



wwPDB EM Validation Summary Report ⓘ

Jul 21, 2026 – 02:32 pm BST

PDB ID : 9S2F / pdb_00009s2f
EMDB ID : EMD-54494
Title : Human debranched intron spliceosome (DIS)
Authors : Boreikaite, V.; Vorlaender, M.K.; Plaschka, C.
Deposited on : 2025-07-21
Resolution : 3.14 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.dev133
Mogul : 1.8.4, CSD as541be (2020)
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) : 2.50

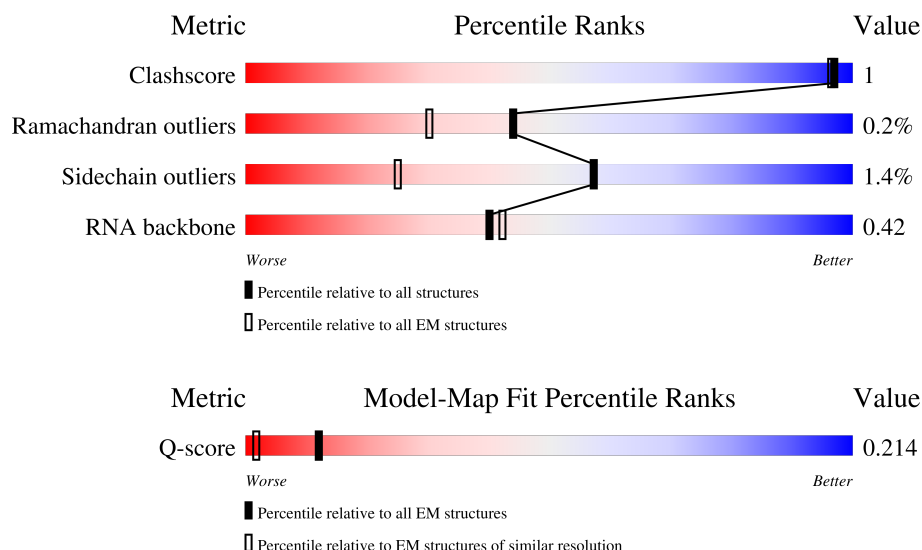
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

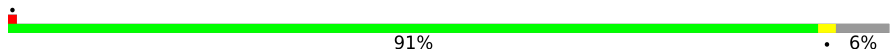
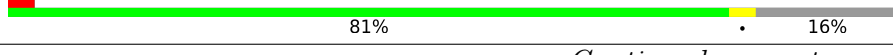
The reported resolution of this entry is 3.14 Å.

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.



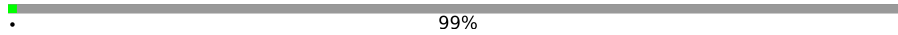
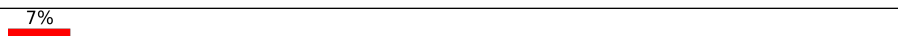
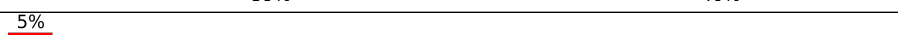
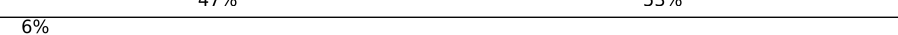
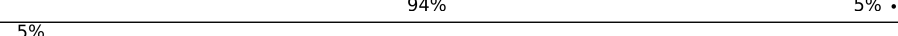
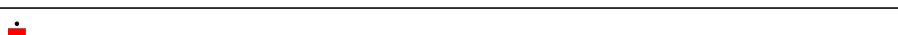
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
RNA backbone	8273	3508	-
Q-score	-	25397	14483 (2.64 - 3.64)

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	35	703	 91% 6%
2	5	116	 61% 13% 5% 21%
3	A	2335	 81% 16%

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Mol	Chain	Length	Quality of chain
4	B	2136	
5	C	972	
6	E	357	
7	GP	931	
8	I	855	
9	J	848	
10	K	225	
11	L	802	
12	M	243	
13	N	144	
14	O	420	
15	P	229	
16	Q	1485	
17	R	536	
18	S	166	
19	T	514	
20	W	579	
21	WD	315	
22	Z	166	
23	a	126	
24	b	240	
25	c	119	
26	d	118	
27	e	92	
28	f	86	

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Mol	Chain	Length	Quality of chain
29	g	76	 93% ..
30	q	504	 20% 80%
30	r	504	 24% 76%
30	s	504	 26% 74%
30	t	504	 20% 80%
31	y	301	 12% 27% 72%
32	D	285	 18% 82%
33	IN	10	 70% 30%
34	6	106	 10% 21% 11% 67%

2 Entry composition

There are 38 unique types of molecules in this entry. The entry contains 77158 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 Probable ATP-dependent RNA helicase DHX35.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	35	658	Total	C	N	O	S	0	0
			5214	3323	916	946	29		

- Molecule 2 is a RNA chain called U5 snRNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	5	92	Total	C	N	O	P	0	0
			1936	867	322	655	92		

- Molecule 3 is a protein called Pre-mRNA-processing-splicing factor 8.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	A	1961	Total	C	N	O	S	0	0
			16319	10523	2860	2865	71		

- Molecule 4 is a protein called U5 small nuclear ribonucleoprotein 200 kDa helicase.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	B	19	Total	C	N	O	S	0	0
			140	86	25	28	1		

- Molecule 5 is a protein called 116 kDa U5 small nuclear ribonucleoprotein component.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	C	890	Total	C	N	O	S	0	0
			7040	4503	1174	1329	34		

- Molecule 6 is a protein called U5 small nuclear ribonucleoprotein 40 kDa protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	E	299	Total	C	N	O	S	0	0
			2341	1470	411	447	13		

- Molecule 7 is a protein called G patch domain-containing protein 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	GP	331	Total	C	N	O	S	0	0
			2447	1550	420	475	2		

- Molecule 8 is a protein called Pre-mRNA-splicing factor SYF1.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	I	719	Total	C	N	O		0	0
			3620	2182	719	719			

- Molecule 9 is a protein called Crooked neck-like protein 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	J	561	Total	C	N	O	S	0	0
			3360	2067	645	643	5		

- Molecule 10 is a protein called Pre-mRNA-splicing factor SPF27.

Mol	Chain	Residues	Atoms					AltConf	Trace
10	K	209	Total	C	N	O		0	0
			1052	634	209	209			

- Molecule 11 is a protein called Cell division cycle 5-like protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
11	L	485	Total	C	N	O	S	0	0
			3057	1882	576	592	7		

- Molecule 12 is a protein called Pre-mRNA-splicing factor SYF2.

Mol	Chain	Residues	Atoms					AltConf	Trace
12	M	113	Total	C	N	O		0	0
			569	343	113	113			

- Molecule 13 is a protein called Protein BUD31 homolog.

Mol	Chain	Residues	Atoms					AltConf	Trace
13	N	142	Total	C	N	O	S	0	0
			1178	743	216	207	12		

- Molecule 14 is a protein called Pre-mRNA-splicing factor RBM22.

Mol	Chain	Residues	Atoms				AltConf	Trace
14	O	245	Total	C	N	O	0	0
			1242	752	245	245		

- Molecule 15 is a protein called Spliceosome-associated protein CWC15 homolog.

Mol	Chain	Residues	Atoms					AltConf	Trace
15	P	85	Total	C	N	O	S	0	0
			738	452	145	139	2		

- Molecule 16 is a protein called Intron-binding protein aquarius.

Mol	Chain	Residues	Atoms				AltConf	Trace
16	Q	1296	Total	C	N	O	0	0
			6558	3966	1296	1296		

- Molecule 17 is a protein called SNW domain-containing protein 1.

Mol	Chain	Residues	Atoms						AltConf	Trace
17	R	250	Total	C	N	O	P	S	0	0
			2000	1256	353	377	2	12		

- Molecule 18 is a protein called Peptidyl-prolyl cis-trans isomerase-like 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
18	S	159	Total	C	N	O	S	0	0
			1236	787	215	227	7		

- Molecule 19 is a protein called Pleiotropic regulator 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
19	T	360	Total	C	N	O	S	0	0
			2714	1706	496	504	8		

- Molecule 20 is a protein called Pre-mRNA-processing factor 17.

Mol	Chain	Residues	Atoms					AltConf	Trace
20	W	485	Total	C	N	O	S	0	0
			3925	2505	678	718	24		

- Molecule 21 is a protein called WD repeat domain-containing protein 83.

Mol	Chain	Residues	Atoms				AltConf	Trace
21	WD	292	Total	C	N	O	0	0
			1446	862	292	292		

- Molecule 22 is a protein called Coiled-coil domain-containing protein 12.

Mol	Chain	Residues	Atoms				AltConf	Trace
22	Z	92	Total	C	N	O	0	0
			473	289	92	92		

- Molecule 23 is a protein called Small nuclear ribonucleoprotein Sm D3.

Mol	Chain	Residues	Atoms					AltConf	Trace
23	a	83	Total	C	N	O	S	0	0
			651	408	114	122	7		

- Molecule 24 is a protein called Small nuclear ribonucleoprotein-associated proteins B and B'.

Mol	Chain	Residues	Atoms					AltConf	Trace
24	b	95	Total	C	N	O	S	0	0
			725	455	136	127	7		

- Molecule 25 is a protein called Small nuclear ribonucleoprotein Sm D1.

Mol	Chain	Residues	Atoms					AltConf	Trace
25	c	81	Total	C	N	O	S	0	0
			641	409	112	116	4		

- Molecule 26 is a protein called Small nuclear ribonucleoprotein Sm D2.

Mol	Chain	Residues	Atoms					AltConf	Trace
26	d	97	Total	C	N	O	S	0	0
			784	490	148	141	5		

- Molecule 27 is a protein called Small nuclear ribonucleoprotein E.

Mol	Chain	Residues	Atoms					AltConf	Trace
27	e	79	Total	C	N	O	S	0	0
			653	412	116	120	5		

- Molecule 28 is a protein called Small nuclear ribonucleoprotein F.

Mol	Chain	Residues	Atoms					AltConf	Trace
28	f	76	Total	C	N	O	S	0	0
			593	383	97	107	6		

- Molecule 29 is a protein called Small nuclear ribonucleoprotein G.

Mol	Chain	Residues	Atoms					AltConf	Trace
29	g	73	Total	C	N	O	S	0	0
			568	358	102	102	6		

- Molecule 30 is a protein called Pre-mRNA-processing factor 19.

Mol	Chain	Residues	Atoms					AltConf	Trace
30	q	103	Total	C	N	O		0	0
			524	318	103	103			
30	r	119	Total	C	N	O		0	0
			606	368	119	119			
30	s	132	Total	C	N	O		0	0
			679	415	132	132			
30	t	103	Total	C	N	O		0	0
			524	318	103	103			

- Molecule 31 is a protein called Peptidyl-prolyl cis-trans isomerase E.

Mol	Chain	Residues	Atoms					AltConf	Trace
31	y	83	Total	C	N	O		0	0
			414	248	83	83			

- Molecule 32 is a protein called Pre-mRNA-splicing factor ISY1 homolog.

Mol	Chain	Residues	Atoms					AltConf	Trace
32	D	51	Total	C	N	O		0	0
			255	153	51	51			

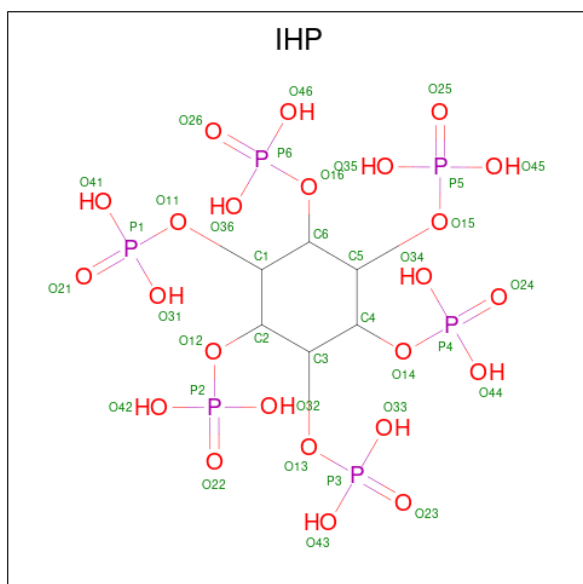
- Molecule 33 is a RNA chain called Intron.

Mol	Chain	Residues	Atoms					AltConf	Trace
33	IN	10	Total	C	O	P		0	0
			120	50	60	10			

- Molecule 34 is a RNA chain called U6 snRNA.

