



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 01:01 PM UTC

PDB ID : 3GAB / pdb_00003gab
Title : C-terminal domain of Bacillus subtilis MutL crystal form I
Authors : Guarne, A.; Pillon, M.C.; Lorenowicz, J.J.; Mitchell, R.R.; Chung, Y.S.; Friedhoff, P.
Deposited on : 2009-02-17
Resolution : 2.50 Å(reported)

This is a Full wwPDB X-ray Structure 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/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

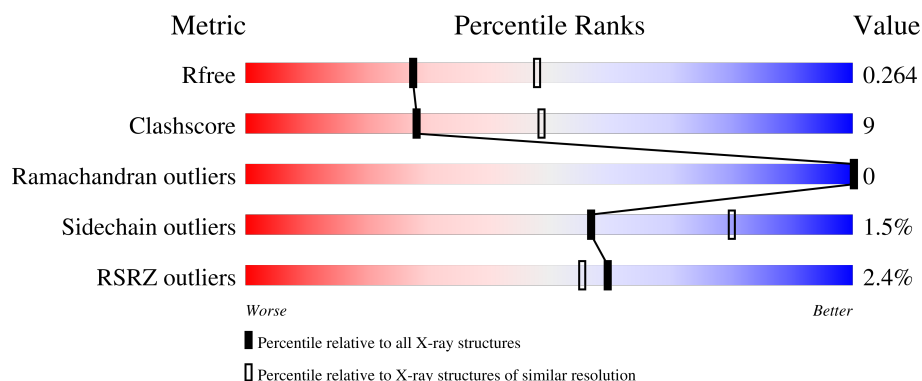
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	197	4% 73% 19% 7%
1	B	197	2% 74% 19% 7%
1	C	197	3% 70% 23% 7%
1	D	197	2% 76% 18% 6%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6122 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, 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 mismatch repair protein mutL.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	183	Total	C	N	O	S	0	0	0
			1496	952	253	281	10			
1	B	183	Total	C	N	O	S	0	0	0
			1498	953	252	283	10			
1	C	184	Total	C	N	O	S	0	1	0
			1510	961	254	284	11			
1	D	186	Total	C	N	O	S	0	0	0
			1517	966	255	286	10			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	431	GLY	-	expression tag	UNP P49850
A	432	ALA	-	expression tag	UNP P49850
A	433	MET	-	expression tag	UNP P49850
B	431	GLY	-	expression tag	UNP P49850
B	432	ALA	-	expression tag	UNP P49850
B	433	MET	-	expression tag	UNP P49850
C	431	GLY	-	expression tag	UNP P49850
C	432	ALA	-	expression tag	UNP P49850
C	433	MET	-	expression tag	UNP P49850
D	431	GLY	-	expression tag	UNP P49850
D	432	ALA	-	expression tag	UNP P49850
D	433	MET	-	expression tag	UNP P49850

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	27	Total	O	0	0
			27	27		
2	B	29	Total	O	0	0
			29	29		

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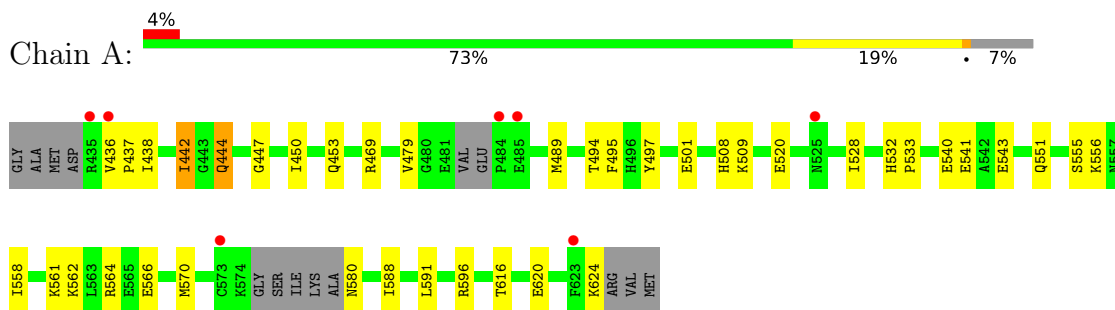
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	C	10	Total	O	0	0
			10	10		
2	D	35	Total	O	0	0
			35	35		

