Full wwPDB X-ray Structure Validation Report ⓘ

Apr 29, 2024 – 08:58 am BST

PDB ID	:	2XD2
Title	:	The crystal structure of MalX from Streptococcus pneumoniae
Authors	:	Abbott, D.W.; Higgins, M.A.; Hyrnuik, S.; Pluvinage, B.; Lammerts van Bueren, A.; Boraston, A.B.
Deposited on	:	2010-04-28
Resolution	:	2.90 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:

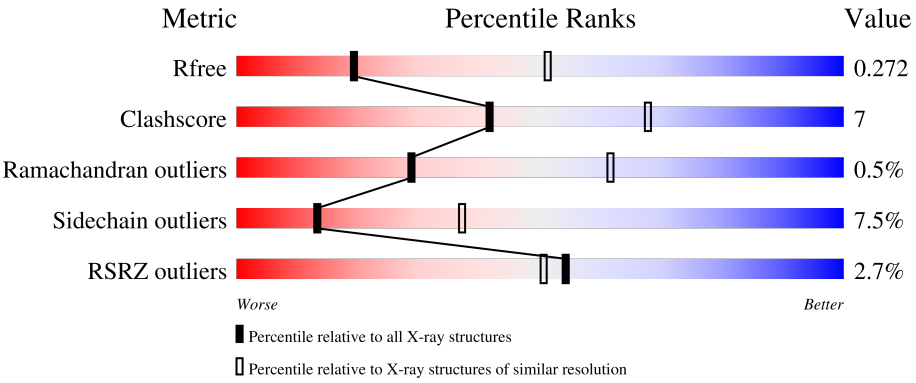
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 2.90 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	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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	416	2% 74% 15% • 9%
1	B	416	3% 72% 16% • 10%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 5798 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 MALTOSE/MALTODEXTRIN-BINDING PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	379	Total	C	N	O	S	0	0	0
			2888	1834	470	578	6			
1	B	375	Total	C	N	O	S	0	0	0
			2852	1812	463	571	6			

There are 50 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	MET	-	expression tag	UNP P59213
A	8	GLY	-	expression tag	UNP P59213
A	9	SER	-	expression tag	UNP P59213
A	10	SER	-	expression tag	UNP P59213
A	11	HIS	-	expression tag	UNP P59213
A	12	HIS	-	expression tag	UNP P59213
A	13	HIS	-	expression tag	UNP P59213
A	14	HIS	-	expression tag	UNP P59213
A	15	HIS	-	expression tag	UNP P59213
A	16	HIS	-	expression tag	UNP P59213
A	17	SER	-	expression tag	UNP P59213
A	18	SER	-	expression tag	UNP P59213
A	19	GLY	-	expression tag	UNP P59213
A	20	LEU	-	expression tag	UNP P59213
A	21	VAL	-	expression tag	UNP P59213
A	22	PRO	-	expression tag	UNP P59213
A	23	ARG	-	expression tag	UNP P59213
A	24	GLY	-	expression tag	UNP P59213
A	25	SER	-	expression tag	UNP P59213
A	26	HIS	-	expression tag	UNP P59213
A	27	MET	-	expression tag	UNP P59213
A	28	ALA	-	expression tag	UNP P59213
A	29	SER	-	expression tag	UNP P59213
B	7	MET	-	expression tag	UNP P59213
B	8	GLY	-	expression tag	UNP P59213

