



wwPDB EM Validation Summary Report ⓘ

Feb 24, 2024 – 01:35 PM EST

PDB ID : 7KZM
EMDB ID : EMD-23082
Title : Outer dynein arm bound to doublet microtubules from *C. reinhardtii*
Authors : Walton, T.; Wu, H.; Brown, A.B.
Deposited on : 2020-12-10
Resolution : 7.50 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.dev70
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4.02b-467
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

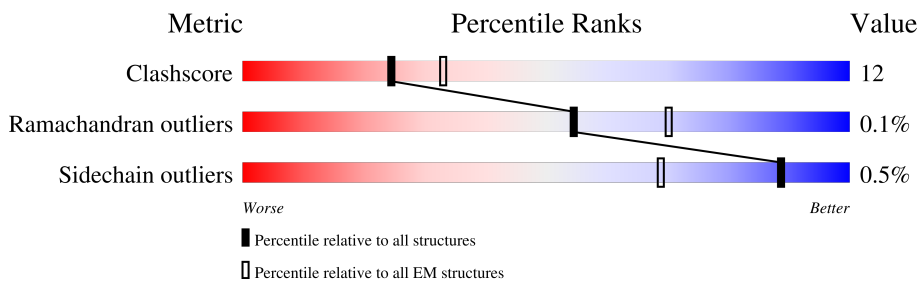
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 7.50 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)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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	A1	443	
1	A3	443	
1	A5	443	
1	A7	443	
1	B1	443	
1	B3	443	
1	B5	443	
1	B7	443	



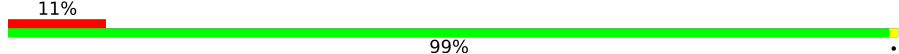
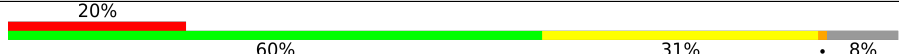
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Mol	Chain	Length	Quality of chain
2	A2	451	
2	A4	451	
2	A6	451	
2	B2	451	
2	B4	451	
2	B6	451	
3	A	4503	
4	B	4568	
5	C	4485	
6	D	683	
7	E	567	
8	F	136	
9	G	159	
10	H	120	
11	I	105	
12	J	100	
13	K	91	
13	L	91	
13	M	91	
13	N	91	
14	O	117	
15	P	103	
16	X	749	
16	X1	749	
17	X0	162	

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Mol	Chain	Length	Quality of chain
18	Y	552	 8% 5% 87%
18	Y1	552	 19% 7% 73%
19	Y0	168	 11% 99%
20	Z	184	 20% 60% 31% 8%

2 Entry composition [i](#)

There are 23 unique types of molecules in this entry. The entry contains 124943 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 Tubulin beta.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A1	426	Total 3346	C 2103	N 574	O 639	S 30	0	0
1	A3	426	Total 3346	C 2103	N 574	O 639	S 30	0	0
1	A5	426	Total 3346	C 2103	N 574	O 639	S 30	0	0
1	A7	426	Total 3346	C 2103	N 574	O 639	S 30	0	0
1	B1	419	Total 3298	C 2077	N 563	O 628	S 30	0	0
1	B3	410	Total 3227	C 2030	N 553	O 614	S 30	0	0
1	B5	426	Total 3346	C 2103	N 574	O 639	S 30	0	0
1	B7	426	Total 3346	C 2103	N 574	O 639	S 30	0	0

- Molecule 2 is a protein called Tubulin alpha.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	A2	430	Total 3339	C 2114	N 568	O 636	S 21	0	0
2	A4	427	Total 3318	C 2103	N 565	O 629	S 21	0	0
2	A6	429	Total 3335	C 2112	N 567	O 635	S 21	0	0
2	B2	411	Total 3204	C 2035	N 544	O 605	S 20	0	0
2	B4	409	Total 3193	C 2028	N 542	O 603	S 20	0	0
2	B6	427	Total 3318	C 2103	N 565	O 629	S 21	0	0

- Molecule 3 is a protein called Heavy chain alpha.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
3	A	3275	16173	9623	3275	3275	0	0

- Molecule 4 is a protein called Flagellar outer dynein arm heavy chain beta.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	B	3540	19163	11601	3735	3803	24	0	0

- Molecule 5 is a protein called Dynein gamma chain, flagellar outer arm.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
5	C	3890	21756	13184	4221	4314	37	0	0

- Molecule 6 is a protein called Dynein, 78 kDa intermediate chain, flagellar outer arm.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
6	D	456	3609	2297	610	678	24	0	0

- Molecule 7 is a protein called Dynein, 70 kDa intermediate chain, flagellar outer arm.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
7	E	474	3697	2332	623	725	17	0	0

- Molecule 8 is a protein called Flagellar outer dynein arm light chain 2.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
8	F	100	495	295	100	100	0	0

- Molecule 9 is a protein called Dynein 18 kDa light chain, flagellar outer arm.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
9	G	138	1089	677	183	220	9	0	0

- Molecule 10 is a protein called Dynein 11 kDa light chain, flagellar outer arm.

Mol	Chain	Residues	Atoms				AltConf	Trace
10	H	91	Total	C	N	O	0	0
			451	269	91	91		

- Molecule 11 is a protein called Dynein light chain roadblock LC7a.

Mol	Chain	Residues	Atoms					AltConf	Trace
11	I	103	Total	C	N	O	S	0	0
			827	525	148	153	1		

- Molecule 12 is a protein called Dynein light chain roadblock LC7b.

Mol	Chain	Residues	Atoms					AltConf	Trace
12	J	94	Total	C	N	O	S	0	0
			741	466	133	140	2		

- Molecule 13 is a protein called Dynein 8 kDa light chain, flagellar outer arm.

Mol	Chain	Residues	Atoms					AltConf	Trace
13	K	82	Total	C	N	O	S	0	0
			671	433	112	122	4		
13	L	82	Total	C	N	O	S	0	0
			671	433	112	122	4		
13	M	82	Total	C	N	O	S	0	0
			671	433	112	122	4		
13	N	82	Total	C	N	O		0	0
			407	243	82	82			

- Molecule 14 is a protein called Dynein light chain 9.

Mol	Chain	Residues	Atoms				AltConf	Trace
14	O	97	Total	C	N	O	0	0
			481	286	97	98		

- Molecule 15 is a protein called Dynein light chain 10.

Mol	Chain	Residues	Atoms					AltConf	Trace
15	P	98	Total	C	N	O	S	0	0
			805	523	128	146	8		

- Molecule 16 is a protein called Outer dynein arm-docking complex subunit 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
16	X	56	Total	C	N	O	S	0	0
			481	292	97	89	3		
16	X1	142	Total	C	N	O	S	0	0
			1178	715	223	235	5		

- Molecule 17 is a protein called DC1.

Mol	Chain	Residues	Atoms				AltConf	Trace
17	X0	162	Total	C	N	O	0	0
			810	486	162	162		

- Molecule 18 is a protein called Outer dynein arm protein 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
18	Y	73	Total	C	N	O	S	0	0
			595	360	112	120	3		
18	Y1	147	Total	C	N	O	S	0	0
			1185	729	223	224	9		

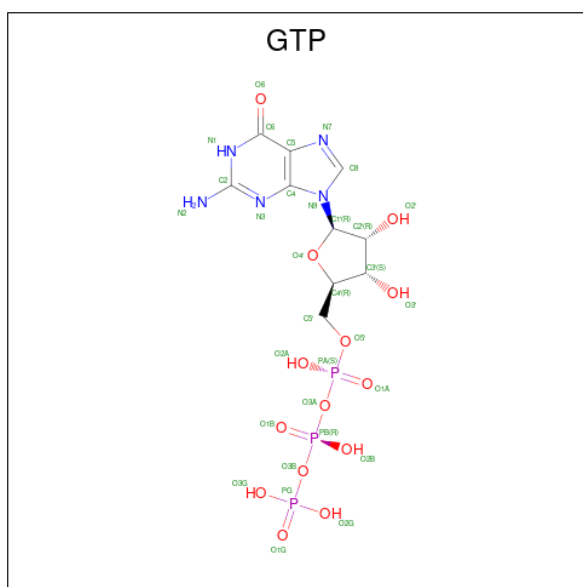
- Molecule 19 is a protein called DC2.

Mol	Chain	Residues	Atoms				AltConf	Trace
19	Y0	168	Total	C	N	O	0	0
			840	504	168	168		

- Molecule 20 is a protein called Outer dynein arm-docking complex protein DC3.

Mol	Chain	Residues	Atoms					AltConf	Trace
20	Z	170	Total	C	N	O	S	0	0
			1384	863	242	270	9		

- Molecule 21 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).



Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
21	A1	1	Total 32	C 10	N 5	O 14	P 3	0
21	A3	1	Total 32	C 10	N 5	O 14	P 3	0
21	A5	1	Total 32	C 10	N 5	O 14	P 3	0
21	A7	1	Total 32	C 10	N 5	O 14	P 3	0
21	B2	1	Total 32	C 10	N 5	O 14	P 3	0
21	B5	1	Total 32	C 10	N 5	O 14	P 3	0
21	B7	1	Total 32	C 10	N 5	O 14	P 3	0

- Molecule 22 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

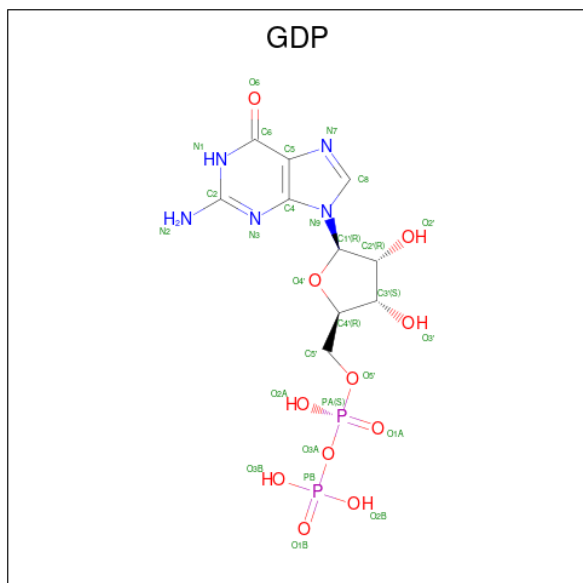
Mol	Chain	Residues	Atoms		AltConf
			Total	Mg	
22	A1	1	Total 1	Mg 1	0
22	A2	1	Total 1	Mg 1	0
22	A4	1	Total 1	Mg 1	0
22	A6	1	Total 1	Mg 1	0
22	B3	1	Total 1	Mg 1	0

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Mol	Chain	Residues	Atoms		AltConf
22	B4	1	Total	Mg	0
			1	1	
22	B6	1	Total	Mg	0
			1	1	

- Molecule 23 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).

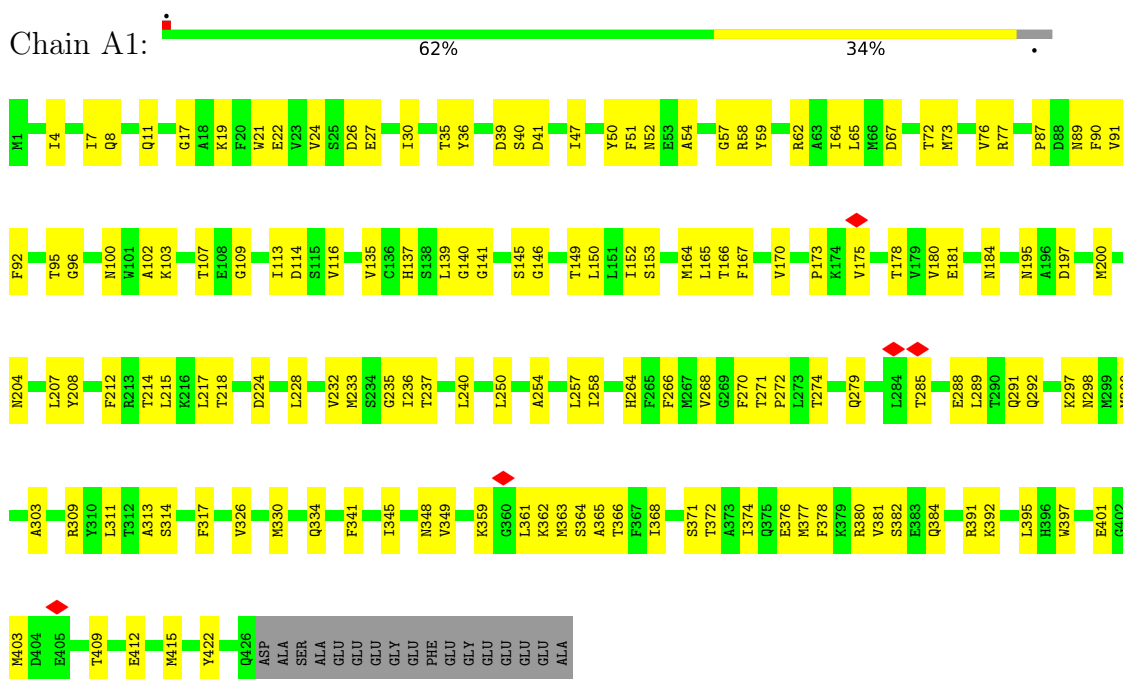


Mol	Chain	Residues	Atoms				AltConf	
23	A1	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	A3	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	A5	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	A7	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	B1	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	B3	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	B5	1	Total	C	N	O	P	0
			28	10	5	11	2	
23	B7	1	Total	C	N	O	P	0
			28	10	5	11	2	

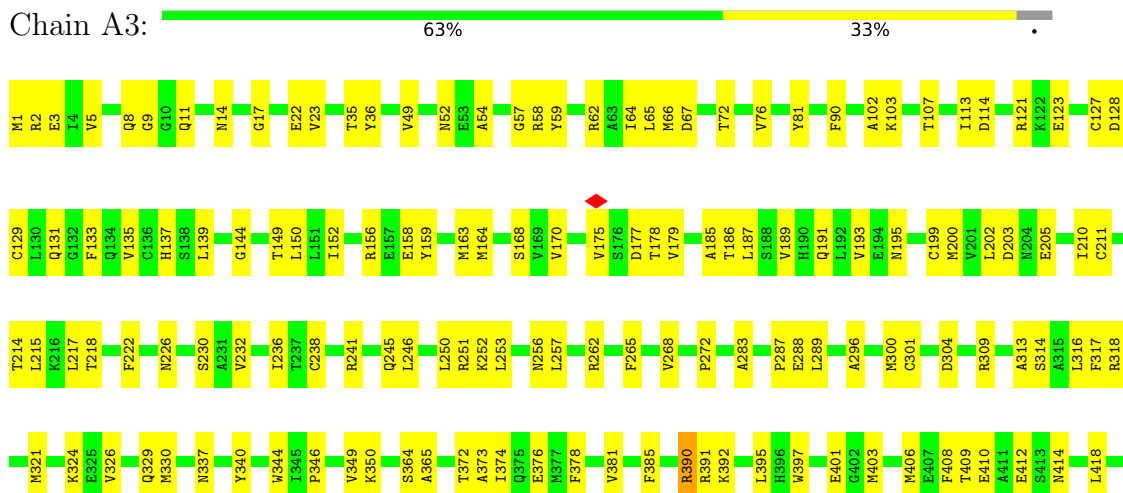
3 Residue-property plots

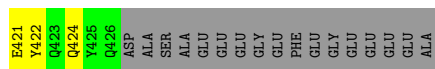
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion 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: Tubulin beta



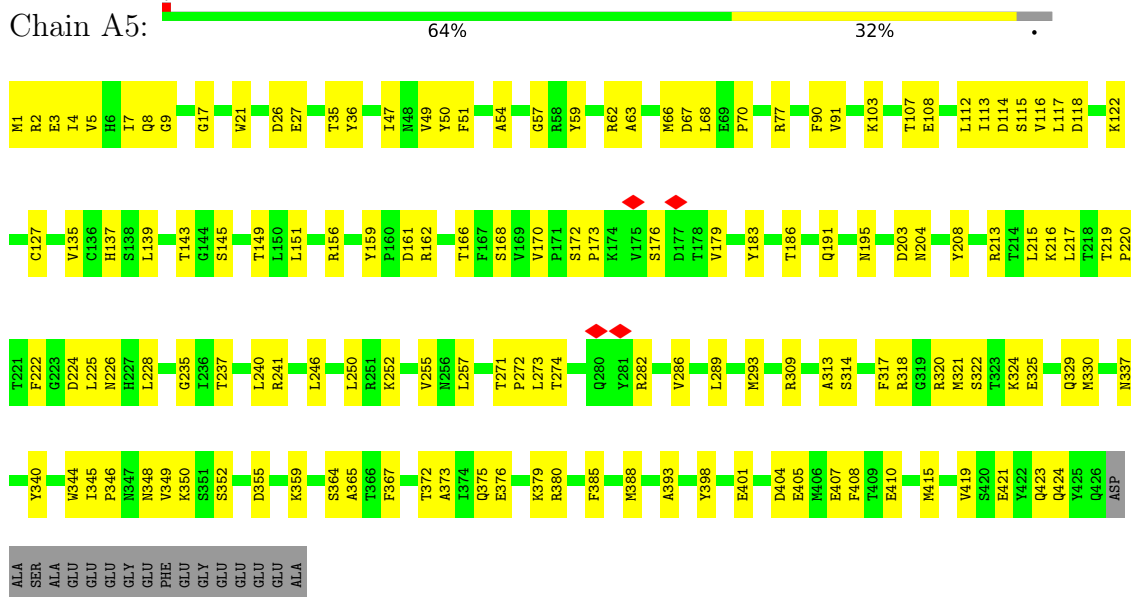
• Molecule 1: Tubulin beta





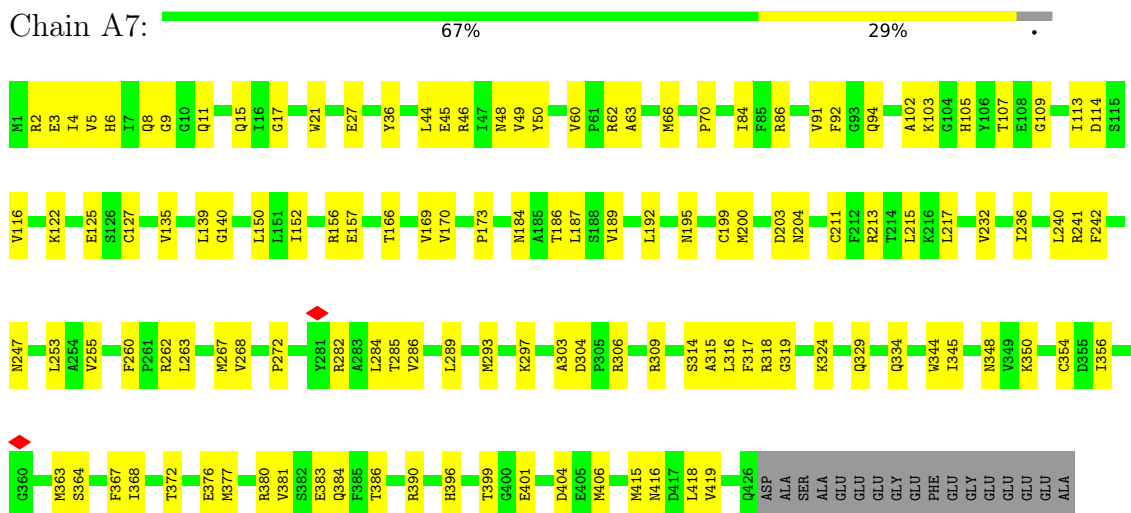
• Molecule 1: Tubulin beta

Chain A5:



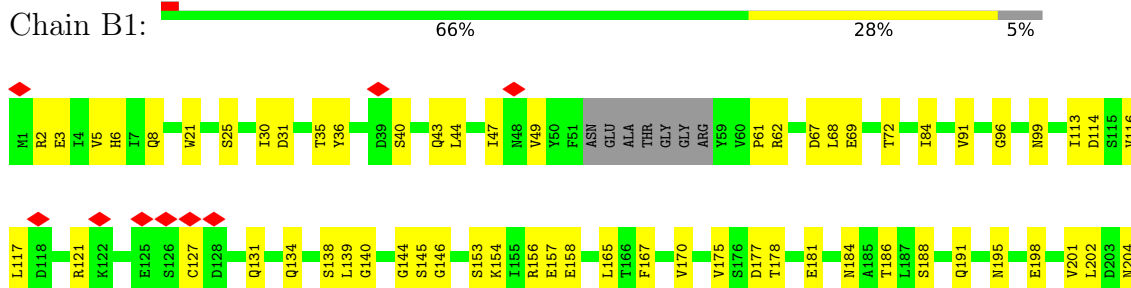
• Molecule 1: Tubulin beta

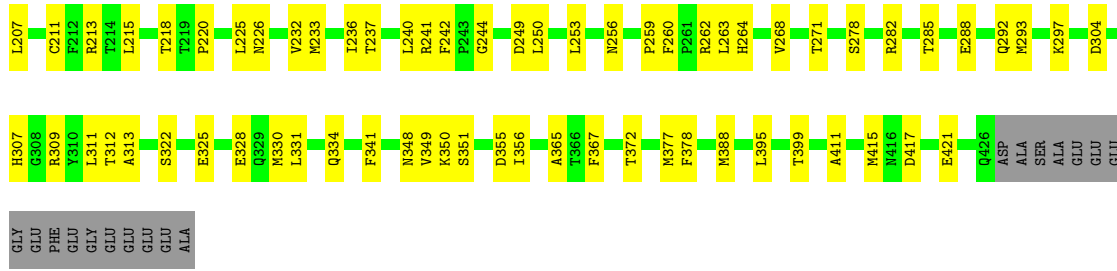
Chain A7:



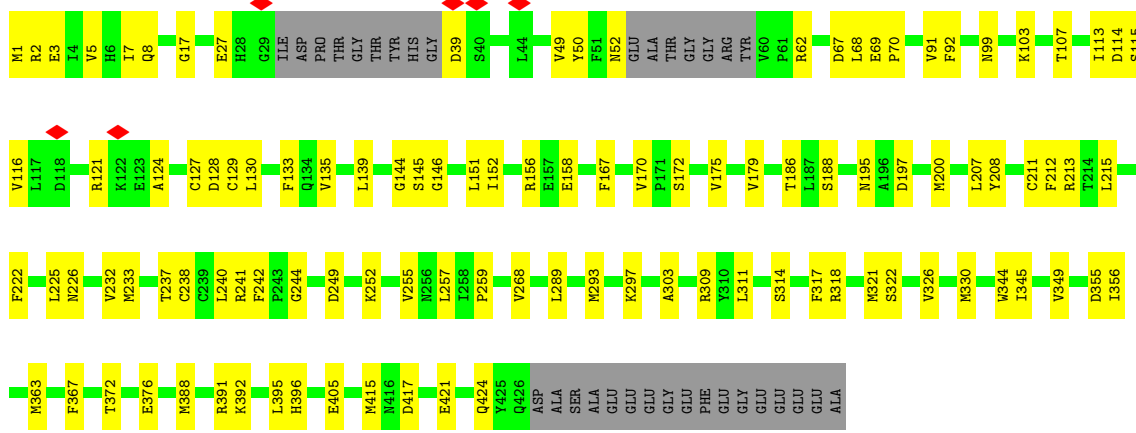
• Molecule 1: Tubulin beta

Chain B1:

