



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 08:18 PM UTC

PDB ID : 5BNB / pdb_00005bnb
Title : Crystal structure of a Ube2S-ubiquitin conjugate
Authors : Lorenz, S.G.; Feiler, C.G.; Kuriyan, J.
Deposited on : 2015-05-25
Resolution : 2.49 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:

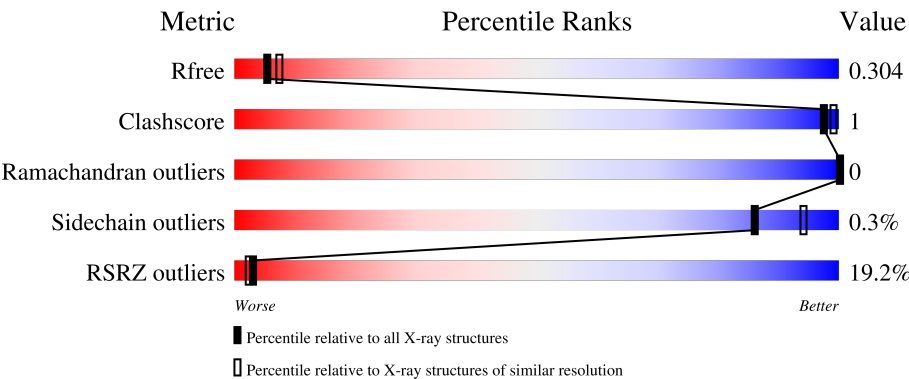
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance i

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

The reported resolution of this entry is 2.49 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	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	156	4% 94% • •
1	B	156	4% 95% • •
1	C	156	17% 92% • • 5%
1	D	156	36% 74% • 26%
2	E	76	3% 97% •

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Mol	Chain	Length	Quality of chain
2	F	76	% 92% 5%
2	G	76	38% 89% 5% 5%
2	I	76	46% 89% 11%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 12010 atoms, of which 5775 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 Ubiquitin-conjugating enzyme E2 S.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	150	Total	C	H	N	O	S	0	0	0
			2277	741	1130	192	211	3			
1	B	150	Total	C	H	N	O	S	0	0	0
			2312	748	1157	198	206	3			
1	C	148	Total	C	H	N	O	S	0	0	0
			2149	711	1053	188	195	2			
1	D	116	Total	C	H	N	O	S	0	0	0
			1348	476	601	127	143	1			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	118	MET	CYS	engineered mutation	UNP Q16763
B	118	MET	CYS	engineered mutation	UNP Q16763
C	118	MET	CYS	engineered mutation	UNP Q16763
D	118	MET	CYS	engineered mutation	UNP Q16763

- Molecule 2 is a protein called Polyubiquitin-B.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	E	76	Total	C	H	N	O	S	0	0	0
			1192	371	602	100	117	2			
2	F	72	Total	C	H	N	O	S	0	0	0
			1102	347	554	93	107	1			
2	G	72	Total	C	H	N	O		0	0	0
			781	279	329	80	93				
2	I	68	Total	C	H	N	O	S	0	0	0
			789	275	349	76	88	1			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	76	CYS	GLY	engineered mutation	UNP P0CG47
F	76	CYS	GLY	engineered mutation	UNP P0CG47
G	76	CYS	GLY	engineered mutation	UNP P0CG47
I	76	CYS	GLY	engineered mutation	UNP P0CG47

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	21	Total O 21 21	0	0
3	B	15	Total O 15 15	0	0
3	C	8	Total O 8 8	0	0
3	E	9	Total O 9 9	0	0
3	F	7	Total O 7 7	0	0

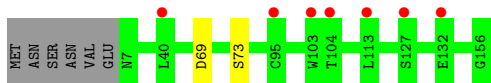
3 Residue-property plots [i](#)

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.

