



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:02 AM UTC

PDB ID : 4KMO / pdb_00004kmo
Title : Crystal Structure of the Vps33-Vps16 HOPS subcomplex from *Chaetomium thermophilum*
Authors : Baker, R.W.; Jeffrey, P.D.; Hughson, F.M.
Deposited on : 2013-05-08
Resolution : 2.60 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

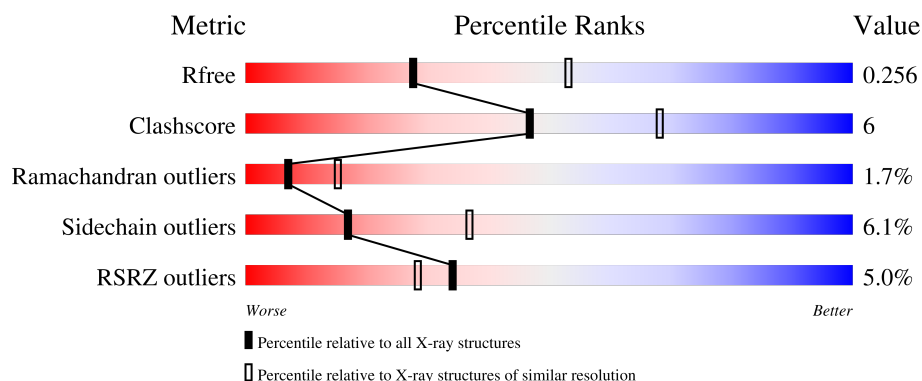
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	669	3% 72% 12% • 14%
2	B	333	6% 62% 13% 5% 20%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6810 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.

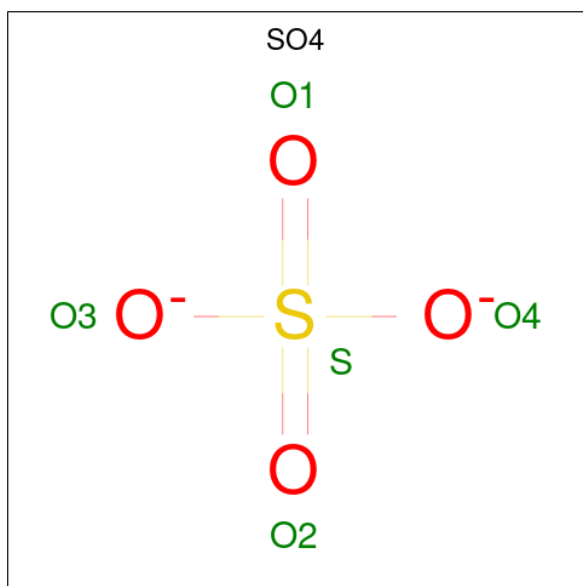
- Molecule 1 is a protein called Small conjugating protein ligase-like protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	574	4536	2870	803	852	4	7	0	0	0

- Molecule 2 is a protein called Putative vacuolar protein sorting-associated protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
2	B	265	2122	1347	374	392	2	7	0	0	0

