



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 16, 2018 – 06:37 am GMT

PDB ID : 1MJX  
Title : STRUCTURE OF INORGANIC PYROPHOSPHATASE MUTANT D65N  
Authors : Oganesyanyan, V.; Harutyunyan, E.H.; Avaeva, S.M.; Huber, R.  
Deposited on : 1997-02-08  
Resolution : 2.15 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

<https://www.wwpdb.org/validation/2017/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 : 1.7.3 (157068), CSD as539be (2018)  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk30686

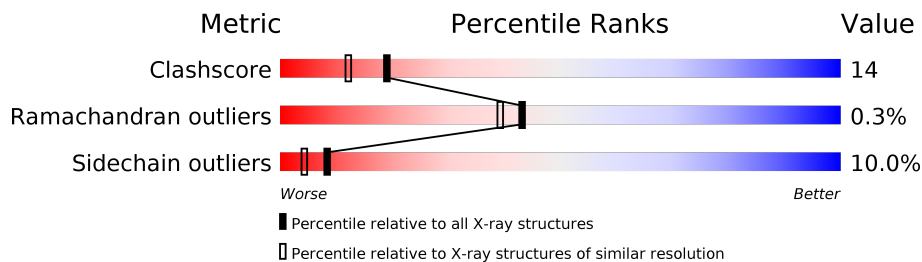
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.15 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	122078	1390 (2.16-2.16)
Ramachandran outliers	120005	1368 (2.16-2.16)
Sidechain outliers	119972	1367 (2.16-2.16)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	175	
1	B	175	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 2943 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 INORGANIC PYROPHOSPHATASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	175	1381	889	225	262	5	0	0	0
1	B	175	1381	889	225	262	5	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	65	ASN	ASP	ENGINEERED	UNP P0A7A9
B	65	ASN	ASP	ENGINEERED	UNP P0A7A9

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	A	1	5	4	1	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is water.

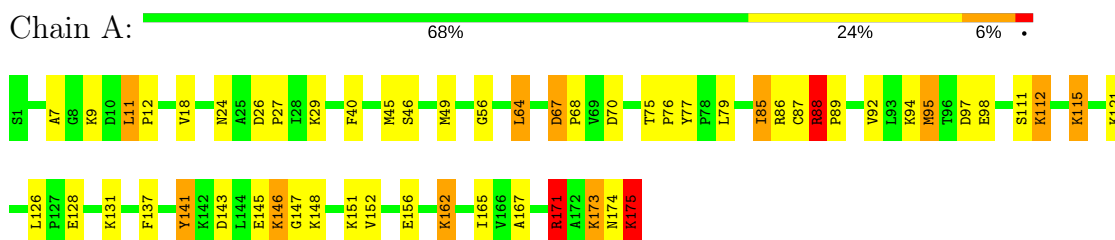
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	84	Total	O	0	0
			84	84		
3	B	87	Total	O	0	0
			87	87		

### 3 Residue-property plots

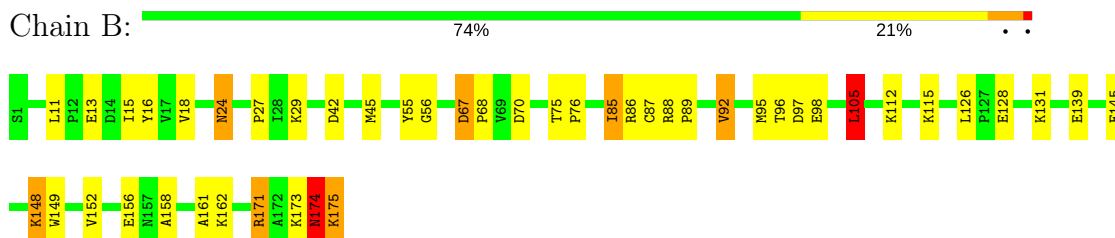
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are 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.

Note EDS was not executed.