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Chain	Residue	Modelled	Actual	Comment	Reference
B	9	SER	-	expression tag	UNP P59213
B	10	SER	-	expression tag	UNP P59213
B	11	HIS	-	expression tag	UNP P59213
B	12	HIS	-	expression tag	UNP P59213
B	13	HIS	-	expression tag	UNP P59213
B	14	HIS	-	expression tag	UNP P59213
B	15	HIS	-	expression tag	UNP P59213
B	16	HIS	-	expression tag	UNP P59213
B	17	SER	-	expression tag	UNP P59213
B	18	SER	-	expression tag	UNP P59213
B	19	GLY	-	expression tag	UNP P59213
B	20	LEU	-	expression tag	UNP P59213
B	21	VAL	-	expression tag	UNP P59213
B	22	PRO	-	expression tag	UNP P59213
B	23	ARG	-	expression tag	UNP P59213
B	24	GLY	-	expression tag	UNP P59213
B	25	SER	-	expression tag	UNP P59213
B	26	HIS	-	expression tag	UNP P59213
B	27	MET	-	expression tag	UNP P59213
B	28	ALA	-	expression tag	UNP P59213
B	29	SER	-	expression tag	UNP P59213
A	90	ASN	SER	conflict	UNP P59213
B	90	ASN	SER	conflict	UNP P59213
A	416	LEU	ILE	conflict	UNP P59213
B	416	LEU	ILE	conflict	UNP P59213

- Molecule 2 is water.

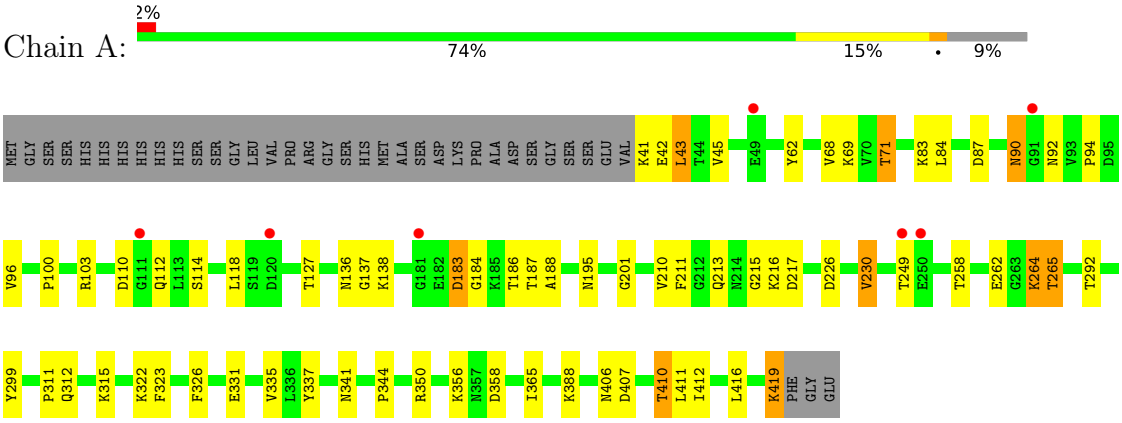
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	33	Total O 33 33	0	0
2	B	25	Total O 25 25	0	0

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.

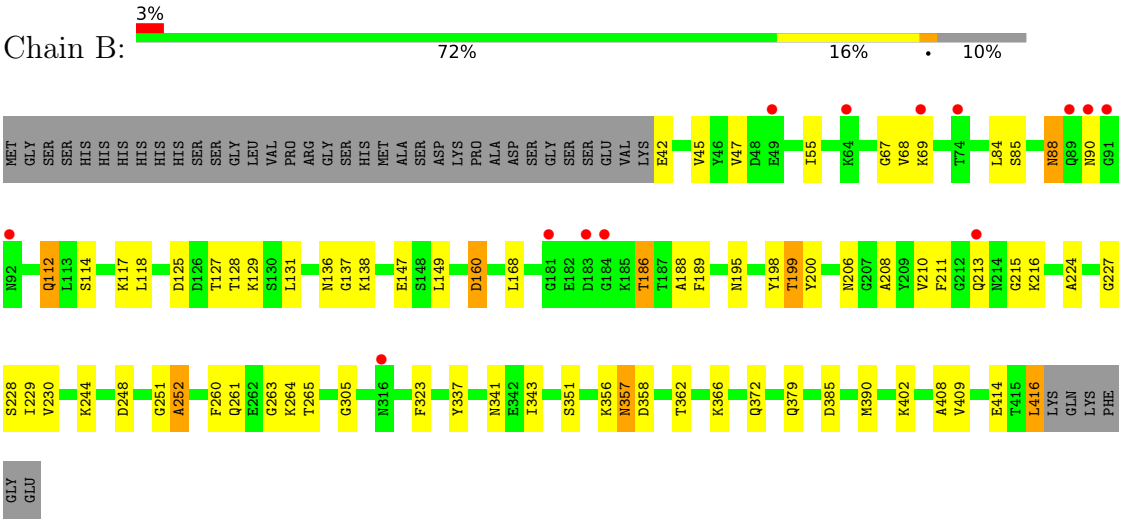
• Molecule 1: MALTOSE/MALTODEXTRIN-BINDING PROTEIN

