



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 17, 2026 – 09:23 PM UTC

PDB ID : 9J8I / pdb_00009j8i
Title : Mutant of a deep sea bacterial PET hydrolase MtCut
Authors : Shanshan, L.; Wei, L.; Lijuan, L.; Yang, J.
Deposited on : 2024-08-21
Resolution : 2.72 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

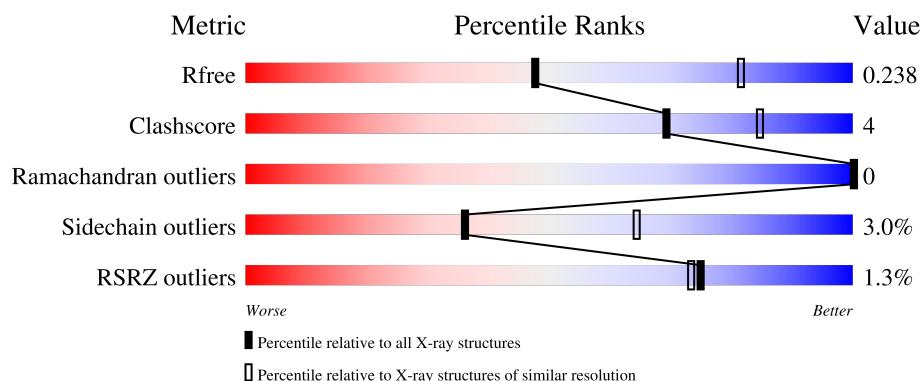
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.72 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	4348 (2.74-2.70)
Clashscore	190562	4665 (2.74-2.70)
Ramachandran outliers	187476	4584 (2.74-2.70)
Sidechain outliers	187428	4585 (2.74-2.70)
RSRZ outliers	180081	4348 (2.74-2.70)

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	270	
1	B	270	
1	C	270	
1	D	270	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 8065 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 Engineered PET hydrolase MtCutM9.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	259	Total	C	N	O	S	0	0	0
			1998	1254	348	388	8			
1	B	259	Total	C	N	O	S	0	0	0
			1998	1254	348	388	8			
1	C	259	Total	C	N	O	S	0	0	0
			1998	1254	348	388	8			
1	D	259	Total	C	N	O	S	0	0	0
			1998	1254	348	388	8			

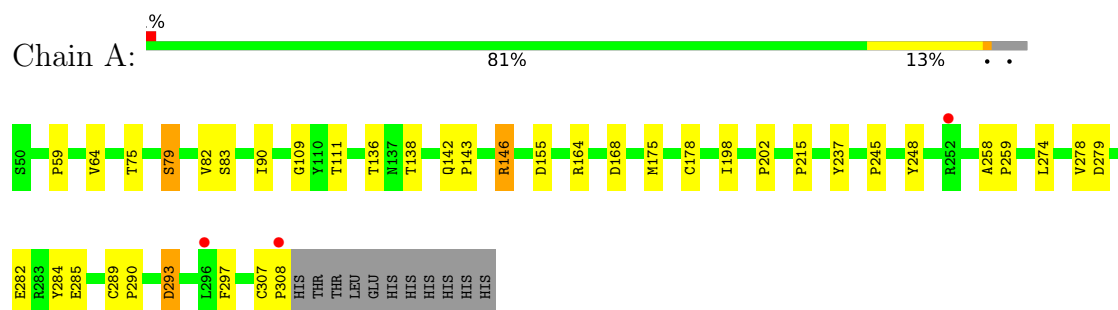
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	17	Total	O	0	0
			17	17		
2	B	14	Total	O	0	0
			14	14		
2	C	28	Total	O	0	0
			28	28		
2	D	14	Total	O	0	0
			14	14		

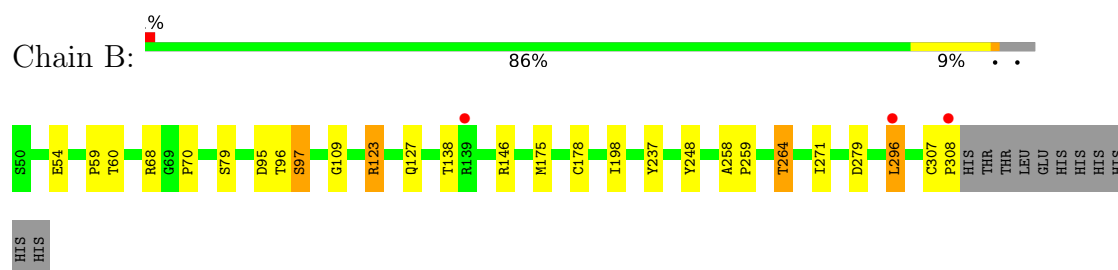
3 Residue-property plots [i](#)

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.

