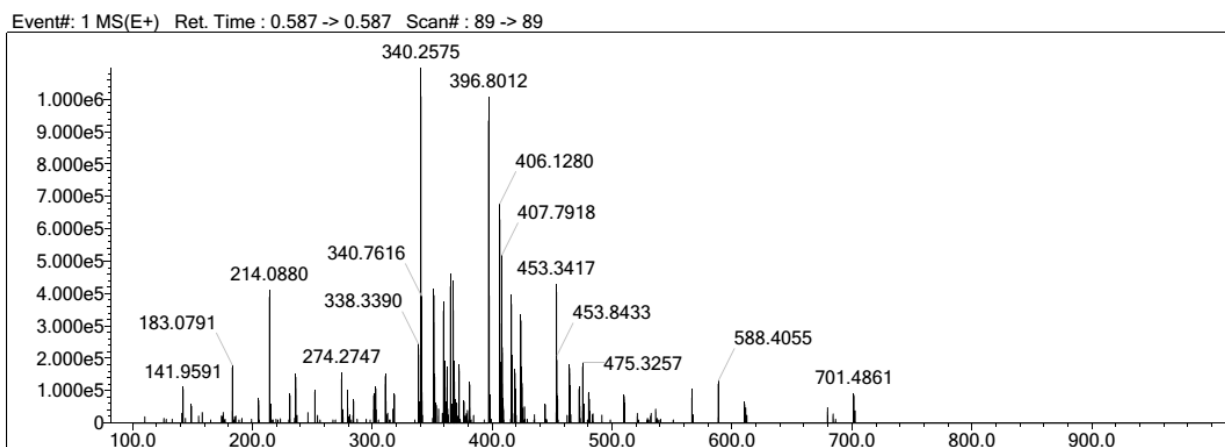
¹³C NMR (100 MHz, DMSO-*d*₆) of **7c**



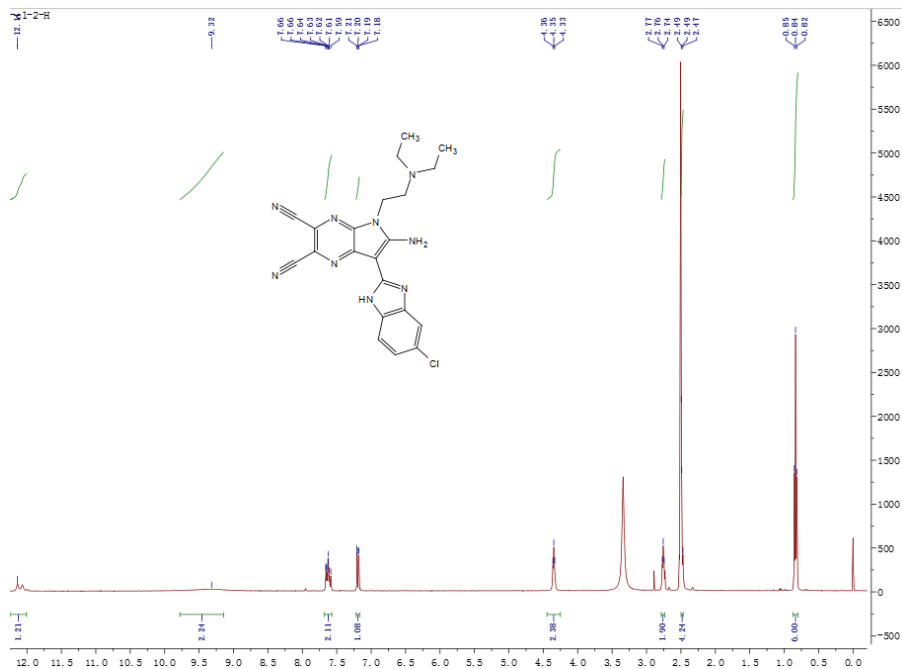
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.449	3890856	444573	99.214	99.456
2	3.013	9613	630	0.245	0.141
3	3.416	4158	322	0.106	0.072
4	3.870	10086	952	0.257	0.213
5	4.248	6981	529	0.178	0.118
Total		3921694	447005	100.000	100.000