Chain A:



• Molecule 1: MALTOSE/MALTODEXTRIN-BINDING PROTEIN

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	181.31Å 56.94Å 113.69Å 90.00° 128.83° 90.00°	Depositor
Resolution (Å)	20.00 – 2.90 19.87 – 2.90	Depositor EDS
% Data completeness (in resolution range)	96.6 (20.00-2.90) 96.6 (19.87-2.90)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.08 (at 2.88Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.216 , 0.274 0.215 , 0.272	Depositor DCC
R_{free} test set	998 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	47.8	Xtriage
Anisotropy	0.579	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 49.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.028 for -h-2*l,-k,l	Xtriage
F_o,F_c correlation	0.91	EDS
Total number of atoms	5798	wwPDB-VP
Average B, all atoms (Å^2)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.55% 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

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	0.40	0/2943	0.55	0/3988
1	B	0.38	0/2907	0.52	1/3942 (0.0%)
All	All	0.39	0/5850	0.54	1/7930 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	416	LEU	CA-CB-CG	6.16	129.46	115.30

There are no chirality outliers.

There are no planarity outliers.

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	2888	0	2837	40	0
1	B	2852	0	2797	39	0
2	A	33	0	0	3	0
2	B	25	0	0	0	0
All	All	5798	0	5634	79	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 7.

