



wwPDB EM Validation Summary Report ⓘ

Mar 8, 2026 – 03:15 PM UTC

PDB ID : 7V33 / pdb_00007v33
EMDB ID : EMD-31651
Title : Active state complex I from rotenone-NADH dataset
Authors : Gu, J.K.; Yang, M.J.
Deposited on : 2021-08-10
Resolution : 2.60 Å(reported)

This is a wwPDB EM Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : 0.0.1.dev132
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

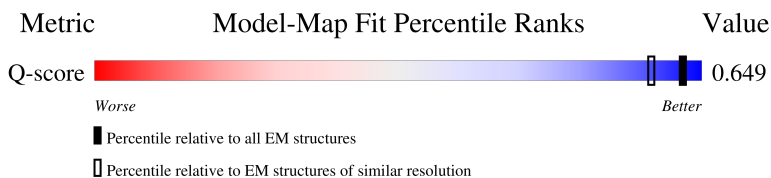
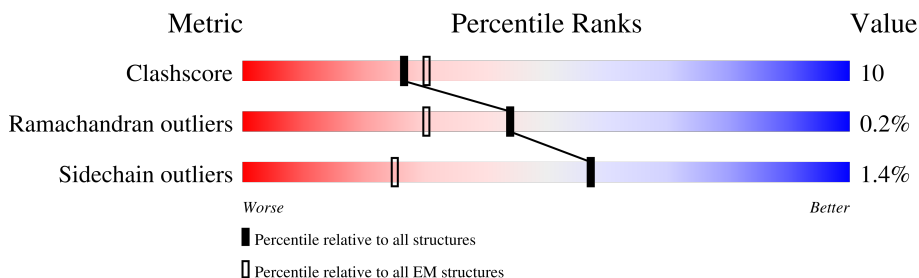
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.60 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



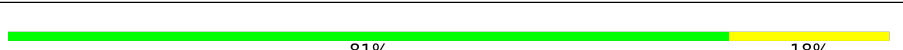
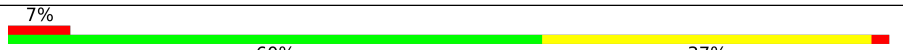
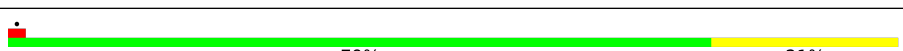
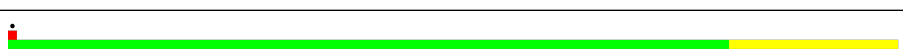
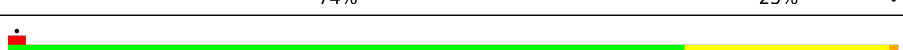
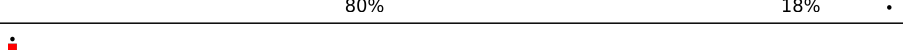
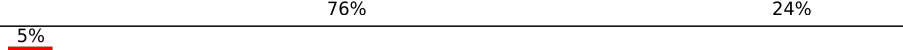
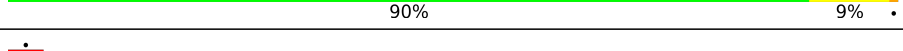
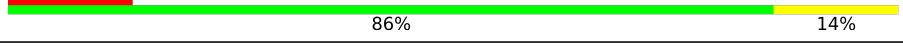
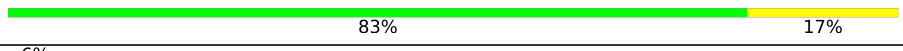
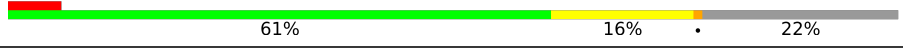
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	7115 (2.00 - 3.00)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the EM map (all-atom inclusion $< 40\%$). The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	433	
2	B	176	
3	C	156	
4	E	115	

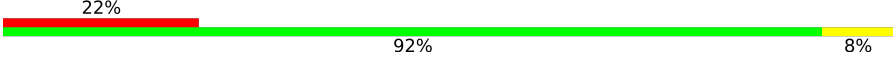
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Mol	Chain	Length	Quality of chain
5	F	86	
6	G	88	
6	X	88	
7	H	112	
8	I	112	
9	J	342	
10	K	43	
11	L	125	
12	M	690	
13	N	144	
14	O	217	
15	P	208	
16	Q	430	
17	S	70	
18	T	96	
19	U	83	
20	V	140	
21	W	142	
22	Y	67	
23	Z	80	
24	a	138	
25	b	126	
26	c	156	
27	d	175	
28	e	104	

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Mol	Chain	Length	Quality of chain
29	f	49	
30	g	122	
31	h	105	
32	i	347	
33	j	115	
34	k	98	
35	l	606	
36	m	175	
37	n	56	
38	o	128	
39	p	178	
40	r	459	
41	s	318	
42	u	171	
43	v	125	
44	w	320	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
45	SF4	M	802	-	-	X	-
48	PEE	l	703	-	-	X	-
51	CDL	l	701	-	-	X	-

2 Entry composition [i](#)

There are 58 unique types of molecules in this entry. The entry contains 68246 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called NADH dehydrogenase [ubiquinone] flavoprotein 1, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	433	Total	C	N	O	S	0	0
			3330	2103	593	614	20		

- Molecule 2 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 8, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	176	Total	C	N	O	S	0	0
			1412	887	243	269	13		

- Molecule 3 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 7, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	156	Total	C	N	O	S	0	0
			1248	794	227	213	14		

- Molecule 4 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	E	115	Total	C	N	O	S	0	0
			971	619	179	168	5		

- Molecule 5 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	F	86	Total	C	N	O	S	0	0
			684	431	129	122	2		

- Molecule 6 is a protein called Acyl carrier protein, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	G	88	Total	C	N	O	S	0	0
			693	447	102	139	5		
6	X	88	Total	C	N	O	S	0	0
			696	449	103	139	5		

- Molecule 7 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	H	112	Total	C	N	O	S	0	0
			910	588	154	165	3		

- Molecule 8 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 7.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	I	97	Total	C	N	O	S	0	0
			780	491	147	139	3		

- Molecule 9 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 9, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	J	342	Total	C	N	O	S	0	0
			2751	1783	481	478	9		

- Molecule 10 is a protein called NADH dehydrogenase [ubiquinone] flavoprotein 3, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
10	K	43	Total	C	N	O	S	0	0
			366	228	68	69	1		

- Molecule 11 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 4, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
11	L	125	Total	C	N	O	S	0	0
			1016	642	181	190	3		

- Molecule 12 is a protein called NADH-ubiquinone oxidoreductase 75 kDa subunit, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
12	M	690	Total	C	N	O	S	0	0
			5293	3319	923	1012	39		

- Molecule 13 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 12.

Mol	Chain	Residues	Atoms					AltConf	Trace
13	N	144	Total	C	N	O	S	0	0
			1204	770	218	212	4		

- Molecule 14 is a protein called NADH dehydrogenase [ubiquinone] flavoprotein 2, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
14	O	217	Total	C	N	O	S	0	0
			1671	1065	281	315	10		

- Molecule 15 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 3, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
15	P	208	Total	C	N	O	S	0	0
			1738	1124	298	314	2		

- Molecule 16 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 2, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
16	Q	430	Total	C	N	O	S	0	0
			3459	2212	594	629	24		

- Molecule 17 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
17	S	70	Total	C	N	O	S	0	0
			566	364	103	94	5		

- Molecule 18 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 6, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
18	T	96	Total	C	N	O	S	0	0
			741	452	140	146	3		

- Molecule 19 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 3.

Mol	Chain	Residues	Atoms					AltConf	Trace
19	U	83	Total	C	N	O	S	0	0
			643	417	110	115	1		

- Molecule 20 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 11.

Mol	Chain	Residues	Atoms					AltConf	Trace
20	V	140	Total	C	N	O	S	0	0
			1021	651	174	190	6		

- Molecule 21 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 13.

Mol	Chain	Residues	Atoms					AltConf	Trace
21	W	142	Total	C	N	O	S	0	0
			1161	749	197	206	9		

- Molecule 22 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 2, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
22	Y	67	Total	C	N	O	S	0	0
			584	385	95	103	1		

- Molecule 23 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 3.

Mol	Chain	Residues	Atoms					AltConf	Trace
23	Z	80	Total	C	N	O	S	0	0
			641	418	108	114	1		

- Molecule 24 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 5, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
24	a	138	Total	C	N	O	S	0	0
			1151	754	195	199	3		

- Molecule 25 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
25	b	98	Total	C	N	O	S	0	0
			819	537	144	137	1		

- Molecule 26 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 8, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
26	c	156	Total	C	N	O	S	0	0
			1315	853	213	241	8		

- Molecule 27 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 10.

Mol	Chain	Residues	Atoms					AltConf	Trace
27	d	175	Total	C	N	O	S	0	0
			1461	916	265	272	8		

- Molecule 28 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 11, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
28	e	104	Total	C	N	O	S	0	0
			867	553	142	168	4		

- Molecule 29 is a protein called NADH dehydrogenase [ubiquinone] 1 subunit C1, mitochondrial.

Mol	Chain	Residues	Atoms				AltConf	Trace
29	f	49	Total	C	N	O	0	0
			377	246	65	66		

- Molecule 30 is a protein called NADH dehydrogenase [ubiquinone] 1 subunit C2.

Mol	Chain	Residues	Atoms					AltConf	Trace
30	g	122	Total	C	N	O	S	0	0
			1005	653	174	172	6		

- Molecule 31 is a protein called NADH dehydrogenase [ubiquinone] iron-sulfur protein 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
31	h	105	Total	C	N	O	S	0	0
			867	550	161	150	6		

- Molecule 32 is a protein called NADH-ubiquinone oxidoreductase chain 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
32	i	347	Total	C	N	O	S	0	0
			2710	1782	420	462	46		

- Molecule 33 is a protein called NADH-ubiquinone oxidoreductase chain 3.

Mol	Chain	Residues	Atoms					AltConf	Trace
33	j	115	Total	C	N	O	S	0	0
			914	615	134	158	7		

- Molecule 34 is a protein called NADH-ubiquinone oxidoreductase chain 4L.

Mol	Chain	Residues	Atoms					AltConf	Trace
34	k	98	Total	C	N	O	S	0	0
			748	493	113	128	14		

- Molecule 35 is a protein called NADH-ubiquinone oxidoreductase chain 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
35	l	606	Total	C	N	O	S	0	0
			4797	3181	743	822	51		

- Molecule 36 is a protein called NADH-ubiquinone oxidoreductase chain 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
36	m	175	Total	C	N	O	S	0	0
			1276	850	187	226	13		

- Molecule 37 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
37	n	56	Total	C	N	O	S	0	0
			479	311	88	79	1		

- Molecule 38 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit

4.

Mol	Chain	Residues	Atoms				AltConf	Trace
38	o	128	Total	C	N	O	0	0
			1062	691	182	189		

- Molecule 39 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 9.

Mol	Chain	Residues	Atoms					AltConf	Trace
39	p	178	Total	C	N	O	S	0	0
			1534	982	279	265	8		

- Molecule 40 is a protein called NADH-ubiquinone oxidoreductase chain 4.

Mol	Chain	Residues	Atoms					AltConf	Trace
40	r	459	Total	C	N	O	S	0	0
			3624	2406	572	608	38		

- Molecule 41 is a protein called NADH-ubiquinone oxidoreductase chain 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
41	s	318	Total	C	N	O	S	0	0
			2508	1678	385	424	21		

- Molecule 42 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 8.

Mol	Chain	Residues	Atoms					AltConf	Trace
42	u	171	Total	C	N	O	S	0	0
			1398	887	250	251	10		

- Molecule 43 is a protein called NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 7.

Mol	Chain	Residues	Atoms					AltConf	Trace
43	v	124	Total	C	N	O	S	0	0
			1036	646	196	185	9		

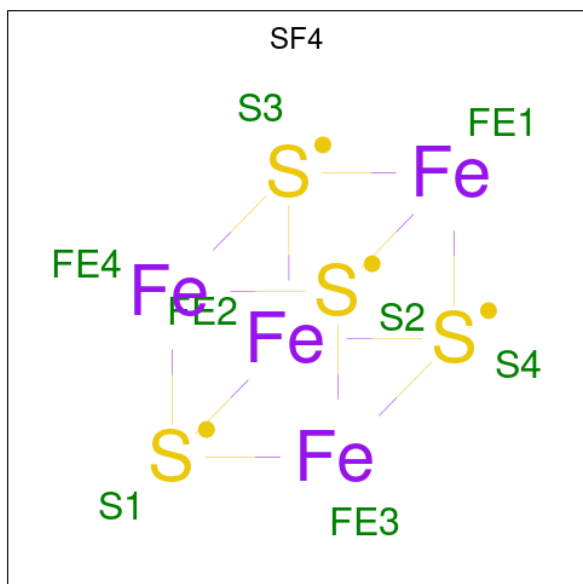
There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
v	1	MYR	-	acetylation	UNP F1SCH1

- Molecule 44 is a protein called NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 10, mitochondrial.

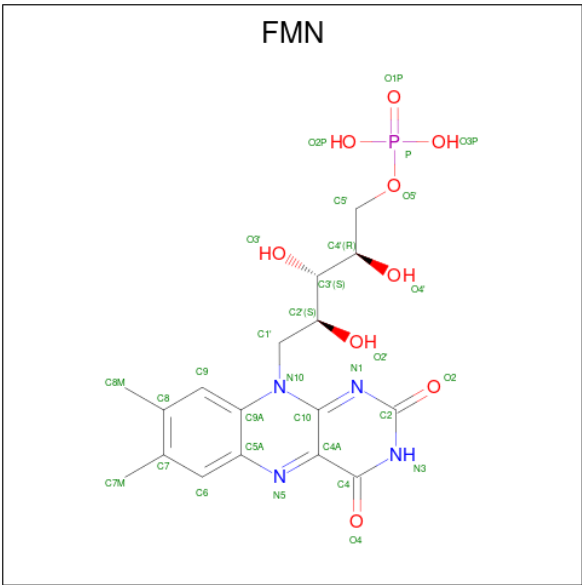
Mol	Chain	Residues	Atoms					AltConf	Trace
44	w	320	Total	C	N	O	S	0	0
			2586	1646	439	491	10		

- Molecule 45 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4) (labeled as "Ligand of Interest" by depositor).



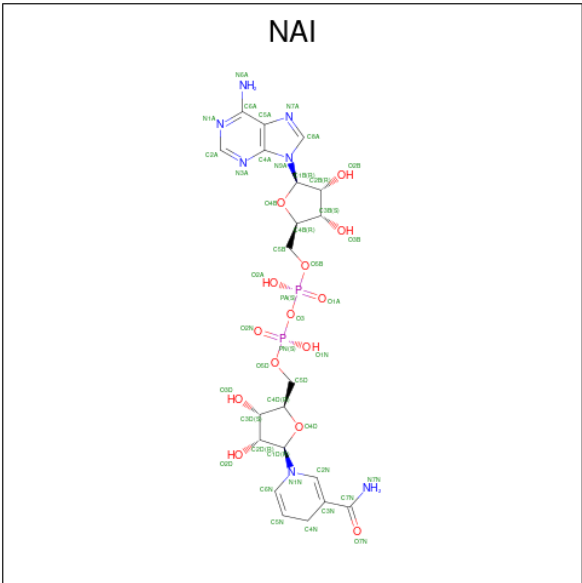
Mol	Chain	Residues	Atoms			AltConf
45	A	1	Total	Fe	S	0
			8	4	4	
45	B	1	Total	Fe	S	0
			8	4	4	
45	B	1	Total	Fe	S	0
			8	4	4	
45	C	1	Total	Fe	S	0
			8	4	4	
45	M	1	Total	Fe	S	0
			8	4	4	
45	M	1	Total	Fe	S	0
			8	4	4	

- Molecule 46 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: $\text{C}_{17}\text{H}_{21}\text{N}_4\text{O}_9\text{P}$) (labeled as "Ligand of Interest" by depositor).



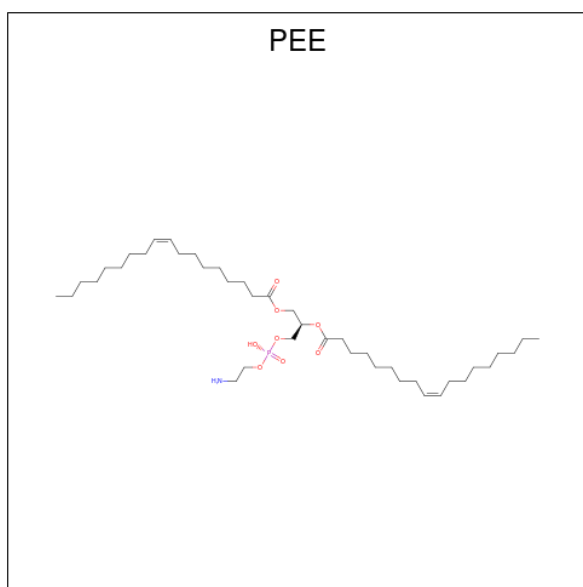
Mol	Chain	Residues	Atoms					AltConf
46	A	1	Total	C	N	O	P	0
			31	17	4	9	1	

- Molecule 47 is 1,4-DIHYDRONICOTINAMIDE ADENINE DINUCLEOTIDE (CCD ID: NAI) (formula: $C_{21}H_{29}N_7O_{14}P_2$) (labeled as "Ligand of Interest" by depositor).



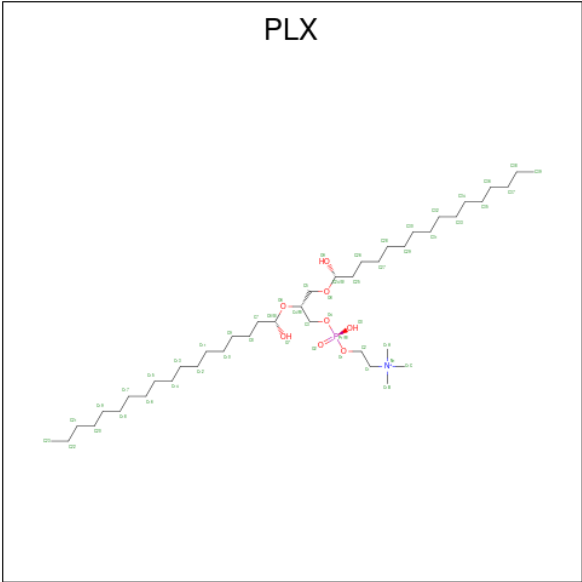
Mol	Chain	Residues	Atoms					AltConf
47	A	1	Total	C	N	O	P	0
			44	21	7	14	2	

- Molecule 48 is 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (CCD ID: PEE) (formula: $C_{41}H_{78}NO_8P$) (labeled as "Ligand of Interest" by depositor).



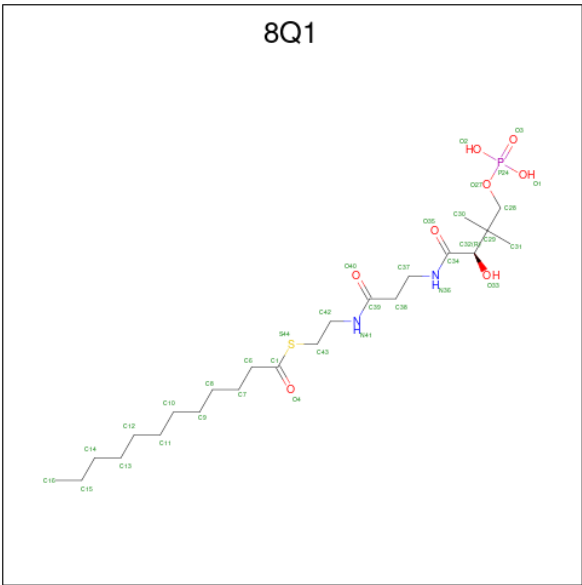
Mol	Chain	Residues	Atoms					AltConf
48	B	1	Total	C	N	O	P	0
			51	41	1	8	1	
48	C	1	Total	C	N	O	P	0
			47	37	1	8	1	
48	U	1	Total	C	N	O	P	0
			51	41	1	8	1	
48	V	1	Total	N				0
			1	1				
48	W	1	Total	C	N	O	P	0
			41	31	1	8	1	
48	j	1	Total	C	N	O	P	0
			41	31	1	8	1	
48	l	1	Total	C	N	O	P	0
			47	37	1	8	1	
48	l	1	Total	C	N	O	P	0
			50	40	1	8	1	
48	l	1	Total	C	N	O	P	0
			46	36	1	8	1	
48	r	1	Total	C	N	O	P	0
			51	41	1	8	1	

- Molecule 49 is (9R,11S)-9-({[(1S)-1-HYDROXYHEXADECYL]OXY}METHYL)-2,2-DIMETHYL-5,7,10-TRIOXA-2LAMBDA 5 -AZA-6LAMBDA 5 -PHOSPHAOCTACOSANE-6,6,11-TRIOL (CCD ID: PLX) (formula: C₄₂H₈₉NO₈P) (labeled as "Ligand of Interest" by depositor).



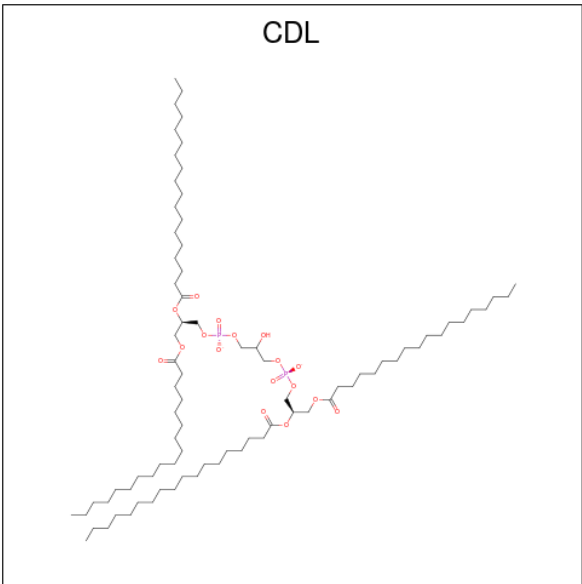
Mol	Chain	Residues	Atoms					AltConf
49	C	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	J	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	a	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	g	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	j	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	r	1	Total	C	N	O	P	0
			52	42	1	8	1	
49	r	1	Total	C	N	O	P	0
			52	42	1	8	1	

- Molecule 50 is S-[2-({N-[(2R)-2-hydroxy-3,3-dimethyl-4-(phosphonooxy)butanoyl]-beta-alanyl}amino)ethyl] dodecanethioate (CCD ID: 8Q1) (formula: C₂₃H₄₅N₂O₈PS) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						AltConf
50	G	1	Total	C	N	O	P	S	0
			35	23	2	8	1	1	
50	X	1	Total	C	N	O	P	S	0
			35	23	2	8	1	1	

- Molecule 51 is CARDIOLIPIN (CCD ID: CDL) (formula: $C_{81}H_{156}O_{17}P_2$) (labeled as "Ligand of Interest" by depositor).



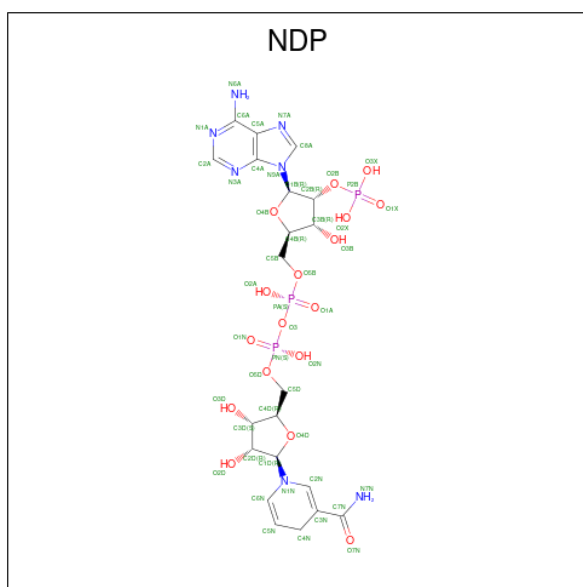
Mol	Chain	Residues	Atoms				AltConf
51	I	1	Total	C	O	P	0
			51	32	17	2	

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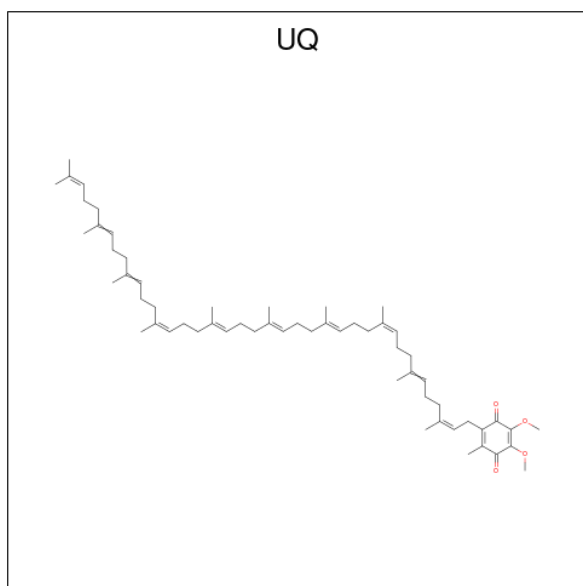
Mol	Chain	Residues	Atoms				AltConf
51	V	1	Total	C	O	P	0
			94	75	17	2	
51	a	1	Total	C	O	P	0
			100	81	17	2	
51	i	1	Total	C	O	P	0
			100	81	17	2	
51	k	1	Total	C	O	P	0
			78	59	17	2	
51	l	1	Total	C	O	P	0
			99	80	17	2	
51	l	1	Total	C	O	P	0
			100	81	17	2	
51	m	1	Total	C	O	P	0
			89	70	17	2	
51	o	1	Total	C	O	P	0
			100	81	17	2	
51	r	1	Total	C	O	P	0
			99	80	17	2	
51	u	1	Total	C	O	P	0
			55	36	17	2	

- Molecule 52 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (CCD ID: NDP) (formula: $C_{21}H_{30}N_7O_{17}P_3$) (labeled as "Ligand of Interest" by depositor).