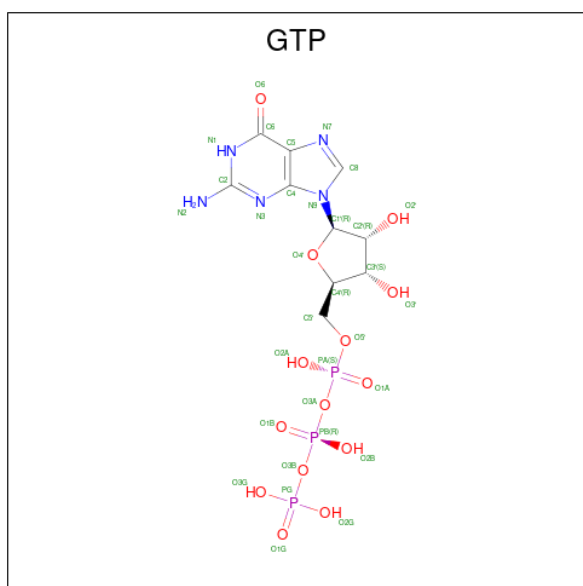
Mol	Chain	Residues	Atoms					AltConf	Trace
34	6	35	Total	C	N	O	P	0	0
			744	333	132	244	35		

- Molecule 35 is INOSITOL HEXAKISPHOSPHATE (CCD ID: IHP) (formula: $\text{C}_6\text{H}_{18}\text{O}_{24}\text{P}_6$).



Mol	Chain	Residues	Atoms				AltConf
35	A	1	Total	C	O	P	0
			36	6	24	6	

- Molecule 36 is GUANOSINE-5'-TRIPHOSPHATE (CCD ID: GTP) (formula: $\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_{14}\text{P}_3$).



Mol	Chain	Residues	Atoms					AltConf
36	C	1	Total	C	N	O	P	0
			32	10	5	14	3	

- Molecule 37 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		AltConf
37	C	1	Total	Mg	0
			1	1	

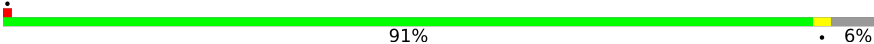
- Molecule 38 is ZINC ION (CCD ID: ZN) (formula: Zn).

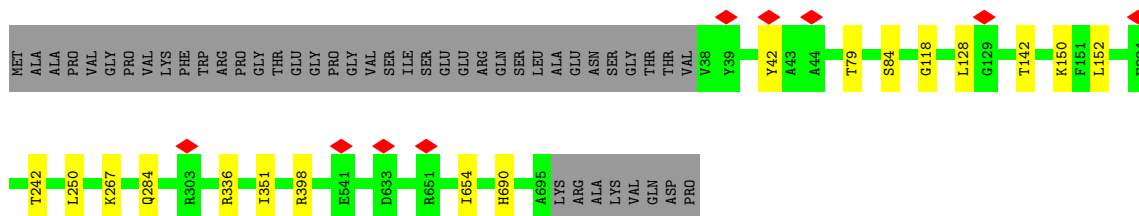
Mol	Chain	Residues	Atoms		AltConf
38	N	3	Total	Zn	0
			3	3	

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.

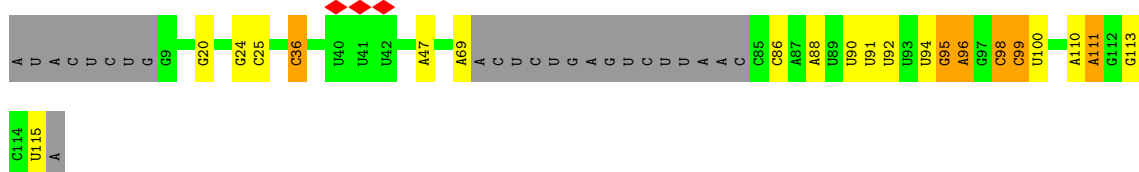
- Molecule 1: Probable ATP-dependent RNA helicase DHX35

Chain 35: 



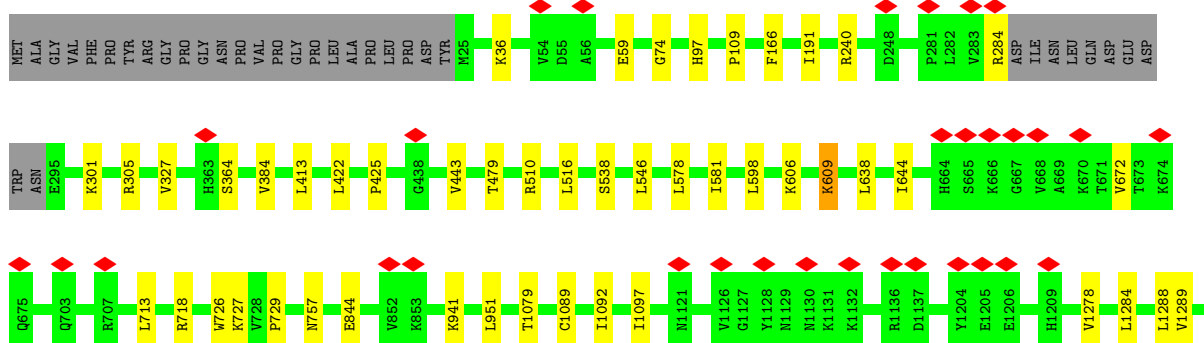
- Molecule 2: U5 snRNA

Chain 5: 



- Molecule 3: Pre-mRNA-processing-splicing factor 8

Chain A: 

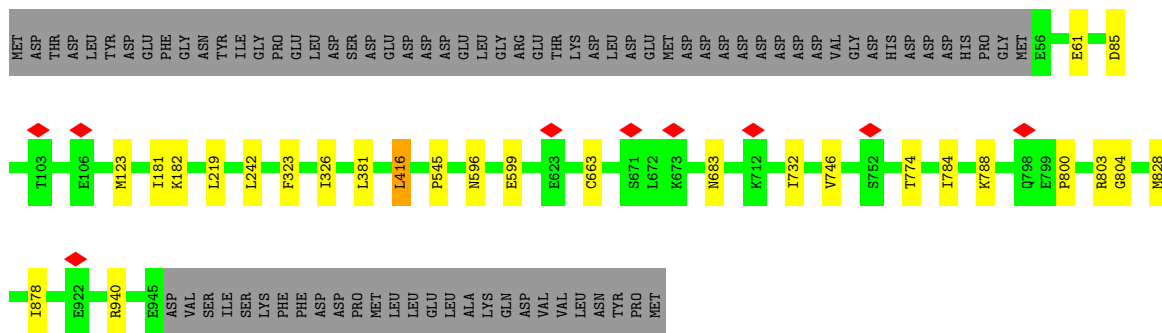




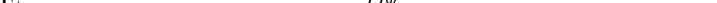
[illegible]

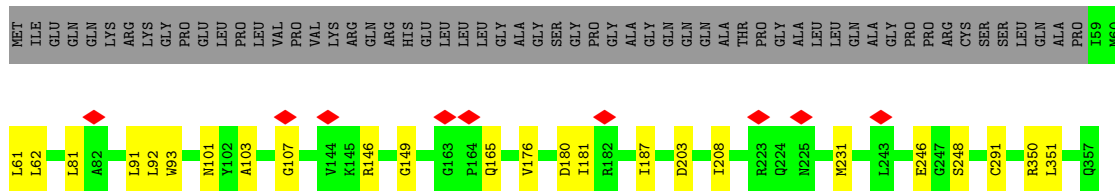
- Molecule 5: 116 kDa U5 small nuclear ribonucleoprotein component

Chain C: 89% 8%

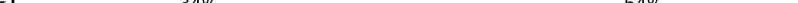


- Molecule 6: U5 small nuclear ribonucleoprotein 40 kDa protein.

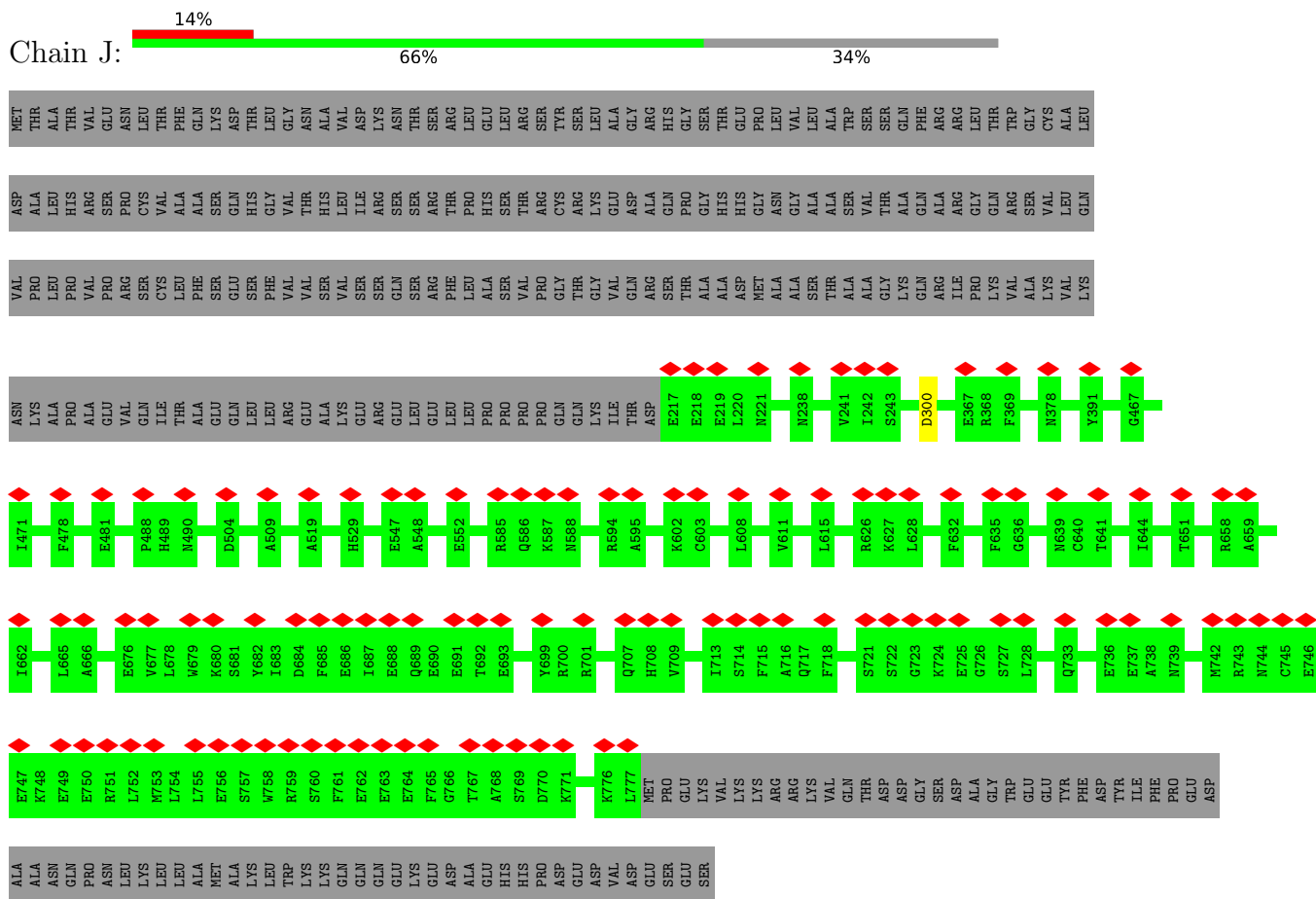
Chain E:  77% 7% 16%



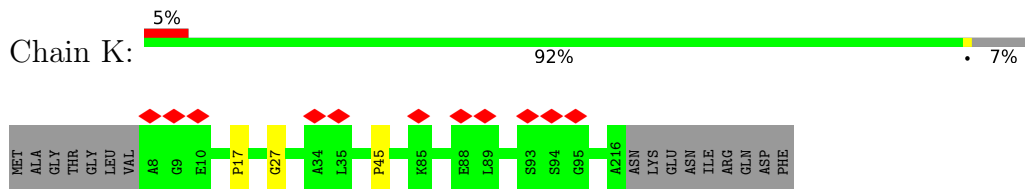
- Molecule 7: G patch domain-containing protein 1

Chain GP: 

