



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 31, 2016 – 08:26 PM GMT

PDB ID : 1KC3  
Title : Crystal structure of dTDP-6-deoxy-L-lyxo-4-hexulose reductase (RmlD) in complex with NADPH and dTDP-L-rhamnose  
Authors : Blankenfeldt, W.; Kerr, I.D.; Giraud, M.F.; McMiken, H.J.; Leonard, G.A.; Whitfield, C.; Messner, P.; Graninger, M.; Naismith, J.H.  
Deposited on : 2001-11-07  
Resolution : 2.70 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](mailto: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.

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

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
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) : trunk26865

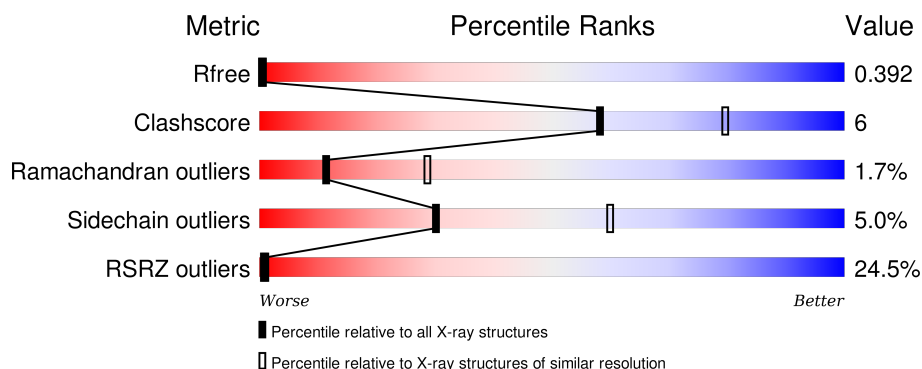
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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	2103 (2.70-2.70)
Clashscore	102246	2422 (2.70-2.70)
Ramachandran outliers	100387	2382 (2.70-2.70)
Sidechain outliers	100360	2382 (2.70-2.70)
RSRZ outliers	91569	2107 (2.70-2.70)

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  $\geq 3$ , 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	299	<div> <div>24%</div> <div>82%</div> <div>17%</div> </div>

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 2473 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.

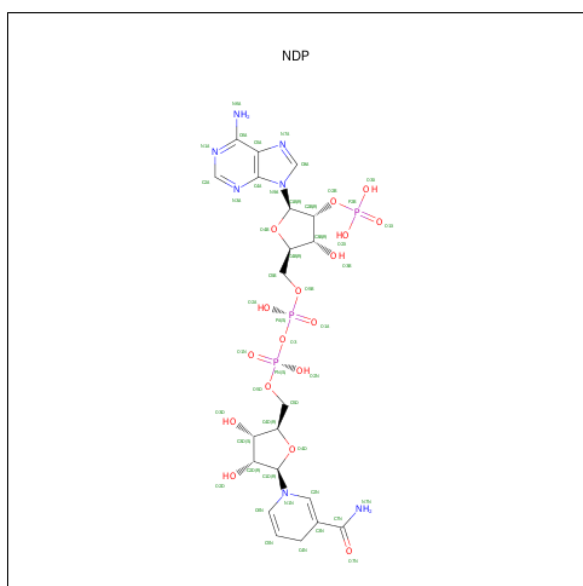
- Molecule 1 is a protein called dTDP-glucose oxidoreductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	298	Total	C	N	O	S	0	1	0
			2296	1456	397	436	7			

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

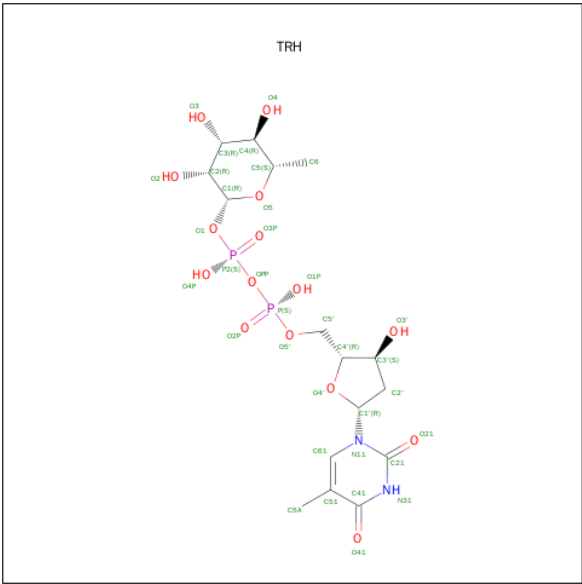
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mg	0	0
			1	1		

