



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:08 AM UTC

PDB ID : 3L82 / pdb_00003l82
Title : X-ray Crystal structure of TRF1 and Fbx4 complex
Authors : Zeng, Z.X.; Wang, W.; Yang, Y.T.; Chen, Y.; Yang, X.M.; Diehl, J.A.; Liu, X.D.; Lei, M.
Deposited on : 2009-12-29
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

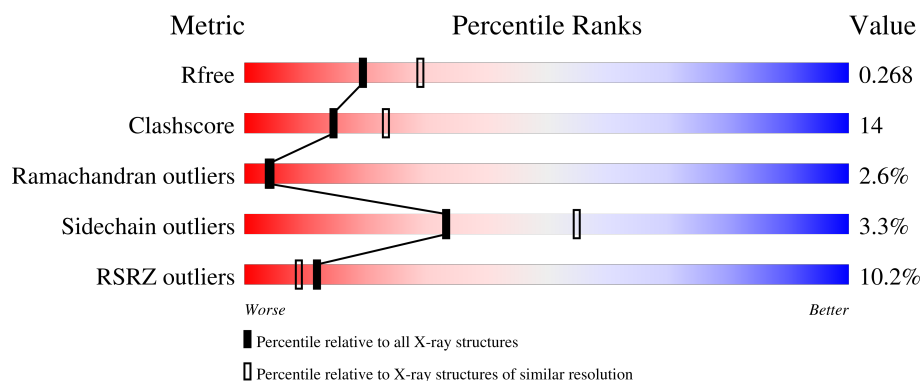
1 Overall quality at a glance

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	215	8% 73% 19% •• 6%
2	B	227	9% 56% 23% • 19%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3137 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 Telomeric repeat-binding factor 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	203	Total	C	N	O	S	Se	0	0	0
			1622	1031	277	301	5	8			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	54	PRO	-	expression tag	UNP P54274
A	55	LEU	-	expression tag	UNP P54274
A	56	GLY	-	expression tag	UNP P54274
A	57	SER	-	expression tag	UNP P54274

- Molecule 2 is a protein called F-box only protein 4.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	184	Total	C	N	O	S	Se	0	0	0
			1455	930	243	273	4	5			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	161	SER	-	expression tag	UNP Q9UKT5

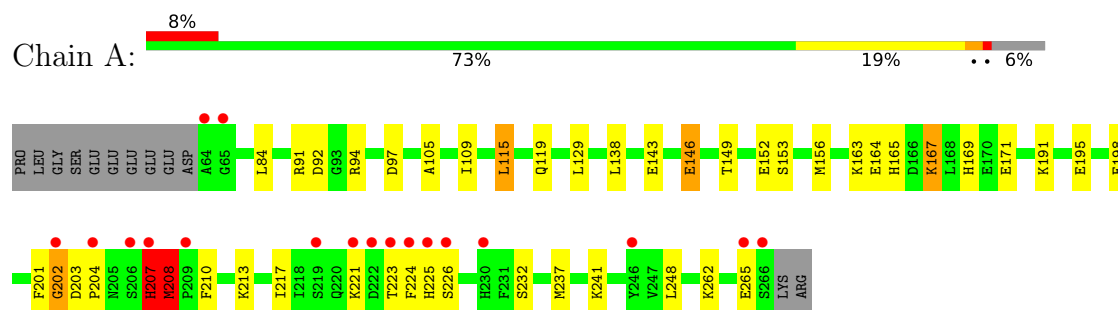
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	30	Total	O	0	0
			30	30		
3	B	30	Total	O	0	0
			30	30		

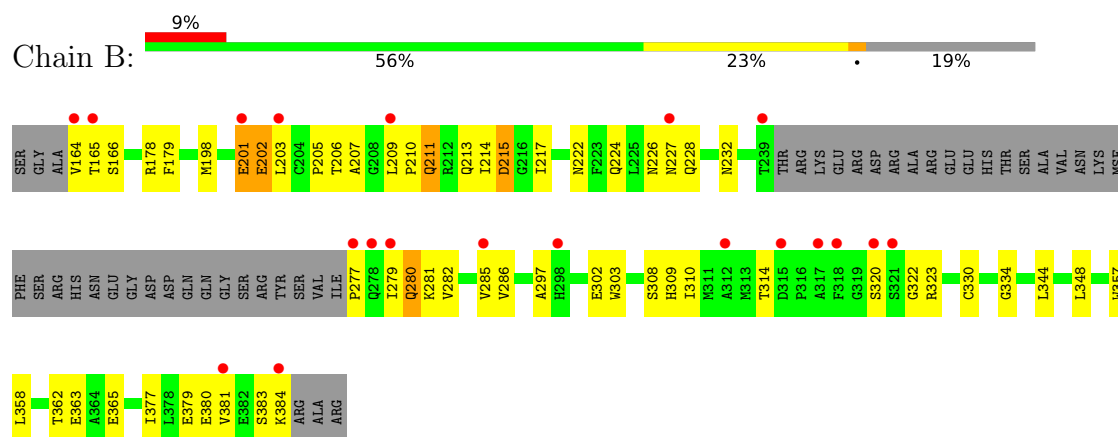
3 Residue-property plots [i](#)

