



wwPDB EM Validation Summary Report ⓘ

Dec 19, 2022 – 08:54 am GMT

PDB ID : 7NFC
EMDB ID : EMD-12299
Title : Cryo-EM structure of NHEJ super-complex (dimer)
Authors : Chaplin, A.K.; Hardwick, S.W.; Kefala Stavridi, A.; Chirgadze, D.Y.; Blundell, T.L.
Deposited on : 2021-02-05
Resolution : 4.14 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.dev43
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.9
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.31.3

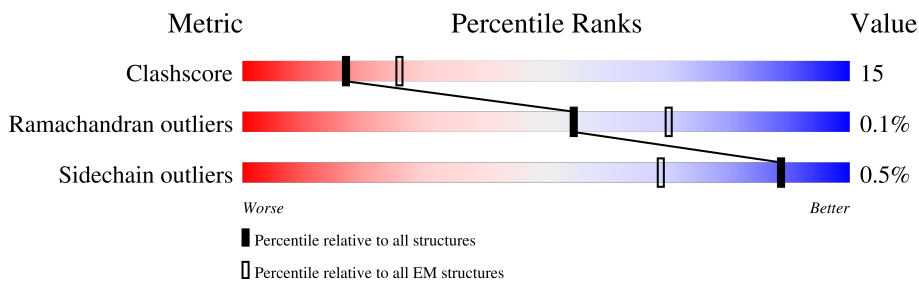
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 4.14 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)
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	A	4148	
1	F	4148	
2	B	609	
2	G	609	
3	C	732	
3	H	732	
4	K	336	
4	L	336	

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Mol	Chain	Length	Quality of chain
4	N	336	<p>21% 47% 12% 40%</p>
4	O	336	<p>27% 45% 13% 42%</p>
5	M	911	<p>6% 22% 7% 72%</p>
5	P	911	<p>16% 10% 73%</p>
6	Q	299	<p>31% 51% 19% 29%</p>
6	R	299	<p>30% 51% 22% 27%</p>
7	D	27	<p>19% 81%</p>
8	E	28	<p>21% 79%</p>
8	I	28	<p>21% 79%</p>
9	J	27	<p>33% 67%</p>

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 89069 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,DNA-dependent protein kinase catalytic subunit,DNA-PKcs.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	3562	Total	C	N	O	S	0	0
			28076	18032	4728	5132	184		
1	F	3557	Total	C	N	O	S	0	0
			28060	18026	4720	5131	183		

- Molecule 2 is a protein called X-ray repair cross-complementing protein 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	476	Total	C	N	O	S	0	0
			3822	2452	648	705	17		
2	G	489	Total	C	N	O	S	0	0
			3948	2529	669	732	18		

- Molecule 3 is a protein called X-ray repair cross-complementing protein 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	C	477	Total	C	N	O	S	0	0
			3849	2466	646	714	23		
3	H	642	Total	C	N	O	S	0	0
			5150	3298	864	963	25		

- Molecule 4 is a protein called DNA repair protein XRCC4.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	K	201	Total	C	N	O	S	0	0
			1625	1028	278	312	7		
4	L	195	Total	C	N	O	S	0	0
			1592	1009	272	304	7		
4	N	201	Total	C	N	O	S	0	0
			1625	1028	278	312	7		
4	O	194	Total	C	N	O	S	0	0
			1579	1000	271	301	7		

- Molecule 5 is a protein called DNA ligase 4.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	M	258	Total	C	N	O	S	0	0
			2095	1333	353	396	13		
5	P	246	Total	C	N	O	S	0	0
			1965	1248	330	374	13		

- Molecule 6 is a protein called Non-homologous end-joining factor 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	Q	211	Total	C	N	O	S	0	0
			1690	1084	282	310	14		
6	R	218	Total	C	N	O	S	0	0
			1728	1105	288	320	15		

- Molecule 7 is a DNA chain called DNA (27-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
7	D	27	Total	C	N	O	P	0	0
			556	268	95	166	27		

- Molecule 8 is a DNA chain called DNA (28-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
8	E	28	Total	C	N	O	P	0	0
			576	277	107	164	28		
8	I	28	Total	C	N	O	P	0	0
			576	277	107	164	28		

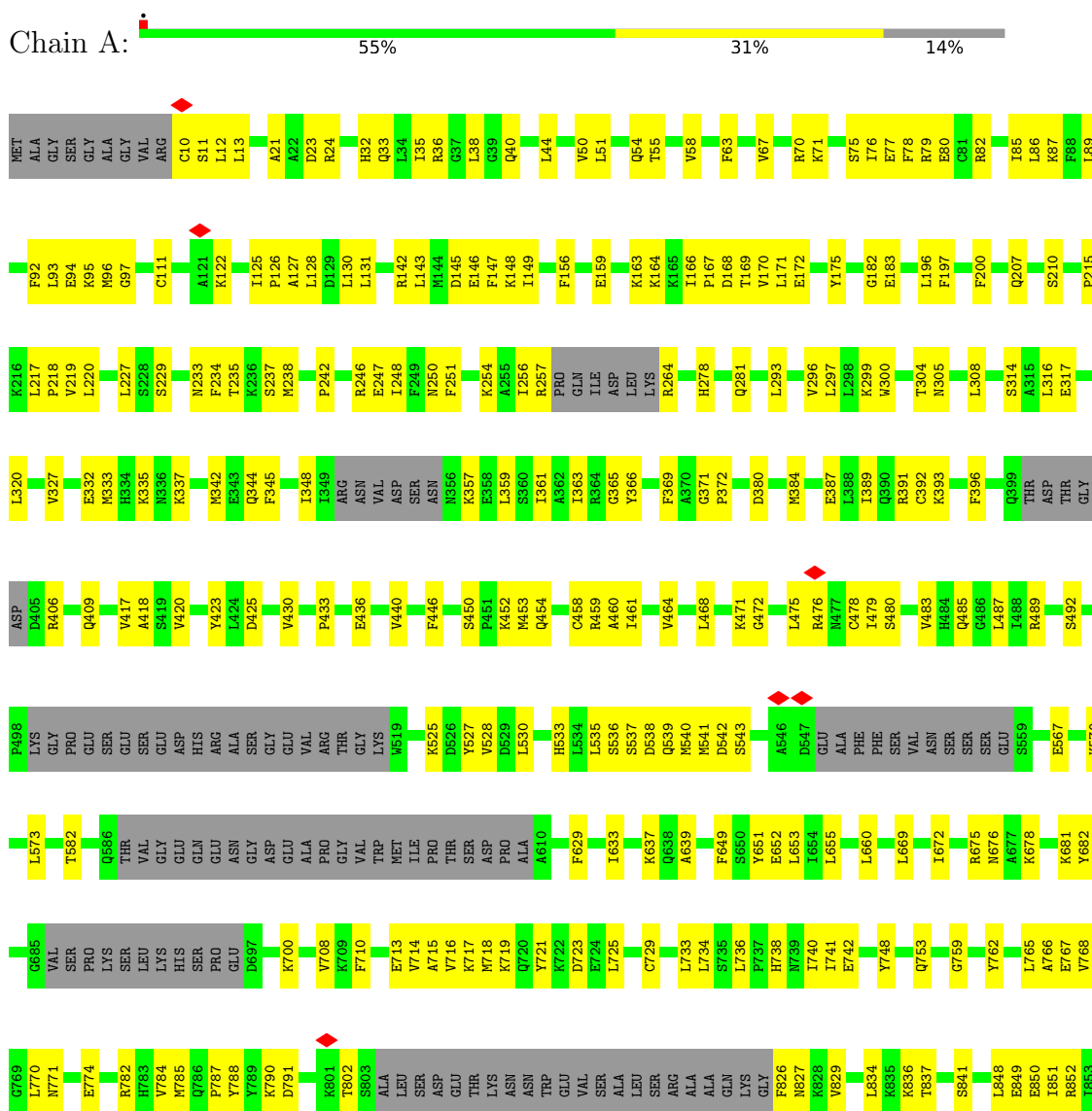
- Molecule 9 is a DNA chain called DNA (27-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
9	J	27	Total	C	N	O	P	0	0
			557	269	94	167	27		

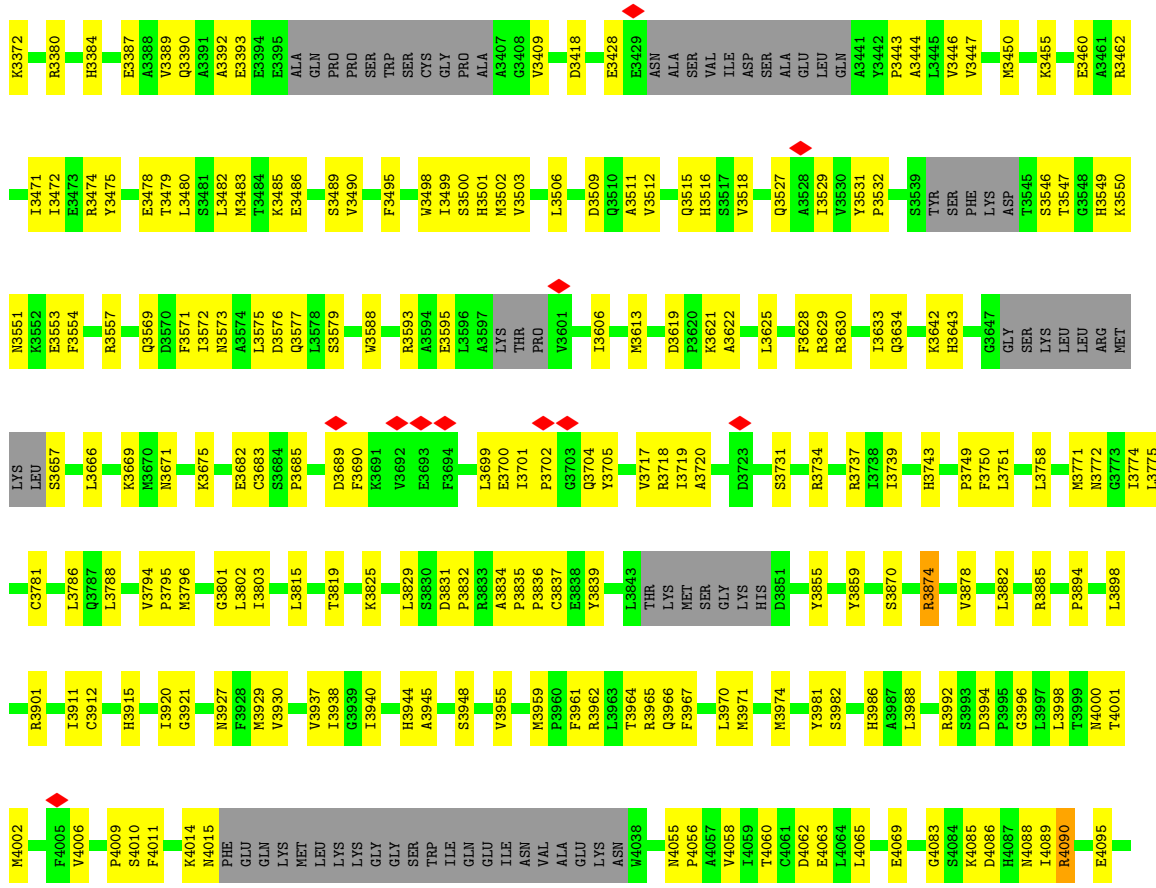
3 Residue-property plots

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.

