wwPDB X-ray Structure Validation Summary Report (i)

Jun 13, 2024 – 10:03 AM EDT

PDB ID	:	1NF5
Title	:	Crystal Structure of Lactose Synthase, Complex with Glucose
Authors	:	Ramakrishnan, B.; Qasba, P.K.
Deposited on	:	2002-12-13
Resolution	:	2.00 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 (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:

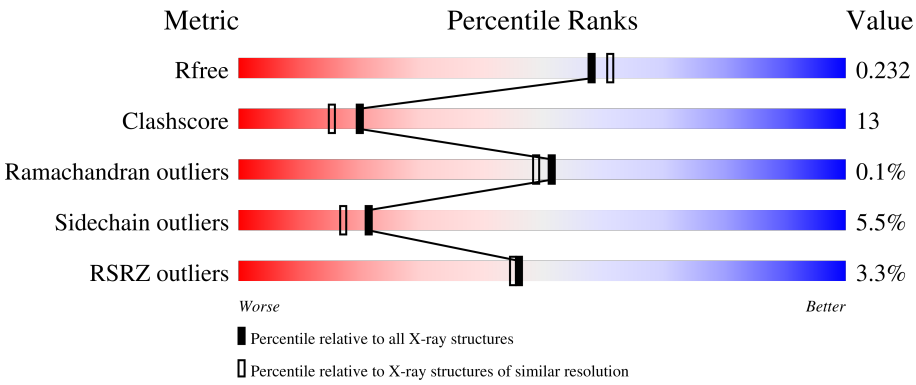
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 2.00 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}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (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 <=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	123	2%, 76%, 20%, • •
1	C	123	2%, 80%, 18%, •
2	B	286	5%, 71%, 20%, •, 5%
2	D	286	2%, 73%, 20%, •, 5%

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 7037 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 Alpha-lactalbumin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	123	980	620	156	195	9	0	0	0
1	C	123	980	620	156	195	9	0	0	0

- Molecule 2 is a protein called beta-1,4-galactosyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	272	2218	1424	382	398	14	0	0	0
2	D	272	2218	1424	382	398	14	0	0	0

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	117	ALA	-	see remark 999	UNP P08037
B	118	SER	-	see remark 999	UNP P08037
B	119	MET	-	see remark 999	UNP P08037
B	120	THR	-	see remark 999	UNP P08037
B	121	GLY	-	see remark 999	UNP P08037
B	122	GLY	-	see remark 999	UNP P08037
B	123	GLN	-	see remark 999	UNP P08037
B	124	GLN	-	see remark 999	UNP P08037
B	125	MET	-	see remark 999	UNP P08037
B	126	GLY	-	see remark 999	UNP P08037
B	127	ARG	-	see remark 999	UNP P08037
B	128	GLY	-	see remark 999	UNP P08037
B	129	SER	-	see remark 999	UNP P08037
D	117	ALA	-	see remark 999	UNP P08037
D	118	SER	-	see remark 999	UNP P08037
D	119	MET	-	see remark 999	UNP P08037

Continued on next page...

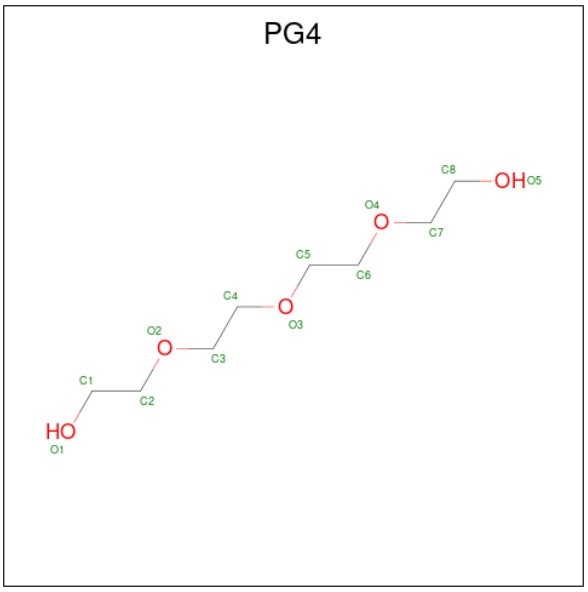
Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
D	120	THR	-	see remark 999	UNP P08037
D	121	GLY	-	see remark 999	UNP P08037
D	122	GLY	-	see remark 999	UNP P08037
D	123	GLN	-	see remark 999	UNP P08037
D	124	GLN	-	see remark 999	UNP P08037
D	125	MET	-	see remark 999	UNP P08037
D	126	GLY	-	see remark 999	UNP P08037
D	127	ARG	-	see remark 999	UNP P08037
D	128	GLY	-	see remark 999	UNP P08037
D	129	SER	-	see remark 999	UNP P08037

