



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 2, 2023 – 06:25 PM EDT

PDB ID : 3UWW
Title : Crystal structure of Staphylococcus Aureus triosephosphate isomerase complexed with 3-phosphoglyceric acid
Authors : Mukherjee, S.; Roychowdhury, A.; Dutta, D.; Das, A.K.
Deposited on : 2011-12-03
Resolution : 2.25 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
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

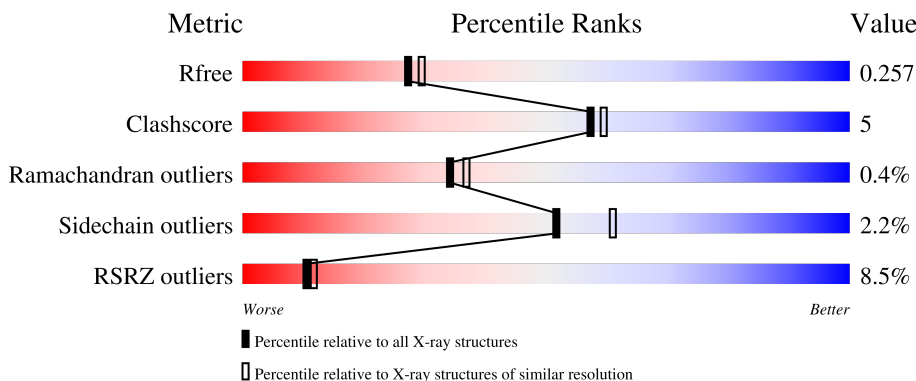
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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	1377 (2.26-2.26)
Clashscore	141614	1487 (2.26-2.26)
Ramachandran outliers	138981	1449 (2.26-2.26)
Sidechain outliers	138945	1450 (2.26-2.26)
RSRZ outliers	127900	1356 (2.26-2.26)

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	261	 8% 90% 7% .
1	B	261	 8% 86% 9% . .

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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	3PG	A	254	-	X	-	-
3	3PG	B	255	-	-	X	-

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 4051 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.

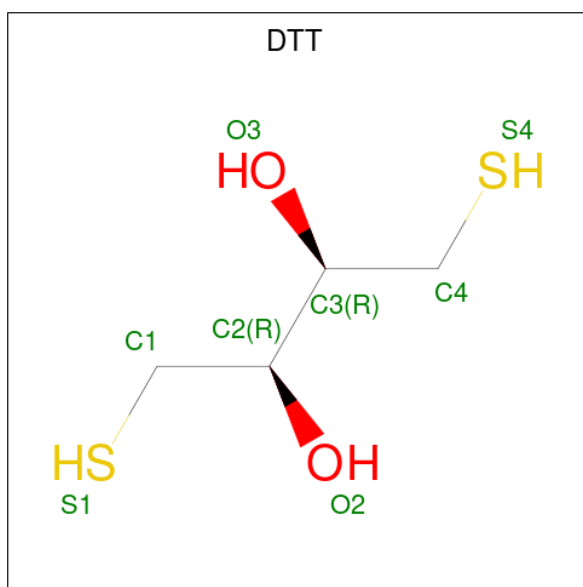
- Molecule 1 is a protein called Triosephosphate isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	254	1918	1197	322	391	8	0	0	0
1	B	251	1891	1180	317	387	7	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

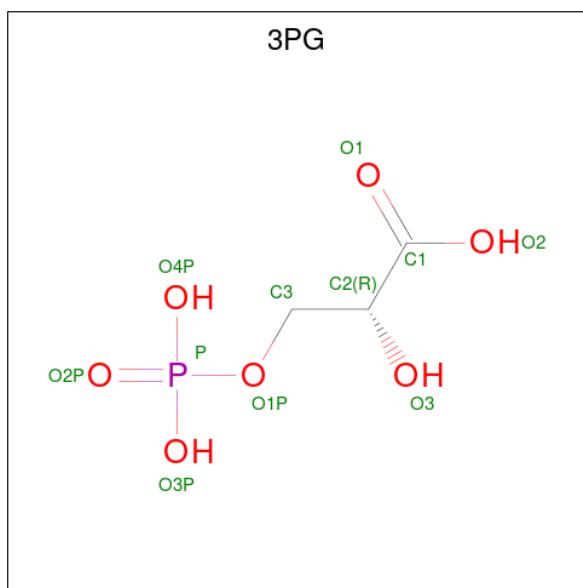
Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	HIS	-	expression tag	UNP Q6GIL6
A	-6	HIS	-	expression tag	UNP Q6GIL6
A	-5	HIS	-	expression tag	UNP Q6GIL6
A	-4	HIS	-	expression tag	UNP Q6GIL6
A	-3	HIS	-	expression tag	UNP Q6GIL6
A	-2	HIS	-	expression tag	UNP Q6GIL6
A	-1	GLY	-	expression tag	UNP Q6GIL6
A	0	SER	-	expression tag	UNP Q6GIL6
B	-7	HIS	-	expression tag	UNP Q6GIL6
B	-6	HIS	-	expression tag	UNP Q6GIL6
B	-5	HIS	-	expression tag	UNP Q6GIL6
B	-4	HIS	-	expression tag	UNP Q6GIL6
B	-3	HIS	-	expression tag	UNP Q6GIL6
B	-2	HIS	-	expression tag	UNP Q6GIL6
B	-1	GLY	-	expression tag	UNP Q6GIL6
B	0	SER	-	expression tag	UNP Q6GIL6