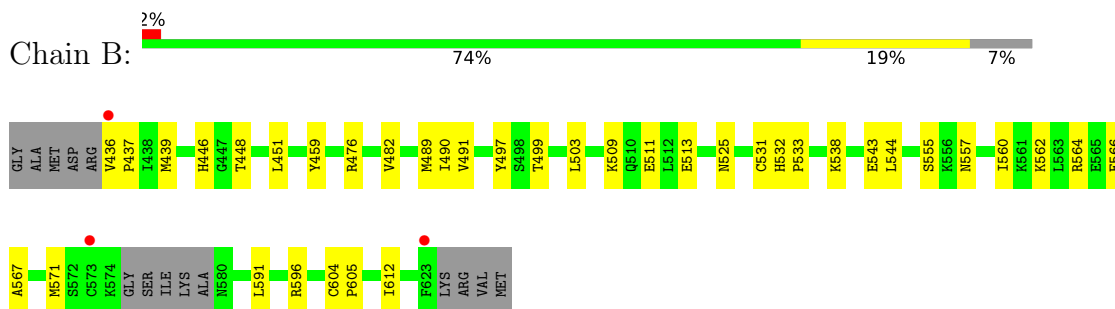
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron 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 dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). 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.

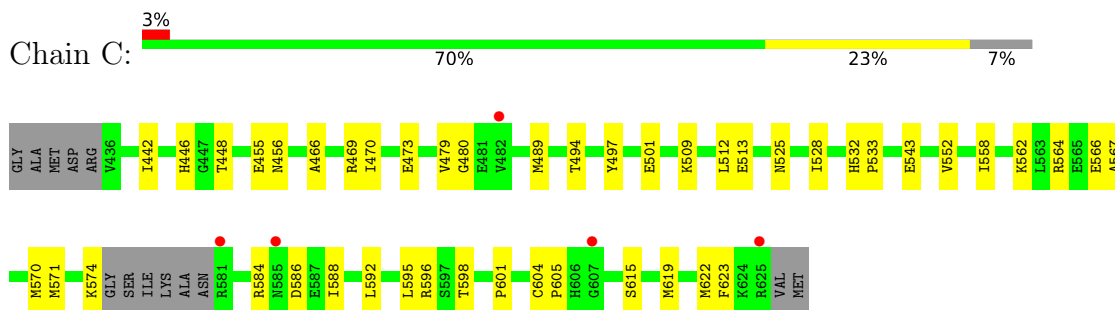
- Molecule 1: DNA mismatch repair protein mutL



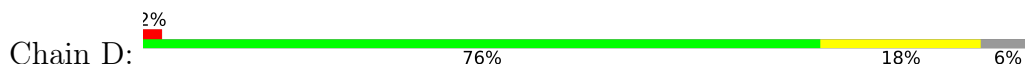
- Molecule 1: DNA mismatch repair protein mutL

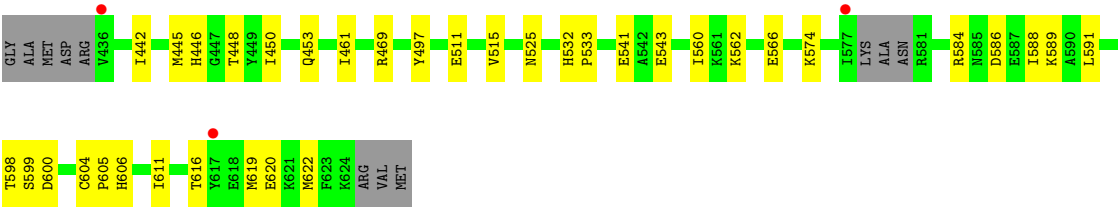


- Molecule 1: DNA mismatch repair protein mutL



- Molecule 1: DNA mismatch repair protein mutL





4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	88.29Å 94.89Å 218.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.78 – 2.50 29.78 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.8 (29.78-2.50) 98.7 (29.78-2.50)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	0.03	Depositor
$\langle I/\sigma(I) \rangle$ ¹	7.72 (at 2.51Å)	Xtriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, R_{free}	0.216 , 0.267 0.211 , 0.264	Depositor DCC
R_{free} test set	1631 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å ²)	49.7	Xtriage
Anisotropy	0.177	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 36.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6122	wwPDB-VP
Average B, all atoms (Å ²)	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.65% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.29	0/1528	0.66	1/2058 (0.0%)
1	B	0.31	0/1531	0.66	0/2066
1	C	0.30	0/1543	0.67	0/2082
1	D	0.31	0/1550	0.71	0/2090
All	All	0.30	0/6152	0.67	1/8296 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	442	ILE	N-CA-C	-5.74	107.22	112.96

