



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 10, 2026 – 12:12 AM UTC

PDB ID : 2Q62 / pdb_00002q62
Title : Crystal Structure of ArsH from Sinorhizobium meliloti
Authors : Ye, J.; Yang, H.; Bhattacharjee, H.; Rosen, B.P.
Deposited on : 2007-06-04
Resolution : 1.80 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

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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

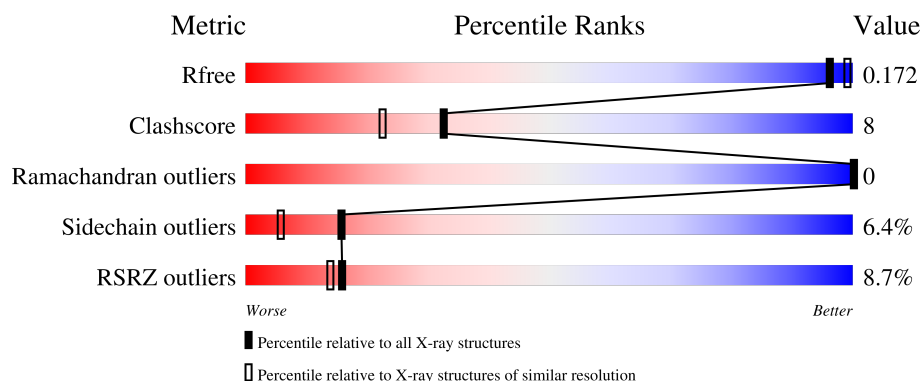
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	247	30% 66% 17% 5% 11%
1	B	247	4% 74% 14% .. 10%
1	C	247	3% 76% 12% . 11%
1	D	247	4% 81% 12% .. 5%
1	E	247	3% 72% 14% .. 11%

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Mol	Chain	Length	Quality of chain
1	F	247	6% 70% 15% • 11%
1	G	247	10% 76% 10% • 11%
1	H	247	3% 74% 13% •• 11%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 15789 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 arsH.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	220	Total	C	N	O	S	0	0	0
			1745	1103	313	320	9			
1	B	222	Total	C	N	O	S	0	0	0
			1756	1109	315	323	9			
1	C	221	Total	C	N	O	S	0	0	0
			1746	1103	312	322	9			
1	D	235	Total	C	N	O	S	0	0	0
			1862	1175	336	342	9			
1	E	221	Total	C	N	O	S	0	0	0
			1746	1103	312	322	9			
1	F	219	Total	C	N	O	S	0	0	0
			1735	1097	310	319	9			
1	G	219	Total	C	N	O	S	0	0	0
			1736	1098	312	317	9			
1	H	221	Total	C	N	O	S	0	0	0
			1746	1103	312	322	9			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	242	HIS	-	expression tag	UNP Q92R45
A	243	HIS	-	expression tag	UNP Q92R45
A	244	HIS	-	expression tag	UNP Q92R45
A	245	HIS	-	expression tag	UNP Q92R45
A	246	HIS	-	expression tag	UNP Q92R45
A	247	HIS	-	expression tag	UNP Q92R45
B	242	HIS	-	expression tag	UNP Q92R45
B	243	HIS	-	expression tag	UNP Q92R45
B	244	HIS	-	expression tag	UNP Q92R45
B	245	HIS	-	expression tag	UNP Q92R45
B	246	HIS	-	expression tag	UNP Q92R45
B	247	HIS	-	expression tag	UNP Q92R45
C	242	HIS	-	expression tag	UNP Q92R45

