



Full wwPDB X-ray Structure Validation Report ⓘ

Jan 8, 2024 – 01:43 pm GMT

PDB ID : 5NZL
Title : Crystal structure of UDP-glucose pyrophosphorylase from *Leishmania major* in complex with resveratrol
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Deposited on : 2017-05-14
Resolution : 2.40 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 : 1.8.4, 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

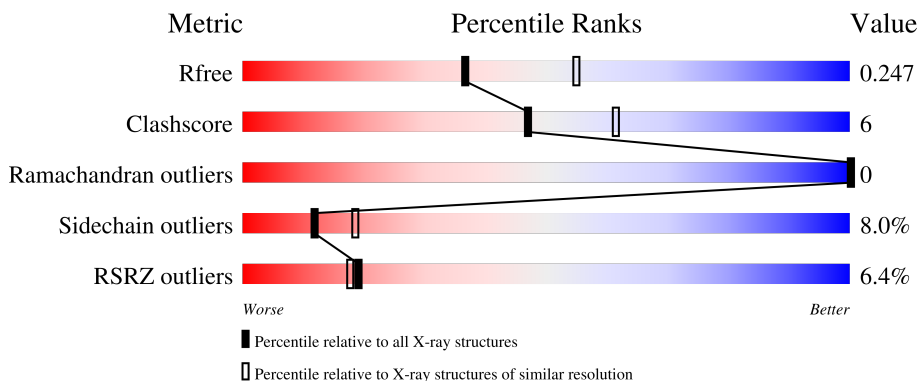
1 Overall quality at a glance i

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}	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (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	505	

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
2	STL	A	601	-	-	-	X

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	609	-	-	-	X

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3851 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.

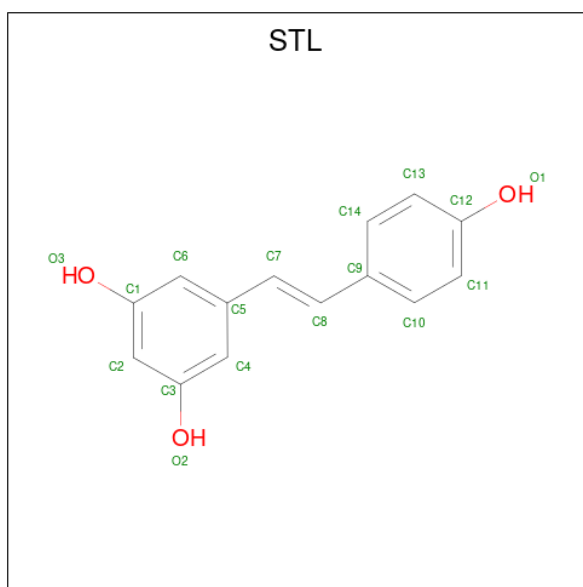
- Molecule 1 is a protein called UDP-glucose pyrophosphorylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	483	3730	2351	636	717	26	0	0	0

There are 11 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	495	MET	-	expression tag	UNP Q4QDU3
A	496	ARG	-	expression tag	UNP Q4QDU3
A	497	PRO	-	expression tag	UNP Q4QDU3
A	498	LEU	-	expression tag	UNP Q4QDU3
A	499	GLU	-	expression tag	UNP Q4QDU3
A	500	HIS	-	expression tag	UNP Q4QDU3
A	501	HIS	-	expression tag	UNP Q4QDU3
A	502	HIS	-	expression tag	UNP Q4QDU3
A	503	HIS	-	expression tag	UNP Q4QDU3
A	504	HIS	-	expression tag	UNP Q4QDU3
A	505	HIS	-	expression tag	UNP Q4QDU3

- Molecule 2 is RESVERATROL (three-letter code: STL) (formula: C₁₄H₁₂O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			17	14	3		

