



# Full wwPDB Geometry-Only Validation Report ⓘ

May 23, 2024 – 03:34 PM EDT

PDB ID : 4LNC  
Title : Neutron structure of the cyclic glucose bound Xylose Isomerase E186Q mutant  
Authors : Munshi, P.; Meilleur, F.; Myles, D.  
Deposited on : 2013-07-11  
Resolution : 2.19 Å(reported)

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<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>.

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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 : 1.8.5 (274361), CSD as541be (2020)  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36.2

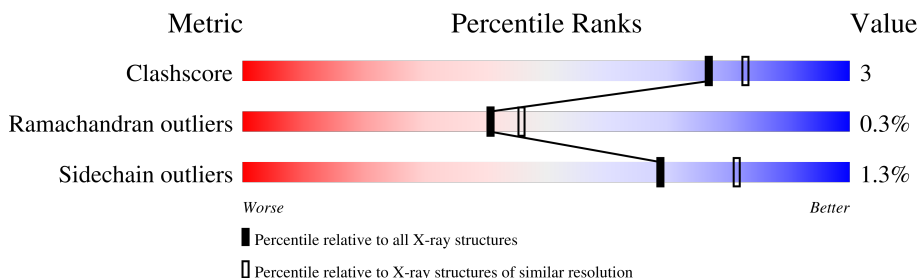
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*NEUTRON DIFFRACTION*

The reported resolution of this entry is 2.19 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))
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)

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  $\geq 3$ , 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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	388	82% 16% ..

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 7245 atoms, of which 2759 are hydrogens and 1155 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.

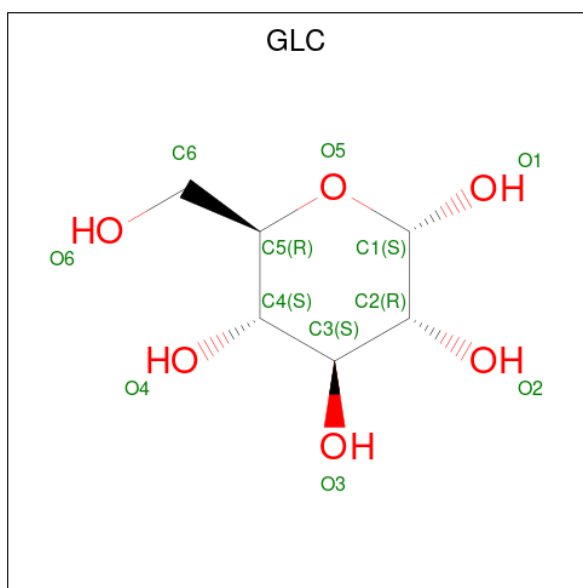
- Molecule 1 is a protein called Xylose isomerase.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
			Total	C	D	H	N	O	S			
1	A	385	6381	1905	606	2748	547	567	8	0	366	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	4	ALA	GLN	engineered mutation	UNP P24300
A	8	VAL	GLU	engineered mutation	UNP P24300
A	186	GLN	GLU	engineered mutation	UNP P24300

- Molecule 2 is alpha-D-glucopyranose (three-letter code: GLC) (formula: C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	D	H	O		
2	A	1	27	6	4	11	6	0	1

- Molecule 3 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	2	Total	Mn		0	0
			2	2			

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

- Molecule 5 is water.


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	289	Total	D	O	0	0
			834	545	289		

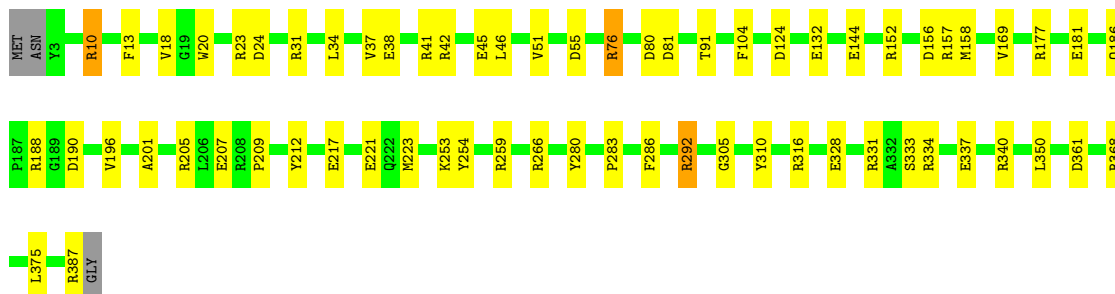
### 3 Residue-property plots [i](#)

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. 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. 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.

Note EDS was not executed.

- Molecule 1: Xylose isomerase

Chain A:  82% 16% ..



