



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 02:25 PM UTC

PDB ID : 2WVZ / pdb_00002wvz
Title : Structure of the Family GH92 Inverting Mannosidase BT3990 from *Bacteroides thetaiotaomicron* VPI-5482
Authors : Suits, M.D.L.; Zhu, Y.; Thompson, A.; Gilbert, H.J.; Davies, G.J.
Deposited on : 2009-10-21
Resolution : 2.40 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 ⓘ 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

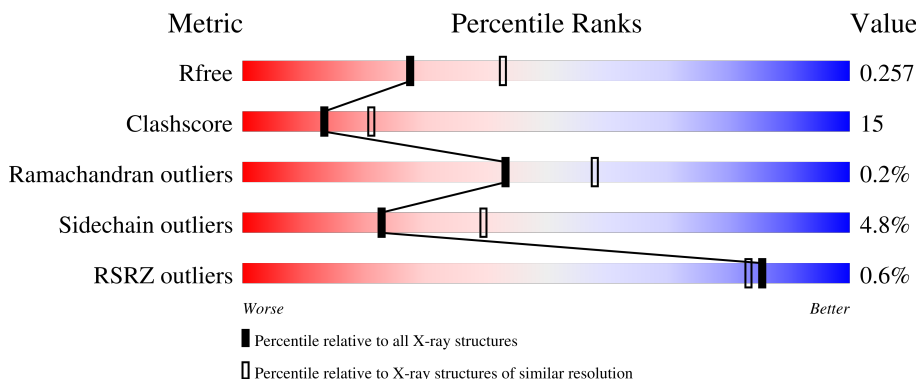
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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 $\leq 5\%$. 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	744	 78% 20% ..
1	B	744	 71% 25% .
1	C	744	 74% 23% ..
1	D	744	 2% 69% 26% ..

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 24878 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.

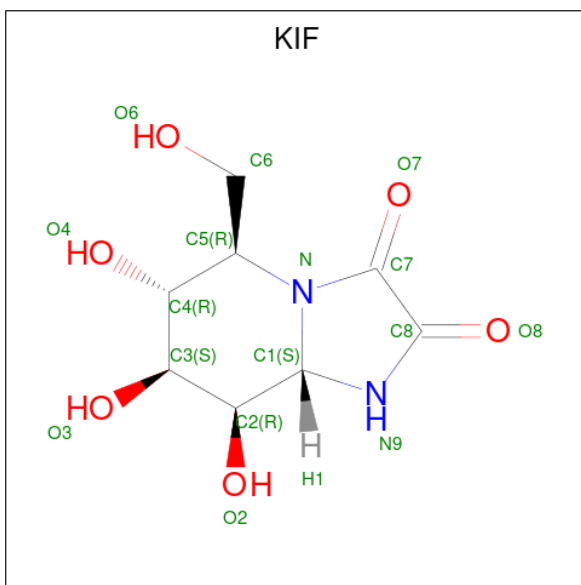
- Molecule 1 is a protein called PUTATIVE ALPHA-1,2-MANNOSIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	738	Total	C	N	O	S	0	2	0
			5994	3847	986	1127	34			
1	B	742	Total	C	N	O	S	0	3	0
			6037	3870	997	1135	35			
1	C	737	Total	C	N	O	S	0	3	0
			5987	3839	984	1130	34			
1	D	736	Total	C	N	O	S	0	1	0
			5970	3828	983	1125	34			

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Ca	0	0
			1	1		
2	B	1	Total	Ca	0	0
			1	1		
2	C	1	Total	Ca	0	0
			1	1		
2	D	1	Total	Ca	0	0
			1	1		

- Molecule 3 is KIFUNENSINE (CCD ID: KIF) (formula: C₈H₁₂N₂O₆).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			16	8	2	6		
3	B	1	Total	C	N	O	0	0
			16	8	2	6		
3	C	1	Total	C	N	O	0	0
			16	8	2	6		
3	D	1	Total	C	N	O	0	0
			16	8	2	6		

- Molecule 4 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	D	1	Total	C	O	0	0
			6	3	3		