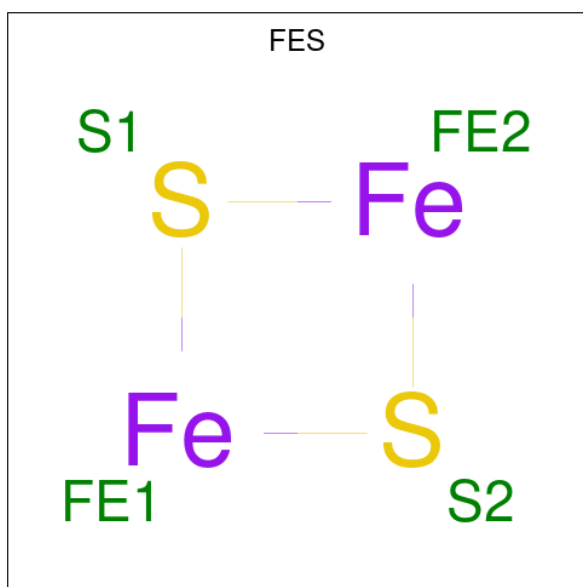
Mol	Chain	Residues	Atoms					AltConf
52	J	1	Total	C	N	O	P	0
			48	21	7	17	3	

- Molecule 53 is Coenzyme Q10, (2Z,6E,10Z,14E,18E,22E,26Z)-isomer (CCD ID: UQ) (formula: C₅₉H₉₀O₄) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			AltConf
53	J	1	Total	C	O	0
			33	29	4	
53	s	1	Total	C	O	0
			38	34	4	

- Molecule 54 is FE2/S2 (INORGANIC) CLUSTER (CCD ID: FES) (formula: Fe₂S₂) (labeled as "Ligand of Interest" by depositor).

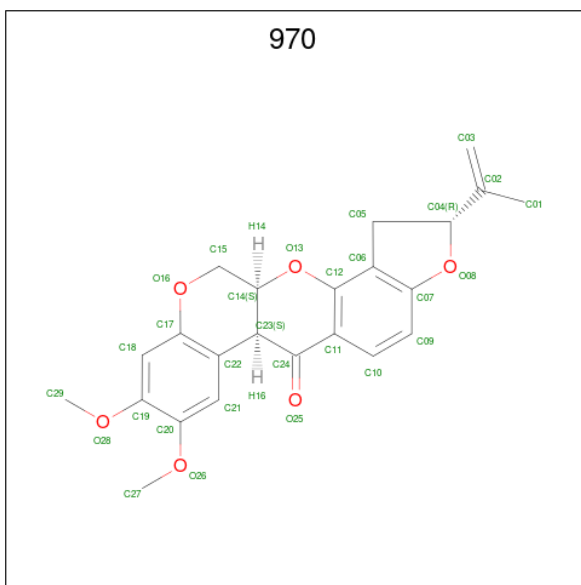


Mol	Chain	Residues	Atoms			AltConf
54	M	1	Total	Fe	S	0
			4	2	2	
54	O	1	Total	Fe	S	0
			4	2	2	

- Molecule 55 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
55	M	1	Total	Mg	0
			1	1	

- Molecule 56 is (2R,6aS,12aS)-8,9-dimethoxy-2-(prop-1-en-2-yl)-1,2,12,12a-tetrahydrofuro[2',3':7,8][1]benzopyrano[2,3-c][1]benzopyran-6(6aH)-one (CCD ID: 970) (formula: C₂₃H₂₂O₆) (labeled as "Ligand of Interest" by depositor).

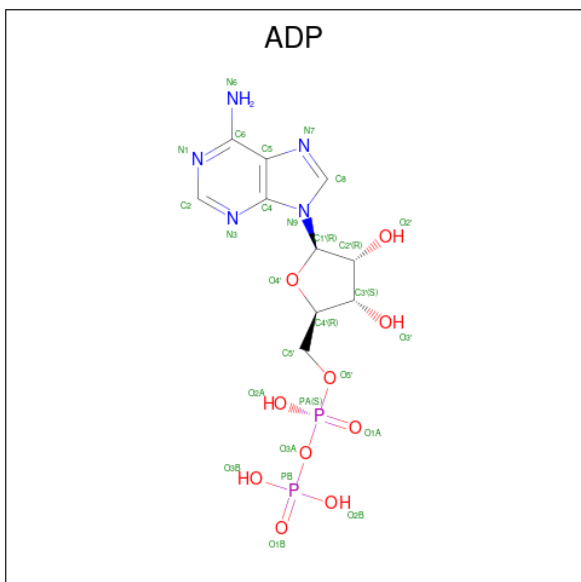


Mol	Chain	Residues	Atoms			AltConf
56	Q	1	Total	C	O	0
			29	23	6	

- Molecule 57 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
57	T	1	Total	Zn	0
			1	1	

- Molecule 58 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂) (labeled as "Ligand of Interest" by depositor).

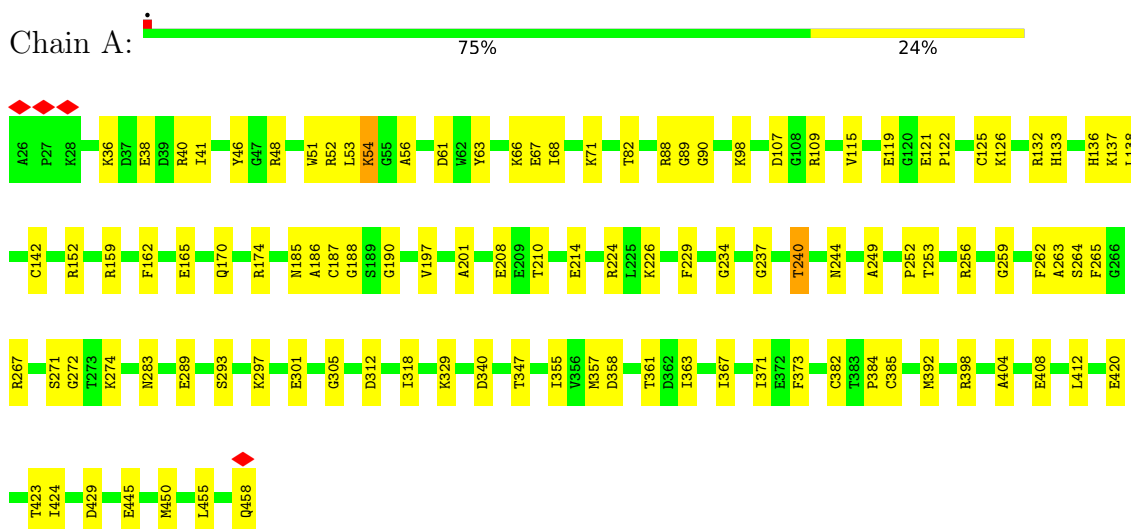


Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
58	w	1	27	10	5	10	2	0

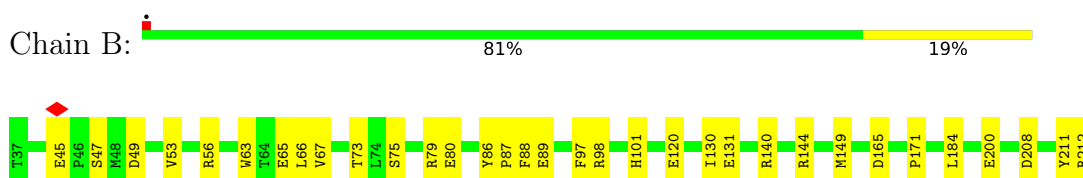
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

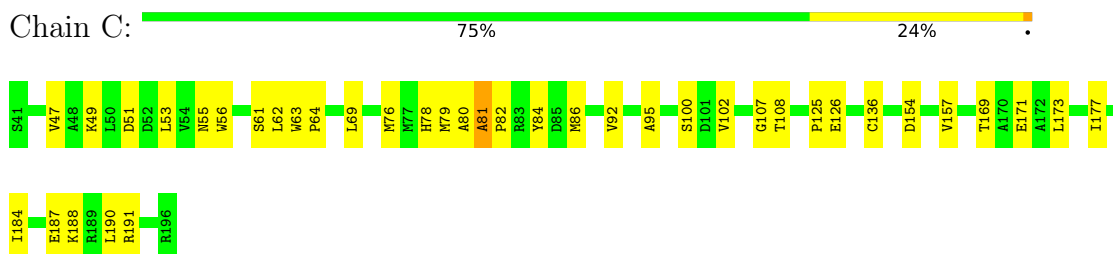
- Molecule 1: NADH dehydrogenase [ubiquinone] flavoprotein 1, mitochondrial



- Molecule 2: NADH dehydrogenase [ubiquinone] iron-sulfur protein 8, mitochondrial



- Molecule 3: NADH dehydrogenase [ubiquinone] iron-sulfur protein 7, mitochondrial



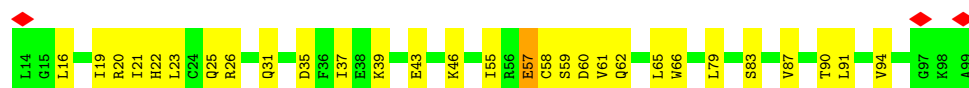
- Molecule 4: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 6

Chain E:  84% 15%



- Molecule 5: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 2

Chain F:  66% 33%



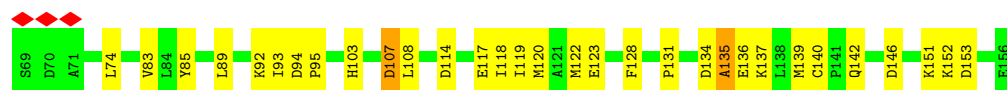
- Molecule 6: Acyl carrier protein, mitochondrial

Chain G:  17% 63% 33% 5%



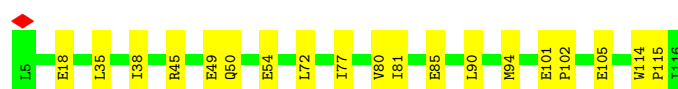
- Molecule 6: Acyl carrier protein, mitochondrial

Chain X:  65% 33%



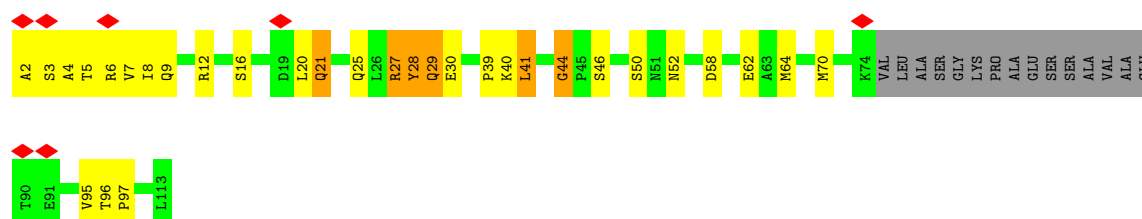
- Molecule 7: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 5

Chain H:  83% 17%

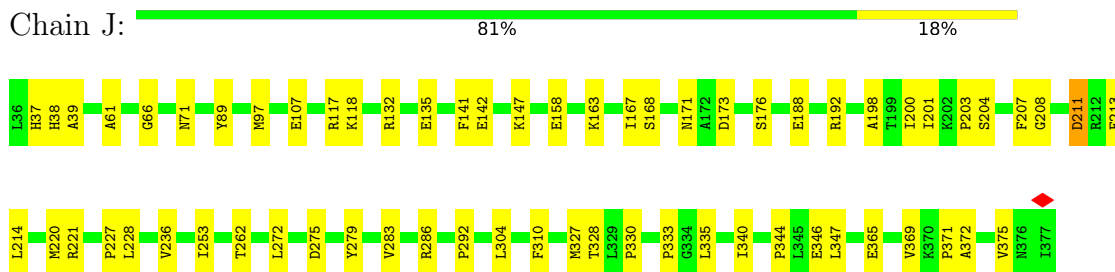


- Molecule 8: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 7

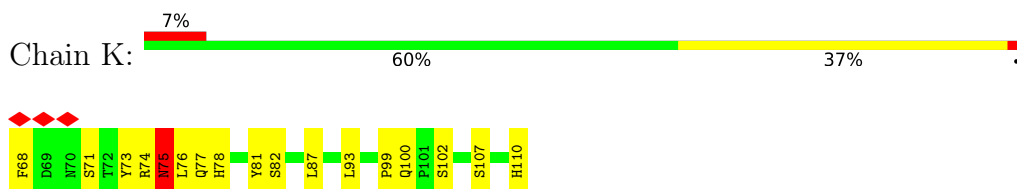
Chain I:  6% 59% 22% 5% 13%



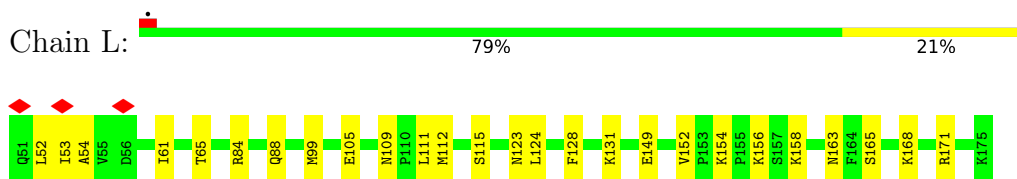
- Molecule 9: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 9, mitochondrial



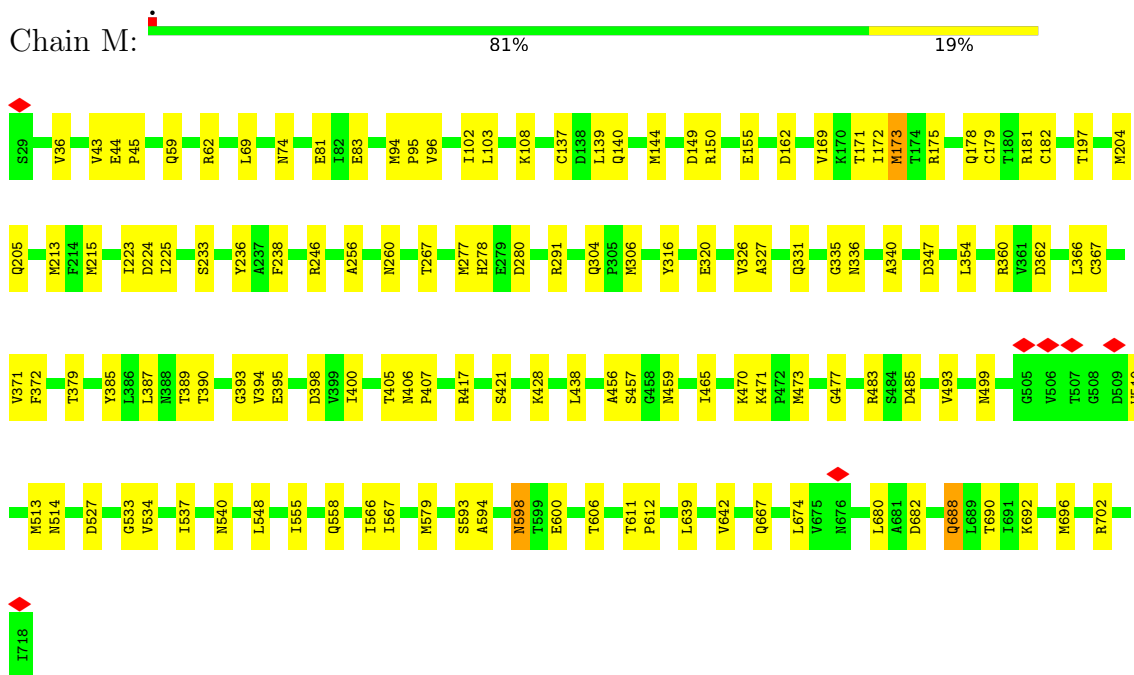
- Molecule 10: NADH dehydrogenase [ubiquinone] flavoprotein 3, mitochondrial



- Molecule 11: NADH dehydrogenase [ubiquinone] iron-sulfur protein 4, mitochondrial

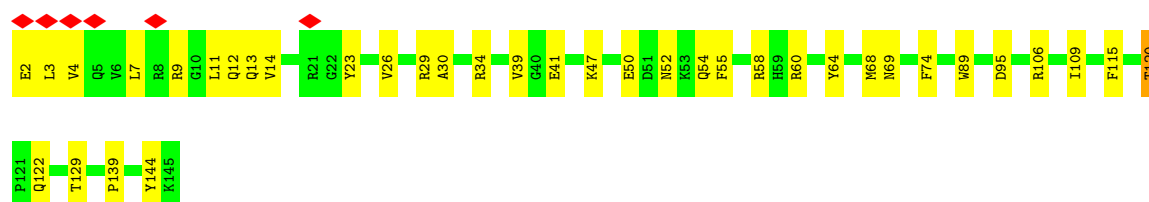


- Molecule 12: NADH-ubiquinone oxidoreductase 75 kDa subunit, mitochondrial



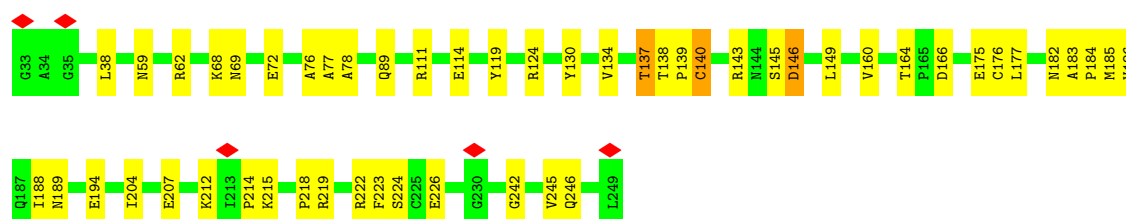
- Molecule 13: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 12

Chain N:  74% 25%



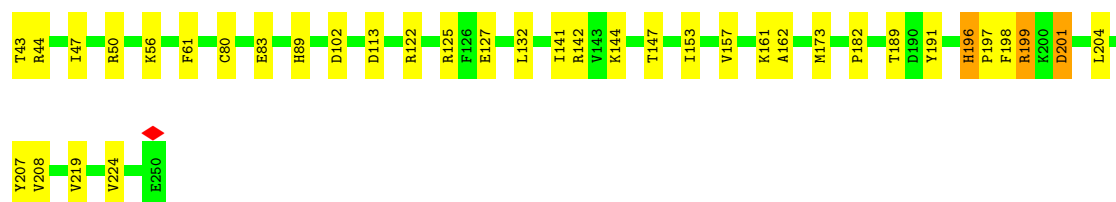
- Molecule 14: NADH dehydrogenase [ubiquinone] flavoprotein 2, mitochondrial

Chain O:  76% 23%



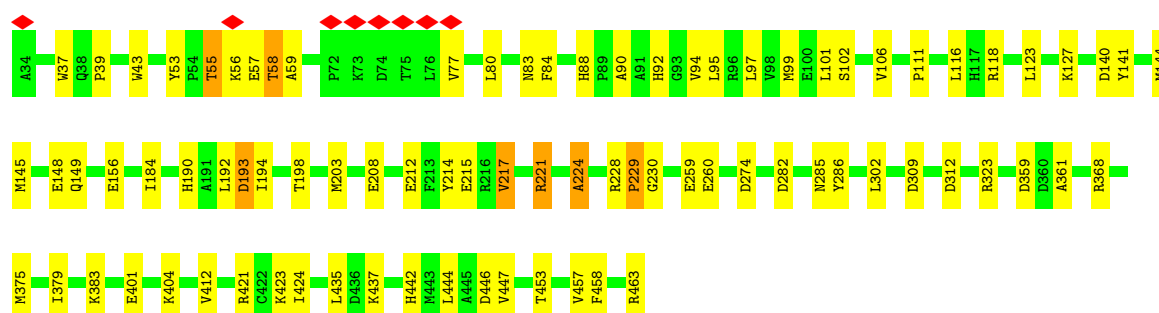
- Molecule 15: NADH dehydrogenase [ubiquinone] iron-sulfur protein 3, mitochondrial

Chain P:  82% 16%



- Molecule 16: NADH dehydrogenase [ubiquinone] iron-sulfur protein 2, mitochondrial

Chain Q:  80% 18%



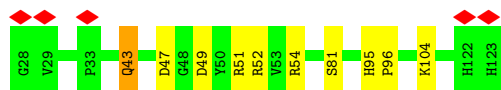
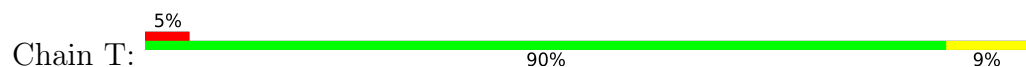
- Molecule 17: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 1

Chain S:  76% 24%

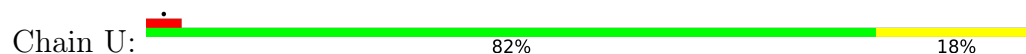




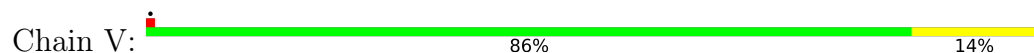
- Molecule 18: NADH dehydrogenase [ubiquinone] iron-sulfur protein 6, mitochondrial



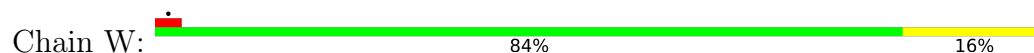
- Molecule 19: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 3



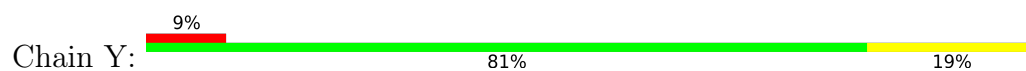
- Molecule 20: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 11



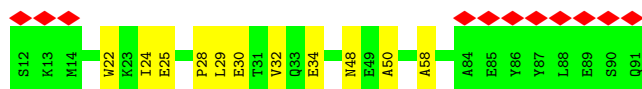
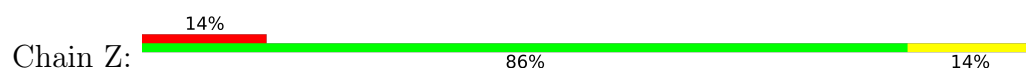
- Molecule 21: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 13



- Molecule 22: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 2, mitochondrial



- Molecule 23: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 3



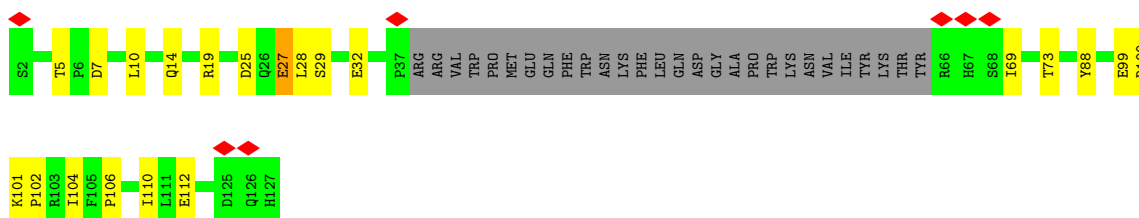
- Molecule 24: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 5, mitochondrial

Chain a: 



- Molecule 25: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 6

Chain b: 



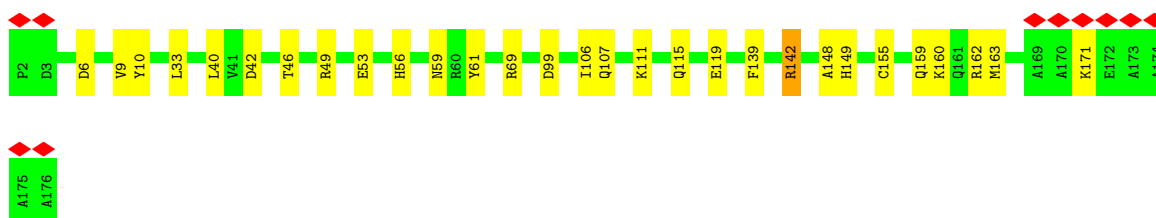
- Molecule 26: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 8, mitochondrial

Chain c: 



- Molecule 27: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 10

Chain d: 

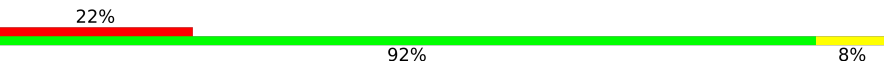


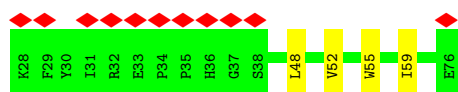
- Molecule 28: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 11, mitochondrial

Chain e: 

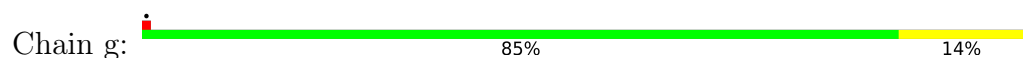


- Molecule 29: NADH dehydrogenase [ubiquinone] 1 subunit C1, mitochondrial

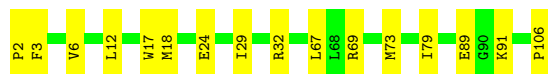
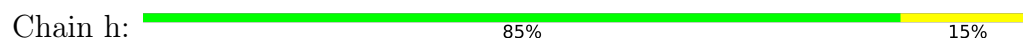
Chain f: 



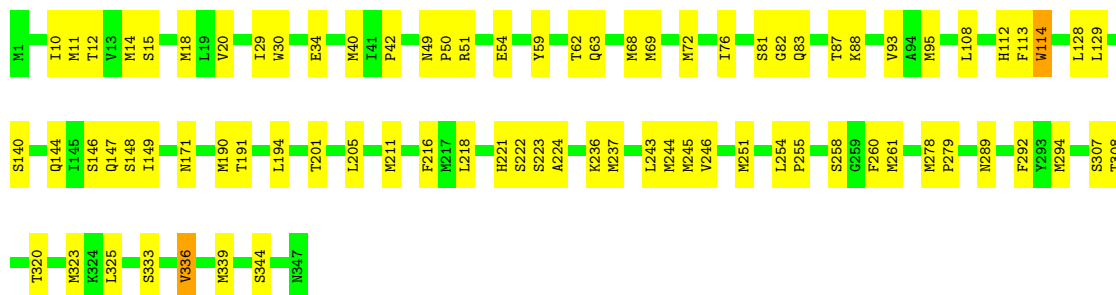
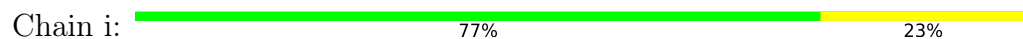
- Molecule 30: NADH dehydrogenase [ubiquinone] 1 subunit C2



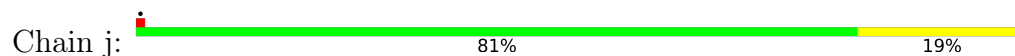
- Molecule 31: NADH dehydrogenase [ubiquinone] iron-sulfur protein 5



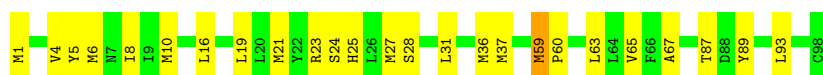
- Molecule 32: NADH-ubiquinone oxidoreductase chain 2



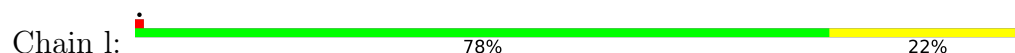
- Molecule 33: NADH-ubiquinone oxidoreductase chain 3

