



wwPDB X-ray Structure Validation Summary Report ⓘ

Dec 2, 2023 – 03:00 pm GMT

PDB ID : 1O9K
Title : Crystal structure of the retinoblastoma tumour suppressor protein bound to E2F peptide
Authors : Xiao, B.; Spencer, J.; Clements, A.; Ali-Khan, N.; Mittnacht, S.; Broceno, C.; Burghammer, M.; Perrakis, A.; Marmorstein, R.; Gamblin, S.J.
Deposited on : 2002-12-16
Resolution : 2.60 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 ⓘ 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 : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.36
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) : 2.36

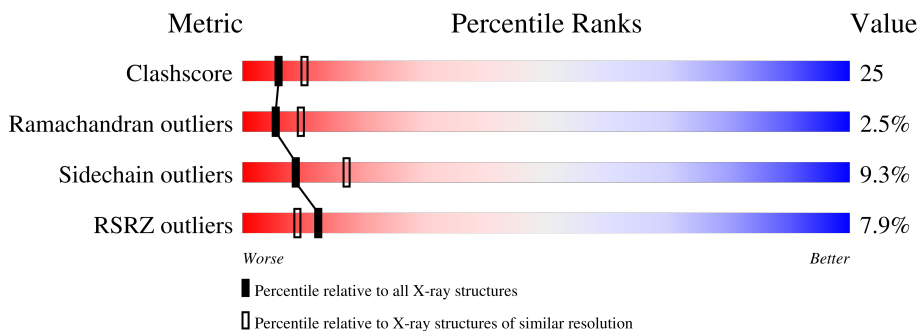
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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.



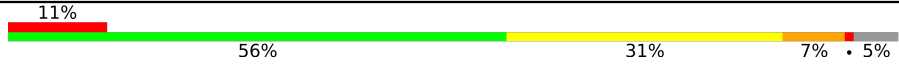


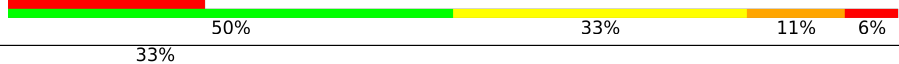
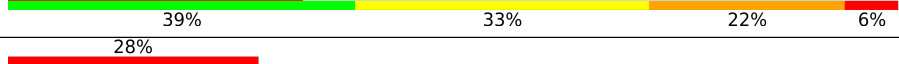
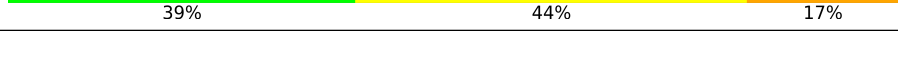
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (2.60-2.60)

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	218	3% (Poor fit) 56% (0 outliers), 27% (1 outlier), 6% (2 outliers), 11% (3+ outliers, not modelled)
1	C	218	4% (Poor fit) 57% (0 outliers), 25% (1 outlier), 6% (2 outliers), 11% (3+ outliers, not modelled)
1	E	218	5% (Poor fit) 51% (0 outliers), 31% (1 outlier), 6% (2 outliers), 11% (3+ outliers, not modelled)
1	G	218	5% (Poor fit) 51% (0 outliers), 32% (1 outlier), 6% (2 outliers), 11% (3+ outliers, not modelled)
2	B	152	9% (Poor fit) 59% (0 outliers), 31% (1 outlier), 5% (2 outliers), 5% (3+ outliers, not modelled)
2	D	152	8% (Poor fit) 57% (0 outliers), 34% (1 outlier), 5% (2 outliers), 5% (3+ outliers, not modelled)

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Mol	Chain	Length	Quality of chain
2	F	152	
2	H	152	
3	P	18	
3	Q	18	
3	R	18	
3	S	18	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 11974 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 RETINOBLASTOMA-ASSOCIATED PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	194	1569	1003	263	290	13	0	0	0
1	C	194	1569	1003	263	290	13	0	0	0
1	E	194	1569	1003	263	290	13	0	0	0
1	G	194	1569	1003	263	290	13	0	0	0

- Molecule 2 is a protein called RETINOBLASTOMA-ASSOCIATED PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	144	1213	789	205	211	8	0	0	0
2	D	144	1213	789	205	211	8	0	0	0
2	F	144	1213	789	205	211	8	0	0	0
2	H	144	1213	789	205	211	8	0	0	0

- Molecule 3 is a protein called TRANSCRIPTION FACTOR E2F1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	P	18	149	96	23	30	0	0	0
3	Q	18	149	96	23	30	0	0	0
3	R	18	149	96	23	30	0	0	0
3	S	18	149	96	23	30	0	0	0