- Molecule 2 is 2,3-DIHYDROXY-1,4-DITHIOBUTANE (three-letter code: DTT) (formula: C₄H₁₀O₂S₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	S		
2	A	1	8	4	2	2	0	0

- Molecule 3 is 3-PHOSPHOGLYCERIC ACID (three-letter code: 3PG) (formula: $C_3H_7O_7P$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	P		
3	A	1	11	3	7	1	0	0
3	B	1	11	3	7	1	0	0

- Molecule 4 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Na	0	0
			1	1		

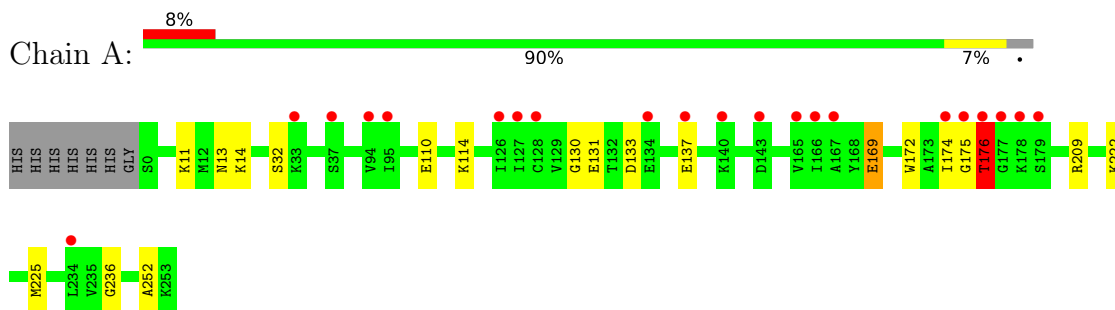
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	126	Total	O	0	0
			126	126		
5	B	85	Total	O	0	0
			85	85		

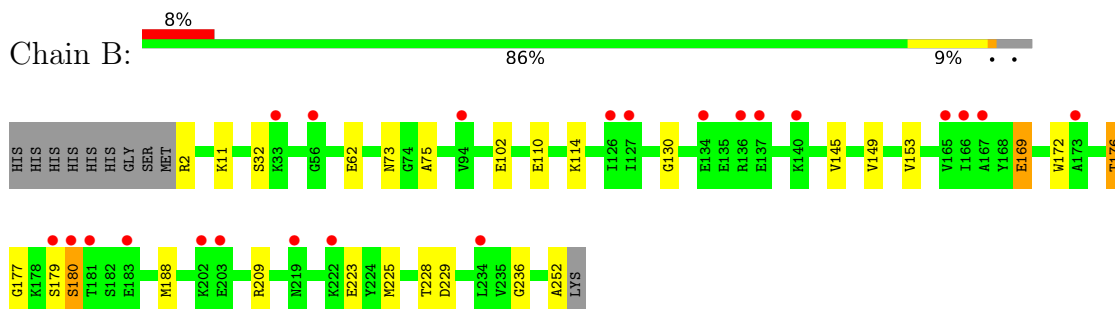
3 Residue-property plots [i](#)

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: Triosephosphate isomerase



- Molecule 1: Triosephosphate isomerase



4 Data and refinement statistics

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	80.58Å 80.58Å 174.04Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.56 – 2.25 29.56 – 2.25	Depositor EDS
% Data completeness (in resolution range)	99.6 (29.56-2.25) 99.6 (29.56-2.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.03 (at 2.24Å)	Xtrriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.206 , 0.248 0.221 , 0.257	Depositor DCC
R_{free} test set	1412 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	31.6	Xtrriage
Anisotropy	0.521	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 35.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	4051	wwPDB-VP
Average B, all atoms (Å ²)	34.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.90% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 3PG, NA, DTT

