Full wwPDB X-ray Structure Validation Report (i)

Jun 23, 2024 – 09:04 PM EDT

PDB ID	:	5M9N
Title	:	Crystal structure of human TDRD1 extended Tudor domain in complex with a symmetrically dimethylated E2F peptide
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Deposited on	:	2016-11-01
Resolution	:	1.95 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 (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:

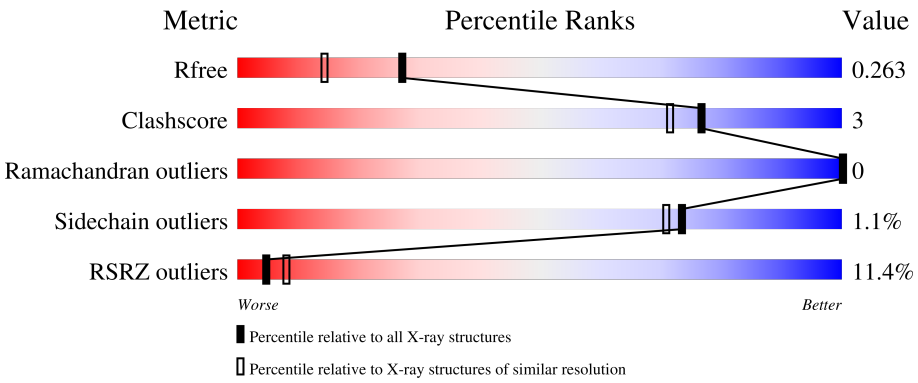
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.37.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)

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 1.95 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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	220	5%; 84%; 6% • 8%
1	B	220	15%; 83%; 6% • 10%
2	C	17	12%; 12%; 12%; 76%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

Validation Pipeline (wwPDB-VP) : 2.37.1

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	2MR	C	10	-	-	-	X

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 3249 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.

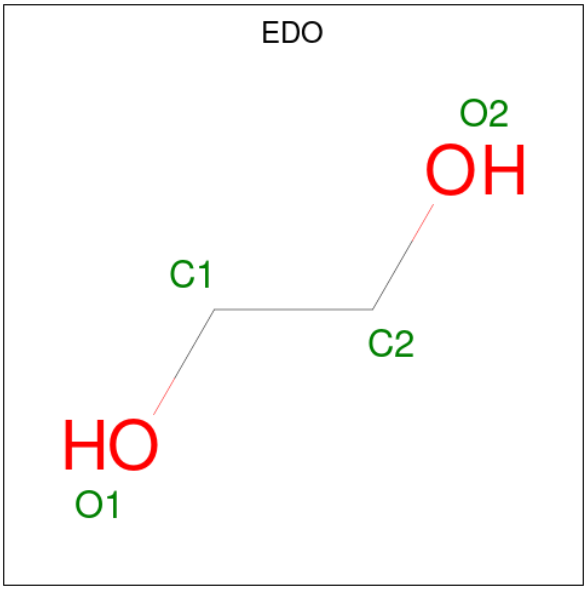
- Molecule 1 is a protein called Tudor domain-containing protein 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	202	1575	1016	252	296	11	0	2	0
1	B	198	1536	989	246	290	11	0	0	0

- Molecule 2 is a protein called E2F peptide.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	4	34	20	10	4	0	0	0

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



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

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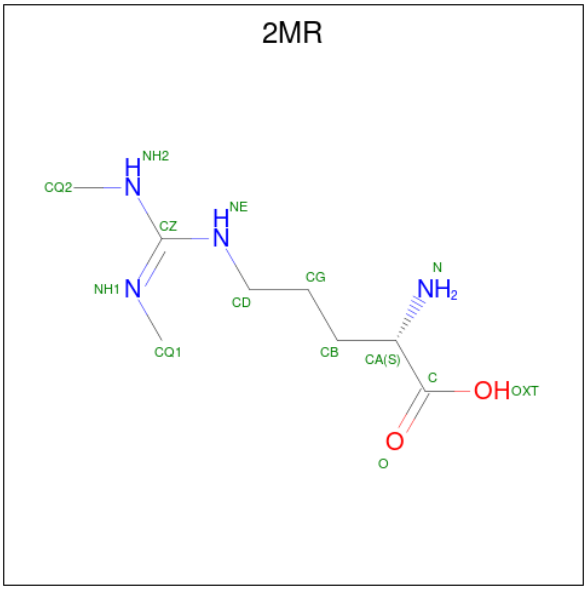
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O			
3	A	1	4	2	2		0	0
			Total	C	O			
3	B	1	4	2	2		0	0

- Molecule 4 is N3, N4-DIMETHYLARGININE (three-letter code: 2MR) (formula: $C_8H_{18}N_4O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
4	B	1	13	8	4	1	0	0

- Molecule 5 is water.

