



Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 3IR8 / pdb_00003ir8
Title : Red fluorescent protein mKeima at pH 7.0
Authors : Henderson, J.N.; Osborn, M.F.; Koon, N.; Gepshtein, R.; Huppert, D.; Remington, S.J.
Deposited on : 2009-08-21
Resolution : 1.63 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
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

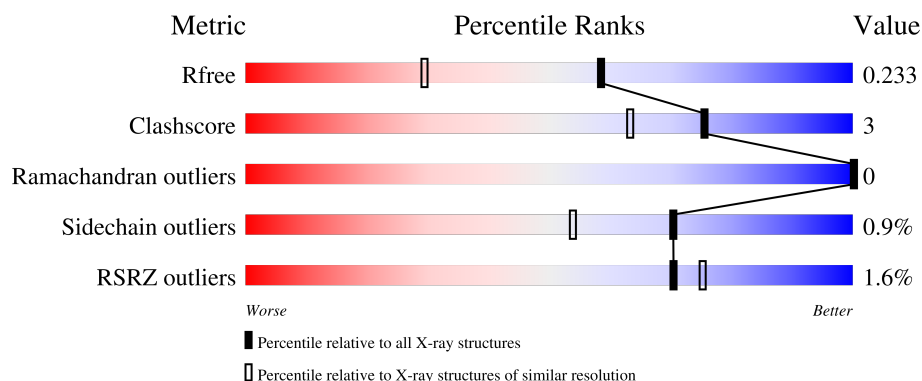
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

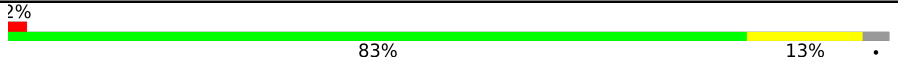
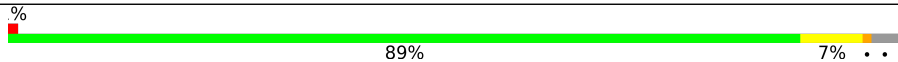
The reported resolution of this entry is 1.63 Å.

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}	180053	1141 (1.64-1.64)
Clashscore	190562	1171 (1.64-1.64)
Ramachandran outliers	187476	1151 (1.64-1.64)
Sidechain outliers	187428	1150 (1.64-1.64)
RSRZ outliers	180081	1141 (1.64-1.64)

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 $\leq 5\%$. 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	221	
1	B	221	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3714 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 Large stokes shift fluorescent protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	214	Total	C	N	O	S	0	2	0
			1695	1084	278	321	12			
1	B	215	Total	C	N	O	S	0	6	0
			1713	1097	280	324	12			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	SER	-	expression tag	UNP Q1JV70
A	0	SER	-	expression tag	UNP Q1JV70
A	64	CRQ	GLN	chromophore	UNP Q1JV70
A	64	CRQ	TYR	chromophore	UNP Q1JV70
A	64	CRQ	GLY	chromophore	UNP Q1JV70
B	-1	SER	-	expression tag	UNP Q1JV70
B	0	SER	-	expression tag	UNP Q1JV70
B	64	CRQ	GLN	chromophore	UNP Q1JV70
B	64	CRQ	TYR	chromophore	UNP Q1JV70
B	64	CRQ	GLY	chromophore	UNP Q1JV70

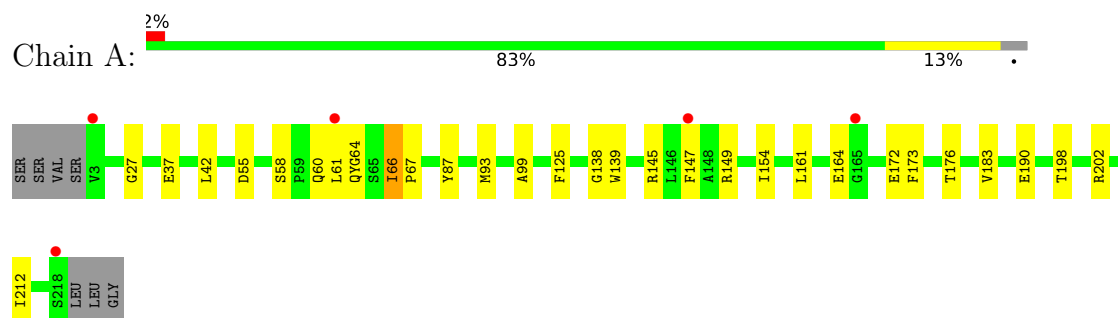
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	141	Total	O	0	0
			141	141		
2	B	165	Total	O	0	0
			165	165		

