



wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 21, 2023 – 01:07 AM JST

PDB ID : 7E88
Title : Crystal structure of the SARS-CoV-2 S RBD in complex with BD-515 Fab
Authors : Gao, C.; Wei, Y.; Xiao, J.
Deposited on : 2021-03-01
Resolution : 3.14 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

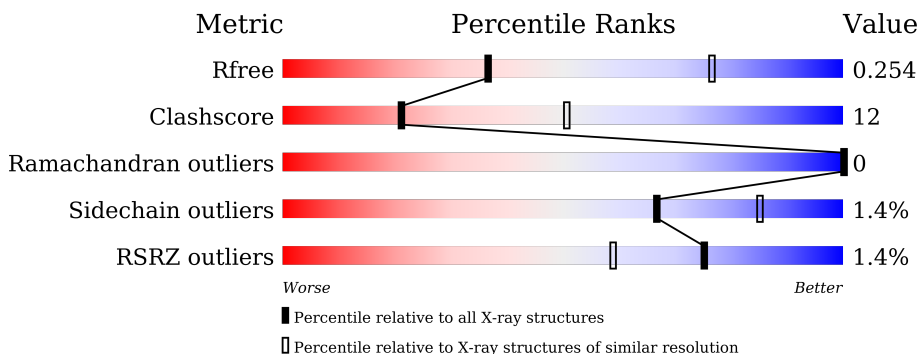
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.14 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}	130704	1626 (3.18-3.10)
Clashscore	141614	1735 (3.18-3.10)
Ramachandran outliers	138981	1677 (3.18-3.10)
Sidechain outliers	138945	1677 (3.18-3.10)
RSRZ outliers	127900	1588 (3.18-3.10)

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	221	67% (0-1 types) 29% (2-3 types) 4% (not modelled)
1	D	221	66% (0-1 types) 29% (2-3 types) 5% (not modelled)
1	G	221	67% (0-1 types) 28% (2-3 types) 5% (not modelled)
1	J	221	70% (0-1 types) 25% (2-3 types) 5% (not modelled)
2	B	214	79% (0-1 types) 21% (2-3 types) 0% (not modelled)
2	E	214	75% (0-1 types) 23% (2-3 types) 2% (not modelled)

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Mol	Chain	Length	Quality of chain
2	H	214	 80% 18% ..
2	K	214	 81% 18% .
3	C	194	 4% 68% 29% ..
3	F	194	 6% 70% 26% ..
3	I	194	 4% 68% 29% .
3	L	194	 3% 69% 28% ..

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 18863 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 BD-515 Fab Heavy Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	213	1587	999	269	313	6	0	0	0
1	D	210	1570	990	266	308	6	0	0	0
1	G	210	1570	990	266	308	6	0	0	0
1	J	210	1567	987	266	308	6	0	0	0

- Molecule 2 is a protein called BD-515 Fab Light Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	212	1646	1029	279	333	5	0	0	0
2	E	212	1646	1029	279	333	5	0	0	0
2	H	212	1646	1029	279	333	5	0	0	0
2	K	212	1646	1029	279	333	5	0	0	0

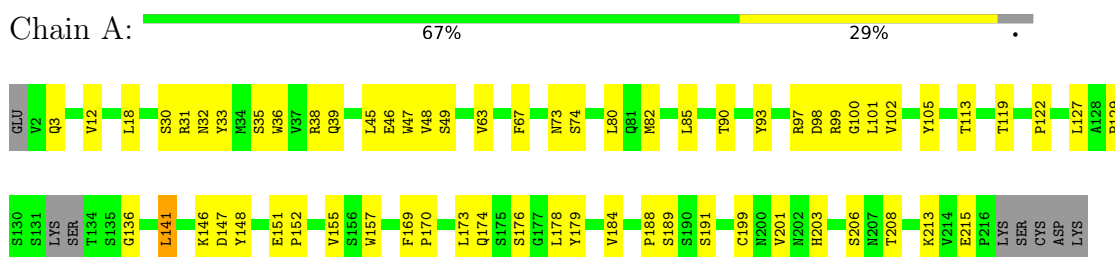
- Molecule 3 is a protein called Spike protein S1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	C	189	1498	958	249	283	8	0	0	0
3	F	188	1491	954	248	281	8	0	0	0
3	I	189	1498	958	249	283	8	0	0	0
3	L	189	1498	958	249	283	8	0	0	0