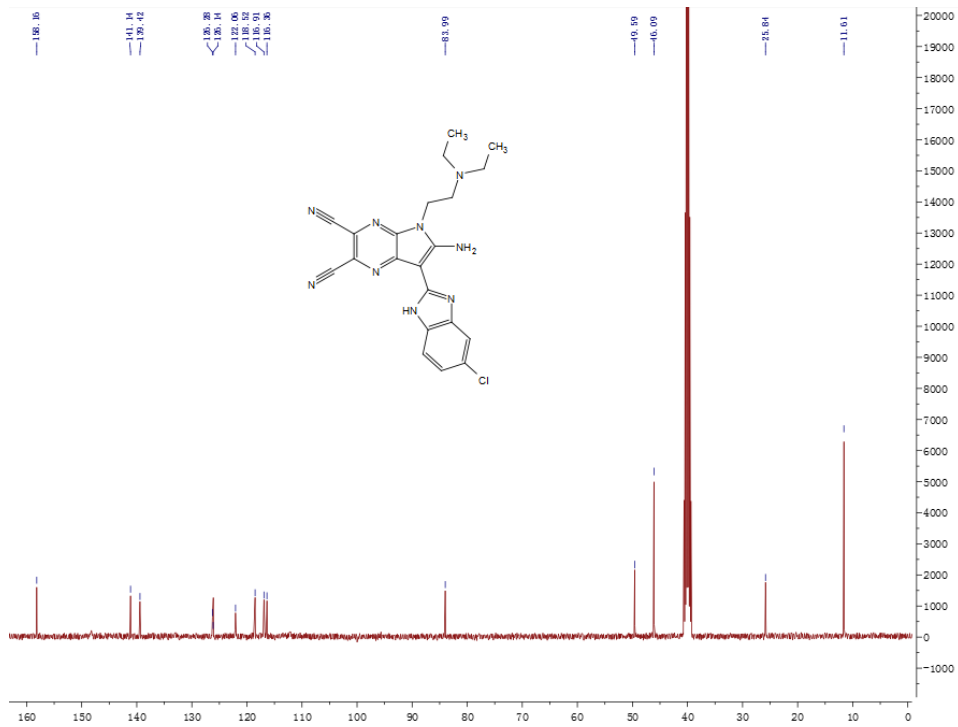
HPLC spectrum of **7c**



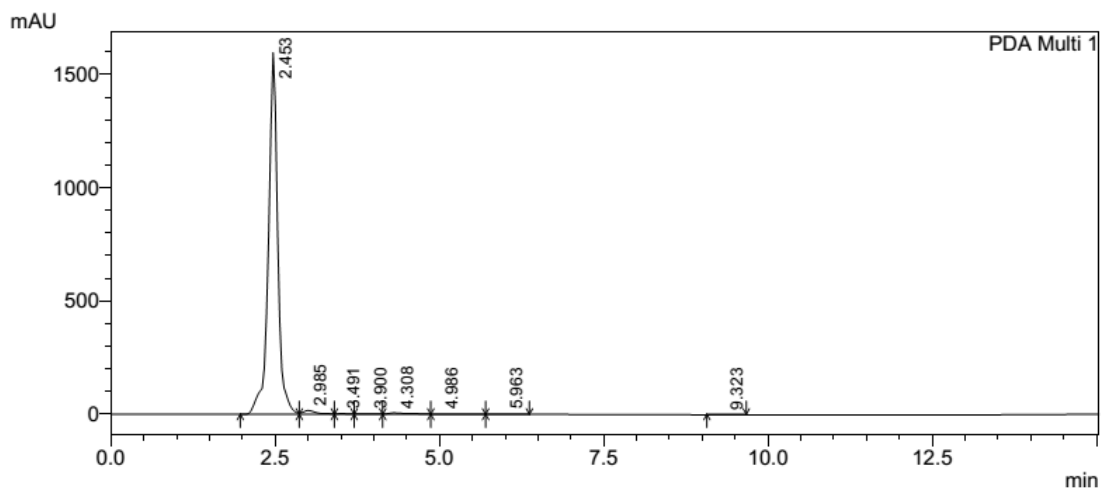
HRMS spectrum of **7c**



¹H NMR (400 MHz, DMSO-*d*₆) of **7d**



¹³C NMR (100 MHz, DMSO-*d*₆) of **7d**



1 PDA Multi 1/254nm 4nm

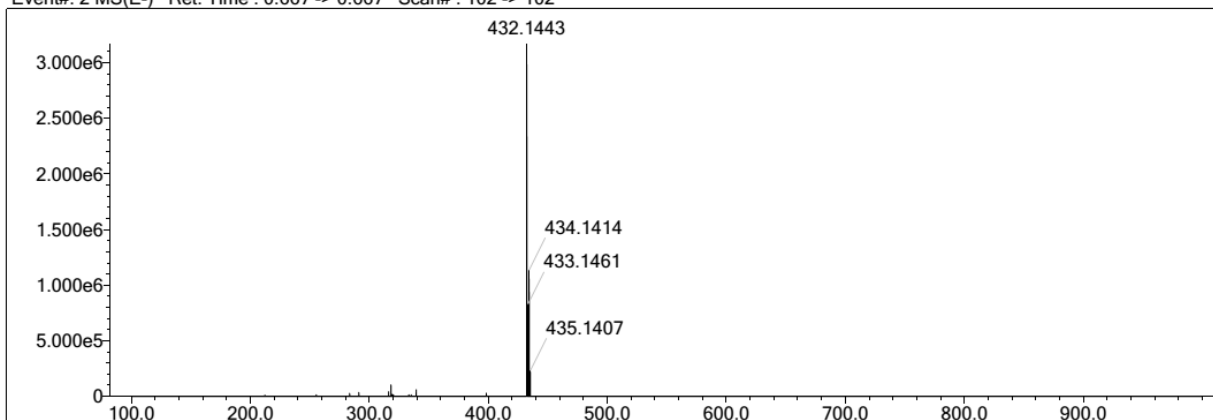
PeakTable

PDA Ch1 254nm 4nm

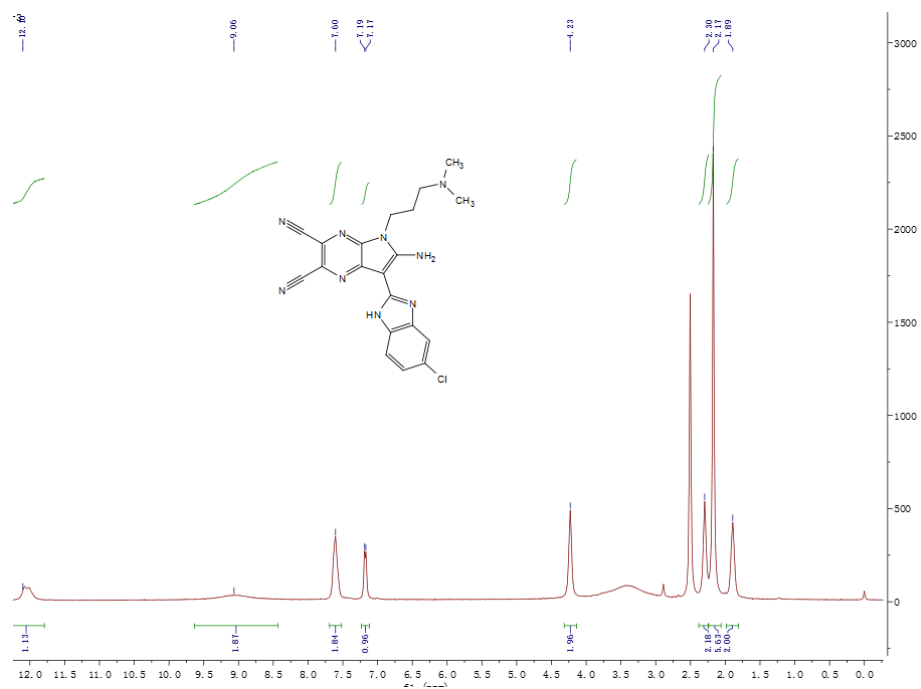
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.453	15726222	1598355	97.058	98.155
2	2.985	228710	16469	1.412	1.011
3	3.491	33841	3525	0.209	0.216
4	3.900	48981	2063	0.302	0.127
5	4.308	129187	6207	0.797	0.381
6	4.986	28626	1310	0.177	0.080
7	5.963	4118	265	0.025	0.016
8	9.323	3205	203	0.020	0.012
Total		16202891	1628398	100.000	100.000

HPLC spectrum of **7d**

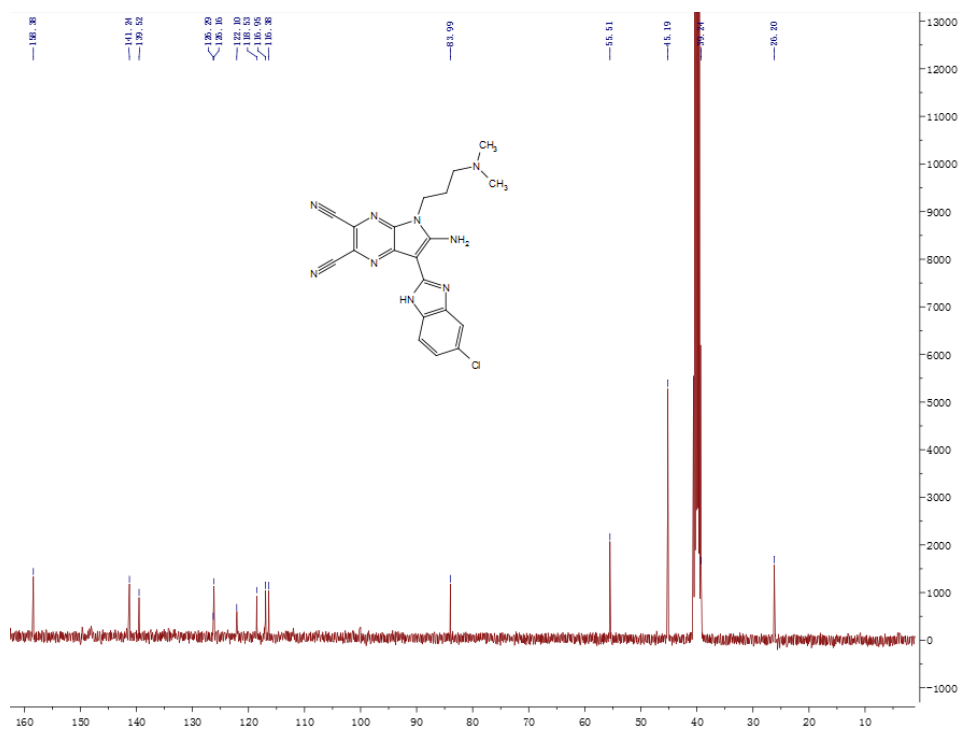
Event#: 2 MS(E-) Ret. Time : 0.667 -> 0.667 Scan#: 102 -> 102