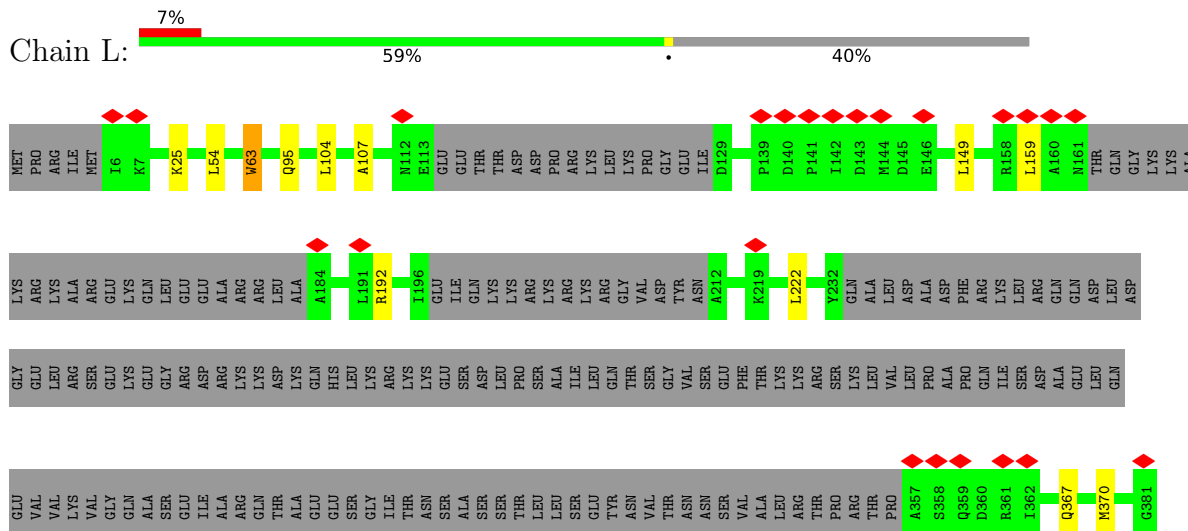




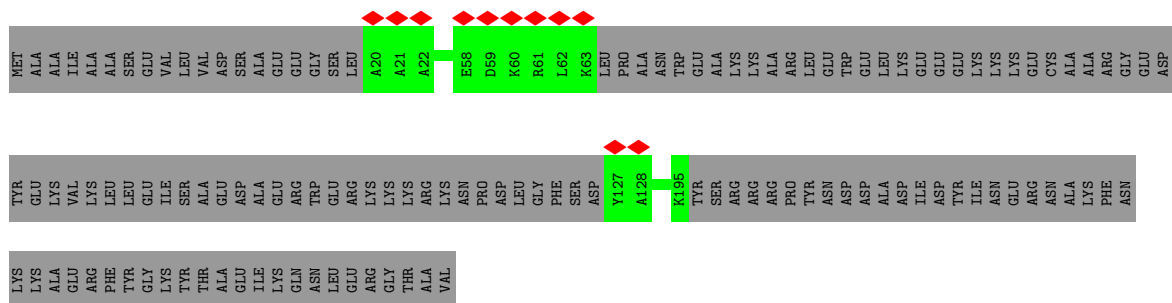
- Molecule 10: Pre-mRNA-splicing factor SPF27



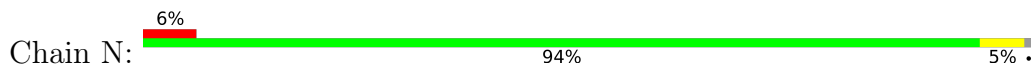
- Molecule 11: Cell division cycle 5-like protein



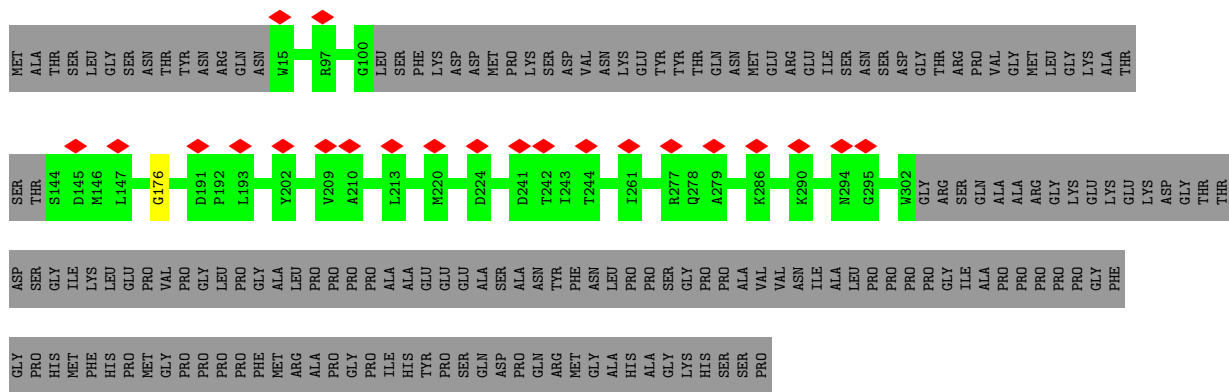
- Molecule 12: Pre-mRNA-splicing factor SYF2



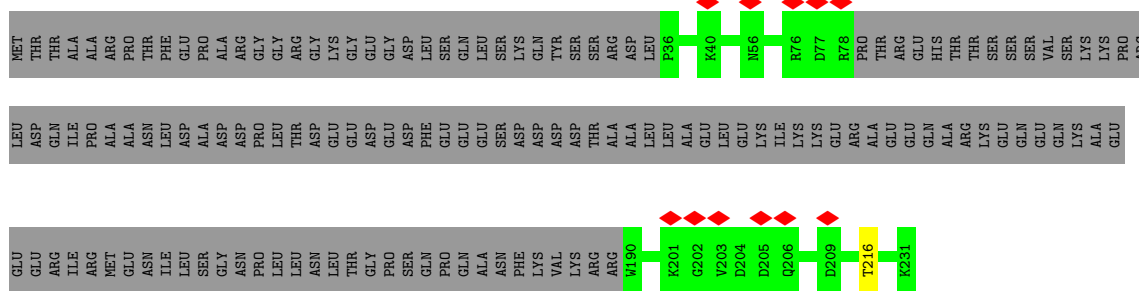
- Molecule 13: Protein BUD31 homolog



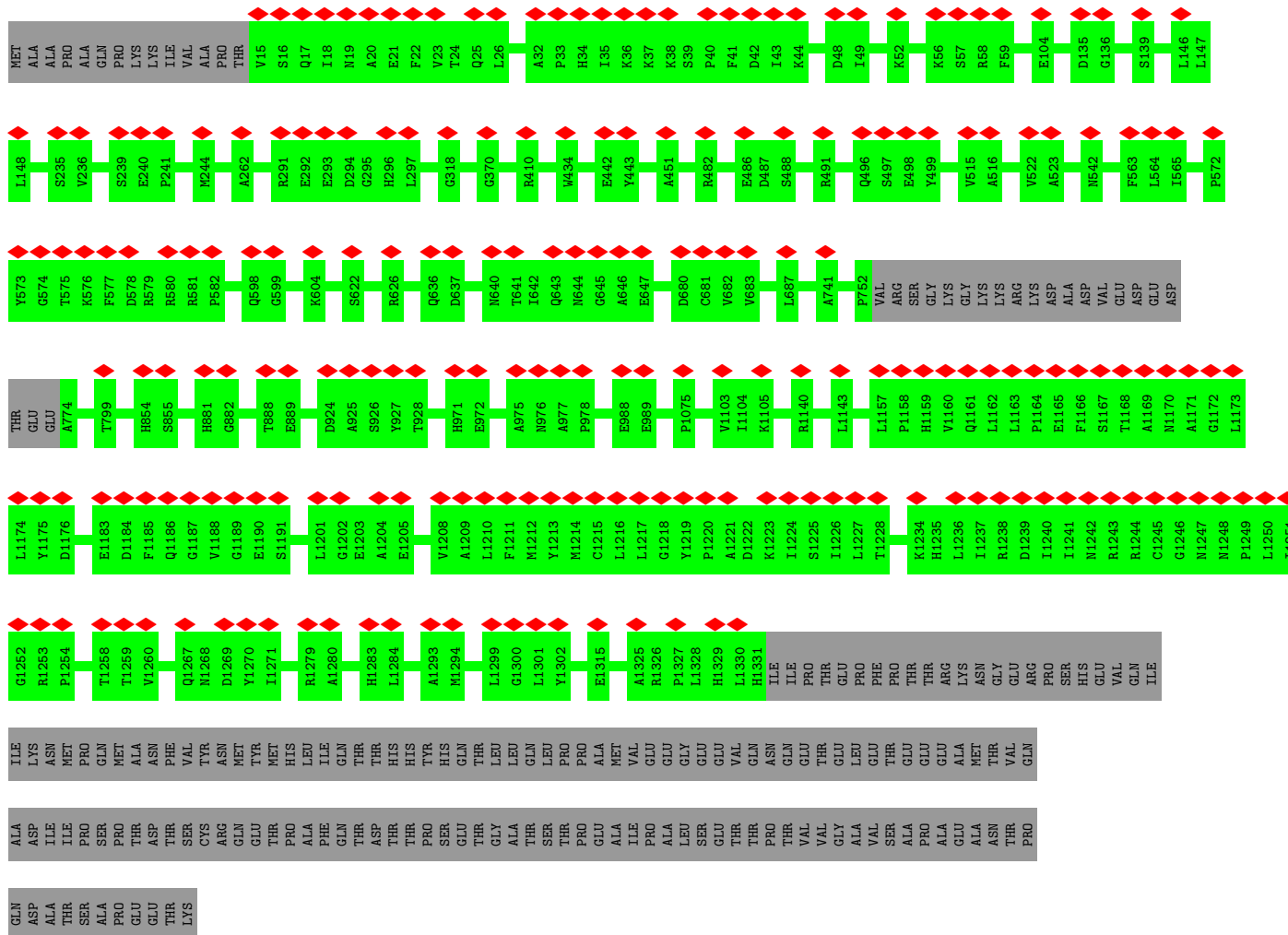
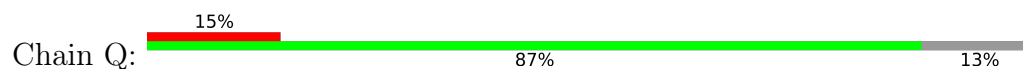
- Molecule 14: Pre-mRNA-splicing factor RBM22



