



wwPDB EM Validation Summary Report ⓘ

Jan 5, 2026 – 05:53 pm GMT

PDB ID : 9QMS / pdb_00009qms
EMDB ID : EMD-53237
Title : DNA-PK bound to 153 bp H2AX nucleosome with ATPyS
Authors : Hall, C.; Chaplin, A.K.
Deposited on : 2025-03-24
Resolution : 5.00 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.dev129
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
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) : 2.47

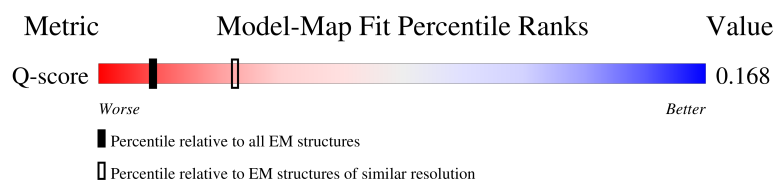
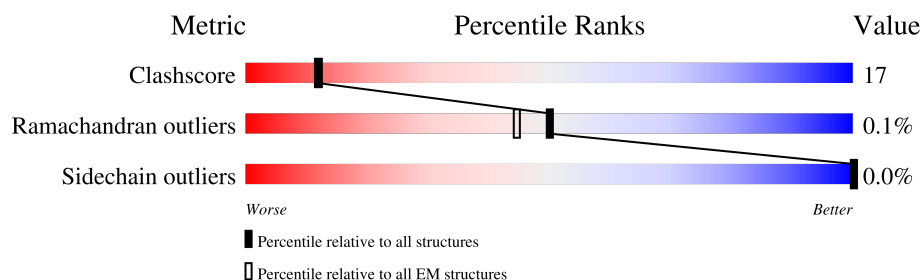
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 5.00 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.



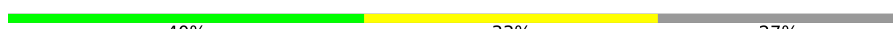
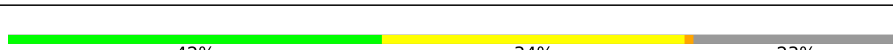
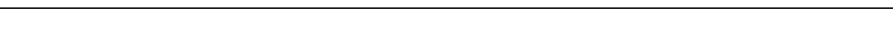
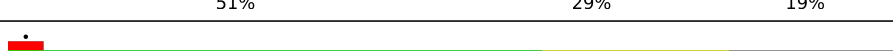
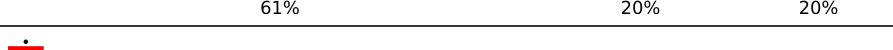
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	210492	15764	-
Ramachandran outliers	207382	16835	-
Sidechain outliers	206894	16415	-
Q-score	-	25397	1057 (4.50 - 5.50)

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	O	4128	
1	o	4128	
2	L	732	
2	N	732	

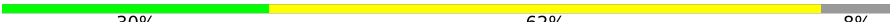
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Mol	Chain	Length	Quality of chain
2	l	732	
2	n	732	
3	C	143	
3	G	143	
3	c	143	
3	g	143	
4	D	126	
4	H	126	
4	d	126	
4	h	126	
5	A	136	
5	E	136	
5	a	136	
5	e	136	
6	B	103	
6	F	103	
6	b	103	
6	f	103	
7	K	609	
7	M	609	
7	k	609	
7	m	609	
8	I	153	
8	i	153	
9	J	153	

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Mol	Chain	Length	Quality of chain
9	j	153	 A horizontal bar chart showing the quality of chain j. The bar is divided into three segments: a green segment on the left labeled '30%', a yellow segment in the middle labeled '62%', and a grey segment on the right labeled '8%'. The segments are separated by thin black lines.

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 113260 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 DNA-dependent protein kinase catalytic subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	O	3514	Total	C	N	O	S	0	0
			28053	18035	4713	5119	186		
1	o	3505	Total	C	N	O	S	0	0
			27969	17985	4707	5090	187		

- Molecule 2 is a protein called X-ray repair cross-complementing protein 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	L	656	Total	C	N	O	S	0	0
			5240	3345	873	996	26		
2	N	640	Total	C	N	O	S	0	0
			5114	3270	850	968	26		
2	l	517	Total	C	N	O	S	0	0
			4117	2640	683	771	23		
2	n	517	Total	C	N	O	S	0	0
			4106	2630	684	769	23		

- Molecule 3 is a protein called Histone H2AX.

Mol	Chain	Residues	Atoms				AltConf	Trace
3	C	100	Total	C	N	O	0	0
			767	485	149	133		
3	G	98	Total	C	N	O	0	0
			745	470	144	131		
3	c	102	Total	C	N	O	0	0
			779	491	153	135		
3	g	99	Total	C	N	O	0	0
			751	473	145	133		

- Molecule 4 is a protein called Histone H2B type 1-J.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	D	92	Total	C	N	O	S	0	0
			706	444	126	134	2		
4	H	91	Total	C	N	O	S	0	0
			703	445	125	131	2		
4	d	91	Total	C	N	O	S	0	0
			708	447	125	134	2		
4	h	92	Total	C	N	O	S	0	0
			718	453	127	136	2		

- Molecule 5 is a protein called Histone H3.1.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	A	95	Total	C	N	O	S	0	0
			778	491	148	135	4		
5	E	96	Total	C	N	O	S	0	0
			794	500	154	136	4		
5	a	88	Total	C	N	O	S	0	0
			717	454	134	125	4		
5	e	88	Total	C	N	O	S	0	0
			721	456	135	126	4		

- Molecule 6 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	B	79	Total	C	N	O	S	0	0
			631	400	121	109	1		
6	F	79	Total	C	N	O	S	0	0
			631	400	121	109	1		
6	b	78	Total	C	N	O	S	0	0
			620	393	120	106	1		
6	f	78	Total	C	N	O	S	0	0
			610	385	117	107	1		

- Molecule 7 is a protein called X-ray repair cross-complementing protein 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	K	493	Total	C	N	O	S	0	0
			3940	2528	658	736	18		
7	M	493	Total	C	N	O	S	0	0
			3970	2543	671	738	18		
7	k	493	Total	C	N	O	S	0	0
			3958	2538	666	736	18		

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Mol	Chain	Residues	Atoms					AltConf	Trace
7	m	489	Total	C	N	O	S	0	0
			3923	2514	660	732	17		

- Molecule 8 is a DNA chain called DNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	I	139	Total	C	N	O	P	0	0
			2829	1345	515	831	138		
8	i	141	Total	C	N	O	P	0	0
			2871	1364	520	846	141		

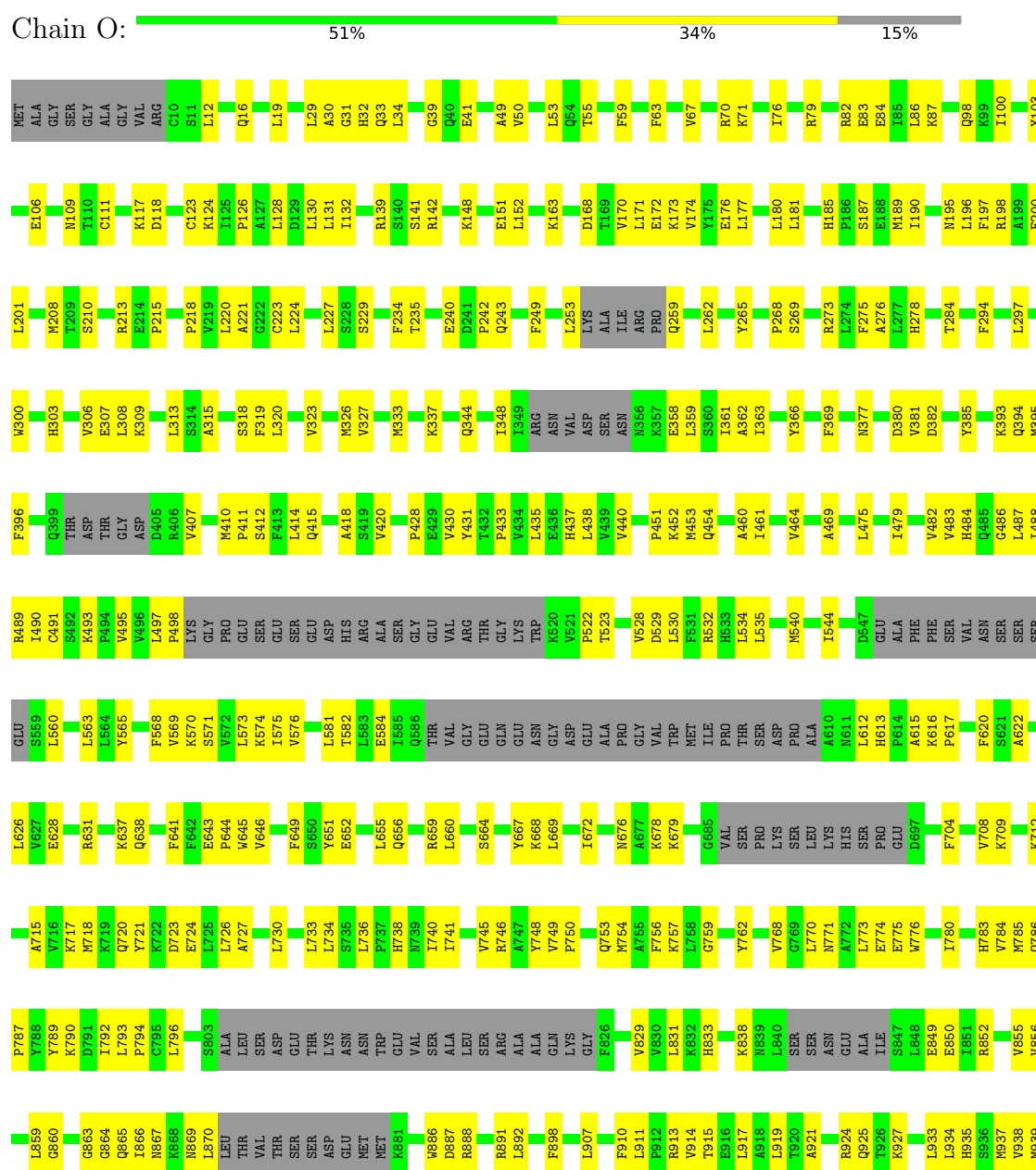
- Molecule 9 is a DNA chain called DNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	J	140	Total	C	N	O	P	0	0
			2886	1365	540	841	140		
9	j	141	Total	C	N	O	P	0	0
			2905	1375	542	847	141		

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: DNA-dependent protein kinase catalytic subunit