All (79) 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:B:251:GLY:HA2	1:B:252:ALA:CB	1.89	1.01
1:B:251:GLY:HA2	1:B:252:ALA:HB2	1.42	1.00
1:B:224:ALA:HB2	1:B:409:VAL:HG21	1.53	0.91
1:B:251:GLY:CA	1:B:252:ALA:CB	2.50	0.88
1:A:419:LYS:HB3	2:A:2033:HOH:O	1.79	0.82
1:B:84:LEU:O	1:B:88:ASN:HB2	1.80	0.81
1:B:251:GLY:CA	1:B:252:ALA:HB3	2.11	0.80
1:A:187:THR:O	1:A:265:THR:HB	1.88	0.73
1:B:343:ILE:H	1:B:343:ILE:HD12	1.53	0.72
1:A:407:ASP:O	1:A:411:LEU:HG	1.88	0.72
1:B:136:ASN:N	1:B:137:GLY:HA2	2.08	0.67
1:B:136:ASN:HB2	1:B:138:LYS:H	1.59	0.67
1:A:213:GLN:HG2	1:A:217:ASP:HB2	1.78	0.64
1:A:45:VAL:HG22	1:A:96:VAL:HB	1.83	0.61
1:A:337:TYR:HE2	1:A:356:LYS:HG3	1.65	0.61
1:B:260:PHE:HA	1:B:265:THR:HG22	1.83	0.60
1:A:41:LYS:N	2:A:2001:HOH:O	2.33	0.60
1:B:229:ILE:HD12	1:B:402:LYS:HA	1.83	0.60
1:B:208:ALA:HB2	1:B:228:SER:HB2	1.85	0.59
1:A:45:VAL:HG21	1:A:323:PHE:HE2	1.67	0.59
1:B:251:GLY:HA3	1:B:252:ALA:HB3	1.86	0.58
1:A:406:ASN:O	1:A:410:THR:HG23	2.03	0.57
1:A:213:GLN:HB2	1:A:216:LYS:HB2	1.87	0.57
1:B:45:VAL:HG21	1:B:323:PHE:HE2	1.70	0.56
1:B:136:ASN:HB2	1:B:138:LYS:N	2.21	0.56
1:A:183:ASP:CG	1:A:184:GLY:HA2	2.28	0.54
1:B:211:PHE:HB2	1:B:215:GLY:HA2	1.91	0.53
1:A:187:THR:O	1:A:265:THR:CB	2.57	0.52
1:A:350:ARG:HG3	1:A:365:ILE:HD13	1.90	0.52
1:B:42:GLU:N	1:B:69:LYS:HG3	2.24	0.52
1:B:337:TYR:HE2	1:B:356:LYS:HG3	1.75	0.51
1:A:42:GLU:OE2	1:A:71:THR:HG21	2.11	0.51
1:A:186:THR:HB	1:A:188:ALA:H	1.76	0.51
1:A:110:ASP:O	1:A:112:GLN:HG2	2.12	0.50
1:B:45:VAL:HG21	1:B:323:PHE:CE2	2.46	0.50
1:A:114:SER:OG	1:A:312:GLN:HA	2.10	0.50
1:B:147:GLU:HG2	1:B:305:GLY:HA2	1.92	0.50
1:A:62:TYR:HB2	1:A:326:PHE:CE2	2.47	0.50
1:B:47:VAL:HG21	1:B:55:ILE:HG13	1.93	0.50
1:B:213:GLN:O	1:B:216:LYS:HG2	2.12	0.50
1:A:187:THR:HB	1:A:265:THR:HG22	1.94	0.49
1:B:379:GLN:OE1	1:B:379:GLN:N	2.38	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:69:LYS:NZ	1:A:71:THR:HB	2.27	0.49
1:A:344:PRO:O	1:A:350:ARG:HD3	2.13	0.49
1:A:258:THR:O	1:A:262:GLU:HG3	2.13	0.49
1:B:224:ALA:HB2	1:B:409:VAL:CG2	2.36	0.48
1:A:337:TYR:CE2	1:A:356:LYS:HG3	2.48	0.48
1:A:350:ARG:HG3	1:A:365:ILE:CD1	2.44	0.48
1:B:128:THR:HA	1:B:131:LEU:HD12	1.96	0.48
1:A:226:ASP:O	1:A:230:VAL:HG13	2.15	0.47
1:A:136:ASN:N	1:A:137:GLY:HA2	2.29	0.47
1:A:331:GLU:O	1:A:335:VAL:HG23	2.15	0.47
1:A:262:GLU:HB2	1:A:264:LYS:HE2	1.97	0.46
1:B:199:THR:O	1:B:200:TYR:C	2.54	0.45
1:B:186:THR:HB	1:B:188:ALA:H	1.82	0.45
1:B:85:SER:HA	1:B:112:GLN:OE1	2.17	0.45
1:A:84:LEU:HA	1:A:87:ASP:HB2	1.99	0.45
1:B:149:LEU:HD11	1:B:198:TYR:HA	1.99	0.45
1:B:206:ASN:O	1:B:227:GLY:HA3	2.17	0.45
1:A:90:ASN:HD22	1:A:92:ASN:H	1.65	0.44
1:A:94:PRO:O	1:A:311:PRO:HG2	2.17	0.44
1:B:160:ASP:OD2	1:B:160:ASP:N	2.50	0.44
1:A:211:PHE:HB2	1:A:215:GLY:HA2	1.99	0.44
1:B:125:ASP:O	1:B:129:LYS:HB2	2.18	0.43
1:A:43:LEU:HD22	1:A:68:VAL:HG11	2.01	0.42
1:B:42:GLU:HG3	1:B:68:VAL:HG13	2.00	0.42
1:A:412:ILE:O	1:A:416:LEU:HG	2.19	0.42
1:A:90:ASN:HD22	1:A:92:ASN:HB2	1.85	0.42
1:B:357:ASN:O	1:B:357:ASN:ND2	2.50	0.42
1:A:350:ARG:CG	1:A:365:ILE:HD13	2.50	0.42
1:B:362:THR:HG22	1:B:366:LYS:HE2	2.02	0.41
1:A:419:LYS:CB	2:A:2033:HOH:O	2.52	0.41
1:B:261:GLN:C	1:B:263:GLY:H	2.23	0.41
1:A:100:PRO:HG2	1:A:103:ARG:CG	2.50	0.41
1:B:168:LEU:HD22	1:B:189:PHE:HB2	2.02	0.41
1:B:88:ASN:HD22	1:B:88:ASN:HA	1.66	0.41
1:B:390:MET:HB2	1:B:408:ALA:HB2	2.02	0.41
1:A:262:GLU:OE1	1:A:264:LYS:HE2	2.21	0.40
1:A:201:GLY:HA3	1:A:299:TYR:CD1	2.56	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	377/416 (91%)	353 (94%)	23 (6%)	1 (0%)	41	71
1	B	373/416 (90%)	341 (91%)	29 (8%)	3 (1%)	19	51
All	All	750/832 (90%)	694 (92%)	52 (7%)	4 (0%)	29	61