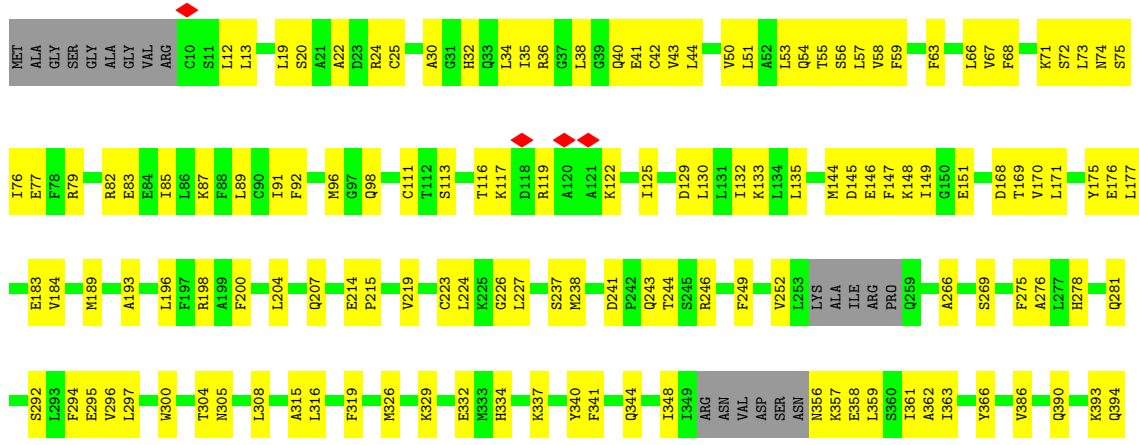
- Molecule 1: DNA-dependent protein kinase catalytic subunit,DNA-dependent protein kinase catalytic subunit,DNA-PKcs



L1934	H935	L1009	F101	L1190	R1274	T1351	L1431	L1517	S1604	H1687	Q1771	SER	L1939
H936	G860	A1012	E102	F1191	A1278	S1352	L1435	F1521	F1605	L1688	H1772	T1862	PHE
S937	S861	I1013	I1106	K1193	L1279	P1353	M1435	F1521	E1606	K1689	H1773	F1863	LEU
V938	L862	G1014	A1112	Y1192	Q1280	G1354	P1439	C1525	E1609	A1692	E1775	I1867	GLY
N941	G863	D1015	L1113	P1196	V1281	H1355	D1440	E1526	A1608	P1697	F1778	T1868	GLY
T946	G864	G1016	L1114	L1197	L1282	H1356	A1441	R1527	Q1610	F1698	K1771	K1869	LEU
N949	Q866	L1017	H1115	L1198	G1283	K1357	A1442	L1528	K1612	F1699	S1781	K1870	LEU
F953	N867	V1018	A1116	R1202	A1286	L1358	V1443	S1530	H1613	THR	R1788	M1871	GLY
P966	K868	R1026	K1119	R1203	Q1287	L1359	D1444	L1531	Q1614	SER	Q1794	Y1874	GLY
P957	M869	D1027	S1120	M1204	S1288	K1361	S1446	L1532	K1617	THR	E1799	L1877	LEU
Y959	L870	F1028	T1123	L1206	L1290	H1366	R1447	S1539	K1617	GLY	E1799	D1878	LEU
Y962	THR	E1034	E1035	V1211	A1293	H1367	V1462	T1540	Q1623	GLY	S1800	M1879	LEU
K963	VAL	R1034	F1036	L1212	V1294	L1368	M1369	ALA	Q1624	SER	Y1801	M1880	GLY
T965	THR	F1036	Y959	L1212	A1295	L1369	R1370	SER	H1625	L1707	Y1802	GLY	GLY
F966	SER	Q1043	Y959	G1216	F1296	V1371	L1372	GLY	W1627	V1713	E1803	R1883	LYS
L969	SER	Q1043	Y959	G1216	F1297	V1371	L1372	SER	K1628	L1714	M1804	L1884	PRO
L972	ASP	P1046	Y962	F1219	E1299	T1375	H1466	SER	W1633	E1715	F1805	P1885	GLY
D975	GLU	Q1047	K963	L1220	E1299	L1467	I1468	GLY	A1634	Q1716	R1806	L1885	LYS
N975	M879	Q1048	T965	F1224	S1300	L1376	L1468	GLY	K1635	L1717	LYS	L1886	ASN
N976	M880	Q1049	T965	F1224	I1301	C1377	P1469	V1550	K1635	I1718	ASP	L1887	LEU
D977	K881	E1050	F966	F1224	A1302	E1378	P1469	V1550	K1635	I1718	ASP	L1887	LEU
N980	W886	K1051	L969	P1232	H1363	I1382	D1474	V1550	E1640	H1721	PRO	L1887	ILE
N981	D887	E1051	L969	P1232	H1363	I1382	L1475	Y1558	E1640	F1721	ARG	L1887	ILE
L1066	R888	V1064	L972	I1235	D1305	G1383	L1475	F1559	K1641	F1722	ARG	L1887	ILE
S1058	R891	S1058	D975	I1235	I1306	F1384	V1479	Y1559	K1642	LEU	LEU	L1887	ILE
K1061	N891	S1058	D975	I1235	I1306	F1384	V1479	Y1559	K1642	LEU	LEU	L1887	ILE
R1062	L892	S1058	D975	I1235	I1306	F1384	V1479	Y1559	K1642	LEU	LEU	L1887	ILE
S1065	S888	S1058	D975	I1235	I1306	F1384	V1479	Y1559	K1642	LEU	LEU	L1887	ILE
L1066	F894	S1058	D975	I1235	I1306	F1384	V1479	Y1559	K1642	LEU	LEU	L1887	ILE
H1069	F898	S1065	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
P1070	R899	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
N1071	E900	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
A1072	M901	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
F1073	K902	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
K1074	P903	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
R1075	P904	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
L1076	I905	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
A1081	V906	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
F1082	L911	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
M1083	L919	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
N1084	T920	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
I1085	A921	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
R1087	S922	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
I1088	D923	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	R924	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	Q1000	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	F1001	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	E1002	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	R924	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	Q925	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	T926	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	K927	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	D1005	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	V1006	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	V1007	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	A1008	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY
H1175	A1008	L1066	N981	T980	F1313	D1397	V1487	M1568	I1652	F1736	L1833	L1833	GLY



- Molecule 1: DNA-dependent protein kinase catalytic subunit, DNA-dependent protein kinase catalytic subunit, DNA-PKcs



T1663	S1664	E1670	T1674	D1685	L1686	H1687	L1688	K1689	G1690	Q1691	T1694	P1697	F1698	F1699	THR	SER	SER	LEU	THR	GLY	GLY	SER	L1707	V1713	L1714	E1715	Q1716	I1717	I1718	H1721	F1722	P1723	M1724	Q1725	S1726	R1727	E1728	F1729	R1735	E1736	M1737	K1642	M1643	K1651	I1655	D1656	S1657	S1658	L1746	D1747	E1565					
V1452	H1465	N1466	I1467	L1468	D1474	L1475	H1476	V1479	E1482	L1483	L1484	V1487	A1492	V1596	L1597	M1598	G1599	M1600	L1601	G1602	Q1603	S1604	F1605	R1606	F1607	R1608	Q1611	K1612	H1613	K1617	I1622	H1625	W1626	K1627	K1628	L1639	E1640	T1641	K1642	M1643	K1651	I1655	D1656	S1657	S1658	L1659	E1565									
W1356	K1357	L1358	K1361	H1367	R1370	V1371	L1372	V1373	L1376	C1377	E1378	P1379	I1382	G1383	F1384	M1385	I1386	G1387	D1388	M1392	Q1603	S1604	F1605	R1606	F1607	R1608	Q1611	K1612	H1613	K1617	I1622	H1625	W1626	K1627	K1628	L1639	E1640	T1641	K1642	M1643	K1651	I1655	D1656	S1657	S1658	L1659	E1565									
P1159	L1163	C1164	L1165	L1168	L1169	K1170	P1171	L1172	H1175	Q1180	L1181	E1182	C1183	R1184	H1185	E1186	S1187	L1190	K1193	F1194	V1195	P1196	L1197	L1198	R1202	S1203	L1204	M1205	L1206	W1211	V1217	S1218	F1219	L1220	F1221	M1222	Q1231	P1232	Q1238	P1239	T1240	LEU	TYR	LEU	LEU	ARG	GLY	PRO								
S1068	L1069	F1069	K1061	R1062	L1063	L1066	H1069	P1070	A1071	F1073	R1074	R1075	F1082	I1085	Y1086	R1087	L1095	V1096	F1099	V1100	F1101	L1104	V1105	A1112	L1113	A1114	H1115	A1116	K1119	S1120	I1131	D1132	H1133	L1134	C1135	R1136	I1137	S1144	A1148	R1151	R1152	L1153	P1154	P1158												
Q865	I866	N867	K868	L871	THR	VAL	THR	SER	SER	ASP	GLY	GLU	THR	L879	M880	K881	E889	K890	R891	F894	F898	R899	E900	M901	P903	V904	I905	D908	V909	H910	F911	L911	V1018	D1019	P1020	W1021	E916	L919	T920	D923	T926	L933	L934	H935	V938	M941	Q953	G954	A955	P956						
G798	K801	T802	S903	ALA	LEU	SER	ASP	GLY	THR	LYS	ASN	TRP	GLU	VAL	SER	LEU	SER	ARG	ALA	GLM	GLN	LYS	GLY	F826	N827	L831	K832	H833	L834	L911	K835	K836	T837	K838	N839	L840	SER	ASN	ASN	GLU	ALA	ILE	S847	R852	I853	R854	M858	L859	G860	S861	G862	G864				
LYS	SER	LEU	LYS	HIS	SER	PRO	GLU	D697	F710	V714	A715	V716	K717	M718	K719	Q720	Y721	L730	T731	F732	L733	L734	S735	L736	I740	V749	Q753	M754	L758	G759	Y762	L765	A766	E767	V768	G769	L770	E774	I778	R782	V784	M785	G885	VAL	SER	PRO	D791									
SER	GLU	SER	GLU	ASP	HIS	ARG	ALA	SER	ALA	VAL	TRP	ARG	THR	THR	GLY	LEU	Y527	E528	D529	R532	L535	S536	S537	Q539	M541	E542	M543	A540	V544	V547	ALA	ALA	PHE	PHE	SER	SER	ASN	ASN	SER	SER	SER	SER	SER	SER	GLU	S559	Y565	D566	E567	L573	L583	E584	I585	L588	THR	VAL
GLY	GLU	GLN	GLU	ASN	ASN	GLY	ASP	GLY	GLU	VAL	TRP	ARG	THR	MET	ILE	PRO	LYS	THR	ASP	PRO	ALA	H610	H613	P614	F629	I633	L634	P635	E636	K637	A639	F642	E643	F649	S650	Y651	L655	R659	L669	I672	T673	M676	K681	G685	VAL	SER	PRO									
M995	K963	L969	D975	Y976	R977	Q978	R981	Q982	L983	Y984	L987	I992	H993	W994	F995	T996	Q1004	D1005	L1010	I1013	L1014	D1015	G1016	I1017	V1018	D1019	P1020	W1021	D1022	S1023	T1024	L1025	R1026	C1029	E1035	F1036	Q1043	I1044	T1045	P1046	Q1047	Q1048	Q1049	I1050	K1051											
F996	S903	ALA	LEU	SER	ASP	GLY	THR	LYS	ASN	TRP	GLU	VAL	SER	LEU	SER	ARG	ALA	GLM	GLN	LYS	GLY	F826	N827	L831	K832	H833	L834	L911	K835	K836	T837	K838	N839	L840	SER	ASN	ASN	GLU	ALA	ILE	S847	R852	I853	R854	M858	L859	G860	S861	G862	G864						

