



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 25, 2026 – 09:12 AM UTC

PDB ID : 1IGP / pdb_00001igp
Title : X-RAY CRYSTALLOGRAPHIC STUDIES OF RECOMBINANT INORGANIC PYROPHOSPHATASE FROM ESCHERICHIA COLI
Authors : Oganessyan, V.Yu.; Avaeva, S.M.; Harutyunyan, E.H.
Deposited on : 1994-08-01
Resolution : 2.20 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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

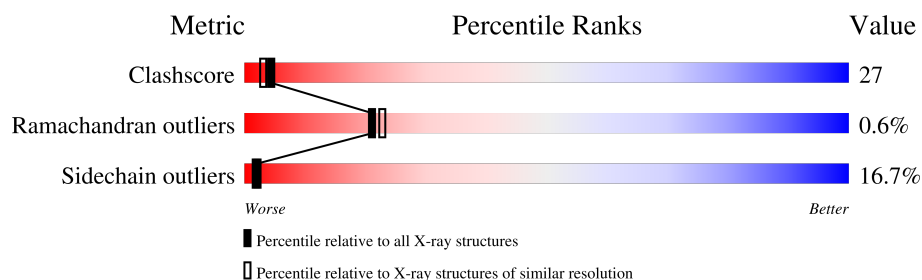
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (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 ≥ 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	175	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1509 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
1	A	175	Total	C	N	O	S	0	0	0
			1379	887	224	263	5			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	85	THR	ILE	conflict	UNP P0A7A9

- Molecule 2 is water.

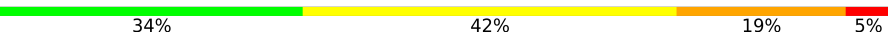
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	130	Total	O	0	0
			130	130		

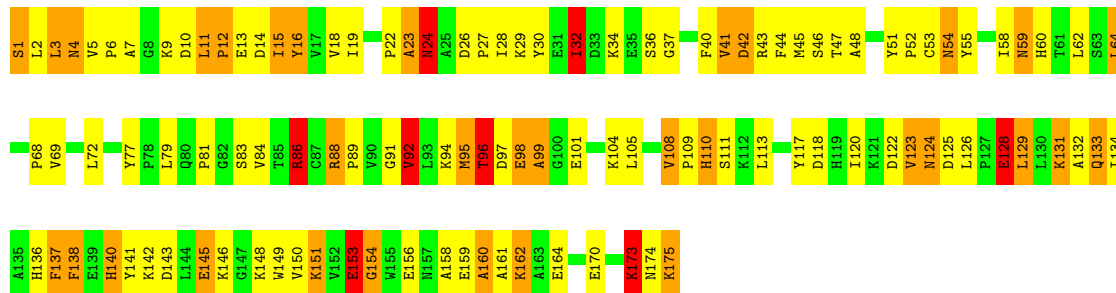
3 Residue-property plots

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: INORGANIC PYROPHOSPHATASE

Chain A: 



4 Data and refinement statistics

Xtriage (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, α , β , γ	110.40 Å 110.40 Å 76.80 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	(Not available) – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.20)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.220 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1509	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

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	1.18	2/1414 (0.1%)	2.41	89/1922 (4.6%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	140	HIS	CA-CB	5.08	1.61	1.54
1	A	48	ALA	N-CA	-5.05	1.40	1.46

All (89) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	4	ASN	CA-CB-CG	12.30	124.90	112.60
1	A	40	PHE	CA-CB-CG	11.45	125.25	113.80
1	A	86	ARG	CD-NE-CZ	10.23	138.72	124.40
1	A	99	ALA	N-CA-C	-9.71	101.93	113.88
1	A	24	ASN	OD1-CG-ND2	9.41	132.01	122.60
1	A	59	ASN	OD1-CG-ND2	8.97	131.57	122.60
1	A	3	LEU	O-C-N	8.96	133.54	122.34
1	A	95	MET	O-C-N	8.63	133.14	123.48
1	A	42	ASP	CA-CB-CG	8.56	121.17	112.60
1	A	24	ASN	CB-CA-C	-8.44	98.18	111.51
1	A	72	LEU	CA-C-O	-8.21	111.29	120.32
1	A	68	PRO	CA-C-O	-8.01	111.94	121.95
1	A	83	SER	CA-C-O	-7.95	111.96	121.66
1	A	110	HIS	CA-C-O	-7.88	113.21	121.87
1	A	29	LYS	CA-CB-CG	7.80	129.70	114.10
1	A	140	HIS	N-CA-C	7.76	123.91	113.97
1	A	151	LYS	O-C-N	7.58	132.22	123.27
1	A	136	HIS	CA-C-N	7.47	130.60	120.44
1	A	136	HIS	C-N-CA	7.47	130.60	120.44
1	A	53	CYS	CA-C-O	-7.45	112.93	121.58
1	A	140	HIS	CA-CB-CG	-7.43	106.37	113.80
1	A	153	GLU	CB-CA-C	7.25	124.38	109.95

