



Full wwPDB X-ray Structure Validation Report

Feb 27, 2014 – 08:32 PM GMT

PDB ID : 2R28
Title : The complex Structure of Calmodulin Bound to a Calcineurin Peptide
Authors : Ye, Q.; Zheng, J.; Jia, Z.
Deposited on : 2007-08-24
Resolution : 1.86 Å(reported)

This is a full wwPDB validation report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

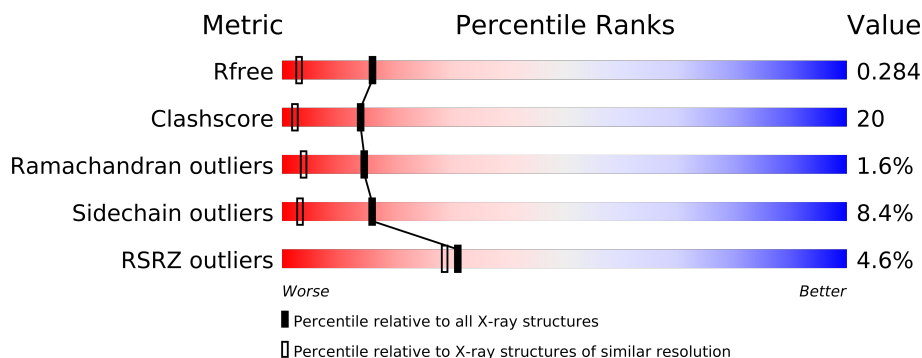
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 1.86 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}	66092	1269 (1.86-1.86)
Clashscore	79885	1470 (1.86-1.86)
Ramachandran outliers	78287	1451 (1.86-1.86)
Sidechain outliers	78261	1451 (1.86-1.86)
RSRZ outliers	66119	1269 (1.86-1.86)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	149	
1	B	149	
2	C	25	
2	D	25	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2803 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Calmodulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	143	Total	C	N	O	S	0	0	0
			1126	690	181	246	9			
1	B	144	Total	C	N	O	S	0	0	0
			1134	696	182	247	9			

- Molecule 2 is a protein called Serine/threonine-proteinphosphatase 2B catalytic subunit alpha isoform.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	15	Total	C	N	O	S	0	0	0
			123	79	27	16	1			
2	D	19	Total	C	N	O	S	0	0	0
			154	98	32	23	1			

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	4	Total	Ca	0	0
			4	4		
3	A	4	Total	Ca	0	0
			4	4		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	138	Total	O	0	0
			138	138		
4	C	5	Total	O	0	0
			5	5		
4	B	112	Total	O	0	0
			112	112		

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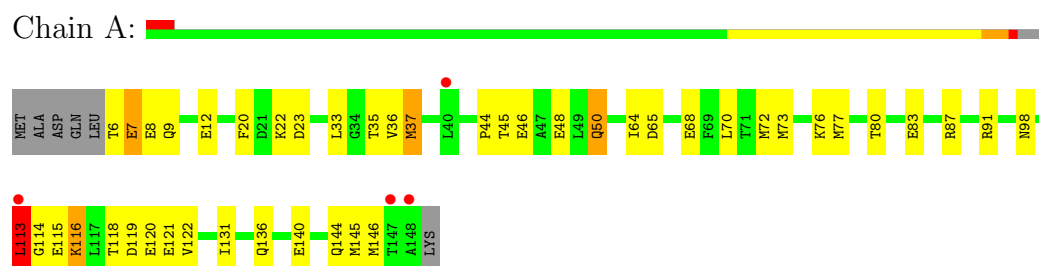
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	D	3	Total	O	0	0
			3	3		

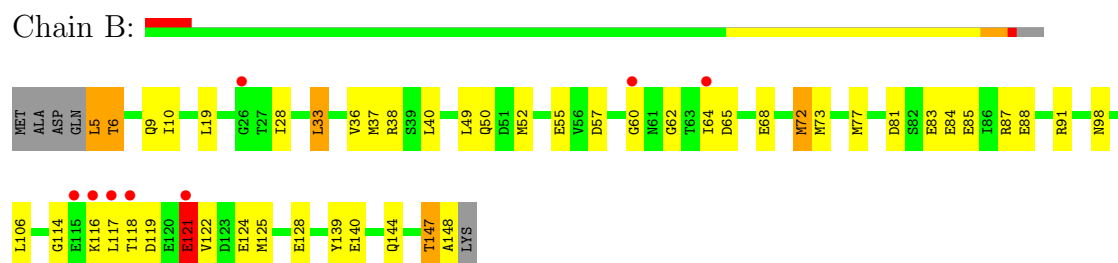
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: Calmodulin