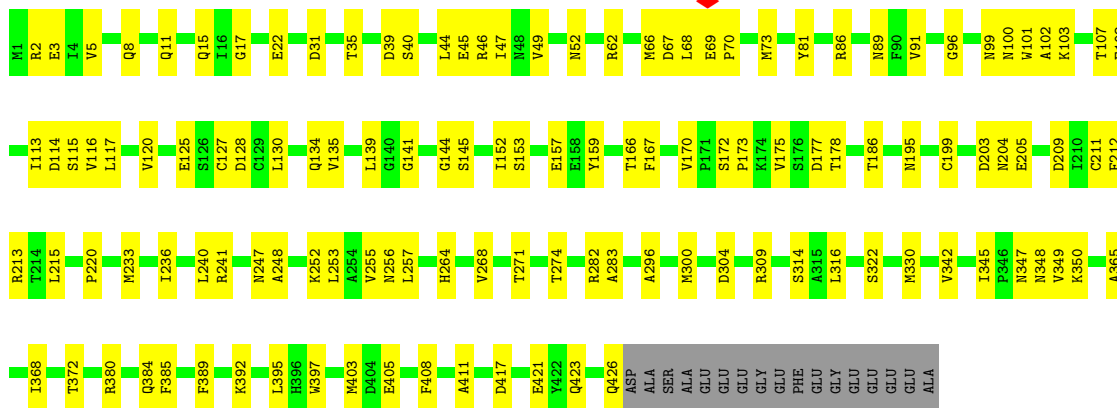




● Molecule 1: Tubulin beta

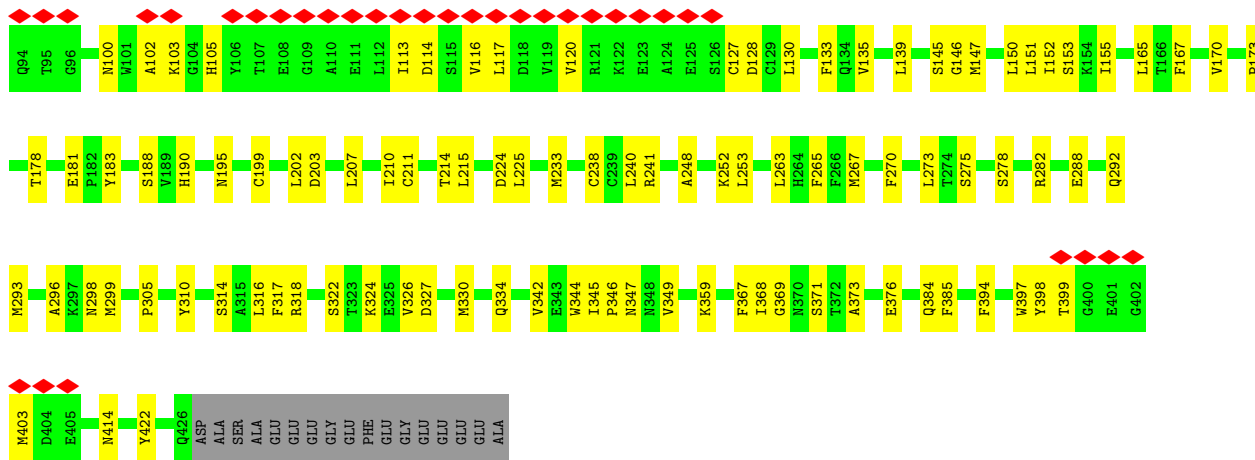


● Molecule 1: Tubulin beta

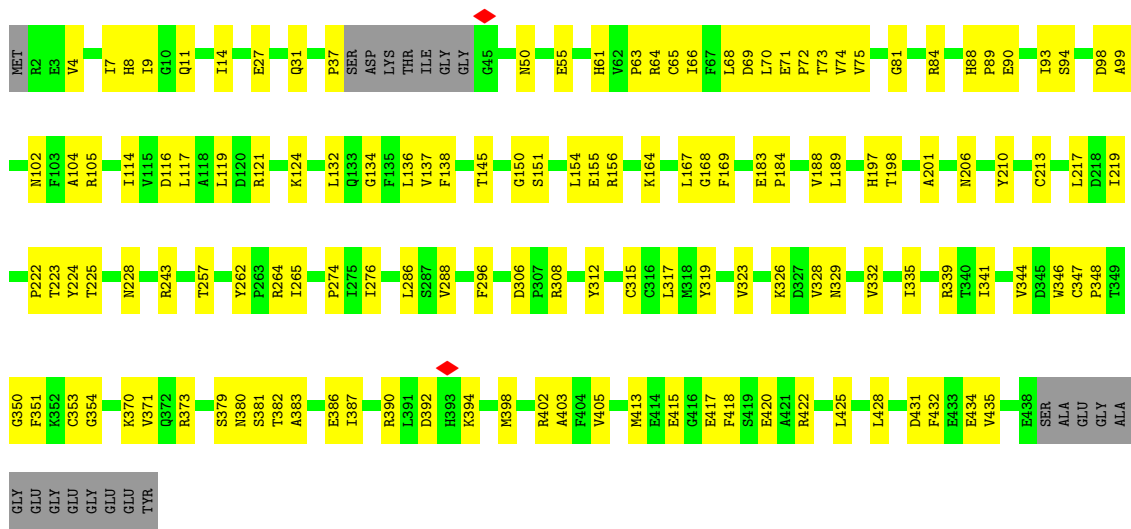


● Molecule 1: Tubulin beta

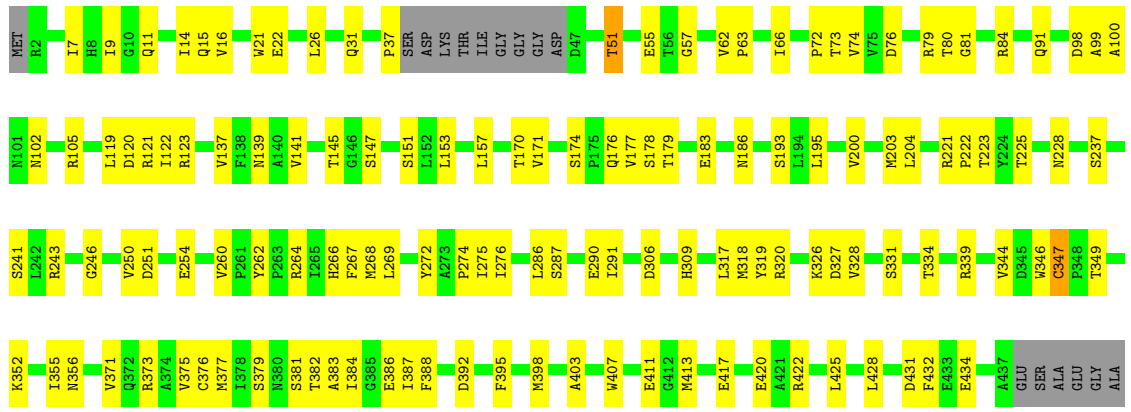




• Molecule 2: Tubulin alpha



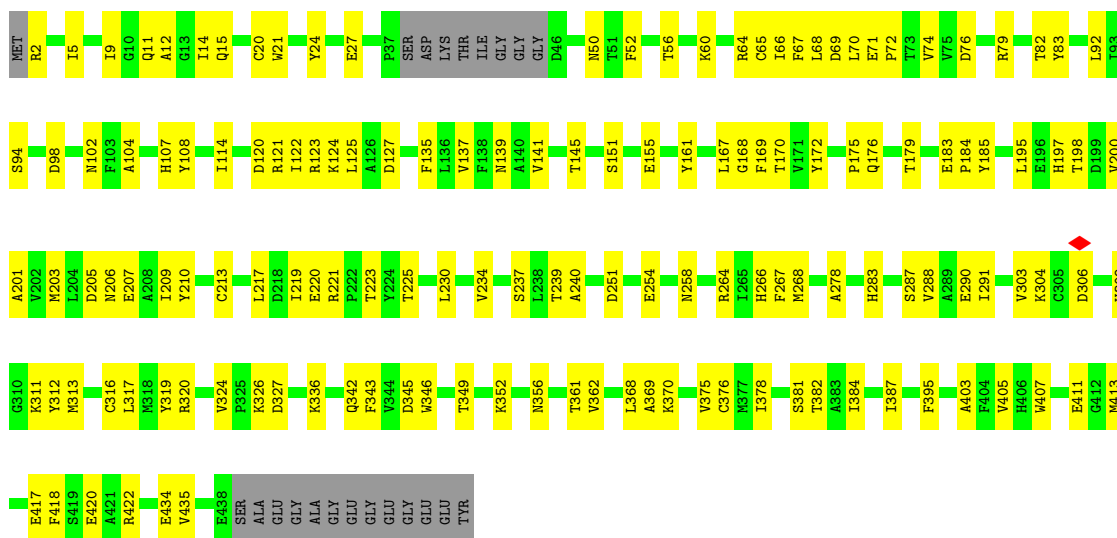
• Molecule 2: Tubulin alpha



GLY
GLU
GLY
GLY
GLY
GLY
GLY
GLY
TYR

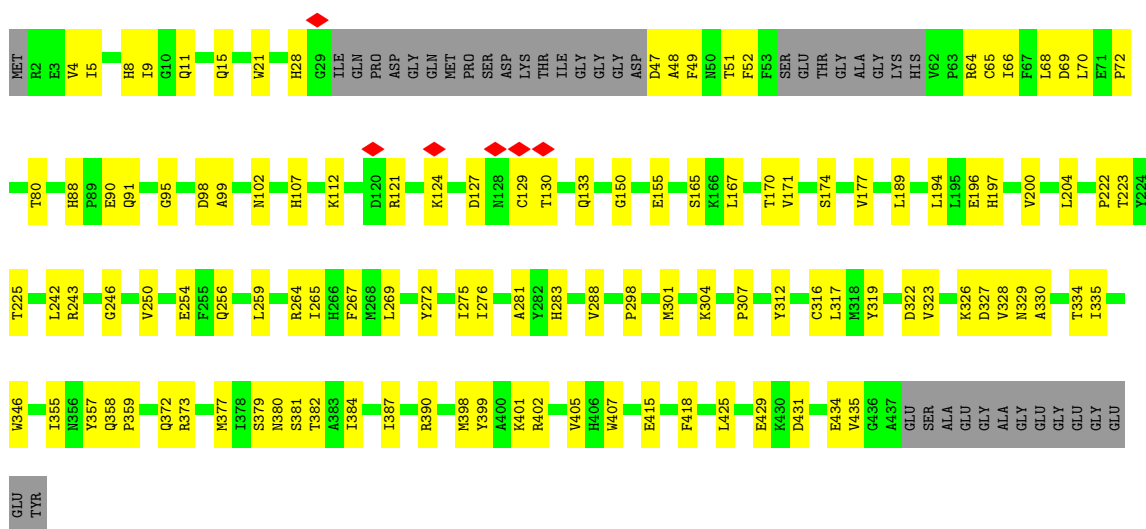
• Molecule 2: Tubulin alpha

Chain A6: 63% 32% 5%



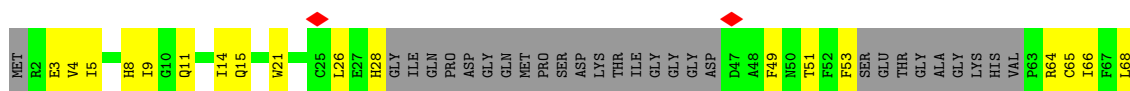
• Molecule 2: Tubulin alpha

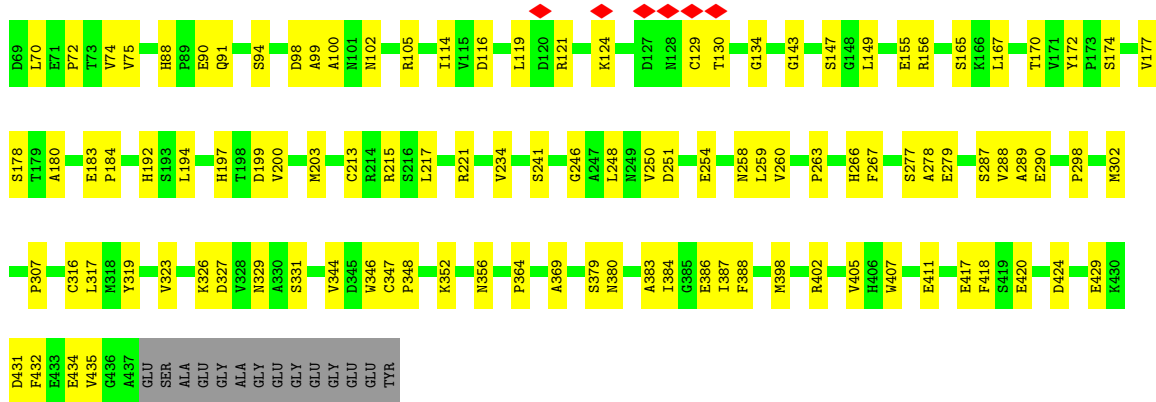
Chain B2: 66% 25% 9%



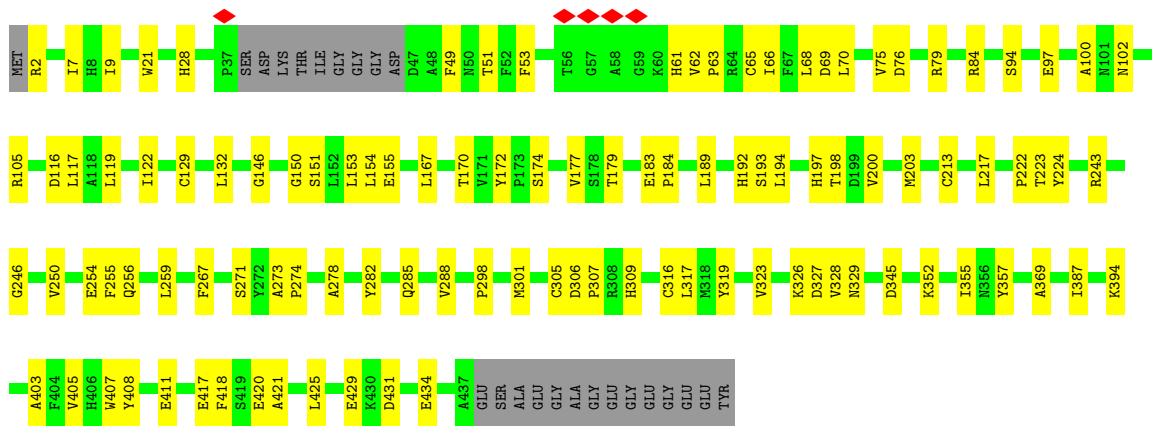
• Molecule 2: Tubulin alpha

Chain B4: 63% 27% 9%

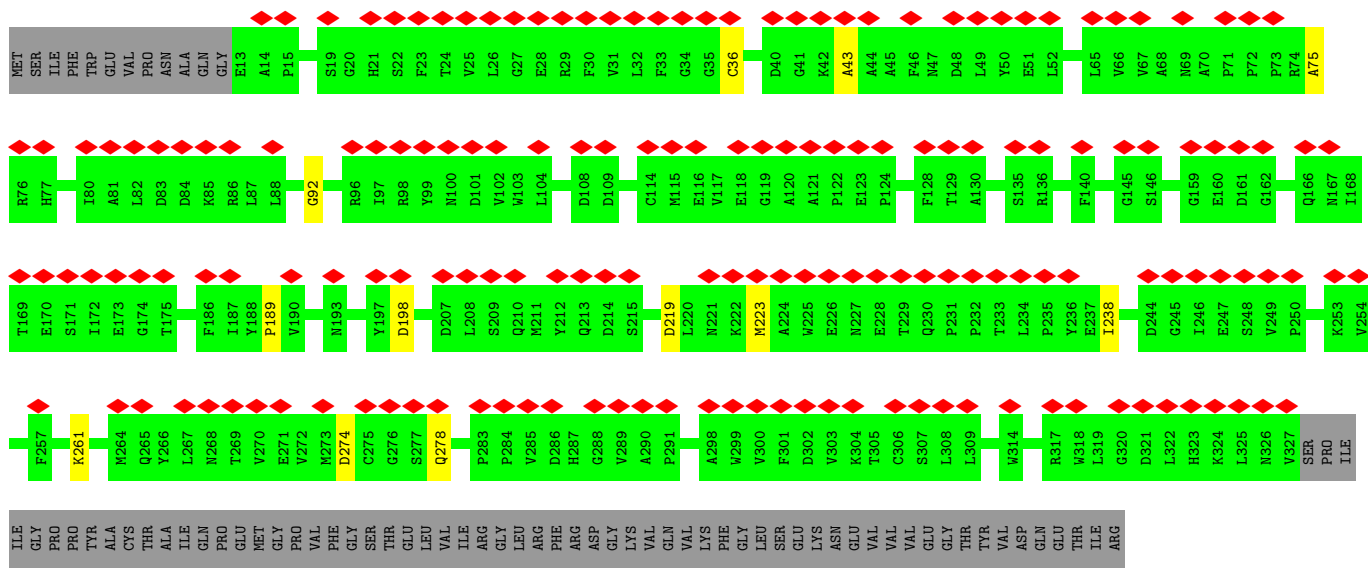




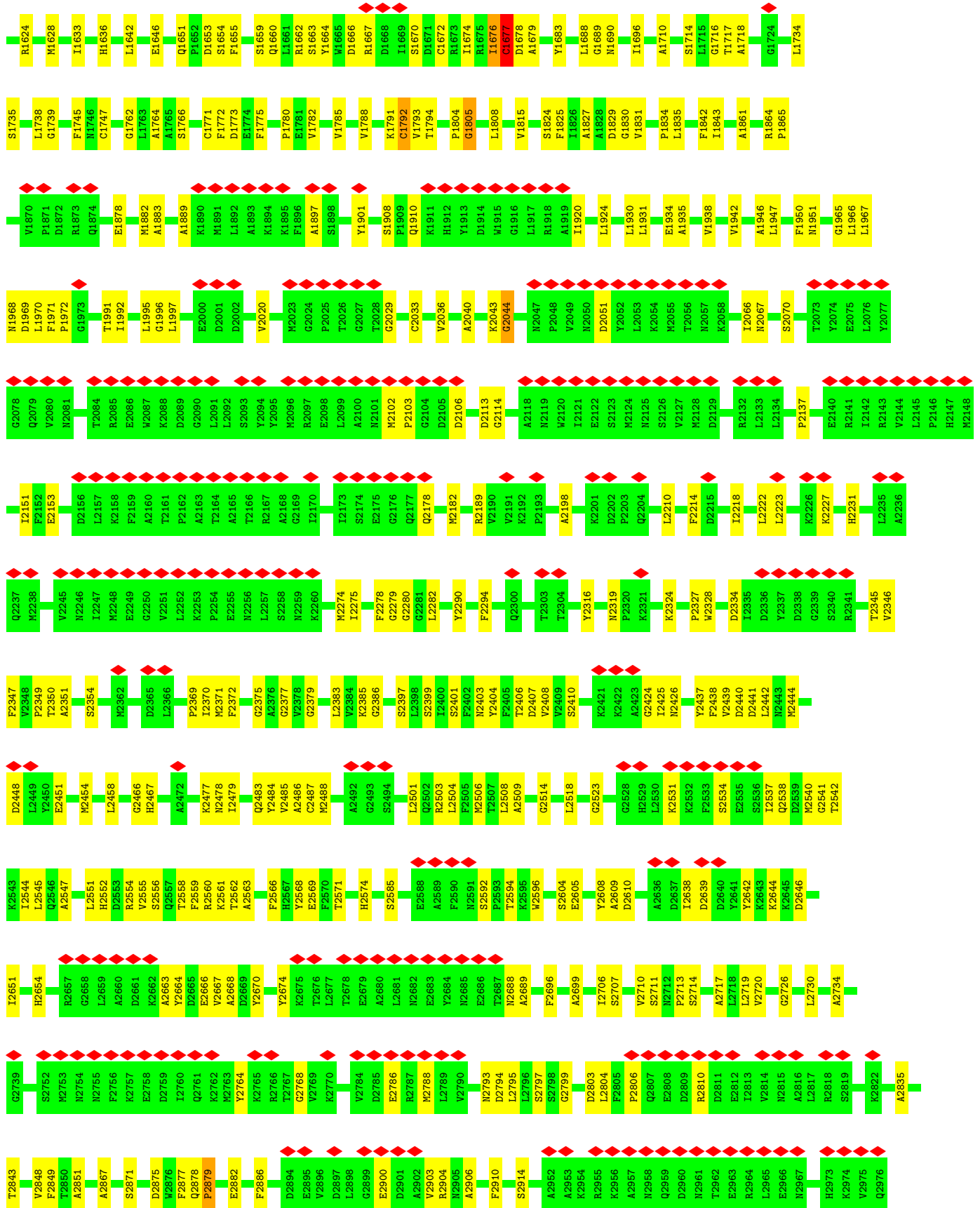
• Molecule 2: Tubulin alpha



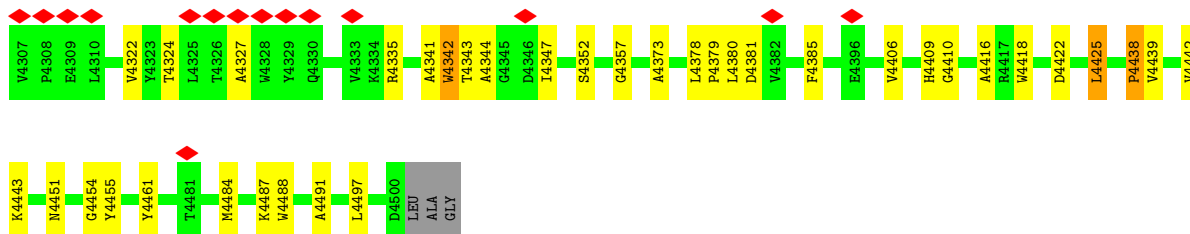
• Molecule 3: Heavy chain alpha



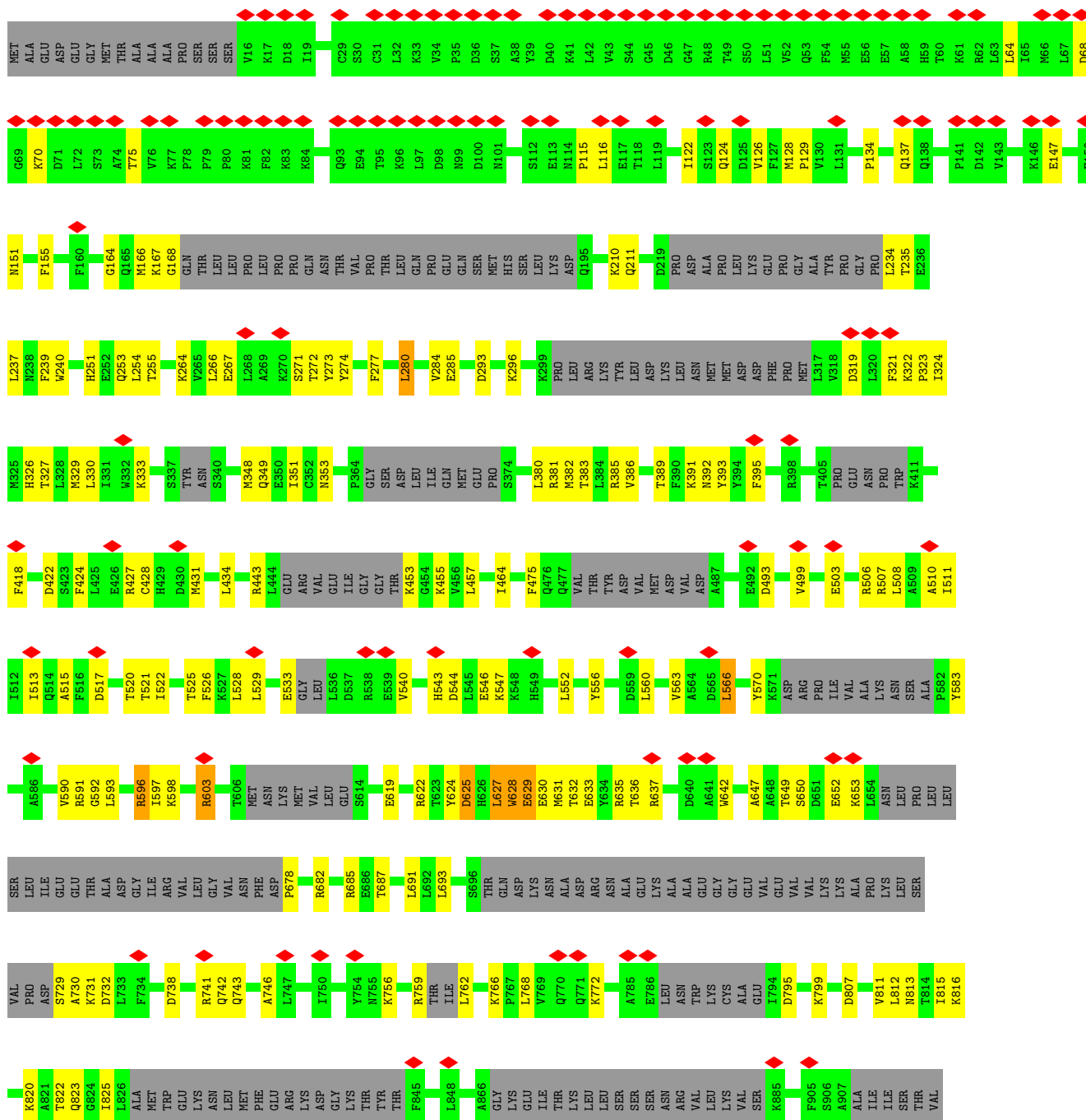
C1509	K1437	M1331	ASP	LEU	ALA	VAL	VAL	GLN	GLN	TYR	GLY	LEU	SER
P1516	A1438	K1341	HIS	TRP	LEU	LEU	LEU	LEU	LEU	VAL	LEU	LEU	GLY
F1517	D1342	D1342	TRP	ILE	GLY	GLY	GLY	GLY	GLY	ASP	ASP	ASP	ALA
S1518	M1440	E1343	ARG	THR	GLN	PHE	PHE	ASP	GLY	GLY	GLY	GLY	GLY
S1519	D1441	I1344	LEU	MET	LEU	GLN	GLN	LEU	ASP	ASP	ASP	ASP	ASP
P1520	Y1442	L1346	ALA	ASP	ASP	ILE	VAL	LEU	GLY	GLY	VAL	PRO	GLY
L1521	M1443	G1348	THR	ALA	GLN	ALA	ALA	GLN	ASP	GLY	ASP	ASP	ASP
P1522	E1444	Q1348	THR	GLY	GLY	GLY	GLY	GLY	TRP	TRP	TRP	TRP	TRP
L1523	S1445	K1349	LEU	GLY	GLY	VAL	VAL	LEU	LEU	LEU	LEU	LEU	LEU
E1524	K1446	L1351	THR	ALA	ALA	ALA	ALA	GLN	GLY	VAL	VAL	VAL	VAL
M1525	M1525	M1352	PHE	ASN	VAL	ASP	ASP	GLY	ILE	LEU	LEU	LEU	LEU
K1526	S1458	D1353	ASN	ASN	VAL	ILE	ILE	GLN	GLY	VAL	VAL	VAL	VAL
Q1529	A1459	Q1359	VAL	PHE	GLY	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
Y1530	D1460	I1360	LYS	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
M1531	L1461	M1361	ASP	PRO	PHE	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
N1532	L1462	A1362	PRO	GLN	GLN	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
D1533	D1463	E1363	LEU	VAL	ILE	THR	THR	THR	THR	THR	THR	THR	THR
A1536	I1464	Y1370	LEU	HIS	PRO	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA
K1537	L1465	ASP	ASP	LYS	VAL	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
M1540	S1466	S1373	LEU	LYS	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
Y1553	G1467	L1374	LEU	VAL	VAL	ARG	ARG	ARG	ARG	ARG	ARG	ARG	ARG
P1554	G1468	F1375	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA
S1555	M1469	I1376	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
R1558	M1470	H1377	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
L1562	Y1471	S1378	HIS	VAL	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP
Q1568	M1472	E1379	LYS	PHE	ARG	ARG	ARG	ARG	ARG	ARG	ARG	ARG	ARG
Y1572	R1473	E1380	PHE	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
I1576	V1474	V1381	GLY	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
Y1577	Q1475	K1382	ASP	GLN	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP
M1578	I1476	K1383	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
E1583	M1479	E1384	VAL	LYS	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
F1586	F1482	L1385	VAL	ASN	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
T1587	I1485	P1386	LEU	LEU	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP
E1588	D1486	Q1387	VAL	VAL	THR	THR	THR	THR	THR	THR	THR	THR	THR
M1589	K1487	T1389	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
A1590	L1488	F1392	PRO	PRO	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
R1591	R1489	I1395	LEU	LEU	CYS	CYS	CYS	CYS	CYS	CYS	CYS	CYS	CYS
G1592	L1490	V1399	VAL	VAL	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
G1595	D1491	K1400	ALA	ALA	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
Y1600	S1492	K1401	ASP	ASP	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN
Q1607	E1493	V1402	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
I1612	E1494	K1410	ARG	ARG	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA
K1621	V1495	M1411	PRO	PRO	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP	TRP
	P1496	N1414	ALA	ALA	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN
	G1498	S1414	MET	MET	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN	GLN
	R1499	G1420	THR	THR	ARG	ARG	ARG	ARG	ARG	ARG	ARG	ARG	ARG
	A1500	N1424	LYS	LYS	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
	P1501		VAL	VAL	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
	K1502		ILE	ILE	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU
	A1503		ASN	ASN	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL	VAL
	L1504		THR	THR	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA
	G1505		PRO	PRO	THR	THR	THR	THR	THR	THR	THR	THR	THR
	M1506		ILE	ILE	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY	GLY
	E1507		GLY	GLY	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP
	S1508		LEU	LEU	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP	ASP



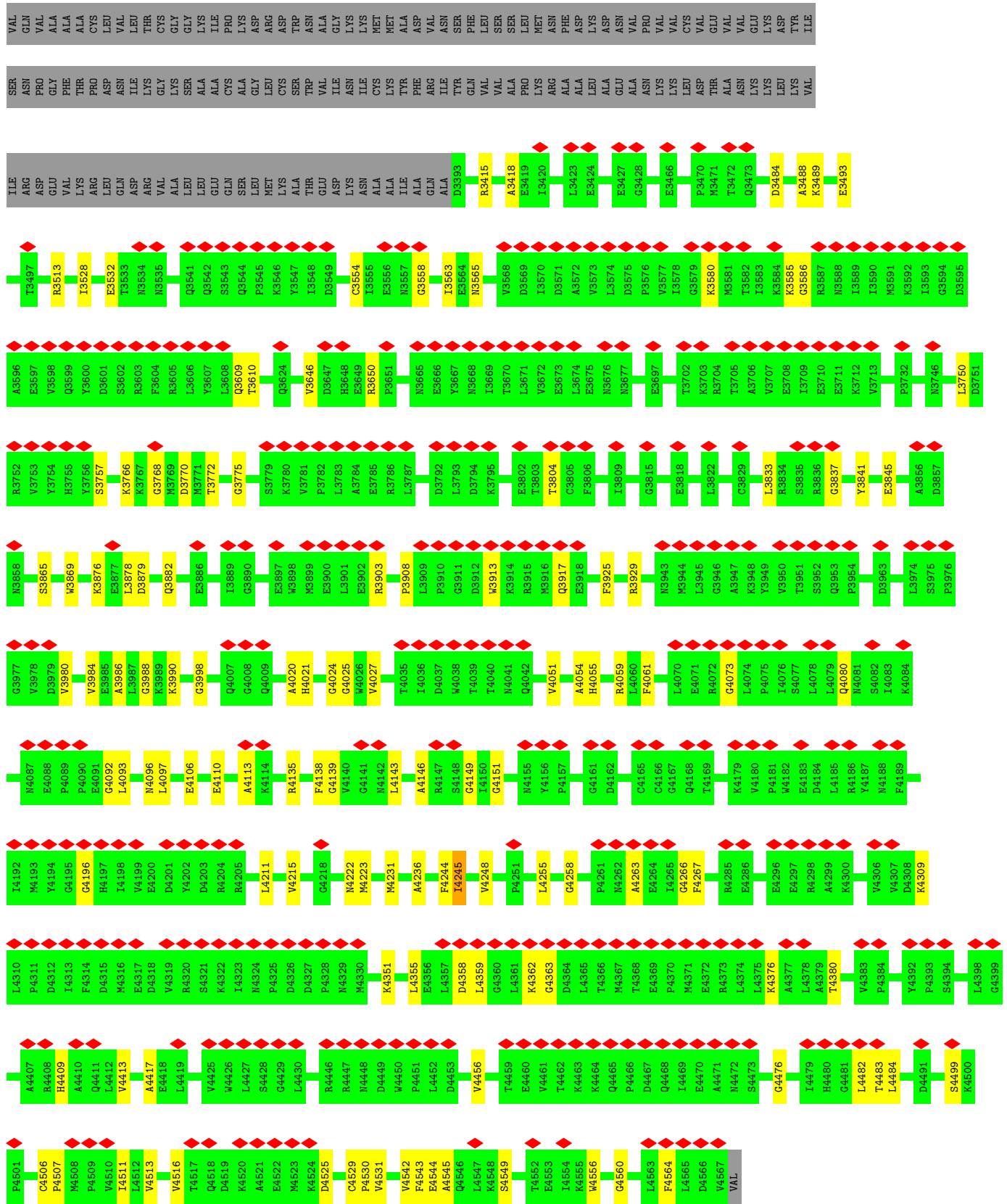
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T4232	A3963	A3699	A3699	T3628	A3528	I3397	T3291	GLN	V2979
K4234	H3964	T3627	R3703	A3528	E3529	A3398	R3295	ALA	D2980
L4237	P3965	Q3631	C3711	S3640	E3529	E3399	L3306	GLN	I2981
P4238	F3967	A3637	R3720	LEU	D3530	R3307	E3307	ALA	L2982
E4239	C3968	A3637	R3721	MET	D3531	E3308	R3308	ASP	V2983
P4240	R3969	E3652	G3722	GLU	I3532	R3309	E3309	GLN	E2984
F4241	F3970	E3652	G3723	ALA	T3533	A3400	A3401	GLY	E2985
N4242	A3973	G3656	F3724	ARG	E3534	V3404	G3401	LEU	A2986
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E4244	A3982	P3667	K3728	SER	A3537	T3420	T3314	VAL	V2988
E4245	A3982	P3667	K3729	SER	A3537	I3421	E3315	LEU	A2989
V4246	E3987	A3668	L3730	GLY	E3540	R3422	P3320	TYR	K2990
L4248	M3870	A3668	I3730	ASP	S3541	R3423	P3321	TYR	A2991
V4257	M3871	A3668	V3731	ARG	S3542	S3424	L3321	ASP	V2991