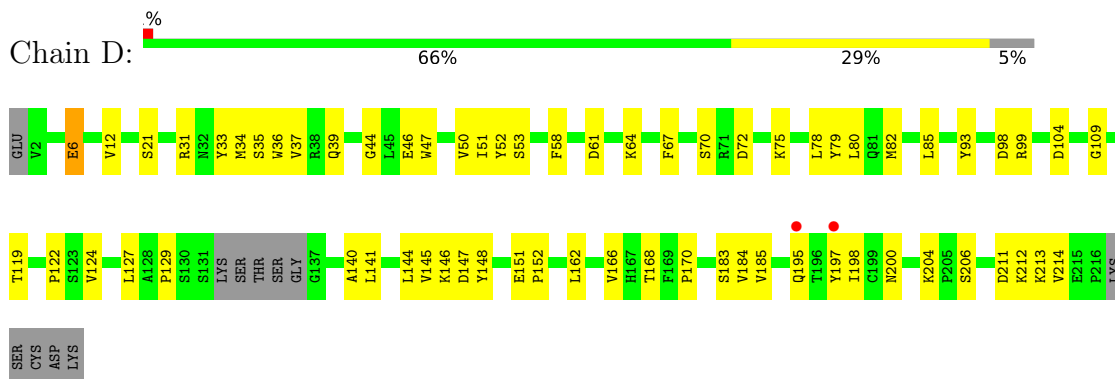
3 Residue-property plots [i](#)

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.

