Full wwPDB X-ray Structure Validation Report (i)

Nov 14, 2023 – 10:54 PM JST

PDB ID	:	6AKE
Title	:	Crystal structure of mouse claudin-3 in complex with C-terminal fragment of Clostridium perfringens enterotoxin
Authors	:	Nakamura, S.; Irie, K.; Fujiyoshi, Y.
Deposited on	:	2018-08-31
Resolution	:	3.60 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 (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (1)) were used in the production of this report:

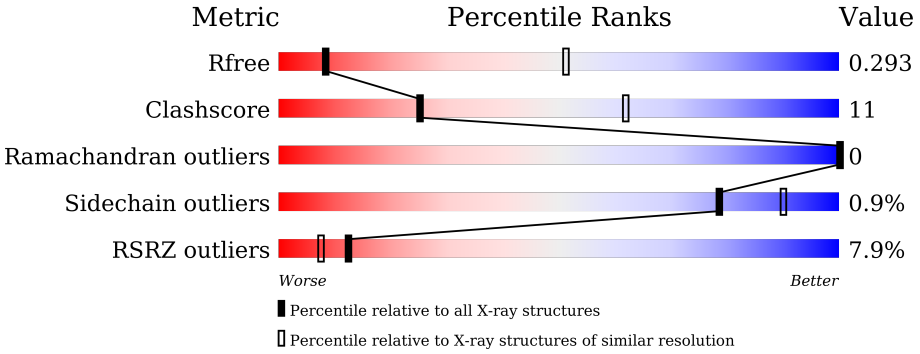
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.60 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}	130704	1257 (3.70-3.50)
Clashscore	141614	1353 (3.70-3.50)
Ramachandran outliers	138981	1307 (3.70-3.50)
Sidechain outliers	138945	1307 (3.70-3.50)
RSRZ outliers	127900	1161 (3.70-3.50)

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 <=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	190	11% 81% 13% 6%
1	C	190	7% 70% 18% • 12%
2	B	119	% 88% 10% •
2	D	119	8% 75% 22% •

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4306 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 Claudin-3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	179	1278	834	206	226	12	0	0	0
1	C	168	1211	795	193	211	12	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	GLY	-	see sequence details	UNP Q9Z0G9
A	-5	HIS	-	see sequence details	UNP Q9Z0G9
A	-4	MET	-	see sequence details	UNP Q9Z0G9
A	-3	ALA	-	see sequence details	UNP Q9Z0G9
A	-2	SER	-	see sequence details	UNP Q9Z0G9
A	-1	GLY	-	see sequence details	UNP Q9Z0G9
A	0	SER	-	see sequence details	UNP Q9Z0G9
A	103	ALA	CYS	engineered mutation	UNP Q9Z0G9
A	106	ALA	CYS	engineered mutation	UNP Q9Z0G9
A	181	ALA	CYS	engineered mutation	UNP Q9Z0G9
A	182	ALA	CYS	engineered mutation	UNP Q9Z0G9
C	-6	GLY	-	see sequence details	UNP Q9Z0G9
C	-5	HIS	-	see sequence details	UNP Q9Z0G9
C	-4	MET	-	see sequence details	UNP Q9Z0G9
C	-3	ALA	-	see sequence details	UNP Q9Z0G9
C	-2	SER	-	see sequence details	UNP Q9Z0G9
C	-1	GLY	-	see sequence details	UNP Q9Z0G9
C	0	SER	-	see sequence details	UNP Q9Z0G9
C	103	ALA	CYS	engineered mutation	UNP Q9Z0G9
C	106	ALA	CYS	engineered mutation	UNP Q9Z0G9
C	181	ALA	CYS	engineered mutation	UNP Q9Z0G9
C	182	ALA	CYS	engineered mutation	UNP Q9Z0G9

- Molecule 2 is a protein called Heat-labile enterotoxin B chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	117	918	586	152	179	1	0	0	0
			Total	C	N	O	S			
2	D	115	899	575	146	177	1	0	0	0

There are 6 discrepancies between the modelled and reference sequences:

