Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2025 – 04:10 PM JST

PDB ID	:	9JWA
Title	:	Crystal Structure of Lon Bound to a Substrate.
Authors	:	Wang, H.J.; Kuan, Y.E.; Chang, C.I.
Deposited on	:	2024-10-10
Resolution	:	2.29 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:

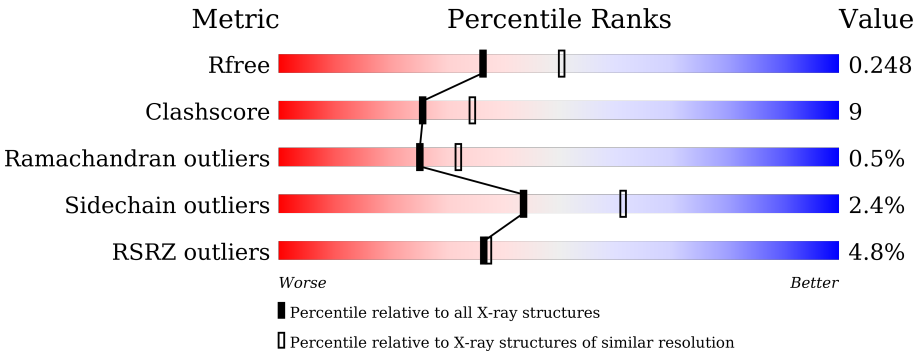
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.2

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 2.29 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	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (2.30-2.30)

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	95	72% 15% 14%
1	C	95	3% 78% 8% 13%
2	B	206	4% 74% 21%
2	D	206	8% 76% 17%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4587 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 DUF1150 domain-containing protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	82	Total	C	N	O	S	0	0	0
			603	380	103	119	1			
1	C	83	Total	C	N	O	S	0	0	0
			613	386	106	120	1			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	HIS	-	expression tag	UNP Q9A2G8
A	-4	HIS	-	expression tag	UNP Q9A2G8
A	-3	HIS	-	expression tag	UNP Q9A2G8
A	-2	HIS	-	expression tag	UNP Q9A2G8
A	-1	HIS	-	expression tag	UNP Q9A2G8
A	0	HIS	-	expression tag	UNP Q9A2G8
A	1	HIS	-	expression tag	UNP Q9A2G8
C	-5	HIS	-	expression tag	UNP Q9A2G8
C	-4	HIS	-	expression tag	UNP Q9A2G8
C	-3	HIS	-	expression tag	UNP Q9A2G8
C	-2	HIS	-	expression tag	UNP Q9A2G8
C	-1	HIS	-	expression tag	UNP Q9A2G8
C	0	HIS	-	expression tag	UNP Q9A2G8
C	1	HIS	-	expression tag	UNP Q9A2G8

- Molecule 2 is a protein called Lon protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	203	Total	C	N	O	S	0	0	0
			1557	996	258	300	3			
2	D	199	Total	C	N	O	S	0	0	0
			1526	975	253	295	3			

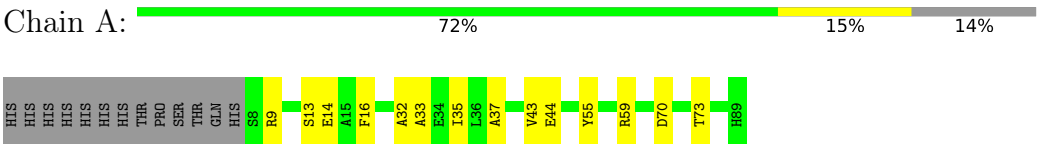
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	63	Total O 63 63	0	0
3	B	88	Total O 88 88	0	0
3	C	61	Total O 61 61	0	0
3	D	76	Total O 76 76	0	0

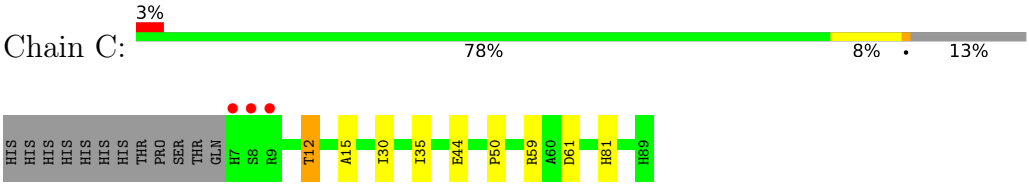
3 Residue-property plots (i)

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.

