wwPDB X-ray Structure Validation Summary Report (i)

Jan 5, 2017 – 12:19 AM EST

PDB ID	:	4NNU
Title	:	Distinct structural features of TFAM drive mitochondrial DNA packaging versus transcriptional activation
Authors	:	Ngo, H.B.; Lovely, G.A.; Phillips, R.; Chan, D.C.
Deposited on	:	2013-11-19
Resolution	:	2.81 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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

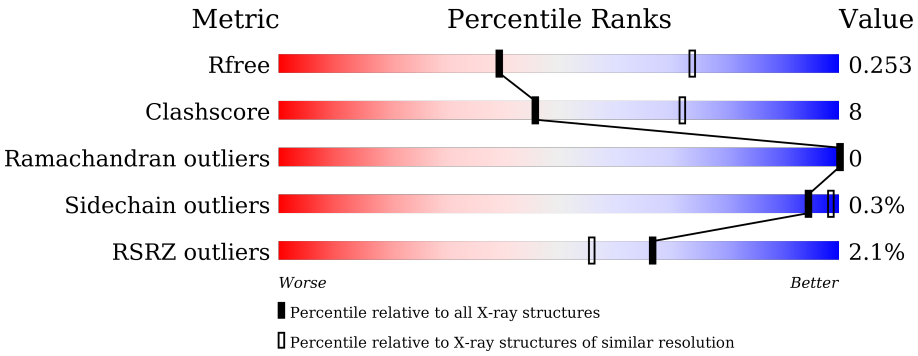
MolProbity	:	4.02b-467
Mogul	:	unknown
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20028442
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)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

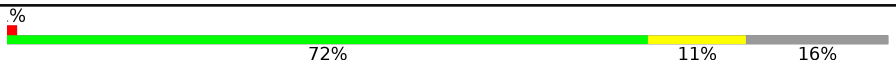
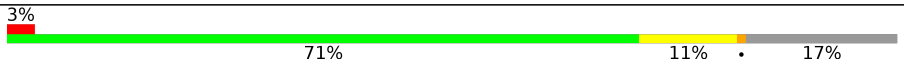
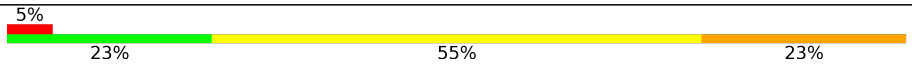
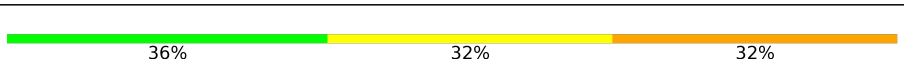
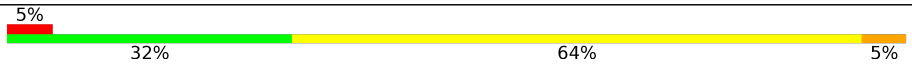
The reported resolution of this entry is 2.81 Å.

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	2676 (2.84-2.80)
Clashscore	102246	3124 (2.84-2.80)
Ramachandran outliers	100387	3072 (2.84-2.80)
Sidechain outliers	100360	3074 (2.84-2.80)
RSRZ outliers	91569	2690 (2.84-2.80)

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 <=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	230	
1	B	230	
2	C	22	
2	E	22	
3	D	22	
3	F	22	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5077 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 Transcription factor A, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	193	Total	C	N	O	S	0	0	0
			1626	1028	293	299	6			
1	B	192	Total	C	N	O	S	0	0	0
			1617	1022	291	298	6			