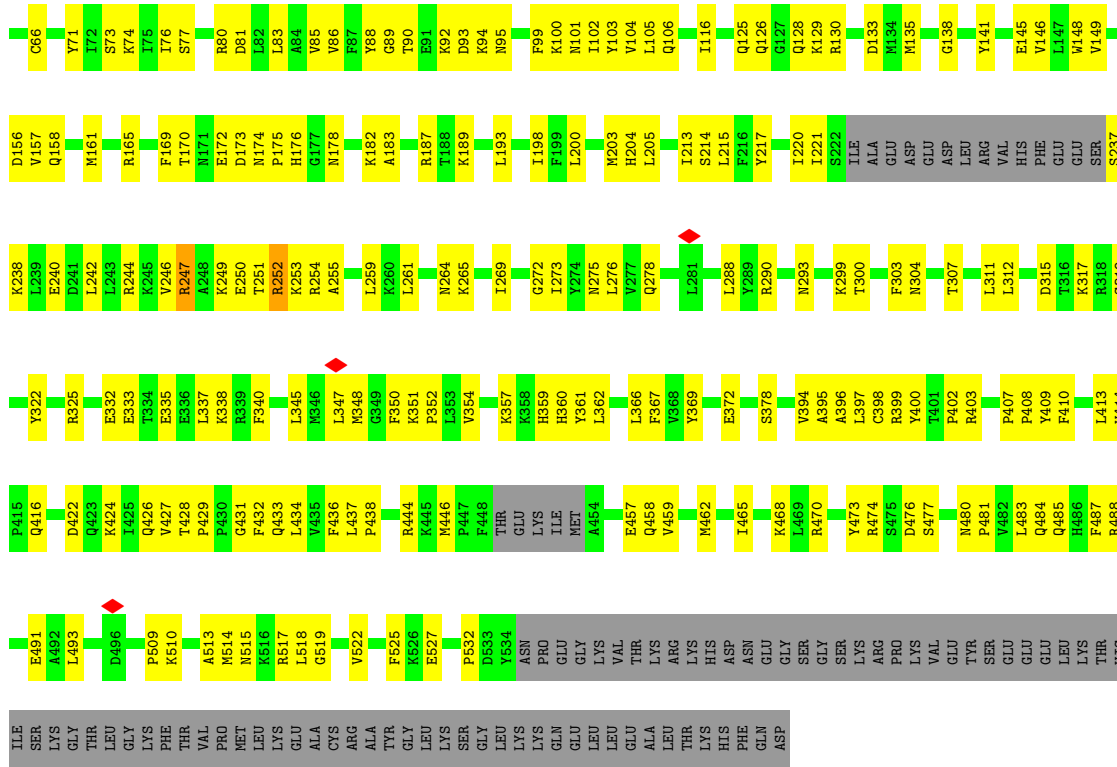
R2940	G2941	L2942	F2943	T2944	L2982	S2985	L2988	A2989	R2962	S2963	D2964	Y2965	S2966	E2967	A2968	R2980	K2978	Q2979	D2980	P2986	T2987	L2990	E2990	K2991	W2994	E2995	L2996	C3001	Y3002	E3007	W3008	K3009	S3010	L3011	E3012	Y3013	C3014	S3015	T3016	E3022	ASN	PRO	PRO	ASP	LEU	ASN	K3029															
L2728	R2729	F2842	R2843	L2844	T2847	F2848	S2849	F2854	L2858	Q2859	A2867	L2868	L2869	A2875	C2880	R2891	K2891	R2891	E2894	E2895	A2896	R2899	L2900	L2901	PRO	ALA	GLU	LEU	PRO	ALA	LYS	ARG	VAL	ARG	ARG	GLY	LYS	K2818	E2819	M2820	D2821	K2822	F2823	K2824	T2825	L2826	S2827	E2828	K2829	M2830	T2833	Q2834	D2839									
F2499	A2381	V2382	L2385	L2386	P2387	K2388	L2396	R2404	V2405	W2408	T2409	L2411	Q2414	L2415	K2418	D2419	R2420	H2426	L2427	D2428	Q2432	I2439	M2443	L2446	L2464	P2465	S2466	C2469	W2479	I2480	H2481	D2482	N2483	D2486	PRO	GLU	SER	GLU	T2491	D2492	PRO	MET	PHE	VAL	L2510	I2511	F2512	Y2517	E2578	H2579	P2580	L2581	C2584	Y2589	T2590	L2591	F2597	T2603	PRO	MET	PHE	VAL
S2308	F2309	V2310	R2311	Y2312	K2313	E2314	V2315	V2316	V2322	L2328	L2328	L2328	C2344	W2345	K2346	Q2347	C2348	L2349	Y2353	L2354	L2355	I2356	F2357	E2358	K2359	F2360	K2361	K2362	N2365	Q2366	K2366	K2369	S2370	F2371	P2372	P2373	L2374	A2375	D2376	R2377	N2380																					
H2222	V2223	F2224	R2225	P2226	K2227	V2230	F2231	I2238	L2241	C2244	W2245	K2246	Q2247	C2248	L2249	Y2253	L2254	L2255	I2256	F2257	E2258	K2259	F2260	K2263	D2264	P2265	K2268	S2271	V2272	G2273	I2274	P2287	Y2288	D2289	P2290	Q2291	C2292	Q2295	E2298	Y2299	F2300	L2301	A2304	M2306	N2307																	
V2138	I2142	R2143	L2146	A2147	I2151	N2152	E2153	E2154	E2155	V2156	F2157	P2158	L2160	A2161	K2162	H2163	W2164	P2167	L2171	A2172	A2173	N2176	ASN	G2179	Y2184	E2188	T2192	W2196	L2199	A2200	T2201	P2202	T2203	D2208	E2209	N2213	R2214	L2215	L2216	M2217	F2218	L2219	M2220																			
THR	GLY	ARG	PHE	ARG	ARG	GLN	GLU	ARG	GLN	ASP	ASP	ASP	VAL	LEU	LEU	LEU	GLU	ASN	R2090	H2091	E2092	C2093	M2094	V2101	L2108	GLY	PRO	PRO	ILE	GLN	GLY	GLU	GLU	ASP	SER	SER	VAL	VAL	PRO	R2120	L2121	L2122	P2123	M2126	H2130	G2131	K2132	L2133	G2134	N2135												
LYS	TYR	ILE	GLU	ILE	ARG	GLY	ALA	ARG	ALA	ALA	ASN	GLY	ASP	ASP	PRO	SER	TYR	LEU	TYR	ASP	LEU	ASP	SER	ASP	THR	GLU	GLU	MET	SER	GLN	PHE	ASP	PHE	THR	THR	ILE	VAL	VAL	VAL	THR	GLN	PHE	GLN	THR	TYR	SER	VAL	TYR	GLU	VAL	LYS											
D1849	V1850	L1851	K1852	SER	ARG	PHE	THR	THR	LYS	LEU	ASN	GLU	GLU	GLU	GLU	GLU	D1878	V1879	M1880	Y1881	F1885	ASP	ASP	ASP	ASP	VAL	HIS	ALA	LYS	ALA	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU	LEU										
S1763	M1767	E1760	L1761	M1762	V1765	L1766	C1767	R1768	E1769	Q1770	Q1771	H1772	V1773	M1774	E1775	F1778	Q1779	S1780	F1781	S1782	R1783	S1790	H2091	T1793	S1800	E1803	L1806	LYS	ASP	ASP	PRO	PRO	ARG	ARG	LEU	PHE	T1815	R1816	Q1817	S1818	F1819	V1820	D1821	R1822	S1823	L1824	A1922	H1830	F1840	V1844												

I3030	I3138	C3286	M3483	D3576	G3678	I3774	E3876	A4091
ASP	F3141	R3287	SER	Q3577	M3679	I3774	S3876	M3984
GLY	F3142	S3288	CYS	L3578	L3680	L3775	S3876	V3985
F3035	I3144	ASP	GLY	L3583	K3681	C3781	L3882	H3986
73036	S3143	PRO	PRO	L3586	E3682	A3785	R3885	R3992
Q3037	F3144	G3292	ALA	K3586	C3683	L3786	A3886	S3993
E3038	I3145	S3294	ALA	D3587	S3684	Q3787	F3887	D3994
73039	S3146	ASP	G3407	W3588	F3685	L3788	V3888	L3997
Y3040	I3147	ARG	G3408	R3589	S3686	R3789	L3889	L3998
S3047	Q3148	MET	V3409	R3593	M3687	S3789	M3889	T3999
Q3149	G3149	GLU	Y3413	R3593	S3688	S3792	M3890	L3999
N3150	N3150	VAL	L3416	A3597	D3689	V3793	S3891	N4000
K3048	L3151	GLN	L3416	LYS	F3690	V3794	T4001	N4001
K3050	S3152	GLN	F3419	THR	F3694	P3795	F4011	F4011
L3051	L3155	GLU	C3420	PRO	L3695	N3796	I3911	D4012
L3052	V3155	D3226	D3421	V3601	L3695	M3796	C3912	D4012
E3056	R3159	Y3229	R3224	K3609	E3700	G3801	H3915	L4013
L3061	I3160	S3229	R3328	A3511	I3701	L3802	H3915	N4014
L3062	L3161	L3230	R3328	D3619	P3702	E3804	G3919	K4014
I3065	T3165	L3231	A3512	P3620	G3703	L3803	I3920	L4014
R3069	N3166	R3232	A3513	K3621	Q3704	N3808	G3921	L4117
L3089	R3167	S3233	A3514	R3629	Y3705	T3809	D3922	L4118
L3089	Y3168	C3234	ALA	R3630	E3714	V3810	R3923	L4119
L3090	P3169	R3238	SER	H3643	I3715	T3811	F3928	L4120
D3097	D3170	K3241	VAL	I3633	H3716	D3814	M3929	W4121
R3098	A3171	M3242	I3633	Q3634	R3718	M3820	V3930	W4121
A3099	D3174	R3244	ALA	Q3634	I3718	E3823	E3933	W4124
K3100	P3175	D3244	ALA	E3639	I3719	E3824	V3937	F4126
I3103	R3176	R3247	GLU	E3647	A3720	K3825	I3938	W4127
F3110	N3177	Q3249	LEU	G3647	D3723	A3826	H3944	W4127
Q3112	N3177	Q3249	GLN	GLY	S3724	A3827	G3947	X6018
S3115	R3186	N3250	GLN	SER	E3724	L3829	V3955	X6023
D3118	R3189	N3251	ASP	LEU	R3725	S3830	L3968	
V3119	L3190	N3251	ASP	LEU	V3726	P3832	M3969	
L3120	S3191	F3252	ASP	LEU	R3733	P3835	R3962	
L3121	E3194	R3253	ASP	LEU	R3734	P3835	I3968	
L3126	L3197	L3254	ASP	LEU	P3735	P3839	N3969	
F3127	THR	A3255	ASP	LEU	K3736	L3843	W3970	
K3128	LEU	L3258	ASP	LEU	R3737	THR	L3971	
L3129	PRO	L3262	ASP	LEU	I3738	LYS	L3972	
Q3130	GLU	S3266	ASP	LEU	I3739	MET	P3973	
Q3133	ASP	K3267	ASP	LEU	I3740	SER	M3974	
K3134	ASN	T3268	ASP	LEU	H3743	LYS	N3975	
K3134	ASN	R3269	ASP	LEU	P3749	LYS	R3976	
T3136	MET	W3272	ASP	LEU	F3750	GLY	L3977	
E3137	ASN	Q3278	ASP	LEU	L3751	LYS	P3977	
	SER	Q3281	ASP	LEU	V3752	HIS	K3975	
	MET	R3282	ASP	LEU	G3755	D3851	E3976	
	ASN	L3283	ASP	LEU	L3758	V3855	M3980	
	VAL	S3284	ASP	LEU	M3771	M3856	V3981	
	ASP	H3285	ASP	LEU	M3772	R3874	S3982	
					G3773		I3983	

