



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 3, 2026 – 01:15 pm GMT

PDB ID : 9SAC / pdb_00009sac
Title : 14-3-3sigma protein binding to the ChREBP peptide and macrocycle 3
Authors : Pennings, M.A.M.; van den Bosch, M.A.W.; Brunsveld, L.
Deposited on : 2025-08-07
Resolution : 2.50 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 : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
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) : 2.47

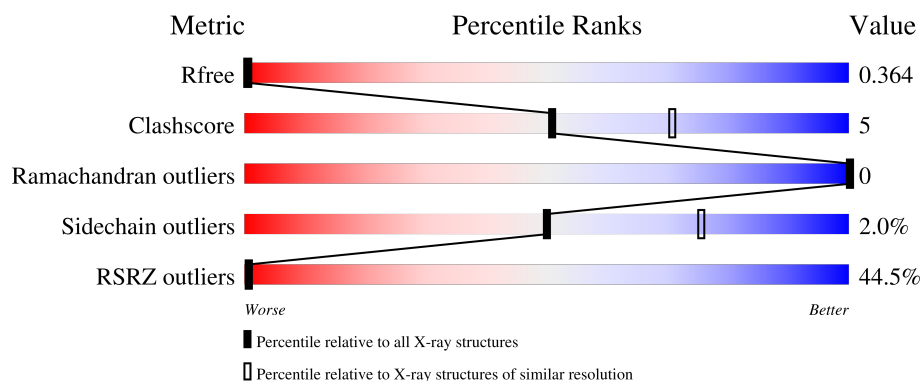
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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}	164625	5504 (2.50-2.50)
Clashscore	180529	6282 (2.50-2.50)
Ramachandran outliers	177936	6191 (2.50-2.50)
Sidechain outliers	177891	6193 (2.50-2.50)
RSRZ outliers	164620	5504 (2.50-2.50)

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	231	39% 84% 10% ..
2	B	14	100% 71% 29%
3	C	7	14% 57% 14% 14%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2113 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 14-3-3 protein sigma.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	221	Total	C	N	O	S	0	3	0
			1784	1117	305	351	11			

- Molecule 2 is a protein called Carbohydrate-responsive element-binding protein.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	14	Total	C	N	O	0	0	0
			134	89	25	20			

- Molecule 3 is a protein called 5,6-DIHYDRO-BENZO[H]CINNOLIN-3-YLAMINE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	7	Total	C	N	O	P	0	0	1
			60	35	11	13	1			

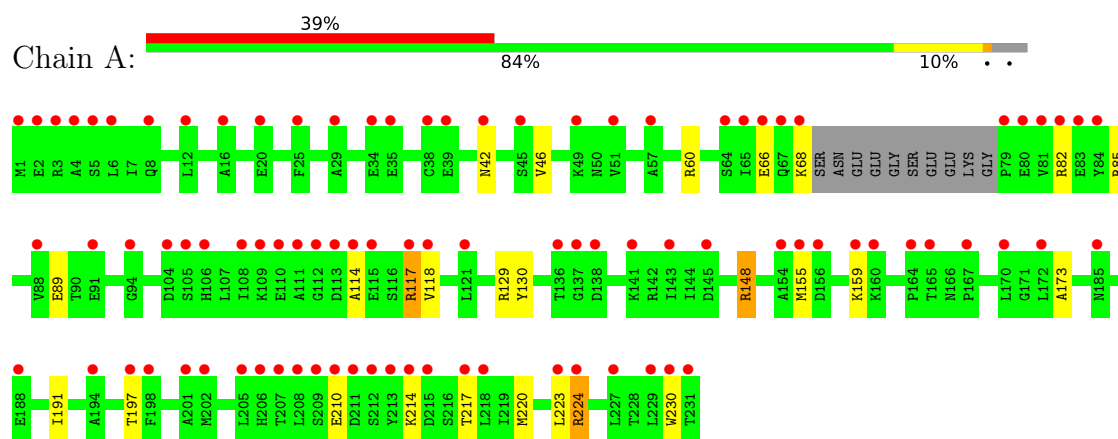
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	132	Total	O	0	0
			132	132		
4	B	1	Total	O	0	0
			1	1		
4	C	2	Total	O	0	0
			2	2		

