wwPDB EM Validation Summary Report (i)

Jun 29, 2023 – 02:01 pm BST

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PDB ID	:	6HV9
EMDB ID	:	EMD-0288
Title	:	S. cerevisiae CMG-Pol epsilon-DNA
Authors	:	Abid Ali, F.; Purkiss, A.G.; Cheung, A.; Costa, A.
Deposited on	:	2018-10-10
Resolution	:	4.98 Å(reported)

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 4.98 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.
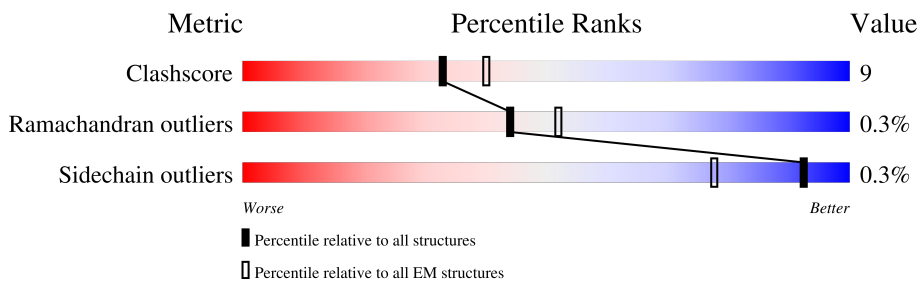
Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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 <=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	3	971	5% / 45% 12% 43%
2	4	933	16% / 51% 12% 37%
3	5	775	13% / 61% 18% • 19%
4	6	1017	10% / 44% 12% 44%
5	2	868	9% / 48% 15% 37%
6	7	845	25% / 58% 15% 27%
7	C	208	6% / 62% 31% 7%
8	D	213	6% / 56% 27% • 15%

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Mol	Chain	Length	Quality of chain
9	E	194	6% / 60% / 21% / 18%
10	F	294	7% / 53% / 19% / 26%
11	G	650	12% / 67% / 16% / 17%
12	X	21	76% / 5% / 95%
13	Y	21	86% / 100%
14	J	7	29% / 14% / 57% / 29%
15	B	689	23% / 54% / 14% / 33%
16	A	914	41% / 63% / 21% / 16%

2 Entry composition ⓘ

There are 18 unique types of molecules in this entry. The entry contains 47617 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 replication licensing factor MCM3.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	3	558	Total	C	N	O	S	0	0
			4270	2689	753	818	10		

- Molecule 2 is a protein called DNA replication licensing factor MCM4.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	4	589	Total	C	N	O	S	0	0
			4543	2848	796	873	26		

- Molecule 3 is a protein called DNA replication licensing factor MCM5.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	5	628	Total	C	N	O	S	0	0
			4690	2942	820	907	21		

- Molecule 4 is a protein called DNA replication licensing factor MCM6.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	6	571	Total	C	N	O	S	0	0
			4307	2704	766	821	16		

- Molecule 5 is a protein called DNA replication licensing factor MCM2.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	2	549	Total	C	N	O	S	0	0
			4184	2639	745	785	15		

- Molecule 6 is a protein called DNA replication licensing factor MCM7.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	7	616	Total	C	N	O	S	0	0
			4785	3024	820	916	25		

- Molecule 7 is a protein called DNA replication complex GINS protein PSF1.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	C	194	Total	C	N	O	S	0	0
			1492	934	265	287	6		

- Molecule 8 is a protein called DNA replication complex GINS protein PSF2.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	D	181	Total	C	N	O	S	0	0
			1461	935	257	265	4		

- Molecule 9 is a protein called DNA replication complex GINS protein PSF3.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	E	159	Total	C	N	O	S	0	0
			1262	824	207	226	5		

- Molecule 10 is a protein called DNA replication complex GINS protein SLD5.

Mol	Chain	Residues	Atoms					AltConf	Trace
10	F	218	Total	C	N	O	S	0	0
			1743	1099	292	339	13		

- Molecule 11 is a protein called Cell division control protein 45.

Mol	Chain	Residues	Atoms					AltConf	Trace
11	G	541	Total	C	N	O	S	0	0
			4239	2684	737	808	10		

- Molecule 12 is a DNA chain called DNA (5'-D(*GP*CP*AP*GP*CP*CP*AP*CP*GP*CP *TP*GP*GP*CP*CP*GP*TP*TP*TP*TP*A)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
12	X	21	Total	C	N	O	P	0	0
			425	203	76	126	20		

- Molecule 13 is a DNA chain called DNA (5'-D(P*TP*AP*AP*AP*AP*CP*GP*GP*CP*C P*AP*GP*CP*GP*TP*GP*GP*CP*TP*GP*C)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
13	Y	21	Total	C	N	O	P	0	0
			433	204	84	124	21		

- Molecule 14 is a DNA chain called DNA (5'-D(P*TP*TP*TP*TP*TP*TP*T)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
14	J	7	Total	C	N	O	P	0	0
			140	70	14	49	7		

- Molecule 15 is a protein called DNA polymerase epsilon subunit B.

Mol	Chain	Residues	Atoms					AltConf	Trace
15	B	465	Total	C	N	O	S	0	0
			3661	2346	620	681	14		

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	266	ASN	MET	conflict	UNP P24482

- Molecule 16 is a protein called DNA polymerase epsilon catalytic subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
16	A	771	Total	C	N	O	S	0	0
			5918	3797	988	1101	32		

- Molecule 17 is PHOSPHOTHIOPHOSPHORIC ACID-ADENYLATE ESTER (three-letter code: AGS) (formula: $C_{10}H_{16}N_5O_{12}P_3S$).
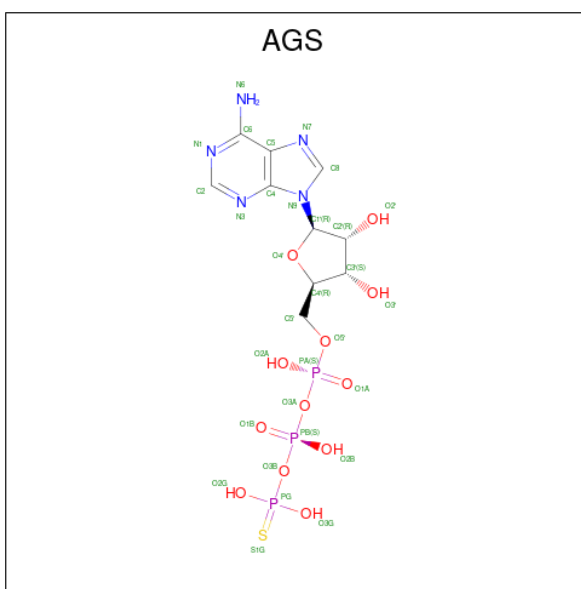
Mol	Chain	Residues	Atoms						AltConf
17	5	1	Total	C	N	O	P	S	0
			31	10	5	12	3	1	
17	5	1	Total	C	N	O	P	S	0
			31	10	5	12	3	1	

- Molecule 18 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		AltConf
18	A	2	Total	Zn	0
			2	2	

3 Residue-property plots ⓘ

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: DNA replication licensing factor MCM3

SER VAL ILE SER PHE ASP ASN VAL GLU PRO GLY THR ILE SER THR GLY ARG LEU LEU SER LEU ILE ILE SER GLY ILE ILE ALA ARG LEU MET GLN THR GLU ILE PHE GLU GLU GLU SER TYR PRO VAL ALA SER LEU PHE GLU ARG ILE ASN GLU GLU LEU PRO GLU GLU LYS PHE SER ALA

GLN GLU TYR LEU ALA GLY LYS ILE LEU MET SER ASP ARG ASN ASN LEU MET VAL ALA ASP LYS VAL TRP ARG VAL

• Molecule 2: DNA replication licensing factor MCM4

16%

Chain 4:   51%   12%   37%

MET SER GLN GLN SER SER SER PRO THR LYS GLU ASP ASN ASN SER SER PRO VAL PRO ASP PRO ASP SER VAL PRO PRO GLN LEU SER SER PRO ALA LEU PHE TYR SER SER SER SER GLN GLY ASP ILE TYR GLY ARG ASN ASN SER GLN ASN LEU SER GLN GLY GLY

ASN ILE ARG ALA ALA ILE GLY SER SER PRO LEU ASN PHE PRO SER SER SER GLN ARG GLN ASN SER ASP VAL PHE GLN SER GLN GLY GLY ARG GLN GLY ARG ILE ARG SER SER ALA SER GLY ARG SER ARG TYR HIS SER ASP LEU ARG SER ASP ARG ALA LEU PRO THR SER SER

SER SER LEU GLY ARG ASN GLY VAL HIS MET ARG ARG ASN ASP ILE HIS THR SER LEU SER SER PRO ARG ARG ILE VAL ASP PHE ASP THR ARG SER GLY VAL ASN THR LEU ASP THR SER SER SER ALA PRO PRO SER GLU ALA SER GLU PRO **L177** **R178** **W181**

I187 **Q188** **E189** **N193** **F197** **K202** **F205** **R206** **K207** **I208** **L209** **D210** **E211** **R212** GLU GLU PHE ILE ASN ASN THR THR **D221** **L224** **Y225** **Y226** **M233** **R234** **E235** **L236** **G237** **T238** SER ASN **L241** **A245** **L248** **Y251** **K252** **Q253** **T254** **E255** **D256** **Q260** **L261** **P265** **V268**

I269 **S270** **I271** **M272** **D273** **Q274** **T275** **I276** **K277** **D278** **C279** **M280** **V281** **S282** **L283** **I284** **V285** **D286** **N287** **N288** **L289** **D290** **Y291** **D292** **L293** **D294** **E295** **I296** **E297** **T298** **K299** PHE TYR LYS VAL ARG PRO TYR ASN VAL GLY **S310** **C311** **K312** **G313** **M314** **R315** **E316** **L317** **N318** **D323** **K324** **L325** **I326** **N327** **L328** **K329** **V332**

L333 **R334** **S335** **T336** **D341** **V344** **A345** **C349** **E359** **I360** **D361** **R362** **I365** **Q366** **E367** **C371** **I374** **D375** **C376** **N377** **S381** **I385** **H386** **N387** **R388** **C389** **A392** **D393** **K394** **Q395** **K398** **D404** **F405** VAL PRO ASP GLY GLN **T411** **S416** **D421** **E422** **D425** **R432**

I433 **E434** **V435** **F439** **R440** **S441** **I442** **P443** **A446** **N447** **V452** **L453** **K464** **S455** **L456** **Y457** **K458** **T459** **Y460** **V461** **D462** **K467** **K468** **V469** SER ASP LYS ARG LEU ASP VAL ASP THR SER THR ILE GLU GLN GLN **L485** MET GLN ASN LYS VAL ASP HIS ASN GLU VAL GLU GLU VAL GLU VAL ARG GLN **I501**