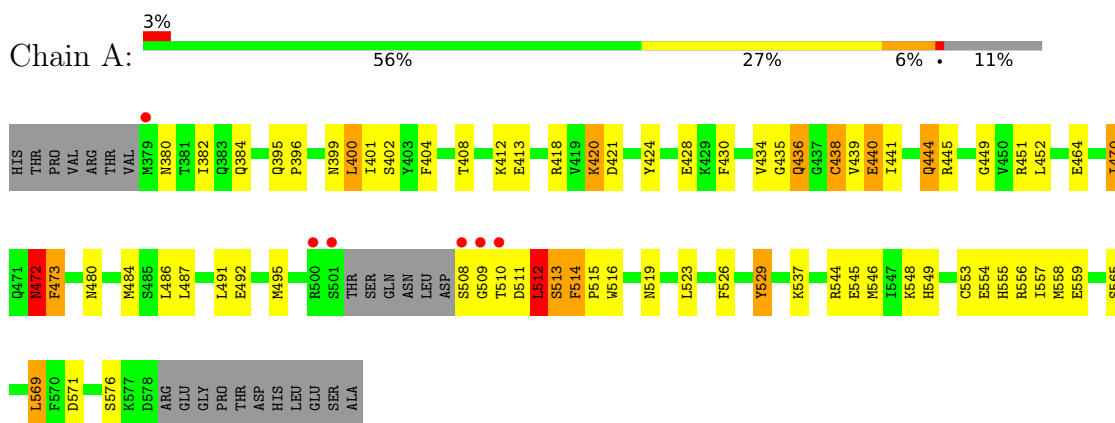
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	39	Total O 39 39	0	0
4	B	18	Total O 18 18	0	0
4	C	47	Total O 47 47	0	0
4	D	24	Total O 24 24	0	0
4	E	38	Total O 38 38	0	0
4	F	16	Total O 16 16	0	0
4	G	39	Total O 39 39	0	0
4	H	15	Total O 15 15	0	0
4	P	1	Total O 1 1	0	0
4	Q	4	Total O 4 4	0	0
4	R	4	Total O 4 4	0	0
4	S	5	Total O 5 5	0	0

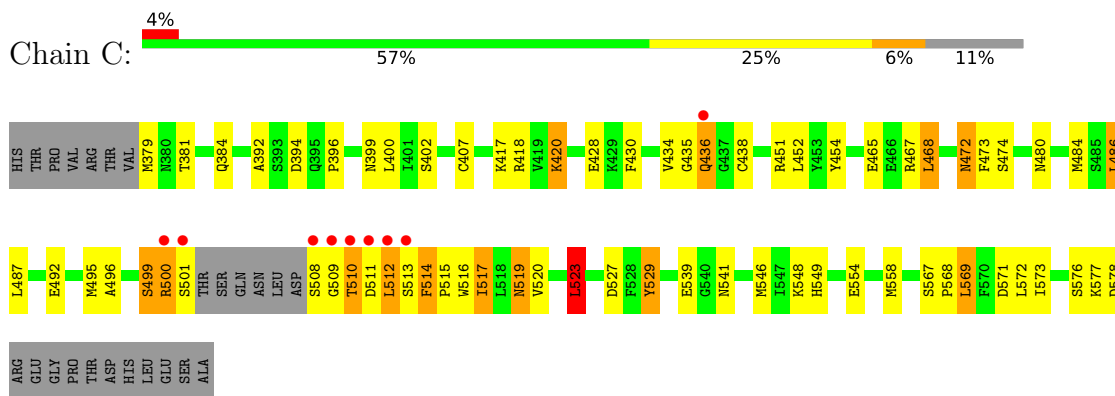
3 Residue-property plots [i](#)

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.

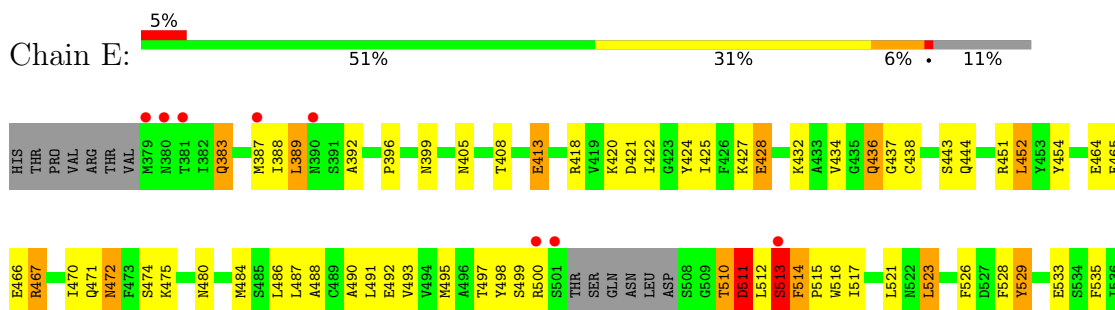
• Molecule 1: RETINOBLASTOMA-ASSOCIATED PROTEIN