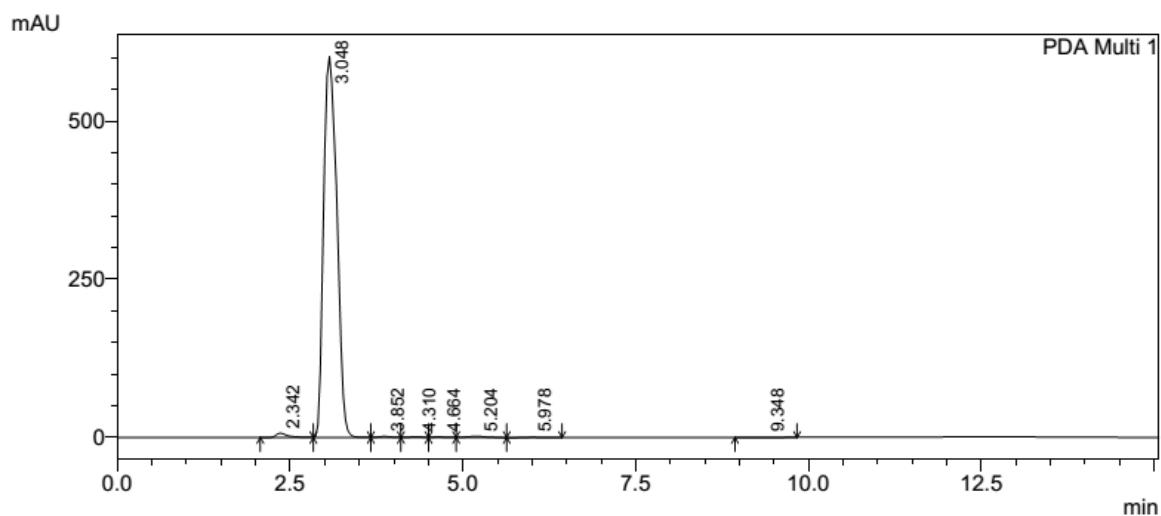
HRMS spectrum of **7d**



¹H NMR (400 MHz, DMSO-*d*₆) of **7m**



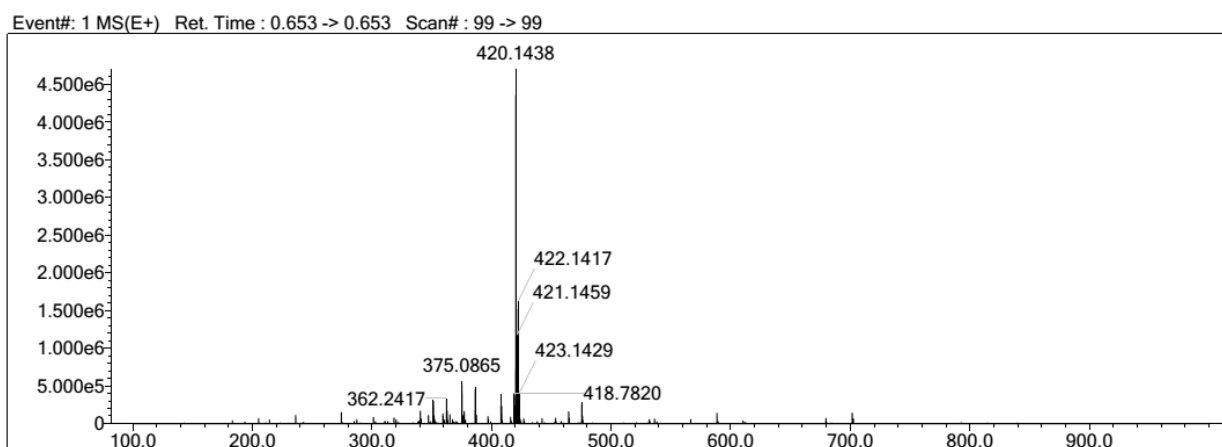
¹³C NMR (100 MHz, DMSO-*d*₆) of **7m**



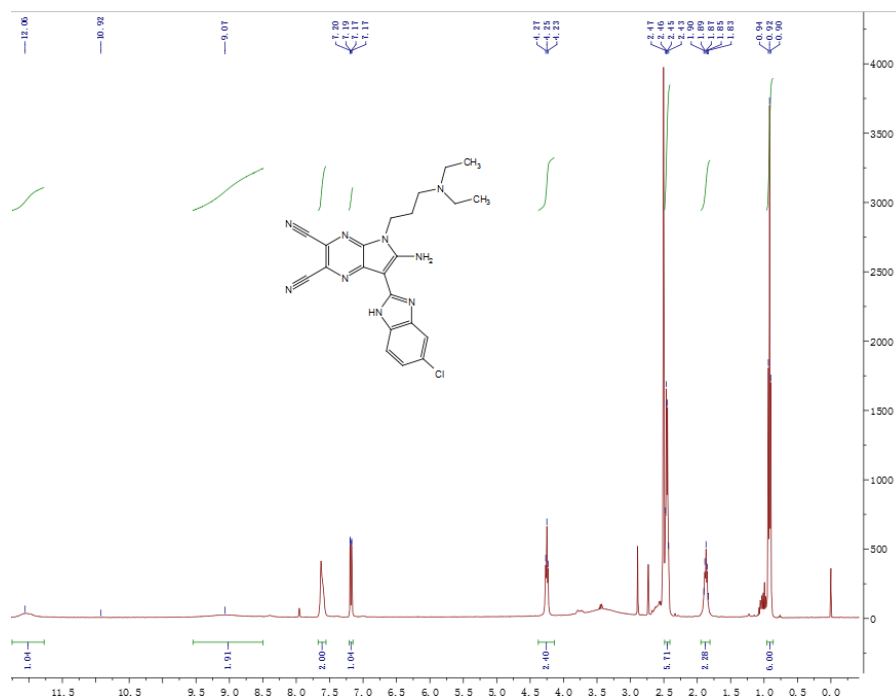
PeakTable

PDA Ch1 254nm 4nm					
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.342	87885	6996	1.068	1.134
2	3.048	8028562	602690	97.587	97.734
3	3.852	24258	1768	0.295	0.287
4	4.310	21150	1427	0.257	0.231
5	4.664	17470	1100	0.212	0.178
6	5.204	37044	2044	0.450	0.332
7	5.978	4770	272	0.058	0.044
8	9.348	5919	367	0.072	0.060
Total		8227057	616665	100.000	100.000