THR **D503** **Q504** **D505** **L506** **A507** **E516** **D517** **L518** **Y519** **S520** **L521** **L522** **A523** **R524** **S525** **I526** **V536** **Q543** **L544** **F545** **G546** **N549** **K550** **T551** **R557** **Y558** **R559** **G560** **D561** **I562** **N563** **I564** **D569** **P570** **S571** **T572** **S573** **K574** **I577** **R587** **Y590** **T591** **S592** **G593** **K594** **G595** **S596** **S597** **A598** **V599**

GLY **L601** **I605** **T606** **R607** **D608** **V609** **D610** **T611** **K612** **Q613** **L614** **V615** **L616** **G619** **A620** **L623** **V628** **C629** **C630** **I631** **D632** **D635** **K636** **D639** **M649** **E650** **Q651** **Q652** **S655** **I656** **A657** **K658** **A659** **G660** **I661** **I662** **T663** **T664** **I671** **I678** **G679** **S680** **N685** **L686** **E690** **P695**

P696 **S700** **R701** **F702** **D703** **Y706** **L707** **V708** **V712** **D713** **E714** **K715** **N716** **E719** **L720** **A721** **K722** **T725** **E730** **D731** **K732** PRO GLU HIS ILE SER GLN **D739** **D740** **V741** **L742** **P743** **F746** **Y753** **A754** **K755** **E756** **H757** **I758** **H759** **P760** **I761** **I762** **K767** **L770** **A773** **Y774** **M777**

R778 **D782** ASP SER ARG SER ASP GLU LYS ILE MET ASN VAL LEU LYS **A793** ASP GLN ALA SER ASP SER SER MET **E799** SER PHE ASN GLU **I802** **R803** **L804** **N815** **E818** **L819** **E820** **D821** **V822** **Q823** **L828** **I829** **R830** **K834** **D835** **Y836** **A837** **T838** ASP PRO LYS THR GLY LYS SER ILE ASP GLU ALA LEU SER ARG MET LEU GLN GLN ASP LYS VAL ILE VAL LEU

LYS LEU GLN GLU ASP LEU SER ARG GLU ILE MET ASN VAL LEU LYS ASP GLN GLN ALA SER ASP SER SER MET SER PHE ASN GLU LEU ILE LYS GLN ILE ASN GLU HIS SER GLN ASP ARG VAL GLU SER ASP ILE GLU GLN ALA LEU SER ARG MET LEU GLN GLN THR GLY LYS SER VAL ILE VAL LEU

GLY GLU GLY VAL ARG SER VAL ARG LEU ASN ARG VAL

• Molecule 3: DNA replication licensing factor MCM5

Chain 5:

13%

61%   18%   •   19%

MET SER PHE ASP ARG PRO GLU ILE TYR SER ALA PRO VAL LEU GLN GLY GLU SER PRO ASN ASP ASP D23 N24 K29 E37 F38 R39 I40 D41 S42 Q43 F44 R47 D48 Q49 L50 R51 K57 T62 M65 L68 D85 P88 L89 F90 K99 R100 I101 S102

I103 L104 S105 ARG ALA GLN SER ALA ASN ASN ASP LYS ASP PRO GLU ASN THR SER MET ASP ASP THR ASP SER LEU LEU LEU N130 L137 I138 L139 N140 SER ALA ASN ILE PRO LEU ARG ASP LEU D152 H155 R161 L162 I167 S168 T169 S170 R175 Y178 L179

S180 R184 S191 I192 T193 F197 N198 SER ILE THR GLY N203 T204 V205 R209 L212 S213 T214 I215 SER GLU SER SER MET ALA ASN GLU SER ASN ILE GLY ASP GLU SER THR LYS LYS N235 C236 G237 P238 D239 I242 Q254 F255 L256 K257 L258 Q259 E260 L264

V265 P266 V267 GLY E269 M270 P271 R272 C278 D279 R280 Y281 L282 G289 Y298 S299 I300 Y301 K304 ASN GLY ALA GLY SER GLU ARG SER GLY GLY LYS ASN GLY GLY SER G320 R324 Y327 G332 I333 Q334 S335 D336 VAL GLU THR SER SER ILE TRP ASN SER VAL THR

MET PHE THR E351 E352 E353 E354 F357 K365 L366 I369 L370 T371 A375 E382 K385 K386 A387 I388 M393 G403 M404 D409 V412 L413 L414 L415 T420 A421 K422 S423 Q424 L425 L426 K427 K431 Y438 T439 S440 S444 S445 A446 A447 G448 L449 THR

A451 R455 ASP P457 A468 L471 V477 C478 I479 D480 M485 R486 D487 E488 D489 R490 V491 A492 I493 H494 E498 A505 L513 L520 A521 A522 A523 I526 R529 Y530 D531 D532 L533 K534 S535 D538 D541 F542 Q543 L547 S548 R549 I555 V556 K557

D558 D559 H560 N561 E562 E563 R564 N570 H571 N574 I575 N579 A580 N581 A582 MET Q584 N585 Q586 Q587 E588 E589 S592 E593 I594 S595 I596 E597 K598 R601 T604 Y605 C606 C610 A611 P612 Q617 A618 A619 L622 V627 K631 Q632 L633 E637 L638 E639 S640

THR GLU ARG SER SER ILE P647 I650 A655 R658 I659 T660 K665 L666 E667 L668 Q673 V677 R682 A686 D690 S693 GLN ASP PRO ILE GLY GLY LEU ASN GLN ALA SER GLY THR SER LEU SER GLU ILE ARG ARG PHE GLU Q716 E717 L718 K719 R720 R721

L722 P723 I724 G725 W726 S727 T728 S729 Y730 L733 R734 R735 E736 F737 V738 D739 THR H741 R742 F743 S744 Q745 L746 A747 L748 Y753 ALA LEU GLU LYS HIS E759 Q766 I770 Y771 R772 S773 G774 V775

• Molecule 4: DNA replication licensing factor MCM6

Chain 6:

10%

44%   12%   44%

MET SER SER PRO PHE PRO ALA ASP THR PRO SER SER ASN ARG PRO SER ASN SER PRO PRO SER ILE GLY ALA GLY PHE GLY SER SER GLY LEU ASP SER GLN ILE GLY SER ARG LEU HIS PHE PRO SER SER GLN HIS VAL SER ASN SER GLN THR GLY PRO

PHE VAL ASN ASP SER THR GLN PHE SER SER GLN ARG LEU GLN THR ASP GLY SER ALA THR ASN ASP MET GLU GLY ASN GLU PRO ALA ARG SER PHE LYS SER ARG ALA LEU ASN HIS VAL LYS LYS V103 D104 D105 G108 E109 R112 E113 A114 F115 E116 L119 E120 D121 F122 S123

V124 Q125 S126 T127 D128 T129 G130 E131 V132 E133 K134 V135 Y136 R137 D147 L148 ASN T150 H157 M160 N163 G164 A167 S171 Y175 R176 F177 L178 R187 V188 V189 R190 A193 PRO GLU LEU LEU ASN THR SER ASP SER LEU LYS ARG SER GLU GLY ASP GLU GLY

GLN ALA ASP GLU ASP GLU GLN GLN ASP ASP ASP MET ASN GLY SER SER LEU PRO ARG ASP SER GLY SER SER ALA ALA PRO GLY ASN GLY THR SER ALA MET ALA THR ARG SER ILE THR THR SER THR SER PRO GLU GLN THR GLU ARG VAL PHE GLN ILE SER PHE ASN LEU PRO

THR V273 R277 D278 I279 R280 S281 E282 K283 L287 T293 V294 T297 S298 E303 L304 Y305 K306 A307 S308 D319 N320 V321 N347 L354 D355 W356 Q357 K358 V359 R360 I361 Q362 E363 N364 T370 G371 G383 K390 P391 G392 D393 R394 T398 G399 V400 E401 I402

D406 VAL T408 Q409 L410 G411 L412 V415 T420 L421 D422 T423 ARG GLY ILE SER LYS THR GLU GLY LEU ASN SER GLY VAL THR GLY LEU ARG S442 L443 GLY V445 R446 D447 L448 T449 I452 S453 F454 L455 A456 C457 H458 V459 I460 G463 SER ASN ILE GLY ALA SER SER

PRO ASP ALA SER ASN ASN ARG GLU GLU THR GLU LEU GLN MET ALA ALA ASN LEU ALA ASN VAL TYR GLN ASP ASN GLU ARG ASP GLU GLN GLU VAL PHE LEU ASN SER LEU SER ASP E512 I513 N514 E515 L516 K517 V520 R531 S532 I533 A534 K544 M551 L552 G553

G554 S558 E561 L565 D568 V573 V574 G575 D576 P577 K581 S582 Q583 F584 L585 V589 Y597 K601 A602 S603 S604 A605 A606 T609 ALA ALA VAL ARG ASP GLU GLU G618 G619 D620 Y621 T622 I623 E624 A625 G626 A627 A631 D632 D642 K643 M644 D645

I646 S647 D648 I652 Q658 Q659 T660 I661 S662 I663 ALA LYS ALA GLY ILE HIS ALA THR LEU ASN A674 R675 T676 V685 Y689 N690 R691 K692 R696 G697 N698 L699 N700 M701 T702 A703 P704 I705 F712 L716 D717 D718 C719 K722 I723 D724 D733 M736 K737 R738

D739 E740 A741 F746 Q750 L751 R752 I755 K756 Y757 A758 R759 T760 P763 I764 L765 T766 K767 L773 K776 Y777 Q786 G787 F788 S789 R790 S791 SER Y793 R794 I795 V796 V797 R798 S802 R805 R812 I824 Y828 R832 R837 V840 ASP ASP VAL

GLU MET ASP GLU PHE ASP ASN ILE GLU GLN SER HIS ALA SER GLY ASN ASN ASP ASP ASN ASP GLY THR GLY SER GLY VAL ILE THR SER GLU PRO PRO ALA ASP ILE GLU GLU GLY GLN GLU SER GLU ALA THR ALA ARG PRO GLY THR SER GLU LYS LYS THR THR

VAL THR TYR ASP LYS TYR VAL SER MET MET ASN MET GLU VAL VAL ARG LYS ILE ALA GLU VAL ASP ARG GLU GLY ALA GLU GLU THR ALA ASP ILE ILE ASP TRP LEU LEU LEU LYS GLU ASP ARG LEU LEU GLU ALA GLU GLU TYR TRP GLU ARG ARG LEU ALA PHE LYS

VAL ILE LYS ARG LEU VAL LYS ASP ARG ILE LEU MET GLU ILE HIS GLY THR ARG HIS ASN LEU ARG ASP LEU GLU ASN GLU GLU ASN LYS THR VAL ILE HIS PRO ASN CYS GLU VAL LEU ASP ASP GLN LEU GLU LEU PRO GLN ASP SER SER

• **Molecule 5: DNA replication licensing factor MCM2**

Chain 2:
9%   48%   15%   37%

MET SER ASP ASN ARG ARG ARG ARG ARG GLU ASP ASP SER ASP SER SER GLU ASN LEU PRO PRO SER GLU LEU GLN PRO GLN HIS PHE ARG GLY GLY MET ASN PRO VAL SER SER PRO ILE GLY SER PRO ASP ASP MET ILE ASN PRO GLU GLY GLY ASP ASN ASN GLU VAL ASP ASP