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Chain	Residue	Modelled	Actual	Comment	Reference
C	243	HIS	-	expression tag	UNP Q92R45
C	244	HIS	-	expression tag	UNP Q92R45
C	245	HIS	-	expression tag	UNP Q92R45
C	246	HIS	-	expression tag	UNP Q92R45
C	247	HIS	-	expression tag	UNP Q92R45
D	242	HIS	-	expression tag	UNP Q92R45
D	243	HIS	-	expression tag	UNP Q92R45
D	244	HIS	-	expression tag	UNP Q92R45
D	245	HIS	-	expression tag	UNP Q92R45
D	246	HIS	-	expression tag	UNP Q92R45
D	247	HIS	-	expression tag	UNP Q92R45
E	242	HIS	-	expression tag	UNP Q92R45
E	243	HIS	-	expression tag	UNP Q92R45
E	244	HIS	-	expression tag	UNP Q92R45
E	245	HIS	-	expression tag	UNP Q92R45
E	246	HIS	-	expression tag	UNP Q92R45
E	247	HIS	-	expression tag	UNP Q92R45
F	242	HIS	-	expression tag	UNP Q92R45
F	243	HIS	-	expression tag	UNP Q92R45
F	244	HIS	-	expression tag	UNP Q92R45
F	245	HIS	-	expression tag	UNP Q92R45
F	246	HIS	-	expression tag	UNP Q92R45
F	247	HIS	-	expression tag	UNP Q92R45
G	242	HIS	-	expression tag	UNP Q92R45
G	243	HIS	-	expression tag	UNP Q92R45
G	244	HIS	-	expression tag	UNP Q92R45
G	245	HIS	-	expression tag	UNP Q92R45
G	246	HIS	-	expression tag	UNP Q92R45
G	247	HIS	-	expression tag	UNP Q92R45
H	242	HIS	-	expression tag	UNP Q92R45
H	243	HIS	-	expression tag	UNP Q92R45
H	244	HIS	-	expression tag	UNP Q92R45
H	245	HIS	-	expression tag	UNP Q92R45
H	246	HIS	-	expression tag	UNP Q92R45
H	247	HIS	-	expression tag	UNP Q92R45

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	F	1	Total	O	S	0	0
			5	4	1		
2	G	1	Total	O	S	0	0
			5	4	1		
2	H	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	172	Total	O	0	0
			172	172		
3	B	188	Total	O	0	0
			188	188		
3	C	245	Total	O	0	0
			245	245		
3	D	256	Total	O	0	0
			256	256		
3	E	232	Total	O	0	0
			232	232		

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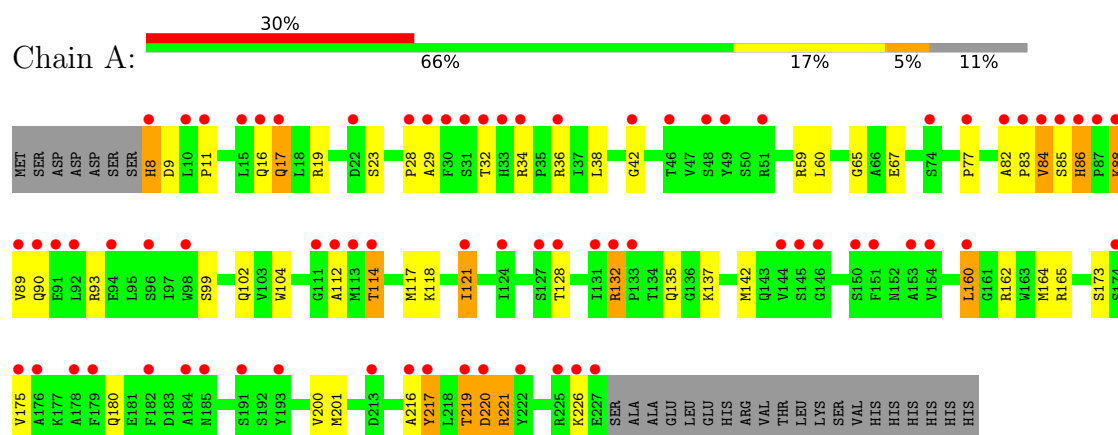
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	F	207	Total 207	O 207	0	0
3	G	184	Total 184	O 184	0	0
3	H	198	Total 198	O 198	0	0

