



Full wwPDB X-ray Structure Validation Report ⓘ

May 21, 2020 – 07:32 pm BST

PDB ID : 1L7A
Title : structural Genomics, crystal structure of Cephalosporin C deacetylase
Authors : Zhang, R.; Koroleva, O.; Collert, F.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)
Deposited on : 2002-03-14
Resolution : 1.50 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.11

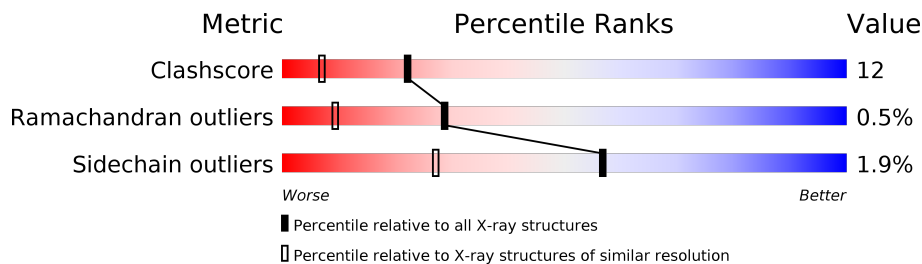
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.50 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))
Clashscore	141614	3144 (1.50-1.50)
Ramachandran outliers	138981	3066 (1.50-1.50)
Sidechain outliers	138945	3064 (1.50-1.50)

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 on 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	318	
1	B	318	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5577 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 Cephalosporin C deacetylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	318	2537	1639	415	476	7	0	0	0
1	B	318	2537	1639	415	476	7	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	122	ARG	SER	SEE REMARK 999	UNP P94388
A	315	ILE	HIS	SEE REMARK 999	UNP P94388
B	122	ARG	SER	SEE REMARK 999	UNP P94388
B	315	ILE	HIS	SEE REMARK 999	UNP P94388

- Molecule 2 is water.

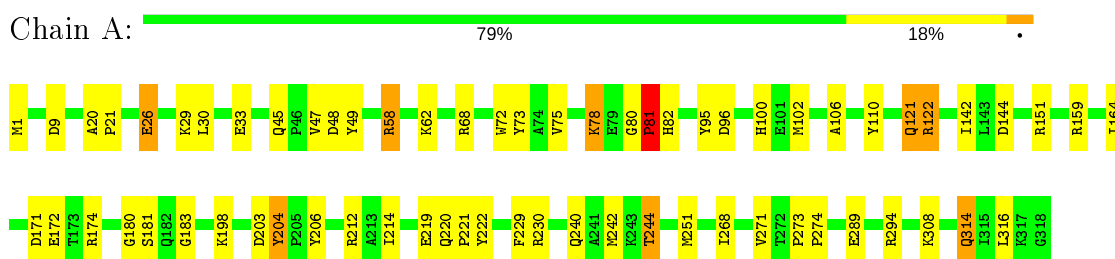
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	248	Total	O	0	0
			248	248		
2	B	255	Total	O	0	0
			255	255		

3 Residue-property plots [i](#)

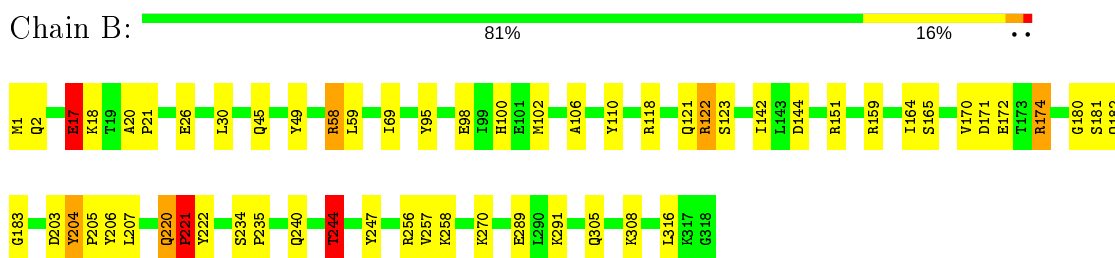
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according 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. 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.

Note EDS was not executed.

