



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 6, 2023 – 11:18 PM EDT

PDB ID : 1KL4
Title : AN ENGINEERED STREPTAVIDIN WITH IMPROVED AFFINITY FOR
THE STREP-TAG II PEPTIDE : apo-SAM2
Authors : Korndorfer, I.P.; Skerra, A.
Deposited on : 2001-12-11
Resolution : 1.70 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 : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.35
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) : 2.35

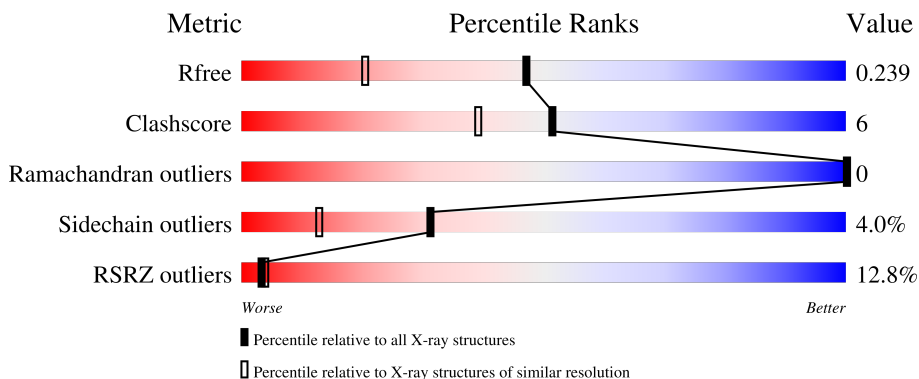
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

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	127	 9% 83% 10% • 6%
1	B	127	 10% 80% 11% • 6%
1	C	127	 13% 83% 9% • 6%
1	D	127	 17% 81% 13% 6%

2 Entry composition i

There are 2 unique types of molecules in this entry. The entry contains 3775 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 streptavidin.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
1	A	120	899	563	159	177	0	0	0
1	B	120	897	561	159	177	0	0	0
1	C	119	892	558	158	176	0	0	0
1	D	119	892	558	158	176	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	13	MET	-	initiating methionine	UNP P22629
A	44	ILE	GLU	engineered mutation	UNP P22629
A	45	GLY	SER	engineered mutation	UNP P22629
A	47	ARG	VAL	engineered mutation	UNP P22629
B	13	MET	-	initiating methionine	UNP P22629
B	44	ILE	GLU	engineered mutation	UNP P22629
B	45	GLY	SER	engineered mutation	UNP P22629
B	47	ARG	VAL	engineered mutation	UNP P22629
C	13	MET	-	initiating methionine	UNP P22629
C	44	ILE	GLU	engineered mutation	UNP P22629
C	45	GLY	SER	engineered mutation	UNP P22629
C	47	ARG	VAL	engineered mutation	UNP P22629
D	13	MET	-	initiating methionine	UNP P22629
D	44	ILE	GLU	engineered mutation	UNP P22629
D	45	GLY	SER	engineered mutation	UNP P22629
D	47	ARG	VAL	engineered mutation	UNP P22629

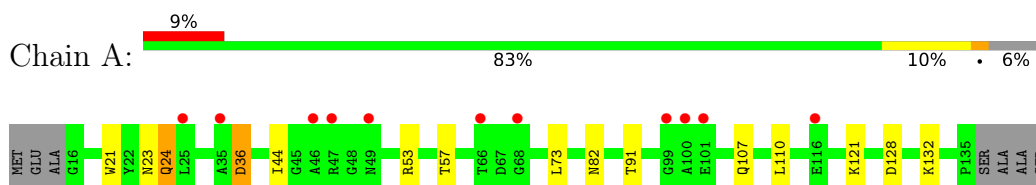
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	51	Total O 51 51	0	0
2	B	51	Total O 51 51	0	0
2	C	59	Total O 59 59	0	0
2	D	34	Total O 34 34	0	0

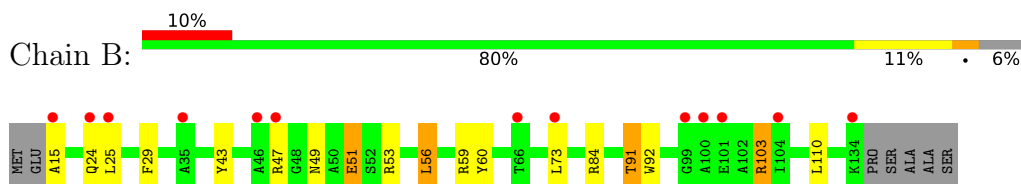
3 Residue-property plots [i](#)

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.