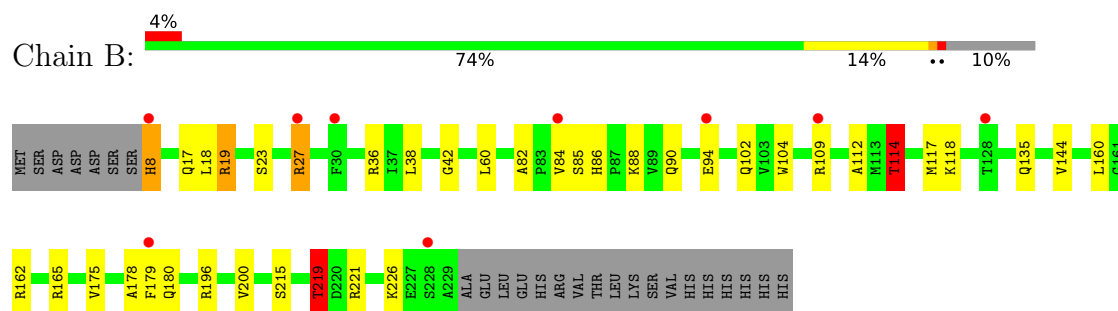
3 Residue-property plots [i](#)

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.

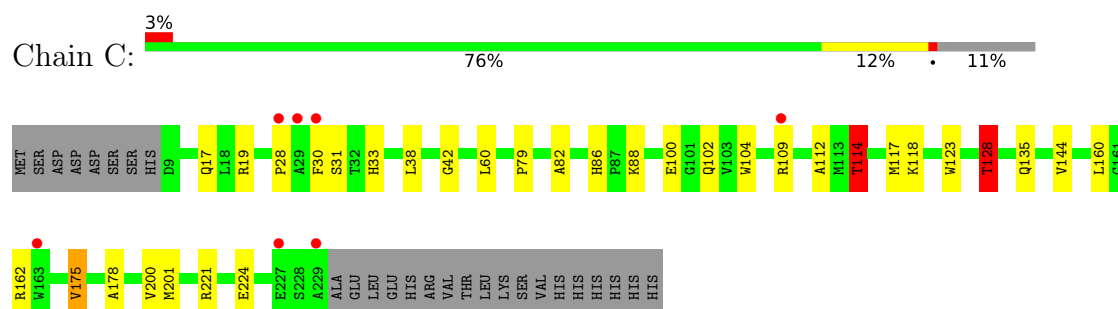
- Molecule 1: arSH



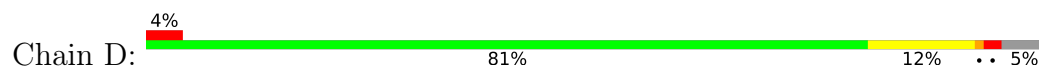
- Molecule 1: arSH

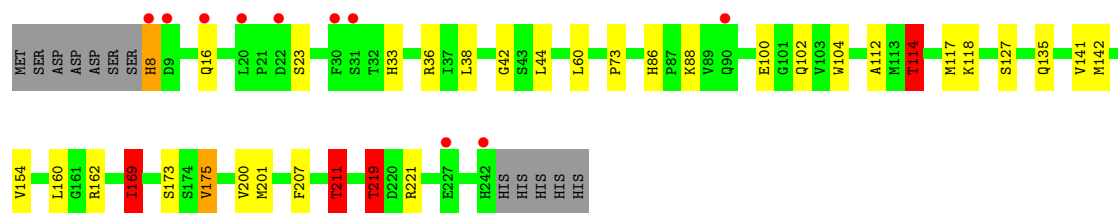


- Molecule 1: arSH

