



wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 11, 2017 – 03:47 PM EST

PDB ID : 5G60
Title : S.pneumoniae ABC-transporter substrate binding protein FusA in complex with nystose
Authors : Culurgioni, S.; Harris, G.; Singh, A.K.; King, S.J.; Walsh, M.A.
Deposited on : 2016-06-10
Resolution : 1.99 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20028442
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20028442

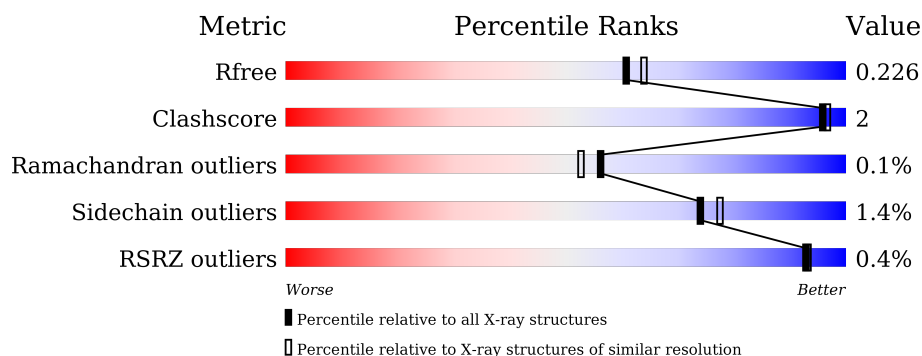
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.99 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}	91344	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	494	<div> <div style="width: 93%;"></div> <div style="width: 5%;"></div> <div style="width: 2%;"></div> <div style="width: 2%;"></div> </div> 93% 5% ..
1	B	494	<div> <div style="width: 95%;"></div> <div style="width: 4%;"></div> <div style="width: 1%;"></div> </div> 95% ..
1	C	494	<div> <div style="width: 94%;"></div> <div style="width: 5%;"></div> <div style="width: 1%;"></div> </div> 94% 5% .
1	D	494	<div> <div style="width: 91%;"></div> <div style="width: 7%;"></div> <div style="width: 2%;"></div> </div> 91% 7% ..

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	GOL	D	1535	-	-	-	X

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 17548 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.

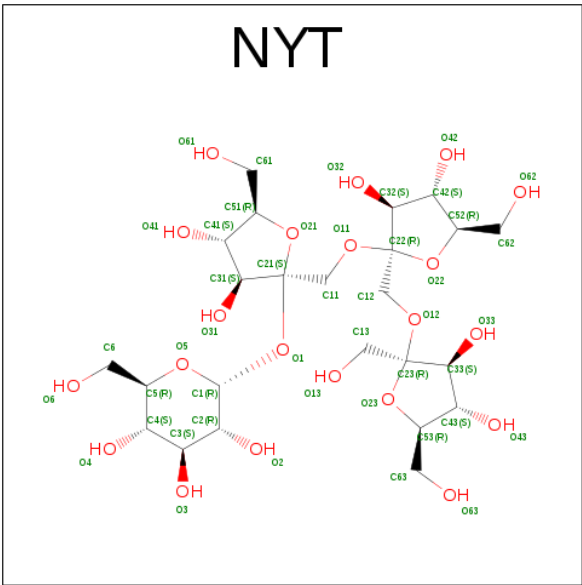
- Molecule 1 is a protein called ABC TRANSPORTER, SUBSTRATE-BINDING PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	488	Total	C	N	O	S	0	0	0
			3884	2472	640	760	12			
1	B	489	Total	C	N	O	S	0	0	0
			3934	2502	648	772	12			
1	C	491	Total	C	N	O	S	0	0	0
			3943	2507	650	774	12			
1	D	487	Total	C	N	O	S	0	0	0
			3924	2496	646	770	12			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	45	GLY	-	EXPRESSION TAG	UNP A0A0H2URD6
A	46	PRO	-	EXPRESSION TAG	UNP A0A0H2URD6
B	45	GLY	-	EXPRESSION TAG	UNP A0A0H2URD6
B	46	PRO	-	EXPRESSION TAG	UNP A0A0H2URD6
C	45	GLY	-	EXPRESSION TAG	UNP A0A0H2URD6
C	46	PRO	-	EXPRESSION TAG	UNP A0A0H2URD6
D	45	GLY	-	EXPRESSION TAG	UNP A0A0H2URD6
D	46	PRO	-	EXPRESSION TAG	UNP A0A0H2URD6

