W O R L D W I D E
wwPDB
PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

Feb 19, 2016 – 11:09 PM GMT

PDB ID : 5F7L
Title : Blood group antigen binding adhesin BabA of Helicobacter pylori strain 17875 in complex with Nanobody Nb-ER14
Authors : Moonens, K.; Gideonsson, P.; Subedi, S.; Romao, E.; Oscarson, S.; Muyldermans, S.; Boren, T.; Remaut, H.
Deposited on : 2015-12-08
Resolution : 2.74 Å(reported)

The following versions of software and data (see references (1)) were used in the production of this report:

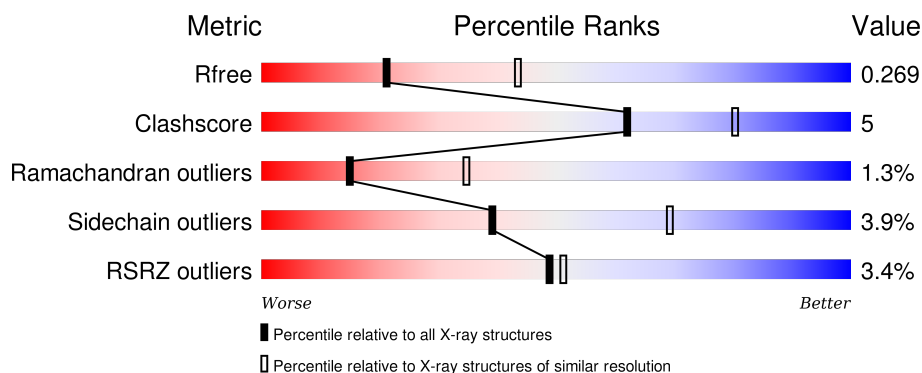|		
MolProbity	:	4.02b-467
Mogul	:	1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026982
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20026982

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 2.74 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		0.269
Clashscore		5
Ramachandran outliers		1.3%
Sidechain outliers		3.9%
RSRZ outliers		3.4%

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}	91344	3050 (2.78-2.70)
Clashscore	102246	3424 (2.78-2.70)
Ramachandran outliers	100387	3367 (2.78-2.70)
Sidechain outliers	100360	3368 (2.78-2.70)
RSRZ outliers	91569	3055 (2.78-2.70)

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. 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	466	3% / 68% / 11% · 20%
1	C	466	2% / 70% / 10% · 20%
2	B	129	5% / 79% / 12% · 6%
2	D	129	5% / 78% / 16% · ·

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	SO4	A	503	-	-	X	-
3	SO4	C	502	-	-	-	X

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 7573 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 Adhesin binding fucosylated histo-blood group antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	375	Total 2789	C 1714	N 482	O 580	S 13	0	0	0
1	C	375	Total 2794	C 1720	N 482	O 579	S 13	0	0	0

There are 60 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	3	ALA	-	expression tag	UNP O52269
A	4	SER	-	expression tag	UNP O52269
A	5	TRP	-	expression tag	UNP O52269
A	6	SER	-	expression tag	UNP O52269
A	7	HIS	-	expression tag	UNP O52269
A	8	PRO	-	expression tag	UNP O52269
A	9	GLN	-	expression tag	UNP O52269
A	10	PHE	-	expression tag	UNP O52269
A	11	GLU	-	expression tag	UNP O52269
A	12	LYS	-	expression tag	UNP O52269
A	13	SER	-	expression tag	UNP O52269
A	14	GLY	-	expression tag	UNP O52269
A	15	GLY	-	expression tag	UNP O52269
A	16	GLY	-	expression tag	UNP O52269
A	17	GLY	-	expression tag	UNP O52269
A	18	GLY	-	expression tag	UNP O52269
A	19	LEU	-	expression tag	UNP O52269
A	20	VAL	-	expression tag	UNP O52269
A	21	PRO	-	expression tag	UNP O52269
A	22	ARG	-	expression tag	UNP O52269
A	23	GLY	-	expression tag	UNP O52269
A	24	SER	-	expression tag	UNP O52269
A	461	GLY	-	expression tag	UNP O52269
A	462	SER	-	expression tag	UNP O52269
A	463	HIS	-	expression tag	UNP O52269

