wwPDB X-ray Structure Validation Summary Report (i)

May 20, 2021 – 02:02 PM EDT

PDB ID	:	4HBQ
Title	:	Crystal structure of a loop deleted mutant of Human MAdCAM-1 D1D2
Authors	:	Springer, T.; Yu, Y.; Zhu, J.
Deposited on	:	2012-09-28
Resolution	:	1.40 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) symbol.

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

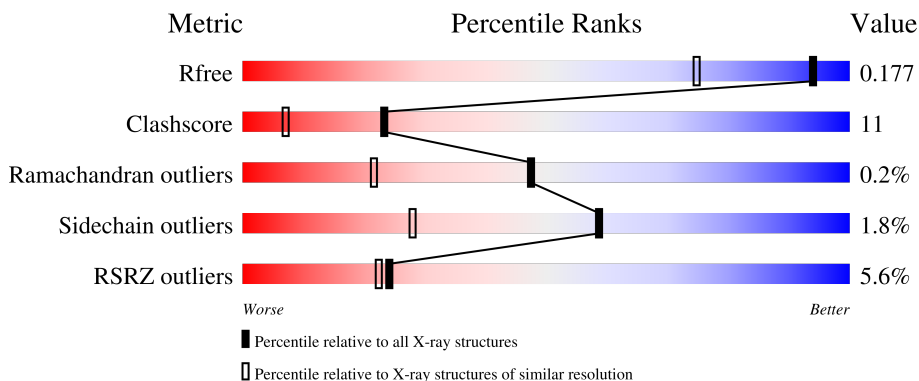|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.18
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.18

1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
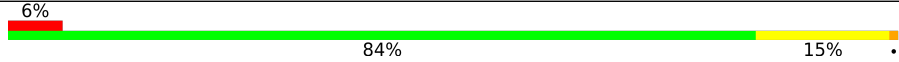*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.40 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	Percentile Ranks	Value
Rfree		0.177
Clashscore		11
Ramachandran outliers		0.2%
Sidechain outliers		1.8%
RSRZ outliers		5.6%

Worse   *Better*

▌ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1714 (1.40-1.40)
Clashscore	141614	1812 (1.40-1.40)
Ramachandran outliers	138981	1763 (1.40-1.40)
Sidechain outliers	138945	1762 (1.40-1.40)
RSRZ outliers	127900	1674 (1.40-1.40)

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	206	5% 80% 19% •
1	B	206	6% 84% 15% •

2 Entry composition ⓘ

There are 5 unique types of molecules in this entry. The entry contains 7883 atoms, of which 3747 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 Mucosal addressin cell adhesion molecule 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	206	Total	C	H	N	O	S	15	45	0
			3584	1109	1821	316	330	8			
1	B	206	Total	C	H	N	O	S	3	52	0
			3713	1148	1892	329	336	8			

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	94	ASN	ASP	engineered mutation	UNP Q13477
A	148	GLN	GLU	engineered mutation	UNP Q13477
A	?	-	GLU	deletion	UNP Q13477
A	?	-	GLU	deletion	UNP Q13477
A	?	-	GLU	deletion	UNP Q13477
A	?	-	PRO	deletion	UNP Q13477
A	?	-	GLN	deletion	UNP Q13477
A	?	-	GLY	deletion	UNP Q13477
A	?	-	GLN	deletion	UNP Q13477
A	?	-	GLY	deletion	UNP Q13477
A	150	PRO	-	insertion	UNP Q13477
A	151	ILE	-	insertion	UNP Q13477
A	152	GLY	-	insertion	UNP Q13477
A	153	GLY	-	insertion	UNP Q13477
A	203	GLY	-	expression tag	UNP Q13477
A	204	GLY	-	expression tag	UNP Q13477
A	205	GLU	-	expression tag	UNP Q13477
A	206	ASN	-	expression tag	UNP Q13477
A	207	LEU	-	expression tag	UNP Q13477
A	208	TYR	-	expression tag	UNP Q13477
A	209	PHE	-	expression tag	UNP Q13477
A	210	GLN	-	expression tag	UNP Q13477
B	94	ASN	ASP	engineered mutation	UNP Q13477
B	148	GLN	GLU	engineered mutation	UNP Q13477
B	?	-	GLU	deletion	UNP Q13477

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Chain	Residue	Modelled	Actual	Comment	Reference
B	?	-	GLU	deletion	UNP Q13477
B	?	-	GLU	deletion	UNP Q13477
B	?	-	PRO	deletion	UNP Q13477
B	?	-	GLN	deletion	UNP Q13477
B	?	-	GLY	deletion	UNP Q13477
B	?	-	GLN	deletion	UNP Q13477
B	?	-	GLY	deletion	UNP Q13477
B	150	PRO	-	insertion	UNP Q13477
B	151	ILE	-	insertion	UNP Q13477
B	152	GLY	-	insertion	UNP Q13477
B	153	GLY	-	insertion	UNP Q13477
B	203	GLY	-	expression tag	UNP Q13477
B	204	GLY	-	expression tag	UNP Q13477
B	205	GLU	-	expression tag	UNP Q13477
B	206	ASN	-	expression tag	UNP Q13477
B	207	LEU	-	expression tag	UNP Q13477
B	208	TYR	-	expression tag	UNP Q13477
B	209	PHE	-	expression tag	UNP Q13477
B	210	GLN	-	expression tag	UNP Q13477