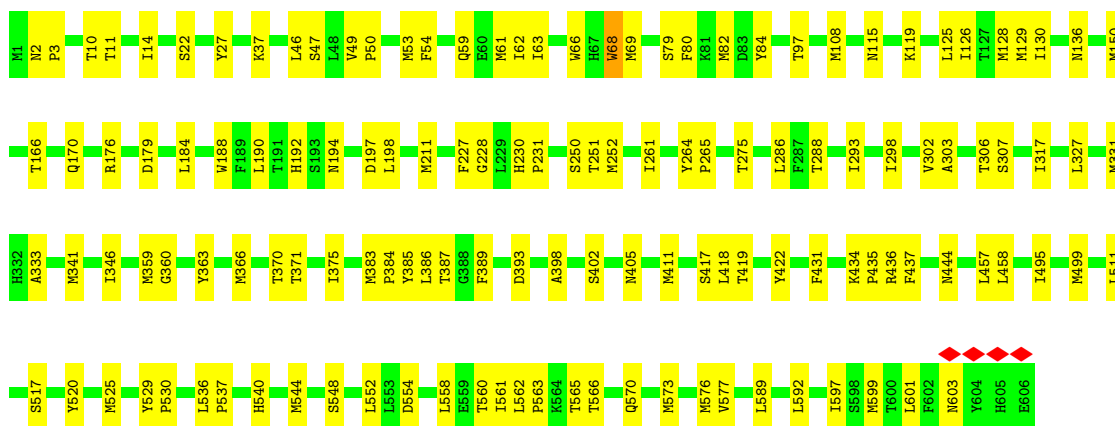


- Molecule 34: NADH-ubiquinone oxidoreductase chain 4L

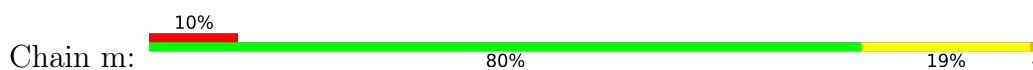


- Molecule 35: NADH-ubiquinone oxidoreductase chain 5

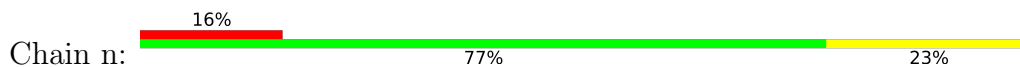




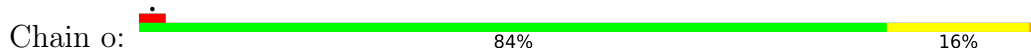
• Molecule 36: NADH-ubiquinone oxidoreductase chain 6



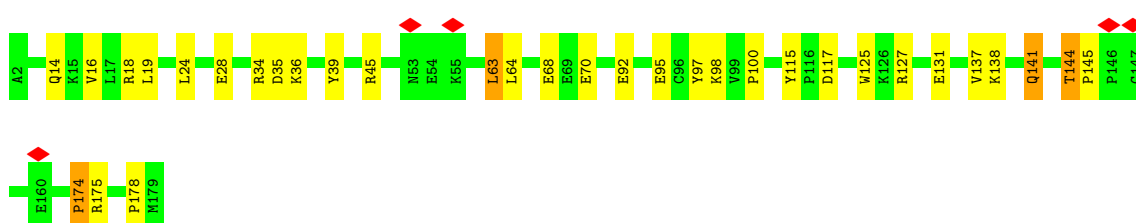
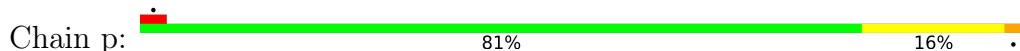
• Molecule 37: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 1



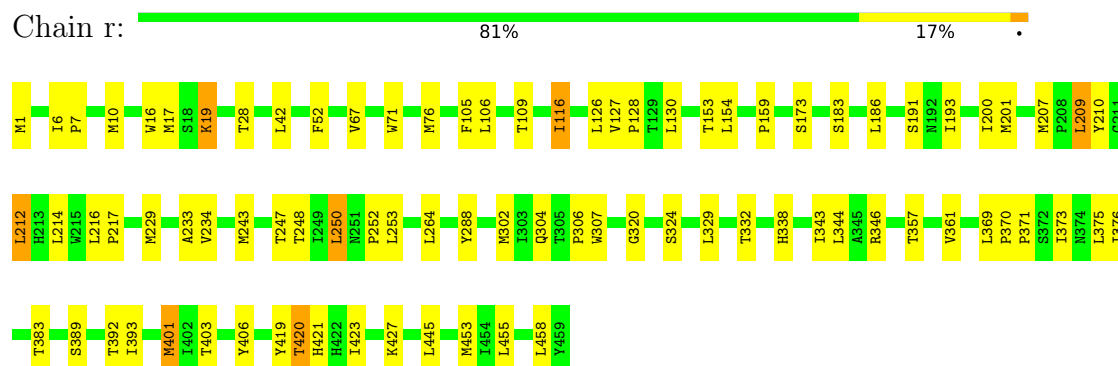
• Molecule 38: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 4



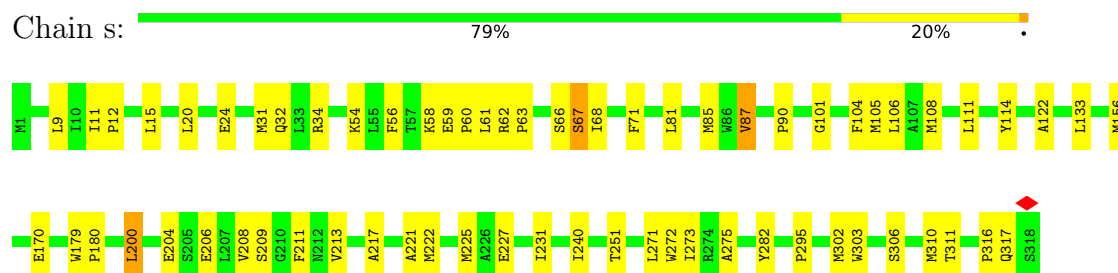
• Molecule 39: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 9



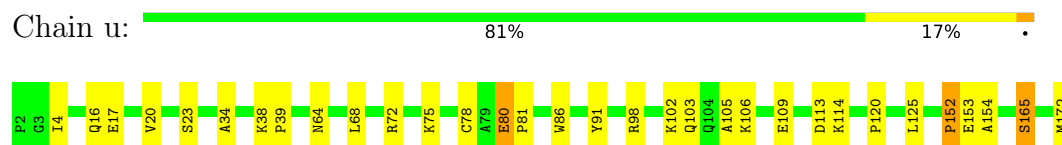
- Molecule 40: NADH-ubiquinone oxidoreductase chain 4



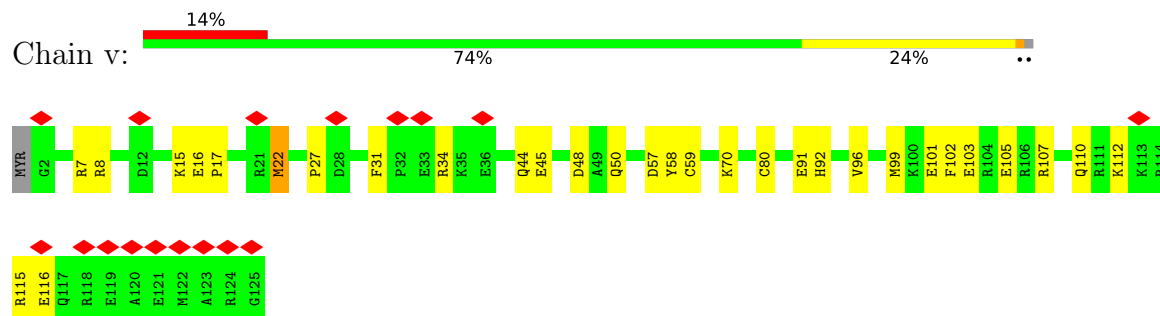
- Molecule 41: NADH-ubiquinone oxidoreductase chain 1



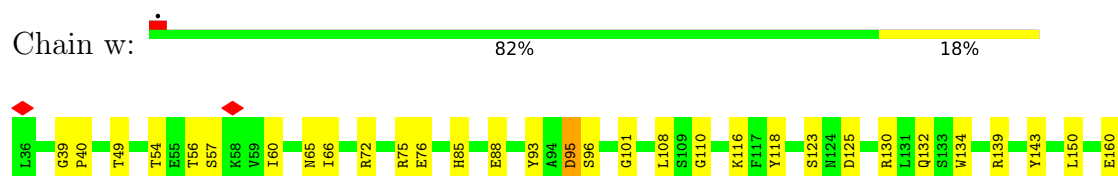
- Molecule 42: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 8



- Molecule 43: NADH dehydrogenase [ubiquinone] 1 beta subcomplex subunit 7



- Molecule 44: NADH dehydrogenase [ubiquinone] 1 alpha subcomplex subunit 10, mitochondrial





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	326044	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1300	Depositor
Maximum defocus (nm)	1800	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	0.248	Depositor
Minimum map value	-0.137	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.007	Depositor
Recommended contour level	0.0271	Depositor
Map size (Å)	333.002, 333.002, 333.002	wwPDB
Map dimensions	310, 310, 310	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.0742, 1.0742, 1.0742	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: SF4, NDP, PLX, FMN, NAI, PEE, 970, MG, UQ, FES, 8Q1, 2MR, ZN, CDL, ADP

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# $ Z > 5$	RMSZ	# $ Z > 5$
1	A	0.24	0/3406	0.46	0/4603
2	B	0.26	0/1443	0.46	2/1952 (0.1%)
3	C	0.31	0/1279	0.52	2/1730 (0.1%)
4	E	0.22	0/995	0.44	1/1340 (0.1%)
5	F	0.27	0/695	0.56	1/936 (0.1%)
6	G	0.22	0/705	0.56	1/956 (0.1%)
6	X	0.26	0/708	0.70	2/959 (0.2%)
7	H	0.23	0/929	0.53	0/1258
8	I	0.29	0/798	0.72	3/1079 (0.3%)
9	J	0.23	0/2828	0.45	1/3834 (0.0%)
10	K	0.29	0/377	0.68	1/509 (0.2%)
11	L	0.24	0/1039	0.38	0/1403
12	M	0.29	0/5381	0.60	7/7291 (0.1%)
13	N	0.19	0/1245	0.38	0/1694
14	O	0.24	0/1711	0.53	0/2328
15	P	0.30	0/1789	0.58	3/2436 (0.1%)
16	Q	0.38	4/3538 (0.1%)	0.55	6/4796 (0.1%)
17	S	0.29	0/581	0.55	0/781
18	T	0.23	0/755	0.42	0/1018
19	U	0.18	0/664	0.33	0/912
20	V	0.22	0/1042	0.45	0/1411
21	W	0.22	0/1192	0.44	0/1610
22	Y	0.17	0/610	0.39	0/836
23	Z	0.15	0/660	0.34	0/892
24	a	0.24	0/1184	0.49	1/1603 (0.1%)
25	b	0.21	0/844	0.40	0/1149
26	c	0.27	0/1371	0.62	4/1875 (0.2%)
27	d	0.23	0/1494	0.48	1/2015 (0.0%)
28	e	0.23	0/891	0.63	2/1210 (0.2%)
29	f	0.18	0/385	0.38	0/522
30	g	0.22	0/1036	0.43	2/1401 (0.1%)
31	h	0.25	0/889	0.46	0/1190

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
32	i	0.28	0/2773	0.53	3/3768 (0.1%)
33	j	0.24	0/938	0.40	0/1281
34	k	0.29	0/759	0.59	0/1029
35	l	0.23	0/4926	0.47	3/6700 (0.0%)
36	m	0.25	0/1307	0.60	2/1777 (0.1%)
37	n	0.17	0/491	0.35	0/663
38	o	0.24	0/1092	0.55	3/1481 (0.2%)
39	p	0.20	0/1590	0.43	2/2155 (0.1%)
40	r	0.26	0/3715	0.49	2/5067 (0.0%)
41	s	0.29	0/2581	0.60	6/3529 (0.2%)
42	u	0.26	0/1436	0.53	0/1938
43	v	0.19	0/1060	0.41	0/1421
44	w	0.18	0/2646	0.37	0/3584
All	All	0.26	4/67778 (0.0%)	0.51	61/91922 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
16	Q	193	ASP	C-N	8.54	1.44	1.33
16	Q	141	TYR	C-N	-7.96	1.25	1.33
16	Q	140	ASP	C-N	6.68	1.45	1.33
16	Q	192	LEU	C-N	-5.05	1.27	1.33

The worst 5 of 61 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
12	M	74	ASN	N-CA-C	9.81	122.06	111.36
41	s	206	GLU	N-CA-C	9.80	122.05	111.36
28	e	143	ASP	CA-C-N	9.60	129.71	119.05
28	e	143	ASP	C-N-CA	9.60	129.71	119.05
36	m	23	LYS	CA-C-N	9.54	131.76	119.84

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3330	0	3292	82	0
2	B	1412	0	1363	25	0
3	C	1248	0	1254	40	0
4	E	971	0	975	17	0
5	F	684	0	700	23	0
6	G	693	0	671	35	0
6	X	696	0	680	25	0
7	H	910	0	950	12	0
8	I	780	0	808	35	0
9	J	2751	0	2773	43	0
10	K	366	0	338	16	0
11	L	1016	0	1016	21	0
12	M	5293	0	5326	92	0
13	N	1204	0	1162	30	0
14	O	1671	0	1674	42	0
15	P	1738	0	1693	34	0
16	Q	3459	0	3396	68	0
17	S	566	0	561	19	0
18	T	741	0	702	7	0
19	U	643	0	642	16	0
20	V	1021	0	1025	16	0
21	W	1161	0	1144	20	0
22	Y	584	0	529	14	0
23	Z	641	0	620	9	0
24	a	1151	0	1164	22	0
25	b	819	0	835	19	0
26	c	1315	0	1208	23	0
27	d	1461	0	1429	34	0
28	e	867	0	817	34	0
29	f	377	0	353	2	0
30	g	1005	0	999	25	0
31	h	867	0	871	15	0
32	i	2710	0	2874	68	0
33	j	914	0	951	29	0
34	k	748	0	799	26	0
35	l	4797	0	4935	107	0
36	m	1276	0	1243	43	0
37	n	479	0	486	14	0
38	o	1062	0	1072	19	0
39	p	1534	0	1470	31	0
40	r	3624	0	3832	62	0
41	s	2508	0	2607	67	0
42	u	1398	0	1374	26	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
43	v	1036	0	992	26	0
44	w	2586	0	2542	43	0
45	A	8	0	0	1	0
45	B	16	0	0	0	0
45	C	8	0	0	1	0
45	M	16	0	0	3	0
46	A	31	0	19	5	0
47	A	44	0	27	5	0
48	B	51	0	82	4	0
48	C	47	0	71	7	0
48	U	51	0	82	18	0
48	V	1	0	0	0	0
48	W	41	0	59	4	0
48	j	41	0	59	15	0
48	l	143	0	217	32	0
48	r	51	0	82	8	0
49	C	52	0	88	8	0
49	J	52	0	88	11	0
49	a	52	0	88	1	0
49	g	52	0	88	7	0
49	j	52	0	88	3	0
49	r	104	0	176	11	0
50	G	35	0	0	1	0
50	X	35	0	0	7	0
51	I	51	0	46	18	0
51	V	94	0	138	10	0
51	a	100	0	156	6	0
51	i	100	0	156	19	0
51	k	78	0	106	5	0
51	l	199	0	307	51	0
51	m	89	0	125	5	0
51	o	100	0	156	9	0
51	r	99	0	151	7	0
51	u	55	0	54	9	0
52	J	48	0	26	1	0
53	J	33	0	39	5	0
53	s	38	0	47	6	0
54	M	4	0	0	0	0
54	O	4	0	0	0	0
55	M	1	0	0	0	0
56	Q	29	0	0	0	0
57	T	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
58	w	27	0	11	8	0
All	All	68246	0	68979	1372	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 10.

The worst 5 of 1372 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
9:J:220:MET:CE	9:J:227:PRO:HD2	1.58	1.32
47:A:503:NAI:C1B	47:A:503:NAI:O4B	1.63	1.22
6:G:105:MET:HG2	6:G:139:MET:CE	1.68	1.21
1:A:66:LYS:HE3	1:A:188:GLY:O	1.42	1.18
49:J:403:PLX:H131	48:j:201:PEE:C37	1.76	1.15

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	431/433 (100%)	414 (96%)	15 (4%)	2 (0%)	24	46
2	B	174/176 (99%)	171 (98%)	3 (2%)	0	100	100
3	C	154/156 (99%)	144 (94%)	10 (6%)	0	100	100
4	E	113/115 (98%)	108 (96%)	4 (4%)	1 (1%)	14	30
5	F	84/86 (98%)	81 (96%)	2 (2%)	1 (1%)	10	23
6	G	86/88 (98%)	80 (93%)	6 (7%)	0	100	100
6	X	86/88 (98%)	83 (96%)	3 (4%)	0	100	100
7	H	110/112 (98%)	105 (96%)	4 (4%)	1 (1%)	14	30

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
8	I	93/112 (83%)	84 (90%)	7 (8%)	2 (2%)	5	10
9	J	340/342 (99%)	329 (97%)	10 (3%)	1 (0%)	36	58
10	K	41/43 (95%)	39 (95%)	1 (2%)	1 (2%)	4	9
11	L	123/125 (98%)	121 (98%)	2 (2%)	0	100	100
12	M	688/690 (100%)	665 (97%)	23 (3%)	0	100	100
13	N	142/144 (99%)	138 (97%)	4 (3%)	0	100	100
14	O	215/217 (99%)	204 (95%)	10 (5%)	1 (0%)	24	46
15	P	206/208 (99%)	198 (96%)	8 (4%)	0	100	100
16	Q	427/430 (99%)	410 (96%)	16 (4%)	1 (0%)	43	66
17	S	68/70 (97%)	64 (94%)	4 (6%)	0	100	100
18	T	94/96 (98%)	93 (99%)	1 (1%)	0	100	100
19	U	81/83 (98%)	77 (95%)	4 (5%)	0	100	100
20	V	138/140 (99%)	134 (97%)	4 (3%)	0	100	100
21	W	140/142 (99%)	133 (95%)	7 (5%)	0	100	100
22	Y	65/67 (97%)	62 (95%)	3 (5%)	0	100	100
23	Z	78/80 (98%)	73 (94%)	5 (6%)	0	100	100
24	a	136/138 (99%)	129 (95%)	7 (5%)	0	100	100
25	b	94/126 (75%)	88 (94%)	6 (6%)	0	100	100
26	c	154/156 (99%)	143 (93%)	10 (6%)	1 (1%)	21	42
27	d	173/175 (99%)	170 (98%)	3 (2%)	0	100	100
28	e	102/104 (98%)	97 (95%)	5 (5%)	0	100	100
29	f	47/49 (96%)	42 (89%)	5 (11%)	0	100	100
30	g	120/122 (98%)	115 (96%)	5 (4%)	0	100	100
31	h	103/105 (98%)	97 (94%)	6 (6%)	0	100	100
32	i	345/347 (99%)	332 (96%)	12 (4%)	1 (0%)	36	58
33	j	113/115 (98%)	109 (96%)	4 (4%)	0	100	100
34	k	96/98 (98%)	95 (99%)	1 (1%)	0	100	100
35	l	604/606 (100%)	587 (97%)	17 (3%)	0	100	100
36	m	173/175 (99%)	154 (89%)	19 (11%)	0	100	100
37	n	54/56 (96%)	54 (100%)	0	0	100	100
38	o	126/128 (98%)	119 (94%)	7 (6%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
39	p	176/178 (99%)	171 (97%)	4 (2%)	1 (1%)	21	42
40	r	457/459 (100%)	451 (99%)	6 (1%)	0	100	100
41	s	316/318 (99%)	305 (96%)	11 (4%)	0	100	100
42	u	169/171 (99%)	163 (96%)	5 (3%)	1 (1%)	21	42
43	v	122/125 (98%)	117 (96%)	4 (3%)	1 (1%)	16	34
44	w	318/320 (99%)	309 (97%)	9 (3%)	0	100	100
All	All	8175/8314 (98%)	7857 (96%)	302 (4%)	16 (0%)	44	66

5 of 16 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
5	F	60	ASP
10	K	75	ASN
1	A	264	SER
8	I	29	GLN
9	J	38	HIS

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	346/346 (100%)	341 (99%)	5 (1%)	59	81
2	B	151/151 (100%)	150 (99%)	1 (1%)	76	89
3	C	132/132 (100%)	131 (99%)	1 (1%)	73	88
4	E	107/107 (100%)	105 (98%)	2 (2%)	50	75
5	F	74/76 (97%)	73 (99%)	1 (1%)	59	81
6	G	76/81 (94%)	69 (91%)	7 (9%)	8	19
6	X	77/81 (95%)	75 (97%)	2 (3%)	40	68
7	H	99/99 (100%)	99 (100%)	0	100	100
8	I	87/97 (90%)	83 (95%)	4 (5%)	24	49
9	J	296/296 (100%)	294 (99%)	2 (1%)	76	89

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
10	K	42/42 (100%)	41 (98%)	1 (2%)	43	70
11	L	113/113 (100%)	111 (98%)	2 (2%)	51	76
12	M	579/580 (100%)	574 (99%)	5 (1%)	70	87
13	N	130/130 (100%)	126 (97%)	4 (3%)	35	63
14	O	183/183 (100%)	178 (97%)	5 (3%)	39	67
15	P	190/190 (100%)	187 (98%)	3 (2%)	55	79
16	Q	370/370 (100%)	364 (98%)	6 (2%)	55	79
17	S	57/58 (98%)	56 (98%)	1 (2%)	51	76
18	T	79/79 (100%)	77 (98%)	2 (2%)	42	69
19	U	69/69 (100%)	68 (99%)	1 (1%)	59	81
20	V	101/101 (100%)	98 (97%)	3 (3%)	36	64
21	W	121/123 (98%)	121 (100%)	0	100	100
22	Y	62/62 (100%)	62 (100%)	0	100	100
23	Z	62/62 (100%)	62 (100%)	0	100	100
24	a	121/121 (100%)	121 (100%)	0	100	100
25	b	90/119 (76%)	89 (99%)	1 (1%)	65	84
26	c	141/141 (100%)	140 (99%)	1 (1%)	76	89
27	d	155/155 (100%)	154 (99%)	1 (1%)	78	91
28	e	96/96 (100%)	92 (96%)	4 (4%)	26	52
29	f	35/45 (78%)	35 (100%)	0	100	100
30	g	108/109 (99%)	107 (99%)	1 (1%)	70	87
31	h	93/93 (100%)	93 (100%)	0	100	100
32	i	311/311 (100%)	306 (98%)	5 (2%)	55	79
33	j	100/100 (100%)	99 (99%)	1 (1%)	68	86
34	k	85/85 (100%)	83 (98%)	2 (2%)	43	70
35	l	536/540 (99%)	532 (99%)	4 (1%)	76	89
36	m	127/141 (90%)	127 (100%)	0	100	100
37	n	53/53 (100%)	53 (100%)	0	100	100
38	o	113/113 (100%)	113 (100%)	0	100	100
39	p	159/159 (100%)	156 (98%)	3 (2%)	50	75
40	r	409/410 (100%)	399 (98%)	10 (2%)	43	70

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
41	s	275/275 (100%)	273 (99%)	2 (1%)	76	89
42	u	153/153 (100%)	147 (96%)	6 (4%)	28	55
43	v	106/111 (96%)	105 (99%)	1 (1%)	70	87
44	w	282/283 (100%)	279 (99%)	3 (1%)	65	84
All	All	7151/7241 (99%)	7048 (99%)	103 (1%)	57	81

5 of 103 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
6	X	140	CYS
33	j	5	LEU
43	v	22	MET
26	c	159	LYS
30	g	69	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 84 such sidechains are listed below:

Mol	Chain	Res	Type
32	i	172	GLN
37	n	14	HIS
33	j	108	GLN
35	l	270	ASN
40	r	81	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
16	2MR	Q	118	16	10,12,13	2.04	2 (20%)	5,13,15	6.14	3 (60%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
16	2MR	Q	118	16	-	3/10/13/15	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
16	Q	118	2MR	CZ-NE	5.63	1.46	1.34
16	Q	118	2MR	CQ2-NH2	-2.08	1.41	1.45

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
16	Q	118	2MR	NE-CZ-NH2	12.39	130.84	119.48
16	Q	118	2MR	CD-NE-CZ	4.46	131.74	123.36
16	Q	118	2MR	CQ2-NH2-CZ	3.43	131.01	123.65

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
16	Q	118	2MR	NE-CD-CG-CB
16	Q	118	2MR	CA-CB-CG-CD
16	Q	118	2MR	CG-CD-NE-CZ

