



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:52 PM UTC

PDB ID : 4J6T / pdb_00004j6t
Title : Crystal Structure of Tyrosinase from Bacillus megaterium F197A mutant
Authors : Kanteev, M.; Goldfeder, M.; Adir, N.; Fishman, A.
Deposited on : 2013-02-12
Resolution : 2.43 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

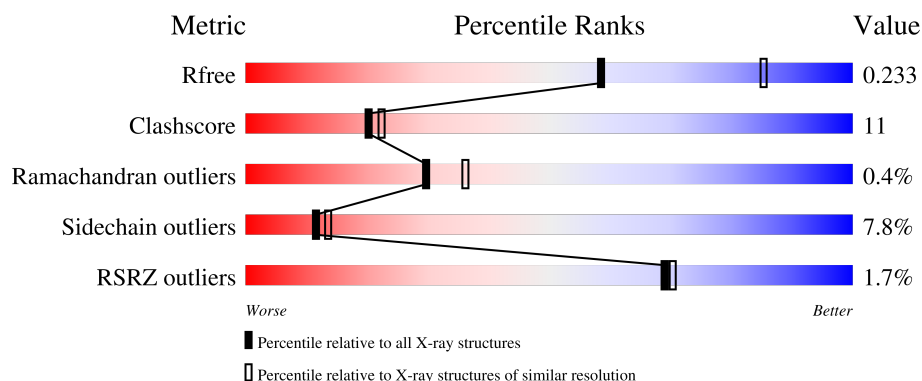
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.43 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	2340 (2.46-2.42)
Clashscore	190562	2400 (2.46-2.42)
Ramachandran outliers	187476	2379 (2.46-2.42)
Sidechain outliers	187428	2379 (2.46-2.42)
RSRZ outliers	180081	2340 (2.46-2.42)

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	303	2% 74% 18% • 5%
1	B	303	% 74% 17% • 6%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4899 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 Tyrosinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	287	Total	C	N	O	S	0	0	0
			2348	1492	424	424	8			
1	B	286	Total	C	N	O	S	0	0	0
			2340	1486	423	423	8			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	GLY	SER	engineered mutation	UNP B2ZB02
A	197	ALA	PHE	engineered mutation	UNP B2ZB02
A	298	HIS	-	expression tag	UNP B2ZB02
A	299	HIS	-	expression tag	UNP B2ZB02
A	300	HIS	-	expression tag	UNP B2ZB02
A	301	HIS	-	expression tag	UNP B2ZB02
A	302	HIS	-	expression tag	UNP B2ZB02
A	303	HIS	-	expression tag	UNP B2ZB02
B	2	GLY	SER	engineered mutation	UNP B2ZB02
B	197	ALA	PHE	engineered mutation	UNP B2ZB02
B	298	HIS	-	expression tag	UNP B2ZB02
B	299	HIS	-	expression tag	UNP B2ZB02
B	300	HIS	-	expression tag	UNP B2ZB02
B	301	HIS	-	expression tag	UNP B2ZB02
B	302	HIS	-	expression tag	UNP B2ZB02
B	303	HIS	-	expression tag	UNP B2ZB02

- Molecule 2 is COPPER (II) ION (CCD ID: CU) (formula: Cu).

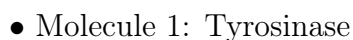
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Cu	0	0
			2	2		
2	B	2	Total	Cu	0	0
			2	2		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	121	Total 121	O 121	0	0
3	B	86	Total 86	O 86	0	0

i

- Molecule 1: Tyrosinase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.01Å 78.81Å 84.34Å 90.00° 106.62° 90.00°	Depositor
Resolution (Å)	27.48 – 2.43 27.48 – 2.43	Depositor EDS
% Data completeness (in resolution range)	99.1 (27.48-2.43) 98.9 (27.48-2.43)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.76 (at 2.42Å)	Xtriage
Refinement program	PHENIX 1.7.3_928	Depositor
R, R_{free}	0.196 , 0.237 0.193 , 0.233	Depositor DCC
R_{free} test set	1321 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å ²)	32.0	Xtriage
Anisotropy	0.255	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 35.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.034 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	4899	wwPDB-VP
Average B, all atoms (Å ²)	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.34% 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: CU