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1496	0	1466	30	0
1	B	1498	0	1466	24	0
1	C	1510	0	1480	29	0
1	D	1517	0	1492	26	0
2	A	27	0	0	1	0
2	B	29	0	0	2	0
2	C	10	0	0	0	0
2	D	35	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	6122	0	5904	106	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.

All (106) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:436:VAL:HB	1:A:596:ARG:HG3	1.44	0.96
1:B:436:VAL:HB	1:B:596:ARG:HG3	1.63	0.80
1:A:444:GLN:HE22	1:A:447:GLY:H	1.30	0.76
1:C:494:THR:HG22	1:C:528:ILE:HG22	1.66	0.75
1:B:538:LYS:HE3	2:B:16:HOH:O	1.97	0.65
1:C:595:LEU:O	1:C:601:PRO:HB3	1.96	0.65
1:C:604[B]:CYS:SG	1:C:605:PRO:HD2	2.38	0.64
1:A:520:GLU:HB2	1:A:528:ILE:HG13	1.80	0.63
1:B:446:HIS:O	1:B:448:THR:HG23	1.98	0.63
1:C:469:ARG:HD2	1:C:598:THR:HG21	1.80	0.63
1:A:532:HIS:HD2	1:A:533:PRO:O	1.82	0.63
1:C:532:HIS:HD2	1:C:533:PRO:O	1.84	0.60
1:C:497:TYR:O	1:C:525:ASN:HB3	2.02	0.60
1:D:619:MET:HA	1:D:622:MET:HG2	1.84	0.59
1:B:612:ILE:HG12	1:C:623:PHE:CE1	2.38	0.59
1:A:436:VAL:HG13	1:A:437:PRO:HD2	1.85	0.58
1:C:588:ILE:O	1:C:592:LEU:HG	2.03	0.58
1:D:584:ARG:HB2	1:D:586:ASP:OD1	2.02	0.58
1:A:494:THR:HG22	1:A:528:ILE:HG22	1.85	0.58
1:D:598:THR:HG22	1:D:600:ASP:H	1.69	0.57
1:A:562:LYS:O	1:A:566:GLU:HG2	2.04	0.57
1:C:446:HIS:O	1:C:448:THR:HG23	2.06	0.56
1:D:450:ILE:HD13	1:D:588:ILE:HG23	1.86	0.55
1:A:508:HIS:HE1	1:A:558:ILE:H	1.53	0.55
1:A:495:PHE:HB3	1:A:497:TYR:CE2	2.42	0.55
1:D:461:ILE:HG12	1:D:611:ILE:HG12	1.87	0.54
1:C:480:GLY:HA2	1:C:564:ARG:HH12	1.73	0.54
1:D:469:ARG:HG3	1:D:598:THR:HG21	1.90	0.53
1:B:562:LYS:O	1:B:566:GLU:HG2	2.09	0.52
1:C:592:LEU:O	1:C:596:ARG:HG3	2.09	0.52
1:C:509:LYS:O	1:C:513:GLU:HG3	2.10	0.52
1:C:489:MET:HG2	1:C:532:HIS:ND1	2.25	0.52
1:D:469:ARG:CG	1:D:598:THR:HG21	2.39	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:591:LEU:C	1:D:591:LEU:HD23	2.35	0.52
1:A:444:GLN:HE22	1:A:447:GLY:N	2.03	0.51
1:B:509:LYS:O	1:B:513:GLU:HG3	2.10	0.51
1:C:558:ILE:HG13	1:C:562:LYS:HD3	1.93	0.51
1:D:446:HIS:O	1:D:448:THR:HG23	2.12	0.49
1:D:532:HIS:CE1	1:D:541:GLU:HG2	2.47	0.49
1:A:620:GLU:HB3	1:A:624:LYS:HE3	1.95	0.49
1:D:616:THR:HA	1:D:619:MET:HE3	1.94	0.49
1:C:479:VAL:HG12	1:C:564:ARG:NH1	2.28	0.48
1:D:532:HIS:HD2	1:D:533:PRO:O	1.96	0.48
1:C:497:TYR:HB3	1:C:501:GLU:HB2	1.94	0.48
1:A:509:LYS:HE3	2:A:17:HOH:O	2.13	0.48
1:B:499:THR:O	1:B:503:LEU:HG	2.13	0.47
1:C:619:MET:HG2	1:C:622:MET:HE2	1.96	0.47
1:A:551:GLN:HB2	1:A:570:MET:HE1	1.95	0.47
