



Full wwPDB X-ray Structure Validation Report ⓘ

May 29, 2020 – 05:33 am BST

PDB ID : 4NDD
Title : X-ray structure of a double mutant of calexcitin - a neuronal calcium-signalling protein
Authors : Erskine, P.T.; Fokas, A.; Muriithi, C.; Razzall, E.; Bowyer, A.; Findlow, I.S.; Werner, J.M.; Wallace, B.A.; Wood, S.P.; Cooper, J.B.
Deposited on : 2013-10-25
Resolution : 2.90 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

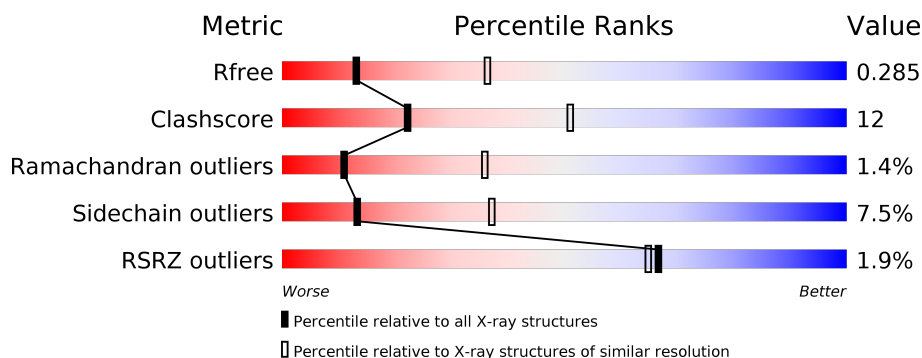
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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}	130704	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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 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	212	
1	B	212	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 3215 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 Calexcitin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	187	Total	C	N	O	S	6	1	0
			1549	983	259	298	9			
1	B	187	Total	C	N	O	S	0	0	0
			1541	978	256	298	9			

There are 46 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	EXPRESSION TAG	UNP O76764
A	-19	GLY	-	EXPRESSION TAG	UNP O76764
A	-18	HIS	-	EXPRESSION TAG	UNP O76764
A	-17	HIS	-	EXPRESSION TAG	UNP O76764
A	-16	HIS	-	EXPRESSION TAG	UNP O76764
A	-15	HIS	-	EXPRESSION TAG	UNP O76764
A	-14	HIS	-	EXPRESSION TAG	UNP O76764
A	-13	HIS	-	EXPRESSION TAG	UNP O76764
A	-12	HIS	-	EXPRESSION TAG	UNP O76764
A	-11	HIS	-	EXPRESSION TAG	UNP O76764
A	-10	HIS	-	EXPRESSION TAG	UNP O76764
A	-9	HIS	-	EXPRESSION TAG	UNP O76764
A	-8	SER	-	EXPRESSION TAG	UNP O76764
A	-7	SER	-	EXPRESSION TAG	UNP O76764
A	-6	GLY	-	EXPRESSION TAG	UNP O76764
A	-5	HIS	-	EXPRESSION TAG	UNP O76764
A	-4	ILE	-	EXPRESSION TAG	UNP O76764
A	-3	GLU	-	EXPRESSION TAG	UNP O76764
A	-2	GLY	-	EXPRESSION TAG	UNP O76764
A	-1	ARG	-	EXPRESSION TAG	UNP O76764
A	0	HIS	-	EXPRESSION TAG	UNP O76764
A	61	ASP	THR	ENGINEERED MUTATION	UNP O76764
A	188	ASP	THR	ENGINEERED MUTATION	UNP O76764
B	-20	MET	-	EXPRESSION TAG	UNP O76764
B	-19	GLY	-	EXPRESSION TAG	UNP O76764