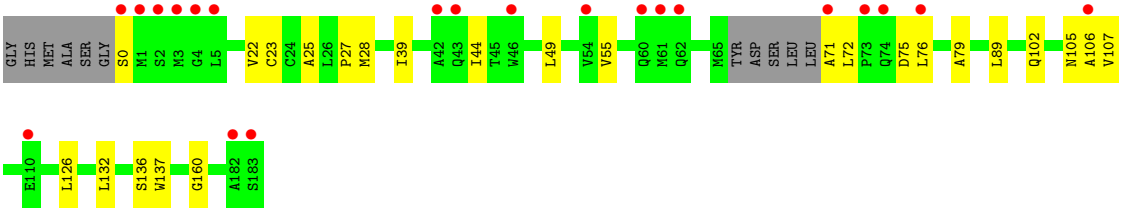
Chain	Residue	Modelled	Actual	Comment	Reference
B	201	GLY	-	see sequence details	UNP P01558
B	202	SER	-	see sequence details	UNP P01558
B	313	ALA	SER	engineered mutation	UNP P01558
D	201	GLY	-	see sequence details	UNP P01558
D	202	SER	-	see sequence details	UNP P01558
D	313	ALA	SER	engineered mutation	UNP P01558

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.

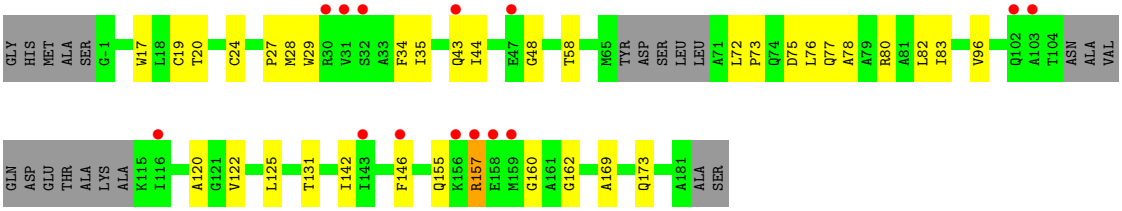
- Molecule 1: Claudin-3

Chain A:



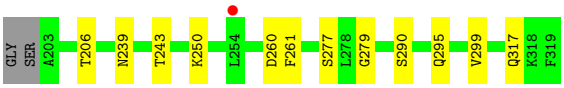
- Molecule 1: Claudin-3

Chain C:



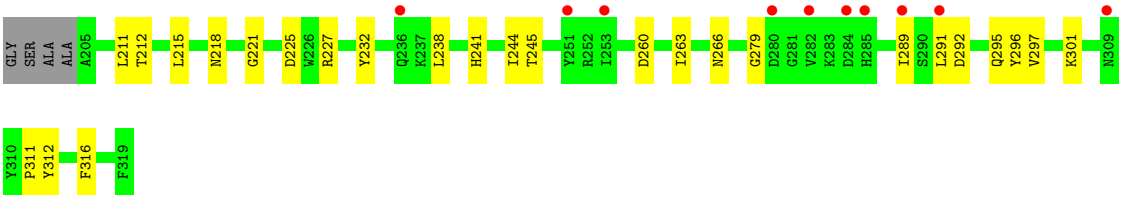
- Molecule 2: Heat-labile enterotoxin B chain

Chain B:



- Molecule 2: Heat-labile enterotoxin B chain

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	92.60Å 66.63Å 111.54Å 90.00° 97.55° 90.00°	Depositor
Resolution (Å)	45.90 – 3.60 47.06 – 3.60	Depositor EDS
% Data completeness (in resolution range)	94.0 (45.90-3.60) 94.0 (47.06-3.60)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.95 (at 3.57Å)	Xtriage
Refinement program	REFMAC 5, PHENIX 1.13_2998	Depositor
R, R_{free}	0.264 , 0.283 0.270 , 0.293	Depositor DCC
R_{free} test set	756 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å^2)	147.3	Xtriage
Anisotropy	0.068	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.25 , 85.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.45$, $< L^2 > = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.83	EDS
Total number of atoms	4306	wwPDB-VP
Average B, all atoms (Å^2)	142.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.35% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.58	0/1299	0.78	1/1778 (0.1%)
1	C	0.59	0/1231	0.76	1/1682 (0.1%)
2	B	0.54	0/939	0.74	0/1281
2	D	0.55	0/920	0.73	0/1257
All	All	0.57	0/4389	0.75	2/5998 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	107	VAL	N-CA-C	-6.40	93.71	111.00
1	C	157	ARG	NE-CZ-NH2	-5.10	117.75	120.30