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	252	ALA
1	B	67	GLY
1	A	210	VAL
1	B	90	ASN

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	297/329 (90%)	276 (93%)	21 (7%)	14	40
1	B	293/329 (89%)	270 (92%)	23 (8%)	12	34
All	All	590/658 (90%)	546 (92%)	44 (8%)	13	37

All (44) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	43	LEU
1	A	71	THR

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Mol	Chain	Res	Type
1	A	83	LYS
1	A	90	ASN
1	A	118	LEU
1	A	127	THR
1	A	138	LYS
1	A	183	ASP
1	A	195	ASN
1	A	230	VAL
1	A	249	THR
1	A	264	LYS
1	A	265	THR
1	A	292	THR
1	A	315	LYS
1	A	322	LYS
1	A	341	ASN
1	A	358	ASP
1	A	388	LYS
1	A	410	THR
1	A	419	LYS
1	B	88	ASN
1	B	112	GLN
1	B	114	SER
1	B	117	LYS
1	B	118	LEU
1	B	127	THR
1	B	160	ASP
1	B	186	THR
1	B	195	ASN
1	B	199	THR
1	B	210	VAL
1	B	230	VAL
1	B	244	LYS
1	B	248	ASP
1	B	264	LYS
1	B	341	ASN
1	B	351	SER
1	B	357	ASN
1	B	358	ASP
1	B	372	GLN
1	B	385	ASP
1	B	414	GLU
1	B	416	LEU

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	88	ASN
1	A	90	ASN
1	A	195	ASN
1	A	418	GLN
1	B	88	ASN
1	B	195	ASN
1	B	261	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry

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, 95^{th} 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	379/416 (91%)	-0.19	7 (1%) 68 67	20, 36, 54, 60	0
1	B	375/416 (90%)	0.13	13 (3%) 44 38	25, 49, 78, 82	0
All	All	754/832 (90%)	-0.03	20 (2%) 54 50	20, 42, 68, 82	0

All (20) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	249	THR	4.3
1	B	181	GLY	3.5
1	B	89	GLN	3.1
1	A	181	GLY	3.1
1	B	183	ASP	3.1
1	B	92	ASN	3.0
1	B	69	LYS	3.0
1	A	250	GLU	2.9
1	A	111	GLY	2.9
1	B	91	GLY	2.8
1	B	90	ASN	2.6
1	B	184	GLY	2.5
1	B	316	ASN	2.5
1	B	64	LYS	2.2
1	A	120	ASP	2.2
1	A	91	GLY	2.2
1	B	49	GLU	2.1
1	A	49	GLU	2.1
1	B	213	GLN	2.0
1	B	74	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 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.