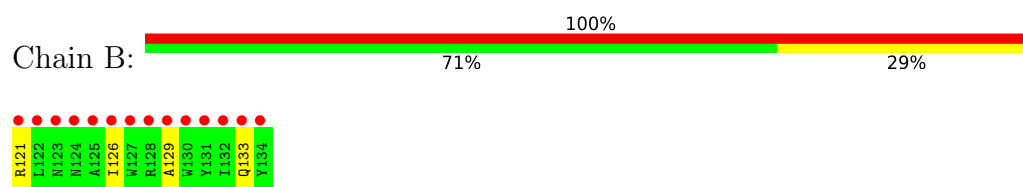
3 Residue-property plots [i](#)

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.

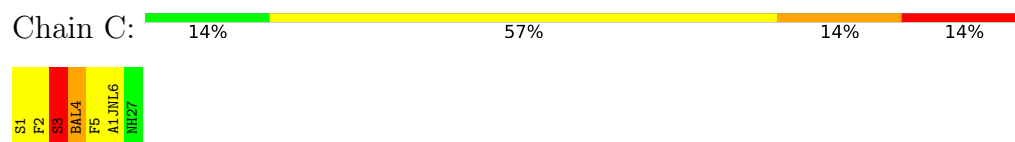
- Molecule 1: 14-3-3 protein sigma



- Molecule 2: Carbohydrate-responsive element-binding protein



- Molecule 3: 5,6-DIHYDRO-BENZO[H]CINNOLIN-3-YLAMINE



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	82.48Å 97.87Å 81.45Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.92 – 2.50 49.92 – 2.50	Depositor EDS
% Data completeness (in resolution range)	93.8 (49.92-2.50) 93.8 (49.92-2.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.59 (at 2.51Å)	Xtriage
Refinement program	PDB-REDO	Depositor
R, R_{free}	0.289 , 0.361 0.291 , 0.364	Depositor DCC
R_{free} test set	568 reflections (4.84%)	wwPDB-VP
Wilson B-factor (Å ²)	-8.6	Xtriage
Anisotropy	-2.554	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 23.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.80	EDS
Total number of atoms	2113	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.62% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SEP, B3S, NH2, A1JNL, BAL, PPN

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	0.46	0/1812	0.89	0/2433
2	B	0.47	0/139	0.92	0/188
3	C	0.28	0/11	1.25	0/13
All	All	0.46	0/1962	0.90	0/2634

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	7
2	B	0	1
3	C	0	2
All	All	0	10

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (10) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	117	ARG	Sidechain
1	A	129	ARG	Sidechain
1	A	148[A]	ARG	Sidechain
1	A	148[B]	ARG	Sidechain
1	A	224[A]	ARG	Sidechain
1	A	60	ARG	Sidechain
1	A	82	ARG	Sidechain

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Mol	Chain	Res	Type	Group
2	B	121	ARG	Sidechain
3	C	3	B3S	Mainchain,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	1784	0	1780	17	0
2	B	134	0	126	1	0
3	C	60	0	28	4	0
4	A	132	0	0	4	0
4	B	1	0	0	0	0
4	C	2	0	0	1	0
All	All	2113	0	1934	20	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 5.