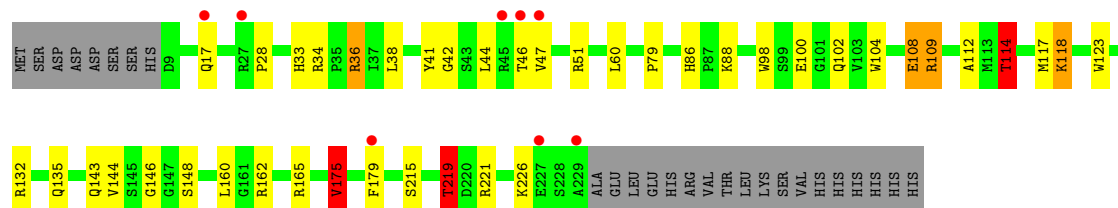


- Molecule 1: arSH

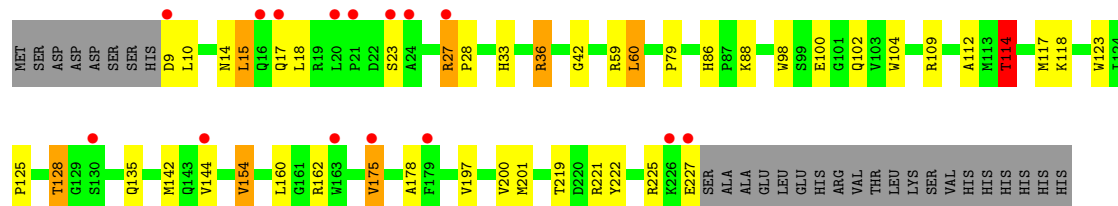




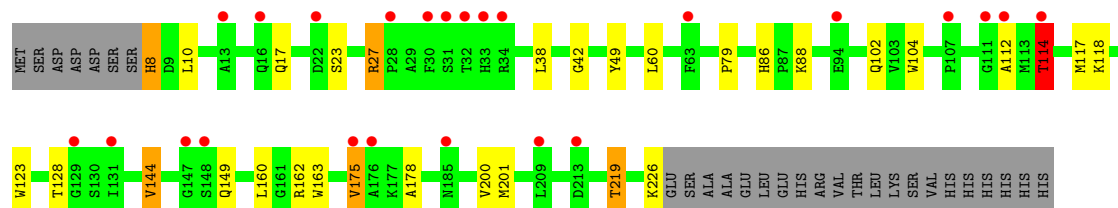
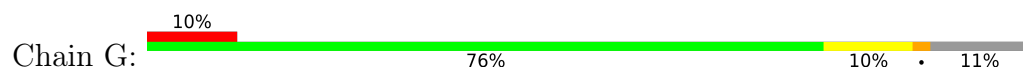
• Molecule 1: arshH



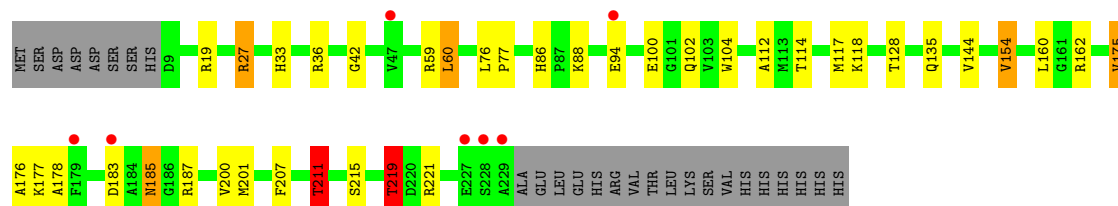
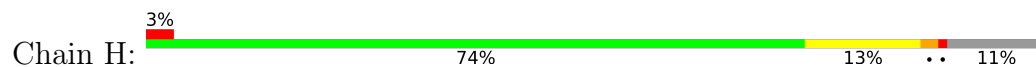
• Molecule 1: arshH