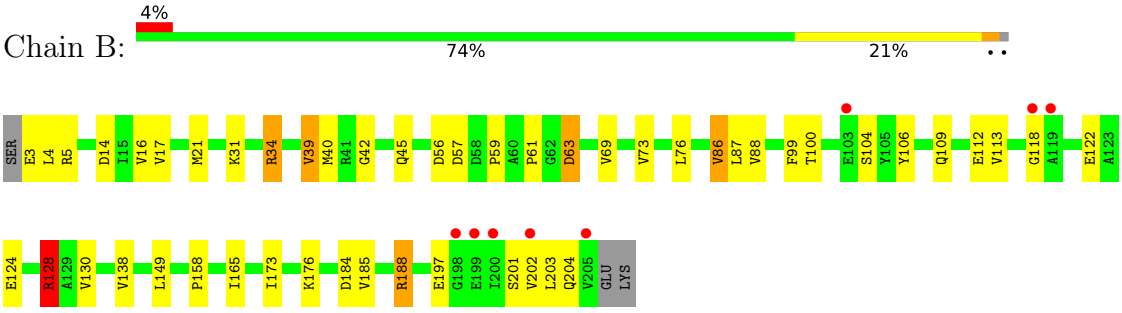
• Molecule 1: DUF1150 domain-containing protein



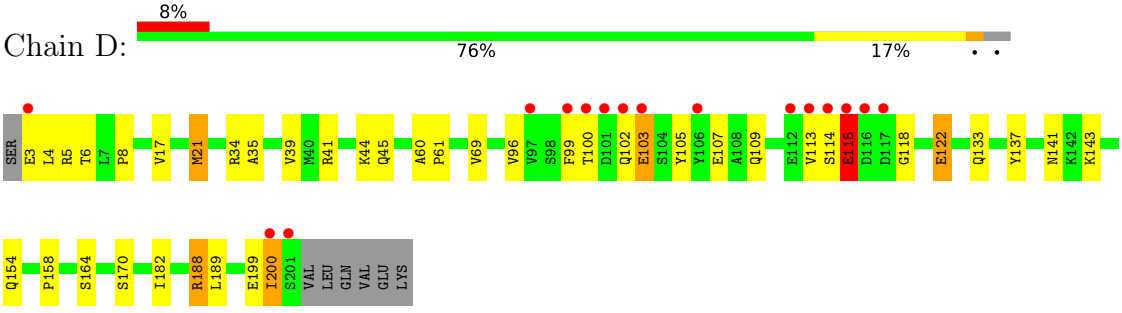
• Molecule 1: DUF1150 domain-containing protein



• Molecule 2: Lon protease



• Molecule 2: Lon protease



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 43	Depositor
Cell constants a, b, c, α, β, γ	81.05Å 81.05Å 104.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.67 – 2.29 28.67 – 2.29	Depositor EDS
% Data completeness (in resolution range)	99.3 (28.67-2.29) 99.3 (28.67-2.29)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.87 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.198 , 0.249 0.198 , 0.248	Depositor DCC
R_{free} test set	1493 reflections (4.91%)	wwPDB-VP
Wilson B-factor (Å^2)	22.8	Xtriage
Anisotropy	0.206	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 36.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.051 for h,-k,-l	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	4587	wwPDB-VP
Average B, all atoms (Å^2)	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.92% 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	0.64	0/613	1.17	2/839 (0.2%)
1	C	0.65	0/624	1.11	1/854 (0.1%)
2	B	0.55	0/1580	1.10	5/2144 (0.2%)
2	D	0.54	0/1549	1.10	5/2101 (0.2%)
All	All	0.58	0/4366	1.11	13/5938 (0.2%)

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
2	B	0	3
2	D	0	1
All	All	0	5

There are no bond length outliers.