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 47 ligands modelled in this entry, 1 is modelled with single atom and 2 are monoatomic - leaving 44 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
51	CDL	a	201	-	99,99,99	1.11	8 (8%)	105,111,111	0.90	4 (3%)
46	FMN	A	502	-	33,33,33	1.10	2 (6%)	48,50,50	1.28	8 (16%)
51	CDL	l	702	-	99,99,99	0.92	4 (4%)	105,111,111	1.11	8 (7%)
48	PEE	r	501	-	50,50,50	1.17	6 (12%)	53,55,55	0.97	2 (3%)
50	8Q1	G	201	-	32,34,34	2.29	7 (21%)	39,43,43	1.84	12 (30%)
45	SF4	M	802	12	0,12,12	-	-	-		
52	NDP	J	401	-	51,52,52	1.18	5 (9%)	71,80,80	1.53	10 (14%)
56	970	Q	501	-	33,33,33	4.85	14 (42%)	48,50,50	2.44	22 (45%)
48	PEE	l	704	-	49,49,50	1.18	6 (12%)	52,54,55	0.97	2 (3%)
45	SF4	M	801	12	0,12,12	-	-	-		
49	PLX	C	303	-	51,51,51	0.61	0	53,59,59	0.75	1 (1%)
51	CDL	I	201	-	50,50,99	1.29	4 (8%)	56,62,111	1.37	6 (10%)
45	SF4	C	301	3	0,12,12	-	-	-		
45	SF4	B	302	2	0,12,12	-	-	-		
49	PLX	a	202	-	51,51,51	1.21	4 (7%)	53,59,59	0.64	1 (1%)
51	CDL	r	504	-	98,98,99	1.10	8 (8%)	104,110,111	0.87	4 (3%)
48	PEE	C	302	-	46,46,50	1.21	6 (13%)	49,51,55	1.01	2 (4%)
53	UQ	J	402	-	33,33,63	3.50	8 (24%)	42,43,79	2.80	14 (33%)
49	PLX	J	403	-	51,51,51	1.18	4 (7%)	53,59,59	0.64	1 (1%)
48	PEE	l	705	-	45,45,50	1.25	6 (13%)	48,50,55	1.00	2 (4%)
51	CDL	o	201	-	99,99,99	1.10	9 (9%)	105,111,111	0.89	5 (4%)
49	PLX	r	502	-	51,51,51	1.20	5 (9%)	53,59,59	0.64	1 (1%)
50	8Q1	X	201	-	32,34,34	2.29	7 (21%)	39,43,43	1.73	11 (28%)
48	PEE	W	201	-	40,40,50	1.16	5 (12%)	43,45,55	1.04	2 (4%)
49	PLX	g	201	-	51,51,51	1.18	3 (5%)	53,59,59	0.69	1 (1%)
51	CDL	i	401	-	99,99,99	0.93	4 (4%)	105,111,111	1.02	4 (3%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
54	FES	M	803	12	0,4,4	-	-	-		
54	FES	O	301	14	0,4,4	-	-	-		
51	CDL	u	201	-	54,54,99	1.23	4 (7%)	60,66,111	1.26	5 (8%)
48	PEE	B	303	-	50,50,50	1.17	6 (12%)	53,55,55	1.01	2 (3%)
45	SF4	A	501	1	0,12,12	-	-	-		
51	CDL	V	201	-	93,93,99	1.14	9 (9%)	99,105,111	0.87	4 (4%)
51	CDL	k	101	-	77,77,99	1.20	7 (9%)	83,89,111	0.96	4 (4%)
48	PEE	U	101	-	50,50,50	1.17	5 (10%)	53,55,55	0.94	2 (3%)
48	PEE	l	703	-	46,46,50	1.21	6 (13%)	49,51,55	1.05	3 (6%)
53	UQ	s	401	-	38,38,63	3.64	11 (28%)	48,49,79	2.77	17 (35%)
47	NAI	A	503	-	47,48,48	3.98	22 (46%)	64,73,73	1.69	12 (18%)
49	PLX	j	202	-	51,51,51	1.19	4 (7%)	53,59,59	0.61	1 (1%)
51	CDL	l	701	-	98,98,99	0.92	4 (4%)	104,110,111	1.10	8 (7%)
49	PLX	r	503	-	51,51,51	1.20	5 (9%)	53,59,59	0.56	1 (1%)
51	CDL	m	201	-	88,88,99	0.98	4 (4%)	94,100,111	1.11	6 (6%)
58	ADP	w	401	-	28,29,29	3.18	9 (32%)	43,45,45	1.87	8 (18%)
45	SF4	B	301	2	0,12,12	-	-	-		
48	PEE	j	201	-	40,40,50	1.18	5 (12%)	43,45,55	1.06	2 (4%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
51	CDL	a	201	-	-	60/110/110/110	-
46	FMN	A	502	-	-	8/18/18/18	0/3/3/3
51	CDL	l	702	-	-	38/110/110/110	-
48	PEE	r	501	-	-	33/54/54/54	-
50	8Q1	G	201	-	-	17/41/41/41	-
52	NDP	J	401	-	-	7/34/77/77	0/5/5/5
45	SF4	M	802	12	-	-	0/6/5/5
56	970	Q	501	-	-	7/8/41/41	0/5/5/5
48	PEE	l	704	-	-	22/53/53/54	-
45	SF4	M	801	12	-	-	0/6/5/5
49	PLX	C	303	-	-	19/55/55/55	-
51	CDL	I	201	-	-	27/61/61/110	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
45	SF4	B	302	2	-	-	0/6/5/5
45	SF4	C	301	3	-	-	0/6/5/5
49	PLX	a	202	-	-	32/55/55/55	-
51	CDL	r	504	-	-	58/109/109/110	-
48	PEE	C	302	-	-	27/50/50/54	-
53	UQ	J	402	-	-	14/27/51/87	0/1/1/1
49	PLX	J	403	-	-	27/55/55/55	-
48	PEE	l	705	-	-	21/49/49/54	-
51	CDL	o	201	-	-	56/110/110/110	-
49	PLX	r	502	-	-	29/55/55/55	-
50	8Q1	X	201	-	-	28/41/41/41	-
48	PEE	W	201	-	-	23/44/44/54	-
49	PLX	g	201	-	-	37/55/55/55	-
51	CDL	i	401	-	-	35/110/110/110	-
54	FES	M	803	12	-	-	0/1/1/1
54	FES	O	301	14	-	-	0/1/1/1
51	CDL	u	201	-	-	17/65/65/110	-
48	PEE	B	303	-	-	25/54/54/54	-
45	SF4	A	501	1	-	-	0/6/5/5
51	CDL	V	201	-	-	58/104/104/110	-
51	CDL	k	101	-	-	40/88/88/110	-
48	PEE	U	101	-	-	27/54/54/54	-
48	PEE	l	703	-	-	25/50/50/54	-
53	UQ	s	401	-	-	13/33/57/87	0/1/1/1
47	NAI	A	503	-	-	4/29/72/72	0/5/5/5
49	PLX	j	202	-	-	33/55/55/55	-
51	CDL	l	701	-	-	38/109/109/110	-
49	PLX	r	503	-	-	38/55/55/55	-
51	CDL	m	201	-	-	34/99/99/110	-
58	ADP	w	401	-	-	6/16/32/32	0/3/3/3
45	SF4	B	301	2	-	-	0/6/5/5
48	PEE	j	201	-	-	17/44/44/54	-

The worst 5 of 226 bond length outliers are listed below:

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
56	Q	501	970	O16-C17	18.66	1.58	1.37
56	Q	501	970	C14-C23	-12.07	1.41	1.52
47	A	503	NAI	C3D-C4D	-10.53	1.26	1.53
53	s	401	UQ	C18-C19	9.98	1.56	1.33
53	J	402	UQ	C18-C19	9.92	1.55	1.33

The worst 5 of 198 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
53	J	402	UQ	C7-C8-C9	-7.93	113.16	126.83
56	Q	501	970	O08-C07-C06	-7.79	108.35	112.99
53	s	401	UQ	C7-C8-C9	-7.60	113.74	126.83
53	J	402	UQ	C12-C13-C14	-6.74	112.19	127.62
53	J	402	UQ	C17-C18-C19	-6.63	112.44	127.62

There are no chirality outliers.

5 of 1000 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
46	A	502	FMN	N10-C1'-C2'-O2'
46	A	502	FMN	N10-C1'-C2'-C3'
46	A	502	FMN	C3'-C4'-C5'-O5'
46	A	502	FMN	O4'-C4'-C5'-O5'
47	A	503	NAI	C5B-O5B-PA-O1A

There are no ring outliers.

38 monomers are involved in 298 short contacts:

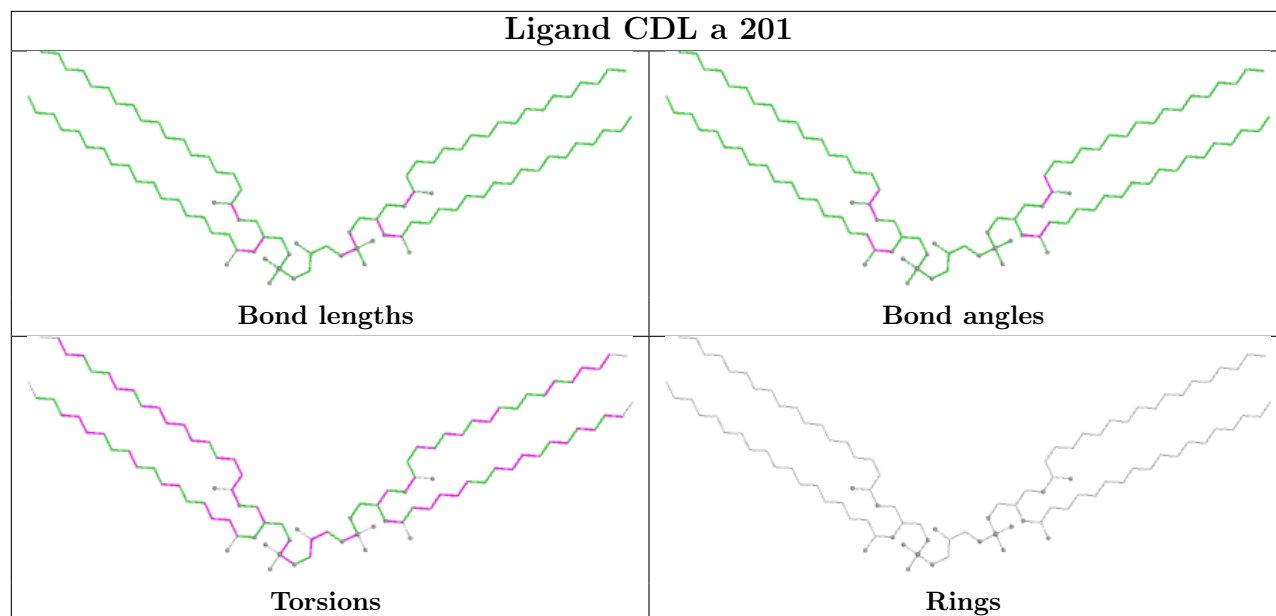
Mol	Chain	Res	Type	Clashes	Symm-Clashes
51	a	201	CDL	6	0
46	A	502	FMN	5	0
51	l	702	CDL	17	0
48	r	501	PEE	8	0
50	G	201	8Q1	1	0
45	M	802	SF4	3	0
52	J	401	NDP	1	0
48	l	704	PEE	4	0
49	C	303	PLX	8	0
51	I	201	CDL	18	0

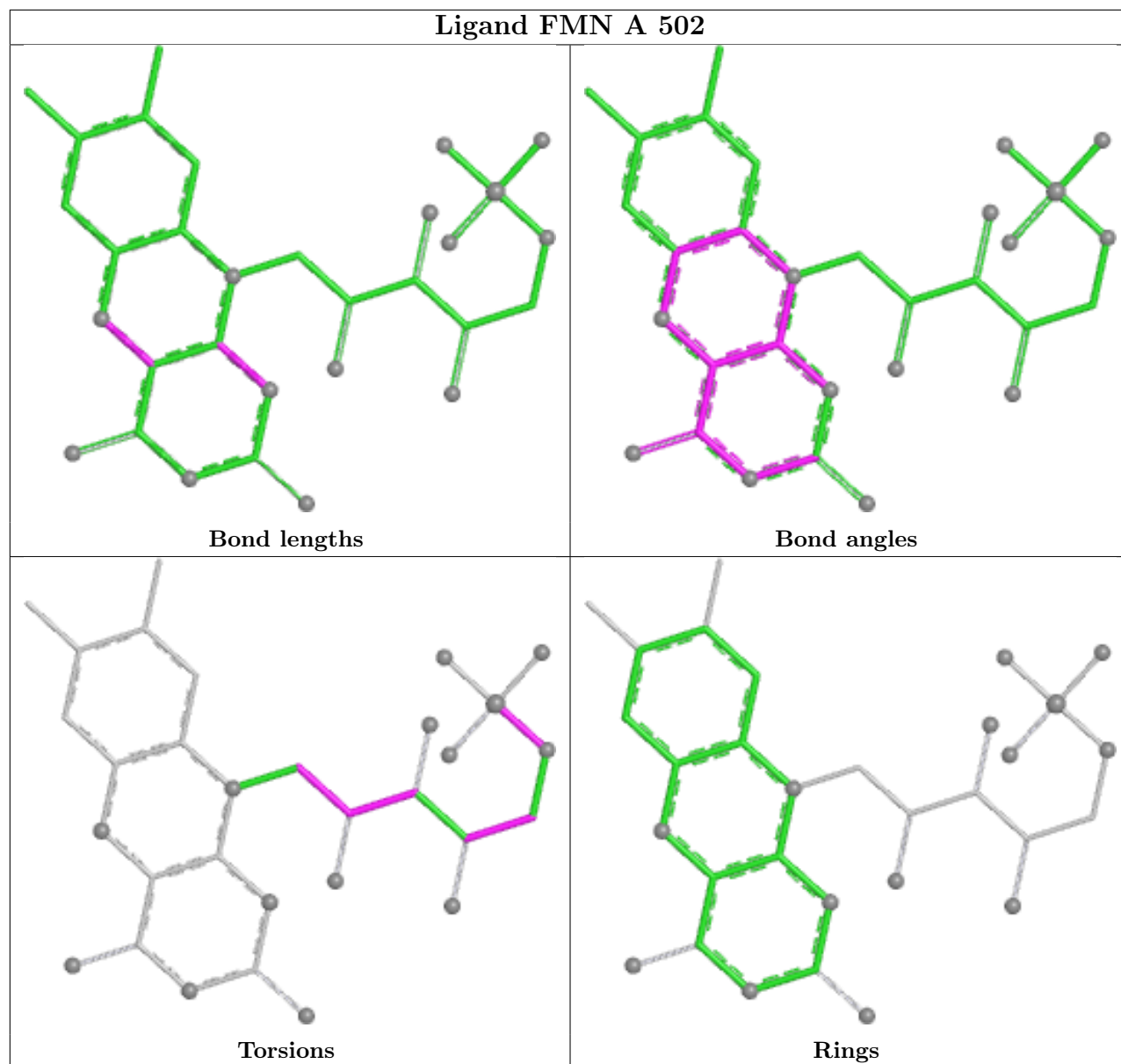
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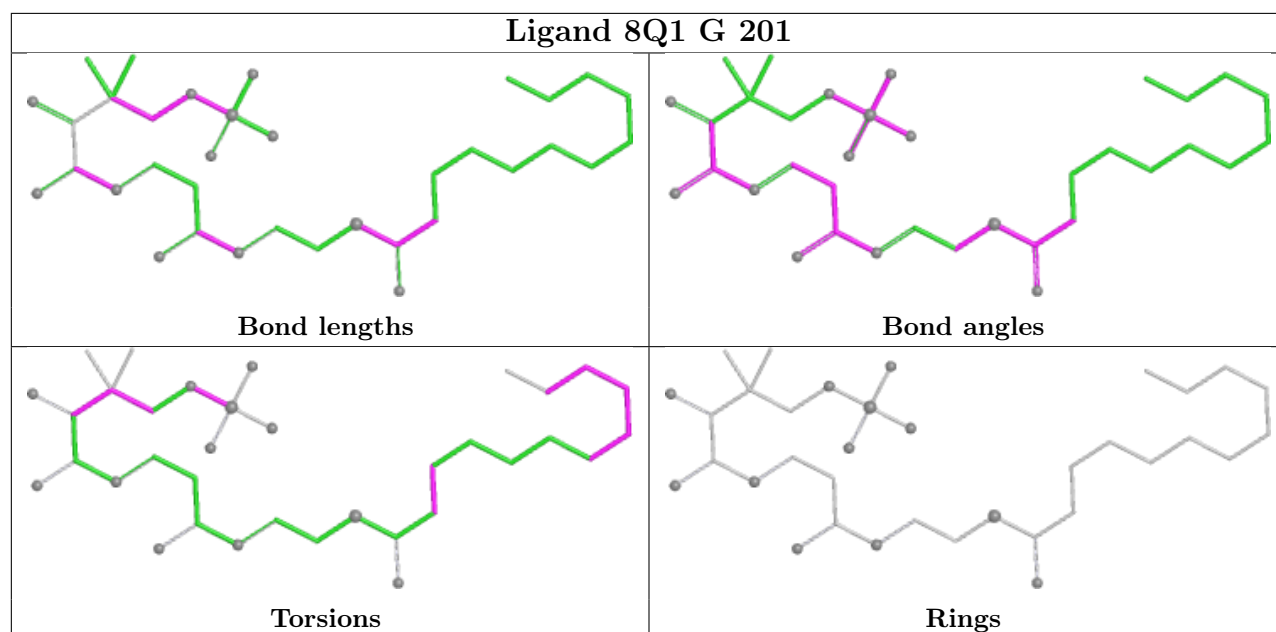
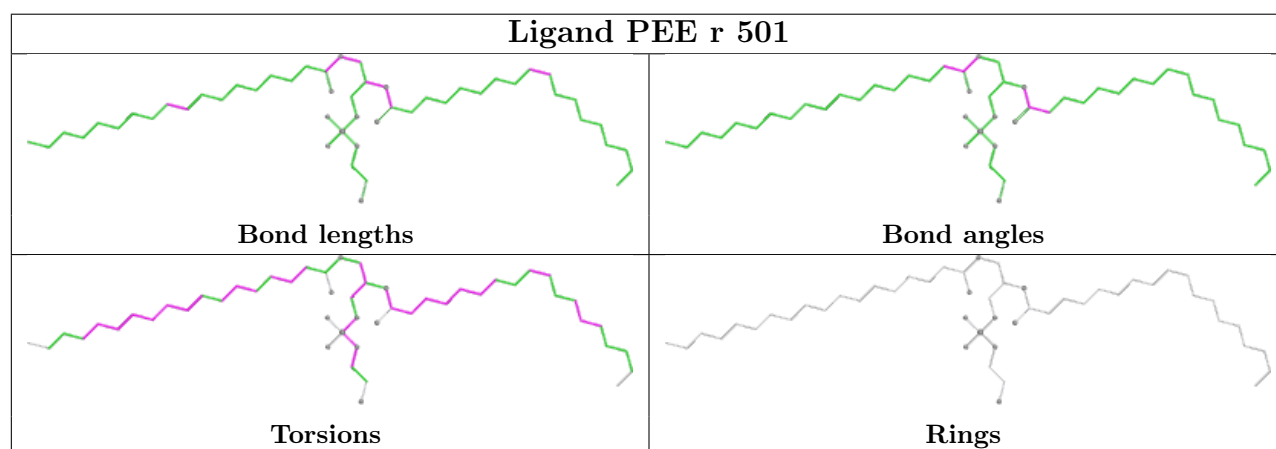
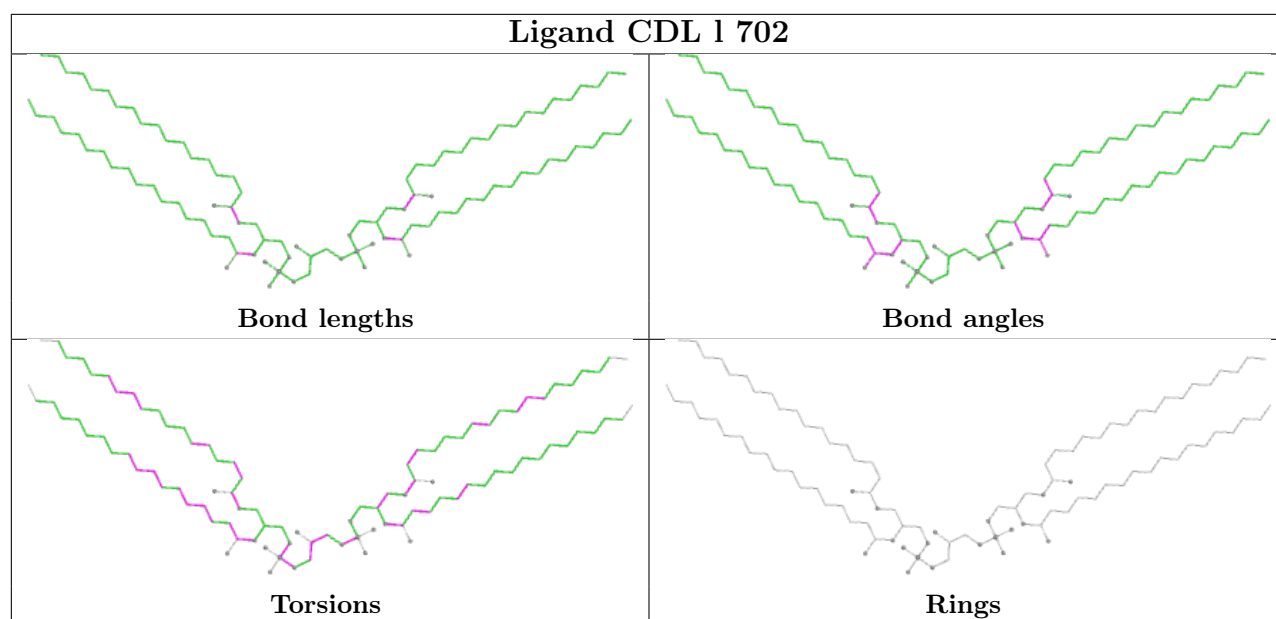
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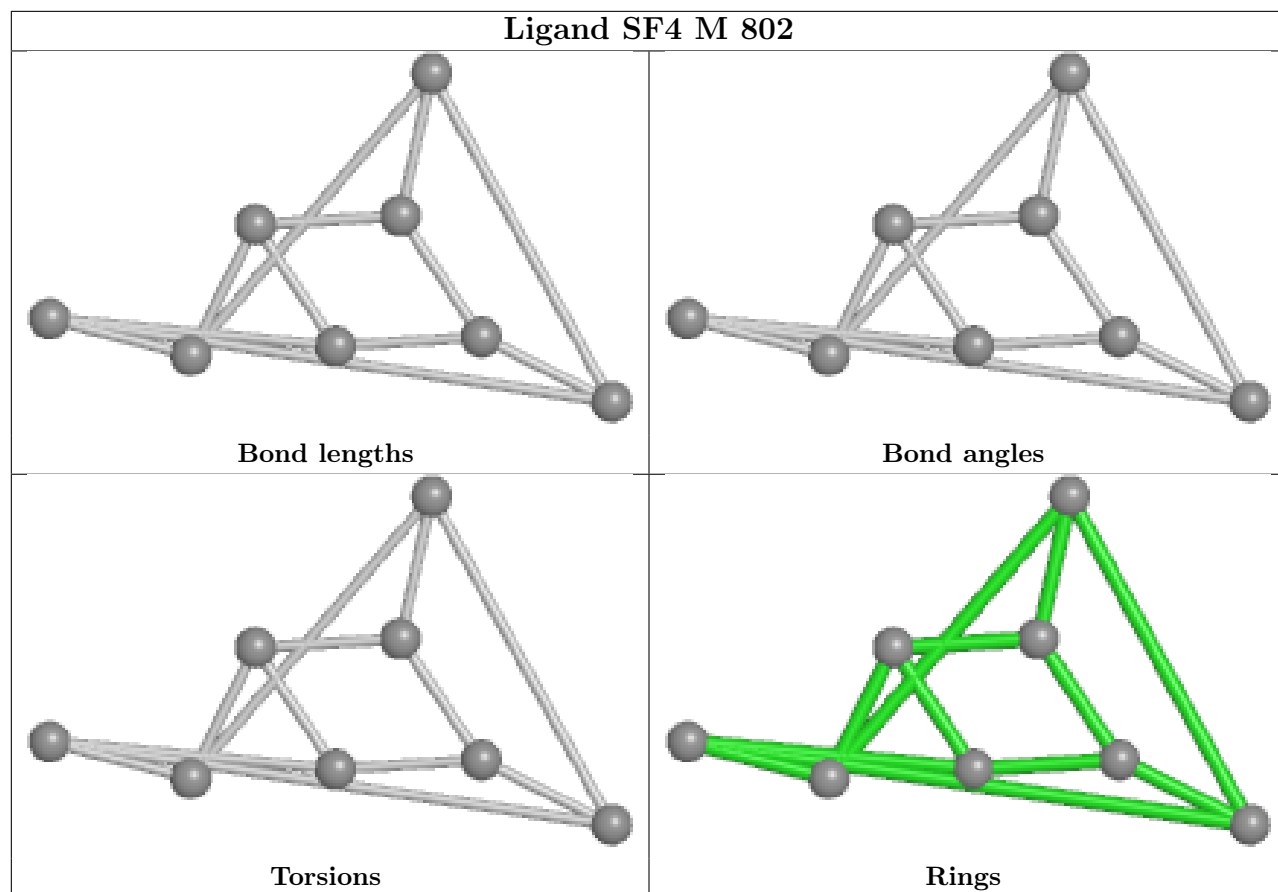
Mol	Chain	Res	Type	Clashes	Symm-Clashes
45	C	301	SF4	1	0
49	a	202	PLX	1	0
51	r	504	CDL	7	0
48	C	302	PEE	7	0
53	J	402	UQ	5	0
49	J	403	PLX	11	0
48	l	705	PEE	7	0
51	o	201	CDL	9	0
49	r	502	PLX	5	0
50	X	201	8Q1	7	0
48	W	201	PEE	4	0
49	g	201	PLX	7	0
51	i	401	CDL	19	0
51	u	201	CDL	9	0
48	B	303	PEE	4	0
45	A	501	SF4	1	0
51	V	201	CDL	10	0
51	k	101	CDL	5	0
48	U	101	PEE	18	0
48	l	703	PEE	21	0
53	s	401	UQ	6	0
47	A	503	NAI	5	0
49	j	202	PLX	3	0
51	l	701	CDL	34	0
49	r	503	PLX	6	0
51	m	201	CDL	5	0
58	w	401	ADP	8	0
48	j	201	PEE	15	0