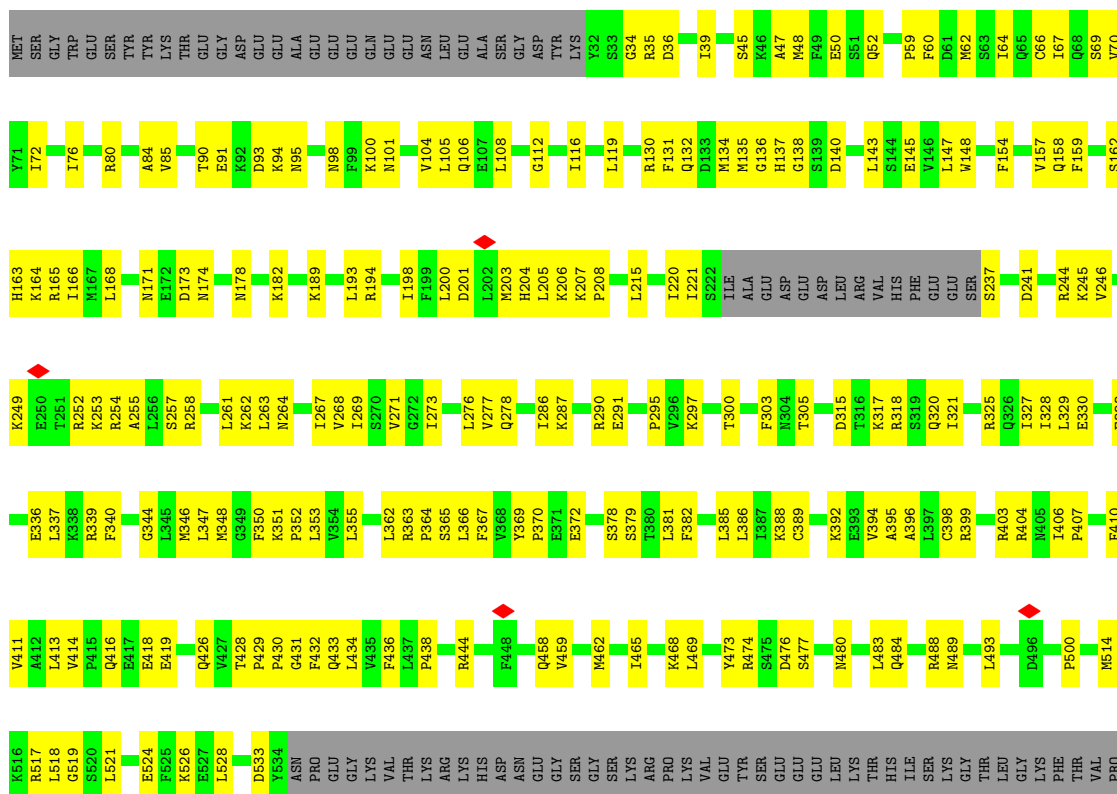
• Molecule 2: X-ray repair cross-complementing protein 6

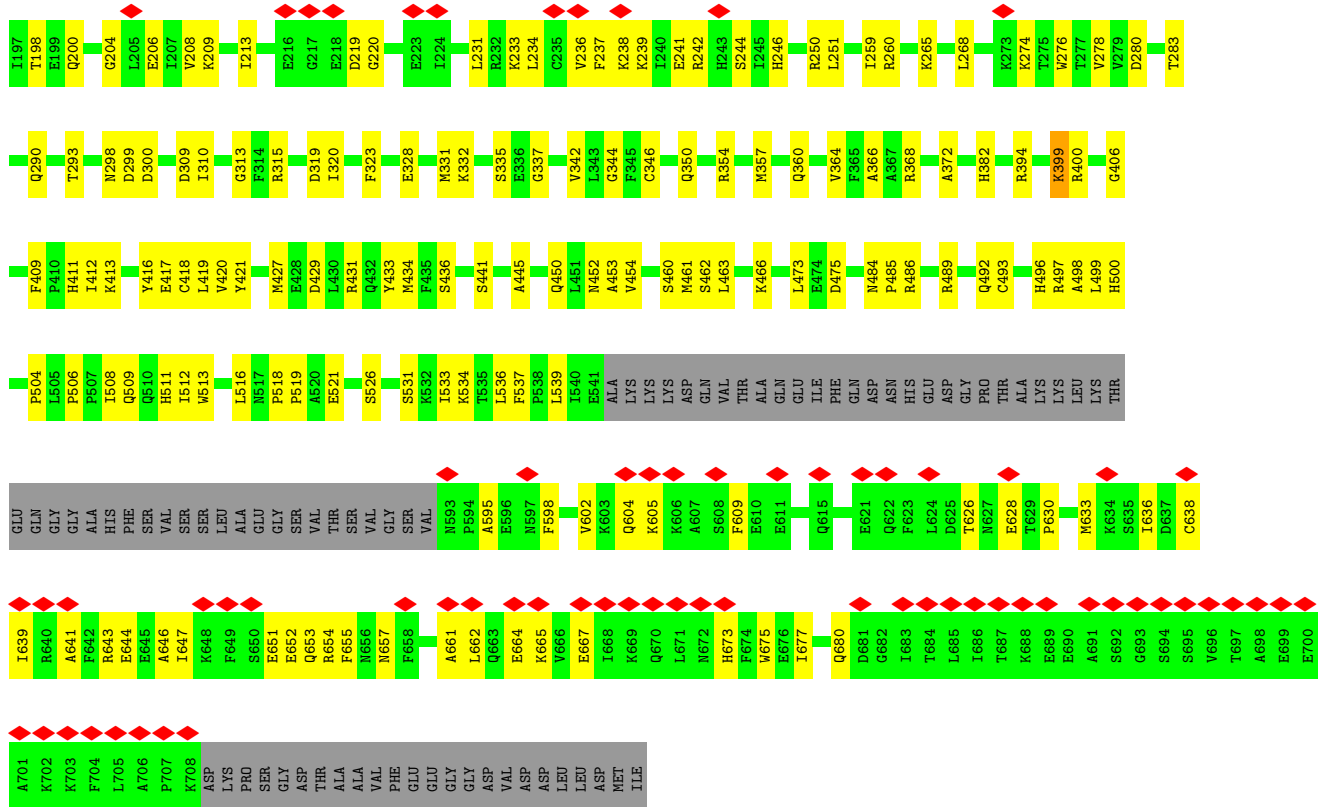


MET	Y32	S45	GLU	T58
SER	S33	M48	SER	F59
TRP	G34	F49	GLN	F60
GLY	R35	V4058	SER	F60
LEU	D36	L4058	GLN	S63
THR	S37	L4065	SER	
GLU	L38	E4069	GLU	
ASP	I39	R4052	ASP	
GLU	F40	D4086	GLU	
LEU	L41	H4087	LEU	
V42	L42	I4088	LEU	
	S45	R4090		

