



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:11 AM UTC

PDB ID : 5OEV / pdb_00005oev
Title : The structure of a glutathione synthetase like-effector (GSS22) from *Globodera pallida* in apoform.
Authors : Lilley, C.J.; Maqbool, A.; Wu, D.; Yusup, H.B.; Jones, L.M.; Birch, P.R.J.; Banfield, M.J.; Urwin, P.E.; Eves-van den Akker, S.
Deposited on : 2017-07-10
Resolution : 2.18 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

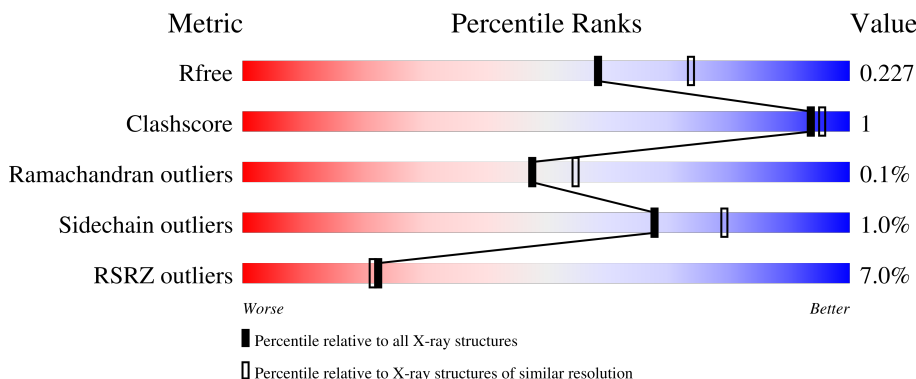
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.18 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	8975 (2.20-2.16)
Clashscore	190562	9786 (2.20-2.16)
Ramachandran outliers	187476	9664 (2.20-2.16)
Sidechain outliers	187428	9664 (2.20-2.16)
RSRZ outliers	180081	8979 (2.20-2.16)

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	510	5% 85% 12%
1	B	510	7% 75% 22%
1	C	510	3% 75% 22%
1	D	510	8% 83% 12%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 13835 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 Glutathione synthetase-like effector 22 (Gpa-GSS22-apo).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	451	Total	C	N	O	S	0	0	0
			3596	2280	631	670	15			
1	B	397	Total	C	N	O	S	0	0	0
			3150	1999	552	586	13			
1	C	397	Total	C	N	O	S	0	0	0
			3150	2000	553	584	13			
1	D	448	Total	C	N	O	S	0	0	0
			3574	2268	625	666	15			

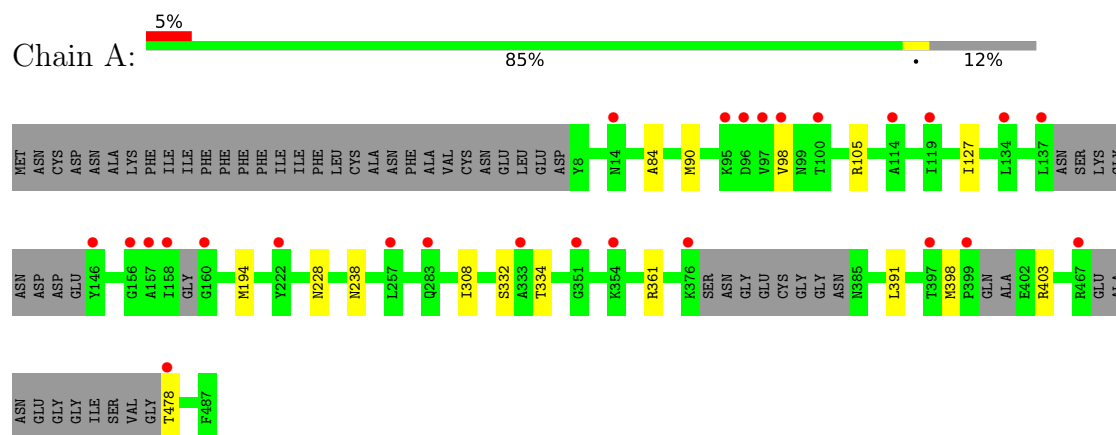
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	111	Total	O	0	0
			111	111		
2	B	58	Total	O	0	0
			58	58		
2	C	113	Total	O	0	0
			113	113		
2	D	83	Total	O	0	0
			83	83		