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



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

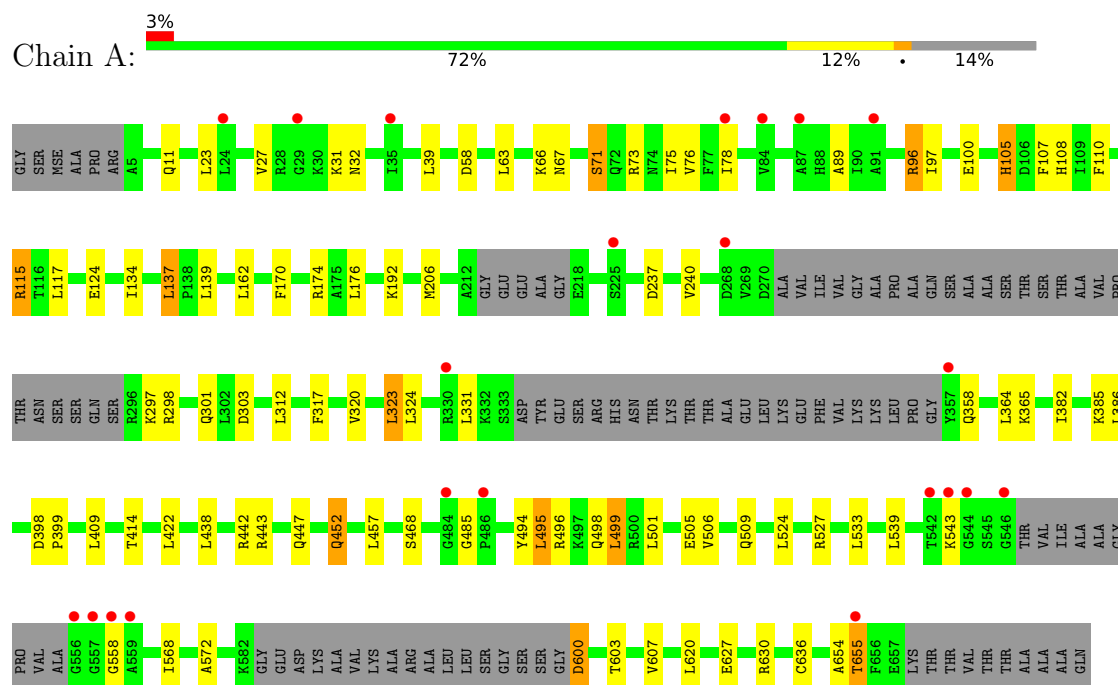
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	118	Total 118	O 118	0	0
4	B	29	Total 29	O 29	0	0

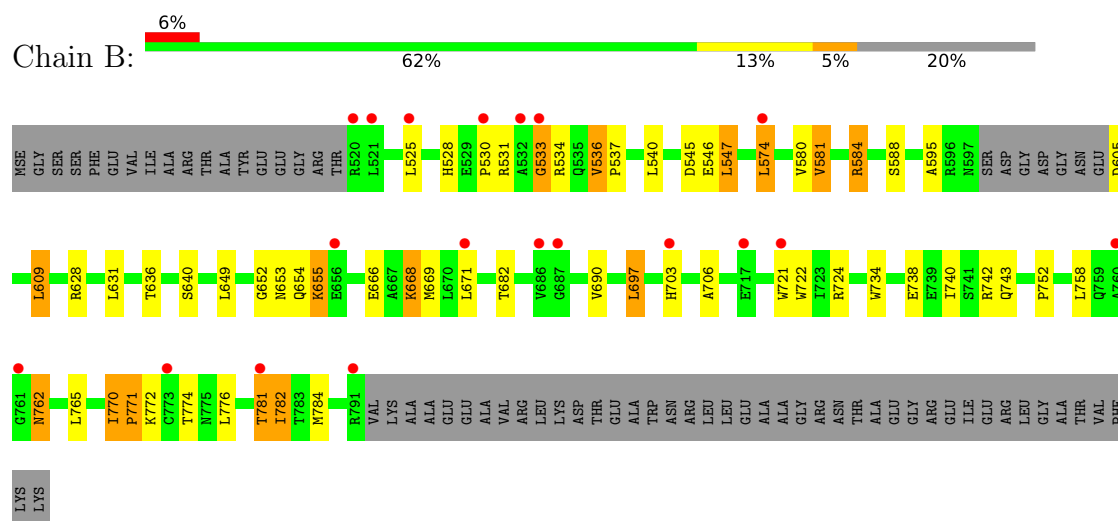
3 Residue-property plots [i](#)

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: Small conjugating protein ligase-like protein