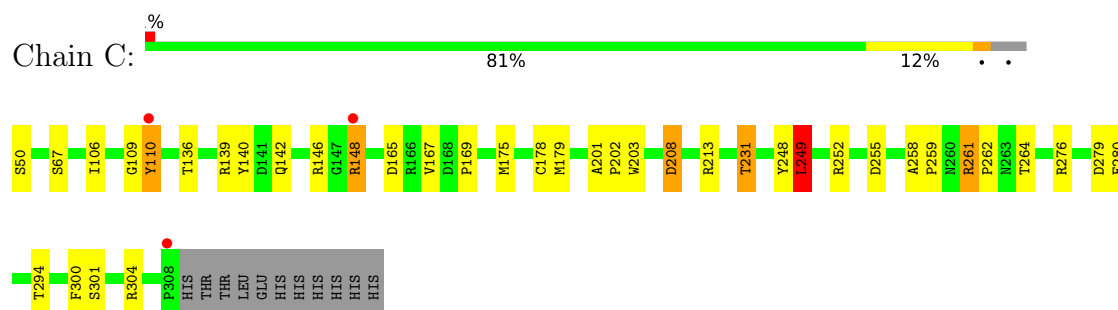
• Molecule 1: Engineered PET hydrolase MtCutM9



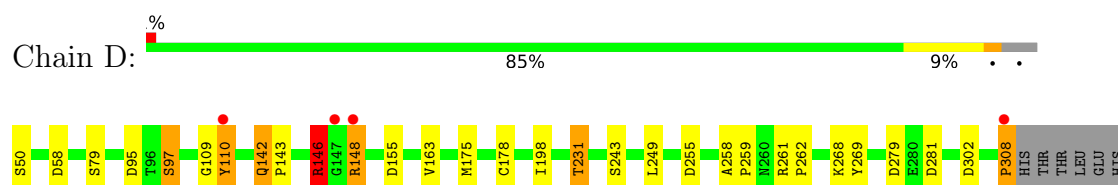
• Molecule 1: Engineered PET hydrolase MtCutM9



• Molecule 1: Engineered PET hydrolase MtCutM9



• Molecule 1: Engineered PET hydrolase MtCutM9



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4 Data and refinement statistics

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, α , β , γ	187.94Å 187.94Å 132.02Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.53 – 2.72 32.53 – 2.72	Depositor EDS
% Data completeness (in resolution range)	99.9 (32.53-2.72) 99.9 (32.53-2.72)	Depositor EDS
R_{merge}	0.33	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.05 (at 2.72Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.189 , 0.232 0.197 , 0.238	Depositor DCC
R_{free} test set	3229 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	64.5	Xtriage
Anisotropy	0.450	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 52.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	8065	wwPDB-VP
Average B, all atoms (Å ²)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 17.85% 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

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	0.61	0/2053	1.12	5/2803 (0.2%)
1	B	0.62	0/2053	1.13	7/2803 (0.2%)
1	C	0.70	1/2053 (0.0%)	1.25	19/2803 (0.7%)
1	D	0.71	1/2053 (0.0%)	1.27	22/2803 (0.8%)
All	All	0.66	2/8212 (0.0%)	1.19	53/11212 (0.5%)

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
1	A	0	1
1	B	0	1
1	C	0	4
1	D	0	2
All	All	0	8

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	148	ARG	NE-CZ	11.81	1.46	1.33
1	D	148	ARG	NE-CZ	10.83	1.45	1.33