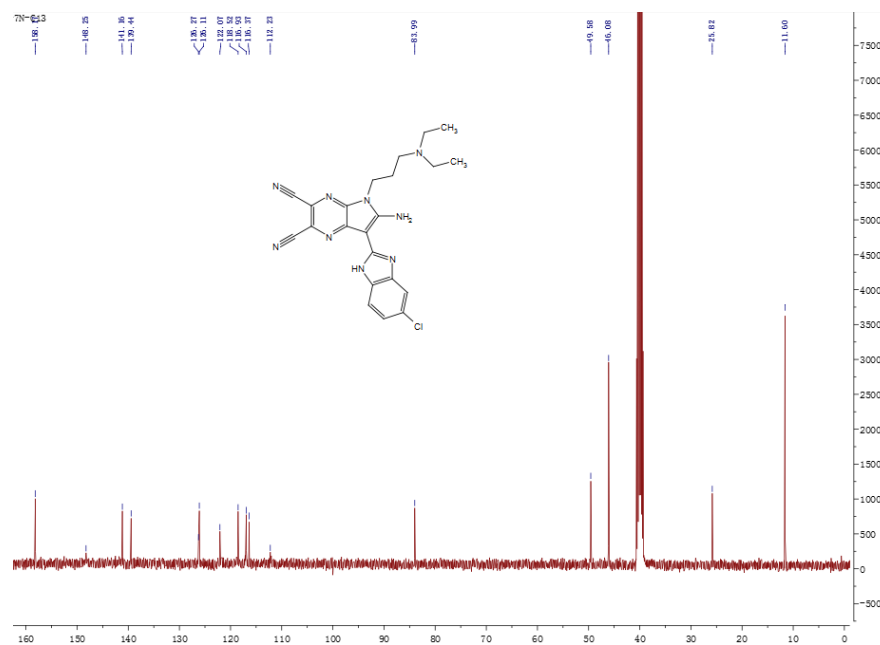
HPLC spectrum of **7m**



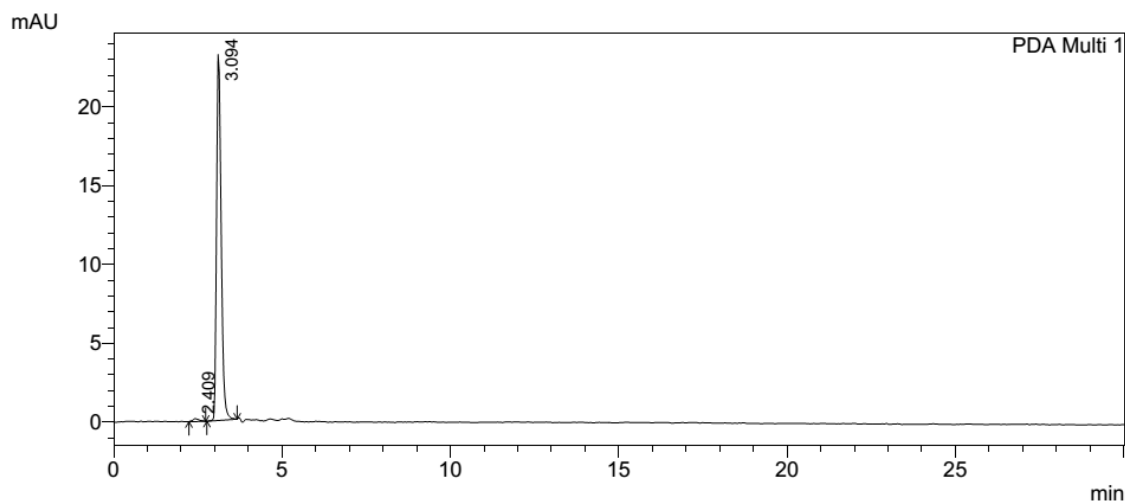
HRMS spectrum of **7m**



¹H NMR (400 MHz, DMSO-*d*₆) of 7n



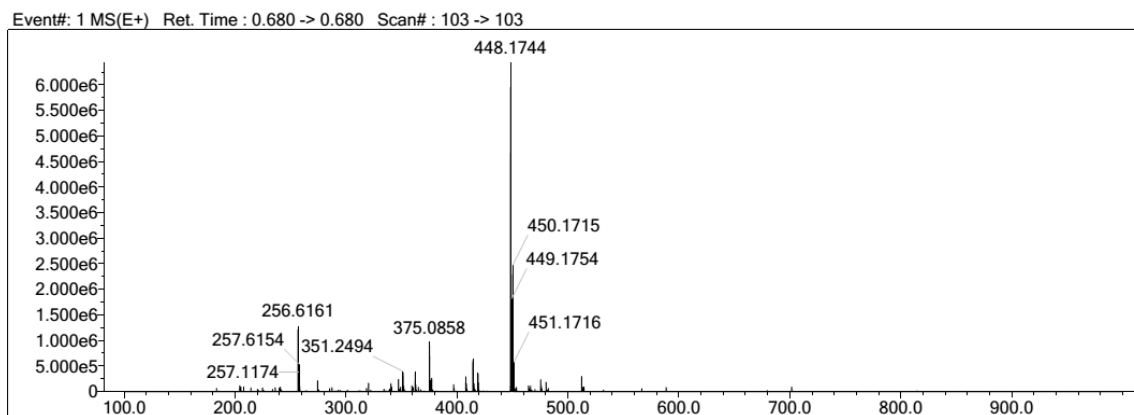
¹³C NMR (100 MHz, DMSO-*d*₆) of 7n



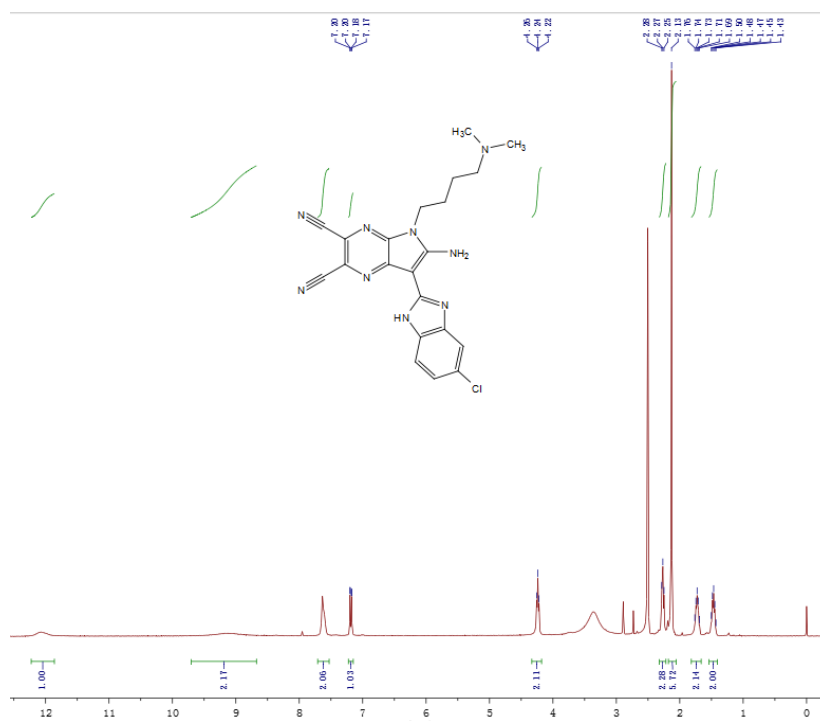
PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.409	2480	193	1.096	0.823
2	3.094	223739	23234	98.904	99.177
Total		226220	23427	100.000	100.000