H2103	S2034	ASN	VAL	D1821	M1743	S1687	S1586	GLY	L1395	A1309	L1221	H1133	W1039	F940
H2104	T2035	LEU	PHE	R1822	K1744	F1668	M1589	ASP	P1396	E1310	I1222	L1134	W1039	H941
H2105	L2036	LEU	HIS	S1823	K1745	P1669	M1589	GLU	D1397	C1312	T1223	T1137	T1056	M948
L2106	M2040	PHE	SER	L1824	F1746	V1671	M1592	GLN	L1398	G1313	C1229	K1140	S1058	P949
L2107	Q2042	ASN	CYS	L1827	L1750	T1674	V1593	LEU	C1399	THR	G1232	L1145	L1059	E950
L2108	L1828	LEU	ILE	L1828	P1756	Y1675	V1596	PRO	M1403	GLY	P1232	L1146	F1060	G952
L2109	H1829	LEU	THR	H1829	M1757	L1676	L1597	S1502	K1404	ALA	S1233	N1146	K1061	P957
L2110	L1836	LEU	GLY	L1836	L1758	L1679	M1600	L1505	G1234	ALA	T1235	K1147	R1062	M958
L2111	L1837	LEU	L1837	L1837	L1759	L1679	L1601	L1508	K1407	ASN	Q1238	K1149	Y1064	Y959
L2112	L1838	ARG	E1910	R1837	L1762	K1683	F1605	Q1508	K1508	ARG	F1239	K1150	Q960	Q960
L2113	L1839	ARG	T1911	F1839	M1762	L1684	R1608	Q1509	Y1411	THR	T1322	R1151	L961	L961
L2114	F1840	TYR	K1913	D1840	C1767	D1685	F1605	L1510	K1412	GLY	T1240	L1152	Y962	K963
L2115	A1847	ASN	T1914	L1847	R1768	L1688	R1608	L1517	D1413	ALA	LEU	L1153	K963	R964
L2116	I1848	PHE	L1915	I1848	H1772	K1689	Q1611	L1517	L1415	E1328	TYR	R1154	F1073	R964
L2117	K1917	VAL	L1916	G1690	H1773	G1690	K1612	L1524	L1416	R1329	LEU	R1155	K1074	
L2118	K1917	GLU	K1917	Q1691	V1773	Q1691	H1613	L1524	E1417	Y1330	LEU	G1156	R1075	Y968
L2119	L1850	GLU	L1850	V1773	M1774	A1692	Q1614	R1527	T1417	M1331	ARG	F1157	L1076	
L2120	L1851	VAL	A1922	L1851	E1775	T1694	Q1615	L1528	H1418	Y1332	GLY	L1165	G1077	L972
L2121	L1852	VAL	M1926	K1852	E1776	T1694	G1615	L1528	K1422	S1333	PHE	L1166	F1082	C974
L2122	SER	PRO	MET	SER	E1777	T1694	K1617	L1531	I1423	V1337	LEU	D1167	Y1085	Q978
L2123	ALA	PRO	ALA	ARG	F1778	L1695	L1618	L1532	T1424	V1339	LEU	L1170	Y1086	Y979
L2124	PHE	GLU	GLY	THR	Q1779	L1696	A1619	L1532	A1425	R1340	PRO	L1171		Y980
L2125	THR	GLU	GLY	THR					Q1426			L1172	F1089	L983
L2126	GLY	ARG	GLU	LYS				A1536	I1428	S1352		L1173	E1092	
L2127	ARG	ASN	ASN	LEU	F1782	THR	L1623	V1537	I1428	S1352		L1173		P886
L2128	ARG	GLN	GLN	GLU	R1783	SER	V1626	L1538		P1353		L1173	L1095	M989
L2129	ARG	LEU	LEU	GLU	R1784	LEU	K1627	S1539	A1441	E1354	L1260	P1179	V1096	M989
L2130	ARG	LEU	LEU	GLU	V1785	GLY	K1628	ALA	D1444	G1355	L1261	Q1180	E1097	Q990
L2131	GLU	LEU	L1934	SER	A1786	GLY	C1629	LEU	L1357	W1356	L1264	C1183	F1099	F995
L2132	GLN	ILE	E1935	T1882	R1787	GLY	D1630	GLY	L1448	L1358		R1184	V1100	T996
L2133	ASP	ILE	ASP	F1883	R1787	SER	S1631	ILE		K1361	Y1267	H1185	F1101	
L2134	PRO	LYS	Y1940	L1867	S1790	L1707	T1641		V1451		F1270	F1191	L1104	K1000
L2135	PRO	LYS	Y1940	L1867	S1790	L1707	K1642		V1452		T1275	P1196	Q1004	
L2136	THR	GLU	M1946	M1871	T1793	V1713	W1632	SER		M1365		P1199	V1107	V1007
L2137	THR	ALA	C1947	Y1874	Q1794	L1714	W1633	GLN		T1366	S1289	G1200	M1103	E1011
L2138	VAL	ARG	A1948		V1795	E1715	A1634	GLY		T1376		N1201	L1111	A1012
L2139	ASP	GLU	I1949		G1796	Q1716	K1635	SER	C1455	H1367	K1292	R1202	L1013	L1013
L2140	ASP	ALA	S1950	L1877	L1797	L1717	D1636	VAL				S1203	A1114	L1014
L2141	VAL	ALA	V1951	L1878	L1798	I1718	S1637	ILE	R1460	R1370			H1115	
L2142	VAL	ASN	V1951	V1879	L1798	I1719	T1641		A1461		L1279			
L2143	LEU	GLY	F1956	M1880	V1801	A1720	K1642	H1552	G1462	Q1374				
L2144	LEU	ASP		Y1881	Y1802	H1721		F1553	L1463	T1374	S1289			
L2145	GLU	SER	L1959	P1885	E1803	F1722	L1646	H1555		T1376				
L2146	ASP	ASP	K1960		M1804	P1723	A1647		L1475	L1376				
L2147	ASP	GLY	F1961	LYS	F1905	M1724	L1648		H1476	P1379				
L2148	VAL	PRO	Y1962	ASP	R1806	Q1725	L1649	Y1560	H1477		A1295			
L2149	LEU	SER	Q1963	ASP	LYS	P1731	A1650	E1565	S1478	T1382	F1296	L1206		
L2150	GLY	THR	GLY	VAL	ASP	G1732	K1651	T1566	V1479	G1383	F1297	W1207	K1119	
L2151	ASN	MET	PHE	VAL	ASP	G1732	K1651	T1566	G1480	F1384	L1298	L1208	S1120	
L2152	GLY	SER	LEU	ALA	PRO	T1733	L1652	L1575	T1481	E1299		K1209	L1121	
L2153	GLY	SER	LEU	LYS	ARG		Q1654	L1576	E1482	S1300	G1222	D1210	G1122	
L2154	GLY	LEU	GLY	GLY	LEU	F1736	L1655	L1577	L1483	L1386	T1123	V1211	T1123	
L2155	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2156	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2157	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2158	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2159	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2160	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2161	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2162	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2163	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2164	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2165	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2166	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2167	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2168	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2169	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2170	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2171	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2172	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2173	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2174	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2175	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2176	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2177	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2178	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2179	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2180	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2181	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2182	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2183	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2184	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2185	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2186	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	
L2187	GLY	LEU	LEU	LEU	LEU	N1737	L1655	L1577	L1483	G1387		L1212	R1026	

[illegible]

L3480	E3582	L3767	L3857	R3965	V4038	R4119
K3483	W3588	V3770	K3858	Q3966	Y4039	T4120
I3487	V3592	I3774	K3860	F3967	R4040	W4124
K4493	A3597	L3788	T3867	I3968	R4041	E4125
Q4494	LYS	E3700	V3868	N3969	Q4042	P4126
F3495	THR	I3701	T3869	L3970	I4043	W4127
I3496	PRO	Q3704	T3870	M3971	I4044	M4128
S3497	V3601	Q3707	F3871	L3972	A4047	
W3498	V3606	R3708	K3872	M3974	R4048	
I3499	I3606	G3707	K3873	K3975	A4054	
S3500	E3607	R3708	K3874	E3976		
V3503	K3608	K3710	E3875	L3977	V4058	
A3504	M3609	G3710	S3876	M3983	I4059	
L3505	A3510	H3716	K3877	V3985	L4064	
L3506	E3611	I3719	L3882	H3986	H4068	
D3509	L3617	A3720	R3889	A3987	H4072	
Q3510	P3623	G3721	P3894	N4000	Y4077	
V3512	L3625	F3722	L3898	M4002	V4078	
A3513	G3626	V3726	A3905	D4003	A4079	
N3524	R3629	M3729	A3909	V4004	V4080	
Q3527	K3631	S3731	A3920	F4005	A4081	
F3533	G3647	L3732	C3912	V4006	G4082	
S3536	GLY	R3734	L3913	K4007	G4083	
S3537	SER	R3735	S3914	F4008	S4084	
E3538	LYS	K3736	H3915	P4009	K4085	
S3539	LEU	R3737	G3919	S4010	H4086	
TVR	ARG	I3738	L3918	D4011	H4087	
SER	MET	R3741	L3920	W4013	I4089	
PHE	LYS	G3742	H3924	K4014	A4090	
LYS	LEU	D3743	L3925	Y4015	A4091	
ASP	ASP	D3744	N3926	PHE	Q4092	
T3546	T3546	E3745	N3927	GLU	E4093	
T3547	T3547	R3746	K3928	GLN	P4094	
G3548	M3665	E3747	F3929	LYS	E4095	
K3549	L3666	P3749	V3930	MET	S4096	
N3551	L3667	F3750	A3931	LEU	G4097	
K3552	L3668	L3751	D3941	LYS	L4098	
F3553	K3669	V3752	F3946	TRP	T4102	
F3554	M3670	E3756		ILE	K4105	
R3557	N3671			ILE	Q4106	
V3567	K3672			GLY	L4107	
L3572	L3680			GLY	M4108	
A3574	K3681			GLY	D4109	
	E3682			GLY	Q4110	
	G3683			ASN	D4113	
	P3685			VAL	P4114	
				ALA	L4117	
				GLU	G4118	
				LYS		
				ASN		

● Molecule 1: DNA-dependent protein kinase catalytic subunit

Chain o:  49% 35% 15%

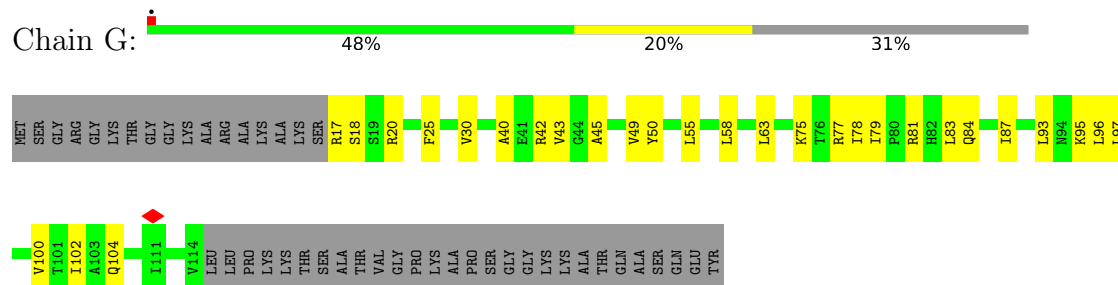
MET	P92	I166	Q243	K626	M410
ALA	L93	P167	T244	V327	P411
GLY	E94	D168	S245	V327	S412
SER	K95	T169	R246	F413	F413
GLY	N96	V170	E247	M333	L414
ALA	G97	L171	I248	K337	V417
GLY	Q98	E172	F249	L338	A418
VAL	K99	Y175	N250	Q339	S419
ARG	I100	E176	F251	Q340	V420
C10	Y103	L177	L253	F341	
L13	S104	L181	LYS	T348	P428
R14	V106		ALA	I349	
L15			ILE	T432	
L19	K108	V184	ARG	L435	
D23	M109	H185	PRO	ASN	L435
R24	T110	P186	Q259	VAL	E436
A27	C111	S187	I260	ASP	H437
L28	T112	E188	D261	SER	L438
L29	S113	M189	L262	ASN	
L34	V114	I190	K263	N356	Q442
L35	Y115	N191	R264	L359	F446
L36	T116	N192	Y265	P447	F446
L37	K117	A193	A266	V267	Q448
L38	A120	E194	P268	A362	Y449
L39	I121	N195	S269	L363	S450
L40	C123	F197	A270	R364	M453
E41	K124	F200	L274	K374	Q454
C42	I125	L201	F275	L455	
S45	L128	L204	T284	D380	L468
A49	D129	C285	R286	V381	A469
A52	L130	Q207	L286	F382	A469
F59	L131	S210	L287	M384	V464
L66	K132	K216	Y290	V385	
V67	K133	V212	V296	V386	L468
R70	L134	K216	K299	E387	A469
K71	Q136	V219	H303	L388	P473
N74	R139	L220	E307	Q390	V474
S75	R142	C223	L308	C392	R475
I76	D145	L224	K309	K393	R476
E77	F147	L227	K310	F396	R477
F78	K148	L230	L313	THR	H484
R79	E151	L231	S314	GLN	Q485
E80	L152	N233	A315	THR	G486
	E159	F234	L316	ASP	L488
	L162	T235	S318	GLY	K493
	L163	E240	F319	ASP	
	K164	D241	L320	ASP	F498
	K165	P242	V323	LYS	V407
				GLY	
				PRO	