All (53) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	148	ARG	NH1-CZ-NH2	-11.98	103.72	119.30
1	C	148	ARG	CG-CD-NE	10.63	135.39	112.00
1	C	148	ARG	NE-CZ-NH2	10.55	128.70	119.20
1	D	148	ARG	NH1-CZ-NH2	-10.25	105.97	119.30
1	D	148	ARG	CG-CD-NE	9.18	132.19	112.00
1	D	148	ARG	NE-CZ-NH2	9.00	127.30	119.20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	279	ASP	CA-CB-CG	7.78	120.38	112.60
1	D	110	TYR	CA-CB-CG	-7.55	100.32	113.90
1	D	148	ARG	CA-CB-CG	7.28	128.65	114.10
1	C	165	ASP	CB-CA-C	-7.14	96.20	110.42
1	D	155	ASP	CA-CB-CG	6.86	119.46	112.60
1	C	110	TYR	CA-CB-CG	-6.85	101.57	113.90
1	D	142	GLN	N-CA-CB	-6.84	100.12	110.03
1	C	148	ARG	CB-CG-CD	6.63	126.56	111.30
1	C	249	LEU	N-CA-CB	-6.49	100.58	110.77
1	D	148	ARG	CD-NE-CZ	6.49	133.48	124.40
1	C	148	ARG	CA-CB-CG	6.46	127.03	114.10
1	C	255	ASP	CA-CB-CG	6.45	119.05	112.60
1	B	70	PRO	N-CA-C	6.25	121.70	114.20
1	B	60	THR	CA-CB-OG1	-6.23	100.26	109.60
1	C	148	ARG	CD-NE-CZ	6.07	132.90	124.40
1	D	148	ARG	CB-CG-CD	6.04	125.19	111.30
1	B	264	THR	CA-CB-OG1	-6.03	100.56	109.60
1	D	255	ASP	CA-CB-CG	6.03	118.63	112.60
1	C	148	ARG	NE-CZ-NH1	5.89	127.39	121.50
1	A	111	THR	CA-CB-OG1	-5.86	100.81	109.60
1	D	249	LEU	N-CA-CB	-5.85	101.52	110.65
1	C	279	ASP	CA-CB-CG	5.83	118.42	112.60
1	D	302	ASP	CA-CB-CG	5.80	118.40	112.60
1	C	231	THR	N-CA-CB	-5.70	102.75	110.67
1	D	58	ASP	CA-CB-CG	5.69	118.29	112.60
1	D	231	THR	N-CA-CB	-5.69	102.76	110.67
1	C	148	ARG	N-CA-C	-5.67	105.19	111.71
1	C	148	ARG	CB-CA-C	5.63	121.05	110.63
1	D	231	THR	CB-CA-C	5.61	118.50	109.07
1	C	231	THR	CB-CA-C	5.57	118.42	109.07
1	B	138	THR	CA-CB-OG1	-5.56	101.26	109.60
1	B	68	ARG	NE-CZ-NH1	-5.53	115.97	121.50
1	D	146	ARG	CA-C-N	-5.53	110.58	121.41
1	D	146	ARG	C-N-CA	-5.53	110.58	121.41
1	C	294	THR	OG1-CB-CG2	-5.50	98.29	109.30
1	D	281	ASP	CA-CB-CG	5.43	118.03	112.60
1	C	231	THR	CA-CB-OG1	-5.39	101.51	109.60
1	B	96	THR	CA-CB-OG1	-5.36	101.55	109.60
1	A	202	PRO	N-CA-CB	-5.34	98.36	103.33
1	A	168	ASP	CA-CB-CG	5.29	117.89	112.60
1	D	146	ARG	N-CA-C	-5.26	103.19	110.35
1	B	279	ASP	CA-CB-CG	5.24	117.84	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	279	ASP	CA-CB-CG	5.12	117.72	112.60
1	D	308	PRO	N-CA-C	5.11	124.88	112.10
1	D	148	ARG	N-CA-C	-5.09	105.74	111.28
1	A	297	PHE	CA-CB-CG	5.07	118.87	113.80
1	C	249	LEU	CB-CA-C	5.00	118.14	110.14

There are no chirality outliers.