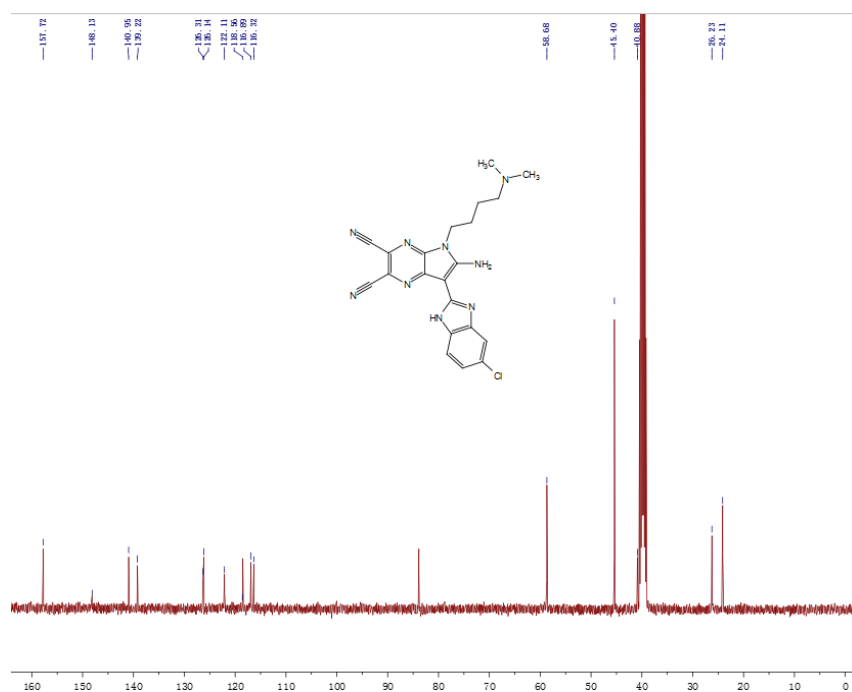
HPLC spectrum of **7n**



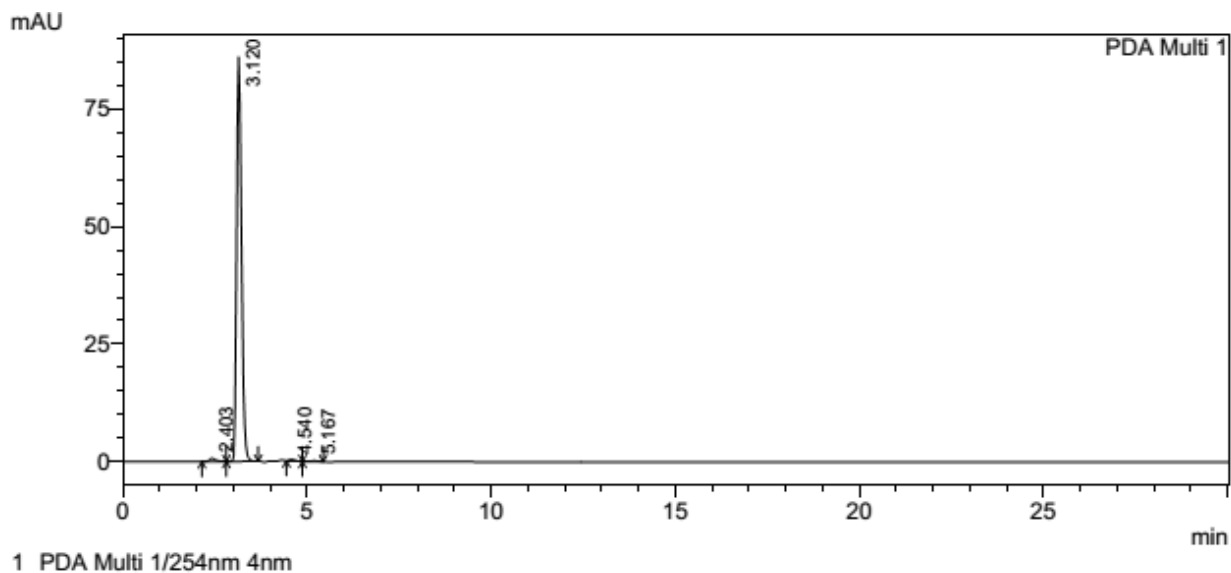
HRMS spectrum of **7n**



¹H NMR (400 MHz, DMSO-*d*₆) of **7t**



¹³C NMR (100 MHz, DMSO-*d*₆) of **7t**

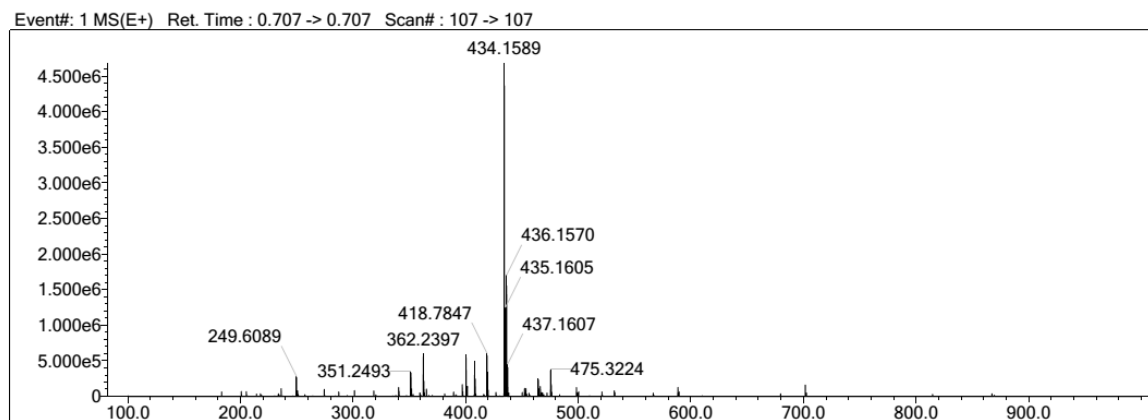


PeakTable

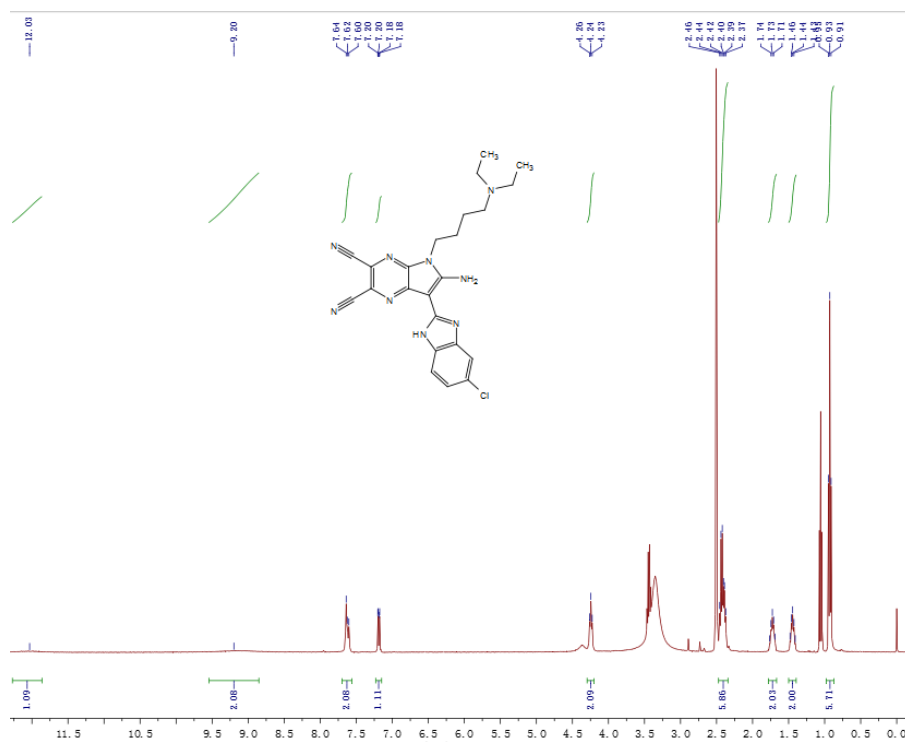
PDA Ch1 254nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.403	9695	734	1.182	0.840
2	3.120	804021	86114	97.992	98.557
3	4.540	3854	349	0.470	0.399
4	5.167	2923	178	0.356	0.204
Total		820493	87375	100.000	100.000

