



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 14, 2026 – 06:12 PM UTC

PDB ID : 3U8C / pdb_00003u8c
Title : Crystal structure of monomeric reversibly photoswitchable red fluorescent protein rsTagRFP in the ON state
Authors : Pletnev, S.
Deposited on : 2011-10-16
Resolution : 2.19 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	:	4-5-2 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

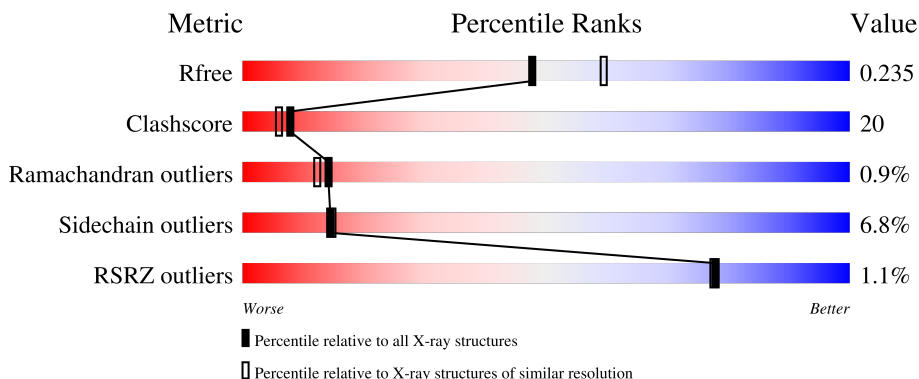
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.19 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	8975 (2.20-2.16)
Clashscore	190562	9786 (2.20-2.16)
Ramachandran outliers	187476	9664 (2.20-2.16)
Sidechain outliers	187428	9664 (2.20-2.16)
RSRZ outliers	180081	8979 (2.20-2.16)

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	243	2% 62% 27% • 8%
1	B	243	63% 24% 5% 8%
1	C	243	60% 26% • • 8%
1	D	243	% 60% 28% 5% 8%

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

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
1	NRQ	B	63[B]	-	-	X	-

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 7816 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 Fluorescent protein rsTagRFP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	224	Total	C	N	O	S	0	3	0
			1821	1157	309	341	14			
1	B	224	Total	C	N	O	S	0	3	0
			1821	1157	309	341	14			
1	C	224	Total	C	N	O	S	0	3	0
			1821	1157	309	341	14			
1	D	224	Total	C	N	O	S	0	3	0
			1821	1157	309	341	14			

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		

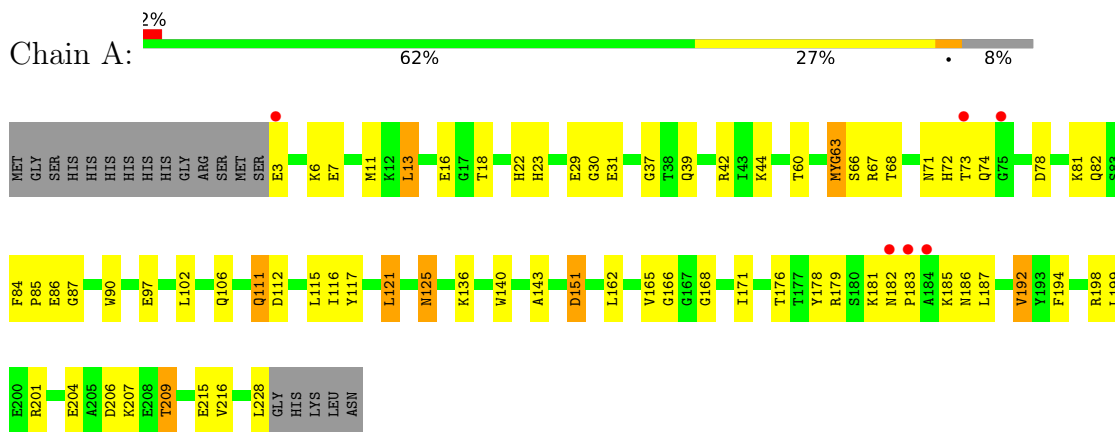
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	143	Total 143	O 143	0	0
3	B	119	Total 119	O 119	0	0
3	C	151	Total 151	O 151	0	0
3	D	113	Total 113	O 113	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: Fluorescent protein rsTagRFP