All (8) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	146	ARG	Sidechain
1	B	146	ARG	Sidechain
1	C	148	ARG	Sidechain
1	C	213	ARG	Sidechain
1	C	261	ARG	Sidechain
1	C	276	ARG	Sidechain
1	D	146	ARG	Sidechain
1	D	148	ARG	Sidechain

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	A	1998	0	1910	16	1
1	B	1998	0	1910	11	0
1	C	1998	0	1912	19	4
1	D	1998	0	1912	9	3
2	A	17	0	0	0	0
2	B	14	0	0	0	0
2	C	28	0	0	1	0
2	D	14	0	0	0	0
All	All	8065	0	7644	53	8

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 4.

All (53) 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:D:175:MET:HG2	1:D:198:ILE:HB	1.78	0.66
1:A:307:CYS:HA	1:A:308:PRO:C	2.27	0.60
1:A:282:GLU:OE1	1:B:54:GLU:OE2	2.22	0.58
1:C:106:ILE:HG12	1:C:175:MET:HE3	1.86	0.58
1:A:142:GLN:HB3	1:A:143:PRO:CD	2.34	0.58
1:B:109:GLY:HA3	1:B:178:CYS:HB3	1.85	0.57
1:C:179:MET:HE2	1:C:203:TRP:CE3	2.40	0.56
1:C:109:GLY:HA3	1:C:178:CYS:HB3	1.89	0.53
1:A:142:GLN:HB3	1:A:143:PRO:HD2	1.90	0.52
1:D:109:GLY:HA3	1:D:178:CYS:HB3	1.92	0.52
1:C:167:VAL:O	1:C:169:PRO:HD3	2.12	0.50
1:D:95:ASP:OD1	1:D:97:SER:HB3	2.12	0.49
1:A:79:SER:O	1:A:82:VAL:HG12	2.14	0.47
1:D:142:GLN:HG2	1:D:143:PRO:HD2	1.97	0.47
1:C:179:MET:HE2	1:C:203:TRP:CZ3	2.50	0.47
1:C:136:THR:HG21	1:C:146:ARG:HG2	1.96	0.47
1:A:258:ALA:N	1:A:259:PRO:CD	2.77	0.46
1:A:175:MET:HG2	1:A:198:ILE:HB	1.97	0.46
1:A:289:CYS:HA	1:A:290:PRO:C	2.40	0.46
1:C:139:ARG:NH1	2:C:403:HOH:O	2.48	0.46
1:C:258:ALA:HB3	1:C:259:PRO:HD3	1.98	0.45
1:C:248:TYR:HB3	1:C:304:ARG:HB2	1.99	0.45
1:C:106:ILE:HA	1:C:175:MET:O	2.17	0.44
1:D:163:VAL:O	1:D:163:VAL:HG23	2.17	0.44
1:D:258:ALA:N	1:D:259:PRO:CD	2.80	0.44
1:D:261:ARG:O	1:D:262:PRO:C	2.60	0.44
1:B:307:CYS:HA	1:B:308:PRO:C	2.43	0.44
1:C:106:ILE:CD1	1:C:175:MET:HE3	2.47	0.44
1:B:175:MET:HG2	1:B:198:ILE:HB	2.00	0.43
1:B:296:LEU:H	1:B:296:LEU:HD12	1.84	0.43
1:A:59:PRO:HB3	1:A:284:TYR:CZ	2.54	0.42
1:C:110:TYR:CE1	1:C:140:TYR:HA	2.54	0.42
1:B:123:ARG:HH22	1:B:264:THR:HG22	1.83	0.42
1:A:109:GLY:HA3	1:A:178:CYS:HB3	2.01	0.42
1:B:296:LEU:H	1:B:296:LEU:CD1	2.32	0.42
1:A:237:TYR:CD1	1:A:248:TYR:HB2	2.54	0.42
1:C:106:ILE:HG12	1:C:175:MET:CE	2.48	0.42
1:C:201:ALA:N	1:C:202:PRO:CD	2.82	0.42
1:B:95:ASP:OD1	1:B:97:SER:HB3	2.20	0.42
1:B:258:ALA:HB3	1:B:259:PRO:HD3	2.01	0.42
1:D:143:PRO:O	1:D:146:ARG:O	2.38	0.42
1:D:268:LYS:HE2	1:D:269:TYR:CE1	2.55	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:237:TYR:CD2	1:B:248:TYR:HB2	2.55	0.42
1:A:155:ASP:OD2	1:C:208:ASP:OD2	2.38	0.41
1:C:252:ARG:NH2	1:C:301:SER:HA	2.35	0.41
1:A:215:PRO:HA	1:A:245:PRO:O	2.20	0.41
1:A:75:THR:HA	1:A:90:ILE:O	2.21	0.41
1:B:127:GLN:HG3	1:B:271:ILE:HD13	2.03	0.41
1:C:261:ARG:O	1:C:262:PRO:C	2.64	0.41
1:A:136:THR:HG21	1:A:146:ARG:HG2	2.04	0.40
1:C:106:ILE:CD1	1:C:175:MET:CE	2.99	0.40
1:C:249:LEU:CD1	1:C:300:PHE:CD1	3.04	0.40
1:A:274:LEU:O	1:A:278:VAL:HB	2.20	0.40