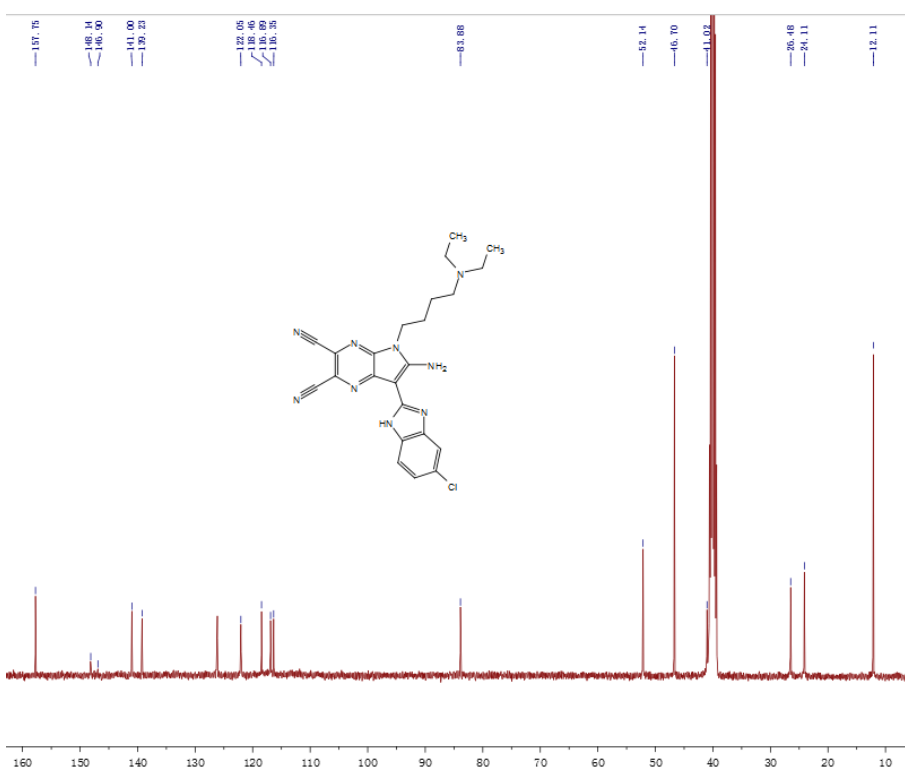
HPLC spectrum of **7t**



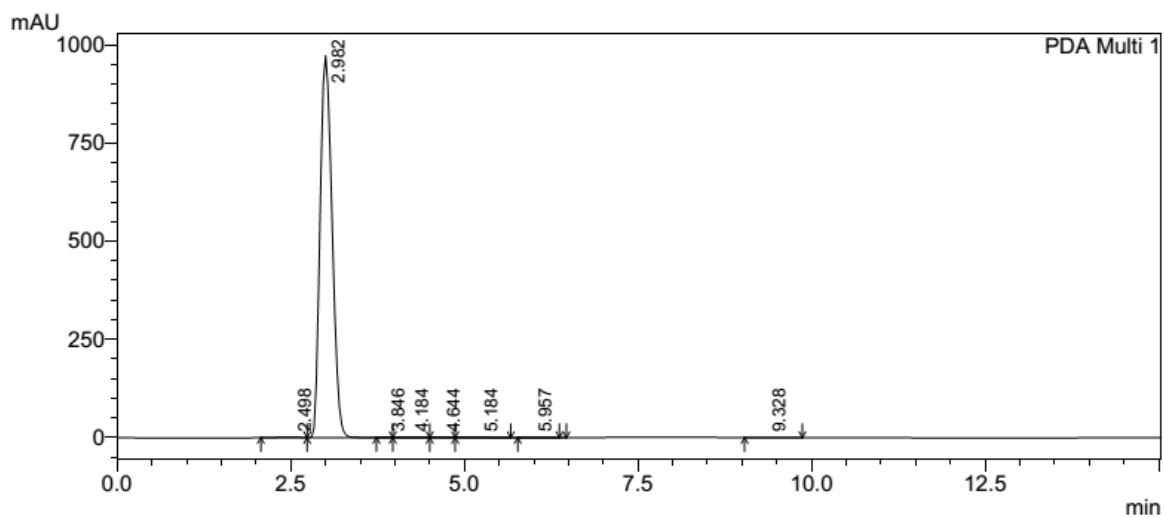
HRMS spectrum of **7t**



¹H NMR (400 MHz, DMSO-*d*₆) of **7u**



¹³C NMR (100 MHz, DMSO-*d*₆) of **7u**



1 PDA Multi 1/254nm 4nm

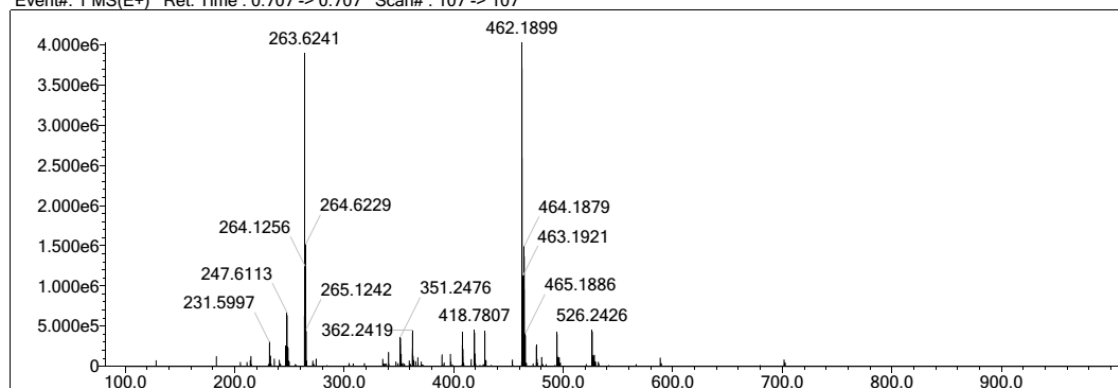
PeakTable

PDA Ch1 254nm 4nm

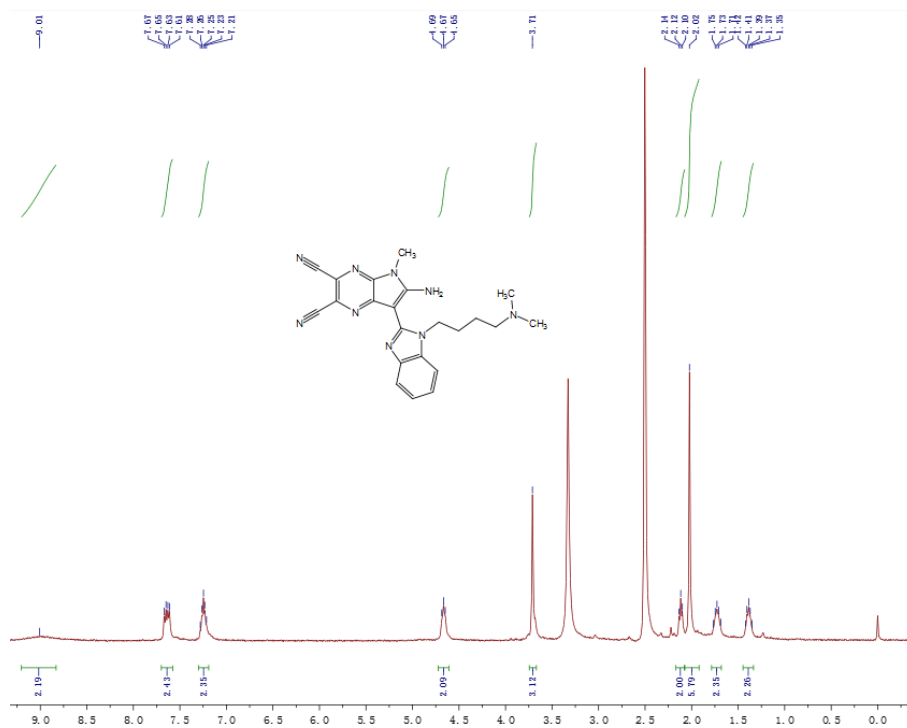
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.498	29509	1525	0.249	0.156
2	2.982	11742145	973187	99.017	99.282
3	3.846	9695	1053	0.082	0.107
4	4.184	19081	733	0.161	0.075
5	4.644	12833	926	0.108	0.094
6	5.184	28148	1558	0.237	0.159
7	5.957	8240	660	0.069	0.067
8	9.328	9055	582	0.076	0.059
Total		11858706	980224	100.000	100.000