- Molecule 2 is beta-D-fructofuranosyl-(2->1)-beta-D-fructofuranosyl-(2->1)-beta-D-fructofuranosyl alpha-D-glucopyranoside (three-letter code: NYT) (formula: C₂₄H₄₂O₂₁).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			45	24	21		
2	B	1	Total	C	O	0	0
			45	24	21		
2	C	1	Total	C	O	0	0
			45	24	21		
2	D	1	Total	C	O	0	0
			45	24	21		

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

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

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



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	C	1	Total	C	O	0	0
			6	3	3		
4	D	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	1	Total	Cl	0	0
			1	1		

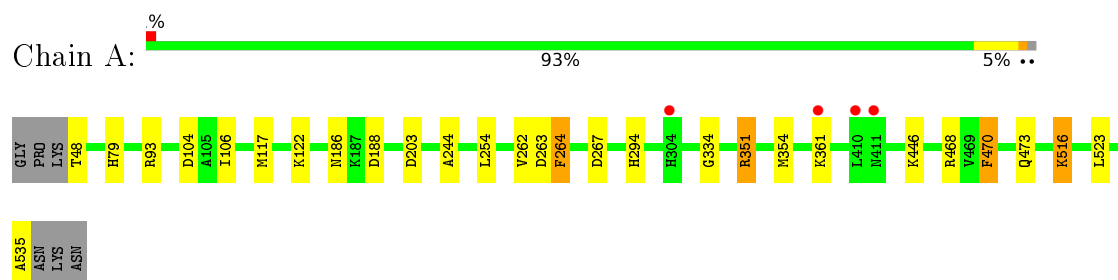
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	364	Total	O	0	0
			364	364		
6	B	450	Total	O	0	0
			450	450		
6	C	446	Total	O	0	0
			446	446		
6	D	390	Total	O	0	0
			390	390		

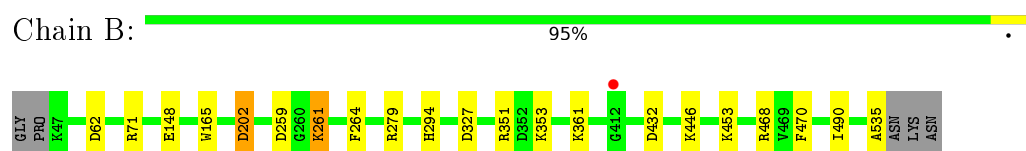
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

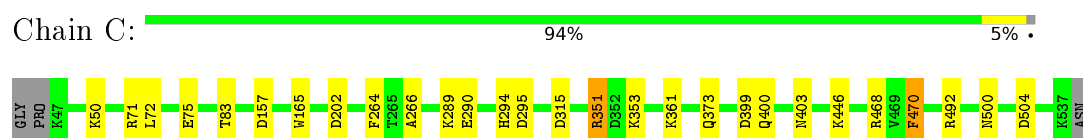
- Molecule 1: ABC TRANSPORTER, SUBSTRATE-BINDING PROTEIN



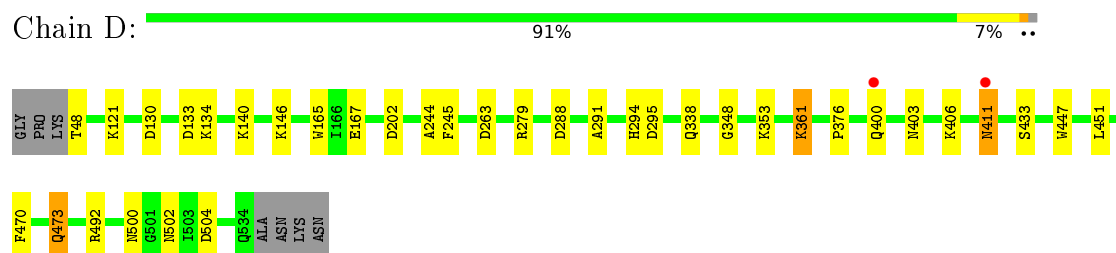
- Molecule 1: ABC TRANSPORTER, SUBSTRATE-BINDING PROTEIN