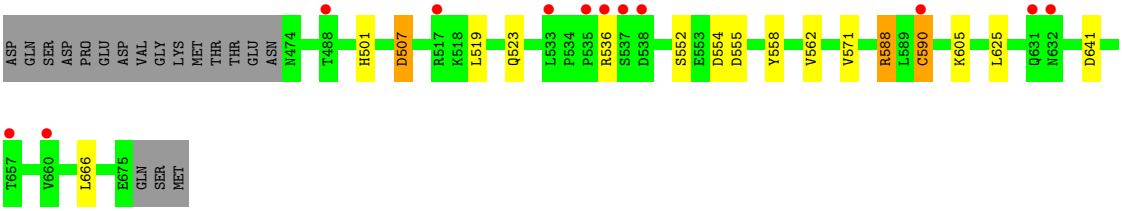
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	47	47	47	0	0
			Total	O		
5	B	32	32	32	0	0

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.

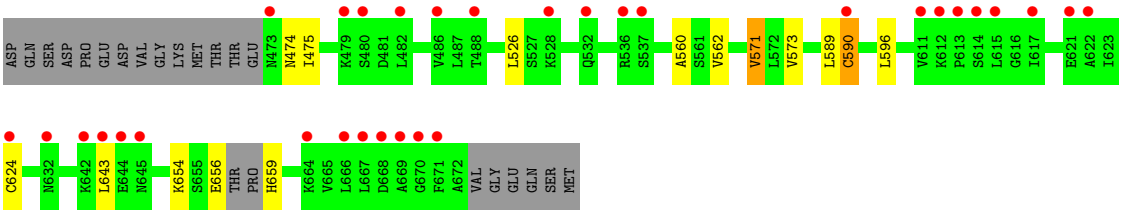
• Molecule 1: Tudor domain-containing protein 1

Chain A:



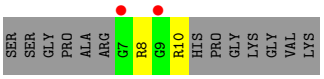
• Molecule 1: Tudor domain-containing protein 1

Chain B:



• Molecule 2: E2F peptide

Chain C:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	42.91Å 52.96Å 59.62Å 64.94° 88.85° 67.67°	Depositor
Resolution (Å)	29.34 – 1.95 29.34 – 1.95	Depositor EDS
% Data completeness (in resolution range)	96.9 (29.34-1.95) 97.0 (29.34-1.95)	Depositor EDS
R_{merge}	0.03	Depositor
R_{sym}	0.03	Depositor
$< I/\sigma(I) >$ [1]	2.32 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.8.0107	Depositor
R, R_{free}	0.212 , 0.260 0.218 , 0.263	Depositor DCC
R_{free} test set	1600 reflections (5.20%)	wwPDB-VP
Wilson B-factor (Å^2)	29.6	Xtriage
Anisotropy	0.675	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 42.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.025 for h,h-k,-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	3249	wwPDB-VP
Average B, all atoms (Å^2)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.74% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: 2MR, EDO

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	1/1611 (0.1%)	0.97	4/2187 (0.2%)
1	B	0.74	0/1563	0.83	2/2120 (0.1%)
2	C	1.28	0/6	0.71	0/4
All	All	0.78	1/3180 (0.0%)	0.90	6/4311 (0.1%)

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	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	590	CYS	CA-CB	6.66	1.68	1.53

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	588	ARG	NE-CZ-NH2	-11.26	114.67	120.30
1	A	588	ARG	NE-CZ-NH1	10.89	125.75	120.30
1	A	590	CYS	CA-CB-SG	10.60	133.08	114.00
1	B	590	CYS	CA-CB-SG	5.65	124.17	114.00
1	A	507	ASP	CB-CG-OD1	5.61	123.35	118.30
1	B	571	VAL	CG1-CB-CG2	-5.20	102.58	110.90

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	536	ARG	Peptide

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	1575	0	1614	10	0
1	B	1536	0	1567	9	0
2	C	34	0	35	0	0
3	A	8	0	12	0	0
3	B	4	0	6	0	0
4	B	13	0	16	0	0
5	A	47	0	0	2	0
5	B	32	0	0	0	0
All	All	3249	0	3250	19	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 3.

All (19) 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:571:VAL:HG11	1:B:589:LEU:HD11	1.64	0.79
1:B:562:VAL:HG13	1:B:571:VAL:HG21	1.76	0.67
1:B:562:VAL:HG13	1:B:571:VAL:CG2	2.32	0.60
1:B:656:GLU:O	1:B:659:HIS:N	2.36	0.59
1:B:560:ALA:HB1	1:B:573:VAL:HB	1.92	0.52
1:B:571:VAL:CG1	1:B:589:LEU:HD11	2.39	0.49
1:A:507:ASP:HA	1:A:605[A]:LYS:HE2	1.95	0.49
1:A:562:VAL:HG13	1:A:571:VAL:HG11	1.96	0.48
1:A:552:SER:HA	1:A:588:ARG:NH2	2.29	0.47
1:A:519:LEU:O	1:A:523:GLN:HG2	2.16	0.46
1:B:526:LEU:HD23	1:B:596:LEU:HD13	1.98	0.46
1:A:625:LEU:HD23	1:A:666:LEU:HD23	1.99	0.44
1:A:555:ASP:OD1	1:A:588:ARG:NH2	2.46	0.44
1:A:641:ASP:HB2	5:A:836:HOH:O	2.18	0.43
1:B:474:ASN:O	1:B:475:ILE:HG23	2.18	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:654:LYS:HG2	1:B:659:HIS:CE1	2.54	0.43
1:A:507:ASP:OD1	1:A:605[A]:LYS:HE2	2.19	0.42
1:A:501[A]:HIS:CD2	5:A:802:HOH:O	2.73	0.41
1:A:554:ASP:OD2	1:A:558:TYR:OH	2.30	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	202/220 (92%)	192 (95%)	10 (5%)	0	100	100
1	B	194/220 (88%)	187 (96%)	7 (4%)	0	100	100
2	C	1/17 (6%)	1 (100%)	0	0	100	100
All	All	397/457 (87%)	380 (96%)	17 (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	181/196 (92%)	180 (99%)	1 (1%)	86	85
1	B	176/196 (90%)	173 (98%)	3 (2%)	60	55
All	All	357/392 (91%)	353 (99%)	4 (1%)	73	71