- Molecule 2: Putative vacuolar protein sorting-associated protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	100.27 Å 100.27 Å 176.22 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.66 – 2.60 48.66 – 2.60	Depositor EDS
% Data completeness (in resolution range)	98.1 (48.66-2.60) 98.1 (48.66-2.60)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.65 (at 2.61 Å)	Xtriage
Refinement program	PHENIX 1.8.1 _1168	Depositor
R, R_{free}	0.225 , 0.254 0.226 , 0.256	Depositor DCC
R_{free} test set	1601 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	56.8	Xtriage
Anisotropy	0.197	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 41.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.027 for -h,-k,l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	6810	wwPDB-VP
Average B, all atoms (Å ²)	60.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.32% 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	0.26	0/4597	0.70	1/6185 (0.0%)
2	B	0.28	0/2153	0.71	2/2894 (0.1%)
All	All	0.27	0/6750	0.70	3/9079 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	655	THR	N-CA-C	5.48	117.46	110.61
2	B	584	ARG	CA-C-N	5.15	125.19	119.32
2	B	584	ARG	C-N-CA	5.15	125.19	119.32

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	4536	0	4597	45	0
2	B	2122	0	2138	34	0
3	B	5	0	0	0	0
4	A	118	0	0	2	0
4	B	29	0	0	2	0
All	All	6810	0	6735	76	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 6.

All (76) 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:452:GLN:NE2	1:A:654:ALA:O	2.28	0.67
1:A:312:LEU:HD23	1:A:323:LEU:HD23	1.81	0.62
1:A:539:LEU:O	1:A:543:LYS:N	2.30	0.59
2:B:762:ASN:OD1	2:B:762:ASN:N	2.35	0.58
1:A:600:ASP:OD1	1:A:600:ASP:N	2.36	0.58
1:A:358:GLN:NE2	4:A:814:HOH:O	2.37	0.57
2:B:636:THR:HB	2:B:671:LEU:HD13	1.86	0.57
2:B:697:LEU:HB3	2:B:706:ALA:HB2	1.87	0.56
1:A:607:VAL:HG22	1:A:636:CYS:HB2	1.87	0.56
2:B:776:LEU:HD11	2:B:784:MSE:HE1	1.87	0.55
1:A:447:GLN:HB2	2:B:690:VAL:HB	1.89	0.55
2:B:536:VAL:HG13	2:B:537:PRO:HD3	1.90	0.54
2:B:581:VAL:HG13	2:B:588:SER:HA	1.89	0.52
1:A:73:ARG:HG3	1:A:105:HIS:HA	1.92	0.51
1:A:499:LEU:HD13	1:A:568:ILE:HG21	1.91	0.51
2:B:721:TRP:HZ3	2:B:740:ILE:HD13	1.76	0.50
1:A:627:GLU:OE2	1:A:630:ARG:NH1	2.44	0.50
1:A:174:ARG:HA	1:A:206:MSE:HE1	1.93	0.50
1:A:301:GLN:NE2	1:A:303:ASP:OD2	2.34	0.50
1:A:78:ILE:HG12	1:A:110:PHE:HB2	1.94	0.49
2:B:772:LYS:NZ	4:B:1008:HOH:O	2.36	0.49
1:A:496:ARG:HA	1:A:501:LEU:HB2	1.94	0.49
1:A:137:LEU:HD22	1:A:139:LEU:HG	1.94	0.48
2:B:546:GLU:HG2	2:B:580:VAL:HG13	1.95	0.48
1:A:23:LEU:HD12	1:A:137:LEU:HG	1.95	0.48
2:B:652:GLY:O	2:B:654:GLN:N	2.46	0.47
1:A:443:ARG:O	1:A:447:GLN:HG2	2.15	0.46
2:B:722:TRP:CH2	2:B:752:PRO:HB3	2.50	0.46
1:A:66:LYS:NZ	1:A:89:ALA:O	2.48	0.46
2:B:740:ILE:O	2:B:743:GLN:HG2	2.15	0.46
1:A:494:TYR:HD2	1:A:495:LEU:HD13	1.80	0.46
1:A:365:LYS:NZ	4:A:802:HOH:O	2.47	0.46
1:A:115:ARG:HG3	1:A:134:ILE:HG21	1.96	0.46
1:A:96:ARG:HG3	1:A:100:GLU:OE1	2.16	0.45
1:A:442:ARG:HG2	1:A:457:LEU:HD13	1.99	0.45
2:B:574:LEU:HD13	2:B:574:LEU:HA	1.81	0.45
1:A:170:PHE:CE2	1:A:174:ARG:HD2	2.52	0.45