V4258	Q3991	A3673	L3732	ARG	E3543	T3425	G3322	VAL	GLU
V4259	I3994	E3676	T3736	PRO	K3546	F3426	V3323	VAL	GLU
V4260	K3995	S3876	L3739	SER	R3547	L3436	V3325	ARG	MET
L4261	T3996	S3876	L3740	GLN	R3547	Y3443	D3326	GLN	VAL
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A4264	M4004	I3880	R3742	GLY	S3549	N3446	R3237	VAL	ALA
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T4265	P4017	I3883	V3746	PRO	E3551	F3447	K3241	LEU	LYS
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A4268	D4021	N3899	R3756	ALA	S3553	S3456	L3244	ALA	ASP
A4269	D4021	N3899	R3756	SER	E3554	S3456	A3245	GLY	LEU
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S4272	A4031	G3808	P3763	SER	K3556	A3466	L3248	ALA	ALA
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L4283	G4057	G3916	P3768	LEU	K3557	T3469	N3250	LEU	VAL
G4284	G4057	G3916	D3768	ALA	R3574	L3470	A3251	GLU	GLU
D4286	G4057	G3916	D3769	ALA	A3577	E3481	A3252	ALA	LYS
A4288	G4063	V3926	L3770	ALA	A3577	D3482	L3252	VAL	PRO
L4289	F4066	V3926	R3772	ALA	S3589	Q3483	S3254	VAL	VAL
N4290	N4073	K3929	A3781	ALA	I3593	I3505	E3255	THR	ASN
N4291	L4094	G3934	L3788	ALA	H3594	Q3506	G3256	ALA	GLY
S4292	P4095	G3935	L3788	ALA	A3595	I3507	A3257	ASP	ALA
D4293	W4096	W3936	F3791	ALA	A3595	T3508	E3257	ASP	ALA
N4294	R4097	A3792	A3791	ALA	Q3598	E3509	R3258	ILE	ALA
N4295	D4098	E3686	H3793	ALA	L3601	S3376	W3259	GLU	ALA
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L4298	G4104	D3689	N3801	ALA	L3614	Q3381	V3263	ASN	ALA
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A4225	E4105	E3691	D3803	ALA	K3615	L3514	Q3265	LYS	LYS
K4300	E4105	S3692	S3803	ALA	E3516	K3513	R3267	ILE	ILE
G4301	E4105	S3692	D3803	ALA	I3523	L3514	K3268	GLU	GLU
I4302	E4105	S3692	D3803	ALA	K3524	L3525	Y3270	LEU	LEU
A4303	E4105	S3692	D3803	ALA	L3525	L3525	E3271	ALA	ALA
S4304	E4105	S3692	D3803	ALA	L3525	L3525	A3250	GLY	GLY
N4305	E4105	S3692	D3803	ALA	L3525	L3525	A3267	VAL	VAL
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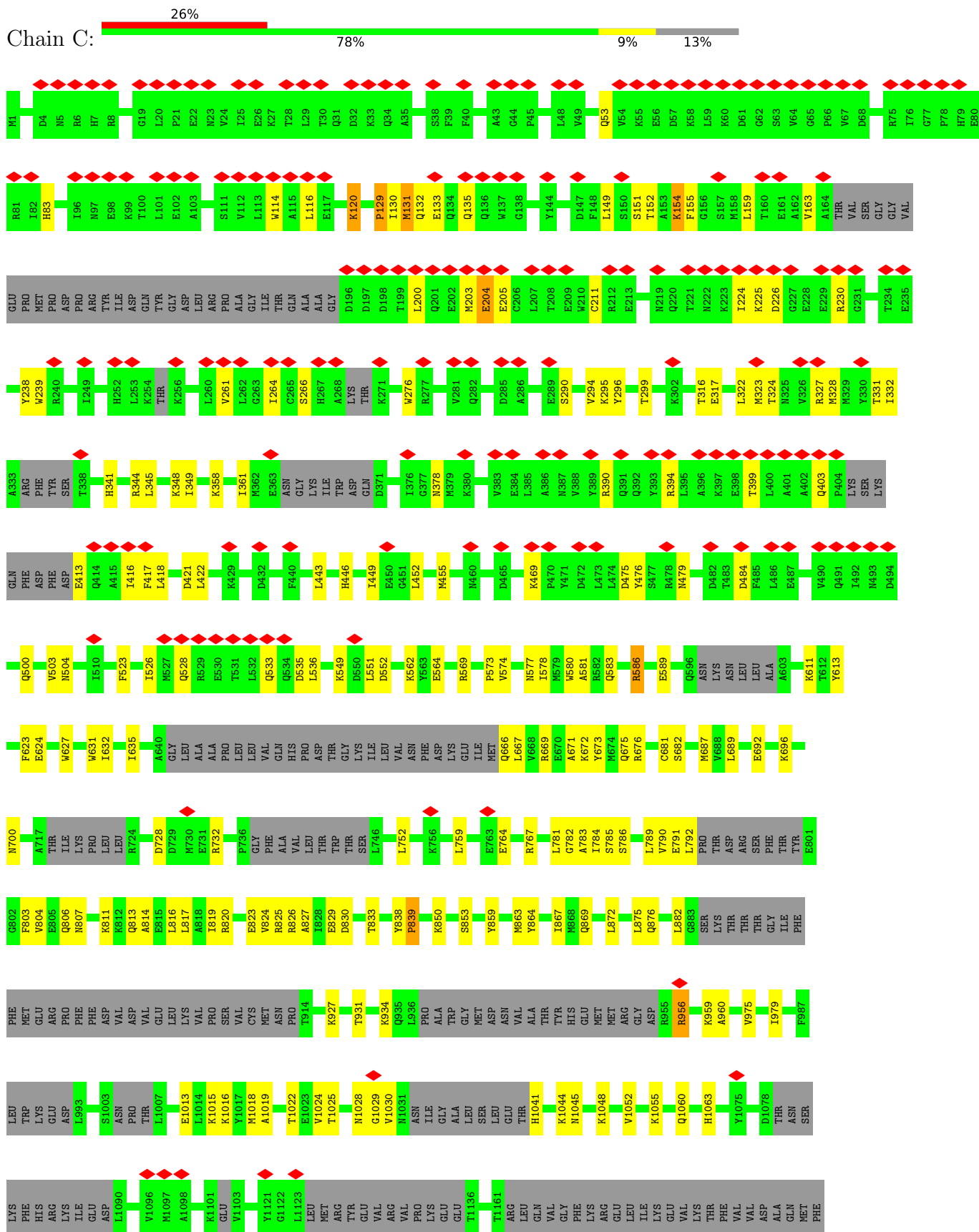
● Molecule 4: Flagellar outer dynein arm heavy chain beta



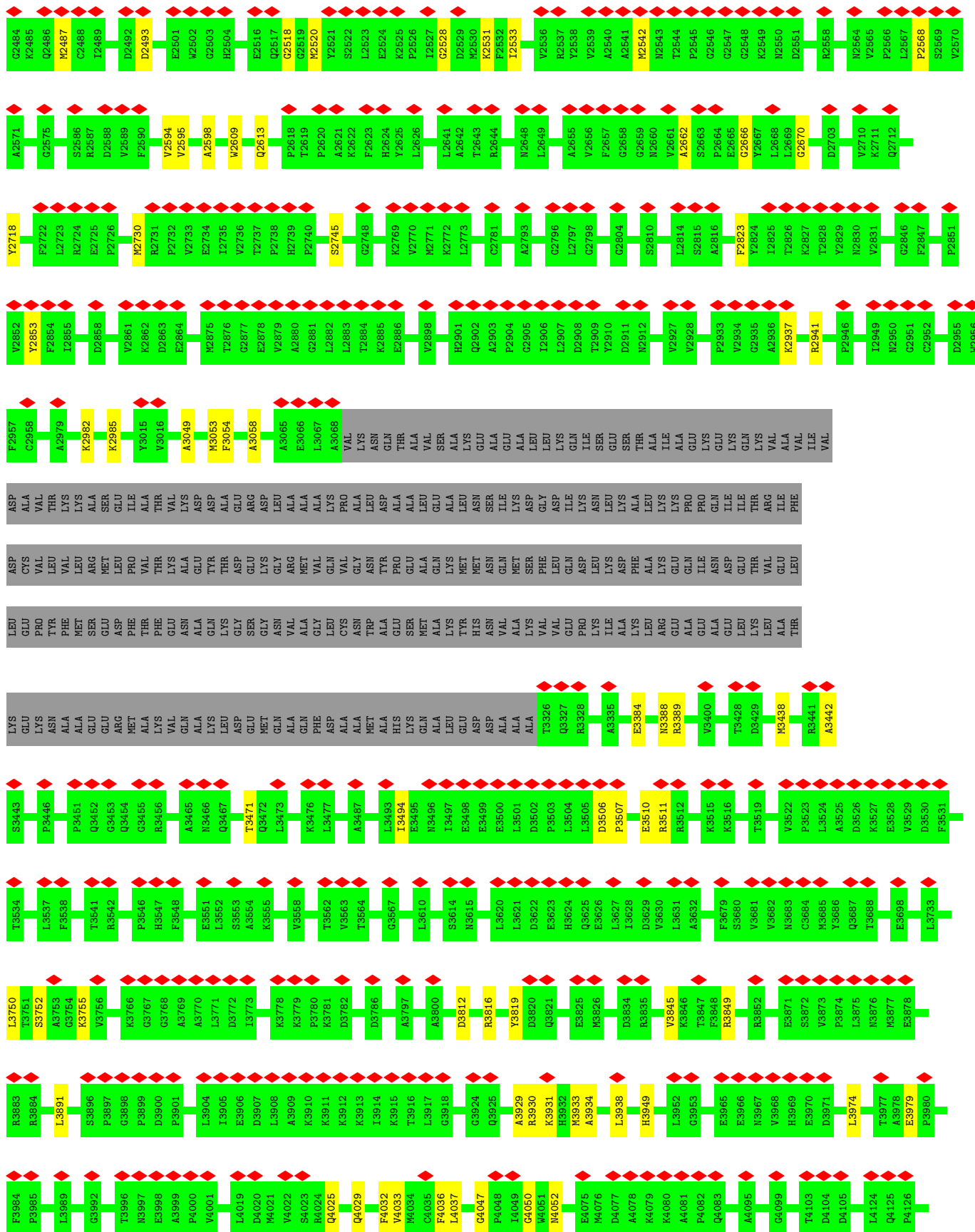
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GLU	H3036	D2938	Y2828	D2767	P2670	P2586	E2477	P2389	D2178	R2108	K2021
ASP	M3057	M2939	D2829	R2768	N2671	P2587	Q2478	L2390	D2179	A2109	M2022
GLU	M3060	M2940	V2830	M2769	A2672	G2588	M2479	L2391	Q2180	A2110	P2023
ALA	F3083	L2941	L2831	L2770	E2673	S2589	Y2483	L2403	F2181	P2111	G2024
THR	F3087	V2942	K2832	E2772	T2675	M2592	M2484	E2404	E2185	E2112	Y2025
LEU	S3103	K2943	T2834	A2773	R2676	Y2594	E2486	G2405	L2198	L2113	P2026
THR	D3114	E2944	L2835	M2774	A2677	Y2596	D2487	L2406	F2199	E2115	G2027
VAL	R3117	M2951	L2836	M2775	M2678	P2602	K2491	L2407	A2204	D2116	R2028
ALA	R3118	D2952	L2837	A2776	Y2679	D2605	F2492	L2408	N2220	K2117	E2030
PHE	R3119	L2953	K2838	K2777	Q2680	D2606	Q2493	P2409	S2221	V2118	F2032
GLN	S2955	L2954	L2839	D2778	Q2681	K2606	Y2494	K2409	S2222	V2119	E2033
GLN	S2956	R2840	R2841	F2779	L2682	T2609	L2495	E2410	N2220	L2119	S2034
ALA	G2957	E2841	E2842	E2780	L2683	Q2610	L2496	E2411	S2221	L2120	R2036
GLU	F2781	D2684	D2685	R2782	D2684	I2613	G2497	E2412	S2222	L2121	A2037
CYS	Y2988	G2685	G2685	F2783	G2685	T2619	T2498	E2413	S2222	D2125	L2035
ARG	I2959	S2689	S2689	V2783	S2689	M2619	D2498	E2414	Y2228	T2132	R2036
GLU	A2960	F2690	F2690	V2786	F2690	V2620	F2499	E2415	Q2229	A2133	L2038
ASP	D2961	D2691	D2691	K2787	D2691	D2621	F2499	E2416	A2230	D2134	F2039
LEU	T2964	A2695	A2695	K2788	K2696	Y2622	T2500	E2417	A2230	D2135	R2040
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PRO	E2966	M2697	M2697	F2790	M2697	G2624	T2500	E2419	P2233	I2138	V2042
ILE	D2967	L2698	L2698	D2791	L2698	G2624	T2500	E2420	A2233	I2139	M2044
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ALA	E2969	M2699	M2699	D2793	M2699	L2633	F2508	E2422	Y2244	G2141	L2057
ALA	A2970	A2720	A2720	G2794	A2720	E2635	T2509	E2423	H2244	L2142	M2058
GLU	F2971	V2721	V2721	C2795	V2721	I2636	T2509	E2424	H2244	L2143	A2059
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ALA	N2973	F2723	F2723	C2797	F2723	A2642	T2509	E2426	A2248	D2145	G2061
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ASN	N2977	G2738	G2738	I2799	G2738	T2648	R2545	E2428	E2251	F2147	V2073
LEU	E2978	R2741	R2741	E2800	R2741	G2650	N2546	E2429	W2252	K2148	L2074
LEU	A2981	A2742	A2742	E2801	A2742	P2656	M2547	E2430	W2252	P2149	L2075
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SER	G2983	K2744	K2744	R2803	K2744	H2661	T2549	E2432	T2260	T2150	Y2076
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LEU	L2985	Y2746	Y2746	L2805	Y2746	T2663	M2552	E2434	M2264	E2152	L2078
LYS	L2986	Y2747	Y2747	L2806	Y2747	T2663	M2552	E2435	A2265	L2153	C2079
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PHE	K3001	E2749	E2749	S2808	E2749	G2650	T2556	E2437	M2267	D2081	D2081
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PRO	L3003	K2752	K2752	A2811	K2752	R2660	D2461	E2439	W2274	A2157	L2083
ALA	H3004	V2753	V2753	M2812	V2753	H2661	D2462	E2440	Q2274	L2158	S2084
GLU	I3005	A2754	A2754	Y2814	A2754	F2662	F2463	E2441	T2275	L2159	R2085
ALA	V3006	R2755	R2755	Y2815	R2755	T2663	F2464	E2442	V2276	K2160	S2086
GLY	F3011	L2756	L2756	T2816	L2756	T2663	F2465	E2443	L2277	K2161	R2087
GLY	A3025	W2757	W2757	D2818	W2757	T2663	E2466	E2444	L2278	A2161	H2088
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GLY	M3031	E2762	E2762	P2820	E2762	T2663	G2468	E2446	G2280	E2164	D2090
GLY	F3032	R2763	R2763	Y2822	R2763	T2663	L2469	E2447	Q2274	A2165	W2091
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GLY	L2825	F2765	F2765	L2825	F2765	T2663	V2470	E2449	L2277	H2167	L2093
GLY	S2826			S2826		T2663	Y2471	E2450	L2278	K2168	R2094
GLY						T2663	D2472	E2451	D2282	A2169	A2095
GLY						T2663	Y2473	E2452	D2283	A2170	K2105
GLY						T2663	Y2474	E2453	D2284	A2171	L2106
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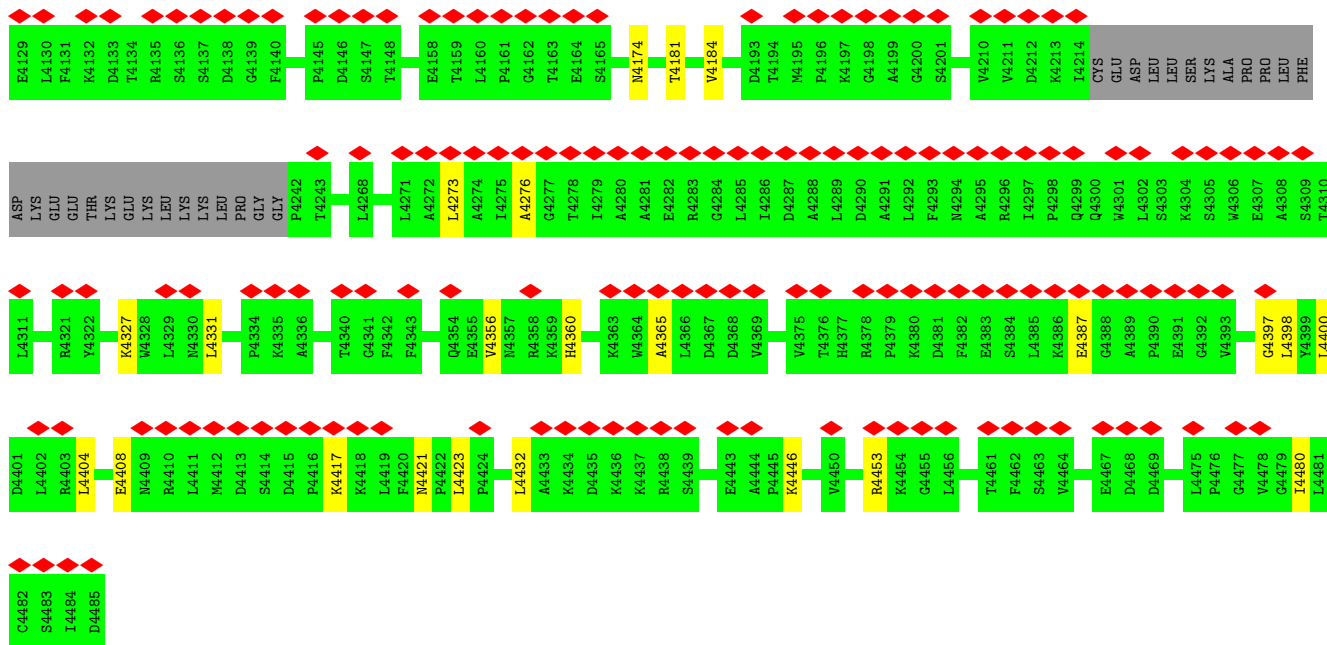


