



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 26, 2026 – 03:35 AM EDT

PDB ID : 8XA9 / pdb_00008xa9
Title : Human MGME1 in complex with 5'-overhang DNA
Authors : Wu, C.C.; Mao, E.Y.C.
Deposited on : 2023-12-03
Resolution : 2.32 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:

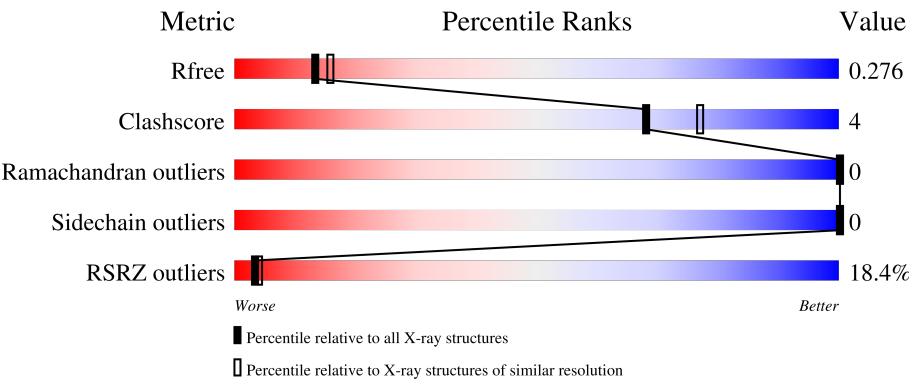
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.32 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	7754 (2.34-2.30)
Clashscore	190562	8383 (2.34-2.30)
Ramachandran outliers	187476	8303 (2.34-2.30)
Sidechain outliers	187428	8303 (2.34-2.30)
RSRZ outliers	180081	7760 (2.34-2.30)

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	251	22% 77% 8% 15%
1	B	251	10% 78% 8% 15%
2	C	18	6% 56% 6% 39%
2	E	18	11% 56% 44%
3	D	11	18% 18% 64%

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Mol	Chain	Length	Quality of chain
3	F	11	 A horizontal bar chart showing the quality of chain F. The bar is divided into three segments: a red segment at the beginning labeled '9%', a green segment in the middle labeled '27%', and a grey segment at the end labeled '73%'. The total length of the bar represents 100%.

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 3988 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 Mitochondrial genome maintenance exonuclease 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	214	Total	C	N	O	S	0	3	0
			1639	1066	271	294	8			
1	B	214	Total	C	N	O	S	0	1	0
			1714	1112	283	310	9			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	94	GLY	-	expression tag	UNP Q9BQP7
B	94	GLY	-	expression tag	UNP Q9BQP7

- Molecule 2 is a DNA chain called DNA (18-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	11	Total	C	N	O	P	0	0	0
			220	109	29	72	10			
2	E	10	Total	C	N	O	P	0	0	0
			198	99	24	66	9			

- Molecule 3 is a DNA chain called DNA (11-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	4	Total	C	N	O	P	0	0	0
			81	38	16	23	4			
3	F	3	Total	C	N	O	P	0	0	0
			62	29	13	17	3			

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Ca	0	0
			1	1		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total 1	Ca 1	0	0
4	C	1	Total 1	Ca 1	0	0
4	E	1	Total 1	Ca 1	0	0

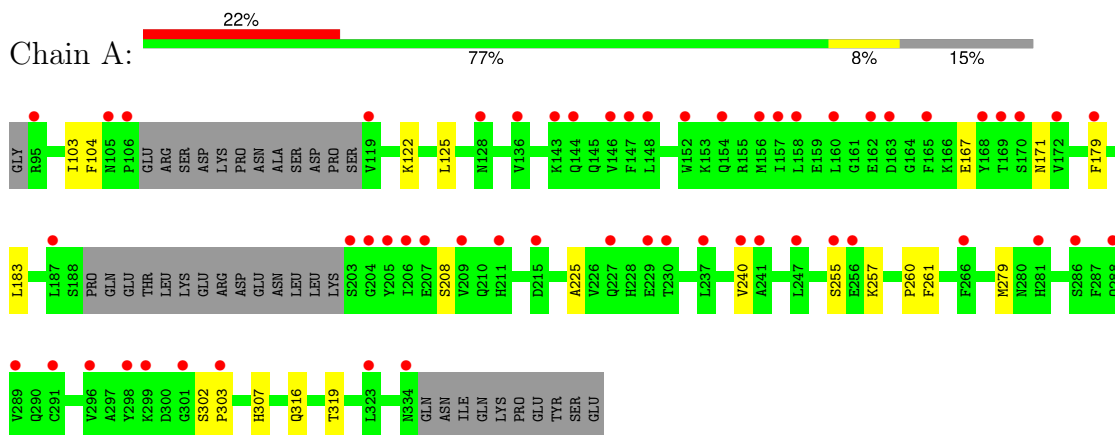
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	20	Total 20	O 20	0	0
5	B	41	Total 41	O 41	0	0
5	C	4	Total 4	O 4	0	0
5	E	5	Total 5	O 5	0	0

