



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 05:44 PM UTC

PDB ID : 4YAM / pdb_00004yam
Title : Crystal structure of LigE-apo form from *Sphingobium* sp. strain SYK-6
Authors : Pereira, J.H.; McAndrew, R.P.; Heins, R.A.; Sale, K.L.; Simmons, B.A.; Adams, P.D.
Deposited on : 2015-02-17
Resolution : 1.91 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
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

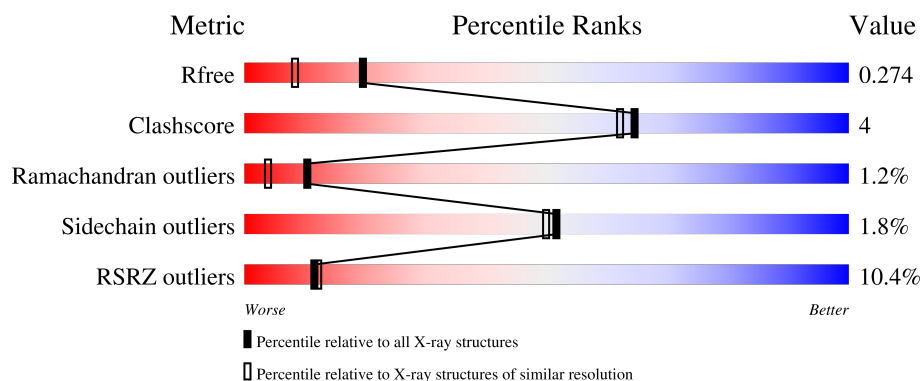
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.91 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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	281	6% 77% 11% 11%
1	B	281	12% 80% 9% 10%
1	C	281	11% 81% 8% 10%
1	D	281	7% 82% 7% 11%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 17330 atoms, of which 7925 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 Beta-etherase.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
1	A	250	Total	C	H	N	O	S	Se	0	0	0
			4038	1328	1980	352	373	2	3			
1	B	252	Total	C	H	N	O	S	Se	0	0	0
			4049	1333	1984	351	376	2	3			
1	C	252	Total	C	H	N	O	S	Se	0	0	0
			4049	1333	1984	351	376	2	3			
1	D	251	Total	C	H	N	O	S	Se	0	0	0
			4035	1328	1977	350	375	2	3			

- Molecule 2 is water.

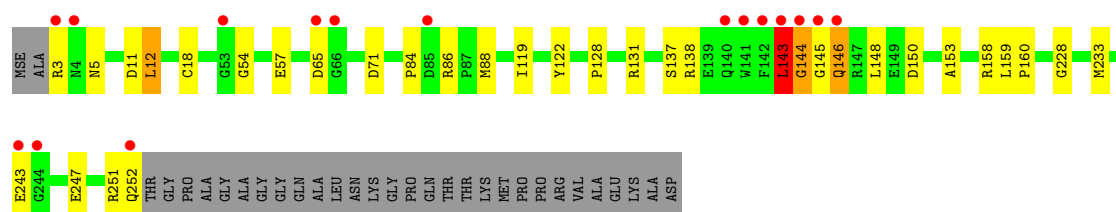
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	297	Total	O	0	0
			297	297		
2	B	303	Total	O	0	0
			303	303		
2	C	262	Total	O	0	0
			262	262		
2	D	297	Total	O	0	0
			297	297		

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.

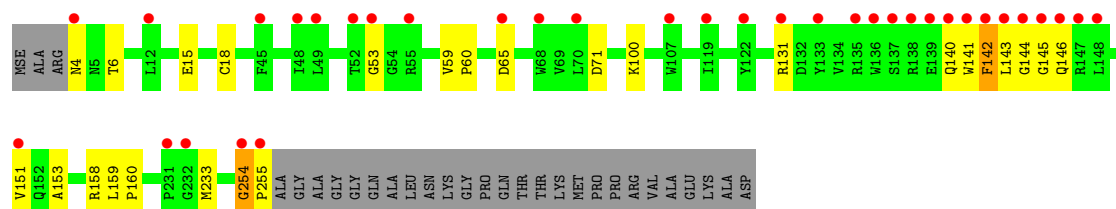
• Molecule 1: Beta-etherase

Chain A: 