• Molecule 5: Dynein gamma chain, flagellar outer arm

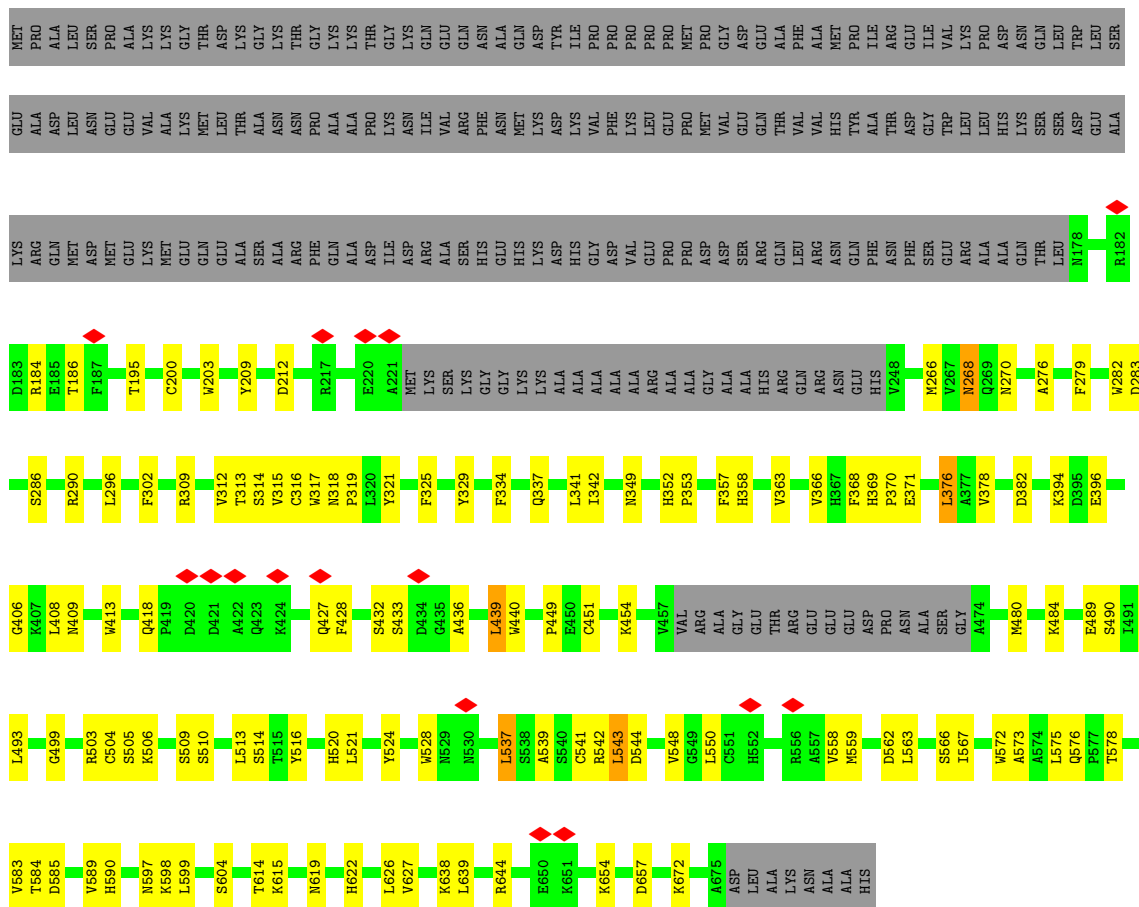


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D2053	A2054	T2055	R2056	P2057	D2058	V2059	N2060	K2061	R2065	E2069	V2074	L2090	V2091	P2100	G2104	A2107	E2118	L2119	G2120	H2123	V2124	L2125	V2126	R2127	P2130	K2131	A2132	T2133	T2134	A2135	P2136	Q2137	M2138	F2139	G2140	R2141	R2142	D2143	D2144	T2145	T2146	D2045	L2046	F2047	P2048	G2049	L2050	K2051	A2052								
W2158	R2159	R2160	A2161	A2162	K2163	N2164	K2165	N2166	Q2167	M2168	T2169	V2172	L2173	D2174	G2175	P2176	V2177	D2178	A2179	I2182	E2183	N2184	L2185	N2186	T2187	V2188	L2189	D2190	D2191	N2192	T2196	L2197	A2198	N2199	G2200	D2201	R2202	I2203	L2204	M2205	S2206	A2207	A2208	E2214	P2215	E2216	E2217	L2218	L2219	N2220	A2221	S2222	A2224				
S2227	R2228	A2229	G2230	I2231	D2236	V2237	V2248	L2249	Q2250	K2251	R2252	A2257	C2258	W2259	A2260	R2261	L2262	F2263	S2264	I2276	S2277	L2278	K2279	P2280	V2281	M2282	D2283	Y2284	I2361	E2285	S2288	L2289	V2290	K2305	E2306	A2307	G2308	T2309	A2310	M2311	N2312	D2313	A2314	K2315	V2319	F2320	L2321	Y2322	T2325	W2326							
G2329	G2330	L2331	L2332	E2333	M2334	K2335	E2336	R2337	P2338	L2339	F2340	K2341	Q2342	R2345	T2346	F2347	A2348	H2349	N2350	M2351	P2352	P2353	K2354	E2355	E2356	D2357	S2358	D2359	T2360	I2361	F2362	V2366	N2367	T2368	T2369	D2370	A2371	E2372	H2375	ARG	HIS	CYS	VAL	PRO	VAL	TRP	TYR	PRO	LYS	ASN	GLY	GLU	LYS	PRO			
GLN	TYR	ALA	GLN	VAL	LEU	TLE	THR	L2402	G2408	A2409	L2410	F2411	N2412	L2413	S2414	Y2415	V2417	D2418	A2419	A2420	V2424	G2425	S2440	T2441	F2442	N2443	A2444	E2445	T2446	T2447	I2361	A2448	N2449	K2450	T2451	L2452	T2453	F2454	S2455	A2371	E2372	H2375	ARG	HIS	CYS	VAL	PRO	VAL	TRP	TYR	PRO	LYS	ASN	GLY	GLU	LYS	PRO

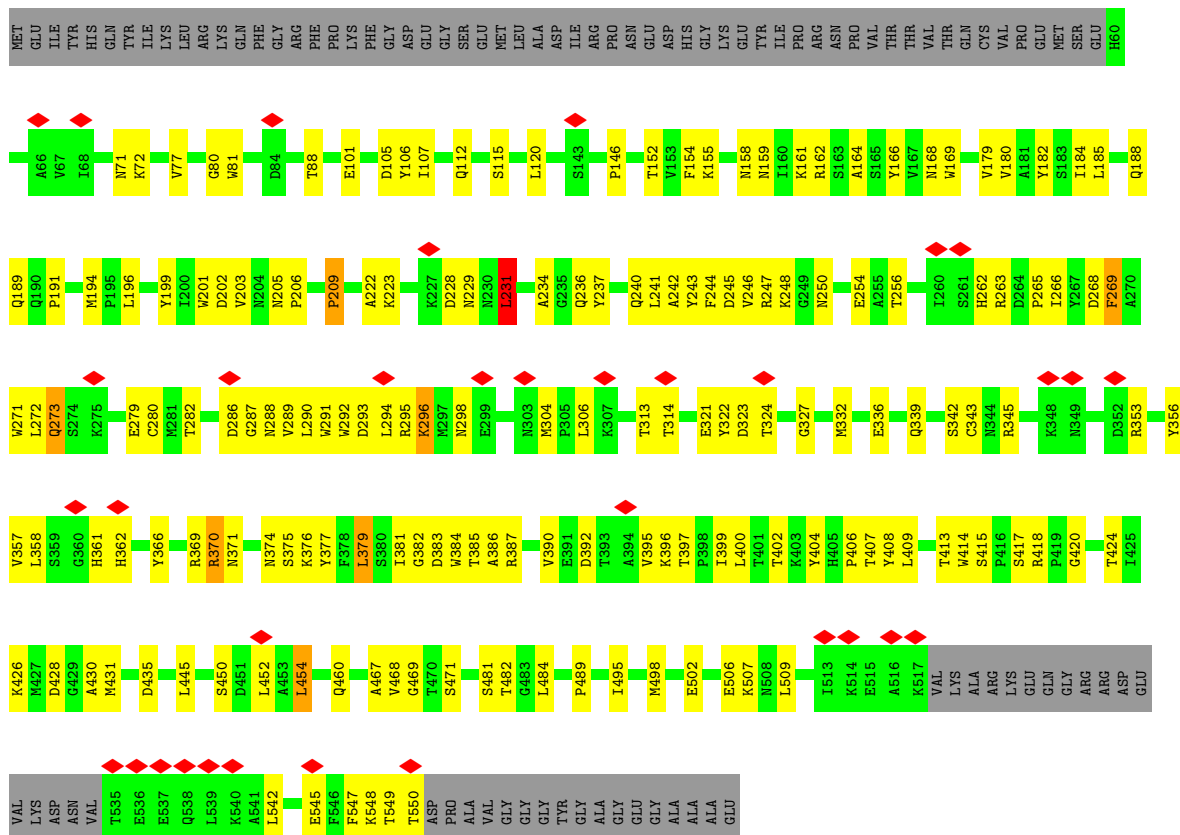




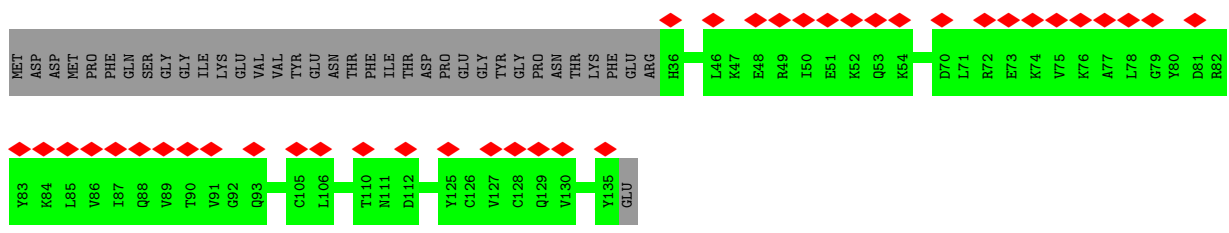
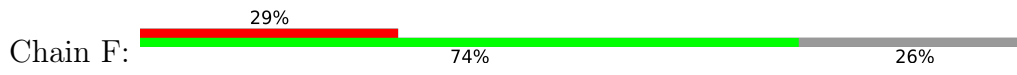
● Molecule 6: Dynein, 78 kDa intermediate chain, flagellar outer arm



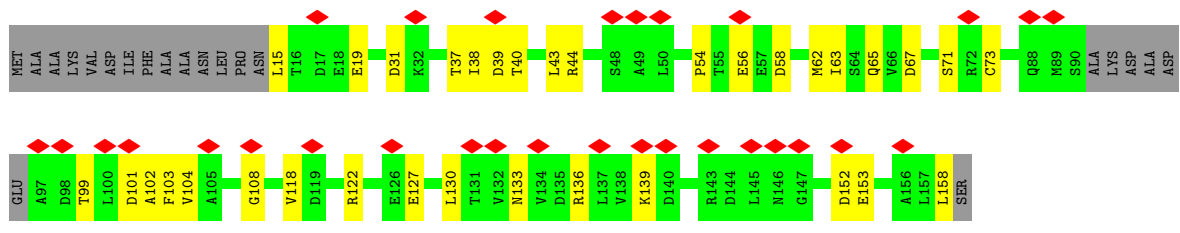
● Molecule 7: Dynein, 70 kDa intermediate chain, flagellar outer arm



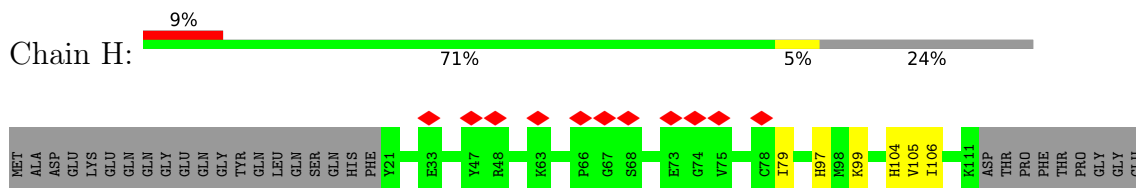
• Molecule 8: Flagellar outer dynein arm light chain 2



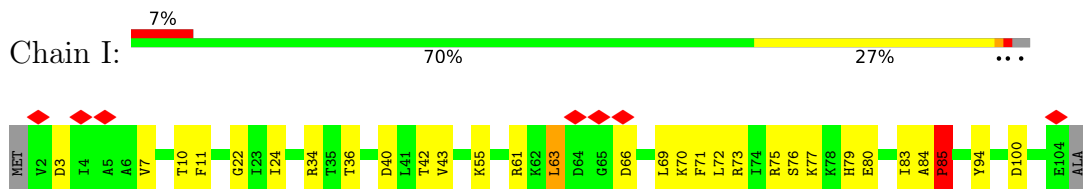
• Molecule 9: Dynein 18 kDa light chain, flagellar outer arm



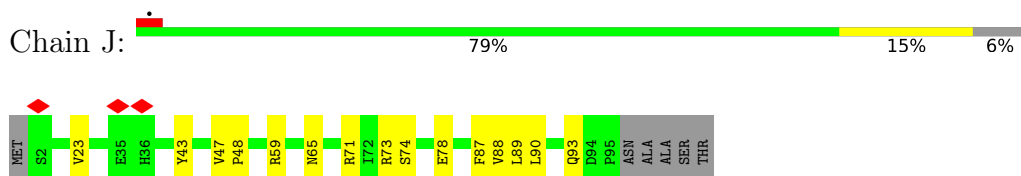
• Molecule 10: Dynein 11 kDa light chain, flagellar outer arm



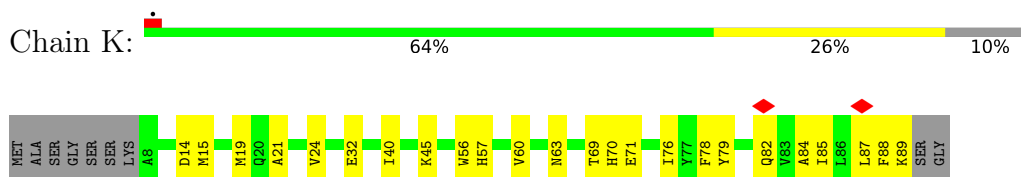
• Molecule 11: Dynein light chain roadblock LC7a



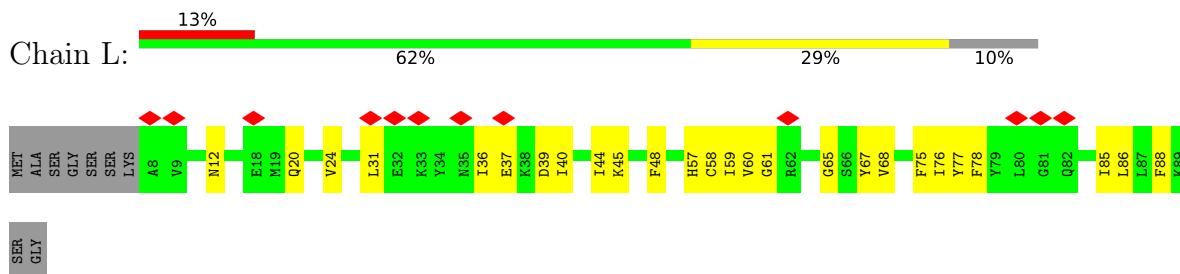
• Molecule 12: Dynein light chain roadblock LC7b



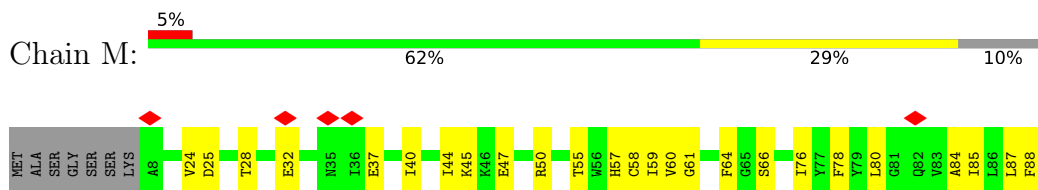
• Molecule 13: Dynein 8 kDa light chain, flagellar outer arm



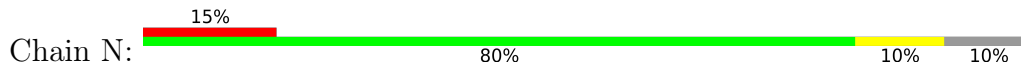
• Molecule 13: Dynein 8 kDa light chain, flagellar outer arm

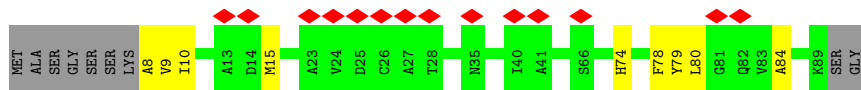


• Molecule 13: Dynein 8 kDa light chain, flagellar outer arm

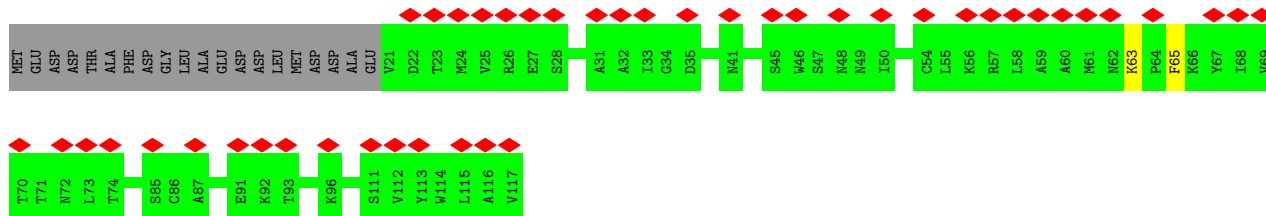
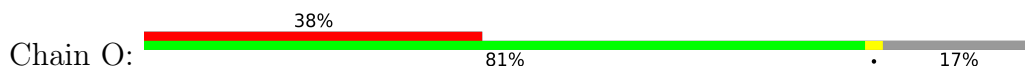


