



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 18, 2025 – 05:20 PM EDT

PDB ID : 9C1S / pdb_00009c1s
Title : Fab F946 in complex with OspC type A
Authors : Rudolph, M.J.; Mantis, N.
Deposited on : 2024-05-29
Resolution : 2.60 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 ⓘ 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 Phenix2.0rc1
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.45.1

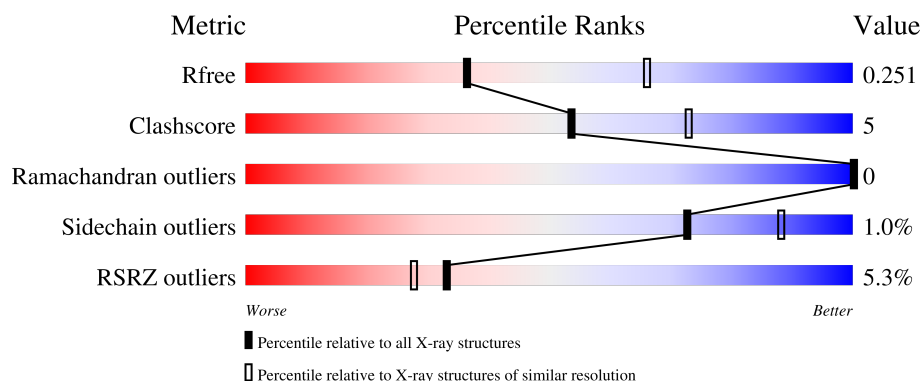
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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}	164625	3775 (2.60-2.60)
Clashscore	180529	4181 (2.60-2.60)
Ramachandran outliers	177936	4129 (2.60-2.60)
Sidechain outliers	177891	4129 (2.60-2.60)
RSRZ outliers	164620	3775 (2.60-2.60)

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	230	
1	H	230	
2	B	214	
2	L	214	
3	C	164	

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Mol	Chain	Length	Quality of chain
3	D	164	<div><div></div><div>14%</div><div>74%</div><div>22%</div><div>••</div></div>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 9193 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 F946 Fab Heavy Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	217	Total	C	N	O	S	0	0	0
			1640	1049	269	318	4			
1	A	221	Total	C	N	O	S	0	0	0
			1670	1067	275	324	4			

- Molecule 2 is a protein called F946 Fab Light Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	213	Total	C	N	O	S	0	0	0
			1640	1032	274	329	5			
2	B	212	Total	C	N	O	S	0	0	0
			1633	1028	273	328	4			

- Molecule 3 is a protein called Outer surface protein C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	158	Total	C	N	O	S	0	0	0
			1189	741	201	245	2			
3	D	159	Total	C	N	O	S	0	0	0
			1188	740	202	244	2			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	H	51	Total	O	0	0
			51	51		
4	L	57	Total	O	0	0
			57	57		
4	A	54	Total	O	0	0
			54	54		
4	B	59	Total	O	0	0
			59	59		

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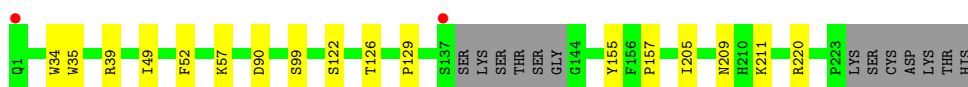
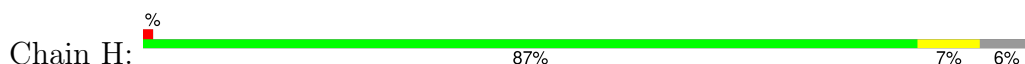
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	C	5	Total	O	0	0
			5	5		
4	D	7	Total	O	0	0
			7	7		

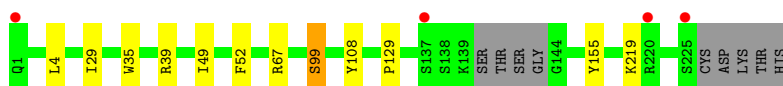
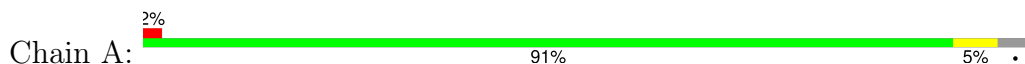
3 Residue-property plots [i](#)

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.