ILE ASP GLU VAL GLU GLU GLN MET ASN GLU VAL ASP LEU MET ASP ASP ASN MET TYR GLU ASP TYR ALA ALA ASP HIS ASN ARG ASP ARG TYR ASP PRO ASP GLN VAL GLN GLN GLN GLU LEU SER LEU SER ASP SER MET ASP ILE ALA GLN LEU ASN GLU ARG ASP

ARG LEU LEU ARG ASN VAL ALA TYR ILE ASP ASP GLU LEU ASP ASP GLU MET GLY LEU PRO VAL GLN ARG ARG ARG GLN GLN TYR ASP LEU GLU ASN SER ASP ASP ASP LEU LEU SER ASP MET ASP ILE ASP PRO LEU ARG GLU GLU

LEU THR LEU GLU LEU SER LEU ASN VAL SER ALA ASN SER TYR SER GLU TRP ILE THR GLN P201 A208 L215 T222 G223 R224 S225 V226 R230 I231 R232 T233 L234 G235 E236 S241 A257 L260 L268 F271 V274 E277 A278 T279 D285 I289 H290

• Molecule 6: DNA replication licensing factor MCM7

T483 T484 G485 K486 G487 G490 V491 G492 L493 T494 ALA ALA V497 D500 P501 V502 T503 ASP GLU M506 I507 L508 L513 V514 L515 A516 D517 N518 GLY ILE CYS C522 I523 D524 E525 F526 D527 K528 D533 R534 E539 V540 M541 S549 K550 A551 G552 I553 N554 T555 T556 L557 N558 A559

R560 T561 SER I563 L564 A567 N568 P569 L570 Y571 G572 R573 Y574 R577 L578 I581 I584 N585 L586 F587 A588 A589 L590 L591 S592 R593 F594 D595 F598 L599 M600 L601 D602 R606 A613 E614 H615 V616 T617 Y618 V619 H620 M621 H622 K623 Q625 L628 S636 K637 M638

R639 I642 A643 Y644 A645 K646 T647 K648 M652 S653 E654 A655 V656 N657 D658 Y659 V660 V661 I665 R668 Q669 K672 R673 E674 M675 D676 S677 K678 F679 S680 Q683 A684 R687 T688 L689 I693 R694 L695 S696 L699 L702 R703 L704 A705 D706 M707 V708 D709 I710 D711

E714 E715 A716 L717 R718 L719 S723 K724 E725 S726 L727 Y728 Q729 GLU THR ASN LYS SER LYS GLU GLU SER PRO THR THR LYS ILE PHE THR ILE ILE LYS LYS MET LEU GLN GLU ASP SER GLU THR GLY LYS ASN THR LEU SER TYR GLU ILE VAL LYS THR VAL ARG LEU ARG GLY PHE

THR MET LEU LEU SER ASN CYS ILE GLU GLN GLU TYR SER TYR LEU ASN VAL TRP HIS LEU ILE ASN GLU GLY ASN THR LEU LYS PHE VAL ASP ASP GLY THR MET ASP THR ASP GLN GLU ASP SER LEU VAL SER THR PRO LYS LEU ALA PRO THR THR ALA SER ALA ASN VAL SER

ALA GLN ASP ASP SER ILE ASP LEU GLN ASP ALA

• Molecule 7: DNA replication complex GINS protein PSF1

Chain C:

6%

62%   31%   7%

M1 D4 K8 L9 T16 L19 R22 S23 N24 Q25 D26 V27 N28 L29 D35 I36 I37 I40 N46 L47 R48 K49 N50 T51 L54 Q58 Q59 L60 G61 M62 L63 D64 K69 Y72 L76 E80 R84 Q90 R93 W102 N103 N104

N105 G106 L107 ASP LEU MET SER SER ILE THR PHE SER GLN GLN ASP T120 N121 N122 H125 E129 Y130 L131 K132 E133 Y134 C135 I138 L141 D145 L146 V147 D148 I149 S152 P157 F162 I163 D164 V165 R166 G172 E173 ILE GLN T176 E177 Y178 G179 V180 K185

D186 S187 Q188 V191 R192 Q201 K207 I208

• Molecule 8: DNA replication complex GINS protein PSF2

Chain D:

6%

56%   27%   •   15%

MET SER L3 L7 Q8 Q9 T10 F11 S12 P13 E14 I19 V20 E21 N22 E23 P24 I25 P29 R30 I31 T32 THR ARG GLN LYS ILE ARG GLY ASP ASP ARG GLY THR ASN HIS THR ARG W50 Q51 L52 I53 T54 T55 D56 M63 V71 V72 L73 L77 K80

C85 S86 I87 V88 A89 T94 T95 K96 K106 T107 H108 R111 F112 S113 E114 W117 N118 W119 L120 V121 R124 I125 L126 F127 D132 D133 F134 P137 I138 H139 R142 D147 L148 I151 R152 Q153 Q154 K155 V156 L157 G158 G159 L160 K161 S166 Q169 L170 D171

S174 L175 L176 E177 I178 L181 R182 M189 D190 K191 L192 R193 E194 I195 A198 S199 L200 THR ALA GLY THR GLU ASN ASP GLU GLU GLU PHE ASN ILE

• Molecule 9: DNA replication complex GINS protein PSF3

Chain E:

6%

60% 21% 18%

• Molecule 10: DNA replication complex GINS protein SLD5

Chain F:

7%

53% 19% 26%

• Molecule 11: Cell division control protein 45

Chain G:

12%

67% 16% 17%

• Molecule 12: DNA (5'-D(*GP*CP*AP*GP*CP*CP*AP*CP*GP*CP*TP*GP*GP*CP*CP*GP*TP*TP*TP*TP*A)-3')

Chain X:

• Molecule 13: DNA (5'-D(P*TP*AP*AP*AP*AP*CP*GP*GP*CP*CP*AP*GP*CP*GP*TP*GP*GP*CP*TP*GP*C)-3')

Chain Y:

• Molecule 14: DNA (5'-D(P*TP*TP*TP*TP*TP*TP*T)-3')

Chain J:
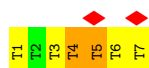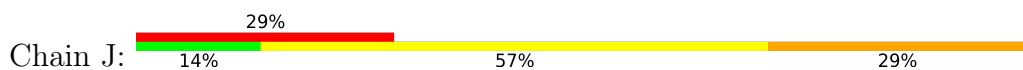
• Molecule 15: DNA polymerase epsilon subunit B

Chain B:
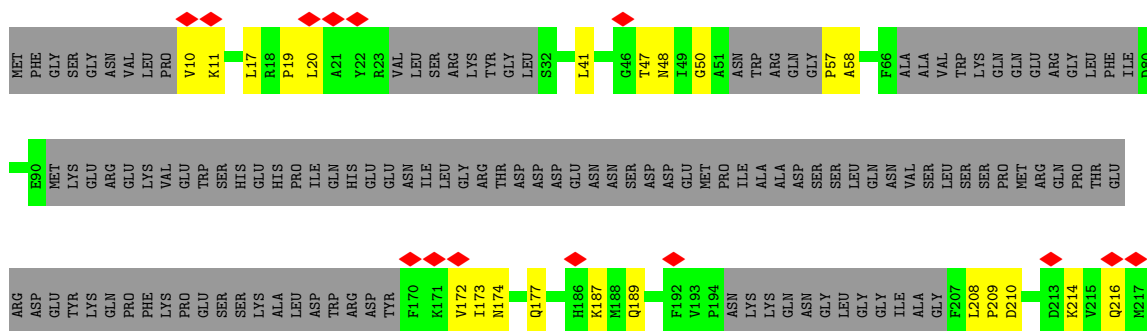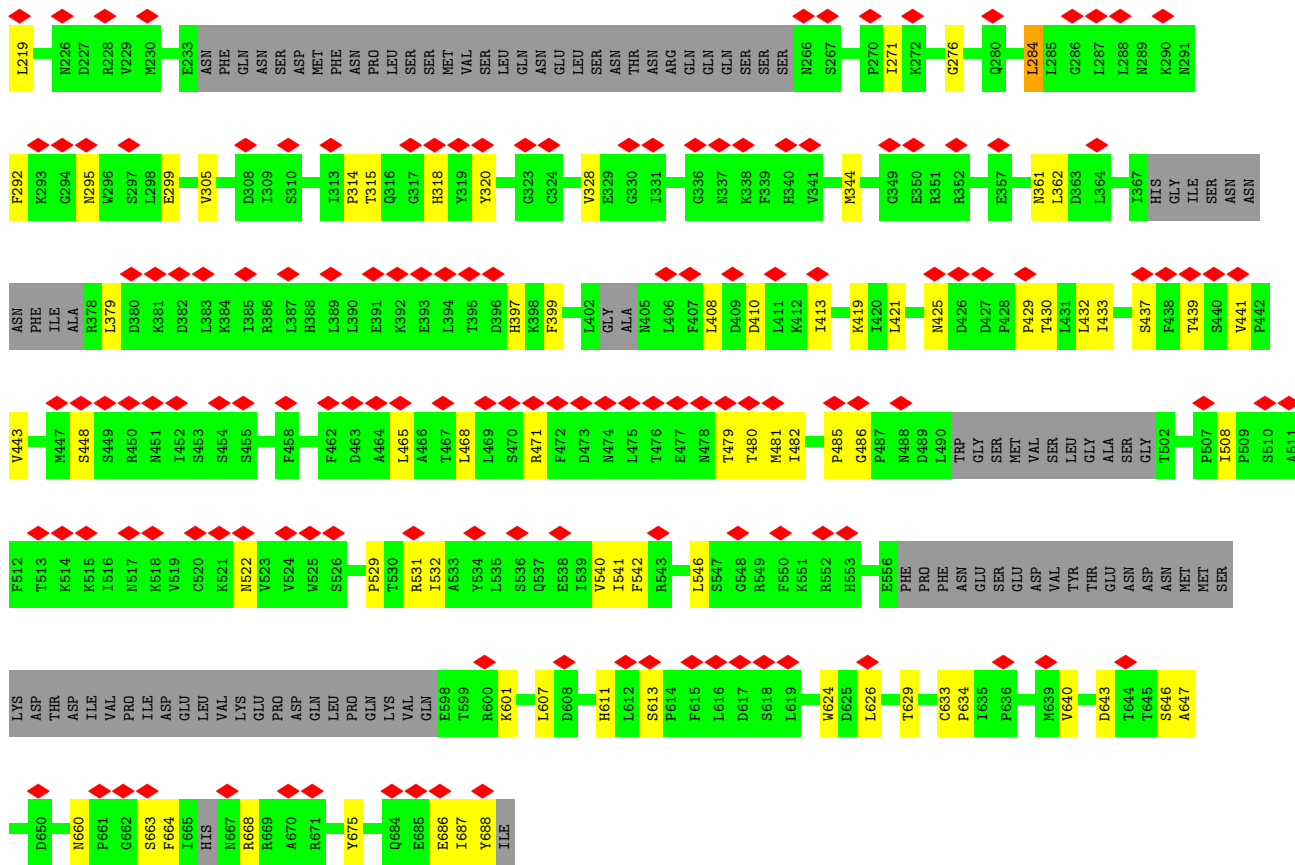
• Molecule 16: DNA polymerase epsilon catalytic subunit