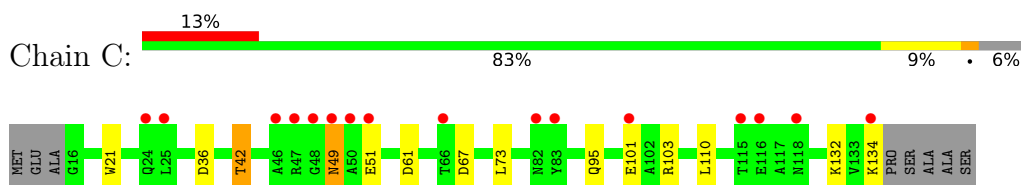
- Molecule 1: streptavidin



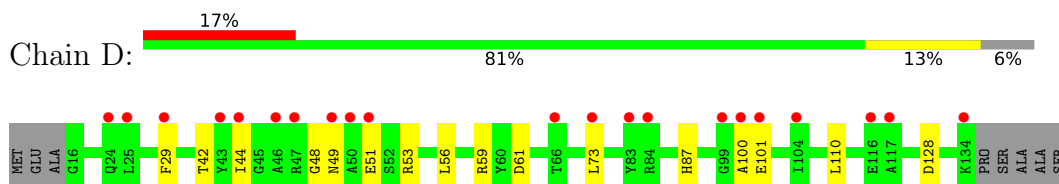
- Molecule 1: streptavidin



- Molecule 1: streptavidin



- Molecule 1: streptavidin



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	58.45Å 86.81Å 47.08Å 90.00° 98.82° 90.00°	Depositor
Resolution (Å)	20.52 – 1.70 20.52 – 1.69	Depositor EDS
% Data completeness (in resolution range)	93.8 (20.52-1.70) 93.4 (20.52-1.69)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.01	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.03 (at 1.69Å)	Xtrriage
Refinement program	CNS, REFMAC	Depositor
R, R_{free}	0.191 , 0.228 0.203 , 0.239	Depositor DCC
R_{free} test set	2387 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	22.8	Xtrriage
Anisotropy	0.266	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 58.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3775	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.15% 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	0.92	0/922	1.42	3/1261 (0.2%)
1	B	0.95	2/919 (0.2%)	1.49	10/1256 (0.8%)
1	C	0.92	0/914	1.40	6/1249 (0.5%)
1	D	0.85	0/914	1.31	2/1249 (0.2%)
All	All	0.91	2/3669 (0.1%)	1.41	21/5015 (0.4%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	92	TRP	CB-CG	-6.38	1.38	1.50
1	B	29	PHE	CD1-CE1	-5.04	1.29	1.39

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	128	ASP	CB-CG-OD2	13.82	130.74	118.30
1	B	84	ARG	NE-CZ-NH2	-9.72	115.44	120.30
1	C	42	THR	OG1-CB-CG2	-9.18	88.88	110.00
1	B	51	GLU	OE1-CD-OE2	-8.12	113.55	123.30
1	C	67	ASP	CB-CG-OD2	8.03	125.53	118.30
1	C	36	ASP	CB-CG-OD2	7.17	124.75	118.30
1	D	61	ASP	CB-CG-OD1	7.12	124.71	118.30
1	A	36	ASP	CB-CG-OD2	6.54	124.19	118.30
1	B	60	TYR	CB-CG-CD2	6.39	124.83	121.00
1	A	128	ASP	CB-CG-OD1	-6.33	112.60	118.30
1	B	92	TRP	CA-CB-CG	6.25	125.56	113.70
1	B	53	ARG	NE-CZ-NH2	-6.08	117.26	120.30
1	C	95	GLN	CA-CB-CG	5.94	126.46	113.40
1	B	91	THR	CA-CB-CG2	-5.79	104.30	112.40
1	B	56	LEU	CB-CG-CD2	-5.60	101.48	111.00
1	B	91	THR	N-CA-CB	5.50	120.76	110.30
1	C	36	ASP	OD1-CG-OD2	-5.49	112.87	123.30
1	B	60	TYR	CB-CG-CD1	-5.46	117.72	121.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	59	ARG	NE-CZ-NH1	5.25	122.92	120.30
1	C	49	ASN	N-CA-CB	-5.09	101.44	110.60
1	B	103	ARG	NE-CZ-NH1	5.01	122.81	120.30