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

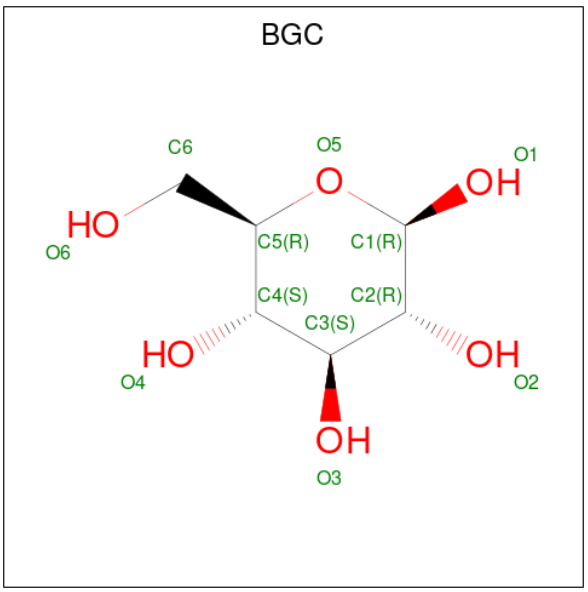
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
3	A	1	1	1	0	0
			Total	Ca		
3	C	1	1	1	0	0

- Molecule 4 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula: $C_8H_{18}O_5$).



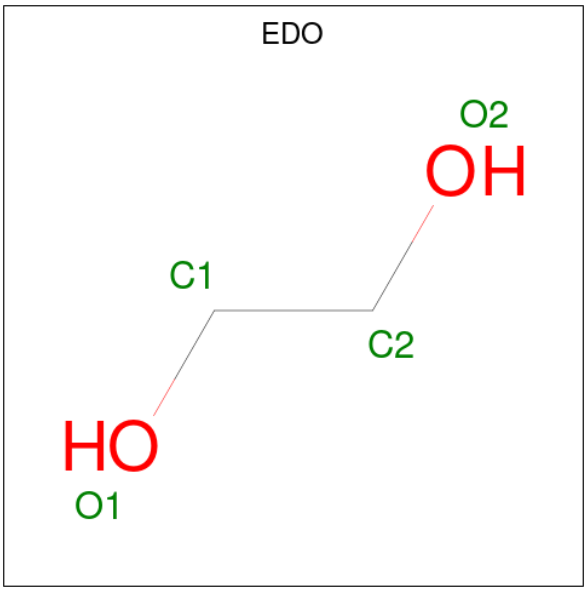
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
4	A	1	10	6	4	0	0
			Total	C	O		
4	B	1	10	6	4	0	0

- Molecule 5 is beta-D-glucopyranose (three-letter code: BGC) (formula: $C_6H_{12}O_6$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
5	B	1	12	6	6	0	0
			Total	C	O		
5	D	1	12	6	6	0	0

- Molecule 6 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
6	C	1	4	2	2	0	0

- Molecule 7 is water.

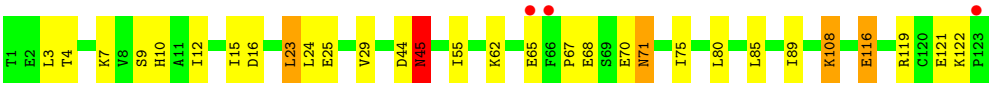
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
7	A	106	106	106	0	0
			Total	O		
7	B	181	181	181	0	0
			Total	O		
7	C	119	119	119	0	0
			Total	O		
7	D	185	185	185	0	0

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: Alpha-lactalbumin

Chain A:

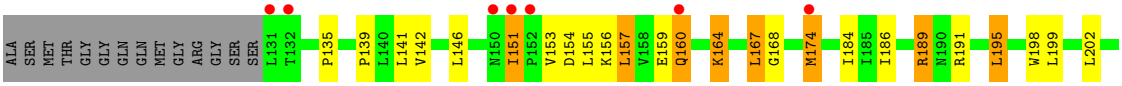


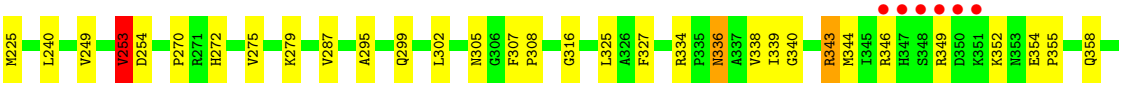
- Molecule 1: Alpha-lactalbumin

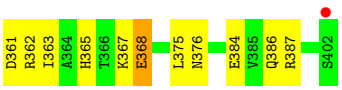
Chain C:

- Molecule 2: beta-1,4-galactosyltransferase

Chain B:

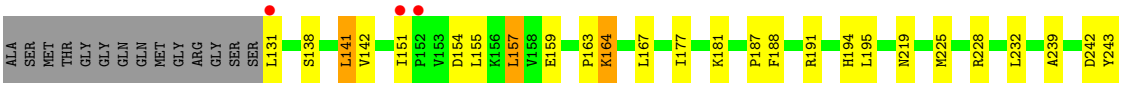


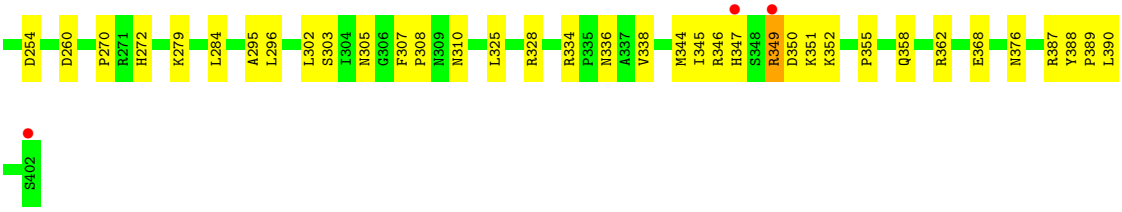




- Molecule 2: beta-1,4-galactosyltransferase

Chain D:




D254
D260
P270
R271
H272
K279
L284
A295
L296
L302
S303
I304
N305
G306
F307
P308
N309
N310
L325
R328
R334
P335
N336
A337
V338
M344
I345
R346
H347
S348
R349
D350
K351
K352
P355
Q358
R362
E368
N376
R387
Y388
P389
L390
S402

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	57.22Å 93.90Å 99.97Å 90.00° 101.50° 90.00°	Depositor
Resolution (Å)	24.73 – 2.00 24.73 – 1.99	Depositor EDS
% Data completeness (in resolution range)	81.7 (24.73-2.00) 80.8 (24.73-1.99)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$< I/\sigma(I) >$ [1]	1.90 (at 1.99Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.190 , 0.241 0.182 , 0.232	Depositor DCC
R_{free} test set	2893 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	25.8	Xtriage
Anisotropy	0.236	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 54.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	7037	wwPDB-VP
Average B, all atoms (Å^2)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.55% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: BGC, PG4, CA, EDO

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	0.57	0/1001	0.78	1/1350 (0.1%)
1	C	0.59	0/1001	0.79	1/1350 (0.1%)
2	B	0.53	0/2278	0.75	1/3085 (0.0%)
2	D	0.53	0/2278	0.77	1/3085 (0.0%)
All	All	0.54	0/6558	0.76	4/8870 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	253	VAL	CB-CA-C	-5.83	100.32	111.40
2	D	284	LEU	CA-CB-CG	5.72	128.47	115.30
1	C	87	ASP	CB-CG-OD1	5.14	122.93	118.30
1	A	45	ASN	O-C-N	-5.10	114.53	123.20

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	980	0	936	28	0
1	C	980	0	936	25	0
2	B	2218	0	2185	60	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	2218	0	2185	49	0
3	A	1	0	0	0	0
3	C	1	0	0	0	0
4	A	10	0	13	0	0
4	B	10	0	13	0	0
5	B	12	0	12	0	0
5	D	12	0	12	2	0
6	C	4	0	6	0	0
7	A	106	0	0	3	0
7	B	181	0	0	1	0
7	C	119	0	0	2	0
7	D	185	0	0	1	0
All	All	7037	0	6298	160	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 13.