- Molecule 15: Spliceosome-associated protein CWC15 homolog

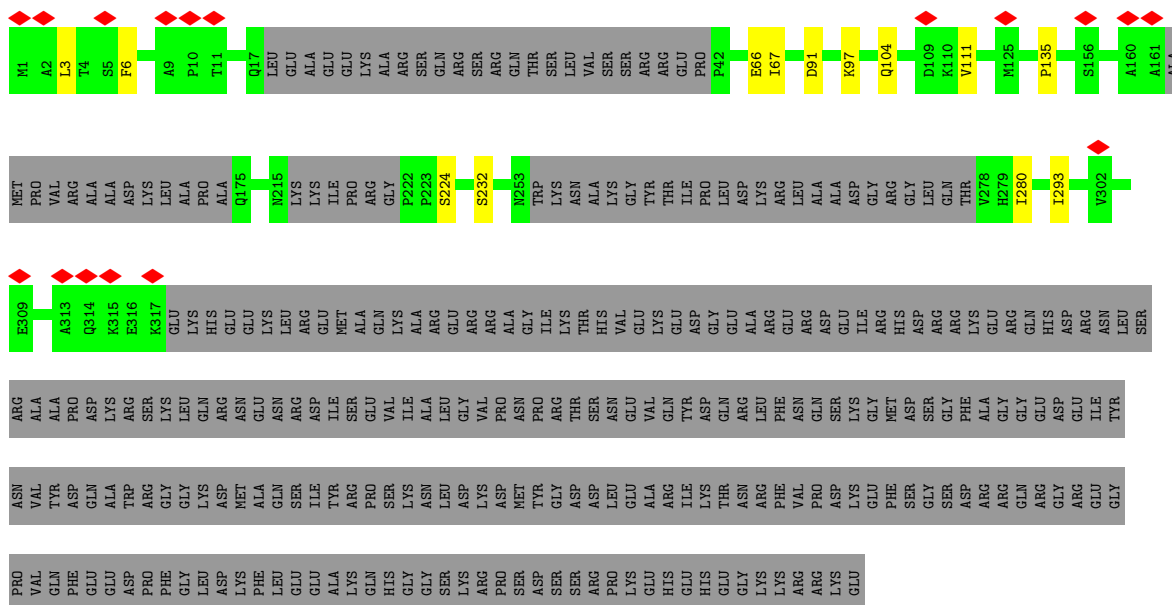


• Molecule 16: Intron-binding protein aquarius

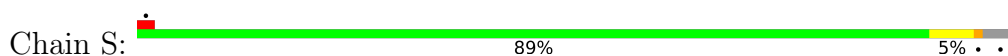


• Molecule 17: SNW domain-containing protein 1

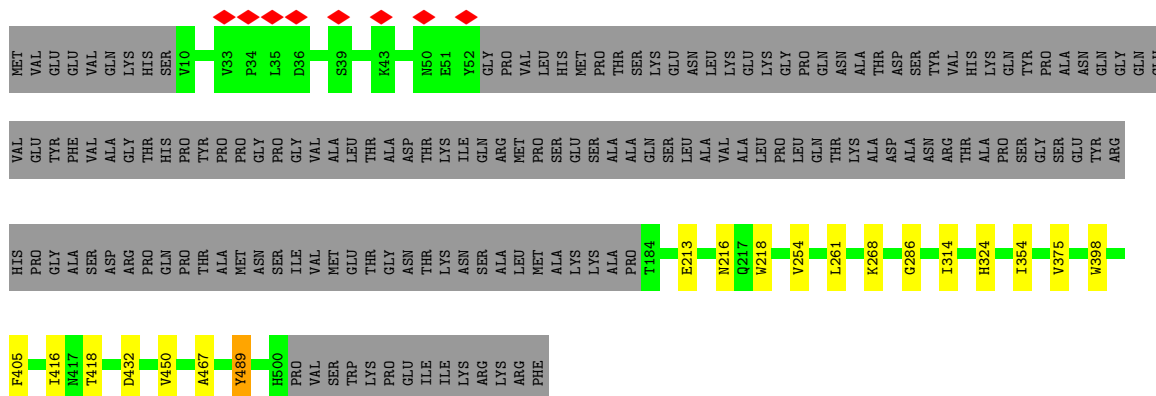




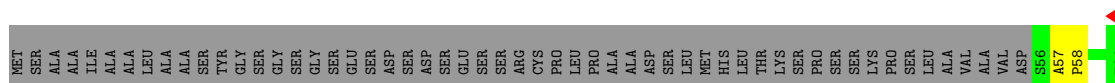
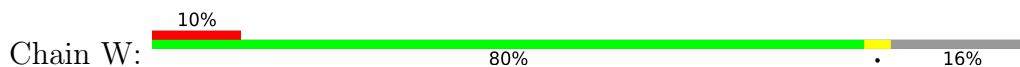
- Molecule 18: Peptidyl-prolyl cis-trans isomerase-like 1

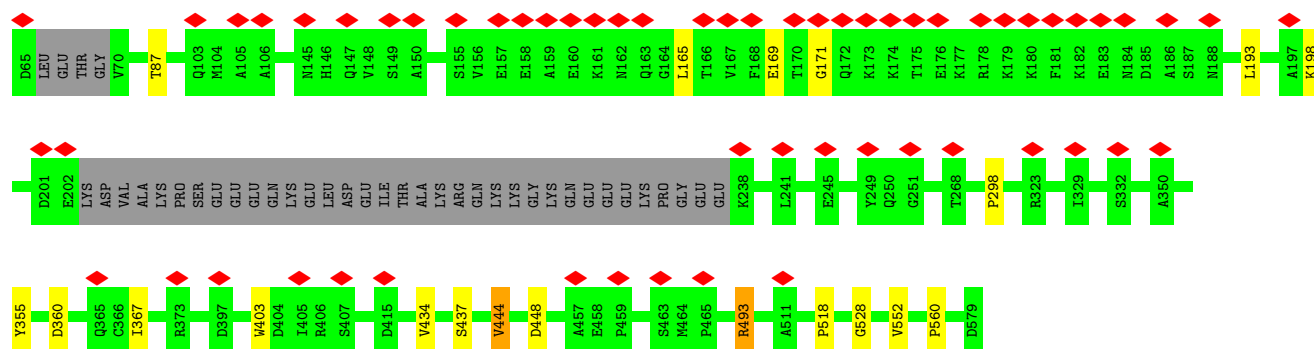


- Molecule 19: Pleiotropic regulator 1

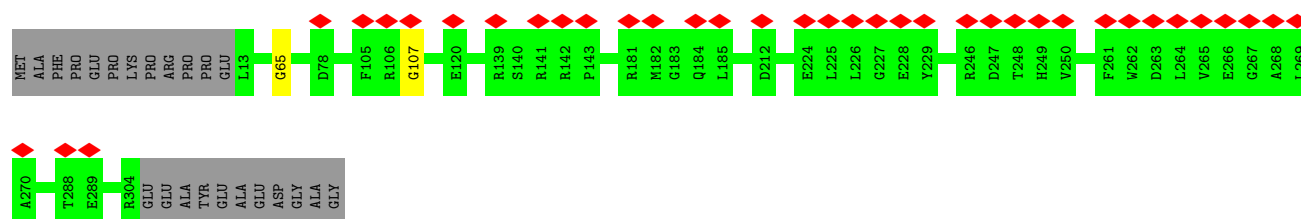


- Molecule 20: Pre-mRNA-processing factor 17

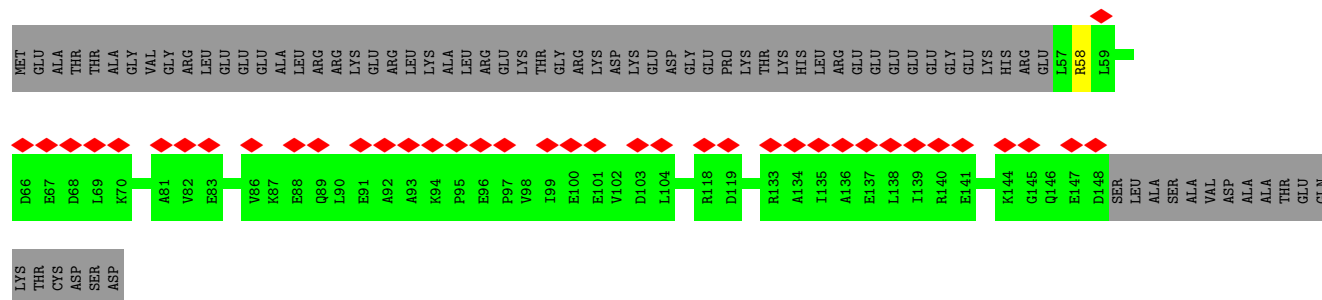




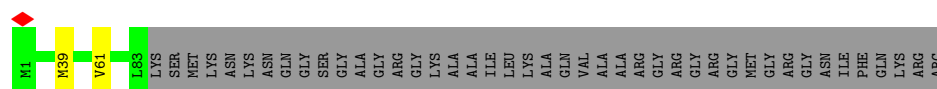
- Molecule 21: WD repeat domain-containing protein 83



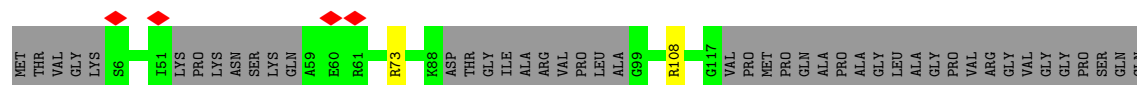
- Molecule 22: Coiled-coil domain-containing protein 12



- Molecule 23: Small nuclear ribonucleoprotein Sm D3



- Molecule 24: Small nuclear ribonucleoprotein-associated proteins B and B'



VAL MET THR PRO GLN ARG GLY THR VAL ALA ALA ALA ALA ALA ALA ALA THR THR ALA ILE SER ARG ALA PRO THR PRO GLY ARG GLY THR MET GLY

PRO PRO MET GLY ILE PRO PRO GLY ARG THR PRO MET GLY MET PRO ALA PRO THR GLY MET ARG PRO GLY PRO GLY ARG PRO GLY MET GLN ARG GLY PRO GLY ARG PRO GLY ARG PRO MET GLY ARG PRO

• Molecule 25: Small nuclear ribonucleoprotein Sm D1

Chain c:  67% 32%

H1 N64 N81 VAL ASP VAL PRO GLY LYS VAL LYS SER LYS LYS ARG GLU ALA VAL ALA GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG GLY ARG

• Molecule 26: Small nuclear ribonucleoprotein Sm D2

Chain d:  10% 78% 18%

MET SER LEU LEU ASN LYS PRO LYS SER SER VAL MET THR PRO THR GLU LEU Q17 E20 R47 P78 K79 S80 G81 K82 G83 K84 K85 K86 S87 K88 I107 V108 F113 LEU ILE ALA GLY LYS

• Molecule 27: Small nuclear ribonucleoprotein E

Chain e:  82% 14%

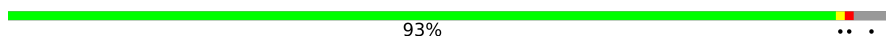
MET ALA TYR ARG GLN GLN LYS VAL LYS VAL M14 Q38 I77 D82 S91 N92

• Molecule 28: Small nuclear ribonucleoprotein F

Chain f:  80% 8% 12%

M1 S2 L3 P4 L5 L23 M27 Y39 V62 E76 GLU GLU GLU GLU ASP GLY GLU MET ARG GLU

• Molecule 29: Small nuclear ribonucleoprotein G

Chain g:  93%

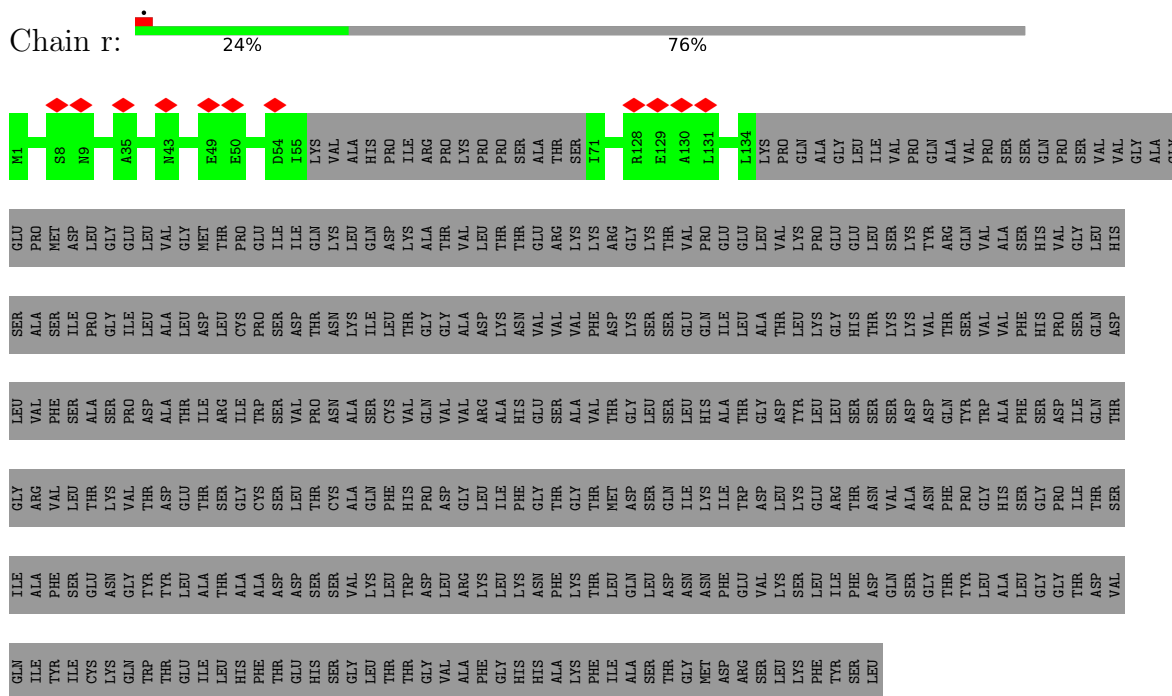
MET SER LYS A4 L17 L70 V76

• Molecule 30: Pre-mRNA-processing factor 19

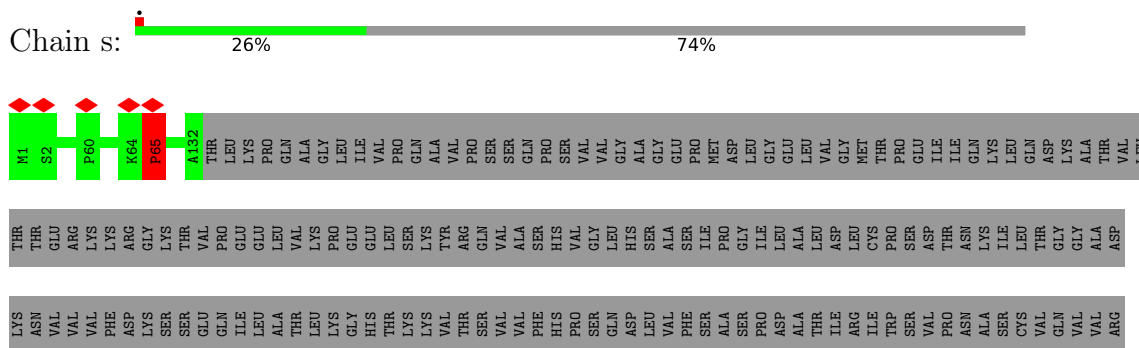
Chain q:  20% 80%

MET SER LEU ILE CYS SER ILE SER ASN GLU VAL PRO E13 H14 S21 N22 L29 E36 P41 I42 N43 N44 Q51 LEU ILE ASP ILE ILE LYS VAL VAL ALA HIS PRO PRO ARG ARG PRO PRO PRO PRO SER SER THR SER I71 L134 LYS PRO PRO GLN ALA ALA GLY LEU ILE VAL VAL GLN

