Full wwPDB X-ray Structure Validation Report ⓘ

May 24, 2020 – 04:17 am BST

PDB ID	:	5C9B
Title	:	Crystal structure of a retropepsin-like aspartic protease from Rickettsia conorii
Authors	:	Li, M.; Gustchina, A.; Cruz, R.; Simoes, M.; Curto, P.; Martinez, J.; Faro, C.; Simoes, I.; Wlodawer, A.
Deposited on	:	2015-06-26
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 following versions of software and data (see references ①) were used in the production of this report:

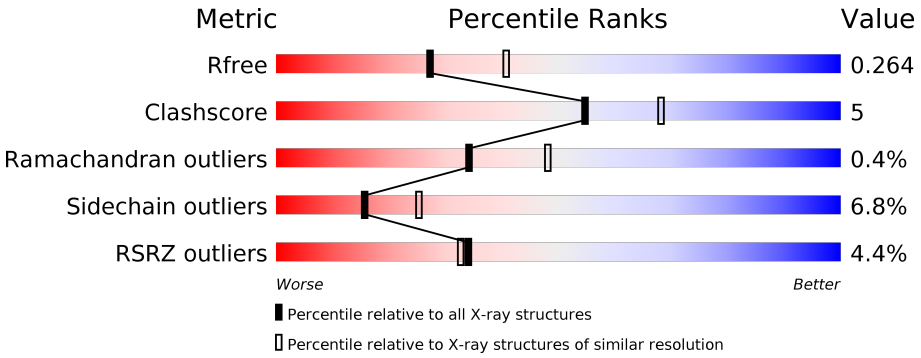
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

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}	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (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 on 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 <=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	139	76% 13% • 9%
1	B	139	% 77% 14% 9%
1	C	139	4% 71% 15% •• 11%
1	D	139	9% 67% 14% • 17%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4020 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 ApRick protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	126	Total	C	N	O	Se	0	0	0
			999	646	168	182	3			
1	B	127	Total	C	N	O	Se	0	0	0
			1007	652	169	183	3			
1	C	124	Total	C	N	O	Se	0	0	0
			982	637	165	177	3			
1	D	115	Total	C	N	O	Se	0	0	0
			904	587	152	162	3			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	104	MSE	-	initiating methionine	UNP Q92FY8
A	232	ALA	-	expression tag	UNP Q92FY8
A	233	ALA	-	expression tag	UNP Q92FY8
A	234	ALA	-	expression tag	UNP Q92FY8
A	235	LEU	-	expression tag	UNP Q92FY8
A	236	GLU	-	expression tag	UNP Q92FY8
A	237	HIS	-	expression tag	UNP Q92FY8
A	238	HIS	-	expression tag	UNP Q92FY8
A	239	HIS	-	expression tag	UNP Q92FY8
A	240	HIS	-	expression tag	UNP Q92FY8
A	241	HIS	-	expression tag	UNP Q92FY8
A	242	HIS	-	expression tag	UNP Q92FY8
B	104	MSE	-	initiating methionine	UNP Q92FY8
B	232	ALA	-	expression tag	UNP Q92FY8
B	233	ALA	-	expression tag	UNP Q92FY8
B	234	ALA	-	expression tag	UNP Q92FY8
B	235	LEU	-	expression tag	UNP Q92FY8
B	236	GLU	-	expression tag	UNP Q92FY8
B	237	HIS	-	expression tag	UNP Q92FY8
B	238	HIS	-	expression tag	UNP Q92FY8
B	239	HIS	-	expression tag	UNP Q92FY8