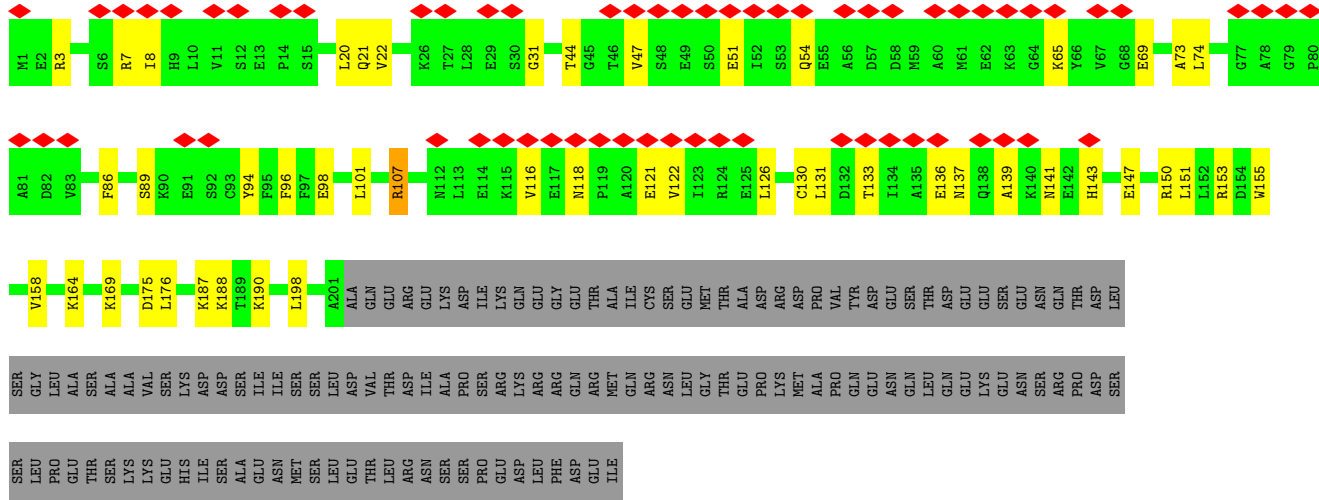


● Molecule 2: X-ray repair cross-complementing protein 6

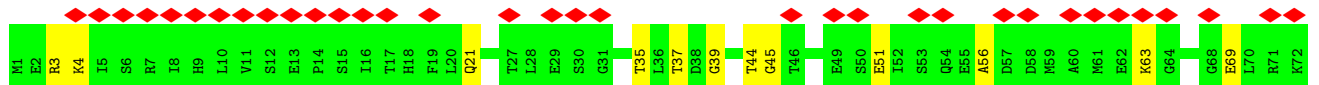


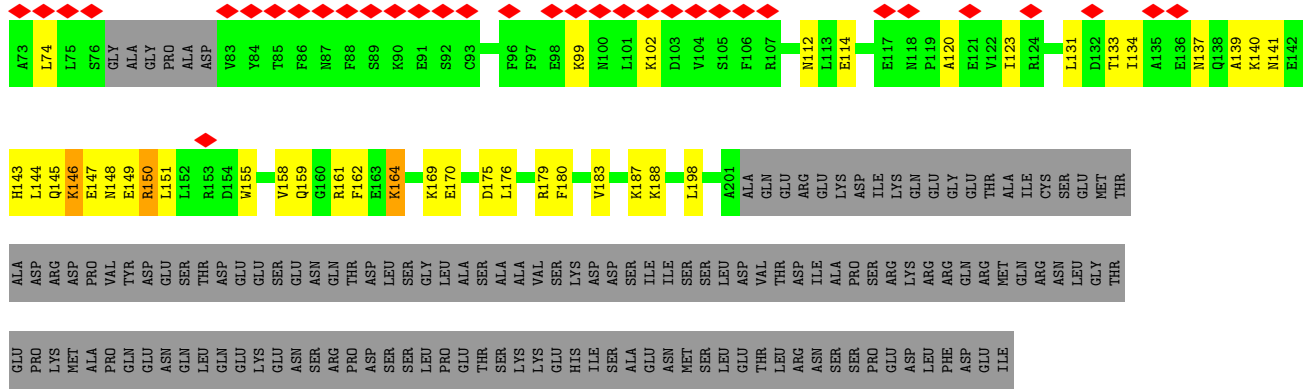


● Molecule 4: DNA repair protein XRCC4

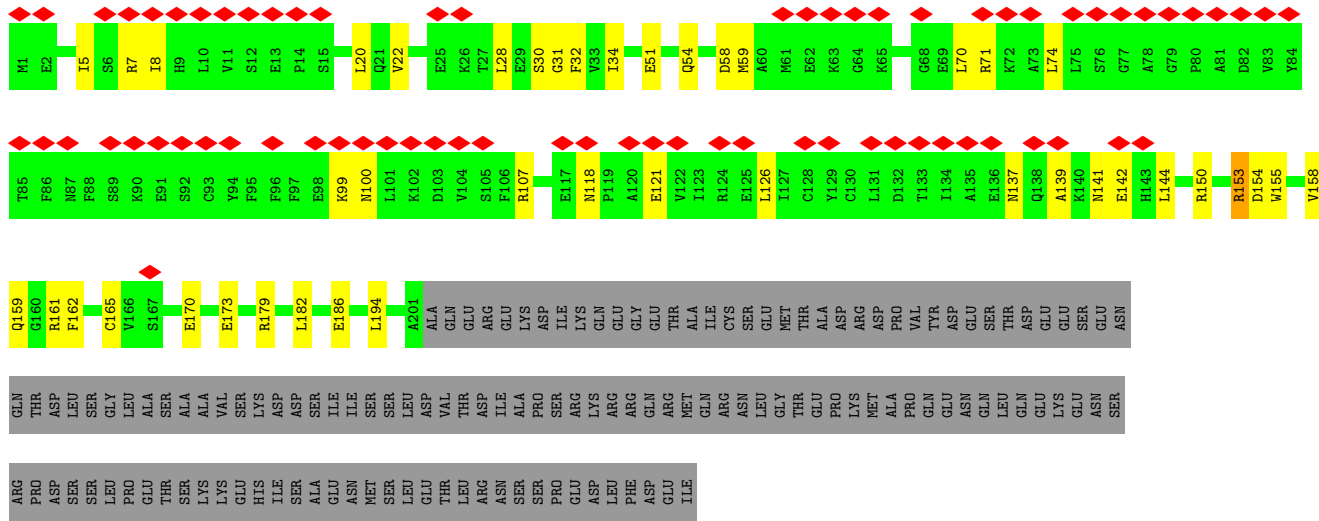


● Molecule 4: DNA repair protein XRCC4

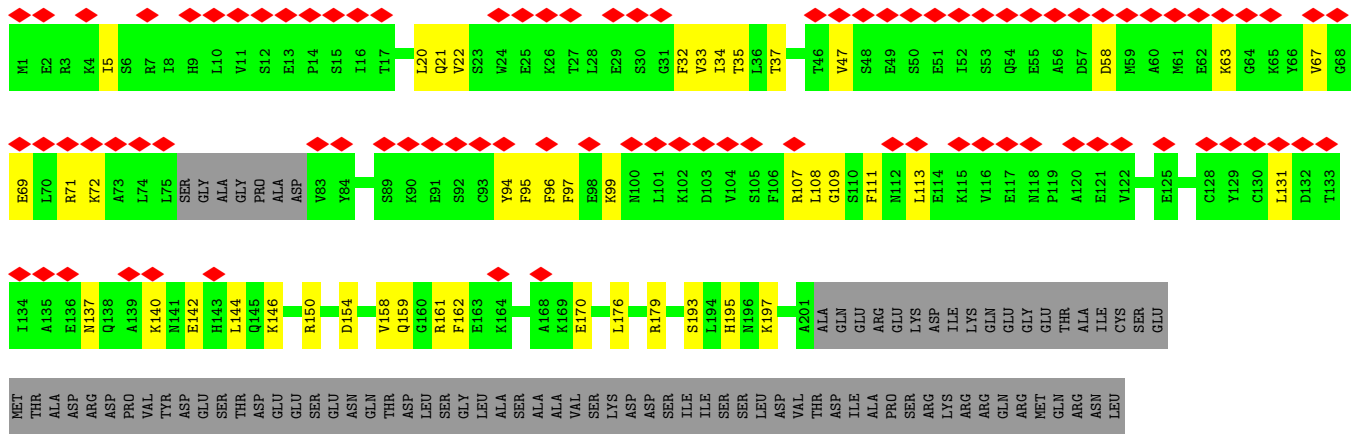


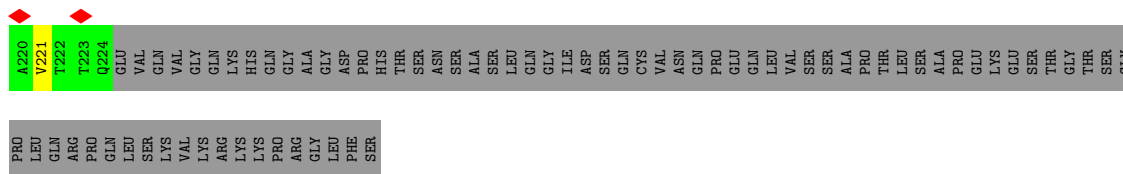


● Molecule 4: DNA repair protein XRCC4

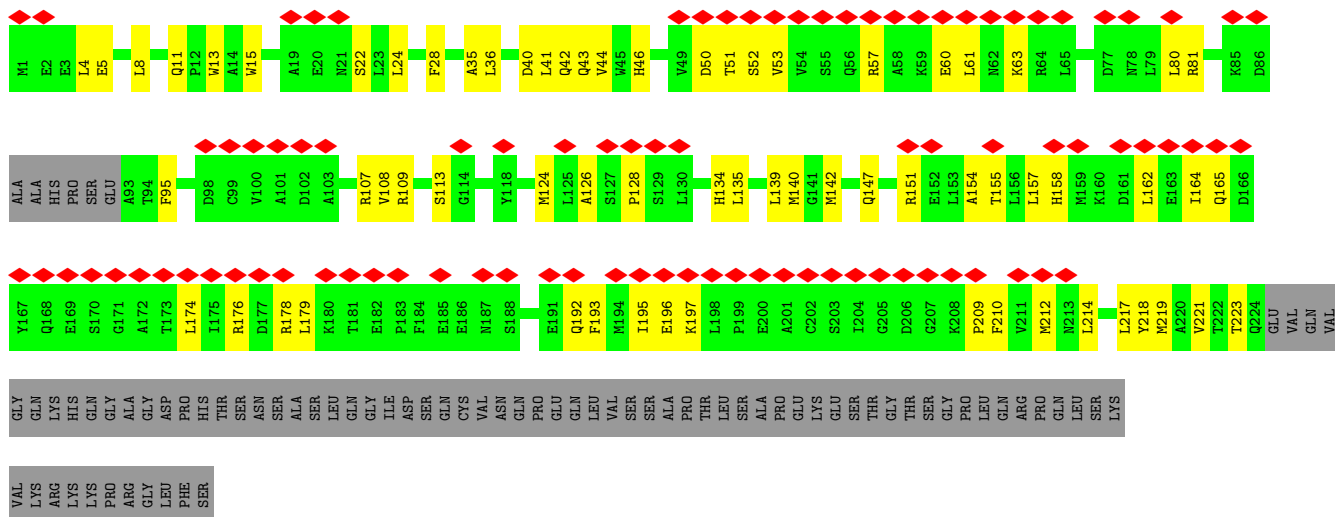


● Molecule 4: DNA repair protein XRCC4

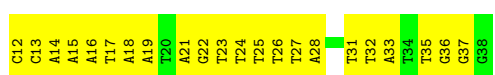




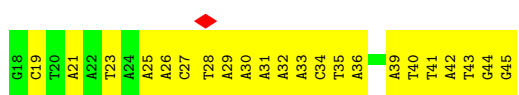
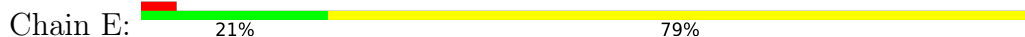
• Molecule 6: Non-homologous end-joining factor 1



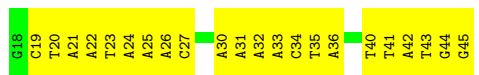
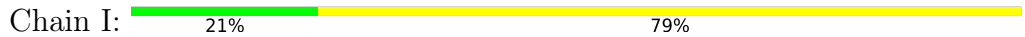
• Molecule 7: DNA (27-MER)



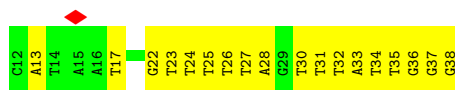
• Molecule 8: DNA (28-MER)



• Molecule 8: DNA (28-MER)



• Molecule 9: DNA (27-MER)



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	23421	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	46.8	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	130000	Depositor
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.695	Depositor
Minimum map value	-0.275	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.024	Depositor
Recommended contour level	0.175	Depositor
Map size (Å)	704.16003, 704.16003, 704.16003	wwPDB
Map dimensions	540, 540, 540	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.304, 1.304, 1.304	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	A	0.27	0/28527	0.47	0/38582
1	F	0.27	0/28510	0.47	1/38552 (0.0%)
2	B	0.26	0/3896	0.50	0/5248
2	G	0.27	0/4025	0.49	0/5421
3	C	0.25	0/3921	0.46	0/5282
3	H	0.26	0/5254	0.47	0/7085
4	K	0.24	0/1654	0.47	0/2224
4	L	0.24	0/1619	0.49	0/2174
4	N	0.24	0/1654	0.47	0/2224
4	O	0.24	0/1605	0.46	0/2155
5	M	0.25	0/2144	0.45	0/2895
5	P	0.28	0/2008	0.48	0/2712
6	Q	0.24	0/1722	0.53	0/2332
6	R	0.24	0/1762	0.51	0/2389
7	D	0.54	0/622	0.96	0/959
8	E	0.55	0/647	0.96	0/996
8	I	0.59	0/647	0.95	0/996
9	J	0.53	0/623	1.02	0/961
All	All	0.28	0/90840	0.50	1/123187 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	956	PRO	N-CA-CB	6.22	110.77	103.30

There are no chirality outliers.

There are no planarity outliers.

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	A	28076	0	28047	898	0
1	F	28060	0	28056	856	0
2	B	3822	0	3899	176	0
2	G	3948	0	4036	181	0
3	C	3849	0	3892	121	0
3	H	5150	0	5176	173	0
4	K	1625	0	1611	40	0
4	L	1592	0	1583	45	0
4	N	1625	0	1611	35	0
4	O	1579	0	1571	39	0
5	M	2095	0	2046	42	0
5	P	1965	0	1904	74	0
6	Q	1690	0	1699	51	0
6	R	1728	0	1728	62	0
7	D	556	0	310	35	0
8	E	576	0	318	28	0
8	I	576	0	318	34	0
9	J	557	0	311	29	0
All	All	89069	0	88116	2724	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 15.

The worst 5 of 2724 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)
1:A:1549:SER:O	1:A:1550:VAL:HG22	1.17	1.29
1:A:1549:SER:O	1:A:1550:VAL:CG2	2.04	1.05
3:H:56:LEU:H	3:H:81:ARG:HB2	1.39	0.88
1:A:327:VAL:HG13	1:A:333:MET:HB2	1.58	0.85
5:P:811:SER:HB2	5:P:849:GLY:HA3	1.57	0.84

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	3474/4148 (84%)	3222 (93%)	248 (7%)	4 (0%)	51	85
1	F	3467/4148 (84%)	3198 (92%)	265 (8%)	4 (0%)	51	85
2	B	468/609 (77%)	430 (92%)	37 (8%)	1 (0%)	47	80
2	G	485/609 (80%)	460 (95%)	25 (5%)	0	100	100
3	C	465/732 (64%)	445 (96%)	20 (4%)	0	100	100
3	H	636/732 (87%)	597 (94%)	39 (6%)	0	100	100
4	K	199/336 (59%)	195 (98%)	4 (2%)	0	100	100
4	L	191/336 (57%)	184 (96%)	7 (4%)	0	100	100
4	N	199/336 (59%)	191 (96%)	8 (4%)	0	100	100
4	O	190/336 (56%)	182 (96%)	8 (4%)	0	100	100
5	M	256/911 (28%)	239 (93%)	17 (7%)	0	100	100
5	P	242/911 (27%)	225 (93%)	16 (7%)	1 (0%)	34	71
6	Q	205/299 (69%)	185 (90%)	20 (10%)	0	100	100
6	R	214/299 (72%)	200 (94%)	14 (6%)	0	100	100
All	All	10691/14742 (72%)	9953 (93%)	728 (7%)	10 (0%)	54	85

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	2291	GLN
1	F	955	ALA
1	F	956	PRO
1	F	2291	GLN
1	A	1550	VAL

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	A	3054/3671 (83%)	3040 (100%)	14 (0%)	88	93
1	F	3058/3671 (83%)	3048 (100%)	10 (0%)	92	95
2	B	427/548 (78%)	425 (100%)	2 (0%)	88	93
2	G	444/548 (81%)	444 (100%)	0	100	100
3	C	434/649 (67%)	432 (100%)	2 (0%)	88	93
3	H	575/649 (89%)	573 (100%)	2 (0%)	92	95
4	K	179/303 (59%)	178 (99%)	1 (1%)	86	92
4	L	177/303 (58%)	174 (98%)	3 (2%)	60	78
4	N	179/303 (59%)	177 (99%)	2 (1%)	73	84
4	O	175/303 (58%)	175 (100%)	0	100	100
5	M	234/808 (29%)	232 (99%)	2 (1%)	78	88
5	P	217/808 (27%)	214 (99%)	3 (1%)	67	80
6	Q	187/262 (71%)	186 (100%)	1 (0%)	88	93
6	R	191/262 (73%)	189 (99%)	2 (1%)	76	86
All	All	9531/13088 (73%)	9487 (100%)	44 (0%)	89	93

5 of 44 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	H	332	LYS
5	M	883	LYS
3	H	399	LYS
4	L	150	ARG
4	N	153	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 49 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	2217	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	F	2834	GLN
1	F	2291	GLN
1	F	2365	ASN
1	F	3704	GLN

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](#)

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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	F	1
1	A	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	F	4128:MET	C	6004:UNK	N	90.10
1	A	4128:MET	C	6004:UNK	N	89.52

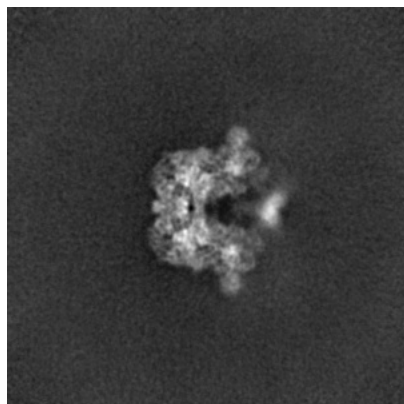
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-12299. These allow visual inspection of the internal detail of the map and identification of artifacts.