• Molecule 1: arshH



• Molecule 1: arshH



4 Data and refinement statistics

Property	Value	Source
Space group	P 42	Depositor
Cell constants a, b, c, α , β , γ	158.53Å 158.53Å 87.95Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.63 – 1.80 39.63 – 1.80	Depositor EDS
% Data completeness (in resolution range)	91.9 (39.63-1.80) 91.9 (39.63-1.80)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.97 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.173 , 0.212 0.174 , 0.172	Depositor DCC
R_{free} test set	9330 reflections (4.63%)	wwPDB-VP
Wilson B-factor (Å ²)	22.2	Xtriage
Anisotropy	0.186	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 35.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.029 for h,-k,-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	15789	wwPDB-VP
Average B, all atoms (Å ²)	22.0	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 20.12 % 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 9.3261e-03.*

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	1.42	20/1784 (1.1%)	1.28	11/2416 (0.5%)
1	B	0.85	1/1795 (0.1%)	1.04	8/2431 (0.3%)
1	C	0.91	0/1784	1.00	5/2416 (0.2%)
1	D	0.83	0/1903	1.00	6/2577 (0.2%)
1	E	0.88	1/1784 (0.1%)	1.04	8/2416 (0.3%)
1	F	0.81	0/1773	0.98	4/2401 (0.2%)
1	G	0.79	0/1775	0.95	3/2404 (0.1%)
1	H	0.84	1/1784 (0.1%)	1.02	8/2416 (0.3%)
All	All	0.93	23/14382 (0.2%)	1.04	53/19477 (0.3%)

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	1	0
1	C	1	0
1	E	1	0
1	H	1	0
All	All	4	0

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	86	HIS	CG-ND1	14.16	1.53	1.38
1	A	32	THR	C-N	13.89	1.51	1.33
1	A	86	HIS	CE1-NE2	10.57	1.43	1.32
1	A	32	THR	C-O	10.34	1.37	1.24
1	A	8	HIS	CE1-NE2	10.06	1.42	1.32

The worst 5 of 53 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	93	ARG	CA-C-O	18.32	139.96	120.55
1	A	93	ARG	O-C-N	-13.58	107.72	122.12
1	H	211	THR	N-CA-CB	-8.60	99.15	110.59
1	G	114	THR	OG1-CB-CG2	7.55	124.40	109.30
1	C	114	THR	OG1-CB-CG2	7.53	124.36	109.30

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	114	THR	CB
1	C	114	THR	CB
1	E	114	THR	CB
1	H	114	THR	CB

There are no planarity outliers.

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.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1745	0	1754	32	0
1	B	1756	0	1764	28	0
1	C	1746	0	1757	26	0
1	D	1862	0	1873	28	0
1	E	1746	0	1757	34	0
1	F	1735	0	1747	37	0
1	G	1736	0	1748	30	0
1	H	1746	0	1757	29	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
2	C	5	0	0	0	0
2	D	5	0	0	0	0
2	F	5	0	0	0	0
2	G	5	0	0	0	0
2	H	5	0	0	0	0
3	A	172	0	0	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	188	0	0	2	0
3	C	245	0	0	3	0
3	D	256	0	0	3	0
3	E	232	0	0	2	0
3	F	207	0	0	1	0
3	G	184	0	0	0	0
3	H	198	0	0	5	0
All	All	15789	0	14157	224	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 8.

The worst 5 of 224 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:H:211:THR:HG23	3:H:2200:HOH:O	1.59	1.02
1:E:42:GLY:O	1:E:114:THR:HG21	1.67	0.95
1:B:42:GLY:O	1:B:114:THR:HG21	1.70	0.91
1:C:42:GLY:O	1:C:114:THR:HG21	1.71	0.90
1:A:114:THR:HG23	1:A:117:MET:H	1.37	0.89