- Molecule 1: ABC TRANSPORTER, SUBSTRATE-BINDING PROTEIN



- Molecule 1: ABC TRANSPORTER, SUBSTRATE-BINDING PROTEIN



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	71.03Å 129.74Å 120.28Å 90.00° 96.34° 90.00°	Depositor
Resolution (Å)	119.54 – 1.99 57.37 – 1.99	Depositor EDS
% Data completeness (in resolution range)	97.2 (119.54-1.99) 97.2 (57.37-1.99)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.41 (at 1.98Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.169 , 0.221 0.178 , 0.226	Depositor DCC
R_{free} test set	7124 reflections (5.20%)	DCC
Wilson B-factor (Å ²)	24.3	Xtriage
Anisotropy	0.267	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 64.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	17548	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 2.73% 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: GOL, CA, NYT, CL

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	0.77	1/3980 (0.0%)	0.88	10/5402 (0.2%)
1	B	0.80	0/4030	0.87	7/5460 (0.1%)
1	C	0.81	1/4039 (0.0%)	0.89	10/5473 (0.2%)
1	D	0.78	0/4020	0.86	6/5446 (0.1%)
All	All	0.79	2/16069 (0.0%)	0.88	33/21781 (0.2%)

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	0	1
1	D	0	1
All	All	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	264	PHE	C-O	-6.81	1.10	1.23
1	C	290	GLU	CD-OE1	5.41	1.31	1.25

The worst 5 of 33 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	327	ASP	CB-CG-OD1	9.29	126.66	118.30
1	C	351	ARG	NE-CZ-NH1	8.11	124.36	120.30
1	C	351	ARG	NE-CZ-NH2	-7.72	116.44	120.30
1	A	264	PHE	CA-C-N	-6.75	102.36	117.20
1	A	264	PHE	N-CA-C	-6.58	93.22	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	264	PHE	Mainchain
1	D	361	LYS	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	3884	0	3685	12	0
1	B	3934	0	3773	8	0
1	C	3943	0	3775	11	0
1	D	3924	0	3766	16	0
2	A	45	0	42	0	0
2	B	45	0	42	0	0
2	C	45	0	42	0	0
2	D	45	0	42	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	2	0	0	0	0
4	A	6	0	8	0	0
4	B	6	0	8	0	0
4	C	6	0	8	0	0
4	D	6	0	8	0	0
5	B	1	0	0	0	0
6	A	364	0	0	2	1
6	B	450	0	0	5	2
6	C	446	0	0	6	2
6	D	390	0	0	4	1
All	All	17548	0	15199	47	3

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 2.

The worst 5 of 47 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:B:453:LYS:NZ	6:B:2400:HOH:O	1.87	1.06
1:C:403:ASN:HA	6:C:2363:HOH:O	1.73	0.88
1:D:361:LYS:NZ	6:D:2292:HOH:O	2.18	0.77
1:A:535:ALA:O	6:A:2354:HOH:O	2.03	0.76
1:D:406:LYS:NZ	6:D:2311:HOH:O	2.21	0.72

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:B:2103:HOH:O	6:C:2080:HOH:O[2_657]	2.10	0.10
6:A:2332:HOH:O	6:D:2039:HOH:O[2_656]	2.14	0.06
6:B:2104:HOH:O	6:C:2080:HOH:O[2_657]	2.19	0.01

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	486/494 (98%)	475 (98%)	11 (2%)	0	100	100
1	B	487/494 (99%)	480 (99%)	7 (1%)	0	100	100
1	C	489/494 (99%)	483 (99%)	6 (1%)	0	100	100
1	D	485/494 (98%)	471 (97%)	13 (3%)	1 (0%)	52	48
All	All	1947/1976 (98%)	1909 (98%)	37 (2%)	1 (0%)	56	53

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	411	ASN

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	411/428 (96%)	407 (99%)	4 (1%)	82	85
1	B	423/428 (99%)	418 (99%)	5 (1%)	78	81
1	C	423/428 (99%)	416 (98%)	7 (2%)	68	71
1	D	423/428 (99%)	416 (98%)	7 (2%)	68	71
All	All	1680/1712 (98%)	1657 (99%)	23 (1%)	74	77

5 of 23 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	202	ASP
1	C	294	HIS
1	D	470	PHE
1	C	289	LYS
1	C	446	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	411	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry

Of 17 ligands modelled in this entry, 9 are monoatomic - leaving 8 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	A	1536	-	5,5,5	0.16	0	5,5,5	0.67	0
2	NYT	A	544	-	48,48,48	0.67	0	71,74,74	0.87	3 (4%)
4	GOL	B	1536	-	5,5,5	0.34	0	5,5,5	0.46	0
2	NYT	B	544	-	48,48,48	0.65	1 (2%)	71,74,74	0.92	4 (5%)
4	GOL	C	1538	-	5,5,5	0.25	0	5,5,5	0.17	0
2	NYT	C	544	-	48,48,48	0.96	2 (4%)	71,74,74	1.29	10 (14%)
4	GOL	D	1535	-	5,5,5	0.42	0	5,5,5	0.78	0
2	NYT	D	544	-	48,48,48	0.90	1 (2%)	71,74,74	1.01	3 (4%)

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	A	1536	-	-	0/4/4/4	0/0/0/0
2	NYT	A	544	-	-	0/30/107/107	0/4/4/4
4	GOL	B	1536	-	-	0/4/4/4	0/0/0/0
2	NYT	B	544	-	-	0/30/107/107	0/4/4/4
4	GOL	C	1538	-	-	0/4/4/4	0/0/0/0
2	NYT	C	544	-	-	0/30/107/107	0/4/4/4
4	GOL	D	1535	-	-	0/4/4/4	0/0/0/0
2	NYT	D	544	-	-	0/30/107/107	0/4/4/4

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	544	NYT	O2-C2	-2.10	1.38	1.43
2	B	544	NYT	O11-C22	2.52	1.45	1.41
2	D	544	NYT	O12-C23	3.43	1.46	1.41

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	544	NYT	O11-C22	3.45	1.46	1.41

The worst 5 of 20 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	544	NYT	C6-C5-C4	-3.51	104.20	112.99
2	C	544	NYT	O3-C3-C4	-3.46	102.55	110.36
2	D	544	NYT	C62-C52-C42	-3.21	107.42	115.08
2	C	544	NYT	C61-C51-C41	-3.00	107.91	115.08
2	D	544	NYT	O62-C62-C52	-2.99	101.31	111.30

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 [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	488/494 (98%)	-0.31	4 (0%) 87 88	18, 30, 48, 66	0
1	B	489/494 (98%)	-0.51	1 (0%) 95 95	16, 24, 39, 64	0
1	C	491/494 (99%)	-0.43	0 100 100	16, 24, 39, 59	0
1	D	487/494 (98%)	-0.24	2 (0%) 93 93	19, 30, 50, 72	0
All	All	1955/1976 (98%)	-0.37	7 (0%) 93 93	16, 27, 46, 72	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	411	ASN	2.9
1	A	410	LEU	2.9
1	D	400	GLN	2.8
1	A	411	ASN	2.6
1	A	361	LYS	2.1

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(\AA^2)	Q<0.9
4	GOL	D	1535	6/6	0.95	0.11	3.29	31,32,34,35	0
4	GOL	B	1536	6/6	0.97	0.09	0.67	23,25,25,25	0
2	NYT	C	544	45/45	0.97	0.08	-0.01	17,20,32,46	0
2	NYT	B	544	45/45	0.98	0.08	-0.09	18,20,29,35	0
2	NYT	A	544	45/45	0.97	0.08	-0.15	19,25,33,42	0
5	CL	B	1537	1/1	0.99	0.07	-0.17	26,26,26,26	0
3	CA	B	601	1/1	0.98	0.07	-0.23	24,24,24,24	0
2	NYT	D	544	45/45	0.96	0.08	-0.38	20,25,38,41	0
4	GOL	A	1536	6/6	0.97	0.07	-0.49	26,27,29,31	0
3	CA	D	601	1/1	0.97	0.05	-1.20	26,26,26,26	0
4	GOL	C	1538	6/6	0.97	0.08	-2.54	28,28,29,30	0
3	CA	C	601	1/1	0.98	0.04	-3.30	28,28,28,28	0
3	CA	A	601	1/1	0.97	0.04	-3.58	35,35,35,35	0
3	CA	A	602	1/1	0.97	0.08	-	21,21,21,21	0
3	CA	C	602	1/1	1.00	0.04	-	23,23,23,23	0
3	CA	D	602	1/1	0.99	0.07	-	24,24,24,24	0
3	CA	B	602	1/1	0.98	0.07	-	21,21,21,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.