



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 09:31 PM UTC

PDB ID : 9HVA / pdb_00009hva
Title : Crystal structure of Fab34 complexed with a 18-mer peptide of FMDV VP1
Authors : Ren, J.; Duyvesteyn, H.M.E.; Stuart, D.I.
Deposited on : 2024-12-25
Resolution : 3.89 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
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

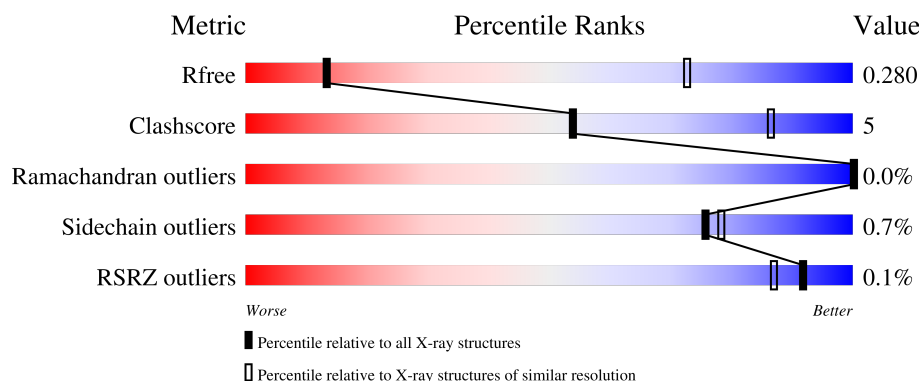
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION






The reported resolution of this entry is 3.89 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	1270 (4.10-3.70)
Clashscore	190562	1034 (4.08-3.72)
Ramachandran outliers	187476	1251 (4.10-3.70)
Sidechain outliers	187428	1243 (4.10-3.70)
RSRZ outliers	180081	1269 (4.10-3.70)

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	B	238	 80% 12% 7%
1	E	238	 84% 9% 7%
1	H	238	 79% 14% 7%
1	I	238	 80% 13% 7%
1	M	238	 80% 13% 7%

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Mol	Chain	Length	Quality of chain
1	P	238	% 
2	C	213	
2	F	213	
2	J	213	
2	L	213	
2	N	213	
2	Q	213	
3	A	18	
3	D	18	
3	G	18	
3	K	18	
3	O	18	
3	R	18	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 19818 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 heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	222	Total	C	N	O	S	0	1	0
			1627	1011	272	332	12			
1	B	221	Total	C	N	O	S	0	1	0
			1621	1008	271	330	12			
1	E	222	Total	C	N	O	S	0	1	0
			1627	1011	272	332	12			
1	I	222	Total	C	N	O	S	0	1	0
			1627	1011	272	332	12			
1	M	222	Total	C	N	O	S	0	1	0
			1627	1011	272	332	12			
1	P	222	Total	C	N	O	S	0	1	0
			1627	1011	272	332	12			

- Molecule 2 is a protein called light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			
2	C	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			
2	F	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			
2	J	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			
2	N	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			
2	Q	211	Total	C	N	O	S	0	0	0
			1588	984	265	334	5			

- Molecule 3 is a protein called Capsid protein VP1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	A	11	Total	C	N	O	0	0	0
			89	58	18	13			
3	D	11	Total	C	N	O	0	0	0
			89	58	18	13			
3	G	11	Total	C	N	O	0	0	0
			89	58	18	13			
3	K	11	Total	C	N	O	0	0	0
			89	58	18	13			
3	O	11	Total	C	N	O	0	0	0
			89	58	18	13			
3	R	11	Total	C	N	O	0	0	0
			89	58	18	13			

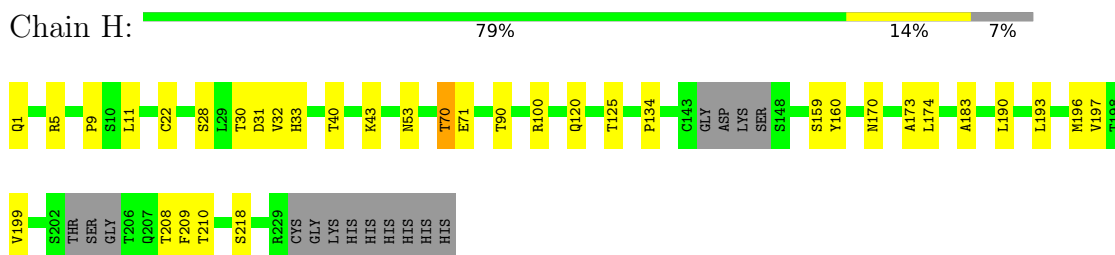
There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	197	ASP	THR	conflict	UNP P03305
A	198	GLN	GLU	conflict	UNP P03305
D	197	ASP	THR	conflict	UNP P03305
D	198	GLN	GLU	conflict	UNP P03305
G	197	ASP	THR	conflict	UNP P03305
G	198	GLN	GLU	conflict	UNP P03305
K	197	ASP	THR	conflict	UNP P03305
K	198	GLN	GLU	conflict	UNP P03305
O	197	ASP	THR	conflict	UNP P03305
O	198	GLN	GLU	conflict	UNP P03305
R	197	ASP	THR	conflict	UNP P03305
R	198	GLN	GLU	conflict	UNP P03305