• Molecule 1: RETINOBLASTOMA-ASSOCIATED PROTEIN

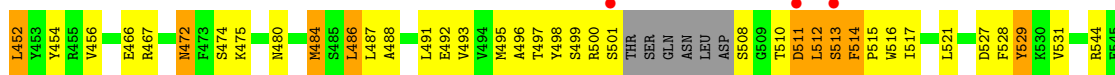


• Molecule 1: RETINOBLASTOMA-ASSOCIATED PROTEIN





- Molecule 1: RETINOBLASTOMA-ASSOCIATED PROTEIN



- Molecule 2: RETINOBLASTOMA-ASSOCIATED PROTEIN



- Molecule 2: RETINOBLASTOMA-ASSOCIATED PROTEIN



- Molecule 2: RETINOBLASTOMA-ASSOCIATED PROTEIN



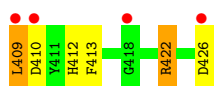
- Molecule 2: RETINOBLASTOMA-ASSOCIATED PROTEIN

Chain H: 



- Molecule 3: TRANSCRIPTION FACTOR E2F1

Chain P: 




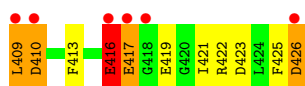
- Molecule 3: TRANSCRIPTION FACTOR E2F1

Chain Q: 



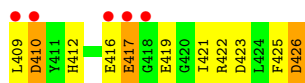
- Molecule 3: TRANSCRIPTION FACTOR E2F1

Chain R: 



- Molecule 3: TRANSCRIPTION FACTOR E2F1

Chain S: 



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	102.00Å 158.55Å 110.62Å 90.00° 93.70° 90.00°	Depositor
Resolution (Å)	20.00 – 2.60 19.82 – 2.60	Depositor EDS
% Data completeness (in resolution range)	88.2 (20.00-2.60) 88.1 (19.82-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.80 (at 2.59Å)	Xtrriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.229 , 0.285 0.228 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	18.3	Xtrriage
Anisotropy	0.129	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 58.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	11974	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.02% 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](#)

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	0.55	0/1595	0.83	3/2141 (0.1%)
1	C	0.52	0/1595	0.81	5/2141 (0.2%)
1	E	0.52	0/1595	0.78	6/2141 (0.3%)
1	G	0.53	0/1595	0.77	5/2141 (0.2%)
2	B	0.46	0/1242	0.72	1/1680 (0.1%)
2	D	0.43	0/1242	0.72	2/1680 (0.1%)
2	F	0.39	0/1242	0.72	1/1680 (0.1%)
2	H	0.44	0/1242	0.73	3/1680 (0.2%)
3	P	0.47	0/152	0.91	1/203 (0.5%)
3	Q	0.40	0/152	0.83	1/203 (0.5%)
3	R	0.49	0/152	0.98	2/203 (1.0%)
3	S	0.42	0/152	0.87	1/203 (0.5%)
All	All	0.49	0/11956	0.77	31/16096 (0.2%)

There are no bond length outliers.

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	509	GLY	N-CA-C	-9.23	90.02	113.10
1	A	571	ASP	CB-CG-OD2	6.71	124.34	118.30
1	C	468	LEU	N-CA-C	-6.58	93.24	111.00
2	H	730	ASP	CB-CG-OD2	6.32	123.99	118.30
2	H	701	ASP	CB-CG-OD2	6.17	123.85	118.30

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	1569	0	1592	84	0
1	C	1569	0	1592	76	0
1	E	1569	0	1592	106	0
1	G	1569	0	1592	112	0
2	B	1213	0	1246	45	0
2	D	1213	0	1246	43	0
2	F	1213	0	1246	57	0
2	H	1213	0	1246	63	0
3	P	149	0	129	4	0
3	Q	149	0	129	11	0
3	R	149	0	129	17	0
3	S	149	0	129	10	0
4	A	39	0	0	9	0
4	B	18	0	0	3	0
4	C	47	0	0	14	0
4	D	24	0	0	1	0
4	E	38	0	0	8	0
4	F	16	0	0	3	0
4	G	39	0	0	9	0
4	H	15	0	0	8	0
4	P	1	0	0	0	0
4	Q	4	0	0	1	0
4	R	4	0	0	1	0
4	S	5	0	0	3	0
All	All	11974	0	11868	588	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 25.