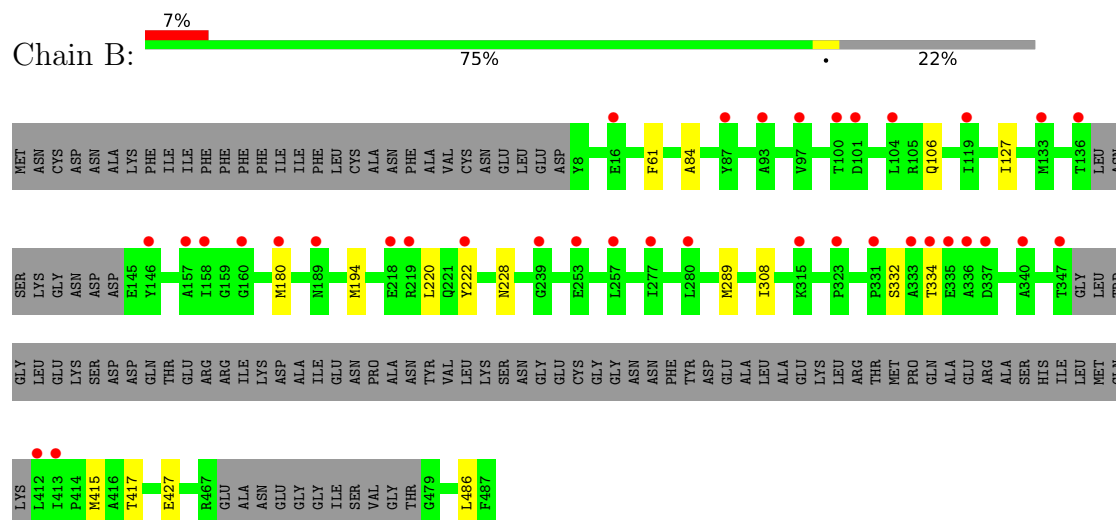
3 Residue-property plots [i](#)

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.

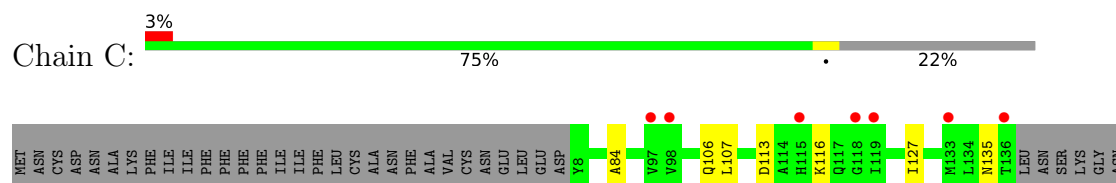
- Molecule 1: Glutathione synthetase-like effector 22 (Gpa-GSS22-apo)

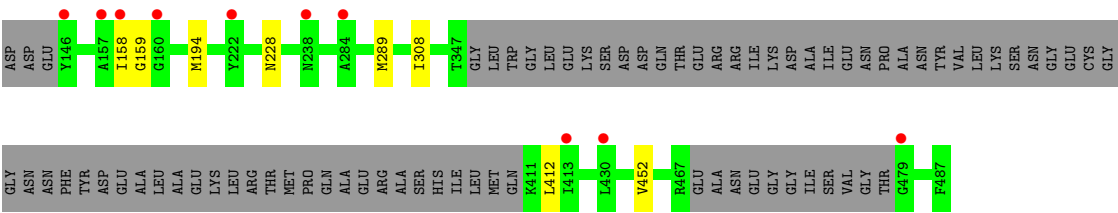


- Molecule 1: Glutathione synthetase-like effector 22 (Gpa-GSS22-apo)

