



Full wwPDB X-ray Structure Validation Report

Feb 27, 2014 – 09:33 AM GMT

PDB ID : 4DS7
Title : Crystal structure of yeast calmodulin bound to the C-terminal fragment of spindle pole body protein Spc110
Authors : Klenchin, V.A.; Rayment, I.
Deposited on : 2012-02-18
Resolution : 2.15 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>

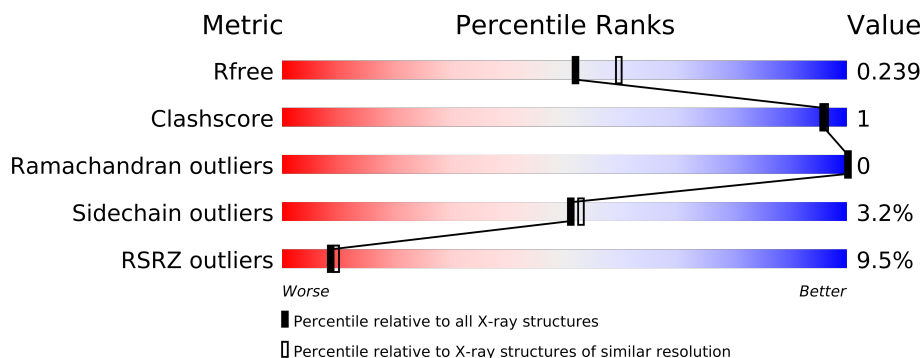
The following versions of software and data (see [references](#)) were used in the production of this report:

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 2.15 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	1094 (2.18-2.14)
Clashscore	79885	1299 (2.18-2.14)
Ramachandran outliers	78287	1272 (2.18-2.14)
Sidechain outliers	78261	1272 (2.18-2.14)
RSRZ outliers	66119	1094 (2.18-2.14)

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	147	
1	B	147	
1	C	147	
1	D	147	
2	E	55	
2	F	55	
2	G	55	
2	H	55	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
4	GOL	B	203	-	X

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Mol	Type	Chain	Res	Geometry	Electron density
4	GOL	B	204	-	X

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 5926 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	144	Total	C	N	O	S	0	0	0
			1093	679	174	235	5			
1	B	142	Total	C	N	O	S	0	0	0
			1076	671	173	227	5			
1	C	143	Total	C	N	O	S	0	0	0
			1086	676	172	233	5			
1	D	143	Total	C	N	O	S	0	0	0
			1078	671	171	231	5			

- Molecule 2 is a protein called Spindle pole body component 110.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	46	Total	C	N	O	S	0	0	0
			361	234	71	54	2			
2	F	39	Total	C	N	O	S	0	0	0
			316	201	63	50	2			
2	G	36	Total	C	N	O	S	0	0	0
			289	186	54	47	2			
2	H	44	Total	C	N	O	S	0	0	0
			330	215	61	52	2			

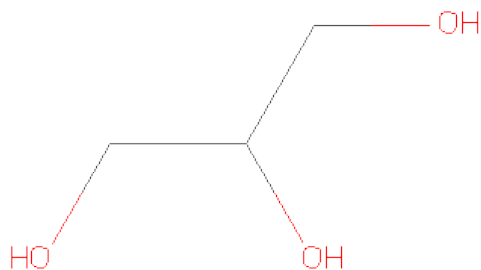
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	890	GLY	-	EXPRESSION TAG	UNP P32380
F	890	GLY	-	EXPRESSION TAG	UNP P32380
G	890	GLY	-	EXPRESSION TAG	UNP P32380
H	890	GLY	-	EXPRESSION TAG	UNP P32380

- Molecule 3 is STRONTIUM ION (three-letter code: SR) (formula: Sr).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total 2	Sr 2	0	0
3	A	2	Total 2	Sr 2	0	0
3	D	2	Total 2	Sr 2	0	0
3	C	2	Total 2	Sr 2	0	0

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total 6	C 3	O 3	0	0
4	B	1	Total 6	C 3	O 3	0	0
4	B	1	Total 6	C 3	O 3	0	0
4	B	1	Total 6	C 3	O 3	0	0

- Molecule 5 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	69	Total	O	0	0
			69	69		
6	B	50	Total	O	0	0
			50	50		
6	C	65	Total	O	0	0
			65	65		
6	D	51	Total	O	0	0
			51	51		
6	E	8	Total	O	0	0
			8	8		
6	F	9	Total	O	0	0
			9	9		
6	G	5	Total	O	0	0
			5	5		
6	H	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.