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-18	HIS	-	EXPRESSION TAG	UNP O76764
B	-17	HIS	-	EXPRESSION TAG	UNP O76764
B	-16	HIS	-	EXPRESSION TAG	UNP O76764
B	-15	HIS	-	EXPRESSION TAG	UNP O76764
B	-14	HIS	-	EXPRESSION TAG	UNP O76764
B	-13	HIS	-	EXPRESSION TAG	UNP O76764
B	-12	HIS	-	EXPRESSION TAG	UNP O76764
B	-11	HIS	-	EXPRESSION TAG	UNP O76764
B	-10	HIS	-	EXPRESSION TAG	UNP O76764
B	-9	HIS	-	EXPRESSION TAG	UNP O76764
B	-8	SER	-	EXPRESSION TAG	UNP O76764
B	-7	SER	-	EXPRESSION TAG	UNP O76764
B	-6	GLY	-	EXPRESSION TAG	UNP O76764
B	-5	HIS	-	EXPRESSION TAG	UNP O76764
B	-4	ILE	-	EXPRESSION TAG	UNP O76764
B	-3	GLU	-	EXPRESSION TAG	UNP O76764
B	-2	GLY	-	EXPRESSION TAG	UNP O76764
B	-1	ARG	-	EXPRESSION TAG	UNP O76764
B	0	HIS	-	EXPRESSION TAG	UNP O76764
B	61	ASP	THR	ENGINEERED MUTATION	UNP O76764
B	188	ASP	THR	ENGINEERED MUTATION	UNP O76764

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	3	Total Ca 3 3	0	0
2	A	3	Total Ca 3 3	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	47	Total O 47 47	0	0
3	B	72	Total O 72 72	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	46.81Å 69.39Å 133.47Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.80 – 2.90 44.17 – 2.90	Depositor EDS
% Data completeness (in resolution range)	97.9 (46.80-2.90) 97.9 (44.17-2.90)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.42 (at 2.90Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, R_{free}	0.171 , 0.283 0.173 , 0.285	Depositor DCC
R_{free} test set	575 reflections (5.79%)	wwPDB-VP
Wilson B-factor (Å ²)	53.7	Xtriage
Anisotropy	0.113	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 52.3	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	3215	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.56% 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: CA

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	0.82	4/1590 (0.3%)	0.79	1/2145 (0.0%)
1	B	0.76	3/1579 (0.2%)	0.79	0/2131
All	All	0.79	7/3169 (0.2%)	0.79	1/4276 (0.0%)

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 (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	86	TRP	CD2-CE2	7.36	1.50	1.41
1	A	90	TRP	CD2-CE2	6.75	1.49	1.41
1	B	48	TRP	CD2-CE2	6.04	1.48	1.41
1	B	90	TRP	CD2-CE2	5.86	1.48	1.41
1	A	106	TRP	CD2-CE2	5.81	1.48	1.41
1	B	106	TRP	CD2-CE2	5.58	1.48	1.41
1	A	48	TRP	CD2-CE2	5.48	1.48	1.41

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	45	LEU	CA-CB-CG	5.38	127.67	115.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	101	GLU	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	1549	0	1470	27	0
1	B	1541	0	1457	43	0
2	A	3	0	0	0	0
2	B	3	0	0	0	0
3	A	47	0	0	1	0
3	B	72	0	0	1	0
All	All	3215	0	2927	70	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 12.