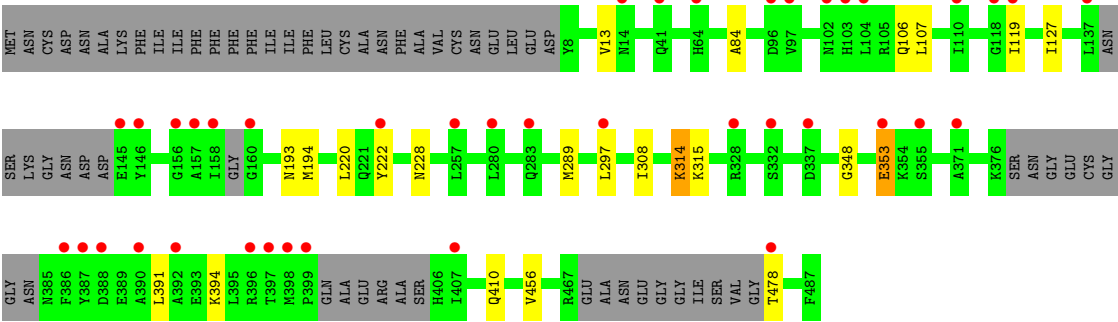
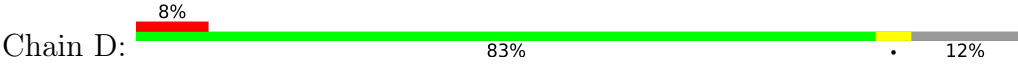


- Molecule 1: Glutathione synthetase-like effector 22 (Gpa-GSS22-apo)





● Molecule 1: Glutathione synthetase-like effector 22 (Gpa-GSS22-apo)



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	62.26Å 122.39Å 132.77Å 90.00° 97.61° 90.00°	Depositor
Resolution (Å)	50.00 – 2.18 50.00 – 2.18	Depositor EDS
% Data completeness (in resolution range)	100.0 (50.00-2.18) 99.9 (50.00-2.18)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.58 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0158	Depositor
R, R_{free}	0.215 , 0.237 (Not available) , 0.227	Depositor DCC
R_{free} test set	4973 reflections (4.83%)	wwPDB-VP
Wilson B-factor (Å ²)	39.6	Xtriage
Anisotropy	0.294	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 29.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	13835	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.49% 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	A	0.60	0/3658	0.80	0/4932
1	B	0.62	0/3206	0.81	0/4326
1	C	0.61	0/3206	0.81	1/4325 (0.0%)
1	D	0.62	0/3636	0.83	3/4903 (0.1%)
All	All	0.61	0/13706	0.81	4/18486 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	13	VAL	N-CA-C	6.55	118.14	111.00
1	C	158	ILE	N-CA-C	5.88	121.57	109.34
1	D	13	VAL	CA-C-O	-5.52	114.81	120.71
1	D	314	LYS	CB-CG-CD	5.05	122.91	111.30

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	3596	0	3618	10	0
1	B	3150	0	3169	9	0
1	C	3150	0	3176	8	0
1	D	3574	0	3595	12	0
2	A	111	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	58	0	0	0	0
2	C	113	0	0	0	0
2	D	83	0	0	0	0
All	All	13835	0	13558	39	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 1.