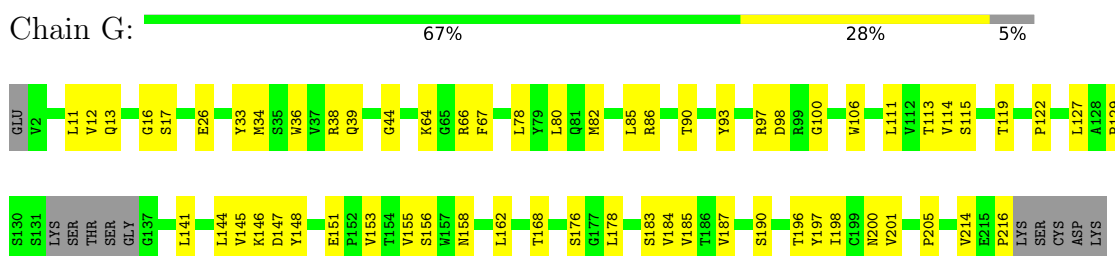
- Molecule 1: BD-515 Fab Heavy Chain



- Molecule 1: BD-515 Fab Heavy Chain

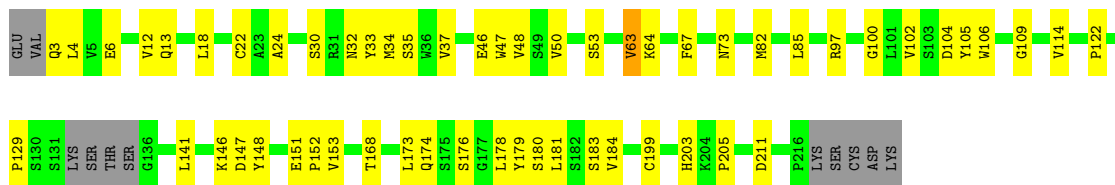


- Molecule 1: BD-515 Fab Heavy Chain



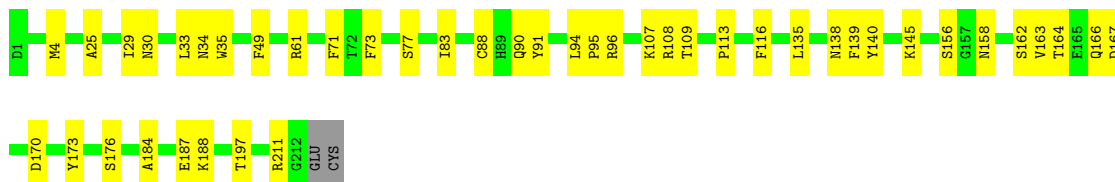
- Molecule 1: BD-515 Fab Heavy Chain





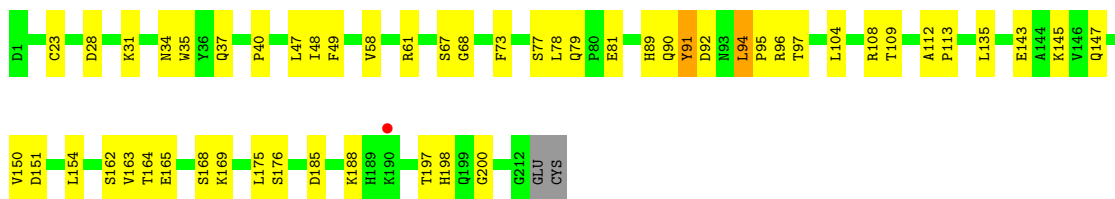
- Molecule 2: BD-515 Fab Light Chain

Chain B: 79% 21%



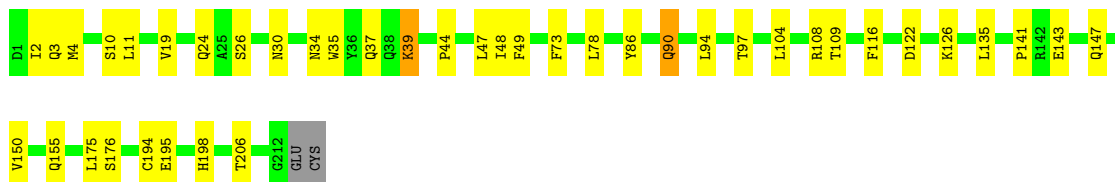
- Molecule 2: BD-515 Fab Light Chain

Chain E: 75% 23%



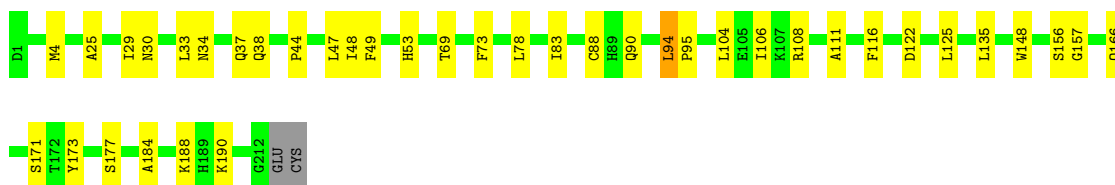
- Molecule 2: BD-515 Fab Light Chain

Chain H: 80% 18%



- Molecule 2: BD-515 Fab Light Chain

Chain K: 81% 18%



- Molecule 3: Spike protein S1

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	103.71Å 107.60Å 108.76Å 63.34° 80.95° 66.85°	Depositor
Resolution (Å)	49.43 – 3.14 49.43 – 3.14	Depositor EDS
% Data completeness (in resolution range)	96.5 (49.43-3.14) 96.5 (49.43-3.14)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.82 (at 3.12Å)	Xtrriage
Refinement program	PHENIX 1.18.2_3874	Depositor
R, R_{free}	0.217 , 0.255 0.218 , 0.254	Depositor DCC
R_{free} test set	2012 reflections (3.10%)	wwPDB-VP
Wilson B-factor (Å ²)	81.4	Xtrriage
Anisotropy	0.166	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 44.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	18863	wwPDB-VP
Average B, all atoms (Å ²)	89.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.11% 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	0.63	1/1622 (0.1%)	0.84	0/2208
1	D	0.51	0/1605	0.77	0/2185
1	G	0.61	0/1605	0.80	0/2185
1	J	0.51	0/1602	0.77	0/2180
2	B	0.57	0/1682	0.85	0/2284
2	E	0.49	0/1682	0.76	0/2284
2	H	0.58	0/1682	0.80	0/2284
2	K	0.51	0/1682	0.76	0/2284
3	C	0.60	0/1538	0.79	0/2090
3	F	0.49	0/1531	0.68	0/2080
3	I	0.55	0/1538	0.72	0/2090
3	L	0.53	1/1538 (0.1%)	0.66	0/2090
All	All	0.55	2/19307 (0.0%)	0.77	0/26244

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	127	LEU	C-N	5.89	1.47	1.34
3	L	505	TYR	C-N	-5.26	1.22	1.34

There are no bond angle outliers.

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	1587	0	1557	46	0
1	D	1570	0	1542	52	0
1	G	1570	0	1542	42	0
1	J	1567	0	1536	41	0
2	B	1646	0	1594	36	0
2	E	1646	0	1594	35	0
2	H	1646	0	1594	28	0
2	K	1646	0	1594	39	0
3	C	1498	0	1411	40	0
3	F	1491	0	1404	32	0
3	I	1498	0	1411	50	0
3	L	1498	0	1411	36	0
All	All	18863	0	18190	448	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 12.