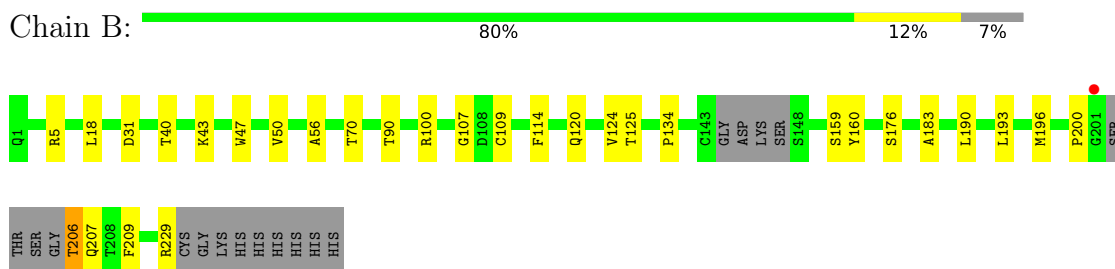
3 Residue-property plots [i](#)

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.

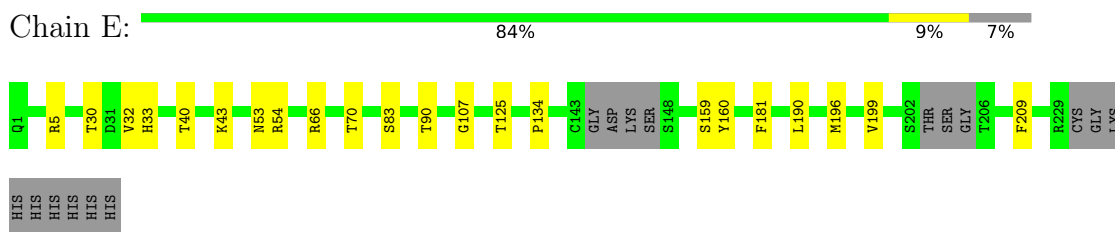
- Molecule 1: heavy chain



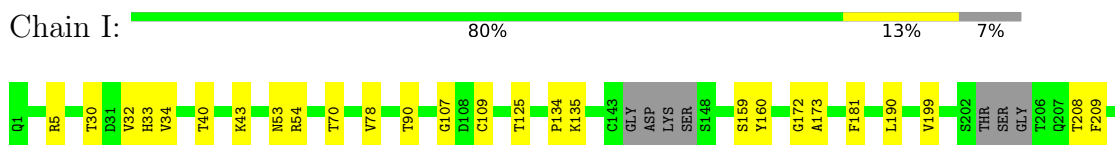
- Molecule 1: heavy chain

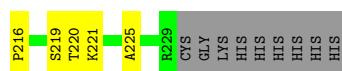


- Molecule 1: heavy chain



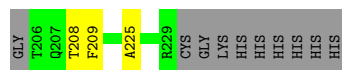
- Molecule 1: heavy chain





- Molecule 1: heavy chain

Chain M: 80% 13% 7%



- Molecule 1: heavy chain

Chain P: % 76% 18% 7%



- Molecule 2: light chain

Chain L: 87% 12% .



- Molecule 2: light chain

Chain C: 89% 9% .



- Molecule 2: light chain

Chain F: 91% 8% .



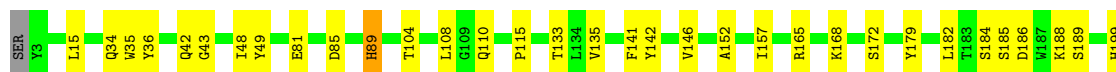
- Molecule 2: light chain

Chain J: 91% 8% .



- Molecule 2: light chain

Chain N: 83% 15% .



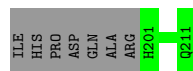
- Molecule 2: light chain

Chain Q: 89% 10% .