All (39) 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:D:193:ASN:OD1	1:D:456:VAL:HG21	1.95	0.66
1:B:180:MET:HA	1:B:180:MET:HE2	1.78	0.66
1:D:127:ILE:CG2	1:D:194:MET:HE1	2.32	0.59
1:C:135:ASN:ND2	1:C:412:LEU:HA	2.19	0.57
1:D:220:LEU:HD12	1:D:222:TYR:CE2	2.41	0.56
1:D:315:LYS:NZ	1:D:353:GLU:OE2	2.37	0.56
1:A:127:ILE:CG2	1:A:194:MET:HE1	2.37	0.55
1:B:220:LEU:HD12	1:B:222:TYR:CE2	2.42	0.55
1:D:127:ILE:HG23	1:D:194:MET:HE1	1.90	0.53
1:C:127:ILE:CG2	1:C:194:MET:HE1	2.38	0.53
1:D:106:GLN:HB3	1:D:289:MET:HE2	1.91	0.53
1:B:332:SER:OG	1:B:334:THR:HG22	2.09	0.53
1:A:127:ILE:HG23	1:A:194:MET:HE1	1.92	0.52
1:A:332:SER:OG	1:A:334:THR:HG22	2.09	0.52
1:B:127:ILE:CG2	1:B:194:MET:HE1	2.41	0.51
1:B:106:GLN:HB3	1:B:289:MET:HE2	1.92	0.51
1:C:127:ILE:HG23	1:C:194:MET:HE1	1.94	0.50
1:C:106:GLN:HB3	1:C:289:MET:HE2	1.94	0.49
1:D:348:GLY:H	1:D:410:GLN:HE21	1.61	0.49
1:A:98:VAL:HG13	1:A:105:ARG:HG3	1.94	0.47
1:B:127:ILE:HG23	1:B:194:MET:HE1	1.96	0.47
1:B:415:MET:HE3	1:B:417:THR:HG23	1.97	0.46
1:A:398:MET:HE3	1:A:403:ARG:CG	2.45	0.46
1:D:84:ALA:CB	1:D:308:ILE:HD13	2.47	0.45
1:A:84:ALA:CB	1:A:308:ILE:HD13	2.46	0.45
1:B:84:ALA:CB	1:B:308:ILE:HD13	2.47	0.45
1:C:84:ALA:CB	1:C:308:ILE:HD13	2.47	0.45
1:C:135:ASN:HD22	1:C:412:LEU:HA	1.81	0.44
1:D:127:ILE:HG21	1:D:194:MET:HE1	1.98	0.44
1:A:398:MET:HE3	1:A:403:ARG:HG2	1.99	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:391:LEU:C	1:D:391:LEU:HD23	2.44	0.42
1:A:391:LEU:C	1:A:391:LEU:HD23	2.44	0.42
1:C:113:ASP:O	1:C:116:LYS:HG2	2.20	0.41
1:A:238:ASN:HD22	1:A:238:ASN:HA	1.74	0.41
1:D:456:VAL:O	1:D:456:VAL:HG23	2.20	0.41
1:B:61:PHE:O	1:B:486:LEU:HA	2.21	0.41
1:C:107:LEU:HD23	1:C:289:MET:HE1	2.03	0.41
1:A:127:ILE:HG21	1:A:194:MET:HE1	2.04	0.40
1:D:107:LEU:HD23	1:D:289:MET:HE1	2.03	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	439/510 (86%)	435 (99%)	4 (1%)	0	100	100
1	B	389/510 (76%)	386 (99%)	3 (1%)	0	100	100
1	C	389/510 (76%)	383 (98%)	5 (1%)	1 (0%)	36	39
1	D	436/510 (86%)	432 (99%)	4 (1%)	0	100	100
All	All	1653/2040 (81%)	1636 (99%)	16 (1%)	1 (0%)	48	55

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	159	GLY

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	390/436 (89%)	386 (99%)	4 (1%)	68	79
1	B	342/436 (78%)	340 (99%)	2 (1%)	78	87
1	C	342/436 (78%)	340 (99%)	2 (1%)	78	87
1	D	388/436 (89%)	381 (98%)	7 (2%)	51	65
All	All	1462/1744 (84%)	1447 (99%)	15 (1%)	68	79

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	90	MET
1	A	228	ASN
1	A	361	ARG
1	A	478	THR
1	B	228	ASN
1	B	427	GLU
1	C	228	ASN
1	C	452	VAL
1	D	119	ILE
1	D	228	ASN
1	D	297	LEU
1	D	314	LYS
1	D	353	GLU
1	D	394	LYS
1	D	478	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	150	GLN
1	A	189	ASN
1	A	221	GLN
1	A	238	ASN
1	B	31	HIS
1	B	117	GLN
1	B	154	ASN
1	B	440	ASN

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Mol	Chain	Res	Type
1	C	31	HIS
1	C	135	ASN
1	C	150	GLN
1	C	240	GLN
1	D	31	HIS
1	D	33	ASN
1	D	238	ASN
1	D	318	GLN
1	D	410	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	451/510 (88%)	0.54	26 (5%)	29	28	26, 45, 70, 82	0
1	B	397/510 (77%)	0.73	36 (9%)	15	14	30, 50, 78, 94	0
1	C	397/510 (77%)	0.37	17 (4%)	40	39	28, 41, 63, 82	0
1	D	448/510 (87%)	0.68	40 (8%)	15	14	29, 47, 72, 99	0
All	All	1693/2040 (82%)	0.58	119 (7%)	22	21	26, 46, 72, 99	0

