



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 15, 2026 – 01:51 PM UTC

PDB ID : 5UBC / pdb_00005ubc
Title : The structure of the Arabidopsis thaliana Toc75 POTRA domains
Authors : O'Neil, P.K.; Noinaj, N.
Deposited on : 2016-12-20
Resolution : 2.86 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

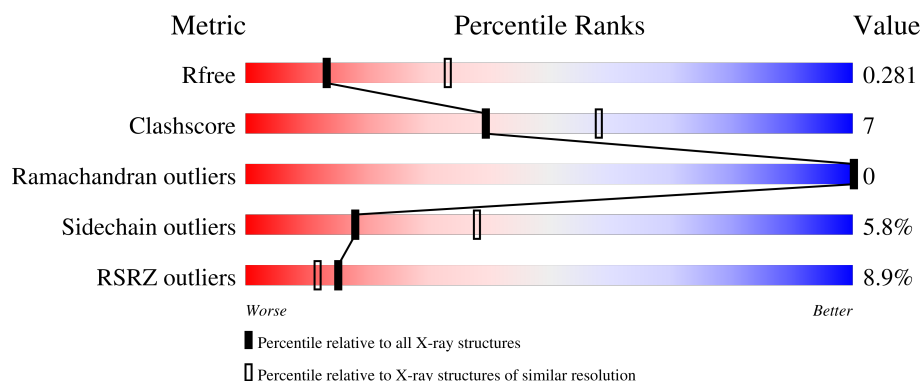
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.86 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	1407 (2.88-2.84)
Clashscore	190562	1446 (2.88-2.84)
Ramachandran outliers	187476	1406 (2.88-2.84)
Sidechain outliers	187428	1407 (2.88-2.84)
RSRZ outliers	180081	1408 (2.88-2.84)

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	314	9% 76% 19% • •
1	B	314	8% 75% 18% • •

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 4501 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 Protein TOC75-3, chloroplastic.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	300	Total	C	N	O	S	Se	0	0	0
			2249	1416	397	425	5	6			
1	B	300	Total	C	N	O	S	Se	0	0	0
			2252	1418	398	425	5	6			

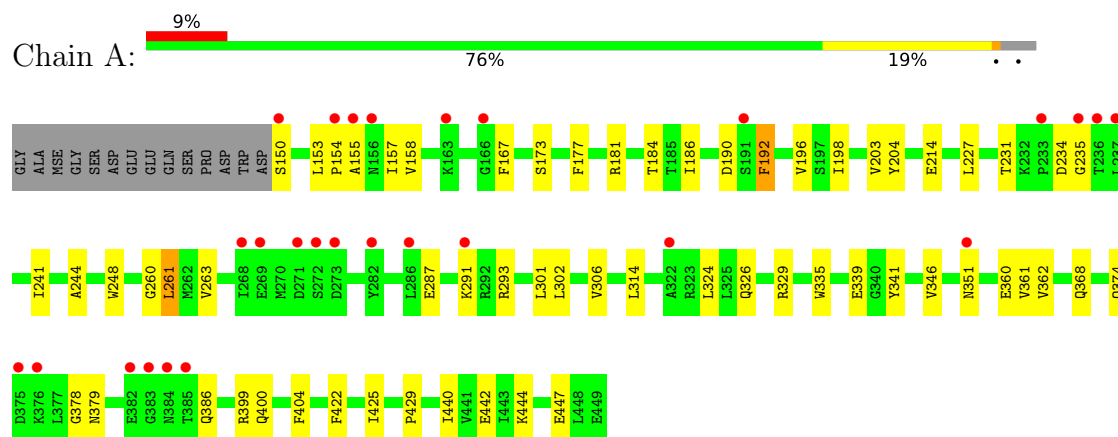
There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	136	GLY	-	expression tag	UNP Q9STE8
A	137	ALA	-	expression tag	UNP Q9STE8
A	138	MSE	-	expression tag	UNP Q9STE8
A	139	GLY	-	expression tag	UNP Q9STE8
A	140	SER	-	expression tag	UNP Q9STE8
B	136	GLY	-	expression tag	UNP Q9STE8
B	137	ALA	-	expression tag	UNP Q9STE8
B	138	MSE	-	expression tag	UNP Q9STE8
B	139	GLY	-	expression tag	UNP Q9STE8
B	140	SER	-	expression tag	UNP Q9STE8