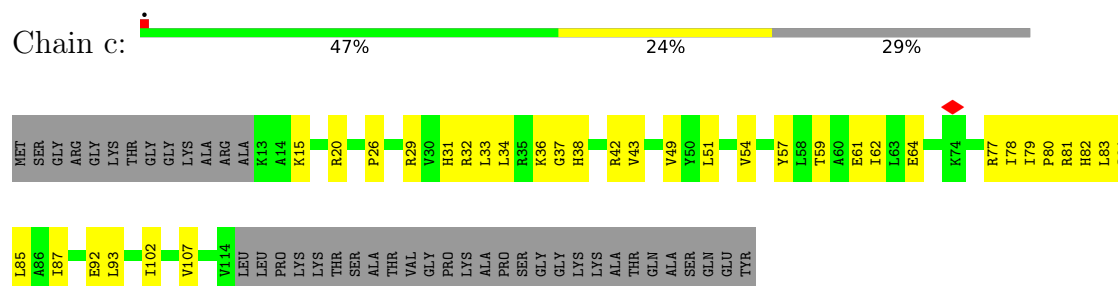




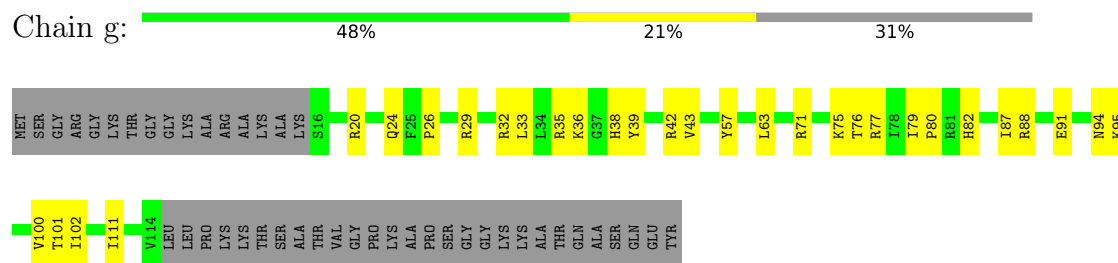
- Molecule 3: Histone H2AX



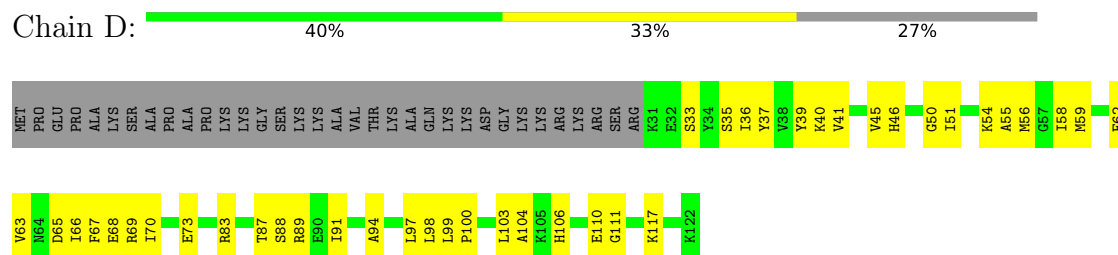
- Molecule 3: Histone H2AX



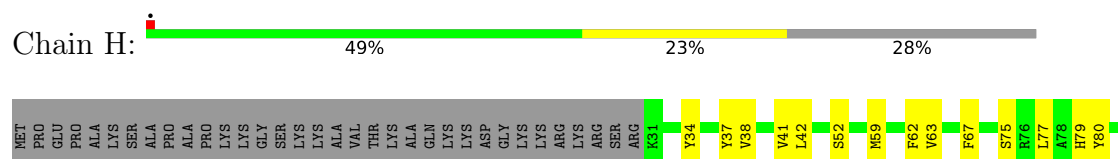
- Molecule 3: Histone H2AX

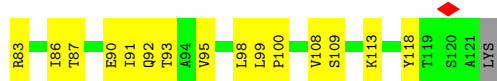


- Molecule 4: Histone H2B type 1-J

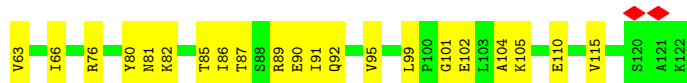
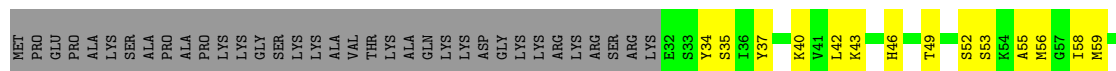


- Molecule 4: Histone H2B type 1-J

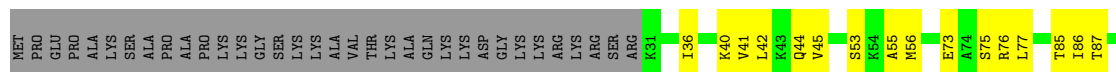




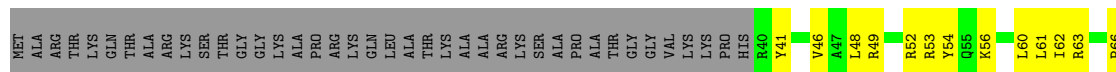
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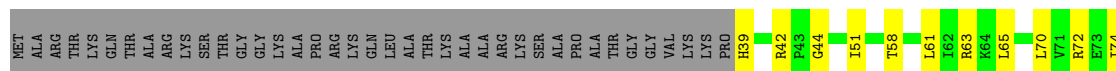
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• Molecule 5: Histone H3.1

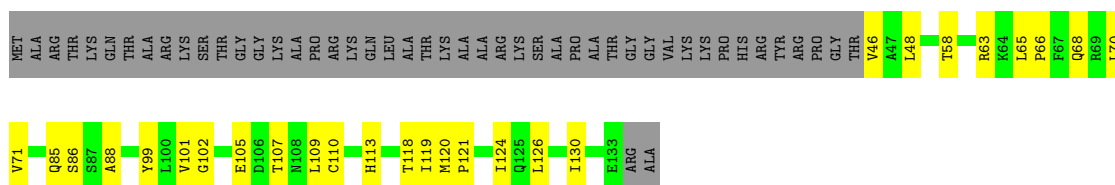


• Molecule 5: Histone H3.1

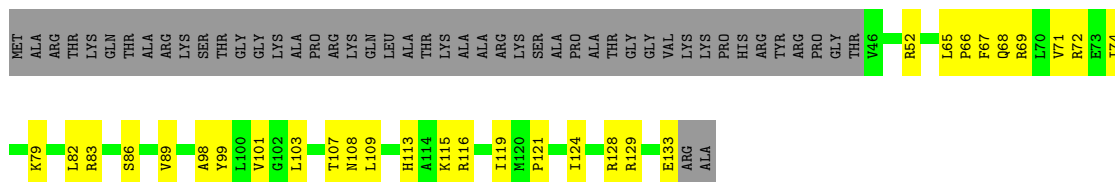


• Molecule 5: Histone H3.1

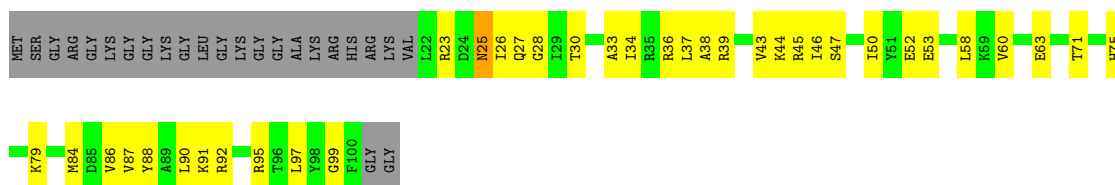




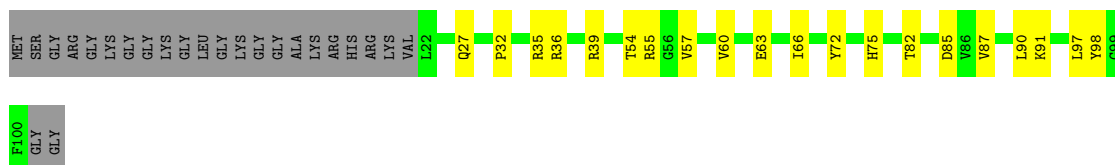
• Molecule 5: Histone H3.1



• Molecule 6: Histone H4



• Molecule 6: Histone H4

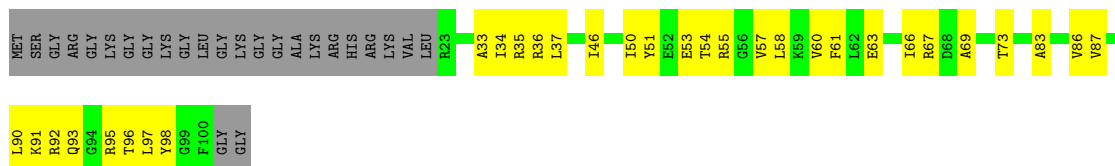


• Molecule 6: Histone H4

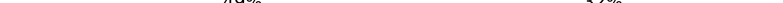


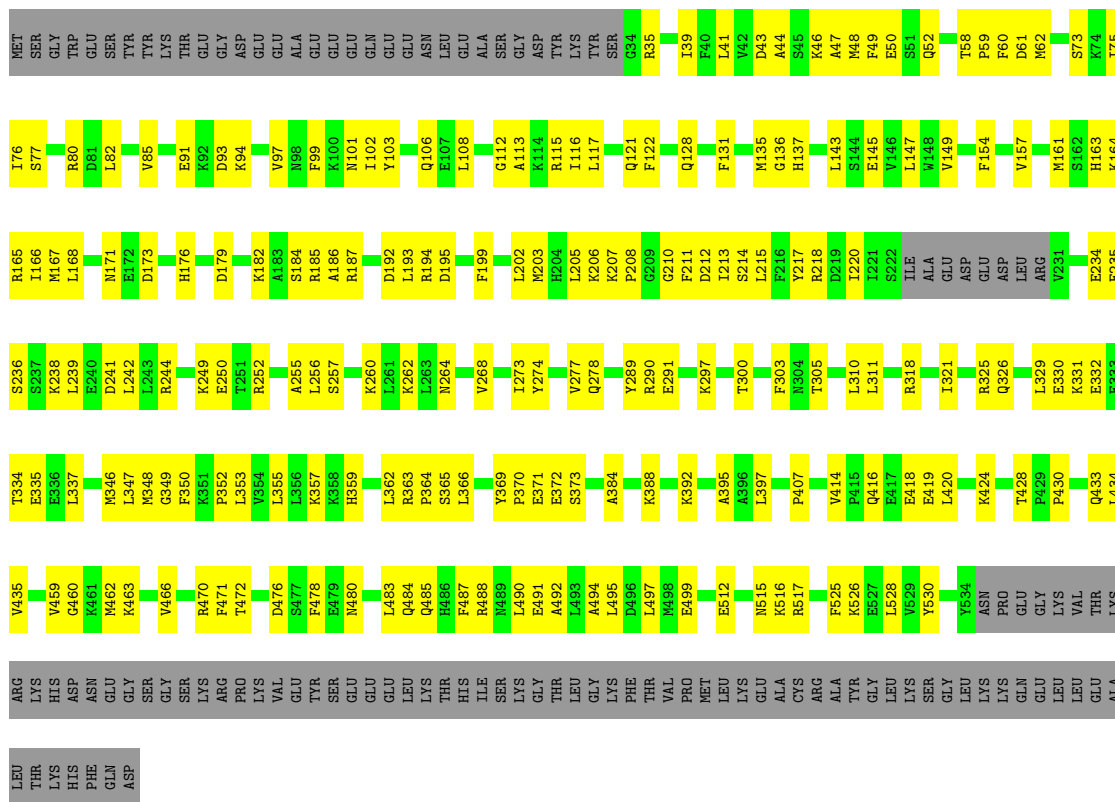
• Molecule 6: Histone H4



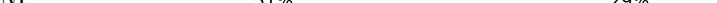


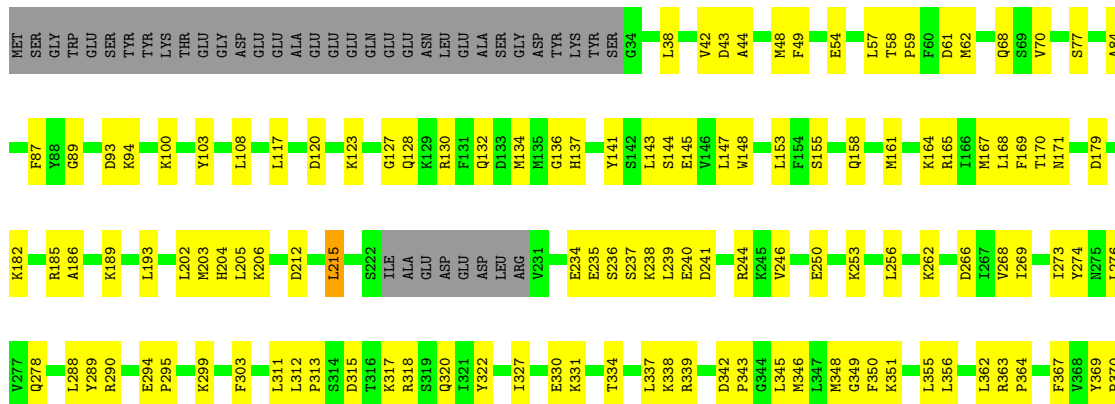
- Molecule 7: X-ray repair cross-complementing protein 6