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	21	MET	CG-SD-CE	9.31	115.10	100.20
2	B	128	ARG	NE-CZ-NH2	6.66	123.63	120.30
2	B	188	ARG	NE-CZ-NH2	-6.64	116.98	120.30
1	A	14	GLU	N-CA-CB	6.55	122.39	110.60
2	B	128	ARG	NE-CZ-NH1	-6.37	117.12	120.30
2	D	115	GLU	CB-CA-C	5.91	122.22	110.40
1	A	9	ARG	N-CA-CB	5.75	120.94	110.60
2	D	154	GLN	CB-CA-C	-5.72	98.95	110.40
2	D	188	ARG	NE-CZ-NH2	-5.59	117.51	120.30
2	B	34	ARG	CD-NE-CZ	5.40	131.16	123.60
2	D	103	GLU	N-CA-CB	5.26	120.08	110.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	21	MET	CB-CG-SD	5.23	128.09	112.40
1	C	12	THR	CA-CB-OG1	-5.15	98.19	109.00

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	59	ARG	Sidechain
2	B	118	GLY	Peptide
2	B	128	ARG	Sidechain
2	B	188	ARG	Sidechain
2	D	114	SER	Peptide

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	603	0	605	11	0
1	C	613	0	612	10	0
2	B	1557	0	1608	36	0
2	D	1526	0	1571	31	0
3	A	63	0	0	6	1
3	B	88	0	0	14	0
3	C	61	0	0	1	0
3	D	76	0	0	9	1
All	All	4587	0	4396	82	1

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 9.

All (82) 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:37:ALA:HB2	3:A:101:HOH:O	1.58	1.00
1:A:37:ALA:CB	3:A:101:HOH:O	2.09	0.99