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:738:GLU:HG2	2:B:742:ARG:HH21	1.81	0.45
2:B:640:SER:HB2	2:B:668:LYS:HD2	1.97	0.45
2:B:545:ASP:O	2:B:547:LEU:N	2.48	0.45
2:B:628:ARG:NH1	4:B:1018:HOH:O	2.50	0.45
2:B:724:ARG:HE	2:B:740:ILE:HD11	1.82	0.45
1:A:58:ASP:N	1:A:58:ASP:OD1	2.50	0.45
1:A:237:ASP:HB3	1:A:240:VAL:HG23	1.99	0.45
2:B:770:ILE:HD11	2:B:781:THR:HG23	1.98	0.45
1:A:385:LYS:HB3	1:A:409:LEU:HD21	2.00	0.44
1:A:443:ARG:NH2	2:B:666:GLU:OE1	2.51	0.44
1:A:438:LEU:HD22	1:A:468:SER:HB2	2.00	0.44
1:A:67:ASN:O	1:A:67:ASN:ND2	2.51	0.44
2:B:776:LEU:HA	2:B:776:LEU:HD12	1.71	0.44
1:A:494:TYR:CE2	1:A:498:GLN:HG3	2.53	0.43
1:A:452:GLN:HE21	1:A:452:GLN:HB2	1.62	0.43
1:A:75:ILE:HB	1:A:107:PHE:HD1	1.83	0.43
1:A:382:ILE:HD13	1:A:414:THR:HG22	2.00	0.43
2:B:697:LEU:HD12	2:B:697:LEU:HA	1.86	0.43
1:A:654:ALA:HB3	2:B:631:LEU:HD13	1.99	0.42
2:B:595:ALA:O	2:B:605:ASP:HB2	2.19	0.42
1:A:317:PHE:HA	1:A:320:VAL:HG23	2.01	0.42
2:B:609:LEU:HD12	2:B:609:LEU:HA	1.84	0.42
1:A:655:THR:O	1:A:655:THR:OG1	2.33	0.42
2:B:540:LEU:HD12	2:B:540:LEU:HA	1.90	0.42
2:B:770:ILE:HD13	2:B:784:MSE:SE	2.70	0.42
1:A:409:LEU:O	1:A:414:THR:HG23	2.19	0.42
2:B:655:LYS:H	2:B:655:LYS:HD3	1.85	0.41
1:A:32:ASN:HD21	1:A:71:SER:HB3	1.85	0.41
1:A:398:ASP:HA	1:A:399:PRO:HD3	1.91	0.41
1:A:76:VAL:HG22	1:A:108:HIS:HB2	2.03	0.41
1:A:192:LYS:HE2	1:A:572:ALA:HB3	2.02	0.41
2:B:734:TRP:HB3	2:B:765:LEU:HD22	2.03	0.41
1:A:386:LEU:HD23	1:A:422:LEU:HD11	2.03	0.41
1:A:331:LEU:HD12	1:A:364:LEU:HD22	2.03	0.41
2:B:531:ARG:O	2:B:533:GLY:N	2.49	0.40
2:B:770:ILE:HD12	2:B:771:PRO:HA	2.03	0.40
2:B:782:ILE:H	2:B:782:ILE:HG13	1.56	0.40
2:B:534:ARG:HD3	2:B:534:ARG:HA	1.67	0.40
1:A:499:LEU:HA	1:A:499:LEU:HD12	1.84	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	562/669 (84%)	528 (94%)	27 (5%)	7 (1%)	10	23
2	B	261/333 (78%)	239 (92%)	15 (6%)	7 (3%)	4	7
All	All	823/1002 (82%)	767 (93%)	42 (5%)	14 (2%)	7	15