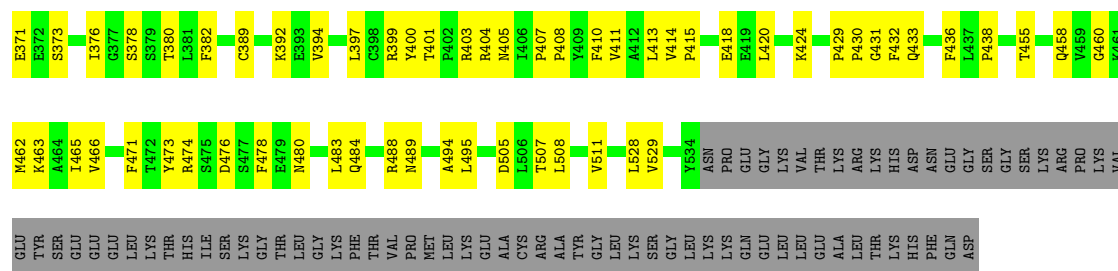
Chain K: 



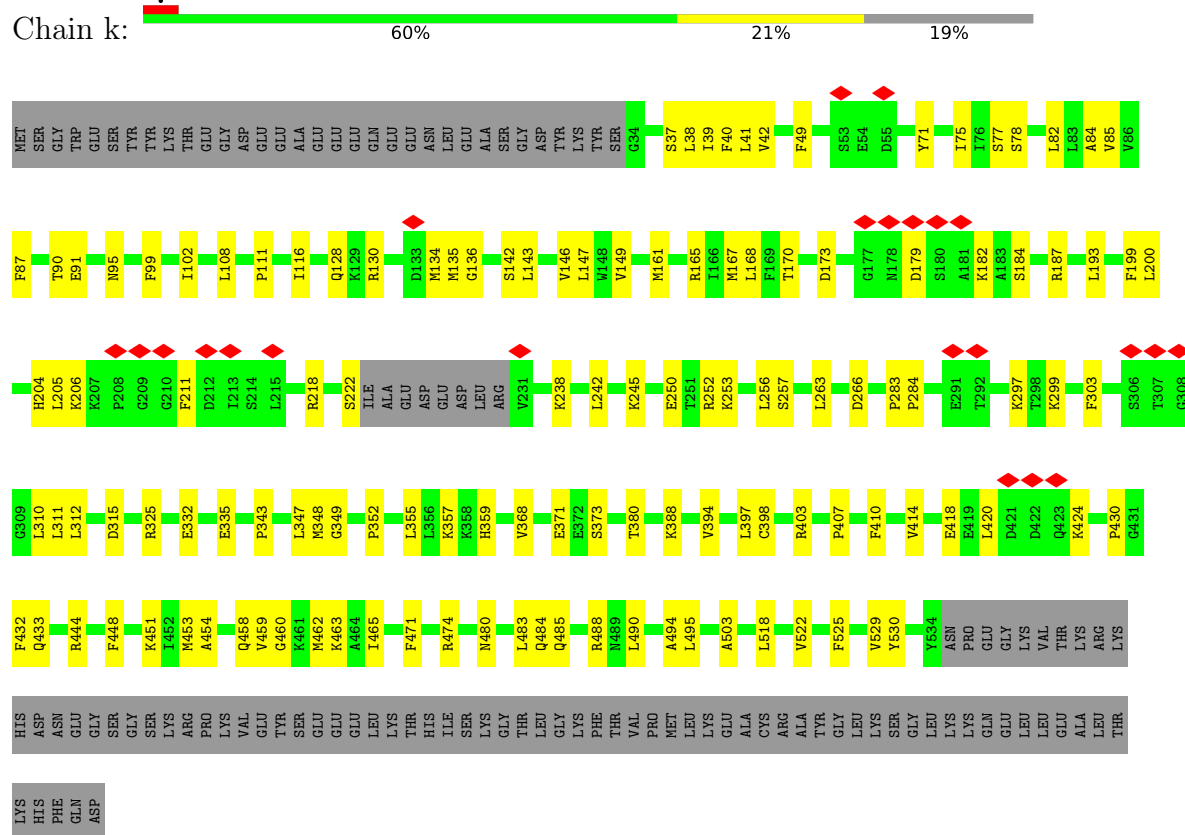
- Molecule 7: X-ray repair cross-complementing protein 6

Chain M:  51% 29% 19%

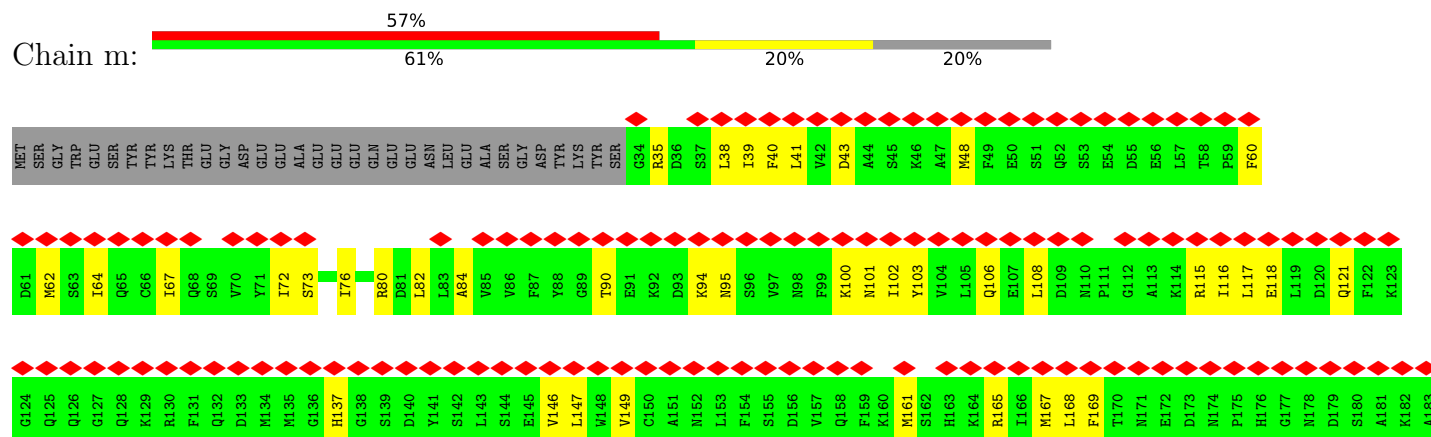


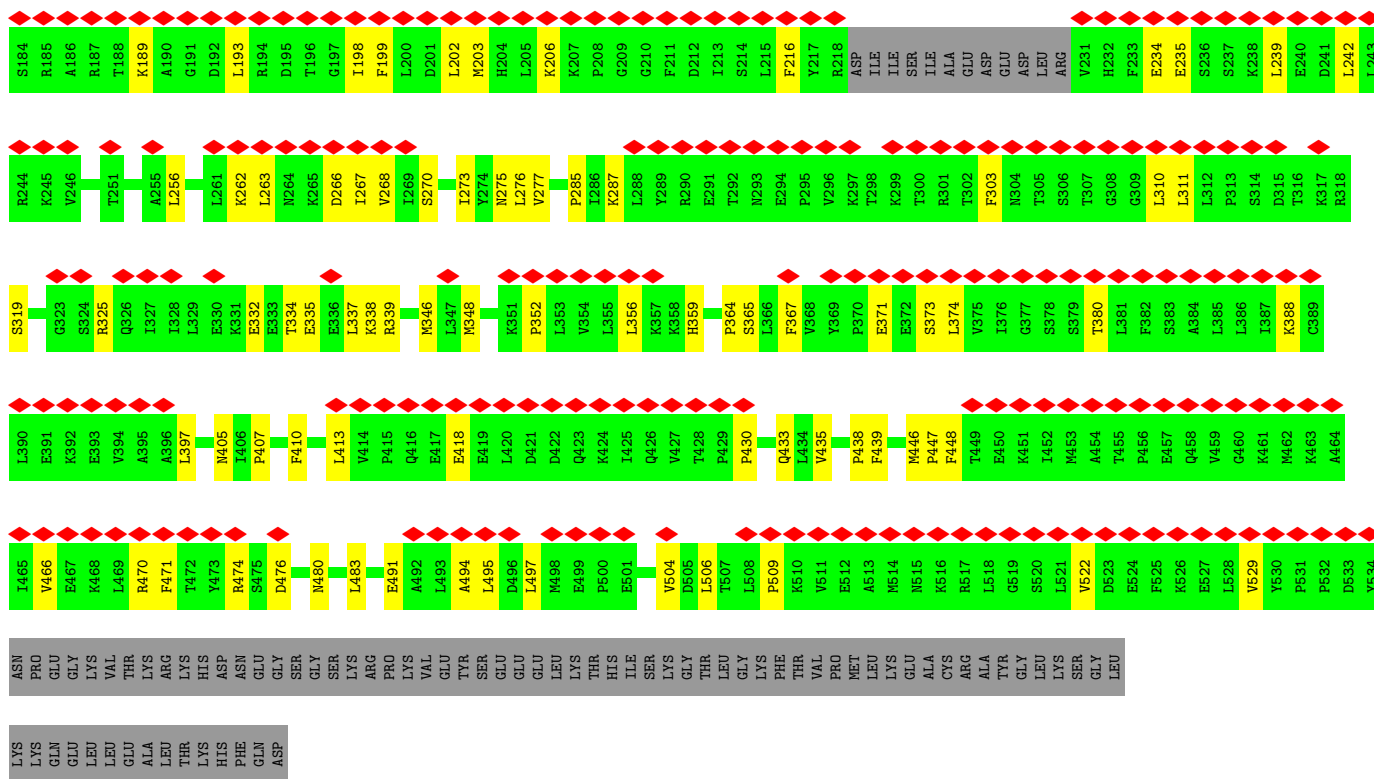


• Molecule 7: X-ray repair cross-complementing protein 6

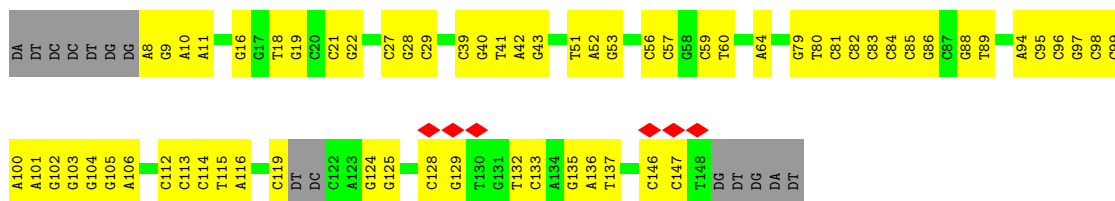


• Molecule 7: X-ray repair cross-complementing protein 6





• Molecule 8: DNA

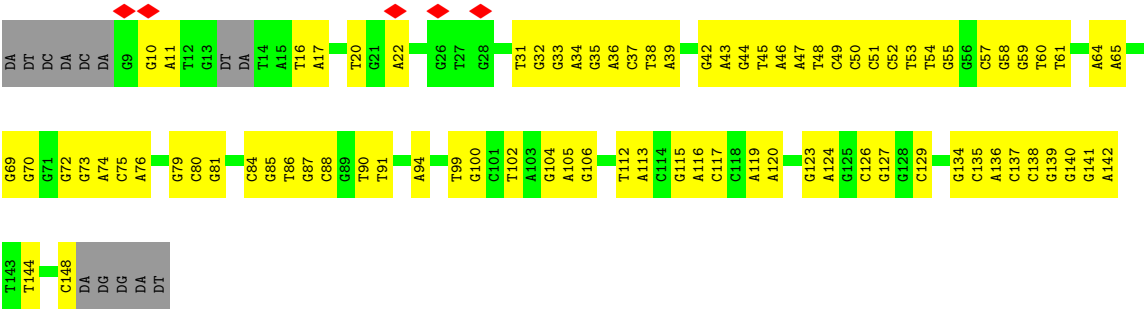


• Molecule 8: DNA

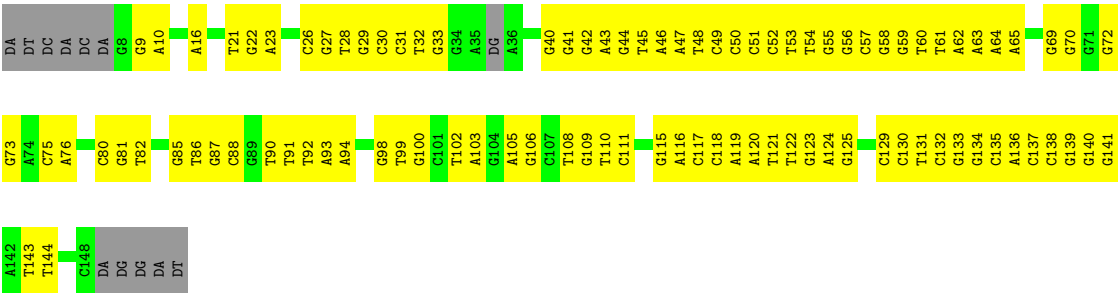


• Molecule 9: DNA





• Molecule 9: DNA



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	77373	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 ($e^-/\text{\AA}^2$)	50.87	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	1.994	Depositor
Minimum map value	-0.606	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.035	Depositor
Recommended contour level	0.21	Depositor
Map size (Å)	1038.24, 1038.24, 1038.24	wwPDB
Map dimensions	420, 420, 420	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	2.472, 2.472, 2.472	Depositor