All (70) 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:65:ILE:HD11	1:B:109:LYS:HB3	1.47	0.95
1:A:90:TRP:CH2	1:A:107:LEU:HD21	2.12	0.84
1:A:90:TRP:HH2	1:A:107:LEU:HD21	1.45	0.82
1:B:94:VAL:O	1:B:98:GLU:HG2	1.81	0.80
1:B:101:GLU:HB3	1:B:102:SER:O	1.82	0.79
1:B:24:CYS:SG	1:B:41:LYS:NZ	2.58	0.75
1:B:35:PHE:HD2	1:B:62:LEU:HD22	1.53	0.73
1:A:82:THR:HG22	1:A:85:GLU:H	1.57	0.70
1:B:65:ILE:CD1	1:B:109:LYS:HB3	2.20	0.69
1:B:69:LEU:HD11	1:B:86:TRP:HZ3	1.57	0.69
1:A:75:GLU:HG3	1:A:76:ASN:N	2.08	0.67
1:B:184:HIS:HE1	1:B:191:LEU:HG	1.62	0.65
1:B:69:LEU:HD11	1:B:86:TRP:CZ3	2.31	0.65
1:A:89:MET:CE	1:A:106:TRP:HZ2	2.12	0.63
1:A:184:HIS:HD2	1:A:189:LEU:H	1.48	0.62
1:A:178:ARG:O	1:A:191:LEU:HD13	2.03	0.58
1:A:16:ARG:NH2	1:A:186:PHE:O	2.31	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:120:THR:HG22	1:B:130:GLU:HG2	1.87	0.57
1:B:120:THR:CG2	1:B:130:GLU:HG2	2.35	0.57
1:B:140:ILE:HG22	1:B:144:ASP:HB2	1.88	0.56
1:A:148:ALA:O	1:A:152:LEU:HG	2.06	0.55
1:B:29:VAL:HG13	1:B:80:GLN:HB2	1.90	0.54
1:A:89:MET:HE3	1:A:106:TRP:HZ2	1.72	0.54
1:A:184:HIS:CD2	1:A:189:LEU:H	2.26	0.54
1:B:38:ALA:O	1:B:42:ILE:HD12	2.07	0.54
1:B:125:ILE:HD13	1:B:159:MET:HB3	1.90	0.54
1:A:127:ASP:C	1:A:127:ASP:OD2	2.47	0.53
1:B:170:THR:O	1:B:174:VAL:HG22	2.10	0.52
1:A:82:THR:HG22	1:A:84:GLU:N	2.28	0.48
1:B:45:LEU:HD21	1:B:134:VAL:HG22	1.94	0.48
1:B:54:LYS:HE3	1:B:54:LYS:HB2	1.63	0.48
1:B:69:LEU:HD12	1:B:106:TRP:CH2	2.49	0.48
1:A:53:LYS:O	1:A:57:GLU:HB2	2.14	0.48
1:A:82:THR:HG23	1:A:84:GLU:H	1.79	0.47
1:B:61:ASP:O	1:B:65:ILE:HD13	2.13	0.47
1:B:141:PRO:O	1:B:143:SER:N	2.47	0.47
1:B:25:ASN:N	1:B:25:ASN:HD22	2.12	0.47
1:B:53:LYS:HG3	1:B:54:LYS:N	2.30	0.47
1:B:105:GLU:O	1:B:108:THR:HG22	2.15	0.46
1:A:82:THR:CG2	1:A:84:GLU:N	2.79	0.46
1:B:69:LEU:CD1	1:B:86:TRP:HZ3	2.28	0.46
1:A:73:ALA:O	1:A:85:GLU:HB3	2.15	0.46
1:A:167:ARG:HG2	3:A:512:HOH:O	2.15	0.45
1:B:48:TRP:CD2	1:B:54:LYS:HD2	2.50	0.45
1:B:53:LYS:HG3	1:B:54:LYS:H	1.81	0.45
1:A:154:ASP:O	1:A:157:LYS:HB2	2.15	0.45
1:A:97:VAL:HG11	1:A:174:VAL:HG11	1.98	0.45
1:B:118:ASN:O	1:B:120:THR:N	2.45	0.45
1:A:82:THR:CG2	1:A:84:GLU:H	2.29	0.45
1:B:93:CYS:O	1:B:97:VAL:HG23	2.17	0.45
1:B:74:ASP:OD2	1:B:77:GLU:HA	2.16	0.44
1:A:116:ASP:OD1	1:A:162[B]:ARG:NH2	2.50	0.44
1:A:68:GLY:HA3	1:A:106:TRP:HB3	1.99	0.44
1:A:78:ASP:O	1:A:79:GLU:HB2	2.17	0.44
1:B:184:HIS:CE1	1:B:191:LEU:HD11	2.52	0.44
1:B:35:PHE:O	1:B:39:ILE:HD12	2.17	0.44
1:B:35:PHE:CD2	1:B:62:LEU:HD22	2.43	0.44
1:B:140:ILE:HG12	1:B:140:ILE:H	1.47	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:48:TRP:CE3	1:B:54:LYS:HB3	2.53	0.43
1:B:120:THR:HG23	1:B:121:SER:H	1.83	0.43
1:B:184:HIS:HE1	1:B:191:LEU:CG	2.30	0.43
1:B:98:GLU:HB3	3:B:512:HOH:O	2.19	0.42
1:B:110:TYR:CE2	1:B:169:TRP:HH2	2.37	0.42
1:B:141:PRO:C	1:B:143:SER:H	2.24	0.42
1:B:140:ILE:CG2	1:B:144:ASP:HB2	2.49	0.41
1:B:87:LEU:HD23	1:B:87:LEU:HA	1.89	0.41
1:A:69:LEU:HD12	1:A:69:LEU:O	2.21	0.41
1:B:184:HIS:CE1	1:B:191:LEU:HG	2.49	0.41
1:A:90:TRP:CH2	1:A:107:LEU:CD2	2.95	0.41
1:A:10:GLN:NE2	1:A:174:VAL:O	2.54	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	186/212 (88%)	173 (93%)	11 (6%)	2 (1%)	14	42
1	B	185/212 (87%)	156 (84%)	26 (14%)	3 (2%)	9	32
All	All	371/424 (88%)	329 (89%)	37 (10%)	5 (1%)	11	37