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Chain	Residue	Modelled	Actual	Comment	Reference
A	464	HIS	-	expression tag	UNP O52269
A	465	HIS	-	expression tag	UNP O52269
A	466	HIS	-	expression tag	UNP O52269
A	467	HIS	-	expression tag	UNP O52269
A	468	HIS	-	expression tag	UNP O52269
C	3	ALA	-	expression tag	UNP O52269
C	4	SER	-	expression tag	UNP O52269
C	5	TRP	-	expression tag	UNP O52269
C	6	SER	-	expression tag	UNP O52269
C	7	HIS	-	expression tag	UNP O52269
C	8	PRO	-	expression tag	UNP O52269
C	9	GLN	-	expression tag	UNP O52269
C	10	PHE	-	expression tag	UNP O52269
C	11	GLU	-	expression tag	UNP O52269
C	12	LYS	-	expression tag	UNP O52269
C	13	SER	-	expression tag	UNP O52269
C	14	GLY	-	expression tag	UNP O52269
C	15	GLY	-	expression tag	UNP O52269
C	16	GLY	-	expression tag	UNP O52269
C	17	GLY	-	expression tag	UNP O52269
C	18	GLY	-	expression tag	UNP O52269
C	19	LEU	-	expression tag	UNP O52269
C	20	VAL	-	expression tag	UNP O52269
C	21	PRO	-	expression tag	UNP O52269
C	22	ARG	-	expression tag	UNP O52269
C	23	GLY	-	expression tag	UNP O52269
C	24	SER	-	expression tag	UNP O52269
C	461	GLY	-	expression tag	UNP O52269
C	462	SER	-	expression tag	UNP O52269
C	463	HIS	-	expression tag	UNP O52269
C	464	HIS	-	expression tag	UNP O52269
C	465	HIS	-	expression tag	UNP O52269
C	466	HIS	-	expression tag	UNP O52269
C	467	HIS	-	expression tag	UNP O52269
C	468	HIS	-	expression tag	UNP O52269

- Molecule 2 is a protein called Nanobody Nb-ER14.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	121	918	568	156	187	7	0	0	0
2	D	124	Total	C	N	O	S	0	0	0
			944	583	163	191	7			

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	33	Total 33	O 33	0	0
4	B	11	Total 11	O 11	0	0
4	C	35	Total 35	O 35	0	0

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| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	D	9	Total O 9 9		0	0

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.
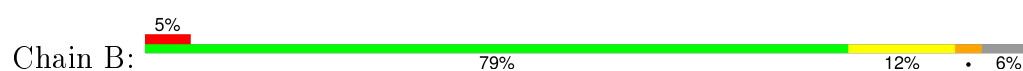
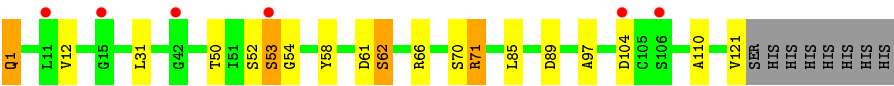- Molecule 1: Adhesin binding fucosylated histo-blood group antigen
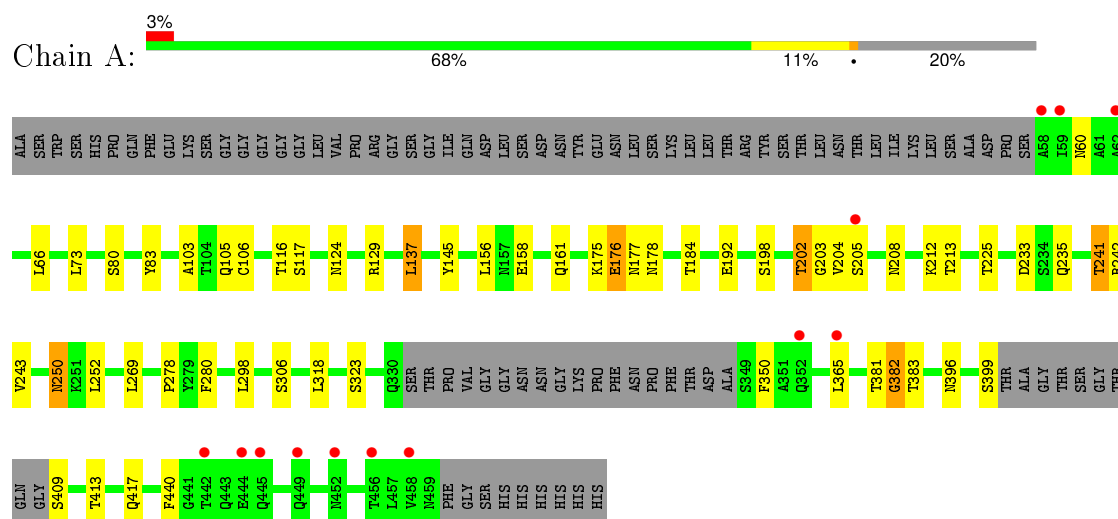
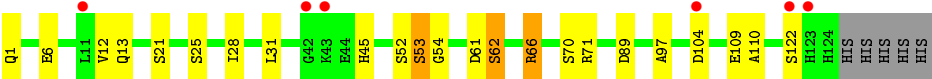- Molecule 1: Adhesin binding fucosylated histo-blood group antigen
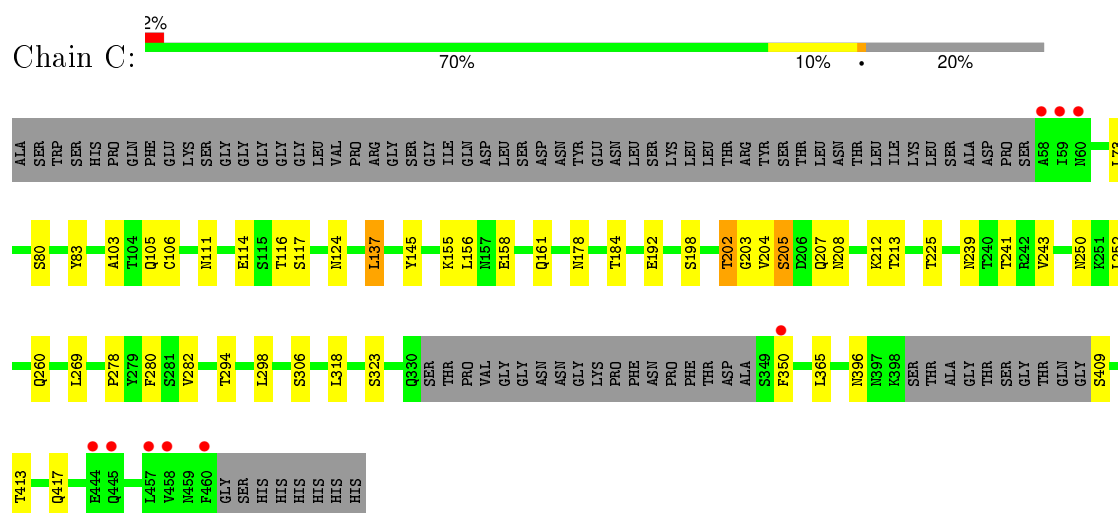
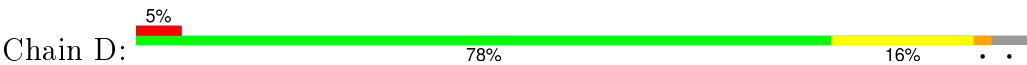- Molecule 2: Nanobody Nb-ER14