## 4 Model quality i

### 4.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: MN, GLC, MG, DOD

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	1.62	58/5425 (1.1%)	1.54	93/7331 (1.3%)

All (58) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	328[A]	GLU	CG-CD	9.44	1.66	1.51
1	A	328[B]	GLU	CG-CD	9.44	1.66	1.51
1	A	132[A]	GLU	CG-CD	8.41	1.64	1.51
1	A	132[B]	GLU	CG-CD	8.41	1.64	1.51
1	A	51[A]	VAL	CB-CG1	-8.28	1.35	1.52
1	A	51[B]	VAL	CB-CG1	-8.28	1.35	1.52
1	A	18[B]	VAL	CB-CG2	7.96	1.69	1.52
1	A	280[A]	TYR	CE1-CZ	-7.73	1.28	1.38
1	A	280[B]	TYR	CE1-CZ	-7.73	1.28	1.38
1	A	207[A]	GLU	CD-OE1	7.48	1.33	1.25
1	A	207[B]	GLU	CD-OE1	7.48	1.33	1.25
1	A	337[A]	GLU	CB-CG	-7.47	1.38	1.52
1	A	337[B]	GLU	CB-CG	-7.47	1.38	1.52
1	A	217[B]	GLU	CD-OE1	-7.08	1.17	1.25
1	A	169[A]	VAL	CA-CB	6.98	1.69	1.54
1	A	292[A]	ARG	CB-CG	-6.84	1.34	1.52
1	A	292[B]	ARG	CB-CG	-6.84	1.34	1.52
1	A	254[A]	TYR	CE1-CZ	-6.69	1.29	1.38
1	A	254[B]	TYR	CE1-CZ	-6.69	1.29	1.38
1	A	310[A]	TYR	CD1-CE1	-6.04	1.30	1.39
1	A	310[B]	TYR	CD1-CE1	-6.04	1.30	1.39
1	A	221[A]	GLU	CG-CD	-6.02	1.43	1.51
1	A	221[B]	GLU	CG-CD	-6.02	1.43	1.51
1	A	333[A]	SER	CB-OG	-5.96	1.34	1.42
1	A	333[B]	SER	CB-OG	-5.96	1.34	1.42
1	A	340[A]	ARG	CZ-NH1	5.91	1.40	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	340[B]	ARG	CZ-NH1	5.91	1.40	1.33
1	A	37[A]	VAL	CB-CG1	-5.86	1.40	1.52
1	A	37[B]	VAL	CB-CG1	-5.86	1.40	1.52
1	A	157[A]	ARG	CG-CD	5.62	1.66	1.51
1	A	157[B]	ARG	CG-CD	5.62	1.66	1.51
1	A	209	PRO	CA-C	-5.60	1.41	1.52
1	A	38[A]	GLU	CG-CD	5.59	1.60	1.51
1	A	38[B]	GLU	CG-CD	5.59	1.60	1.51
1	A	201[A]	ALA	CA-CB	5.54	1.64	1.52
1	A	254[A]	TYR	CD1-CE1	5.49	1.47	1.39
1	A	254[B]	TYR	CD1-CE1	5.49	1.47	1.39
1	A	328[A]	GLU	CB-CG	5.45	1.62	1.52
1	A	328[B]	GLU	CB-CG	5.45	1.62	1.52
1	A	181[B]	GLU	CB-CG	5.25	1.62	1.52
1	A	144[A]	GLU	CD-OE2	-5.19	1.20	1.25
1	A	144[B]	GLU	CD-OE2	-5.19	1.20	1.25
1	A	253[A]	LYS	CE-NZ	-5.16	1.36	1.49
1	A	253[B]	LYS	CE-NZ	-5.16	1.36	1.49
1	A	45[A]	GLU	CD-OE1	5.13	1.31	1.25
1	A	45[B]	GLU	CD-OE1	5.13	1.31	1.25
1	A	286[A]	PHE	CE1-CZ	5.10	1.47	1.37
1	A	217[B]	GLU	CB-CG	-5.08	1.42	1.52
1	A	266[A]	ARG	CZ-NH1	5.08	1.39	1.33
1	A	266[B]	ARG	CZ-NH1	5.08	1.39	1.33
1	A	305[A]	GLY	C-O	5.05	1.31	1.23
1	A	305[B]	GLY	C-O	5.05	1.31	1.23
1	A	334[A]	ARG	CD-NE	-5.05	1.37	1.46
1	A	334[B]	ARG	CD-NE	-5.05	1.37	1.46
1	A	20[B]	TRP	CG-CD1	5.02	1.43	1.36
1	A	20[A]	TRP	CG-CD1	5.02	1.43	1.36
1	A	23[A]	ARG	CG-CD	5.01	1.64	1.51
1	A	23[B]	ARG	CG-CD	5.01	1.64	1.51

