Full wwPDB X-ray Structure Validation Report (i)

Jun 16, 2024 – 01:34 PM EDT

PDB ID	:	4ZTB
Title	:	Crystal structure of nsP2 protease from Chikungunya virus in P212121 space group at 2.59 A (4molecules/ASU).
Authors	:	Narwal, M.; Pratap, S.; Singh, H.; Kumar, P.; Tomar, S.
Deposited on	:	2015-05-14
Resolution	:	2.59 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 (i) 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 (i)) were used in the production of this report:

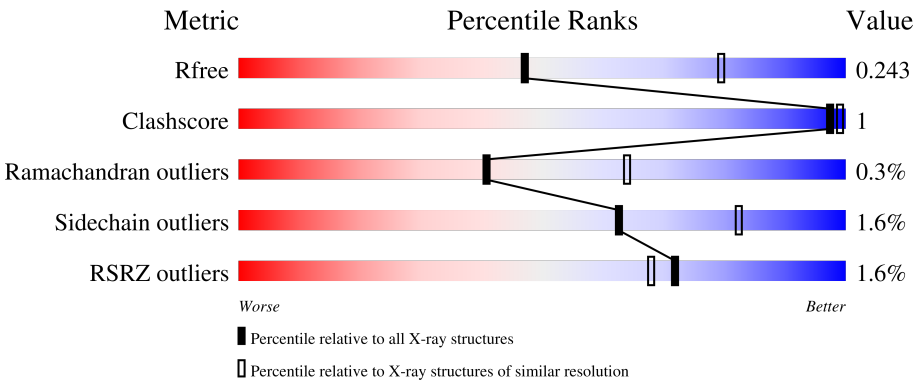
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.37.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.59 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}	130704	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (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 <=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	321	2% 93% 6% •
1	B	321	96% •
1	C	321	% 96% •
1	D	321	3% 95% 5%

2 Entry composition (i)

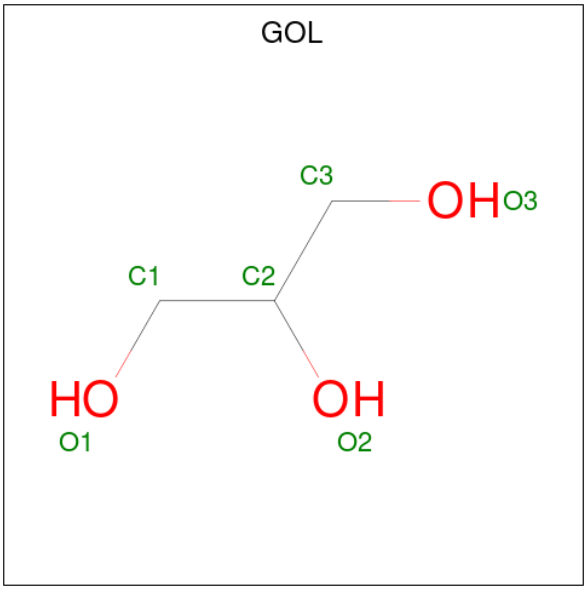
There are 3 unique types of molecules in this entry. The entry contains 10617 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Protease nsP2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	321	2574	1643	467	451	13	0	0	0
1	B	321	2574	1643	467	451	13	0	0	0
1	C	321	2574	1643	467	451	13	0	0	0
1	D	321	2574	1643	467	451	13	0	0	0

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



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

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	C	1	6	3	3	0	0
			Total	C	O		
2	C	1	6	3	3	0	0
			Total	C	O		
2	C	1	6	3	3	0	0
			Total	C	O		
2	D	1	6	3	3	0	0
			Total	C	O		
2	D	1	6	3	3	0	0
			Total	C	O		
2	D	1	6	3	3	0	0
			Total	C	O		
2	D	1	6	3	3	0	0
			Total	C	O		
2	D	1	6	3	3	0	0

- Molecule 3 is water.

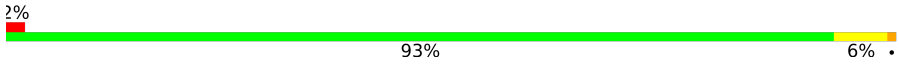
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	69	69	69	0	0
			Total	O		
3	B	72	72	72	0	0
			Total	O		
3	C	71	71	71	0	0
			Total	O		
3	D	49	49	49	0	0

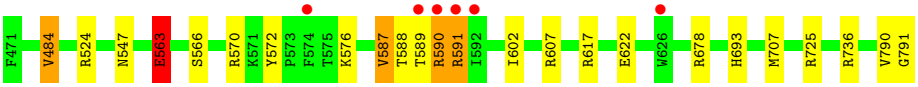
3 Residue-property plots (i)