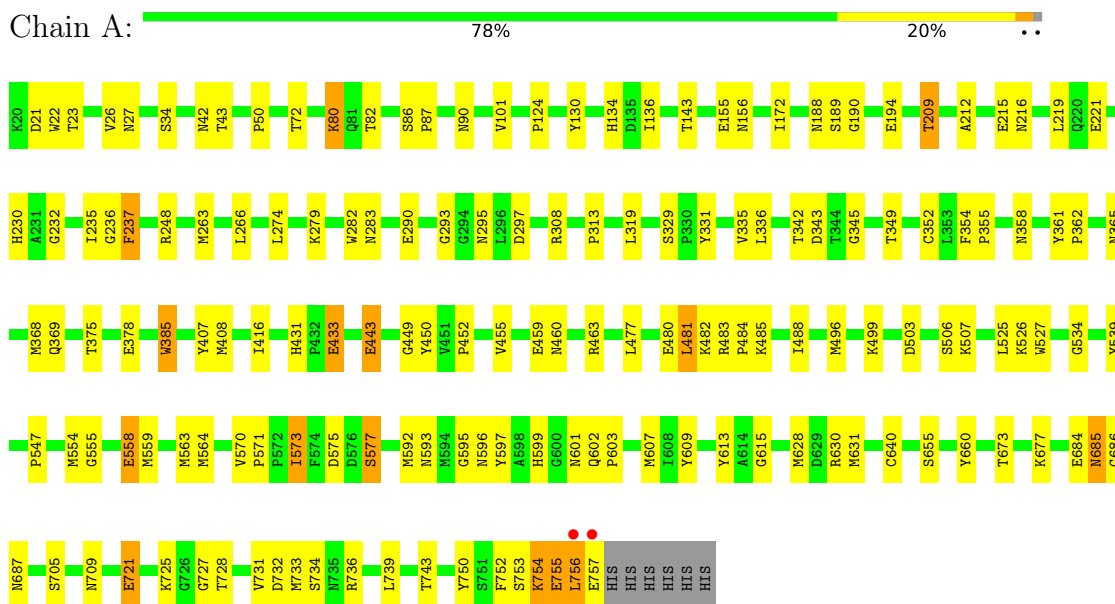
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	244	Total	O	0	0
			244	244		
5	B	179	Total	O	0	0
			179	179		
5	C	203	Total	O	0	0
			203	203		
5	D	166	Total	O	0	0
			166	166		

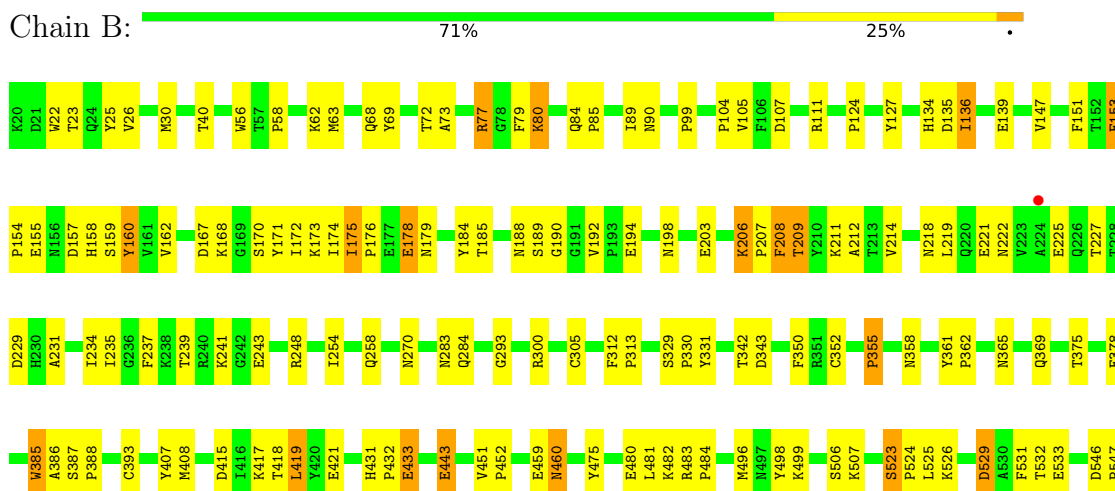
3 Residue-property plots

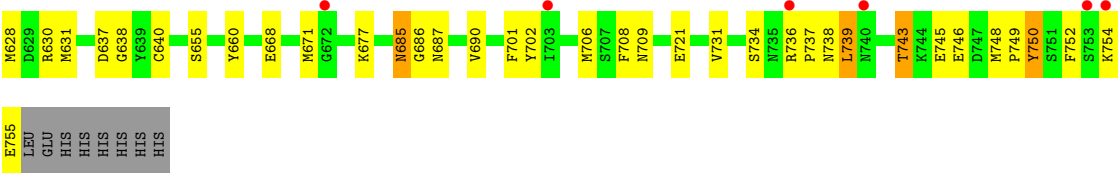
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: PUTATIVE ALPHA-1,2-MANNOSIDASE