- Molecule 1: Calmodulin



- Molecule 2: Serine/threonine-proteinphosphatase 2B catalytic subunit alpha isoform



- Molecule 2: Serine/threonine-proteinphosphatase 2B catalytic subunit alpha isoform



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	120.70Å 43.20Å 70.90Å 90.00° 109.90° 90.00°	Depositor
Resolution (Å)	66.67 – 1.86 28.46 – 1.85	Depositor EDS
% Data completeness (in resolution range)	(Not available) (66.67-1.86) 93.7 (28.46-1.85)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.37 (at 1.85Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.230 , 0.280 0.239 , 0.284	Depositor DCC
R_{free} test set	1397 reflections (5.32%)	DCC
Wilson B-factor (Å ²)	32.5	Xtriage
Anisotropy	0.027	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 52.8	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 27639 reflections	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2803	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.04% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CA

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	0.99	0/1138	0.93	2/1528 (0.1%)
1	B	0.82	0/1146	0.90	2/1539 (0.1%)
2	C	0.64	0/123	0.77	0/160
2	D	0.68	0/154	0.81	0/201
All	All	0.89	0/2561	0.90	4/3428 (0.1%)

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	B	0	2

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	72	MET	CG-SD-CE	-5.83	90.88	100.20
1	A	113	LEU	CA-CB-CG	5.53	128.01	115.30
1	B	33	LEU	CA-CB-CG	5.49	127.93	115.30
1	A	23	ASP	CB-CG-OD2	5.11	122.90	118.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	118	THR	Peptide
1	B	121	GLU	Peptide

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1126	0	1052	42	0
1	B	1134	0	1063	42	0
2	C	123	0	143	12	0
2	D	154	0	176	20	0
3	A	4	0	0	0	0
3	B	4	0	0	0	0
4	A	138	0	0	13	0
4	B	112	0	0	11	0
4	C	5	0	0	1	0
4	D	3	0	0	2	0
All	All	2803	0	2434	99	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 20.

All (99) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:91:ARG:HB2	4:B:1080:HOH:O	1.46	1.17
1:A:140:GLU:HG2	4:A:1056:HOH:O	1.47	1.14
1:A:8:GLU:HA	4:A:1116:HOH:O	1.54	1.03
1:A:108:HIS:HB2	4:A:1118:HOH:O	1.61	0.98
4:A:1114:HOH:O	2:D:399:LYS:HD3	1.63	0.97
1:A:140:GLU:HG2	4:A:1019:HOH:O	1.66	0.96
2:D:407:ALA:O	2:D:411:SER:HB3	1.63	0.96
1:B:38:ARG:NH1	4:B:1074:HOH:O	1.99	0.94
1:A:73:MET:HG3	4:A:1117:HOH:O	1.76	0.86
1:A:118:THR:HG21	4:A:1096:HOH:O	1.77	0.83
1:A:7:GLU:HG3	1:A:9:GLN:HG3	1.61	0.81
2:D:393:LYS:HD2	2:D:394:GLU:H	1.46	0.80
1:A:77:MET:SD	4:A:1132:HOH:O	2.44	0.75
1:B:84:GLU:HG2	4:B:1042:HOH:O	1.87	0.73
2:C:410:PHE:HZ	1:B:73:MET:HE3	1.54	0.72
1:B:84:GLU:OE1	2:D:408:ARG:NH2	2.22	0.72
2:C:410:PHE:HZ	1:B:73:MET:CE	2.04	0.71