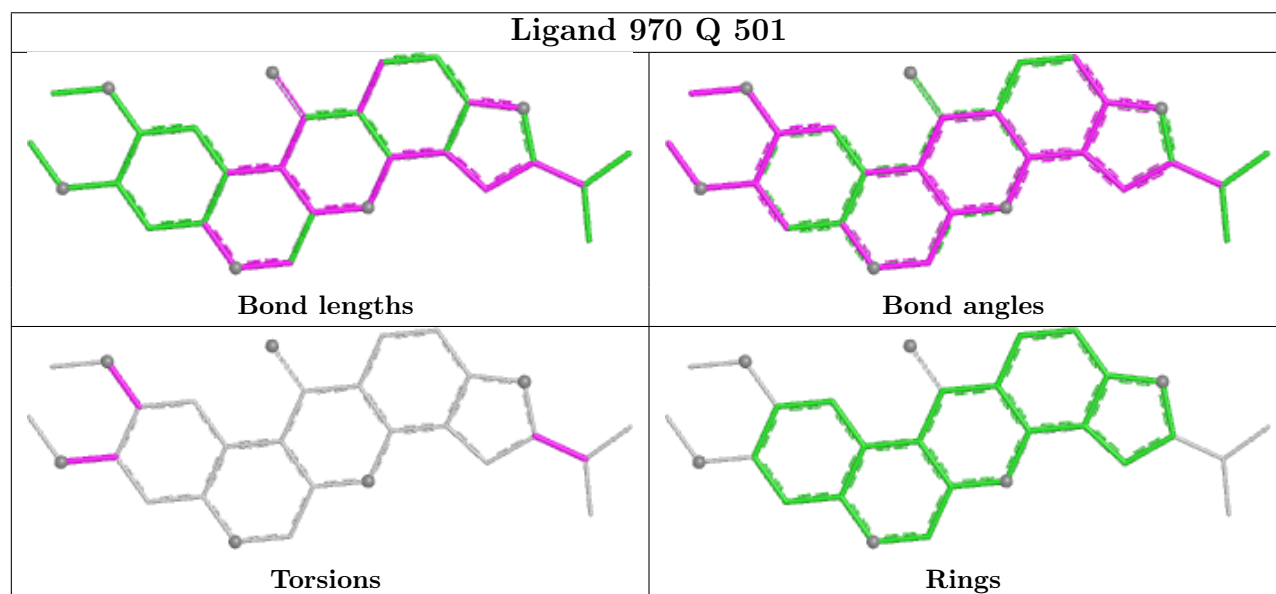
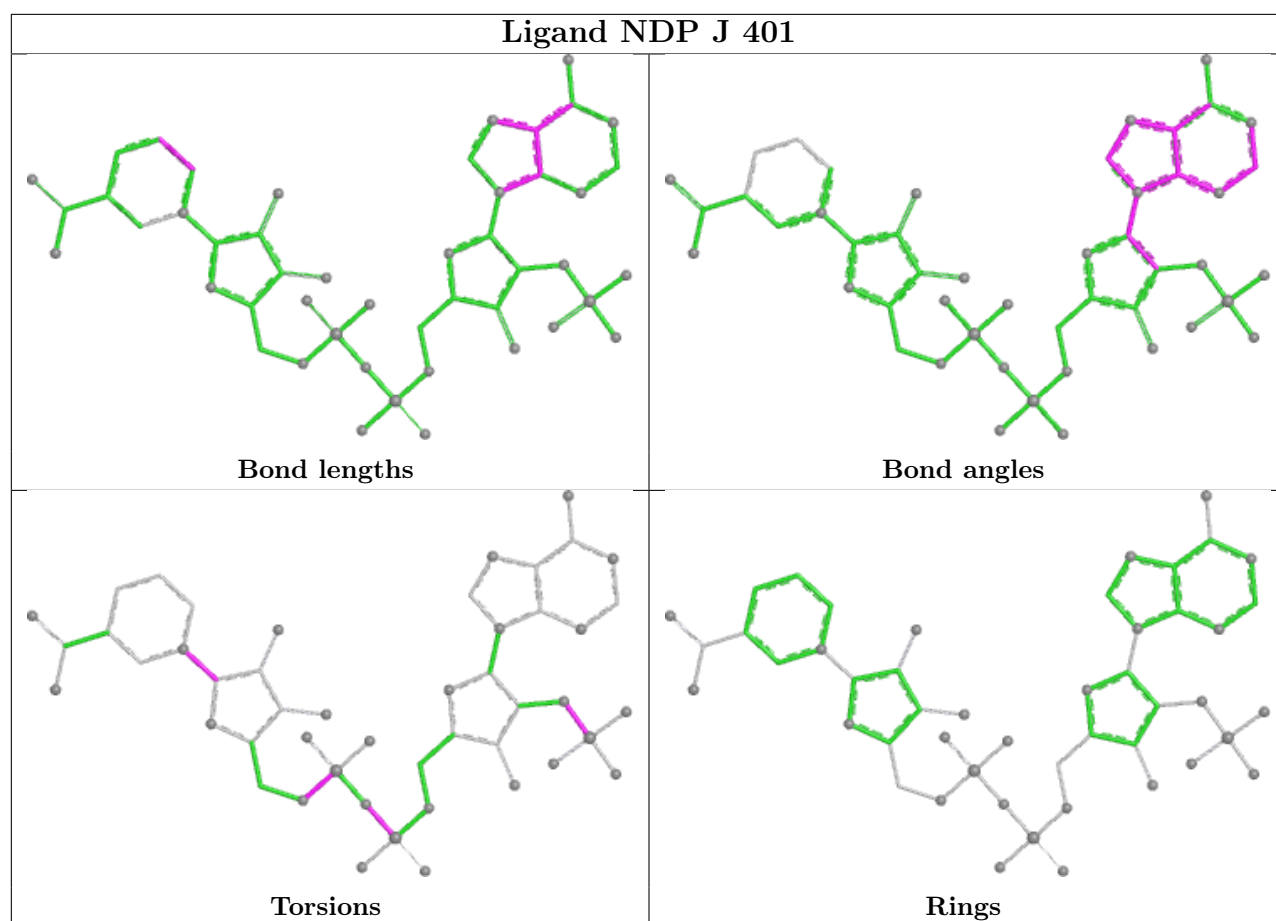
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

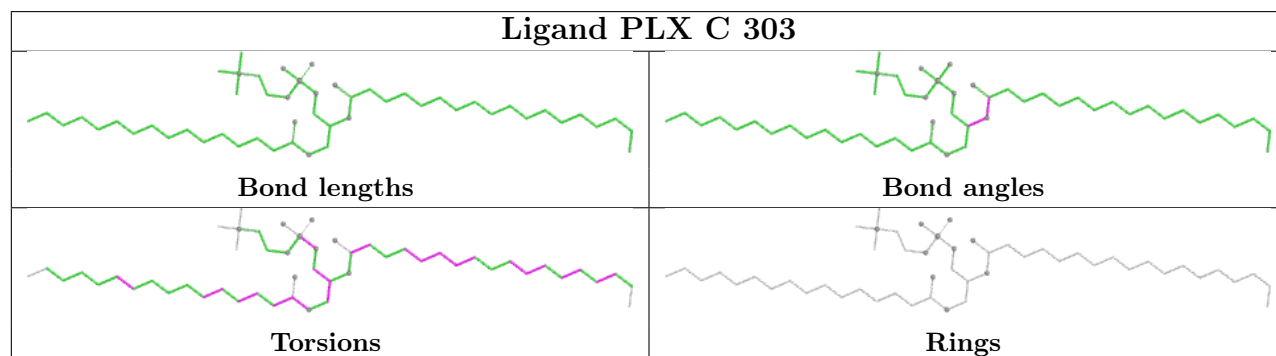
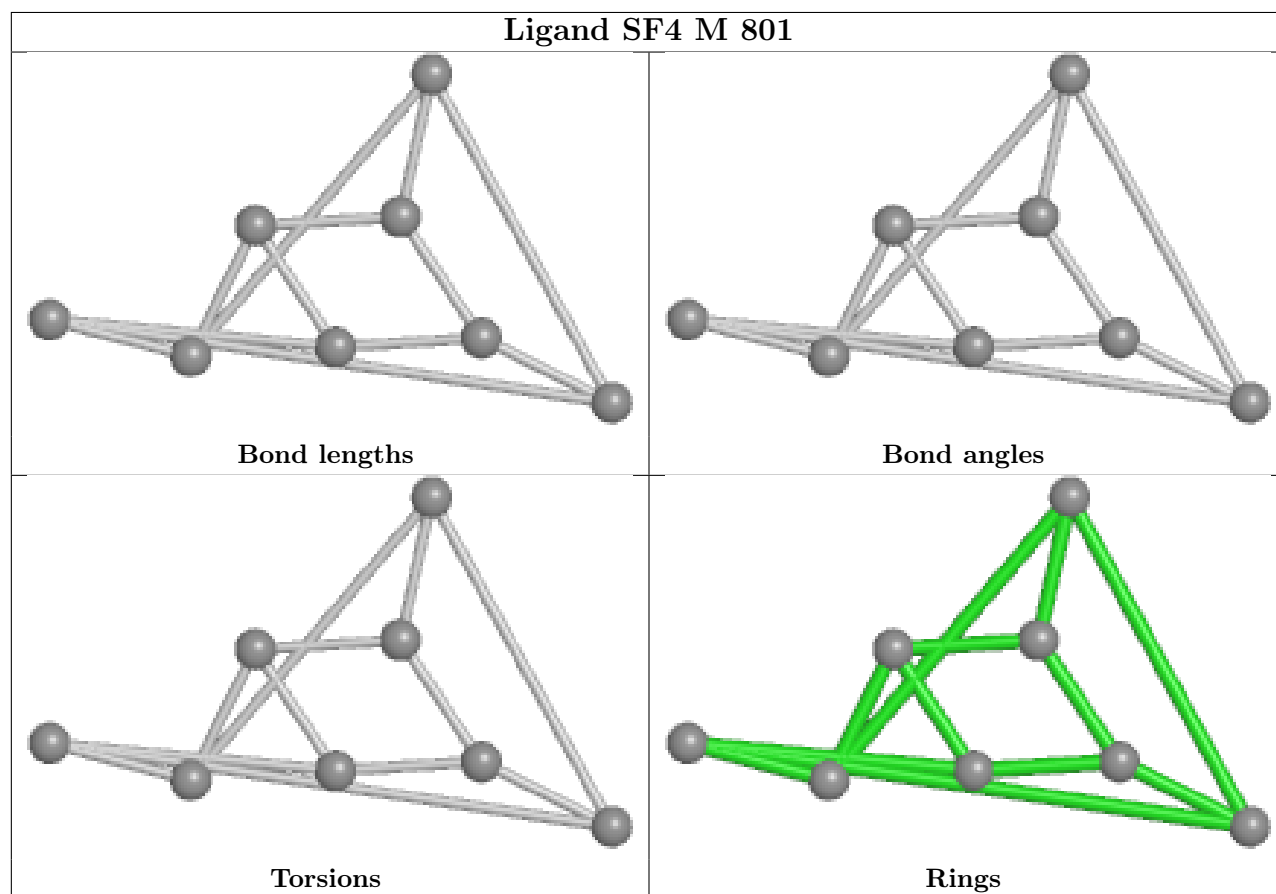
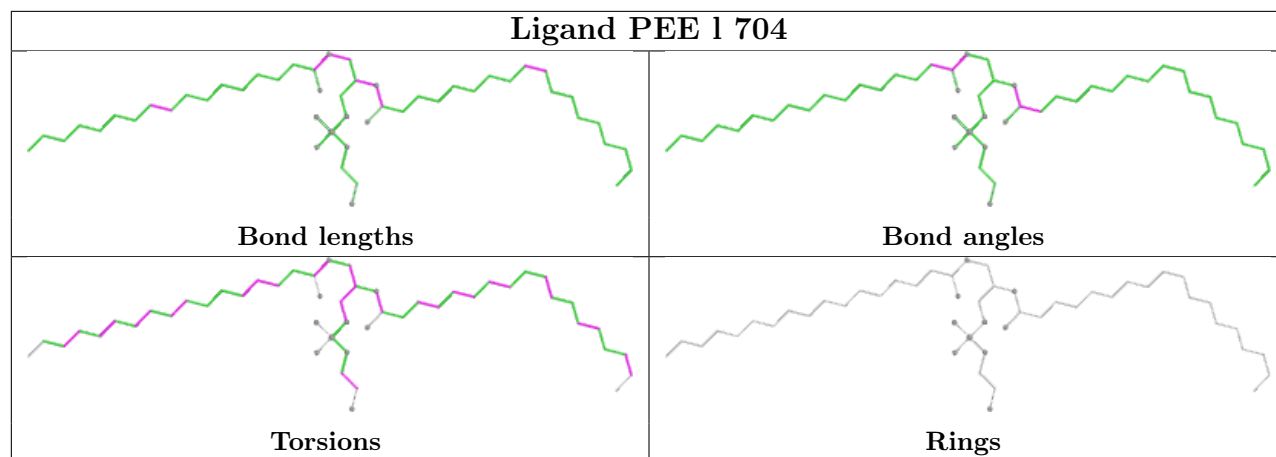


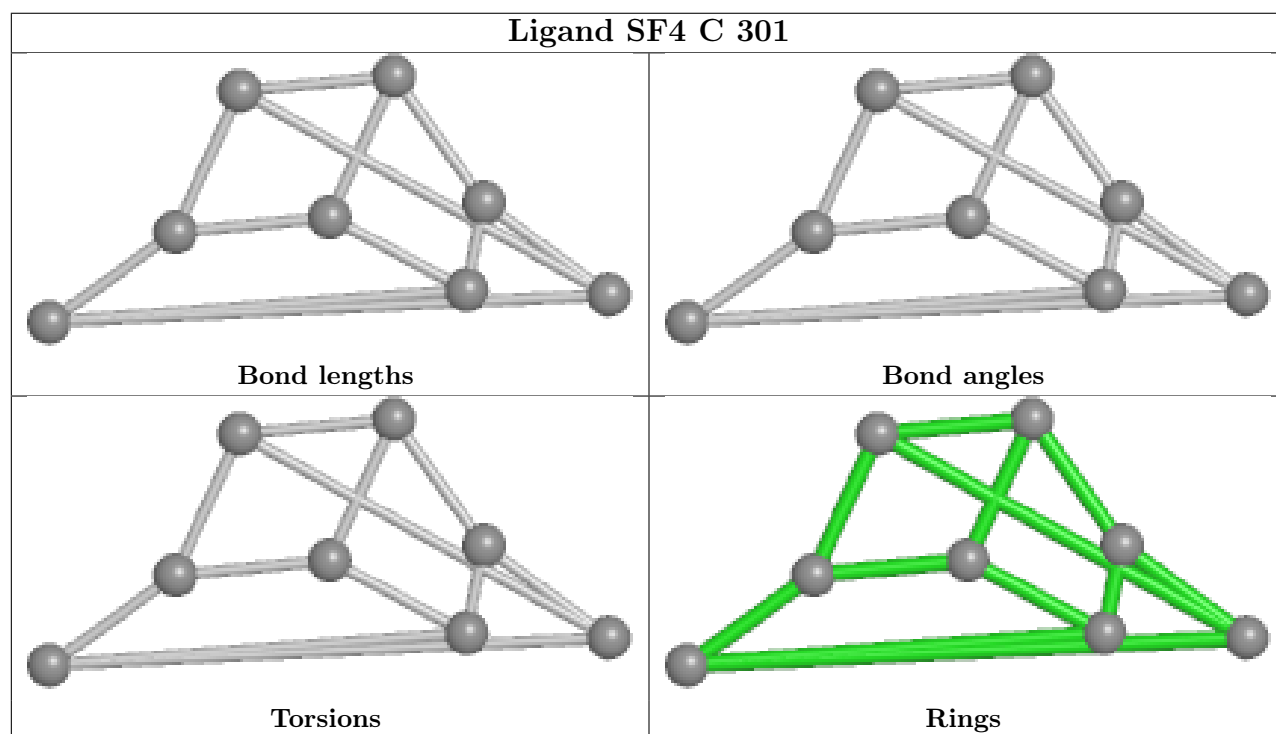
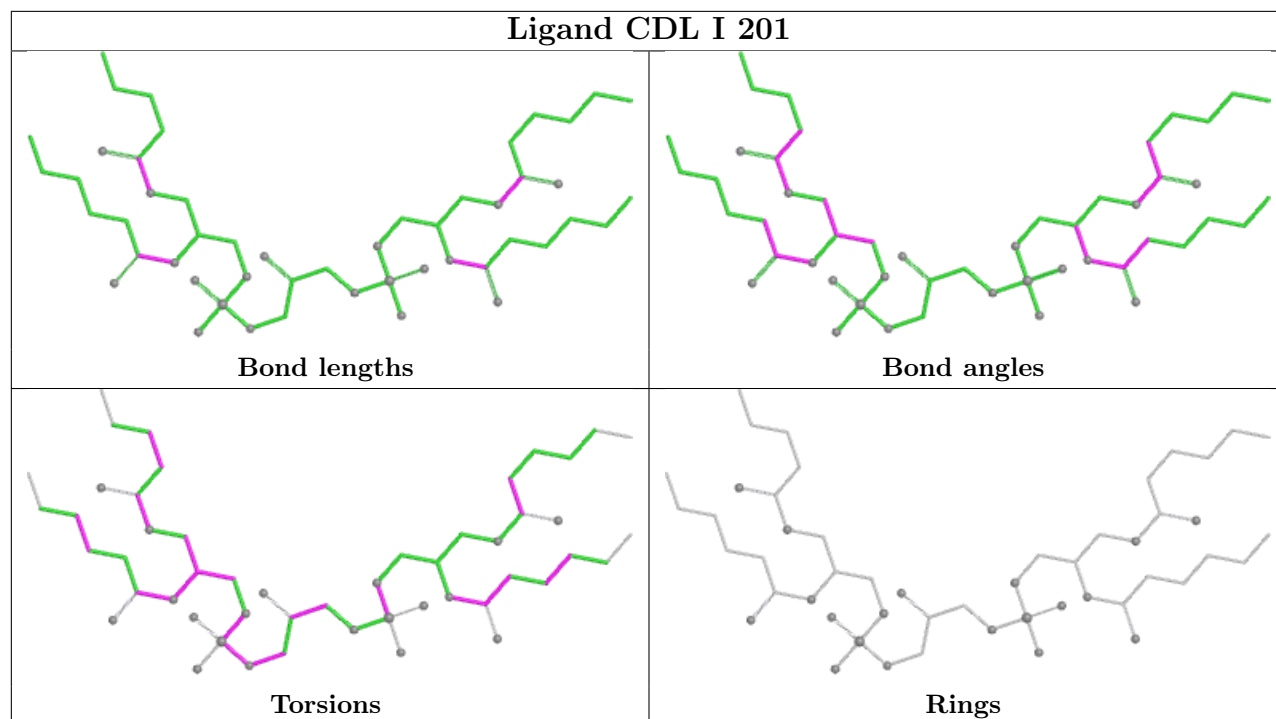


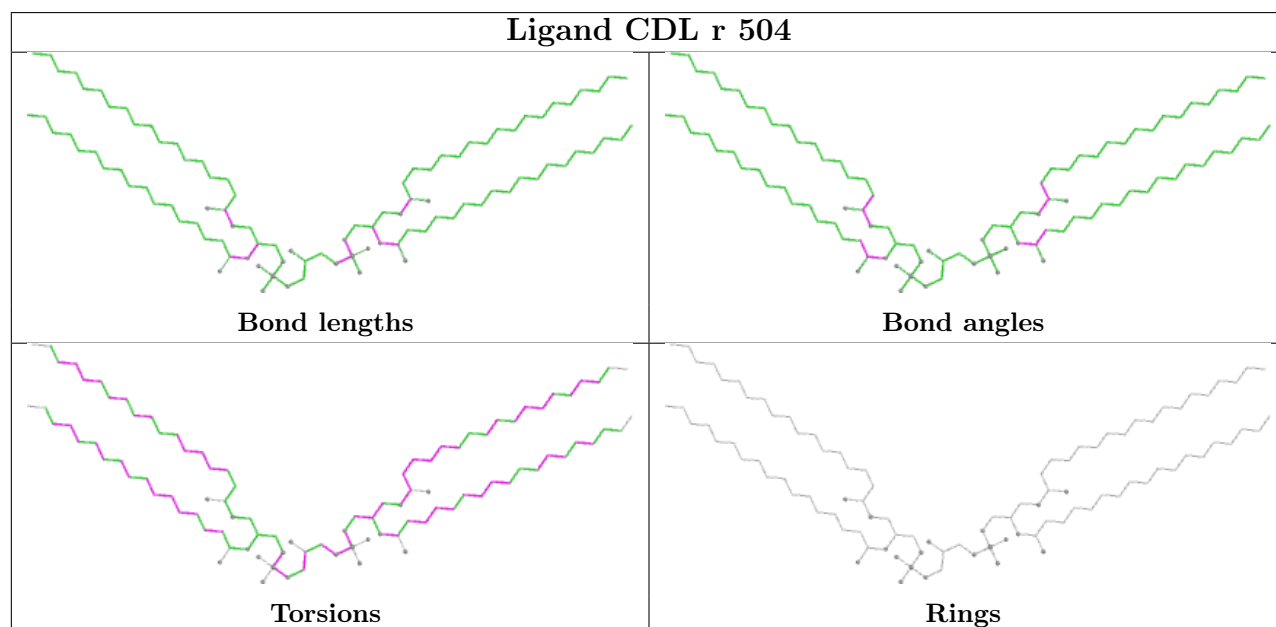
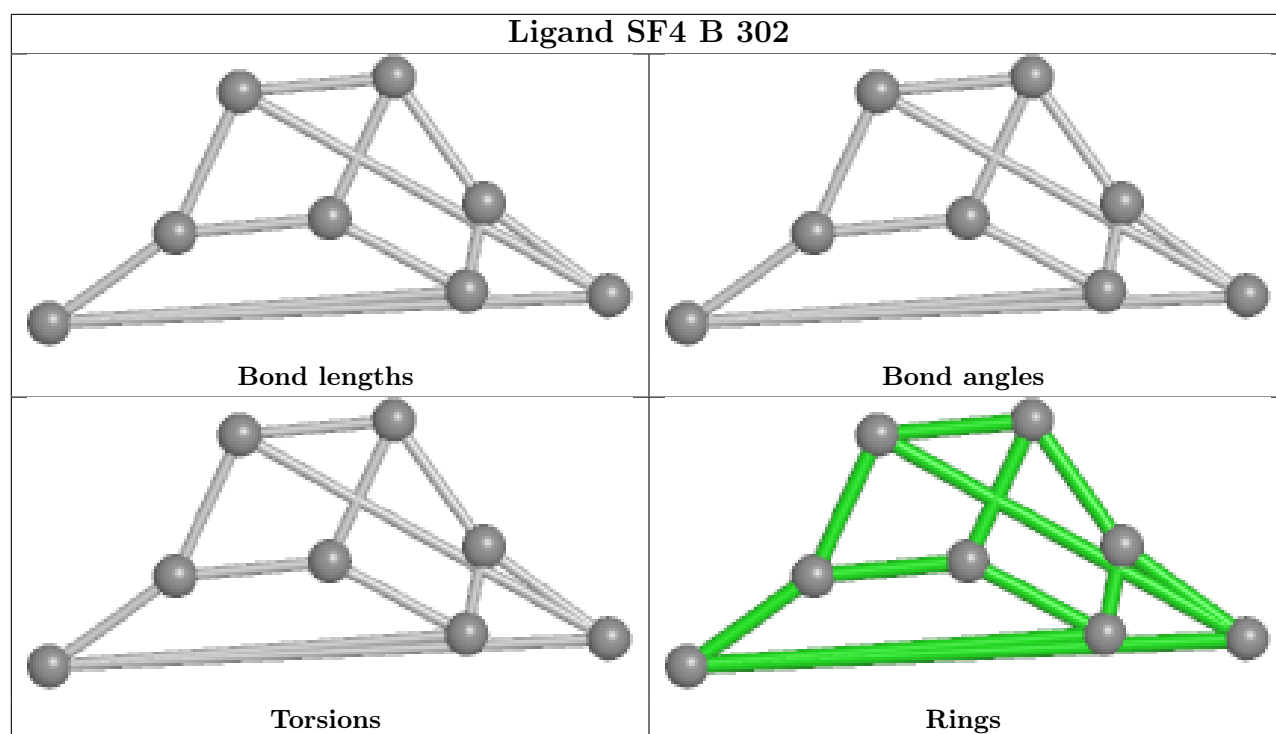


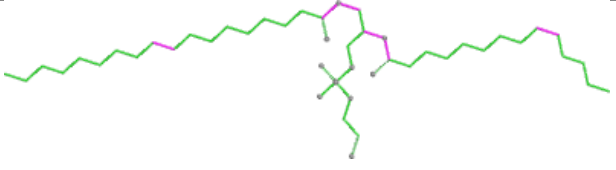
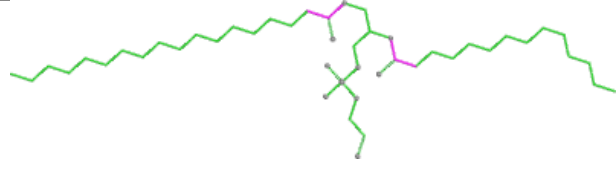
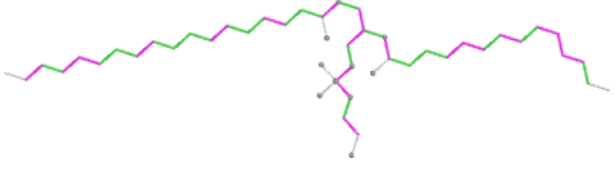
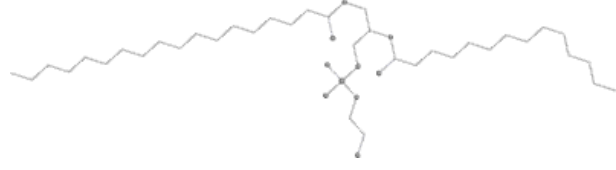


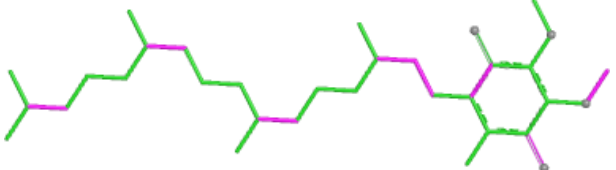
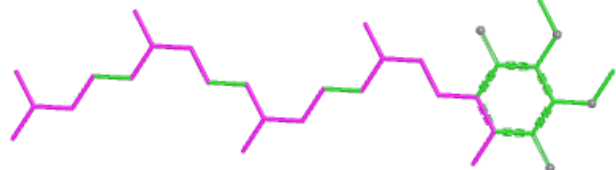
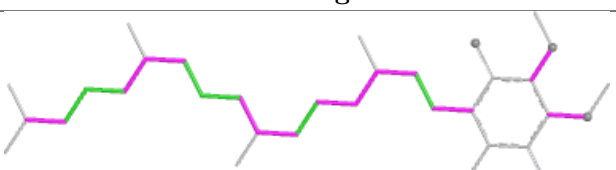
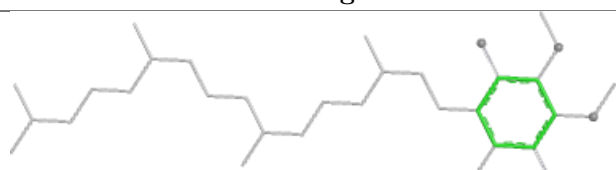


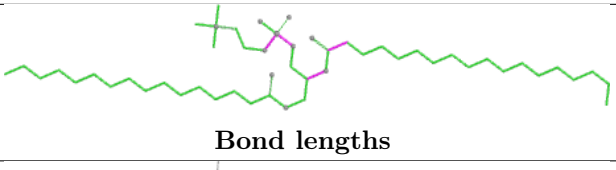
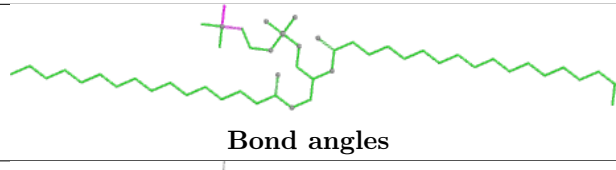
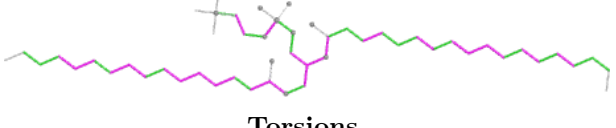
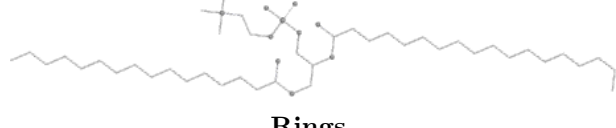