• Molecule 2: Nanobody Nb-ER14

Chain D:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 2 21 21	Depositor
Cell constants a, b, c, α, β, γ	42.40Å 133.72Å 201.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.40 – 2.74 47.40 – 2.74	Depositor EDS
% Data completeness (in resolution range)	99.0 (47.40-2.74) 99.2 (47.40-2.74)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	1.80 (at 2.73Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.212 , 0.265 0.217 , 0.269	Depositor DCC
R_{free} test set	1646 reflections (5.59%)	DCC
Wilson B-factor (Å^2)	43.1	Xtriage
Anisotropy	0.414	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 39.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning[2]	$<|L|> = 0.49$, $<L^2> = 0.33$	Xtriage
Outliers	2 of 31105 reflections (0.006%)	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	7573	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 48.34 % 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 8.7212e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $<|L|>$, $<L^2>$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.65	0/2826	0.79	2/3838 (0.1%)
1	C	0.66	0/2832	0.78	2/3846 (0.1%)
2	B	0.68	0/935	0.82	1/1267 (0.1%)
2	D	0.67	0/963	0.84	1/1305 (0.1%)
All	All	0.66	0/7556	0.79	6/10256 (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	A	0	1

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	318	LEU	CA-CB-CG	7.00	131.40	115.30
1	C	318	LEU	CA-CB-CG	6.98	131.35	115.30
2	D	66	ARG	NE-CZ-NH1	6.04	123.32	120.30
2	B	71	ARG	NE-CZ-NH1	5.35	122.97	120.30
1	C	178	ASN	N-CA-CB	-5.18	101.28	110.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	176	GLU	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	2789	0	2718	27	1
1	C	2794	0	2722	27	0
2	B	918	0	874	14	0
2	D	944	0	893	15	0
3	A	15	0	0	2	0
3	C	25	0	0	0	0
4	A	33	0	0	1	0
4	B	11	0	0	0	0
4	C	35	0	0	3	1
4	D	9	0	0	0	0
All	All	7573	0	7207	79	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 5.

