Full wwPDB X-ray Structure Validation Report ⓘ

Sep 22, 2025 – 06:08 PM JST

PDB ID	:	9JSA / pdb_00009jsa
Title	:	CatPSAM-H8
Authors	:	Makabe, K.
Deposited on	:	2024-09-30
Resolution	:	2.20 Å(reported)

The following versions of software and data (see references ⓘ) were used in the production of this report:

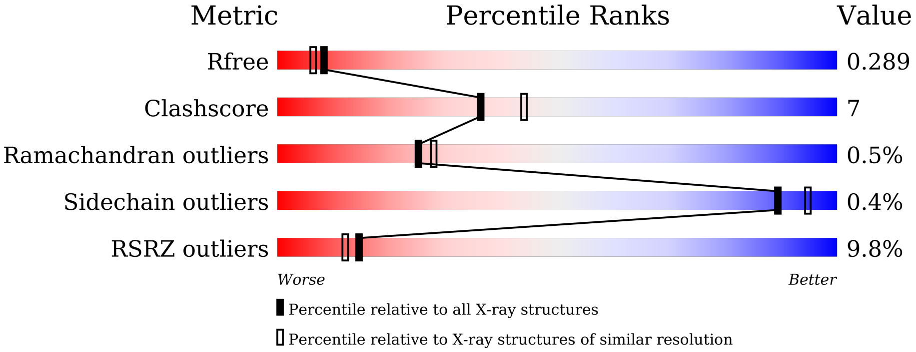
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

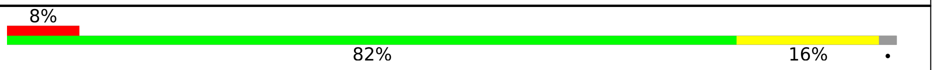
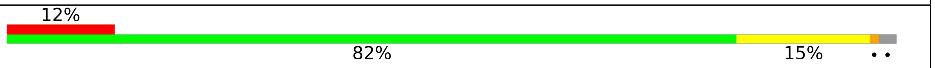
The reported resolution of this entry is 2.20 Å.

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}	164625	5791 (2.20-2.20)
Clashscore	180529	6634 (2.20-2.20)
Ramachandran outliers	177936	6560 (2.20-2.20)
Sidechain outliers	177891	6561 (2.20-2.20)
RSRZ outliers	164620	5791 (2.20-2.20)

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 <=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	320	
1	B	320	

2 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 5010 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 Outer Surface Protein A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	315	2378	1454	408	515	1	0	0	0
1	B	315	2378	1454	408	515	1	0	0	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	123	HIS	TYR	conflict	UNP D0VWU8
A	125	LYS	LEU	conflict	UNP D0VWU8
A	134	GLU	LEU	conflict	UNP D0VWU8
A	136	HIS	TYR	conflict	UNP D0VWU8
A	146	HIS	TYR	conflict	UNP D0VWU8
A	148	LYS	LEU	conflict	UNP D0VWU8
A	157	GLU	LEU	conflict	UNP D0VWU8
A	159	HIS	TYR	conflict	UNP D0VWU8
A	169	HIS	TYR	conflict	UNP D0VWU8
A	171	LYS	LEU	conflict	UNP D0VWU8
A	182	HIS	LYS	conflict	UNP D0VWU8
A	192	HIS	TYR	conflict	UNP D0VWU8
A	194	LYS	LEU	conflict	UNP D0VWU8
A	201	VAL	LEU	conflict	UNP D0VWU8
A	203	GLU	LEU	conflict	UNP D0VWU8
A	205	HIS	TYR	conflict	UNP D0VWU8
B	123	HIS	TYR	conflict	UNP D0VWU8
B	125	LYS	LEU	conflict	UNP D0VWU8
B	134	GLU	LEU	conflict	UNP D0VWU8
B	136	HIS	TYR	conflict	UNP D0VWU8
B	146	HIS	TYR	conflict	UNP D0VWU8
B	148	LYS	LEU	conflict	UNP D0VWU8
B	157	GLU	LEU	conflict	UNP D0VWU8
B	159	HIS	TYR	conflict	UNP D0VWU8
B	169	HIS	TYR	conflict	UNP D0VWU8

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Chain	Residue	Modelled	Actual	Comment	Reference
B	171	LYS	LEU	conflict	UNP D0VWU8
B	182	HIS	LYS	conflict	UNP D0VWU8
B	192	HIS	TYR	conflict	UNP D0VWU8
B	194	LYS	LEU	conflict	UNP D0VWU8
B	201	VAL	LEU	conflict	UNP D0VWU8
B	203	GLU	LEU	conflict	UNP D0VWU8
B	205	HIS	TYR	conflict	UNP D0VWU8

