



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2026 – 12:07 PM UTC

PDB ID : 5I1D / pdb_00005i1d
Title : CRYSTAL STRUCTURE OF HUMAN GERMLINE ANTIBODY IGHV3-23/IGKV4-1
Authors : Teplyakov, A.; Obmolova, G.; Malia, T.; Luo, J.; Gilliland, G.
Deposited on : 2016-02-05
Resolution : 2.00 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 : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

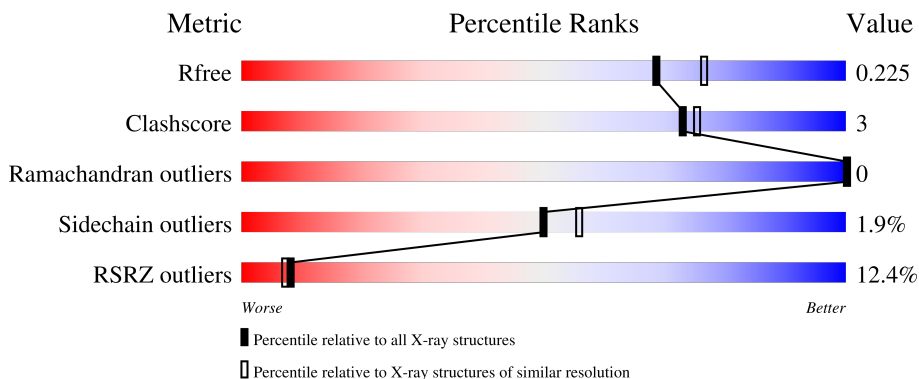
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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 $\leq 5\%$. 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	220	 14% 87% 10% 8%
1	L	220	 10% 95% 5%
2	B	228	 15% 83% 8% 8%
2	H	228	 9% 93% 5%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 7210 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.

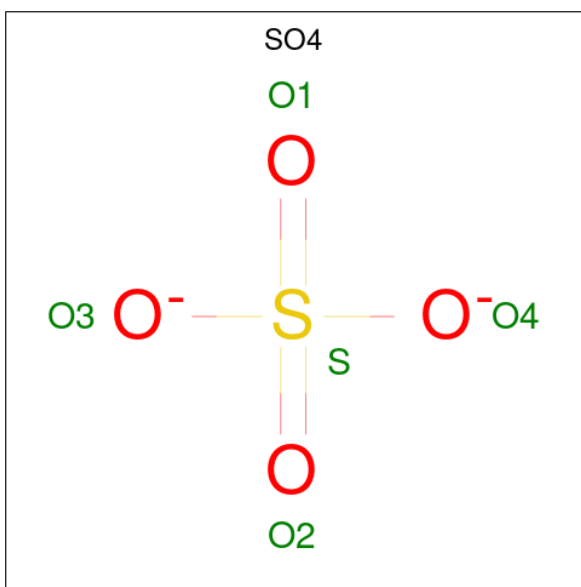
- Molecule 1 is a protein called FAB LIGHT CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	L	220	Total 1710	C 1070	N 284	O 348	S 8	0	2	0
1	A	218	Total 1693	C 1062	N 281	O 345	S 5	0	1	0

- Molecule 2 is a protein called FAB HEAVY CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	H	216	Total 1601	C 1012	N 264	O 318	S 7	0	0	0
2	B	210	Total 1556	C 983	N 257	O 310	S 6	0	0	0

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

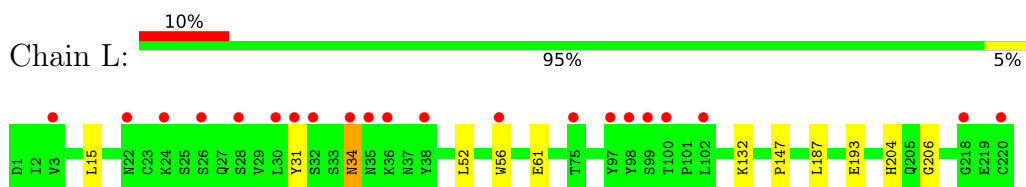
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	L	198	Total O 198 198	0	0
4	H	196	Total O 196 196	0	0
4	A	89	Total O 89 89	0	0
4	B	152	Total O 152 152	0	0

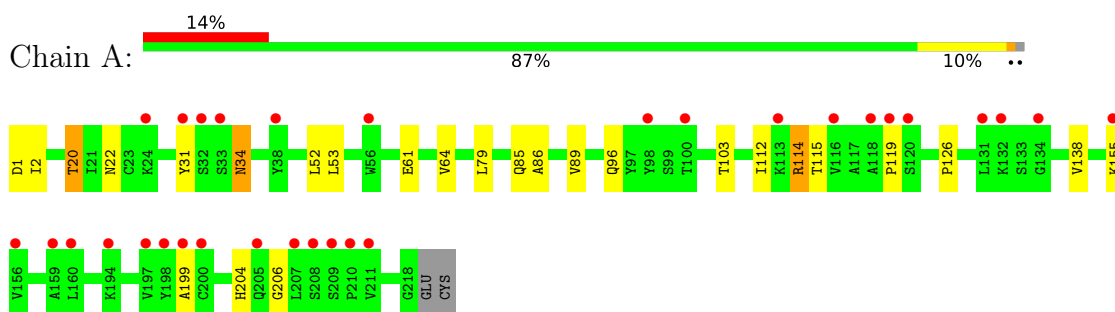
3 Residue-property plots [i](#)

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.