- Molecule 1: INORGANIC PYROPHOSPHATASE



- Molecule 1: INORGANIC PYROPHOSPHATASE



## 4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	110.20Å 110.20Å 155.20Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	15.00 – 2.15	Depositor
% Data completeness (in resolution range)	(Not available) (15.00-2.15)	Depositor
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.190 , 0.263	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	2943	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	34.0	wwPDB-VP

## 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: SO4

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	1.87	1/1416 (0.1%)	1.48	13/1923 (0.7%)
1	B	1.20	2/1416 (0.1%)	1.43	13/1923 (0.7%)
All	All	1.57	3/2832 (0.1%)	1.45	26/3846 (0.7%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	175	LYS	C-OXT	63.73	2.44	1.23
1	B	175	LYS	C-OXT	34.88	1.89	1.23
1	B	174	ASN	C-N	-9.36	1.12	1.34

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	174	ASN	O-C-N	-12.36	102.92	122.70
1	A	174	ASN	O-C-N	-8.57	108.99	122.70
1	B	88	ARG	NE-CZ-NH2	7.80	124.20	120.30
1	A	70	ASP	CB-CG-OD2	7.79	125.31	118.30
1	B	174	ASN	C-N-CA	7.44	140.30	121.70
1	B	42	ASP	CB-CG-OD1	7.01	124.61	118.30
1	A	88	ARG	NE-CZ-NH2	6.84	123.72	120.30
1	A	77	TYR	CB-CG-CD1	-6.79	116.93	121.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	174	ASN	CA-C-N	6.78	132.11	117.20
1	A	67	ASP	CB-CG-OD1	6.47	124.12	118.30
1	A	147	GLY	N-CA-C	-6.37	97.18	113.10
1	B	171	ARG	NE-CZ-NH2	6.06	123.33	120.30
1	B	97	ASP	CB-CG-OD1	6.05	123.75	118.30
1	A	171	ARG	NE-CZ-NH2	5.75	123.17	120.30
1	A	45	MET	CG-SD-CE	5.72	109.36	100.20
1	A	40	PHE	CB-CG-CD1	5.67	124.77	120.80
1	A	67	ASP	CB-CG-OD2	-5.56	113.30	118.30
1	A	146	LYS	CA-C-N	-5.41	105.37	116.20
1	B	16	TYR	CG-CD1-CE1	5.39	125.61	121.30
1	B	88	ARG	CB-CA-C	-5.32	99.75	110.40
1	B	55	TYR	CB-CG-CD2	-5.31	117.81	121.00
1	A	146	LYS	O-C-N	5.28	132.18	123.20
1	B	105	LEU	CA-CB-CG	5.20	127.26	115.30
1	A	95	MET	CA-CB-CG	5.17	122.08	113.30
1	B	95	MET	CG-SD-CE	-5.06	92.10	100.20
1	B	24	ASN	CB-CG-OD1	-5.03	111.53	121.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	174	ASN	Mainchain

## 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	1381	0	1371	51	0
1	B	1381	0	1370	26	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	84	0	0	0	0
3	B	87	0	0	0	0
All	All	2943	0	2741	77	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 14.