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	899	0	850	12	1
1	B	897	0	848	10	1
1	C	892	0	843	11	0
1	D	892	0	843	10	0
2	A	51	0	0	0	0
2	B	51	0	0	4	0
2	C	59	0	0	0	0
2	D	34	0	0	0	0
All	All	3775	0	3384	39	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 6.

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:B:49:ASN:ND2	1:B:51:GLU:OE1	1.87	1.05
1:C:101:GLU:HA	1:C:101:GLU:OE1	1.57	1.03
1:A:24:GLN:NE2	1:A:24:GLN:H	1.63	0.96
1:B:15:ALA:HA	2:B:179:HOH:O	1.77	0.82
1:B:43:TYR:OH	2:B:185:HOH:O	2.01	0.77
1:C:49:ASN:ND2	1:C:51:GLU:HG3	2.01	0.75
1:C:61:ASP:OD2	1:D:87:HIS:HD2	1.71	0.73
1:A:24:GLN:NE2	1:A:24:GLN:N	2.37	0.70
1:A:23:ASN:HB2	1:A:24:GLN:NE2	2.09	0.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:23:ASN:HB2	1:A:24:GLN:HE22	1.59	0.68
1:D:49:ASN:ND2	1:D:51:GLU:OE1	2.27	0.67
1:C:49:ASN:ND2	1:C:51:GLU:CG	2.60	0.64
1:A:24:GLN:N	1:A:24:GLN:HE21	1.95	0.63
1:B:15:ALA:N	2:B:159:HOH:O	2.35	0.58
1:A:21:TRP:CZ2	1:A:132:LYS:HE3	2.40	0.56
1:B:51:GLU:H	1:B:51:GLU:CD	2.10	0.56
1:A:24:GLN:H	1:A:24:GLN:CD	2.15	0.50
1:D:100:ALA:O	1:D:101:GLU:HB2	2.12	0.50
1:C:21:TRP:CZ2	1:C:132:LYS:HE3	2.47	0.49
1:C:49:ASN:HD22	1:C:51:GLU:HB2	1.76	0.49
1:C:103:ARG:HH11	1:C:103:ARG:HG3	1.78	0.49
1:D:100:ALA:O	1:D:101:GLU:CB	2.62	0.48
1:A:91:THR:HB	1:B:91:THR:HB	1.97	0.47
1:D:29:PHE:CD1	1:D:56:LEU:HD22	2.50	0.46
1:A:36:ASP:N	1:A:36:ASP:OD1	2.46	0.46
1:C:61:ASP:OD2	1:D:87:HIS:CD2	2.59	0.46
1:C:101:GLU:O	1:C:103:ARG:NH1	2.47	0.46
1:C:73:LEU:HD12	1:C:73:LEU:C	2.37	0.45
1:B:103:ARG:HD2	2:B:184:HOH:O	2.17	0.44
1:B:103:ARG:HE	1:B:103:ARG:HB3	1.44	0.44
1:C:110:LEU:C	1:C:110:LEU:HD23	2.37	0.44
1:A:110:LEU:C	1:A:110:LEU:HD23	2.39	0.43
1:D:44:ILE:HG12	1:D:53:ARG:HG2	2.00	0.43
1:D:51:GLU:H	1:D:51:GLU:CD	2.22	0.42
1:D:110:LEU:C	1:D:110:LEU:HD23	2.40	0.42
1:B:51:GLU:OE2	1:B:51:GLU:N	2.54	0.41
1:A:57:THR:HG22	1:B:59:ARG:HG2	2.02	0.40
1:D:44:ILE:HG22	1:D:48:GLY:HA2	2.02	0.40
1:A:44:ILE:CD1	1:A:53:ARG:NH1	2.84	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:82:ASN:O	1:B:47:ARG:NH1[1_556]	2.14	0.06