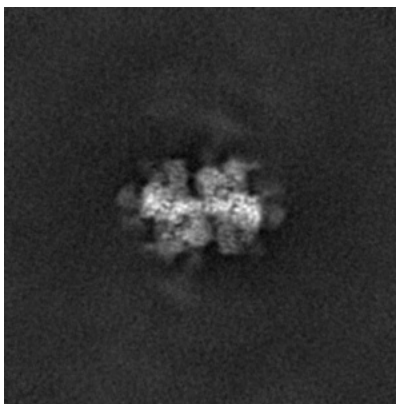
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

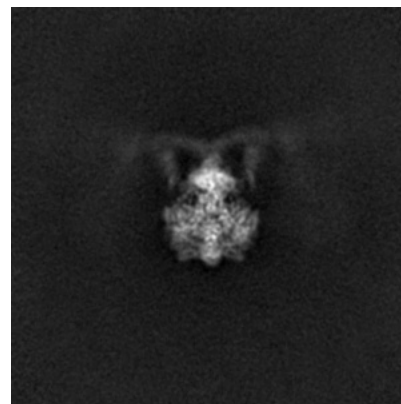
6.1.1 Primary map



X

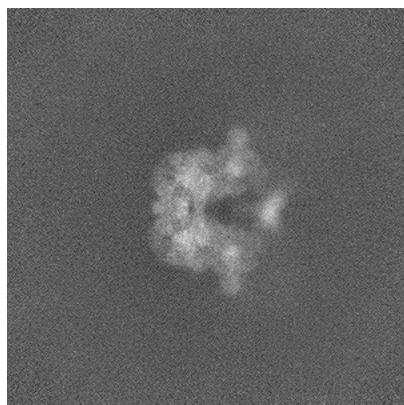


Y

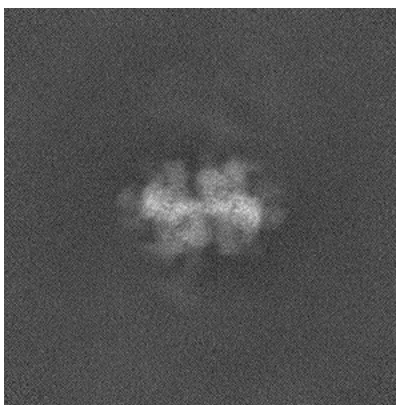


Z

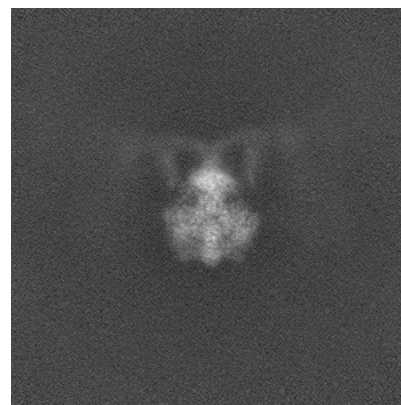
6.1.2 Raw map



X



Y

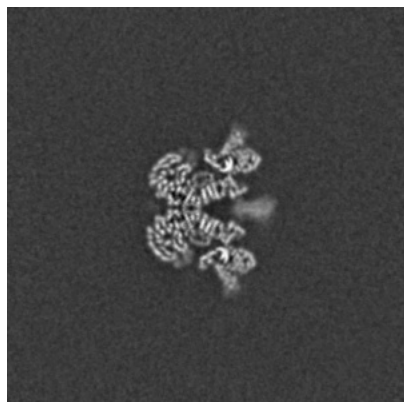


Z

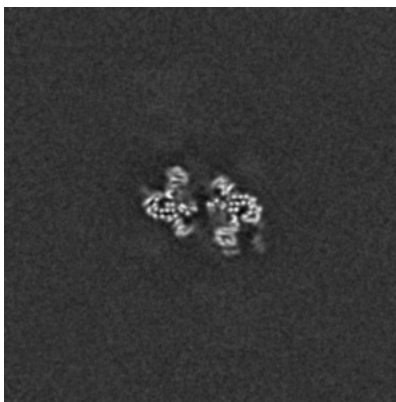
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

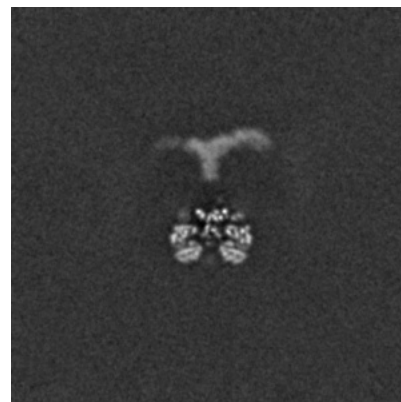
6.2.1 Primary map



X Index: 270

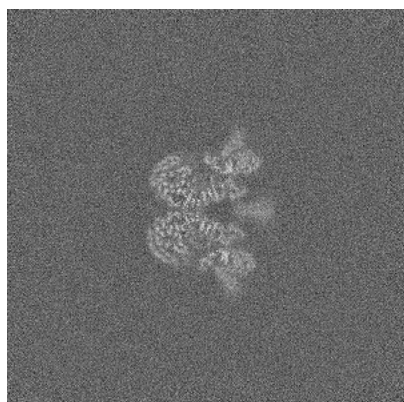


Y Index: 270

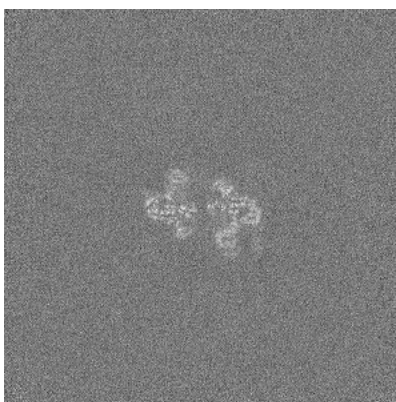


Z Index: 270

6.2.2 Raw map



X Index: 270



Y Index: 270

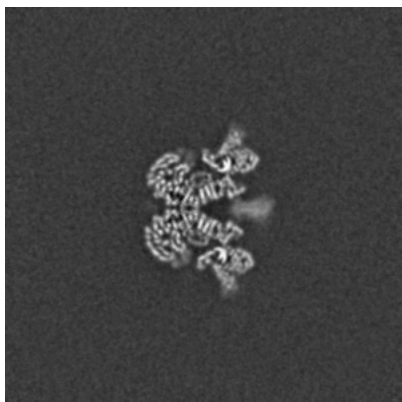


Z Index: 270

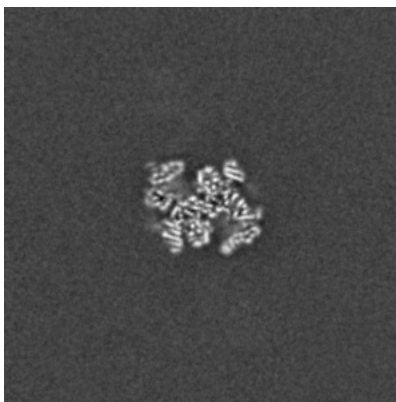
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

6.3.1 Primary map



X Index: 270

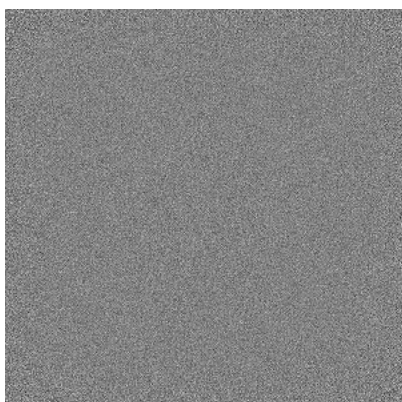


Y Index: 241

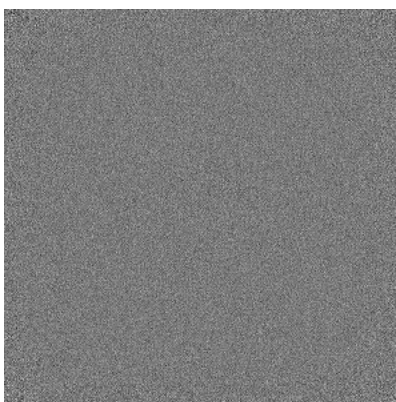


Z Index: 313

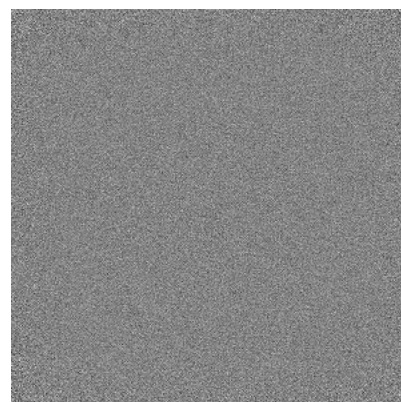
6.3.2 Raw map



X Index: 0



Y Index: 0

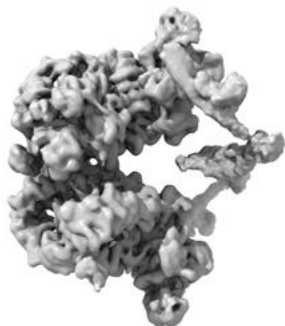


Z Index: 0

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

6.4 Orthogonal surface views [i](#)

6.4.1 Primary map



X



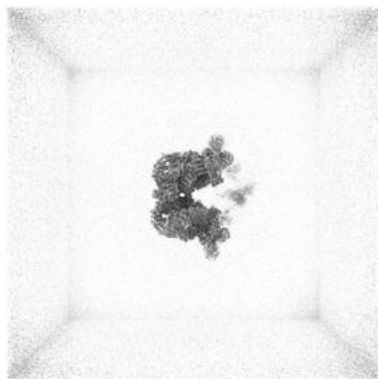
Y



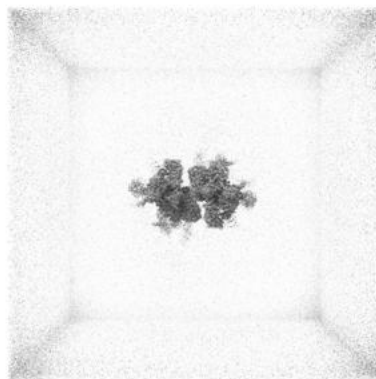
Z

The images above show the 3D surface view of the map at the recommended contour level 0.175. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

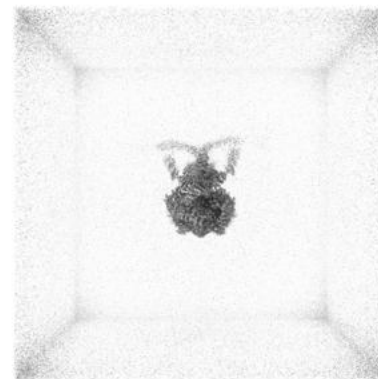
6.4.2 Raw map



X



Y



Z

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.