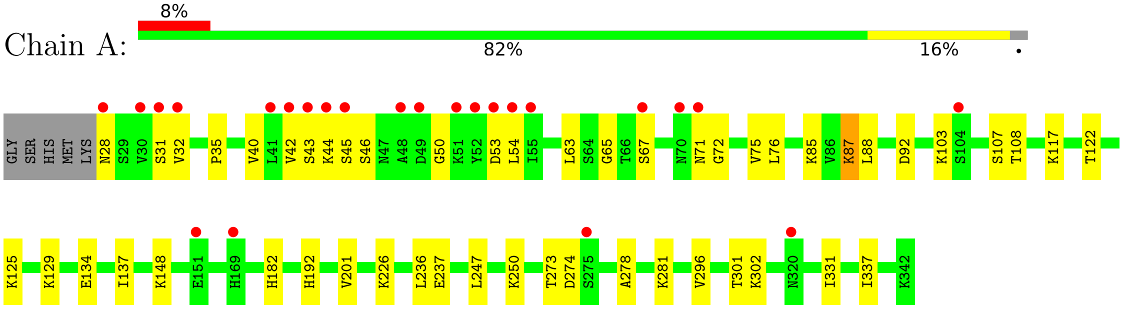
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	196	Total O 196 196	0	0
2	B	58	Total O 58 58	0	0

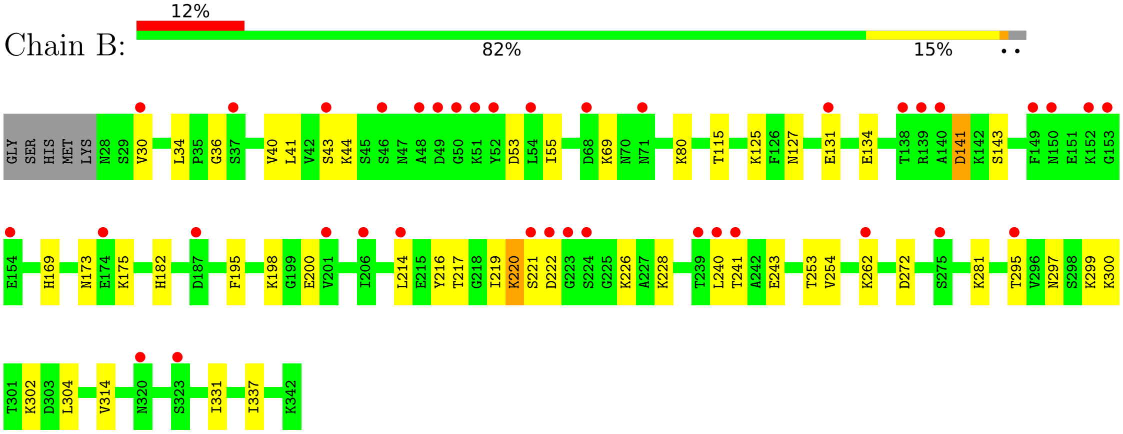
3 Residue-property plots ⓘ

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: Outer Surface Protein A



- Molecule 1: Outer Surface Protein A



4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	36.20Å 79.45Å 227.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20 20.00 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.9 (20.00-2.20) 99.8 (20.00-2.20)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.92 (at 2.19Å)	Xtriage
Refinement program	PHENIX 1.171	Depositor
R, R_{free}	0.263 , 0.288 0.264 , 0.289	Depositor DCC
R_{free} test set	1757 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å^2)	38.8	Xtriage
Anisotropy	0.322	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 38.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	5010	wwPDB-VP
Average B, all atoms (Å^2)	57.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.53% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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	0.38	0/2398	0.62	1/3217 (0.0%)
1	B	0.25	0/2398	0.52	0/3217
All	All	0.32	0/4796	0.57	1/6434 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	72	GLY	N-CA-C	-5.58	107.32	114.85

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	2378	0	2398	35	0
1	B	2378	0	2398	33	0
2	A	196	0	0	8	0
2	B	58	0	0	5	0
All	All	5010	0	4796	68	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 7.