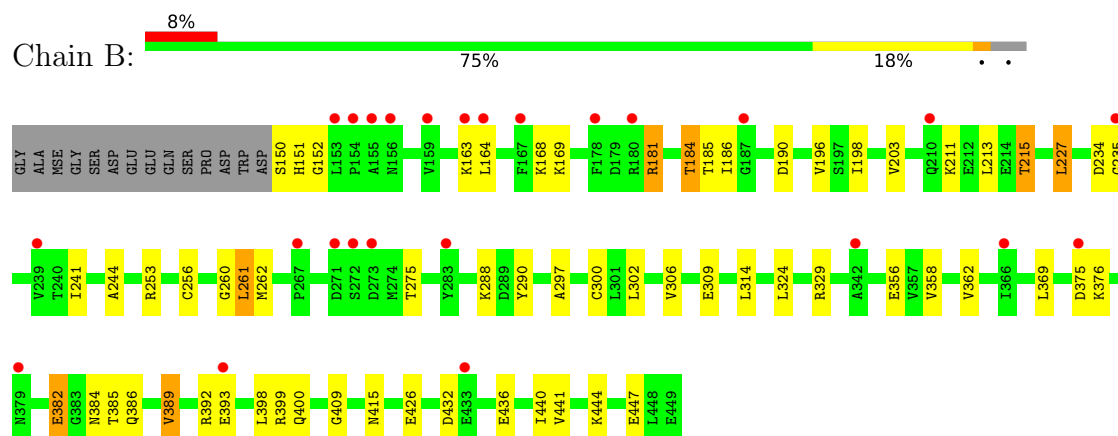
3 Residue-property plots [i](#)

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: Protein TOC75-3, chloroplastic



• Molecule 1: Protein TOC75-3, chloroplastic



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	92.37Å 50.45Å 94.80Å 90.00° 115.56° 90.00°	Depositor
Resolution (Å)	47.21 – 2.86 47.21 – 2.86	Depositor EDS
% Data completeness (in resolution range)	89.7 (47.21-2.86) 81.2 (47.21-2.86)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.15	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.77 (at 2.86Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.224 , 0.280 0.229 , 0.281	Depositor DCC
R_{free} test set	1675 reflections (10.05%)	wwPDB-VP
Wilson B-factor (Å ²)	47.6	Xtriage
Anisotropy	0.582	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 38.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.027 for l,-k,h	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	4501	wwPDB-VP
Average B, all atoms (Å ²)	63.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.18% 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

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	0.46	0/2278	0.91	4/3080 (0.1%)
1	B	0.47	0/2281	0.89	3/3083 (0.1%)
All	All	0.47	0/4559	0.90	7/6163 (0.1%)

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

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	378	GLY	N-CA-C	8.60	127.39	115.00
1	B	275	THR	CB-CA-C	-6.47	108.09	115.79
1	A	192	PHE	N-CA-C	-5.89	106.09	113.28
1	A	153	LEU	CA-C-N	5.48	125.45	120.03
1	A	153	LEU	C-N-CA	5.48	125.45	120.03
1	B	168	LYS	N-CA-C	-5.24	101.34	109.14
1	B	409	GLY	N-CA-C	-5.09	106.25	112.77

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	152	GLY	Peptide

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	2249	0	2124	30	0
1	B	2252	0	2129	29	0
All	All	4501	0	4253	59	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 7.