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	0.63	0/2425	0.90	2/3305 (0.1%)
1	B	0.57	0/2417	0.87	3/3294 (0.1%)
All	All	0.60	0/4842	0.88	5/6599 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	147	GLY	N-CA-C	6.34	124.90	115.64
1	A	246	ARG	N-CA-C	6.00	118.61	111.71
1	A	147	GLY	N-CA-C	5.38	123.01	115.43
1	B	129	GLY	CA-C-N	5.37	124.99	119.56
1	B	129	GLY	C-N-CA	5.37	124.99	119.56

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	2348	0	2234	55	0
1	B	2340	0	2223	48	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	121	0	0	5	0
3	B	86	0	0	2	0
All	All	4899	0	4457	103	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 11.

All (103) 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:159:ALA:CB	1:A:209:ARG:HG2	1.50	1.40
1:A:156:THR:HG21	1:A:209:ARG:NE	1.59	1.18
1:A:159:ALA:HB3	1:A:209:ARG:CG	1.83	1.08
1:A:96:THR:HG22	1:A:165:ARG:HE	1.31	0.96
1:A:156:THR:HG21	1:A:209:ARG:HE	1.24	0.94
1:A:159:ALA:HB3	1:A:209:ARG:HG2	0.95	0.94
1:A:159:ALA:CB	1:A:209:ARG:CG	2.46	0.88
1:A:156:THR:HG21	1:A:209:ARG:CD	2.05	0.87
1:A:94:TRP:HE1	1:A:230:HIS:HD2	1.22	0.83
1:A:159:ALA:HB2	1:A:209:ARG:HG2	1.60	0.82
1:A:156:THR:CG2	1:A:209:ARG:HE	1.94	0.80
1:A:156:THR:CG2	1:A:209:ARG:NE	2.44	0.80
1:B:215:MET:HE1	1:B:227:PHE:HD2	1.46	0.79
1:A:196:GLY:HA3	1:A:202:GLN:O	1.82	0.78
1:B:287:ASP:O	1:B:288:ILE:HG22	1.84	0.78
1:B:156:THR:HG22	1:B:159:ALA:H	1.49	0.77
1:B:287:ASP:O	1:B:288:ILE:CB	2.35	0.75
1:B:4:LYS:HA	1:B:285:VAL:HG13	1.70	0.72
1:B:280:ARG:HD2	1:B:285:VAL:HG12	1.72	0.72
1:A:94:TRP:NE1	1:A:230:HIS:HD2	1.89	0.71
1:B:287:ASP:O	1:B:288:ILE:HB	1.89	0.71
1:B:287:ASP:O	1:B:288:ILE:CG2	2.39	0.70
1:B:94:TRP:NE1	1:B:230:HIS:HD2	1.90	0.69
1:A:8:ARG:HG2	1:A:89:LEU:O	1.92	0.69
1:B:56:ARG:HD3	1:B:62:SER:OG	1.93	0.68
1:A:156:THR:HG22	1:A:159:ALA:H	1.59	0.67
1:A:204:HIS:CD2	1:A:230:HIS:HE1	2.12	0.66
1:A:193:GLN:HG2	1:A:198:ILE:HD12	1.77	0.66
1:B:94:TRP:HE1	1:B:230:HIS:HD2	1.44	0.66
1:A:94:TRP:HE1	1:A:230:HIS:CD2	2.11	0.64
1:B:215:MET:HE2	1:B:221:ALA:HB1	1.78	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:96:THR:HG22	1:B:165:ARG:HE	1.64	0.62
1:B:6:ARG:NH1	1:B:284:TYR:HB3	2.15	0.62
1:B:288:ILE:O	1:B:288:ILE:HG23	1.99	0.62
1:B:81:GLN:HG3	1:B:85:PRO:HA	1.83	0.61
1:B:286:TYR:O	1:B:289:GLU:HG2	2.01	0.61
1:B:215:MET:HE1	1:B:227:PHE:CD2	2.32	0.60
1:A:96:THR:HG22	1:A:165:ARG:NE	2.09	0.60
1:A:217:VAL:HG23	1:A:219:PRO:HD2	1.82	0.59
1:A:196:GLY:CA	1:A:202:GLN:O	2.49	0.59
1:B:89:LEU:HD13	1:B:232:ALA:HB2	1.83	0.59
1:A:127:ASP:HB2	3:A:621:HOH:O	2.02	0.59
1:A:204:HIS:HD2	1:A:230:HIS:CE1	2.22	0.58
1:A:204:HIS:HD2	1:A:230:HIS:HE1	1.49	0.56
1:B:8:ARG:HG2	1:B:89:LEU:O	2.06	0.56