The worst 5 of 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:A:116:THR:HG22	3:A:503:SO4:O1	1.63	0.99
1:C:241:THR:CG2	1:C:243:VAL:HG12	1.99	0.92
2:D:1:GLN:N	2:D:1:GLN:OE1	2.06	0.89
1:A:381:THR:O	1:A:382:GLY:O	1.92	0.87
2:B:1:GLN:N	2:B:1:GLN:OE1	2.07	0.86

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)
1:A:383:THR:CG2	4:C:601:HOH:O[3_544]	2.11	0.09

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	369/466 (79%)	343 (93%)	21 (6%)	5 (1%)	14	33
1	C	369/466 (79%)	347 (94%)	19 (5%)	3 (1%)	24	50
2	B	119/129 (92%)	113 (95%)	4 (3%)	2 (2%)	11	27
2	D	122/129 (95%)	116 (95%)	3 (2%)	3 (2%)	7	16
All	All	979/1190 (82%)	919 (94%)	47 (5%)	13 (1%)	15	35

5 of 13 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	242	ARG
1	A	382	GLY
2	B	53	SER
2	D	53	SER
2	B	62	SER

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	308/381 (81%)	294 (96%)	14 (4%)	34	63
1	C	308/381 (81%)	297 (96%)	11 (4%)	42	72
2	B	98/106 (92%)	95 (97%)	3 (3%)	47	77
2	D	101/106 (95%)	97 (96%)	4 (4%)	38	68
All	All	815/974 (84%)	783 (96%)	32 (4%)	39	69

5 of 32 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	1	GLN
1	C	137	LEU
2	D	13	GLN
2	B	104	ASP
1	C	145	TYR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	445	GLN
2	B	45	HIS
1	C	290	GLN
1	A	428	GLN
1	C	208	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry (i)

8 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	$\#|Z| > 2$
3	SO4	A	501	-	4,4,4	0.59	0	6,6,6	0.74	0
3	SO4	A	502	-	4,4,4	0.54	0	6,6,6	0.17	0
3	SO4	A	503	-	4,4,4	0.57	0	6,6,6	0.33	0
3	SO4	C	501	-	4,4,4	0.39	0	6,6,6	0.49	0
3	SO4	C	502	-	4,4,4	0.68	0	6,6,6	0.43	0
3	SO4	C	503	-	4,4,4	0.45	0	6,6,6	0.49	0
3	SO4	C	504	-	4,4,4	0.57	0	6,6,6	0.32	0
3	SO4	C	505	-	4,4,4	0.51	0	6,6,6	0.37	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
3	SO4	A	501	-	-	0/0/0/0	0/0/0/0
3	SO4	A	502	-	-	0/0/0/0	0/0/0/0
3	SO4	A	503	-	-	0/0/0/0	0/0/0/0
3	SO4	C	501	-	-	0/0/0/0	0/0/0/0
3	SO4	C	502	-	-	0/0/0/0	0/0/0/0
3	SO4	C	503	-	-	0/0/0/0	0/0/0/0
3	SO4	C	504	-	-	0/0/0/0	0/0/0/0
3	SO4	C	505	-	-	0/0/0/0	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.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	503	SO4	2	0

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

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	375/466 (80%)	0.09	13 (3%)	48	50	22, 40, 70, 83	0
1	C	375/466 (80%)	0.11	9 (2%)	62	64	24, 41, 69, 98	0
2	B	121/129 (93%)	0.33	6 (4%)	32	32	29, 43, 69, 75	0
2	D	124/129 (96%)	0.34	6 (4%)	34	34	28, 45, 72, 89	0
All	All	995/1190 (83%)	0.16	34 (3%)	49	51	22, 41, 70, 98	0

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	460	PHE	7.8
1	C	458	VAL	6.5
2	B	53	SER	4.0
1	A	59	ILE	3.9
1	A	58	ALA	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 carbohydrates 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. 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	RSCC	RSR	LLDF	B-factors(Å^2)	Q<0.9
3	SO4	C	502	5/5	0.81	0.27	4.18	73,76,93,94	0
3	SO4	C	504	5/5	0.91	0.25	1.76	67,70,77,78	0
3	SO4	C	503	5/5	0.90	0.26	1.51	82,85,89,95	0
3	SO4	A	502	5/5	0.90	0.22	0.50	77,80,82,84	0
3	SO4	A	501	5/5	0.90	0.22	0.20	68,70,78,82	0
3	SO4	C	501	5/5	0.97	0.15	-0.72	44,48,54,54	0
3	SO4	A	503	5/5	0.97	0.12	-1.67	56,57,62,65	0
3	SO4	C	505	5/5	0.89	0.28	-	90,92,99,100	0

6.5 Other polymers (i)

There are no such residues in this entry.