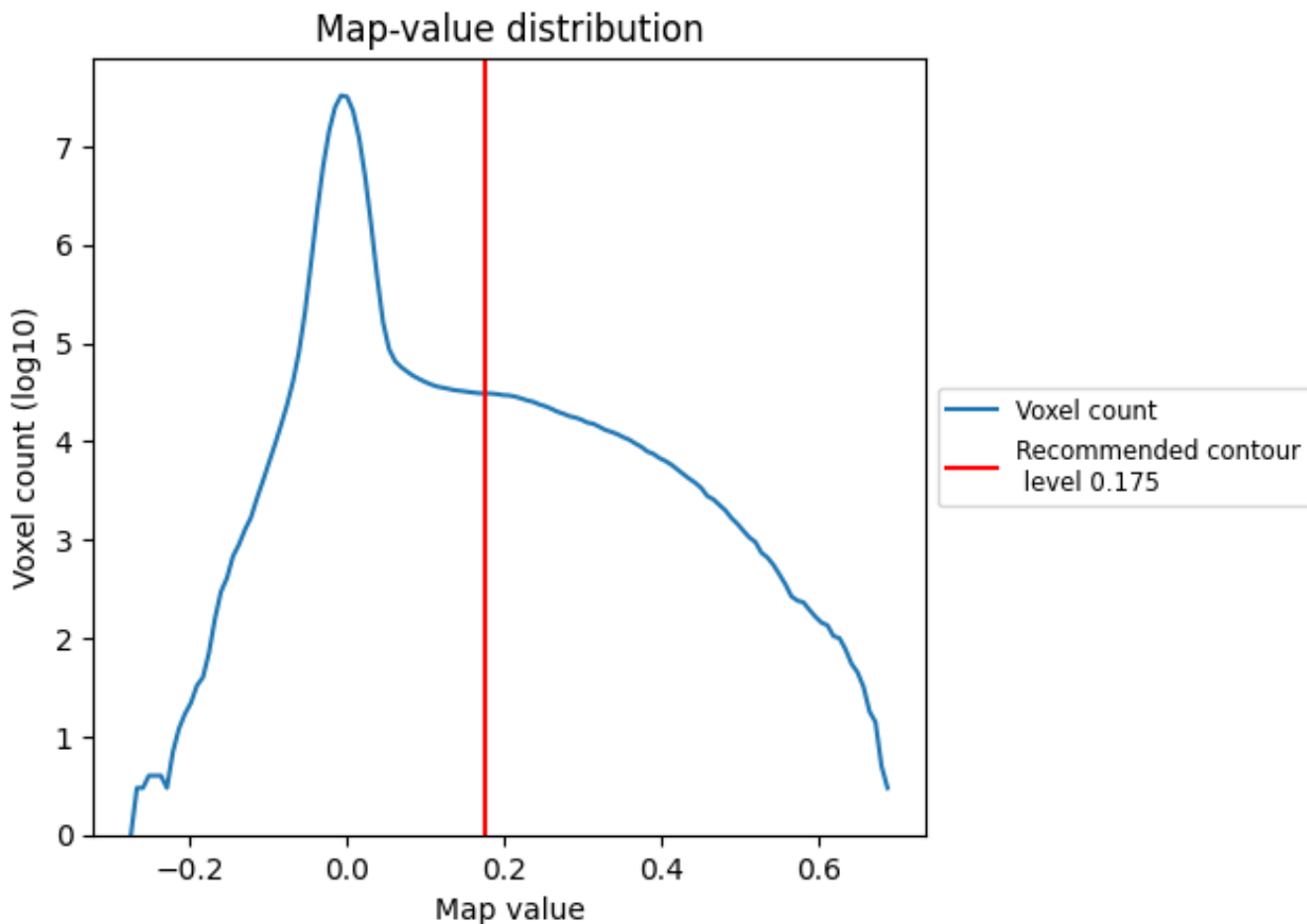
6.5 Mask visualisation [i](#)

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

7 Map analysis [i](#)

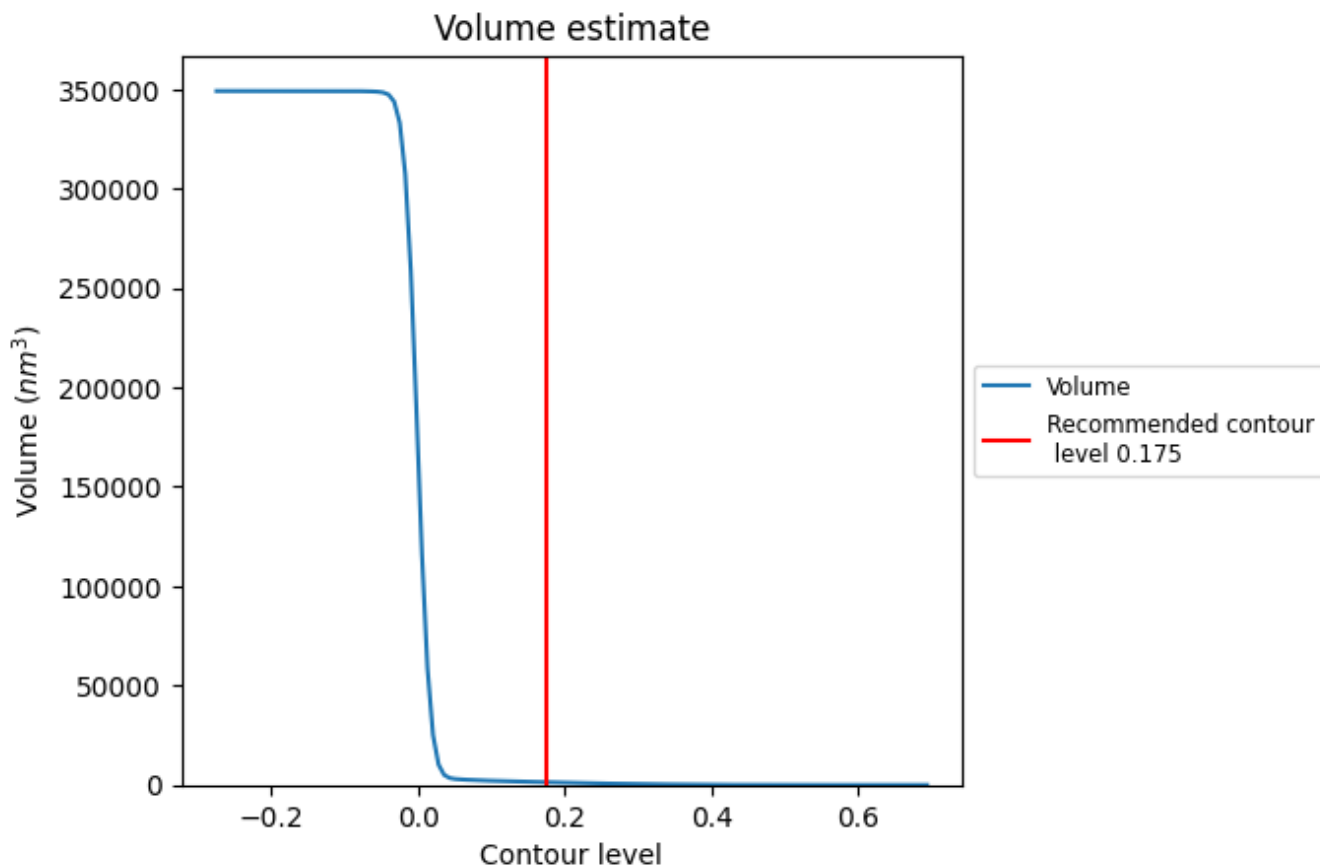
This section contains the results of statistical analysis of the map.

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.

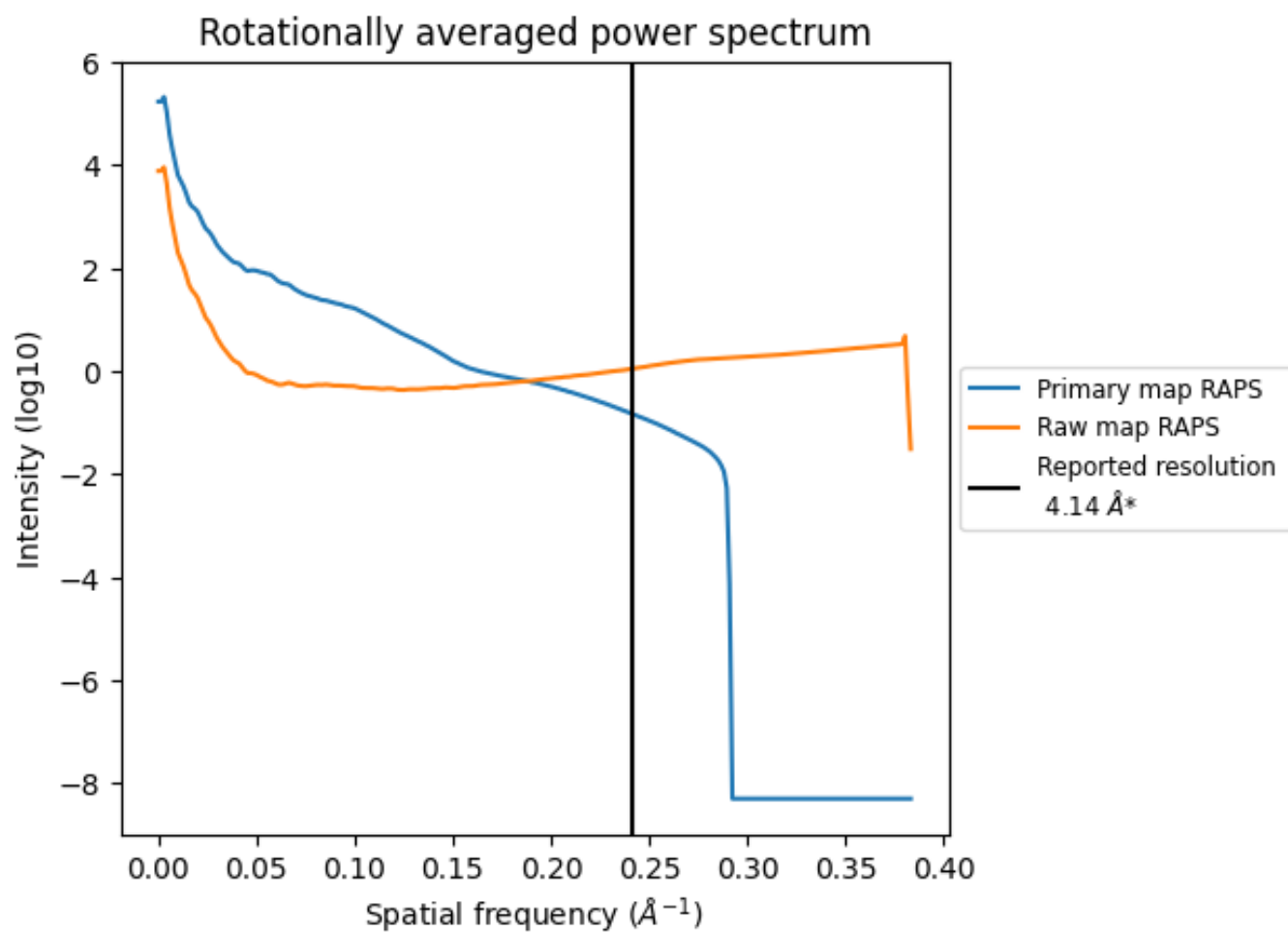
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 1371 nm³; this corresponds to an approximate mass of 1239 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