All (93) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	334[A]	ARG	NE-CZ-NH2	21.63	131.11	120.30
1	A	334[B]	ARG	NE-CZ-NH2	21.63	131.11	120.30
1	A	334[A]	ARG	NE-CZ-NH1	-15.95	112.33	120.30
1	A	334[B]	ARG	NE-CZ-NH1	-15.95	112.33	120.30
1	A	76[A]	ARG	NE-CZ-NH2	-14.62	112.99	120.30
1	A	76[B]	ARG	NE-CZ-NH2	-14.62	112.99	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	340[A]	ARG	NE-CZ-NH1	12.27	126.43	120.30
1	A	340[B]	ARG	NE-CZ-NH1	12.27	126.43	120.30
1	A	10[B]	ARG	NE-CZ-NH1	10.92	125.76	120.30
1	A	10[A]	ARG	NE-CZ-NH1	10.92	125.76	120.30
1	A	152[A]	ARG	NE-CZ-NH2	-9.95	115.33	120.30
1	A	152[B]	ARG	NE-CZ-NH2	-9.95	115.33	120.30
1	A	340[A]	ARG	NE-CZ-NH2	-9.06	115.77	120.30
1	A	340[B]	ARG	NE-CZ-NH2	-9.06	115.77	120.30
1	A	266[A]	ARG	NE-CZ-NH2	-8.73	115.93	120.30
1	A	266[B]	ARG	NE-CZ-NH2	-8.73	115.93	120.30
1	A	177[B]	ARG	NE-CZ-NH1	-8.56	116.02	120.30
1	A	177[A]	ARG	NE-CZ-NH1	-8.56	116.02	120.30
1	A	23[A]	ARG	NE-CZ-NH1	8.52	124.56	120.30
1	A	23[B]	ARG	NE-CZ-NH1	8.52	124.56	120.30
1	A	316[A]	ARG	NE-CZ-NH1	-8.15	116.23	120.30
1	A	316[B]	ARG	NE-CZ-NH1	-8.15	116.23	120.30
1	A	156[A]	ASP	CB-CG-OD1	8.09	125.58	118.30
1	A	156[B]	ASP	CB-CG-OD1	8.09	125.58	118.30
1	A	368[A]	ARG	NE-CZ-NH1	7.77	124.19	120.30
1	A	368[B]	ARG	NE-CZ-NH1	7.77	124.19	120.30
1	A	340[A]	ARG	CG-CD-NE	7.17	126.86	111.80
1	A	340[B]	ARG	CG-CD-NE	7.17	126.86	111.80
1	A	81[A]	ASP	CB-CG-OD1	7.12	124.71	118.30
1	A	81[B]	ASP	CB-CG-OD1	7.12	124.71	118.30
1	A	24[B]	ASP	CB-CG-OD2	-7.11	111.90	118.30
1	A	331[B]	ARG	NE-CZ-NH2	-7.08	116.76	120.30
1	A	331[A]	ARG	NE-CZ-NH2	-7.08	116.76	120.30
1	A	41[A]	ARG	NE-CZ-NH2	-7.03	116.78	120.30
1	A	41[B]	ARG	NE-CZ-NH2	-7.03	116.78	120.30
1	A	188[A]	ARG	NE-CZ-NH2	-6.74	116.93	120.30
1	A	188[B]	ARG	NE-CZ-NH2	-6.74	116.93	120.30
1	A	350[A]	LEU	CB-CG-CD2	-6.74	99.54	111.00
1	A	350[B]	LEU	CB-CG-CD2	-6.74	99.54	111.00
1	A	334[A]	ARG	CD-NE-CZ	6.74	133.03	123.60
1	A	334[B]	ARG	CD-NE-CZ	6.74	133.03	123.60
1	A	259[A]	ARG	NE-CZ-NH1	6.47	123.53	120.30
1	A	259[B]	ARG	NE-CZ-NH1	6.47	123.53	120.30
1	A	46[A]	LEU	CB-CG-CD2	-6.40	100.12	111.00
1	A	46[B]	LEU	CB-CG-CD2	-6.40	100.12	111.00
1	A	361[A]	ASP	CB-CG-OD2	-6.37	112.57	118.30
1	A	361[B]	ASP	CB-CG-OD2	-6.37	112.57	118.30
1	A	76[A]	ARG	NH1-CZ-NH2	6.30	126.33	119.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	76[B]	ARG	NH1-CZ-NH2	6.30	126.33	119.40
1	A	196[A]	VAL	CG1-CB-CG2	-6.28	100.85	110.90
1	A	196[B]	VAL	CG1-CB-CG2	-6.28	100.85	110.90
1	A	223[A]	MET	CG-SD-CE	6.22	110.15	100.20
1	A	223[B]	MET	CG-SD-CE	6.22	110.15	100.20
1	A	80[A]	ASP	CB-CG-OD1	6.01	123.70	118.30
1	A	80[B]	ASP	CB-CG-OD1	6.01	123.70	118.30
1	A	124[B]	ASP	CB-CG-OD1	5.99	123.69	118.30
1	A	55[B]	ASP	CB-CG-OD1	5.95	123.66	118.30
1	A	375[A]	LEU	CB-CG-CD1	5.95	121.12	111.00
1	A	375[B]	LEU	CB-CG-CD1	5.95	121.12	111.00
1	A	42[A]	ARG	NE-CZ-NH2	5.92	123.26	120.30
1	A	42[B]	ARG	NE-CZ-NH2	5.92	123.26	120.30
1	A	188[A]	ARG	NE-CZ-NH1	5.90	123.25	120.30