HPLC spectrum of **7u**

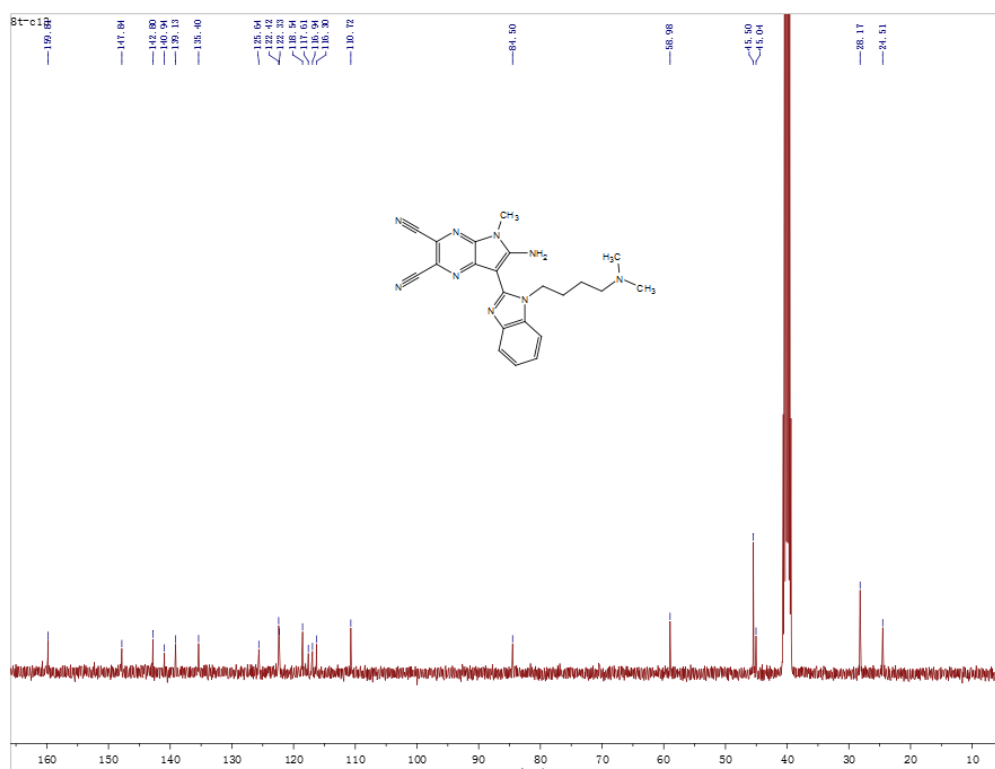
Event#: 1 MS(E+) Ret. Time : 0.707 -> 0.707 Scan#: 107 -> 107



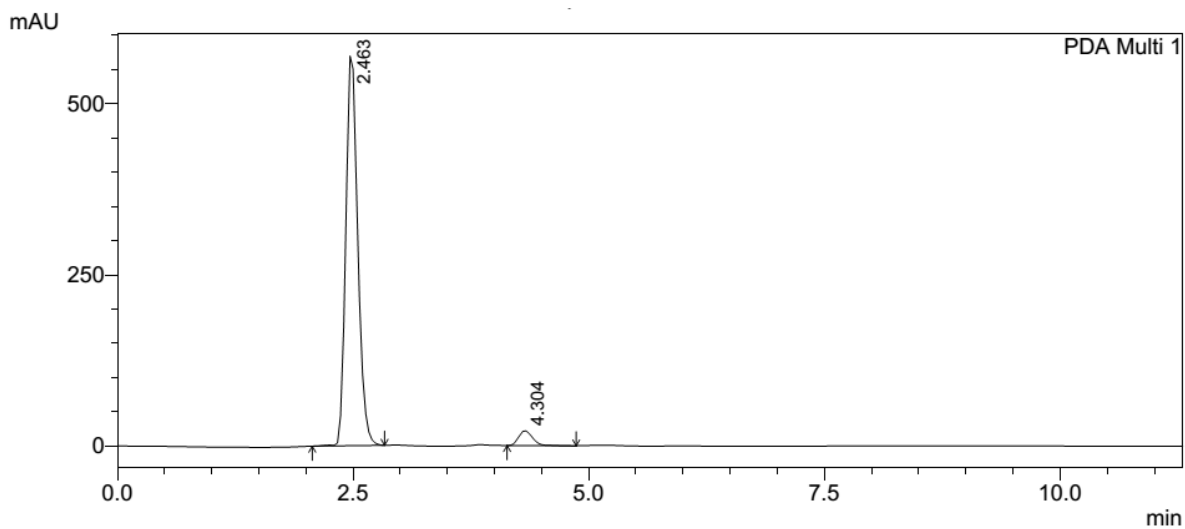
HRMS spectrum of **7u**



¹H NMR (400 MHz, DMSO-*d*₆) of **8t**



¹³C NMR (100 MHz, DMSO-*d*₆) of **8t**



1 PDA Multi 1/254nm 4nm

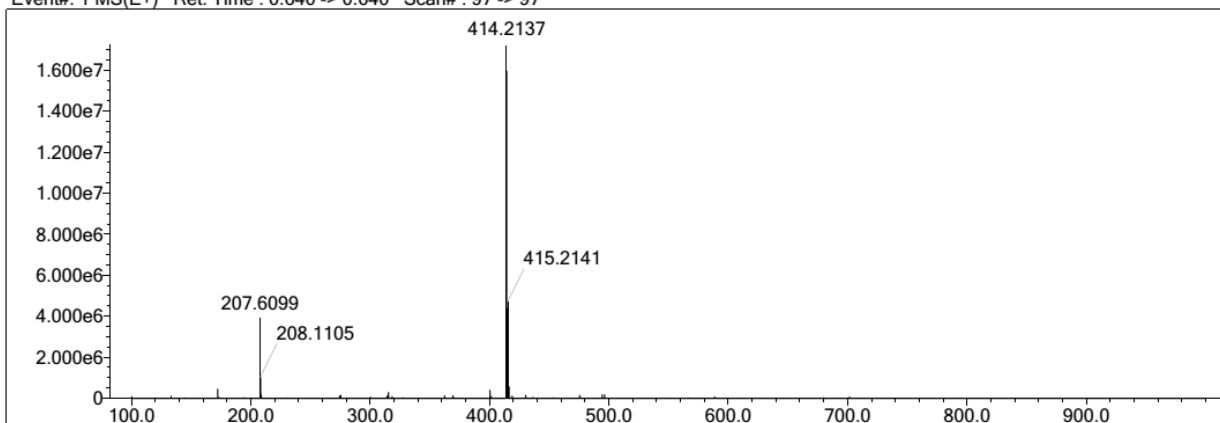
PeakTable

PDA Ch1 254nm 4nm

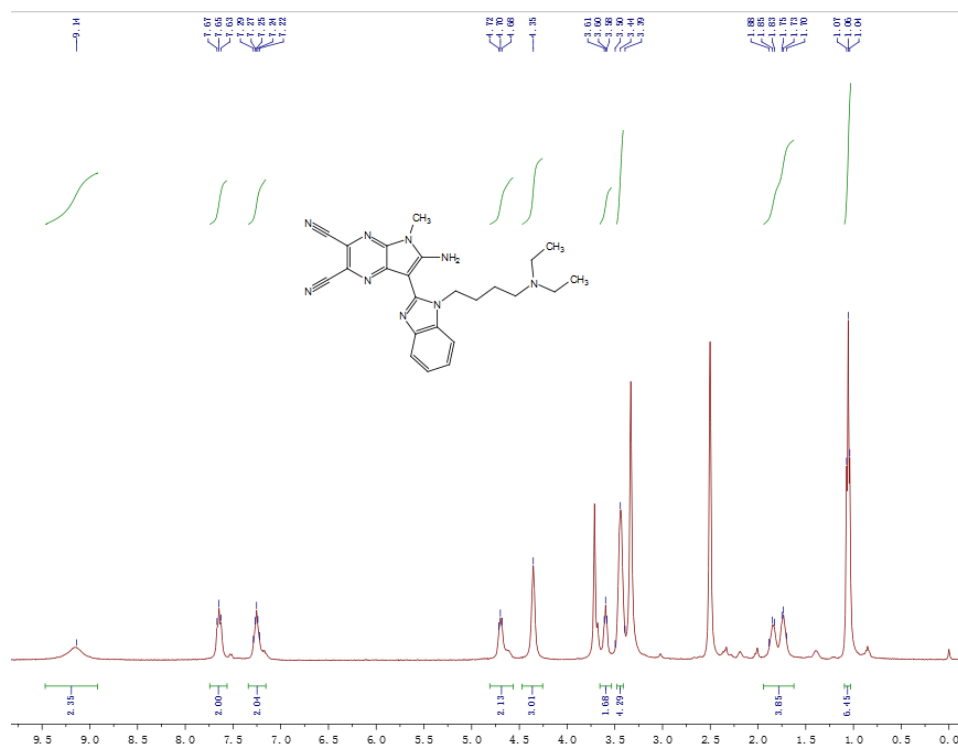
Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.463	5034926	569781	95.688	96.370
2	4.304	226885	21461	4.312	3.630
Total		5261811	591242	100.000	100.000