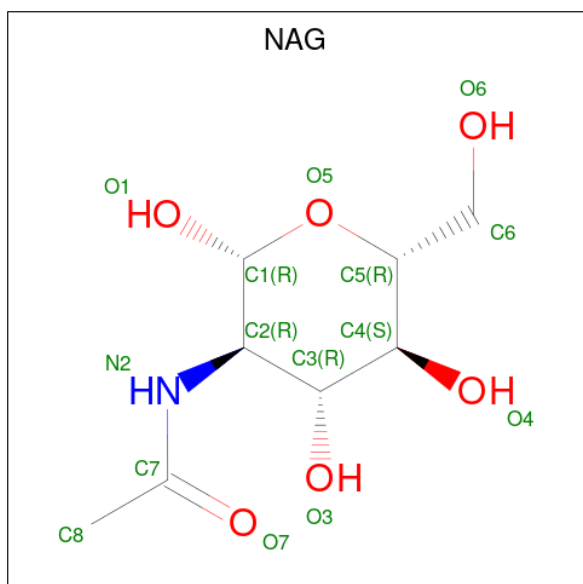- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

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

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	H	O	0	0
			14	3	8	3		

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	B	1	Total	C	H	N	O	0	1
			54	16	26	2	10		

- Molecule 5 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	261	Total O 261 261		0	2
5	B	247	Total O 247 247		0	6

3 Residue-property plots ⓘ

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: Mucosal addressin cell adhesion molecule 1

Chain A:

• Molecule 1: Mucosal addressin cell adhesion molecule 1

Chain B:
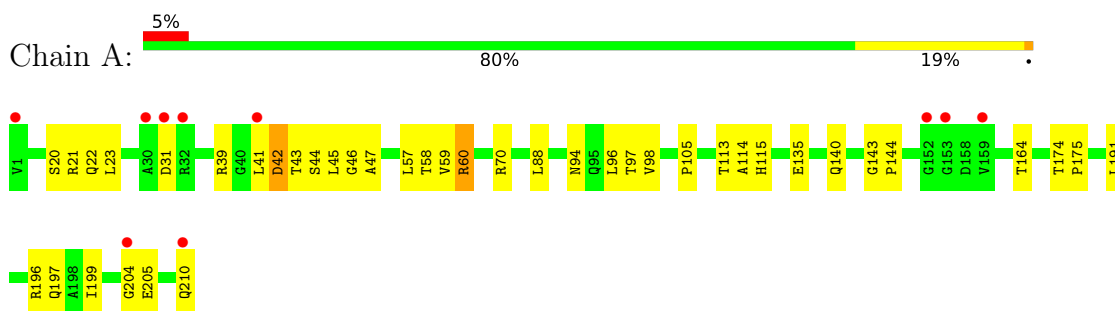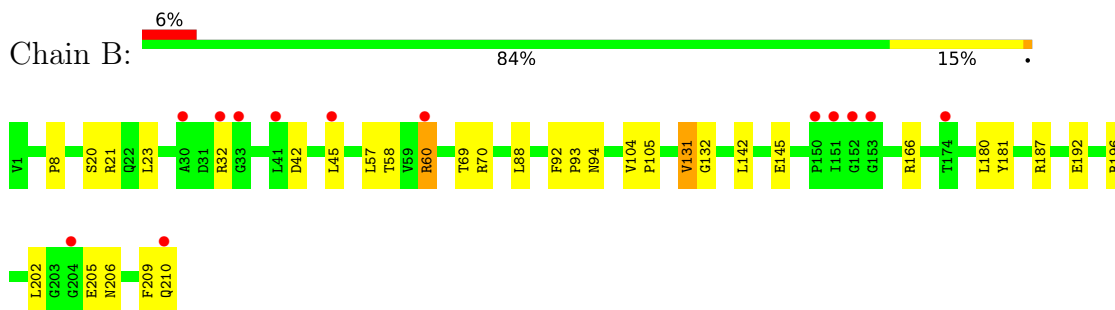
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	58.32Å　69.70Å　101.20Å 90.00°　90.00°　90.00°	Depositor
Resolution (Å)	44.73　–　1.40 44.73　–　1.40	Depositor EDS
% Data completeness (in resolution range)	99.2 (44.73-1.40) 99.3 (44.73-1.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	1.83 (at 1.40Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8_1069)	Depositor
R, R_{free}	0.143　,　0.178 0.142　,　0.177	Depositor DCC
R_{free} test set	1553 reflections (1.91%)	wwPDB-VP
Wilson B-factor (Å^2)	14.5	Xtriage
Anisotropy	0.000	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.41 , 51.3	EDS
L-test for twinning[2]	$<|L|> = 0.48, <L^2> = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	7883	wwPDB-VP
Average B, all atoms (Å^2)	23.0	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 34.27 % 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 7.0058e-04.*

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[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 ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, NAG, SO4

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	0/1909	0.66	0/2608
1	B	0.46	0/1951	0.69	0/2664
All	All	0.46	0/3860	0.67	0/5272

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	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	131[B]	VAL	Peptide

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.