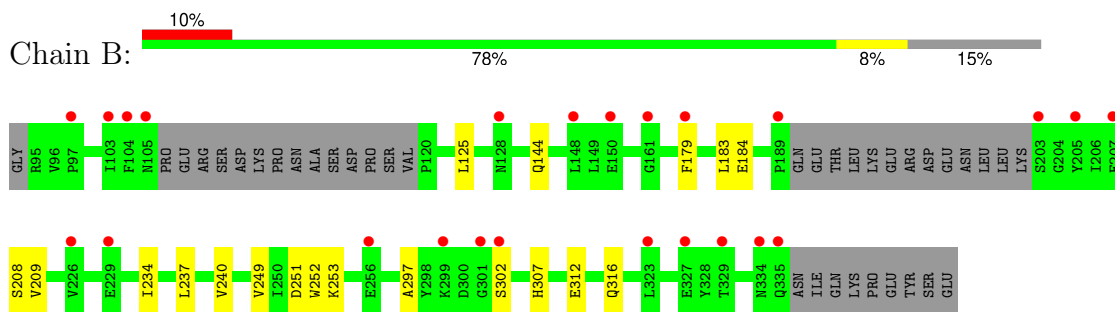
3 Residue-property plots [i](#)

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: Mitochondrial genome maintenance exonuclease 1



- Molecule 1: Mitochondrial genome maintenance exonuclease 1



- Molecule 2: DNA (18-MER)

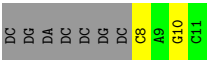


- Molecule 2: DNA (18-MER)

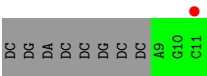




● Molecule 3: DNA (11-MER)



● Molecule 3: DNA (11-MER)



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	180.76Å 56.19Å 114.44Å 90.00° 113.02° 90.00°	Depositor
Resolution (Å)	24.46 – 2.32 24.46 – 2.32	Depositor EDS
% Data completeness (in resolution range)	94.6 (24.46-2.32) 94.5 (24.46-2.32)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.13 (at 2.31Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.258 , 0.278 0.258 , 0.276	Depositor DCC
R_{free} test set	2164 reflections (4.68%)	wwPDB-VP
Wilson B-factor (Å ²)	48.5	Xtriage
Anisotropy	0.237	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 43.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	3988	wwPDB-VP
Average B, all atoms (Å ²)	60.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 13.73% 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 [i](#)

5.1 Standard geometry [i](#)

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	0.25	0/1691	0.36	0/2312
1	B	0.17	0/1761	0.29	0/2391
2	C	0.21	0/243	0.54	0/374
2	E	0.20	0/218	0.52	0/335
3	D	0.17	0/90	0.34	0/136
3	F	0.13	0/69	0.24	0/104
All	All	0.21	0/4072	0.36	0/5652

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	1639	0	1531	15	0
1	B	1714	0	1666	13	0
2	C	220	0	131	1	0
2	E	198	0	120	0	0
3	D	81	0	45	2	0
3	F	62	0	34	0	0
4	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	E	1	0	0	0	0
5	A	20	0	0	0	0
5	B	41	0	0	1	0
5	C	4	0	0	0	0
5	E	5	0	0	0	0
All	All	3988	0	3527	26	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 4.

All (26) 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:307:HIS:ND1	5:B:501:HOH:O	2.30	0.65
1:A:179:PHE:CE1	1:A:183:LEU:HD21	2.34	0.63
1:A:122:LYS:NZ	1:B:184:GLU:OE2	2.34	0.55
1:B:312:GLU:OE2	1:B:316:GLN:NE2	2.41	0.53
1:B:208:SER:OG	1:B:302:SER:O	2.24	0.53
1:A:208:SER:OG	1:A:302:SER:O	2.26	0.52
1:A:260:PRO:HD2	1:A:261:PHE:H	1.77	0.49
1:A:240:VAL:HG21	1:A:279:MET:CE	2.43	0.48
1:A:225:ALA:HB1	1:B:125:LEU:HD13	1.97	0.47
1:A:103:ILE:HG23	1:A:104[B]:PHE:CD1	2.50	0.46
1:B:209:VAL:HG13	1:B:297:ALA:HB2	1.98	0.46
1:A:260:PRO:HD2	1:A:261:PHE:N	2.32	0.45
1:A:302:SER:O	1:A:303:PRO:C	2.59	0.45
1:B:179:PHE:CZ	1:B:183:LEU:HD11	2.51	0.45
1:B:251:ASP:OD2	1:B:253:LYS:NZ	2.50	0.44
1:B:183:LEU:HD13	1:B:252:TRP:CD2	2.52	0.44
1:A:167:GLU:O	1:A:171:ASN:OD1	2.36	0.43
1:B:144:GLN:NE2	3:D:10:DG:O6	2.51	0.43
1:B:237:LEU:HD12	1:B:237:LEU:O	2.18	0.42
1:B:240:VAL:HG22	1:B:249:VAL:HG12	2.01	0.42
1:A:255:SER:OG	1:A:257:LYS:O	2.37	0.41
2:C:11:DG:H1	3:D:8:DC:H42	1.69	0.41
1:A:260:PRO:C	1:A:307:HIS:HE1	2.28	0.41
1:A:125:LEU:HD21	1:B:234:ILE:HD13	2.03	0.41
1:A:240:VAL:HG21	1:A:279:MET:HE2	2.02	0.41
1:A:316:GLN:O	1:A:319[B]:THR:OG1	2.39	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	211/251 (84%)	201 (95%)	10 (5%)	0	100	100
1	B	209/251 (83%)	204 (98%)	5 (2%)	0	100	100
All	All	420/502 (84%)	405 (96%)	15 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	166/230 (72%)	166 (100%)	0	100	100
1	B	185/230 (80%)	185 (100%)	0	100	100
All	All	351/460 (76%)	351 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	211	HIS
1	A	316	GLN
1	B	211	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 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 ⓘ