- Molecule 30: Pre-mRNA-processing factor 19



- Molecule 30: Pre-mRNA-processing factor 19



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	153470	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1250	Depositor
Maximum defocus (nm)	2250	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor
Maximum map value	13.703	Depositor
Minimum map value	0.000	Depositor
Average map value	0.013	Depositor
Map value standard deviation	0.117	Depositor
Recommended contour level	0.5	Depositor
Map size (Å)	532.5376, 532.5376, 532.5376	wwPDB
Map dimensions	448, 448, 448	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.1887, 1.1887, 1.1887	Depositor

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: SEP, MG, GTP, ZN, IHP

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	35	0.36	0/5319	0.61	0/7204
2	5	0.46	0/2157	0.81	4/3351 (0.1%)
3	A	0.47	0/16762	0.71	5/22721 (0.0%)
4	B	0.33	0/139	0.71	0/183
5	C	0.34	0/7199	0.61	0/9782
6	E	0.26	0/2394	0.60	0/3243
7	GP	0.35	0/2504	0.64	0/3400
8	I	0.20	0/3644	0.73	0/5105
9	J	0.24	0/3403	0.66	0/4702
10	K	0.18	0/1058	0.64	0/1481
11	L	0.28	0/3094	0.62	0/4240
12	M	0.15	0/570	0.54	0/796
13	N	0.24	0/1204	0.61	0/1614
14	O	0.23	0/1255	0.68	0/1758
15	P	0.36	0/749	0.71	0/992
16	Q	0.20	0/6624	0.62	0/9290
17	R	0.31	0/2017	0.62	0/2707
18	S	0.25	0/1268	0.56	0/1714
19	T	0.48	0/2781	0.75	0/3798
20	W	0.22	0/4030	0.59	0/5449
21	WD	0.12	0/1453	0.38	0/2021
22	Z	0.18	0/479	0.57	0/674
23	a	0.79	0/659	0.80	0/888
24	b	0.60	0/734	0.75	0/977
25	c	0.68	0/649	0.84	0/877
26	d	0.61	0/794	0.92	0/1061
27	e	0.73	0/661	0.88	0/886
28	f	0.66	0/605	0.91	1/817 (0.1%)
29	g	0.85	0/575	0.99	1/768 (0.1%)
30	q	0.22	0/527	0.69	0/738
30	r	0.21	0/610	0.63	0/855
30	s	0.25	0/688	0.70	1/969 (0.1%)

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
30	t	0.22	0/527	0.60	0/738
31	y	0.17	0/415	0.44	0/578
32	D	0.27	0/255	0.70	0/355
33	IN	0.26	0/129	0.66	0/196
34	6	0.23	0/831	0.68	1/1292 (0.1%)
All	All	0.37	0/78762	0.67	13/108220 (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
1	35	0	2
3	A	0	2
6	E	0	1
10	K	0	1
20	W	0	1
All	All	0	7

There are no bond length outliers.

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	609	LYS	CB-CG-CD	-10.85	86.34	111.30
3	A	609	LYS	CA-CB-CG	7.96	130.03	114.10
3	A	941	LYS	N-CA-C	7.87	127.19	109.81
28	f	39	TYR	CA-CB-CG	7.06	126.61	113.90
2	5	98	C	O3'-P-O5'	6.46	113.70	104.00

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	35	336	ARG	Sidechain
1	35	398	ARG	Sidechain
3	A	1370	ARG	Sidechain
3	A	1384	ARG	Sidechain
6	E	146	ARG	Sidechain

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	35	5214	0	5301	4	0
2	5	1936	0	982	4	0
3	A	16319	0	16319	25	0
4	B	140	0	148	1	0
5	C	7040	0	7057	13	0
6	E	2341	0	2275	10	0
7	GP	2447	0	2282	6	0
8	I	3620	0	1770	2	0
9	J	3360	0	2194	0	0
10	K	1052	0	516	1	0
11	L	3057	0	2289	7	0
12	M	569	0	271	0	0
13	N	1178	0	1184	4	0
14	O	1242	0	615	0	0
15	P	738	0	723	0	0
16	Q	6558	0	3186	0	0
17	R	2000	0	2018	4	0
18	S	1236	0	1210	5	0
19	T	2714	0	2548	11	0
20	W	3925	0	3826	8	0
21	WD	1446	0	698	0	0
22	Z	473	0	246	1	0
23	a	651	0	669	1	0
24	b	725	0	747	2	0
25	c	641	0	689	0	0
26	d	784	0	826	4	0
27	e	653	0	668	0	0
28	f	593	0	607	3	0
29	g	568	0	590	1	0
30	q	524	0	266	0	0
30	r	606	0	306	0	0
30	s	679	0	359	0	0
30	t	524	0	266	0	0
31	y	414	0	216	1	0
32	D	255	0	126	0	0
33	IN	120	0	61	0	0
34	6	744	0	377	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
35	A	36	0	6	0	0
36	C	32	0	12	0	0
37	C	1	0	0	0	0
38	N	3	0	0	0	0
All	All	77158	0	64449	99	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 1.

The worst 5 of 99 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)
3:A:672:VAL:HG23	19:T:268:LYS:HE3	1.78	0.66
20:W:165:LEU:HD11	20:W:171:GLY:HA2	1.77	0.65
7:GP:368:PRO:HG2	7:GP:371:TYR:HB2	1.82	0.61
3:A:606:LYS:HD3	3:A:609:LYS:HE2	1.81	0.61
11:L:25:LYS:HD2	11:L:159:LEU:HD12	1.82	0.61

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	35	656/703 (93%)	644 (98%)	12 (2%)	0	100	100
3	A	1955/2335 (84%)	1896 (97%)	55 (3%)	4 (0%)	43	70
4	B	17/2136 (1%)	17 (100%)	0	0	100	100
5	C	888/972 (91%)	865 (97%)	22 (2%)	1 (0%)	48	76
6	E	297/357 (83%)	281 (95%)	14 (5%)	2 (1%)	18	47
7	GP	321/931 (34%)	302 (94%)	19 (6%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
8	I	717/855 (84%)	703 (98%)	14 (2%)	0	100	100
9	J	559/848 (66%)	549 (98%)	10 (2%)	0	100	100
10	K	207/225 (92%)	192 (93%)	14 (7%)	1 (0%)	24	54
11	L	471/802 (59%)	464 (98%)	5 (1%)	2 (0%)	30	59
12	M	109/243 (45%)	108 (99%)	1 (1%)	0	100	100
13	N	140/144 (97%)	139 (99%)	1 (1%)	0	100	100
14	O	241/420 (57%)	225 (93%)	15 (6%)	1 (0%)	30	59
15	P	81/229 (35%)	76 (94%)	5 (6%)	0	100	100
16	Q	1292/1485 (87%)	1264 (98%)	28 (2%)	0	100	100
17	R	238/536 (44%)	226 (95%)	11 (5%)	1 (0%)	30	59
18	S	157/166 (95%)	152 (97%)	5 (3%)	0	100	100
19	T	356/514 (69%)	336 (94%)	19 (5%)	1 (0%)	36	64
20	W	479/579 (83%)	450 (94%)	27 (6%)	2 (0%)	30	59
21	WD	290/315 (92%)	286 (99%)	2 (1%)	2 (1%)	18	47
22	Z	90/166 (54%)	85 (94%)	5 (6%)	0	100	100
23	a	81/126 (64%)	81 (100%)	0	0	100	100
24	b	89/240 (37%)	87 (98%)	2 (2%)	0	100	100
25	c	79/119 (66%)	75 (95%)	4 (5%)	0	100	100
26	d	95/118 (80%)	92 (97%)	3 (3%)	0	100	100
27	e	77/92 (84%)	72 (94%)	5 (6%)	0	100	100
28	f	74/86 (86%)	71 (96%)	3 (4%)	0	100	100
29	g	71/76 (93%)	70 (99%)	1 (1%)	0	100	100
30	q	99/504 (20%)	97 (98%)	2 (2%)	0	100	100
30	r	115/504 (23%)	113 (98%)	2 (2%)	0	100	100
30	s	130/504 (26%)	127 (98%)	2 (2%)	1 (1%)	16	44
30	t	99/504 (20%)	98 (99%)	0	1 (1%)	12	38
31	y	81/301 (27%)	81 (100%)	0	0	100	100
32	D	49/285 (17%)	49 (100%)	0	0	100	100
All	All	10700/18420 (58%)	10373 (97%)	308 (3%)	19 (0%)	44	70

5 of 19 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
14	O	176	GLY
17	R	135	PRO
30	s	65	PRO
3	A	1092	ILE
20	W	298	PRO

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	35	567/603 (94%)	558 (98%)	9 (2%)	55	71
3	A	1773/2108 (84%)	1740 (98%)	33 (2%)	50	69
4	B	15/1908 (1%)	15 (100%)	0	100	100
5	C	790/866 (91%)	785 (99%)	5 (1%)	78	80
6	E	256/300 (85%)	253 (99%)	3 (1%)	63	74
7	GP	239/795 (30%)	235 (98%)	4 (2%)	53	70
8	I	25/749 (3%)	25 (100%)	0	100	100
9	J	139/751 (18%)	138 (99%)	1 (1%)	76	79
10	K	7/196 (4%)	7 (100%)	0	100	100
11	L	180/709 (25%)	179 (99%)	1 (1%)	78	80
12	M	3/209 (1%)	3 (100%)	0	100	100
13	N	129/130 (99%)	128 (99%)	1 (1%)	73	78
14	O	15/361 (4%)	15 (100%)	0	100	100
15	P	79/203 (39%)	78 (99%)	1 (1%)	61	73
16	Q	68/1336 (5%)	68 (100%)	0	100	100
17	R	214/457 (47%)	211 (99%)	3 (1%)	59	72
18	S	129/134 (96%)	126 (98%)	3 (2%)	44	66
19	T	275/441 (62%)	271 (98%)	4 (2%)	57	71
20	W	425/502 (85%)	417 (98%)	8 (2%)	50	69
21	WD	8/264 (3%)	8 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
22	Z	7/143 (5%)	7 (100%)	0	100	100
23	a	73/101 (72%)	72 (99%)	1 (1%)	59	72
24	b	75/177 (42%)	75 (100%)	0	100	100
25	c	76/101 (75%)	75 (99%)	1 (1%)	61	73
26	d	91/110 (83%)	91 (100%)	0	100	100
27	e	74/84 (88%)	70 (95%)	4 (5%)	20	46
28	f	65/74 (88%)	64 (98%)	1 (2%)	57	71
29	g	63/66 (96%)	62 (98%)	1 (2%)	55	71
30	q	5/435 (1%)	5 (100%)	0	100	100
30	r	6/435 (1%)	6 (100%)	0	100	100
30	s	10/435 (2%)	9 (90%)	1 (10%)	7	25
30	t	5/435 (1%)	5 (100%)	0	100	100
31	y	2/252 (1%)	2 (100%)	0	100	100
32	D	1/240 (0%)	1 (100%)	0	100	100
All	All	5889/16110 (37%)	5804 (99%)	85 (1%)	57	72

5 of 85 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
15	P	216	THR
20	W	403	TRP
17	R	280	ILE
19	T	416	ILE
20	W	493	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 35 such sidechains are listed below:

Mol	Chain	Res	Type
18	S	13	ASN
19	T	283	HIS
20	W	484	GLN
3	A	1468	ASN
3	A	1466	ASN

5.3.3 RNA

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	5	90/116 (77%)	15 (16%)	6 (6%)
33	IN	9/10 (90%)	3 (33%)	0
34	6	34/106 (32%)	13 (38%)	3 (8%)
All	All	133/232 (57%)	31 (23%)	9 (6%)

5 of 31 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	5	20	G
2	5	25	C
2	5	36	C
2	5	69	A
2	5	86	C

5 of 9 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
34	6	27	A
34	6	33	G
2	5	90	U
2	5	91	U
2	5	95	G

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

2 non-standard protein/DNA/RNA residues are 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	$\# Z > 2$
17	SEP	R	224	17	8,9,10	1.47	1 (12%)	8,12,14	1.20	1 (12%)
17	SEP	R	232	17	8,9,10	1.44	1 (12%)	8,12,14	1.78	2 (25%)

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
17	SEP	R	224	17	-	0/5/8/10	-
17	SEP	R	232	17	-	0/5/8/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
17	R	224	SEP	P-O1P	3.25	1.61	1.50
17	R	232	SEP	P-O1P	3.08	1.60	1.50

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
17	R	232	SEP	P-OG-CB	-3.59	108.40	118.30
17	R	232	SEP	OG-CB-CA	2.85	110.91	108.14
17	R	224	SEP	P-OG-CB	-2.53	111.32	118.30

There are no chirality outliers.