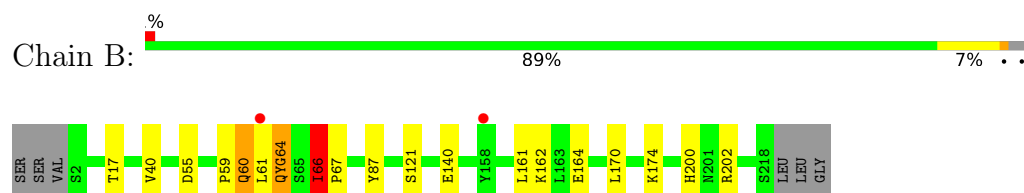
3 Residue-property plots [i](#)

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 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: Large stokes shift fluorescent protein



- Molecule 1: Large stokes shift fluorescent protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	66.96Å 75.69Å 85.67Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	31.18 – 1.63 31.18 – 1.63	Depositor EDS
% Data completeness (in resolution range)	97.5 (31.18-1.63) 97.4 (31.18-1.63)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.97 (at 1.63Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.193 , 0.235 0.192 , 0.233	Depositor DCC
R_{free} test set	2718 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	16.2	Xtriage
Anisotropy	0.084	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 37.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3714	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.46% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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

Bond lengths and bond angles in the following residue types are not validated in this section: CRQ

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	1.37	5/1722 (0.3%)	1.25	10/2330 (0.4%)
1	B	1.35	3/1752 (0.2%)	1.23	5/2375 (0.2%)
All	All	1.36	8/3474 (0.2%)	1.24	15/4705 (0.3%)

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	A	0	1
1	B	0	1
All	All	0	2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66	ILE	CA-C	6.13	1.59	1.52
1	A	198	THR	N-CA	5.76	1.53	1.45
1	A	176	THR	CA-CB	-5.63	1.45	1.53
1	A	138	GLY	N-CA	5.43	1.50	1.45
1	B	40	VAL	C-O	5.35	1.29	1.23
1	B	121	SER	C-O	-5.22	1.18	1.24
1	A	58	SER	N-CA	5.19	1.51	1.46
1	B	66	ILE	CA-CB	5.10	1.60	1.54

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	61	LEU	CA-C-O	-8.07	107.08	120.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	61	LEU	CA-C-O	-7.37	108.28	120.80
1	A	66	ILE	CA-C-N	-6.19	113.25	119.56
1	A	66	ILE	C-N-CA	-6.19	113.25	119.56
1	B	66	ILE	CA-C-N	-5.59	114.05	119.87
1	B	66	ILE	C-N-CA	-5.59	114.05	119.87
1	A	183	VAL	CA-C-O	-5.41	116.34	121.64
1	A	125	PHE	CA-C-N	-5.26	114.96	120.38
1	A	125	PHE	C-N-CA	-5.26	114.96	120.38
1	B	202	ARG	N-CA-C	5.18	116.93	111.28
1	A	164	GLU	N-CA-C	-5.09	102.75	110.24
1	B	61	LEU	N-CA-CB	5.08	119.14	110.50
1	A	99	ALA	N-CA-C	-5.07	103.35	110.50
1	A	202	ARG	CA-C-N	-5.01	114.62	122.49
1	A	202	ARG	C-N-CA	-5.01	114.62	122.49

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	60	GLN	Mainchain
1	B	60	GLN	Mainchain

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	1695	0	1589	12	0
1	B	1713	0	1608	11	0
2	A	141	0	0	0	0
2	B	165	0	0	4	0
All	All	3714	0	3197	20	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 (20) 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:147:PHE:HZ	1:B:170:LEU:HD11	1.35	0.92
1:A:147:PHE:CZ	1:B:170:LEU:HD11	2.19	0.77
1:B:162:LYS:HE2	2:B:359:HOH:O	1.88	0.73
1:B:200:HIS:NE2	2:B:299:HOH:O	2.25	0.58
1:A:67:PRO:HD3	1:A:87:TYR:OH	2.06	0.56
1:A:145:ARG:HG2	1:A:190:GLU:HG2	1.89	0.54
1:A:27:GLY:HA3	1:A:42:LEU:HD23	1.89	0.54
1:A:93:MET:HE3	1:A:173:PHE:CZ	2.45	0.51
1:A:37:GLU:HG2	1:A:212:ILE:HD12	1.93	0.50
1:B:17[B]:THR:HG21	2:B:346:HOH:O	2.14	0.47
1:A:172:GLU:OE1	1:B:174:LYS:NZ	2.47	0.47
1:B:67:PRO:HD3	1:B:87:TYR:OH	2.15	0.46
1:A:149:ARG:HD2	1:A:154:ILE:HD11	1.98	0.45
1:B:55:ASP:HB3	1:B:161:LEU:HD21	1.99	0.44
1:B:66:ILE:N	1:B:67:PRO:CD	2.83	0.42
1:A:55:ASP:HB3	1:A:161:LEU:HD21	2.00	0.42
1:A:66:ILE:N	1:A:67:PRO:CD	2.83	0.41
1:B:140:GLU:OE1	2:B:318:HOH:O	2.22	0.41
1:A:139:TRP:CZ3	1:A:161:LEU:HG	2.56	0.41
1:B:59:PRO:O	1:B:64:CRQ:C2	2.69	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	211/221 (96%)	209 (99%)	2 (1%)	0	100	100
1	B	216/221 (98%)	214 (99%)	2 (1%)	0	100	100
All	All	427/442 (97%)	423 (99%)	4 (1%)	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	175/191 (92%)	175 (100%)	0	100	100
1	B	177/191 (93%)	174 (98%)	3 (2%)	53	27
All	All	352/382 (92%)	349 (99%)	3 (1%)	70	54