- Molecule 1: Cephalosporin C deacetylase



- Molecule 1: Cephalosporin C deacetylase



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α , β , γ	156.45Å 156.45Å 131.75Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	47.73 – 1.50	Depositor
% Data completeness (in resolution range)	95.9 (47.73-1.50)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.185 , 0.189	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	5577	wwPDB-VP
Average B, all atoms (Å ²)	14.0	wwPDB-VP

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	0.41	0/2606	1.23	19/3537 (0.5%)
1	B	0.44	0/2606	1.33	26/3537 (0.7%)
All	All	0.42	0/5212	1.28	45/7074 (0.6%)

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	2
1	B	0	3
All	All	0	5

There are no bond length outliers.

All (45) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	220	GLN	CA-C-O	-15.49	87.56	120.10
1	A	159	ARG	NE-CZ-NH1	13.46	127.03	120.30
1	B	151	ARG	NE-CZ-NH2	-12.84	113.88	120.30
1	A	294	ARG	NE-CZ-NH1	12.04	126.32	120.30
1	B	151	ARG	NE-CZ-NH1	11.01	125.80	120.30
1	B	220	GLN	C-N-CD	-9.89	98.85	120.60
1	B	221	PRO	O-C-N	-9.87	106.91	122.70
1	A	95	TYR	CB-CG-CD2	-8.90	115.66	121.00
1	B	95	TYR	CB-CG-CD2	-8.29	116.03	121.00
1	B	159	ARG	NE-CZ-NH1	8.10	124.35	120.30
1	B	144	ASP	CB-CG-OD1	8.09	125.58	118.30
1	B	174	ARG	NE-CZ-NH2	-8.01	116.30	120.30
1	A	58	ARG	NE-CZ-NH1	7.63	124.11	120.30
1	B	118	ARG	NE-CZ-NH2	-7.44	116.58	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	220	GLN	O-C-N	7.37	135.11	121.10
1	B	122	ARG	O-C-N	-7.33	110.97	122.70
1	A	48	ASP	CB-CG-OD1	6.99	124.59	118.30
1	A	230	ARG	NE-CZ-NH2	-6.86	116.87	120.30
1	B	171	ASP	CB-CG-OD1	-6.69	112.28	118.30
1	A	95	TYR	CB-CG-CD1	6.44	124.86	121.00
1	A	81	PRO	O-C-N	-6.31	112.61	122.70
1	B	58	ARG	NE-CZ-NH2	-6.23	117.18	120.30
1	B	95	TYR	CB-CG-CD1	6.22	124.73	121.00
1	B	256	ARG	NE-CZ-NH2	-6.03	117.28	120.30
1	A	219	GLU	C-N-CA	-5.98	106.75	121.70
1	A	251	MET	CG-SD-CE	-5.96	90.66	100.20
1	A	26	GLU	CA-CB-CG	5.93	126.45	113.40
1	B	174	ARG	NE-CZ-NH1	5.91	123.25	120.30
1	B	17	GLU	OE1-CD-OE2	5.90	130.38	123.30
1	B	118	ARG	NE-CZ-NH1	5.86	123.23	120.30
1	B	220	GLN	N-CA-C	5.84	126.76	111.00
1	A	144	ASP	CB-CG-OD2	-5.68	113.19	118.30
1	A	9	ASP	CB-CG-OD1	5.65	123.38	118.30
1	B	244	THR	N-CA-CB	5.55	120.85	110.30
1	B	58	ARG	NE-CZ-NH1	5.49	123.04	120.30
1	A	171	ASP	CB-CG-OD1	-5.45	113.40	118.30
1	A	212	ARG	CD-NE-CZ	-5.40	116.04	123.60
1	A	151	ARG	NE-CZ-NH2	-5.37	117.61	120.30
1	A	144	ASP	CB-CG-OD1	5.37	123.13	118.30
1	A	314	GLN	CA-CB-CG	5.32	125.11	113.40
1	B	256	ARG	NE-CZ-NH1	-5.25	117.67	120.30
1	A	159	ARG	NH1-CZ-NH2	-5.20	113.68	119.40
1	B	159	ARG	CG-CD-NE	5.15	122.62	111.80
1	B	256	ARG	NH1-CZ-NH2	5.13	125.04	119.40
1	B	98	GLU	OE1-CD-OE2	5.09	129.41	123.30

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	122	ARG	Sidechain
1	A	81	PRO	Mainchain
1	B	220	GLN	Mainchain,Peptide
1	B	221	PRO	Mainchain

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	2537	0	2485	74	0
1	B	2537	0	2485	43	5
2	A	248	0	0	11	0
2	B	255	0	0	1	0
All	All	5577	0	4970	117	5

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 12.

