



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:41 AM UTC

PDB ID : 4FWV / pdb_00004fwv
Title : Crystal structure of the N-terminal domain of the Lon-like protease MtaLonC
Authors : Chang, C.I.; Li, J.K.; Kuo, C.I.; Huang, K.F.
Deposited on : 2012-07-02
Resolution : 2.40 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

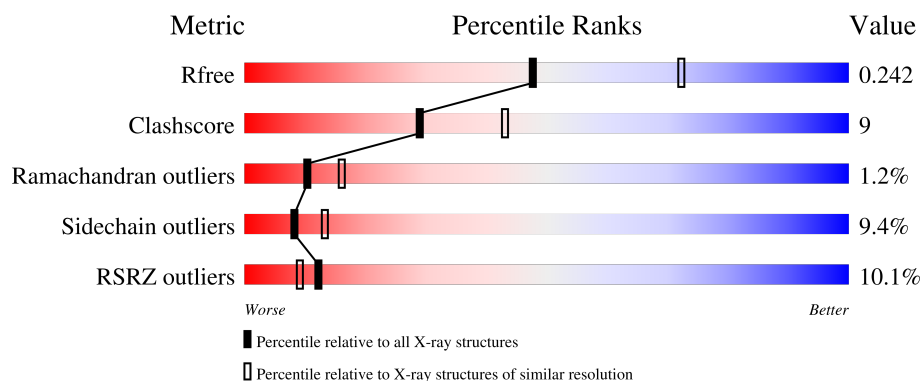
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	355	10% 77% 13% ...

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 2771 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.

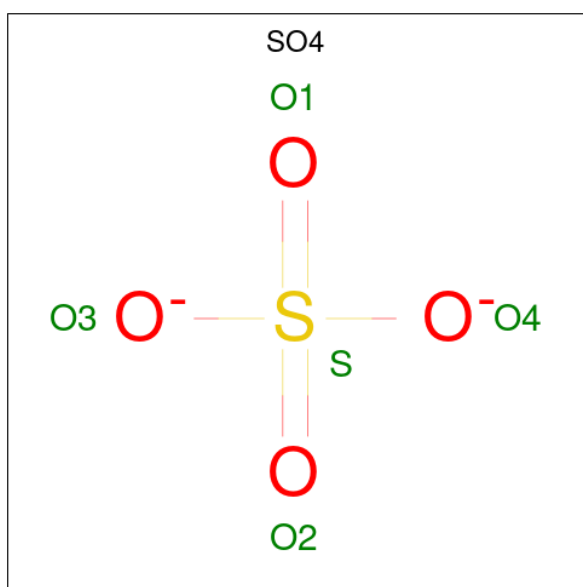
- Molecule 1 is a protein called TTC1975 peptidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	Se			
1	A	340	2691	1715	477	495	4	0	0	0

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	33	GLY	-	expression tag	UNP C9DRU9
A	34	GLN	-	expression tag	UNP C9DRU9
A	91	MSE	LEU	engineered mutation	UNP C9DRU9
A	188	MSE	LEU	engineered mutation	UNP C9DRU9
A	359	MSE	ILE	engineered mutation	UNP C9DRU9

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	A	1	5	4	1	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		

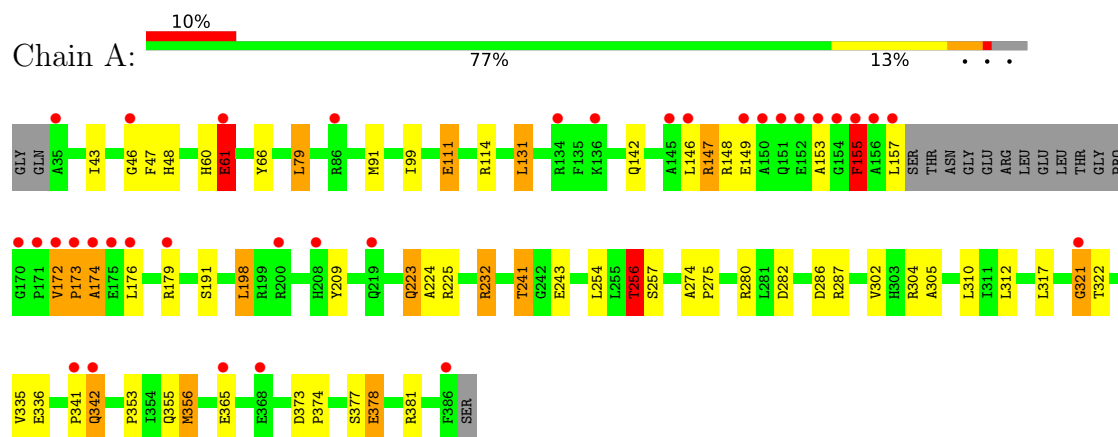
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	70	Total	O	0	0
			70	70		