Chain A:

41%

63% 21% · 16%
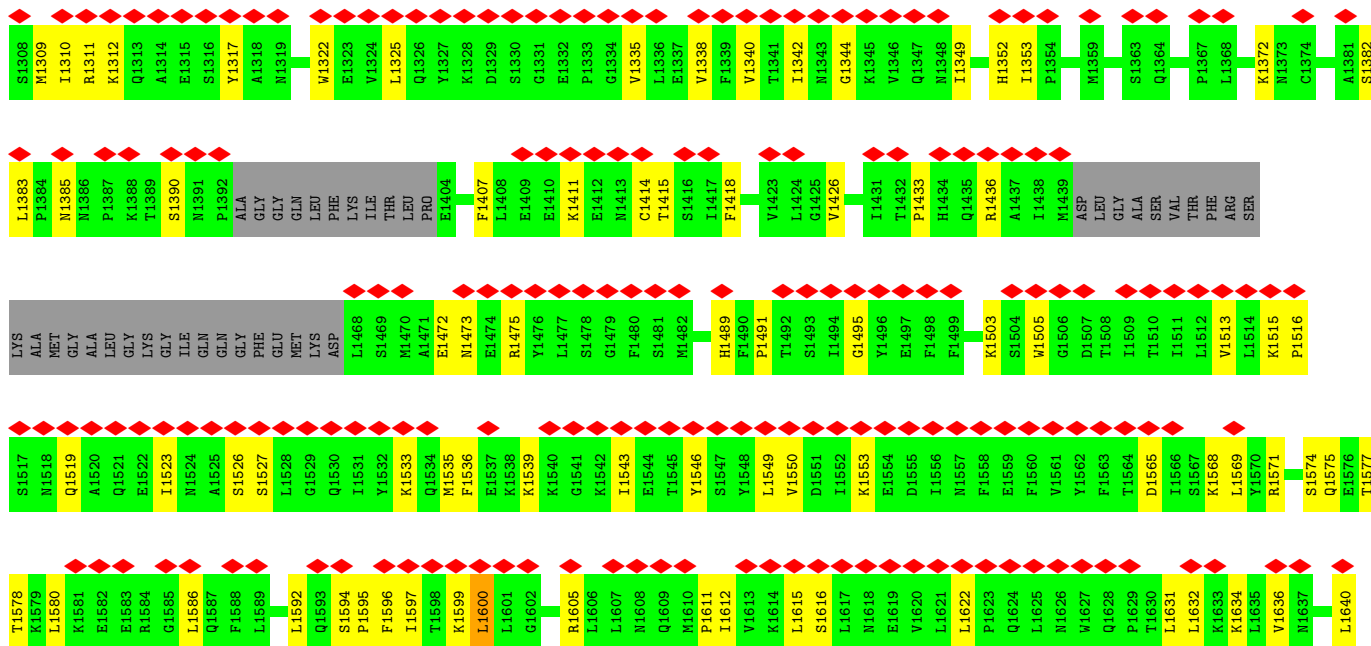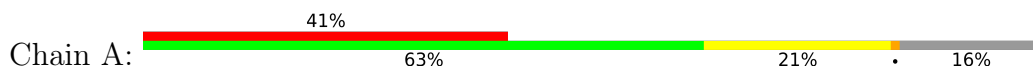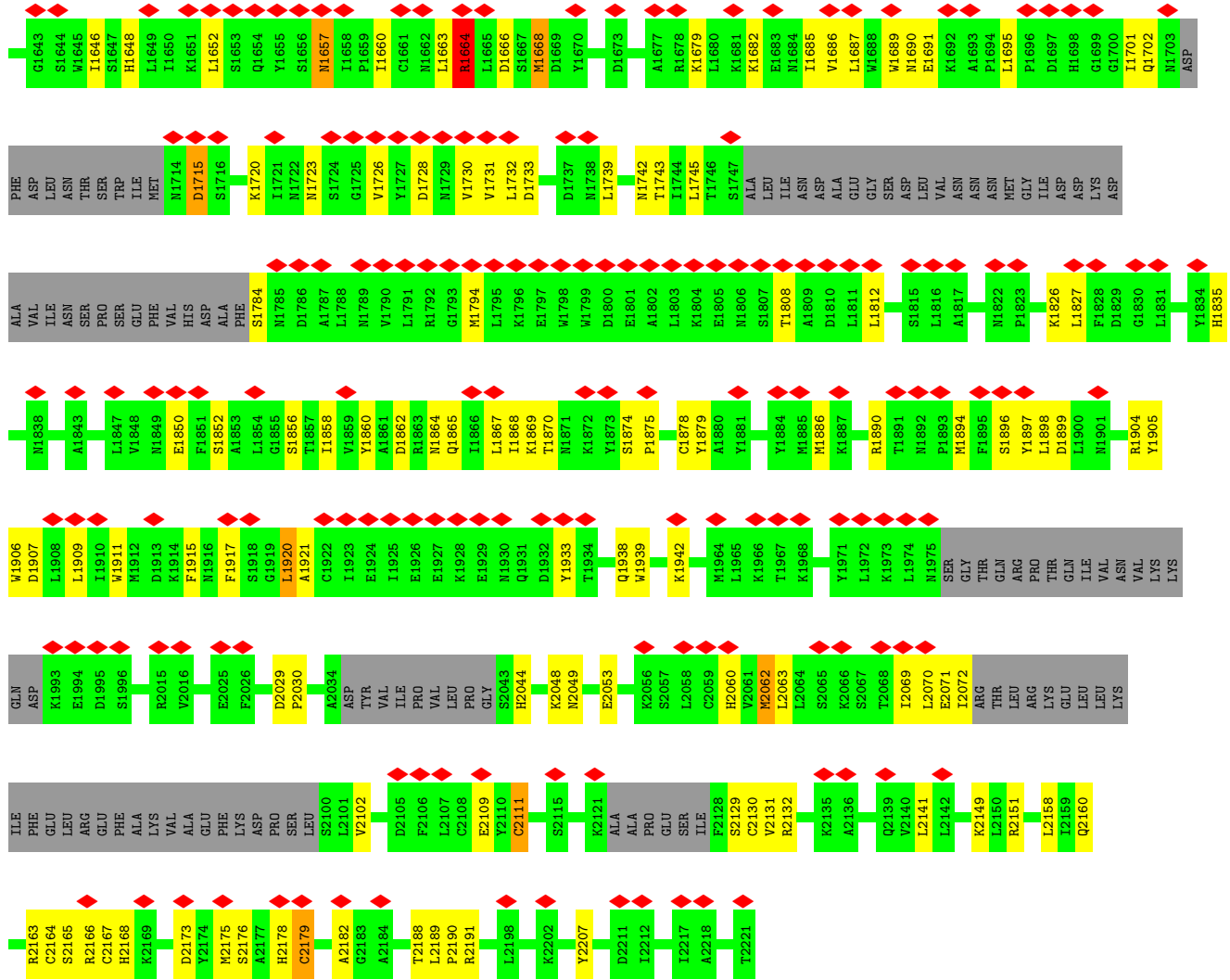
4 Experimental information ⓘ

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	78556	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 $(e^-/\text{Å}^2)$	4.2	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	5.270	Depositor
Minimum map value	-2.822	Depositor
Average map value	0.035	Depositor
Map value standard deviation	0.184	Depositor
Recommended contour level	1.01	Depositor
Map size (Å)	353.28, 353.28, 353.28	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.38, 1.38, 1.38	Depositor

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, AGS

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	3	0.59	1/4330 (0.0%)	0.95	9/5872 (0.2%)
2	4	0.42	0/4594	0.79	5/6203 (0.1%)
3	5	0.75	3/4741 (0.1%)	1.13	24/6405 (0.4%)
4	6	0.50	0/4359	0.83	3/5882 (0.1%)
5	2	0.65	2/4241 (0.0%)	0.99	10/5720 (0.2%)
6	7	0.44	0/4853	0.76	2/6553 (0.0%)
7	C	0.57	0/1511	1.07	9/2039 (0.4%)
8	D	0.64	0/1489	1.10	5/2016 (0.2%)
9	E	0.64	0/1294	1.00	4/1750 (0.2%)
10	F	0.54	0/1771	1.01	8/2386 (0.3%)
11	G	0.52	0/4311	0.98	17/5832 (0.3%)
12	X	0.86	0/475	1.01	0/731
13	Y	0.85	0/486	0.94	0/748
14	J	1.53	3/153 (2.0%)	1.78	3/234 (1.3%)
15	B	0.47	0/3727	0.84	3/5041 (0.1%)
16	A	0.47	1/6029 (0.0%)	0.92	16/8179 (0.2%)
All	All	0.56	10/48364 (0.0%)	0.94	118/65591 (0.2%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
10	F	0	4
11	G	0	3
All	All	0	7

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	5	269	GLU	C-N	-10.85	1.09	1.34
3	5	606	CYS	CB-SG	-7.06	1.70	1.82
5	2	622	GLU	CB-CG	-6.66	1.39	1.52
5	2	397	VAL	CB-CG2	-6.61	1.39	1.52
14	J	3	DT	P-O5'	6.34	1.66	1.59

The worst 5 of 118 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
11	G	98	ILE	C-N-CA	10.63	148.27	121.70
14	J	3	DT	O4'-C1'-N1	-9.61	101.27	108.00
14	J	5	DT	O4'-C1'-N1	9.34	114.54	108.00
3	5	137	LEU	CA-CB-CG	9.03	136.07	115.30
2	4	821	ASP	CB-CG-OD1	8.88	126.30	118.30

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
10	F	212	THR	Mainchain,Peptide
10	F	216	VAL	Mainchain,Peptide
11	G	523	ARG	Sidechain
11	G	98	ILE	Mainchain,Peptide

5.2 Too-close contacts　ⓘ

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	3	4270	0	4258	82	0
2	4	4543	0	4517	75	0
3	5	4690	0	4526	101	0
4	6	4307	0	4166	86	0
5	2	4184	0	4126	82	0
6	7	4785	0	4761	80	0
7	C	1492	0	1394	37	0
8	D	1461	0	1445	45	0
9	E	1262	0	1240	31	0
10	F	1743	0	1671	40	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
11	G	4239	0	4082	51	0
12	X	425	0	238	18	0
13	Y	433	0	235	19	0
14	J	140	0	85	7	0
15	B	3661	0	3656	56	0
16	A	5918	0	5682	121	0
17	5	62	0	24	8	0
18	A	2	0	0	0	0
All	All	47617	0	46106	856	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 9.