All (59) 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:386:GLN:NE2	1:B:447:GLU:OE2	2.18	0.75
1:A:386:GLN:NE2	1:A:447:GLU:OE2	2.25	0.70
1:B:262:MSE:HE1	1:B:297:ALA:HA	1.77	0.66
1:B:150:SER:HB3	1:B:203:VAL:HG11	1.77	0.64
1:B:227:LEU:HD23	1:B:241:ILE:HG12	1.82	0.62
1:A:157:ILE:O	1:A:231:THR:OG1	2.12	0.62
1:B:426:GLU:HB2	1:B:444:LYS:HB2	1.82	0.61
1:A:368:GLN:HB3	1:A:440:ILE:HG12	1.81	0.61
1:A:263:VAL:O	1:A:293:ARG:NH1	2.34	0.60
1:A:155:ALA:H	1:A:231:THR:HG21	1.68	0.59
1:B:432:ASP:HB3	1:B:440:ILE:HG13	1.84	0.59
1:B:384:ASN:O	1:B:385:THR:HG22	2.02	0.59
1:A:150:SER:HB3	1:A:203:VAL:HG11	1.84	0.58
1:B:302:LEU:HD11	1:B:306:VAL:HG11	1.89	0.55
1:A:314:LEU:HD23	1:A:324:LEU:HD21	1.91	0.52
1:B:382:GLU:HG3	1:B:384:ASN:H	1.72	0.52
1:B:181:ARG:HD2	1:B:244:ALA:HB1	1.91	0.52
1:A:293:ARG:HH21	1:A:360:GLU:CD	2.18	0.51
1:B:196:VAL:HG12	1:B:198:ILE:H	1.76	0.50
1:A:293:ARG:NH2	1:A:360:GLU:OE1	2.41	0.50
1:B:213:LEU:HD13	1:B:227:LEU:HB2	1.93	0.50
1:A:181:ARG:HD2	1:A:244:ALA:HB1	1.93	0.49
1:B:261:LEU:HA	1:B:436:GLU:HB3	1.94	0.49
1:A:346:VAL:HG22	1:A:361:VAL:HG12	1.94	0.48
1:B:151:HIS:HB3	1:B:169:LYS:O	2.13	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:290:TYR:HE2	1:B:358:VAL:HG21	1.78	0.48
1:A:301:LEU:HD13	1:A:341:TYR:CZ	2.49	0.47
1:A:177:PHE:HB3	1:A:186:ILE:HB	1.95	0.47
1:B:393:GLU:HB3	1:B:415:ASN:HB3	1.97	0.47
1:A:302:LEU:HD11	1:A:306:VAL:HG11	1.97	0.46
1:B:234:ASP:HA	1:B:235:GLY:HA2	1.64	0.46
1:A:198:ILE:HG23	1:A:204:TYR:CE2	2.50	0.46
1:B:256:CYS:HG	1:B:300:CYS:HG	1.63	0.46
1:A:154:PRO:HB3	1:A:231:THR:HB	1.97	0.46
1:A:196:VAL:HG12	1:A:198:ILE:H	1.81	0.46
1:A:260:GLY:O	1:A:261:LEU:HB2	2.16	0.46
1:B:389:VAL:HG12	1:B:392:ARG:NH2	2.31	0.46
1:A:190:ASP:C	1:A:192:PHE:H	2.25	0.44
1:A:234:ASP:HA	1:A:235:GLY:HA2	1.55	0.44
1:A:374:GLN:HE22	1:A:444:LYS:HE3	1.82	0.44
1:B:211:LYS:O	1:B:215:THR:OG1	2.34	0.44
1:B:314:LEU:HD23	1:B:324:LEU:HD21	2.00	0.44
1:A:404:PHE:CE2	1:A:429:PRO:HG3	2.52	0.44
1:A:227:LEU:HG	1:A:241:ILE:HG12	1.99	0.43
1:A:192:PHE:HA	1:A:326:GLN:HE22	1.83	0.43
1:A:422:PHE:HB2	1:A:425:ILE:HD11	2.00	0.43
1:B:398:LEU:HD22	1:B:441:VAL:HG11	2.01	0.42
1:A:248:TRP:CH2	1:A:351:ASN:HB3	2.55	0.41
1:A:260:GLY:HA2	1:A:362:VAL:HG12	2.01	0.41
1:A:287:GLU:O	1:A:291:LYS:HG2	2.20	0.41
1:A:335:TRP:CZ2	1:A:339:GLU:HG3	2.55	0.41
1:A:154:PRO:CB	1:A:231:THR:HB	2.50	0.41
1:B:389:VAL:HG12	1:B:392:ARG:HH22	1.86	0.41
1:B:184:THR:HG22	1:B:185:THR:H	1.86	0.41
1:B:186:ILE:HG23	1:B:190:ASP:OD2	2.21	0.41
1:B:260:GLY:HA2	1:B:362:VAL:HG12	2.03	0.40
1:B:393:GLU:OE2	1:B:415:ASN:HB3	2.22	0.40
1:B:253:ARG:HD2	1:B:356:GLU:CD	2.47	0.40
1:B:375:ASP:HA	1:B:376:LYS:HA	1.85	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	298/314 (95%)	281 (94%)	17 (6%)	0	100	100
1	B	298/314 (95%)	282 (95%)	16 (5%)	0	100	100
All	All	596/628 (95%)	563 (94%)	33 (6%)	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	225/268 (84%)	214 (95%)	11 (5%)	22	45
1	B	225/268 (84%)	210 (93%)	15 (7%)	15	31
All	All	450/536 (84%)	424 (94%)	26 (6%)	18	38