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: TTC1975 peptidase



4 Data and refinement statistics

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α , β , γ	147.68Å 147.68Å 163.85Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.40 30.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.7 (30.00-2.40) 99.7 (30.00-2.40)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.51 (at 2.39Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.201 , 0.229 0.211 , 0.242	Depositor DCC
R_{free} test set	1351 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	56.3	Xtriage
Anisotropy	0.432	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 43.5	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	2771	wwPDB-VP
Average B, all atoms (Å ²)	66.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.37% 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: SO4

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	0.80	4/2749 (0.1%)	0.99	12/3727 (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	2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	61	GLU	CA-C	7.02	1.62	1.52
1	A	61	GLU	CA-CB	6.07	1.63	1.53
1	A	61	GLU	CG-CD	5.81	1.66	1.52
1	A	48	HIS	CG-CD2	5.09	1.41	1.35

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	61	GLU	CB-CG-CD	8.97	127.85	112.60
1	A	322	THR	N-CA-C	7.23	122.27	113.38
1	A	61	GLU	N-CA-C	-7.16	104.01	112.89
1	A	61	GLU	CB-CA-C	7.03	124.69	109.99
1	A	47	PHE	N-CA-C	6.52	120.50	110.20
1	A	61	GLU	CG-CD-OE2	6.28	132.84	118.40
1	A	155	PHE	N-CA-C	5.60	118.60	110.42
1	A	61	GLU	CA-CB-CG	5.43	124.96	114.10
1	A	61	GLU	OE1-CD-OE2	-5.36	110.05	122.90

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	153	ALA	N-CA-C	5.32	117.26	108.48
1	A	256	THR	CB-CA-C	-5.23	98.56	110.07
1	A	176	LEU	N-CA-C	-5.16	106.95	113.20

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	321	GLY	Peptide
1	A	46	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	2691	0	2686	47	0
2	A	10	0	0	1	0
3	A	70	0	0	2	0
All	All	2771	0	2686	47	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 9.

All (47) 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:310:LEU:HD22	1:A:356:MSE:HE2	1.27	1.09
1:A:310:LEU:CD2	1:A:356:MSE:HE2	1.94	0.96
1:A:172:VAL:HB	1:A:173:PRO:HD2	1.49	0.95
1:A:60:HIS:HE2	1:A:61:GLU:CD	1.75	0.94
1:A:60:HIS:NE2	1:A:61:GLU:OE2	2.00	0.93
1:A:310:LEU:HD22	1:A:356:MSE:CE	1.98	0.93
1:A:60:HIS:NE2	1:A:61:GLU:CD	2.33	0.85
1:A:111:GLU:OE2	1:A:114:ARG:HG3	1.82	0.79
1:A:232:ARG:HH11	1:A:232:ARG:HG2	1.48	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:147:ARG:HD2	1:A:155:PHE:HB3	1.67	0.75
1:A:232:ARG:NH1	3:A:506:HOH:O	2.20	0.72
1:A:223:GLN:HE21	1:A:223:GLN:H	1.36	0.72
1:A:223:GLN:H	1:A:223:GLN:NE2	1.89	0.70
1:A:60:HIS:CD2	1:A:61:GLU:CD	2.71	0.67
1:A:241:THR:CG2	1:A:243:GLU:HB2	2.25	0.66
1:A:241:THR:HG22	1:A:243:GLU:HB2	1.77	0.65
1:A:321:GLY:HA3	3:A:532:HOH:O	1.98	0.63
1:A:131:LEU:HD11	1:A:198:LEU:CD1	2.31	0.61
1:A:274:ALA:HB3	1:A:275:PRO:HD3	1.82	0.61
1:A:256:THR:HG23	1:A:304:ARG:HA	1.83	0.59
1:A:147:ARG:C	1:A:149:GLU:H	2.12	0.58
1:A:173:PRO:O	1:A:174:ALA:HB3	2.06	0.56
1:A:241:THR:HG22	1:A:243:GLU:H	1.71	0.56
1:A:172:VAL:HB	1:A:173:PRO:CD	2.31	0.55
1:A:341:PRO:O	1:A:342:GLN:HG2	2.07	0.54
1:A:79:LEU:HD13	1:A:91:MSE:HB3	1.89	0.54
1:A:256:THR:HG22	2:A:402:SO4:O2	2.08	0.54
1:A:256:THR:CG2	1:A:304:ARG:HA	2.39	0.53
1:A:91:MSE:HE2	1:A:224:ALA:HA	1.92	0.51
1:A:173:PRO:O	1:A:174:ALA:CB	2.58	0.51
1:A:155:PHE:N	1:A:155:PHE:CD1	2.78	0.51
1:A:305:ALA:HB3	1:A:356:MSE:HE3	1.93	0.50
1:A:286:ASP:OD1	1:A:287:ARG:NH1	2.47	0.48
1:A:232:ARG:HG2	1:A:232:ARG:NH1	2.18	0.47
1:A:353:PRO:HB2	1:A:355:GLN:HE21	1.80	0.47
1:A:335:VAL:HG22	1:A:336:GLU:N	2.30	0.46
1:A:280:ARG:NH1	1:A:282:ASP:OD1	2.47	0.46
1:A:274:ALA:N	1:A:275:PRO:CD	2.80	0.45
1:A:111:GLU:HG3	1:A:209:TYR:HE2	1.83	0.44
1:A:302:VAL:HA	1:A:356:MSE:HE1	1.99	0.43
1:A:241:THR:HG22	1:A:243:GLU:N	2.33	0.43
1:A:43:ILE:CD1	1:A:66:TYR:HE2	2.33	0.42
1:A:374:PRO:O	1:A:378:GLU:HG3	2.20	0.42
1:A:91:MSE:CE	1:A:224:ALA:HA	2.50	0.41
1:A:377:SER:O	1:A:381:ARG:HD3	2.21	0.41
1:A:373:ASP:OD1	1:A:373:ASP:C	2.64	0.41
1:A:147:ARG:C	1:A:149:GLU:N	2.79	0.41