• Molecule 13: Dynein 8 kDa light chain, flagellar outer arm

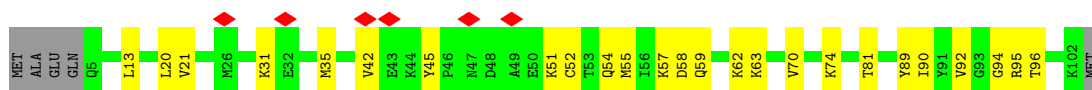




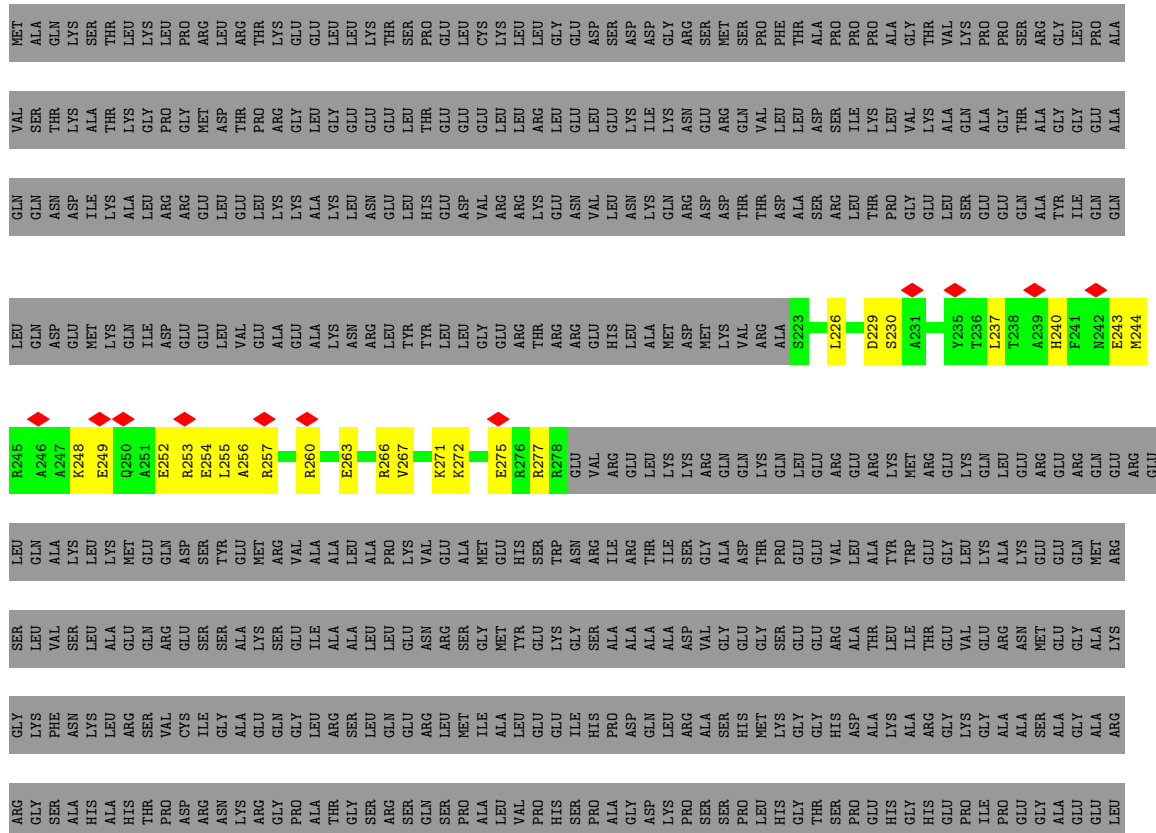
Molecule 14: Dynein light chain 9

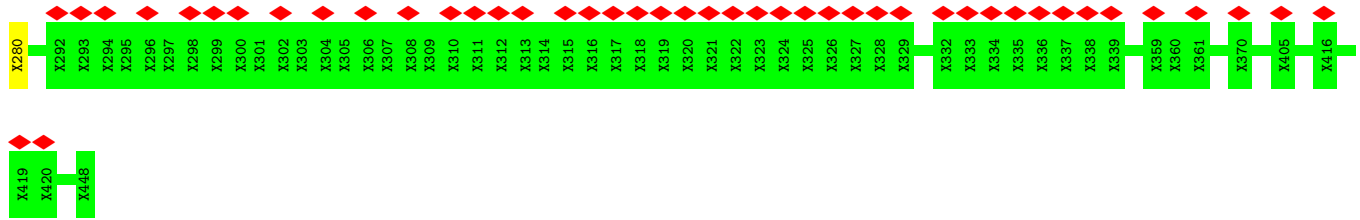


Molecule 15: Dynein light chain 10

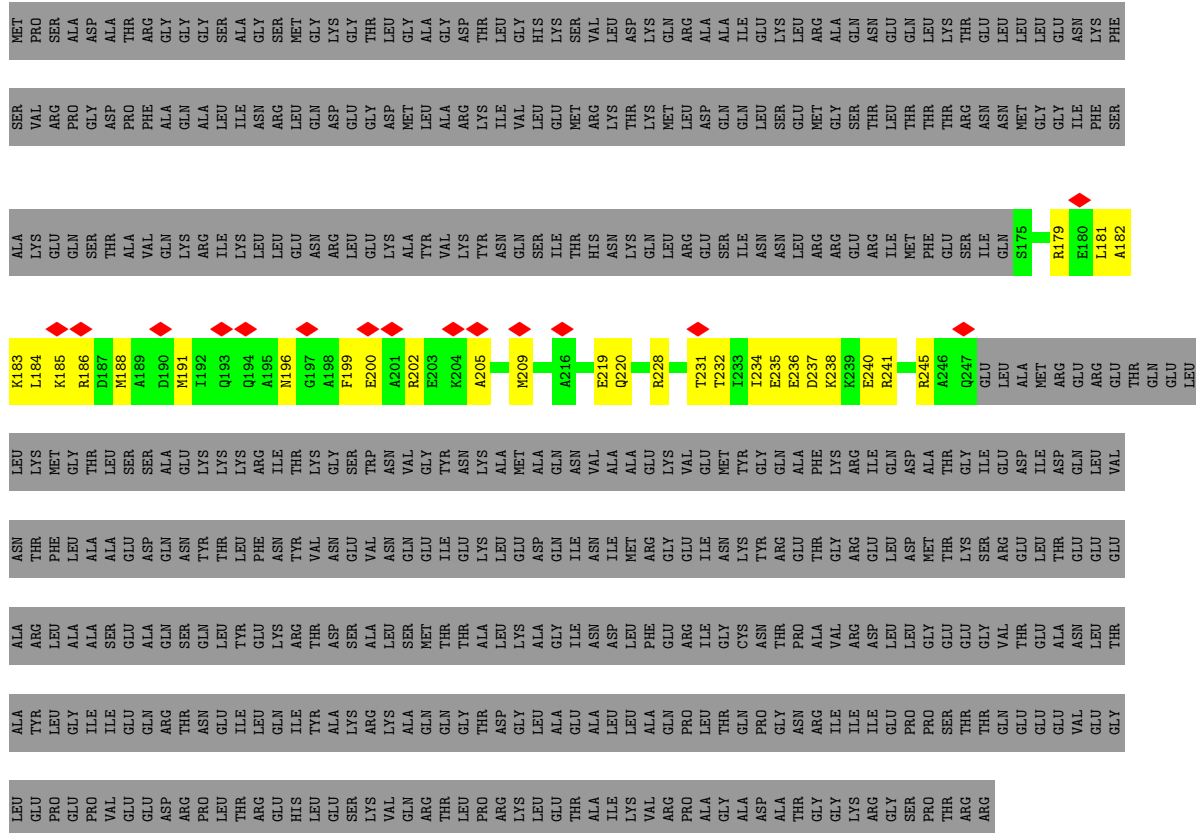


Molecule 16: Outer dynein arm-docking complex subunit 1

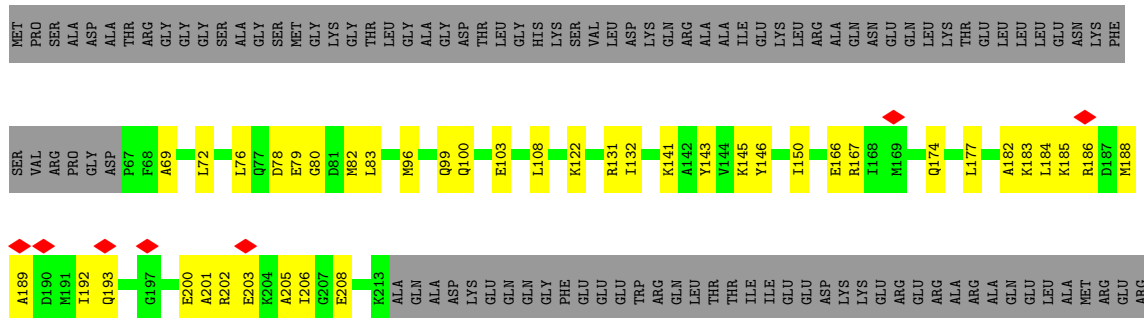




• Molecule 18: Outer dynein arm protein 1

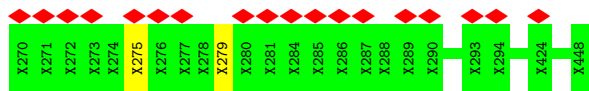


• Molecule 18: Outer dynein arm protein 1

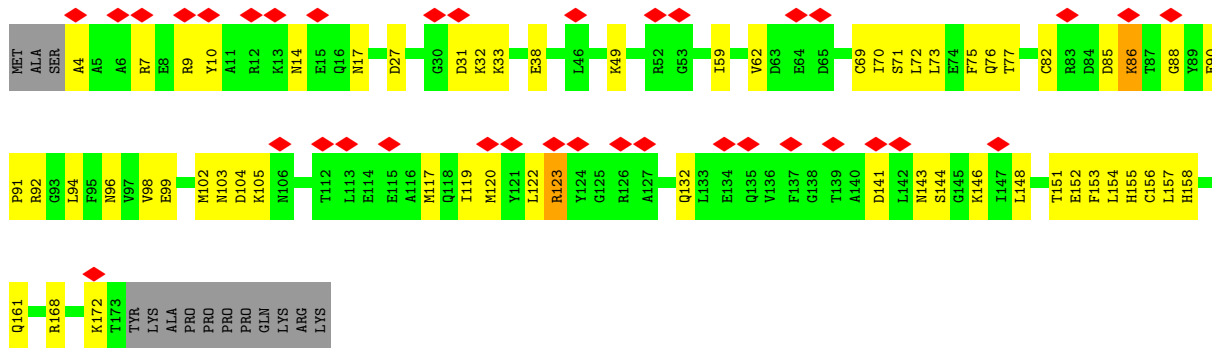




- Molecule 19: DC2



- Molecule 20: Outer dynein arm-docking complex protein DC3



4 Experimental information

Property	Value	Source
EM reconstruction method	HELICAL	Depositor
Imposed symmetry	HELICAL, twist=0°, rise=82 Å, axial sym=C1	Depositor
Number of segments used	485694	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION; The composite map was assembled on a box 700 reference map (7.5 Å) using the ODA-DC and ODA core composite maps (deposited separately), and maps targeting the aHC AAA+ domain (4.5 Å), bHC AAA+ domain (6.2 Å), aHC AAA+ domain (11.4 Å), and aHC tail domain (5.3 Å). A second conformation of bHC AAA+ domain (9.8 Å) is also provided.	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{Å}^2$)	61.48	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.093	Depositor
Minimum map value	0.000	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.001	Depositor
Recommended contour level	0.01	Depositor
Map size (Å)	952.0, 952.0, 952.0	wwPDB
Map dimensions	700, 700, 700	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.36, 1.36, 1.36	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: GDP, MG, GTP

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	A1	0.28	0/3420	0.53	0/4628
1	A3	0.31	0/3420	0.54	0/4628
1	A5	0.30	0/3420	0.52	0/4628
1	A7	0.28	0/3420	0.51	0/4628
1	B1	0.29	0/3371	0.49	0/4561
1	B3	0.32	0/3295	0.49	0/4454
1	B5	0.31	0/3420	0.51	0/4628
1	B7	0.29	0/3420	0.50	0/4628
2	A2	0.31	0/3410	0.53	0/4623
2	A4	0.34	0/3389	0.58	0/4595
2	A6	0.31	0/3406	0.54	0/4618
2	B2	0.31	0/3271	0.52	0/4434
2	B4	0.32	0/3260	0.52	0/4418
2	B6	0.29	0/3389	0.50	0/4595
3	A	0.32	0/16168	0.55	0/22506
4	B	0.34	1/19223 (0.0%)	0.61	7/26574 (0.0%)
5	C	0.34	0/21839	0.57	7/30089 (0.0%)
6	D	0.70	2/3699 (0.1%)	0.88	6/5023 (0.1%)
7	E	0.71	1/3784 (0.0%)	0.90	7/5152 (0.1%)
8	F	0.24	0/494	0.52	0/687
9	G	0.34	0/1098	0.63	0/1471
10	H	0.26	0/450	0.46	0/626
11	I	0.56	0/840	0.85	3/1133 (0.3%)
12	J	0.55	0/752	0.78	0/1019
13	K	0.53	0/687	0.70	0/926
13	L	0.56	0/687	0.74	0/926
13	M	0.43	0/687	0.73	0/926
13	N	0.25	0/406	0.49	0/565
14	O	0.26	0/480	0.56	0/666
15	P	0.58	0/823	0.87	1/1108 (0.1%)
16	X	0.29	0/485	0.57	0/642
16	X1	0.32	0/1186	0.51	0/1582

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
18	Y	0.30	0/598	0.52	0/793
18	Y1	0.29	0/1192	0.52	0/1585
20	Z	0.34	0/1403	0.67	0/1885
All	All	0.36	4/124292 (0.0%)	0.59	31/169950 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
3	A	0	21
4	B	0	15
5	C	0	7
All	All	0	43

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	D	314	SER	CA-CB	-5.69	1.44	1.52
4	B	3908	PRO	C-N	-5.56	1.21	1.34
7	E	336	GLU	CA-C	-5.46	1.38	1.52
6	D	378	VAL	CB-CG2	-5.19	1.42	1.52

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	D	376	LEU	CB-CG-CD1	8.76	125.90	111.00
4	B	4073	GLY	C-N-CA	8.14	142.06	121.70
4	B	4499	SER	C-N-CA	7.97	141.63	121.70
5	C	129	PRO	CA-N-CD	-7.73	100.68	111.50
7	E	370	ARG	C-N-CA	-7.37	103.28	121.70

There are no chirality outliers.

5 of 43 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	A	1300	PHE	Peptide
3	A	1482	PHE	Peptide
3	A	1508	SER	Peptide
3	A	1633	ILE	Peptide

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Mol	Chain	Res	Type	Group
3	A	1654	SER	Peptide

5.2 Too-close contacts [i](#)

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	A1	3346	0	3238	102	0
1	A3	3346	0	3238	110	0
1	A5	3346	0	3238	102	0
1	A7	3346	0	3238	88	0
1	B1	3298	0	3196	83	0
1	B3	3227	0	3134	80	0
1	B5	3346	0	3238	106	0
1	B7	3346	0	3238	91	0
2	A2	3339	0	3272	102	0
2	A4	3318	0	3259	94	0
2	A6	3335	0	3269	108	0
2	B2	3204	0	3152	84	0
2	B4	3193	0	3141	107	0
2	B6	3318	0	3259	80	0
3	A	16173	0	7306	417	0
4	B	19163	0	10961	281	0
5	C	21756	0	13263	244	0
6	D	3609	0	3534	90	0
7	E	3697	0	3534	133	0
8	F	495	0	221	0	0
9	G	1089	0	1072	24	0
10	H	451	0	204	3	0
11	I	827	0	841	24	0
12	J	741	0	750	12	0
13	K	671	0	654	20	0
13	L	671	0	654	20	0
13	M	671	0	654	23	0
13	N	407	0	192	5	0
14	O	481	0	230	1	0
15	P	805	0	801	19	0
16	X	481	0	488	19	0
16	X1	1178	0	1179	27	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
17	X0	810	0	170	1	0
18	Y	595	0	586	22	0
18	Y1	1185	0	1230	35	0
19	Y0	840	0	181	1	0
20	Z	1384	0	1359	46	0
21	A1	32	0	12	0	0
21	A3	32	0	12	1	0
21	A5	32	0	12	1	0
21	A7	32	0	12	4	0
21	B2	32	0	12	1	0
21	B5	32	0	12	1	0
21	B7	32	0	12	0	0
22	A1	1	0	0	0	0
22	A2	1	0	0	0	0
22	A4	1	0	0	0	0
22	A6	1	0	0	0	0
22	B3	1	0	0	0	0
22	B4	1	0	0	0	0
22	B6	1	0	0	0	0
23	A1	28	0	12	0	0
23	A3	28	0	12	2	0
23	A5	28	0	12	0	0
23	A7	28	0	12	2	0
23	B1	28	0	12	3	0
23	B3	28	0	12	2	0
23	B5	28	0	12	1	0
23	B7	28	0	12	1	0
All	All	124943	0	95354	2603	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 12.

The worst 5 of 2603 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)
4:B:3879:ASP:HA	5:C:1534:GLU:CB	1.40	1.48
4:B:3879:ASP:CB	5:C:1530:PRO:O	1.86	1.23
4:B:3879:ASP:CA	5:C:1534:GLU:CB	2.17	1.23
3:A:1676:ILE:O	3:A:1679:ALA:HB3	1.56	1.05
3:A:2399:SER:HA	3:A:2438:PHE:O	1.57	1.03

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	A1	424/443 (96%)	399 (94%)	25 (6%)	0	100	100
1	A3	424/443 (96%)	405 (96%)	19 (4%)	0	100	100
1	A5	424/443 (96%)	407 (96%)	17 (4%)	0	100	100
1	A7	424/443 (96%)	405 (96%)	19 (4%)	0	100	100
1	B1	415/443 (94%)	396 (95%)	19 (5%)	0	100	100
1	B3	404/443 (91%)	392 (97%)	12 (3%)	0	100	100
1	B5	424/443 (96%)	403 (95%)	21 (5%)	0	100	100
1	B7	424/443 (96%)	405 (96%)	19 (4%)	0	100	100
2	A2	426/451 (94%)	402 (94%)	24 (6%)	0	100	100
2	A4	423/451 (94%)	409 (97%)	14 (3%)	0	100	100
2	A6	425/451 (94%)	408 (96%)	17 (4%)	0	100	100
2	B2	405/451 (90%)	391 (96%)	14 (4%)	0	100	100
2	B4	403/451 (89%)	385 (96%)	18 (4%)	0	100	100
2	B6	423/451 (94%)	407 (96%)	16 (4%)	0	100	100
3	A	3266/4503 (72%)	2704 (83%)	550 (17%)	12 (0%)	34	72
4	B	3500/4568 (77%)	3121 (89%)	377 (11%)	2 (0%)	51	86
5	C	3840/4485 (86%)	3484 (91%)	353 (9%)	3 (0%)	51	86
6	D	450/683 (66%)	387 (86%)	63 (14%)	0	100	100
7	E	470/567 (83%)	371 (79%)	94 (20%)	5 (1%)	14	52
8	F	98/136 (72%)	94 (96%)	4 (4%)	0	100	100
9	G	134/159 (84%)	125 (93%)	9 (7%)	0	100	100
10	H	89/120 (74%)	77 (86%)	12 (14%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
11	I	101/105 (96%)	89 (88%)	11 (11%)	1 (1%)	15	54
12	J	92/100 (92%)	81 (88%)	11 (12%)	0	100	100
13	K	80/91 (88%)	73 (91%)	7 (9%)	0	100	100
13	L	80/91 (88%)	72 (90%)	8 (10%)	0	100	100
13	M	80/91 (88%)	73 (91%)	7 (9%)	0	100	100
13	N	80/91 (88%)	68 (85%)	12 (15%)	0	100	100
14	O	95/117 (81%)	92 (97%)	3 (3%)	0	100	100
15	P	96/103 (93%)	89 (93%)	7 (7%)	0	100	100
16	X	54/749 (7%)	54 (100%)	0	0	100	100
16	X1	140/749 (19%)	140 (100%)	0	0	100	100
18	Y	71/552 (13%)	71 (100%)	0	0	100	100
18	Y1	145/552 (26%)	145 (100%)	0	0	100	100
20	Z	168/184 (91%)	155 (92%)	11 (6%)	2 (1%)	13	50
All	All	18997/25046 (76%)	17179 (90%)	1793 (9%)	25 (0%)	54	86

5 of 25 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	1677	CYS
4	B	625	ASP
4	B	1876	ASP
5	C	4432	LEU
7	E	298	ASN

5.3.2 Protein sidechains [i](#)

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	A1	367/379 (97%)	367 (100%)	0	100	100
1	A3	367/379 (97%)	366 (100%)	1 (0%)	92	95
1	A5	367/379 (97%)	367 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A7	367/379 (97%)	367 (100%)	0	100	100
1	B1	363/379 (96%)	363 (100%)	0	100	100
1	B3	356/379 (94%)	356 (100%)	0	100	100
1	B5	367/379 (97%)	367 (100%)	0	100	100
1	B7	367/379 (97%)	366 (100%)	1 (0%)	92	95
2	A2	361/374 (96%)	360 (100%)	1 (0%)	92	95
2	A4	359/374 (96%)	354 (99%)	5 (1%)	67	80
2	A6	361/374 (96%)	361 (100%)	0	100	100
2	B2	347/374 (93%)	347 (100%)	0	100	100
2	B4	346/374 (92%)	346 (100%)	0	100	100
2	B6	359/374 (96%)	359 (100%)	0	100	100
4	B	463/3998 (12%)	455 (98%)	8 (2%)	60	78
5	C	702/3945 (18%)	696 (99%)	6 (1%)	78	87
6	D	401/584 (69%)	396 (99%)	5 (1%)	71	83
7	E	400/489 (82%)	396 (99%)	4 (1%)	76	86
9	G	121/136 (89%)	121 (100%)	0	100	100
11	I	90/91 (99%)	89 (99%)	1 (1%)	73	84
12	J	83/87 (95%)	83 (100%)	0	100	100
13	K	70/76 (92%)	70 (100%)	0	100	100
13	L	70/76 (92%)	69 (99%)	1 (1%)	67	80
13	M	70/76 (92%)	70 (100%)	0	100	100
15	P	86/90 (96%)	86 (100%)	0	100	100
16	X	50/618 (8%)	50 (100%)	0	100	100
16	X1	125/618 (20%)	121 (97%)	4 (3%)	39	61
18	Y	59/462 (13%)	59 (100%)	0	100	100
18	Y1	128/462 (28%)	127 (99%)	1 (1%)	81	89
20	Z	150/162 (93%)	146 (97%)	4 (3%)	44	65
All	All	8122/17246 (47%)	8080 (100%)	42 (0%)	89	93

5 of 42 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
7	E	279	GLU

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Mol	Chain	Res	Type
16	X1	213	HIS
7	E	296	LYS
13	L	45	LYS
18	Y1	166	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 46 such sidechains are listed below:

Mol	Chain	Res	Type
1	B5	348	ASN
5	C	500	GLN
1	B5	384	GLN
1	B7	100	ASN
5	C	515	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 22 ligands modelled in this entry, 7 are monoatomic - leaving 15 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
23	GDP	A7	502	-	24,30,30	0.94	1 (4%)	30,47,47	1.27	5 (16%)
23	GDP	B7	502	-	24,30,30	0.94	1 (4%)	30,47,47	1.41	5 (16%)
21	GTP	B2	501	22	26,34,34	1.19	2 (7%)	32,54,54	1.73	7 (21%)
23	GDP	B1	501	-	24,30,30	0.97	1 (4%)	30,47,47	1.34	4 (13%)
23	GDP	A5	502	-	24,30,30	0.94	1 (4%)	30,47,47	1.32	5 (16%)
23	GDP	A1	503	-	24,30,30	0.95	1 (4%)	30,47,47	1.28	4 (13%)
23	GDP	B3	502	-	24,30,30	0.93	1 (4%)	30,47,47	1.35	4 (13%)
21	GTP	B7	501	22	26,34,34	1.20	2 (7%)	32,54,54	1.58	7 (21%)
23	GDP	A3	502	-	24,30,30	0.96	1 (4%)	30,47,47	1.34	5 (16%)
21	GTP	A5	501	22	26,34,34	1.22	2 (7%)	32,54,54	1.66	7 (21%)
21	GTP	A3	501	22	26,34,34	1.18	2 (7%)	32,54,54	1.72	7 (21%)
23	GDP	B5	502	-	24,30,30	0.95	1 (4%)	30,47,47	1.33	4 (13%)
21	GTP	A7	501	22	26,34,34	1.20	2 (7%)	32,54,54	1.67	7 (21%)
21	GTP	A1	501	22	26,34,34	1.13	2 (7%)	32,54,54	1.64	7 (21%)
21	GTP	B5	501	22	26,34,34	1.21	2 (7%)	32,54,54	1.62	7 (21%)

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
23	GDP	A7	502	-	-	4/12/32/32	0/3/3/3
23	GDP	B7	502	-	-	6/12/32/32	0/3/3/3
21	GTP	B2	501	22	-	4/18/38/38	0/3/3/3
23	GDP	B1	501	-	-	2/12/32/32	0/3/3/3
23	GDP	A5	502	-	-	1/12/32/32	0/3/3/3
23	GDP	A1	503	-	-	3/12/32/32	0/3/3/3
23	GDP	B3	502	-	-	3/12/32/32	0/3/3/3
21	GTP	B7	501	22	-	6/18/38/38	0/3/3/3
23	GDP	A3	502	-	-	1/12/32/32	0/3/3/3
21	GTP	A5	501	22	-	6/18/38/38	0/3/3/3
21	GTP	A3	501	22	-	7/18/38/38	0/3/3/3
23	GDP	B5	502	-	-	4/12/32/32	0/3/3/3
21	GTP	A7	501	22	-	7/18/38/38	0/3/3/3
21	GTP	A1	501	22	-	5/18/38/38	0/3/3/3

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
21	GTP	B5	501	22	-	7/18/38/38	0/3/3/3

The worst 5 of 22 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
21	A7	501	GTP	C5-C6	-4.28	1.38	1.47
21	B7	501	GTP	C5-C6	-4.26	1.38	1.47
21	A5	501	GTP	C5-C6	-4.26	1.38	1.47
21	B5	501	GTP	C5-C6	-4.24	1.38	1.47
21	B2	501	GTP	C5-C6	-4.16	1.39	1.47

The worst 5 of 85 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
21	B2	501	GTP	PB-O3B-PG	-5.00	115.69	132.83
21	A5	501	GTP	PA-O3A-PB	-4.67	116.82	132.83
21	A3	501	GTP	PB-O3B-PG	-4.46	117.52	132.83
21	A3	501	GTP	PA-O3A-PB	-4.46	117.53	132.83
21	A7	501	GTP	PA-O3A-PB	-4.46	117.53	132.83

There are no chirality outliers.

5 of 66 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
21	A1	501	GTP	C5'-O5'-PA-O1A
21	A3	501	GTP	C5'-O5'-PA-O1A
21	A3	501	GTP	C5'-O5'-PA-O2A
21	A5	501	GTP	C5'-O5'-PA-O1A
21	A7	501	GTP	C5'-O5'-PA-O1A

There are no ring outliers.

11 monomers are involved in 19 short contacts:

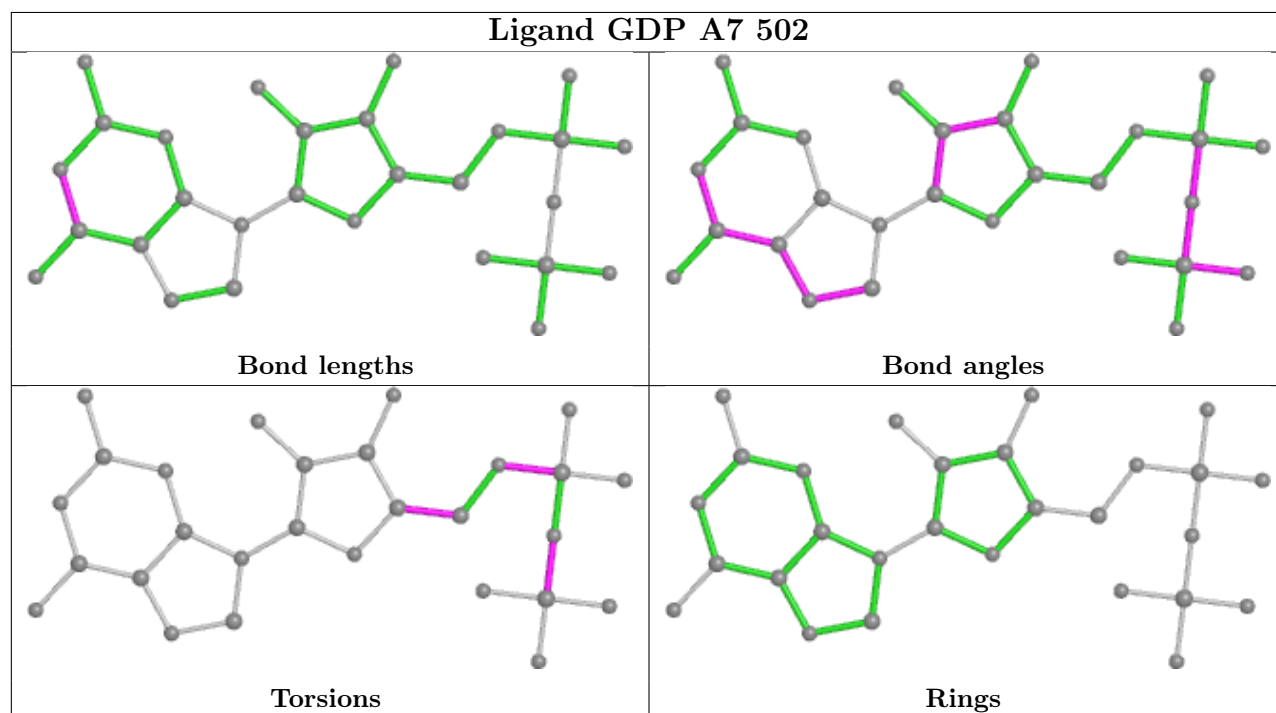
Mol	Chain	Res	Type	Clashes	Symm-Clashes
23	A7	502	GDP	2	0
23	B7	502	GDP	1	0
21	B2	501	GTP	1	0
23	B1	501	GDP	3	0
23	B3	502	GDP	2	0
23	A3	502	GDP	2	0
21	A5	501	GTP	1	0

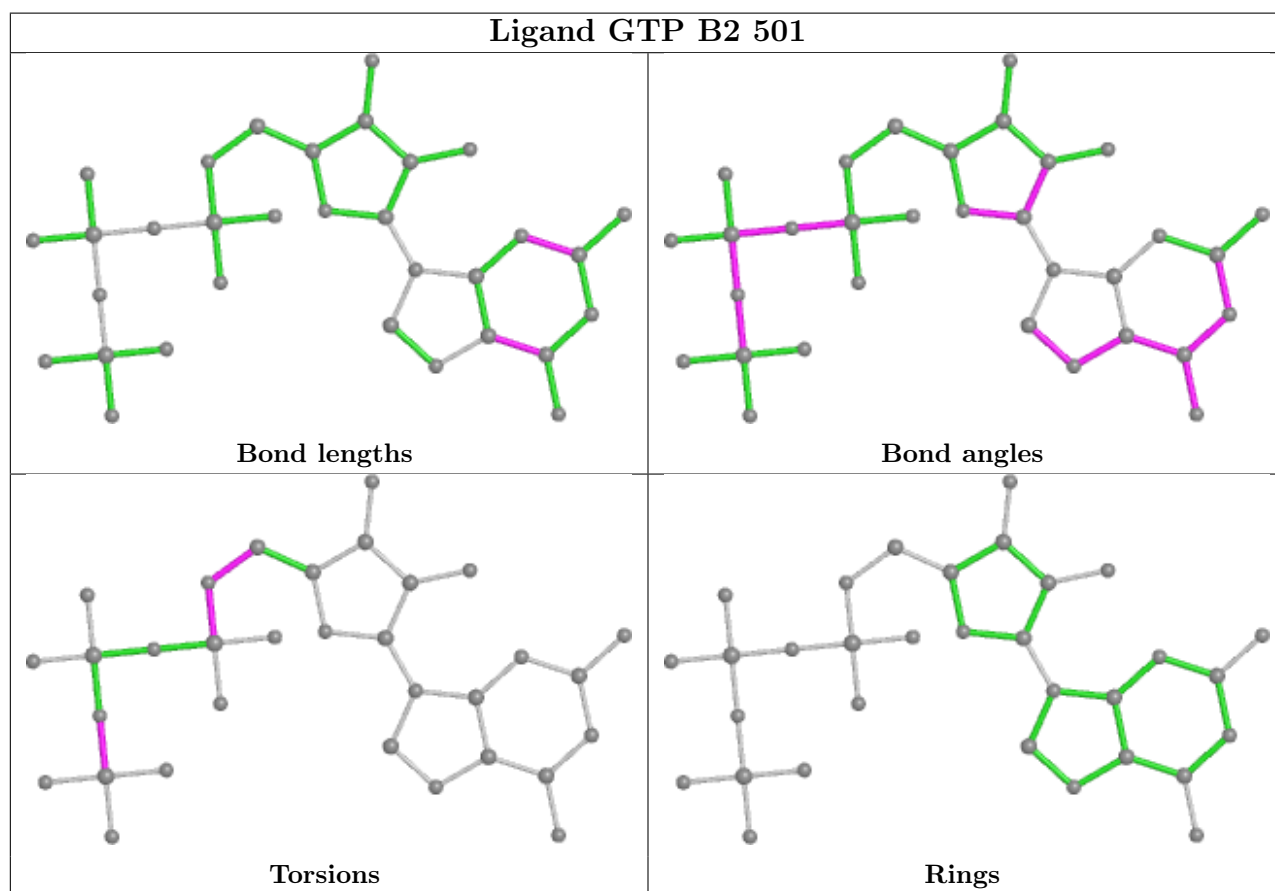
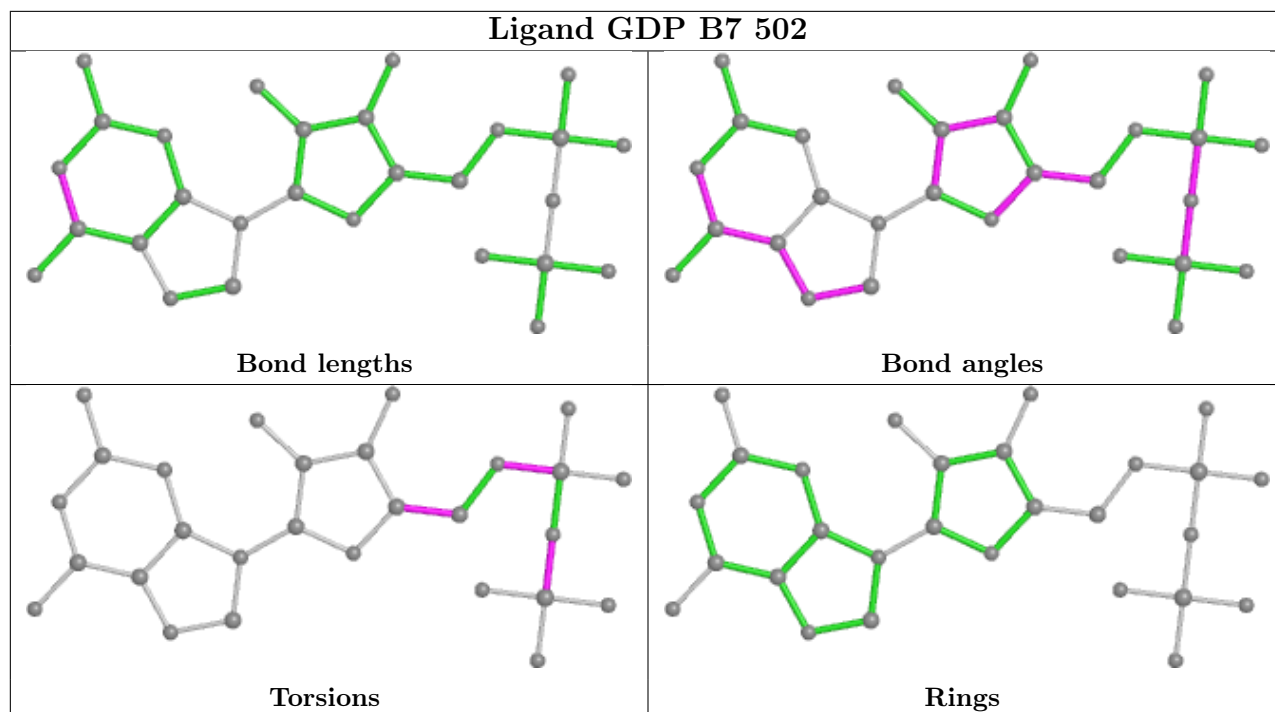
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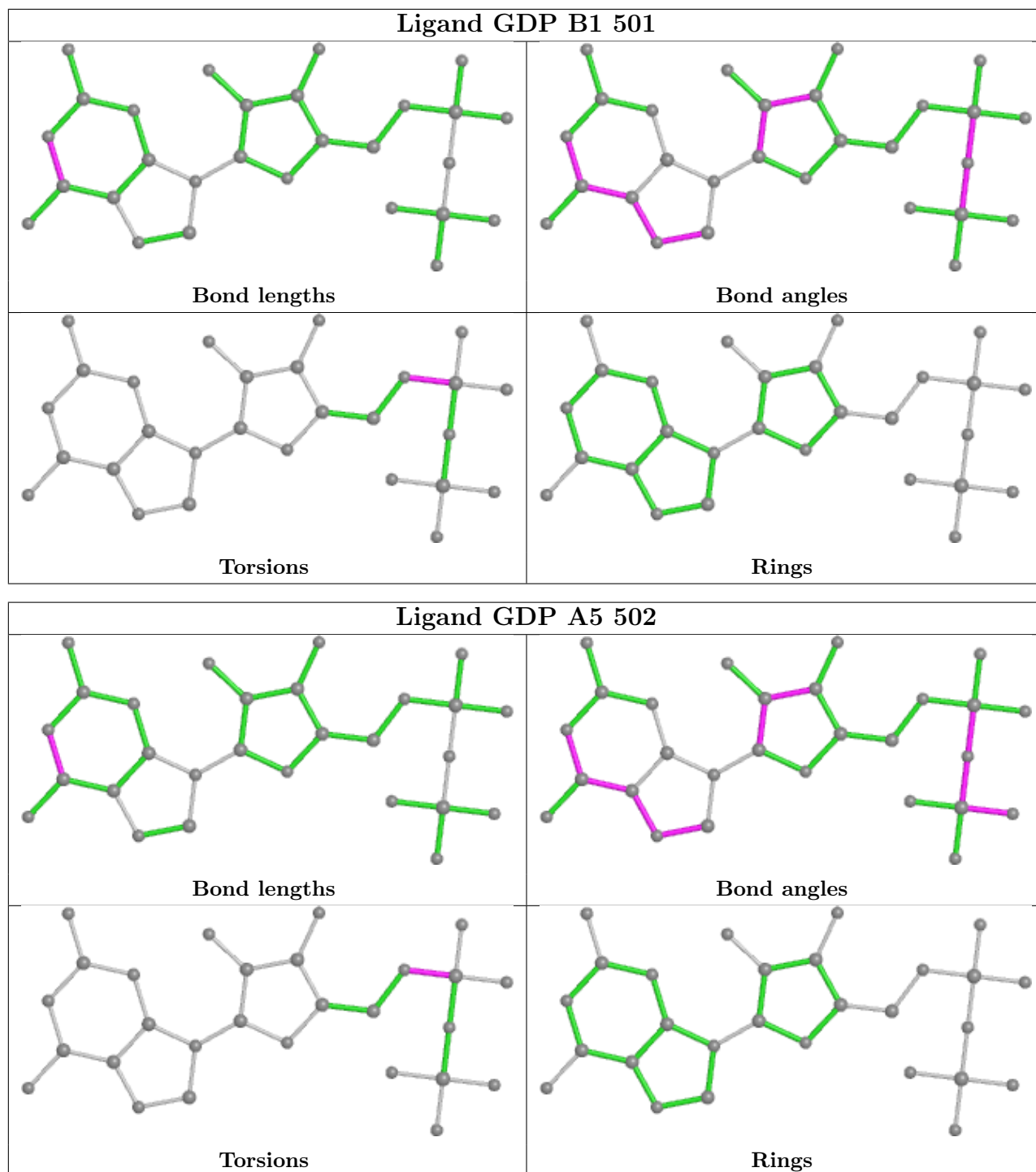
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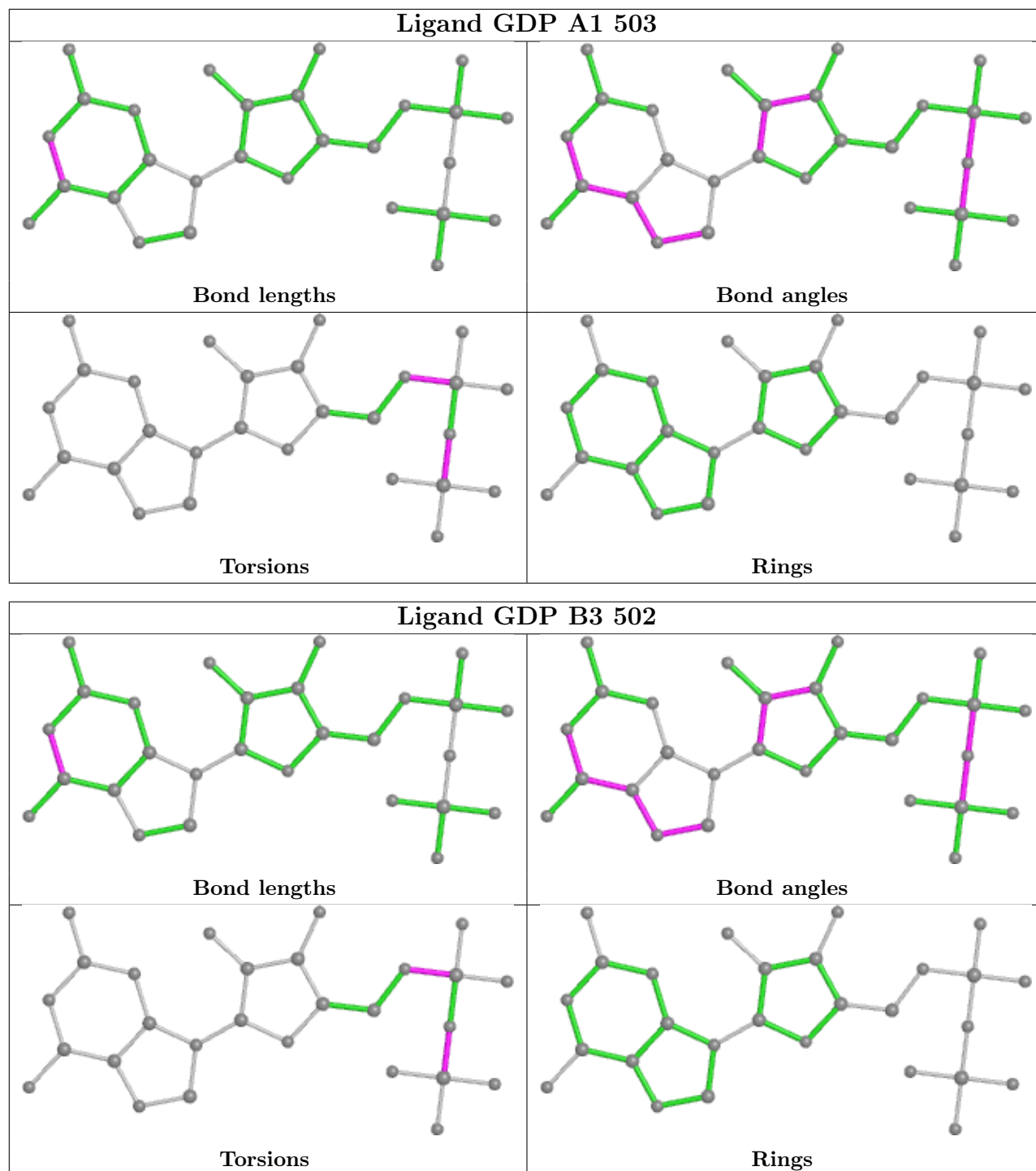
Mol	Chain	Res	Type	Clashes	Symm-Clashes
21	A3	501	GTP	1	0
23	B5	502	GDP	1	0
21	A7	501	GTP	4	0
21	B5	501	GTP	1	0

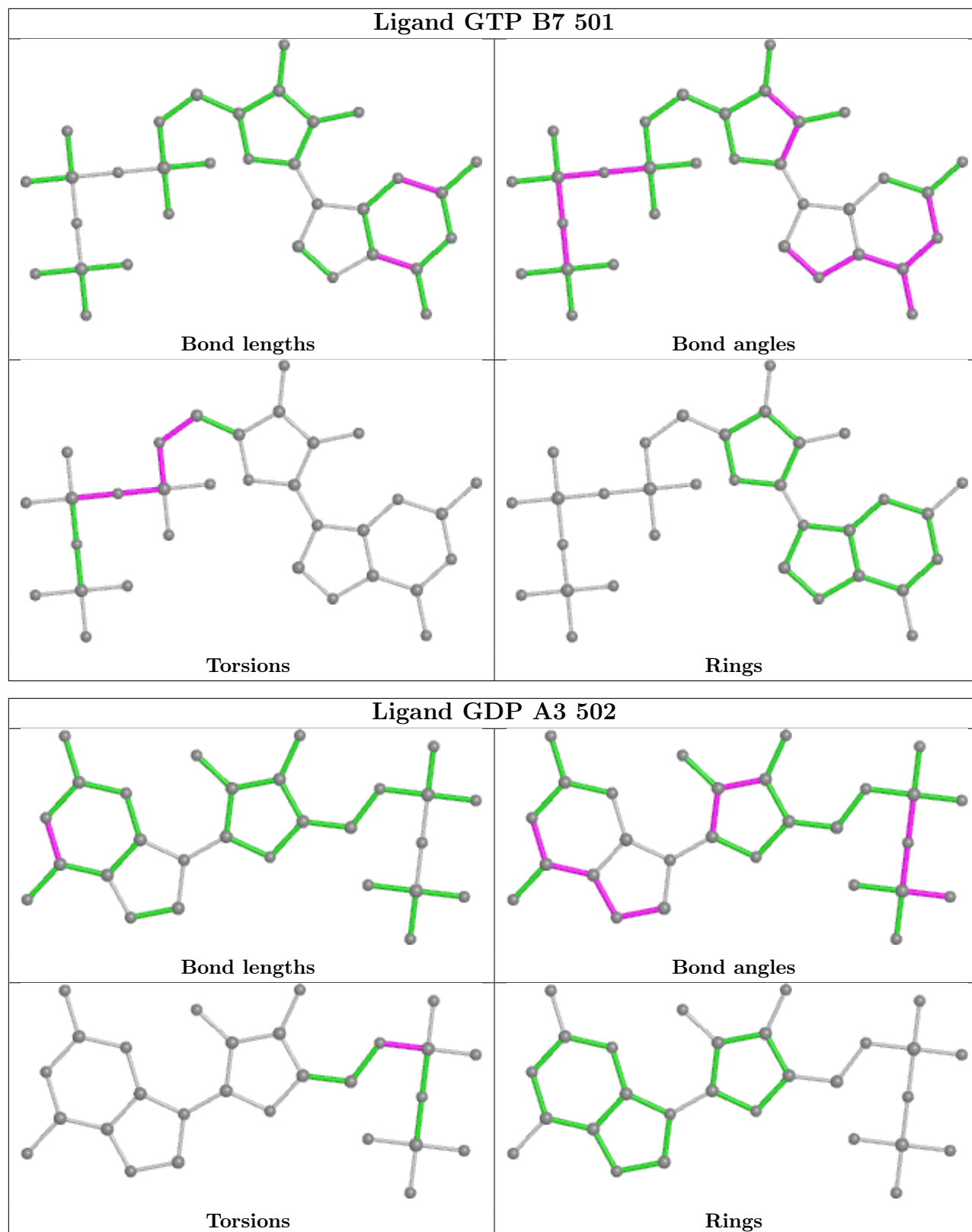
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.