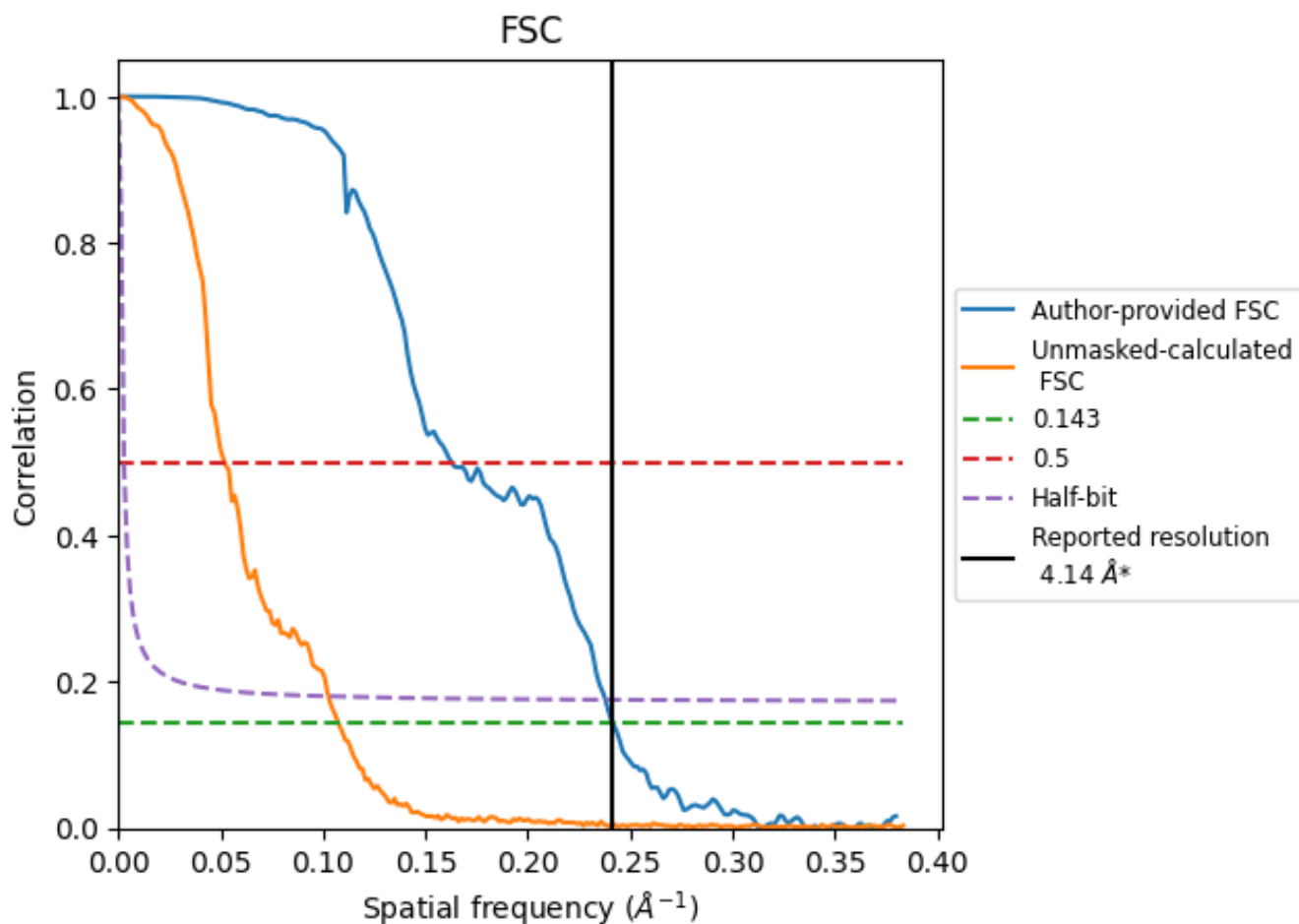


*Reported resolution corresponds to spatial frequency of 0.242 \AA^{-1}

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 0.242 Å⁻¹

8.2 Resolution estimates [i](#)

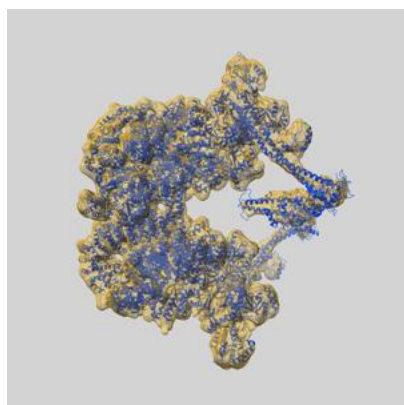
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.14	-	-
Author-provided FSC curve	4.14	6.14	4.20
Unmasked-calculated*	9.30	19.27	9.74

*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 9.30 differs from the reported value 4.14 by more than 10 %

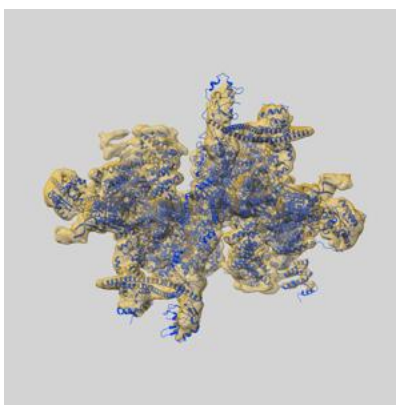
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-12299 and PDB model 7NFC. Per-residue inclusion information can be found in section 3 on page 6.

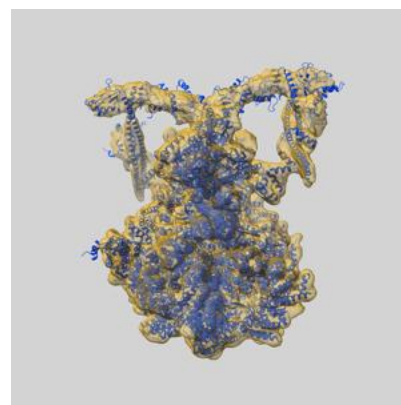
9.1 Map-model overlay [i](#)



X



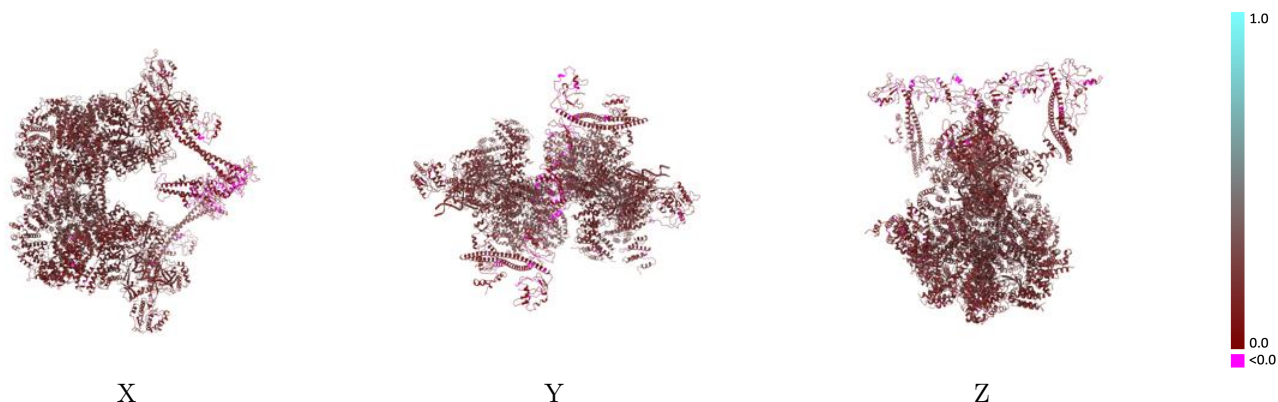
Y



Z

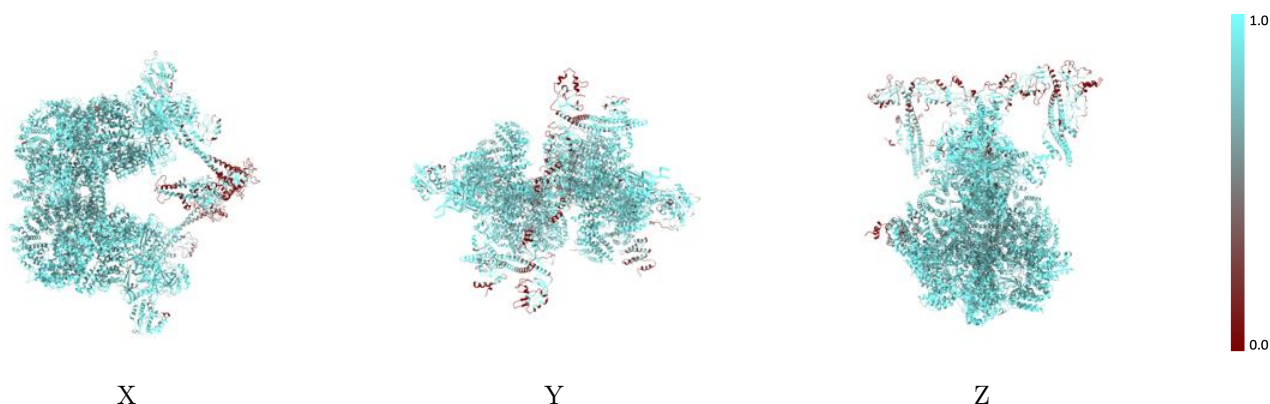
The images above show the 3D surface view of the map at the recommended contour level 0.175 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



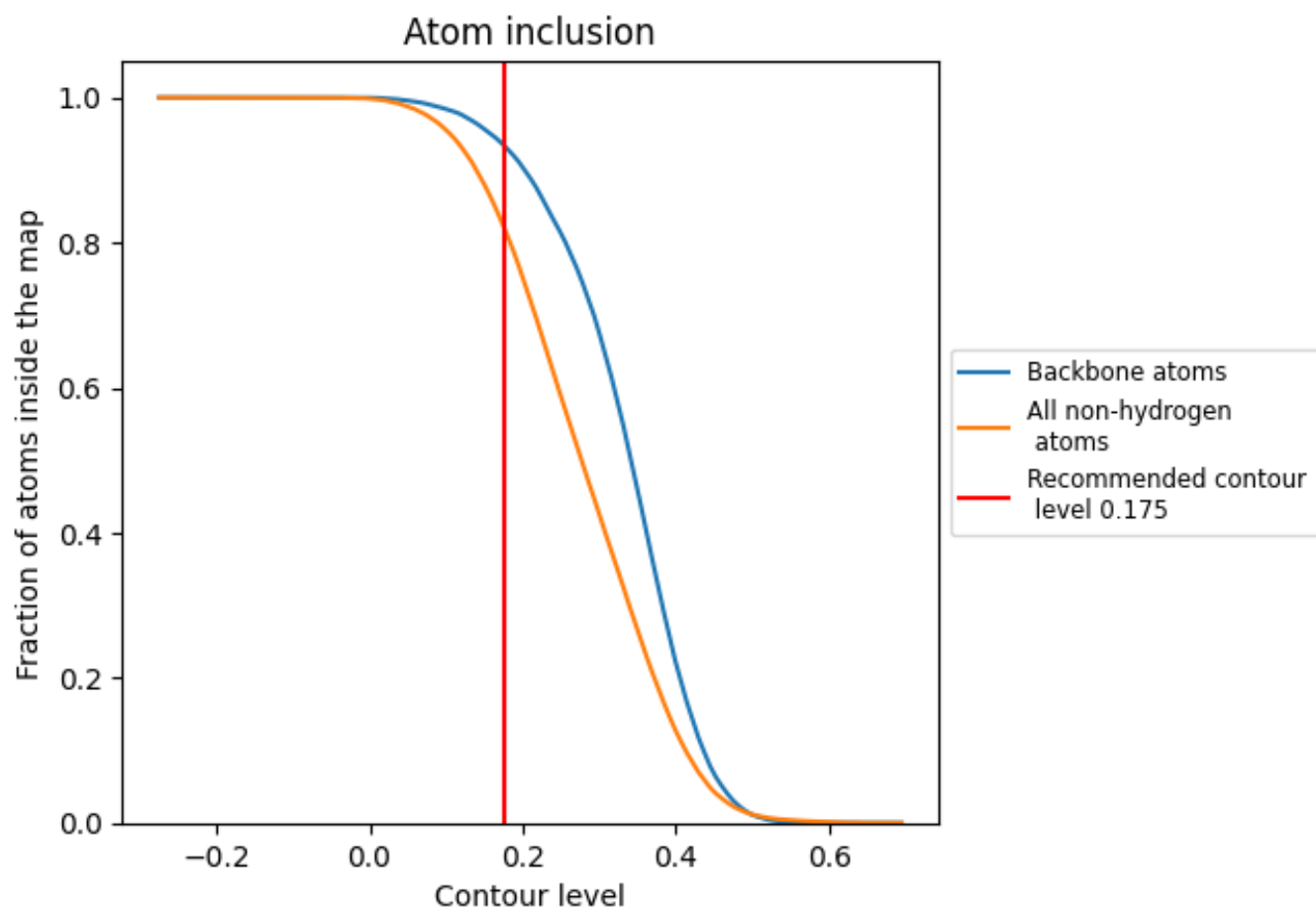
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.175).







































9.4 Atom inclusion [i](#)



At the recommended contour level, 93% of all backbone atoms, 82% 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 (0.175) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8224	 0.2000
A	 0.8612	 0.2150
B	 0.8785	 0.2140
C	 0.8575	 0.2000
D	 0.9191	 0.2360
E	 0.9288	 0.2190
F	 0.8628	 0.2170
G	 0.8787	 0.2170
H	 0.7593	 0.1840
I	 0.9288	 0.2420
J	 0.9318	 0.2470
K	 0.6287	 0.1220
L	 0.5850	 0.1210
M	 0.7294	 0.1570
N	 0.5899	 0.1080
O	 0.5000	 0.1150
P	 0.8410	 0.1680
Q	 0.5409	 0.1000
R	 0.5341	 0.0830