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:173:ILE:HB	3:B:329:HOH:O	1.63	0.96
2:B:184:ASP:OD2	2:D:143:LYS:HE2	1.66	0.94
2:B:59:PRO:O	2:B:106:TYR:OH	1.89	0.90
2:B:57:ASP:OD1	3:B:301:HOH:O	2.01	0.79
1:A:37:ALA:N	3:A:101:HOH:O	2.20	0.73
2:B:122:GLU:HG2	3:B:305:HOH:O	1.92	0.69
1:A:33:ALA:O	3:A:101:HOH:O	2.12	0.68
2:B:204:GLN:HB2	1:C:81:HIS:CD2	2.29	0.67
2:B:204:GLN:HB2	1:C:81:HIS:HD2	1.57	0.67
2:D:122:GLU:OE1	3:D:301:HOH:O	2.12	0.66
2:D:133:GLN:NE2	3:D:304:HOH:O	2.29	0.65
2:D:34:ARG:HD3	3:D:327:HOH:O	1.96	0.65
1:C:50:PRO:O	3:C:101:HOH:O	2.14	0.64
2:B:61:PRO:HB3	2:B:99:PHE:CD2	2.34	0.62
2:B:176:LYS:HE3	3:B:356:HOH:O	1.99	0.61
2:B:197:GLU:OE1	1:C:81:HIS:CE1	2.55	0.60
2:B:197:GLU:OE1	1:C:81:HIS:HE1	1.86	0.59
1:C:12:THR:HG23	1:C:15:ALA:H	1.69	0.58
2:D:141:ASN:OD1	2:D:143:LYS:HE3	2.03	0.58
2:D:60:ALA:HB1	2:D:61:PRO:HD2	1.84	0.58
2:D:39:VAL:HG22	2:D:45:GLN:O	2.06	0.55
2:D:170:SER:HB2	3:D:302:HOH:O	2.07	0.55
2:B:4:LEU:HD21	2:B:109:GLN:HB2	1.89	0.55
2:B:34:ARG:NH1	2:B:104:SER:O	2.43	0.52
2:B:14:ASP:O	3:B:302:HOH:O	2.19	0.52
2:D:41:ARG:NH1	3:D:309:HOH:O	2.43	0.52
2:B:57:ASP:CG	3:B:301:HOH:O	2.44	0.52
2:B:113:VAL:HA	3:B:318:HOH:O	2.10	0.51
2:B:138:VAL:HG11	2:B:149:LEU:HD22	1.93	0.51
2:D:188:ARG:NH2	3:D:310:HOH:O	2.44	0.51
2:D:122:GLU:H	2:D:122:GLU:CD	2.13	0.51
2:B:158:PRO:HB2	2:B:185:VAL:HG11	1.92	0.51
2:D:96:VAL:HG11	2:D:99:PHE:CZ	2.46	0.51
2:B:17:VAL:O	2:B:69:VAL:HG21	2.12	0.50
2:D:199:GLU:OE1	3:D:302:HOH:O	2.19	0.50
2:B:176:LYS:CE	3:B:356:HOH:O	2.57	0.50
2:D:35:ALA:HB2	2:D:105:TYR:HB2	1.93	0.49
2:D:39:VAL:CG2	2:D:45:GLN:O	2.60	0.49
2:D:137:TYR:HA	2:D:200:ILE:HD11	1.94	0.49
2:B:63:ASP:HB2	3:B:308:HOH:O	2.11	0.49
2:B:73:VAL:HG13	2:B:86:VAL:HG22	1.93	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:5:ARG:O	2:B:109:GLN:HA	2.12	0.49
2:B:3:GLU:N	2:B:112:GLU:OE1	2.47	0.48
2:D:113:VAL:HG13	2:D:115:GLU:HG3	1.96	0.48
2:B:42:GLY:HA3	3:B:325:HOH:O	2.14	0.48
2:D:113:VAL:HG13	2:D:115:GLU:HB2	1.95	0.47
2:B:197:GLU:OE2	2:B:201:SER:HB2	2.14	0.47
2:B:40:MET:HG3	2:B:76:LEU:HD13	1.98	0.45
2:D:118:GLY:HA2	3:D:362:HOH:O	2.15	0.45
2:D:3:GLU:HG3	2:D:4:LEU:HG	1.98	0.45
1:A:55:TYR:OH	3:B:301:HOH:O	2.16	0.44
1:C:59:ARG:HB3	1:C:61:ASP:OD1	2.17	0.44
2:D:5:ARG:O	2:D:109:GLN:HA	2.17	0.44
2:D:113:VAL:CG1	2:D:115:GLU:HB2	2.47	0.44
2:B:149:LEU:HD12	3:B:379:HOH:O	2.17	0.43
2:B:201:SER:C	2:B:203:LEU:H	2.21	0.43
1:C:12:THR:HG22	1:C:15:ALA:CB	2.49	0.43
1:A:44:GLU:HG2	3:A:147:HOH:O	2.17	0.43
2:D:44:LYS:NZ	3:D:303:HOH:O	2.22	0.43
1:A:70:ASP:OD1	1:A:73:THR:OG1	2.31	0.42
2:D:137:TYR:CA	2:D:200:ILE:HD11	2.49	0.42
2:B:31:LYS:HB2	3:B:314:HOH:O	2.19	0.42
2:B:86:VAL:HG13	2:B:88:VAL:HG13	2.01	0.42
2:B:130:VAL:CG1	2:B:165:ILE:HD12	2.49	0.42
2:B:176:LYS:CD	3:B:356:HOH:O	2.68	0.42
1:A:32:ALA:HA	1:A:35:ILE:HD12	2.00	0.42
2:D:8:PRO:HG2	2:D:39:VAL:HG23	2.01	0.42
2:D:21:MET:CE	2:D:164:SER:HA	2.50	0.42
1:A:33:ALA:HB1	3:A:118:HOH:O	2.19	0.42
1:A:16:PHE:HE1	2:B:87:LEU:HB2	1.84	0.41
1:A:35:ILE:HG22	1:A:43:VAL:HG11	2.02	0.41
2:B:39:VAL:HG22	2:B:45:GLN:O	2.20	0.41
2:B:124:GLU:HG2	2:B:128:ARG:HH12	1.85	0.41
1:C:30:ILE:HG22	1:C:35:ILE:HG13	2.02	0.41
2:D:100:THR:OG1	2:D:107:GLU:OE1	2.35	0.41
2:D:182:ILE:O	2:D:188:ARG:HD3	2.20	0.41
2:D:5:ARG:HG2	2:D:6:THR:N	2.35	0.41
2:D:17:VAL:O	2:D:69:VAL:HG21	2.20	0.41
2:D:158:PRO:HB3	2:D:189:LEU:HD11	2.03	0.41
1:C:44:GLU:OE1	1:C:44:GLU:HA	2.20	0.40

