wwPDB X-ray Structure Validation Summary Report (i)

Aug 21, 2023 – 06:16 PM EDT

PDB ID	:	2OTE
Title	:	Crystal structure of a monomeric cyan fluorescent protein in the photobleached state
Authors	:	Henderson, J.N.; Ai, H.; Campbell, R.E.; Remington, S.J.
Deposited on	:	2007-02-07
Resolution	:	1.47 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (i)) were used in the production of this report:

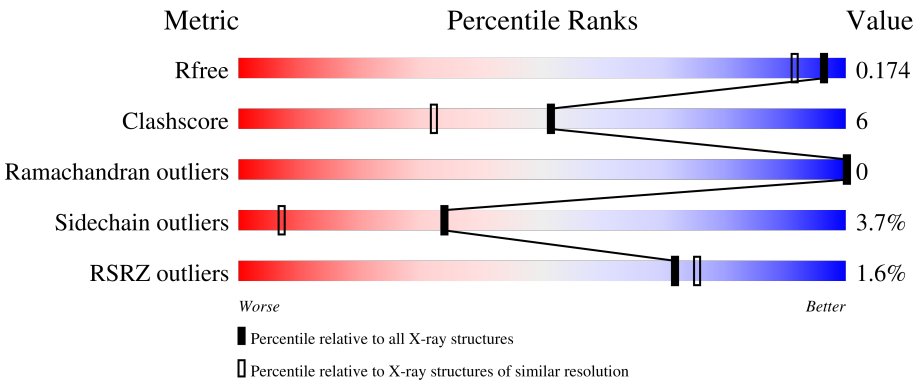
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

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 1.47 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	4690 (1.50-1.46)
Clashscore	141614	4955 (1.50-1.46)
Ramachandran outliers	138981	4846 (1.50-1.46)
Sidechain outliers	138945	4844 (1.50-1.46)
RSRZ outliers	127900	4614 (1.50-1.46)

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 <=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	214	2% 86% 11% •
1	B	214	% 85% 14% •

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4007 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 GFP-like fluorescent chromoprotein cFP484.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	214	1779	1164	282	328	5	0	19	0
1	B	214	1774	1149	285	335	5	0	14	0

There are 46 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	42	ASN	HIS	engineered mutation	UNP Q9U6Y3
A	44	ILE	LEU	engineered mutation	UNP Q9U6Y3
A	62	THR	SER	engineered mutation	UNP Q9U6Y3
A	66	PIA	GLN	chromophore	UNP Q9U6Y3
A	66	PIA	TYR	chromophore	UNP Q9U6Y3
A	66	PIA	GLY	chromophore	UNP Q9U6Y3
A	72	PHE	LEU	engineered mutation	UNP Q9U6Y3
A	80	PRO	ALA	engineered mutation	UNP Q9U6Y3
A	81	ASN	ASP	engineered mutation	UNP Q9U6Y3
A	123	HIS	ARG	engineered mutation	UNP Q9U6Y3
A	124	LEU	PHE	engineered mutation	UNP Q9U6Y3
A	125	LYS	ASP	engineered mutation	UNP Q9U6Y3
A	127	GLU	MET	engineered mutation	UNP Q9U6Y3
A	150	LEU	MET	engineered mutation	UNP Q9U6Y3
A	162	LYS	SER	engineered mutation	UNP Q9U6Y3
A	164	LYS	SER	engineered mutation	UNP Q9U6Y3
A	173	HIS	TYR	engineered mutation	UNP Q9U6Y3
A	175	VAL	CYS	engineered mutation	UNP Q9U6Y3
A	179	THR	SER	engineered mutation	UNP Q9U6Y3
A	182	ARG	LYS	engineered mutation	UNP Q9U6Y3
A	186	ALA	VAL	engineered mutation	UNP Q9U6Y3
A	213	VAL	LEU	engineered mutation	UNP Q9U6Y3
A	216	SER	ASN	engineered mutation	UNP Q9U6Y3
B	42	ASN	HIS	engineered mutation	UNP Q9U6Y3
B	44	ILE	LEU	engineered mutation	UNP Q9U6Y3