- Molecule 3 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NDP) (formula: C<sub>21</sub>H<sub>30</sub>N<sub>7</sub>O<sub>17</sub>P<sub>3</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 4 is 2'-DEOXY-THYMIDINE-BETA-L-RHAMNOSE (three-letter code: TRH) (formula: C<sub>16</sub>H<sub>26</sub>N<sub>2</sub>O<sub>15</sub>P<sub>2</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			35	16	2	15	2		

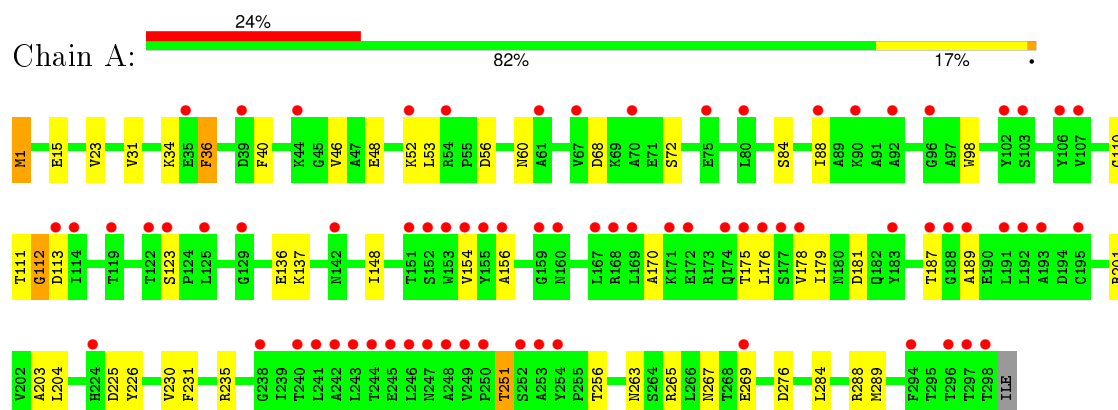
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	93	Total	O	0	0
			93	93		

### 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: dTDP-glucose oxidoreductase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 2 <sub>1</sub> 2 <sub>1</sub> 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	47.98 Å 72.26 Å 82.68 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.87 – 2.70 28.74 – 2.70	Depositor EDS
% Data completeness (in resolution range)	98.7 (28.87-2.70) 98.7 (28.74-2.70)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.33 (at 2.72 Å)	Xtriage
Refinement program	REFMAC 5	Depositor
R, $R_{free}$	0.191 , 0.289 0.324 , 0.392	Depositor DCC
$R_{free}$ test set	413 reflections (5.29%)	DCC
Wilson B-factor (Å <sup>2</sup> )	57.1	Xtriage
Anisotropy	0.212	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 51.2	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	1 of 8219 reflections (0.012%)	Xtriage
$F_o, F_c$ correlation	0.86	EDS
Total number of atoms	2473	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.19% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: TRH, MG, NDP

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	1.13	2/2347 (0.1%)	1.17	10/3199 (0.3%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	15	GLU	CD-OE1	-6.01	1.19	1.25
1	A	23	VAL	CB-CG2	5.91	1.65	1.52

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	201	ARG	NE-CZ-NH2	-5.81	117.39	120.30
1	A	288	ARG	NE-CZ-NH2	-5.60	117.50	120.30
1	A	225	ASP	CB-CG-OD2	5.45	123.21	118.30
1	A	201	ARG	NE-CZ-NH1	5.38	122.99	120.30
1	A	288	ARG	NE-CZ-NH1	5.30	122.95	120.30
1	A	56	ASP	CB-CG-OD2	5.25	123.03	118.30
1	A	235	ARG	NE-CZ-NH1	5.17	122.89	120.30
1	A	265	ARG	NE-CZ-NH1	5.15	122.87	120.30
1	A	68	ASP	CB-CG-OD1	5.13	122.92	118.30
1	A	276	ASP	CB-CG-OD2	5.13	122.92	118.30

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	2296	0	2283	26	0
2	A	1	0	0	0	0
3	A	48	0	26	3	0
4	A	35	0	24	3	0
5	A	93	0	0	0	0
All	All	2473	0	2333	28	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 6.