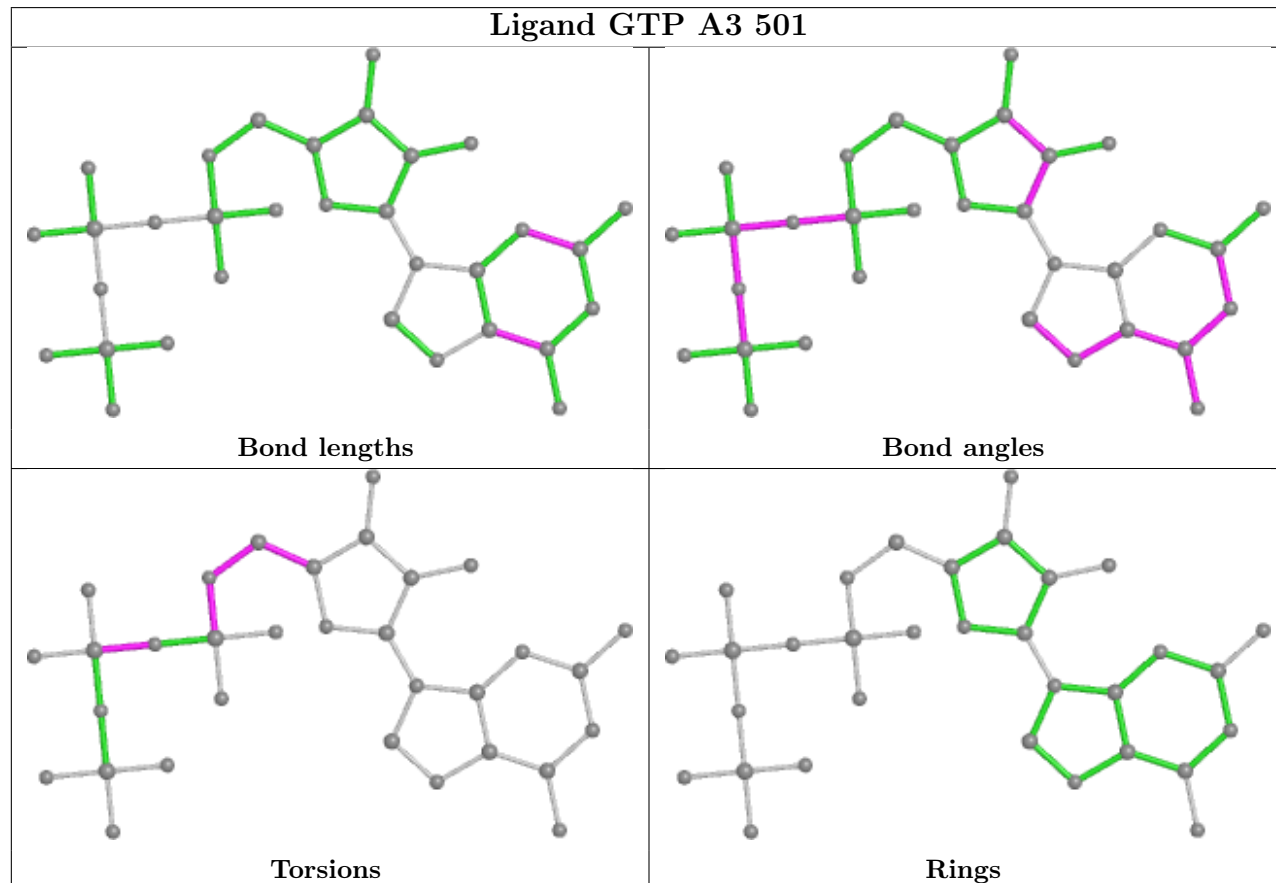
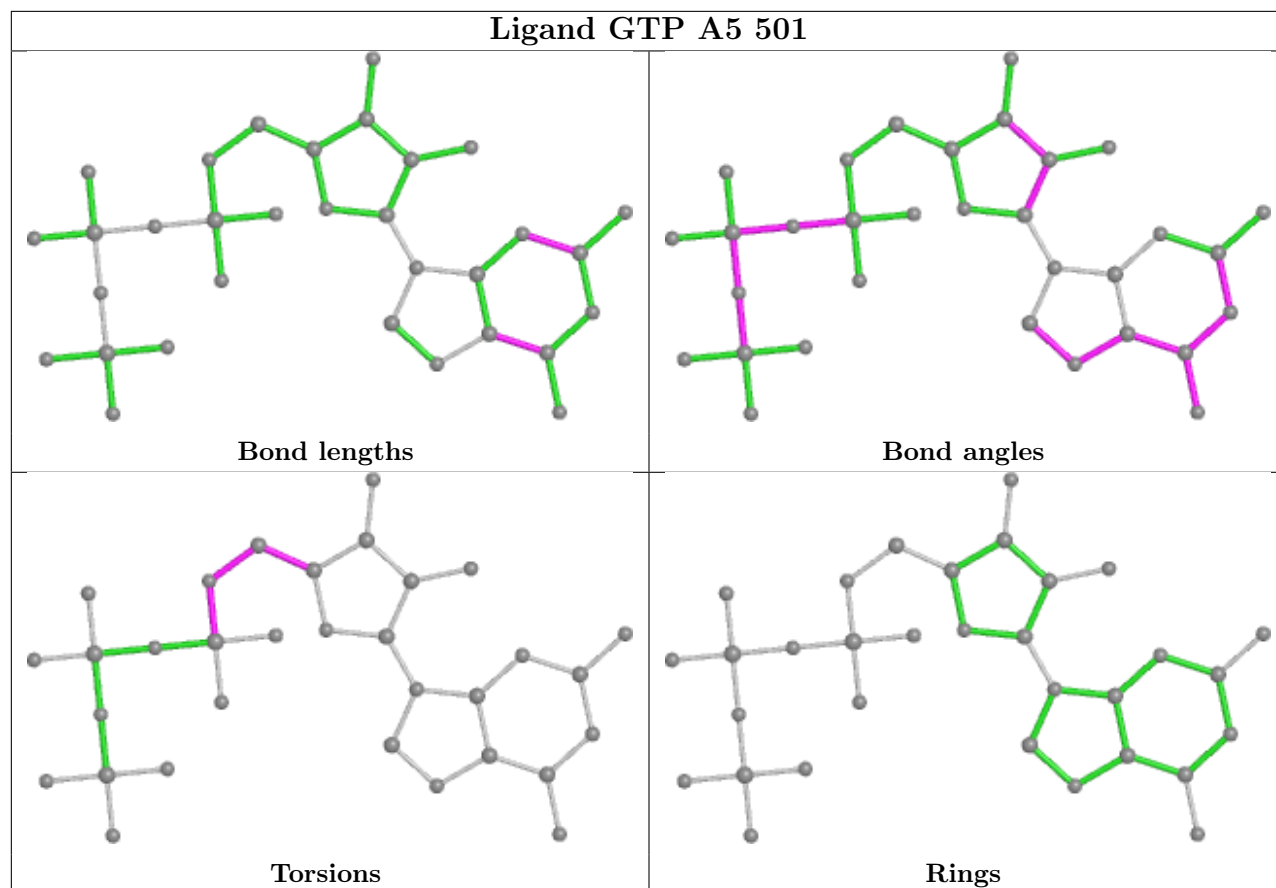


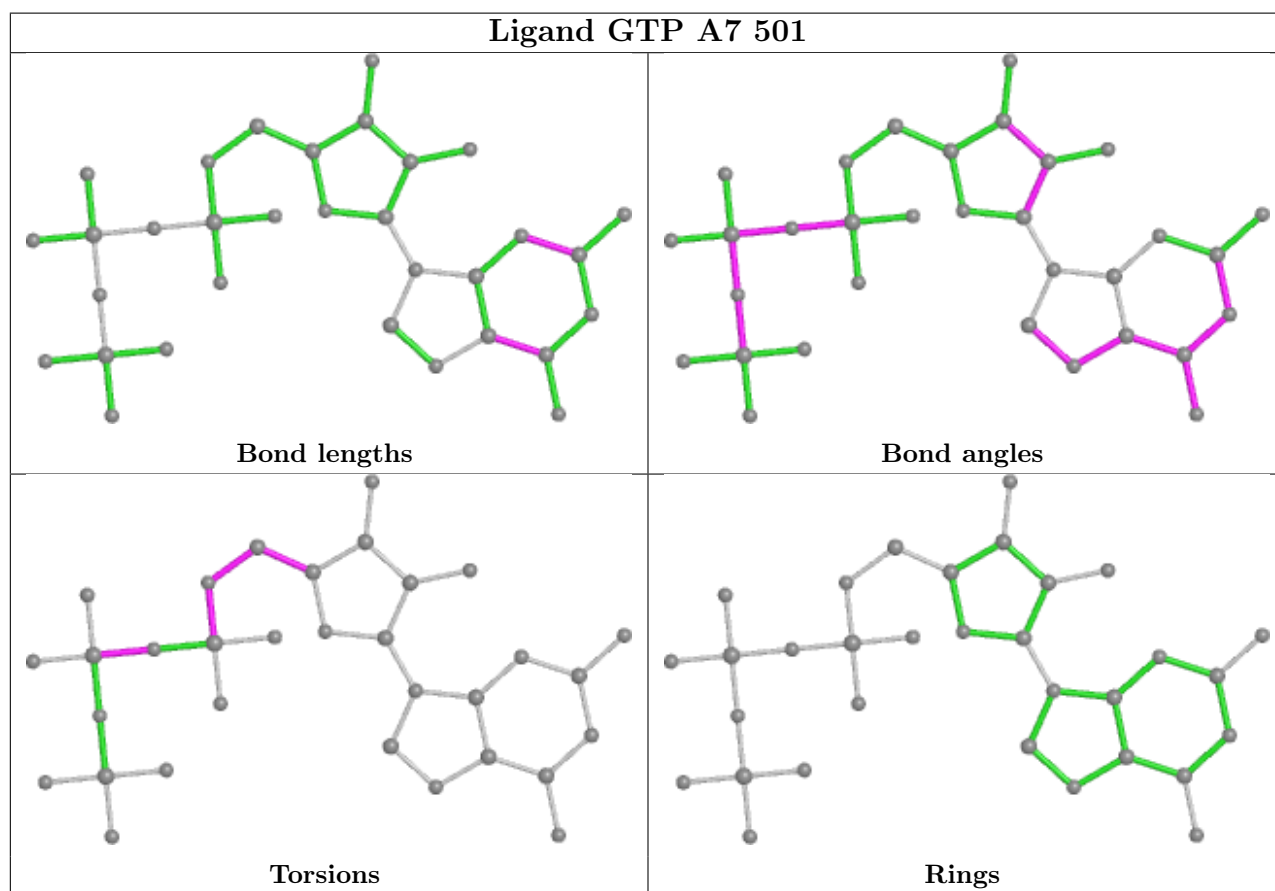
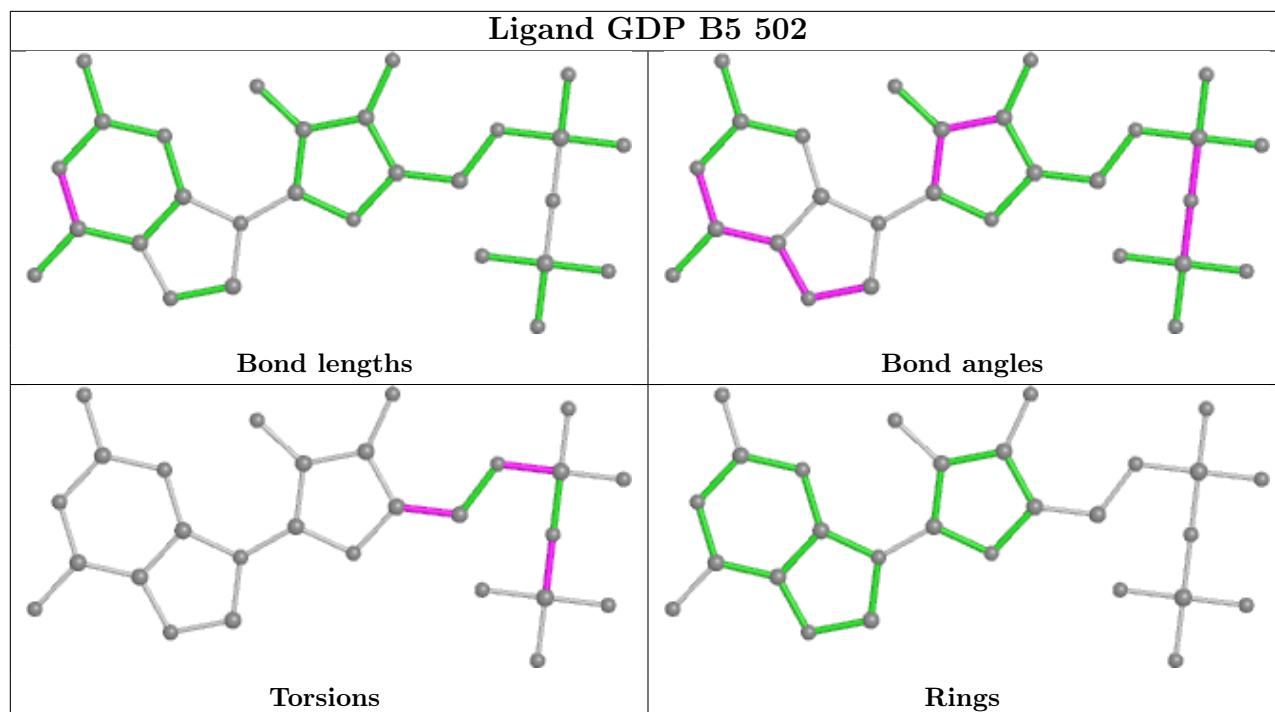


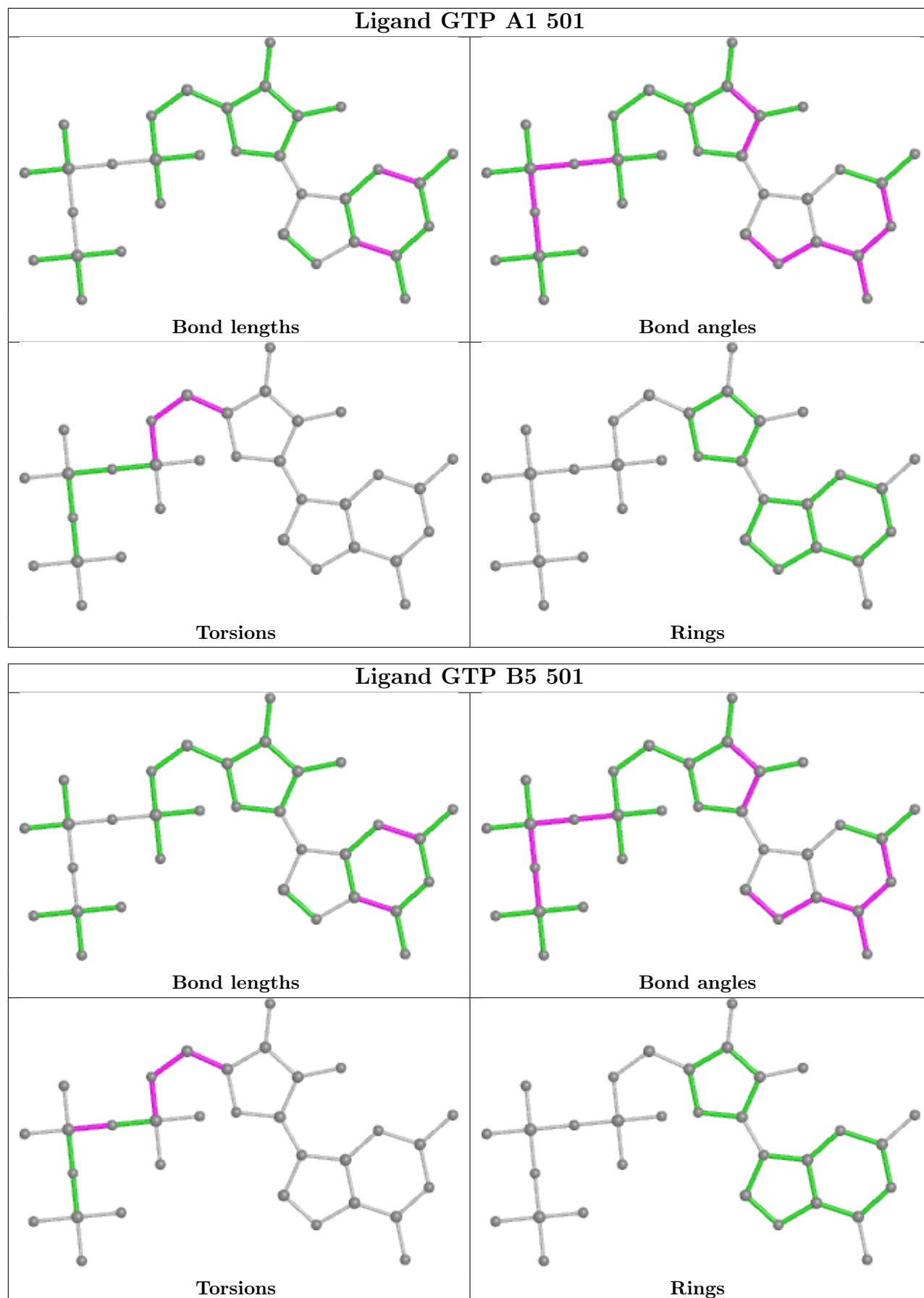












5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
19	Y0	3
17	X0	2

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	X0	396:UNK	C	403:UNK	N	28.65
1	Y0	387:UNK	C	394:UNK	N	22.26
1	Y0	420:UNK	C	424:UNK	N	12.82
1	X0	346:UNK	C	348:UNK	N	9.65
1	Y0	281:UNK	C	284:UNK	N	6.72

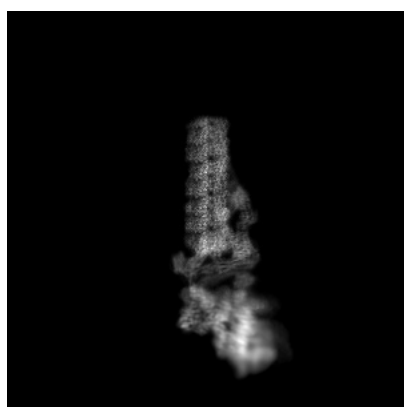
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-23082. These allow visual inspection of the internal detail of the map and identification of artifacts.

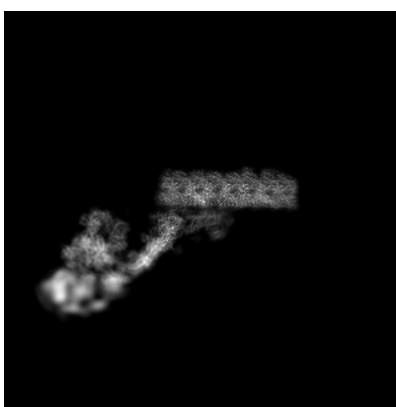
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

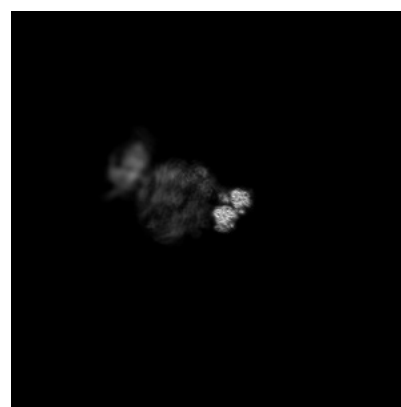
6.1.1 Primary map



X



Y

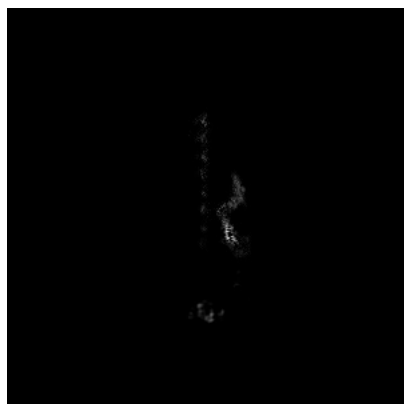


Z

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

6.2 Central slices [i](#)

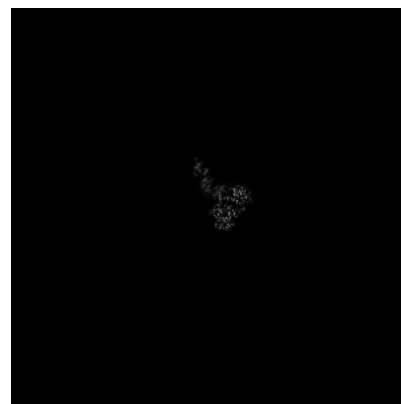
6.2.1 Primary map



X Index: 350



Y Index: 350

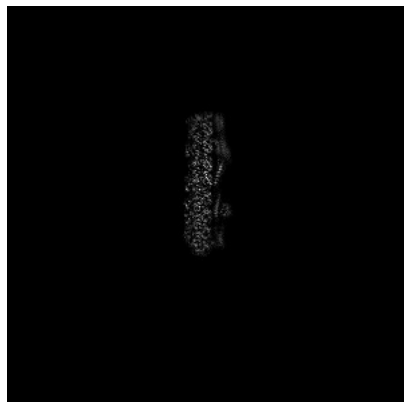


Z Index: 350

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: 372



Y Index: 347

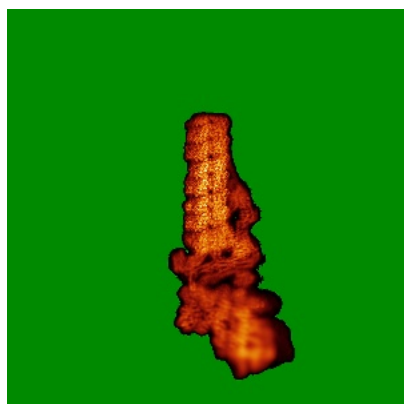


Z Index: 294

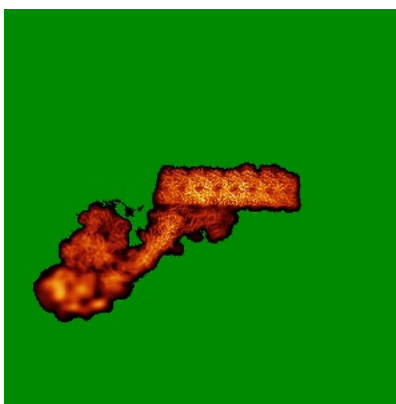
The images above show the largest variance slices of the map in three orthogonal directions.