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: Telomeric repeat-binding factor 1



- Molecule 2: F-box only protein 4



4 Data and refinement statistics

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	68.10Å 68.10Å 234.42Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.40 50.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	93.7 (50.00-2.40) 96.2 (50.00-2.40)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.06 (at 2.39Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.237 , 0.263 0.247 , 0.268	Depositor DCC
R_{free} test set	3742 reflections (9.70%)	wwPDB-VP
Wilson B-factor (Å ²)	44.5	Xtriage
Anisotropy	0.516	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 54.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3137	wwPDB-VP
Average B, all atoms (Å ²)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.04% 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

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	0.53	1/1645 (0.1%)	0.89	4/2197 (0.2%)
2	B	0.50	1/1484 (0.1%)	1.01	12/2005 (0.6%)
All	All	0.51	2/3129 (0.1%)	0.95	16/4202 (0.4%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	207	HIS	N-CA	5.82	1.53	1.46
2	B	201	GLU	CA-C	5.68	1.60	1.52

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	202	GLU	N-CA-C	-7.94	93.88	110.80
1	A	208	MSE	CA-C-N	-6.49	113.47	121.00
1	A	208	MSE	C-N-CA	-6.49	113.47	121.00
2	B	357	TRP	N-CA-C	6.40	118.68	109.14
2	B	383	SER	N-CA-C	-5.82	106.18	113.28
2	B	201	GLU	CA-C-N	5.75	132.53	121.54
2	B	201	GLU	C-N-CA	5.75	132.53	121.54
2	B	380	GLU	N-CA-C	-5.68	106.43	113.19
2	B	201	GLU	N-CA-C	5.45	122.42	110.80
1	A	232	SER	N-CA-C	5.43	117.08	110.41
2	B	365	GLU	N-CA-C	5.35	117.19	111.36
2	B	323	ARG	CA-C-N	5.25	125.19	119.78
2	B	323	ARG	C-N-CA	5.25	125.19	119.78
1	A	138	LEU	N-CA-C	5.14	121.75	110.80
2	B	297	ALA	N-CA-C	5.14	116.57	111.07
2	B	330	CYS	N-CA-C	5.07	118.00	109.95

There are no chirality outliers.

There are no planarity outliers.

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	1622	0	1608	41	0
2	B	1455	0	1422	45	0
3	A	30	0	0	0	0
3	B	30	0	0	0	0
All	All	3137	0	3030	85	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 14.