There are no torsion outliers.

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 [i](#)

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 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
36	GTP	C	1500	37	30,34,34	0.97	1 (3%)	46,54,54	1.88	11 (23%)
35	IHP	A	3000	-	36,36,36	2.33	10 (27%)	54,60,60	1.66	9 (16%)

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
36	GTP	C	1500	37	-	0/22/38/38	0/3/3/3
35	IHP	A	3000	-	-	8/30/54/54	0/1/1/1

The worst 5 of 11 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
35	A	3000	IHP	P2-O12	6.40	1.71	1.59
35	A	3000	IHP	P6-O16	4.70	1.68	1.59
35	A	3000	IHP	P3-O13	4.50	1.67	1.59
35	A	3000	IHP	C3-C2	-4.35	1.43	1.52
35	A	3000	IHP	P1-O11	4.29	1.67	1.59

The worst 5 of 20 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
35	A	3000	IHP	O12-C2-C1	7.09	125.41	108.69
36	C	1500	GTP	PB-O3B-PG	-4.96	115.81	132.83
36	C	1500	GTP	C5-C4-N3	-4.94	120.45	128.46
36	C	1500	GTP	C2-N3-C4	4.33	120.01	112.30
35	A	3000	IHP	O11-C1-C2	3.69	117.38	108.69

There are no chirality outliers.

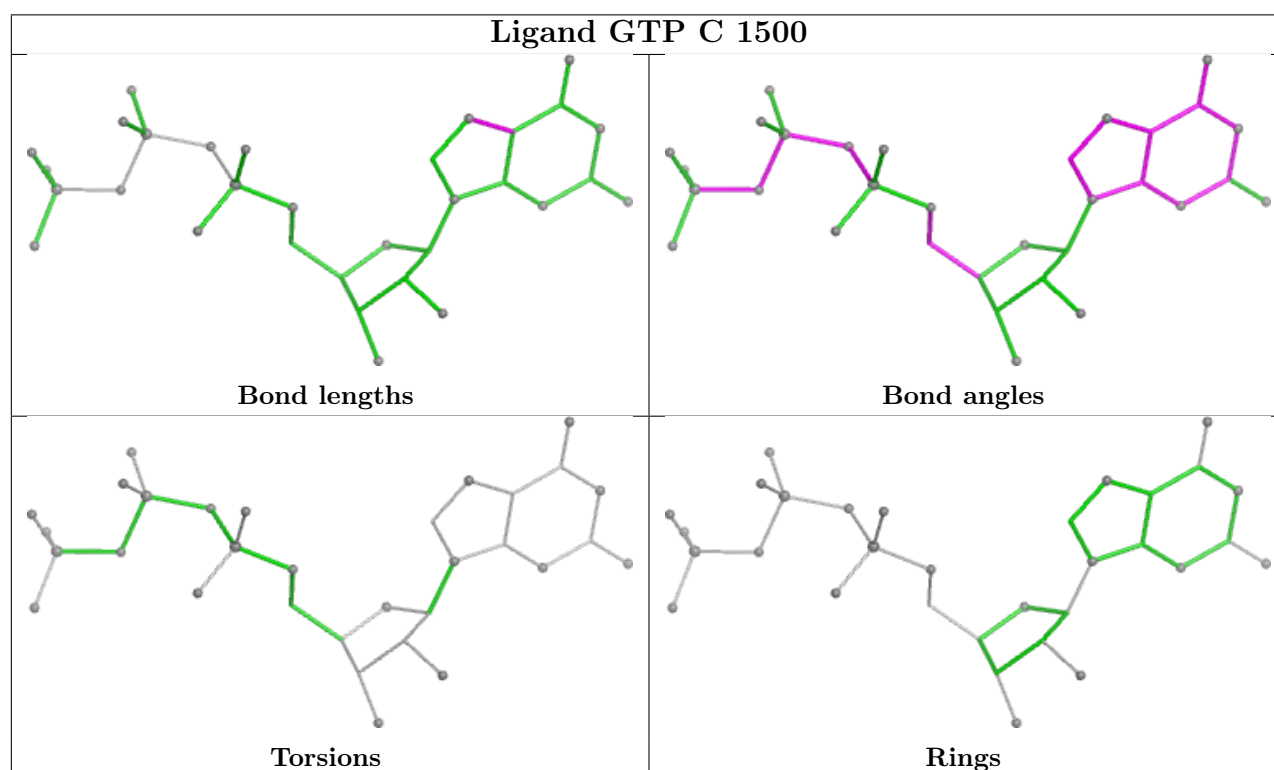
5 of 8 torsion outliers are listed below:

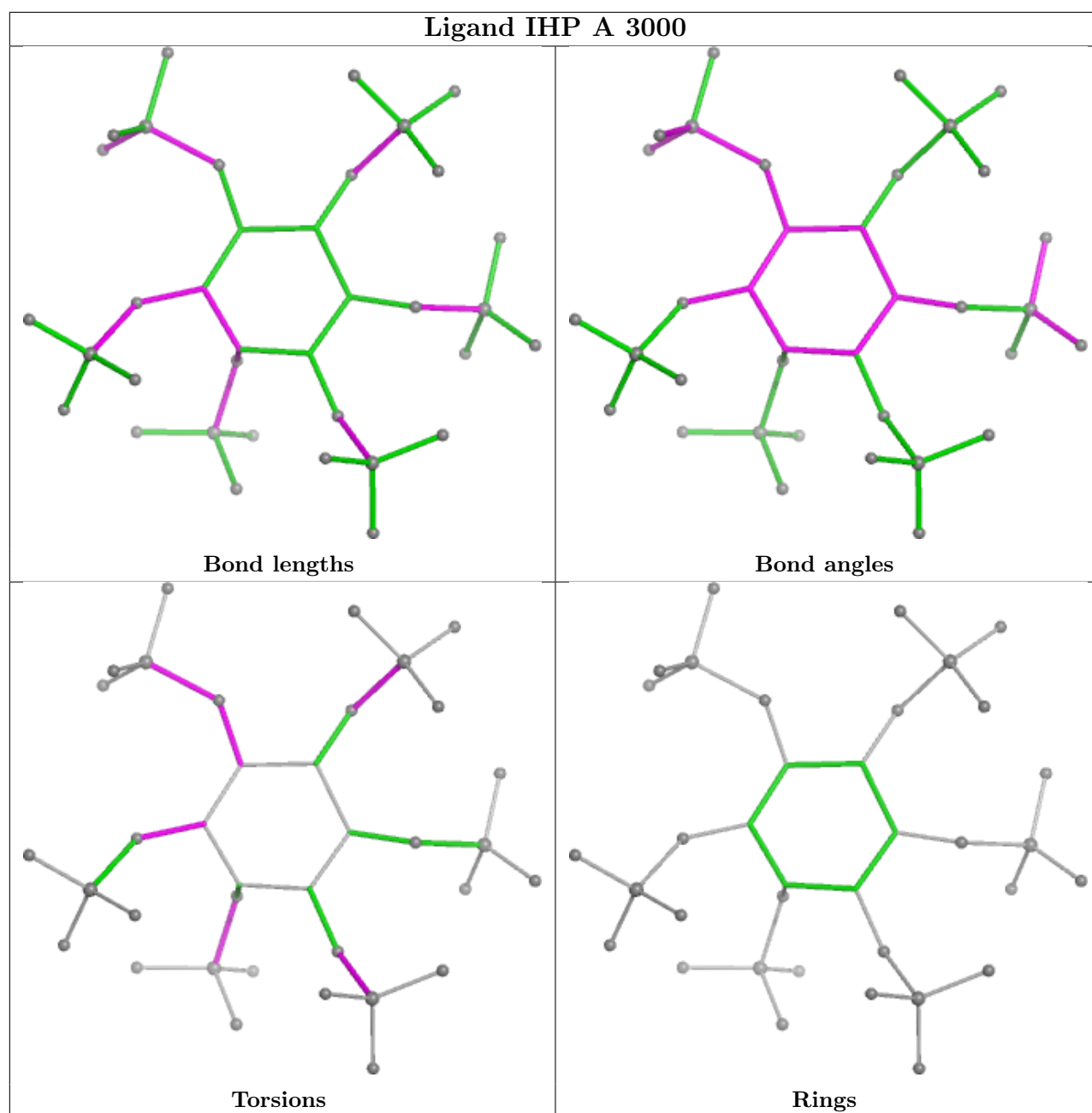
Mol	Chain	Res	Type	Atoms
35	A	3000	IHP	C2-C1-O11-P1
35	A	3000	IHP	C6-C1-O11-P1
35	A	3000	IHP	C4-O14-P4-O44
35	A	3000	IHP	C6-O16-P6-O26
35	A	3000	IHP	C3-C2-O12-P2

There are no ring outliers.

No monomer is involved in short contacts.

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](#)

There are no chain breaks in this entry.

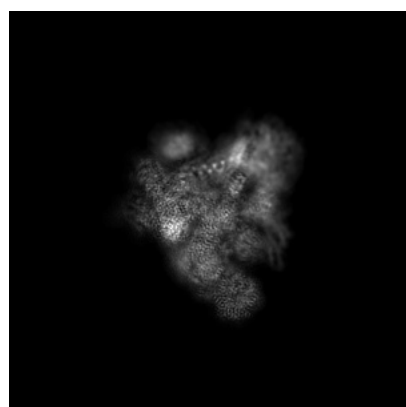
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-54494. These allow visual inspection of the internal detail of the map and identification of artifacts.