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	214/251 (85%)	1.55	56 (26%) 1 1	28, 61, 94, 102	3 (1%)
1	B	214/251 (85%)	1.12	24 (11%) 10 11	33, 52, 71, 81	1 (0%)
2	C	11/18 (61%)	0.91	1 (9%) 15 17	50, 53, 100, 104	0
2	E	10/18 (55%)	0.96	2 (20%) 3 3	61, 67, 112, 115	0
3	D	4/11 (36%)	1.47	0 100 100	90, 93, 96, 102	0
3	F	3/11 (27%)	1.85	1 (33%) 1 1	109, 109, 111, 112	0
All	All	456/560 (81%)	1.32	84 (18%) 3 4	28, 56, 93, 115	4 (0%)

All (84) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	207	GLU	5.1
1	A	334	ASN	5.1
1	A	106	PRO	4.9
1	A	163	ASP	4.9
1	A	162	GLU	4.3
1	B	104[A]	PHE	4.2
1	B	334	ASN	3.9
1	A	105	ASN	3.9
1	A	301	GLY	3.8
1	A	291	CYS	3.7
1	A	215	ASP	3.7
1	A	299	LYS	3.5
1	A	157	ILE	3.5
1	A	206	ILE	3.5
1	A	158	LEU	3.4
1	B	301	GLY	3.4
1	A	148	LEU	3.3
1	B	229	GLU	3.3
1	A	146	VAL	3.3

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Mol	Chain	Res	Type	RSRZ
1	A	247	LEU	3.2
1	A	204	GLY	3.2
1	A	187	LEU	3.2
1	A	128	ASN	3.1
2	E	9	DC	3.1
1	A	266	PHE	3.0
2	C	11	DG	3.0
1	A	281	HIS	2.9
1	A	147	PHE	2.9
1	A	211	HIS	2.8
1	B	148	LEU	2.8
1	A	205	TYR	2.8
1	A	289[A]	VAL	2.8
1	B	203	SER	2.7
1	A	119	VAL	2.7
1	B	335	GLN	2.7
1	A	172	VAL	2.7
1	A	209	VAL	2.6
1	A	240	VAL	2.6
1	B	205	TYR	2.6
1	A	288	GLN	2.5
1	A	323	LEU	2.5
1	A	143	LYS	2.5
1	B	179	PHE	2.5
1	B	226	VAL	2.5
1	A	156	MET	2.5
1	A	144	GLN	2.5
1	A	95	ARG	2.5
1	B	150	GLU	2.5
1	A	179	PHE	2.4
1	A	203	SER	2.4
1	A	286	SER	2.4
2	E	10	DT	2.4
1	B	189	PRO	2.4
1	A	255	SER	2.4
1	A	160	LEU	2.4
1	B	302	SER	2.4
1	A	256	GLU	2.4
1	A	298	TYR	2.3
1	B	105	ASN	2.3
1	B	128	ASN	2.3
1	A	241	ALA	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	170	SER	2.3
1	B	207	GLU	2.3
1	A	152	TRP	2.3
1	A	169	THR	2.3
1	A	165	PHE	2.3
1	A	168	TYR	2.3
1	A	303	PRO	2.2
1	B	161	GLY	2.2
1	A	136	VAL	2.2
1	B	323	LEU	2.2
1	B	256	GLU	2.2
1	A	230	THR	2.2
1	B	299	LYS	2.1
1	B	329	THR	2.1
1	A	296	VAL	2.1
1	A	227	GLN	2.1
3	F	11	DC	2.1
1	B	327	GLU	2.1
1	B	97	PRO	2.1
1	A	229	GLU	2.0
1	A	154	GLN	2.0
1	A	237	LEU	2.0
1	B	103	ILE	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](#)

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.

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	CA	C	101	1/1	0.85	0.22	61,61,61,61	0
4	CA	E	101	1/1	0.90	0.16	78,78,78,78	0
4	CA	A	401	1/1	0.96	0.05	53,53,53,53	0
4	CA	B	401	1/1	0.99	0.02	43,43,43,43	0

6.5 Other polymers [i](#)

There are no such residues in this entry.