All (77) 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:B:175:LYS:OXT	1:B:175:LYS:C	1.89	1.11
1:A:86:ARG:HH11	1:A:112:LYS:HD3	1.34	0.91
1:B:86:ARG:NH1	1:B:112:LYS:HD2	1.86	0.90
1:A:111:SER:HB3	1:A:115:LYS:HZ1	1.37	0.89
1:A:151:LYS:NZ	1:A:152:VAL:H	1.71	0.88
1:A:171:ARG:HG3	1:A:171:ARG:HH11	1.38	0.87
1:B:67:ASP:HB2	1:B:68:PRO:HD2	1.56	0.87
1:A:151:LYS:HZ3	1:A:152:VAL:H	1.23	0.86
1:A:86:ARG:NH1	1:A:112:LYS:HD3	1.95	0.81
1:A:49:MET:CE	1:A:141:TYR:HB3	2.11	0.80
1:A:126:LEU:HB2	1:A:131:LYS:HD2	1.66	0.77
1:A:49:MET:HE1	1:A:141:TYR:HB3	1.73	0.71
1:B:67:ASP:CB	1:B:68:PRO:HD2	2.21	0.70
1:A:79:LEU:HD13	1:A:85:ILE:HG21	1.72	0.70
1:A:49:MET:HE3	1:A:137:PHE:CD1	2.27	0.69
1:A:49:MET:HE2	1:A:141:TYR:CB	2.23	0.68
1:B:67:ASP:HB2	1:B:68:PRO:CD	2.23	0.68
1:A:49:MET:CE	1:A:141:TYR:CB	2.74	0.66
1:A:111:SER:HB3	1:A:115:LYS:NZ	2.11	0.65
1:A:86:ARG:HH11	1:A:112:LYS:CD	2.10	0.64
1:B:67:ASP:CB	1:B:68:PRO:CD	2.76	0.64
1:A:143:ASP:HA	1:A:146:LYS:HE3	1.81	0.63
1:A:79:LEU:CD1	1:A:85:ILE:HG21	2.28	0.63
1:A:98:GLU:OE2	1:A:148:LYS:HD3	1.98	0.63
1:A:171:ARG:HH11	1:A:171:ARG:CG	2.09	0.62
1:B:145:GLU:HB3	1:B:148:LYS:HG3	1.81	0.61
1:B:86:ARG:HH12	1:B:112:LYS:HD2	1.64	0.59
1:A:46:SER:OG	1:A:145:GLU:HG3	2.03	0.58
1:B:75:THR:HB	1:B:76:PRO:HD2	1.86	0.58
1:A:12:PRO:HG2	1:A:162:LYS:HG2	1.85	0.58
1:A:67:ASP:HB3	1:A:68:PRO:HD2	1.85	0.57
1:A:175:LYS:C	1:A:175:LYS:OXT	2.44	0.56
1:B:158:ALA:O	1:B:162:LYS:HG3	2.05	0.55
1:B:11:LEU:HD23	1:B:15:ILE:HG22	1.90	0.54
1:B:11:LEU:CD2	1:B:15:ILE:HG22	2.38	0.53
1:A:143:ASP:O	1:A:146:LYS:HG3	2.08	0.52
1:A:92:VAL:HG13	1:A:156:GLU:HB2	1.91	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:75:THR:HB	1:A:76:PRO:HD2	1.91	0.52
1:B:126:LEU:HB2	1:B:131:LYS:HD2	1.91	0.52
1:A:151:LYS:HZ3	1:A:152:VAL:N	2.00	0.51
1:A:85:ILE:HG13	1:A:87:CYS:SG	2.52	0.50
1:A:146:LYS:HD3	1:A:148:LYS:O	2.12	0.50
1:A:146:LYS:HA	1:A:148:LYS:H	1.77	0.49
1:B:139:GLU:HG3	1:B:152:VAL:HG23	1.95	0.49
1:B:92:VAL:HG13	1:B:156:GLU:HB2	1.95	0.49
1:B:85:ILE:HG23	1:B:87:CYS:SG	2.52	0.49
1:A:49:MET:CE	1:A:141:TYR:HA	2.43	0.48
1:A:94:LYS:NZ	1:A:156:GLU:OE1	2.46	0.48
1:A:64:LEU:HD13	1:A:171:ARG:NE	2.28	0.48
1:A:9:LYS:HD3	1:A:86:ARG:NH2	2.29	0.48
1:B:86:ARG:HH12	1:B:112:LYS:CD	2.26	0.47
1:A:49:MET:CE	1:A:141:TYR:CA	2.92	0.47
1:A:151:LYS:HZ2	1:A:152:VAL:H	1.57	0.46
1:B:174:ASN:O	1:B:175:LYS:HG2	2.16	0.46
1:A:86:ARG:NH1	1:A:112:LYS:CD	2.73	0.45
1:B:171:ARG:O	1:B:171:ARG:HG2	2.16	0.45
1:A:18:VAL:O	1:A:56:GLY:HA3	2.16	0.45
1:A:97:ASP:O	1:A:98:GLU:C	2.55	0.45
1:B:105:LEU:HD13	1:B:161:ALA:HB1	1.98	0.45
1:A:11:LEU:HD23	1:A:165:ILE:CG2	2.46	0.45
1:A:171:ARG:CG	1:A:171:ARG:NH1	2.75	0.45
1:A:7:ALA:HB3	1:A:11:LEU:HD11	1.98	0.44
1:A:88:ARG:HA	1:A:89:PRO:HD3	1.84	0.44
1:B:27:PRO:HB2	1:B:45:MET:HB2	2.01	0.43
1:B:75:THR:HB	1:B:76:PRO:CD	2.49	0.43
1:B:18:VAL:O	1:B:56:GLY:HA3	2.19	0.43
1:B:86:ARG:NH1	1:B:112:LYS:CD	2.71	0.42
1:A:26:ASP:HB3	1:A:27:PRO:HD2	2.01	0.42
1:A:173:LYS:HG3	1:A:173:LYS:H	1.65	0.42
1:A:9:LYS:HZ2	1:A:9:LYS:HB3	1.84	0.42
1:A:64:LEU:HD22	1:A:171:ARG:HH21	1.85	0.42
1:B:175:LYS:HA	1:B:175:LYS:HD3	1.91	0.41
1:B:98:GLU:HB3	1:B:149:TRP:CD1	2.56	0.41
1:A:49:MET:HE2	1:A:141:TYR:HA	2.02	0.41
1:A:167:ALA:O	1:A:171:ARG:HB2	2.20	0.41
1:A:67:ASP:HB3	1:A:68:PRO:CD	2.50	0.40
1:A:126:LEU:CB	1:A:131:LYS:HD2	2.45	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	173/175 (99%)	167 (96%)	6 (4%)	0	100	100
1	B	173/175 (99%)	166 (96%)	6 (4%)	1 (1%)	27	19
All	All	346/350 (99%)	333 (96%)	12 (4%)	1 (0%)	43	39