All (117) 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:26:GLU:O	1:A:30:LEU:HD13	1.39	1.20
1:B:26:GLU:O	1:B:30:LEU:HD13	1.50	1.12
1:A:220:GLN:HB3	1:A:221:PRO:HA	1.22	1.11
1:B:289:GLU:OE2	1:B:291:LYS:HE2	1.58	1.00
1:A:229:PHE:HE2	1:A:242:MET:HE1	1.30	0.97
1:B:121:GLN:NE2	1:B:122:ARG:HH11	1.66	0.93
1:A:229:PHE:HE2	1:A:242:MET:CE	1.87	0.88
1:B:289:GLU:OE2	1:B:291:LYS:CE	2.21	0.87
1:A:229:PHE:CE2	1:A:242:MET:CE	2.61	0.84
1:A:78:LYS:NZ	1:A:78:LYS:CB	2.40	0.83
1:A:229:PHE:CE2	1:A:242:MET:HE1	2.15	0.80
1:A:198:LYS:HD2	2:A:751:HOH:O	1.83	0.79
1:A:72:TRP:CZ2	1:A:122:ARG:NH1	2.51	0.78
1:B:121:GLN:NE2	1:B:122:ARG:NH1	2.30	0.78
1:A:220:GLN:HB3	1:A:221:PRO:CA	2.11	0.77
1:A:73:TYR:CE1	1:A:164:ILE:HD11	2.19	0.77
1:A:49:TYR:OH	1:A:100:HIS:HD2	1.68	0.76
1:A:29:LYS:HE3	1:A:30:LEU:HD12	1.69	0.74
1:A:78:LYS:NZ	1:A:78:LYS:HB3	2.03	0.73
1:A:68:ARG:NE	2:A:718:HOH:O	2.21	0.72
1:A:220:GLN:CB	1:A:221:PRO:HA	1.99	0.71
1:A:229:PHE:CE2	1:A:242:MET:HE2	2.24	0.71
1:A:62:LYS:HE3	2:A:721:HOH:O	1.90	0.71