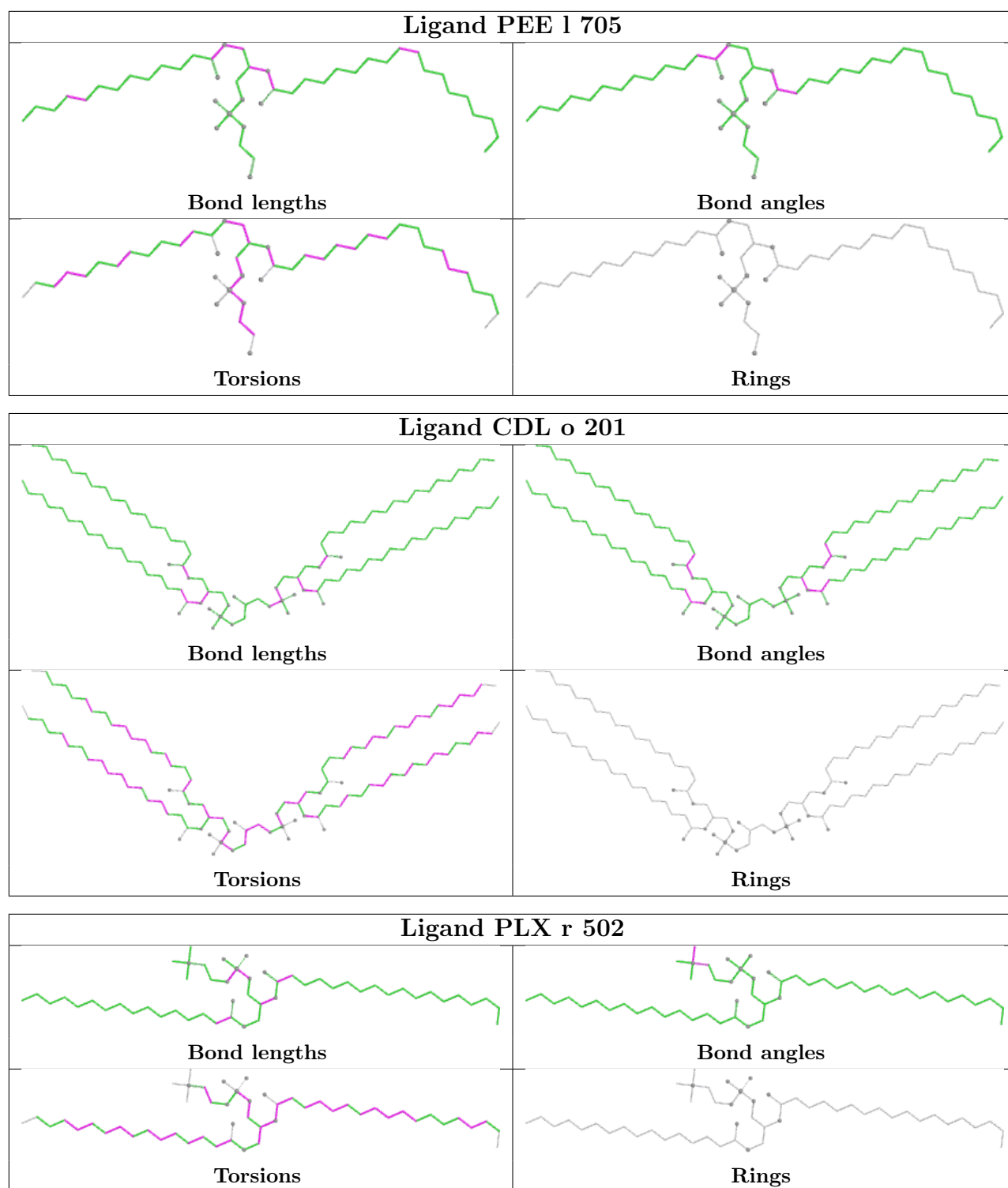


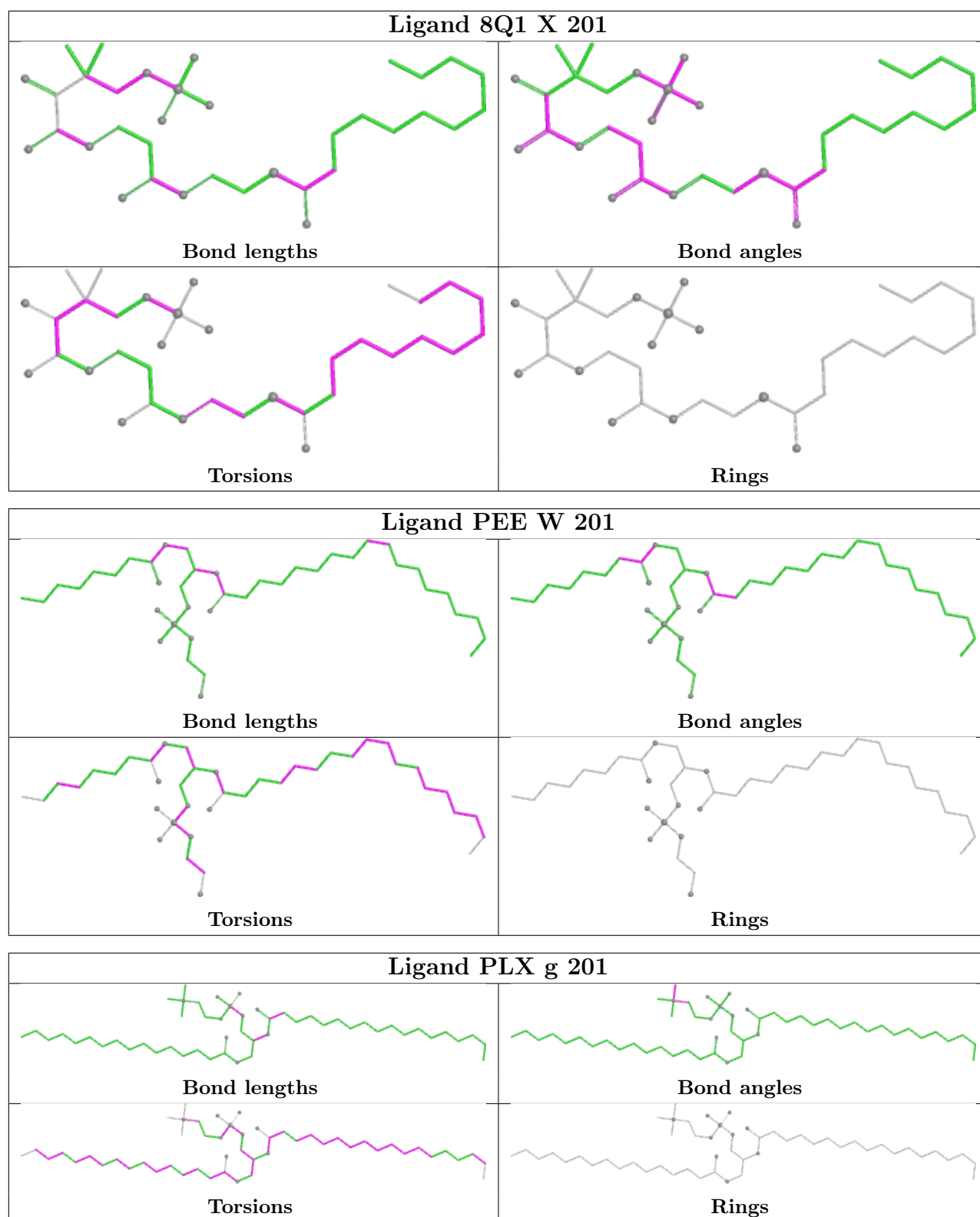


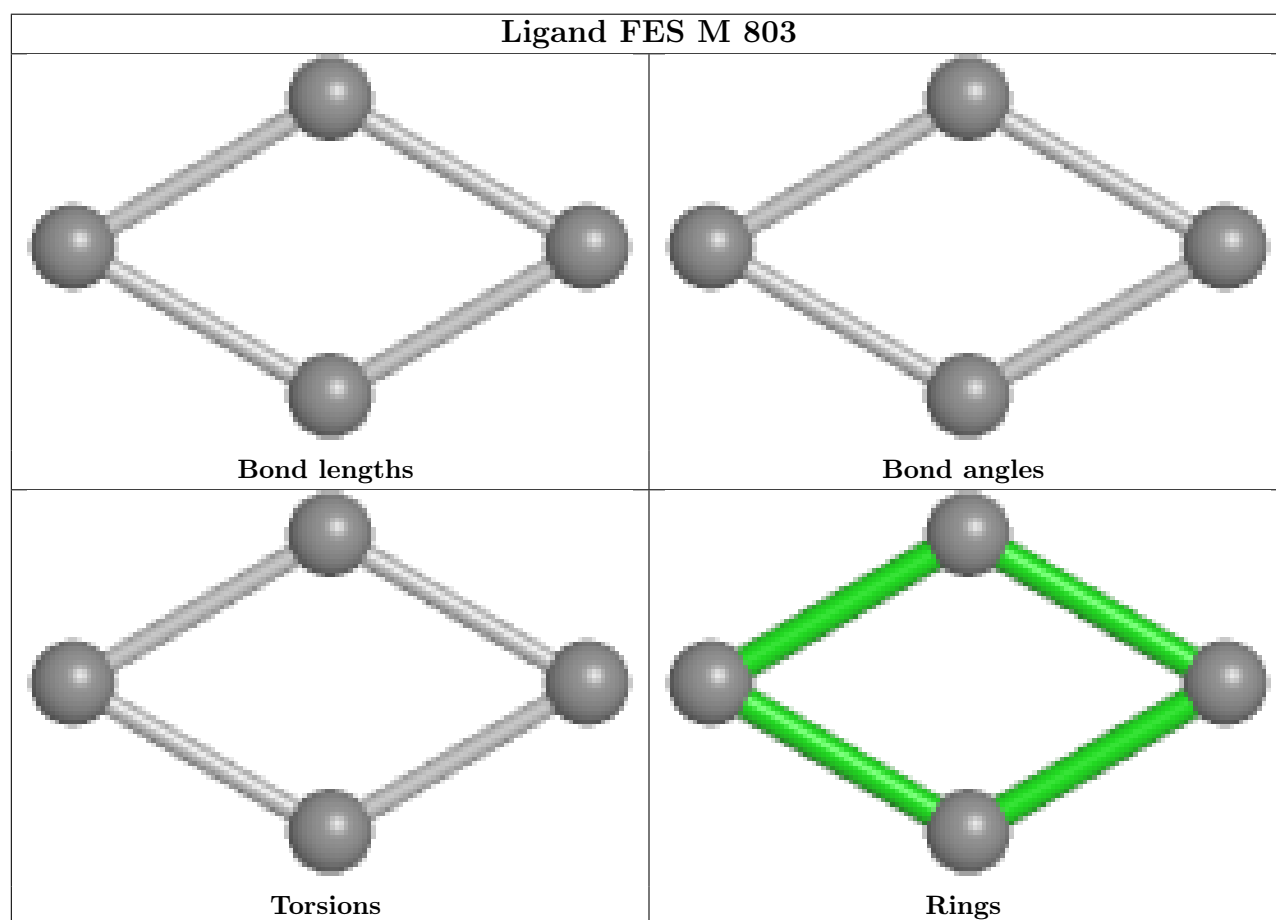
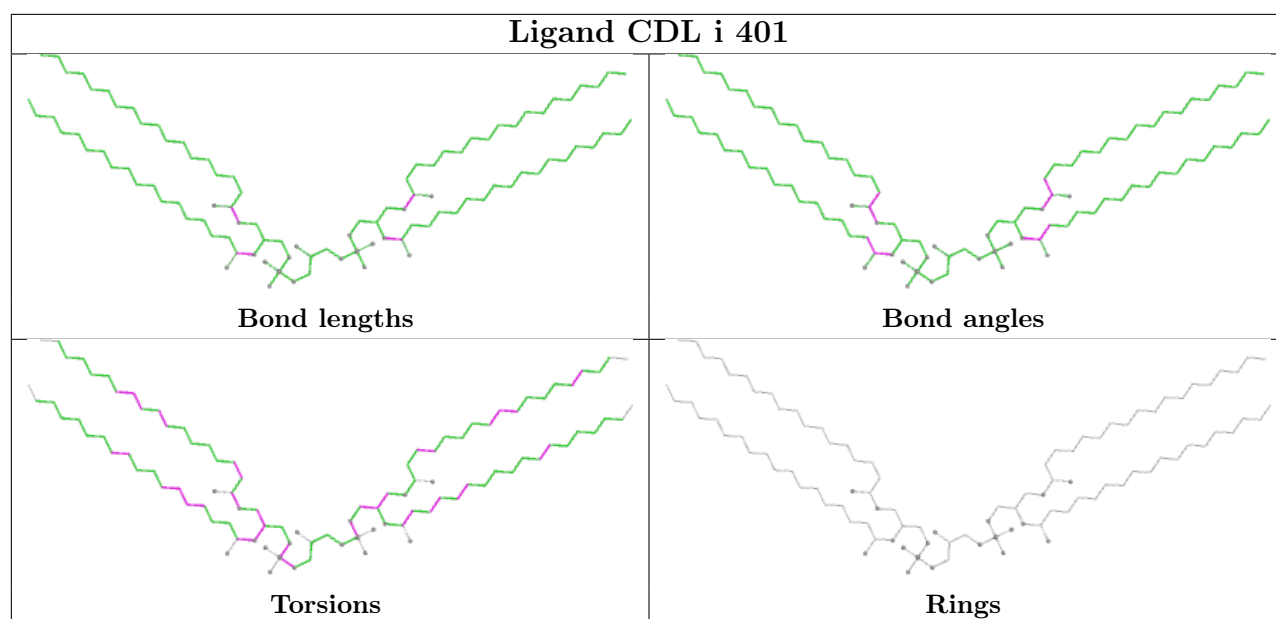
Ligand PEE C 302	
 Bond lengths	 Bond angles
 Torsions	 Rings

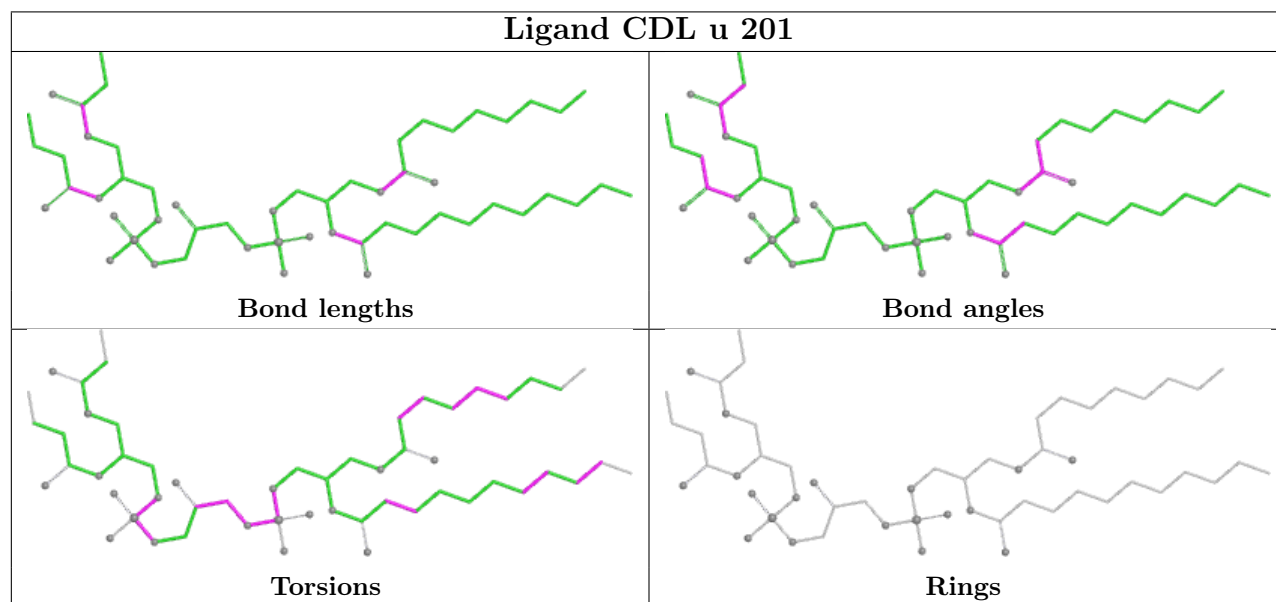
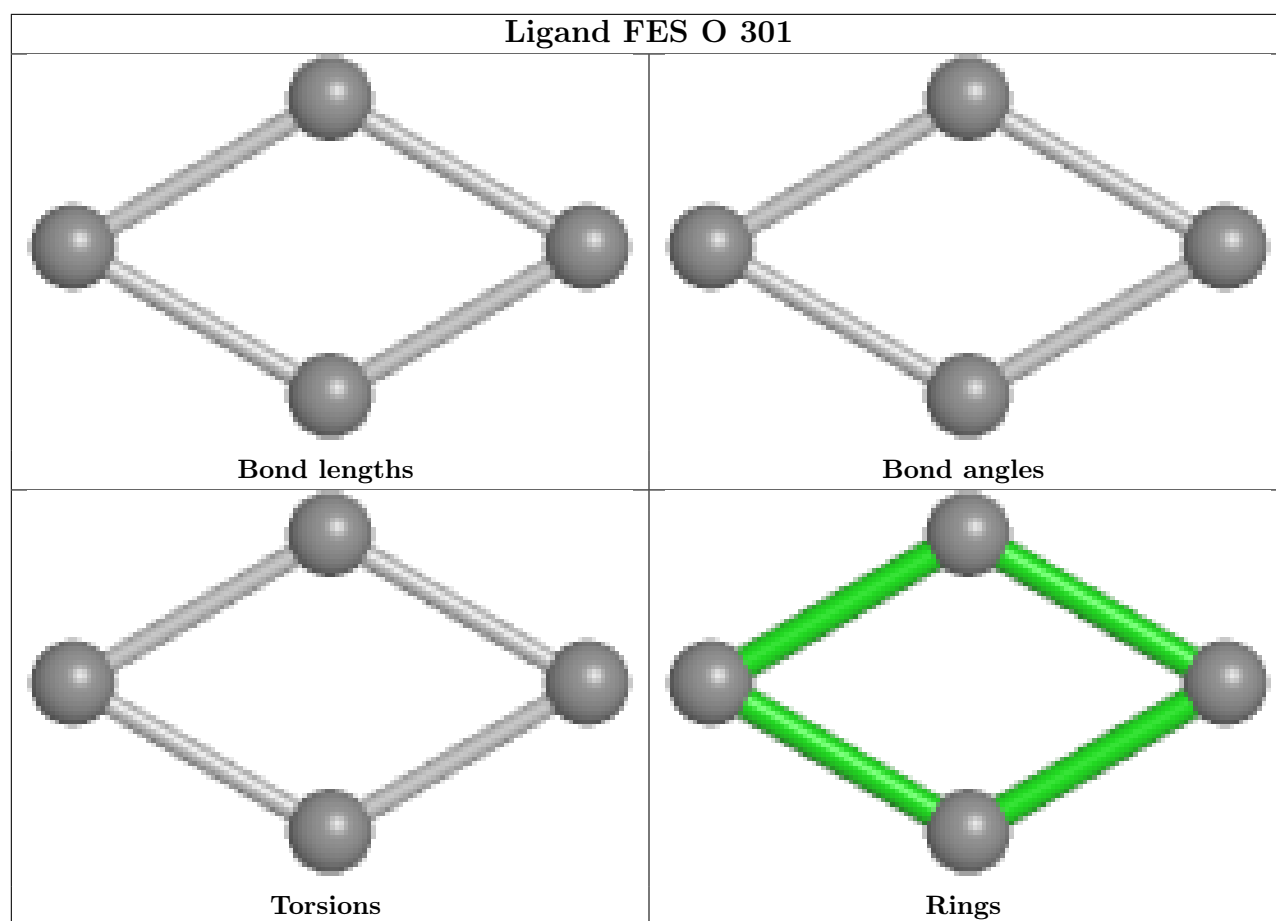
Ligand UQ J 402	
 Bond lengths	 Bond angles
 Torsions	 Rings

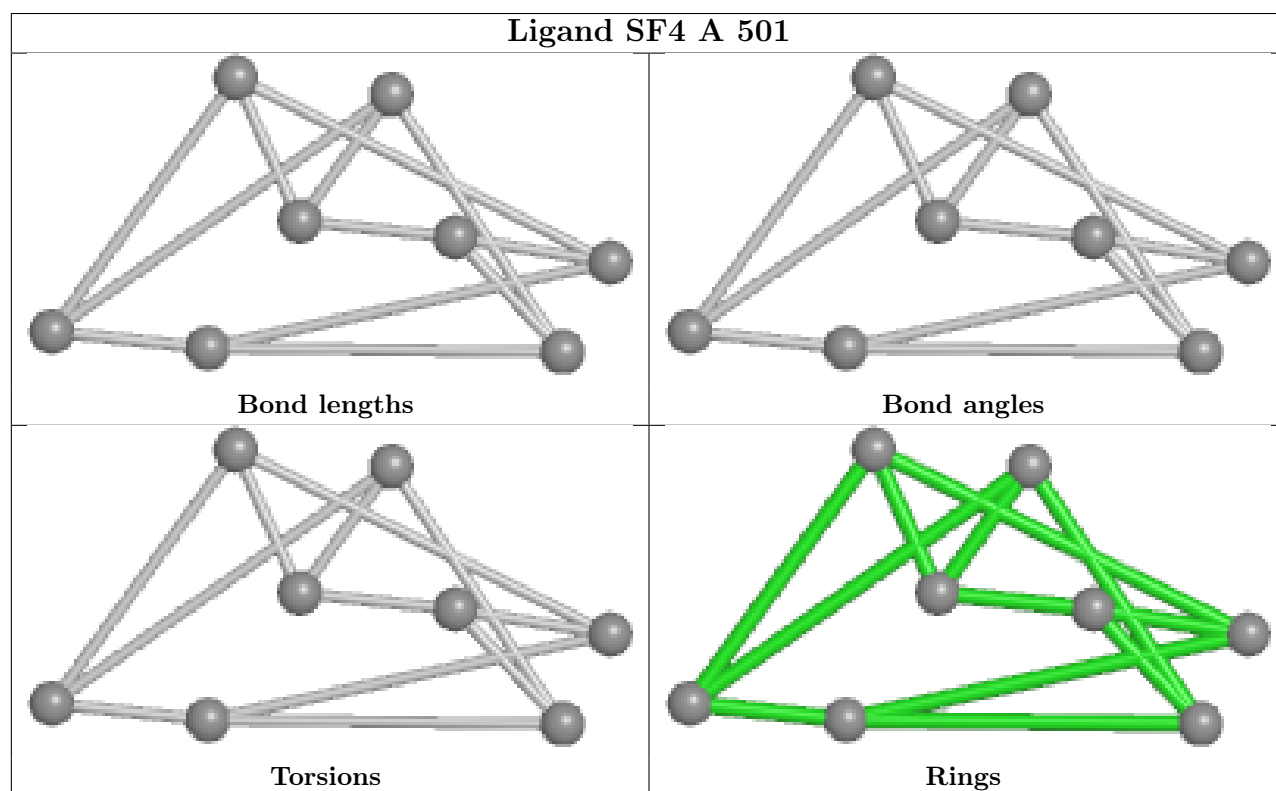
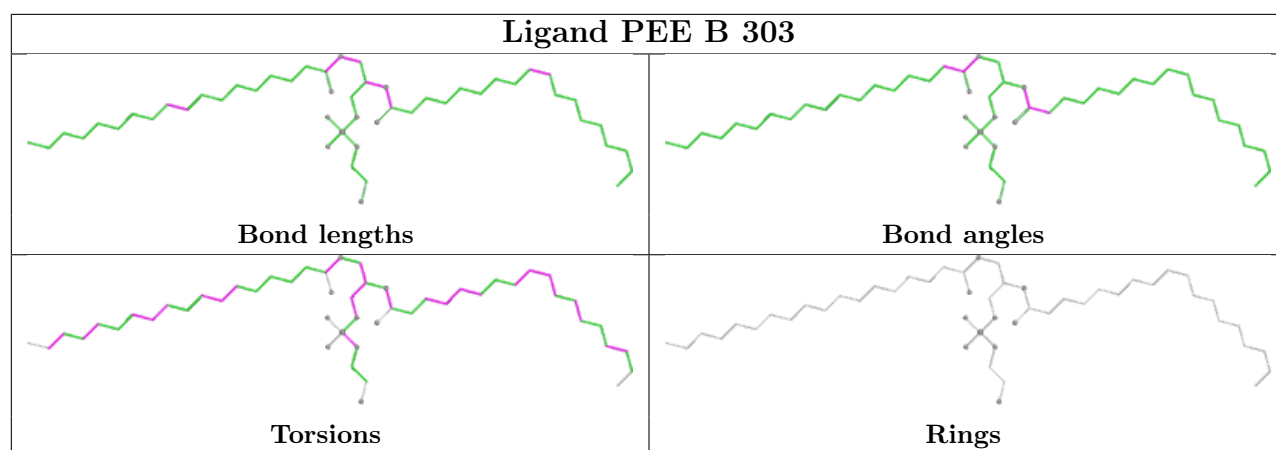
Ligand PLX J 403	
 Bond lengths	 Bond angles
 Torsions	 Rings