All (1) 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)
3:A:116:HOH:O	3:D:372:HOH:O[2_544]	2.15	0.05

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	80/95 (84%)	79 (99%)	1 (1%)	0	100 100
1	C	81/95 (85%)	78 (96%)	3 (4%)	0	100 100
2	B	201/206 (98%)	192 (96%)	8 (4%)	1 (0%)	25 32
2	D	197/206 (96%)	190 (96%)	5 (2%)	2 (1%)	13 15
All	All	559/602 (93%)	539 (96%)	17 (3%)	3 (0%)	25 32

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	D	115	GLU
2	B	100	THR
2	D	200	ILE

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	61/74 (82%)	60 (98%)	1 (2%)	58 74
1	C	62/74 (84%)	62 (100%)	0	100 100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
2	B	172/175 (98%)	166 (96%)	6 (4%)	31 46
2	D	168/175 (96%)	164 (98%)	4 (2%)	44 61
All	All	463/498 (93%)	452 (98%)	11 (2%)	44 61

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	SER
2	B	16	VAL
2	B	39	VAL
2	B	56	ASP
2	B	63	ASP
2	B	86	VAL
2	B	202	VAL
2	D	102	GLN
2	D	103	GLU
2	D	115	GLU
2	D	122	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	81	HIS
2	D	102	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

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	82/95 (86%)	-0.51	0 100 100	12, 23, 47, 66	0
1	C	83/95 (87%)	-0.50	3 (3%) 46 48	6, 16, 61, 164	0
2	B	203/206 (98%)	-0.25	8 (3%) 44 45	9, 25, 68, 110	0
2	D	199/206 (96%)	-0.00	16 (8%) 20 21	13, 31, 100, 128	0
All	All	567/602 (94%)	-0.24	27 (4%) 36 37	6, 26, 75, 164	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	113	VAL	4.8
2	D	200	ILE	4.3
2	D	101	ASP	4.2
2	B	205	VAL	4.1
2	D	99	PHE	3.8
2	D	100	THR	3.8
2	D	106	TYR	3.7
2	D	114	SER	3.6
2	B	202	VAL	3.6
2	D	112	GLU	3.3
2	D	97	VAL	3.3
2	B	199	GLU	3.2
1	C	7	HIS	3.1
2	D	117	ASP	3.0
2	D	103	GLU	3.0
2	B	119	ALA	2.8
2	B	198	GLY	2.8
2	D	3	GLU	2.7
1	C	9	ARG	2.7
2	B	200	ILE	2.7
1	C	8	SER	2.6

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Mol	Chain	Res	Type	RSRZ
2	B	103	GLU	2.5
2	D	115	GLU	2.4
2	D	201	SER	2.4
2	D	102	GLN	2.3
2	D	116	ASP	2.2
2	B	118	GLY	2.1

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.