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: Protease nsP2

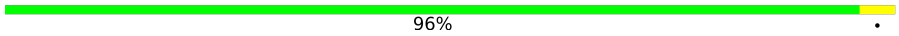
Chain A:

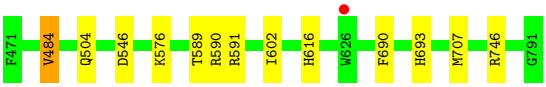




• Molecule 1: Protease nsP2

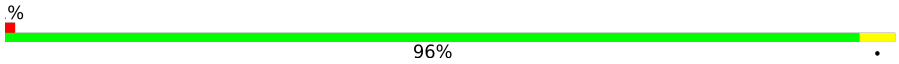
Chain B:

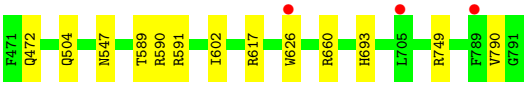




• Molecule 1: Protease nsP2

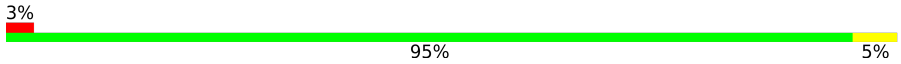
Chain C:

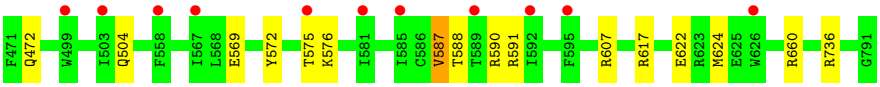




• Molecule 1: Protease nsP2

Chain D:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	87.04Å 158.96Å 158.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.21 – 2.59 47.21 – 2.59	Depositor EDS
% Data completeness (in resolution range)	82.2 (47.21-2.59) 82.2 (47.21-2.59)	Depositor EDS
R_{merge}	0.20	Depositor
R_{sym}	0.20	Depositor
$< I/\sigma(I) >$ [1]	1.09 (at 2.58Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.210 , 0.242 0.213 , 0.243	Depositor DCC
R_{free} test set	2877 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å^2)	47.9	Xtriage
Anisotropy	0.059	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 21.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.349 for -h,l,k	Xtriage
Reported twinning fraction	0.639 for H, K, L 0.361 for -H, L, K	Depositor
Outliers	7 of 56663 reflections (0.012%)	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	10617	wwPDB-VP
Average B, all atoms (Å^2)	60.0	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 22.89 % 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 5.2047e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: 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	0.83	3/2639 (0.1%)	0.91	12/3578 (0.3%)
1	B	0.80	1/2639 (0.0%)	0.84	2/3578 (0.1%)
1	C	0.79	1/2639 (0.0%)	0.84	3/3578 (0.1%)
1	D	0.81	1/2639 (0.0%)	0.88	6/3578 (0.2%)
All	All	0.81	6/10556 (0.1%)	0.87	23/14312 (0.2%)

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	563	GLU	CB-CG	7.66	1.66	1.52
1	A	622	GLU	CB-CG	5.99	1.63	1.52
1	D	622	GLU	CB-CG	5.87	1.63	1.52
1	C	790	VAL	CA-CB	5.50	1.66	1.54
1	A	566	SER	CA-CB	5.50	1.61	1.52
1	B	546	ASP	CA-CB	5.49	1.66	1.53

All (23) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	678	ARG	NE-CZ-NH1	8.31	124.46	120.30
1	A	591	ARG	NE-CZ-NH1	7.34	123.97	120.30
1	A	587	VAL	CB-CA-C	7.07	124.83	111.40
1	D	736	ARG	NE-CZ-NH1	7.03	123.81	120.30
1	D	587	VAL	CB-CA-C	6.92	124.55	111.40
1	A	607	ARG	NE-CZ-NH1	6.66	123.63	120.30
1	A	736	ARG	NE-CZ-NH1	6.65	123.62	120.30
1	D	736	ARG	NE-CZ-NH2	-6.57	117.02	120.30
1	C	617	ARG	NE-CZ-NH1	6.44	123.52	120.30
1	B	484	VAL	CB-CA-C	-6.35	99.33	111.40
1	A	617	ARG	NE-CZ-NH1	6.34	123.47	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	736	ARG	NE-CZ-NH2	-6.29	117.15	120.30
1	A	484	VAL	CB-CA-C	-6.29	99.45	111.40
1	D	607	ARG	NE-CZ-NH1	6.23	123.42	120.30
1	C	626	TRP	CA-CB-CG	6.19	125.46	113.70
1	D	617	ARG	NE-CZ-NH1	6.12	123.36	120.30
1	A	678	ARG	NE-CZ-NH2	-5.99	117.31	120.30
1	B	746	ARG	NE-CZ-NH1	5.58	123.09	120.30
1	C	749	ARG	NE-CZ-NH1	5.47	123.04	120.30
1	A	524	ARG	NE-CZ-NH1	5.35	122.98	120.30
1	A	590	ARG	NE-CZ-NH1	5.11	122.86	120.30
1	A	725	ARG	NE-CZ-NH1	5.00	122.80	120.30
1	D	624	MET	CG-SD-CE	5.00	108.20	100.20