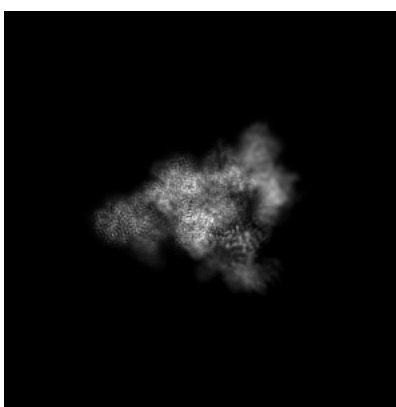
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

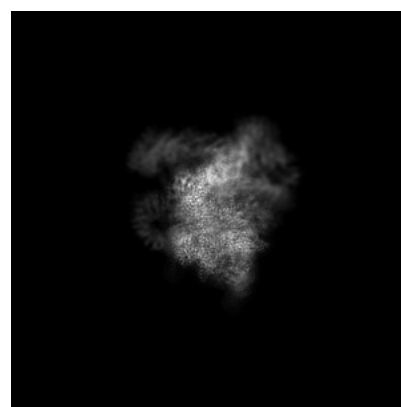
6.1.1 Primary map



X



Y

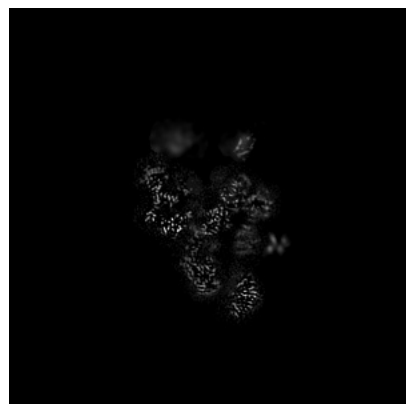


Z

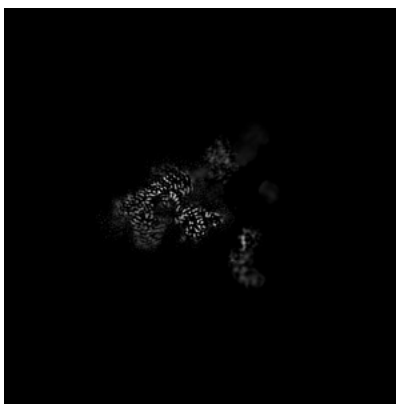
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

6.2.1 Primary map



X Index: 224



Y Index: 224



Z Index: 224

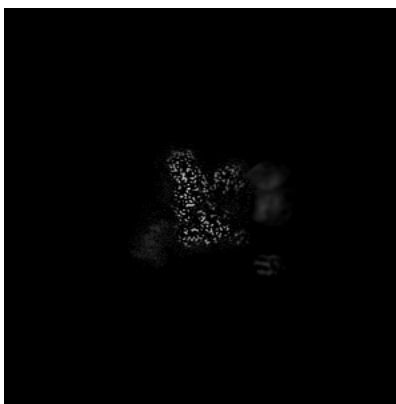
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

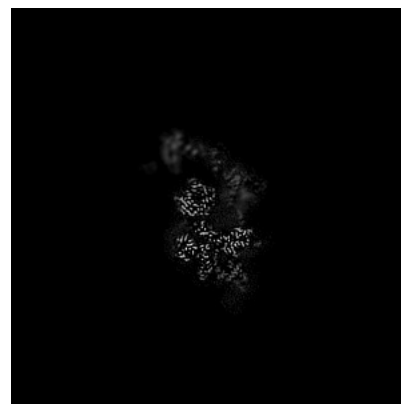
6.3.1 Primary map



X Index: 214



Y Index: 186

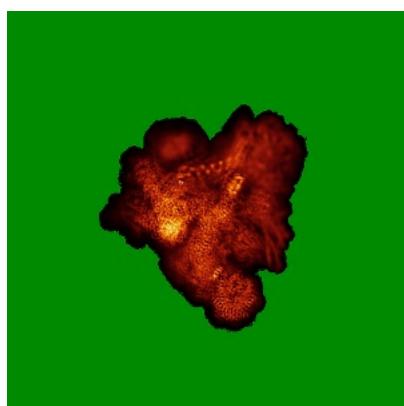


Z Index: 213

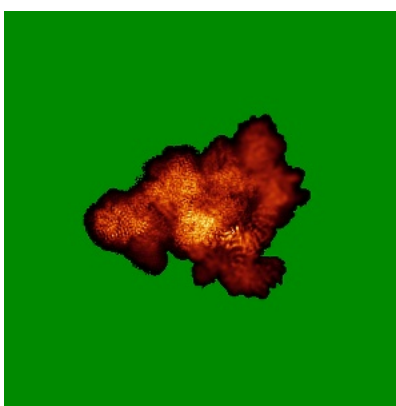
The images above show the largest variance slices of the map in three orthogonal directions.

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 0.5. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

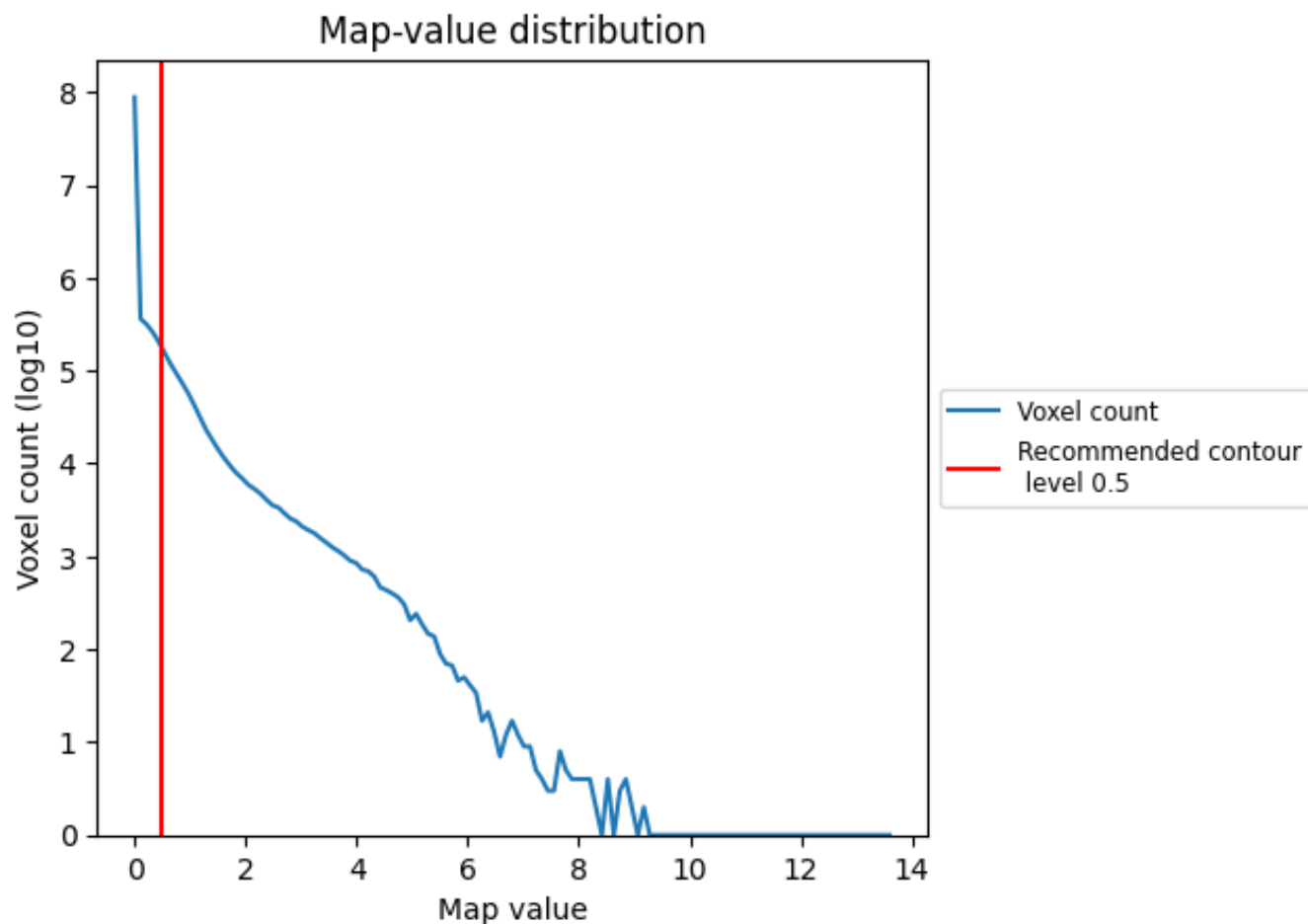
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

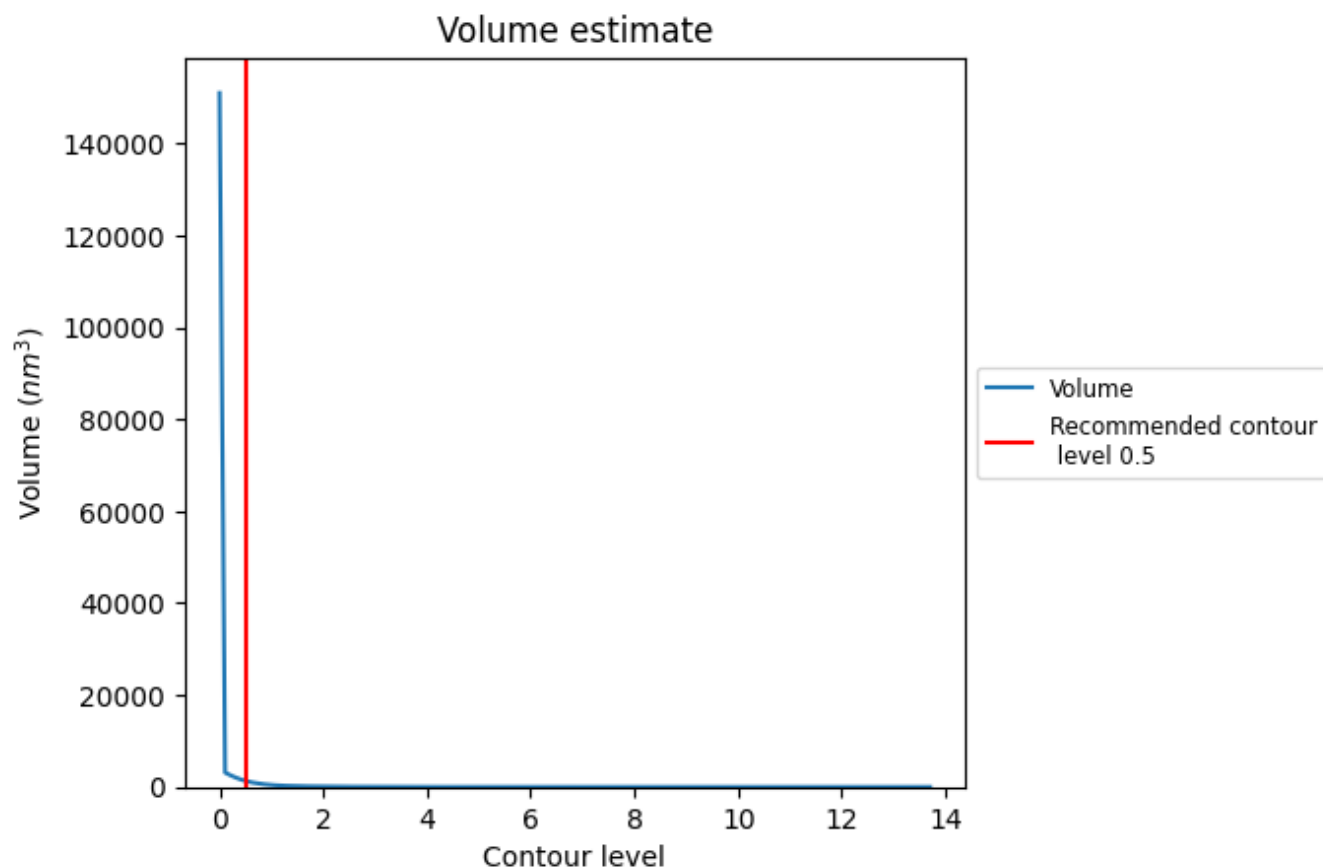
This section contains the results of statistical analysis of the map.

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.

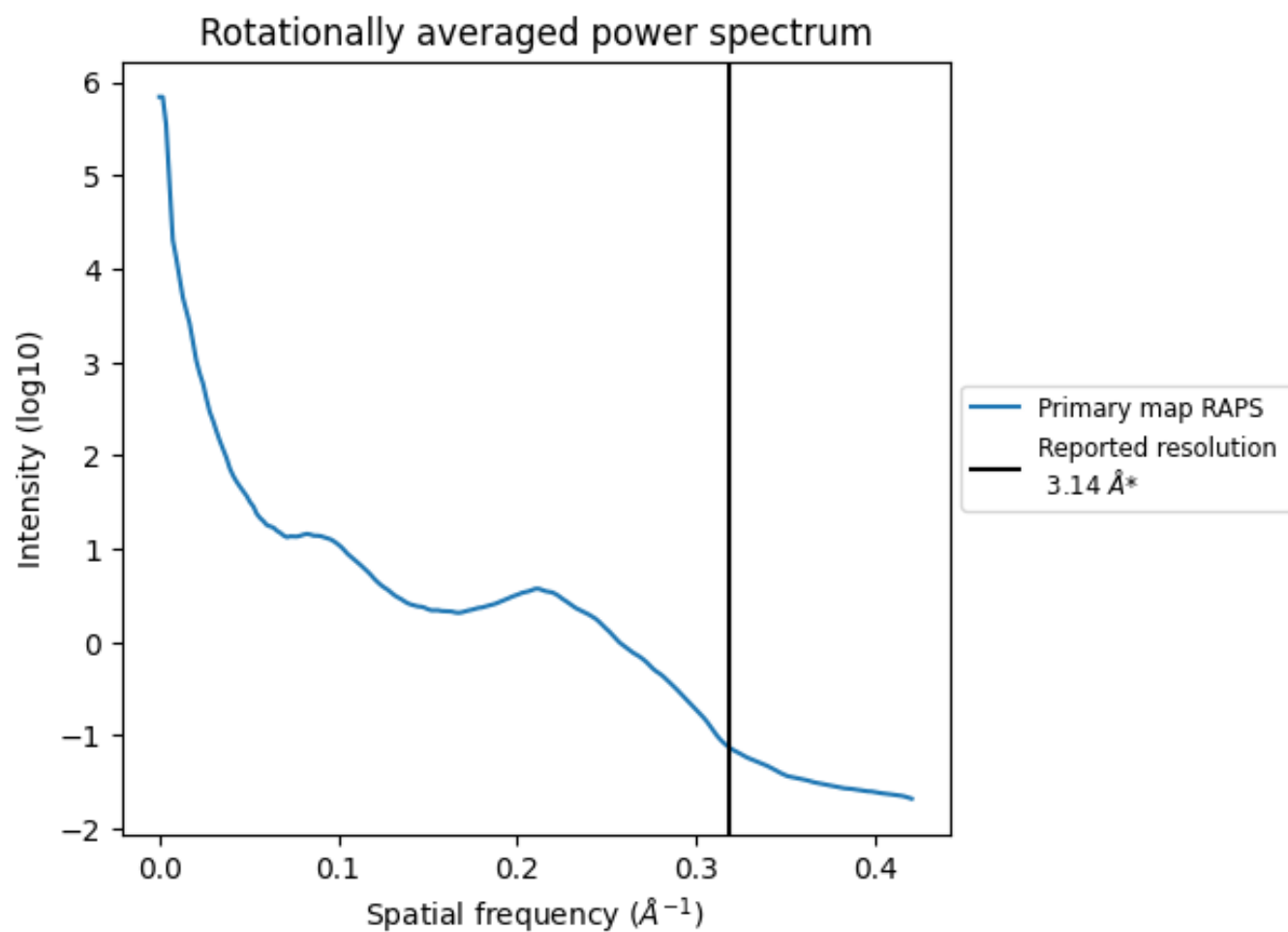
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 1327 nm^3 ; this corresponds to an approximate mass of 1199 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 0.318 Å⁻¹