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



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

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

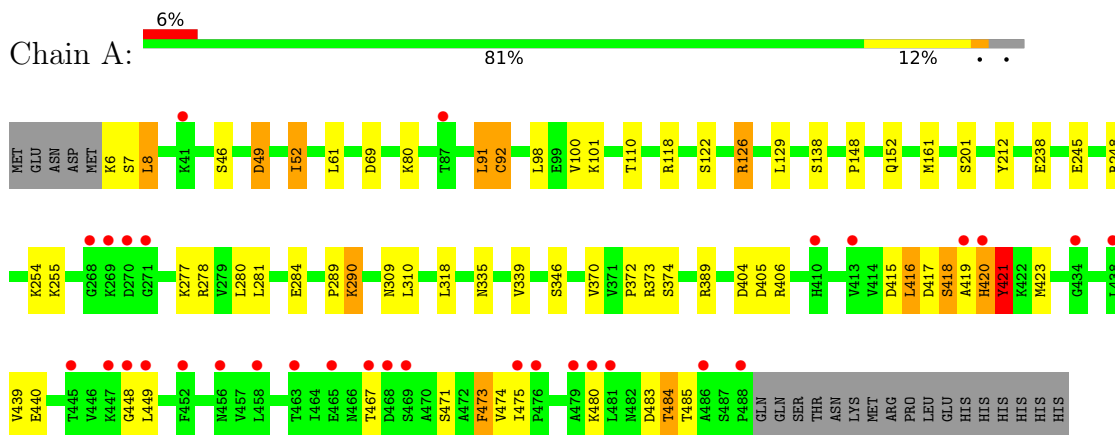
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	72	Total O 72 72	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: UDP-glucose pyrophosphorylase



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	72.52Å 108.45Å 153.07Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.36 – 2.40 47.36 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.9 (47.36-2.40) 100.0 (47.36-2.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.11 (at 2.39Å)	Xtrriage
Refinement program	PHENIX (1.11.1_2575: ???)	Depositor
R, R_{free}	0.224 , 0.249 0.228 , 0.247	Depositor DCC
R_{free} test set	1197 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	50.0	Xtrriage
Anisotropy	0.428	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3851	wwPDB-VP
Average B, all atoms (Å ²)	57.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.73% 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: EDO, STL

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	0.38	0/3800	0.53	1/5147 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	421	TYR	N-CA-C	8.05	132.72	111.00

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	3730	0	3720	47	4
2	A	17	0	10	5	0
3	A	32	0	48	3	0
4	A	72	0	0	5	2
All	All	3851	0	3778	47	4

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 6.