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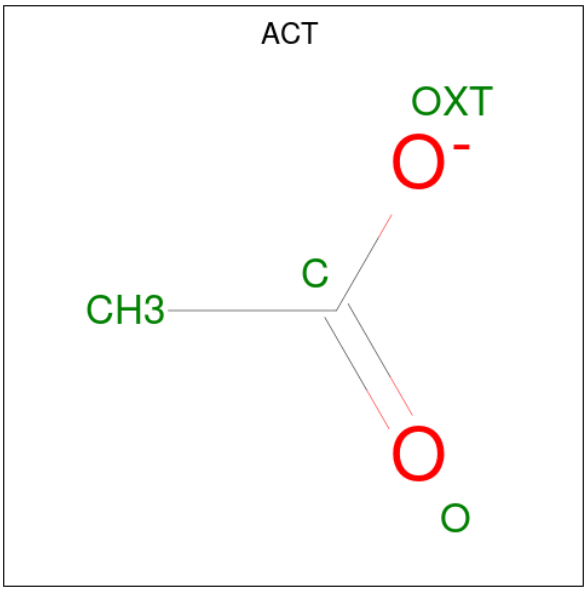
Chain	Residue	Modelled	Actual	Comment	Reference
B	62	THR	SER	engineered mutation	UNP Q9U6Y3
B	66	PIA	GLN	chromophore	UNP Q9U6Y3
B	66	PIA	TYR	chromophore	UNP Q9U6Y3
B	66	PIA	GLY	chromophore	UNP Q9U6Y3
B	72	PHE	LEU	engineered mutation	UNP Q9U6Y3
B	80	PRO	ALA	engineered mutation	UNP Q9U6Y3
B	81	ASN	ASP	engineered mutation	UNP Q9U6Y3
B	123	HIS	ARG	engineered mutation	UNP Q9U6Y3
B	124	LEU	PHE	engineered mutation	UNP Q9U6Y3
B	125	LYS	ASP	engineered mutation	UNP Q9U6Y3
B	127	GLU	MET	engineered mutation	UNP Q9U6Y3
B	150	LEU	MET	engineered mutation	UNP Q9U6Y3
B	162	LYS	SER	engineered mutation	UNP Q9U6Y3
B	164	LYS	SER	engineered mutation	UNP Q9U6Y3
B	173	HIS	TYR	engineered mutation	UNP Q9U6Y3
B	175	VAL	CYS	engineered mutation	UNP Q9U6Y3
B	179	THR	SER	engineered mutation	UNP Q9U6Y3
B	182	ARG	LYS	engineered mutation	UNP Q9U6Y3
B	186	ALA	VAL	engineered mutation	UNP Q9U6Y3
B	213	VAL	LEU	engineered mutation	UNP Q9U6Y3
B	216	SER	ASN	engineered mutation	UNP Q9U6Y3

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula: $C_2H_3O_2$).



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

- Molecule 3 is water.

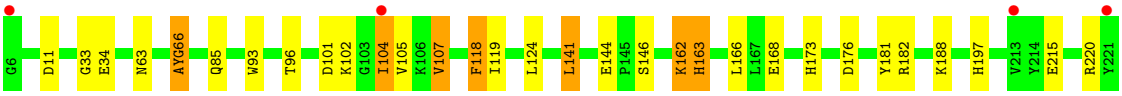
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	243	243	243	0	13
			Total	O		
3	B	207	207	207	0	6

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: GFP-like fluorescent chromoprotein cFP484

Chain A:



• Molecule 1: GFP-like fluorescent chromoprotein cFP484

Chain B:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.49Å 66.31Å 97.20Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.47 31.03 – 1.47	Depositor EDS
% Data completeness (in resolution range)	94.7 (10.00-1.47) 85.7 (31.03-1.47)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.74 (at 1.47Å)	Xtriage
Refinement program	SHELX, SHELXL	Depositor
R, R_{free}	0.190 , 0.261 0.168 , 0.174	Depositor DCC
R_{free} test set	3441 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å^2)	14.2	Xtriage
Anisotropy	0.273	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 75.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.52$, $< L^2 > = 0.36$	Xtriage
Estimated twinning fraction	0.000 for k,h,-l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	4007	wwPDB-VP
Average B, all atoms (Å^2)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 38.45 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 3.6779e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: PIA, ACT

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	0.50	0/1847	1.23	5/2504 (0.2%)
1	B	0.51	0/1824	1.29	10/2468 (0.4%)
All	All	0.50	0/3671	1.26	15/4972 (0.3%)

There are no bond length outliers.