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Chain	Residue	Modelled	Actual	Comment	Reference
B	240	HIS	-	expression tag	UNP Q92FY8
B	241	HIS	-	expression tag	UNP Q92FY8
B	242	HIS	-	expression tag	UNP Q92FY8
C	104	MSE	-	initiating methionine	UNP Q92FY8
C	232	ALA	-	expression tag	UNP Q92FY8
C	233	ALA	-	expression tag	UNP Q92FY8
C	234	ALA	-	expression tag	UNP Q92FY8
C	235	LEU	-	expression tag	UNP Q92FY8
C	236	GLU	-	expression tag	UNP Q92FY8
C	237	HIS	-	expression tag	UNP Q92FY8
C	238	HIS	-	expression tag	UNP Q92FY8
C	239	HIS	-	expression tag	UNP Q92FY8
C	240	HIS	-	expression tag	UNP Q92FY8
C	241	HIS	-	expression tag	UNP Q92FY8
C	242	HIS	-	expression tag	UNP Q92FY8
D	104	MSE	-	initiating methionine	UNP Q92FY8
D	232	ALA	-	expression tag	UNP Q92FY8
D	233	ALA	-	expression tag	UNP Q92FY8
D	234	ALA	-	expression tag	UNP Q92FY8
D	235	LEU	-	expression tag	UNP Q92FY8
D	236	GLU	-	expression tag	UNP Q92FY8
D	237	HIS	-	expression tag	UNP Q92FY8
D	238	HIS	-	expression tag	UNP Q92FY8
D	239	HIS	-	expression tag	UNP Q92FY8
D	240	HIS	-	expression tag	UNP Q92FY8
D	241	HIS	-	expression tag	UNP Q92FY8
D	242	HIS	-	expression tag	UNP Q92FY8

- Molecule 2 is water.

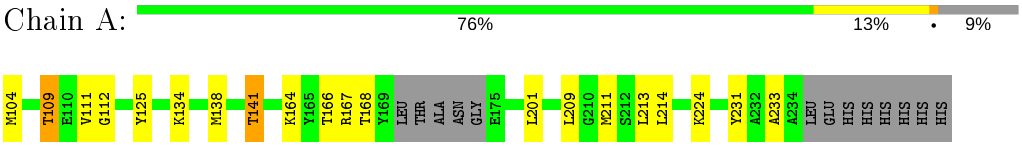
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	38	Total O 38 38	0	0
2	B	42	Total O 42 42	0	0
2	C	24	Total O 24 24	0	0
2	D	24	Total O 24 24	0	0

3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA 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.

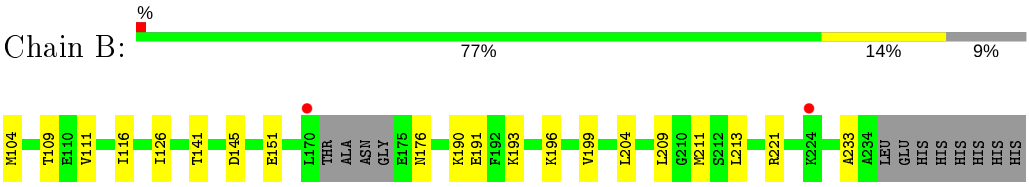
- Molecule 1: ApRick protease

Chain A:



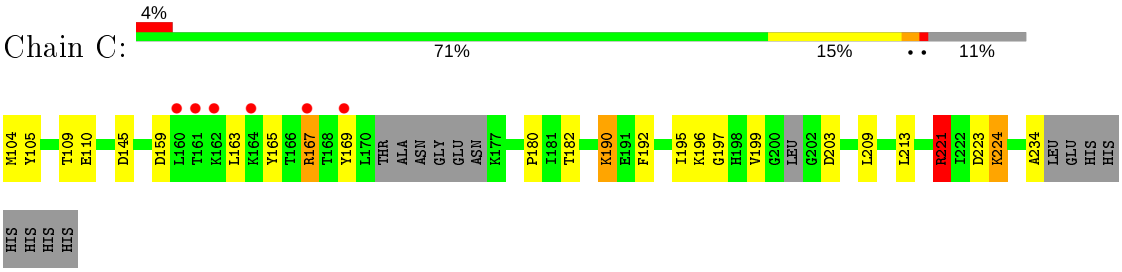
- Molecule 1: ApRick protease

Chain B:



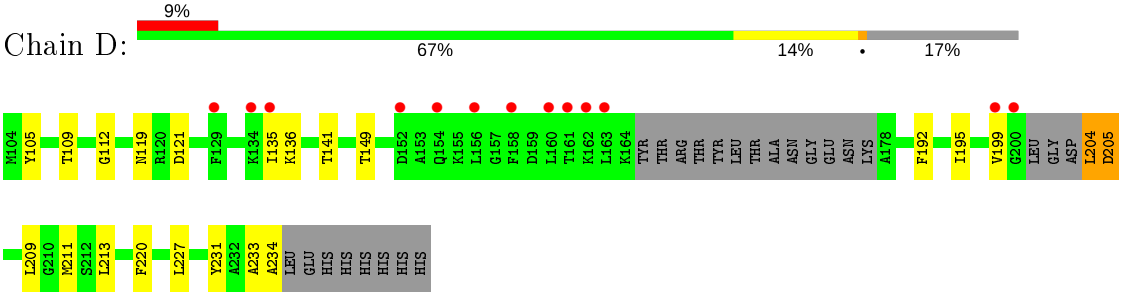
- Molecule 1: ApRick protease

Chain C:



- Molecule 1: ApRick protease

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	101.98Å 101.98Å 127.06Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	47.37 – 2.40 47.32 – 2.37	Depositor EDS
% Data completeness (in resolution range)	91.0 (47.37-2.40) 91.0 (47.32-2.37)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	0.05	Depositor
$< I/\sigma(I) >$ [1]	2.69 (at 2.37Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.199 , 0.262 0.204 , 0.264	Depositor DCC
R_{free} test set	1458 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å^2)	52.1	Xtriage
Anisotropy	0.544	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 50.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.027 for -h,-k,l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4020	wwPDB-VP
Average B, all atoms (Å^2)	71.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.20% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.80	0/1012	0.90	0/1355
1	B	0.89	1/1020 (0.1%)	1.02	2/1366 (0.1%)
1	C	0.71	0/994	0.92	1/1329 (0.1%)
1	D	0.68	0/914	0.80	0/1221
All	All	0.78	1/3940 (0.0%)	0.92	3/5271 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	145	ASP	CB-CG	-5.81	1.39	1.51

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	190	LYS	CD-CE-NZ	7.46	128.86	111.70
1	C	221	ARG	NE-CZ-NH1	7.08	123.84	120.30
1	B	145	ASP	N-CA-CB	-6.91	98.17	110.60

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	999	0	1029	11	0
1	B	1007	0	1040	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	982	0	1016	10	0
1	D	904	0	940	16	0
2	A	38	0	0	1	0
2	B	42	0	0	0	0
2	C	24	0	0	2	0
2	D	24	0	0	0	0
All	All	4020	0	4025	41	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 5.

All (41) 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:141:THR:HA	1:B:211:MSE:HE3	1.36	1.03
1:A:141:THR:HA	1:A:211:MSE:HE3	1.44	0.98
1:D:209:LEU:HD11	1:D:213:LEU:HD23	1.46	0.94
1:A:211:MSE:HE1	1:A:214:LEU:HD12	1.53	0.89
1:A:211:MSE:CE	1:A:214:LEU:HD12	2.09	0.83
1:C:209:LEU:HD11	1:C:213:LEU:HD23	1.60	0.82
1:B:209:LEU:HD11	1:B:213:LEU:HD23	1.63	0.80
1:B:109:THR:HB	1:B:233:ALA:O	1.84	0.78
1:C:167:ARG:NH1	1:C:169:TYR:OH	2.21	0.73
1:D:141:THR:HG23	1:D:211:MSE:HE2	1.73	0.71
1:C:221:ARG:NH2	2:C:302:HOH:O	2.26	0.67
1:D:119:ASN:HD22	1:D:121:ASP:H	1.42	0.66
1:C:234:ALA:O	2:C:301:HOH:O	2.15	0.64
1:D:192:PHE:HB3	1:D:195:ILE:HD11	1.86	0.57
1:D:205:ASP:OD1	1:D:205:ASP:N	2.38	0.56
1:C:223:ASP:O	1:C:224:LYS:CB	2.57	0.52
1:D:220:PHE:CE1	1:D:227:LEU:HD11	2.46	0.50
1:A:125:TYR:OH	1:A:138:MSE:HE2	2.12	0.50
1:B:221:ARG:HD2	1:C:105:TYR:OH	2.11	0.49
1:D:112:GLY:HA3	1:D:231:TYR:CZ	2.47	0.49
1:D:109:THR:HB	1:D:233:ALA:O	2.12	0.49
1:A:112:GLY:HA3	1:A:231:TYR:CZ	2.47	0.49
1:A:109:THR:HG22	1:A:233:ALA:O	2.12	0.49
1:B:116:ILE:HD11	1:B:126:ILE:HD13	1.96	0.48
1:D:209:LEU:HD11	1:D:213:LEU:CD2	2.32	0.47
1:D:135:ILE:HG22	1:D:136:LYS:N	2.30	0.47
1:A:211:MSE:HE2	1:A:214:LEU:HD12	1.92	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:145:ASP:OD1	1:C:197:GLY:HA2	2.16	0.46
1:A:209:LEU:HD11	1:A:213:LEU:HD23	1.97	0.46
1:C:159:ASP:O	1:C:163:LEU:HG	2.15	0.46
1:D:109:THR:HG22	1:D:234:ALA:HA	1.99	0.45
1:D:149:THR:HG22	1:D:204:LEU:HD13	1.98	0.44
1:B:191:GLU:OE1	1:B:193:LYS:HE2	2.19	0.43
1:A:164:LYS:HB3	1:A:166:THR:HG23	2.01	0.42
1:A:224:LYS:HE2	1:D:105:TYR:CE2	2.55	0.42
1:C:109:THR:HG22	1:C:234:ALA:HA	2.01	0.42
1:A:111:VAL:HG13	2:A:319:HOH:O	2.20	0.41
1:D:220:PHE:HE1	1:D:227:LEU:HD11	1.85	0.41
1:D:149:THR:HG21	1:D:205:ASP:O	2.21	0.41
1:D:105:TYR:CD1	1:D:105:TYR:N	2.88	0.40
1:C:190:LYS:HE2	1:C:192:PHE:CE1	2.56	0.40