1	A	188[B]	ARG	NE-CZ-NH1	5.90	123.25	120.30
1	A	158[A]	MET	CG-SD-CE	-5.87	90.80	100.20
1	A	334[A]	ARG	CG-CD-NE	-5.81	99.60	111.80
1	A	334[B]	ARG	CG-CD-NE	-5.81	99.60	111.80
1	A	387[A]	ARG	NE-CZ-NH2	-5.74	117.43	120.30
1	A	387[B]	ARG	NE-CZ-NH2	-5.74	117.43	120.30
1	A	13[A]	PHE	CB-CG-CD2	-5.70	116.81	120.80
1	A	328[A]	GLU	OE1-CD-OE2	-5.70	116.47	123.30
1	A	328[B]	GLU	OE1-CD-OE2	-5.70	116.47	123.30
1	A	23[A]	ARG	NE-CZ-NH2	-5.68	117.46	120.30
1	A	23[B]	ARG	NE-CZ-NH2	-5.68	117.46	120.30
1	A	104[A]	PHE	CB-CG-CD1	5.67	124.77	120.80
1	A	104[B]	PHE	CB-CG-CD1	5.67	124.77	120.80
1	A	205[A]	ARG	NE-CZ-NH1	5.58	123.09	120.30
1	A	205[B]	ARG	NE-CZ-NH1	5.58	123.09	120.30
1	A	31[A]	ARG	NE-CZ-NH2	5.51	123.05	120.30
1	A	31[B]	ARG	NE-CZ-NH2	5.51	123.05	120.30
1	A	156[A]	ASP	CB-CG-OD2	-5.43	113.41	118.30
1	A	156[B]	ASP	CB-CG-OD2	-5.43	113.41	118.30
1	A	368[A]	ARG	NE-CZ-NH2	-5.40	117.60	120.30
1	A	368[B]	ARG	NE-CZ-NH2	-5.40	117.60	120.30
1	A	10[B]	ARG	NE-CZ-NH2	-5.25	117.67	120.30
1	A	10[A]	ARG	NE-CZ-NH2	-5.25	117.67	120.30
1	A	259[A]	ARG	NE-CZ-NH2	-5.11	117.75	120.30
1	A	259[B]	ARG	NE-CZ-NH2	-5.11	117.75	120.30
1	A	34[A]	LEU	CB-CG-CD1	-5.10	102.33	111.00
1	A	34[B]	LEU	CB-CG-CD1	-5.10	102.33	111.00
1	A	212[A]	TYR	CB-CG-CD2	-5.06	117.97	121.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	212[B]	TYR	CB-CG-CD2	-5.06	117.97	121.00
1	A	190[A]	ASP	CB-CG-OD2	-5.01	113.79	118.30
1	A	190[B]	ASP	CB-CG-OD2	-5.01	113.79	118.30

There are no chirality outliers.

There are no planarity outliers.

## 4.2 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	3633	2748	133	1	0
2	A	16	11	0	0	0
3	A	2	0	0	0	0
4	A	1	0	0	0	0
5	A	834	0	0	13	0
All	All	4486	2759	133	14	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 3.

All (14) 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)
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There are no symmetry-related clashes.

## 4.3 Torsion angles [i](#)

### 4.3.1 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	660/388 (170%)	646 (98%)	13 (2%)	1 (0%)	47 55

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	186[A]	GLN

#### 4.3.2 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	528/303 (174%)	520 (98%)	8 (2%)	65 78

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	10[B]	ARG
1	A	10[A]	ARG
1	A	76[A]	ARG
1	A	76[B]	ARG
1	A	91[A]	THR
1	A	91[B]	THR
1	A	292[A]	ARG
1	A	292[B]	ARG

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

#### 4.3.3 RNA [i](#)

There are no RNA molecules in this entry.

#### 4.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

#### 4.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

#### 4.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 3 are monoatomic - leaving 2 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

#### 4.7 Other polymers [i](#)

There are no such residues in this entry.

#### 4.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.