# WORLDWIDE PDB

## PROTEIN DATA BANK

# Full wwPDB EM Validation Report (i)

Mar 5, 2024 – 10:40 AM EST

|  |  |  |
|---|---|---|
| PDB ID | : | 6MUX |
| EMDB ID | : | EMD-9259 |
| Title | : | The structure of the Plasmodium falciparum 20S proteasome in complex with one PA28 activator |
| Authors | : | Metcalfe, R.D.; Xie, S.C.; Hanssen, E.; Gillett, D.L.; Leis, A.P.; Tilley, L.; Griffin, M.D.W. |
| Deposited on | : | 2018-10-23 |
| Resolution | : | 3.90 Å(reported) |
| Based on initial models | : | 6MUW, 6DFK |

This is a Full wwPDB EM Validation 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 (i) 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 (i)) were used in the production of this report:
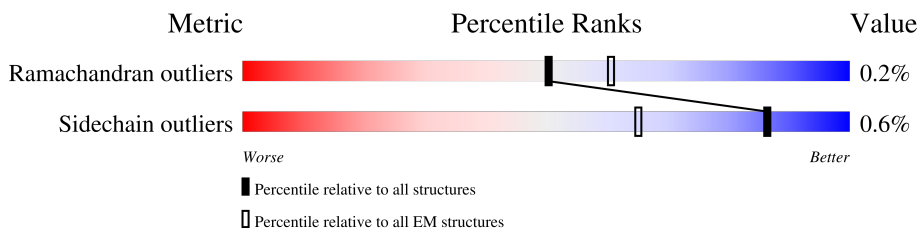
|  |  |  |
|---|---|---|
| EMDB validation analysis | : | 0.0.1.dev70 |
| MolProbity | : | 4.02b-467 |
| Percentile statistics | : | 20191225.v01 (using entries in the PDB archive December 25th 2019) |
| MapQ | : | 1.9.13 |
| Ideal geometry (proteins) | : | Engh & Huber (2001) |
| Ideal geometry (DNA, RNA) | : | Parkinson et al. (1996) |
| Validation Pipeline (wwPDB-VP) | : | 2.36 |

# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
*ELECTRON MICROSCOPY*

The reported resolution of this entry is 3.90 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 | Percentile Ranks | Value |
|--------|------------------|-------|
| Ramachandran outliers | | 0.2% |
| Sidechain outliers | | 0.6% |

*Worse*                  *Better*

▮ Percentile relative to all structures

▯ Percentile relative to all EM structures

| Metric | Whole archive (#Entries) | EM structures (#Entries) |
|--------|:---:|:---:|
| 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 <=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 | 260 | 11%   93%   6% |
| 1 | O | 260 | 19%   93%   6% |
| 2 | B | 235 | 7%   95%   5% |
| 2 | P | 235 | 9%   97%   • |
| 3 | C | 246 | 10%   97%   • • |
| 3 | Q | 246 | 9%   98%   • |
| 4 | D | 241 | 10%   93%   • 6% |
| 4 | R | 241 | 10%   96%   • • |
| 5 | E | 256 | 11%   88%   • 11% |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Length | Quality of chain |
|-----|-------|--------|------------------|
| 5 | S | 256 | 13% / 89% / 11% |
| 6 | F | 254 | 9% / 92% / 7% |
| 6 | T | 254 | 11% / 90% / 8% |
| 7 | G | 252 | 6% / 90% / 8% |
| 7 | U | 252 | 10% / 91% / 8% |
| 8 | H | 252 | 8% / 75% / 23% |
| 8 | V | 252 | 6% / 76% / 23% |
| 9 | I | 229 | 10% / 93% |
| 9 | W | 229 | 9% / 94% |
| 10 | J | 218 | 92% / 7% |
| 10 | X | 218 | 93% / 7% |
| 11 | K | 195 | 100% |
| 11 | Y | 195 | 100% |
| 12 | L | 211 | 96% |
| 12 | Z | 211 | 95% |
| 13 | M | 240 | 87% / 12% |
| 13 | a | 240 | 87% / 12% |
| 14 | N | 265 | 6% / 83% / 15% |
| 14 | b | 265 | 6% / 84% / 15% |
| 15 | c | 279 | 47% / 65% / 33% |
| 15 | d | 279 | 61% / 67% / 32% |
| 15 | e | 279 | 59% / 66% / 33% |
| 15 | f | 279 | 59% / 67% / 32% |
| 15 | g | 279 | 53% / 67% / 32% |
| 15 | h | 279 | 48% / 66% / 32% |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Length | Quality of chain |
|-----|-------|--------|------------------|
| 15 | i | 279 | 42% ... 67% ... 32% |

# 2 Entry composition ⓘ

There are 15 unique types of molecules in this entry. The entry contains 60284 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 20S proteasome alpha-1 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 244 | Total 1928 | C 1213 | N 323 | O 377 | S 15 | 0 | 0 |
| 1 | O | 244 | Total 1928 | C 1213 | N 323 | O 377 | S 15 | 0 | 0 |

- Molecule 2 is a protein called 20S proteasome alpha-2 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 2 | B | 224 | Total 1782 | C 1146 | N 293 | O 337 | S 6 | 0 | 0 |
| 2 | P | 229 | Total 1826 | C 1175 | N 298 | O 347 | S 6 | 0 | 0 |

- Molecule 3 is a protein called 20S proteasome alpha-3 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 3 | C | 240 | Total 1918 | C 1230 | N 308 | O 377 | S 3 | 0 | 0 |
| 3 | Q | 245 | Total 1965 | C 1258 | N 319 | O 385 | S 3 | 0 | 0 |

- Molecule 4 is a protein called 20S proteasome alpha-4 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 4 | D | 227 | Total 1795 | C 1147 | N 303 | O 337 | S 8 | 0 | 0 |
| 4 | R | 233 | Total 1845 | C 1178 | N 312 | O 347 | S 8 | 0 | 0 |

- Molecule 5 is a protein called 20S proteasome alpha-5 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 5 | E | 227 | Total 1760 | C 1109 | N 291 | O 350 | S 10 | 0 | 0 |
| 5 | S | 228 | Total 1767 | C 1115 | N 292 | O 349 | S 11 | 0 | 0 |

- Molecule 6 is a protein called 20S proteasome alpha-6 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 6 | F | 235 | Total 1870 | C 1191 | N 308 | O 361 | S 10 | 0 | 0 |
| 6 | T | 234 | Total 1858 | C 1182 | N 307 | O 359 | S 10 | 0 | 0 |

- Molecule 7 is a protein called 20S proteasome alpha-7 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 7 | G | 233 | Total 1906 | C 1215 | N 319 | O 360 | S 12 | 0 | 0 |
| 7 | U | 233 | Total 1906 | C 1215 | N 319 | O 360 | S 12 | 0 | 0 |

- Molecule 8 is a protein called 20S proteasome beta-1 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 8 | H | 194 | Total 1547 | C 978 | N 265 | O 292 | S 12 | 0 | 0 |
| 8 | V | 194 | Total 1547 | C 978 | N 265 | O 292 | S 12 | 0 | 0 |

- Molecule 9 is a protein called 20S proteasome beta-2 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 9 | I | 219 | Total 1676 | C 1058 | N 291 | O 313 | S 14 | 0 | 0 |
| 9 | W | 219 | Total 1676 | C 1058 | N 291 | O 313 | S 14 | 0 | 0 |

- Molecule 10 is a protein called 20S proteasome beta-3 subunit.

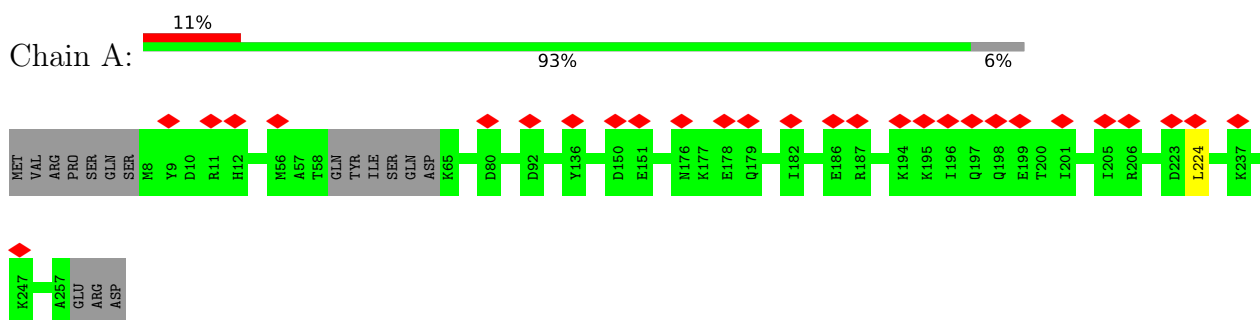| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|
| 10 | J | 203 | Total 1595 | C 1017 | N 258 | O 306 | S 14 | 0 | 0 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 10 | X | 203 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1017 | 258 | 306 | 14 | | |

- Molecule 11 is a protein called 20S proteasome beta-4 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 11 | K | 195 | Total | C | N | O | S | 0 | 0 |
| | | | 1614 | 1042 | 266 | 298 | 8 | | |
| 11 | Y | 195 | Total | C | N | O | S | 0 | 0 |
| | | | 1614 | 1042 | 266 | 298 | 8 | | |

- Molecule 12 is a protein called 20S proteasome beta-5 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 12 | L | 204 | Total | C | N | O | S | 0 | 0 |
| | | | 1600 | 1021 | 265 | 307 | 7 | | |
| 12 | Z | 204 | Total | C | N | O | S | 0 | 0 |
| | | | 1600 | 1021 | 265 | 307 | 7 | | |

- Molecule 13 is a protein called 20S proteasome beta-6 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 13 | M | 211 | Total | C | N | O | S | 0 | 0 |
| | | | 1676 | 1073 | 277 | 319 | 7 | | |
| 13 | a | 211 | Total | C | N | O | S | 0 | 0 |
| | | | 1676 | 1073 | 277 | 319 | 7 | | |

- Molecule 14 is a protein called 20S proteasome beta-7 subunit.

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 14 | N | 224 | Total | C | N | O | S | 0 | 0 |
| | | | 1845 | 1177 | 313 | 348 | 7 | | |
| 14 | b | 224 | Total | C | N | O | S | 0 | 0 |
| | | | 1845 | 1177 | 313 | 348 | 7 | | |

- Molecule 15 is a protein called Proteasome activator PA28.

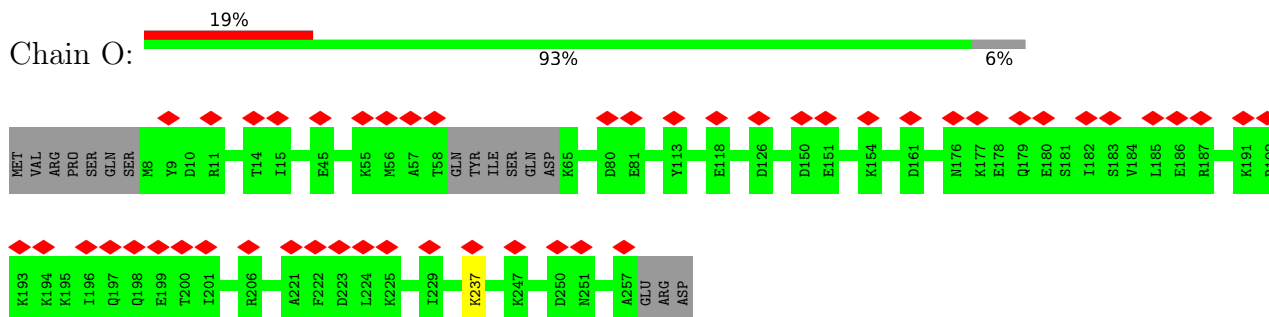| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 15 | c | 188 | Total | C | N | O | S | 0 | 0 |
| | | | 1578 | 1019 | 261 | 295 | 3 | | |
| 15 | d | 190 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1029 | 265 | 298 | 3 | | |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Residues | Atoms | | | | | AltConf | Trace |
|-----|-------|----------|-------|---|---|---|---|---------|-------|
| 15 | e | 187 | Total | C | N | O | S | 0 | 0 |
| | | | 1571 | 1014 | 260 | 294 | 3 | | |
| 15 | f | 190 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1029 | 265 | 298 | 3 | | |
| 15 | g | 190 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1029 | 265 | 298 | 3 | | |
| 15 | h | 190 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1029 | 265 | 298 | 3 | | |
| 15 | i | 190 | Total | C | N | O | S | 0 | 0 |
| | | | 1595 | 1029 | 265 | 298 | 3 | | |