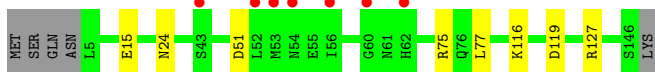
- Molecule 1: Calmodulin

Chain A: 



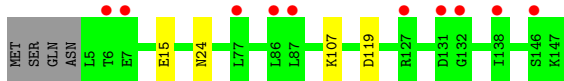
- Molecule 1: Calmodulin

Chain B: 



- Molecule 1: Calmodulin

Chain C: 



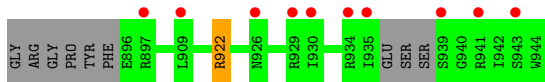
- Molecule 1: Calmodulin

Chain D: 



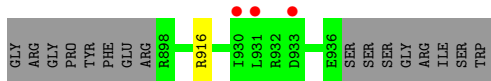
- Molecule 2: Spindle pole body component 110

Chain E: 

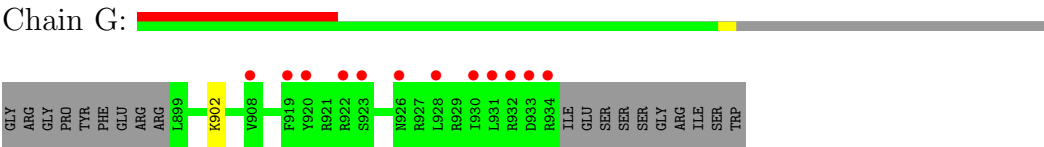


- Molecule 2: Spindle pole body component 110

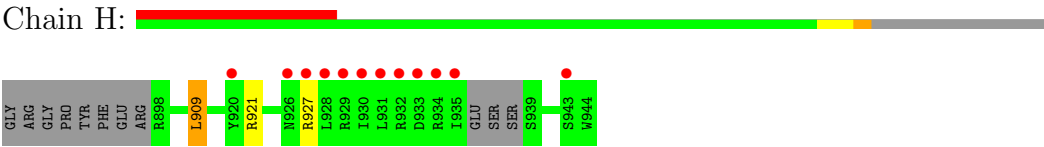
Chain F: 



● Molecule 2: Spindle pole body component 110



● Molecule 2: Spindle pole body component 110



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	114.67Å 145.44Å 49.84Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.15 29.72 – 2.13	Depositor EDS
% Data completeness (in resolution range)	99.9 (30.00-2.15) 99.0 (29.72-2.13)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.28 (at 2.14Å)	Xtriage
Refinement program	REFMAC 5.5.0088	Depositor
R, R_{free}	0.197 , 0.240 0.199 , 0.239	Depositor DCC
R_{free} test set	2374 reflections (5.32%)	DCC
Wilson B-factor (Å ²)	32.8	Xtriage
Anisotropy	0.393	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 50.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 47015 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5926	wwPDB-VP
Average B, all atoms (Å ²)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 20.97 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 7.7470e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: GOL, SO4, SR

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	0.47	0/1103	0.51	0/1483
1	B	0.44	0/1086	0.50	0/1460
1	C	0.43	0/1096	0.50	0/1473
1	D	0.44	0/1088	0.52	0/1464
2	E	0.40	0/364	0.50	0/487
2	F	0.44	0/318	0.51	0/425
2	G	0.36	0/291	0.48	0/389
2	H	0.40	0/333	0.54	1/447 (0.2%)
All	All	0.44	0/5679	0.51	1/7628 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	H	909	LEU	CA-CB-CG	5.39	127.69	115.30

There are no chirality outliers.

There are no planarity outliers.

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	1093	0	0	0	0
1	B	1076	0	0	2	0
1	C	1086	0	0	1	0
1	D	1078	0	0	3	0
2	E	361	0	3	1	0
2	F	316	0	0	0	0
2	G	289	0	0	0	0
2	H	330	0	0	3	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	2	0	0	0	0
4	A	6	0	8	0	0
4	B	18	0	24	2	0
5	A	5	0	0	0	0
6	A	69	0	0	0	0
6	B	50	0	0	0	0
6	C	65	0	0	0	0
6	D	51	0	0	0	0
6	E	8	0	0	0	0
6	F	9	0	0	0	0
6	G	5	0	0	0	0
6	H	3	0	0	0	0
All	All	5926	0	35	7	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 1.