There are 70 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	8	MET	-	EXPRESSION TAG	UNP Q00059
A	9	GLY	-	EXPRESSION TAG	UNP Q00059
A	10	SER	-	EXPRESSION TAG	UNP Q00059
A	11	SER	-	EXPRESSION TAG	UNP Q00059
A	12	HIS	-	EXPRESSION TAG	UNP Q00059
A	13	HIS	-	EXPRESSION TAG	UNP Q00059
A	14	HIS	-	EXPRESSION TAG	UNP Q00059
A	15	HIS	-	EXPRESSION TAG	UNP Q00059
A	16	HIS	-	EXPRESSION TAG	UNP Q00059
A	17	HIS	-	EXPRESSION TAG	UNP Q00059
A	18	SER	-	EXPRESSION TAG	UNP Q00059
A	19	SER	-	EXPRESSION TAG	UNP Q00059
A	20	GLY	-	EXPRESSION TAG	UNP Q00059
A	21	LEU	-	EXPRESSION TAG	UNP Q00059
A	22	VAL	-	EXPRESSION TAG	UNP Q00059
A	23	PRO	-	EXPRESSION TAG	UNP Q00059
A	24	ARG	-	EXPRESSION TAG	UNP Q00059
A	25	GLY	-	EXPRESSION TAG	UNP Q00059
A	26	SER	-	EXPRESSION TAG	UNP Q00059
A	27	HIS	-	EXPRESSION TAG	UNP Q00059
A	28	MET	-	EXPRESSION TAG	UNP Q00059
A	29	ALA	-	EXPRESSION TAG	UNP Q00059
A	30	SER	-	EXPRESSION TAG	UNP Q00059
A	31	MET	-	EXPRESSION TAG	UNP Q00059
A	32	THR	-	EXPRESSION TAG	UNP Q00059

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
A	33	GLY	-	EXPRESSION TAG	UNP Q00059
A	34	GLY	-	EXPRESSION TAG	UNP Q00059
A	35	GLN	-	EXPRESSION TAG	UNP Q00059
A	36	GLN	-	EXPRESSION TAG	UNP Q00059
A	37	MET	-	EXPRESSION TAG	UNP Q00059
A	38	GLY	-	EXPRESSION TAG	UNP Q00059
A	39	ARG	-	EXPRESSION TAG	UNP Q00059
A	40	GLY	-	EXPRESSION TAG	UNP Q00059
A	41	SER	-	EXPRESSION TAG	UNP Q00059
A	42	MET	-	EXPRESSION TAG	UNP Q00059
B	8	MET	-	EXPRESSION TAG	UNP Q00059
B	9	GLY	-	EXPRESSION TAG	UNP Q00059
B	10	SER	-	EXPRESSION TAG	UNP Q00059
B	11	SER	-	EXPRESSION TAG	UNP Q00059
B	12	HIS	-	EXPRESSION TAG	UNP Q00059
B	13	HIS	-	EXPRESSION TAG	UNP Q00059
B	14	HIS	-	EXPRESSION TAG	UNP Q00059
B	15	HIS	-	EXPRESSION TAG	UNP Q00059
B	16	HIS	-	EXPRESSION TAG	UNP Q00059
B	17	HIS	-	EXPRESSION TAG	UNP Q00059
B	18	SER	-	EXPRESSION TAG	UNP Q00059
B	19	SER	-	EXPRESSION TAG	UNP Q00059
B	20	GLY	-	EXPRESSION TAG	UNP Q00059
B	21	LEU	-	EXPRESSION TAG	UNP Q00059
B	22	VAL	-	EXPRESSION TAG	UNP Q00059
B	23	PRO	-	EXPRESSION TAG	UNP Q00059
B	24	ARG	-	EXPRESSION TAG	UNP Q00059
B	25	GLY	-	EXPRESSION TAG	UNP Q00059
B	26	SER	-	EXPRESSION TAG	UNP Q00059
B	27	HIS	-	EXPRESSION TAG	UNP Q00059
B	28	MET	-	EXPRESSION TAG	UNP Q00059
B	29	ALA	-	EXPRESSION TAG	UNP Q00059
B	30	SER	-	EXPRESSION TAG	UNP Q00059
B	31	MET	-	EXPRESSION TAG	UNP Q00059
B	32	THR	-	EXPRESSION TAG	UNP Q00059
B	33	GLY	-	EXPRESSION TAG	UNP Q00059
B	34	GLY	-	EXPRESSION TAG	UNP Q00059
B	35	GLN	-	EXPRESSION TAG	UNP Q00059
B	36	GLN	-	EXPRESSION TAG	UNP Q00059
B	37	MET	-	EXPRESSION TAG	UNP Q00059
B	38	GLY	-	EXPRESSION TAG	UNP Q00059
B	39	ARG	-	EXPRESSION TAG	UNP Q00059

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	40	GLY	-	EXPRESSION TAG	UNP Q00059
B	41	SER	-	EXPRESSION TAG	UNP Q00059
B	42	MET	-	EXPRESSION TAG	UNP Q00059

- Molecule 2 is a DNA chain called DNA1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	22	Total	C	N	O	P	0	0	0
			456	216	84	134	22			
2	E	22	Total	C	N	O	P	0	0	0
			456	216	84	134	22			

- Molecule 3 is a DNA chain called DNA2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	22	Total	C	N	O	P	0	0	0
			446	212	82	130	22			
3	F	22	Total	C	N	O	P	0	0	0
			446	212	82	130	22			

- Molecule 4 is water.