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:45:THR:HG23	1:A:48:GLU:H	1.56	0.71
1:A:73:MET:CE	2:D:410:PHE:HZ	2.04	0.71
1:A:46:GLU:O	1:A:50:GLN:HG2	1.92	0.70
2:D:405:LYS:NZ	4:D:414:HOH:O	2.09	0.70
1:A:73:MET:HE3	2:D:410:PHE:HZ	1.56	0.69
1:A:20:PHE:HA	1:A:36:VAL:HG21	1.75	0.68
1:B:73:MET:HG3	4:B:1083:HOH:O	1.92	0.68
1:B:121:GLU:HG2	1:B:124:GLU:HB3	1.76	0.67
1:A:140:GLU:CG	4:A:1019:HOH:O	2.33	0.64
2:D:405:LYS:CE	4:D:414:HOH:O	2.45	0.63
1:B:5:LEU:HD12	1:B:9:GLN:NE2	2.15	0.62
1:B:85:GLU:OE1	4:B:1071:HOH:O	2.16	0.60
1:A:115:GLU:HA	1:A:115:GLU:OE1	2.01	0.60
2:D:395:VAL:O	2:D:398:ASN:HB2	2.01	0.59
2:C:410:PHE:CZ	1:B:73:MET:HE3	2.36	0.59
1:A:145:MET:SD	1:A:146:MET:CE	2.91	0.58
1:A:146:MET:HE3	2:C:400:ILE:HG21	1.85	0.58
1:A:22:LYS:HE3	1:A:35:THR:HG21	1.87	0.57
1:B:88:GLU:HG3	1:B:91:ARG:HH11	1.71	0.56
2:D:397:ARG:O	2:D:401:ARG:HG3	2.05	0.56
1:B:88:GLU:HG2	2:D:407:ALA:CB	2.36	0.55
1:A:145:MET:SD	1:A:146:MET:HE2	2.47	0.55
1:B:33:LEU:HB3	1:B:49:LEU:HD22	1.89	0.55
1:B:140:GLU:HG3	4:B:1019:HOH:O	2.06	0.55
2:C:408:ARG:C	2:C:408:ARG:HD3	2.28	0.55
1:B:91:ARG:CG	4:B:1080:HOH:O	2.54	0.54
2:C:410:PHE:CZ	1:B:73:MET:CE	2.86	0.54
1:A:37:MET:HG2	1:A:44:PRO:HG3	1.89	0.54
2:C:402:ALA:HA	2:C:405:LYS:HE3	1.90	0.53
1:B:28:ILE:HB	1:B:64:ILE:HB	1.90	0.53
1:B:65:ASP:OD1	1:B:68:GLU:HG3	2.09	0.52
1:B:116:LYS:HG3	1:B:116:LYS:O	2.10	0.51
1:B:5:LEU:O	1:B:9:GLN:OE1	2.28	0.51
2:C:408:ARG:NH1	4:C:416:HOH:O	2.44	0.49
1:A:45:THR:CG2	1:A:48:GLU:H	2.25	0.49
2:C:408:ARG:NH2	2:D:408:ARG:HH22	2.11	0.48
1:A:87:ARG:HD3	4:A:1073:HOH:O	2.12	0.48
1:B:88:GLU:HG2	2:D:407:ALA:HB1	1.97	0.47
1:B:114:GLY:C	1:B:116:LYS:H	2.18	0.47
1:A:131:ILE:HD11	4:A:1121:HOH:O	2.15	0.47
1:B:77:MET:HE2	4:B:1091:HOH:O	2.14	0.47
1:B:117:LEU:HB2	1:B:125:MET:HE1	1.97	0.47

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
2:D:393:LYS:CD	2:D:394:GLU:H	2.19	0.46
1:A:118:THR:HG23	1:A:121:GLU:H	1.80	0.46
2:D:396:ILE:O	2:D:400:ILE:HG13	2.16	0.46
1:B:36:VAL:O	1:B:40:LEU:HG	2.15	0.46
1:A:145:MET:SD	1:A:146:MET:HE1	2.55	0.46
1:A:73:MET:CE	2:D:410:PHE:CZ	2.91	0.46
1:B:139:TYR:OH	4:B:1064:HOH:O	2.12	0.46
1:B:121:GLU:HA	4:B:1060:HOH:O	2.15	0.46
1:A:65:ASP:OD1	1:A:68:GLU:HG3	2.16	0.45
1:A:119:ASP:HA	1:A:122:VAL:HG22	1.99	0.45
1:B:121:GLU:O	1:B:121:GLU:HG2	2.16	0.44
2:C:410:PHE:HZ	1:B:73:MET:HE1	1.82	0.44
1:B:88:GLU:HG2	2:D:407:ALA:HB3	2.00	0.44
1:A:113:LEU:O	4:A:1095:HOH:O	2.21	0.44
1:A:9:GLN:O	1:A:12:GLU:HB2	2.18	0.43
2:C:408:ARG:HH21	2:D:408:ARG:HH22	1.66	0.43
1:B:6:THR:O	1:B:10:ILE:HG12	2.18	0.43
4:B:1071:HOH:O	2:D:408:ARG:NE	2.51	0.43
2:C:408:ARG:NH2	1:B:81:ASP:OD2	2.45	0.43
1:A:80:THR:HA	1:A:83:GLU:HG2	2.00	0.43
1:A:118:THR:HG23	1:A:120:GLU:N	2.34	0.43
1:B:72:MET:HG2	1:B:73:MET:CE	2.48	0.43
1:A:6:THR:O	1:A:9:GLN:OE1	2.37	0.43
1:A:145:MET:CE	1:A:146:MET:HE2	2.50	0.42
1:A:118:THR:CG2	1:A:121:GLU:H	2.32	0.42
1:B:124:GLU:OE1	1:B:128:GLU:OE1	2.37	0.42
1:A:87:ARG:HB2	1:A:87:ARG:NH2	2.35	0.42
1:B:147:THR:O	1:B:148:ALA:HB3	2.20	0.42
1:A:22:LYS:HD2	1:A:35:THR:HG21	2.00	0.42
1:A:64:ILE:CD1	1:A:72:MET:CE	2.98	0.42
1:A:76:LYS:HB3	2:D:409:VAL:CG1	2.49	0.42
1:B:83:GLU:OE2	1:B:87:ARG:NH2	2.53	0.42
1:B:57:ASP:OD1	1:B:62:GLY:N	2.50	0.42
1:B:73:MET:O	1:B:77:MET:HG3	2.21	0.41
1:A:111:THR:O	1:A:114:GLY:N	2.44	0.41
1:B:106:LEU:HG	1:B:122:VAL:HG13	2.03	0.41
1:B:5:LEU:O	1:B:9:GLN:HB2	2.21	0.41
1:A:116:LYS:HD2	1:A:116:LYS:HA	1.65	0.41
1:B:52:MET:HE2	1:B:72:MET:HE2	2.03	0.40
1:A:131:ILE:CD1	4:A:1121:HOH:O	2.68	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone ⓘ