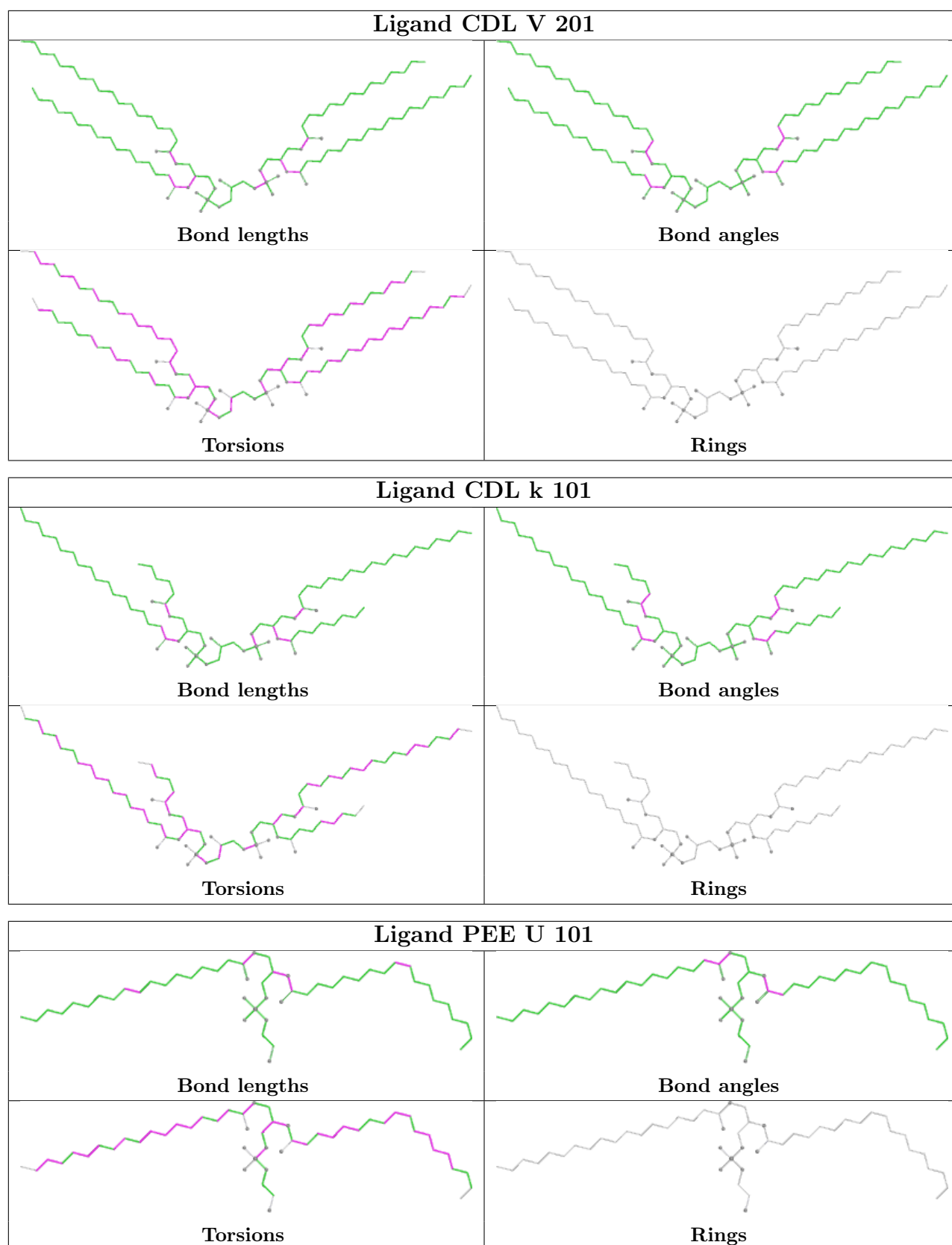


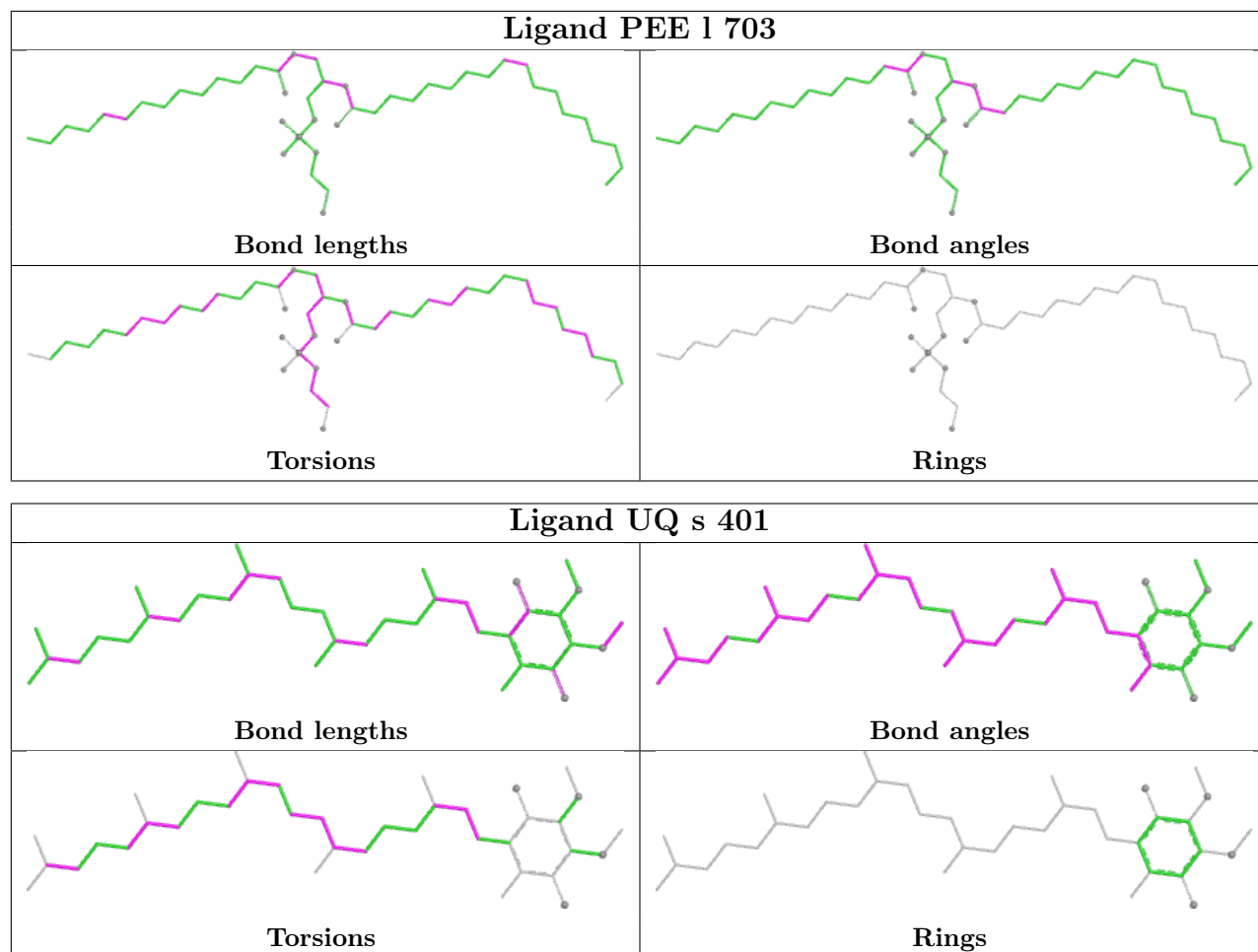


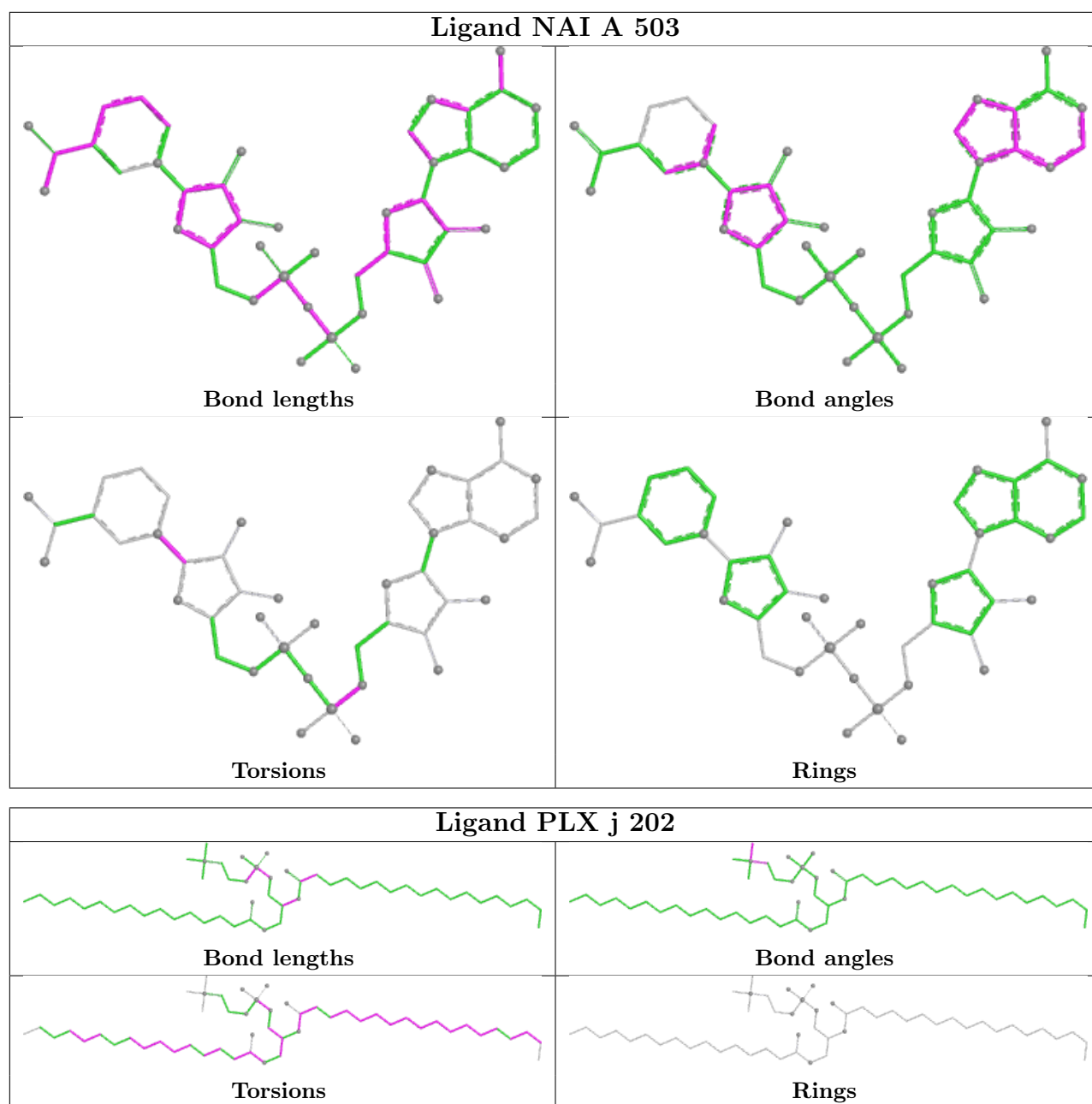


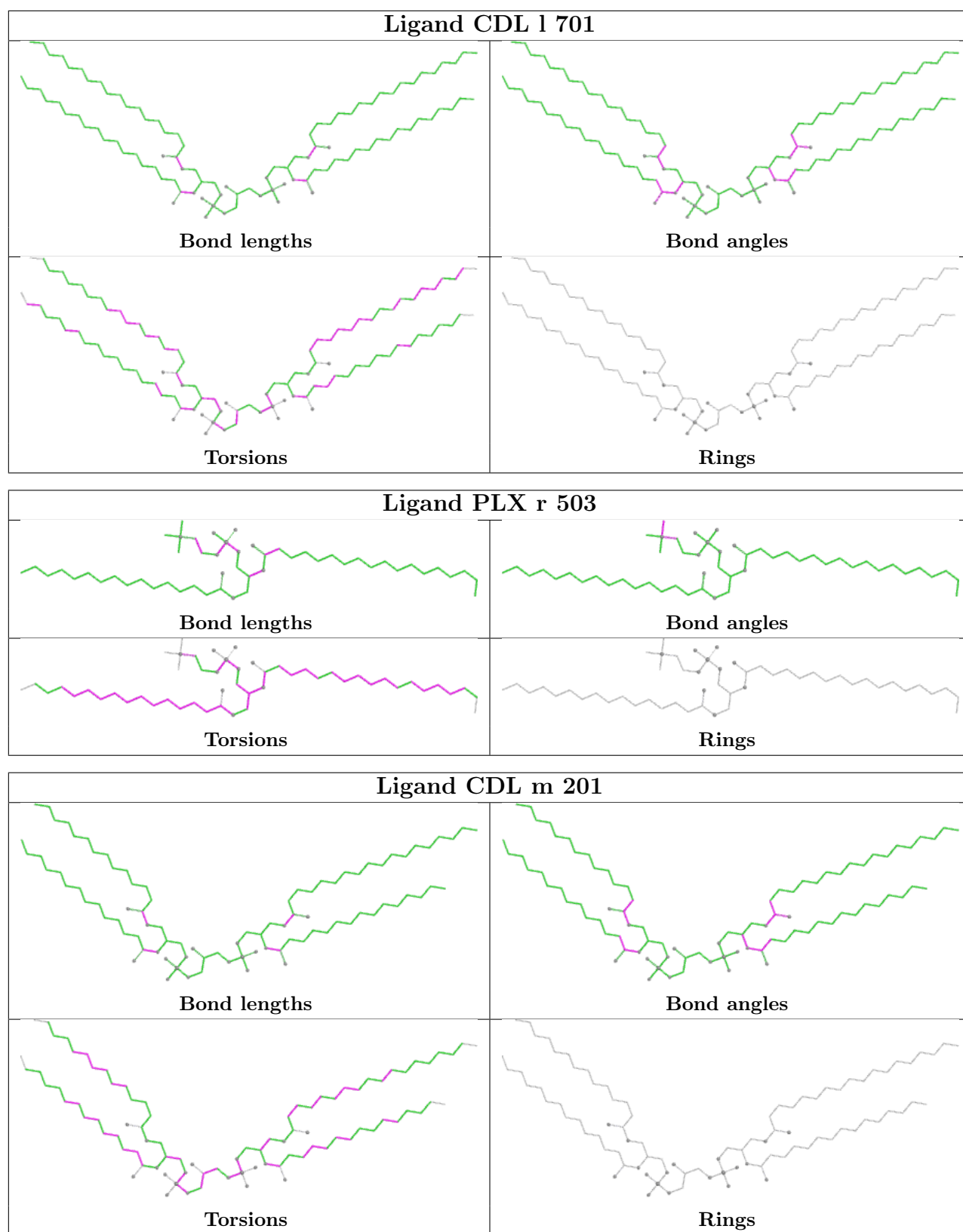


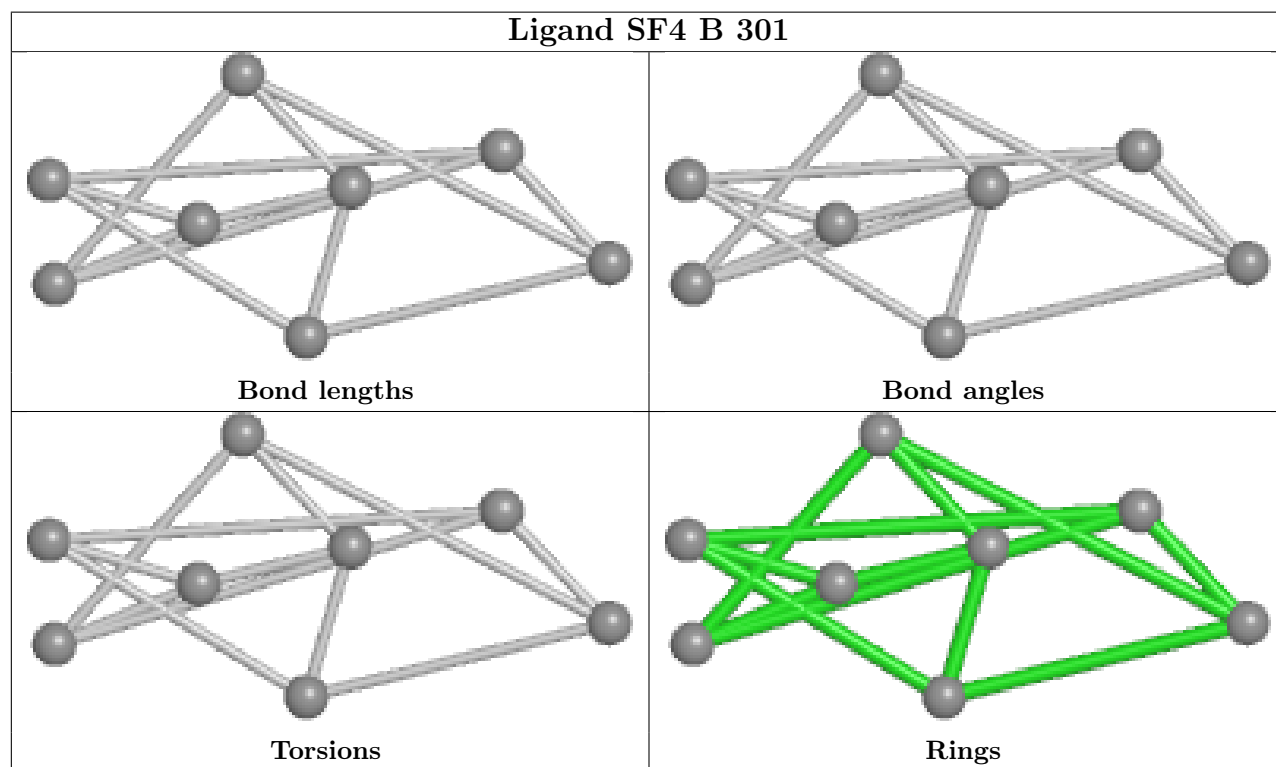
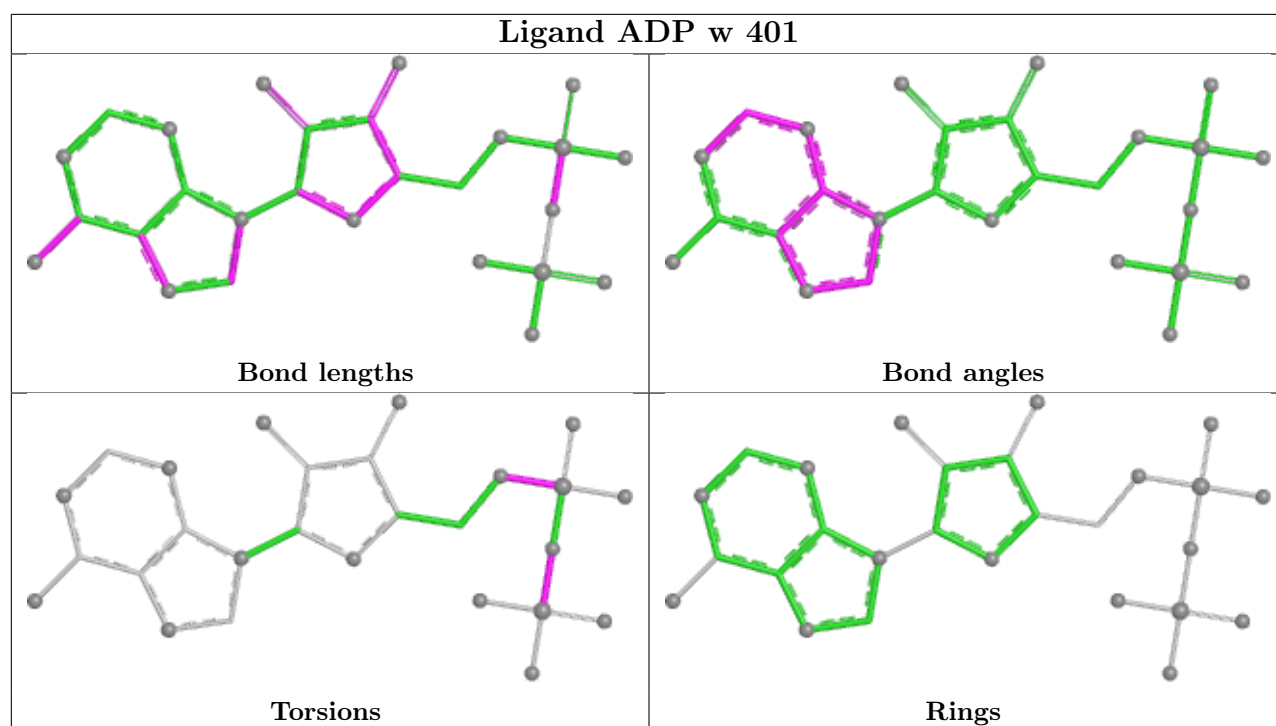


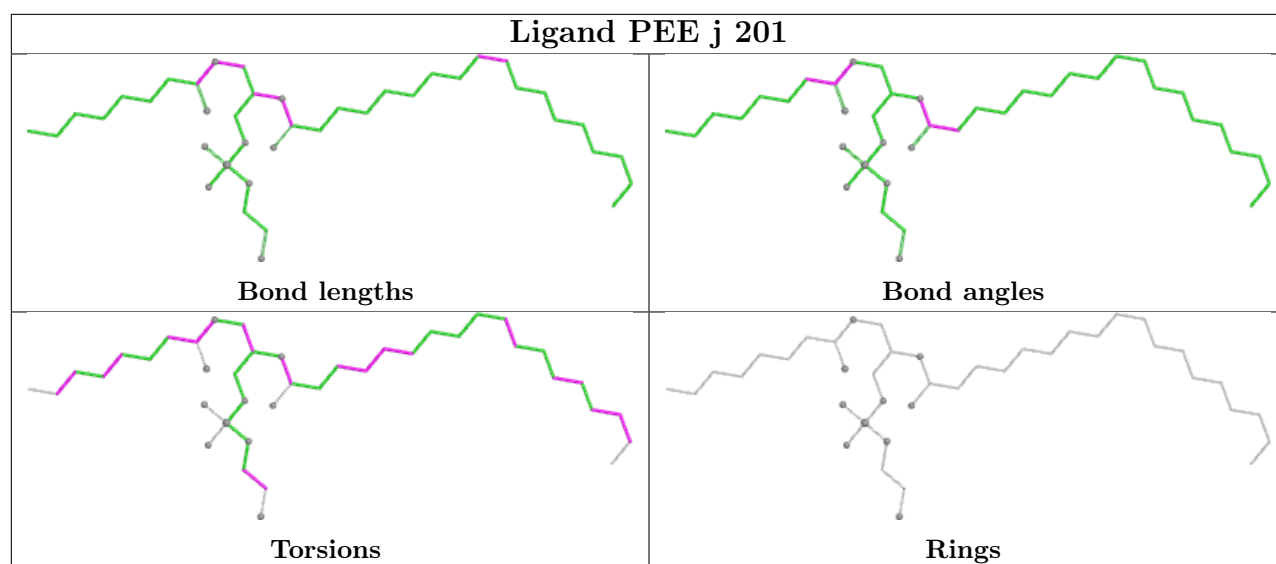












5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

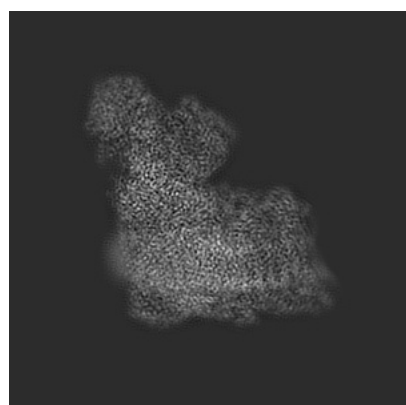
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-31651. These allow visual inspection of the internal detail of the map and identification of artifacts.

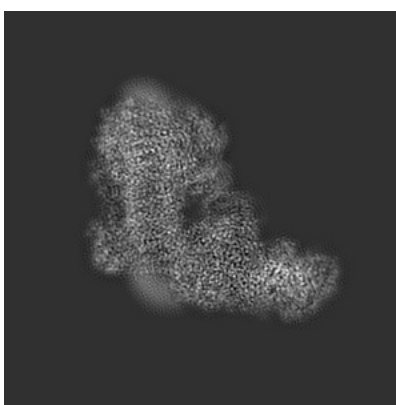
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

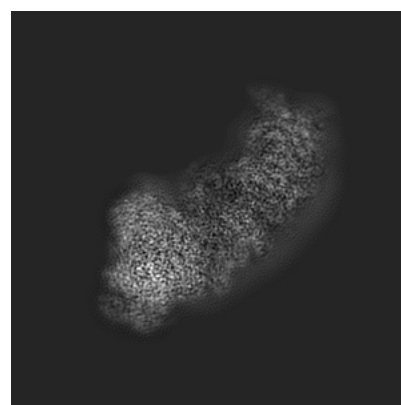
6.1.1 Primary map



X



Y

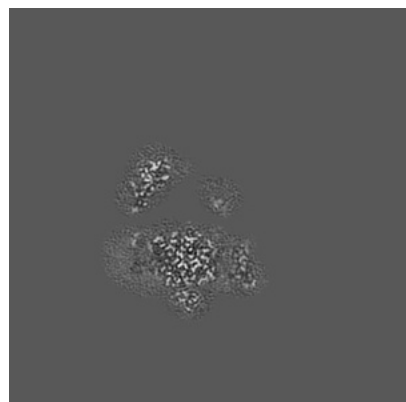


Z

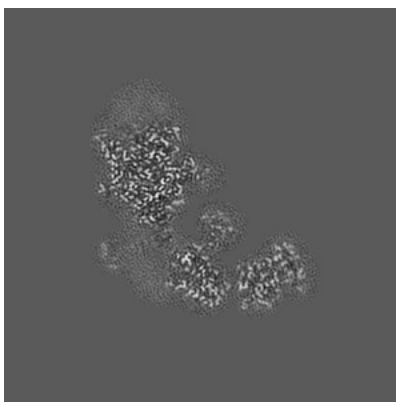
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

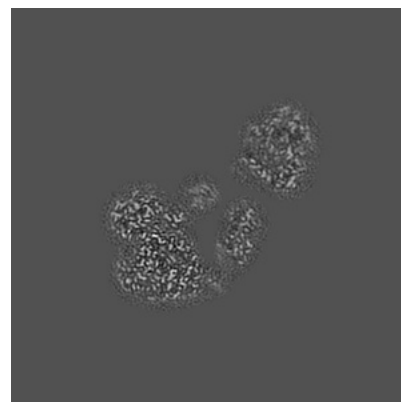
6.2.1 Primary map



X Index: 155



Y Index: 155

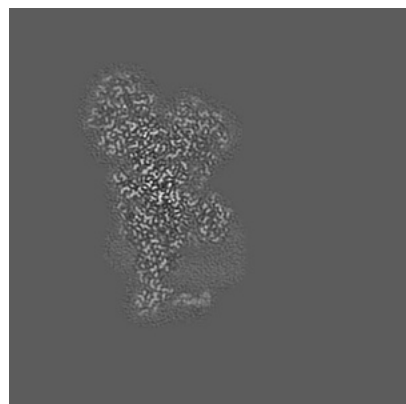


Z Index: 155

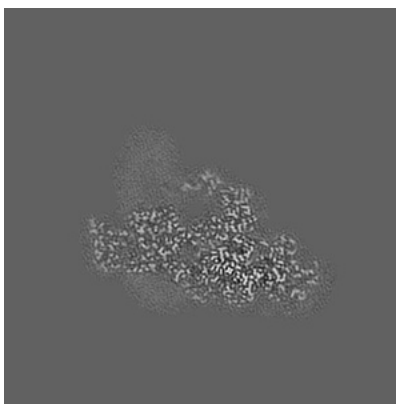
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