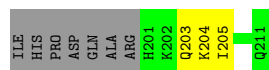
- Molecule 3: Capsid protein VP1

Chain A: 61% 39%



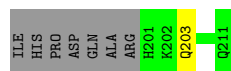
- Molecule 3: Capsid protein VP1

Chain D: 44% 17% 39%



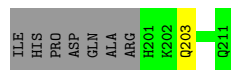
- Molecule 3: Capsid protein VP1

Chain G: 56% 6% 39%

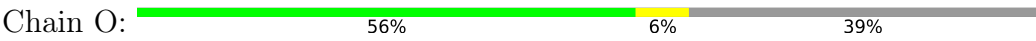


- Molecule 3: Capsid protein VP1

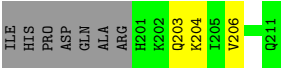
Chain K: 56% 6% 39%



- Molecule 3: Capsid protein VP1



● Molecule 3: Capsid protein VP1



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	302.54Å 111.91Å 140.57Å 90.00° 115.99° 90.00°	Depositor
Resolution (Å)	75.17 – 3.89 75.17 – 3.89	Depositor EDS
% Data completeness (in resolution range)	99.5 (75.17-3.89) 99.6 (75.17-3.89)	Depositor EDS
R_{merge}	0.39	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.07 (at 3.89Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.233 , 0.279 0.233 , 0.280	Depositor DCC
R_{free} test set	2006 reflections (5.16%)	wwPDB-VP
Wilson B-factor (Å ²)	145.7	Xtriage
Anisotropy	0.304	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 175.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.35$, $\langle L^2 \rangle = 0.18$	Xtriage
Estimated twinning fraction	0.189 for -h-2*k,-k,l	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	19818	wwPDB-VP
Average B, all atoms (Å ²)	188.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.89% 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	B	0.11	0/1656	0.33	0/2263
1	E	0.10	0/1662	0.31	0/2271
1	H	0.12	0/1662	0.34	0/2271
1	I	0.10	0/1662	0.31	0/2271
1	M	0.14	0/1662	0.37	0/2271
1	P	0.12	0/1662	0.33	0/2271
2	C	0.10	0/1623	0.28	0/2210
2	F	0.08	0/1623	0.27	0/2210
2	J	0.09	0/1623	0.29	0/2210
2	L	0.14	0/1623	0.37	0/2210
2	N	0.13	0/1623	0.36	0/2210
2	Q	0.11	0/1623	0.28	0/2210
3	A	0.10	0/90	0.25	0/119
3	D	0.22	0/90	0.57	0/119
3	G	0.12	0/90	0.38	0/119
3	K	0.11	0/90	0.39	0/119
3	O	0.15	0/90	0.46	0/119
3	R	0.24	0/90	0.58	0/119
All	All	0.11	0/20244	0.32	0/27592

There are no bond length outliers.

There are no bond angle outliers.

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	B	1621	0	1583	24	0
1	E	1627	0	1588	15	1
1	H	1627	0	1589	30	0
1	I	1627	0	1588	25	0
1	M	1627	0	1589	21	1
1	P	1627	0	1588	31	0
2	C	1588	0	1526	13	0
2	F	1588	0	1526	11	0
2	J	1588	0	1526	10	0
2	L	1588	0	1527	16	2
2	N	1588	0	1527	23	2
2	Q	1588	0	1526	14	0
3	A	89	0	102	0	0
3	D	89	0	102	4	0
3	G	89	0	102	2	0
3	K	89	0	102	2	0
3	O	89	0	102	2	0
3	R	89	0	102	4	0
All	All	19818	0	19295	192	3

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.

The worst 5 of 192 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)
2:L:81:GLU:HG2	1:P:200:PRO:HG2	1.48	0.94
1:B:120:GLN:NE2	1:M:208:THR:O	2.09	0.85
2:L:182:LEU:HB3	2:L:186:ASP:HB2	1.64	0.80
2:C:41:GLY:O	1:M:173:ALA:HB1	1.82	0.79
1:H:53:ASN:O	1:I:5:ARG:NH1	2.20	0.74

All (3) 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)
2:L:189:SER:OG	2:N:184:SER:O[1_565]	2.02	0.18
1:E:5:ARG:NH1	1:M:53:ASN:O[4_555]	2.16	0.04
2:L:186:ASP:O	2:N:185:SER:OG[1_565]	2.19	0.01