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	0.42	0/1945	0.51	0/2629
1	B	0.40	0/1918	0.50	0/2596
All	All	0.41	0/3863	0.50	0/5225

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	1918	0	1904	16	0
1	B	1891	0	1862	22	0
2	A	8	0	10	0	0
3	A	11	0	4	2	0
3	B	11	0	4	4	0
4	B	1	0	0	0	0
5	A	126	0	0	1	0
5	B	85	0	0	6	0
All	All	4051	0	3784	37	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 5.

All (37) 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:175:GLY:HA3	1:A:176:THR:HB	1.17	1.16
1:B:62:GLU:HG3	5:B:307:HOH:O	1.63	0.99
1:A:175:GLY:CA	1:A:176:THR:HB	1.99	0.92
1:A:175:GLY:HA3	1:A:176:THR:CB	2.09	0.76
1:A:174:ILE:HG22	1:A:174:ILE:O	1.97	0.64
1:B:102:GLU:HB2	5:B:291:HOH:O	1.98	0.61
1:B:11:LYS:NZ	3:B:255:3PG:H31	2.16	0.61
1:A:131:GLU:OE2	1:A:172:TRP:CD1	2.54	0.60
1:A:236:GLY:HA3	3:A:254:3PG:O2P	2.02	0.60
1:A:13:ASN:HA	1:B:73:ASN:HD22	1.70	0.57
1:B:2:ARG:N	5:B:335:HOH:O	2.40	0.54
1:B:176:THR:N	1:B:177:GLY:HA2	2.23	0.53
1:B:11:LYS:HZ1	3:B:255:3PG:H31	1.71	0.53
1:B:179:SER:O	1:B:180:SER:HB3	2.09	0.53
1:A:175:GLY:CA	1:A:176:THR:CB	2.78	0.51
1:A:174:ILE:O	1:A:174:ILE:CG2	2.58	0.50
1:B:73:ASN:ND2	5:B:273:HOH:O	2.45	0.49
1:B:228:THR:HG23	1:B:229:ASP:OD2	2.13	0.49
1:A:11:LYS:HD3	1:B:75:ALA:HA	1.97	0.47
3:A:254:3PG:O3P	5:A:271:HOH:O	2.21	0.47
1:B:169:GLU:HB3	5:B:283:HOH:O	2.15	0.46
1:B:11:LYS:CE	3:B:255:3PG:H31	2.46	0.45
1:B:225:MET:HG3	1:B:252:ALA:HA	1.97	0.45
1:B:223:GLU:HG3	5:B:300:HOH:O	2.16	0.45
1:A:130:GLY:HA3	1:A:169:GLU:O	2.18	0.44
1:B:188:MET:HB3	1:B:188:MET:HE2	1.69	0.43
1:B:149:VAL:O	1:B:153:VAL:HG22	2.19	0.42
1:B:130:GLY:HA3	1:B:169:GLU:O	2.19	0.42
1:A:131:GLU:OE2	1:A:172:TRP:NE1	2.52	0.42
1:B:145:VAL:HG11	1:B:188:MET:CE	2.50	0.42
1:B:236:GLY:HA3	3:B:255:3PG:H32	2.02	0.41
1:B:110:GLU:O	1:B:114:LYS:HG3	2.20	0.41
1:A:110:GLU:O	1:A:114:LYS:HG3	2.21	0.41
1:A:225:MET:HG3	1:A:252:ALA:HA	2.03	0.41
1:A:13:ASN:O	1:A:14:LYS:HB2	2.21	0.40
1:A:133:ASP:O	1:A:137:GLU:HG2	2.21	0.40
1:B:172:TRP:CH2	1:B:180:SER:HB2	2.57	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	252/261 (97%)	243 (96%)	8 (3%)	1 (0%)	34	37
1	B	249/261 (95%)	241 (97%)	7 (3%)	1 (0%)	34	37
All	All	501/522 (96%)	484 (97%)	15 (3%)	2 (0%)	34	37

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	176	THR
1	B	180	SER

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	206/212 (97%)	201 (98%)	5 (2%)	49	58
1	B	202/212 (95%)	198 (98%)	4 (2%)	55	64
All	All	408/424 (96%)	399 (98%)	9 (2%)	52	61