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	53	CYS	O-C-N	7.22	132.83	122.94
1	A	7	ALA	CA-C-O	7.21	128.25	120.24
1	A	47	THR	CA-C-N	7.01	132.59	122.08
1	A	47	THR	C-N-CA	7.01	132.59	122.08
1	A	133	GLN	CB-CG-CD	-7.00	100.70	112.60
1	A	138	PHE	CB-CA-C	6.94	122.30	110.79
1	A	41	VAL	N-CA-C	-6.80	99.91	108.89
1	A	16	TYR	CA-C-O	-6.70	113.61	120.71
1	A	18	VAL	CA-C-N	6.63	131.08	121.80
1	A	18	VAL	C-N-CA	6.63	131.08	121.80
1	A	91	GLY	CA-C-O	-6.62	115.13	121.62
1	A	150	VAL	N-CA-C	6.62	117.84	108.17
1	A	161	ALA	CB-CA-C	-6.57	100.57	110.88
1	A	59	ASN	N-CA-CB	-6.54	100.75	110.17
1	A	54	ASN	N-CA-C	-6.43	100.76	110.28
1	A	10	ASP	CA-C-N	6.38	129.96	120.83
1	A	10	ASP	C-N-CA	6.38	129.96	120.83
1	A	92	VAL	O-C-N	6.34	130.23	123.00
1	A	44	PHE	N-CA-C	-6.34	98.91	109.24
1	A	161	ALA	O-C-N	6.26	128.52	122.07
1	A	44	PHE	CA-C-O	-6.26	113.61	120.43
1	A	54	ASN	O-C-N	6.25	130.51	122.89
1	A	15	ILE	N-CA-CB	-6.21	104.58	112.60
1	A	81	PRO	CA-C-O	-6.19	114.28	121.34
1	A	145	GLU	O-C-N	6.15	130.31	122.93
1	A	23	ALA	CA-C-O	-6.14	114.87	121.56
1	A	137	PHE	CA-CB-CG	-6.13	107.67	113.80
1	A	123	VAL	N-CA-C	6.06	118.63	111.05
1	A	136	HIS	CA-CB-CG	-5.94	107.86	113.80
1	A	154	GLY	CA-C-O	-5.88	116.89	122.13
1	A	28	ILE	CA-C-O	-5.85	114.31	120.57
1	A	129	LEU	CA-C-N	5.78	128.03	120.28
1	A	129	LEU	C-N-CA	5.78	128.03	120.28
1	A	151	LYS	N-CA-CB	5.78	119.62	110.55
1	A	133	GLN	CA-CB-CG	-5.72	102.66	114.10
1	A	26	ASP	N-CA-C	-5.72	101.89	109.84
1	A	77	TYR	CA-CB-CG	-5.63	103.76	113.90
1	A	77	TYR	O-C-N	5.61	126.62	121.80
1	A	37	GLY	N-CA-C	-5.56	107.65	115.32
1	A	54	ASN	CA-C-O	-5.52	114.98	121.16
1	A	24	ASN	N-CA-CB	-5.52	103.91	112.30
1	A	43	ARG	N-CA-CB	-5.51	102.48	111.24

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	150	VAL	CB-CA-C	-5.45	101.67	110.28
1	A	128	GLU	CB-CG-CD	5.43	121.83	112.60
1	A	132	ALA	CA-C-N	5.40	128.51	120.31
1	A	132	ALA	C-N-CA	5.40	128.51	120.31
1	A	131	LYS	N-CA-C	-5.38	105.50	111.36
1	A	12	PRO	CA-C-N	5.37	127.92	120.29
1	A	12	PRO	C-N-CA	5.37	127.92	120.29
1	A	3	LEU	N-CA-C	-5.33	106.45	113.17
1	A	108	VAL	CG1-CB-CG2	-5.33	99.07	110.80
1	A	151	LYS	CA-C-O	-5.31	114.48	120.32
1	A	96	THR	N-CA-C	-5.27	101.29	109.72
1	A	134	ILE	CA-C-O	5.27	126.90	121.05
1	A	55	TYR	CA-C-N	-5.26	115.57	121.83
1	A	55	TYR	C-N-CA	-5.26	115.57	121.83
1	A	24	ASN	CA-C-O	-5.25	114.31	120.81
1	A	153	GLU	CA-CB-CG	5.19	124.47	114.10
1	A	153	GLU	N-CA-CB	-5.14	101.77	110.41
1	A	7	ALA	N-CA-C	-5.12	105.39	111.69
1	A	88	ARG	O-C-N	5.12	127.21	121.32
1	A	156	GLU	CA-C-O	5.11	127.42	121.44
1	A	32	ILE	O-C-N	5.06	128.42	122.81
1	A	23	ALA	CB-CA-C	-5.04	100.26	109.54
1	A	133	GLN	OE1-CD-NE2	5.03	127.63	122.60
1	A	160	ALA	CA-C-N	5.03	126.97	120.44
1	A	160	ALA	C-N-CA	5.03	126.97	120.44