All (28) 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)
3:A:901:NDP:H41N	4:A:601:TRH:HC4	1.48	0.92
1:A:112:GLY:HA2	1:A:263:ASN:HB2	1.53	0.91
1:A:1:MET:CE	1:A:204:LEU:HD11	2.16	0.75
3:A:901:NDP:H41N	4:A:601:TRH:C4	2.17	0.74
1:A:1:MET:HE1	1:A:204:LEU:HD11	1.73	0.70
1:A:1:MET:HE2	1:A:204:LEU:HD11	1.84	0.59
1:A:267:ASN:OD1	1:A:269:GLU:HG2	2.02	0.59
1:A:178:VAL:HG13	4:A:601:TRH:O21	2.04	0.57
1:A:112:GLY:HA2	1:A:263:ASN:CB	2.31	0.56
1:A:154:VAL:HB	3:A:901:NDP:C7N	2.39	0.52
1:A:170:ALA:HB2	1:A:231:PHE:CE2	2.44	0.52
1:A:1:MET:HE2	1:A:204:LEU:CD1	2.40	0.51
1:A:40:PHE:CD1	1:A:46:VAL:HG11	2.47	0.50
1:A:40:PHE:CZ	1:A:60:ASN:ND2	2.81	0.47
1:A:40:PHE:O	1:A:84:SER:OG	2.27	0.46
1:A:178:VAL:HG12	1:A:179:ILE:N	2.32	0.44
1:A:178:VAL:CG1	1:A:179:ILE:N	2.82	0.43
1:A:36:PHE:CZ	1:A:53:LEU:HD21	2.53	0.43
1:A:154:VAL:HA	1:A:187:THR:O	2.19	0.43
1:A:98:TRP:CH2	1:A:203:ALA:HB1	2.54	0.43
1:A:181:ASP:OD2	1:A:251:THR:N	2.51	0.42
1:A:170:ALA:CB	1:A:231:PHE:CE2	3.02	0.42
1:A:48:GLU:O	1:A:52:LYS:HB2	2.19	0.42
1:A:226:TYR:O	1:A:230:VAL:HG23	2.19	0.42
1:A:40:PHE:CZ	1:A:88:ILE:CD1	3.03	0.41
1:A:156:ALA:HB2	1:A:189:ALA:HB2	2.01	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:98:TRP:CZ2	1:A:203:ALA:HB1	2.55	0.41
1:A:136:GLU:HB2	1:A:148:ILE:HD13	2.04	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	297/299 (99%)	269 (91%)	23 (8%)	5 (2%)	11 29

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	251	THR
1	A	110	GLY
1	A	112	GLY
1	A	113	ASP
1	A	111	THR

### 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	241/241 (100%)	229 (95%)	12 (5%)	30 60

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	31	VAL
1	A	34	LYS
1	A	36	PHE
1	A	72	SER
1	A	123	SER
1	A	137	LYS
1	A	175	THR
1	A	176	LEU
1	A	256	THR
1	A	284	LEU
1	A	289	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	60	ASN
1	A	117	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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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	TRH	A	601	-	29,37,37	0.65	0	43,57,57	2.86	14 (32%)
3	NDP	A	901	-	42,52,52	1.29	3 (7%)	55,80,80	2.44	16 (29%)

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	TRH	A	601	-	-	0/17/53/53	0/3/3/3
3	NDP	A	901	-	-	0/30/77/77	0/5/5/5

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	901	NDP	C2A-N3A	2.76	1.37	1.32
3	A	901	NDP	C2A-N1A	3.07	1.39	1.33
3	A	901	NDP	O4B-C1B	4.52	1.46	1.41

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	901	NDP	N3A-C2A-N1A	-11.53	120.07	128.89
4	A	601	TRH	C51-C41-N31	-7.49	116.80	125.14
3	A	901	NDP	C1B-N9A-C4A	-5.10	119.25	126.94
4	A	601	TRH	C2'-C1'-N11	-4.60	102.97	114.16
3	A	901	NDP	PN-O3-PA	-4.39	120.41	132.73
4	A	601	TRH	P-OPP-P2	-4.19	120.95	132.73
3	A	901	NDP	C4N-C5N-C6N	-3.77	116.36	122.58
3	A	901	NDP	C4B-O4B-C1B	-3.24	106.16	109.72
4	A	601	TRH	C1-C2-C3	-3.24	103.59	109.97
3	A	901	NDP	O4B-C1B-C2B	-2.48	102.11	106.60
4	A	601	TRH	O4'-C1'-C2'	-2.47	101.34	106.27
3	A	901	NDP	O3D-C3D-C2D	-2.38	104.08	111.83
4	A	601	TRH	OPP-P2-O1	-2.36	96.83	103.63
4	A	601	TRH	O4-C4-C3	-2.33	105.08	110.34
3	A	901	NDP	C3B-C2B-C1B	-2.31	98.25	102.73
3	A	901	NDP	O2D-C2D-C3D	2.01	118.37	111.83