• Molecule 1: PUTATIVE ALPHA-1,2-MANNOSIDASE





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	68.90Å 150.19Å 382.29Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	191.14 – 2.40 191.14 – 2.40	Depositor EDS
% Data completeness (in resolution range)	88.1 (191.14-2.40) 88.1 (191.14-2.40)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.08 (at 2.40Å)	Xtriage
Refinement program	REFMAC 5.4.0077	Depositor
R, R_{free}	0.201 , 0.257 0.201 , 0.257	Depositor DCC
R_{free} test set	6859 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å ²)	33.7	Xtriage
Anisotropy	0.071	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 34.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	24878	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.52% 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: KIF, CA, GOL

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	0.70	0/6183	0.95	4/8389 (0.0%)
1	B	0.67	0/6231	0.96	14/8452 (0.2%)
1	C	0.66	0/6177	0.92	7/8379 (0.1%)
1	D	0.64	0/6154	0.97	12/8348 (0.1%)
All	All	0.67	0/24745	0.95	37/33568 (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	B	0	1

There are no bond length outliers.

The worst 5 of 37 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	175	ILE	CA-C-N	9.06	131.16	119.84
1	B	175	ILE	C-N-CA	9.06	131.16	119.84
1	B	523	SER	CA-C-N	8.71	130.73	119.84
1	B	523	SER	C-N-CA	8.71	130.73	119.84
1	A	754	LYS	N-CA-C	-7.36	101.36	110.41

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	756	LEU	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.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5994	0	5664	148	0
1	B	6037	0	5699	180	0
1	C	5987	0	5655	155	0
1	D	5970	0	5640	207	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	16	0	10	0	0
3	B	16	0	10	1	0
3	C	16	0	10	1	0
3	D	16	0	10	1	0
4	A	6	0	8	0	0
4	B	12	0	16	0	0
4	C	6	0	8	0	0
4	D	6	0	8	0	0
5	A	244	0	0	12	0
5	B	179	0	0	20	0
5	C	203	0	0	8	0
5	D	166	0	0	12	0
All	All	24878	0	22738	688	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 15.

The worst 5 of 688 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:C:507:LYS:CE	1:C:559:MET:HE2	1.17	1.61
1:C:507:LYS:CD	1:C:559:MET:HE3	1.31	1.56
1:C:507:LYS:HE3	1:C:559:MET:CE	1.32	1.55
1:C:507:LYS:CE	1:C:559:MET:CE	1.88	1.46
1:C:507:LYS:CD	1:C:559:MET:CE	1.94	1.46

There are no symmetry-related clashes.

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	738/744 (99%)	707 (96%)	30 (4%)	1 (0%)	48	64
1	B	743/744 (100%)	700 (94%)	39 (5%)	4 (0%)	24	37
1	C	738/744 (99%)	695 (94%)	43 (6%)	0	100	100
1	D	735/744 (99%)	692 (94%)	42 (6%)	1 (0%)	48	64
All	All	2954/2976 (99%)	2794 (95%)	154 (5%)	6 (0%)	43	58

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	757	GLU
1	A	755	GLU
1	B	755	GLU
1	B	758	HIS
1	B	529	ASP

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	637/643 (99%)	614 (96%)	23 (4%)	31	52
1	B	643/643 (100%)	607 (94%)	36 (6%)	19	33
1	C	637/643 (99%)	609 (96%)	28 (4%)	25	43
1	D	635/643 (99%)	600 (94%)	35 (6%)	19	34
All	All	2552/2572 (99%)	2430 (95%)	122 (5%)	23	40

5 of 122 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	756	LEU
1	D	596	ASN
1	C	292	GLU
1	D	577	SER
1	D	739	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 72 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	264	ASN
1	D	716	ASN
1	D	358	ASN
1	D	446	ASN
1	B	246	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](#)

Of 13 ligands modelled in this entry, 4 are monoatomic - leaving 9 for Mogul analysis.