5 Model quality

5.1 Standard geometry

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	O	0.15	0/28610	0.36	0/38654
1	o	0.17	0/28521	0.39	0/38527
2	L	0.11	0/5337	0.31	0/7193
2	N	0.14	0/5210	0.33	0/7024
2	l	0.10	0/4200	0.30	0/5673
2	n	0.10	0/4187	0.30	0/5654
3	C	0.13	0/777	0.37	0/1050
3	G	0.11	0/755	0.26	0/1021
3	c	0.12	0/789	0.35	0/1064
3	g	0.10	0/761	0.29	0/1029
4	D	0.15	0/716	0.46	0/963
4	H	0.12	0/714	0.30	0/961
4	d	0.12	0/719	0.33	0/967
4	h	0.12	0/729	0.30	0/979
5	A	0.12	0/788	0.31	0/1057
5	E	0.12	0/805	0.36	0/1079
5	a	0.11	0/725	0.29	0/972
5	e	0.11	0/729	0.35	0/977
6	B	0.13	0/638	0.30	0/856
6	F	0.10	0/638	0.30	0/856
6	b	0.11	0/627	0.28	0/841
6	f	0.10	0/616	0.30	0/827
7	K	0.16	0/4018	0.33	0/5418
7	M	0.11	0/4048	0.32	0/5454
7	k	0.11	0/4036	0.28	0/5439
7	m	0.10	0/4001	0.28	0/5395
8	I	0.32	0/3169	0.50	0/4882
8	i	0.34	0/3216	0.52	0/4956
9	J	0.30	0/3240	0.48	0/5003
9	j	0.31	0/3261	0.48	0/5035
All	All	0.17	0/116580	0.37	0/159806

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	O	28053	0	28316	1046	0
1	o	27969	0	28250	1129	0
2	L	5240	0	5249	200	0
2	N	5114	0	5119	215	0
2	l	4117	0	4135	118	0
2	n	4106	0	4133	101	0
3	C	767	0	812	41	0
3	G	745	0	779	31	0
3	c	779	0	823	30	0
3	g	751	0	784	28	0
4	D	706	0	719	38	0
4	H	703	0	714	32	0
4	d	708	0	724	24	0
4	h	718	0	740	26	0
5	A	778	0	813	33	0
5	E	794	0	831	26	0
5	a	717	0	753	30	0
5	e	721	0	759	28	0
6	B	631	0	670	38	0
6	F	631	0	670	14	0
6	b	620	0	651	23	0
6	f	610	0	641	27	0
7	K	3940	0	3982	168	0
7	M	3970	0	4037	143	0
7	k	3958	0	4022	87	0
7	m	3923	0	3971	86	0
8	I	2829	0	1562	66	0
8	i	2871	0	1583	129	0
9	J	2886	0	1571	75	0
9	j	2905	0	1583	97	0
All	All	113260	0	109396	3808	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 17.

The worst 5 of 3808 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)
2:l:328:GLU:O	2:l:332:LYS:HB2	1.54	1.05
9:j:55:DG:N2	9:j:56:DG:H22	1.62	0.97
9:j:55:DG:N2	9:j:56:DG:N2	2.12	0.96
1:o:3686:TRP:HA	1:o:3690:PHE:HB3	1.46	0.93
9:j:55:DG:C2	9:j:56:DG:N2	2.40	0.89

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	O	3438/4128 (83%)	3136 (91%)	300 (9%)	2 (0%)	48	83
1	o	3427/4128 (83%)	3081 (90%)	341 (10%)	5 (0%)	48	83
2	L	648/732 (88%)	583 (90%)	65 (10%)	0	100	100
2	N	632/732 (86%)	577 (91%)	54 (8%)	1 (0%)	44	78
2	l	513/732 (70%)	473 (92%)	40 (8%)	0	100	100
2	n	513/732 (70%)	478 (93%)	35 (7%)	0	100	100
3	C	98/143 (68%)	83 (85%)	14 (14%)	1 (1%)	13	49
3	G	96/143 (67%)	96 (100%)	0	0	100	100
3	c	100/143 (70%)	92 (92%)	8 (8%)	0	100	100
3	g	97/143 (68%)	93 (96%)	3 (3%)	1 (1%)	13	49
4	D	90/126 (71%)	80 (89%)	10 (11%)	0	100	100
4	H	89/126 (71%)	86 (97%)	3 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
4	d	89/126 (71%)	86 (97%)	2 (2%)	1 (1%)	12	46
4	h	90/126 (71%)	86 (96%)	4 (4%)	0	100	100
5	A	93/136 (68%)	89 (96%)	4 (4%)	0	100	100
5	E	94/136 (69%)	89 (95%)	5 (5%)	0	100	100
5	a	86/136 (63%)	80 (93%)	6 (7%)	0	100	100
5	e	86/136 (63%)	78 (91%)	8 (9%)	0	100	100
6	B	77/103 (75%)	75 (97%)	2 (3%)	0	100	100
6	F	77/103 (75%)	74 (96%)	3 (4%)	0	100	100
6	b	76/103 (74%)	76 (100%)	0	0	100	100
6	f	76/103 (74%)	75 (99%)	1 (1%)	0	100	100
7	K	489/609 (80%)	455 (93%)	34 (7%)	0	100	100
7	M	489/609 (80%)	454 (93%)	33 (7%)	2 (0%)	30	68
7	k	489/609 (80%)	468 (96%)	21 (4%)	0	100	100
7	m	485/609 (80%)	457 (94%)	27 (6%)	1 (0%)	44	78
All	All	12537/15652 (80%)	11500 (92%)	1023 (8%)	14 (0%)	50	83

5 of 14 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	O	76	ILE
3	C	19	SER
1	o	1557	GLU
2	N	299	ASP
7	M	215	LEU

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	O	3106/3671 (85%)	3103 (100%)	3 (0%)	92	95
1	o	3090/3671 (84%)	3089 (100%)	1 (0%)	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	L	585/649 (90%)	585 (100%)	0	100	100
2	N	570/649 (88%)	570 (100%)	0	100	100
2	l	461/649 (71%)	461 (100%)	0	100	100
2	n	460/649 (71%)	460 (100%)	0	100	100
3	C	77/106 (73%)	77 (100%)	0	100	100
3	G	74/106 (70%)	74 (100%)	0	100	100
3	c	77/106 (73%)	77 (100%)	0	100	100
3	g	75/106 (71%)	75 (100%)	0	100	100
4	D	75/105 (71%)	75 (100%)	0	100	100
4	H	74/105 (70%)	74 (100%)	0	100	100
4	d	76/105 (72%)	76 (100%)	0	100	100
4	h	78/105 (74%)	78 (100%)	0	100	100
5	A	82/111 (74%)	82 (100%)	0	100	100
5	E	84/111 (76%)	84 (100%)	0	100	100
5	a	76/111 (68%)	76 (100%)	0	100	100
5	e	77/111 (69%)	77 (100%)	0	100	100
6	B	65/79 (82%)	64 (98%)	1 (2%)	60	75
6	F	65/79 (82%)	65 (100%)	0	100	100
6	b	62/79 (78%)	62 (100%)	0	100	100
6	f	62/79 (78%)	62 (100%)	0	100	100
7	K	439/548 (80%)	439 (100%)	0	100	100
7	M	445/548 (81%)	445 (100%)	0	100	100
7	k	443/548 (81%)	443 (100%)	0	100	100
7	m	438/548 (80%)	438 (100%)	0	100	100
All	All	11216/13734 (82%)	11211 (100%)	5 (0%)	100	100

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	O	415	GLN
1	O	2137	ILE
1	O	2295	GLN
6	B	25	ASN
1	o	3383	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
2	N	673	HIS
6	f	93	GLN
5	e	85	GLN
7	K	485	GLN
6	B	25	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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.

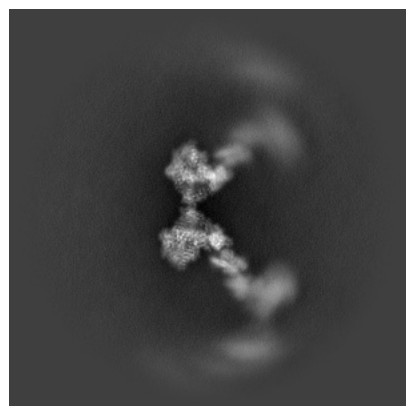
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-53237. These allow visual inspection of the internal detail of the map and identification of artifacts.

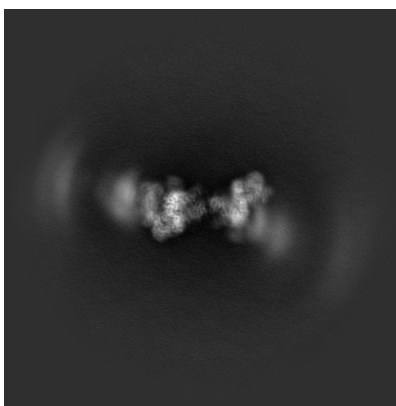
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