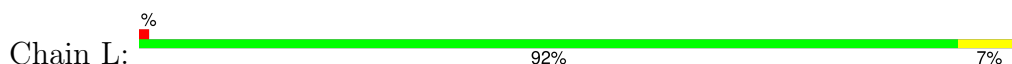
- Molecule 1: F946 Fab Heavy Chain



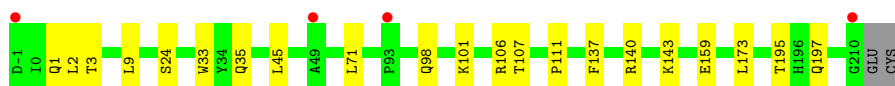
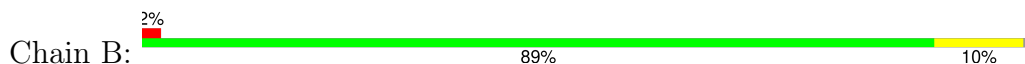
- Molecule 1: F946 Fab Heavy Chain



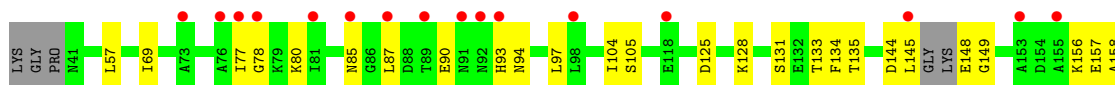
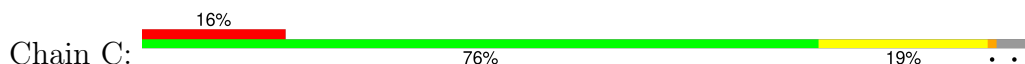
- Molecule 2: F946 Fab Light Chain

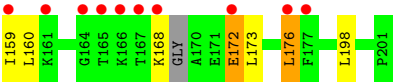


- Molecule 2: F946 Fab Light Chain

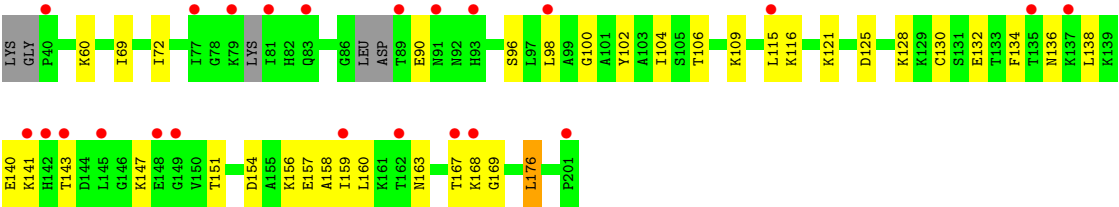


- Molecule 3: Outer surface protein C





● Molecule 3: Outer surface protein C



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	79.81Å 95.14Å 182.97Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.57 – 2.60 47.57 – 2.60	Depositor EDS
% Data completeness (in resolution range)	96.2 (47.57-2.60) 96.4 (47.57-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.89 (at 2.61Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.196 , 0.251 0.196 , 0.251	Depositor DCC
R_{free} test set	2085 reflections (4.76%)	wwPDB-VP
Wilson B-factor (Å ²)	38.5	Xtriage
Anisotropy	0.620	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 38.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	9193	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 6.22% 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	0.09	0/1716	0.29	0/2344
1	H	0.09	0/1686	0.29	0/2306
2	B	0.09	0/1669	0.31	0/2266
2	L	0.10	0/1676	0.37	0/2275
3	C	0.10	0/1193	0.30	0/1596
3	D	0.10	0/1193	0.34	0/1595
All	All	0.09	0/9133	0.32	0/12382

There are no bond length outliers.

There are no bond angle outliers.

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	1670	0	1645	7	0
1	H	1640	0	1609	9	0
2	B	1633	0	1598	11	0
2	L	1640	0	1605	13	0
3	C	1189	0	1243	25	0
3	D	1188	0	1242	25	0
4	A	54	0	0	0	0
4	B	59	0	0	1	0
4	C	5	0	0	0	0
4	D	7	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	H	51	0	0	0	0
4	L	57	0	0	0	0
All	All	9193	0	8942	86	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 5.