All (20) 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)
3:C:2:PHE:O	4:C:101:HOH:O	2.14	0.64
1:A:155:MET:CE	1:A:159:LYS:HE2	2.28	0.63
1:A:224[B]:ARG:HA	1:A:224[B]:ARG:HE	1.65	0.61
1:A:223:LEU:HD11	4:A:334:HOH:O	2.05	0.56
1:A:148[B]:ARG:HG2	1:A:148[B]:ARG:NH1	2.22	0.53
1:A:42:ASN:OD1	3:C:5:PPN:N	2.46	0.49
1:A:117:ARG:HD3	4:A:309:HOH:O	2.12	0.48
1:A:85:ARG:NH1	1:A:89:GLU:OE1	2.46	0.47
1:A:114:ALA:O	1:A:118:VAL:HG23	2.15	0.47
1:A:148[B]:ARG:HG2	1:A:148[B]:ARG:HH11	1.78	0.46
1:A:173:ALA:HB3	4:A:334:HOH:O	2.17	0.45
1:A:197:THR:HG21	4:A:334:HOH:O	2.17	0.44
1:A:210:GLU:O	1:A:214:LYS:HG3	2.19	0.43
3:C:3:B3S:O	3:C:4:BAL:C	2.68	0.42
1:A:130:TYR:OH	3:C:1:SEP:O2P	2.31	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:155:MET:HE1	1:A:159:LYS:HE2	2.02	0.41
1:A:217:THR:HA	1:A:220:MET:HB2	2.03	0.41
1:A:155:MET:HE3	1:A:159:LYS:HE2	2.02	0.41
1:A:191:ILE:HD11	1:A:230:TRP:HB3	2.03	0.41
2:B:129:ALA:O	2:B:133:GLN:HG2	2.21	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	220/231 (95%)	216 (98%)	4 (2%)	0	100	100
2	B	12/14 (86%)	12 (100%)	0	0	100	100
3	C	1/7 (14%)	1 (100%)	0	0	100	100
All	All	233/252 (92%)	229 (98%)	4 (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	191/196 (97%)	188 (98%)	3 (2%)	58	80
2	B	12/12 (100%)	11 (92%)	1 (8%)	9	19

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
3	C	1/1 (100%)	1 (100%)	0	100	100
All	All	204/209 (98%)	200 (98%)	4 (2%)	50	75

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

Mol	Chain	Res	Type
1	A	46	VAL
1	A	66	GLU
1	A	68	LYS
2	B	126	ILE

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	8	GLN
1	A	15	GLN
2	B	123	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

5 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	$\# Z > 2$
3	PPN	C	5	3	12,14,15	0.51	0	13,18,20	1.02	0
3	A1JNL	C	6	3	10,12,15	1.15	2 (20%)	8,13,18	1.93	3 (37%)
3	B3S	C	3	3	6,6,7	0.54	0	4,6,8	2.15	2 (50%)
3	BAL	C	4	3	4,4,5	0.49	0	3,3,5	1.89	1 (33%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	SEP	C	1	3	8,9,10	0.57	0	8,12,14	0.96	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
3	PPN	C	5	3	-	2/7/10/12	0/1/1/1
3	A1JNL	C	6	3	-	1/6/7/13	0/1/1/1
3	B3S	C	3	3	-	4/5/5/6	-
3	BAL	C	4	3	-	1/1/2/3	-
3	SEP	C	1	3	-	4/5/8/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	6	A1JNL	N6-N5	-2.31	1.31	1.34
3	C	6	A1JNL	C10-N6	2.07	1.36	1.34

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	6	A1JNL	N6-N5-N4	-3.31	107.13	111.24
3	C	4	BAL	CB-CA-C	3.13	116.07	111.42
3	C	3	B3S	CA-CB-C	3.11	116.83	112.25
3	C	6	A1JNL	CA-N-C7	2.95	118.01	113.33
3	C	3	B3S	CB-CA-CG	2.52	116.69	112.22
3	C	6	A1JNL	C11-C10-N6	-2.10	108.22	111.34

There are no chirality outliers.

All (12) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	1	SEP	N-CA-CB-OG
3	C	1	SEP	CB-OG-P-O2P
3	C	1	SEP	CB-OG-P-O3P
3	C	3	B3S	N-CA-CB-C
3	C	3	B3S	CG-CA-CB-C
3	C	5	PPN	CE1-CZ-N1-O1

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Mol	Chain	Res	Type	Atoms
3	C	5	PPN	CE2-CZ-N1-O1
3	C	3	B3S	O-C-CB-CA
3	C	4	BAL	C-CA-CB-N
3	C	6	A1JNL	C-CA-N-C7
3	C	3	B3S	CB-CA-CG-OD
3	C	1	SEP	CB-OG-P-O1P

There are no ring outliers.