HPLC spectrum of **8t**

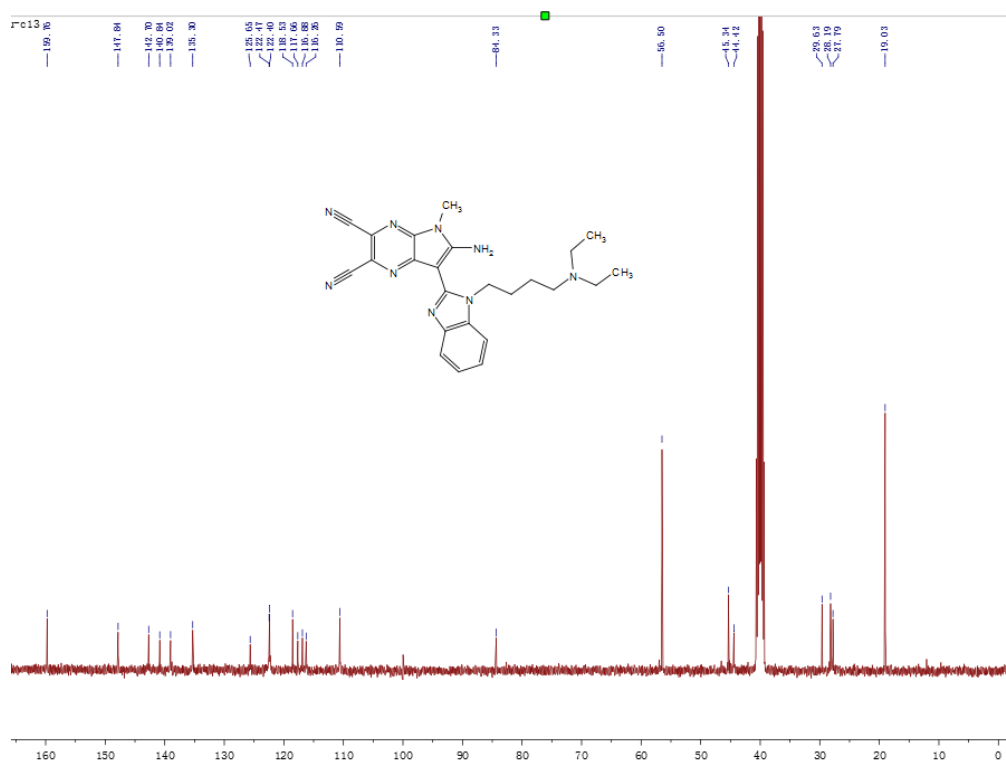
Event#: 1 MS(E+) Ret. Time : 0.640 -> 0.640 Scan#: 97 -> 97



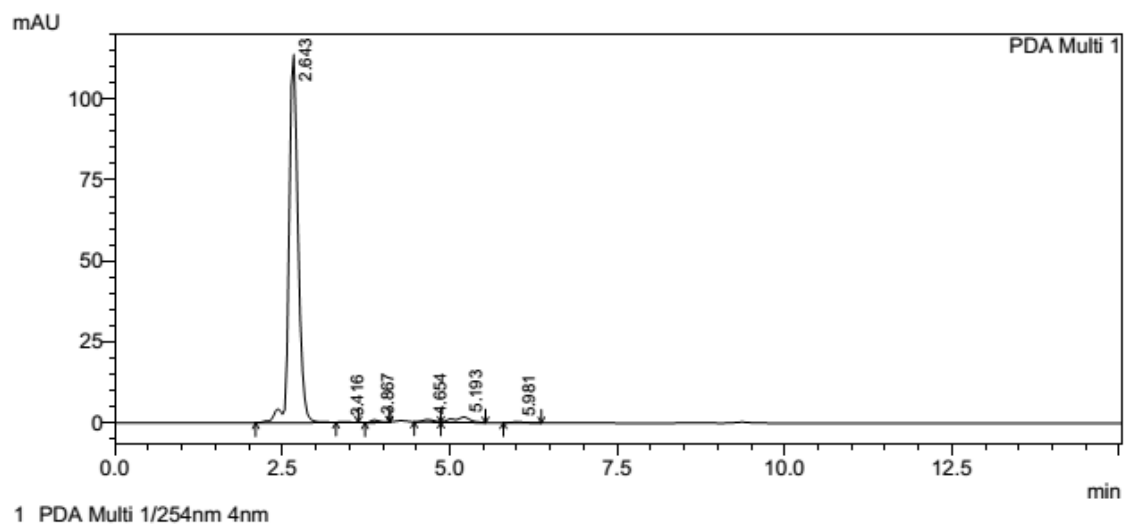
HRMS spectrum of **8t**



¹H NMR (400 MHz, DMSO-d₆) of **8u**



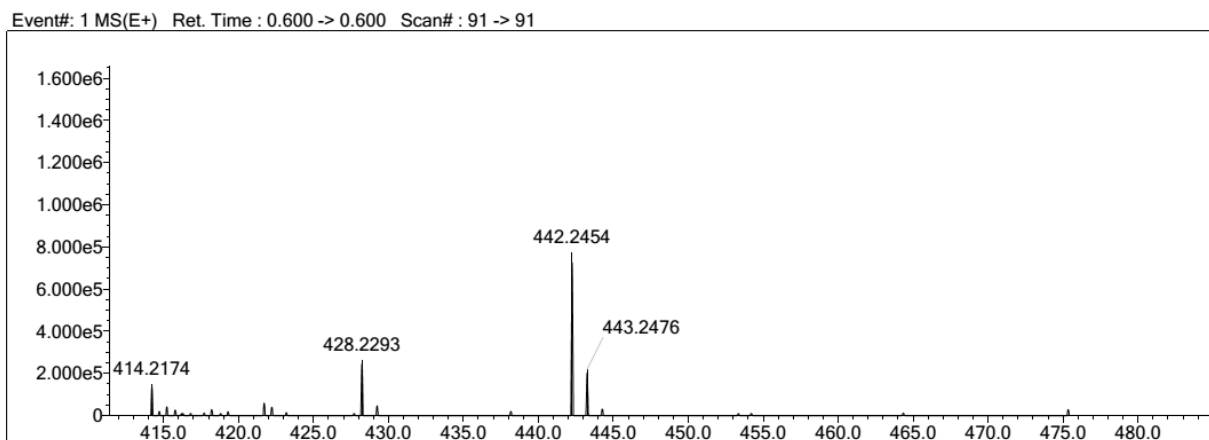
¹³C NMR (100 MHz, DMSO-d₆) of **8u**



PeakTable

Peak#	Ret. Time	Area	Height	Area %	Height %
1	2.643	1068728	113793	95.374	96.753
2	3.416	1679	198	0.150	0.168
3	3.867	7330	867	0.654	0.737
4	4.654	9359	751	0.835	0.639
5	5.193	28940	1675	2.583	1.424
6	5.981	4526	328	0.404	0.279
Total		1120562	117612	100.000	100.000

HPLC spectrum of **8u**



HRMS spectrum of **8u**

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