1:B:544:LEU:HD21	1:B:571:MET:HG2	1.97	0.47
1:B:555:SER:C	1:B:557:ASN:H	2.23	0.47
1:A:442:ILE:HD11	1:A:453:GLN:HB3	1.97	0.47
1:A:489:MET:HG2	1:A:532:HIS:ND1	2.30	0.47
1:D:598:THR:HG22	1:D:600:ASP:N	2.28	0.47
1:D:604:CYS:SG	1:D:605:PRO:HD2	2.54	0.47
1:A:532:HIS:NE2	1:A:541:GLU:HG2	2.30	0.46
1:B:543:GLU:HG3	2:B:5:HOH:O	2.14	0.46
1:C:566:GLU:O	1:C:570:MET:HG3	2.16	0.46
1:A:479:VAL:CG1	1:A:564:ARG:HG2	2.46	0.46
1:A:497:TYR:HB3	1:A:501:GLU:HB2	1.97	0.46
1:D:511:GLU:HG3	1:D:560:ILE:HG12	1.97	0.46
1:A:555:SER:O	1:A:556:LYS:HB2	2.17	0.45
1:C:567:ALA:O	1:C:571:MET:HE3	2.17	0.45
1:B:612:ILE:HG12	1:C:623:PHE:CZ	2.52	0.45
1:A:540:GLU:HA	1:A:543:GLU:OE1	2.17	0.45
1:A:543:GLU:H	1:A:543:GLU:CD	2.25	0.45
1:C:473:GLU:HG3	1:C:598:THR:HG23	2.00	0.44
1:C:469:ARG:HD2	1:C:598:THR:CG2	2.47	0.44
1:D:497:TYR:O	1:D:525:ASN:HB3	2.16	0.44
1:B:476:ARG:NH2	1:B:564:ARG:HD3	2.33	0.44
1:B:489:MET:HG3	1:B:531:CYS:HA	2.00	0.44
1:A:438:ILE:HA	1:A:596:ARG:NH2	2.32	0.44
1:B:490:ILE:HG22	1:B:491:VAL:HG23	2.00	0.44
1:D:604:CYS:C	1:D:606:HIS:H	2.26	0.43
1:B:436:VAL:HA	1:B:437:PRO:HD3	1.89	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:512:LEU:HD21	1:C:552:VAL:HG21	2.00	0.43
1:A:450:ILE:HD13	1:A:588:ILE:HG23	2.00	0.43
1:C:584:ARG:O	1:C:588:ILE:HG13	2.18	0.43
1:D:584:ARG:O	1:D:588:ILE:HG13	2.19	0.43
1:A:532:HIS:CE1	1:A:541:GLU:HG2	2.54	0.42
1:A:566:GLU:O	1:A:570:MET:HG3	2.19	0.42
1:B:532:HIS:HD2	1:B:533:PRO:O	2.02	0.42
1:D:598:THR:HG22	1:D:599:SER:N	2.33	0.42
1:B:451:LEU:CD1	1:C:442:ILE:HD13	2.49	0.42
1:C:466:ALA:O	1:C:470:ILE:HG13	2.19	0.42
1:B:497:TYR:O	1:B:525:ASN:HB3	2.19	0.42
1:D:598:THR:CG2	1:D:599:SER:N	2.83	0.42
1:A:561:LYS:HD3	1:A:561:LYS:HA	1.77	0.41
1:B:591:LEU:C	1:B:591:LEU:HD23	2.44	0.41
1:D:442:ILE:HD11	1:D:453:GLN:HB3	2.02	0.41
1:A:469:ARG:HD3	1:A:469:ARG:O	2.20	0.41
1:B:604:CYS:HB2	1:B:605:PRO:CD	2.51	0.41
1:C:456:ASN:O	1:C:615:SER:HA	2.20	0.41
1:C:567:ALA:C	1:C:571:MET:HE3	2.46	0.41
1:B:511:GLU:HA	1:B:560:ILE:HG12	2.03	0.41
1:B:567:ALA:O	1:B:571:MET:HG3	2.21	0.41
1:C:595:LEU:O	1:C:598:THR:HB	2.21	0.41
1:D:445:MET:HE2	1:D:446:HIS:CD2	2.56	0.41
1:D:574:LYS:HB3	1:D:574:LYS:HE2	1.61	0.41
1:D:543:GLU:CD	1:D:543:GLU:H	2.28	0.41
1:A:508:HIS:CE1	1:A:558:ILE:H	2.37	0.40
1:A:591:LEU:C	1:A:591:LEU:HD23	2.46	0.40
1:A:616:THR:O	1:A:620:GLU:HG3	2.20	0.40
1:B:604:CYS:HB2	1:B:605:PRO:HD2	2.03	0.40
1:D:511:GLU:HG3	1:D:560:ILE:CG1	2.51	0.40
1:D:562:LYS:O	1:D:566:GLU:HG2	2.22	0.40
1:B:439:MET:HE2	1:B:459:TYR:CD2	2.57	0.40