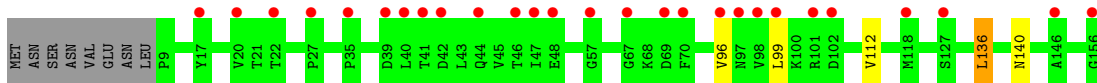
- Molecule 1: Ubiquitin-conjugating enzyme E2 S



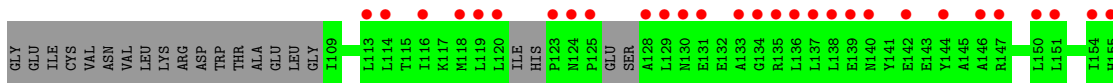
- Molecule 1: Ubiquitin-conjugating enzyme E2 S



- Molecule 1: Ubiquitin-conjugating enzyme E2 S



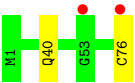
- Molecule 1: Ubiquitin-conjugating enzyme E2 S



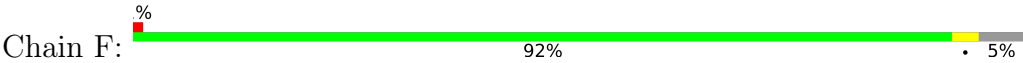
GLY

- Molecule 2: Polyubiquitin-B

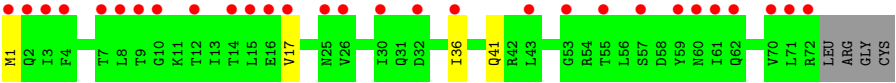
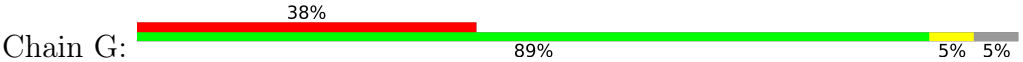




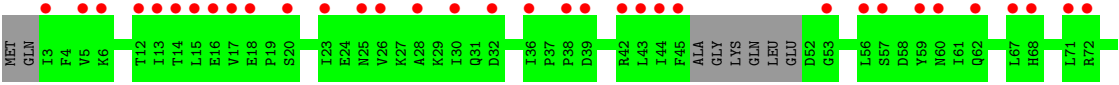
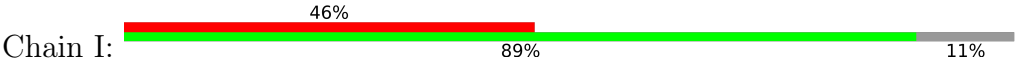
● Molecule 2: Polyubiquitin-B



● Molecule 2: Polyubiquitin-B



● Molecule 2: Polyubiquitin-B



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	94.91Å 45.85Å 110.58Å 90.00° 93.14° 90.00°	Depositor
Resolution (Å)	47.38 – 2.49 47.38 – 2.49	Depositor EDS
% Data completeness (in resolution range)	97.1 (47.38-2.49) 97.1 (47.38-2.49)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.23 (at 2.48Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.243 , 0.304 0.249 , 0.304	Depositor DCC
R_{free} test set	1649 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å ²)	47.0	Xtriage
Anisotropy	0.427	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 63.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	12010	wwPDB-VP
Average B, all atoms (Å ²)	72.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.18% 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	0.30	0/1176	0.63	0/1609
1	B	0.27	0/1184	0.61	0/1615
1	C	0.28	0/1125	0.64	0/1541
1	D	0.31	0/763	0.68	0/1055
2	E	0.28	0/596	0.58	0/803
2	F	0.28	0/554	0.65	0/751
2	G	0.28	0/457	0.63	0/630
2	I	0.32	0/445	0.66	0/611
All	All	0.29	0/6300	0.63	0/8615

There are no bond length outliers.

There are no bond angle outliers.