# 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.
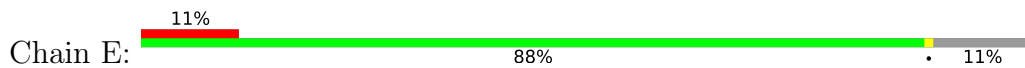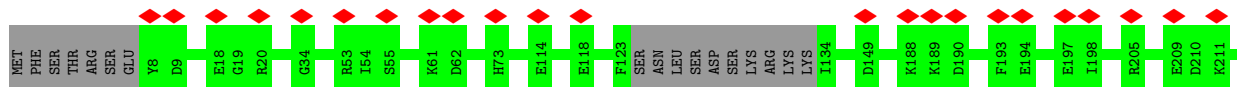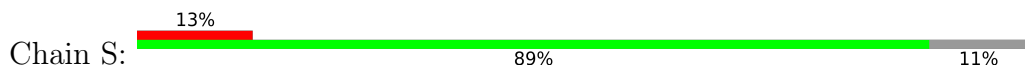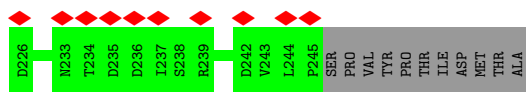
• Molecule 1: 20S proteasome alpha-1 subunit

Chain A:

• Molecule 1: 20S proteasome alpha-1 subunit

Chain O:

• Molecule 2: 20S proteasome alpha-2 subunit
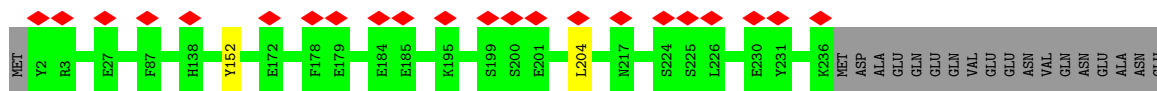
Chain B:

• Molecule 2: 20S proteasome alpha-2 subunit

Chain P:

• Molecule 3: 20S proteasome alpha-3 subunit

10%

Chain C:

97%

MET ALA ARG ARG TYR ASP S7 R8 T9 T10 G16 R17 L18 Y19 K40 I52 L55 A59 N60 E63 G125 L169 D201 T202 E203 I204 E208 K209 I210 E229 I232 E233 Y239 K242 Y243 I244 K245 E246

• Molecule 3: 20S proteasome alpha-3 subunit

9%

Chain Q:

98%

MET A2 R3 R4 R17 N30 D41 L55 A59 N60 D82 G125 D201 T202 E203 K206 I210 D219 E233 Y239 T240 Q241 K242 Y243 I244 K245 E246

• Molecule 4: 20S proteasome alpha-4 subunit

10%

Chain D:

93% 6%

MET SER TYR ASP ARG ALA ILE T8 V9 F10 S11 P12 D13 E24 K28 N49 N55 P56 K57 T58 T59 E60 G123 L132 K140 E178 K183 F194 V197 E198 L199 K212 E219 I229 D230 Q231 E232 R233 T234 LYS ASN ASN GLU GLN ASN GLU

• Molecule 4: 20S proteasome alpha-4 subunit

10%

Chain R:

96%

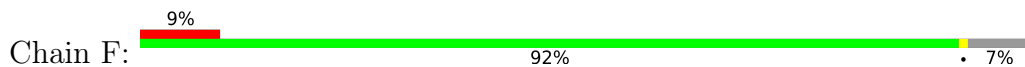MET S2 Y3 D4 R5 N55 P56 K57 T58 T59 E60 E67 E178 C185 F194 E195 V196 V197 E198 L199 S200 L208 K212 E218 E219 Q220 M225 Q231 E232 R233 T234 LYS ASN ASN GLU GLN ASN GLU

• Molecule 5: 20S proteasome alpha-5 subunit

11%

Chain E:

88% 11%

MET PHE SER THR ARG SER E7 Y8 D9 R10 G11 E18 Q23 R53 D62 D90 L115 F123 SER ASN LEU SER ASP SER LYS ARG LYS LYS ILE MET S136 D149 E180 K189 D190 E194 E197 M208 E209 E218 D226 T234 D235

S238 R239 I240 I241 D242 V243 L244 P245 SER PRO VAL TYR PRO THR ILE ASP MET THR ALA

• Molecule 5: 20S proteasome alpha-5 subunit

13%

Chain S:

89% 11%

MET PHE SER THR ARG SER GLU Y8 D9 E18 G19 R20 G34 R53 I54 S55 K61 D62 H73 E114 E118 F123 SER ASN LEU SER ASP SER LYS ARG LYS LYS I134 D149 K188 K189 D190 F193 E194 E197 I198 R205 E209 D210 K211
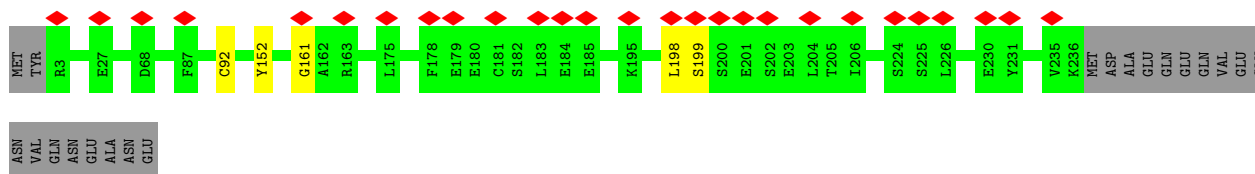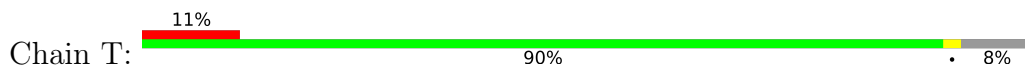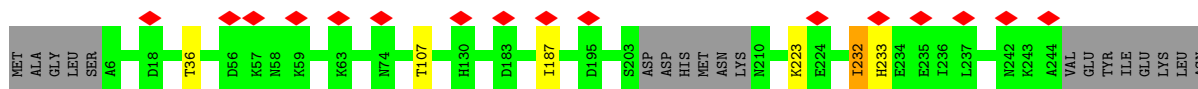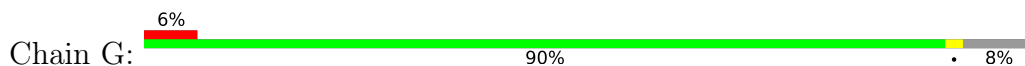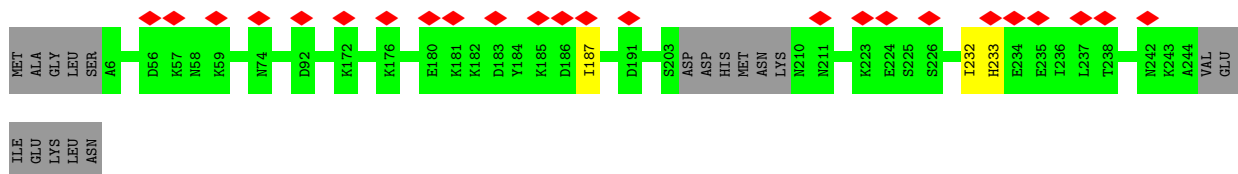
• Molecule 6: 20S proteasome alpha-6 subunit

Chain F:



• Molecule 6: 20S proteasome alpha-6 subunit
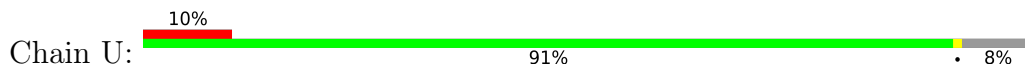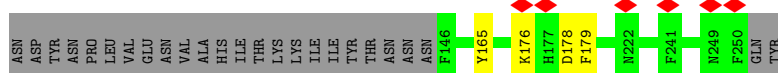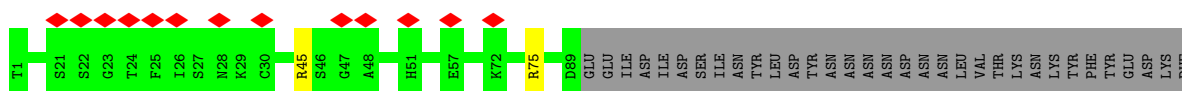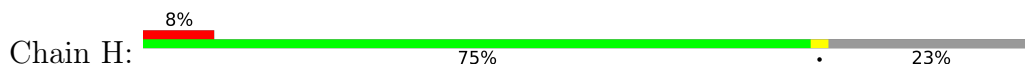
Chain T:



• Molecule 7: 20S proteasome alpha-7 subunit
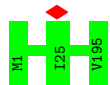
Chain G:



• Molecule 7: 20S proteasome alpha-7 subunit

Chain U:


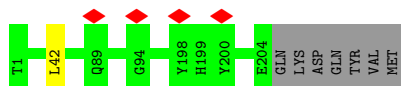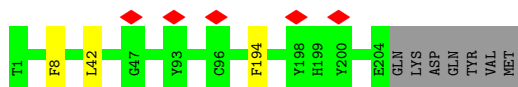
• Molecule 8: 20S proteasome beta-1 subunit

Chain H:

• Molecule 8: 20S proteasome beta-1 subunit

Chain V:

6%

76%

23%

T1 R19 T20 S21 S22 G23 T24 S27 N28 G47 A48 S49 K72 R75 D89 GLU GLU ILE ASP ILE ASP SER ILE ASN TYR LEU ASP TYR ASN ASN ASN ASP ASN ASN LEU VAL THR LYS ASN LYS TYR PHE TYR GLU ASP LYS PHE ASN ASP TYR ASN PRO LEU

VAL GLU ASN VAL ALA HIS ILE THR LYS LYS ILE ILE TYR THR ASN ASN ASN F146 H177 L211 T234 F241 N249 F250 GLN TYR

• Molecule 9: 20S proteasome beta-2 subunit

Chain I:

10%

93%

T1 G23 L65 T72 L87 F88 K89 Y90 Q91 G92 Y93 K94 H116 L122 N165 D174 P192 N193 M194 R195 L196 Y197 H198 L199 P200 H201 Y205 E218 Y219 ILE LYS LYS PHE ILE SER VAL GLU ASP ALA

• Molecule 9: 20S proteasome beta-2 subunit

Chain W:

9%

94%

T1 P24 G47 Q85 F88 K89 Y90 Q91 G92 Y93 D104 H116 N145 E150 D181 P192 N193 M194 R195 L196 Y197 H198 L199 P200 Y205 Y219 ILE LYS LYS PHE ILE SER VAL GLU ASP ALA

• Molecule 10: 20S proteasome beta-3 subunit

Chain J:

92%

7%

MET GLY SER ILE Y5 D81 A82 F102 L116 LYS HIS TYR VAL ASP GLU GLU GLY GLU LYS LYS V128 R147 T179 D189 W196 D218

• Molecule 10: 20S proteasome beta-3 subunit

Chain X:

93%

7%

MET GLY SER ILE Y5 F34 F102 S103 P104 L116 LYS HIS TYR VAL ASP GLU GLU GLY GLU LYS LYS V128 E145 T146 R147 D189 D218

• Molecule 11: 20S proteasome beta-4 subunit

Chain K:

100%

M1 D18 I25 V195

• Molecule 11: 20S proteasome beta-4 subunit

Chain Y:

100%

M1   I25   V195

• Molecule 12: 20S proteasome beta-5 subunit

Chain L:

96%

T1 L42 Q89 G94 Y198 H199 Y200 E204 GLN LYS ASP GLN TYR VAL MET

• Molecule 12: 20S proteasome beta-5 subunit

Chain Z:

95%

T1 F8 L42 G47 Y93 C96 F194 Y198 H199 Y200 E204 GLN LYS ASP GLN TYR VAL MET

• Molecule 13: 20S proteasome beta-6 subunit

Chain M:

87%
12%

MET ASP LEU ILE LEU TYR ASN ASP ASN LEU THR GLU LYS LYS THR GLU LYS GLU ASN VAL ILE GLU HIS GLY ARG GLY PHE LYS ARG W30 K46 D112 R128 E143 Y152 K189 N190 G217 M228 D240

• Molecule 13: 20S proteasome beta-6 subunit

Chain a:

87%
12%

MET ASP LEU ILE LEU TYR ASN ASP ASN LEU THR GLU LYS LYS THR GLU LYS GLU ASN VAL ILE GLU HIS GLY ARG GLY PHE LYS ARG W30 D35 K46 Y64 D76 Y110 E143 N144 N145 N190 M228 L235 D240

• Molecule 14: 20S proteasome beta-7 subunit

Chain N:

6%
83%
15%

MET T2 L3 G4 P5 T8 G32 S33 K36 T50 F54 R70 D84 I106 L109 N126 D127 D128 N129 L132 THR THR ASN LYS ASN ASN ASP ASP GLU GLN ASN GLU TYR LYS ASN ASN E149 E153 D195 D217 I241 LEU PRO CYS VAL

LEU ASN SER ALA ASP TYR VAL TYR PRO SER THR LEU LEU PRO PRO ALA GLY CYS MET TRP

• Molecule 14: 20S proteasome beta-7 subunit

Chain b:

6%
84%
15%

MET T2 L3 G4 T8 D26 R70 I106 L109 D127 D128 N129 V130 L131 L132 TYR THR ASN LYS ASN ASP GLU GLN ASN GLU TYR LYS ASN ASN E149 E150 E153 L189 D195 D217 I241 LEU PRO CYS VAL LEU ASN SER ALA ASP TYR VAL

TYR PRO SER THR LEU PRO ALA GLY CYS MET TRP

• Molecule 15: Proteasome activator PA28

Chain c:

MET GLU ALA TYR LEU ASN LYS ILE ASP LYS ILE GLU PRO SER ASP Q16 K17 I18 K19 E20 E21 Y22 N23 K24 F25 K26 Y27 D28 I29 T30 K31 I34 E35 S36 L37 R38 E39 I45 I46 N50 N53 V54 N55 S56 E57 P58 G59 S60 I61 L62 N63 V64 N65 D66 L67 D68

GLY VAL SER TYR LYS TYR LYS ILE ASN LYS ILE GLU GLU ASN VAL ARG LYS LYS HIS LYS GLY ASN ASN SER SER ASP PHE ASP GLU ARG GLU LYS LYS ASP SER LEU ASP GLY HIS VAL LYS HIS PHE SER ASN ASN GLU ASP SER LEU ILE ILE ASP ASP VAL LEU TYR

THR HIS TYR VAL PRO S134 H135 K136 Q137 I138 Y139 L140 E141 L142 E143 K146 T147 Y148 A149 S150 E151 L152 I153 E154 I155 I156 G157 K160 I163 Q164 L165 N166 R169 I170 E171 D172 G173 N174 N175 F176 G177 V178 G179 E182 E183 A184 I185 Q186 E187 L188 A189 R190 V191 E192 E193

S194 A195 F196 N197 L198 Y199 D200 A201 I202 V203 K204 Y205 Y206 M207 E208 R209 A210 K211 I212 S213 T214 K215 V216 L217 K218 Y219 P220 N221 V222 S223 D224 Y225 Q226 E227 R230 E231 L232 D233 E234 K235 E236 W237 I238 H239 I242 T243 I244 V245 D246 M247 R248 N249 N250 Y251 I252 M253 L254

L257 L258 Y259 K260 N261 W262 E263 K264 V265 V266 K267 P268 LYS ASN GLU ASP ALA HIS HIS ARG MET THR PHE

• Molecule 15: Proteasome activator PA28

Chain d:

MET GLU ALA TYR LEU ASN LYS ILE ASP LYS ILE GLU PRO SER ASP Q16 K17 I18 K19 E20 E21 Y22 N23 K24 F25 K26 Y27 D28 K31 Q32 A33 I34 E35 S36 L37 R38 E39 R40 I41 P42 K43 R44 I45 I46 F47 F48 N49 N50 L51 V52 N53 V54 N55 S56 E57 P58 G59 S60 I61

L62 N63 V64 N65 D66 L67 D68 GLY VAL SER TYR LYS TYR LYS TYR LYS ILE ASN LYS ILE GLU GLU ASN VAL ARG LYS LYS HIS LYS GLY ASN ASN SER SER ASP PHE ASP GLU ARG GLU LYS LYS ASP SER LEU ASP GLY HIS VAL LYS HIS PHE SER ASN ASN GLU ASN GLU ASP SER LEU ILE

ILE ASP ASP LYS VAL LEU TYR THR HIS TYR VAL PRO S134 H135 K136 Q137 I138 Y139 L140 E141 L142 E143 K144 I145 K146 T147 S150 E151 L152 I153 E154 I155 I156 G157 N158 I159 K160 L161 W162 I163 Q164 L165 N166 V167 P168 R169 I170 E171 D172 G173 N174 N175 F176 G177 V178 G179 I180 Q181 E182

E183 A184 I185 Q186 E187 L188 A189 R190 V191 E192 E193 S194 A195 F196 N197 L198 Y199 D200 A201 I202 V203 K204 Y205 Y206 M207 E208 R209 A210 K211 I212 S213 T214 K215 V216 L217 K218 Y219 P220 N221 V222 S223 D224 Y225 Q226 E227 A228 V229 R230 E231 L232 D233 E234 K235 E236 W237 I238 H239 I240 K241 I242

T243 I244 V245 D246 M247 Y251 I252 M253 L254 Y255 D256 L257 L258 Y259 K260 N261 W262 E263 K264 V265 V266 K267 P268 K269 N270 GLU ASP ALA HIS HIS ARG MET THR PHE

• Molecule 15: Proteasome activator PA28

Chain e:

59%

66% · 33%

MET GLU ALA TYR LEU ASN LYS ILE ASP LYS ILE GLU PRO SER ASP Q16 K17 I18 K19 E20 E21 Y22 N23 K24 F25 K26 Y27 D28 I29 T30 K31 Q32 A33 I34 E35 S36 L37 R38 E39 R40 I41 P42 K43 R44 I45 I46 F47 F48 N49 N50 L51 V52 N53 V54 N55 S56 E57 P58 G59 S60

I61 L62 N63 V64 N65 D66 L67 D68 GLY VAL SER TYR LYS TYR LYS ILE ASN LYS ILE GLU GLU ASN VAL ARG LYS LYS HIS LYS GLY ASN ASN SER SER ASP PHE ASP GLU ARG GLU LYS LYS ASP SER LEU ASP GLY HIS VAL LYS HIS PHE SER ASN GLU ASP SER LYS LEU

ILE ILE ASP ASP LYS VAL LEU TYR THR HIS TYR VAL PRO S134 H135 K136 Q137 I138 Y139 L140 E141 L142 E143 K144 I145 K146 T147 Y148 A149 S150 E151 L152 I153 E154 I155 I156 G157 N158 I159 K160 L161 W162 I163 Q164 L165 N166 V167 P168 R169 I170 E171 D172 G173 N174 N175 F176 G177 V178 G179 I180

Q181 E182 E183 A184 I185 Q186 E187 L188 A189 R190 V191 E192 E193 S194 A195 F196 N197 L198 Y199 D200 A201 I202 V203 K204 Y205 Y206 M207 E208 R209 A210 K211 I212 S213 T214 K215 V216 L217 K218 Y219 P220 N221 V222 S223 D224 Y225 Q226 E227 A228 V229 R230 E231 L232 D233 E234 W237 I238 H239 I240 K241

I242 T243 I244 V245 D246 M247 R248 Y251 I252 M253 L254 Y255 D256 L257 L258 Y259 K260 N261 W262 E263 K264 V265 V266 K267 PRO LYS ASN GLU ASP ALA HIS HIS ARG MET THR PHE

• Molecule 15: Proteasome activator PA28

Chain f:

59%

67% · 32%

MET GLU ALA TYR LEU ASN LYS ILE ASP LYS ILE GLU PRO SER ASP Q16 K17 I18 K19 E20 E21 Y22 N23 K24 F25 K26 Y27 D28 I29 T30 K31 Q32 A33 I34 E35 S36 L37 R38 E39 R40 K43 I46 F47 F48 N49 N50 L51 V52 N53 V54 N55 S56 E57 P58 G59 S60 I61 L62

N63 V64 N65 D66 L67 D68 GLY VAL SER TYR LYS TYR LYS ILE ASN LYS ILE GLU GLU ASN VAL ARG LYS LYS HIS LYS GLY ASN ASN SER SER ASP PHE ASP GLU ARG GLU LYS LYS ASP SER LEU ASP GLY HIS VAL LYS HIS PHE SER ASN GLU ASP SER LYS LEU ILE ILE

ASP ASP LYS VAL LEU TYR THR HIS TYR VAL PRO S134 H135 K136 Q137 I138 Y139 L140 E141 L142 E143 K144 I145 K146 T147 Y148 A149 S150 E151 E154 I155 N158 I159 K160 L161 W162 I163 Q164 L165 N166 V167 P168 R169 I170 E171 D172 G173 N174 N175 F176 G177 V178 G179 I180 Q181 E182 E183 A184

I185 Q186 E187 L188 A189 R190 V191 E192 E193 S194 A195 F196 N197 L198 Y199 D200 A201 I202 V203 K204 Y205 Y206 M207 E208 R209 A210 K211 I212 S213 T214 K215 V216 L217 K218 Y219 P220 N221 V222 S223 D224 Y225 Q226 E227 A228 V229 R230 E231 L232 D233 E234 K235 E236 W237 I238 H239 I240 K241 I242 T243 I244

V245 D246 M247 R248 N249 N250 Y251 I252 M253 L254 Y255 D256 L257 L258 Y259 K260 N261 W262 E263 K264 V265 V266 K267 P268 K269 N270 GLU ASP ALA HIS HIS ARG MET THR PHE

• Molecule 15: Proteasome activator PA28

Chain g:

53%

67% · 32%

MET GLU ALA TYR LEU ASN LYS ILE ASP LYS ILE GLU PRO SER ASP Q16 K17 I18 K19 E20 E21 Y22 N23 K24 F25 K26 Y27 D28 A33 I34 E35 S36 L37 R38 E39 R40 I41 P42 K43 R44 I45 I46 F47 F48 N49 N50 L51 V52 N53 V54 N55 S56 E57 P58 G59 S60 I61 L62 N63

• Molecule 15: Proteasome activator PA28

Chain h:

48%

66%     •     32%

• Molecule 15: Proteasome activator PA28

Chain i:

42%

67%     •     32%

# 4 Experimental information ⓘ

| Property | Value | Source |
|---|---|---|
| EM reconstruction method | SINGLE PARTICLE | Depositor |
| Imposed symmetry | POINT, C1 | Depositor |
| Number of particles used | 57337 | Depositor |
| Resolution determination method | FSC 0.143 CUT-OFF | Depositor |
| CTF correction method | NONE | Depositor |
| Microscope | FEI TALOS ARCTICA | Depositor |
| Voltage (kV) | 200 | Depositor |
| Electron dose $(e^-/\text{Å}^2)$ | 32 | Depositor |
| Minimum defocus (nm) | 1000 | Depositor |
| Maximum defocus (nm) | 3000 | Depositor |
| Magnification | 100000 | Depositor |
| Image detector | GATAN K2 QUANTUM (4k x 4k) | Depositor |
| Maximum map value | 33.420 | Depositor |
| Minimum map value | -19.000 | Depositor |
| Average map value | -0.000 | Depositor |
| Map value standard deviation | 1.000 | Depositor |
| Recommended contour level | 6.0 | Depositor |
| Map size (Å) | 450.63998, 450.63998, 450.63998 | wwPDB |
| Map dimensions | 344, 344, 344 | wwPDB |
| Map angles (°) | 90.0, 90.0, 90.0 | wwPDB |
| Pixel spacing (Å) | 1.31, 1.31, 1.31 | 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 | A | 0.41 | 0/1953 | 0.64 | 1/2632 (0.0%) |
| 1 | O | 0.38 | 0/1953 | 0.66 | 0/2632 |
| 2 | B | 0.43 | 0/1814 | 0.63 | 0/2450 |
| 2 | P | 0.41 | 0/1860 | 0.63 | 0/2512 |
| 3 | C | 0.48 | 0/1953 | 0.64 | 1/2643 (0.0%) |
| 3 | Q | 0.45 | 0/2001 | 0.65 | 1/2707 (0.0%) |
| 4 | D | 0.42 | 0/1824 | 0.64 | 2/2461 (0.1%) |
| 4 | R | 0.40 | 0/1875 | 0.63 | 1/2530 (0.0%) |
| 5 | E | 0.37 | 0/1784 | 0.60 | 1/2410 (0.0%) |
| 5 | S | 0.37 | 0/1791 | 0.59 | 0/2419 |
| 6 | F | 0.48 | 1/1905 (0.1%) | 0.64 | 0/2566 |
| 6 | T | 0.45 | 1/1892 (0.1%) | 0.65 | 2/2548 (0.1%) |
| 7 | G | 0.46 | 0/1947 | 0.71 | 1/2631 (0.0%) |
| 7 | U | 0.44 | 0/1947 | 0.67 | 0/2631 |
| 8 | H | 0.50 | 0/1571 | 0.69 | 1/2105 (0.0%) |
| 8 | V | 0.45 | 0/1571 | 0.66 | 0/2105 |
| 9 | I | 0.42 | 1/1712 (0.1%) | 0.67 | 2/2328 (0.1%) |
| 9 | W | 0.41 | 1/1712 (0.1%) | 0.65 | 1/2328 (0.0%) |
| 10 | J | 0.53 | 0/1621 | 0.67 | 0/2189 |
| 10 | X | 0.53 | 0/1621 | 0.66 | 0/2189 |
| 11 | K | 0.55 | 0/1649 | 0.67 | 0/2223 |
| 11 | Y | 0.54 | 0/1649 | 0.67 | 0/2223 |
| 12 | L | 0.50 | 0/1633 | 0.68 | 1/2202 (0.0%) |
| 12 | Z | 0.55 | 1/1633 (0.1%) | 0.69 | 1/2202 (0.0%) |
| 13 | M | 0.47 | 0/1708 | 0.67 | 0/2314 |
| 13 | a | 0.49 | 0/1708 | 0.69 | 0/2314 |
| 14 | N | 0.44 | 0/1882 | 0.69 | 4/2538 (0.2%) |
| 14 | b | 0.44 | 0/1882 | 0.64 | 2/2538 (0.1%) |
| 15 | c | 0.37 | 0/1606 | 0.69 | 4/2166 (0.2%) |
| 15 | d | 0.34 | 0/1623 | 0.67 | 2/2188 (0.1%) |
| 15 | e | 0.33 | 0/1598 | 0.68 | 1/2154 (0.0%) |
| 15 | f | 0.32 | 0/1623 | 0.66 | 2/2188 (0.1%) |
| 15 | g | 0.33 | 0/1623 | 0.67 | 4/2188 (0.2%) |
| 15 | h | 0.35 | 0/1623 | 0.65 | 3/2188 (0.1%) |

| Mol | Chain | Bond lengths | | Bond angles | |
|---|---|---|---|---|---|
| | | RMSZ | #\|Z\| >5 | RMSZ | #\|Z\| >5 |
| 15 | i | 0.35 | 0/1623 | 0.65 | 2/2188 (0.1%) |
| All | All | 0.44 | 5/61370 (0.0%) | 0.66 | 40/82830 (0.0%) |