All (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:A:420:HIS:NE2	1:A:449:LEU:HB2	1.21	1.48
1:A:420:HIS:CD2	1:A:449:LEU:HA	1.46	1.48
1:A:420:HIS:CD2	1:A:449:LEU:CA	2.13	1.30
1:A:420:HIS:NE2	1:A:449:LEU:CB	1.95	1.30
1:A:419:ALA:HB1	4:A:731:HOH:O	1.01	1.16
1:A:420:HIS:NE2	1:A:449:LEU:CA	2.21	1.02
1:A:420:HIS:CD2	1:A:449:LEU:CB	2.45	0.95
1:A:417:ASP:OD1	1:A:448:GLY:N	2.00	0.94
1:A:420:HIS:CE1	1:A:449:LEU:HB2	2.07	0.90
1:A:420:HIS:HD2	1:A:449:LEU:HA	0.78	0.88
1:A:420:HIS:CD2	1:A:449:LEU:HB2	2.08	0.83
1:A:419:ALA:CB	4:A:731:HOH:O	1.80	0.70
1:A:420:HIS:NE2	1:A:449:LEU:N	2.40	0.69
1:A:69:ASP:OD2	4:A:701:HOH:O	2.11	0.68
1:A:405:ASP:OD1	4:A:702:HOH:O	2.13	0.66
1:A:420:HIS:CE1	4:A:731:HOH:O	2.51	0.64
1:A:374:SER:HB3	2:A:601:STL:H11	1.80	0.62
1:A:248:ARG:HB2	2:A:601:STL:H2	1.81	0.62
1:A:439:VAL:HG13	1:A:440:GLU:HG2	1.80	0.62
1:A:467:THR:HG23	1:A:467:THR:O	2.01	0.60
1:A:52:ILE:HD11	1:A:281:LEU:HD11	1.84	0.59
1:A:372:PRO:HA	2:A:601:STL:H6	1.86	0.57
1:A:420:HIS:CD2	1:A:449:LEU:N	2.71	0.57
1:A:373:ARG:H	2:A:601:STL:C7	2.21	0.53
1:A:474:VAL:HG12	1:A:475:ILE:N	2.24	0.52
1:A:290:LYS:HE2	1:A:290:LYS:H	1.77	0.49
1:A:126:ARG:HD2	1:A:212:TYR:CZ	2.47	0.49
1:A:339:VAL:HG12	1:A:346:SER:HB2	1.95	0.49
1:A:473:PHE:C	1:A:473:PHE:CD1	2.85	0.49
1:A:421:TYR:CD1	1:A:421:TYR:N	2.81	0.48
1:A:416:LEU:HA	1:A:416:LEU:HD12	1.70	0.47
1:A:373:ARG:H	2:A:601:STL:H7	1.80	0.47
1:A:404:ASP:OD1	1:A:405:ASP:N	2.47	0.47
1:A:91:LEU:HD21	1:A:98:LEU:HD13	1.99	0.45
1:A:370:VAL:HG12	3:A:604:EDO:H11	1.98	0.45
1:A:80:LYS:HG3	1:A:110:THR:HG21	1.99	0.44
1:A:484:THR:OG1	1:A:485:THR:N	2.50	0.44
1:A:245:GLU:HB2	1:A:309:ASN:HB2	1.98	0.43
1:A:6:LYS:C	1:A:8:LEU:H	2.22	0.43
1:A:161:MET:H	3:A:603:EDO:H22	1.84	0.42
1:A:46:SER:OG	1:A:289:PRO:HG3	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:100:VAL:O	1:A:389:ARG:HG2	2.19	0.42
1:A:148:PRO:O	1:A:152:GLN:HG2	2.19	0.42
1:A:415:ASP:O	1:A:416:LEU:HD12	2.20	0.41
1:A:91:LEU:HD12	1:A:91:LEU:HA	1.83	0.41
1:A:118:ARG:HA	1:A:122:SER:O	2.20	0.41
1:A:201:SER:HB3	3:A:603:EDO:H21	2.02	0.41

All (4) 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)
1:A:418:SER:CB	1:A:418:SER:CB[3_554]	1.37	0.83
1:A:92:CYS:CB	1:A:92:CYS:SG[3_554]	1.81	0.39
1:A:49:ASP:O	4:A:701:HOH:O[8_455]	2.14	0.06
1:A:52:ILE:O	4:A:701:HOH:O[8_455]	2.15	0.05

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	481/505 (95%)	468 (97%)	13 (3%)	0	100 100

There are no Ramachandran outliers to report.

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	410/432 (95%)	377 (92%)	33 (8%)	12 18

All (33) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	SER
1	A	8	LEU
1	A	49	ASP
1	A	52	ILE
1	A	61	LEU
1	A	91	LEU
1	A	92	CYS
1	A	101	LYS
1	A	126	ARG
1	A	129	LEU
1	A	138	SER
1	A	238	GLU
1	A	254	LYS
1	A	255	LYS
1	A	277	LYS
1	A	278	ARG
1	A	280	LEU
1	A	284	GLU
1	A	290	LYS
1	A	310	LEU
1	A	318	LEU
1	A	335	ASN
1	A	406	ARG
1	A	416	LEU
1	A	418	SER
1	A	420	HIS
1	A	421	TYR
1	A	423	MET
1	A	471	SER
1	A	473	PHE
1	A	480	LYS
1	A	483	ASP
1	A	484	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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](#)