K227
L228
GLY
HIS
LYS
LEU
ASN

● Molecule 1: Fluorescent protein rsTagRFP



MET	GLY	SER	HIS	HIS	HIS	HIS	HIS	HIS	GLY	ARG	SER	MET	SER	E3	L4	N8	M11	K12	L13	E16	G17	T18	H23	K33	G37	T38	Q39	T40	M41	L51	MYG83	S66	R67	T73	Q74	D78	Q82	S83	F84	P85	E86	G87	F88	V93	E97
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V101	T105	Q106	D107	T108	Q111	L115	I116	Y117	N118	L121	R122	F126	P127	S128	N129	G130	P131	Q134	K135	K136	E141	E145	M146	L147	Y148	P149	A150	D151	V165	I171	C172	T176	T177	Y178	R179	S180	K181	M182	P183	A184	K185	N186	L187	K188	M189	F194
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L199	I202	K203	E204	K207	E208	T209	Y210	V211	E212	E215	V216	L228	GLY	HIS	LYS	LEU	ASN
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	49.56Å 69.34Å 73.70Å 78.69° 83.60° 71.97°	Depositor
Resolution (Å)	26.89 – 2.19 26.89 – 2.19	Depositor EDS
% Data completeness (in resolution range)	97.3 (26.89-2.19) 97.3 (26.89-2.19)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.89 (at 2.20Å)	Xtriage
Refinement program	PHENIX 1.6.4_486	Depositor
R, R_{free}	0.160 , 0.244 0.161 , 0.235	Depositor DCC
R_{free} test set	1434 reflections (3.12%)	wwPDB-VP
Wilson B-factor (Å ²)	36.3	Xtriage
Anisotropy	0.315	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 67.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	7816	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.31% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, NRQ

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	1.07	0/1816	1.16	7/2451 (0.3%)
1	B	0.97	0/1816	1.12	11/2451 (0.4%)
1	C	1.04	2/1816 (0.1%)	1.17	4/2451 (0.2%)
1	D	0.94	1/1816 (0.1%)	1.08	2/2451 (0.1%)
All	All	1.01	3/7264 (0.0%)	1.13	24/9804 (0.2%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	76	ILE	N-CA	-5.61	1.41	1.46
1	C	33	LYS	C-O	-5.60	1.18	1.24
1	D	66	SER	N-CA	-5.53	1.35	1.46

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	183	PRO	N-CA-C	-6.83	98.40	112.47
1	A	168	GLY	N-CA-C	-6.43	105.48	112.04
1	A	121	LEU	N-CA-C	6.10	118.34	109.07
1	C	121	LEU	N-CA-C	5.99	118.18	109.07
1	B	189	MET	CA-C-N	5.97	126.80	120.11

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	1821	0	1763	54	1
1	B	1821	0	1763	71	0
1	C	1821	0	1763	88	0
1	D	1821	0	1762	81	0
2	A	6	0	8	0	0
3	A	143	0	0	6	0
3	B	119	0	0	7	0
3	C	151	0	0	9	1
3	D	113	0	0	6	0
All	All	7816	0	7059	284	1

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 20.

The worst 5 of 284 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:106:GLN:HG2	3:B:416:HOH:O	1.48	1.13
1:C:181:LYS:C	1:C:183:PRO:HD3	1.75	1.10
1:D:86:GLU:O	1:D:181:LYS:HE3	1.52	1.06
1:C:190:PRO:HD3	3:C:415:HOH:O	1.53	1.06
1:C:41:MET:HG3	1:C:63[B]:NRQ:CE	1.86	1.04

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:72:HIS:O	3:C:500:HOH:O[1_554]	2.19	0.01

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	221/243 (91%)	211 (96%)	8 (4%)	2 (1%)	14	12
1	B	221/243 (91%)	212 (96%)	7 (3%)	2 (1%)	14	12
1	C	221/243 (91%)	203 (92%)	13 (6%)	5 (2%)	5	2
1	D	221/243 (91%)	213 (96%)	5 (2%)	3 (1%)	9	6
All	All	884/972 (91%)	839 (95%)	33 (4%)	12 (1%)	14	6

5 of 12 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	151[A]	ASP
1	C	151[B]	ASP
1	C	182	ASN
1	B	151[A]	ASP
1	B	151[B]	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	191/206 (93%)	180 (94%)	11 (6%)	18	20
1	B	191/206 (93%)	180 (94%)	11 (6%)	18	20
1	C	191/206 (93%)	174 (91%)	17 (9%)	9	8
1	D	191/206 (93%)	176 (92%)	15 (8%)	11	11
All	All	764/824 (93%)	710 (93%)	54 (7%)	14	14

5 of 54 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	111	GLN
1	C	186	ASN
1	D	188	LYS
1	C	147	LEU

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Mol	Chain	Res	Type
1	C	181	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	82	GLN
1	D	129	ASN
1	C	111	GLN
1	D	134	GLN
1	B	74	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