All (5) bond length outliers are listed below:

| Mol | Chain | Res | Type | Atoms | Z | Observed(Å) | Ideal(Å) |
|---|---|---|---|---|---|---|---|
| 6 | T | 152 | TYR | CD1-CE1 | -6.05 | 1.30 | 1.39 |
| 9 | I | 199 | LEU | C-N | 5.70 | 1.45 | 1.34 |
| 6 | F | 152 | TYR | CD1-CE1 | -5.44 | 1.31 | 1.39 |
| 9 | W | 199 | LEU | C-N | 5.44 | 1.44 | 1.34 |
| 12 | Z | 8 | PHE | CB-CG | -5.16 | 1.42 | 1.51 |

All (40) bond angle outliers are listed below:

| Mol | Chain | Res | Type | Atoms | Z | Observed(°) | Ideal(°) |
|---|---|---|---|---|---|---|---|
| 14 | N | 109 | LEU | CA-CB-CG | 9.67 | 137.54 | 115.30 |
| 14 | b | 109 | LEU | CA-CB-CG | 9.00 | 136.00 | 115.30 |
| 15 | f | 254 | LEU | CA-CB-CG | 8.37 | 134.54 | 115.30 |
| 15 | i | 165 | LEU | CA-CB-CG | 7.62 | 132.84 | 115.30 |
| 3 | Q | 55 | LEU | CA-CB-CG | 7.16 | 131.76 | 115.30 |
| 1 | A | 224 | LEU | CA-CB-CG | 6.96 | 131.31 | 115.30 |
| 15 | e | 37 | LEU | CA-CB-CG | 6.82 | 130.98 | 115.30 |
| 6 | T | 161 | GLY | N-CA-C | 6.80 | 130.10 | 113.10 |
| 4 | D | 132 | LEU | CA-CB-CG | 6.66 | 130.62 | 115.30 |
| 15 | g | 152 | LEU | CA-CB-CG | 6.57 | 130.40 | 115.30 |
| 12 | L | 42 | LEU | CA-CB-CG | 6.46 | 130.16 | 115.30 |
| 14 | N | 3 | LEU | CA-CB-CG | 6.30 | 129.79 | 115.30 |
| 14 | N | 217 | ASP | CB-CG-OD1 | 6.26 | 123.93 | 118.30 |
| 15 | h | 254 | LEU | CB-CG-CD1 | -6.25 | 100.37 | 111.00 |
| 3 | C | 55 | LEU | CA-CB-CG | 6.15 | 129.44 | 115.30 |
| 15 | c | 200 | ASP | CB-CG-OD1 | 5.89 | 123.61 | 118.30 |
| 4 | D | 199 | LEU | CA-CB-CG | 5.82 | 128.69 | 115.30 |
| 15 | g | 256 | ASP | CB-CG-OD1 | 5.80 | 123.52 | 118.30 |
| 15 | h | 200 | ASP | CB-CG-OD2 | 5.80 | 123.52 | 118.30 |
| 15 | i | 258 | LEU | CB-CG-CD2 | 5.76 | 120.79 | 111.00 |
| 15 | g | 258 | LEU | CB-CG-CD1 | 5.70 | 120.69 | 111.00 |
| 15 | d | 198 | LEU | CA-CB-CG | 5.63 | 128.26 | 115.30 |
| 14 | b | 189 | LEU | CA-CB-CG | 5.58 | 128.13 | 115.30 |
| 9 | I | 65 | LEU | CA-CB-CG | 5.57 | 128.12 | 115.30 |
| 15 | f | 254 | LEU | CB-CG-CD1 | -5.49 | 101.67 | 111.00 |
| 12 | Z | 42 | LEU | CA-CB-CG | 5.46 | 127.86 | 115.30 |
| 6 | T | 198 | LEU | CA-CB-CG | 5.39 | 127.70 | 115.30 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Res | Type | Atoms | Z | Observed(°) | Ideal(°) |
|-----|-------|-----|------|-------|---|-------------|----------|
| 7 | G | 232 | ILE | C-N-CA | 5.35 | 135.08 | 121.70 |
| 15 | g | 254 | LEU | CA-CB-CG | 5.33 | 127.55 | 115.30 |
| 15 | c | 254 | LEU | CB-CG-CD1 | 5.24 | 119.90 | 111.00 |
| 15 | d | 37 | LEU | CA-CB-CG | 5.22 | 127.31 | 115.30 |
| 9 | I | 122 | LEU | CA-CB-CG | 5.21 | 127.28 | 115.30 |
| 15 | c | 258 | LEU | CB-CG-CD2 | 5.19 | 119.83 | 111.00 |
| 14 | N | 54 | PHE | C-N-CA | 5.14 | 134.55 | 121.70 |
| 4 | R | 208 | LEU | CA-CB-CG | 5.12 | 127.06 | 115.30 |
| 5 | E | 115 | LEU | CA-CB-CG | 5.11 | 127.04 | 115.30 |
| 9 | W | 200 | PRO | C-N-CA | 5.08 | 134.40 | 121.70 |
| 15 | h | 188 | LEU | CA-CB-CG | 5.06 | 126.93 | 115.30 |
| 8 | H | 165 | TYR | CA-CB-CG | 5.03 | 122.95 | 113.40 |
| 15 | c | 142 | LEU | CB-CG-CD1 | 5.03 | 119.55 | 111.00 |

There are no chirality outliers.

There are no planarity outliers.

## 5.2 Too-close contacts ⓘ

Due to software issues we are unable to calculate clashes - this section is therefore empty.

## 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 | 240/260 (92%) | 214 (89%) | 26 (11%) | 0 | 100 | 100 |
| 1 | O | 240/260 (92%) | 211 (88%) | 29 (12%) | 0 | 100 | 100 |
| 2 | B | 222/235 (94%) | 203 (91%) | 19 (9%) | 0 | 100 | 100 |
| 2 | P | 227/235 (97%) | 205 (90%) | 22 (10%) | 0 | 100 | 100 |
| 3 | C | 238/246 (97%) | 217 (91%) | 20 (8%) | 1 (0%) | 34 | 71 |
| 3 | Q | 243/246 (99%) | 218 (90%) | 24 (10%) | 1 (0%) | 34 | 71 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Analysed | Favoured | Allowed | Outliers | Percentiles | |
|-----|-------|----------|----------|---------|----------|-----|-----|
| 4 | D | 225/241 (93%) | 200 (89%) | 25 (11%) | 0 | 100 | 100 |
| 4 | R | 231/241 (96%) | 211 (91%) | 20 (9%) | 0 | 100 | 100 |
| 5 | E | 223/256 (87%) | 197 (88%) | 26 (12%) | 0 | 100 | 100 |
| 5 | S | 224/256 (88%) | 200 (89%) | 24 (11%) | 0 | 100 | 100 |
| 6 | F | 233/254 (92%) | 195 (84%) | 37 (16%) | 1 (0%) | 34 | 71 |
| 6 | T | 232/254 (91%) | 204 (88%) | 27 (12%) | 1 (0%) | 34 | 71 |
| 7 | G | 229/252 (91%) | 189 (82%) | 37 (16%) | 3 (1%) | 12 | 48 |
| 7 | U | 229/252 (91%) | 197 (86%) | 29 (13%) | 3 (1%) | 12 | 48 |
| 8 | H | 190/252 (75%) | 159 (84%) | 29 (15%) | 2 (1%) | 14 | 51 |
| 8 | V | 190/252 (75%) | 162 (85%) | 28 (15%) | 0 | 100 | 100 |
| 9 | I | 217/229 (95%) | 175 (81%) | 42 (19%) | 0 | 100 | 100 |
| 9 | W | 217/229 (95%) | 190 (88%) | 26 (12%) | 1 (0%) | 29 | 67 |
| 10 | J | 199/218 (91%) | 175 (88%) | 24 (12%) | 0 | 100 | 100 |
| 10 | X | 199/218 (91%) | 176 (88%) | 23 (12%) | 0 | 100 | 100 |
| 11 | K | 193/195 (99%) | 171 (89%) | 22 (11%) | 0 | 100 | 100 |
| 11 | Y | 193/195 (99%) | 168 (87%) | 25 (13%) | 0 | 100 | 100 |
| 12 | L | 202/211 (96%) | 166 (82%) | 36 (18%) | 0 | 100 | 100 |
| 12 | Z | 202/211 (96%) | 171 (85%) | 31 (15%) | 0 | 100 | 100 |
| 13 | M | 209/240 (87%) | 184 (88%) | 25 (12%) | 0 | 100 | 100 |
| 13 | a | 209/240 (87%) | 178 (85%) | 31 (15%) | 0 | 100 | 100 |
| 14 | N | 220/265 (83%) | 189 (86%) | 31 (14%) | 0 | 100 | 100 |
| 14 | b | 220/265 (83%) | 192 (87%) | 28 (13%) | 0 | 100 | 100 |
| 15 | c | 184/279 (66%) | 178 (97%) | 6 (3%) | 0 | 100 | 100 |
| 15 | d | 186/279 (67%) | 180 (97%) | 6 (3%) | 0 | 100 | 100 |
| 15 | e | 183/279 (66%) | 177 (97%) | 6 (3%) | 0 | 100 | 100 |
| 15 | f | 186/279 (67%) | 179 (96%) | 7 (4%) | 0 | 100 | 100 |
| 15 | g | 186/279 (67%) | 180 (97%) | 6 (3%) | 0 | 100 | 100 |
| 15 | h | 186/279 (67%) | 179 (96%) | 7 (4%) | 0 | 100 | 100 |
| 15 | i | 186/279 (67%) | 180 (97%) | 6 (3%) | 0 | 100 | 100 |
| All | All | 7393/8661 (85%) | 6570 (89%) | 810 (11%) | 13 (0%) | 50 | 79 |

All (13) Ramachandran outliers are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 7 | G | 233 | HIS |
| 8 | H | 178 | ASP |
| 6 | T | 199 | SER |
| 6 | F | 204 | LEU |
| 7 | G | 232 | ILE |
| 7 | U | 233 | HIS |
| 3 | C | 210 | ILE |
| 8 | H | 179 | PHE |
| 3 | Q | 210 | ILE |
| 7 | U | 232 | ILE |
| 7 | G | 187 | ILE |
| 7 | U | 187 | ILE |
| 9 | W | 24 | 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 | A | 215/231 (93%) | 215 (100%) | 0 | 100 | 100 |
| 1 | O | 215/231 (93%) | 214 (100%) | 1 (0%) | 88 | 93 |
| 2 | B | 196/205 (96%) | 196 (100%) | 0 | 100 | 100 |
| 2 | P | 201/205 (98%) | 200 (100%) | 1 (0%) | 88 | 93 |
| 3 | C | 208/213 (98%) | 208 (100%) | 0 | 100 | 100 |
| 3 | Q | 212/213 (100%) | 211 (100%) | 1 (0%) | 88 | 93 |
| 4 | D | 194/207 (94%) | 193 (100%) | 1 (0%) | 88 | 93 |
| 4 | R | 199/207 (96%) | 198 (100%) | 1 (0%) | 88 | 93 |
| 5 | E | 195/223 (87%) | 194 (100%) | 1 (0%) | 88 | 93 |
| 5 | S | 196/223 (88%) | 196 (100%) | 0 | 100 | 100 |
| 6 | F | 210/227 (92%) | 210 (100%) | 0 | 100 | 100 |
| 6 | T | 209/227 (92%) | 208 (100%) | 1 (0%) | 88 | 93 |
| 7 | G | 212/229 (93%) | 209 (99%) | 3 (1%) | 67 | 81 |
| 7 | U | 212/229 (93%) | 212 (100%) | 0 | 100 | 100 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Analysed | Rotameric | Outliers | Percentiles | |
|-----|-------|----------|-----------|----------|-------------|---|
| 8 | H | 174/231 (75%) | 171 (98%) | 3 (2%) | 60 | 78 |
| 8 | V | 174/231 (75%) | 171 (98%) | 3 (2%) | 60 | 78 |
| 9 | I | 185/194 (95%) | 183 (99%) | 2 (1%) | 73 | 84 |
| 9 | W | 185/194 (95%) | 184 (100%) | 1 (0%) | 88 | 93 |
| 10 | J | 178/191 (93%) | 176 (99%) | 2 (1%) | 73 | 84 |
| 10 | X | 178/191 (93%) | 177 (99%) | 1 (1%) | 86 | 91 |
| 11 | K | 174/174 (100%) | 174 (100%) | 0 | 100 | 100 |
| 11 | Y | 174/174 (100%) | 174 (100%) | 0 | 100 | 100 |
| 12 | L | 169/176 (96%) | 169 (100%) | 0 | 100 | 100 |
| 12 | Z | 169/176 (96%) | 168 (99%) | 1 (1%) | 86 | 91 |
| 13 | M | 189/216 (88%) | 187 (99%) | 2 (1%) | 73 | 84 |
| 13 | a | 189/216 (88%) | 186 (98%) | 3 (2%) | 62 | 79 |
| 14 | N | 201/239 (84%) | 200 (100%) | 1 (0%) | 88 | 93 |
| 14 | b | 201/239 (84%) | 201 (100%) | 0 | 100 | 100 |
| 15 | c | 175/261 (67%) | 172 (98%) | 3 (2%) | 60 | 78 |
| 15 | d | 177/261 (68%) | 177 (100%) | 0 | 100 | 100 |
| 15 | e | 174/261 (67%) | 171 (98%) | 3 (2%) | 60 | 78 |
| 15 | f | 177/261 (68%) | 174 (98%) | 3 (2%) | 60 | 78 |
| 15 | g | 177/261 (68%) | 176 (99%) | 1 (1%) | 86 | 91 |
| 15 | h | 177/261 (68%) | 174 (98%) | 3 (2%) | 60 | 78 |
| 15 | i | 177/261 (68%) | 176 (99%) | 1 (1%) | 86 | 91 |
| All | All | 6648/7739 (86%) | 6605 (99%) | 43 (1%) | 86 | 91 |