The worst 5 of 856 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)
6:7:460:GLY:HA3	6:7:600:MET:HB2	1.62	0.81
5:2:617:ARG:O	5:2:621:HIS:HB2	1.84	0.77
7:C:102:TRP:HE1	7:C:134:TYR:HH	1.33	0.76
9:E:48:LEU:O	9:E:52:ARG:HB2	1.85	0.76
11:G:244:GLY:HA3	11:G:603:ASN:HB2	1.67	0.76

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	3	542/971 (56%)	500 (92%)	40 (7%)	2 (0%)	34	72
2	4	569/933 (61%)	508 (89%)	60 (10%)	1 (0%)	47	81
3	5	598/775 (77%)	547 (92%)	51 (8%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
4	6	551/1017 (54%)	496 (90%)	55 (10%)	0	100	100
5	2	527/868 (61%)	483 (92%)	44 (8%)	0	100	100
6	7	588/845 (70%)	539 (92%)	48 (8%)	1 (0%)	47	81
7	C	188/208 (90%)	177 (94%)	10 (5%)	1 (0%)	29	68
8	D	177/213 (83%)	164 (93%)	10 (6%)	3 (2%)	9	43
9	E	151/194 (78%)	143 (95%)	8 (5%)	0	100	100
10	F	206/294 (70%)	184 (89%)	21 (10%)	1 (0%)	29	68
11	G	525/650 (81%)	478 (91%)	44 (8%)	3 (1%)	25	65
15	B	441/689 (64%)	390 (88%)	50 (11%)	1 (0%)	47	81
16	A	751/914 (82%)	553 (74%)	193 (26%)	5 (1%)	22	62
All	All	5814/8571 (68%)	5162 (89%)	634 (11%)	18 (0%)	44	76

5 of 18 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	4	374	ILE
8	D	54	THR
8	D	113	SER
8	D	171	ASP
11	G	284	TYR

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	3	458/835 (55%)	457 (100%)	1 (0%)	93	96
2	4	493/848 (58%)	492 (100%)	1 (0%)	93	96
3	5	488/688 (71%)	488 (100%)	0	100	100
4	6	435/886 (49%)	434 (100%)	1 (0%)	93	96
5	2	435/770 (56%)	435 (100%)	0	100	100
6	7	524/753 (70%)	524 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
7	C	149/193 (77%)	148 (99%)	1 (1%)	84	90
8	D	156/198 (79%)	155 (99%)	1 (1%)	86	92
9	E	135/173 (78%)	135 (100%)	0	100	100
10	F	194/279 (70%)	194 (100%)	0	100	100
11	G	443/586 (76%)	442 (100%)	1 (0%)	93	96
15	B	409/629 (65%)	407 (100%)	2 (0%)	88	93
16	A	624/837 (75%)	615 (99%)	9 (1%)	67	81
All	All	4943/7675 (64%)	4926 (100%)	17 (0%)	92	95

5 of 17 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
16	A	1668	MET
16	A	2062	MET
15	B	48	ASN
16	A	1309	MET
16	A	1312	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 47 such sidechains are listed below:

Mol	Chain	Res	Type
7	C	202	GLN
11	G	273	ASN
8	D	22	ASN
9	E	133	GLN
15	B	48	ASN

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 ⓘ

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#|Z| > 2$	Counts	RMSZ	$\#|Z| > 2$
17	AGS	5	802	3	26,33,33	0.91	0	26,52,52	1.92	5 (19%)
17	AGS	5	801	3	26,33,33	0.75	1 (3%)	26,52,52	1.19	3 (11%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
17	AGS	5	802	3	-	3/17/38/38	0/3/3/3
17	AGS	5	801	3	-	8/17/38/38	0/3/3/3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
17	5	801	AGS	PG-S1G	2.24	1.95	1.90

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
17	5	802	AGS	O4'-C1'-C2'	-5.71	98.58	106.93
17	5	802	AGS	PA-O3A-PB	-4.91	115.99	132.83
17	5	802	AGS	C1'-N9-C4	3.47	132.73	126.64
17	5	801	AGS	PA-O3A-PB	-2.96	122.67	132.83
17	5	802	AGS	C3'-C2'-C1'	-2.39	97.38	100.98

There are no chirality outliers.

5 of 11 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
17	5	801	AGS	C5'-O5'-PA-O1A
17	5	801	AGS	C5'-O5'-PA-O2A
17	5	802	AGS	C5'-O5'-PA-O1A
17	5	802	AGS	C5'-O5'-PA-O2A
17	5	801	AGS	C4'-C5'-O5'-PA

There are no ring outliers.

2 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
17	5	802	AGS	3	0
17	5	801	AGS	5	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand AGS 5 802

Bond lengths

Bond angles

Torsions

Rings

Ligand AGS 5 801

Bond lengths

Bond angles

Torsions

Rings
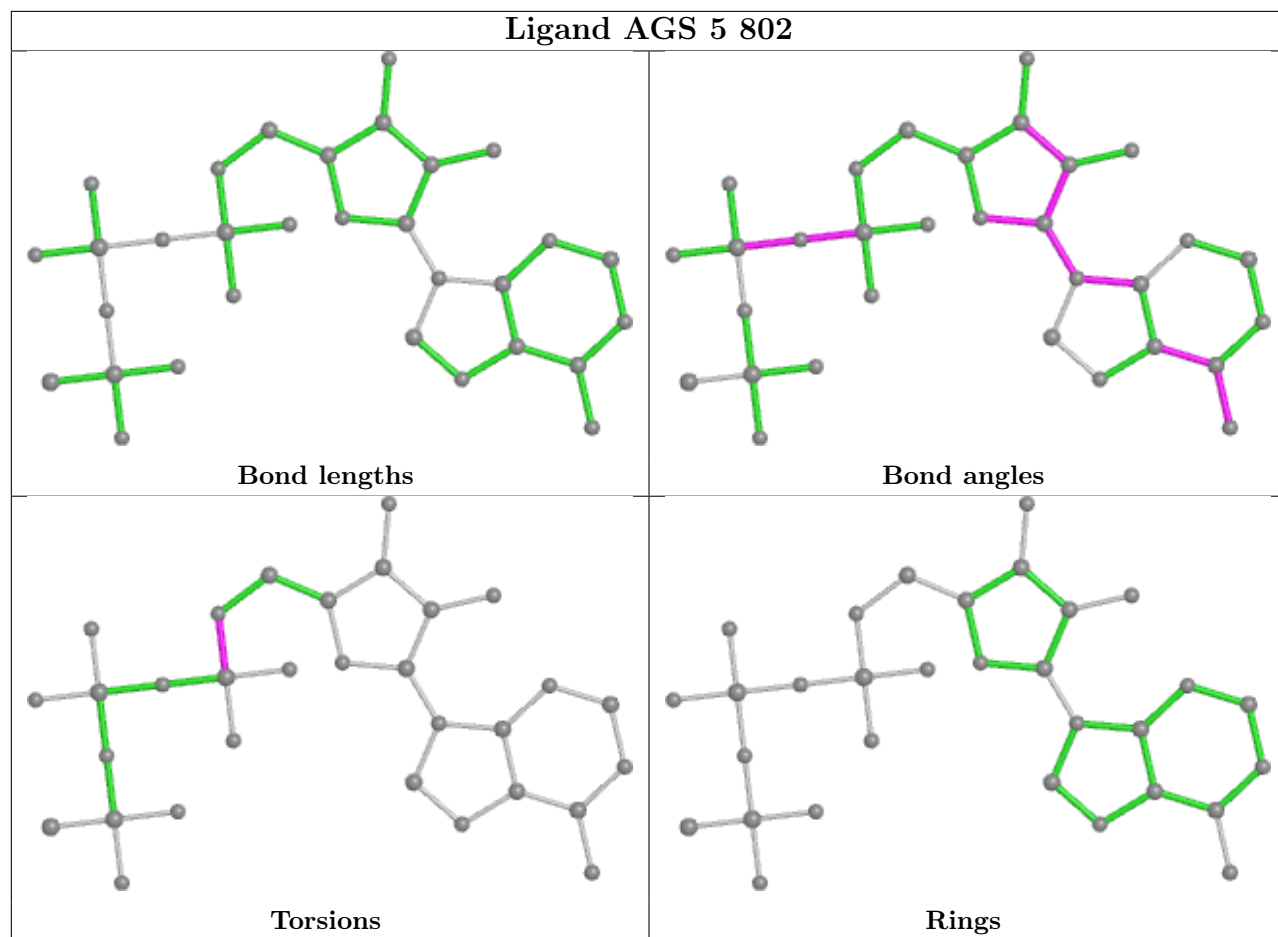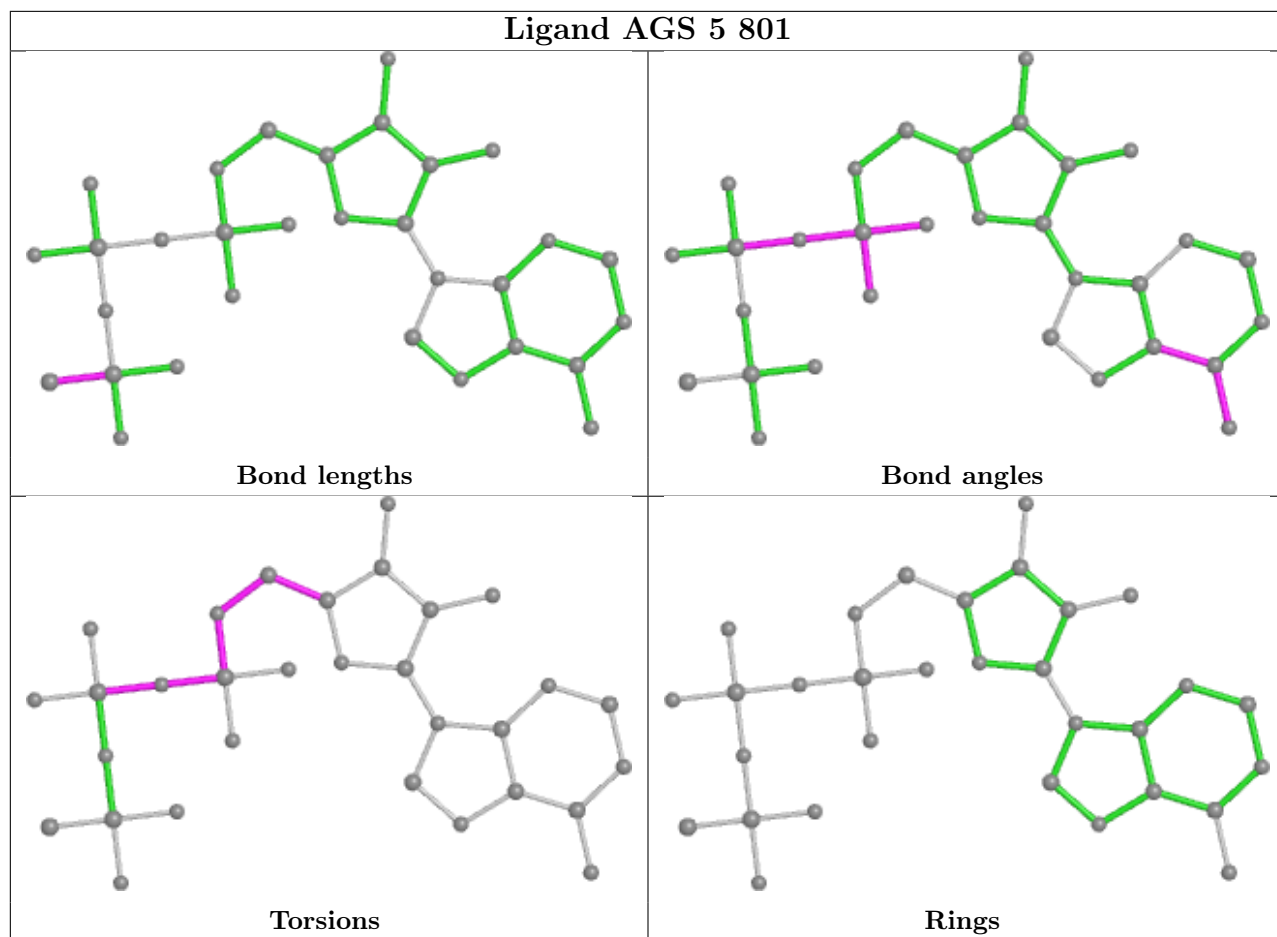
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