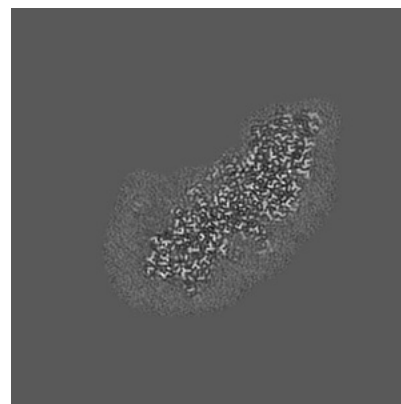
6.3.1 Primary map



X Index: 109



Y Index: 112

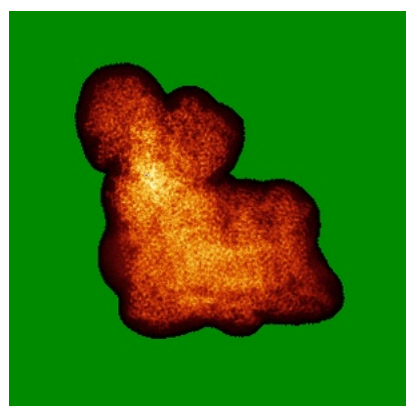


Z Index: 124

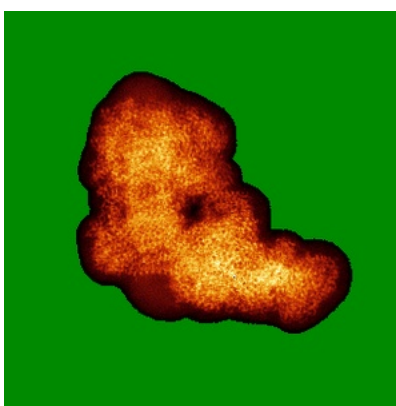
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) [i](#)

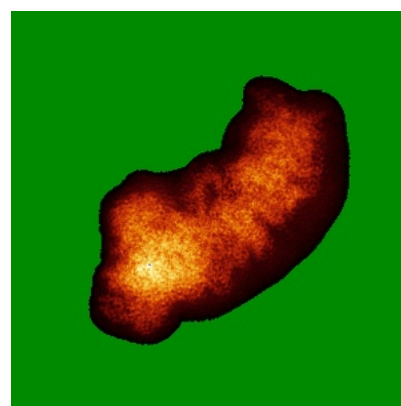
6.4.1 Primary map



X



Y

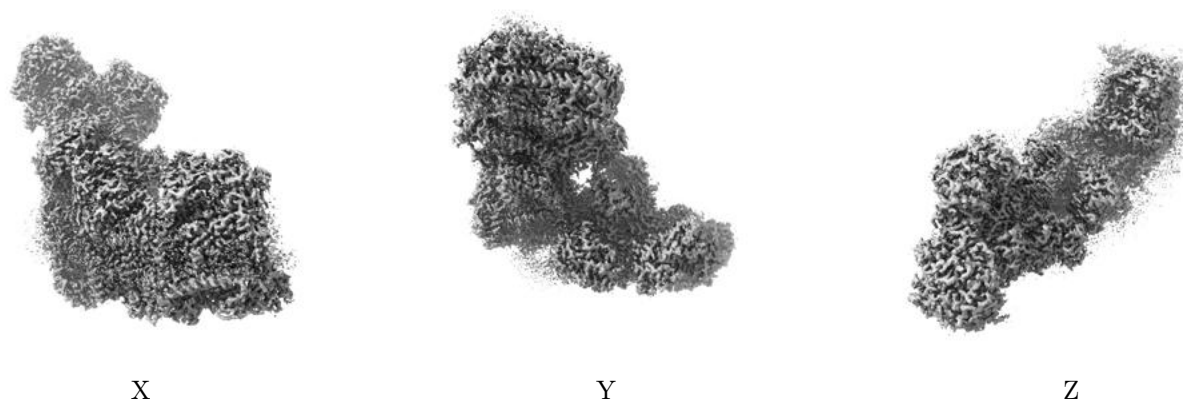


Z

The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.0271. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

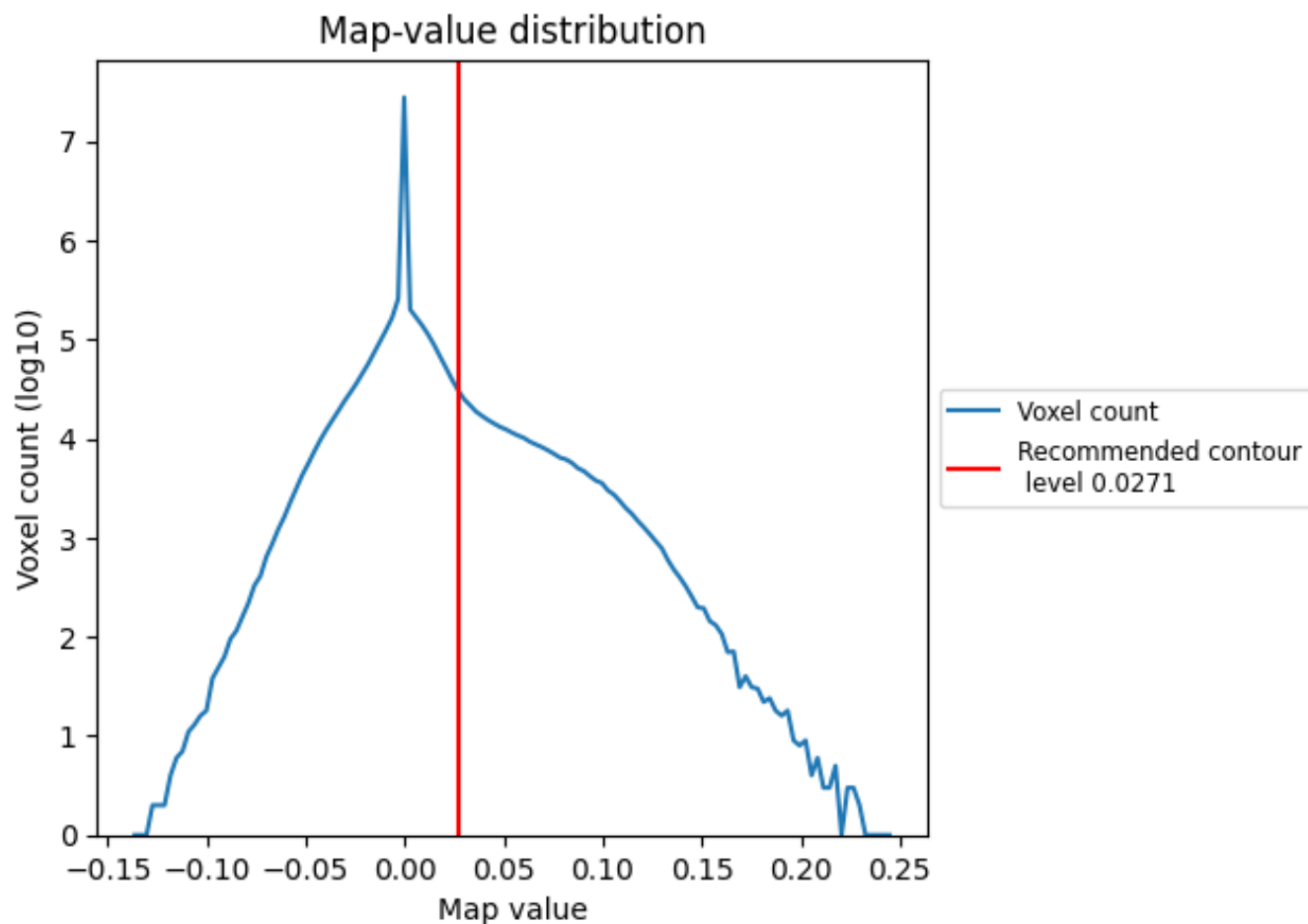
6.6 Mask visualisation [i](#)

This section was not generated. No masks/segmentation were deposited.

7 Map analysis [i](#)

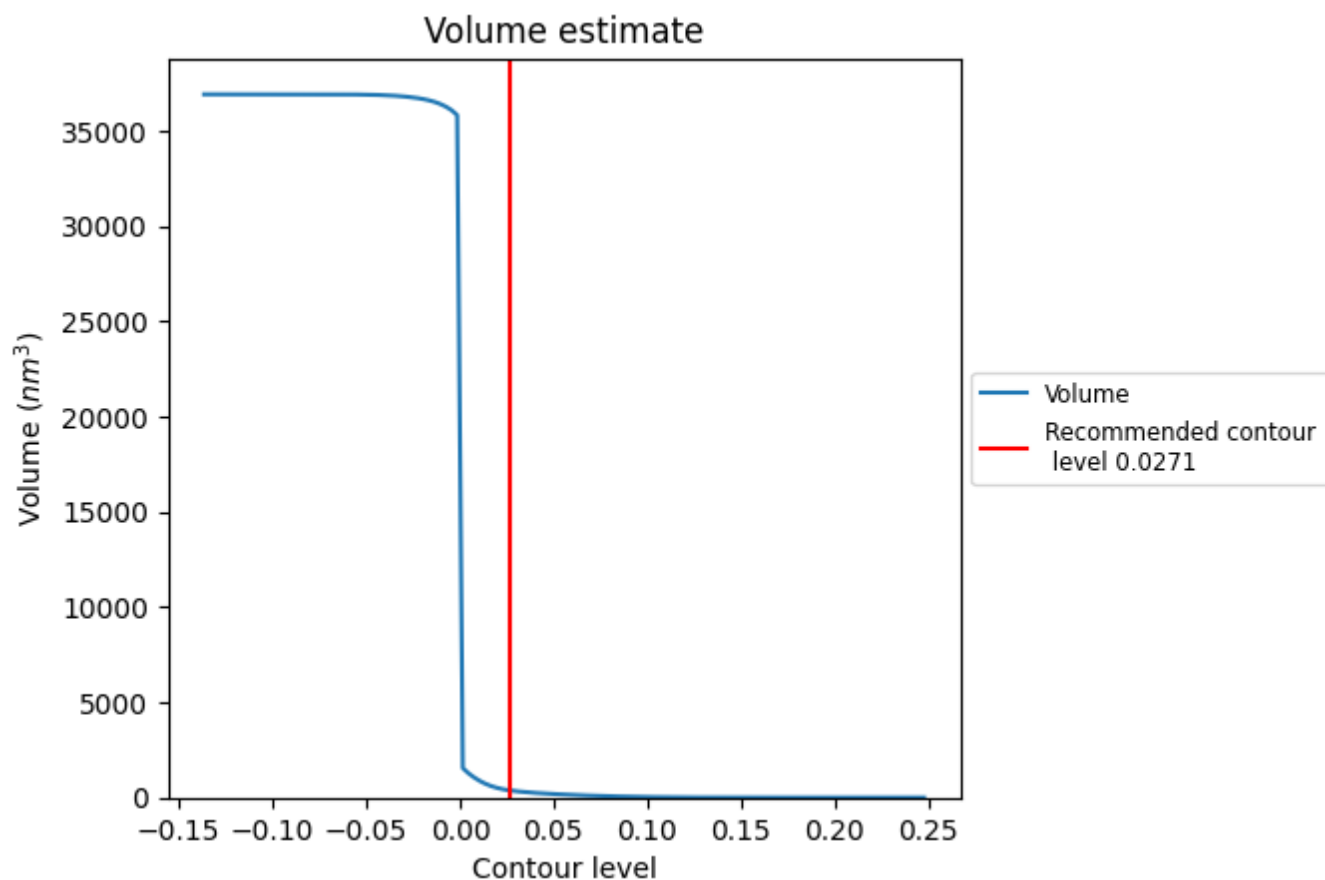
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

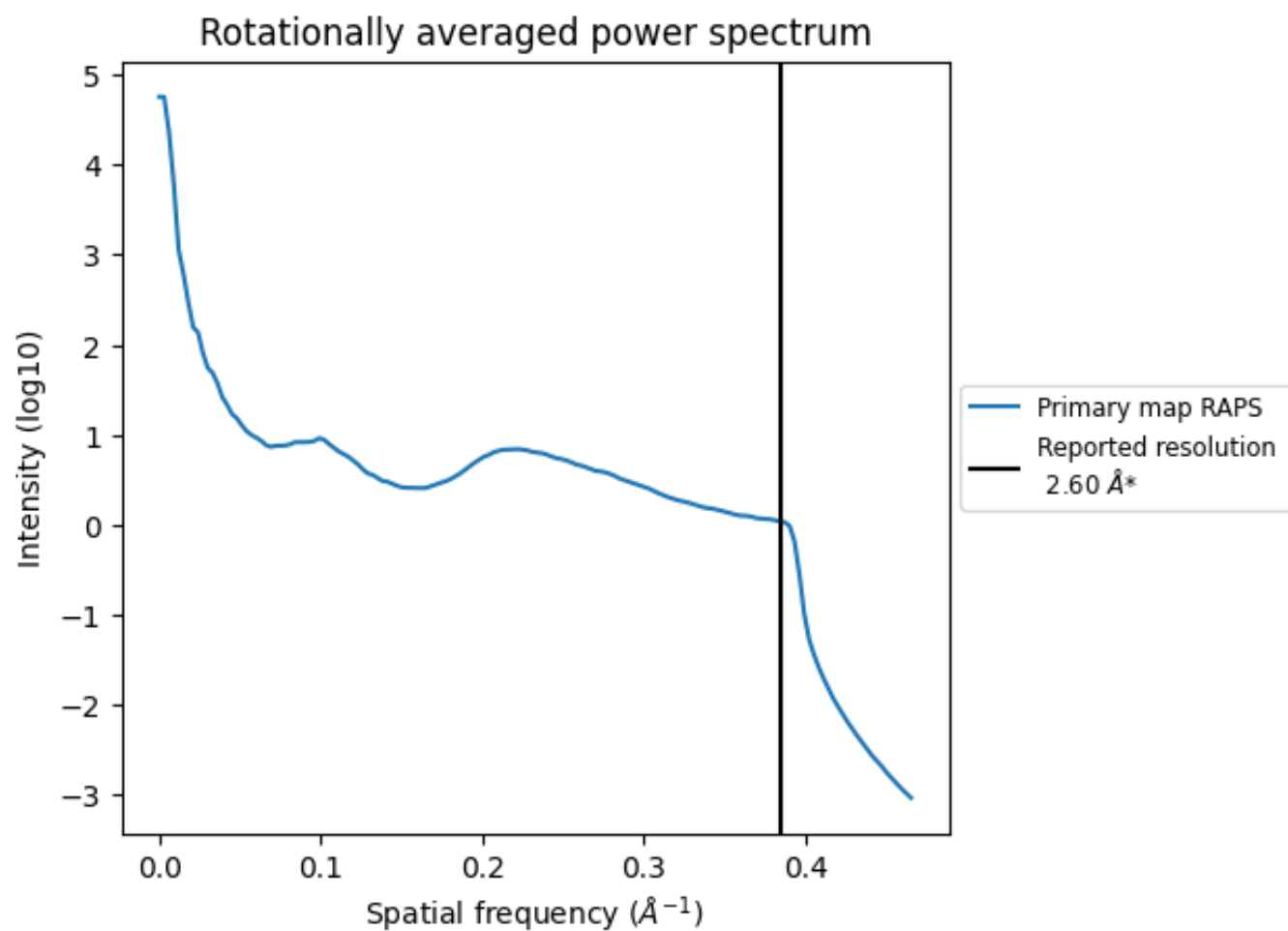
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 371 nm³; this corresponds to an approximate mass of 335 kDa.

The volume estimate graph shows how the enclosed volume varies with the contour level. The recommended contour level is shown as a vertical line and the intersection between the line and the curve gives the volume of the enclosed surface at the given level.

7.3 Rotationally averaged power spectrum ⓘ



*Reported resolution corresponds to spatial frequency of 0.385 Å⁻¹

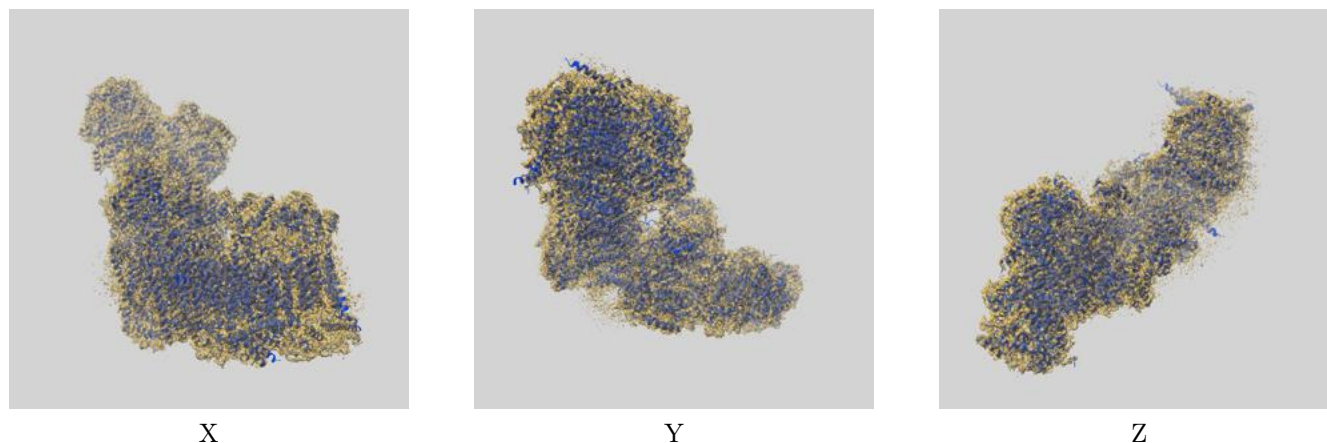
8 Fourier-Shell correlation

This section was not generated. No FSC curve or half-maps provided.

9 Map-model fit [i](#)

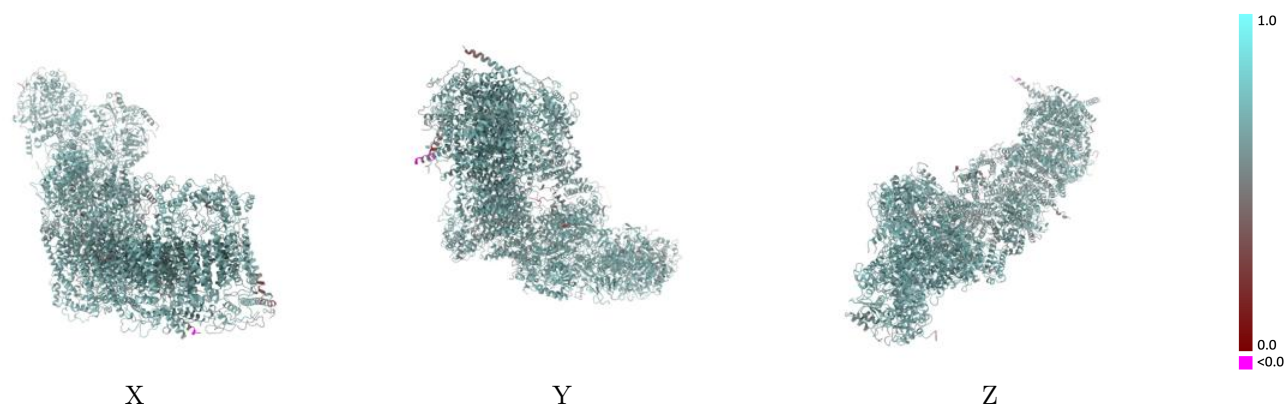
This section contains information regarding the fit between EMD map EMD-31651 and PDB model 7V33. Per-residue inclusion information can be found in section [3](#) on page [22](#).

9.1 Map-model overlay [i](#)



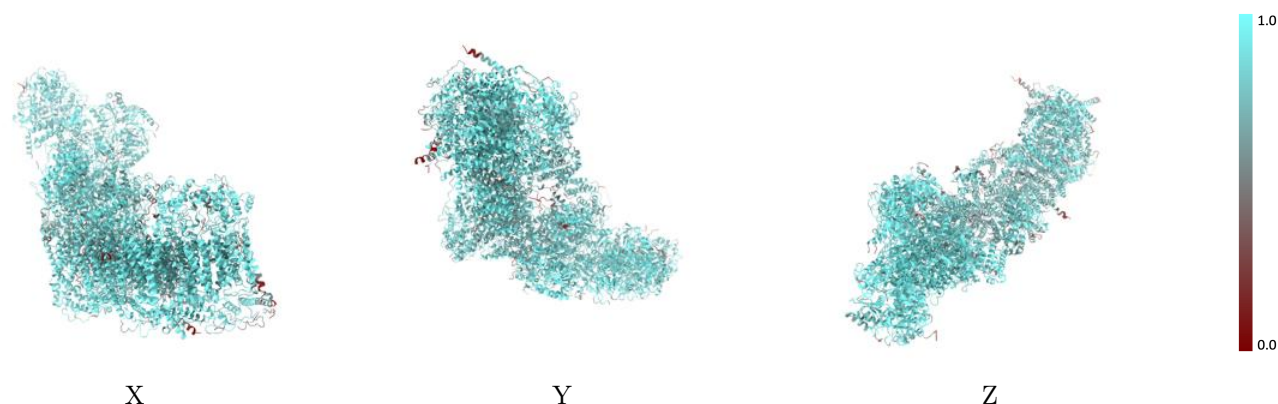
The images above show the 3D surface view of the map at the recommended contour level 0.0271 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

9.2 Q-score mapped to coordinate model [i](#)



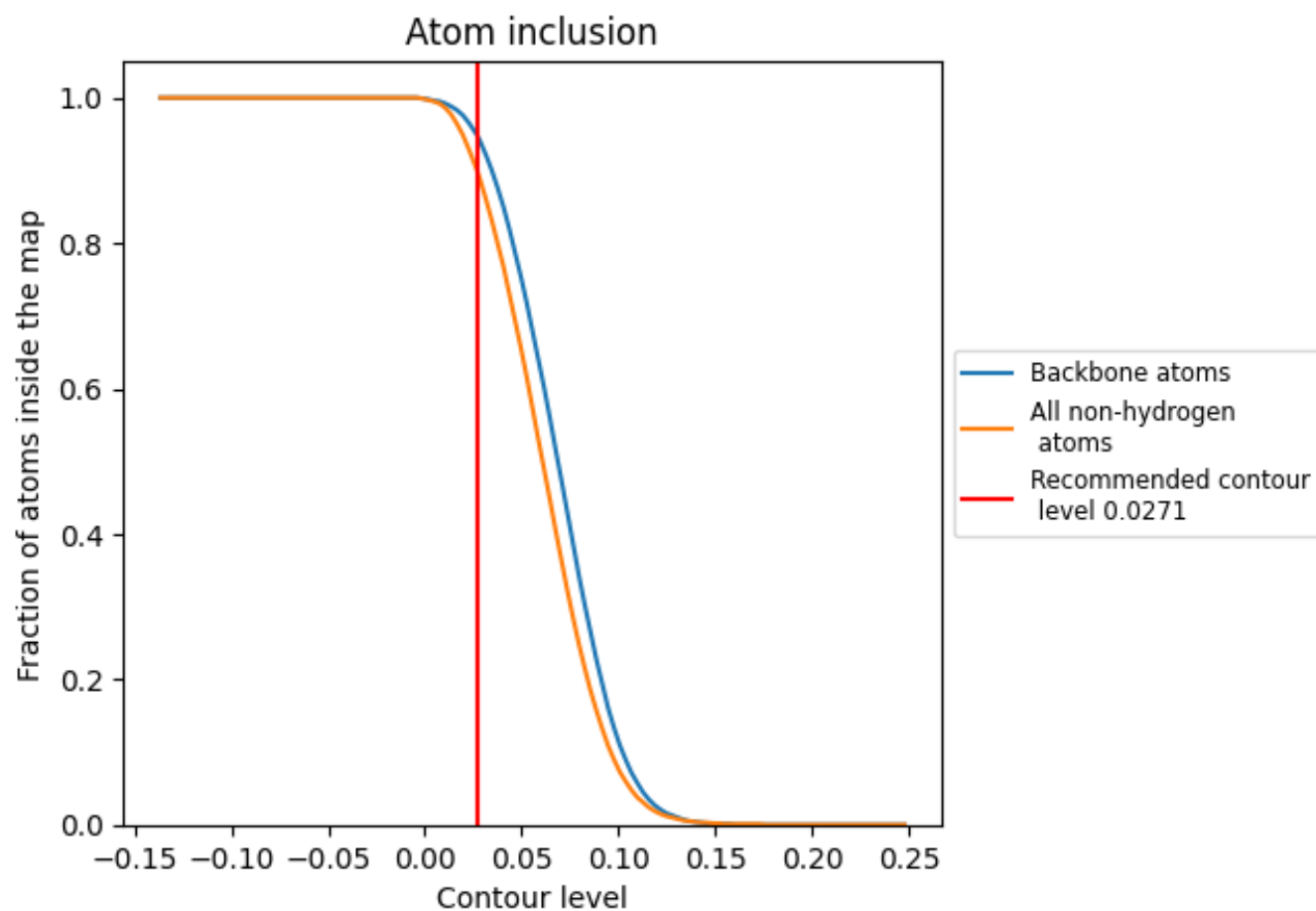
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions at which atoms can be resolved. Low Q-score values may therefore be expected for many entries.

9.3 Atom inclusion mapped to coordinate model [i](#)



The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.0271).

9.4 Atom inclusion [i](#)



At the recommended contour level, 95% of all backbone atoms, 90% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary ⓘ

The table lists the average atom inclusion at the recommended contour level (0.0271) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8990	 0.6490
A	 0.9060	 0.6390
B	 0.9650	 0.6870
C	 0.9600	 0.6870
E	 0.9080	 0.6600
F	 0.8290	 0.5970
G	 0.6930	 0.5290
H	 0.9170	 0.6420
I	 0.8040	 0.6240
J	 0.9200	 0.6570
K	 0.8230	 0.6020
L	 0.9210	 0.6720
M	 0.9310	 0.6570
N	 0.8840	 0.6480
O	 0.8670	 0.6220
P	 0.9680	 0.6890
Q	 0.9610	 0.6850
S	 0.9580	 0.6650
T	 0.8890	 0.6610
U	 0.8720	 0.6430
V	 0.8590	 0.6340
W	 0.8970	 0.6460
X	 0.8080	 0.6030
Y	 0.7730	 0.5930
Z	 0.7360	 0.5720
a	 0.8990	 0.6580
b	 0.8260	 0.6170
c	 0.8600	 0.6320
d	 0.8480	 0.6230
e	 0.8490	 0.6280
f	 0.7510	 0.5920
g	 0.9130	 0.6550
h	 0.8910	 0.6410
i	 0.9450	 0.6770
j	 0.8980	 0.6650



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Chain	Atom inclusion	Q-score
k	 0.9400	 0.6740
l	 0.9100	 0.6560
m	 0.8500	 0.6310
n	 0.7500	 0.5980
o	 0.8260	 0.6290
p	 0.8730	 0.6350
r	 0.9530	 0.6750
s	 0.9610	 0.6780
u	 0.9040	 0.6500
v	 0.7460	 0.5730
w	 0.8640	 0.6270