The worst 5 of 448 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:32:ASN:HD21	1:A:97:ARG:HH21	1.28	0.78
1:G:12:VAL:HG21	1:G:85:LEU:HD13	1.66	0.78
3:I:364:ASP:HB2	3:I:388:ASN:HD22	1.50	0.77
2:E:37:GLN:HB2	2:E:47:LEU:HD11	1.65	0.77
1:D:122:PRO:HB3	1:D:148:TYR:HB3	1.65	0.77

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	209/221 (95%)	203 (97%)	6 (3%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	D	206/221 (93%)	201 (98%)	5 (2%)	0	100	100
1	G	206/221 (93%)	197 (96%)	9 (4%)	0	100	100
1	J	206/221 (93%)	200 (97%)	6 (3%)	0	100	100
2	B	210/214 (98%)	196 (93%)	14 (7%)	0	100	100
2	E	210/214 (98%)	193 (92%)	17 (8%)	0	100	100
2	H	210/214 (98%)	194 (92%)	16 (8%)	0	100	100
2	K	210/214 (98%)	195 (93%)	15 (7%)	0	100	100
3	C	185/194 (95%)	166 (90%)	19 (10%)	0	100	100
3	F	184/194 (95%)	168 (91%)	16 (9%)	0	100	100
3	I	185/194 (95%)	172 (93%)	13 (7%)	0	100	100
3	L	185/194 (95%)	168 (91%)	17 (9%)	0	100	100
All	All	2406/2516 (96%)	2253 (94%)	153 (6%)	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	179/187 (96%)	178 (99%)	1 (1%)	86	94
1	D	177/187 (95%)	176 (99%)	1 (1%)	86	94
1	G	177/187 (95%)	174 (98%)	3 (2%)	60	82
1	J	176/187 (94%)	174 (99%)	2 (1%)	73	88
2	B	188/190 (99%)	187 (100%)	1 (0%)	88	95
2	E	188/190 (99%)	185 (98%)	3 (2%)	62	84
2	H	188/190 (99%)	183 (97%)	5 (3%)	44	72
2	K	188/190 (99%)	187 (100%)	1 (0%)	88	95
3	C	163/167 (98%)	162 (99%)	1 (1%)	86	94
3	F	162/167 (97%)	157 (97%)	5 (3%)	40	69

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
3	I	163/167 (98%)	159 (98%)	4 (2%)	47	74
3	L	163/167 (98%)	161 (99%)	2 (1%)	71	87
All	All	2112/2176 (97%)	2083 (99%)	29 (1%)	67	85

5 of 29 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	151	GLU
3	L	387	LEU
2	H	39	LYS
1	J	63	VAL
2	H	11	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
3	I	388	ASN
3	I	460	ASN
3	L	388	ASN
2	B	138	ASN
2	B	137	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	213/221 (96%)	-0.32	0 100 100	54, 75, 102, 159	0
1	D	210/221 (95%)	-0.09	2 (0%) 82 70	58, 85, 129, 167	0
1	G	210/221 (95%)	-0.25	0 100 100	51, 72, 114, 140	0
1	J	210/221 (95%)	-0.28	0 100 100	62, 86, 114, 147	0
2	B	212/214 (99%)	-0.34	0 100 100	55, 78, 98, 174	0
2	E	212/214 (99%)	-0.16	1 (0%) 91 83	62, 94, 132, 150	0
2	H	212/214 (99%)	-0.23	0 100 100	53, 75, 105, 148	0
2	K	212/214 (99%)	-0.27	0 100 100	61, 91, 115, 137	0
3	C	189/194 (97%)	-0.03	7 (3%) 41 22	55, 79, 135, 174	0
3	F	188/194 (96%)	0.04	11 (5%) 22 10	65, 95, 152, 184	0
3	I	189/194 (97%)	-0.00	8 (4%) 36 18	49, 92, 160, 186	0
3	L	189/194 (97%)	-0.03	5 (2%) 56 35	65, 99, 164, 199	0
All	All	2446/2516 (97%)	-0.17	34 (1%) 75 59	49, 85, 138, 199	0

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	F	365	TYR	4.9
3	I	365	TYR	4.4
3	F	387	LEU	3.9
3	I	515	PHE	3.9
3	C	360	ASN	3.2

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.