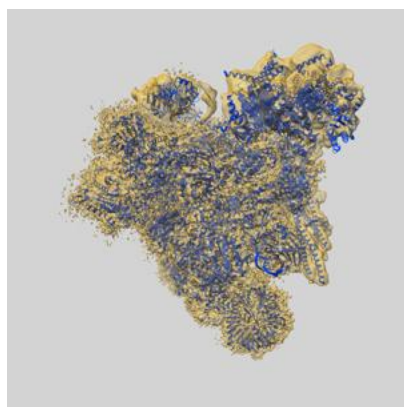
8 Fourier-Shell correlation

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

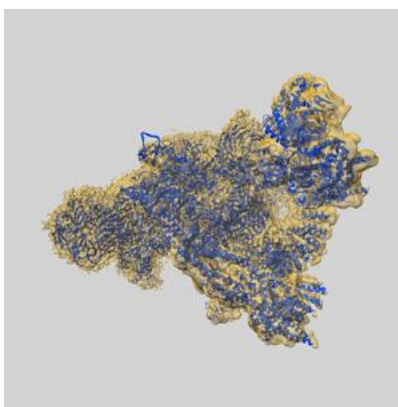
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-54494 and PDB model 9S2F. Per-residue inclusion information can be found in section [3](#) on page [12](#).

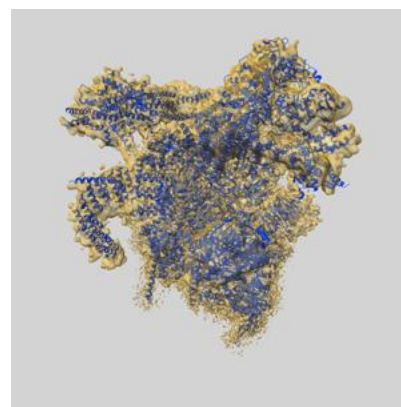
9.1 Map-model overlay [i](#)



X



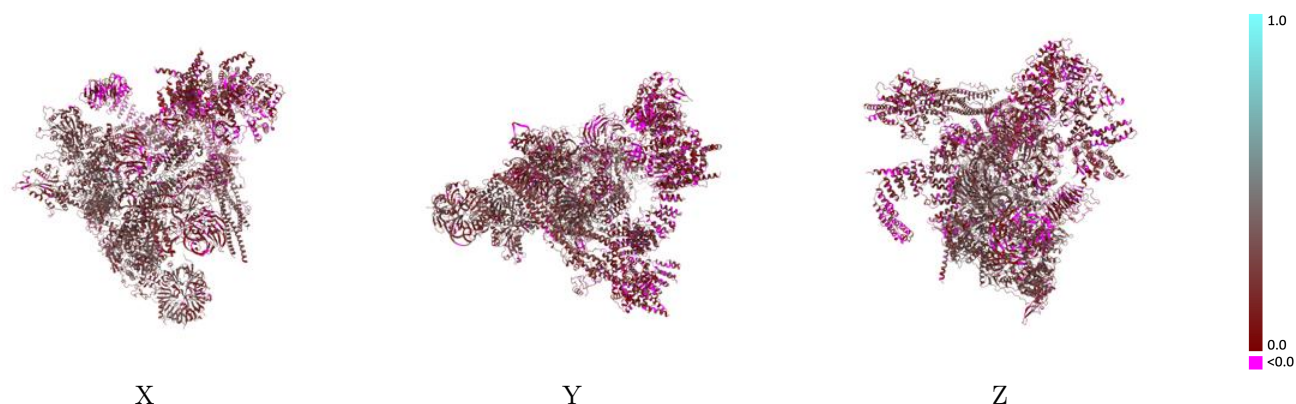
Y



Z

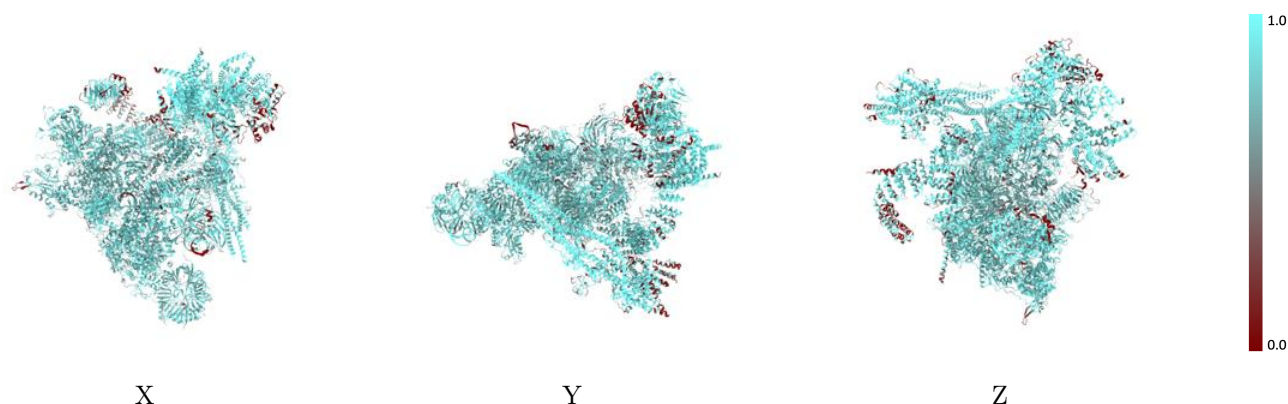
The images above show the 3D surface view of the map at the recommended contour level 0.5 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



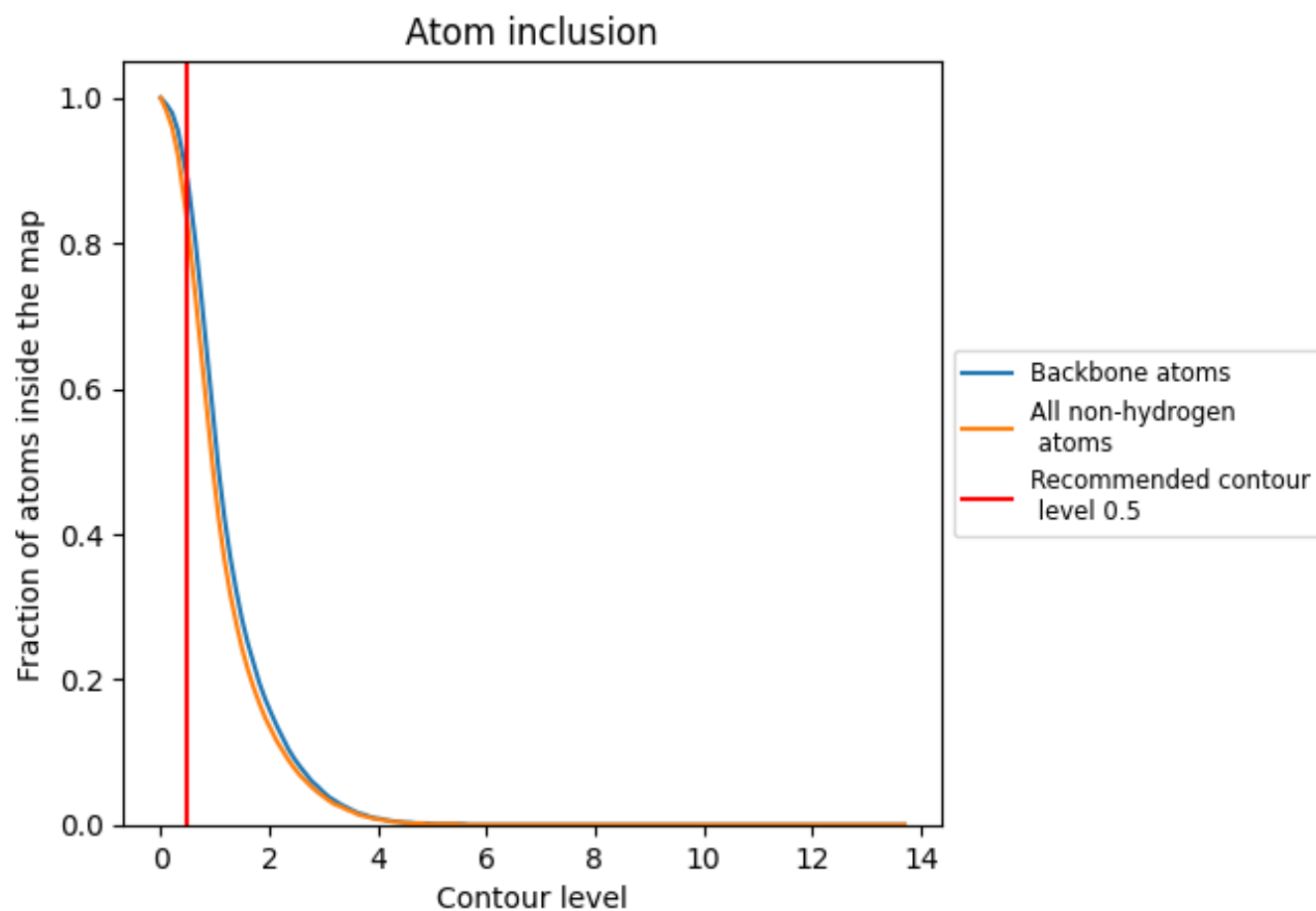
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.5).

9.4 Atom inclusion ⓘ



At the recommended contour level, 88% of all backbone atoms, 83% 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 (0.5) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8260	 0.2140
35	 0.8180	 0.2690
5	 0.8840	 0.2420
6	 0.6090	 0.0970
A	 0.8430	 0.2780
B	 0.7100	 0.2670
C	 0.8620	 0.2550
D	 0.9250	 0.1580
E	 0.8460	 0.1650
GP	 0.7690	 0.2570
I	 0.9060	 0.1610
IN	 0.9080	 0.1730
J	 0.7700	 0.1650
K	 0.9150	 0.1990
L	 0.7930	 0.2040
M	 0.8770	 0.2030
N	 0.7500	 0.2100
O	 0.8410	 0.2250
P	 0.7080	 0.2290
Q	 0.8100	 0.1080
R	 0.7980	 0.2090
S	 0.8650	 0.1770
T	 0.8800	 0.3010
W	 0.7450	 0.1210
WD	 0.8620	 0.0440
Z	 0.5880	 0.0700
a	 0.8540	 0.2430
b	 0.8000	 0.2610
c	 0.8370	 0.2380
d	 0.7020	 0.1770
e	 0.8370	 0.2780
f	 0.8320	 0.2870
g	 0.8540	 0.2420
q	 0.8630	 0.2020
r	 0.8730	 0.1630



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Chain	Atom inclusion	Q-score
s	 0.9400	 0.1890
t	 0.8760	 0.1560
y	 0.5480	 0.0870