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:49:TYR:OH	1:B:100:HIS:HD2	1.74	0.71
1:A:172:GLU:H	1:A:172:GLU:CD	1.94	0.70
1:A:203:ASP:O	1:A:204:TYR:C	2.30	0.69
1:B:289:GLU:OE2	1:B:291:LYS:NZ	2.26	0.68
1:B:1:MET:HG3	1:B:2:GLN:H	1.59	0.68
1:B:289:GLU:CD	1:B:291:LYS:HE2	2.15	0.68
1:B:203:ASP:O	1:B:204:TYR:C	2.32	0.67
1:B:121:GLN:HE21	1:B:122:ARG:HH11	1.39	0.67
1:B:305:GLN:HE22	1:B:308:LYS:HD2	1.62	0.65
1:A:206:TYR:OH	1:A:221:PRO:HG2	1.96	0.64
1:A:78:LYS:HB2	1:A:78:LYS:NZ	2.10	0.64
1:B:240:GLN:HE21	1:B:244:THR:HG22	1.62	0.64
1:B:1:MET:HG3	1:B:2:GLN:N	2.13	0.64
1:A:96:ASP:HA	1:A:122:ARG:HH21	1.63	0.63
1:A:72:TRP:HZ2	1:A:122:ARG:NH1	1.98	0.62
1:A:78:LYS:HZ2	1:A:78:LYS:HB3	1.65	0.62
1:A:240:GLN:HE21	1:A:244:THR:HG22	1.67	0.59
1:A:29:LYS:CE	1:A:30:LEU:HD12	2.33	0.58
1:B:121:GLN:HE22	1:B:122:ARG:NH1	2.02	0.57
1:A:121:GLN:HE21	1:A:122:ARG:HE	1.52	0.57
1:A:30:LEU:N	1:A:30:LEU:HD12	2.20	0.57
1:A:96:ASP:HA	1:A:121:GLN:HE22	1.69	0.57
1:B:1:MET:CG	1:B:2:GLN:H	2.16	0.57
1:B:206:TYR:O	1:B:207:LEU:HB2	2.05	0.56
1:A:198:LYS:CD	2:A:751:HOH:O	2.46	0.56
1:A:1:MET:N	1:A:268:ILE:HD12	2.20	0.56
1:B:1:MET:HG2	1:B:270:LYS:NZ	2.20	0.56
1:A:75:VAL:HG11	2:A:623:HOH:O	2.05	0.56
1:A:121:GLN:HE21	1:A:122:ARG:NE	2.03	0.55
1:B:258:LYS:HE3	2:B:666:HOH:O	2.07	0.55
1:A:174:ARG:HD2	1:A:316:LEU:O	2.06	0.55
1:B:174:ARG:HD2	1:B:316:LEU:O	2.06	0.55
1:A:78:LYS:CB	1:A:78:LYS:HZ1	2.21	0.54
1:A:206:TYR:CZ	1:A:221:PRO:HG2	2.42	0.54
1:A:82:HIS:HE1	2:A:580:HOH:O	1.90	0.54
1:B:59:LEU:CD2	1:B:164:ILE:HD11	2.38	0.54
1:B:180:GLY:HA2	1:B:203:ASP:HB2	1.91	0.53
1:A:45:GLN:NE2	1:A:58:ARG:HH11	2.06	0.53
1:A:220:GLN:CB	1:A:221:PRO:CA	2.76	0.52
1:A:30:LEU:N	1:A:30:LEU:CD1	2.72	0.52
1:B:180:GLY:O	1:B:183:GLY:N	2.43	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:72:TRP:HZ2	1:A:122:ARG:HH12	1.58	0.50
1:B:30:LEU:HD12	1:B:30:LEU:N	2.27	0.50
1:A:73:TYR:CD1	1:A:164:ILE:HD11	2.48	0.49
1:B:182:GLN:HA	1:B:206:TYR:HB3	1.93	0.49
1:B:45:GLN:NE2	1:B:58:ARG:HH11	2.10	0.49
1:A:47:VAL:HG21	1:A:72:TRP:HZ3	1.78	0.49
1:B:121:GLN:HE21	1:B:122:ARG:HD2	1.77	0.49
1:B:221:PRO:O	1:B:222:TYR:C	2.48	0.49
1:A:1:MET:H2	1:A:268:ILE:HD12	1.79	0.47
1:A:121:GLN:O	1:A:122:ARG:HB2	2.13	0.47
1:A:229:PHE:CZ	1:A:242:MET:HE2	2.50	0.47
1:A:96:ASP:HA	1:A:122:ARG:NH2	2.29	0.47
1:A:214:ILE:HD11	1:A:242:MET:HE3	1.97	0.47
1:A:180:GLY:HA2	1:A:203:ASP:HB2	1.97	0.47
1:A:214:ILE:CD1	1:A:242:MET:HE3	2.45	0.47
1:B:142:ILE:O	1:B:244:THR:CG2	2.63	0.47
1:B:30:LEU:N	1:B:30:LEU:CD1	2.78	0.46
1:A:78:LYS:HB2	1:A:78:LYS:HZ1	1.77	0.46
1:B:1:MET:HG2	1:B:270:LYS:HZ2	1.81	0.46
1:A:172:GLU:OE1	2:A:458:HOH:O	2.21	0.45
1:A:289:GLU:OE1	2:A:734:HOH:O	2.21	0.45
1:A:80:GLY:HA3	1:A:81:PRO:HA	1.73	0.45
1:A:220:GLN:O	1:A:271:VAL:HG13	2.17	0.45
1:B:165:SER:HB2	1:B:172:GLU:HB2	1.97	0.45
1:B:206:TYR:O	1:B:207:LEU:CB	2.65	0.45
1:A:47:VAL:HG21	1:A:72:TRP:CZ3	2.52	0.44
1:A:222:TYR:HB2	2:A:403:HOH:O	2.16	0.44
1:A:33:GLU:OE1	2:A:842:HOH:O	2.21	0.44
1:A:45:GLN:HE21	1:A:58:ARG:HH11	1.67	0.43
1:B:21:PRO:HG2	1:B:247:TYR:CZ	2.53	0.43
1:B:20:ALA:HA	1:B:21:PRO:HD3	1.92	0.43
1:A:308:LYS:HB2	1:A:308:LYS:HE3	1.85	0.43
1:A:180:GLY:O	1:A:183:GLY:N	2.52	0.43
1:A:214:ILE:CD1	1:A:242:MET:CE	2.97	0.43
1:A:106:ALA:HA	1:A:110:TYR:O	2.19	0.43
1:A:29:LYS:CE	1:A:30:LEU:CD1	2.96	0.43
1:A:96:ASP:HA	1:A:121:GLN:NE2	2.34	0.42
1:B:234:SER:HA	1:B:235:PRO:HD3	1.84	0.42
1:A:172:GLU:CD	1:A:172:GLU:N	2.67	0.42
1:B:106:ALA:HA	1:B:110:TYR:O	2.20	0.42
1:B:164:ILE:HG23	1:B:170:VAL:HG21	2.02	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:257:VAL:O	1:B:258:LYS:HD3	2.20	0.42
1:A:26:GLU:O	1:A:30:LEU:CD1	2.34	0.41
1:B:69:ILE:HD13	1:B:123:SER:HB3	2.02	0.41
1:B:142:ILE:O	1:B:244:THR:HG21	2.21	0.41
1:A:142:ILE:O	1:A:244:THR:CG2	2.68	0.41
1:A:229:PHE:CZ	1:A:242:MET:CE	3.03	0.41
1:A:273:PRO:HA	1:A:274:PRO:HD3	1.94	0.41
1:A:58:ARG:HG3	2:A:874:HOH:O	2.21	0.41
1:B:203:ASP:O	1:B:205:PRO:N	2.53	0.41
1:A:20:ALA:HA	1:A:21:PRO:HD3	1.85	0.41
1:B:17:GLU:HG3	1:B:18:LYS:N	2.36	0.40
1:A:29:LYS:HE2	1:A:30:LEU:CD1	2.52	0.40