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	1278	0	1316	33	0
1	C	1211	0	1259	36	0
2	B	918	0	874	8	0
2	D	899	0	844	24	0
All	All	4306	0	4293	92	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 11.

All (92) 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:71:ALA:CB	1:A:76:LEU:HD23	1.15	1.63
1:A:71:ALA:CB	1:A:76:LEU:CD2	1.77	1.52
1:A:71:ALA:HB1	1:A:76:LEU:CD2	1.44	1.33
2:D:212:THR:OG1	2:D:245:THR:HG23	1.32	1.28
1:A:71:ALA:HB3	1:A:76:LEU:CD2	1.54	1.19
2:D:212:THR:OG1	2:D:245:THR:CG2	1.92	1.16
1:A:71:ALA:CB	1:A:76:LEU:HD21	1.75	1.13
2:D:212:THR:HG1	2:D:245:THR:HG23	0.82	0.98
1:A:71:ALA:HB3	1:A:76:LEU:HD23	1.02	0.96
2:D:212:THR:OG1	2:D:245:THR:CB	2.15	0.94
1:A:71:ALA:HB1	1:A:76:LEU:HD23	0.98	0.86
1:A:71:ALA:HB3	1:A:76:LEU:CG	2.09	0.81
1:A:106:ALA:HA	1:C:35:ILE:CG2	2.11	0.81
1:C:78:ALA:O	1:C:82:LEU:CB	2.31	0.78
2:D:260:ASP:OD1	2:D:279:GLY:N	2.20	0.74
1:C:78:ALA:O	1:C:82:LEU:HB3	1.87	0.73
1:C:76:LEU:CD1	1:C:80:ARG:HG3	2.17	0.73
1:C:72:LEU:HD23	1:C:75:ASP:CG	2.10	0.73
2:D:212:THR:OG1	2:D:245:THR:OG1	2.07	0.72
1:C:76:LEU:HD11	1:C:80:ARG:HG3	1.71	0.72
1:A:106:ALA:HA	1:C:35:ILE:HG22	1.71	0.72
1:A:28:MET:O	1:A:160:GLY:HA3	1.89	0.71
1:A:71:ALA:HB2	1:A:76:LEU:HD21	1.74	0.69
2:B:206:THR:HG22	2:B:239:ASN:HB2	1.74	0.67
1:C:43:GLN:HE22	2:D:218:ASN:HD22	1.41	0.67
1:C:73:PRO:HA	1:C:77:GLN:HG2	1.77	0.66
1:C:72:LEU:HB3	1:C:75:ASP:HB2	1.77	0.65
1:C:155:GLN:HE21	2:D:225:ASP:HA	1.60	0.65
1:A:49:LEU:HD22	1:A:79:ALA:HB3	1.79	0.63
1:A:106:ALA:HA	1:C:35:ILE:HG21	1.82	0.62
1:C:76:LEU:HD12	1:C:76:LEU:O	1.99	0.61
1:A:49:LEU:HD22	1:A:79:ALA:CB	2.31	0.59
1:C:78:ALA:O	1:C:82:LEU:HB2	2.00	0.59
1:A:72:LEU:H	1:A:76:LEU:HD23	1.67	0.58
1:C:35:ILE:HD11	1:C:44:ILE:HD11	1.87	0.57
1:A:39:ILE:HD13	2:B:317:GLN:HE22	1.70	0.57
1:C:35:ILE:HD11	1:C:44:ILE:CD1	2.34	0.57
1:A:106:ALA:CA	1:C:35:ILE:HG21	2.35	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:77:GLN:HA	1:C:77:GLN:OE1	2.07	0.55
2:D:212:THR:CB	2:D:245:THR:HG1	2.20	0.54
1:C:24:CYS:HB2	1:C:83:ILE:HG21	1.90	0.53
1:A:71:ALA:HB3	1:A:76:LEU:HG	1.90	0.53
1:A:27:PRO:HD2	1:A:28:MET:HE3	1.93	0.51