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	2574	0	2579	7	0
1	B	2574	0	2579	5	0
1	C	2574	0	2579	3	0
1	D	2574	0	2579	5	0
2	A	6	0	8	0	0
2	B	6	0	8	0	0
2	C	18	0	24	0	0
2	D	30	0	40	0	0
3	A	69	0	0	0	0
3	B	72	0	0	0	0
3	C	71	0	0	0	0
3	D	49	0	0	0	0
All	All	10617	0	10396	17	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 1.

All (17) 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:D:572:TYR:O	1:D:575:THR:HG22	1.83	0.79
1:A:791:GLY:HA2	1:B:602:ILE:HD12	1.65	0.77
1:B:707:MET:SD	1:C:660:ARG:NH1	2.81	0.54
1:A:563:GLU:N	1:A:563:GLU:OE2	2.43	0.51
1:B:616:HIS:HB2	1:B:690:PHE:CE2	2.47	0.48
1:A:707:MET:SD	1:D:660:ARG:NH1	2.86	0.47
1:D:572:TYR:CD2	1:D:587:VAL:HG21	2.52	0.45
1:C:602:ILE:HD11	1:C:693:HIS:CD2	2.53	0.44
1:D:569:GLU:HG2	1:D:575:THR:HG23	1.99	0.44
1:B:602:ILE:HD11	1:B:693:HIS:CD2	2.54	0.43
1:A:572:TYR:CD2	1:A:587:VAL:HG21	2.53	0.43
1:A:572:TYR:CE2	1:A:587:VAL:HG21	2.54	0.43
1:D:572:TYR:CE2	1:D:587:VAL:HG21	2.55	0.42
1:A:602:ILE:HD11	1:A:693:HIS:CE1	2.57	0.40
1:A:589:THR:O	1:A:591:ARG:N	2.53	0.40
1:B:589:THR:O	1:B:591:ARG:N	2.54	0.40
1:C:589:THR:O	1:C:591:ARG:N	2.54	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	319/321 (99%)	302 (95%)	16 (5%)	1 (0%)	41	64
1	B	319/321 (99%)	302 (95%)	16 (5%)	1 (0%)	41	64
1	C	319/321 (99%)	303 (95%)	15 (5%)	1 (0%)	41	64
1	D	319/321 (99%)	302 (95%)	16 (5%)	1 (0%)	41	64
All	All	1276/1284 (99%)	1209 (95%)	63 (5%)	4 (0%)	41	64

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	590	ARG
1	B	590	ARG
1	C	590	ARG
1	D	590	ARG

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	278/278 (100%)	271 (98%)	7 (2%)	47	73
1	B	278/278 (100%)	275 (99%)	3 (1%)	73	88
1	C	278/278 (100%)	275 (99%)	3 (1%)	73	88
1	D	278/278 (100%)	273 (98%)	5 (2%)	59	80
All	All	1112/1112 (100%)	1094 (98%)	18 (2%)	62	82

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	484	VAL
1	A	547	ASN
1	A	563	GLU
1	A	570	ARG
1	A	576	LYS
1	A	588	THR
1	A	790	VAL
1	B	484	VAL
1	B	504	GLN
1	B	576	LYS
1	C	472	GLN
1	C	504	GLN
1	C	547	ASN
1	D	472	GLN
1	D	504	GLN
1	D	576	LYS
1	D	588	THR
1	D	591	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	783	ASN
1	B	693	HIS
1	B	771	ASN
1	C	693	HIS
1	C	779	HIS
1	C	783	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