The worst 5 of 160 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:44:ASP:C	1:A:45:ASN:HD22	1.52	1.13
2:B:343:ARG:HG2	2:B:343:ARG:HH11	1.16	1.09
2:B:151:ILE:HD12	2:B:151:ILE:H	1.28	0.99
2:B:336:ASN:HD22	2:B:338:VAL:H	1.20	0.89
2:B:343:ARG:HH11	2:B:343:ARG:CG	1.87	0.88

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	121/123 (98%)	119 (98%)	1 (1%)	1 (1%)	19	13
1	C	121/123 (98%)	117 (97%)	4 (3%)	0	100	100
2	B	270/286 (94%)	259 (96%)	11 (4%)	0	100	100
2	D	270/286 (94%)	263 (97%)	7 (3%)	0	100	100
All	All	782/818 (96%)	758 (97%)	23 (3%)	1 (0%)	51	49

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	45	ASN

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	109/109 (100%)	102 (94%)	7 (6%)	17	13
1	C	109/109 (100%)	106 (97%)	3 (3%)	43	44
2	B	245/254 (96%)	224 (91%)	21 (9%)	10	6
2	D	245/254 (96%)	237 (97%)	8 (3%)	38	37
All	All	708/726 (98%)	669 (94%)	39 (6%)	21	17

5 of 39 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	71	ASN
2	D	302	LEU
1	C	85	LEU
2	D	157	LEU
2	D	355	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	310	ASN
2	D	305	ASN
1	C	39	GLN
2	D	194	HIS
1	C	32	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 7 ligands modelled in this entry, 2 are monoatomic - leaving 5 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	$\#\|Z\| > 2$
5	BGC	D	527	-	12,12,12	1.17	1 (8%)	17,17,17	2.33	9 (52%)
4	PG4	B	404	-	9,9,12	0.43	0	8,8,11	0.31	0
5	BGC	B	403	-	12,12,12	1.05	1 (8%)	17,17,17	1.86	3 (17%)
6	EDO	C	128	-	3,3,3	0.44	0	2,2,2	0.09	0
4	PG4	A	126	-	9,9,12	0.48	0	8,8,11	0.27	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
5	BGC	D	527	-	-	0/2/22/22	0/1/1/1
4	PG4	B	404	-	-	4/7/7/10	-
5	BGC	B	403	-	-	1/2/22/22	0/1/1/1
6	EDO	C	128	-	-	1/1/1/1	-
4	PG4	A	126	-	-	3/7/7/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	D	527	BGC	O5-C5	2.44	1.50	1.44
5	B	403	BGC	O5-C5	2.38	1.50	1.44

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	B	403	BGC	O5-C5-C6	-4.75	94.62	106.44
5	D	527	BGC	O5-C5-C6	-4.28	95.79	106.44
5	D	527	BGC	O5-C1-C2	4.18	117.75	110.28
5	D	527	BGC	O1-C1-C2	3.35	118.48	109.03
5	D	527	BGC	O3-C3-C4	-3.33	102.65	110.35

There are no chirality outliers.

5 of 9 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	404	PG4	O3-C5-C6-O4
4	A	126	PG4	O1-C1-C2-O2
4	B	404	PG4	O1-C1-C2-O2
5	B	403	BGC	C4-C5-C6-O6
4	B	404	PG4	C6-C5-O3-C4

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	D	527	BGC	2	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	123/123 (100%)	-0.44	3 (2%)	59	57	18, 26, 51, 63	0
1	C	123/123 (100%)	-0.37	3 (2%)	59	57	15, 23, 43, 70	0
2	B	272/286 (95%)	-0.20	14 (5%)	28	27	18, 28, 52, 73	0
2	D	272/286 (95%)	-0.32	6 (2%)	62	60	17, 27, 51, 61	0
All	All	790/818 (96%)	-0.31	26 (3%)	46	45	15, 27, 51, 73	0

The worst 5 of 26 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	123	PRO	6.8
2	B	402	SER	5.2
1	C	122	LYS	4.8
2	B	351	LYS	4.5
2	B	348	SER	4.4

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
4	PG4	B	404	10/13	0.84	0.17	50,52,53,54	0
6	EDO	C	128	4/4	0.86	0.24	50,50,51,52	0
4	PG4	A	126	10/13	0.89	0.16	44,47,50,50	0
5	BGC	D	527	12/12	0.97	0.10	17,19,20,21	0
5	BGC	B	403	12/12	0.98	0.10	19,21,24,24	0
3	CA	A	124	1/1	0.99	0.07	24,24,24,24	0
3	CA	C	526	1/1	1.00	0.09	24,24,24,24	0

6.5 Other polymers (i)

There are no such residues in this entry.