The following chains have linkage breaks:

Mol	Chain	Number of breaks
16	A	1
15	B	1
3	5	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	2060:HIS	C	2061:VAL	N	14.58
1	B	280:GLN	C	281:ASN	N	5.05
1	5	269:GLU	C	270:MET	N	1.09

6   Map visualisation ⓘ

This section contains visualisations of the EMDB entry EMD-0288. These allow visual inspection of the internal detail of the map and identification of artifacts.

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

6.1   Orthogonal projections ⓘ

6.1.1   Primary map

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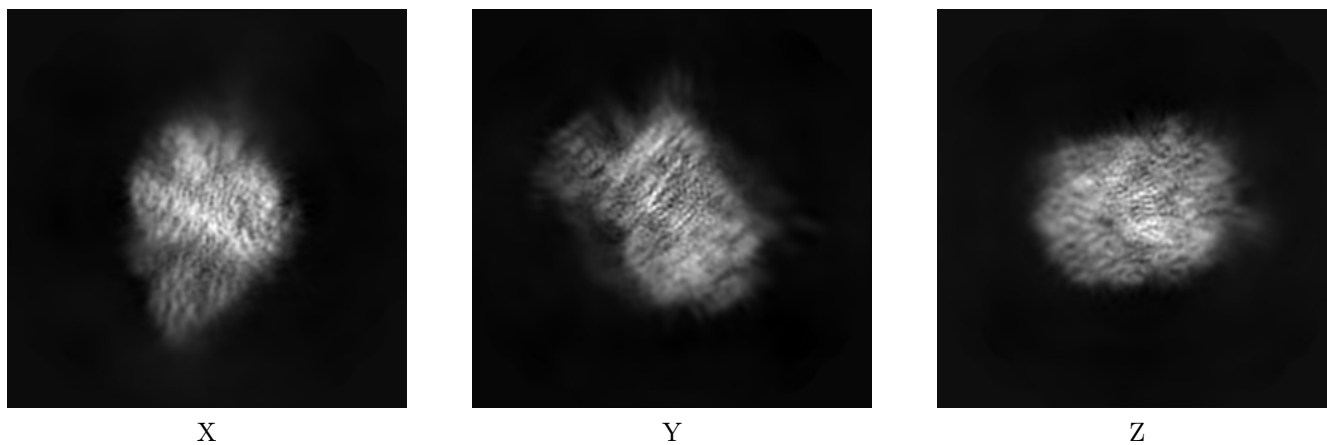
The images above show the map projected in three orthogonal directions.

6.2   Central slices ⓘ

6.2.1   Primary map

| X Index: 128 | Y Index: 128 | Z Index: 128 |
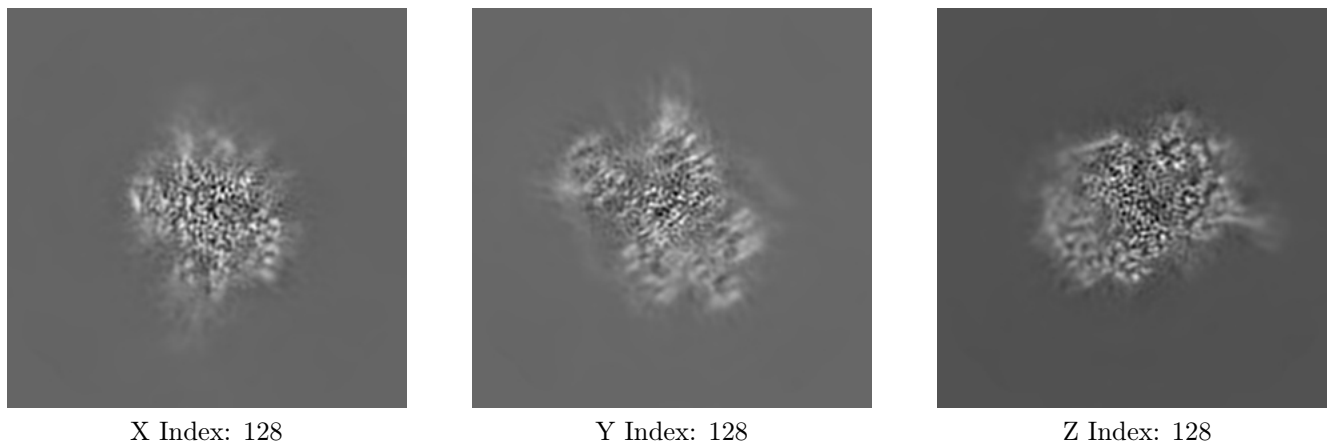
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices ⓘ
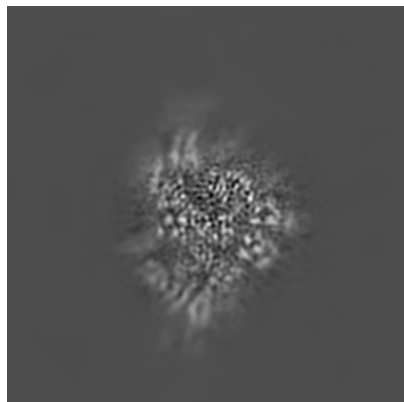
6.3.1 Primary map
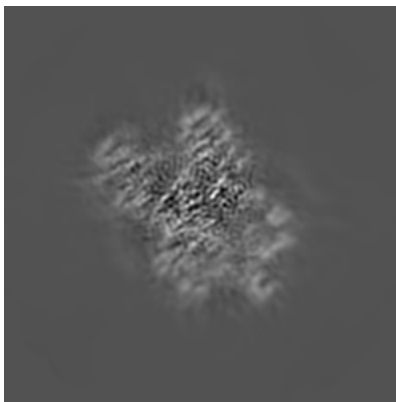
| X Index: 139 | Y Index: 132 | Z Index: 129 |
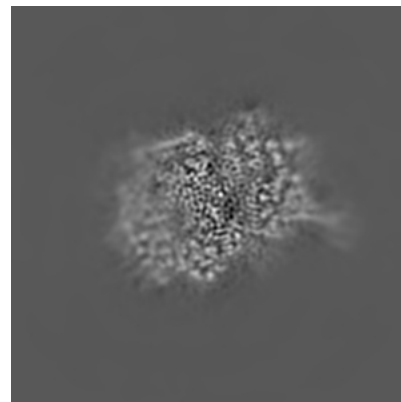
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map

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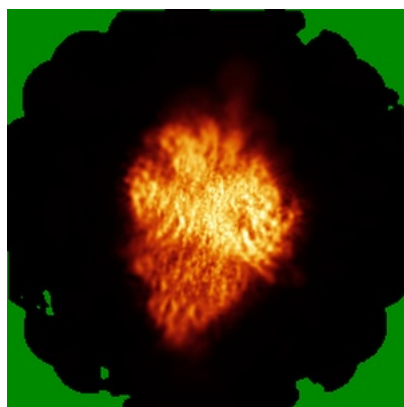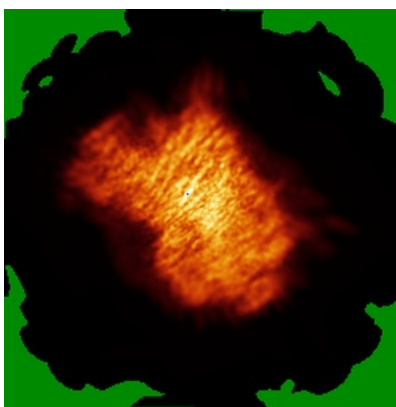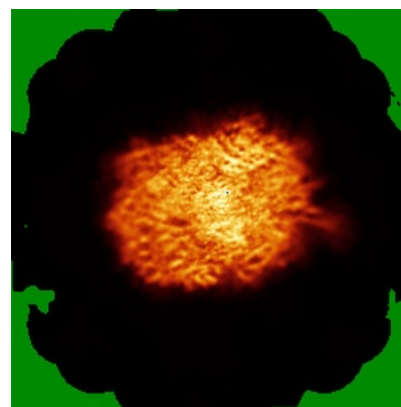
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views (i)

6.5.1 Primary map
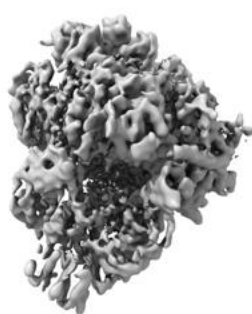
X   Y   Z
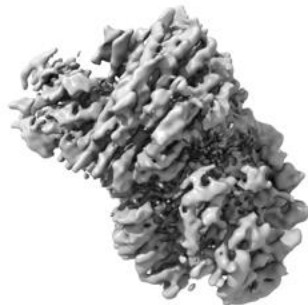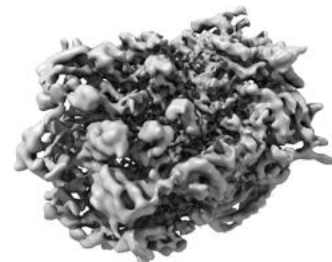
The images above show the 3D surface view of the map at the recommended contour level 1.01. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.6 Mask visualisation (i)