All (86) 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)
2:L:4:GLN:H	2:L:98:GLN:HE22	1.19	0.89
2:B:3:THR:HA	2:B:98:GLN:HE22	1.49	0.77
3:D:158:ALA:HA	3:D:169:GLY:HA3	1.69	0.73
3:C:125:ASP:HA	3:C:128:LYS:HD3	1.72	0.71
1:A:99:SER:HB3	1:A:108:TYR:HB3	1.76	0.68
3:D:156:LYS:HB3	3:D:163:ASN:HD21	1.58	0.68
2:B:143:LYS:HB3	2:B:195:THR:HB	1.80	0.64
3:D:109:LYS:HE2	3:D:132:GLU:HG2	1.80	0.64
1:A:39:ARG:HB2	1:A:49:ILE:HD11	1.81	0.63
3:C:97:LEU:HB2	3:D:96:SER:HB2	1.80	0.62
3:C:93:HIS:HA	3:C:149:GLY:HA2	1.80	0.62
3:C:133:THR:HG22	3:C:172:GLU:HG3	1.81	0.62
2:L:121:GLU:OE2	2:L:121:GLU:N	2.24	0.60
3:D:125:ASP:HA	3:D:128:LYS:HB2	1.83	0.60
2:B:35:GLN:HB2	2:B:45:LEU:HD11	1.83	0.60
2:L:98:GLN:H	2:L:98:GLN:CD	2.11	0.59
2:B:140:ARG:NH1	4:B:301:HOH:O	2.32	0.58
3:C:85:ASN:ND2	3:C:87:LEU:O	2.37	0.58
2:L:4:GLN:H	2:L:98:GLN:NE2	1.96	0.57
3:D:130:CYS:HB3	3:D:176:LEU:HD23	1.86	0.56
3:C:104:ILE:HD11	3:D:72:ILE:HG23	1.87	0.55
3:C:144:ASP:OD1	3:C:144:ASP:N	2.36	0.54
2:B:1:GLN:HG2	2:B:24:SER:HB3	1.89	0.54
1:H:39:ARG:NH1	1:H:90:ASP:OD1	2.38	0.53
3:C:80:LYS:HD2	3:C:90:GLU:HB2	1.90	0.53
3:C:157:GLU:HG2	3:C:168:LYS:HG2	1.91	0.52
2:L:118:PRO:HD3	2:L:130:VAL:HG22	1.91	0.51
3:C:173:LEU:HD12	3:C:176:LEU:HD21	1.93	0.50
2:L:191:ALA:HB2	2:L:206:SER:HB3	1.94	0.49
2:L:27:ILE:N	2:L:66:GLY:O	2.41	0.49
1:H:209:ASN:HD21	1:H:211:LYS:HE2	1.76	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:C:90:GLU:OE1	3:C:93:HIS:ND1	2.42	0.48
1:H:34:TRP:HB2	1:H:99:SER:OG	2.13	0.48
3:C:105:SER:HB2	3:C:135:THR:HG22	1.97	0.47
3:D:115:LEU:O	3:D:116:LYS:HD2	2.14	0.47
2:L:4:GLN:HG2	2:L:98:GLN:NE2	2.29	0.47
3:C:145:LEU:HD11	3:C:168:LYS:HB3	1.95	0.47
3:D:98:LEU:HD22	3:D:159:ILE:HD12	1.96	0.47
3:D:154:ASP:HA	3:D:157:GLU:HB3	1.96	0.47
3:C:156:LYS:O	3:C:160:LEU:HB3	2.15	0.47
1:H:126:THR:HG22	1:H:157:PRO:HD3	1.96	0.47
1:H:129:PRO:HB3	1:H:155:TYR:HB3	1.95	0.47
3:C:131:SER:O	3:C:135:THR:HG23	2.15	0.46
3:D:121:LYS:NZ	3:D:125:ASP:OD2	2.37	0.45
3:D:136:ASN:O	3:D:140:GLU:N	2.47	0.45
2:L:28:SER:OG	2:L:29:SER:N	2.48	0.45
1:H:205:ILE:HD13	1:H:220:ARG:HA	1.98	0.45
2:L:27:ILE:O	2:L:28:SER:HB3	2.17	0.45
2:B:159:GLU:HG2	2:B:173:LEU:HD21	1.98	0.45
1:A:4:LEU:HD11	1:A:35:TRP:HZ3	1.82	0.45
3:D:134:PHE:O	3:D:138:LEU:HD12	2.17	0.45