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	60	GLN
1	B	66	ILE
1	B	164	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	117	ASN
1	A	137	GLN
1	A	156	ASN
1	B	137	GLN
1	B	156	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

2 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	CRQ	B	64	1	25,25,26	3.23	9 (36%)	28,34,36	3.45	4 (14%)
1	CRQ	A	64	1	25,25,26	3.55	6 (24%)	28,34,36	2.93	9 (32%)

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
1	CRQ	B	64	1	-	0/10/32/33	0/2/2/2
1	CRQ	A	64	1	-	0/10/32/33	0/2/2/2

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	64	CRQ	CB2-CA2	15.42	1.50	1.35
1	B	64	CRQ	CB2-CA2	12.87	1.47	1.35
1	A	64	CRQ	C1-N2	5.39	1.44	1.33
1	B	64	CRQ	C1-N2	5.29	1.44	1.33
1	B	64	CRQ	CA2-C2	-4.34	1.43	1.48
1	A	64	CRQ	CA2-C2	-3.87	1.44	1.48
1	B	64	CRQ	C1-CA1	3.12	1.52	1.48
1	A	64	CRQ	O2-C2	2.78	1.28	1.23
1	A	64	CRQ	CA1-N1	2.66	1.33	1.27
1	B	64	CRQ	CA3-N3	-2.64	1.42	1.47
1	B	64	CRQ	O2-C2	2.58	1.28	1.23
1	B	64	CRQ	C2-N3	-2.40	1.34	1.40
1	B	64	CRQ	CA2-N2	-2.27	1.33	1.38
1	A	64	CRQ	C2-N3	-2.19	1.35	1.40
1	B	64	CRQ	CA1-N1	2.13	1.32	1.27

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	64	CRQ	O2-C2-CA2	-14.03	122.07	131.02
1	A	64	CRQ	CA2-C2-N3	8.97	111.03	103.50
1	A	64	CRQ	O2-C2-CA2	-8.59	125.54	131.02
1	B	64	CRQ	CA2-C2-N3	8.49	110.63	103.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	64	CRQ	C3-CA3-N3	4.90	123.59	112.43
1	A	64	CRQ	CD2-CG2-CD1	3.68	123.12	117.65
1	A	64	CRQ	C3-CA3-N3	3.46	120.30	112.43
1	A	64	CRQ	CD1-CE1-CZ	-3.42	116.26	119.88
1	B	64	CRQ	CD2-CG2-CD1	3.07	122.21	117.65
1	A	64	CRQ	CE2-CZ-CE1	2.95	124.45	119.77
1	A	64	CRQ	CG2-CB2-CA2	2.81	133.21	129.87
1	A	64	CRQ	CE2-CD2-CG2	-2.32	118.23	121.22
1	A	64	CRQ	CB2-CA2-C2	-2.20	119.69	122.36

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	64	CRQ	1	0

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 [i](#)

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

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, 95th 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	213/221 (96%)	-0.33	5 (2%) 61 66	8, 14, 23, 33	2 (0%)
1	B	214/221 (96%)	-0.28	2 (0%) 81 85	8, 15, 24, 34	6 (2%)
All	All	427/442 (96%)	-0.30	7 (1%) 70 75	8, 15, 24, 34	8 (1%)

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	147	PHE	3.6
1	A	3	VAL	3.4
1	A	61	LEU	3.0
1	A	218	SER	2.4
1	B	61	LEU	2.4
1	A	165	GLY	2.2
1	B	158	TYR	2.1

6.2 Non-standard residues in protein, DNA, RNA chains [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. The B-factors column lists the minimum, median, 95th 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	B-factors(Å ²)	Q<0.9
1	CRQ	B	64	24/25	0.92	0.10	15,17,23,30	0
1	CRQ	A	64	24/25	0.93	0.10	12,18,22,27	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.