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	1147	1130	1130	2	0
1	B	1155	1157	1157	1	0
1	C	1096	1053	1053	3	0
1	D	747	601	601	1	0
2	E	590	602	602	1	0
2	F	548	554	554	1	0
2	G	452	329	329	2	0
2	I	440	349	348	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	21	0	0	1	0
3	B	15	0	0	0	0
3	C	8	0	0	0	0
3	E	9	0	0	0	0
3	F	7	0	0	0	0
All	All	6235	5775	5774	10	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 (10) 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)
2:G:1:MET:N	2:G:17:VAL:O	2.25	0.69
1:C:99:LEU:HD23	1:C:112:VAL:HG13	1.85	0.58
1:A:11:HIS:ND1	3:A:201:HOH:O	2.32	0.58
1:B:69:ASP:O	1:B:73:SER:N	2.38	0.56
1:A:36:ASN:ND2	1:A:39:ASP:O	2.45	0.49
1:C:96:VAL:N	2:E:76:CYS:SG	2.88	0.46
2:G:36:ILE:O	2:G:41:GLN:NE2	2.48	0.46
2:F:36:ILE:O	2:F:41:GLN:NE2	2.50	0.42
1:D:55:TYR:N	1:D:55:TYR:CD1	2.88	0.41
1:C:136:LEU:O	1:C:140:ASN:N	2.47	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	148/156 (95%)	141 (95%)	7 (5%)	0	100	100
1	B	148/156 (95%)	145 (98%)	3 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	146/156 (94%)	142 (97%)	4 (3%)	0	100	100
1	D	108/156 (69%)	103 (95%)	5 (5%)	0	100	100
2	E	74/76 (97%)	72 (97%)	2 (3%)	0	100	100
2	F	70/76 (92%)	69 (99%)	1 (1%)	0	100	100
2	G	70/76 (92%)	64 (91%)	6 (9%)	0	100	100
2	I	64/76 (84%)	59 (92%)	5 (8%)	0	100	100
All	All	828/928 (89%)	795 (96%)	33 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	120/134 (90%)	120 (100%)	0	100	100
1	B	120/134 (90%)	120 (100%)	0	100	100
1	C	106/134 (79%)	105 (99%)	1 (1%)	70	87
1	D	55/134 (41%)	55 (100%)	0	100	100
2	E	66/69 (96%)	65 (98%)	1 (2%)	57	80
2	F	60/69 (87%)	60 (100%)	0	100	100
2	G	29/69 (42%)	29 (100%)	0	100	100
2	I	34/69 (49%)	34 (100%)	0	100	100
All	All	590/812 (73%)	588 (100%)	2 (0%)	86	94

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

Mol	Chain	Res	Type
1	C	136	LEU
2	E	40	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such

sidechains are listed below:

Mol	Chain	Res	Type
2	E	68	HIS
2	F	40	GLN
2	G	41	GLN
2	G	68	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 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(Å²)	Q<0.9
1	A	150/156 (96%)	0.32	7 (4%)	36	32	35, 49, 77, 90	0
1	B	150/156 (96%)	0.62	7 (4%)	36	32	46, 62, 86, 90	0
1	C	148/156 (94%)	1.25	27 (18%)	3	2	53, 82, 102, 109	0
1	D	116/156 (74%)	2.03	56 (48%)	0	0	75, 94, 111, 121	0
2	E	76/76 (100%)	0.22	2 (2%)	57	52	38, 50, 80, 102	0
2	F	72/76 (94%)	0.50	1 (1%)	73	70	48, 67, 80, 82	0
2	G	72/76 (94%)	1.71	29 (40%)	0	0	73, 96, 110, 116	0
2	I	68/76 (89%)	2.10	35 (51%)	0	0	90, 106, 121, 134	0
All	All	852/928 (91%)	1.03	164 (19%)	3	2	35, 76, 108, 134	0

All (164) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	134	GLY	6.1
2	I	36	ILE	5.3
1	C	99	LEU	5.1
1	D	133	ALA	4.9
1	C	102	ASP	4.8
1	C	96	VAL	4.7
1	D	7	ASN	4.6
1	D	56	ALA	4.4
1	D	138	LEU	4.3
2	I	53	GLY	4.3
2	G	16	GLU	4.2
2	I	72	ARG	4.2
1	A	96	VAL	4.1
2	I	25	ASN	4.0
1	B	127	SER	4.0
2	I	13	ILE	4.0