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	118/127 (93%)	116 (98%)	2 (2%)	0	100	100
1	B	118/127 (93%)	115 (98%)	3 (2%)	0	100	100
1	C	117/127 (92%)	114 (97%)	3 (3%)	0	100	100
1	D	117/127 (92%)	113 (97%)	4 (3%)	0	100	100
All	All	470/508 (92%)	458 (97%)	12 (3%)	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	88/92 (96%)	84 (96%)	4 (4%)	27	10
1	B	87/92 (95%)	82 (94%)	5 (6%)	20	6
1	C	87/92 (95%)	85 (98%)	2 (2%)	50	33
1	D	87/92 (95%)	84 (97%)	3 (3%)	37	18
All	All	349/368 (95%)	335 (96%)	14 (4%)	31	13

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	24	GLN
1	A	73	LEU

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Mol	Chain	Res	Type
1	A	107	GLN
1	A	121	LYS
1	B	24	GLN
1	B	25	LEU
1	B	56	LEU
1	B	73	LEU
1	B	110	LEU
1	C	42	THR
1	C	134	LYS
1	D	42	THR
1	D	73	LEU
1	D	128	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	24	GLN
1	A	105	ASN
1	B	127	HIS
1	C	24	GLN
1	C	49	ASN
1	D	87	HIS
1	D	105	ASN
1	D	127	HIS

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

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	120/127 (94%)	0.55	11 (9%) 9 10	13, 22, 42, 56	0
1	B	120/127 (94%)	0.67	13 (10%) 5 6	13, 21, 42, 49	0
1	C	119/127 (93%)	0.82	16 (13%) 3 3	14, 21, 44, 61	0
1	D	119/127 (93%)	0.91	21 (17%) 1 1	14, 25, 49, 63	0
All	All	478/508 (94%)	0.74	61 (12%) 3 4	13, 22, 44, 63	0

All (61) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	46	ALA	8.8
1	D	47	ARG	8.5
1	D	46	ALA	8.4
1	C	47	ARG	8.0
1	D	100	ALA	6.9
1	B	15	ALA	6.0
1	A	47	ARG	6.0
1	C	49	ASN	5.6
1	B	47	ARG	5.1
1	B	25	LEU	4.7
1	C	24	GLN	4.6
1	D	25	LEU	4.5
1	B	66	THR	4.5
1	C	101	GLU	4.4
1	B	134	LYS	3.9
1	B	24	GLN	3.9
1	D	24	GLN	3.9
1	A	66	THR	3.8
1	D	99	GLY	3.8
1	C	83	TYR	3.7
1	C	51	GLU	3.6

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Mol	Chain	Res	Type	RSRZ
1	D	101	GLU	3.5
1	D	117	ALA	3.5
1	D	50	ALA	3.4
1	A	46	ALA	3.3
1	B	100	ALA	3.3
1	D	83	TYR	3.3
1	D	29	PHE	3.3
1	B	35	ALA	3.2
1	D	134	LYS	3.1
1	C	50	ALA	3.1
1	C	25	LEU	3.0
1	D	73	LEU	3.0
1	B	46	ALA	2.9
1	C	115	THR	2.7
1	A	68	GLY	2.7
1	D	51	GLU	2.7
1	D	84	ARG	2.7
1	D	43	TYR	2.7
1	C	82	ASN	2.6
1	B	99	GLY	2.6
1	C	116	GLU	2.6
1	D	116	GLU	2.6
1	A	116	GLU	2.5
1	D	49	ASN	2.5
1	A	35	ALA	2.4
1	B	101	GLU	2.3
1	B	73	LEU	2.3
1	D	104	ILE	2.3
1	D	66	THR	2.3
1	A	101	GLU	2.3
1	A	99	GLY	2.3
1	C	134	LYS	2.3
1	C	48	GLY	2.2
1	A	100	ALA	2.2
1	B	104	ILE	2.2
1	D	44	ILE	2.2
1	C	66	THR	2.1
1	A	49	ASN	2.1
1	A	25	LEU	2.1
1	C	118	ASN	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 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.