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

7　Map analysis ⓘ

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

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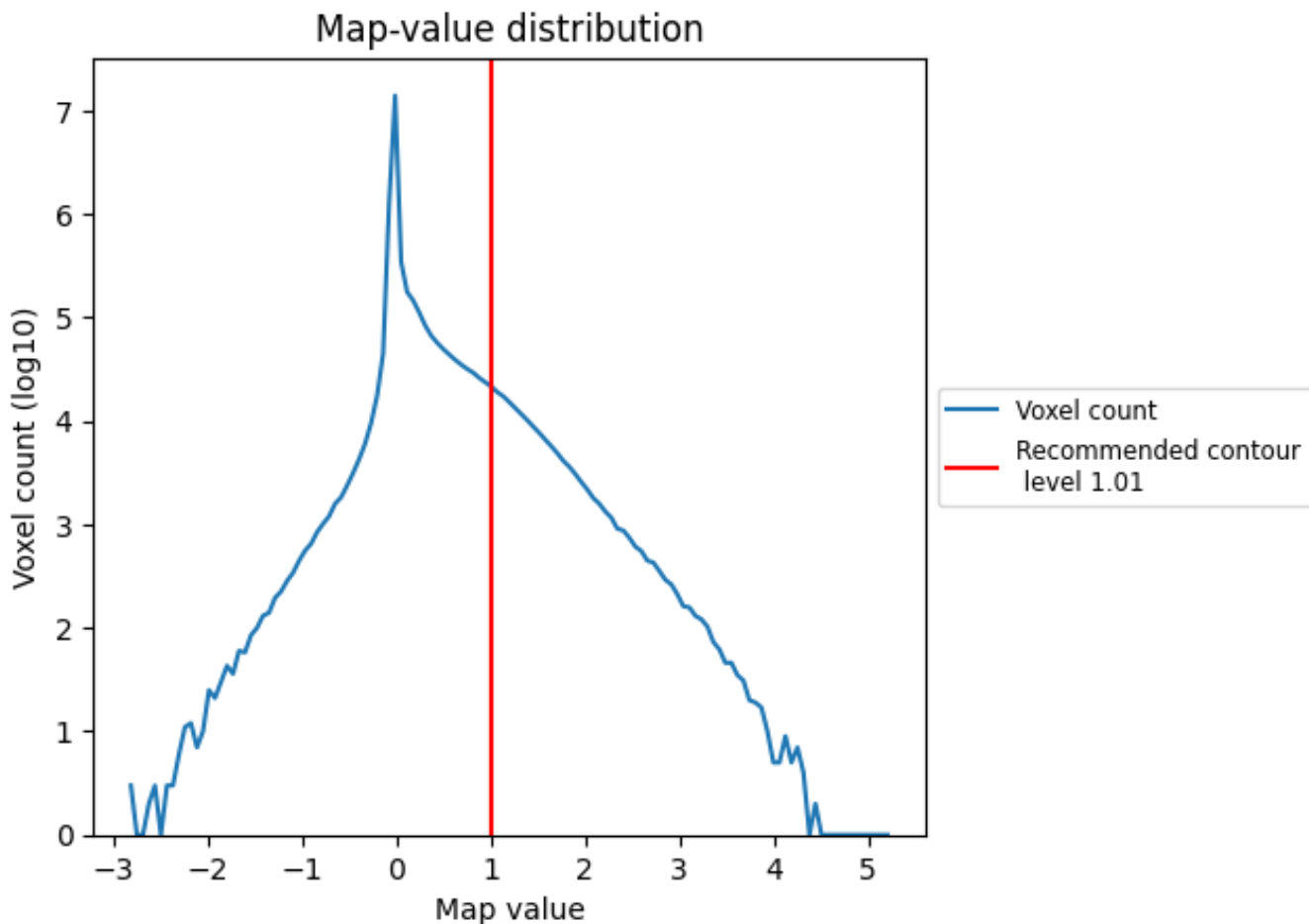
The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

7.2   Volume estimate ⓘ
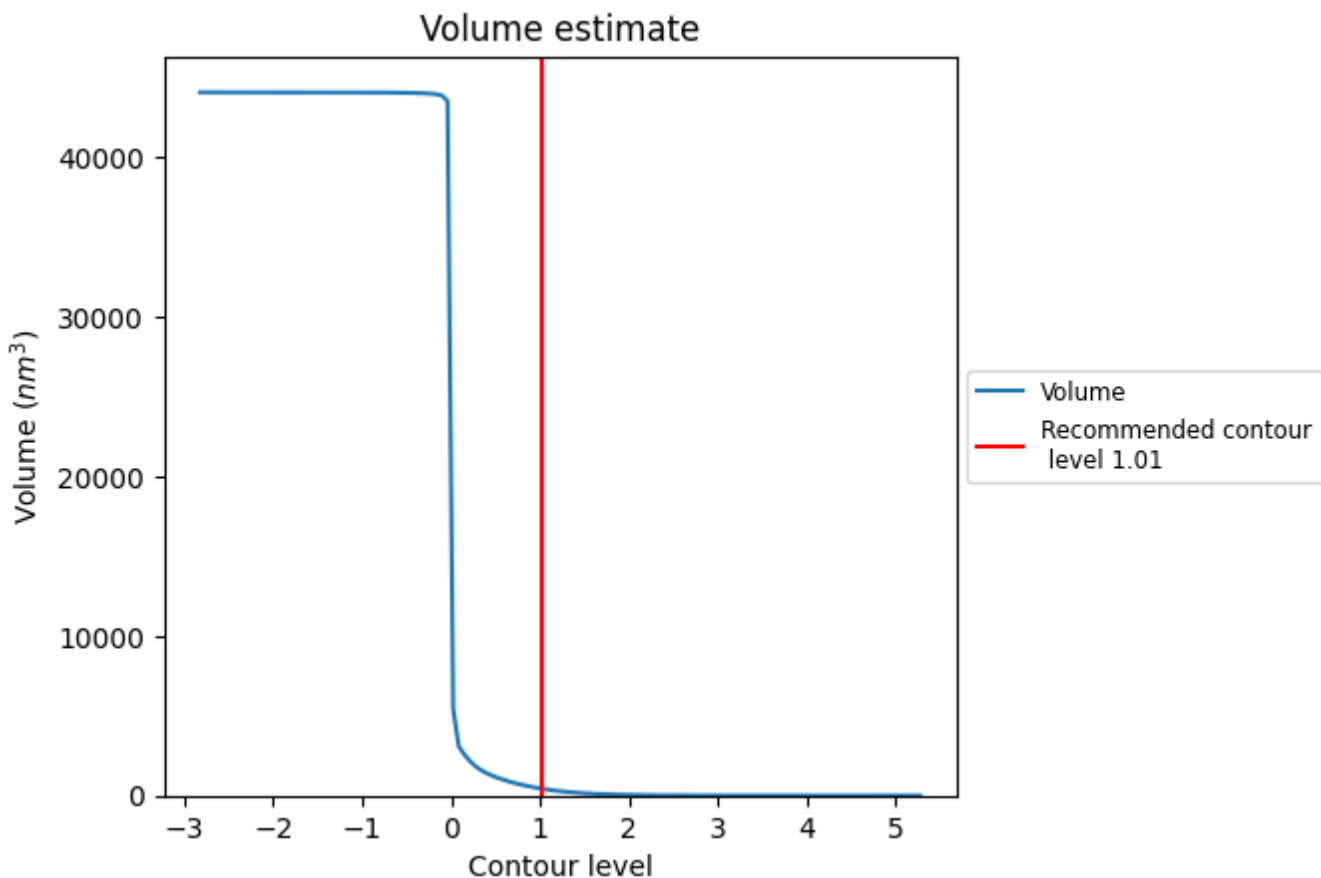
The volume at the recommended contour level is 440 nm^3; this corresponds to an approximate mass of 397 kDa.

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 ⓘ
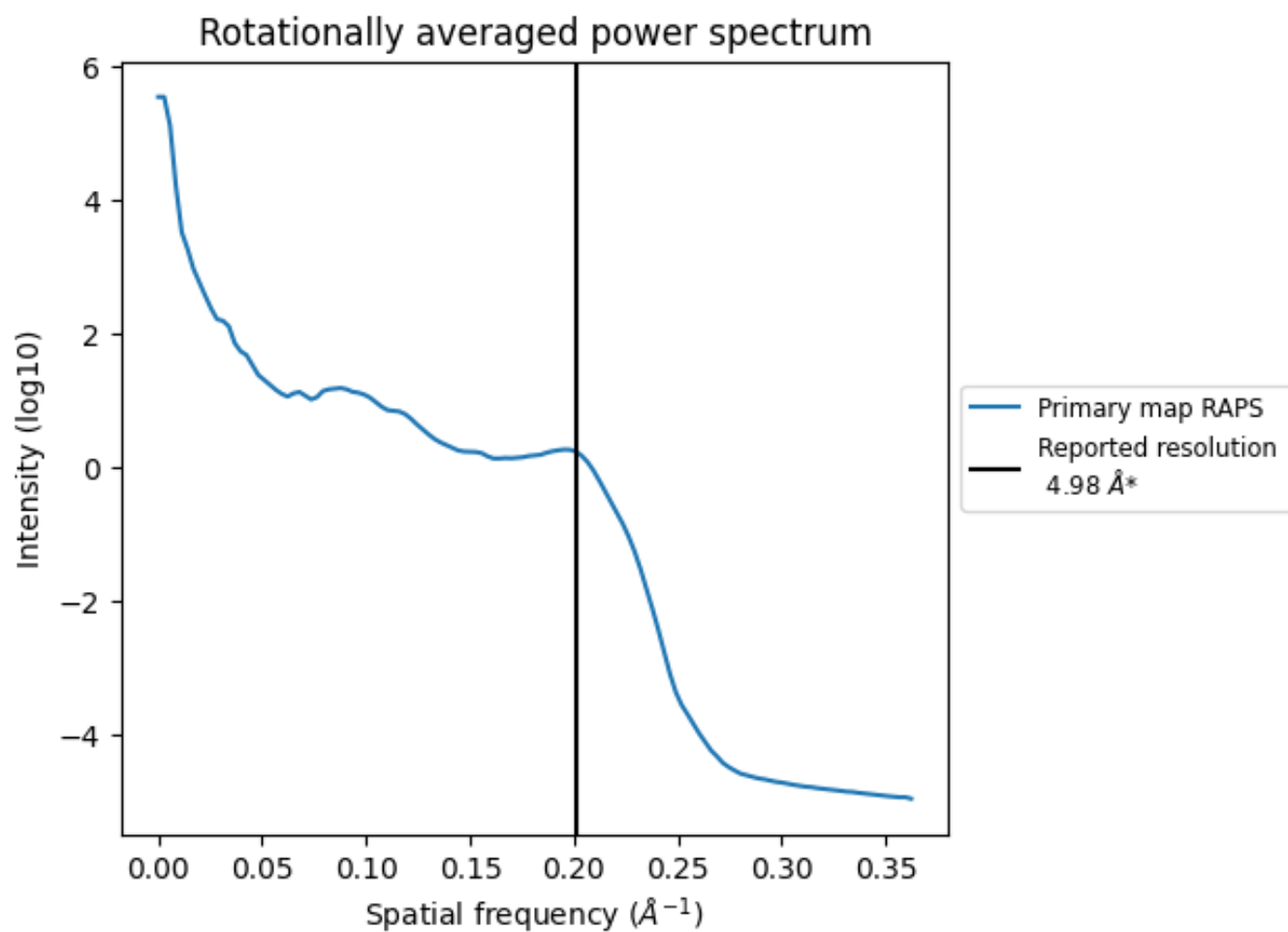
*Reported resolution corresponds to spatial frequency of 0.201 Å^{-1}

8 Fourier-Shell correlation (i)

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

9   Map-model fit ⓘ

This section contains information regarding the fit between EMDB map EMD-0288 and PDB model 6HV9. Per-residue inclusion information can be found in section 3 on page 8.