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	218/247 (88%)	210 (96%)	8 (4%)	0	100	100
1	B	220/247 (89%)	218 (99%)	2 (1%)	0	100	100
1	C	219/247 (89%)	219 (100%)	0	0	100	100
1	D	233/247 (94%)	232 (100%)	1 (0%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	E	219/247 (89%)	218 (100%)	1 (0%)	0	100	100
1	F	217/247 (88%)	216 (100%)	1 (0%)	0	100	100
1	G	217/247 (88%)	216 (100%)	1 (0%)	0	100	100
1	H	219/247 (89%)	218 (100%)	1 (0%)	0	100	100
All	All	1762/1976 (89%)	1747 (99%)	15 (1%)	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	191/216 (88%)	175 (92%)	16 (8%)	10	3
1	B	192/216 (89%)	179 (93%)	13 (7%)	14	5
1	C	191/216 (88%)	181 (95%)	10 (5%)	21	9
1	D	204/216 (94%)	191 (94%)	13 (6%)	16	6
1	E	191/216 (88%)	179 (94%)	12 (6%)	16	6
1	F	190/216 (88%)	177 (93%)	13 (7%)	14	5
1	G	190/216 (88%)	180 (95%)	10 (5%)	20	9
1	H	191/216 (88%)	179 (94%)	12 (6%)	16	6
All	All	1540/1728 (89%)	1441 (94%)	99 (6%)	16	6

5 of 99 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	109	ARG
1	F	128	THR
1	E	118	LYS
1	F	23	SER
1	F	219	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 52 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	135	GLN
1	F	102	GLN
1	H	135	GLN
1	E	155	ASN
1	F	33	HIS

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](#)

7 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	$\# Z > 2$
2	SO4	B	2002	-	4,4,4	0.30	0	6,6,6	0.36	0
2	SO4	C	2003	-	4,4,4	0.34	0	6,6,6	0.35	0
2	SO4	A	2001	-	4,4,4	0.54	0	6,6,6	0.58	0
2	SO4	H	2008	-	4,4,4	0.30	0	6,6,6	0.55	0
2	SO4	F	2006	-	4,4,4	0.34	0	6,6,6	0.33	0
2	SO4	D	2004	-	4,4,4	0.25	0	6,6,6	0.14	0
2	SO4	G	2007	-	4,4,4	0.36	0	6,6,6	0.37	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 ⓘ

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	220/247 (89%)	1.76	74 (33%) 1 1	16, 23, 33, 40	0
1	B	222/247 (89%)	0.60	9 (4%) 41 41	16, 21, 29, 38	0
1	C	221/247 (89%)	0.20	7 (3%) 50 50	16, 20, 32, 41	0
1	D	235/247 (95%)	0.53	10 (4%) 40 39	16, 20, 31, 45	0
1	E	221/247 (89%)	0.22	8 (3%) 46 46	16, 20, 32, 40	0
1	F	219/247 (88%)	0.55	15 (6%) 23 22	16, 21, 31, 43	0
1	G	219/247 (88%)	0.94	24 (10%) 10 9	16, 20, 30, 36	0
1	H	221/247 (89%)	0.26	7 (3%) 50 50	16, 21, 30, 40	0
All	All	1778/1976 (89%)	0.63	154 (8%) 16 14	16, 21, 31, 45	0

The worst 5 of 154 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	84	VAL	6.7
1	A	29	ALA	6.5
1	A	86	HIS	5.7
1	A	128	THR	5.7
1	G	32	THR	5.5

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 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($\text{\AA}^2$)	Q<0.9
2	SO4	H	2008	5/5	0.93	0.26	29,30,34,35	0
2	SO4	B	2002	5/5	0.96	0.19	20,22,25,25	0
2	SO4	A	2001	5/5	0.96	0.20	19,20,24,24	0
2	SO4	F	2006	5/5	0.97	0.19	21,21,24,26	0
2	SO4	G	2007	5/5	0.97	0.22	23,25,29,31	0
2	SO4	D	2004	5/5	0.97	0.20	15,22,23,23	0
2	SO4	C	2003	5/5	0.98	0.19	16,17,18,19	0

6.5 Other polymers [i](#)

There are no such residues in this entry.