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	336/355 (95%)	322 (96%)	10 (3%)	4 (1%)	10	16

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	174	ALA
1	A	173	PRO
1	A	148	ARG
1	A	172	VAL

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	277/285 (97%)	251 (91%)	26 (9%)	8	13

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

Mol	Chain	Res	Type
1	A	61	GLU
1	A	79	LEU
1	A	99	ILE
1	A	111	GLU
1	A	131	LEU
1	A	142	GLN
1	A	146	LEU

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Mol	Chain	Res	Type
1	A	147	ARG
1	A	155	PHE
1	A	157	LEU
1	A	179	ARG
1	A	191	SER
1	A	198	LEU
1	A	223	GLN
1	A	225	ARG
1	A	232	ARG
1	A	241	THR
1	A	254	LEU
1	A	256	THR
1	A	257	SER
1	A	312	LEU
1	A	317	LEU
1	A	342	GLN
1	A	356	MSE
1	A	365	GLU
1	A	378	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	70	GLN
1	A	121	GLN
1	A	223	GLN
1	A	355	GLN
1	A	357	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

2 ligands 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	$\# Z > 2$
2	SO4	A	402	-	4,4,4	0.38	0	6,6,6	0.36	0
2	SO4	A	401	-	4,4,4	0.46	0	6,6,6	0.31	0

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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	402	SO4	1	0

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	336/355 (94%)	0.54	34 (10%) 12 9	39, 58, 117, 144	0

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	157	LEU	6.9
1	A	172	VAL	6.0
1	A	171	PRO	6.0
1	A	173	PRO	5.5
1	A	150	ALA	5.3
1	A	156	ALA	5.3
1	A	386	PHE	4.8
1	A	155	PHE	4.8
1	A	35	ALA	4.5
1	A	170	GLY	4.4
1	A	61	GLU	4.2
1	A	152	GLU	4.1
1	A	151	GLN	4.0
1	A	145	ALA	4.0
1	A	321	GLY	3.9
1	A	176	LEU	3.6
1	A	153	ALA	3.6
1	A	174	ALA	3.4
1	A	154	GLY	3.3
1	A	46	GLY	3.2
1	A	342	GLN	3.2
1	A	146	LEU	3.2
1	A	208	HIS	3.0
1	A	175	GLU	2.8
1	A	200	ARG	2.5
1	A	219	GLN	2.5
1	A	179	ARG	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	341	PRO	2.4
1	A	365	GLU	2.4
1	A	136	LYS	2.4
1	A	86	ARG	2.3
1	A	368	GLU	2.2
1	A	134	ARG	2.1
1	A	149	GLU	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.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	SO4	A	402	5/5	0.95	0.13	69,71,76,81	0
2	SO4	A	401	5/5	0.98	0.05	47,52,54,55	0

6.5 Other polymers [i](#)

There are no such residues in this entry.