8 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	NRQ	A	63[A]	1	24,24,25	1.31	3 (12%)	24,32,34	1.90	5 (20%)
1	NRQ	C	63[B]	1	24,24,25	1.38	4 (16%)	24,32,34	1.49	5 (20%)
1	NRQ	B	63[B]	1	24,24,25	1.67	4 (16%)	24,32,34	1.31	4 (16%)
1	NRQ	C	63[A]	1	24,24,25	1.10	3 (12%)	24,32,34	1.70	6 (25%)
1	NRQ	D	63[B]	1	24,24,25	1.08	0	24,32,34	1.27	4 (16%)
1	NRQ	B	63[A]	1	24,24,25	1.20	2 (8%)	24,32,34	2.14	4 (16%)
1	NRQ	D	63[A]	1	24,24,25	1.08	2 (8%)	24,32,34	2.27	5 (20%)
1	NRQ	A	63[B]	1	24,24,25	1.23	2 (8%)	24,32,34	1.29	3 (12%)

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	NRQ	A	63[A]	1	-	5/9/31/32	0/2/2/2
1	NRQ	C	63[B]	1	-	3/9/31/32	0/2/2/2
1	NRQ	B	63[B]	1	-	2/9/31/32	0/2/2/2
1	NRQ	C	63[A]	1	-	5/9/31/32	0/2/2/2
1	NRQ	D	63[B]	1	-	2/9/31/32	0/2/2/2
1	NRQ	B	63[A]	1	-	5/9/31/32	0/2/2/2
1	NRQ	D	63[A]	1	-	6/9/31/32	0/2/2/2
1	NRQ	A	63[B]	1	-	2/9/31/32	0/2/2/2

The worst 5 of 20 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	63[B]	NRQ	CA1-N1	5.49	1.39	1.27
1	C	63[B]	NRQ	C1-CA1	-3.94	1.42	1.48
1	A	63[A]	NRQ	CA1-N1	3.55	1.35	1.27
1	B	63[B]	NRQ	C1-CA1	-3.36	1.43	1.48
1	A	63[B]	NRQ	C1-CA1	3.36	1.52	1.48

The worst 5 of 36 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	63[A]	NRQ	CB2-CA2-C2	5.80	129.39	122.36
1	D	63[A]	NRQ	CG2-CB2-CA2	5.66	136.60	129.87
1	B	63[A]	NRQ	O2-C2-CA2	5.58	134.58	131.02
1	B	63[A]	NRQ	CB2-CA2-C2	5.11	128.55	122.36
1	A	63[A]	NRQ	CB2-CA2-C2	4.49	127.80	122.36

There are no chirality outliers.

5 of 30 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	63[A]	NRQ	C3-CA3-N3-C1
1	B	63[A]	NRQ	C1-CA1-CB1-CG1
1	B	63[B]	NRQ	C1-CA1-CB1-CG1
1	C	63[A]	NRQ	C3-CA3-N3-C1
1	C	63[A]	NRQ	C3-CA3-N3-C2

There are no ring outliers.

8 monomers are involved in 38 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	63[A]	NRQ	4	0
1	C	63[B]	NRQ	6	0
1	B	63[B]	NRQ	11	0
1	C	63[A]	NRQ	3	0
1	D	63[B]	NRQ	4	0
1	B	63[A]	NRQ	3	0
1	D	63[A]	NRQ	4	0
1	A	63[B]	NRQ	3	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides 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	GOL	A	234	-	5,5,5	0.34	0	5,5,5	0.79	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
2	GOL	A	234	-	-	0/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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	223/243 (91%)	-0.45	6 (2%) 56 55	21, 40, 77, 138	2 (0%)
1	B	223/243 (91%)	-0.46	0 100 100	22, 44, 73, 109	2 (0%)
1	C	223/243 (91%)	-0.38	1 (0%) 88 88	21, 42, 77, 126	2 (0%)
1	D	223/243 (91%)	-0.39	3 (1%) 75 75	23, 46, 80, 146	2 (0%)
All	All	892/972 (91%)	-0.42	10 (1%) 78 77	21, 44, 77, 146	8 (0%)

The worst 5 of 10 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	73	THR	3.5
1	D	187	LEU	2.6
1	A	184	ALA	2.5
1	A	3	GLU	2.3
1	A	183	PRO	2.3

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	NRQ	A	63[A]	23/24	0.86	0.10	31,37,44,62	23
1	NRQ	A	63[B]	23/24	0.86	0.10	23,38,45,63	23
1	NRQ	D	63[A]	23/24	0.86	0.13	39,43,56,69	23
1	NRQ	D	63[B]	23/24	0.86	0.13	32,43,55,66	23
1	NRQ	C	63[A]	23/24	0.90	0.12	39,44,52,59	23
1	NRQ	C	63[B]	23/24	0.90	0.12	32,42,50,57	23
1	NRQ	B	63[A]	23/24	0.91	0.11	31,39,49,69	23

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
1	NRQ	B	63[B]	23/24	0.91	0.11	29,36,45,64	23

6.3 Carbohydrates [i](#)

There are no oligosaccharides 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($\text{\AA}^2$)	Q<0.9
2	GOL	A	234	6/6	0.89	0.10	36,54,58,62	0

6.5 Other polymers [i](#)

There are no such residues in this entry.