All (7) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:D:55:GLU:OE2	2:H:921:ARG:NE	1.96	0.98
1:D:55:GLU:CD	2:H:921:ARG:NE	2.18	0.97
2:E:922:ARG:NH1	2:E:922:ARG:CG	2.62	0.62
1:D:55:GLU:OE1	2:H:921:ARG:NE	2.33	0.60
1:C:107:LYS:NZ	1:C:119:ASP:OD1	2.52	0.43
1:B:116:LYS:N	4:B:204:GOL:H32	2.34	0.42
1:B:119:ASP:N	4:B:203:GOL:HO1	2.19	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	142/147 (97%)	140 (99%)	2 (1%)	0	100	100
1	B	140/147 (95%)	136 (97%)	4 (3%)	0	100	100
1	C	141/147 (96%)	138 (98%)	3 (2%)	0	100	100
1	D	141/147 (96%)	140 (99%)	1 (1%)	0	100	100
2	E	42/55 (76%)	39 (93%)	3 (7%)	0	100	100
2	F	37/55 (67%)	37 (100%)	0	0	100	100
2	G	34/55 (62%)	34 (100%)	0	0	100	100
2	H	40/55 (73%)	38 (95%)	2 (5%)	0	100	100
All	All	717/808 (89%)	702 (98%)	15 (2%)	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	118/124 (95%)	115 (98%)	3 (2%)	60	64
1	B	117/124 (94%)	111 (95%)	6 (5%)	33	29
1	C	117/124 (94%)	115 (98%)	2 (2%)	73	79
1	D	115/124 (93%)	112 (97%)	3 (3%)	59	62
2	E	34/49 (69%)	33 (97%)	1 (3%)	55	57
2	F	32/49 (65%)	31 (97%)	1 (3%)	52	54
2	G	30/49 (61%)	29 (97%)	1 (3%)	50	51
2	H	28/49 (57%)	26 (93%)	2 (7%)	21	16

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	591/692 (85%)	572 (97%)	19 (3%)	51 53

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	GLU
1	A	91	LYS
1	A	144	LEU
1	B	15	GLU
1	B	24	ASN
1	B	51	ASP
1	B	75	ARG
1	B	77	LEU
1	B	127	ARG
1	C	15	GLU
1	C	24	ASN
1	D	62	HIS
1	D	125	MET
1	D	127	ARG
2	E	922	ARG
2	F	916	ARG
2	G	902	LYS
2	H	909	LEU
2	H	927	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 13 ligands modelled in this entry, 8 are monoatomic - leaving 5 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	GOL	A	203	-	5,5,5	0.34	0	5,5,5	0.34	0
5	SO4	A	204	-	4,4,4	0.18	0	6,6,6	0.10	0
4	GOL	B	203	-	5,5,5	0.33	0	5,5,5	0.17	0
4	GOL	B	204	-	5,5,5	0.32	0	5,5,5	0.26	0
4	GOL	B	205	-	5,5,5	0.33	0	5,5,5	0.36	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	GOL	A	203	-	-	0/4/4/4	0/0/0/0
5	SO4	A	204	-	-	0/0/0/0	0/0/0/0
4	GOL	B	203	-	-	0/4/4/4	0/0/0/0
4	GOL	B	204	-	-	0/4/4/4	0/0/0/0
4	GOL	B	205	-	-	0/4/4/4	0/0/0/0

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	144/147 (97%)	0.23	7 (4%)	28 32	20, 33, 57, 90	2 (1%)
1	B	142/147 (96%)	0.26	7 (4%)	28 32	23, 42, 74, 84	2 (1%)
1	C	143/147 (97%)	0.33	10 (6%)	16 19	20, 39, 69, 104	5 (3%)
1	D	143/147 (97%)	0.30	10 (6%)	16 19	20, 42, 66, 88	4 (2%)
2	E	46/55 (83%)	1.09	10 (21%)	1 1	22, 59, 94, 97	7 (15%)
2	F	39/55 (70%)	0.74	3 (7%)	13 16	19, 41, 69, 77	2 (5%)
2	G	36/55 (65%)	1.49	12 (33%)	1 1	28, 52, 94, 116	1 (2%)
2	H	44/55 (80%)	1.17	12 (27%)	1 1	22, 60, 102, 123	3 (6%)
All	All	737/808 (91%)	0.47	71 (9%)	8 9	19, 40, 84, 123	26 (3%)