1:A:61:MET:O	1:A:62:SER:HB2	2.06	0.56
1:B:91:TYR:CE2	1:B:287:ASP:OD1	2.61	0.54
1:B:119:ASN:ND2	1:B:122:LYS:HD2	2.22	0.53
1:B:263:ARG:NH1	1:B:274:GLU:OE1	2.42	0.53
1:B:91:TYR:HE2	1:B:287:ASP:OD1	1.92	0.52
1:A:233:ASN:O	1:A:237:ILE:HG12	2.09	0.52
1:A:62:SER:O	1:A:191:ARG:HD3	2.10	0.52
1:B:156:THR:HB	3:B:519:HOH:O	2.10	0.52
1:A:94:TRP:CE3	1:A:163:PRO:HG2	2.46	0.52
1:B:179:THR:HB	1:B:180:PRO:HD2	1.91	0.51
1:B:278:ASN:HB3	1:B:281:LYS:HB2	1.92	0.51
1:B:119:ASN:HD22	1:B:122:LYS:HD2	1.75	0.51
1:B:215:MET:CE	1:B:221:ALA:HB1	2.41	0.51
1:B:215:MET:HE2	1:B:215:MET:HA	1.93	0.51
1:A:62:SER:HB3	3:A:615:HOH:O	2.11	0.50
1:A:4:LYS:HG3	1:A:280:ARG:HG2	1.93	0.50
1:A:156:THR:HG21	1:A:209:ARG:CG	2.42	0.49
1:A:69:HIS:CD2	1:A:231:HIS:CE1	3.01	0.49
1:B:161:THR:HG22	1:B:206:ARG:NH1	2.28	0.49
1:B:217:VAL:HG22	1:B:220:THR:OG1	2.13	0.49
1:B:182:TRP:CZ2	1:B:252:PRO:HB3	2.48	0.48
1:B:180:PRO:HA	1:B:182:TRP:N	2.29	0.48
1:A:156:THR:CG2	1:A:159:ALA:H	2.26	0.48
1:B:287:ASP:O	1:B:287:ASP:OD1	2.31	0.48
1:B:194:LEU:HA	1:B:203:LEU:HD13	1.96	0.48
1:B:4:LYS:HA	1:B:285:VAL:CG1	2.42	0.47
1:B:217:VAL:HG23	1:B:219:PRO:HD2	1.97	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:156:THR:CB	1:A:209:ARG:HE	2.28	0.46
1:B:207:VAL:HG11	1:B:230:HIS:CD2	2.51	0.46
1:B:62:SER:OG	1:B:182:TRP:O	2.24	0.46
1:A:246:ARG:HA	1:A:246:ARG:HD2	1.61	0.45
1:B:163:PRO:HG3	1:B:203:LEU:HA	1.98	0.45
1:A:8:ARG:HD2	1:A:77:GLU:OE2	2.16	0.45
1:A:6:ARG:NH2	1:A:282:LEU:O	2.50	0.45
1:A:6:ARG:HH21	1:A:283:GLY:HA3	1.81	0.45
1:A:94:TRP:CZ3	1:A:163:PRO:HG2	2.52	0.45
1:A:261:ASN:HB2	1:A:264:ASP:CG	2.43	0.43
1:B:156:THR:HG22	1:B:159:ALA:N	2.26	0.43
1:B:180:PRO:HA	1:B:182:TRP:H	1.84	0.43
1:A:158:GLU:H	1:A:158:GLU:HG2	1.48	0.43
1:A:273:PRO:O	1:A:277:MET:HG2	2.18	0.43
1:A:207:VAL:HG11	1:A:230:HIS:CD2	2.54	0.42
1:B:156:THR:HG23	1:B:158:GLU:H	1.84	0.42
1:B:204:HIS:CD2	1:B:230:HIS:HE1	2.37	0.42
1:A:156:THR:HB	3:A:524:HOH:O	2.20	0.42
1:B:91:TYR:OH	1:B:287:ASP:OD1	2.30	0.42
1:A:183:ASP:HB2	3:A:508:HOH:O	2.18	0.42
1:A:161:THR:O	1:A:206:ARG:HD3	2.20	0.41
1:A:113:PHE:HB3	1:A:114:MET:H	1.69	0.41
1:B:179:THR:CB	1:B:180:PRO:HD2	2.51	0.41
1:A:51:PRO:O	1:A:54:SER:HB3	2.21	0.41
1:A:102:ASP:O	1:A:105:GLN:HB2	2.21	0.41
1:B:277:MET:HE1	3:B:570:HOH:O	2.20	0.41
1:A:106:SER:OG	1:A:108:ILE:HG22	2.21	0.41
1:A:19:LYS:HE3	3:A:541:HOH:O	2.21	0.40
1:A:73:LEU:HD11	1:A:231:HIS:HB3	2.02	0.40
1:A:93:GLU:OE1	1:A:96:THR:HG21	2.21	0.40
1:A:204:HIS:CD2	1:A:230:HIS:CE1	2.97	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	285/303 (94%)	274 (96%)	11 (4%)	0	100	100
1	B	284/303 (94%)	272 (96%)	10 (4%)	2 (1%)	18	21
All	All	569/606 (94%)	546 (96%)	21 (4%)	2 (0%)	30	36