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	32	SER
1	A	169	GLU
1	A	176	THR
1	A	209	ARG

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Mol	Chain	Res	Type
1	A	222	LYS
1	B	32	SER
1	B	169	GLU
1	B	176	THR
1	B	209	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	73	ASN
1	A	112	ASN
1	A	142	ASN
1	A	227	GLN
1	B	73	ASN
1	B	112	ASN
1	B	142	ASN
1	B	227	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 1 is monoatomic - leaving 3 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
2	DTT	A	255	-	7,7,7	0.57	0	4,8,8	0.82	0
3	3PG	A	254	-	9,10,10	1.62	2 (22%)	12,14,14	1.56	4 (33%)
3	3PG	B	255	-	9,10,10	0.91	0	12,14,14	1.28	1 (8%)

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	DTT	A	255	-	-	2/8/8/8	-
3	3PG	A	254	-	-	8/10/10/10	-
3	3PG	B	255	-	-	1/10/10/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	254	3PG	P-O2P	2.72	1.59	1.50
3	A	254	3PG	C2-C1	2.08	1.55	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	254	3PG	O4P-P-O1P	2.68	113.86	106.73
3	A	254	3PG	O1-C1-C2	-2.40	117.84	122.54
3	B	255	3PG	O2-C1-C2	2.40	117.99	112.72
3	A	254	3PG	O3P-P-O2P	-2.16	102.24	110.68
3	A	254	3PG	O2-C1-C2	2.15	117.46	112.72

There are no chirality outliers.

All (11) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	255	DTT	O3-C3-C4-S4
3	A	254	3PG	C1-C2-C3-O1P
3	A	254	3PG	C2-C3-O1P-P
3	B	255	3PG	C1-C2-C3-O1P

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Mol	Chain	Res	Type	Atoms
3	A	254	3PG	O3-C2-C3-O1P
3	A	254	3PG	O1-C1-C2-C3
3	A	254	3PG	O2-C1-C2-C3
2	A	255	DTT	C2-C3-C4-S4
3	A	254	3PG	C3-O1P-P-O3P
3	A	254	3PG	O1-C1-C2-O3
3	A	254	3PG	O2-C1-C2-O3

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	254	3PG	2	0
3	B	255	3PG	4	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

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	254/261 (97%)	0.27	21 (8%) 11 12	20, 30, 51, 60	1 (0%)
1	B	251/261 (96%)	0.40	22 (8%) 10 11	20, 35, 59, 68	1 (0%)
All	All	505/522 (96%)	0.33	43 (8%) 10 12	20, 32, 56, 68	2 (0%)

All (43) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	175	GLY	6.0
1	B	179	SER	5.6
1	A	176	THR	4.9
1	A	177	GLY	4.2
1	B	137	GLU	3.9
1	A	234	LEU	3.7
1	B	136	ARG	3.6
1	A	126	ILE	3.6
1	B	126	ILE	3.4
1	A	33	LYS	3.3
1	A	134	GLU	3.1
1	B	183	GLU	2.9
1	B	94	VAL	2.9
1	B	166	ILE	2.9
1	A	140	LYS	2.8
1	A	167	ALA	2.7
1	B	181	THR	2.7
1	B	33	LYS	2.7
1	A	95	ILE	2.7
1	B	180	SER	2.7
1	A	174	ILE	2.7
1	B	56	GLY	2.7
1	A	166	ILE	2.6
1	B	219	ASN	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	140	LYS	2.6
1	A	127	ILE	2.6
1	B	165	VAL	2.5
1	B	127	ILE	2.5
1	B	202	LYS	2.5
1	A	128	CYS	2.4
1	A	137	GLU	2.3
1	B	234	LEU	2.3
1	B	173	ALA	2.3
1	A	165	VAL	2.3
1	A	37	SER	2.3
1	B	167	ALA	2.2
1	A	94	VAL	2.1
1	B	203	GLU	2.1
1	A	143	ASP	2.1
1	B	134	GLU	2.1
1	A	179	SER	2.1
1	A	178	LYS	2.0
1	B	222	LYS	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
3	3PG	A	254	11/11	0.78	0.22	53,61,62,63	3
2	DTT	A	255	8/8	0.94	0.31	30,35,36,36	8
3	3PG	B	255	11/11	0.94	0.17	35,44,49,49	0
4	NA	B	254	1/1	0.94	0.13	10,10,10,10	0

6.5 Other polymers [i](#)

There are no such residues in this entry.