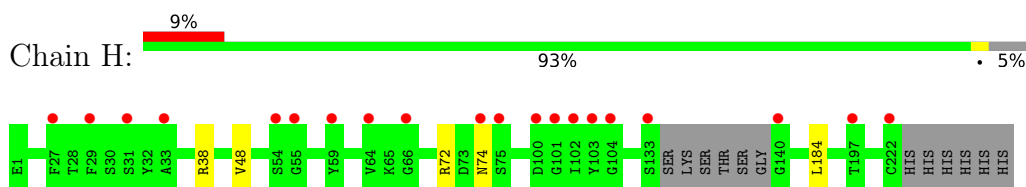
- Molecule 1: FAB LIGHT CHAIN



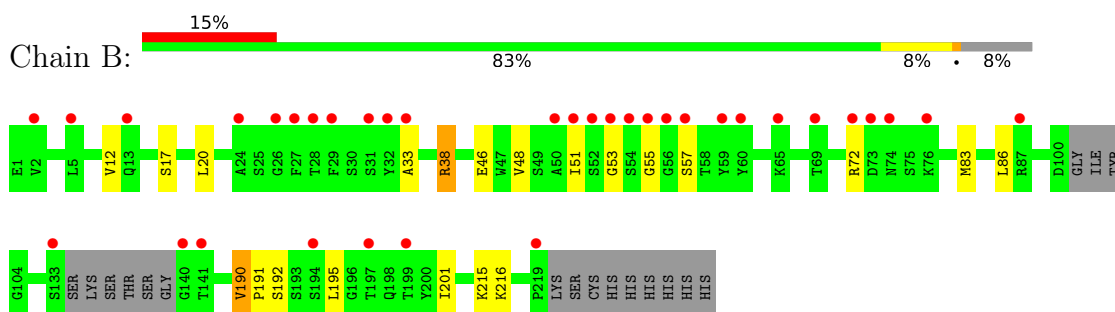
- Molecule 1: FAB LIGHT CHAIN



- Molecule 2: FAB HEAVY CHAIN



- Molecule 2: FAB HEAVY CHAIN



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	62.71Å 111.00Å 159.99Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	15.00 – 2.00 15.00 – 2.00	Depositor EDS
% Data completeness (in resolution range)	98.2 (15.00-2.00) 99.4 (15.00-2.00)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.11 (at 2.01Å)	Xtrriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.216 , 0.251 (Not available) , 0.225	Depositor DCC
R_{free} test set	1110 reflections (1.47%)	wwPDB-VP
Wilson B-factor (Å ²)	23.6	Xtrriage
Anisotropy	0.394	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 51.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	7210	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.54% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 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	0.48	0/1734	0.70	0/2357
1	L	0.51	0/1752	0.70	0/2381
2	B	0.54	0/1591	0.71	0/2164
2	H	0.53	0/1638	0.71	0/2228
All	All	0.51	0/6715	0.71	0/9130

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	1693	0	1641	17	0
1	L	1710	0	1652	9	0
2	B	1556	0	1516	13	0
2	H	1601	0	1562	4	0
3	A	5	0	0	0	0
3	B	5	0	0	0	0
3	L	5	0	0	0	0
4	A	89	0	0	0	0
4	B	152	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	H	196	0	0	0	0
4	L	198	0	0	2	0
All	All	7210	0	6371	42	0

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 3.