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	288	ILE
1	B	254	LYS

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	249/264 (94%)	231 (93%)	18 (7%)	13	16
1	B	248/264 (94%)	227 (92%)	21 (8%)	10	11
All	All	497/528 (94%)	458 (92%)	39 (8%)	11	13

All (39) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	ARG
1	A	17	THR
1	A	23	VAL
1	A	29	LEU
1	A	89	LEU
1	A	127	ASP
1	A	139	ILE
1	A	141	GLU
1	A	149	LEU
1	A	156	THR
1	A	158	GLU

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Mol	Chain	Res	Type
1	A	169	LEU
1	A	194	LEU
1	A	209	ARG
1	A	217	VAL
1	A	229	LEU
1	A	280	ARG
1	A	281	LYS
1	B	4	LYS
1	B	7	VAL
1	B	17	THR
1	B	24	ARG
1	B	29	LEU
1	B	81	GLN
1	B	89	LEU
1	B	101	GLN
1	B	122	LYS
1	B	139	ILE
1	B	149	LEU
1	B	156	THR
1	B	161	THR
1	B	169	LEU
1	B	194	LEU
1	B	198	ILE
1	B	217	VAL
1	B	226	VAL
1	B	229	LEU
1	B	254	LYS
1	B	280	ARG

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	13	HIS
1	A	49	HIS
1	A	230	HIS
1	B	230	HIS
1	B	255	ASN

5.3.3 RNA ⓘ

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 [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	287/303 (94%)	-0.14	6 (2%) 63 64	17, 27, 48, 87	1 (0%)
1	B	286/303 (94%)	0.04	4 (1%) 73 75	18, 34, 56, 95	0
All	All	573/606 (94%)	-0.05	10 (1%) 69 70	17, 31, 54, 95	1 (0%)

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	198	ILE	4.5
1	A	209	ARG	3.6
1	A	5	TYR	3.5
1	A	113	PHE	3.2
1	B	5	TYR	3.0
1	A	127	ASP	2.8
1	A	61	MET	2.5
1	B	285	VAL	2.4
1	B	288	ILE	2.3
1	A	112	ASP	2.1

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.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	CU	B	402	1/1	0.89	0.14	68,68,68,68	1
2	CU	A	402	1/1	0.96	0.06	58,58,58,58	1
2	CU	B	401	1/1	0.97	0.06	40,40,40,40	1
2	CU	A	401	1/1	0.97	0.06	35,35,35,35	1

6.5 Other polymers [i](#)

There are no such residues in this entry.