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	590	CYS
1	B	590	CYS
1	B	624	CYS
1	B	643	LEU

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	659	HIS
1	B	645	ASN
1	B	659	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)

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	$\#\|Z\| > 2$
2	2MR	C	10	2	10,12,13	0.59	0	5,13,15	1.45	1 (20%)
2	2MR	C	8	2	10,12,13	0.64	0	5,13,15	2.05	1 (20%)

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
2	2MR	C	10	2	-	1/10/13/15	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	2MR	C	8	2	-	1/10/13/15	-

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	8	2MR	NE-CZ-NH2	4.35	123.47	119.48
2	C	10	2MR	NE-CZ-NH2	2.53	121.80	119.48

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	10	2MR	O-C-CA-CB
2	C	8	2MR	NE-CD-CG-CB

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

4 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	$\#\|Z\| > 2$
4	2MR	B	701	-	10,12,13	1.20	1 (10%)	5,13,15	1.27	1 (20%)
3	EDO	A	701	-	3,3,3	0.40	0	2,2,2	0.31	0
3	EDO	B	702	-	3,3,3	0.48	0	2,2,2	0.41	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
3	EDO	A	702	-	3,3,3	0.45	0	2,2,2	0.38	0

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
4	2MR	B	701	-	-	0/10/13/15	-
3	EDO	A	701	-	-	0/1/1/1	-
3	EDO	B	702	-	-	0/1/1/1	-
3	EDO	A	702	-	-	1/1/1/1	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	701	2MR	CZ-NH2	-3.26	1.26	1.33

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	701	2MR	CQ2-NH2-CZ	2.39	129.14	123.86

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	702	EDO	O1-C1-C2-O2

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	202/220 (91%)	0.53	12 (5%)	22	30	21, 38, 62, 87	0
1	B	198/220 (90%)	0.84	32 (16%)	1	2	25, 45, 79, 93	0
2	C	2/17 (11%)	6.58	2 (100%)	0	0	74, 74, 74, 82	0
All	All	402/457 (87%)	0.71	46 (11%)	5	8	21, 42, 74, 93	0

All (46) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	7	GLY	8.3
1	B	615	LEU	6.5
1	A	657	THR	6.0
1	B	614	SER	5.8
1	B	621	GLU	5.6
1	B	617	ILE	5.6
2	C	9	GLY	4.9
1	A	536	ARG	4.5
1	A	537	SER	4.4
1	A	590	CYS	4.0
1	A	535	PRO	3.9
1	B	671	PHE	3.9
1	B	666	LEU	3.7
1	A	538	ASP	3.7
1	B	643	LEU	3.7
1	B	611	VAL	3.5
1	B	669	ALA	3.4
1	B	644	GLU	3.4
1	B	482	LEU	3.3
1	B	667	LEU	3.2
1	B	622	ALA	3.2
1	B	613	PRO	3.0
1	B	473	ASN	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	517	ARG	2.9
1	B	486	VAL	2.8
1	B	642	LYS	2.8
1	B	664	LYS	2.7
1	B	590	CYS	2.7
1	B	645	ASN	2.7
1	B	528	LYS	2.6
1	B	670	GLY	2.6
1	B	488	THR	2.5
1	A	631	GLN	2.5
1	B	536	ARG	2.4
1	A	632	ASN	2.4
1	A	488	THR	2.3
1	B	480	SER	2.3
1	B	612	LYS	2.2
1	A	660	VAL	2.2
1	B	632	ASN	2.2
1	B	532	GLN	2.1
1	B	624	CYS	2.1
1	B	479	LYS	2.1
1	B	537	SER	2.0
1	B	668	ASP	2.0
1	A	533	LEU	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
2	2MR	C	8	13/14	0.69	0.25	37,44,79,81	0
2	2MR	C	10	13/14	0.69	0.52	76,78,82,83	0

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
4	2MR	B	701	13/14	0.76	0.26	42,53,73,75	0
3	EDO	A	702	4/4	0.84	0.27	53,53,55,57	0
3	EDO	A	701	4/4	0.85	0.27	64,64,65,66	0
3	EDO	B	702	4/4	0.90	0.32	59,61,61,61	0

6.5 Other polymers (i)

There are no such residues in this entry.