4 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	5	PPN	1	0
3	C	3	B3S	1	0
3	C	4	BAL	1	0
3	C	1	SEP	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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	221/231 (95%)	1.98	91 (41%)  	12, 24, 40, 51	3 (1%)
2	B	14/14 (100%)	5.08	14 (100%)  	44, 46, 52, 53	0
3	C	1/7 (14%)	1.93	0  	5, 5, 5, 5	0
All	All	236/252 (93%)	2.17	105 (44%)  	5, 25, 46, 53	3 (1%)

All (105) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	122	LEU	8.0
2	B	130	TRP	6.4
1	A	67	GLN	6.3
2	B	131	TYR	6.2
2	B	134	TYR	6.1
1	A	207	THR	5.8
1	A	34	GLU	5.7
1	A	210	GLU	5.6
2	B	123	ASN	5.6
1	A	68	LYS	5.5
1	A	112	GLY	5.4
2	B	133	GLN	5.2
2	B	132	ILE	5.1
1	A	1	MET	5.1
1	A	231	THR	4.9
2	B	121	ARG	4.8
1	A	82	ARG	4.7
1	A	109	LYS	4.7
1	A	188	GLU	4.6
2	B	127	TRP	4.4
1	A	111	ALA	4.3
1	A	79	PRO	4.2
2	B	125	ALA	4.1

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Mol	Chain	Res	Type	RSRZ
1	A	211	ASP	4.1
1	A	110	GLU	4.1
2	B	126	ILE	4.0
2	B	129	ALA	4.0
1	A	2	GLU	3.9
1	A	155	MET	3.9
2	B	128	ARG	3.9
1	A	80	GLU	3.7
1	A	5	SER	3.7
1	A	65	ILE	3.7
1	A	38	CYS	3.6
1	A	202[A]	MET	3.6
1	A	138	ASP	3.6
1	A	209	SER	3.5
1	A	227	LEU	3.5
1	A	230	TRP	3.4
1	A	215	ASP	3.4
1	A	35	GLU	3.4
2	B	124	ASN	3.3
1	A	159	LYS	3.3
1	A	8	GLN	3.3
1	A	224[A]	ARG	3.3
1	A	136	THR	3.3
1	A	64	SER	3.2
1	A	108	ILE	3.2
1	A	185	ASN	3.2
1	A	229	LEU	3.2
1	A	201	ALA	3.1
1	A	218	LEU	3.0
1	A	66	GLU	3.0
1	A	104	ASP	3.0
1	A	29	ALA	2.9
1	A	212	SER	2.9
1	A	214	LYS	2.8
1	A	20	GLU	2.8
1	A	141	LYS	2.8
1	A	81	VAL	2.8
1	A	12	LEU	2.8
1	A	83	GLU	2.8
1	A	115	GLU	2.8
1	A	16	ALA	2.7
1	A	206	HIS	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	39	GLU	2.7
1	A	154	ALA	2.6
1	A	165	THR	2.6
1	A	117	ARG	2.6
1	A	118	VAL	2.6
1	A	4	ALA	2.6
1	A	25	PHE	2.6
1	A	208	LEU	2.5
1	A	172	LEU	2.5
1	A	213	TYR	2.5
1	A	121	LEU	2.4
1	A	143	ILE	2.4
1	A	88	VAL	2.4
1	A	217	THR	2.4
1	A	42	ASN	2.4
1	A	3	ARG	2.4
1	A	6	LEU	2.4
1	A	205	LEU	2.4
1	A	114	ALA	2.4
1	A	105	SER	2.2
1	A	198	PHE	2.2
1	A	51	VAL	2.2
1	A	223	LEU	2.2
1	A	156	ASP	2.2
1	A	84	TYR	2.2
1	A	49	LYS	2.2
1	A	106	HIS	2.2
1	A	91	GLU	2.2
1	A	113	ASP	2.2
1	A	170	LEU	2.1
1	A	57	ALA	2.1
1	A	94	GLY	2.1
1	A	45	SER	2.1
1	A	145	ASP	2.1
1	A	194	ALA	2.1
1	A	164	PRO	2.1
1	A	167	PRO	2.0
1	A	137	GLY	2.0
1	A	160	LYS	2.0
1	A	197	THR	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($\text{\AA}^2$)	Q<0.9
3	A1JNL	C	6	12/15	0.71	0.35	2,33,121,142	0
3	BAL	C	4	5/6	0.79	0.32	2,2,25,117	0
3	B3S	C	3	7/8	0.81	0.30	2,2,49,102	0
3	PPN	C	5	14/15	0.84	0.26	2,2,47,170	0
3	SEP	C	1	10/11	0.93	0.13	2,2,2,31	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.