All (85) 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:208:MSE:CE	1:A:210:PHE:HB2	1.71	1.21
1:A:208:MSE:HE1	1:A:210:PHE:HB2	1.17	1.12
1:A:208:MSE:SE	1:A:210:PHE:H	1.83	1.11
2:B:209:LEU:HB3	2:B:211:GLN:HE21	1.15	1.04
1:A:262:LYS:O	1:A:265:GLU:HG2	1.63	0.98
1:A:208:MSE:SE	1:A:210:PHE:HB2	2.16	0.95
1:A:208:MSE:HE1	1:A:210:PHE:CB	2.02	0.89
1:A:208:MSE:SE	1:A:210:PHE:N	2.60	0.85
1:A:208:MSE:SE	1:A:210:PHE:HD1	2.12	0.82
2:B:310:ILE:O	2:B:314:THR:HG22	1.79	0.82
1:A:208:MSE:SE	1:A:210:PHE:CB	2.82	0.77
1:A:201:PHE:CZ	1:A:208:MSE:HE3	2.20	0.76
1:A:208:MSE:SE	1:A:210:PHE:CD1	2.90	0.74
2:B:280:GLN:NE2	2:B:280:GLN:H	1.85	0.74
2:B:209:LEU:HB3	2:B:211:GLN:NE2	1.98	0.73
1:A:201:PHE:CE2	1:A:208:MSE:HE3	2.27	0.69
2:B:164:VAL:HG23	2:B:166:SER:H	1.55	0.69
1:A:207:HIS:O	1:A:208:MSE:O	2.12	0.68
1:A:94:ARG:HD2	1:A:97:ASP:OD2	1.96	0.65
2:B:201:GLU:C	2:B:203:LEU:H	2.05	0.65
2:B:322:GLY:HA3	2:B:384:LYS:NZ	2.14	0.63
1:A:224:PHE:CE1	1:A:226:SER:HB3	2.35	0.61
2:B:205:PRO:HA	2:B:222:ASN:O	1.99	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:280:GLN:H	2:B:280:GLN:HE21	1.47	0.61
2:B:210:PRO:HA	2:B:213:GLN:HE21	1.68	0.59
1:A:143:GLU:HG3	1:A:156:MSE:HE1	1.85	0.58
1:A:153:SER:HA	1:A:156:MSE:CE	2.34	0.58
2:B:279:ILE:H	2:B:279:ILE:HD12	1.68	0.58
2:B:322:GLY:HA3	2:B:384:LYS:HZ1	1.67	0.57
2:B:277:PRO:N	2:B:280:GLN:NE2	2.54	0.56
1:A:105:ALA:O	1:A:109:ILE:HG13	2.05	0.56
1:A:223:THR:HB	1:A:225:HIS:CE1	2.40	0.56
2:B:279:ILE:HD12	2:B:279:ILE:N	2.21	0.56
2:B:179:PHE:HA	2:B:286:VAL:CG2	2.37	0.55
2:B:344:LEU:HD23	2:B:348:LEU:HD12	1.89	0.54
1:A:198:GLU:O	1:A:202:GLY:HA3	2.09	0.53
1:A:146:GLU:H	1:A:146:GLU:CD	2.17	0.53
1:A:153:SER:HA	1:A:156:MSE:HE2	1.90	0.52
1:A:262:LYS:HA	1:A:265:GLU:CD	2.36	0.51
2:B:210:PRO:CA	2:B:213:GLN:HE21	2.22	0.51
1:A:91:ARG:HD2	1:A:92:ASP:OD1	2.10	0.51
2:B:281:LYS:O	2:B:285:VAL:HG12	2.11	0.50
1:A:163:LYS:HG2	1:A:169:HIS:CG	2.47	0.49
1:A:191:LYS:O	1:A:195:GLU:HG3	2.13	0.49
1:A:164:GLU:HB3	1:A:165:HIS:CE1	2.48	0.49
2:B:280:GLN:H	2:B:280:GLN:CD	2.16	0.49
1:A:115:LEU:O	2:B:358:LEU:HD12	2.12	0.48
2:B:279:ILE:H	2:B:279:ILE:CD1	2.26	0.48
2:B:377:ILE:O	2:B:381:VAL:HG23	2.13	0.48
1:A:149:THR:OG1	1:A:152:GLU:HG3	2.14	0.48
1:A:207:HIS:O	1:A:208:MSE:HB3	2.14	0.48
1:A:208:MSE:SE	1:A:210:PHE:CA	3.11	0.48
1:A:115:LEU:CD2	1:A:119:GLN:HB2	2.45	0.47
2:B:178:ARG:HE	2:B:232:ASN:ND2	2.12	0.47
2:B:314:THR:O	2:B:314:THR:HG23	2.14	0.47
1:A:149:THR:HG1	1:A:152:GLU:HG3	1.80	0.47
2:B:211:GLN:CD	2:B:211:GLN:H	2.23	0.46
1:A:207:HIS:C	1:A:208:MSE:O	2.58	0.46
2:B:279:ILE:N	2:B:280:GLN:HE21	2.14	0.46
1:A:84:LEU:HD12	1:A:248:LEU:HD23	1.97	0.45
2:B:344:LEU:CD2	2:B:348:LEU:HD12	2.47	0.45
2:B:210:PRO:HB3	2:B:213:GLN:HE21	1.82	0.44
2:B:206:THR:HG22	2:B:207:ALA:N	2.32	0.44
1:A:164:GLU:HB3	1:A:165:HIS:ND1	2.33	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:214:ILE:O	2:B:217:ILE:HB	2.18	0.44
2:B:178:ARG:HE	2:B:232:ASN:HD22	1.64	0.43
1:A:207:HIS:O	1:A:207:HIS:CG	2.71	0.43
2:B:214:ILE:O	2:B:215:ASP:C	2.61	0.43
2:B:164:VAL:HG23	2:B:165:THR:N	2.33	0.43
2:B:280:GLN:NE2	2:B:280:GLN:N	2.60	0.43
2:B:277:PRO:O	2:B:280:GLN:HG2	2.18	0.43
1:A:153:SER:HA	1:A:156:MSE:HE3	1.99	0.42
2:B:362:THR:HG22	2:B:363:GLU:N	2.34	0.42
2:B:210:PRO:O	2:B:213:GLN:HG3	2.19	0.41
2:B:279:ILE:O	2:B:282:VAL:HB	2.21	0.41
1:A:237:MSE:CE	1:A:241:LYS:HE3	2.50	0.41
2:B:210:PRO:HB3	2:B:213:GLN:NE2	2.35	0.41
2:B:210:PRO:HA	2:B:213:GLN:HG3	2.02	0.41
1:A:167:LYS:O	1:A:171:GLU:HG3	2.21	0.41
2:B:224:GLN:NE2	2:B:227:ASN:HA	2.35	0.41
2:B:308:SER:O	2:B:309:HIS:C	2.64	0.41
2:B:379:GLU:C	2:B:381:VAL:H	2.26	0.40
1:A:217:ILE:HG23	1:A:224:PHE:HB2	2.03	0.40
2:B:210:PRO:CB	2:B:213:GLN:HE21	2.35	0.40
2:B:226:ASN:C	2:B:228:GLN:H	2.28	0.40