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 X-ray entries followed by that with respect to entries

of similar resolution.

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	177/197 (90%)	173 (98%)	4 (2%)	0	100	100
1	B	179/197 (91%)	172 (96%)	7 (4%)	0	100	100
1	C	181/197 (92%)	178 (98%)	3 (2%)	0	100	100
1	D	182/197 (92%)	178 (98%)	4 (2%)	0	100	100
All	All	719/788 (91%)	701 (98%)	18 (2%)	0	100	100

There are no Ramachandran outliers to report.

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 X-ray entries followed by that with respect to entries of similar resolution.

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	165/176 (94%)	163 (99%)	2 (1%)	63	83
1	B	166/176 (94%)	165 (99%)	1 (1%)	78	91
1	C	167/176 (95%)	163 (98%)	4 (2%)	43	70
1	D	168/176 (96%)	165 (98%)	3 (2%)	51	77
All	All	666/704 (95%)	656 (98%)	10 (2%)	57	80

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	444	GLN
1	A	580	ASN
1	B	482	VAL
1	C	455	GLU
1	C	543	GLU
1	C	574	LYS
1	C	586	ASP
1	D	515	VAL

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Mol	Chain	Res	Type
1	D	589	LYS
1	D	620	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	444	GLN
1	A	467	GLN
1	A	500	ASN
1	A	508	HIS
1	A	510	GLN
1	A	532	HIS
1	A	580	ASN
1	B	453	GLN
1	B	467	GLN
1	B	507	GLN
1	B	508	HIS
1	B	525	ASN
1	C	464	HIS
1	C	500	ASN
1	C	525	ASN
1	D	532	HIS

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	183/197 (92%)	0.27	7 (3%) 44 39	38, 58, 78, 113	0
1	B	183/197 (92%)	-0.01	3 (1%) 70 67	32, 49, 73, 104	0
1	C	184/197 (93%)	0.18	5 (2%) 56 51	36, 55, 81, 98	1 (0%)
1	D	186/197 (94%)	0.02	3 (1%) 70 67	29, 46, 81, 103	0
All	All	736/788 (93%)	0.12	18 (2%) 59 55	29, 53, 79, 113	1 (0%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	484	PRO	4.1
1	A	525	ASN	3.7
1	A	436	VAL	3.6
1	B	623	PHE	2.9
1	A	573	CYS	2.7
1	C	581	ARG	2.5
1	B	436	VAL	2.5
1	C	482	VAL	2.5
1	A	435	ARG	2.5
1	C	607	GLY	2.4
1	C	585	ASN	2.4
1	D	617	TYR	2.3
1	C	625	ARG	2.3
1	B	573	CYS	2.3
1	A	485	GLU	2.2
1	A	623	PHE	2.2
1	D	436	VAL	2.1
1	D	577	ILE	2.1

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.