All (43) residues with a non-rotameric sidechain are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 4 | D | 55 | ASN |
| 5 | E | 53 | ARG |
| 7 | G | 36 | THR |
| 7 | G | 107 | THR |
| 7 | G | 223 | LYS |
| 8 | H | 45 | ARG |
| 8 | H | 75 | ARG |
| 8 | H | 176 | LYS |
| 9 | I | 165 | ASN |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 9 | I | 174 | ASP |
| 10 | J | 147 | ARG |
| 10 | J | 179 | THR |
| 13 | M | 112 | ASP |
| 13 | M | 152 | TYR |
| 14 | N | 50 | THR |
| 1 | O | 237 | LYS |
| 2 | P | 82 | ASP |
| 3 | Q | 3 | ARG |
| 4 | R | 55 | ASN |
| 6 | T | 92 | CYS |
| 8 | V | 19 | ARG |
| 8 | V | 75 | ARG |
| 8 | V | 234 | THR |
| 9 | W | 200 | PRO |
| 10 | X | 147 | ARG |
| 12 | Z | 194 | PHE |
| 13 | a | 110 | TYR |
| 13 | a | 228 | MET |
| 13 | a | 235 | LEU |
| 15 | c | 140 | LEU |
| 15 | c | 235 | LYS |
| 15 | c | 258 | LEU |
| 15 | e | 142 | LEU |
| 15 | e | 165 | LEU |
| 15 | e | 175 | ASN |
| 15 | f | 26 | LYS |
| 15 | f | 188 | LEU |
| 15 | f | 235 | LYS |
| 15 | g | 258 | LEU |
| 15 | h | 53 | ASN |
| 15 | h | 188 | LEU |
| 15 | h | 258 | LEU |
| 15 | i | 224 | ASP |

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (101) such sidechains are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 1 | A | 24 | GLN |
| 1 | A | 133 | GLN |
| 1 | A | 153 | ASN |
| 2 | B | 21 | GLN |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 3 | C | 29 | ASN |
| 3 | C | 146 | GLN |
| 3 | C | 168 | ASN |
| 4 | D | 159 | GLN |
| 4 | D | 223 | ASN |
| 5 | E | 23 | GLN |
| 5 | E | 186 | ASN |
| 5 | E | 206 | GLN |
| 6 | F | 117 | GLN |
| 6 | F | 121 | GLN |
| 6 | F | 221 | GLN |
| 7 | G | 54 | ASN |
| 7 | G | 104 | ASN |
| 7 | G | 157 | ASN |
| 7 | G | 171 | ASN |
| 8 | H | 163 | GLN |
| 8 | H | 194 | GLN |
| 8 | H | 220 | ASN |
| 8 | H | 222 | ASN |
| 9 | I | 133 | ASN |
| 10 | J | 152 | ASN |
| 10 | J | 171 | GLN |
| 10 | J | 182 | GLN |
| 11 | K | 69 | GLN |
| 11 | K | 150 | ASN |
| 11 | K | 177 | ASN |
| 12 | L | 29 | GLN |
| 12 | L | 89 | GLN |
| 12 | L | 162 | HIS |
| 12 | L | 180 | HIS |
| 13 | M | 171 | GLN |
| 13 | M | 183 | GLN |
| 14 | N | 38 | GLN |
| 14 | N | 75 | ASN |
| 14 | N | 92 | HIS |
| 14 | N | 125 | ASN |
| 14 | N | 126 | ASN |
| 1 | O | 24 | GLN |
| 1 | O | 133 | GLN |
| 1 | O | 153 | ASN |
| 1 | O | 179 | GLN |
| 2 | P | 21 | GLN |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 2 | P | 71 | HIS |
| 2 | P | 100 | GLN |
| 2 | P | 216 | ASN |
| 3 | Q | 89 | GLN |
| 3 | Q | 146 | GLN |
| 4 | R | 77 | ASN |
| 5 | S | 23 | GLN |
| 5 | S | 97 | ASN |
| 5 | S | 195 | GLN |
| 6 | T | 60 | GLN |
| 6 | T | 121 | GLN |
| 6 | T | 217 | ASN |
| 7 | U | 64 | ASN |
| 7 | U | 89 | ASN |
| 7 | U | 157 | ASN |
| 8 | V | 163 | GLN |
| 8 | V | 168 | ASN |
| 8 | V | 194 | GLN |
| 8 | V | 208 | ASN |
| 8 | V | 219 | HIS |
| 8 | V | 220 | ASN |
| 8 | V | 232 | ASN |
| 8 | V | 247 | GLN |
| 9 | W | 71 | ASN |
| 9 | W | 85 | GLN |
| 9 | W | 106 | ASN |
| 9 | W | 172 | ASN |
| 10 | X | 158 | GLN |
| 11 | Y | 73 | ASN |
| 11 | Y | 123 | ASN |
| 12 | Z | 29 | GLN |
| 12 | Z | 158 | ASN |
| 12 | Z | 162 | HIS |
| 13 | a | 183 | GLN |
| 14 | b | 92 | HIS |
| 14 | b | 111 | ASN |
| 15 | c | 50 | ASN |
| 15 | c | 158 | ASN |
| 15 | c | 164 | GLN |
| 15 | d | 55 | ASN |
| 15 | d | 158 | ASN |
| 15 | e | 164 | GLN |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 15 | e | 261 | ASN |
| 15 | f | 16 | GLN |
| 15 | f | 65 | ASN |
| 15 | f | 197 | ASN |
| 15 | g | 49 | ASN |
| 15 | g | 63 | ASN |
| 15 | g | 65 | ASN |
| 15 | g | 158 | ASN |
| 15 | g | 250 | ASN |
| 15 | h | 197 | ASN |
| 15 | h | 250 | ASN |
| 15 | i | 50 | ASN |
| 15 | i | 164 | GLN |

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

## 5.6 Ligand geometry ⓘ

There are no ligands in this entry.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

# 6 Map visualisation (i)

This section contains visualisations of the EMDB entry EMD-9259. 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
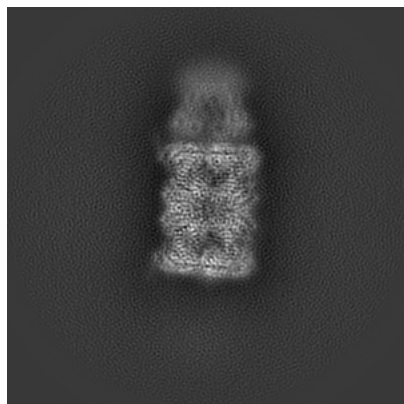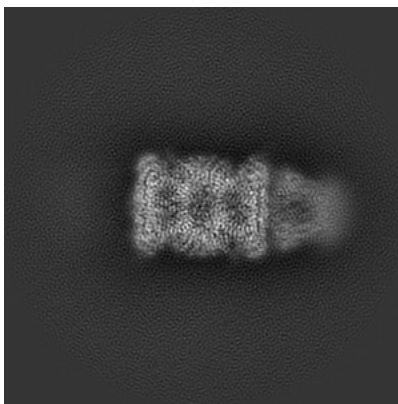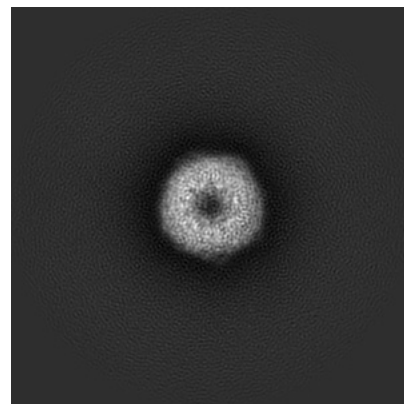


|   |   |   |
|---|---|---|
| X | Y | Z |

### 6.1.2 Raw map



|   |   |   |
|---|---|---|
| X | Y | Z |
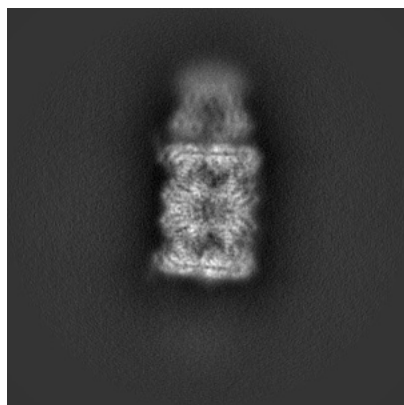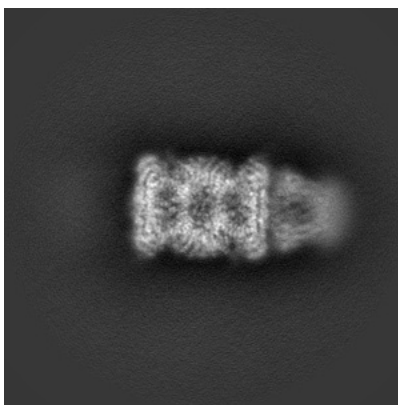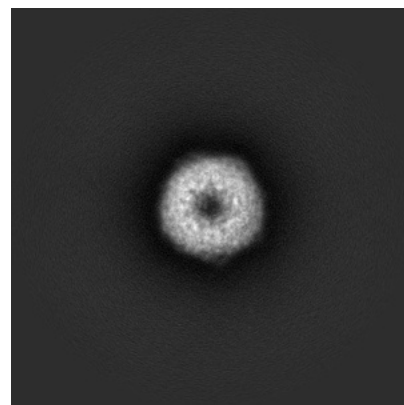
The images above show the map projected in three orthogonal directions.

## 6.2 Central slices (i)

### 6.2.1 Primary map
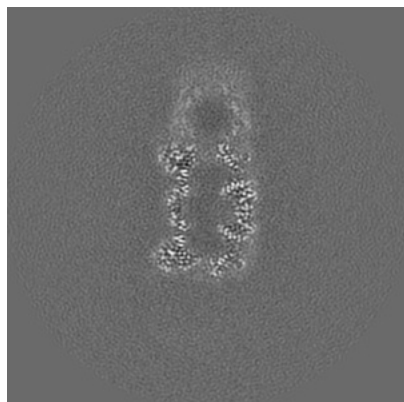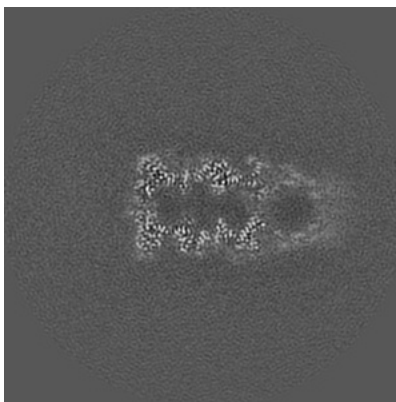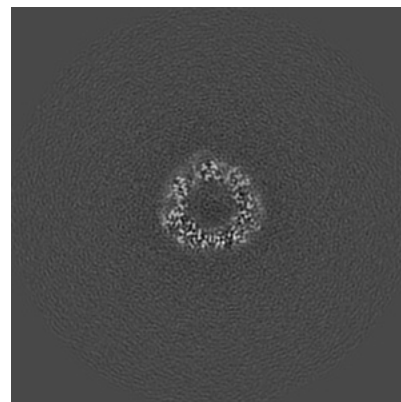