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	1379	0	1365	73	9
2	A	130	0	0	12	9
All	All	1509	0	1365	73	10

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 27.

All (73) 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:174:ASN:HB2	1:A:175:LYS:HD2	1.38	1.04
1:A:108:VAL:HG11	1:A:117:TYR:HB3	1.49	0.95
1:A:58:ILE:HD12	1:A:69:VAL:HG21	1.59	0.85
1:A:98:GLU:HB3	1:A:149:TRP:NE1	1.94	0.82
1:A:108:VAL:HG11	1:A:117:TYR:CB	2.14	0.77
1:A:13:GLU:HG3	2:A:304:HOH:O	1.94	0.67
1:A:2:LEU:HD13	1:A:32:ILE:HD12	1.77	0.66
1:A:170:GLU:HA	1:A:170:GLU:OE1	1.98	0.64
1:A:164:GLU:OE2	2:A:235:HOH:O	2.15	0.63
1:A:108:VAL:HG13	1:A:109:PRO:HD2	1.82	0.62
1:A:23:ALA:O	1:A:24:ASN:HB2	1.99	0.62
1:A:101:GLU:HG3	2:A:302:HOH:O	2.00	0.61
1:A:34:LYS:NZ	2:A:193:HOH:O	2.35	0.60
1:A:51:TYR:HD1	2:A:279:HOH:O	1.85	0.60
1:A:24:ASN:ND2	2:A:215:HOH:O	2.33	0.60
1:A:92:VAL:HG13	1:A:105:LEU:HD23	1.84	0.60
1:A:108:VAL:CG1	1:A:109:PRO:HD2	2.32	0.59
1:A:98:GLU:HB3	1:A:149:TRP:HE1	1.65	0.58
1:A:12:PRO:HG2	1:A:162:LYS:HG2	1.86	0.58
1:A:108:VAL:CG1	1:A:117:TYR:CB	2.82	0.57
1:A:59:ASN:ND2	2:A:243:HOH:O	2.38	0.57
1:A:14:ASP:OD1	1:A:86:ARG:HD2	2.05	0.57
1:A:2:LEU:HD13	1:A:32:ILE:CD1	2.35	0.57
1:A:9:LYS:HD3	1:A:16:TYR:OH	2.06	0.55
1:A:27:PRO:CB	1:A:45:MET:HE3	2.36	0.55
1:A:122:ASP:O	1:A:125:ASP:HB2	2.06	0.55
1:A:22:PRO:HB3	1:A:79:LEU:O	2.07	0.55
1:A:126:LEU:HB2	1:A:131:LYS:HE2	1.89	0.55
1:A:173:LYS:HG2	1:A:175:LYS:HG2	1.91	0.53
1:A:97:ASP:HB2	1:A:149:TRP:O	2.09	0.52
1:A:108:VAL:CG1	1:A:117:TYR:CG	2.93	0.52
1:A:173:LYS:CG	1:A:174:ASN:H	2.23	0.51
1:A:27:PRO:HB3	1:A:45:MET:HE3	1.92	0.51
1:A:158:ALA:O	1:A:162:LYS:HD2	2.11	0.50
1:A:124:ASN:HA	1:A:131:LYS:NZ	2.27	0.49
1:A:27:PRO:CA	1:A:45:MET:HE3	2.43	0.49
1:A:123:VAL:O	1:A:131:LYS:NZ	2.43	0.49