9.1   Map-model overlay ⓘ

X	Y	Z
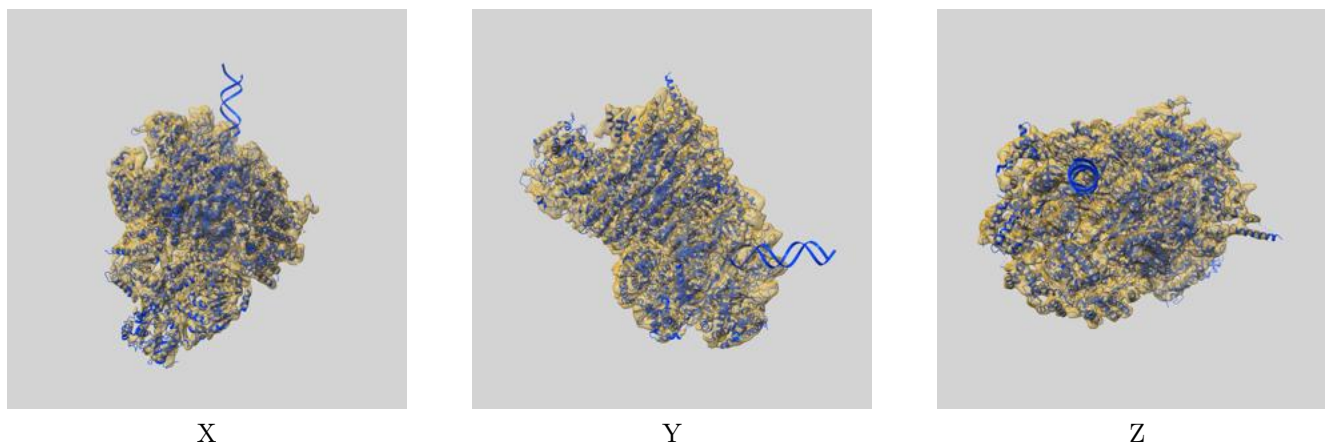
The images above show the 3D surface view of the map at the recommended contour level 1.01 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

9.2   Q-score mapped to coordinate model ⓘ

X   Y   Z
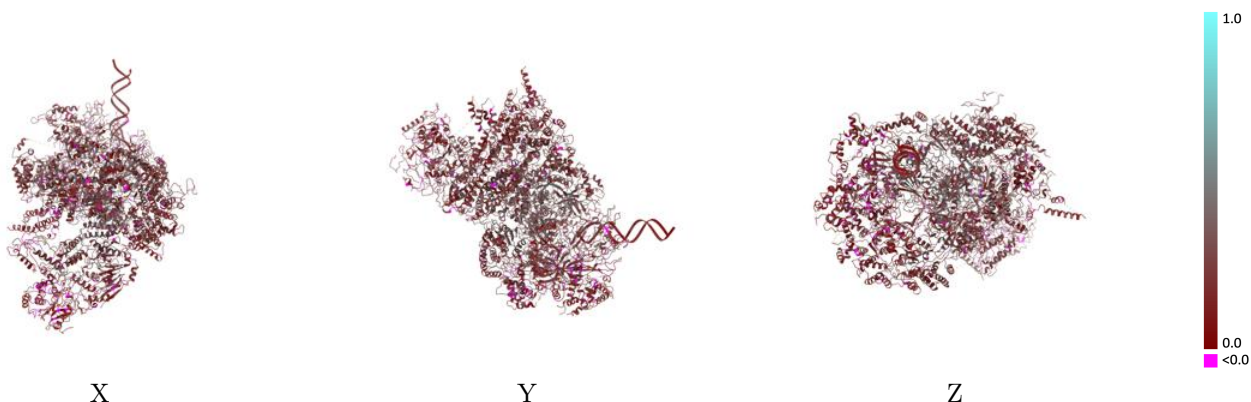
The images above show the model with each residue coloured according its Q-score. This shows
their resolvability in the map with higher Q-score values reflecting better resolvability. Please
note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at
resolutions 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
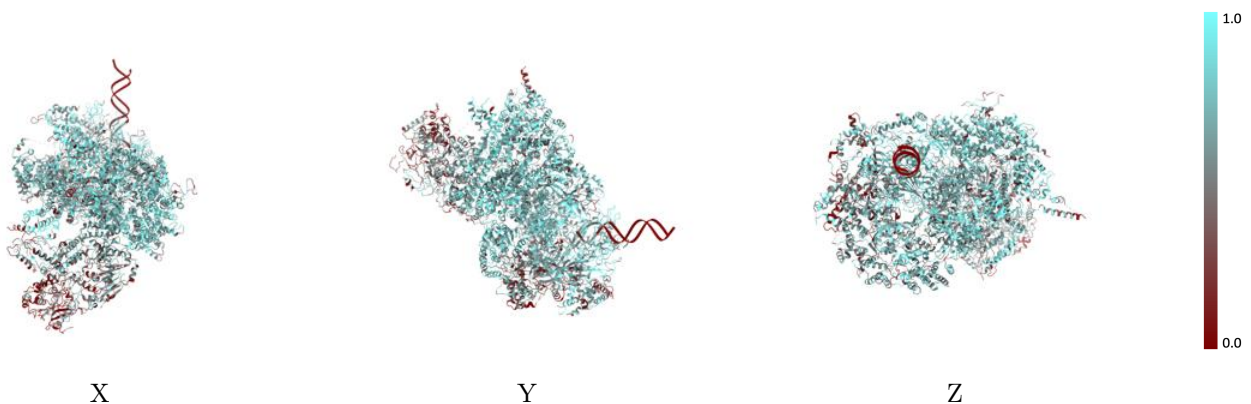
The images above show the model with each residue coloured according to its atom inclusion. This
shows to what extent they are inside the map at the recommended contour level (1.01).

9.4   Atom inclusion ⓘ
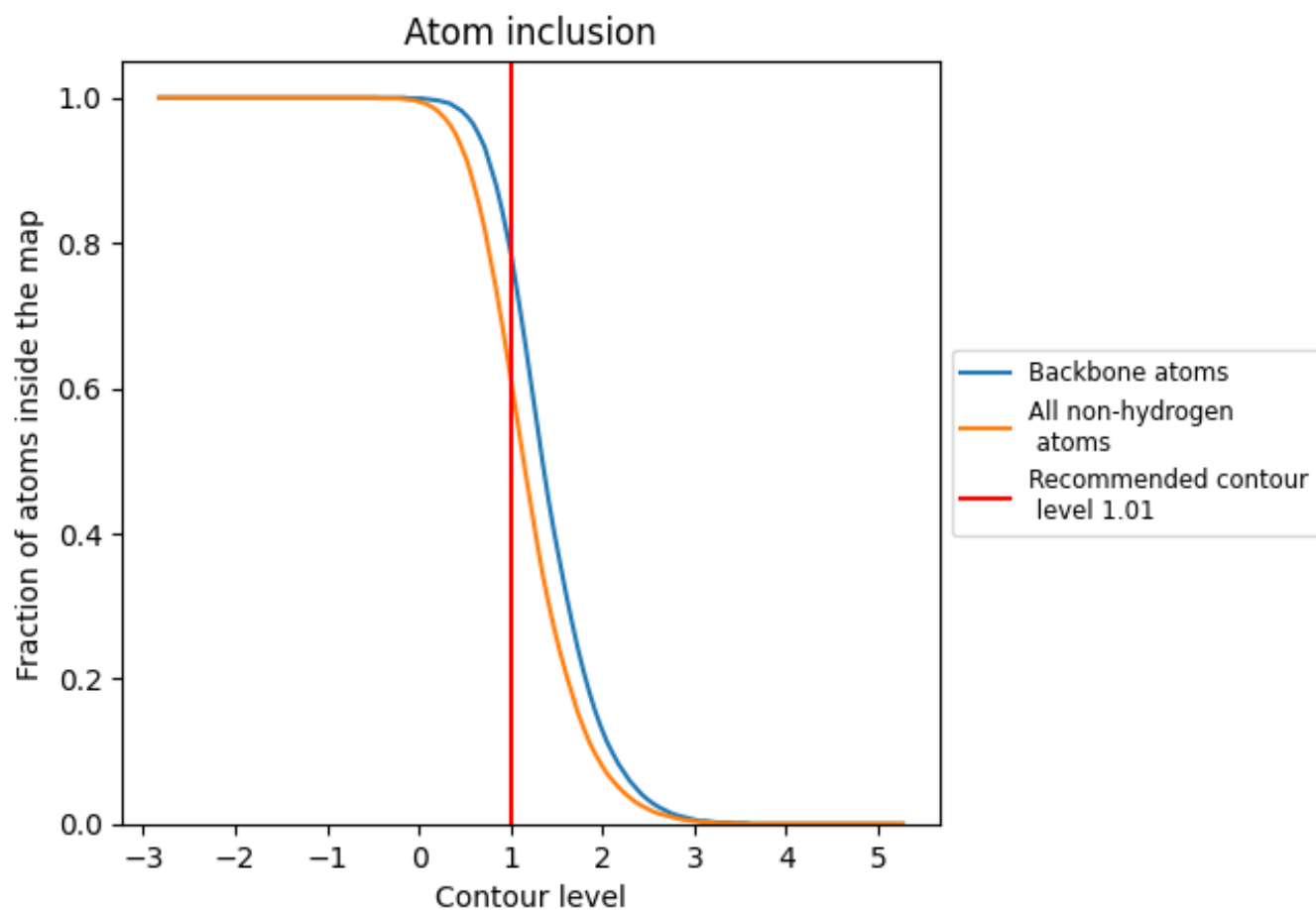
At the recommended contour level, 78% of all backbone atoms, 61% of all non-hydrogen atoms, are inside the map.

9.5   Map-model fit summary ⓘ

The table lists the average atom inclusion at the recommended contour level (1.01) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.6090	0.2310
2	0.6910	0.2780
3	0.7390	0.2870
4	0.5710	0.1860
5	0.6920	0.3050
6	0.6500	0.2140
7	0.5230	0.1890
A	0.4210	0.1710
B	0.5140	0.2290
C	0.7020	0.2280
D	0.7350	0.2480
E	0.7440	0.2690
F	0.6930	0.2300
G	0.6860	0.2410
J	0.5710	0.2480
X	0.1650	0.1690
Y	0.1520	0.1610

1.0

0.0
<0.0