2:D:212:THR:HG1	2:D:245:THR:CG2	1.73	0.51
1:A:49:LEU:CD2	1:A:79:ALA:CB	2.88	0.51
1:C:76:LEU:HD12	1:C:80:ARG:HG3	1.93	0.50
1:C:27:PRO:HA	1:C:48:GLY:HA3	1.95	0.49
2:D:225:ASP:OD1	2:D:227:ARG:NH1	2.46	0.49
1:C:122:VAL:HA	1:C:125:LEU:HB2	1.95	0.49
2:D:291:LEU:HD22	2:D:296:TYR:CE2	2.48	0.49
1:A:49:LEU:CD2	1:A:79:ALA:HB1	2.44	0.48
2:D:211:LEU:HD11	2:D:316:PHE:CG	2.48	0.48
1:C:72:LEU:HD12	1:C:73:PRO:HD2	1.95	0.48
2:D:212:THR:OG1	2:D:245:THR:N	2.46	0.48
1:C:142:ILE:HG23	1:C:157:ARG:O	2.14	0.48
2:D:263:ILE:HD13	2:D:289:ILE:HD12	1.95	0.47
1:A:22:VAL:O	1:A:25:ALA:N	2.47	0.47
1:C:58:THR:HG22	1:C:58:THR:O	2.14	0.47
1:A:106:ALA:CA	1:C:35:ILE:CG2	2.87	0.46
1:A:132:LEU:O	1:A:136:SER:OG	2.24	0.46
1:A:72:LEU:N	1:A:76:LEU:HD23	2.31	0.46
2:B:250:LYS:HA	2:B:290:SER:HA	1.98	0.45
1:A:75:ASP:CG	1:A:137:TRP:CZ3	2.90	0.45
2:D:212:THR:HG23	2:D:244:ILE:HG23	1.98	0.45
1:C:19:CYS:HB3	1:C:169:ALA:HB2	1.99	0.45
2:D:241:HIS:CD2	2:D:297:VAL:HG22	2.52	0.44
1:A:75:ASP:OD1	1:A:137:TRP:CH2	2.70	0.44
1:A:75:ASP:OD2	1:A:137:TRP:CZ3	2.71	0.44
1:C:34:PHE:C	1:C:35:ILE:HG13	2.38	0.43
2:D:266:ASN:HB3	2:D:295:GLN:HB3	2.01	0.43
1:A:44:ILE:HB	1:A:55:VAL:CG1	2.48	0.43
1:C:20:THR:HB	1:C:131:THR:HG21	2.01	0.43
2:D:291:LEU:HD22	2:D:296:TYR:CD2	2.54	0.43
2:D:232:TYR:CE2	2:D:238:LEU:HD13	2.54	0.43
2:B:239:ASN:OD1	2:B:299:VAL:HG22	2.20	0.42
2:B:260:ASP:OD1	2:B:279:GLY:N	2.52	0.42
2:D:301:LYS:HA	2:D:312:TYR:OH	2.19	0.42
1:C:96:VAL:HG12	1:C:120:ALA:HB2	2.01	0.42
2:D:292:ASP:O	2:D:296:TYR:OH	2.30	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:212:THR:CG2	2:D:244:ILE:HG23	2.50	0.42
2:B:243:THR:HG23	2:B:295:GLN:HE22	1.85	0.42
2:D:215:LEU:O	2:D:221:GLY:HA2	2.20	0.42
1:A:89:LEU:HD21	1:A:126:LEU:HB2	2.01	0.41
1:C:20:THR:HG23	1:C:169:ALA:HB1	2.03	0.41
1:C:29:TRP:O	1:C:160:GLY:N	2.53	0.41
1:C:76:LEU:HD11	1:C:80:ARG:CG	2.47	0.41
2:B:206:THR:HG22	2:B:239:ASN:HD22	1.85	0.41
1:A:0:SER:HB3	1:C:146:PHE:CE1	2.56	0.41
2:B:261:PHE:CE1	2:B:277:SER:HB3	2.55	0.41
1:A:72:LEU:HB3	1:A:76:LEU:HB3	2.02	0.41
1:C:17:TRP:HA	1:C:173:GLN:NE2	2.36	0.40
1:C:28:MET:O	1:C:162:GLY:N	2.55	0.40

