



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 5, 2026 – 02:03 PM UTC

PDB ID : 22ZV / pdb_000022zv
Title : norovirus GII23 P domain
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Deposited on : 2026-01-29
Resolution : 2.00 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
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

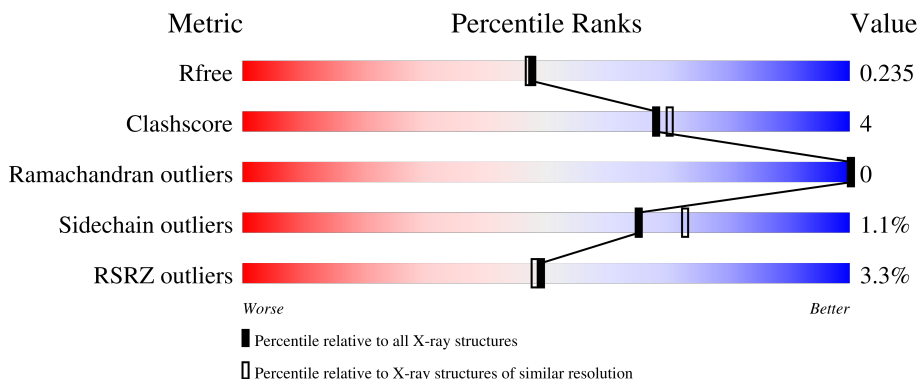
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	311	<div> <div>2%</div> <div> <div></div> <div>92%</div> <div>8%</div> </div> </div>
1	B	311	<div> <div>6%</div> <div> <div></div> <div>92%</div> <div>8%</div> </div> </div>
1	C	311	<div> <div>2%</div> <div> <div></div> <div>91%</div> <div>9%</div> </div> </div>
1	D	311	<div> <div>4%</div> <div> <div></div> <div>90%</div> <div>9%</div> </div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 10606 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 Major capsid protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	310	Total	C	N	O	S	0	0	0
			2430	1547	410	464	9			
1	B	311	Total	C	N	O	S	0	1	0
			2442	1554	412	466	10			
1	C	310	Total	C	N	O	S	0	2	0
			2445	1557	412	467	9			
1	D	311	Total	C	N	O	S	0	2	0
			2451	1560	414	468	9			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	223	GLY	-	expression tag	UNP A0A0F6VXX1
A	224	SER	-	expression tag	UNP A0A0F6VXX1
B	223	GLY	-	expression tag	UNP A0A0F6VXX1
B	224	SER	-	expression tag	UNP A0A0F6VXX1
C	223	GLY	-	expression tag	UNP A0A0F6VXX1
C	224	SER	-	expression tag	UNP A0A0F6VXX1
D	223	GLY	-	expression tag	UNP A0A0F6VXX1
D	224	SER	-	expression tag	UNP A0A0F6VXX1

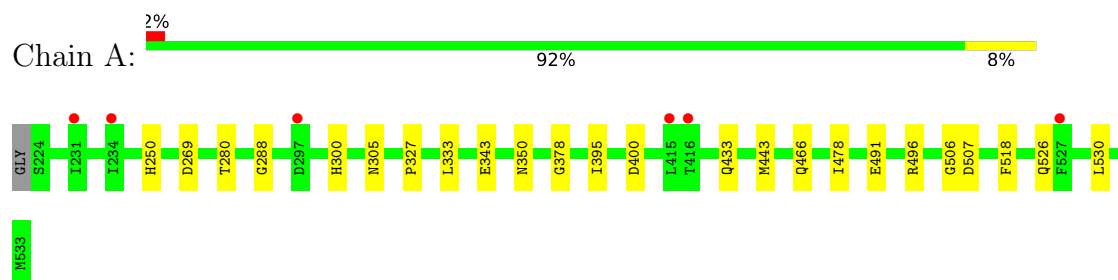
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	221	Total	O	0	0
			221	221		
2	B	197	Total	O	0	0
			197	197		
2	C	207	Total	O	0	0
			207	207		
2	D	213	Total	O	0	0
			213	213		