X Index: 172 Y Index: 172 Z Index: 172

### 6.2.2 Raw map
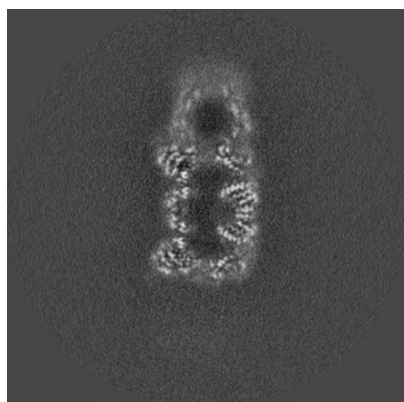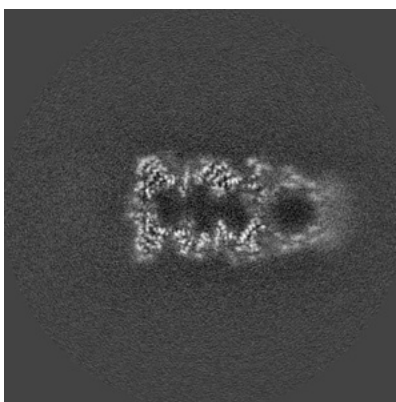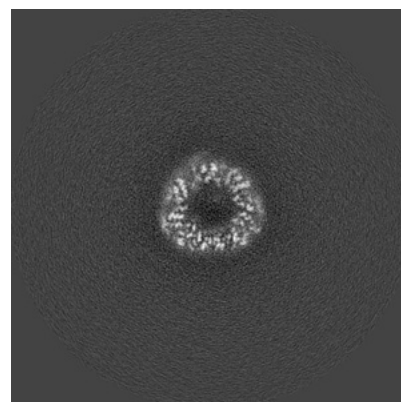


X Index: 172 Y Index: 172 Z Index: 172

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

## 6.3 Largest variance slices (i)

### 6.3.1 Primary map
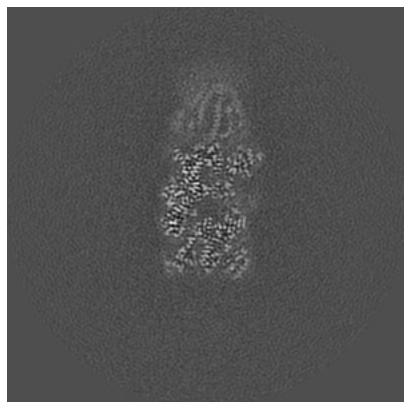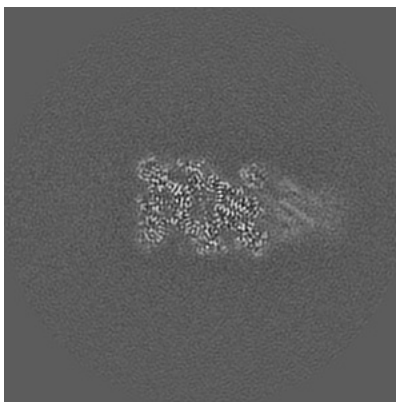


X Index: 154        Y Index: 152        Z Index: 156
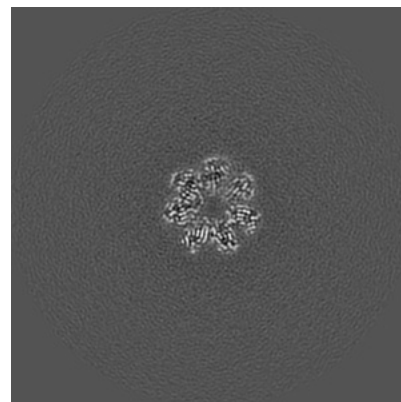
### 6.3.2 Raw map
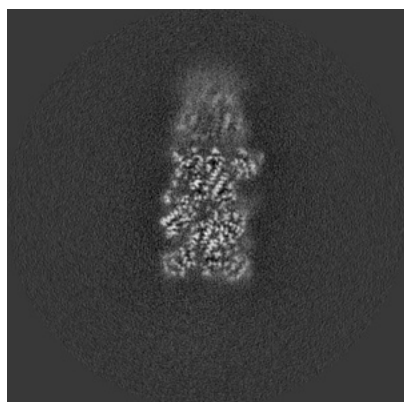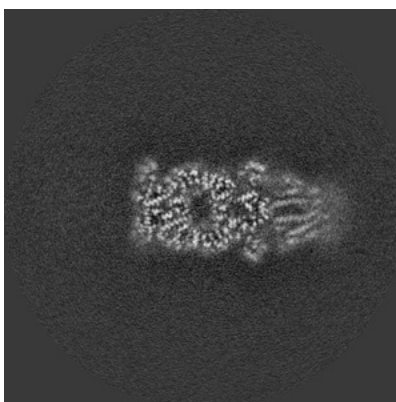


X Index: 151        Y Index: 190        Z Index: 156
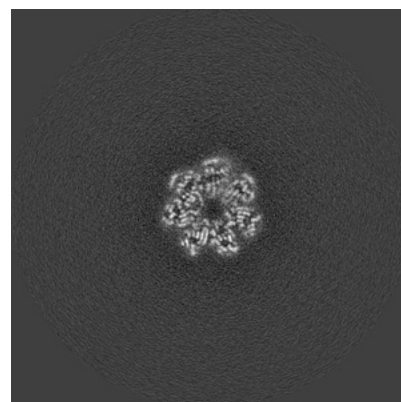
The images above show the largest variance slices of the map in three orthogonal directions.

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

### 6.4.1 Primary map



X Y Z

### 6.4.2 Raw map



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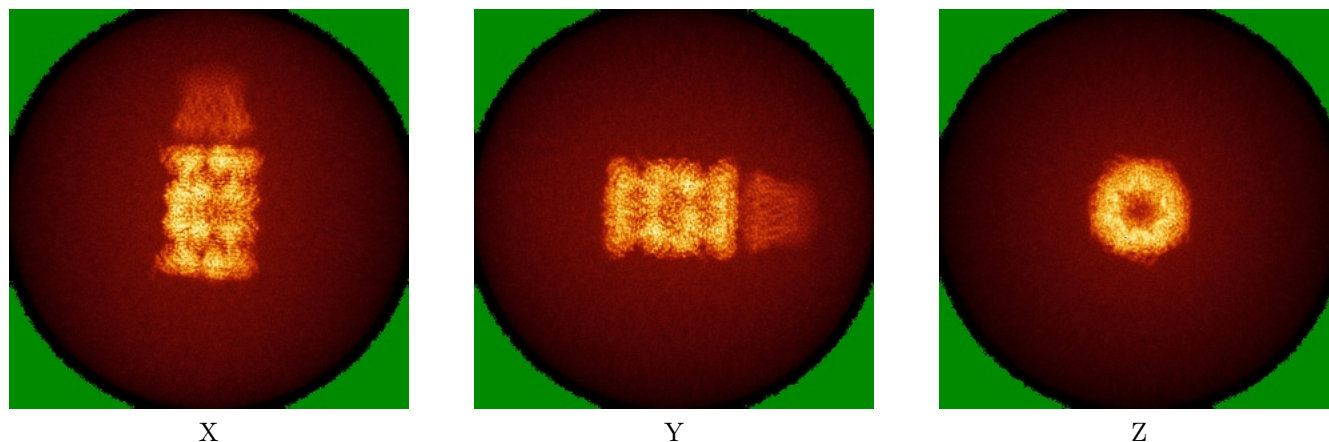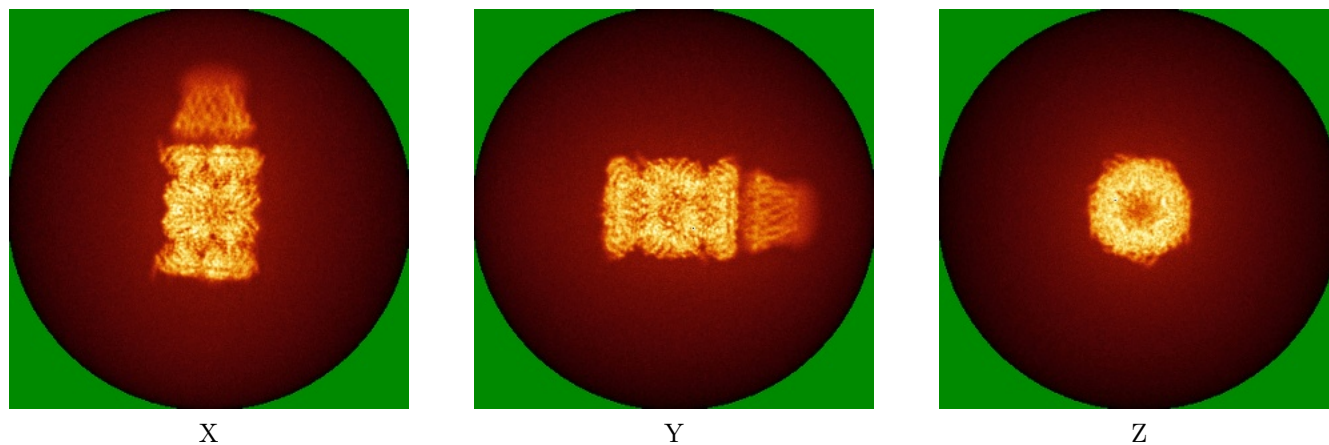
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

## 6.5 Orthogonal surface views ⓘ

### 6.5.1 Primary map



X            Y            Z
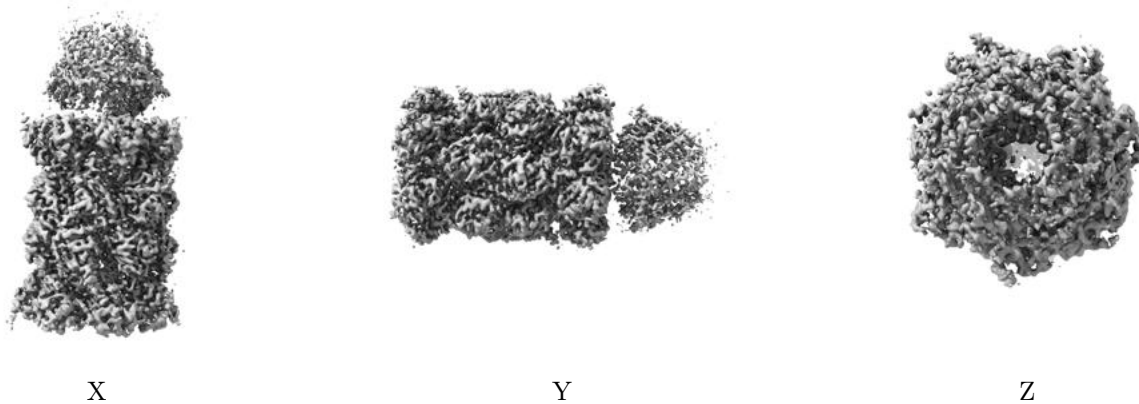
The images above show the 3D surface view of the map at the recommended contour level 6.0. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

### 6.5.2 Raw map



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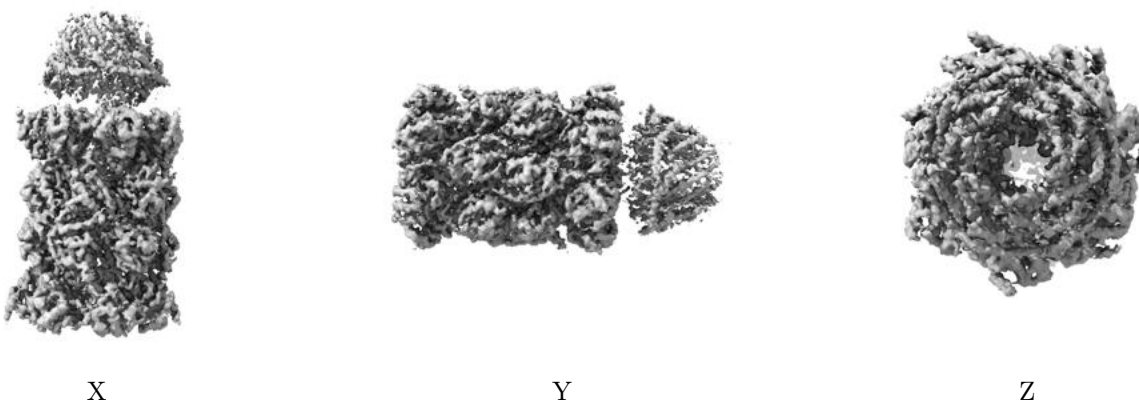
These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