All (119) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	158	ILE	6.7
1	D	399	PRO	6.7
1	C	146	TYR	4.9
1	A	158	ILE	4.8
1	D	222	TYR	4.7
1	A	399	PRO	4.6
1	A	119	ILE	4.5
1	B	157	ALA	4.4
1	D	146	TYR	4.3
1	B	100	THR	4.2
1	D	337	ASP	4.2
1	B	136	THR	4.1
1	B	222	TYR	4.1
1	B	158	ILE	4.1
1	D	137	LEU	3.9
1	C	119	ILE	3.8
1	D	157	ALA	3.6
1	B	119	ILE	3.6
1	B	336	ALA	3.6
1	A	157	ALA	3.5
1	A	146	TYR	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	97	VAL	3.4
1	D	386	PHE	3.3
1	C	157	ALA	3.3
1	B	334	THR	3.2
1	B	412	LEU	3.2
1	C	158	ILE	3.2
1	B	335	GLU	3.2
1	D	156	GLY	3.1
1	C	284	ALA	3.1
1	B	97	VAL	3.1
1	A	137	LEU	3.1
1	B	277	ILE	3.0
1	B	413	ILE	3.0
1	D	398	MET	3.0
1	C	118	GLY	2.9
1	D	478	THR	2.9
1	B	16	GLU	2.9
1	A	98	VAL	2.9
1	B	347	THR	2.9
1	D	102	ASN	2.9
1	C	136	THR	2.8
1	C	222	TYR	2.8
1	C	115	HIS	2.8
1	A	333	ALA	2.8
1	B	333	ALA	2.8
1	B	160	GLY	2.8
1	D	387	TYR	2.8
1	B	133	MET	2.7
1	B	218	GLU	2.7
1	B	189	ASN	2.7
1	B	101	ASP	2.7
1	B	104	LEU	2.7
1	B	146	TYR	2.7
1	D	103	HIS	2.7
1	B	340	ALA	2.7
1	D	280	LEU	2.7
1	D	119	ILE	2.7
1	A	354	LYS	2.6
1	D	392	ALA	2.6
1	A	222	TYR	2.6
1	D	97	VAL	2.6
1	A	283	GLN	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	239	GLY	2.6
1	A	114	ALA	2.6
1	D	396	ARG	2.6
1	D	355	SER	2.6
1	C	98	VAL	2.5
1	D	41	GLN	2.5
1	A	156	GLY	2.5
1	A	14	ASN	2.5
1	B	337	ASP	2.4
1	A	478	THR	2.4
1	D	397	THR	2.4
1	A	376	LYS	2.4
1	D	118	GLY	2.4
1	D	283	GLN	2.4
1	C	97	VAL	2.4
1	D	407	ILE	2.4
1	D	104	LEU	2.4
1	A	257	LEU	2.4
1	B	257	LEU	2.4
1	D	353	GLU	2.4
1	D	14	ASN	2.4
1	C	430	LEU	2.3
1	A	160	GLY	2.3
1	D	64	HIS	2.3
1	B	280	LEU	2.3
1	D	328	ARG	2.3
1	C	413	ILE	2.3
1	C	238	ASN	2.3
1	C	479	GLY	2.3
1	D	96	ASP	2.3
1	A	95	LYS	2.3
1	B	315	LYS	2.2
1	C	160	GLY	2.2
1	A	96	ASP	2.2
1	D	160	GLY	2.2
1	B	180	MET	2.2
1	D	110	ILE	2.2
1	B	331	PRO	2.1
1	B	93	ALA	2.1
1	A	134	LEU	2.1
1	B	253	GLU	2.1
1	A	397	THR	2.1

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Mol	Chain	Res	Type	RSRZ
1	D	145	GLU	2.1
1	B	87	TYR	2.1
1	A	467	ARG	2.1
1	D	257	LEU	2.1
1	D	297	LEU	2.1
1	C	133	MET	2.1
1	D	388	ASP	2.1
1	A	351	GLY	2.1
1	D	390	ALA	2.1
1	B	219	ARG	2.0
1	B	323	PRO	2.0
1	D	332	SER	2.0
1	D	371	ALA	2.0
1	A	100	THR	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 oligosaccharides 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.