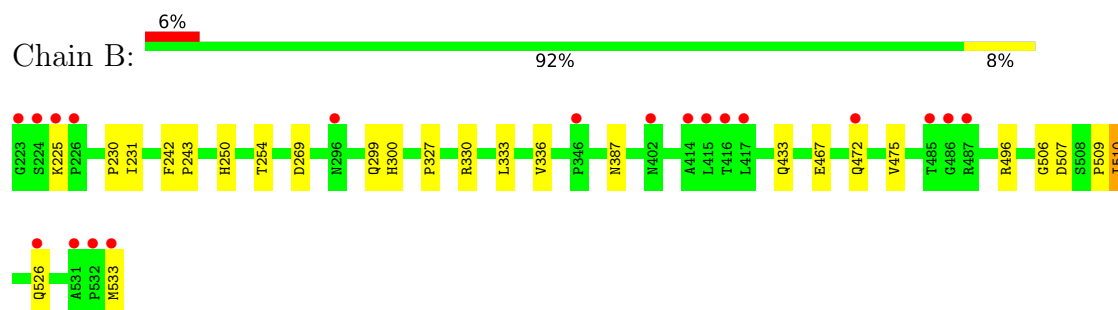
3 Residue-property plots [i](#)

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.

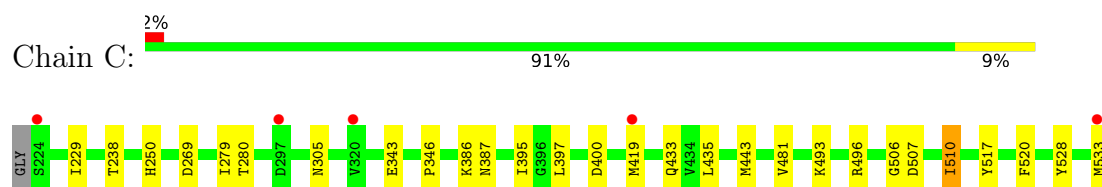
- Molecule 1: Major capsid protein



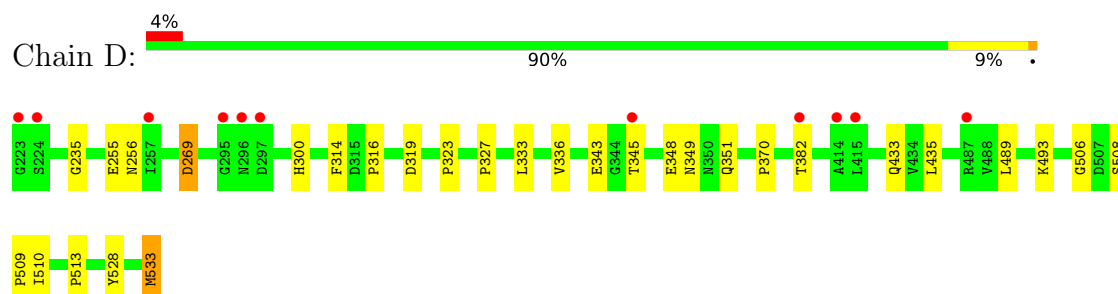
- Molecule 1: Major capsid protein



- Molecule 1: Major capsid protein



- Molecule 1: Major capsid protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	60.83Å 107.31Å 220.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.76 – 2.00 47.76 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.9 (47.76-2.00) 99.9 (47.76-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.91 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.8.0415	Depositor
R, R_{free}	0.182 , 0.228 0.191 , 0.235	Depositor DCC
R_{free} test set	4880 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	23.7	Xtriage
Anisotropy	0.113	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 38.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10606	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.96% 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	0.60	0/2503	0.97	0/3417
1	B	0.60	0/2515	0.98	0/3432
1	C	0.62	0/2518	0.96	0/3438
1	D	0.61	0/2524	0.94	1/3446 (0.0%)
All	All	0.61	0/10060	0.96	1/13733 (0.0%)

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	B	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	269	ASP	CA-CB-CG	5.39	117.99	112.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	330	ARG	Sidechain

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	2430	0	2334	14	0
1	B	2442	0	2345	20	0
1	C	2445	0	2350	19	0
1	D	2451	0	2355	21	1
2	A	221	0	0	2	0
2	B	197	0	0	7	0
2	C	207	0	0	6	0
2	D	213	0	0	3	0
All	All	10606	0	9384	68	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 4.