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	141/149 (95%)	133 (94%)	7 (5%)	1 (1%)	30	12
1	B	142/149 (95%)	131 (92%)	7 (5%)	4 (3%)	8	1
2	C	13/25 (52%)	13 (100%)	0	0	100	100
2	D	17/25 (68%)	17 (100%)	0	0	100	100
All	All	313/348 (90%)	294 (94%)	14 (4%)	5 (2%)	14	4

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	60	GLY
1	B	6	THR
1	B	121	GLU
1	B	119	ASP
1	A	7	GLU

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	122/127 (96%)	112 (92%)	10 (8%)	17	3
1	B	123/127 (97%)	115 (94%)	8 (6%)	24	7
2	C	12/19 (63%)	9 (75%)	3 (25%)	1	0
2	D	16/19 (84%)	14 (88%)	2 (12%)	7	1
All	All	273/292 (94%)	250 (92%)	23 (8%)	16	3

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	LEU
1	A	37	MET
1	A	50	GLN
1	A	70	LEU
1	A	91	ARG
1	A	98	ASN
1	A	113	LEU
1	A	116	LYS
1	A	136	GLN
1	A	144	GLN
2	C	396	ILE
2	C	401	ARG
2	C	408	ARG
1	B	5	LEU
1	B	19	LEU
1	B	37	MET
1	B	50	GLN
1	B	55	GLU
1	B	98	ASN
1	B	144	GLN
1	B	147	THR
2	D	393	LYS
2	D	396	ILE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	43	ASN
1	A	98	ASN
1	A	144	GLN
1	B	50	GLN
1	B	98	ASN
1	B	112	ASN
1	B	136	GLN
1	B	144	GLN

5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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, 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	143/149 (95%)	0.27	5 (3%) 42 39	21, 33, 51, 61	0
1	B	144/149 (96%)	0.50	8 (5%) 24 21	22, 40, 64, 78	0
2	C	15/25 (60%)	0.66	0 100 100	33, 44, 54, 55	0
2	D	19/25 (76%)	0.97	2 (10%) 7 7	30, 45, 65, 67	0
All	All	321/348 (92%)	0.44	15 (4%) 31 28	21, 36, 59, 78	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	117	LEU	7.1
1	A	147	THR	4.3
2	D	393	LYS	3.9
1	B	60	GLY	3.5
1	A	148	ALA	3.5
1	A	113	LEU	3.3
1	B	116	LYS	3.2
1	B	64	ILE	2.9
1	B	118	THR	2.8
2	D	396	ILE	2.4
1	B	115	GLU	2.4
1	A	40	LEU	2.3
1	A	112	ASN	2.2
1	B	26	GLY	2.1
1	B	121	GLU	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no carbohydrates in this entry.

6.4 Ligands

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSR	LLDF	B-factors(Å ²)	Q<0.9
3	CA	A	1003	1/1	0.10	0.08	23,23,23,23	0
3	CA	A	1004	1/1	0.08	-0.55	21,21,21,21	0
3	CA	B	1003	1/1	0.08	-0.66	24,24,24,24	0
3	CA	B	1004	1/1	0.09	-0.85	22,22,22,22	0
3	CA	A	1001	1/1	0.08	-1.27	26,26,26,26	0
3	CA	B	1001	1/1	0.07	-2.04	50,50,50,50	0
3	CA	B	1002	1/1	0.06	-2.42	42,42,42,42	0
3	CA	A	1002	1/1	0.04	-2.92	30,30,30,30	0

6.5 Other polymers

There are no such residues in this entry.