3:C:69:ILE:HD11	3:C:104:ILE:HB	1.98	0.45
3:C:158:ALA:HB2	3:C:168:LYS:HB2	1.99	0.45
3:D:156:LYS:O	3:D:160:LEU:HB3	2.18	0.44
2:B:2:LEU:O	2:B:98:GLN:NE2	2.50	0.44
3:C:78:GLY:H	3:C:94:ASN:HD21	1.65	0.44
3:D:157:GLU:OE2	3:D:167:THR:N	2.51	0.44
1:H:35:TRP:HB2	1:H:52:PHE:CE2	2.54	0.43
3:D:156:LYS:HB3	3:D:163:ASN:ND2	2.28	0.43
3:D:102:TYR:O	3:D:106:THR:HG23	2.18	0.43
2:L:35:GLN:HB2	2:L:45:LEU:HD11	1.99	0.43
3:D:157:GLU:OE2	3:D:168:LYS:N	2.47	0.43
3:D:69:ILE:HG23	3:D:159:ILE:HG23	2.01	0.43
3:D:141:LYS:HB3	3:D:143:THR:HG22	2.00	0.43
3:C:57:LEU:HD22	3:D:60:LYS:HG3	2.01	0.43
3:C:198:LEU:HD23	3:C:198:LEU:HA	1.92	0.42
1:A:35:TRP:HB2	1:A:52:PHE:CE1	2.54	0.42
1:A:219:LYS:HD3	1:A:219:LYS:HA	1.86	0.42
3:D:100:GLY:O	3:D:104:ILE:HG13	2.19	0.42
1:H:57:LYS:HD2	1:H:57:LYS:HA	1.84	0.42
2:B:33:TRP:CE2	2:B:71:LEU:HB2	2.55	0.42
3:C:77:ILE:HD11	3:C:159:ILE:HD11	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:D:125:ASP:N	3:D:125:ASP:OD1	2.52	0.42
2:B:106:ARG:HG2	2:B:107:THR:N	2.34	0.41
3:C:134:PHE:CZ	3:C:173:LEU:HD13	2.55	0.41
1:A:129:PRO:HB3	1:A:155:TYR:HB3	2.01	0.41
1:A:29:ILE:HG22	1:A:35:TRP:CE2	2.55	0.41
3:C:93:HIS:O	3:C:94:ASN:ND2	2.54	0.41
3:C:148:GLU:HB2	3:D:90:GLU:OE2	2.21	0.41
2:B:111:PRO:HB3	2:B:137:PHE:HB3	2.03	0.41
3:D:147:LYS:HB3	3:D:147:LYS:HE2	1.90	0.41
2:L:186:LYS:HE3	2:L:187:HIS:NE2	2.35	0.41
1:H:39:ARG:HB2	1:H:49:ILE:HD11	2.03	0.40
2:L:40:LYS:HA	2:L:40:LYS:HD3	1.82	0.40
2:B:98:GLN:H	2:B:98:GLN:CD	2.29	0.40
3:C:78:GLY:H	3:C:94:ASN:ND2	2.19	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	217/230 (94%)	215 (99%)	2 (1%)	0	100	100
1	H	213/230 (93%)	211 (99%)	2 (1%)	0	100	100
2	B	210/214 (98%)	206 (98%)	4 (2%)	0	100	100
2	L	211/214 (99%)	207 (98%)	4 (2%)	0	100	100
3	C	152/164 (93%)	151 (99%)	1 (1%)	0	100	100
3	D	153/164 (93%)	153 (100%)	0	0	100	100
All	All	1156/1216 (95%)	1143 (99%)	13 (1%)	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	191/199 (96%)	189 (99%)	2 (1%)	73	88
1	H	187/199 (94%)	186 (100%)	1 (0%)	86	95
2	B	185/187 (99%)	182 (98%)	3 (2%)	58	79
2	L	186/187 (100%)	186 (100%)	0	100	100
3	C	131/134 (98%)	129 (98%)	2 (2%)	60	81
3	D	130/134 (97%)	128 (98%)	2 (2%)	60	81
All	All	1010/1040 (97%)	1000 (99%)	10 (1%)	73	88