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	201/215 (94%)	187 (93%)	9 (4%)	5 (2%)	4	5
2	B	180/227 (79%)	161 (89%)	14 (8%)	5 (3%)	4	3
All	All	381/442 (86%)	348 (91%)	23 (6%)	10 (3%)	4	4

All (10) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	221	LYS
2	B	215	ASP
2	B	303	TRP
1	A	202	GLY
1	A	208	MSE
2	B	202	GLU
2	B	320	SER
1	A	204	PRO
2	B	334	GLY
1	A	203	ASP

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	175/178 (98%)	168 (96%)	7 (4%)	28	47
2	B	163/193 (84%)	159 (98%)	4 (2%)	42	64
All	All	338/371 (91%)	327 (97%)	11 (3%)	33	55

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	115	LEU
1	A	129	LEU
1	A	146	GLU
1	A	167	LYS
1	A	207	HIS
1	A	208	MSE
1	A	213	LYS
2	B	198	MSE
2	B	211	GLN
2	B	280	GLN
2	B	302	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11)

such sidechains are listed below:

Mol	Chain	Res	Type
1	A	179	GLN
1	A	187	ASN
1	A	189	ASN
1	A	229	GLN
2	B	190	ASN
2	B	211	GLN
2	B	213	GLN
2	B	224	GLN
2	B	232	ASN
2	B	280	GLN
2	B	372	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 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	195/215 (90%)	0.29	18 (9%) 14 12	25, 46, 102, 125	0
2	B	179/227 (78%)	0.82	20 (11%) 10 7	29, 54, 100, 112	0
All	All	374/442 (84%)	0.54	38 (10%) 12 9	25, 51, 100, 125	0

All (38) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	64	ALA	7.5
2	B	277	PRO	6.1
2	B	164	VAL	5.1
1	A	265	GLU	4.8
1	A	224	PHE	4.5
1	A	207	HIS	4.1
1	A	206	SER	3.9
1	A	223	THR	3.7
1	A	266	SER	3.7
1	A	209	PRO	3.4
2	B	317	ALA	3.2
2	B	203	LEU	3.1
2	B	384	LYS	3.0
2	B	279	ILE	3.0
2	B	381	VAL	3.0
2	B	320	SER	2.9
1	A	222	ASP	2.9
2	B	209	LEU	2.6
2	B	278	GLN	2.5
2	B	318	PHE	2.5
2	B	239	THR	2.4
2	B	312	ALA	2.4
2	B	321	SER	2.4
1	A	65	GLY	2.4

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Mol	Chain	Res	Type	RSRZ
2	B	227	ASN	2.3
1	A	221	LYS	2.3
2	B	285	VAL	2.3
1	A	204	PRO	2.3
1	A	246	TYR	2.3
1	A	202	GLY	2.2
1	A	230	HIS	2.2
2	B	315	ASP	2.1
1	A	219	SER	2.1
1	A	225	HIS	2.1
2	B	165	THR	2.0
1	A	226	SER	2.0
2	B	298	HIS	2.0
2	B	201	GLU	2.0

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

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

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

There are no ligands in this entry.

6.5 Other polymers ⓘ

There are no such residues in this entry.