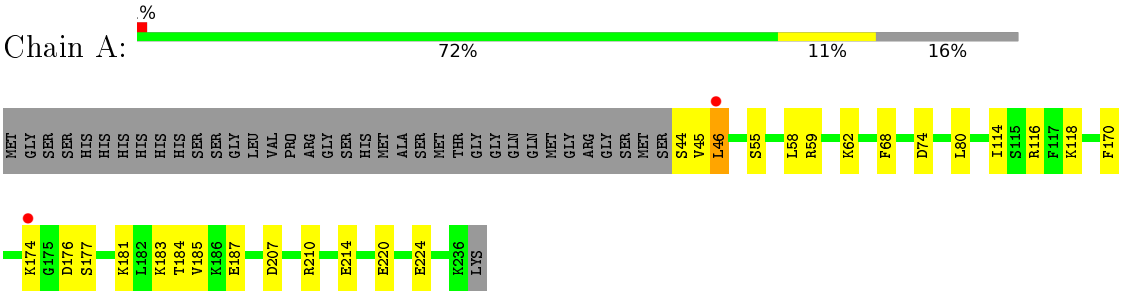
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	13	Total	O	0	0
			13	13		
4	B	6	Total	O	0	0
			6	6		
4	C	4	Total	O	0	0
			4	4		
4	E	1	Total	O	0	0
			1	1		
4	D	1	Total	O	0	0
			1	1		
4	F	5	Total	O	0	0
			5	5		

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.

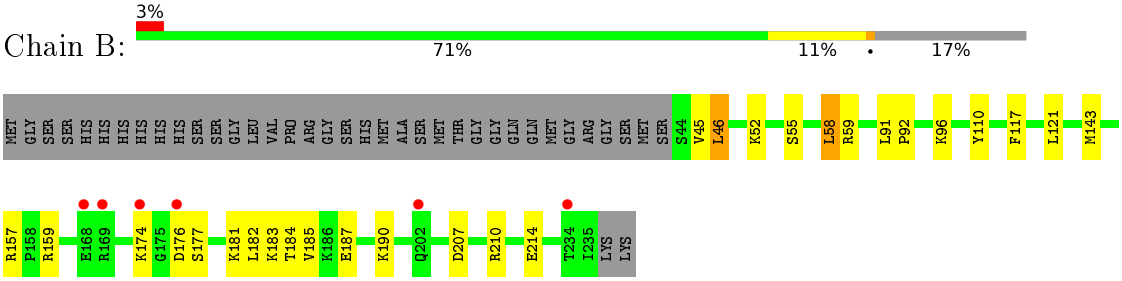
- Molecule 1: Transcription factor A, mitochondrial

Chain A:



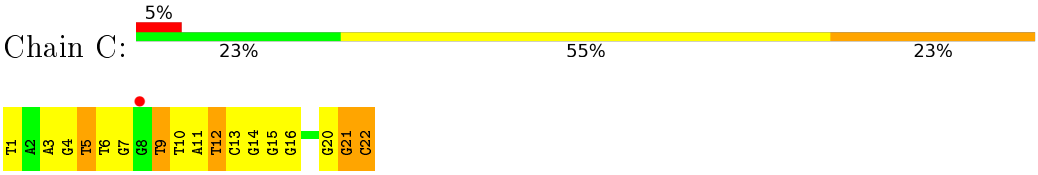
- Molecule 1: Transcription factor A, mitochondrial

Chain B:



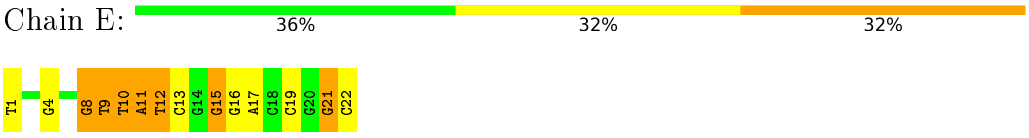
- Molecule 2: DNA1

Chain C:



- Molecule 2: DNA1

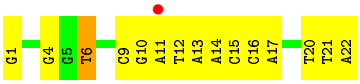
Chain E:



- Molecule 3: DNA2

Chain D:

• Molecule 3: DNA2



4 Data and refinement statistics (i)

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α, β, γ	109.80Å 114.38Å 144.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.02 – 2.81 36.02 – 2.81	Depositor EDS
% Data completeness (in resolution range)	97.4 (36.02-2.81) 93.0 (36.02-2.81)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.06 (at 2.81Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.3_928)	Depositor
R, R_{free}	0.214 , 0.261 0.206 , 0.253	Depositor DCC
R_{free} test set	1904 reflections (9.08%)	DCC
Wilson B-factor (Å^2)	62.1	Xtriage
Anisotropy	0.210	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 48.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.013 for -k,-h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	5077	wwPDB-VP
Average B, all atoms (Å^2)	82.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 14.87% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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

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	0.31	0/1657	0.58	1/2216 (0.0%)
1	B	0.30	0/1648	0.57	1/2205 (0.0%)
2	C	0.66	0/511	1.67	13/788 (1.6%)
2	E	0.69	0/511	1.74	12/788 (1.5%)
3	D	0.73	0/499	1.54	13/766 (1.7%)
3	F	0.73	0/499	1.64	11/766 (1.4%)
All	All	0.50	0/5325	1.15	51/7529 (0.7%)

There are no bond length outliers.

The worst 5 of 51 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	E	16	DG	O4'-C1'-N9	12.95	117.07	108.00
2	E	10	DT	O4'-C1'-N1	10.75	115.52	108.00
2	C	9	DT	O4'-C1'-N1	9.91	114.94	108.00
3	F	22	DA	C3'-C2'-C1'	-9.60	90.98	102.50
2	E	11	DA	O4'-C1'-N9	9.41	114.58	108.00

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	1626	0	1674	18	0
1	B	1617	0	1661	18	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	456	0	249	13	0
2	E	456	0	249	9	0
3	D	446	0	247	8	0
3	F	446	0	247	10	0
4	A	13	0	0	2	0
4	B	6	0	0	0	0
4	C	4	0	0	1	0
4	D	1	0	0	0	0
4	E	1	0	0	0	0
4	F	5	0	0	0	0
All	All	5077	0	4327	62	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 8.

The worst 5 of 62 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)
2:C:14:DG:H1	3:D:9:DC:H42	1.26	0.83
1:A:44:SER:OG	4:A:312:HOH:O	2.05	0.73
3:D:15:DC:H2'	3:D:16:DC:C6	2.30	0.65
2:C:13:DC:H2"	2:C:14:DG:C8	2.32	0.65
2:C:14:DG:N2	3:D:9:DC:N3	2.36	0.59

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	191/230 (83%)	186 (97%)	5 (3%)	0	100	100
1	B	190/230 (83%)	185 (97%)	5 (3%)	0	100	100

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	381/460 (83%)	371 (97%)	10 (3%)	0	100 100

There are no Ramachandran outliers to report.

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	179/208 (86%)	179 (100%)	0	100 100
1	B	178/208 (86%)	177 (99%)	1 (1%)	90 97
All	All	357/416 (86%)	356 (100%)	1 (0%)	94 98

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	58	LEU

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

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

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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^{th} 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	193/230 (83%)	0.02	2 (1%) 84 77	34, 63, 117, 156	0
1	B	192/230 (83%)	0.13	6 (3%) 52 40	37, 73, 135, 178	0
2	C	22/22 (100%)	0.34	1 (4%) 37 26	58, 74, 150, 164	0
2	E	22/22 (100%)	0.25	0 100 100	60, 89, 145, 154	0
3	D	22/22 (100%)	-0.14	0 100 100	49, 76, 126, 139	0
3	F	22/22 (100%)	0.31	1 (4%) 37 26	51, 95, 162, 172	0
All	All	473/548 (86%)	0.09	10 (2%) 67 56	34, 69, 138, 178	0

The worst 5 of 10 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	176	ASP	3.5
1	A	174	LYS	3.0
1	B	174	LYS	2.9
3	F	11	DA	2.8
1	A	46	LEU	2.8

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates

There are no carbohydrates in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.