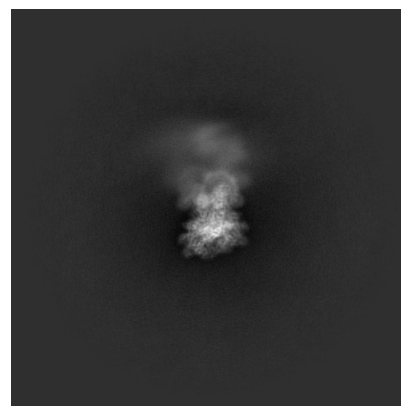
6.1.1 Primary map



X

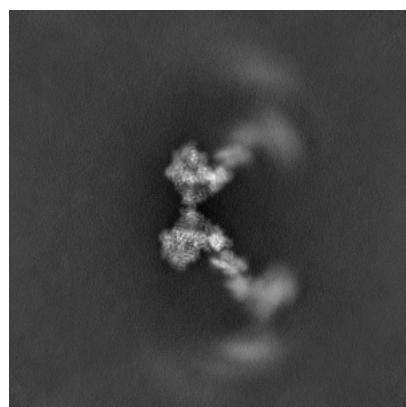


Y

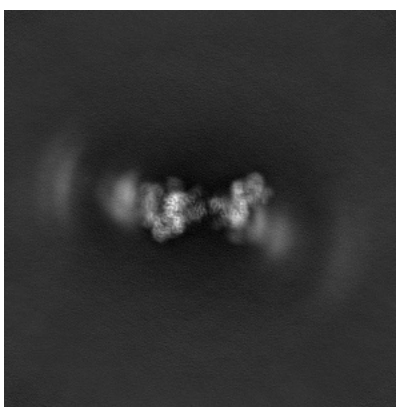


Z

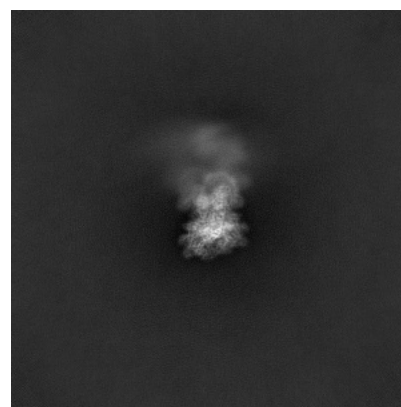
6.1.2 Raw map



X



Y

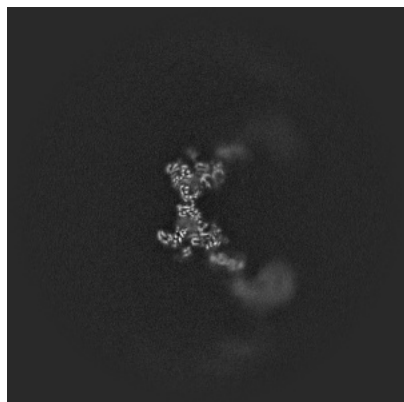


Z

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

6.2 Central slices [i](#)

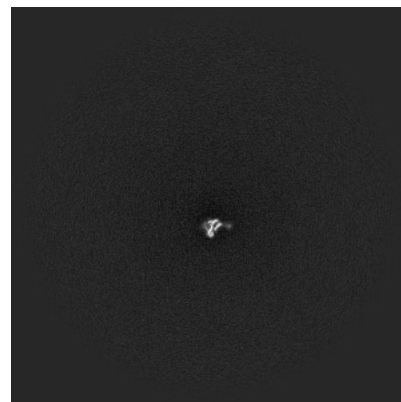
6.2.1 Primary map



X Index: 210

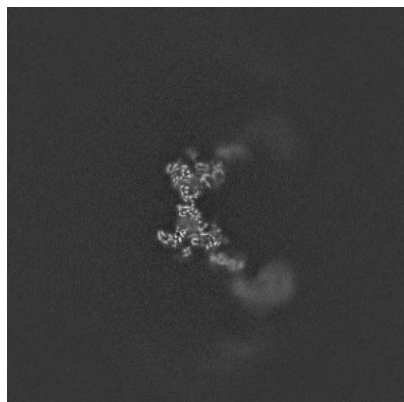


Y Index: 210



Z Index: 210

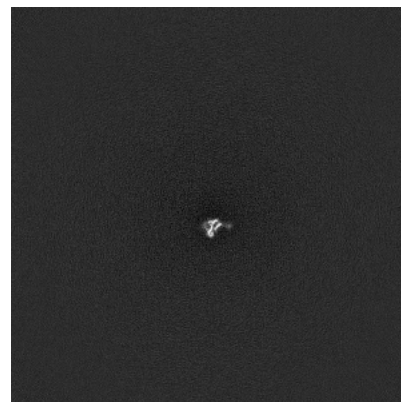
6.2.2 Raw map



X Index: 210



Y Index: 210

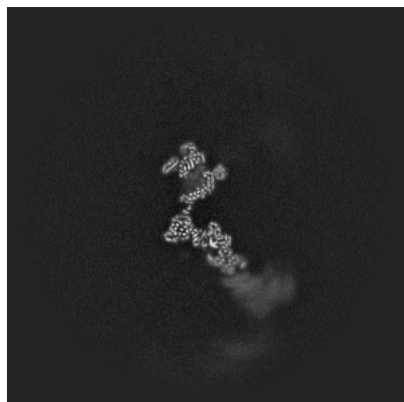


Z Index: 210

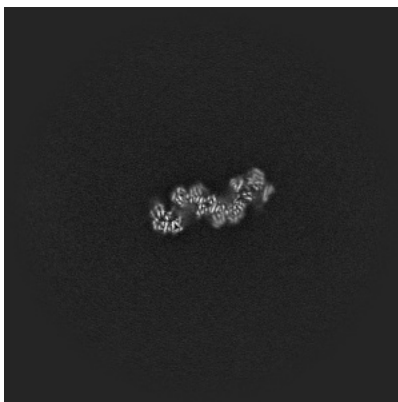
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

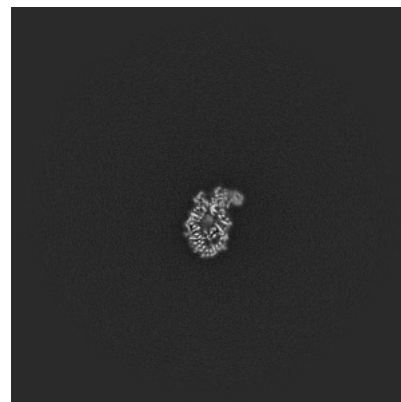
6.3.1 Primary map



X Index: 220



Y Index: 189

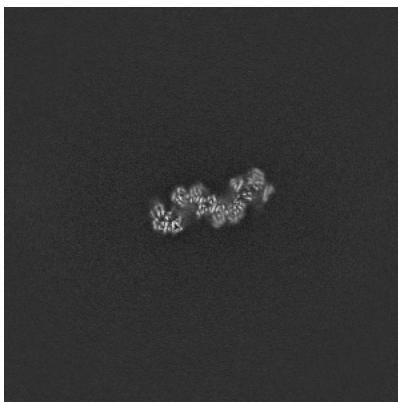


Z Index: 181

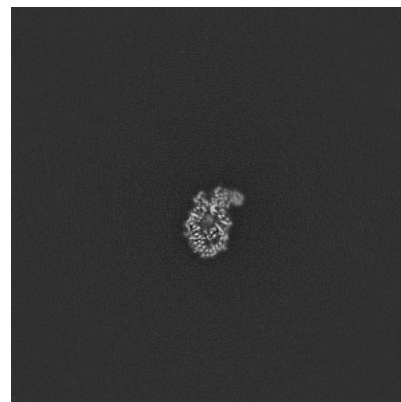
6.3.2 Raw map



X Index: 220



Y Index: 189

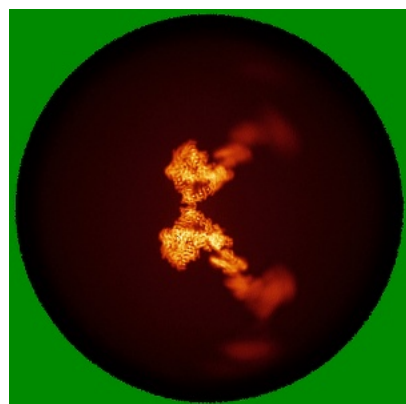


Z Index: 181

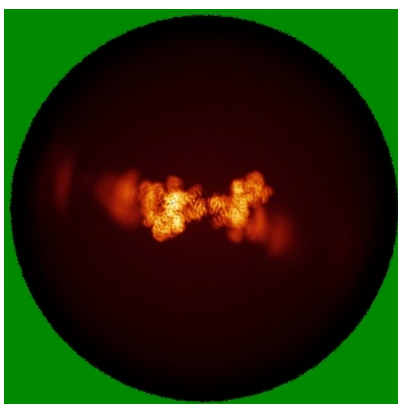
The images above show the largest variance slices of the map in three orthogonal directions.

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

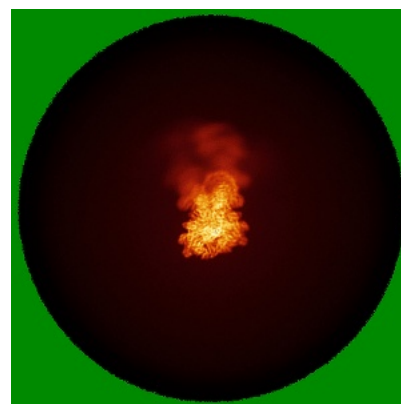
6.4.1 Primary map



X

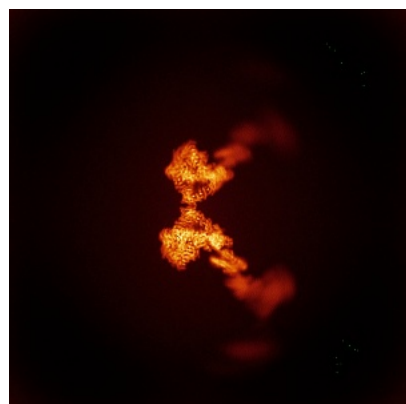


Y

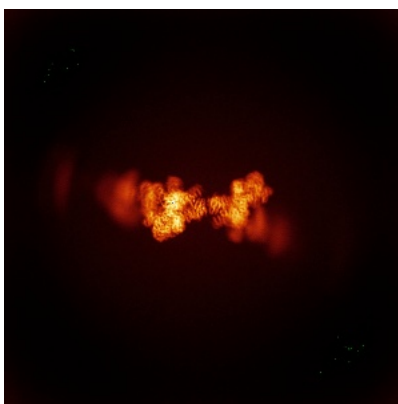


Z

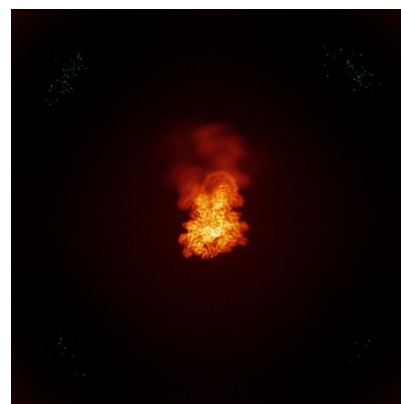
6.4.2 Raw map



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.

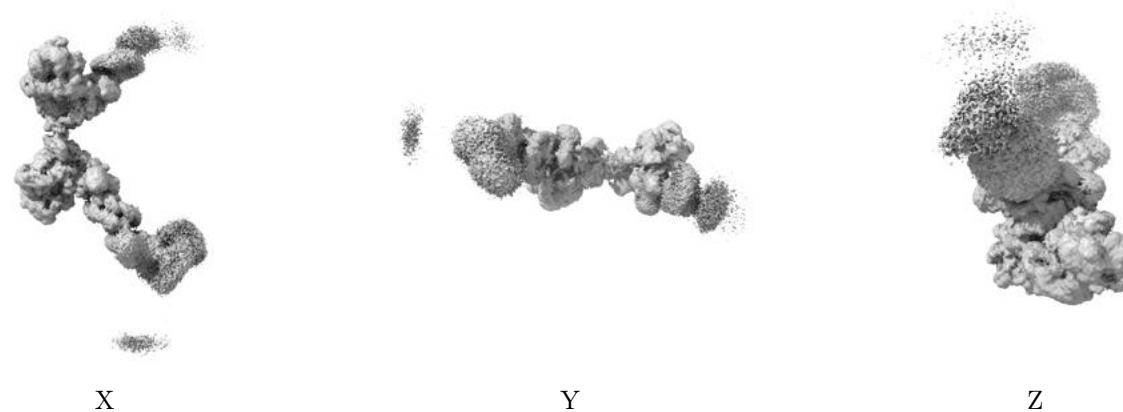
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.21. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.5.2 Raw map



These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

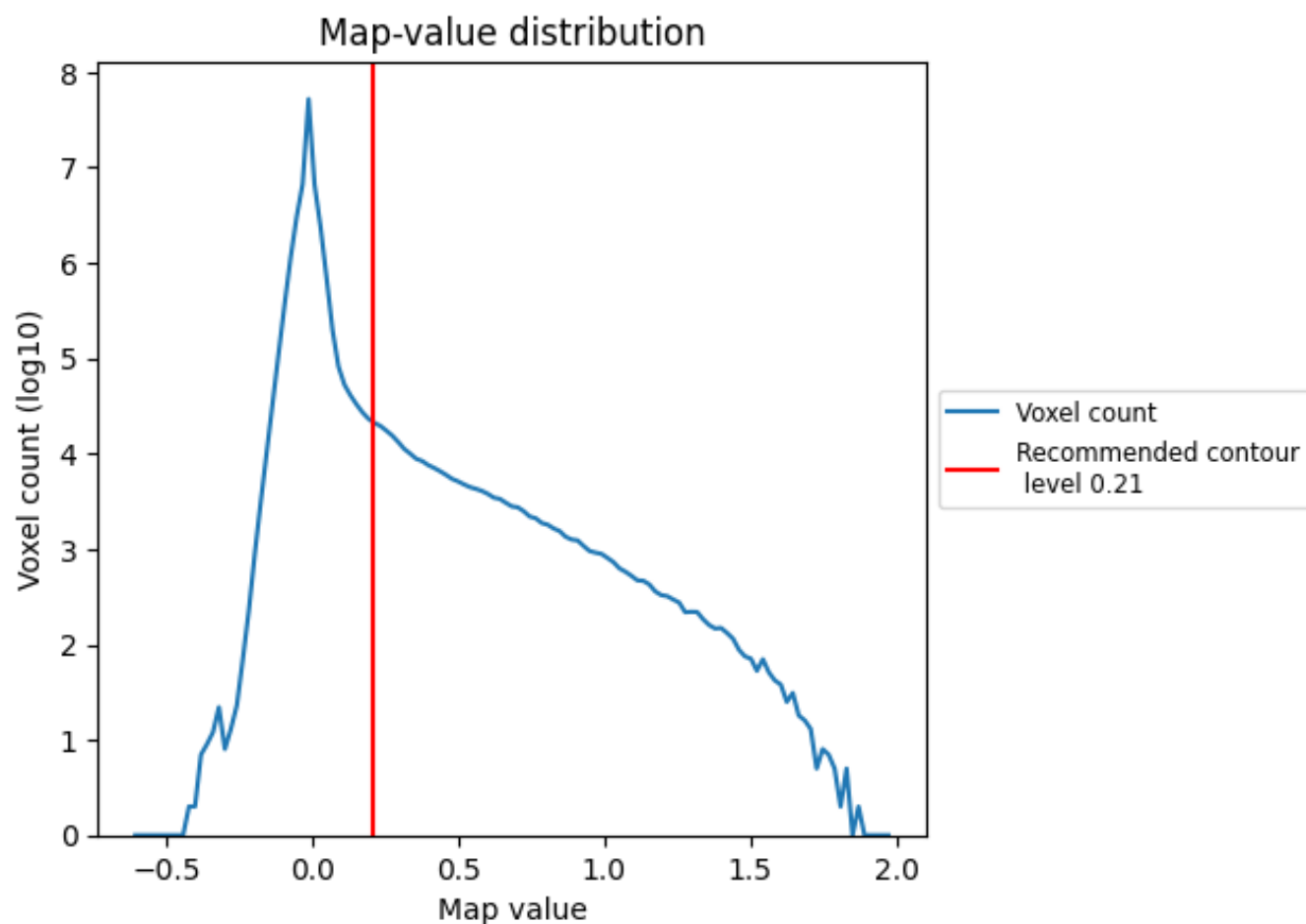
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