All (71) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	H	933	ASP	5.6
1	C	132	GLY	5.2
2	F	930	ILE	5.1
2	G	920	TYR	4.7
2	H	935	ILE	4.7
1	C	7	GLU	4.7
2	H	929	ARG	4.4
2	H	943	SER	4.3
2	E	930	ILE	4.3
1	D	132	GLY	4.3
2	E	897	ARG	4.1
2	G	930	ILE	4.1
2	G	926	ASN	4.1
2	G	933	ASP	4.0
1	D	131	ASP	3.9
1	B	56	ILE	3.9

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Mol	Chain	Res	Type	RSRZ
2	G	934	ARG	3.8
1	B	60	GLY	3.7
1	C	131	ASP	3.6
2	H	932	ARG	3.5
1	B	54	ASN	3.5
2	E	935	ILE	3.5
2	F	931	LEU	3.5
1	B	62	HIS	3.4
2	G	928	LEU	3.4
2	H	926	ASN	3.4
1	A	147	LYS	3.4
2	E	943	SER	3.3
2	G	923	SER	3.3
1	A	131	ASP	3.3
2	H	928	LEU	3.2
1	B	43	SER	3.2
1	D	147	LYS	3.2
1	D	138	ILE	3.2
2	H	927	ARG	3.1
2	E	926	ASN	3.1
2	H	931	LEU	3.0
2	G	931	LEU	2.9
2	G	919	PHE	2.8
2	G	922	ARG	2.8
1	A	7	GLU	2.8
1	C	86	LEU	2.7
2	F	933	ASP	2.6
2	H	930	ILE	2.6
2	E	941	ARG	2.6
1	D	145	LEU	2.5
1	D	142	ALA	2.5
2	G	932	ARG	2.5
2	E	929	ARG	2.4
1	A	8	GLU	2.4
1	A	86	LEU	2.4
1	B	52	LEU	2.4
2	G	908	VAL	2.4
1	A	4	ASN	2.4
1	D	5	LEU	2.4
1	B	53	MET	2.3
2	E	909	LEU	2.2
2	E	934	ARG	2.2

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Mol	Chain	Res	Type	RSRZ
1	D	141	PHE	2.2
1	C	77	LEU	2.2
1	C	6	THR	2.2
1	C	87	LEU	2.1
1	D	127	ARG	2.1
1	C	138	ILE	2.1
1	D	86	LEU	2.1
2	H	934	ARG	2.1
2	E	939	SER	2.1
1	A	87	LEU	2.0
2	H	920	TYR	2.0
1	C	127	ARG	2.0
1	C	146	SER	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
4	GOL	B	203	6/6	0.19	6.53	52,60,63,65	0
4	GOL	B	204	6/6	0.14	4.12	35,50,53,57	0
4	GOL	B	205	6/6	0.16	1.01	61,68,69,70	0
3	SR	D	201	1/1	0.07	-1.16	26,26,26,26	0
3	SR	B	202	1/1	0.05	-1.37	53,53,53,53	0
3	SR	D	202	1/1	0.04	-1.37	67,67,67,67	0
3	SR	A	201	1/1	0.07	-1.47	24,24,24,24	0
3	SR	C	201	1/1	0.03	-1.99	49,49,49,49	0

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Mol	Type	Chain	Res	Atoms	RSR	LLDF	B-factors(\AA^2)	Q<0.9
3	SR	C	202	1/1	0.05	-2.16	44,44,44,44	0
3	SR	B	201	1/1	0.03	-2.39	50,50,50,50	0
3	SR	A	202	1/1	0.03	-2.82	48,48,48,48	0
5	SO4	A	204	5/5	0.05	-4.76	50,53,56,58	0
4	GOL	A	203	6/6	0.21	-	74,75,75,76	0

6.5 Other polymers ⓘ

There are no such residues in this entry.