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	174	ASN

### 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	150/150 (100%)	134 (89%)	16 (11%)	7	3
1	B	150/150 (100%)	136 (91%)	14 (9%)	10	5
All	All	300/300 (100%)	270 (90%)	30 (10%)	8	4

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	LEU
1	A	24	ASN
1	A	29	LYS
1	A	64	LEU
1	A	85	ILE

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Mol	Chain	Res	Type
1	A	88	ARG
1	A	95	MET
1	A	112	LYS
1	A	115	LYS
1	A	121	LYS
1	A	128	GLU
1	A	141	TYR
1	A	162	LYS
1	A	171	ARG
1	A	173	LYS
1	A	175	LYS
1	B	13	GLU
1	B	24	ASN
1	B	29	LYS
1	B	67	ASP
1	B	70	ASP
1	B	85	ILE
1	B	89	PRO
1	B	92	VAL
1	B	96	THR
1	B	105	LEU
1	B	115	LYS
1	B	128	GLU
1	B	148	LYS
1	B	173	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	174	ASN

### 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](#)

2 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	$\# Z  > 2$
2	SO4	A	176	-	4,4,4	0.68	0	6,6,6	0.21	0
2	SO4	B	176	-	4,4,4	0.74	0	6,6,6	0.28	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
2	SO4	A	176	-	-	0/0/0/0	0/0/0/0
2	SO4	B	176	-	-	0/0/0/0	0/0/0/0

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.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	B	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	174:ASN	C	175:LYS	N	1.12

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.