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

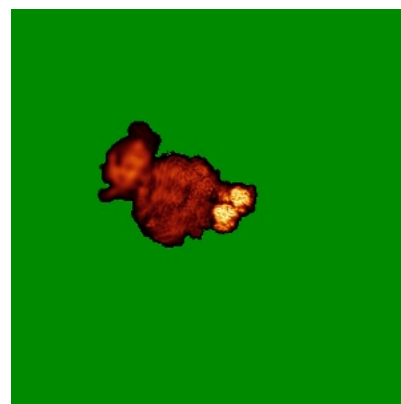
6.4.1 Primary map



X



Y



Z

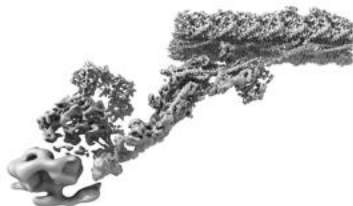
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.01. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

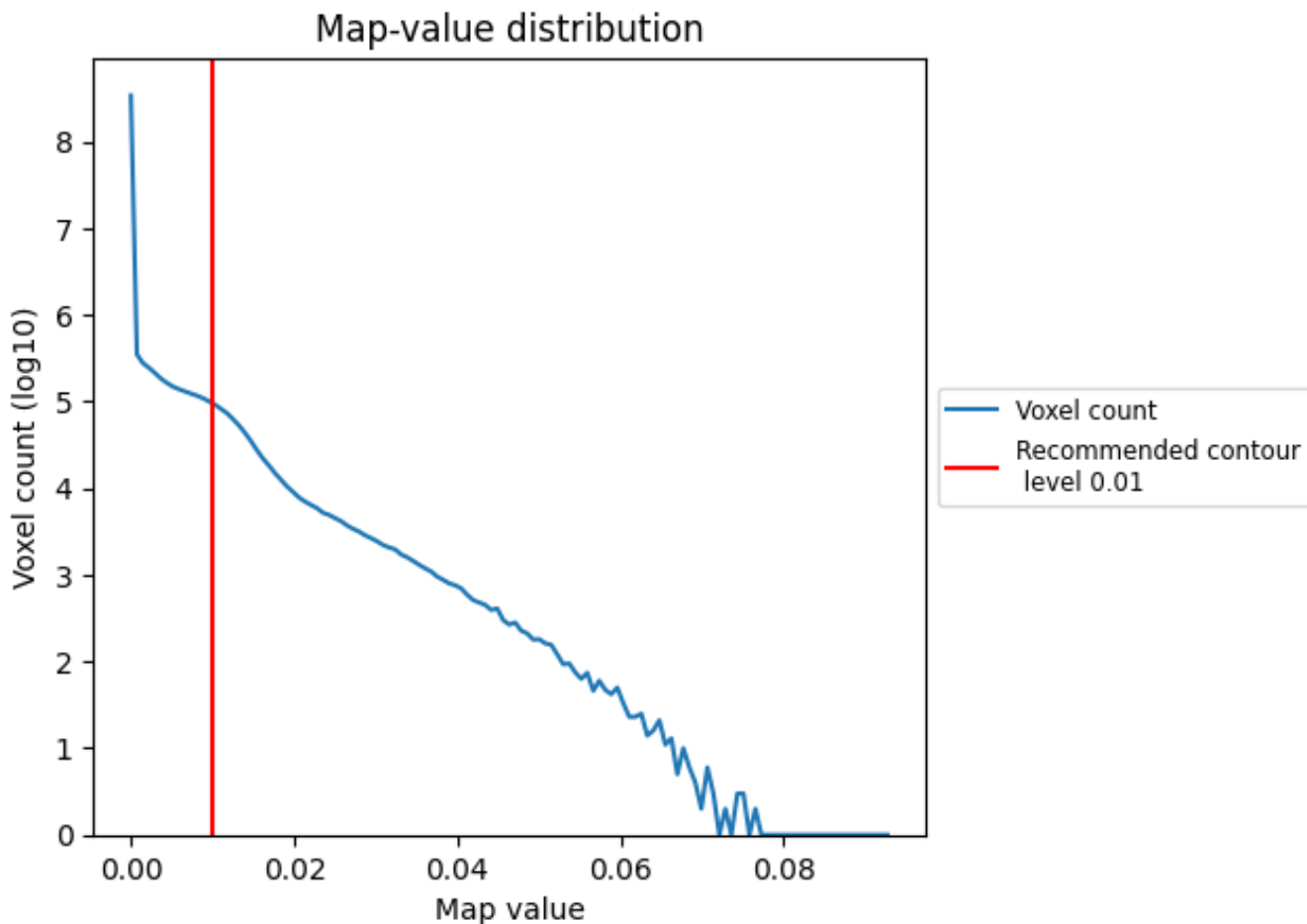
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

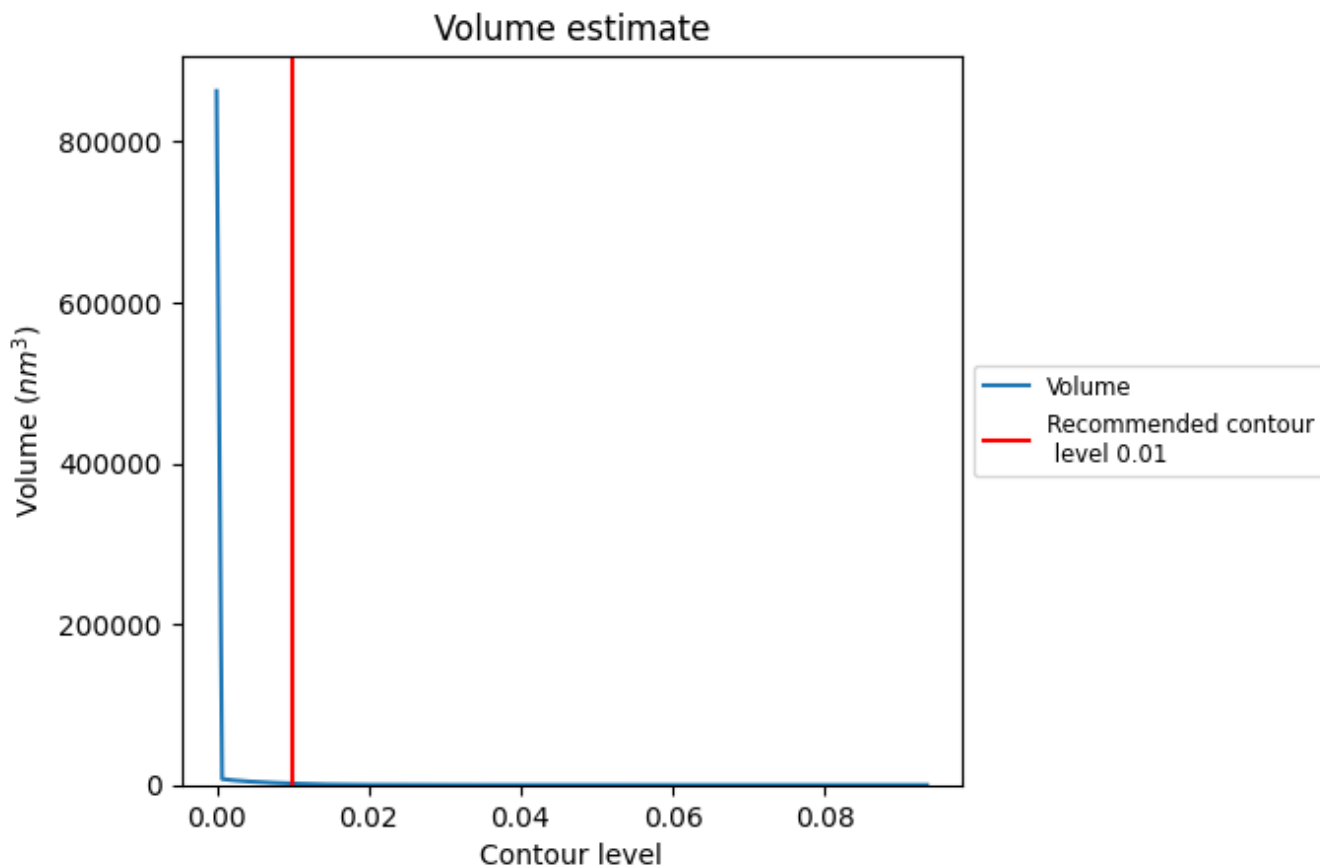
This section contains the results of statistical analysis of the map.

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.

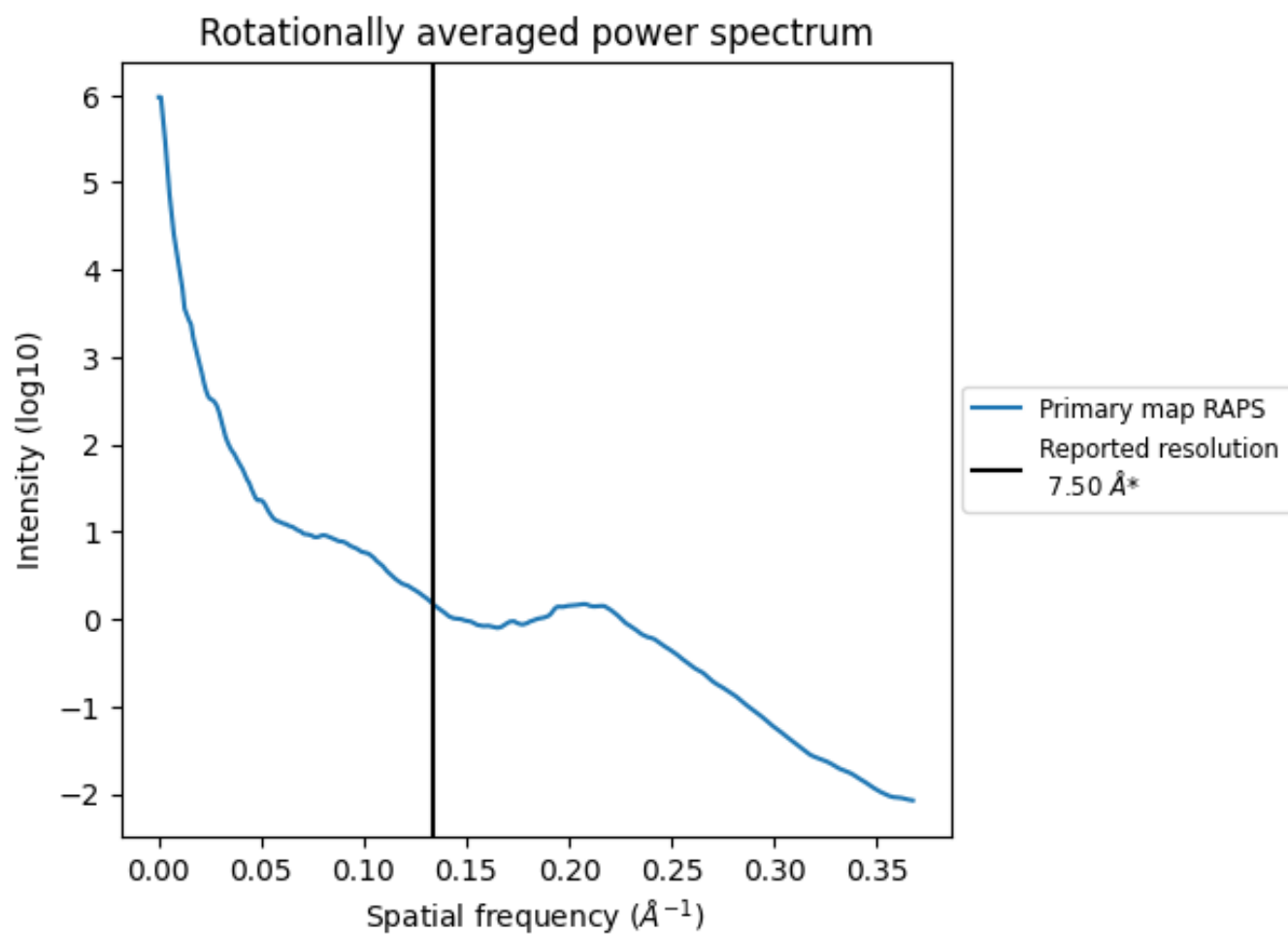
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 1728 nm^3 ; this corresponds to an approximate mass of 1561 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 i



*Reported resolution corresponds to spatial frequency of 0.133 Å⁻¹

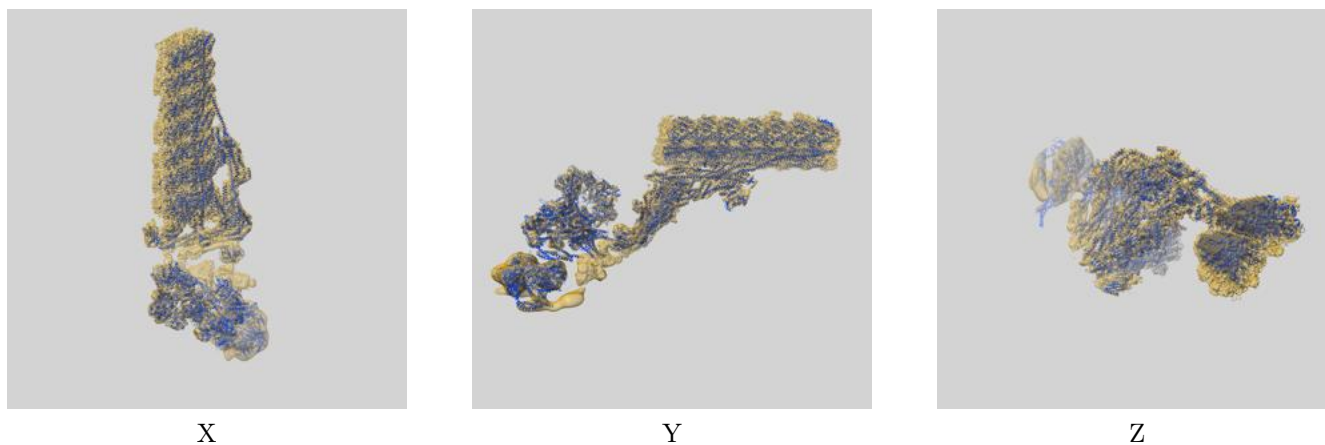
8 Fourier-Shell correlation

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

9 Map-model fit [i](#)

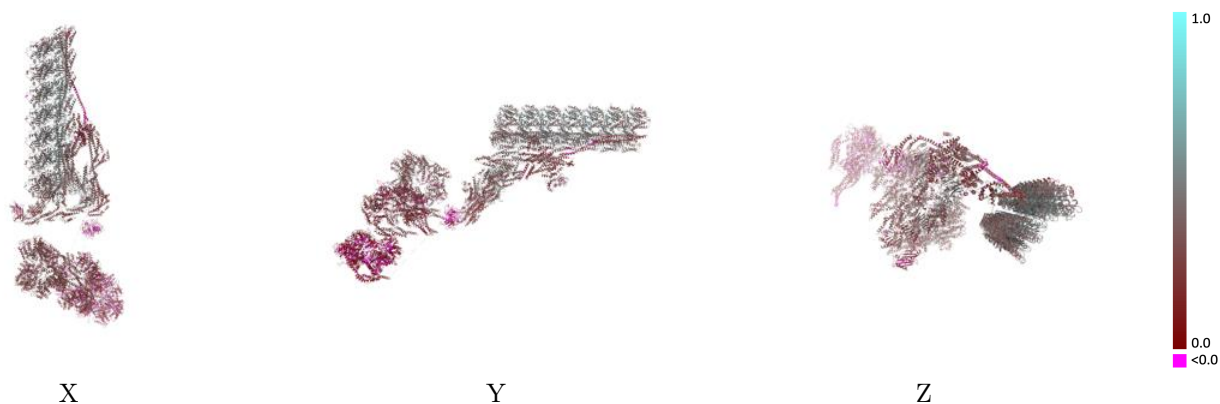
This section contains information regarding the fit between EMDB map EMD-23082 and PDB model 7KZM. Per-residue inclusion information can be found in section [3](#) on page [11](#).

9.1 Map-model overlay [i](#)



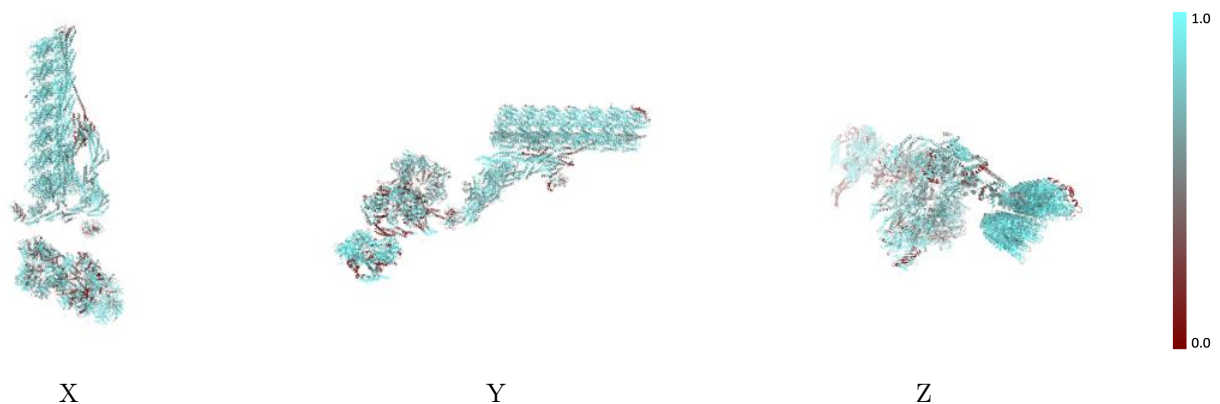
The images above show the 3D surface view of the map at the recommended contour level 0.01 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



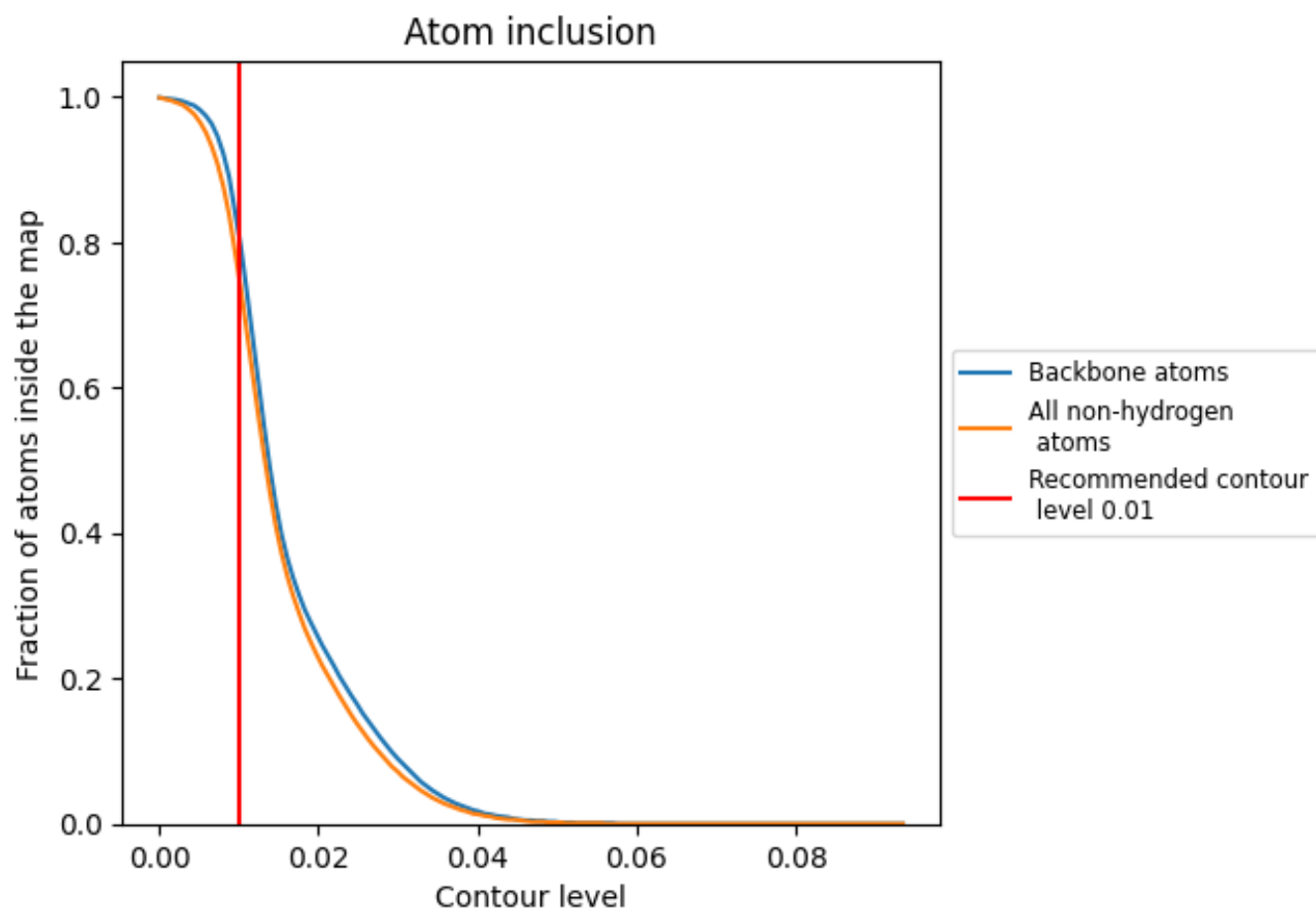
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.01).







































































9.4 Atom inclusion [i](#)



At the recommended contour level, 81% of all backbone atoms, 75% 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 (0.01) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.7540	 0.3150
A	 0.7810	 0.0650
A1	 0.8450	 0.3840
A2	 0.8870	 0.4210
A3	 0.8970	 0.4330
A4	 0.9160	 0.4440
A5	 0.8980	 0.4460
A6	 0.8770	 0.4270
A7	 0.8660	 0.4160
B	 0.6070	 0.2190
B1	 0.8400	 0.4360
B2	 0.8840	 0.4760
B3	 0.8990	 0.4820
B4	 0.8970	 0.4800
B5	 0.9160	 0.4850
B6	 0.8640	 0.4590
B7	 0.7600	 0.4270
C	 0.6330	 0.2820
D	 0.7970	 0.4230
E	 0.7600	 0.3780
F	 0.5860	 0.1700
G	 0.6020	 0.3060
H	 0.8030	 0.2800
I	 0.7090	 0.3720
J	 0.7690	 0.4100
K	 0.7760	 0.3300
L	 0.6550	 0.2720
M	 0.7190	 0.2500
N	 0.7940	 0.2540
O	 0.5340	 0.1970
P	 0.7180	 0.3530
X	 0.5990	 0.2680
X0	 0.6880	 0.2490
X1	 0.7470	 0.4100
Y	 0.6530	 0.2380



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Chain	Atom inclusion	Q-score
Y0	 0.8320	 0.3350
Y1	 0.7730	 0.4060
Z	 0.6060	 0.2750