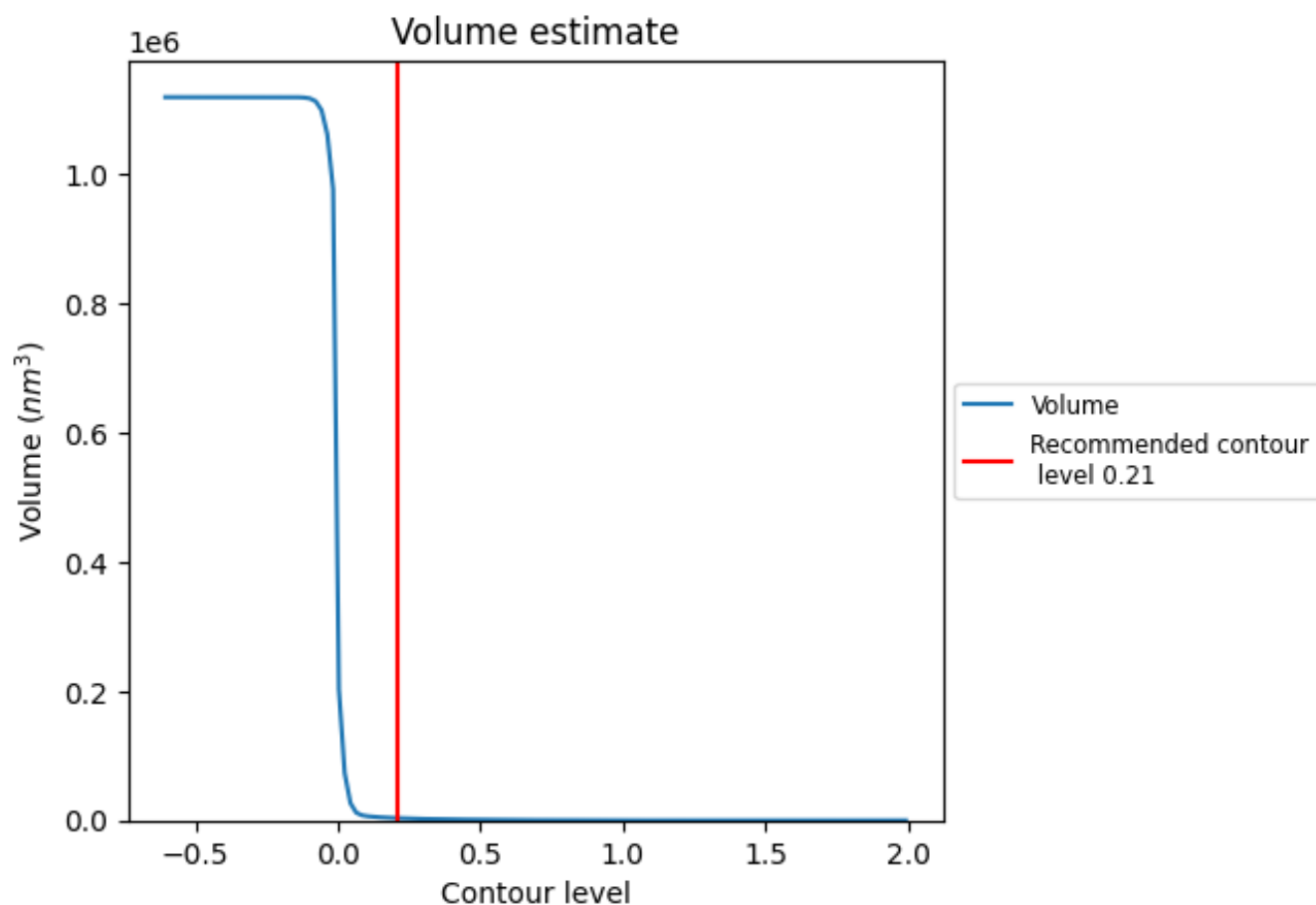
This section contains the results of statistical analysis of the map.

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.

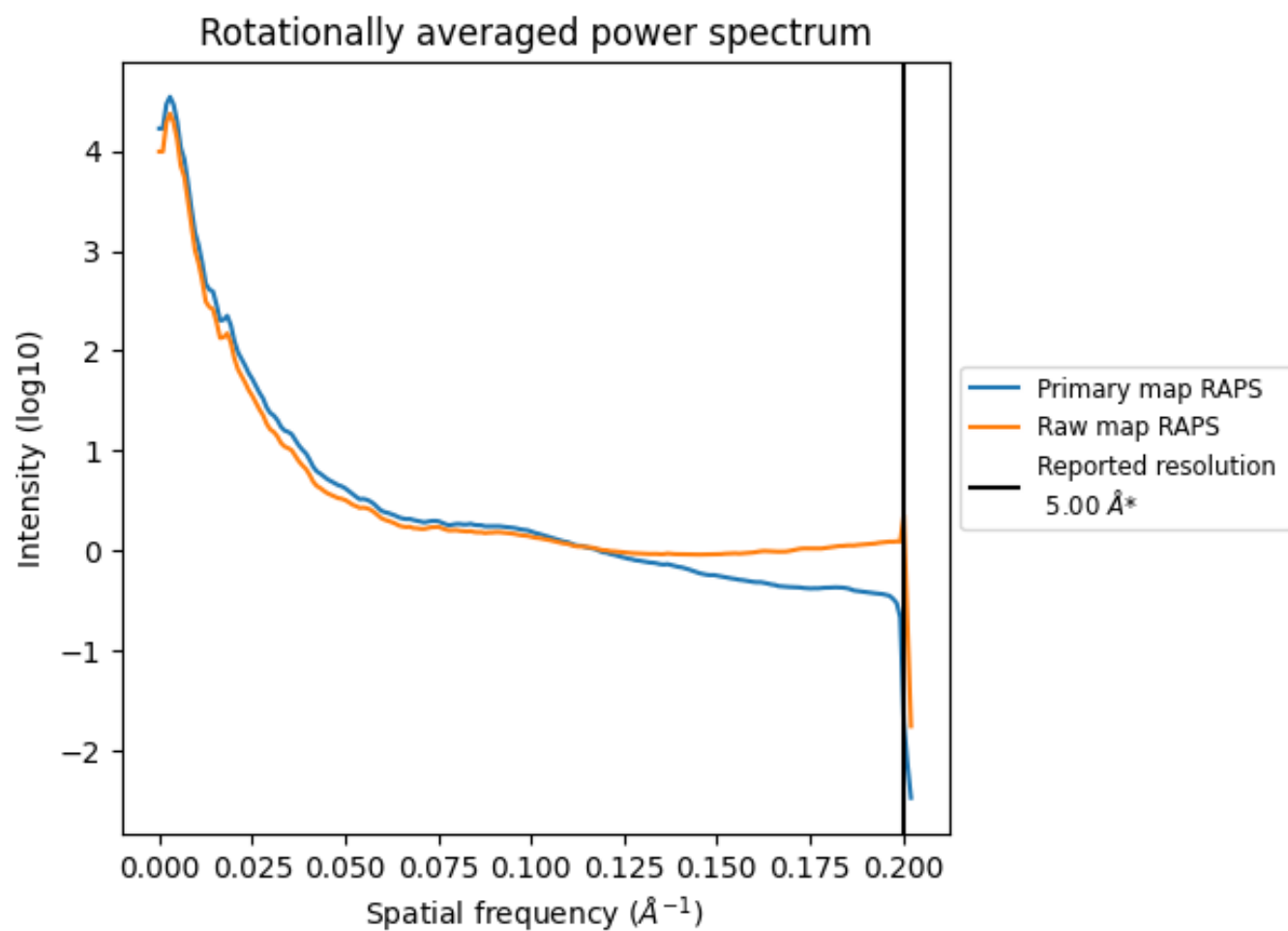
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 3518 nm³; this corresponds to an approximate mass of 3178 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 ⓘ

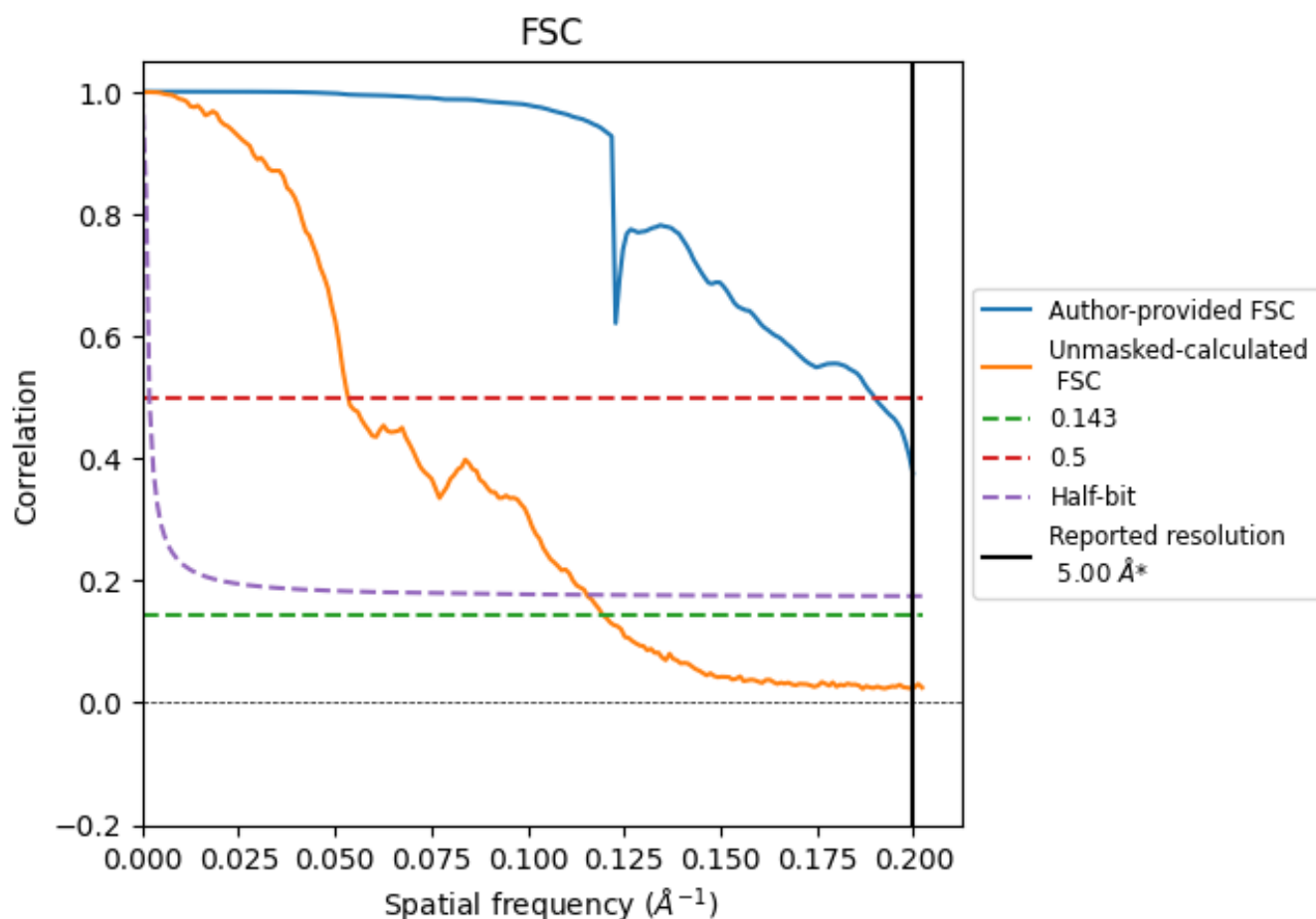


*Reported resolution corresponds to spatial frequency of 0.200 Å⁻¹

8 Fourier-Shell correlation [i](#)

Fourier-Shell Correlation (FSC) is the most commonly used method to estimate the resolution of single-particle and subtomogram-averaged maps. The shape of the curve depends on the imposed symmetry, mask and whether or not the two 3D reconstructions used were processed from a common reference. The reported resolution is shown as a black line. A curve is displayed for the half-bit criterion in addition to lines showing the 0.143 gold standard cut-off and 0.5 cut-off.