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	901	NDP	O4B-C1B-N9A	2.06	112.41	108.10
3	A	901	NDP	C1D-N1N-C2N	2.09	124.55	120.91
4	A	601	TRH	O1P-P-O2P	2.23	124.63	112.53
3	A	901	NDP	C5N-C4N-C3N	2.34	118.96	112.52
4	A	601	TRH	C6-C5-C4	2.39	117.79	113.08
4	A	601	TRH	C3'-C2'-C1'	2.59	108.63	102.40
3	A	901	NDP	O2A-PA-O3	2.62	116.98	105.09
3	A	901	NDP	O2B-C2B-C1B	2.68	120.47	110.02
3	A	901	NDP	C2A-N1A-C6A	2.70	123.59	118.77
4	A	601	TRH	O4-C4-C5	2.89	116.63	109.84
3	A	901	NDP	P2B-O2B-C2B	4.61	132.62	121.56
4	A	601	TRH	C3-C4-C5	4.79	117.79	109.72
4	A	601	TRH	C41-N31-C21	6.74	121.08	115.25
4	A	601	TRH	O4'-C1'-N11	10.13	125.25	107.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	601	TRH	3	0
3	A	901	NDP	3	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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	298/299 (99%)	1.46	73 (24%) <b>1</b> <b>1</b>	10, 40, 70, 81	0

All (73) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	254	TYR	10.9
1	A	246	LEU	10.5
1	A	241	LEU	9.8
1	A	240	THR	8.2
1	A	253	ALA	8.0
1	A	244	THR	6.7
1	A	242	ALA	6.4
1	A	178	VAL	6.2
1	A	245	GLU	5.9
1	A	44	LYS	5.7
1	A	114	ILE	5.2
1	A	175	THR	4.7
1	A	169	LEU	4.7
1	A	188	GLY	4.6
1	A	296	THR	4.5
1	A	123	SER	4.0
1	A	238	GLY	3.9
1	A	298	THR	3.9
1	A	250	PRO	3.8
1	A	119	THR	3.8
1	A	297	THR	3.7
1	A	247	ASN	3.7
1	A	159	GLY	3.4
1	A	193	ALA	3.4
1	A	167	LEU	3.4
1	A	171	LYS	3.4
1	A	252	SER	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	176	LEU	3.4
1	A	192	LEU	3.4
1	A	189	ALA	3.3
1	A	102	TYR	3.3
1	A	142	ASN	3.2
1	A	52	LYS	3.1
1	A	113	ASP	3.0
1	A	224	HIS	3.0
1	A	80	LEU	3.0
1	A	106	TYR	3.0
1	A	249	VAL	3.0
1	A	243	LEU	2.9
1	A	248	ALA	2.8
1	A	129	GLY	2.8
1	A	155	TYR	2.8
1	A	39	ASP	2.7
1	A	177	SER	2.7
1	A	156	ALA	2.7
1	A	152	SER	2.6
1	A	172	GLU	2.6
1	A	269	GLU	2.6
1	A	125	LEU	2.6
1	A	151	THR	2.6
1	A	61	ALA	2.5
1	A	191	LEU	2.5
1	A	96	GLY	2.5
1	A	122	THR	2.5
1	A	35	GLU	2.4
1	A	92	ALA	2.4
1	A	70	ALA	2.4
1	A	195	CYS	2.4
1	A	187	THR	2.4
1	A	160	ASN	2.4
1	A	90	LYS	2.3
1	A	174	GLN	2.3
1	A	154	VAL	2.3
1	A	75	GLU	2.2
1	A	183	TYR	2.2
1	A	107	VAL	2.2
1	A	168	ARG	2.2
1	A	54	ARG	2.1
1	A	88	ILE	2.1

*Continued on next page...*

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Mol	Chain	Res	Type	RSRZ
1	A	294	PHE	2.1
1	A	67	VAL	2.0
1	A	153	TRP	2.0
1	A	103	SER	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 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, 95<sup>th</sup> 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(Å <sup>2</sup> )	Q<0.9
3	NDP	A	901	48/48	0.72	0.37	1.10	80,92,98,99	0
4	TRH	A	601	35/35	0.74	0.29	-0.36	56,72,78,79	0
2	MG	A	501	1/1	0.99	0.23	-	12,12,12,12	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.