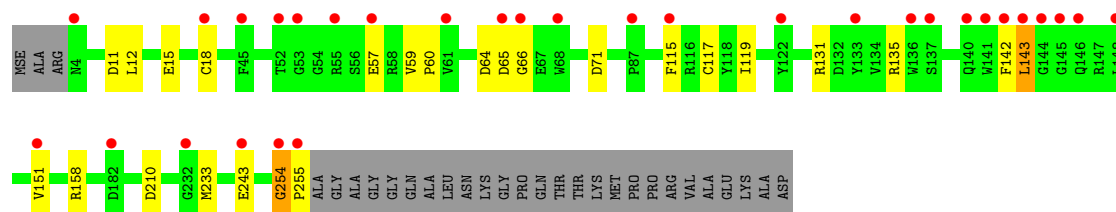
• Molecule 1: Beta-etherase

Chain B: 



• Molecule 1: Beta-etherase

Chain C: 



• Molecule 1: Beta-etherase

Chain D: 



Q252	PRO	ALA	GLY	ALA	GLY	GLY	GLY	GLN	ALA	LEU	ASN	LYS	GLY	PRO	GLN	THR	THR	LYS	MET	PRO	PRO	ARG	VAL	ALA	GLU	LYS	ALA	ASP
T253																												
G254																												

4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	122.56Å 97.16Å 131.39Å 90.00° 106.65° 90.00°	Depositor
Resolution (Å)	50.00 – 1.91 50.00 – 1.91	Depositor EDS
% Data completeness (in resolution range)	99.2 (50.00-1.91) 95.4 (50.00-1.91)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.02 (at 1.91Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.3_1479)	Depositor
R, R_{free}	0.227 , 0.271 0.231 , 0.274	Depositor DCC
R_{free} test set	2000 reflections (1.74%)	wwPDB-VP
Wilson B-factor (Å ²)	20.4	Xtriage
Anisotropy	0.351	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 56.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	17330	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.77% 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	0.38	0/2121	0.71	1/2887 (0.0%)
1	B	0.36	0/2129	0.68	1/2900 (0.0%)
1	C	0.35	0/2129	0.66	0/2900
1	D	0.37	0/2121	0.67	0/2888
All	All	0.36	0/8500	0.68	2/11575 (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 (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	B	142	PHE	N-CA-C	6.12	121.03	113.50
1	A	54	GLY	N-CA-C	-5.34	106.86	115.08