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	GOL	D	802	-	5,5,5	0.40	0	5,5,5	0.51	0
3	KIF	A	801	2	15,17,17	1.50	1 (6%)	14,26,26	2.08	3 (21%)
3	KIF	B	801	2	15,17,17	1.11	1 (6%)	14,26,26	2.05	4 (28%)
4	GOL	B	802	-	5,5,5	0.29	0	5,5,5	0.57	0
4	GOL	B	803	-	5,5,5	0.39	0	5,5,5	0.24	0
3	KIF	C	801	2	15,17,17	0.94	1 (6%)	14,26,26	1.96	3 (21%)
4	GOL	A	802	-	5,5,5	0.31	0	5,5,5	0.31	0
3	KIF	D	801	2	15,17,17	1.02	1 (6%)	14,26,26	2.06	3 (21%)
4	GOL	C	802	-	5,5,5	0.36	0	5,5,5	0.72	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	GOL	D	802	-	-	0/4/4/4	-
3	KIF	A	801	2	-	0/2/38/38	0/2/2/2
3	KIF	B	801	2	-	2/2/38/38	0/2/2/2
4	GOL	B	802	-	-	2/4/4/4	-
4	GOL	B	803	-	-	4/4/4/4	-
3	KIF	C	801	2	-	2/2/38/38	0/2/2/2
4	GOL	A	802	-	-	2/4/4/4	-
3	KIF	D	801	2	-	2/2/38/38	0/2/2/2
4	GOL	C	802	-	-	2/4/4/4	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	801	KIF	C1-N9	4.96	1.50	1.44
3	B	801	KIF	C1-N9	2.95	1.48	1.44
3	C	801	KIF	C1-N9	2.73	1.48	1.44
3	D	801	KIF	C1-N9	2.59	1.47	1.44

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	801	KIF	C8-C7-N	5.35	110.50	106.20
3	C	801	KIF	C7-C8-N9	5.25	110.46	105.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	801	KIF	C7-C8-N9	4.90	110.12	105.30
3	B	801	KIF	C7-C8-N9	4.66	109.89	105.30
3	A	801	KIF	C7-C8-N9	4.59	109.82	105.30

There are no chirality outliers.

5 of 16 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	801	KIF	C4-C5-C6-O6
3	C	801	KIF	C4-C5-C6-O6
3	D	801	KIF	C4-C5-C6-O6
4	A	802	GOL	O1-C1-C2-C3
4	B	802	GOL	C1-C2-C3-O3

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	801	KIF	1	0
3	C	801	KIF	1	0
3	D	801	KIF	1	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	738/744 (99%)	-0.45	2 (0%) 90 88	12, 26, 40, 62	2 (0%)
1	B	742/744 (99%)	-0.07	3 (0%) 88 86	18, 33, 51, 60	3 (0%)
1	C	737/744 (99%)	-0.34	1 (0%) 92 90	17, 30, 43, 50	3 (0%)
1	D	736/744 (98%)	0.03	13 (1%) 67 63	17, 35, 63, 76	1 (0%)
All	All	2953/2976 (99%)	-0.21	19 (0%) 85 83	12, 30, 54, 76	9 (0%)

The worst 5 of 19 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	756	LEU	4.2
1	A	756	LEU	4.1
1	A	757	GLU	2.9
1	C	756	LEU	2.9
1	D	753	SER	2.6

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 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
4	GOL	B	802	6/6	0.61	0.21	55,55,56,56	0
4	GOL	C	802	6/6	0.78	0.17	44,46,46,48	0
4	GOL	B	803	6/6	0.86	0.16	59,60,61,61	0
4	GOL	A	802	6/6	0.87	0.17	54,57,57,57	0
3	KIF	B	801	16/16	0.91	0.09	31,36,37,38	0
4	GOL	D	802	6/6	0.91	0.13	44,45,45,45	0
3	KIF	D	801	16/16	0.93	0.09	33,38,40,40	0
3	KIF	A	801	16/16	0.93	0.09	21,26,30,30	0
3	KIF	C	801	16/16	0.93	0.08	32,35,37,38	0
2	CA	C	800	1/1	0.97	0.04	26,26,26,26	0
2	CA	B	800	1/1	0.97	0.06	30,30,30,30	0
2	CA	D	800	1/1	0.99	0.02	45,45,45,45	0
2	CA	A	800	1/1	0.99	0.03	32,32,32,32	0

6.5 Other polymers [i](#)

There are no such residues in this entry.