All (68) 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:41:LEU:HB2	1:B:55:ILE:HG22	1.66	0.75
1:B:331:ILE:HD13	1:B:337:ILE:HG12	1.70	0.74
1:A:103:LYS:NZ	2:A:405:HOH:O	2.25	0.69
1:B:198:LYS:HB2	1:B:200:GLU:HB2	1.76	0.67
1:B:141:ASP:HB3	1:B:143:SER:H	1.60	0.65
1:A:182:HIS:HB2	1:A:192:HIS:HD2	1.62	0.64
1:B:241:THR:HG22	1:B:243:GLU:H	1.64	0.62
1:A:125:LYS:NZ	2:A:408:HOH:O	2.32	0.60
1:A:32:VAL:HG22	1:A:40:VAL:HG12	1.85	0.59
1:B:44:LYS:NZ	2:B:407:HOH:O	2.34	0.58
1:A:302:LYS:NZ	2:A:409:HOH:O	2.35	0.57
1:A:226:LYS:NZ	2:A:410:HOH:O	2.36	0.57
1:B:295:THR:HG22	1:B:300:LYS:HA	1.88	0.55
1:B:69:LYS:HA	1:B:69:LYS:HE3	1.90	0.54
1:B:299:LYS:HD3	2:B:402:HOH:O	2.08	0.53
1:A:281:LYS:HG3	1:A:296:VAL:HG22	1.91	0.52
1:B:80:LYS:NZ	2:B:404:HOH:O	2.29	0.52
1:B:34:LEU:HD11	1:B:40:VAL:HB	1.92	0.52
1:A:43:SER:HB3	1:A:53:ASP:H	1.74	0.52
1:B:216:TYR:CD1	1:B:240:LEU:HD22	2.45	0.51
1:A:35:PRO:HG3	1:A:117:LYS:HD3	1.93	0.50
1:B:254:VAL:HG21	1:B:281:LYS:HD3	1.94	0.50
1:B:297:ASN:HB3	2:B:402:HOH:O	2.12	0.50
1:A:28:ASN:CA	1:A:44:LYS:HG3	2.42	0.49
1:B:217:THR:HB	1:B:226:LYS:HB3	1.94	0.49
1:A:43:SER:OG	1:A:45:SER:O	2.30	0.49
1:A:250:LYS:O	2:A:401:HOH:O	2.20	0.49
1:A:31:SER:HA	1:A:40:VAL:O	2.12	0.49
1:B:220:LYS:HB2	1:B:222:ASP:OD1	2.12	0.49
1:A:54:LEU:HD11	1:A:67:SER:HB3	1.94	0.49
1:B:216:TYR:HB3	1:B:219:ILE:HD11	1.95	0.48
1:B:214:LEU:HD13	1:B:216:TYR:OH	2.13	0.48
1:A:46:SER:OG	1:A:50:GLY:HA2	2.12	0.48
1:A:182:HIS:HB2	1:A:192:HIS:CD2	2.44	0.48
1:B:195:PHE:HA	1:B:200:GLU:O	2.14	0.47
1:A:278:ALA:O	2:A:402:HOH:O	2.20	0.47
1:A:32:VAL:HG22	1:A:40:VAL:CG1	2.45	0.46
1:A:301:THR:HG23	1:A:302:LYS:HG2	1.98	0.46
1:A:42:VAL:HA	1:A:53:ASP:O	2.16	0.45
1:A:122:THR:HG22	1:A:137:ILE:HG12	1.99	0.45
1:A:273:THR:O	1:A:274:ASP:C	2.60	0.44
1:B:200:GLU:CD	1:B:221:SER:HB2	2.42	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:65:GLY:HA3	1:A:75:VAL:O	2.17	0.44
1:A:28:ASN:N	1:A:44:LYS:HG3	2.32	0.44
1:B:173:ASN:OD1	1:B:175:LYS:HG2	2.18	0.43
1:A:331:ILE:HG21	1:A:337:ILE:HG13	1.99	0.43
1:B:127:ASN:HD21	1:B:131:GLU:HG2	1.83	0.43
1:B:304:LEU:CD2	1:B:314:VAL:HG22	2.48	0.43
1:A:236:LEU:C	1:A:247:LEU:HD22	2.43	0.43
1:A:134:GLU:HG2	1:A:148:LYS:HG2	2.01	0.42
1:A:301:THR:HG21	2:A:533:HOH:O	2.18	0.42
1:B:30:VAL:HG23	1:B:44:LYS:HD3	2.01	0.42
1:A:237:GLU:C	1:A:247:LEU:HD23	2.45	0.42
1:A:71:ASN:ND2	1:A:92:ASP:O	2.53	0.42
1:A:201:VAL:HG12	2:A:513:HOH:O	2.18	0.42
1:A:107:SER:OG	1:A:108:THR:N	2.53	0.41
1:B:262:LYS:HG3	2:B:424:HOH:O	2.20	0.41
1:B:253:THR:OG1	1:B:272:ASP:OD1	2.31	0.41
1:B:36:GLY:HA2	1:B:115:THR:HG21	2.03	0.41
1:B:125:LYS:HB2	1:B:134:GLU:HG2	2.02	0.41
1:B:169:HIS:HB3	1:B:182:HIS:HB3	2.01	0.41
1:B:226:LYS:HE2	1:B:228:LYS:HD3	2.02	0.41
1:A:85:LYS:HB3	1:A:85:LYS:HE3	1.89	0.41
1:B:127:ASN:ND2	1:B:131:GLU:HG2	2.36	0.41
1:A:63:LEU:HB3	1:A:76:LEU:HB3	2.02	0.40
1:B:302:LYS:HB3	1:B:302:LYS:HE2	1.73	0.40
1:A:87:LYS:HB2	1:A:87:LYS:HE2	1.88	0.40
1:B:43:SER:OG	1:B:53:ASP:N	2.53	0.40