All (68) 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:472:GLN:HG3	2:B:766:HOH:O	1.67	0.94
1:D:510:ILE:HD13	1:D:533:MET:HE1	1.56	0.86
1:B:299:GLN:HG3	2:B:759:HOH:O	1.76	0.84
1:D:345:THR:HG22	1:D:348:GLU:HG3	1.61	0.79
1:A:466:GLN:HE22	1:B:230:PRO:HB3	1.50	0.75
1:D:255:GLU:HB2	2:D:768:HOH:O	1.90	0.71
1:A:395:ILE:CD1	1:B:336:VAL:HG21	2.20	0.71
1:B:250:HIS:HE1	1:B:507:ASP:OD2	1.77	0.67
1:B:433:GLN:HE22	1:B:506:GLY:H	1.43	0.65
1:D:510:ILE:CD1	1:D:533:MET:HE1	2.27	0.64
1:C:238[B]:THR:HG21	2:D:734:HOH:O	1.97	0.64
1:C:395:ILE:CD1	1:D:336:VAL:HG21	2.30	0.62
1:D:433:GLN:HE22	1:D:506:GLY:H	1.47	0.62
1:C:305:ASN:ND2	2:C:601:HOH:O	2.34	0.59
1:B:510:ILE:N	1:B:510:ILE:HD12	2.17	0.59
1:C:481:VAL:CG2	1:C:517:TYR:CE2	2.89	0.56
1:C:433:GLN:HE22	1:C:506:GLY:H	1.53	0.56
1:D:435[A]:LEU:CD1	1:D:510:ILE:HD12	2.35	0.56
1:C:496:ARG:HD3	2:C:787:HOH:O	2.05	0.55
1:A:395:ILE:HD13	1:B:336:VAL:HG21	1.88	0.55
1:A:526:GLN:HG2	2:A:675:HOH:O	2.06	0.55
1:D:345:THR:HG22	1:D:348:GLU:CG	2.36	0.55
1:B:475:VAL:HG21	1:B:526:GLN:HA	1.90	0.54
1:C:435[B]:LEU:C	1:C:435[B]:LEU:HD23	2.33	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:510:ILE:HG23	1:C:533:MET:HE1	1.90	0.53
1:B:242:PHE:CD2	1:B:243:PRO:HD2	2.44	0.53
1:D:349:ASN:HB3	1:D:351:GLN:HE21	1.73	0.53
1:A:327:PRO:HG3	1:A:333:LEU:HD22	1.91	0.52
1:B:387:ASN:ND2	2:B:606:HOH:O	2.42	0.52
1:C:280:THR:HG21	2:D:734:HOH:O	2.10	0.52
1:B:300:HIS:CE1	2:B:622:HOH:O	2.63	0.52
1:B:300:HIS:HE1	2:B:622:HOH:O	1.92	0.51
1:C:229:ILE:HD12	1:C:520:PHE:HB2	1.93	0.51
1:B:231:ILE:HG13	1:B:231:ILE:O	2.11	0.51
1:C:250:HIS:HE1	1:C:507:ASP:OD2	1.95	0.50
1:C:387:ASN:ND2	2:C:607:HOH:O	2.43	0.50
1:A:250:HIS:HE1	1:A:507:ASP:OD2	1.96	0.49
1:C:419:MET:HB3	2:C:677:HOH:O	2.13	0.48
1:D:345:THR:CG2	1:D:348:GLU:HG3	2.38	0.48
1:A:496:ARG:HD3	2:A:656:HOH:O	2.13	0.48
1:C:279:ILE:HD11	1:D:235:GLY:O	2.13	0.48
1:A:433:GLN:HE22	1:A:506:GLY:H	1.62	0.47
1:C:493:LYS:HE3	1:C:528:TYR:O	2.15	0.47
1:D:489:LEU:CD1	1:D:513:PRO:CD	2.93	0.47
1:B:225:LYS:HE2	1:B:467:GLU:O	2.16	0.46
1:A:478:ILE:HD12	1:A:518:PHE:CD1	2.50	0.46
1:D:256:ASN:OD1	1:D:256:ASN:N	2.48	0.46
1:D:435[A]:LEU:HD13	1:D:510:ILE:HD12	1.97	0.46
1:B:496:ARG:HD3	2:B:643:HOH:O	2.18	0.44
1:A:491:GLU:HG3	1:A:530:LEU:HD22	2.00	0.44
1:B:327:PRO:HG3	1:B:333:LEU:HD22	2.00	0.43
1:C:400:ASP:HB2	1:C:443:MET:SD	2.58	0.43
1:D:314:PHE:O	1:D:316:PRO:HD3	2.18	0.43
1:A:400:ASP:HB2	1:A:443:MET:SD	2.58	0.43
1:B:254:THR:HG23	2:B:667:HOH:O	2.17	0.43
1:D:435[B]:LEU:C	1:D:435[B]:LEU:HD23	2.45	0.42
1:B:509:PRO:C	1:B:510:ILE:HD12	2.44	0.42
1:C:397:LEU:O	1:C:443:MET:HA	2.20	0.42
1:D:323:PRO:HD2	1:D:370:PRO:HB2	2.02	0.42
1:A:288:GLY:HA3	1:A:305:ASN:O	2.20	0.41
1:D:327:PRO:HG3	1:D:333:LEU:HD22	2.02	0.41
1:C:386:LYS:HG3	2:C:772:HOH:O	2.20	0.41
1:A:395:ILE:CD1	1:B:336:VAL:CG2	2.95	0.41
1:D:300:HIS:CE1	1:D:382:THR:CG2	3.03	0.41
1:D:493:LYS:HE3	1:D:528:TYR:O	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:300:HIS:O	1:A:378:GLY:HA2	2.22	0.40
1:C:346:PRO:HD2	2:C:760:HOH:O	2.22	0.40
1:D:508:SER:HB2	1:D:509:PRO:HD2	2.04	0.40