The worst 5 of 15 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	182	ARG	CD-NE-CZ	19.47	150.86	123.60
1	B	182	ARG	NE-CZ-NH1	12.65	126.62	120.30
1	A	220	ARG	NE-CZ-NH2	-10.60	115.00	120.30
1	A	173	HIS	CA-CB-CG	7.67	126.63	113.60
1	B	70[A]	ARG	NE-CZ-NH2	7.07	123.83	120.30

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	1779	0	1704	23	0
1	B	1774	0	1688	16	0
2	A	4	0	3	1	0
3	A	243	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	207	0	0	6	0
All	All	4007	0	3395	39	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 6.

The worst 5 of 39 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:66[A]:PIA:HE2	1:B:181:TYR:OH	1.89	0.71
1:B:209:ASN:HB3	3:B:368:HOH:O	1.91	0.70
1:A:85:GLN:HE22	1:A:188:LYS:H	1.36	0.70
1:A:96:THR:HG23	1:A:104[A]:ILE:HD11	1.78	0.65
1:A:33:GLY:HA2	2:A:1:ACT:H1	1.83	0.61

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	224/214 (105%)	219 (98%)	5 (2%)	0	100	100
1	B	218/214 (102%)	212 (97%)	6 (3%)	0	100	100
All	All	442/428 (103%)	431 (98%)	11 (2%)	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	184/188 (98%)	175 (95%)	9 (5%)	25 3
1	B	187/188 (100%)	179 (96%)	8 (4%)	29 5
All	All	371/376 (99%)	354 (95%)	17 (5%)	34 4

5 of 17 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	163	HIS
1	B	215[A]	GLU
1	A	163	HIS
1	A	197[A]	HIS
1	B	23	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	45	ASN
1	A	85	GLN
1	B	23	ASN
1	B	42	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	PIA	A	66[A]	1	21,21,22	2.31	8 (38%)	27,29,31	2.85	12 (44%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	PIA	A	66[A]	1	-	6/8/27/28	0/2/2/2

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66[A]	PIA	OH-CZ	-4.76	1.25	1.37
1	A	66[A]	PIA	CG2-CB2	-4.70	1.37	1.46
1	A	66[A]	PIA	C1-N3	3.97	1.43	1.37
1	A	66[A]	PIA	CE1-CZ	3.44	1.45	1.38
1	A	66[A]	PIA	CE2-CZ	3.14	1.44	1.38

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	66[A]	PIA	O2-C2-CA2	10.70	136.97	130.96
1	A	66[A]	PIA	O3-C3-CA3	-3.84	114.80	126.39
1	A	66[A]	PIA	CA3-N3-C1	-3.42	123.05	127.16
1	A	66[A]	PIA	CD2-CE2-CZ	3.07	123.24	119.88
1	A	66[A]	PIA	O2-C2-N3	-2.96	118.45	124.35

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	66[A]	PIA	N2-CA2-CB2-CG2
1	A	66[A]	PIA	C2-CA2-CB2-CG2
1	A	66[A]	PIA	C3-CA3-N3-C2
1	A	66[A]	PIA	CA2-CB2-CG2-CD2
1	A	66[A]	PIA	CA2-CB2-CG2-CD1

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	66[A]	PIA	1	0

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

1 ligand is 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	ACT	A	1	-	3,3,3	1.81	1 (33%)	3,3,3	1.49	1 (33%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1	ACT	O-C	2.87	1.35	1.22

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	1	ACT	OXT-C-CH3	2.03	123.58	115.18

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	1	ACT	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 (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	213/214 (99%)	-0.28	4 (1%)	66	70	13, 18, 26, 35	10 (4%)
1	B	213/214 (99%)	-0.27	3 (1%)	75	78	14, 18, 26, 31	10 (4%)
All	All	426/428 (99%)	-0.27	7 (1%)	72	75	13, 18, 26, 35	20 (4%)

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	221	TYR	2.8
1	B	199	ILE	2.8
1	B	213	VAL	2.4
1	A	104[A]	ILE	2.0
1	B	201	ILE	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (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
1	PIA	B	66[A]	20/21	0.95	0.13	13,18,30,38	8
1	PIA	A	66[A]	20/21	0.96	0.11	13,18,30,38	8

6.3 Carbohydrates (i)

There are no monosaccharides 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	ACT	A	1	4/4	0.90	0.10	29,34,37,37	0

6.5 Other polymers (i)

There are no such residues in this entry.