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	122/139 (88%)	116 (95%)	6 (5%)	0	100 100
1	B	123/139 (88%)	116 (94%)	7 (6%)	0	100 100
1	C	118/139 (85%)	105 (89%)	11 (9%)	2 (2%)	9 11
1	D	109/139 (78%)	103 (94%)	6 (6%)	0	100 100
All	All	472/556 (85%)	440 (93%)	30 (6%)	2 (0%)	34 48

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	165	TYR

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Mol	Chain	Res	Type
1	C	224	LYS

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	106/114 (93%)	99 (93%)	7 (7%)	16 26
1	B	107/114 (94%)	100 (94%)	7 (6%)	17 27
1	C	104/114 (91%)	93 (89%)	11 (11%)	6 9
1	D	96/114 (84%)	93 (97%)	3 (3%)	40 60
All	All	413/456 (91%)	385 (93%)	28 (7%)	16 25

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	MSE
1	A	109	THR
1	A	134	LYS
1	A	141	THR
1	A	167	ARG
1	A	168	THR
1	A	201	LEU
1	B	104	MSE
1	B	111	VAL
1	B	151	GLU
1	B	176	ASN
1	B	196	LYS
1	B	199	VAL
1	B	204	LEU
1	C	104	MSE
1	C	110	GLU
1	C	167	ARG
1	C	180	PRO
1	C	182	THR
1	C	190	LYS

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Mol	Chain	Res	Type
1	C	195	ILE
1	C	196	LYS
1	C	199	VAL
1	C	203	ASP
1	C	221	ARG
1	D	199	VAL
1	D	204	LEU
1	D	205	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	119	ASN
1	D	198	HIS

5.3.3 RNA

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates

There are no carbohydrates in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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

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, 95^{th} 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	123/139 (88%)	-0.17	0 100 100	41, 56, 92, 146	0
1	B	124/139 (89%)	-0.14	2 (1%) 72 70	40, 55, 101, 129	0
1	C	121/139 (87%)	0.06	6 (4%) 28 27	43, 74, 122, 153	0
1	D	112/139 (80%)	0.47	13 (11%) 4 4	48, 81, 129, 149	0
All	All	480/556 (86%)	0.04	21 (4%) 34 33	40, 64, 122, 153	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	161	THR	5.0
1	D	160	LEU	4.9
1	D	162	LYS	4.7
1	C	164	LYS	4.4
1	C	160	LEU	3.4
1	D	200	GLY	2.9
1	C	169	TYR	2.8
1	D	135	ILE	2.7
1	D	158	PHE	2.7
1	D	156	LEU	2.5
1	C	162	LYS	2.5
1	D	152	ASP	2.4
1	D	199	VAL	2.3
1	D	163	LEU	2.2
1	D	129	PHE	2.2
1	D	154	GLN	2.2
1	C	161	THR	2.1
1	C	167	ARG	2.1
1	D	134	LYS	2.1
1	B	170	LEU	2.0
1	B	224	LYS	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 carbohydrates 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.