10 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	GOL	A	801	-	5,5,5	0.51	0	5,5,5	0.27	0
2	GOL	C	802	-	5,5,5	0.35	0	5,5,5	0.69	0
2	GOL	B	801	-	5,5,5	0.86	0	5,5,5	0.91	0
2	GOL	D	802	-	5,5,5	0.83	0	5,5,5	0.41	0
2	GOL	D	801	-	5,5,5	0.80	0	5,5,5	0.33	0
2	GOL	C	801	-	5,5,5	0.55	0	5,5,5	0.62	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	GOL	D	804	-	5,5,5	0.53	0	5,5,5	0.36	0
2	GOL	C	803	-	5,5,5	0.65	0	5,5,5	0.62	0
2	GOL	D	803	-	5,5,5	0.51	0	5,5,5	0.35	0
2	GOL	D	805	-	5,5,5	0.86	0	5,5,5	0.54	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
2	GOL	A	801	-	-	1/4/4/4	-
2	GOL	C	802	-	-	2/4/4/4	-
2	GOL	B	801	-	-	2/4/4/4	-
2	GOL	D	802	-	-	4/4/4/4	-
2	GOL	D	801	-	-	2/4/4/4	-
2	GOL	C	801	-	-	1/4/4/4	-
2	GOL	D	804	-	-	1/4/4/4	-
2	GOL	C	803	-	-	3/4/4/4	-
2	GOL	D	803	-	-	3/4/4/4	-
2	GOL	D	805	-	-	4/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (23) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	803	GOL	O1-C1-C2-C3
2	D	801	GOL	O1-C1-C2-C3
2	D	805	GOL	O1-C1-C2-O2
2	D	805	GOL	O1-C1-C2-C3
2	B	801	GOL	O1-C1-C2-C3
2	C	802	GOL	C1-C2-C3-O3
2	D	802	GOL	O1-C1-C2-C3
2	D	802	GOL	C1-C2-C3-O3
2	D	805	GOL	C1-C2-C3-O3
2	C	802	GOL	O2-C2-C3-O3
2	C	803	GOL	O1-C1-C2-O2

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Mol	Chain	Res	Type	Atoms
2	D	801	GOL	O1-C1-C2-O2
2	D	805	GOL	O2-C2-C3-O3
2	B	801	GOL	O1-C1-C2-O2
2	D	802	GOL	O1-C1-C2-O2
2	D	802	GOL	O2-C2-C3-O3
2	D	803	GOL	O1-C1-C2-O2
2	C	803	GOL	C1-C2-C3-O3
2	D	804	GOL	O2-C2-C3-O3
2	C	801	GOL	O1-C1-C2-C3
2	D	803	GOL	O1-C1-C2-C3
2	D	803	GOL	C1-C2-C3-O3
2	A	801	GOL	C1-C2-C3-O3

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	321/321 (100%)	0.52	6 (1%)	66	62	42, 58, 89, 113	0
1	B	321/321 (100%)	0.52	1 (0%)	94	93	45, 58, 76, 97	0
1	C	321/321 (100%)	0.48	3 (0%)	84	82	44, 57, 78, 94	0
1	D	321/321 (100%)	0.59	11 (3%)	45	38	42, 61, 89, 106	0
All	All	1284/1284 (100%)	0.53	21 (1%)	72	68	42, 58, 84, 113	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	589	THR	2.7
1	A	589	THR	2.6
1	D	575	THR	2.6
1	A	626	TRP	2.6
1	A	591	ARG	2.5
1	A	592	ILE	2.5
1	A	574	PHE	2.5
1	D	595	PHE	2.5
1	B	626	TRP	2.5
1	D	499	TRP	2.5
1	D	567	ILE	2.5
1	D	626	TRP	2.5
1	C	626	TRP	2.4
1	A	590	ARG	2.4
1	C	705	LEU	2.3
1	D	581	ILE	2.2
1	D	592	ILE	2.2
1	D	558	PHE	2.2
1	C	789	PHE	2.1
1	D	503	ILE	2.0
1	D	585	ILE	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 monosaccharides 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
2	GOL	B	801	6/6	0.88	0.15	48,55,56,56	0
2	GOL	C	801	6/6	0.92	0.30	63,70,72,72	0
2	GOL	D	802	6/6	0.92	0.28	57,64,65,67	0
2	GOL	C	803	6/6	0.95	0.15	58,60,61,61	0
2	GOL	A	801	6/6	0.95	0.26	65,71,74,78	0
2	GOL	D	803	6/6	0.95	0.10	69,74,75,75	0
2	GOL	C	802	6/6	0.97	0.16	54,58,60,60	0
2	GOL	D	801	6/6	0.97	0.14	50,53,54,54	0
2	GOL	D	804	6/6	0.97	0.18	62,66,70,71	0
2	GOL	D	805	6/6	0.97	0.16	51,60,62,62	0

6.5 Other polymers (i)

There are no such residues in this entry.