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	B	216/238 (91%)	205 (95%)	11 (5%)	0	100	100
1	E	217/238 (91%)	206 (95%)	11 (5%)	0	100	100
1	H	217/238 (91%)	207 (95%)	10 (5%)	0	100	100
1	I	217/238 (91%)	206 (95%)	11 (5%)	0	100	100
1	M	217/238 (91%)	207 (95%)	10 (5%)	0	100	100
1	P	217/238 (91%)	205 (94%)	11 (5%)	1 (0%)	24	59
2	C	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
2	F	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
2	J	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
2	L	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
2	N	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
2	Q	209/213 (98%)	206 (99%)	3 (1%)	0	100	100
3	A	9/18 (50%)	8 (89%)	1 (11%)	0	100	100
3	D	9/18 (50%)	7 (78%)	2 (22%)	0	100	100
3	G	9/18 (50%)	8 (89%)	1 (11%)	0	100	100
3	K	9/18 (50%)	7 (78%)	2 (22%)	0	100	100
3	O	9/18 (50%)	8 (89%)	1 (11%)	0	100	100
3	R	9/18 (50%)	7 (78%)	2 (22%)	0	100	100
All	All	2609/2814 (93%)	2517 (96%)	91 (4%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	P	100	ARG

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	B	191/204 (94%)	188 (98%)	3 (2%)	55	69
1	E	192/204 (94%)	190 (99%)	2 (1%)	68	75
1	H	192/204 (94%)	190 (99%)	2 (1%)	68	75
1	I	192/204 (94%)	190 (99%)	2 (1%)	68	75
1	M	192/204 (94%)	189 (98%)	3 (2%)	55	69
1	P	192/204 (94%)	190 (99%)	2 (1%)	68	75
2	C	183/185 (99%)	182 (100%)	1 (0%)	81	82
2	F	183/185 (99%)	182 (100%)	1 (0%)	81	82
2	J	183/185 (99%)	182 (100%)	1 (0%)	81	82
2	L	183/185 (99%)	182 (100%)	1 (0%)	81	82
2	N	183/185 (99%)	181 (99%)	2 (1%)	65	74
2	Q	183/185 (99%)	182 (100%)	1 (0%)	81	82
3	A	10/16 (62%)	10 (100%)	0	100	100
3	D	10/16 (62%)	10 (100%)	0	100	100
3	G	10/16 (62%)	10 (100%)	0	100	100
3	K	10/16 (62%)	10 (100%)	0	100	100
3	O	10/16 (62%)	10 (100%)	0	100	100
3	R	10/16 (62%)	10 (100%)	0	100	100
All	All	2309/2430 (95%)	2288 (99%)	21 (1%)	76	75

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	M	70[A]	THR
2	N	189	SER
2	Q	89	HIS
1	P	70[A]	THR
2	N	89	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
2	J	95	HIS
2	N	31	GLN
1	P	3	GLN
2	F	38	GLN
2	F	95	HIS

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	B	221/238 (92%)	-0.43	1 (0%) 87 72	122, 176, 239, 295	1 (0%)
1	E	222/238 (93%)	-0.48	0 100 100	125, 182, 253, 356	1 (0%)
1	H	222/238 (93%)	-0.47	0 100 100	106, 185, 289, 338	1 (0%)
1	I	222/238 (93%)	-0.44	0 100 100	111, 170, 240, 343	1 (0%)
1	M	222/238 (93%)	-0.35	0 100 100	125, 200, 280, 389	1 (0%)
1	P	222/238 (93%)	-0.40	2 (0%) 81 62	121, 172, 260, 355	1 (0%)
2	C	211/213 (99%)	-0.61	0 100 100	121, 155, 210, 243	0
2	F	211/213 (99%)	-0.55	0 100 100	133, 177, 239, 304	0
2	J	211/213 (99%)	-0.53	0 100 100	132, 172, 221, 270	0
2	L	211/213 (99%)	-0.46	0 100 100	130, 188, 314, 454	0
2	N	211/213 (99%)	-0.30	0 100 100	149, 216, 391, 543	0
2	Q	211/213 (99%)	-0.59	0 100 100	127, 157, 212, 270	0
3	A	11/18 (61%)	-0.28	0 100 100	164, 191, 240, 274	0
3	D	11/18 (61%)	-0.39	0 100 100	196, 223, 272, 273	0
3	G	11/18 (61%)	-0.61	0 100 100	164, 193, 247, 257	0
3	K	11/18 (61%)	-0.58	0 100 100	170, 187, 265, 282	0
3	O	11/18 (61%)	-0.28	0 100 100	175, 190, 243, 270	0
3	R	11/18 (61%)	-0.47	0 100 100	197, 233, 322, 327	0
All	All	2663/2814 (94%)	-0.47	3 (0%) 92 87	106, 177, 280, 543	6 (0%)

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	P	206	THR	2.5
1	P	202	SER	2.3
1	B	201	GLY	2.2

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 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.