All (8) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:293:ASP:OD1	1:A:293:ASP:OD1[2_555]	1.63	0.57
1:D:110:TYR:OH	1:D:110:TYR:OH[8_556]	1.81	0.39
1:D:110:TYR:CZ	1:D:110:TYR:OH[8_556]	2.06	0.14
1:C:110:TYR:CZ	1:C:110:TYR:CZ[8_556]	2.10	0.10
1:D:110:TYR:CZ	1:D:110:TYR:CZ[8_556]	2.11	0.09
1:C:110:TYR:OH	1:C:110:TYR:OH[8_556]	2.12	0.08
1:C:110:TYR:CZ	1:C:110:TYR:OH[8_556]	2.15	0.05
1:C:110:TYR:CE1	1:C:110:TYR:OH[8_556]	2.16	0.04

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all 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	257/270 (95%)	248 (96%)	9 (4%)	0	100	100
1	B	257/270 (95%)	249 (97%)	8 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	257/270 (95%)	246 (96%)	11 (4%)	0	100	100
1	D	257/270 (95%)	242 (94%)	15 (6%)	0	100	100
All	All	1028/1080 (95%)	985 (96%)	43 (4%)	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	217/228 (95%)	210 (97%)	7 (3%)	34	62
1	B	217/228 (95%)	212 (98%)	5 (2%)	44	71
1	C	217/228 (95%)	209 (96%)	8 (4%)	30	57
1	D	217/228 (95%)	211 (97%)	6 (3%)	38	67
All	All	868/912 (95%)	842 (97%)	26 (3%)	36	64

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	64	VAL
1	A	79	SER
1	A	83	SER
1	A	138	THR
1	A	164	ARG
1	A	285	GLU
1	A	293	ASP
1	B	59	PRO
1	B	79	SER
1	B	97	SER
1	B	123	ARG
1	B	296	LEU
1	C	50	SER
1	C	67	SER

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Mol	Chain	Res	Type
1	C	142	GLN
1	C	208	ASP
1	C	231	THR
1	C	249	LEU
1	C	264	THR
1	C	280	GLU
1	D	50	SER
1	D	79	SER
1	D	97	SER
1	D	231	THR
1	D	243	SER
1	D	308	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	114	GLN
1	A	170	ASN
1	A	211	ASN
1	A	286	GLN
1	B	137	ASN
1	B	142	GLN
1	C	142	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

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 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	259/270 (95%)	-0.11	3 (1%) 76 75	49, 63, 83, 130	0
1	B	259/270 (95%)	-0.07	3 (1%) 76 75	49, 63, 81, 119	0
1	C	259/270 (95%)	-0.24	3 (1%) 76 75	47, 58, 76, 100	0
1	D	259/270 (95%)	-0.20	4 (1%) 72 70	46, 58, 76, 97	0
All	All	1036/1080 (95%)	-0.16	13 (1%) 75 73	46, 61, 79, 130	0

All (13) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	308	PRO	7.5
1	A	308	PRO	7.4
1	A	296	LEU	5.5
1	B	296	LEU	4.8
1	D	308	PRO	3.8
1	D	110	TYR	3.6
1	C	308	PRO	3.2
1	D	148	ARG	3.2
1	C	110	TYR	2.8
1	C	148	ARG	2.8
1	A	252	ARG	2.3
1	B	139	ARG	2.2
1	D	147	GLY	2.1

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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.