## 6.6 Mask visualisation ⓘ

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

# 7　Map analysis ⓘ

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

## 7.1　Map-value distribution ⓘ
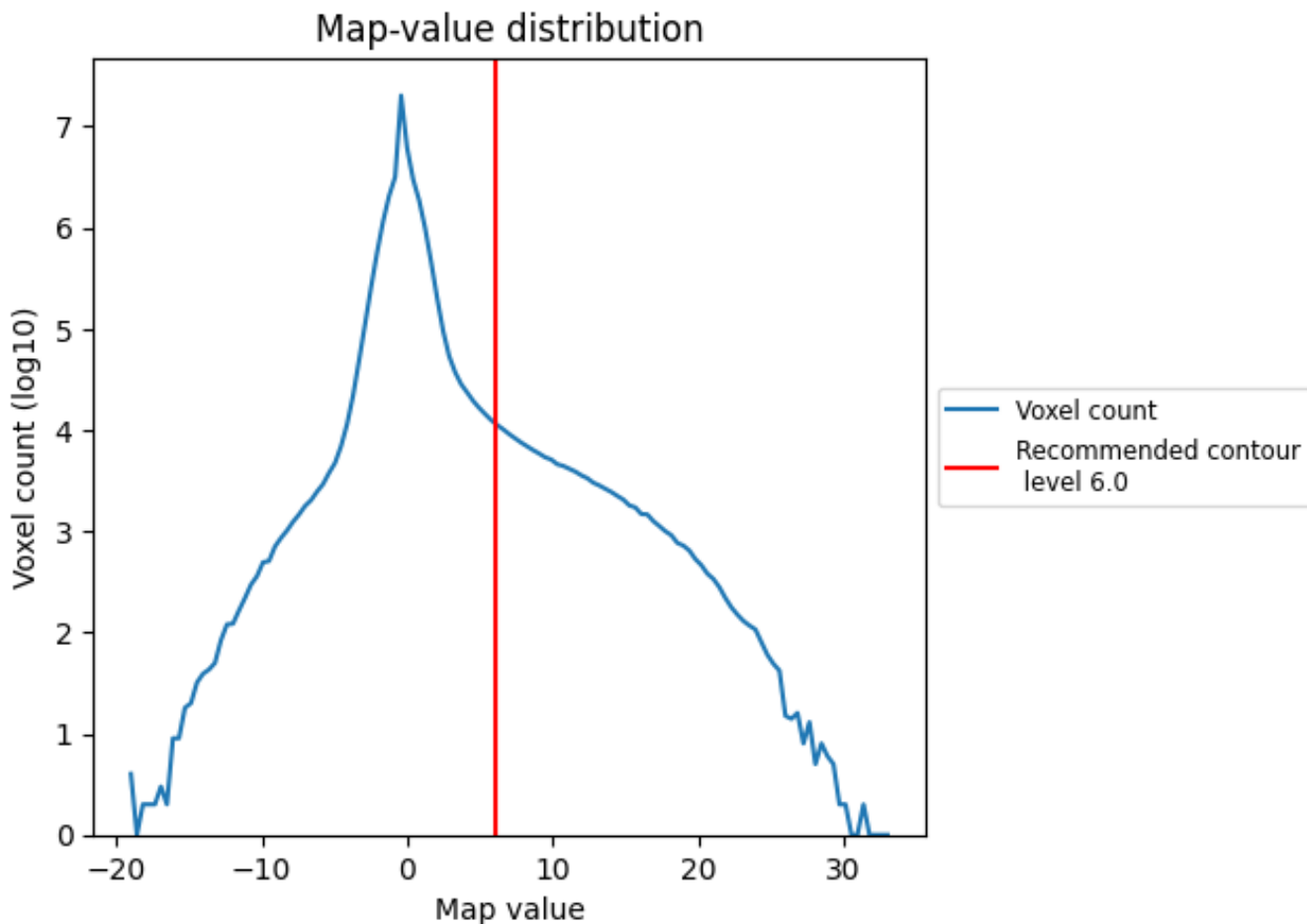


The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

## 7.2　Volume estimate ⓘ
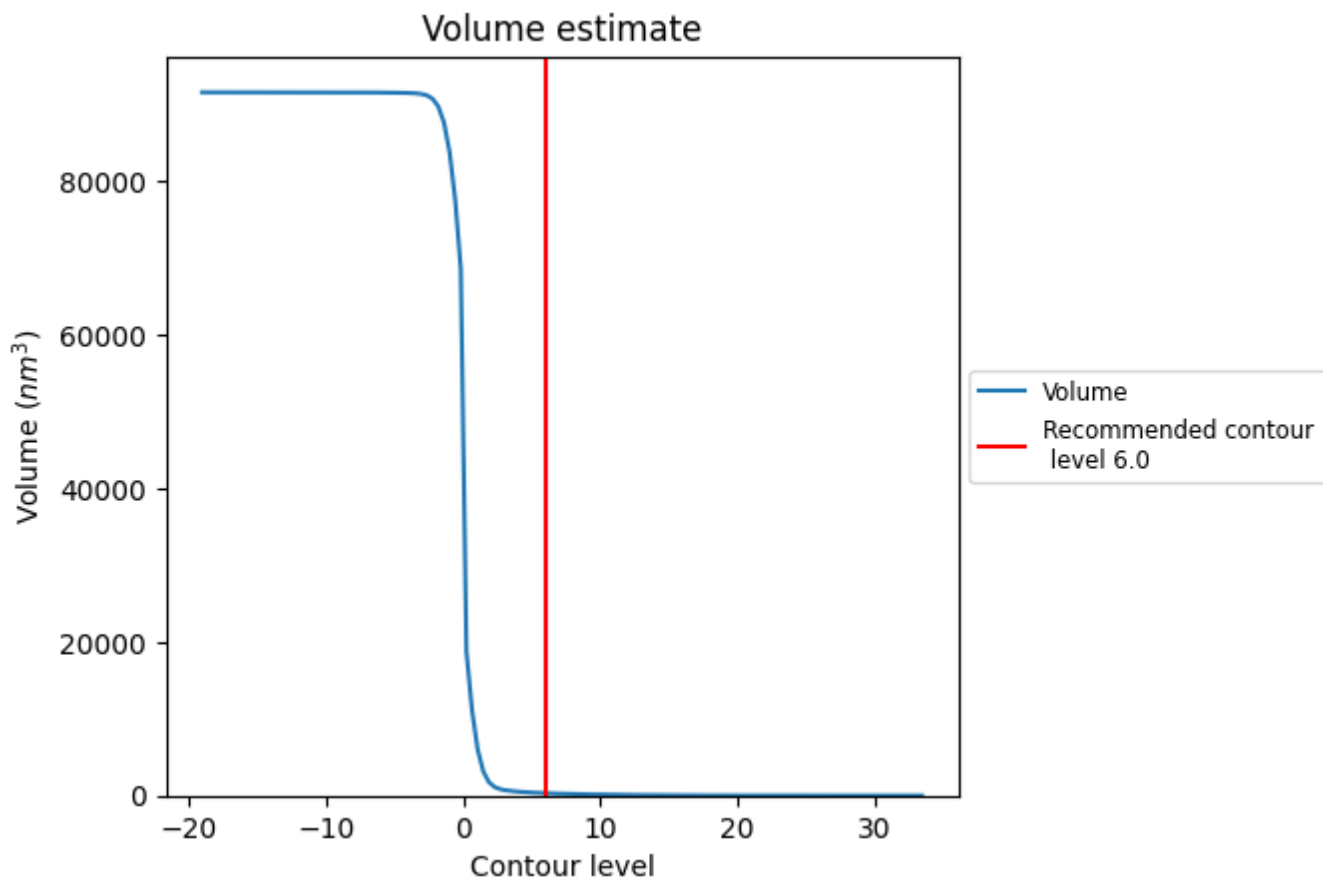


The volume at the recommended contour level is 307 nm$^3$; this corresponds to an approximate mass of 277 kDa.

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 ⓘ
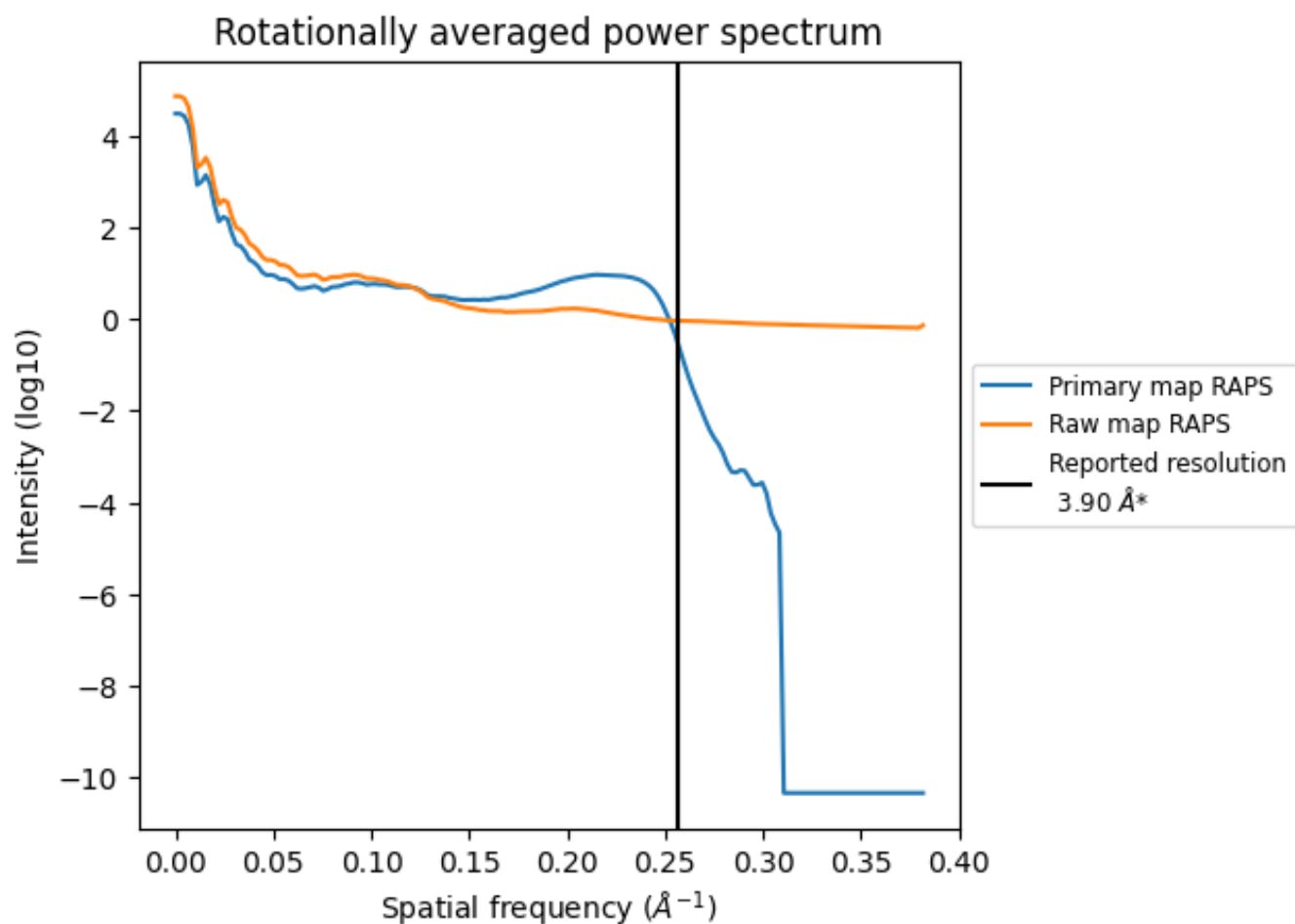


*Reported resolution corresponds to spatial frequency of 0.256 Å$^{-1}$

# 8　Fourier-Shell correlation ⓘ

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 ⓘ
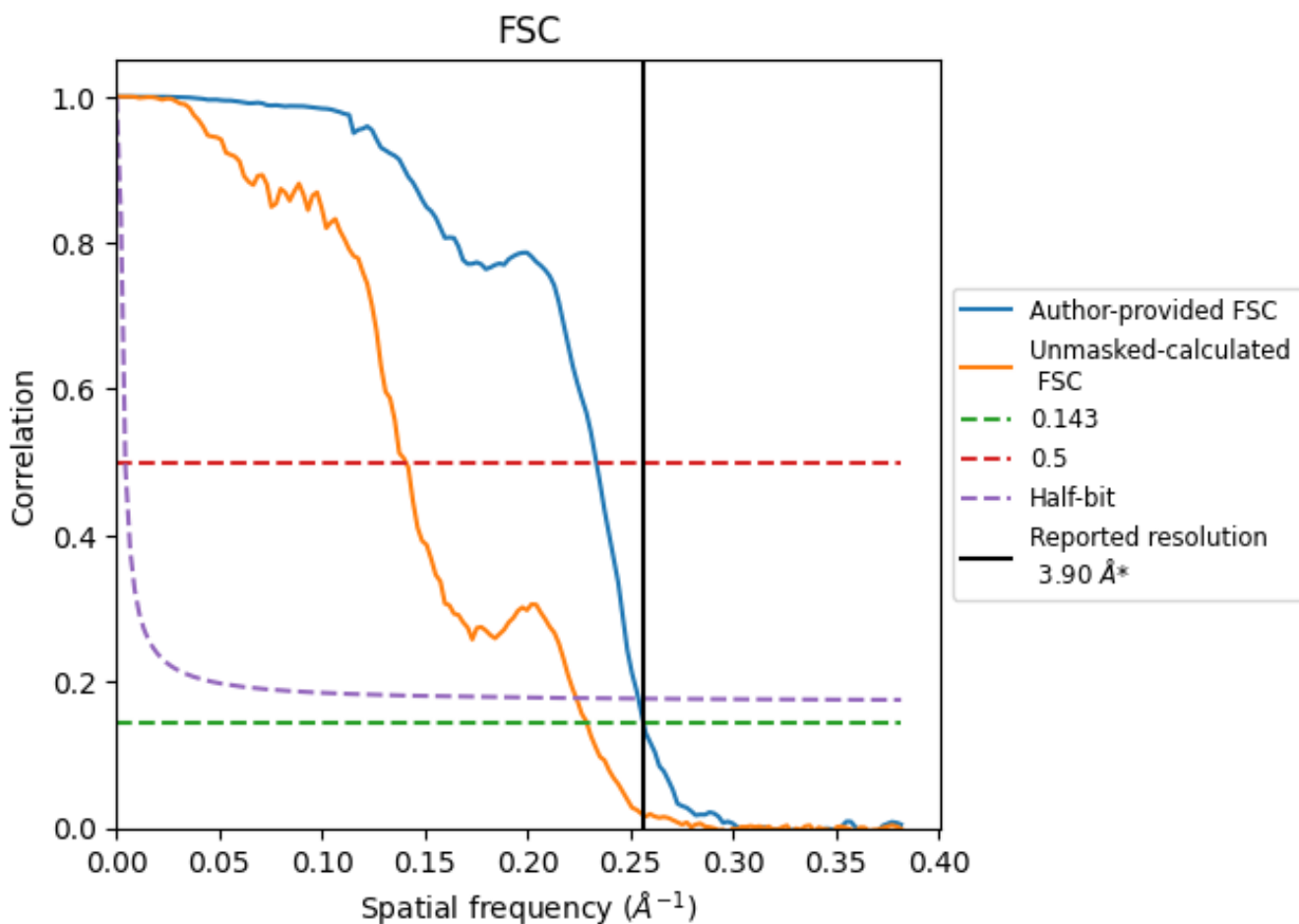


*Reported resolution corresponds to spatial frequency of 0.256 Å$^{-1}$

## 8.2　Resolution estimates　ⓘ

| Resolution estimate (Å) | Estimation criterion (FSC cut-off) | | |
|---|---|---|---|
| | 0.143 | 0.5 | Half-bit |
| Reported by author | 3.90 | - | - |
| Author-provided FSC curve | 3.90 | 4.28 | 3.94 |
| Unmasked-calculated* | 4.37 | 7.11 | 4.47 |

*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 4.37 differs from the reported value 3.9 by more than 10 %

# 9 Map-model fit ⓘ

This section contains information regarding the fit between EMDB map EMD-9259 and PDB model 6MUX. Per-residue inclusion information can be found in section 3 on page 9.