8.1 FSC [i](#)



*Reported resolution corresponds to spatial frequency of 0.200 Å⁻¹

8.2 Resolution estimates [i](#)

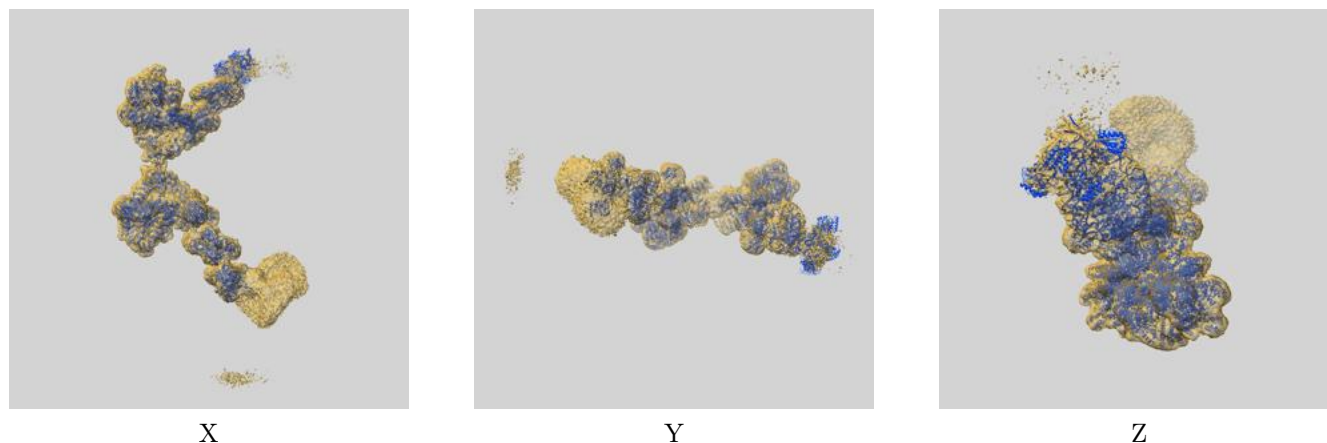
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	5.00	-	-
Author-provided FSC curve	-	5.27	-
Unmasked-calculated*	8.36	18.73	8.67

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 8.36 differs from the reported value 5.0 by more than 10 %

9 Map-model fit [i](#)

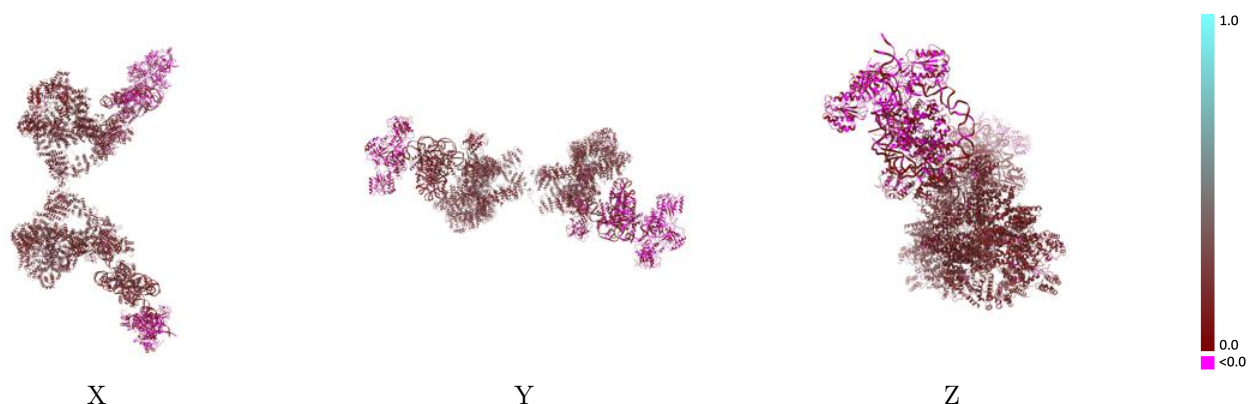
This section contains information regarding the fit between EMDB map EMD-53237 and PDB model 9QMS. Per-residue inclusion information can be found in [section 3](#) on [page 8](#).

9.1 Map-model overlay [i](#)



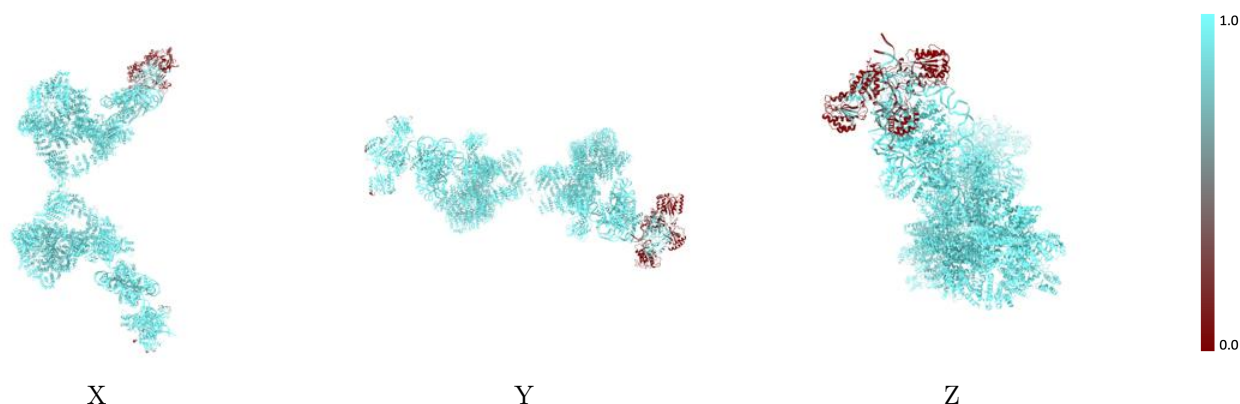
The images above show the 3D surface view of the map at the recommended contour level 0.21 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



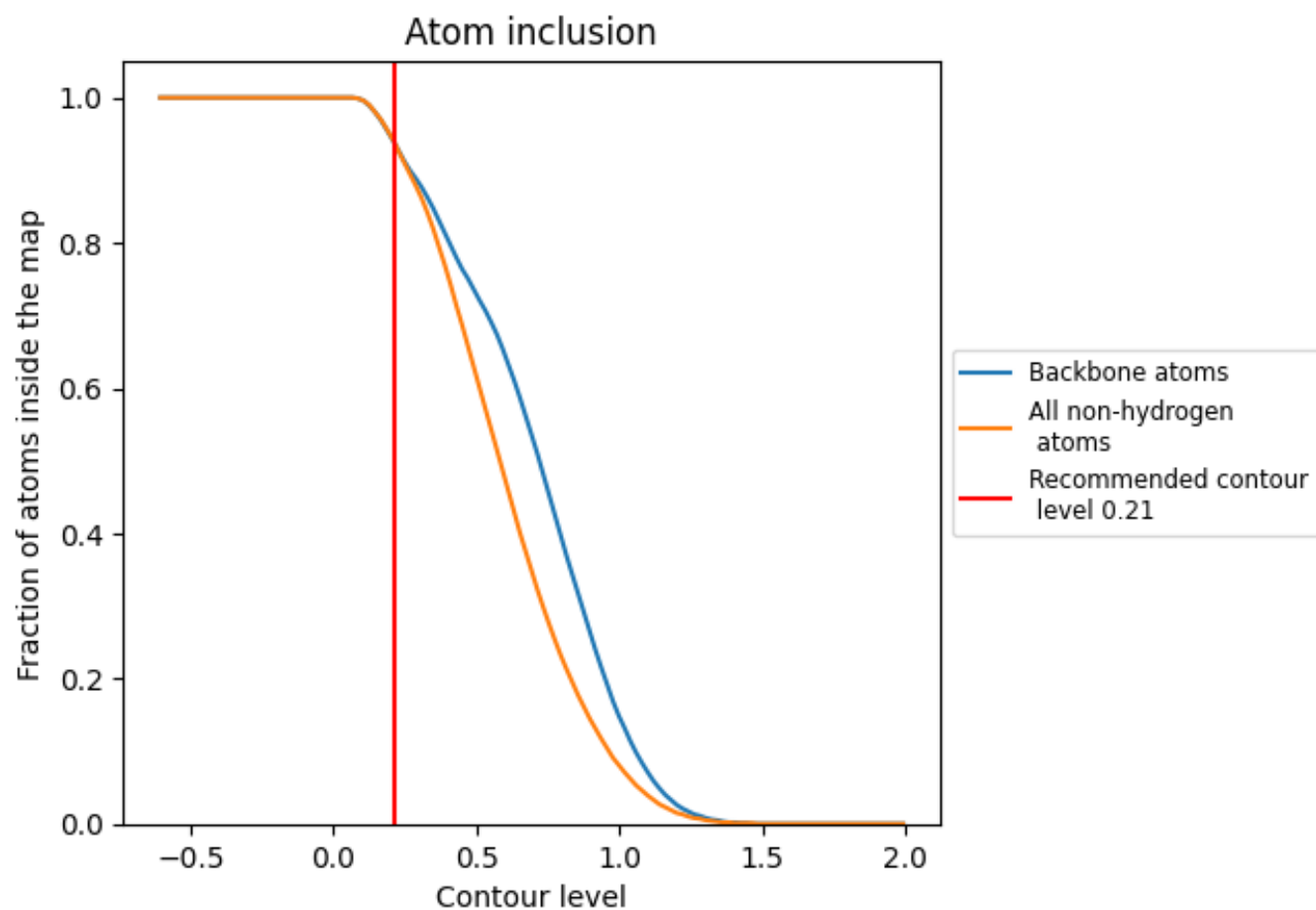
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.21).

9.4 Atom inclusion [i](#)



At the recommended contour level, 94% of all backbone atoms, 94% 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 (0.21) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.9410	 0.1680
A	 1.0000	 0.1560
B	 1.0000	 0.1600
C	 0.9990	 0.1930
D	 1.0000	 0.2000
E	 1.0000	 0.0780
F	 0.9970	 0.0470
G	 0.9920	 0.0740
H	 0.9940	 0.1010
I	 0.9310	 0.1070
J	 0.9190	 0.1070
K	 0.9990	 0.2320
L	 0.9950	 0.1460
M	 1.0000	 0.1740
N	 0.9990	 0.2040
O	 0.9980	 0.2010
a	 1.0000	 0.0550
b	 1.0000	 0.0610
c	 0.9740	 0.0620
d	 0.9670	 0.0690
e	 1.0000	 0.1690
f	 1.0000	 0.1690
g	 1.0000	 0.1640
h	 1.0000	 0.1770
i	 1.0000	 0.1870
j	 1.0000	 0.2000
k	 0.9320	 0.0600
l	 0.9490	 0.0630
m	 0.2810	 0.0320
n	 0.3350	 0.0270
o	 0.9960	 0.2210