All (42) 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:96:GLN:HE21	1:A:103:THR:HG22	1.34	0.92
1:A:2:ILE:O	1:A:103:THR:HG21	1.71	0.90
2:B:38:ARG:HG2	2:B:48:VAL:CG2	2.15	0.75
1:L:204:HIS:CD2	1:L:206:GLY:H	2.09	0.71
1:A:86:ALA:HA	1:A:112:ILE:HD13	1.74	0.70
2:H:38:ARG:HG2	2:H:48:VAL:CG2	2.22	0.69
4:L:516:HOH:O	1:A:20:THR:HG23	1.92	0.69
1:L:204:HIS:HD2	1:L:206:GLY:H	1.46	0.64
2:B:190:VAL:HG22	2:B:191:PRO:HD2	1.81	0.62
1:A:119:PRO:HD3	1:A:204:HIS:CD2	2.36	0.61
1:L:52:LEU:HD23	1:L:61:GLU:HG3	1.81	0.60
2:B:38:ARG:HG2	2:B:48:VAL:HG23	1.82	0.59
2:B:20:LEU:HG	2:B:83:MET:HE2	1.84	0.58
2:B:201:ILE:HG12	2:B:216:LYS:HG2	1.90	0.54
1:A:52:LEU:HD23	1:A:61:GLU:HG3	1.89	0.53
2:B:33:ALA:HA	2:B:72:ARG:HH22	1.74	0.53
1:A:126:PRO:HD3	1:A:138:VAL:HG22	1.92	0.51
2:B:38:ARG:HD2	2:B:46:GLU:OE1	2.10	0.50
2:H:72:ARG:CD	2:H:74:ASN:HD21	2.24	0.50
1:A:89:VAL:HG23	1:A:112:ILE:HD12	1.92	0.50
1:L:147:PRO:O	1:L:204:HIS:HE1	1.93	0.50
1:A:86:ALA:HA	1:A:112:ILE:CD1	2.41	0.49
2:H:72:ARG:HD3	2:H:74:ASN:HD21	1.78	0.49
1:L:193:GLU:OE1	4:L:401:HOH:O	2.20	0.48
1:A:155:LYS:HB2	1:A:199:ALA:HB3	1.97	0.47
2:B:17:SER:HB3	4:B:1106:HOH:O	2.14	0.46
2:B:51:ILE:HG23	2:B:72:ARG:HH21	1.82	0.45
1:A:53:LEU:HA	1:A:64:VAL:HG21	1.98	0.45
2:B:53:GLY:HA2	2:B:72:ARG:CZ	2.47	0.45
1:L:15:LEU:HD13	1:A:20:THR:HG21	1.98	0.44
1:A:114:ARG:HD3	1:A:115:THR:O	2.18	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:51:ILE:HD11	2:B:55:GLY:HA2	2.01	0.43
2:H:72:ARG:HD3	2:H:74:ASN:ND2	2.34	0.43
1:L:52:LEU:CD2	1:L:61:GLU:HG3	2.48	0.43
1:L:56:TRP:HA	1:L:56:TRP:CE3	2.53	0.42
1:A:31:TYR:CD2	1:A:34:ASN:HB2	2.54	0.42
1:A:52:LEU:CD2	1:A:61:GLU:HG3	2.50	0.42
2:B:12:VAL:HG11	2:B:86:LEU:HD13	2.01	0.42
1:L:31:TYR:HB3	1:L:34:ASN:HD21	1.86	0.40
2:B:192:SER:HA	2:B:195:LEU:HD13	2.02	0.40
1:A:85:GLN:O	1:A:112:ILE:HD11	2.21	0.40
1:A:204:HIS:CD2	1:A:206:GLY:H	2.38	0.40

There are no symmetry-related clashes.

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	217/220 (99%)	211 (97%)	6 (3%)	0	100	100
1	L	220/220 (100%)	216 (98%)	4 (2%)	0	100	100
2	B	204/228 (90%)	198 (97%)	6 (3%)	0	100	100
2	H	212/228 (93%)	211 (100%)	1 (0%)	0	100	100
All	All	853/896 (95%)	836 (98%)	17 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	194/195 (100%)	188 (97%)	6 (3%)	35	37
1	L	197/195 (101%)	194 (98%)	3 (2%)	57	64
2	B	173/189 (92%)	169 (98%)	4 (2%)	44	49
2	H	178/189 (94%)	177 (99%)	1 (1%)	78	85
All	All	742/768 (97%)	728 (98%)	14 (2%)	50	56

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	L	34	ASN
1	L	132	LYS
1	L	187	LEU
2	H	184	LEU
1	A	1	ASP
1	A	20	THR
1	A	22	ASN
1	A	34	ASN
1	A	79	LEU
1	A	114	ARG
2	B	38	ARG
2	B	57	SER
2	B	190	VAL
2	B	215	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	L	34	ASN
1	L	153	GLN
1	L	204	HIS
2	H	3	GLN
2	H	13	GLN
2	H	74	ASN
2	H	77	ASN
2	H	82	GLN
2	H	198	GLN
1	A	34	ASN
1	A	43	GLN

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Mol	Chain	Res	Type
1	A	44	GLN
1	A	48	GLN
1	A	144	ASN
1	A	204	HIS
2	B	39	GLN
2	B	77	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 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	301	-	4,4,4	0.24	0	6,6,6	0.13	0
3	SO4	B	901	-	4,4,4	0.22	0	6,6,6	0.19	0
3	SO4	L	301	-	4,4,4	0.22	0	6,6,6	0.12	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.