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:D:319:ASP:OD2	1:D:343:GLU:OE2[4_545]	2.12	0.08

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	308/311 (99%)	301 (98%)	7 (2%)	0	100	100
1	B	310/311 (100%)	302 (97%)	8 (3%)	0	100	100
1	C	310/311 (100%)	302 (97%)	8 (3%)	0	100	100
1	D	311/311 (100%)	304 (98%)	7 (2%)	0	100	100
All	All	1239/1244 (100%)	1209 (98%)	30 (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	272/272 (100%)	268 (98%)	4 (2%)	57	64
1	B	273/272 (100%)	270 (99%)	3 (1%)	65	73
1	C	274/272 (101%)	271 (99%)	3 (1%)	65	73
1	D	274/272 (101%)	272 (99%)	2 (1%)	76	82
All	All	1093/1088 (100%)	1081 (99%)	12 (1%)	65	73

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	269	ASP
1	A	280	THR
1	A	343	GLU
1	A	350	ASN
1	B	269	ASP
1	B	510	ILE
1	B	533	MET
1	C	269	ASP
1	C	343	GLU
1	C	510	ILE
1	D	269	ASP
1	D	533	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (24) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	250	HIS
1	A	398	ASN
1	A	433	GLN
1	B	250	HIS
1	B	293	HIS
1	B	308	ASN
1	B	387	ASN
1	B	398	ASN
1	B	433	GLN
1	B	526	GLN
1	C	250	HIS
1	C	308	ASN
1	C	349	ASN
1	C	351	GLN
1	C	387	ASN

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Mol	Chain	Res	Type
1	C	398	ASN
1	C	433	GLN
1	D	250	HIS
1	D	293	HIS
1	D	305	ASN
1	D	308	ASN
1	D	351	GLN
1	D	398	ASN
1	D	433	GLN

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	310/311 (99%)	0.06	6 (1%) 66 66	14, 24, 48, 71	0
1	B	311/311 (100%)	0.18	19 (6%) 27 26	13, 26, 54, 88	1 (0%)
1	C	310/311 (99%)	0.00	5 (1%) 70 70	10, 24, 44, 73	2 (0%)
1	D	311/311 (100%)	0.05	11 (3%) 47 46	10, 24, 49, 85	2 (0%)
All	All	1242/1244 (99%)	0.07	41 (3%) 49 48	10, 24, 49, 88	5 (0%)

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	223	GLY	4.3
1	B	531	ALA	4.3
1	B	415	LEU	4.2
1	A	415	LEU	4.2
1	D	223	GLY	3.5
1	B	224	SER	3.2
1	D	415	LEU	3.2
1	B	532	PRO	3.2
1	B	487	ARG	3.0
1	D	295	GLY	3.0
1	A	527	PHE	2.9
1	C	224	SER	2.9
1	B	533	MET	2.9
1	C	320	VAL	2.8
1	B	472	GLN	2.7
1	A	297	ASP	2.7
1	B	414	ALA	2.6
1	D	414	ALA	2.6
1	B	486	GLY	2.5
1	D	224	SER	2.5
1	B	416	THR	2.5

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Mol	Chain	Res	Type	RSRZ
1	D	257	ILE	2.5
1	B	526	GLN	2.4
1	C	297	ASP	2.4
1	D	382	THR	2.4
1	B	225	LYS	2.4
1	B	346	PRO	2.4
1	C	419	MET	2.3
1	A	234	ILE	2.3
1	D	487	ARG	2.3
1	C	533	MET	2.3
1	D	297	ASP	2.2
1	B	296	ASN	2.2
1	B	402	ASN	2.2
1	D	345	THR	2.2
1	A	231	ILE	2.1
1	D	296	ASN	2.1
1	A	416	THR	2.1
1	B	417	LEU	2.0
1	B	226	PRO	2.0
1	B	485	THR	2.0

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 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.