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

Mol	Chain	Res	Type
1	H	122	SER
1	A	67	ARG
1	A	99	SER
2	B	9	LEU
2	B	101	LYS
2	B	197	GLN
3	C	172	GLU
3	C	176	LEU
3	D	151	THR
3	D	176	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	40	GLN
1	H	54	HIS
1	H	78	GLN
1	H	174	HIS
2	L	36	GLN
2	L	98	GLN
2	L	135	ASN

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Mol	Chain	Res	Type
2	L	136	ASN
2	L	197	GLN
1	A	40	GLN
1	A	174	HIS
1	A	202	GLN
2	B	35	GLN
2	B	36	GLN
2	B	135	ASN
3	C	53	ASN
3	C	83	GLN
3	C	94	ASN

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 [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	221/230 (96%)	-0.35	4 (1%) 67 62	24, 38, 61, 83	0
1	H	217/230 (94%)	-0.14	2 (0%) 81 77	25, 46, 74, 94	0
2	B	212/214 (99%)	-0.37	4 (1%) 66 61	27, 38, 55, 94	0
2	L	213/214 (99%)	-0.24	3 (1%) 73 68	28, 41, 61, 128	0
3	C	158/164 (96%)	0.90	26 (16%) 5 4	29, 83, 139, 177	0
3	D	159/164 (96%)	0.90	23 (14%) 7 5	30, 83, 142, 169	0
All	All	1180/1216 (97%)	0.04	62 (5%) 33 28	24, 44, 123, 177	0

All (62) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	D	159	ILE	5.0
3	D	40	PRO	4.7
3	D	81	ILE	4.5
1	H	137	SER	4.5
3	C	76	ALA	4.5
3	C	85	ASN	4.2
3	C	87	LEU	4.1
3	D	89	THR	4.0
2	B	210	GLY	4.0
2	L	26	GLY	3.7
2	L	212	CYS	3.5
1	A	1	GLN	3.3
1	A	225	SER	3.3
3	D	141	LYS	3.2
3	D	149	GLY	3.0
3	D	143	THR	3.0
3	C	91	ASN	3.0
2	B	49	ALA	3.0
3	C	159	ILE	2.8

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Mol	Chain	Res	Type	RSRZ
3	C	176	LEU	2.8
3	D	79	LYS	2.8
3	C	77	ILE	2.8
3	D	167	THR	2.8
3	C	98	LEU	2.8
3	D	98	LEU	2.7
3	C	164	GLY	2.7
3	C	81	ILE	2.6
3	D	137	LYS	2.6
3	D	135	THR	2.6
2	B	-1	ASP	2.5
1	A	220	ARG	2.5
3	D	142	HIS	2.5
2	L	27	ILE	2.5
3	C	167	THR	2.5
3	D	148	GLU	2.4
3	C	165	THR	2.4
3	D	162	THR	2.4
3	D	93	HIS	2.4
3	D	91	ASN	2.4
3	D	115	LEU	2.3
3	C	153	ALA	2.3
1	H	1	GLN	2.3
3	D	145	LEU	2.3
3	C	168	LYS	2.3
3	C	73	ALA	2.3
3	C	172	GLU	2.2
3	C	93	HIS	2.2
2	B	93	PRO	2.2
1	A	137	SER	2.2
3	C	177	PHE	2.2
3	C	92	ASN	2.1
3	C	155	ALA	2.1
3	D	83	GLN	2.1
3	C	78	GLY	2.1
3	C	118	GLU	2.1
3	C	161	LYS	2.0
3	D	168	LYS	2.0
3	D	77	ILE	2.0
3	C	145	LEU	2.0
3	D	201	PRO	2.0
3	C	166	LYS	2.0

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Mol	Chain	Res	Type	RSRZ
3	C	89	THR	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 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.