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	158	VAL
1	A	167	PHE
1	A	173	SER
1	A	184	THR
1	A	214	GLU
1	A	261	LEU
1	A	329	ARG
1	A	379	ASN

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Mol	Chain	Res	Type
1	A	399	ARG
1	A	400	GLN
1	A	442	GLU
1	B	163	LYS
1	B	164	LEU
1	B	181	ARG
1	B	184	THR
1	B	215	THR
1	B	227	LEU
1	B	261	LEU
1	B	288	LYS
1	B	309	GLU
1	B	329	ARG
1	B	369	LEU
1	B	382	GLU
1	B	389	VAL
1	B	399	ARG
1	B	400	GLN

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	374	GLN
1	B	151	HIS
1	B	348	ASN
1	B	372	GLN
1	B	374	GLN

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 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

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	292/314 (92%)	0.67	27 (9%) 14 11	30, 61, 104, 142	0
1	B	292/314 (92%)	0.62	25 (8%) 16 12	31, 59, 106, 142	0
All	All	584/628 (92%)	0.64	52 (8%) 15 12	30, 61, 105, 142	0

All (52) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	268	ILE	5.2
1	A	156	ASN	5.0
1	A	155	ALA	4.5
1	A	273	ASP	4.4
1	A	237	LEU	3.9
1	A	282	TYR	3.9
1	B	156	ASN	3.8
1	A	236	THR	3.5
1	A	233	PRO	3.5
1	A	351	ASN	3.4
1	A	385	THR	3.3
1	B	267	PRO	3.2
1	A	269	GLU	3.2
1	B	272	SER	3.1
1	A	271	ASP	3.1
1	A	163	LYS	3.0
1	A	235	GLY	2.9
1	B	154	PRO	2.9
1	B	235	GLY	2.8
1	B	433	GLU	2.7
1	B	379	ASN	2.7
1	B	271	ASP	2.7
1	B	187	GLY	2.6
1	B	366	ILE	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	180	ARG	2.5
1	B	164	LEU	2.5
1	A	384	ASN	2.5
1	B	163	LYS	2.5
1	B	393	GLU	2.5
1	A	383	GLY	2.4
1	A	150	SER	2.4
1	A	286	LEU	2.4
1	B	283	TYR	2.4
1	A	154	PRO	2.4
1	B	239	VAL	2.3
1	B	273	ASP	2.3
1	B	153	LEU	2.3
1	B	159	VAL	2.3
1	B	155	ALA	2.3
1	A	191	SER	2.3
1	A	322	ALA	2.3
1	B	167	PHE	2.2
1	A	382	GLU	2.2
1	B	375	ASP	2.1
1	A	376	LYS	2.1
1	A	166	GLY	2.1
1	A	272	SER	2.1
1	B	178	PHE	2.1
1	A	375	ASP	2.1
1	A	291	LYS	2.0
1	B	342	ALA	2.0
1	B	210	GLN	2.0

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

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

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.