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	72	TYR
1	B	105	GLU
1	A	155	GLY
1	B	142	LYS
1	B	119	ASP

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	168/187 (90%)	154 (92%)	14 (8%)	11	32
1	B	167/187 (89%)	156 (93%)	11 (7%)	16	44
All	All	335/374 (90%)	310 (92%)	25 (8%)	13	37

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

Mol	Chain	Res	Type
1	A	8	ASP
1	A	13	LYS
1	A	47	SER
1	A	72	TYR
1	A	75	GLU
1	A	82	THR
1	A	84	GLU
1	A	97	VAL
1	A	99	LYS
1	A	109	LYS
1	A	127	ASP
1	A	152	LEU
1	A	157	LYS
1	A	176	ASN
1	B	25	ASN
1	B	29	VAL
1	B	50	THR
1	B	53	LYS
1	B	54	LYS
1	B	61	ASP
1	B	88	LYS
1	B	120	THR
1	B	140	ILE
1	B	146	ASP
1	B	150	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	55	HIS
1	A	176	ASN
1	A	184	HIS
1	B	184	HIS

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](#)

Of 6 ligands modelled in this entry, 6 are monoatomic - leaving 0 for Mogul analysis.

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 [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	187/212 (88%)	-0.18	0 100 100	27, 41, 70, 92	1 (0%)
1	B	187/212 (88%)	0.33	7 (3%) 41 37	29, 51, 83, 111	1 (0%)
All	All	374/424 (88%)	0.08	7 (1%) 66 65	27, 45, 78, 111	2 (0%)

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	191	LEU	4.2
1	B	95	LYS	3.3
1	B	189	LEU	3.3
1	B	188	ASP	2.9
1	B	103	LEU	2.4
1	B	102	SER	2.0
1	B	169	TRP	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 carbohydrates in this entry.

6.4 Ligands [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(\AA^2)	Q<0.9
2	CA	B	403	1/1	0.93	0.05	37,37,37,37	0
2	CA	B	402	1/1	0.95	0.14	27,27,27,27	0
2	CA	A	401	1/1	0.96	0.05	15,15,15,15	0
2	CA	A	403	1/1	0.97	0.04	26,26,26,26	0
2	CA	A	402	1/1	0.98	0.04	14,14,14,14	0
2	CA	B	401	1/1	0.99	0.03	19,19,19,19	0

6.5 Other polymers [i](#)

There are no such residues in this entry.