9 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
3	EDO	A	608	-	3,3,3	0.28	0	2,2,2	0.98	0
3	EDO	A	606	-	3,3,3	0.32	0	2,2,2	0.15	0
3	EDO	A	605	-	3,3,3	0.27	0	2,2,2	0.66	0
2	STL	A	601	-	18,18,18	1.85	4 (22%)	24,24,24	1.39	2 (8%)
3	EDO	A	604	-	3,3,3	0.26	0	2,2,2	0.49	0
3	EDO	A	602	-	3,3,3	0.35	0	2,2,2	0.21	0
3	EDO	A	603	-	3,3,3	0.36	0	2,2,2	0.22	0
3	EDO	A	607	-	3,3,3	0.26	0	2,2,2	0.95	0
3	EDO	A	609	-	3,3,3	0.31	0	2,2,2	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
3	EDO	A	608	-	-	0/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	EDO	A	606	-	-	0/1/1/1	-
3	EDO	A	605	-	-	1/1/1/1	-
2	STL	A	601	-	-	3/5/5/5	0/2/2/2
3	EDO	A	604	-	-	1/1/1/1	-
3	EDO	A	602	-	-	1/1/1/1	-
3	EDO	A	603	-	-	0/1/1/1	-
3	EDO	A	607	-	-	1/1/1/1	-
3	EDO	A	609	-	-	1/1/1/1	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	STL	O2-C3	4.38	1.47	1.37
2	A	601	STL	C4-C5	-3.07	1.34	1.39
2	A	601	STL	C6-C5	-2.95	1.35	1.39
2	A	601	STL	C5-C7	2.36	1.54	1.47

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	601	STL	C9-C8-C7	-4.34	108.75	125.87
2	A	601	STL	C5-C6-C1	2.17	122.21	120.28

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	601	STL	C7-C8-C9-C10
2	A	601	STL	C7-C8-C9-C14
3	A	609	EDO	O1-C1-C2-O2
3	A	605	EDO	O1-C1-C2-O2
3	A	607	EDO	O1-C1-C2-O2
3	A	604	EDO	O1-C1-C2-O2
2	A	601	STL	C4-C5-C7-C8
3	A	602	EDO	O1-C1-C2-O2

There are no ring outliers.

3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	601	STL	5	0
3	A	604	EDO	1	0
3	A	603	EDO	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

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	483/505 (95%)	0.41	31 (6%) 19 18	30, 53, 88, 122	0

All (31) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	467	THR	6.6
1	A	271	GLY	6.4
1	A	481	LEU	6.3
1	A	468	ASP	5.8
1	A	475	ILE	4.5
1	A	438	LEU	4.4
1	A	269	LYS	4.4
1	A	458	LEU	4.4
1	A	448	GLY	4.3
1	A	420	HIS	4.2
1	A	452	PHE	3.8
1	A	419	ALA	3.6
1	A	488	PRO	3.5
1	A	270	ASP	3.5
1	A	268	GLY	3.5
1	A	41	LYS	3.0
1	A	449	LEU	2.9
1	A	476	PRO	2.9
1	A	465	GLU	2.8
1	A	480	LYS	2.8
1	A	413	VAL	2.7
1	A	479	ALA	2.7
1	A	456	ASN	2.7
1	A	87	THR	2.7
1	A	469	SER	2.4
1	A	410	HIS	2.1
1	A	486	ALA	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	434	GLY	2.1
1	A	447	LYS	2.1
1	A	463	THR	2.0
1	A	445	THR	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	STL	A	601	17/17	0.58	0.50	66,72,83,85	0
3	EDO	A	603	4/4	0.64	0.26	60,63,67,72	0
3	EDO	A	609	4/4	0.65	0.42	62,65,65,81	0
3	EDO	A	602	4/4	0.73	0.25	70,71,76,81	0
3	EDO	A	604	4/4	0.82	0.26	56,58,67,71	0
3	EDO	A	606	4/4	0.89	0.27	55,60,66,76	0
3	EDO	A	608	4/4	0.92	0.27	46,56,57,64	0
3	EDO	A	605	4/4	0.94	0.20	45,50,51,53	0
3	EDO	A	607	4/4	0.94	0.15	58,60,65,67	0

6.5 Other polymers [i](#)

There are no such residues in this entry.