There are no symmetry-related clashes.

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	A	313/320 (98%)	304 (97%)	8 (3%)	1 (0%)	37	42
1	B	313/320 (98%)	298 (95%)	13 (4%)	2 (1%)	22	23
All	All	626/640 (98%)	602 (96%)	21 (3%)	3 (0%)	25	28

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	129	LYS
1	B	141	ASP
1	B	220	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	275/279 (99%)	273 (99%)	2 (1%)	81	90
1	B	275/279 (99%)	275 (100%)	0	100	100
All	All	550/558 (99%)	548 (100%)	2 (0%)	89	95

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	87	LYS
1	A	88	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	123	HIS
1	A	146	HIS
1	A	169	HIS
1	A	316	GLN
1	B	159	HIS
1	B	205	HIS

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Mol	Chain	Res	Type
1	B	259	ASN

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 oligosaccharides 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, 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	315/320 (98%)	0.52	24 (7%)	21	19	27, 41, 105, 163	0
1	B	315/320 (98%)	1.04	38 (12%)	10	8	38, 66, 103, 115	0
All	All	630/640 (98%)	0.78	62 (9%)	14	12	27, 56, 103, 163	0

All (62) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	70	ASN	4.7
1	B	140	ALA	4.4
1	A	275	SER	4.2
1	B	48	ALA	3.8
1	A	320	ASN	3.7
1	B	71	ASN	3.7
1	A	71	ASN	3.3
1	B	241	THR	3.2
1	B	224	SER	3.2
1	A	48	ALA	3.2
1	B	37	SER	2.9
1	B	320	ASN	2.9
1	A	53	ASP	2.8
1	B	262	LYS	2.8
1	B	152	LYS	2.6
1	A	42	VAL	2.6
1	B	153	GLY	2.6
1	B	68	ASP	2.6
1	B	154	GLU	2.6
1	A	43	SER	2.6
1	B	223	GLY	2.5
1	A	104	SER	2.5
1	B	206	ILE	2.5
1	A	51	LYS	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	150	ASN	2.5
1	B	275	SER	2.4
1	A	54	LEU	2.4
1	B	49	ASP	2.4
1	A	28	ASN	2.4
1	A	45	SER	2.4
1	B	54	LEU	2.4
1	B	214	LEU	2.4
1	B	131	GLU	2.3
1	B	138	THR	2.3
1	B	43	SER	2.3
1	A	44	LYS	2.3
1	B	51	LYS	2.2
1	A	41	LEU	2.2
1	B	295	THR	2.2
1	B	221	SER	2.2
1	B	174	GLU	2.2
1	B	201	VAL	2.2
1	A	52	TYR	2.2
1	A	30	VAL	2.2
1	B	187	ASP	2.2
1	B	139	ARG	2.1
1	B	52	TYR	2.1
1	A	151	GLU	2.1
1	B	50	GLY	2.1
1	B	30	VAL	2.1
1	B	149	PHE	2.1
1	B	46	SER	2.1
1	A	169	HIS	2.1
1	B	239	THR	2.1
1	A	31	SER	2.1
1	A	55	ILE	2.1
1	A	32	VAL	2.0
1	B	222	ASP	2.0
1	B	240	LEU	2.0
1	A	49	ASP	2.0
1	A	67	SER	2.0
1	B	323	SER	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.