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:92:VAL:HG13	1:A:105:LEU:CD2	2.42	0.49
1:A:12:PRO:O	1:A:89:PRO:HG3	2.13	0.49
1:A:11:LEU:HD22	1:A:15:ILE:HG22	1.95	0.48
1:A:64:LEU:HD13	1:A:64:LEU:HA	1.71	0.48
1:A:23:ALA:H	1:A:54:ASN:ND2	2.11	0.48
1:A:154:GLY:HA2	2:A:276:HOH:O	2.14	0.47
1:A:19:ILE:HD12	1:A:54:ASN:HB3	1.97	0.46
1:A:111:SER:HB3	1:A:118:ASP:OD1	2.16	0.46
1:A:108:VAL:HG11	1:A:117:TYR:CG	2.51	0.46
1:A:94:LYS:O	1:A:153:GLU:N	2.49	0.45
1:A:86:ARG:HG3	1:A:110:HIS:HB2	1.99	0.45
1:A:30:TYR:CE1	1:A:41:VAL:HG22	2.51	0.45
1:A:88:ARG:HA	1:A:89:PRO:HD2	1.84	0.44
1:A:1:SER:O	1:A:4:ASN:HB2	2.17	0.44
1:A:5:VAL:HA	1:A:6:PRO:HD3	1.84	0.44
1:A:51:TYR:HA	1:A:52:PRO:HD3	1.71	0.44
1:A:137:PHE:O	1:A:141:TYR:HB3	2.18	0.44
1:A:170:GLU:OE1	1:A:170:GLU:CA	2.63	0.44
1:A:97:ASP:OD1	1:A:99:ALA:N	2.49	0.43
1:A:52:PRO:HB3	1:A:133:GLN:OE1	2.18	0.43
1:A:128:GLU:HG2	2:A:234:HOH:O	2.19	0.43
1:A:58:ILE:HB	1:A:69:VAL:HG22	2.00	0.43
1:A:95:MET:HA	1:A:153:GLU:H	1.84	0.42
1:A:148:LYS:HD3	1:A:148:LYS:HA	1.83	0.42
1:A:2:LEU:HD23	1:A:2:LEU:HA	1.91	0.42
1:A:117:TYR:HD1	1:A:120:ILE:HD12	1.83	0.42
1:A:22:PRO:HA	1:A:54:ASN:HD22	1.83	0.42
1:A:23:ALA:O	1:A:24:ASN:CB	2.66	0.41
1:A:96:THR:HG22	1:A:101:GLU:OE2	2.21	0.41
1:A:59:ASN:ND2	2:A:237:HOH:O	2.54	0.41
1:A:59:ASN:O	1:A:60:HIS:HB2	2.20	0.41
1:A:9:LYS:HG2	2:A:230:HOH:O	2.20	0.41
1:A:117:TYR:HB2	2:A:207:HOH:O	2.20	0.41
1:A:142:LYS:O	1:A:145:GLU:HB2	2.20	0.41
1:A:27:PRO:HA	1:A:45:MET:HE3	2.03	0.40
1:A:104:LYS:HE3	1:A:138:PHE:CE1	2.57	0.40

All (10) 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:175:LYS:O	2:A:240:HOH:O[4_556]	1.57	0.63
1:A:160:ALA:O	2:A:292:HOH:O[4_556]	1.60	0.60
1:A:1:SER:OG	1:A:36:SER:O[3_565]	1.69	0.51
1:A:143:ASP:OD2	2:A:257:HOH:O[11_565]	1.75	0.45
1:A:140:HIS:CD2	2:A:257:HOH:O[11_565]	1.87	0.33
2:A:251:HOH:O	2:A:292:HOH:O[4_556]	2.08	0.12
1:A:143:ASP:OD1	2:A:257:HOH:O[11_565]	2.10	0.10
1:A:143:ASP:CG	2:A:257:HOH:O[11_565]	2.10	0.10
1:A:175:LYS:C	2:A:240:HOH:O[4_556]	2.10	0.10
1:A:174:ASN:OD1	2:A:300:HOH:O[4_556]	2.14	0.06

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%)	163 (94%)	9 (5%)	1 (1%)	21	23

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	173	LYS

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%)	125 (83%)	25 (17%)	2	2

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	SER
1	A	3	LEU
1	A	11	LEU
1	A	24	ASN
1	A	32	ILE
1	A	42	ASP
1	A	46	SER
1	A	62	LEU
1	A	64	LEU
1	A	84	VAL
1	A	86	ARG
1	A	92	VAL
1	A	96	THR
1	A	98	GLU
1	A	113	LEU
1	A	124	ASN
1	A	128	GLU
1	A	129	LEU
1	A	146	LYS
1	A	151	LYS
1	A	153	GLU
1	A	159	GLU
1	A	162	LYS
1	A	173	LYS
1	A	175	LYS

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

Mol	Chain	Res	Type
1	A	24	ASN
1	A	59	ASN

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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.