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	146	GLN	Peptide

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	2058	1980	1983	22	1
1	B	2065	1984	1987	16	0
1	C	2065	1984	1987	13	0
1	D	2058	1977	1980	12	1
2	A	297	0	0	3	0
2	B	303	0	0	4	0
2	C	262	0	0	2	0
2	D	297	0	0	6	0
All	All	9405	7925	7937	63	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 (63) 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:153:ALA:O	1:A:158:ARG:NH2	2.17	0.77
1:B:53:GLY:N	2:B:301:HOH:O	2.16	0.77
1:D:25:TRP:O	2:D:566:HOH:O	2.05	0.74
1:A:228:GLY:O	2:A:505:HOH:O	2.11	0.68
1:C:210:ASP:OD1	2:C:497:HOH:O	2.13	0.67
1:C:151:VAL:O	1:C:158:ARG:NH2	2.28	0.67
1:D:203:ARG:NH1	2:D:506:HOH:O	2.28	0.66
1:D:135:ARG:NE	2:D:301:HOH:O	2.32	0.61
1:A:143:LEU:HA	1:A:144:GLY:C	2.26	0.59
1:A:65:ASP:OD2	2:A:590:HOH:O	2.16	0.59
1:A:18:CYS:SG	1:A:233:MSE:SE	3.11	0.59
1:C:131:ARG:NH1	2:C:426:HOH:O	2.35	0.58
1:B:15:GLU:OE1	1:B:131:ARG:NH2	2.36	0.58
1:B:141:TRP:NE1	2:B:425:HOH:O	2.36	0.57
1:A:143:LEU:HA	1:A:145:GLY:N	2.20	0.56
1:C:18:CYS:SG	1:C:233:MSE:SE	3.14	0.56
1:A:247:GLU:N	1:A:247:GLU:OE1	2.39	0.55
1:B:153:ALA:O	1:B:158:ARG:NH2	2.39	0.55
1:D:4:ASN:N	2:D:553:HOH:O	2.39	0.54
1:D:28:LYS:HB2	2:D:566:HOH:O	2.09	0.53
1:B:18:CYS:SG	1:B:233:MSE:SE	3.16	0.53
1:B:151:VAL:O	1:B:158:ARG:NH2	2.41	0.53
1:B:142:PHE:N	1:B:143:LEU:HA	2.24	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:15:GLU:OE1	1:D:131:ARG:NH2	2.42	0.52
1:D:135:ARG:NH2	1:D:149:GLU:OE2	2.43	0.51
1:C:15:GLU:OE1	1:C:131:ARG:NH2	2.45	0.50
1:A:137:SER:OG	1:A:138:ARG:NH1	2.44	0.50
1:A:11:ASP:OD1	1:A:12:LEU:N	2.43	0.50
1:C:254:GLY:H	1:C:255:PRO:CD	2.24	0.49
1:A:143:LEU:HA	1:A:145:GLY:CA	2.45	0.47
1:A:84:PRO:C	1:A:88:MSE:HE1	2.39	0.47
1:A:3:ARG:HB3	1:A:65:ASP:OD1	2.15	0.46
1:A:5:ASN:OD1	1:A:86:ARG:NH2	2.42	0.46
1:A:86:ARG:O	1:A:88:MSE:HE2	2.16	0.46
1:B:254:GLY:H	1:B:255:PRO:HD3	1.82	0.45
1:D:5:ASN:OD1	1:D:86:ARG:NH2	2.48	0.45
1:A:84:PRO:HA	1:A:88:MSE:HE1	1.99	0.45
1:C:11:ASP:OD1	1:C:12:LEU:N	2.50	0.44
1:A:158:ARG:NE	2:A:391:HOH:O	2.49	0.44
1:B:4:ASN:CA	1:B:6:THR:H	2.31	0.44
1:C:254:GLY:H	1:C:255:PRO:HD3	1.81	0.44
1:D:5:ASN:CG	1:D:5:ASN:O	2.60	0.44
1:C:59:VAL:HB	1:C:60:PRO:HA	2.00	0.44
1:D:171:ARG:NH2	2:D:417:HOH:O	2.50	0.44
1:B:140:GLN:OE1	2:B:445:HOH:O	2.20	0.43
1:C:64:ASP:O	1:C:66:GLY:N	2.52	0.43
1:B:100:LYS:NZ	2:B:489:HOH:O	2.36	0.43
1:A:119:ILE:HG13	1:A:148:LEU:HD22	2.00	0.42
1:A:243:GLU:OE1	1:A:243:GLU:N	2.50	0.42
1:B:142:PHE:N	1:B:143:LEU:CA	2.83	0.42
1:D:59:VAL:HB	1:D:60:PRO:HA	2.01	0.42
1:B:59:VAL:HB	1:B:60:PRO:HA	2.02	0.42
1:B:144:GLY:HA3	1:B:145:GLY:C	2.46	0.41
1:B:159:LEU:N	1:B:160:PRO:CD	2.84	0.41
1:C:115:PHE:CZ	1:C:119:ILE:HD13	2.55	0.41
1:A:143:LEU:HD12	1:A:145:GLY:HA2	2.03	0.41
1:A:159:LEU:N	1:A:160:PRO:CD	2.84	0.41
1:C:117:CYS:SG	1:C:158:ARG:NH1	2.94	0.40
1:C:143:LEU:HD11	1:C:151:VAL:HG21	2.03	0.40
1:D:25:TRP:CZ2	1:D:233:MSE:HE1	2.55	0.40
1:A:57:GLU:OE1	1:A:57:GLU:N	2.48	0.40
1:A:128:PRO:HA	1:A:131:ARG:HG3	2.03	0.40
1:B:141:TRP:C	1:B:143:LEU:HB3	2.46	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the sym-

metry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:150:ASP:OD1	1:D:147:ARG:NH2[4_456]	2.17	0.03

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	248/281 (88%)	238 (96%)	6 (2%)	4 (2%)	7	2
1	B	250/281 (89%)	238 (95%)	9 (4%)	3 (1%)	10	4
1	C	250/281 (89%)	239 (96%)	7 (3%)	4 (2%)	7	2
1	D	249/281 (89%)	240 (96%)	8 (3%)	1 (0%)	30	22
All	All	997/1124 (89%)	955 (96%)	30 (3%)	12 (1%)	10	4

All (12) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	143	LEU
1	A	144	GLY
1	A	146	GLN
1	B	65	ASP
1	C	65	ASP
1	C	254	GLY
1	C	135	ARG
1	A	71	ASP
1	C	71	ASP
1	B	71	ASP
1	B	254	GLY
1	D	71	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	219/235 (93%)	213 (97%)	6 (3%)	39	34
1	B	220/235 (94%)	220 (100%)	0	100	100
1	C	220/235 (94%)	216 (98%)	4 (2%)	51	50
1	D	219/235 (93%)	213 (97%)	6 (3%)	39	34
All	All	878/940 (93%)	862 (98%)	16 (2%)	51	50