The worst 5 of 588 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:512:LEU:HD22	1:A:512:LEU:O	1.28	1.27
1:C:513:SER:O	1:C:515:PRO:HD2	1.35	1.23
2:H:737:GLU:HB2	4:H:2008:HOH:O	1.36	1.21
1:C:509:GLY:HA2	4:C:2028:HOH:O	1.50	1.10
1:A:512:LEU:O	1:A:512:LEU:CD2	2.05	1.04

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	190/218 (87%)	178 (94%)	6 (3%)	6 (3%)	4 6
1	C	190/218 (87%)	170 (90%)	14 (7%)	6 (3%)	4 6
1	E	190/218 (87%)	178 (94%)	10 (5%)	2 (1%)	14 30
1	G	190/218 (87%)	174 (92%)	10 (5%)	6 (3%)	4 6
2	B	142/152 (93%)	129 (91%)	11 (8%)	2 (1%)	11 22
2	D	142/152 (93%)	127 (89%)	13 (9%)	2 (1%)	11 22
2	F	142/152 (93%)	127 (89%)	11 (8%)	4 (3%)	5 7
2	H	142/152 (93%)	124 (87%)	15 (11%)	3 (2%)	7 13
3	P	16/18 (89%)	14 (88%)	2 (12%)	0	100 100
3	Q	16/18 (89%)	14 (88%)	1 (6%)	1 (6%)	1 1
3	R	16/18 (89%)	13 (81%)	1 (6%)	2 (12%)	0 0
3	S	16/18 (89%)	13 (81%)	2 (12%)	1 (6%)	1 1
All	All	1392/1552 (90%)	1261 (91%)	96 (7%)	35 (2%)	5 9

5 of 35 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	514	PHE
1	C	514	PHE
2	D	784	HIS
2	D	786	PRO
2	F	779	LEU

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	178/200 (89%)	162 (91%)	16 (9%)	9	18
1	C	178/200 (89%)	163 (92%)	15 (8%)	11	21
1	E	178/200 (89%)	160 (90%)	18 (10%)	7	14
1	G	178/200 (89%)	163 (92%)	15 (8%)	11	21
2	B	139/147 (95%)	123 (88%)	16 (12%)	5	10
2	D	139/147 (95%)	127 (91%)	12 (9%)	10	20
2	F	139/147 (95%)	126 (91%)	13 (9%)	8	17
2	H	139/147 (95%)	129 (93%)	10 (7%)	14	29
3	P	15/15 (100%)	13 (87%)	2 (13%)	4	7
3	Q	15/15 (100%)	13 (87%)	2 (13%)	4	7
3	R	15/15 (100%)	11 (73%)	4 (27%)	0	1
3	S	15/15 (100%)	14 (93%)	1 (7%)	16	33
All	All	1328/1448 (92%)	1204 (91%)	124 (9%)	9	17

5 of 124 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	750	ASP
2	H	700	LEU
1	E	510	THR
2	H	685	GLN
3	Q	422	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 55 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	395	GLN
2	F	678	HIS
3	S	412	HIS
2	H	685	GLN
1	E	405	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](#)

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

5.5 Carbohydrates [i](#)

There are no monosaccharides 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 [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	194/218 (88%)	0.01	6 (3%) 49 42	20, 29, 56, 74	0
1	C	194/218 (88%)	-0.02	9 (4%) 32 26	20, 29, 55, 69	0
1	E	194/218 (88%)	0.16	11 (5%) 23 18	21, 30, 56, 77	0
1	G	194/218 (88%)	0.07	11 (5%) 23 18	21, 29, 58, 75	0
2	B	144/152 (94%)	0.37	14 (9%) 7 5	21, 38, 71, 79	0
2	D	144/152 (94%)	0.43	12 (8%) 11 8	24, 39, 72, 80	0
2	F	144/152 (94%)	0.56	17 (11%) 4 3	27, 43, 73, 80	0
2	H	144/152 (94%)	0.51	14 (9%) 7 5	27, 40, 72, 83	0
3	P	18/18 (100%)	0.83	4 (22%) 0 0	41, 48, 61, 64	0
3	Q	18/18 (100%)	0.80	4 (22%) 0 0	40, 49, 58, 61	0
3	R	18/18 (100%)	1.09	6 (33%) 0 0	39, 52, 65, 68	0
3	S	18/18 (100%)	1.17	5 (27%) 0 0	41, 51, 62, 64	0
All	All	1424/1552 (91%)	0.27	113 (7%) 12 9	20, 36, 65, 83	0

The worst 5 of 113 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	H	774	THR	9.1
2	D	774	THR	8.8
1	E	379	MET	7.6
2	B	776	PRO	7.2
2	H	787	ARG	7.2

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 monosaccharides 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.