## 9.1 Map-model overlay ⓘ



| X | Y | Z |
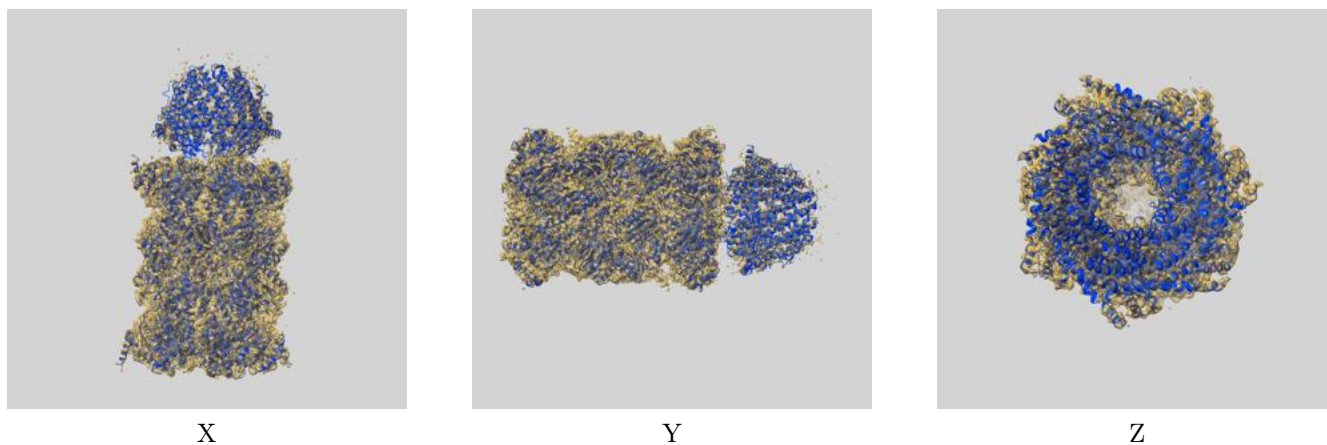
The images above show the 3D surface view of the map at the recommended contour level 6.0 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

## 9.2　Q-score mapped to coordinate model ⓘ



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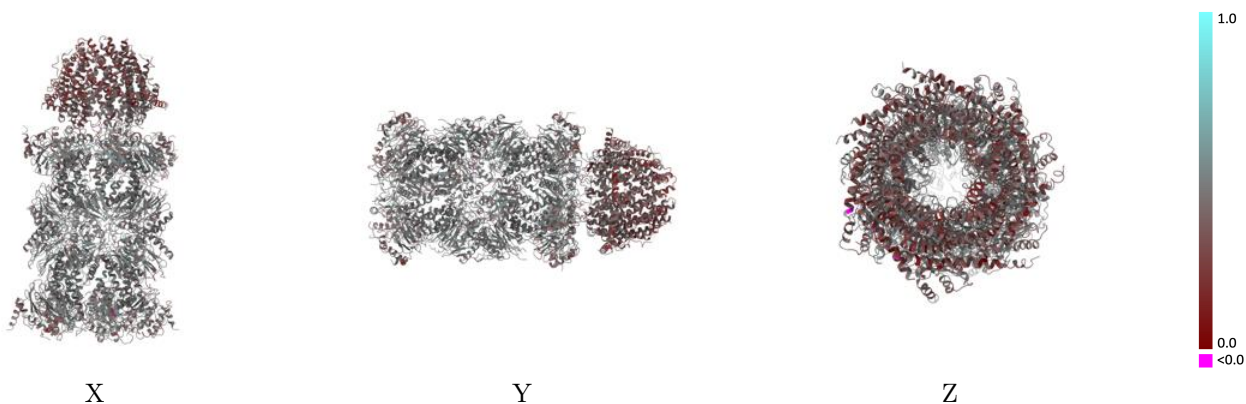
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

## 9.3　Atom inclusion mapped to coordinate model ⓘ



X　　　　　　　　　Y　　　　　　　　　Z
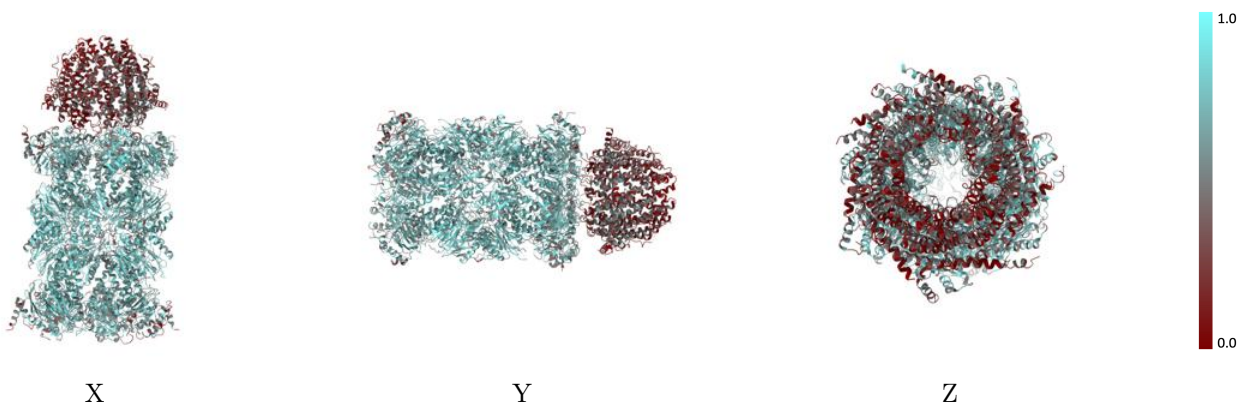
The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (6.0).

## 9.4 Atom inclusion ⓘ
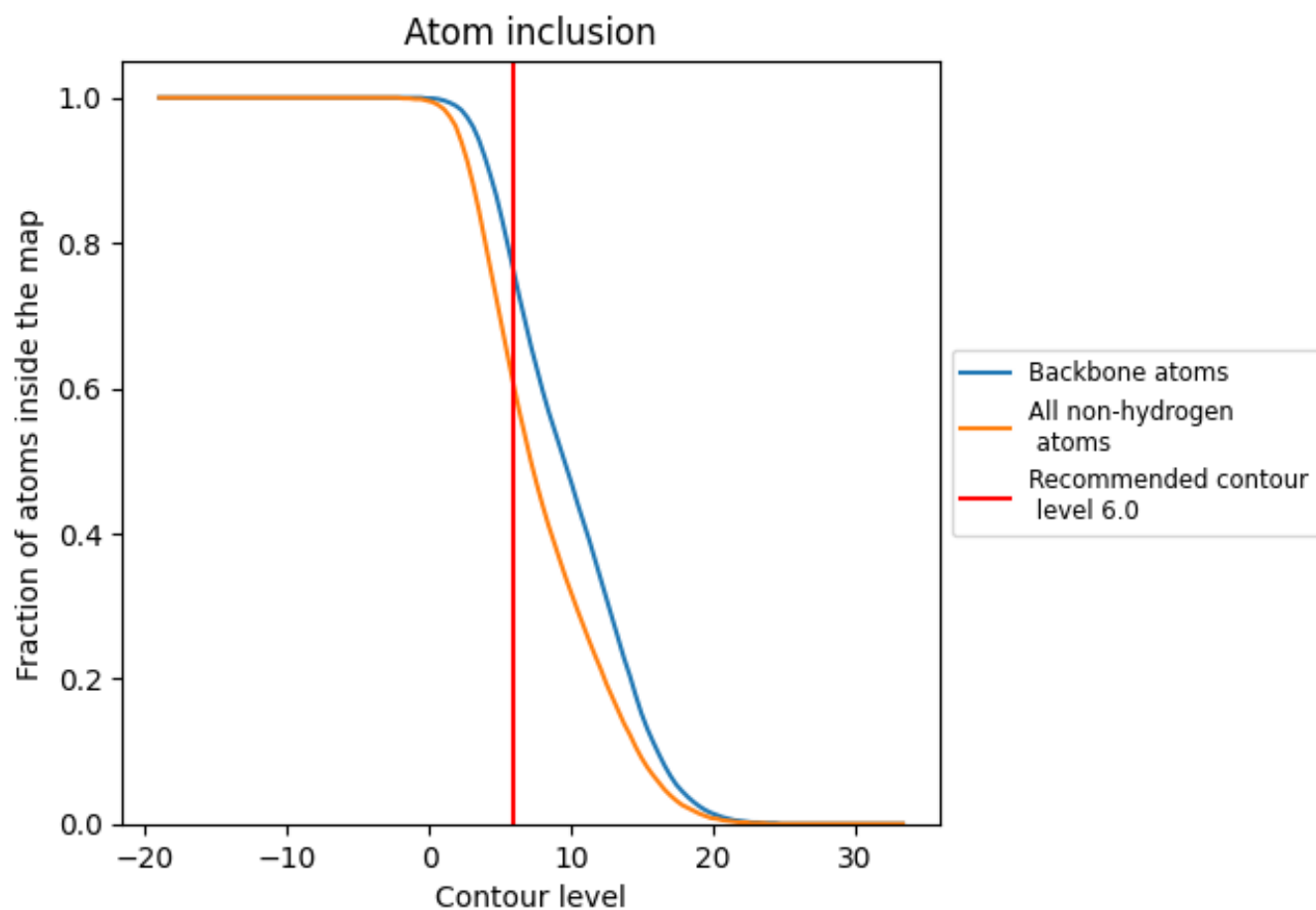


At the recommended contour level, 76% of all backbone atoms, 60% of all non-hydrogen atoms, are inside the map.

## 9.5 Map-model fit summary ⓘ

The table lists the average atom inclusion at the recommended contour level (6.0) and Q-score for the entire model and for each chain.

| Chain | Atom inclusion | Q-score |
|:-----:|:--------------:|:-------:|
| All | 0.6020 | 0.4390 |
| A | 0.6440 | 0.4620 |
| B | 0.6640 | 0.4590 |
| C | 0.6660 | 0.4550 |
| D | 0.6240 | 0.4530 |
| E | 0.6050 | 0.4530 |
| F | 0.6620 | 0.4540 |
| G | 0.6960 | 0.4640 |
| H | 0.6900 | 0.4470 |
| I | 0.6730 | 0.4500 |
| J | 0.7520 | 0.4800 |
| K | 0.7720 | 0.4800 |
| L | 0.7520 | 0.4750 |
| M | 0.7210 | 0.4800 |
| N | 0.6820 | 0.4760 |
| O | 0.5940 | 0.4450 |
| P | 0.6340 | 0.4550 |
| Q | 0.6690 | 0.4520 |
| R | 0.6290 | 0.4560 |
| S | 0.6170 | 0.4450 |
| T | 0.6600 | 0.4500 |
| U | 0.6750 | 0.4610 |
| V | 0.6830 | 0.4530 |
| W | 0.6710 | 0.4560 |
| X | 0.7420 | 0.4760 |
| Y | 0.7590 | 0.4770 |
| Z | 0.7570 | 0.4720 |
| a | 0.7380 | 0.4840 |
| b | 0.6990 | 0.4760 |
| c | 0.3030 | 0.3570 |
| d | 0.2000 | 0.3330 |
| e | 0.1730 | 0.3040 |
| f | 0.2000 | 0.3210 |
| g | 0.2630 | 0.3390 |
| h | 0.3150 | 0.3550 |
| i | 0.3340 | 0.3640 |

1.0

0.0
<0.0