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12	LEU
1	A	122	TYR
1	A	143	LEU
1	A	146	GLN
1	A	251	ARG
1	A	252	GLN
1	C	57	GLU
1	C	142	PHE
1	C	143	LEU
1	C	243	GLU
1	D	5	ASN
1	D	58	ARG
1	D	122	TYR
1	D	138	ARG
1	D	142	PHE
1	D	252	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	4	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 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	247/281 (87%)	0.41	16 (6%) 25 26	14, 25, 49, 87	0
1	B	249/281 (88%)	0.85	35 (14%) 6 6	14, 31, 58, 90	0
1	C	249/281 (88%)	0.91	31 (12%) 8 8	17, 32, 59, 100	0
1	D	248/281 (88%)	0.61	21 (8%) 16 17	15, 29, 54, 67	0
All	All	993/1124 (88%)	0.69	103 (10%) 11 12	14, 29, 56, 100	0

All (103) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	142	PHE	10.3
1	C	141	TRP	8.4
1	C	142	PHE	8.3
1	B	141	TRP	7.5
1	D	254	GLY	7.1
1	B	255	PRO	6.9
1	A	4	ASN	6.4
1	A	143	LEU	6.1
1	C	53	GLY	5.6
1	A	145	GLY	5.6
1	C	232	GLY	5.5
1	B	143	LEU	5.4
1	A	144	GLY	5.4
1	B	254	GLY	5.3
1	C	143	LEU	5.3
1	C	144	GLY	5.2
1	A	141	TRP	5.1
1	A	252	GLN	5.0
1	A	142	PHE	5.0
1	B	145	GLY	4.9
1	D	141	TRP	4.8

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Mol	Chain	Res	Type	RSRZ
1	D	142	PHE	4.5
1	A	53	GLY	4.5
1	B	136	TRP	4.4
1	B	151	VAL	4.4
1	C	45	PHE	4.3
1	D	53	GLY	4.2
1	D	144	GLY	4.2
1	A	3	ARG	4.1
1	B	146	GLN	4.0
1	B	53	GLY	4.0
1	C	254	GLY	4.0
1	C	140	GLN	4.0
1	D	50	GLU	4.0
1	B	144	GLY	3.9
1	C	151	VAL	3.8
1	C	65	ASP	3.7
1	C	4	ASN	3.7
1	C	136	TRP	3.6
1	D	145	GLY	3.5
1	B	138	ARG	3.5
1	A	146	GLN	3.3
1	B	137	SER	3.3
1	A	243	GLU	3.3
1	D	252	GLN	3.2
1	A	66	GLY	3.2
1	B	45	PHE	3.2
1	B	140	GLN	3.2
1	C	148	LEU	3.1
1	A	140	GLN	3.1
1	C	243	GLU	3.1
1	B	148	LEU	3.0
1	B	133	TYR	3.0
1	D	65	ASP	3.0
1	B	119	ILE	3.0
1	B	139	GLU	3.0
1	C	18	CYS	3.0
1	D	143	LEU	2.9
1	D	147	ARG	2.9
1	C	68	TRP	2.9
1	B	232	GLY	2.9
1	C	255	PRO	2.8
1	C	145	GLY	2.8

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Mol	Chain	Res	Type	RSRZ
1	B	122	TYR	2.8
1	B	70	LEU	2.7
1	C	133	TYR	2.7
1	C	52	THR	2.7
1	B	147	ARG	2.7
1	B	4	ASN	2.7
1	B	52	THR	2.6
1	D	253	THR	2.5
1	A	244	GLY	2.4
1	B	131	ARG	2.4
1	D	4	ASN	2.4
1	B	49	LEU	2.3
1	C	122	TYR	2.3
1	B	65	ASP	2.3
1	D	136	TRP	2.3
1	A	85	ASP	2.3
1	D	156	GLU	2.3
1	D	52	THR	2.3
1	D	66	GLY	2.2
1	B	12	LEU	2.2
1	C	66	GLY	2.2
1	A	65	ASP	2.2
1	C	146	GLN	2.2
1	D	90	PHE	2.2
1	C	115	PHE	2.2
1	B	48	ILE	2.2
1	B	107	TRP	2.2
1	D	8	THR	2.2
1	B	231	PRO	2.2
1	C	55	ARG	2.2
1	B	55	ARG	2.1
1	B	135	ARG	2.1
1	C	87	PRO	2.1
1	D	55	ARG	2.1
1	C	57	GLU	2.0
1	C	137	SER	2.0
1	C	61	VAL	2.0
1	B	68	TRP	2.0
1	C	182	ASP	2.0
1	D	54	GLY	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.