All (14) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	506	VAL
2	B	530	PRO
2	B	774	THR
1	A	71	SER
1	A	97	ILE
1	A	505	GLU
2	B	781	THR
1	A	105	HIS
1	A	558	GLY
2	B	533	GLY
2	B	653	ASN
2	B	703	HIS
1	A	485	GLY
2	B	771	PRO

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	494/556 (89%)	468 (95%)	26 (5%)	20	43
2	B	226/272 (83%)	208 (92%)	18 (8%)	11	25
All	All	720/828 (87%)	676 (94%)	44 (6%)	17	37

All (44) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	GLN
1	A	27	VAL
1	A	31	LYS
1	A	39	LEU
1	A	63	LEU
1	A	96	ARG
1	A	115	ARG
1	A	117	LEU
1	A	124	GLU
1	A	137	LEU
1	A	162	LEU
1	A	176	LEU
1	A	297	LYS
1	A	298	ARG
1	A	323	LEU
1	A	324	LEU
1	A	452	GLN
1	A	495	LEU
1	A	499	LEU
1	A	509	GLN
1	A	524	LEU
1	A	527	ARG
1	A	533	LEU
1	A	600	ASP
1	A	603	THR
1	A	620	LEU
2	B	525	LEU
2	B	528	HIS
2	B	536	VAL
2	B	547	LEU
2	B	574	LEU
2	B	581	VAL
2	B	584	ARG
2	B	609	LEU
2	B	649	LEU

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
2	B	655	LYS
2	B	668	LYS
2	B	669	MSE
2	B	682	THR
2	B	697	LEU
2	B	758	LEU
2	B	762	ASN
2	B	770	ILE
2	B	782	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	98	GLN
1	A	452	GLN
1	A	488	GLN
1	A	536	GLN

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](#)

1 ligand is 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	B	901	-	4,4,4	0.24	0	6,6,6	0.08	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	567/669 (84%)	0.20	22 (3%) 43 38	26, 48, 115, 157	0
2	B	258/333 (77%)	0.49	19 (7%) 20 16	39, 62, 115, 134	0
All	All	825/1002 (82%)	0.29	41 (4%) 34 28	26, 54, 115, 157	0

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	357	TYR	5.3
1	A	559	ALA	5.2
1	A	558	GLY	4.9
1	A	546	GLY	4.2
2	B	687	GLY	4.1
1	A	557	GLY	3.9
2	B	520	ARG	3.7
1	A	542	THR	3.4
1	A	35	ILE	3.2
2	B	773	CYS	3.1
2	B	530	PRO	3.0
1	A	87	ALA	3.0
1	A	544	GLY	2.9
2	B	525	LEU	2.9
1	A	655	THR	2.9
2	B	686	VAL	2.9
2	B	532	ALA	2.9
1	A	84	VAL	2.9
1	A	78	ILE	2.8
2	B	721	TRP	2.8
1	A	29	GLY	2.7
1	A	484	GLY	2.7
1	A	556	GLY	2.7
2	B	761	GLY	2.7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	543	LYS	2.6
2	B	760	ALA	2.6
2	B	703	HIS	2.5
2	B	656	GLU	2.5
2	B	533	GLY	2.5
2	B	791	ARG	2.4
2	B	671	LEU	2.4
1	A	486	PRO	2.4
1	A	268	ASP	2.3
2	B	781	THR	2.3
1	A	24	LEU	2.3
2	B	717	GLU	2.2
1	A	91	ALA	2.2
1	A	225	SER	2.2
2	B	574	LEU	2.2
1	A	330	ARG	2.0
2	B	521	LEU	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($\text{\AA}^2$)	Q<0.9
3	SO4	B	901	5/5	0.89	0.09	79,80,81,81	0

6.5 Other polymers [i](#)

There are no such residues in this entry.