There are no symmetry-related clashes.

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	175/190 (92%)	169 (97%)	6 (3%)	0	100	100
1	C	162/190 (85%)	161 (99%)	1 (1%)	0	100	100
2	B	115/119 (97%)	115 (100%)	0	0	100	100
2	D	113/119 (95%)	111 (98%)	2 (2%)	0	100	100
All	All	565/618 (91%)	556 (98%)	9 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	127/144 (88%)	124 (98%)	3 (2%)	49	75
1	C	122/144 (85%)	122 (100%)	0	100	100
2	B	98/102 (96%)	98 (100%)	0	100	100
2	D	96/102 (94%)	95 (99%)	1 (1%)	76	88
All	All	443/492 (90%)	439 (99%)	4 (1%)	78	90

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	CYS
1	A	102	GLN
1	A	105	ASN
2	D	311	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	105	ASN
2	B	295	GLN
1	C	43	GLN
1	C	74	GLN
1	C	173	GLN
2	D	218	ASN
2	D	276	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 monosaccharides 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)

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	179/190 (94%)	0.35	21 (11%)	4	3	84, 135, 202, 228	0
1	C	168/190 (88%)	0.20	14 (8%)	11	7	88, 134, 200, 264	0
2	B	117/119 (98%)	-0.30	1 (0%)	84	73	114, 144, 174, 204	0
2	D	115/119 (96%)	0.24	10 (8%)	10	6	122, 147, 177, 212	0
All	All	579/618 (93%)	0.15	46 (7%)	12	7	84, 141, 196, 264	0

All (46) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	0	SER	8.1
1	A	61	MET	8.0
1	A	73	PRO	7.7
1	C	103	ALA	6.4
1	A	62	GLN	6.3
1	A	60	GLN	5.6
1	C	32	SER	5.0
1	A	71	ALA	4.8
1	A	43	GLN	3.9
1	A	2	SER	3.9
2	D	251	TYR	3.8
1	A	183	SER	3.8
1	C	31	VAL	3.7
1	A	54	VAL	3.7
1	C	158	GLU	3.6
1	A	1	MET	3.4
1	C	156	LYS	3.3
1	A	74	GLN	3.3
1	A	76	LEU	3.3
1	C	157	ARG	3.1
1	A	3	MET	3.1

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Mol	Chain	Res	Type	RSRZ
2	D	309	ASN	3.1
2	D	282	VAL	2.9
2	D	236	GLN	2.9
1	A	110	GLU	2.8
1	C	47	GLU	2.8
1	A	46	TRP	2.6
2	D	289	ILE	2.5
1	C	43	GLN	2.5
2	D	253	ILE	2.5
1	C	30	ARG	2.5
1	A	5	LEU	2.5
1	C	116	ILE	2.4
2	D	284	ASP	2.4
1	C	102	GLN	2.4
1	C	143	ILE	2.4
1	C	146	PHE	2.4
1	A	182	ALA	2.3
1	A	4	GLY	2.3
2	D	280	ASP	2.3
1	A	106	ALA	2.2
2	D	291	LEU	2.2
1	C	159	MET	2.1
2	B	254	LEU	2.1
1	A	42	ALA	2.0
2	D	285	HIS	2.0

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 monosaccharides 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.