All (5) 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:B:17:GLU:OE2	1:B:17:GLU:OE2[16_544]	1.51	0.69
1:B:17:GLU:CD	1:B:17:GLU:OE2[16_544]	1.58	0.62
1:B:17:GLU:OE1	1:B:17:GLU:OE2[16_544]	1.68	0.52
1:B:17:GLU:CD	1:B:17:GLU:CD[16_544]	1.80	0.40
1:B:17:GLU:CD	1:B:17:GLU:OE1[16_544]	1.88	0.32

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	316/318 (99%)	302 (96%)	13 (4%)	1 (0%)	41 18
1	B	316/318 (99%)	301 (95%)	13 (4%)	2 (1%)	25 7
All	All	632/636 (99%)	603 (95%)	26 (4%)	3 (0%)	29 9

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	221	PRO
1	A	204	TYR
1	B	204	TYR

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all 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	267/267 (100%)	261 (98%)	6 (2%)	52	22
1	B	267/267 (100%)	263 (98%)	4 (2%)	65	39
All	All	534/534 (100%)	524 (98%)	10 (2%)	57	27

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

Mol	Chain	Res	Type
1	A	78	LYS
1	A	102	MET
1	A	121	GLN
1	A	181	SER
1	A	244	THR
1	A	314	GLN
1	B	17	GLU
1	B	102	MET
1	B	181	SER
1	B	244	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	45	GLN
1	A	82	HIS
1	A	100	HIS
1	A	121	GLN

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Mol	Chain	Res	Type
1	A	220	GLN
1	A	240	GLN
1	A	282	ASN
1	B	45	GLN
1	B	82	HIS
1	B	100	HIS
1	B	121	GLN
1	B	220	GLN
1	B	240	GLN
1	B	282	ASN
1	B	305	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.