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1763	1821	1716	47	0
1	B	1821	1892	1824	49	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	6	8	8	1	0
4	B	28	26	26	0	0
5	A	261	0	0	18	3
5	B	247	0	0	13	4
All	All	4136	3747	3574	83	5

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 11.

The worst 5 of 83 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:70[B]:ARG:NH1	1:B:45[B]:LEU:O	1.91	1.02
1:A:20:SER:OG	5:A:658[B]:HOH:O	1.77	1.02
1:A:45[A]:LEU:O	1:B:70[A]:ARG:NH1	1.92	1.01
1:A:42[B]:ASP:OD1	5:A:628:HOH:O	1.99	0.79
1:A:46[B]:GLY:HA2	1:B:58[B]:THR:O	1.84	0.77

All (5) 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)
5:B:402:HOH:O	5:B:645:HOH:O[4_446]	1.42	0.78
5:A:627:HOH:O	5:B:647:HOH:O[3_555]	1.75	0.45
5:A:622:HOH:O	5:B:597:HOH:O[2_544]	2.04	0.16
5:A:430:HOH:O	5:A:520:HOH:O[4_545]	2.13	0.07
5:B:446:HOH:O	5:B:643:HOH:O[4_546]	2.13	0.07

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	248/206 (120%)	245 (99%)	3 (1%)	0	100	100
1	B	256/206 (124%)	247 (96%)	7 (3%)	2 (1%)	19	4
All	All	504/412 (122%)	492 (98%)	10 (2%)	2 (0%)	47	12

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	132[A]	GLY
1	B	132[B]	GLY

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	204/165 (124%)	197 (97%)	7 (3%)	37	8
1	B	208/165 (126%)	205 (99%)	3 (1%)	67	40
All	All	412/330 (125%)	402 (98%)	10 (2%)	59	16

5 of 10 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	60[A]	ARG
1	B	60[B]	ARG
1	B	94	ASN
1	A	60[B]	ARG
1	A	94	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	49	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 ⓘ

5 ligands are modelled in this entry.

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	NAG	B	2061[A]	1	14,14,15	0.52	0	17,19,21	0.95	1 (5%)
2	SO4	A	301	-	4,4,4	0.16	0	6,6,6	0.11	0
2	SO4	B	301	-	4,4,4	0.13	0	6,6,6	0.14	0
4	NAG	B	2061[B]	1	14,14,15	0.49	0	17,19,21	1.15	2 (11%)
3	GOL	A	302	-	5,5,5	0.35	0	5,5,5	0.27	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	NAG	B	2061[B]	1	-	0/6/23/26	0/1/1/1
3	GOL	A	302	-	-	4/4/4/4	-
4	NAG	B	2061[A]	1	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	2061[B]	NAG	C1-O5-C5	2.71	115.86	112.19
4	B	2061[A]	NAG	O5-C5-C6	2.49	111.10	107.20
4	B	2061[B]	NAG	O5-C1-C2	-2.42	107.46	111.29

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	302	GOL	O1-C1-C2-C3
3	A	302	GOL	C1-C2-C3-O3
3	A	302	GOL	O1-C1-C2-O2
3	A	302	GOL	O2-C2-C3-O3

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	302	GOL	1	0

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 (i)

6.1 Protein, DNA and RNA chains (i)

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	206/206 (100%)	-0.17	10 (4%)	29	29	10, 18, 38, 51	5 (2%)
1	B	206/206 (100%)	-0.10	13 (6%)	20	18	9, 18, 41, 57	2 (0%)
All	All	412/412 (100%)	-0.14	23 (5%)	24	22	9, 18, 39, 57	7 (1%)

The worst 5 of 23 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	151	ILE	5.4
1	B	153	GLY	4.9
1	A	41[A]	LEU	4.2
1	B	32[A]	ARG	3.9
1	B	174	THR	3.6

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)

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. 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	RSCC	RSR	B-factors(Å²)	Q<0.9
4	NAG	B	2061[A]	14/15	0.75	0.18	28,37,44,45	27
4	NAG	B	2061[B]	14/15	0.75	0.18	34,42,51,52	27
2	SO4	B	301	5/5	0.82	0.13	54,59,62,65	5
3	GOL	A	302	6/6	0.88	0.15	35,42,52,62	0
2	SO4	A	301	5/5	0.93	0.14	52,57,61,61	0

6.5 Other polymers ⓘ

There are no such residues in this entry.