No monomer is involved in short contacts.

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	218/220 (99%)	0.98	31 (14%) 6 5	23, 52, 80, 94	1 (0%)
1	L	220/220 (100%)	0.22	21 (9%) 14 12	13, 36, 74, 91	2 (0%)
2	B	210/228 (92%)	0.79	35 (16%) 4 4	22, 47, 74, 103	0
2	H	216/228 (94%)	0.30	20 (9%) 14 13	22, 37, 66, 129	0
All	All	864/896 (96%)	0.57	107 (12%) 8 7	13, 44, 76, 129	3 (0%)

All (107) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	H	103	TYR	5.2
2	B	2	VAL	4.1
1	L	38	TYR	3.8
1	A	98	TYR	3.8
2	B	31	SER	3.7
2	B	24	ALA	3.7
2	B	76	LYS	3.6
2	B	55	GLY	3.6
1	L	98	TYR	3.5
1	L	220	CYS	3.5
2	B	29	PHE	3.5
1	A	197	VAL	3.5
1	L	22	ASN	3.4
2	H	102	ILE	3.4
1	L	24	LYS	3.4
1	A	132	LYS	3.3
2	B	54	SER	3.3
1	L	31	TYR	3.3
2	B	57	SER	3.3
1	L	56	TRP	3.2
1	L	35	ASN	3.2

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Mol	Chain	Res	Type	RSRZ
2	B	140	GLY	3.1
1	L	102	LEU	3.1
1	L	3	VAL	3.1
1	A	207	LEU	3.1
1	A	33	SER	3.0
1	L	34	ASN	3.0
2	H	222	CYS	3.0
2	B	52	SER	3.0
1	A	118	ALA	3.0
2	B	56	GLY	3.0
2	B	32	TYR	3.0
1	A	24	LYS	2.9
1	L	75	THR	2.9
1	L	100	THR	2.9
2	B	27	PHE	2.9
1	L	36	LYS	2.9
2	H	101	GLY	2.9
2	H	133	SER	2.8
1	L	32	SER	2.8
1	L	28	SER	2.8
1	L	30	LEU	2.8
2	H	74	ASN	2.7
1	L	218	GLY	2.7
1	A	199	ALA	2.7
2	B	50	ALA	2.7
1	A	160	LEU	2.7
1	A	116	VAL	2.7
2	B	26	GLY	2.7
2	B	5	LEU	2.7
1	A	31	TYR	2.7
2	H	29	PHE	2.6
2	B	28	THR	2.6
2	B	74	ASN	2.6
1	A	210	PRO	2.6
2	B	53	GLY	2.6
1	A	159	ALA	2.6
2	B	51	ILE	2.5
2	H	59	TYR	2.5
2	H	33	ALA	2.5
2	B	33	ALA	2.5
1	L	97	TYR	2.4
1	A	198	TYR	2.4

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Mol	Chain	Res	Type	RSRZ
1	L	99	SER	2.4
1	A	194	LYS	2.4
2	H	27	PHE	2.4
2	B	59	TYR	2.4
2	B	73	ASP	2.4
2	B	72	ARG	2.4
1	A	211	VAL	2.4
2	B	65	LYS	2.4
2	B	197	THR	2.4
1	A	155	LYS	2.3
1	A	113	LYS	2.3
2	B	194	SER	2.3
1	A	32	SER	2.3
2	B	133	SER	2.3
2	H	54	SER	2.2
2	H	66	GLY	2.2
1	A	208	SER	2.2
2	B	199	THR	2.2
2	H	140	GLY	2.2
2	B	87	ARG	2.2
2	H	64	VAL	2.2
2	H	55	GLY	2.2
1	A	200	CYS	2.2
2	B	60	TYR	2.2
1	A	56	TRP	2.2
1	A	119	PRO	2.1
2	H	197	THR	2.2
2	H	75	SER	2.1
1	A	120	SER	2.1
2	H	31	SER	2.1
2	B	219	PRO	2.1
2	H	104	GLY	2.1
1	A	38	TYR	2.1
2	B	141	THR	2.1
1	A	156	VAL	2.1
1	L	26	SER	2.1
1	A	131	LEU	2.0
2	H	100	ASP	2.0
2	B	69	THR	2.0
1	A	209	SER	2.0
1	A	205	GLN	2.0
2	B	13	GLN	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	100	THR	2.0
1	A	134	GLY	2.0

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 oligosaccharides 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(Å ²)	Q < 0.9
3	SO4	L	301	5/5	0.92	0.13	56,61,71,77	0
3	SO4	A	301	5/5	0.94	0.14	54,58,70,75	0
3	SO4	B	901	5/5	0.98	0.11	27,30,37,38	0

6.5 Other polymers [i](#)

There are no such residues in this entry.