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Mol	Chain	Res	Type	RSRZ
1	D	124	ASN	3.9
1	D	155	HIS	3.9
1	D	30	GLY	3.9
2	G	36	ILE	3.7
1	D	78	TYR	3.7
2	I	32	ASP	3.7
2	G	43	LEU	3.6
2	G	72	ARG	3.6
1	D	135	ARG	3.6
1	C	69	ASP	3.6
1	D	125	PRO	3.6
2	I	44	ILE	3.6
1	D	71	PRO	3.5
1	C	146	ALA	3.5
1	C	46	THR	3.5
1	D	118	MET	3.4
2	I	39	ASP	3.3
1	D	55	TYR	3.3
2	G	70	VAL	3.3
1	D	144	TYR	3.3
1	D	123	PRO	3.3
1	D	139	GLU	3.3
1	D	142	GLU	3.3
2	G	12	THR	3.3
1	D	66	LEU	3.1
1	D	40	LEU	3.1
1	D	120	LEU	3.1
2	G	61	ILE	3.1
1	D	65	LEU	3.1
2	G	32	ASP	3.1
1	C	22	THR	3.0
1	C	40	LEU	3.0
2	G	8	LEU	3.0
1	D	72	ALA	3.0
1	C	97	ASN	3.0
2	G	25	ASN	3.0
1	D	146	ALA	2.9
1	D	15	LEU	2.9
2	I	56	LEU	2.9
1	D	39	ASP	2.9
2	G	55	THR	2.9
1	D	79	PHE	2.9

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Mol	Chain	Res	Type	RSRZ
2	G	57	SER	2.8
1	D	128	ALA	2.8
2	I	59	TYR	2.8
2	I	30	ILE	2.8
2	I	60	ASN	2.8
2	I	12	THR	2.8
2	I	71	LEU	2.8
2	I	26	VAL	2.8
1	D	151	LEU	2.8
1	C	39	ASP	2.7
2	G	15	LEU	2.7
1	D	48	GLU	2.7
1	C	67	GLY	2.7
2	G	1	MET	2.7
1	D	116	ILE	2.6
2	E	76	CYS	2.6
2	I	3	ILE	2.6
1	C	101	ARG	2.6
1	C	41	THR	2.6
1	C	57	GLY	2.6
1	B	132	GLU	2.6
1	D	137	LEU	2.6
2	G	26	VAL	2.6
2	G	2	GLN	2.6
2	G	7	THR	2.6
2	G	59	TYR	2.6
2	I	38	PRO	2.6
2	I	18	GLU	2.6
1	D	130	ASN	2.6
1	D	54	PRO	2.5
2	I	23	ILE	2.5
1	D	150	LEU	2.5
2	G	71	LEU	2.5
2	I	17	VAL	2.5
1	D	17	TYR	2.5
1	C	98	VAL	2.5
1	D	114	LEU	2.5
1	D	11	HIS	2.5
2	I	68	HIS	2.5
1	C	70	PHE	2.5
2	G	62	GLN	2.4
1	D	131	GLU	2.4

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Mol	Chain	Res	Type	RSRZ
1	D	57	GLY	2.4
1	B	104	THR	2.4
2	I	14	THR	2.4
1	C	35	PRO	2.4
1	D	52	GLY	2.4
2	G	10	GLY	2.4
1	A	36	ASN	2.4
1	A	97	ASN	2.4
1	D	140	ASN	2.4
2	I	28	ALA	2.4
2	I	6	LYS	2.4
1	D	113	LEU	2.4
1	B	95	CYS	2.4
2	I	76	CYS	2.4
1	C	47	ILE	2.3
2	I	67	LEU	2.3
2	G	9	THR	2.3
1	C	127	SER	2.3
1	A	67	GLY	2.3
1	B	40	LEU	2.3
1	C	27	PRO	2.3
1	A	95	CYS	2.3
1	C	20	VAL	2.3
2	I	62	GLN	2.3
1	D	63	LYS	2.3
1	D	74	PRO	2.3
1	D	119	LEU	2.2
2	I	15	LEU	2.2
2	I	20	SER	2.2
2	G	17	VAL	2.2
2	I	42	ARG	2.2
1	D	129	LEU	2.2
2	I	45	PHE	2.2
2	I	57	SER	2.2
1	B	103	TRP	2.2
1	C	44	GLN	2.2
1	C	156	GLY	2.2
2	E	53	GLY	2.2
2	G	30	ILE	2.2
2	G	4	PHE	2.2
2	I	5	VAL	2.1
2	G	60	ASN	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	98	VAL	2.1
1	C	118	MET	2.1
1	D	36	ASN	2.1
1	A	116	ILE	2.1
1	C	42	ASP	2.1
1	D	75	PRO	2.1
1	B	113	LEU	2.1
1	D	8	LEU	2.1
1	D	46	THR	2.1
1	D	147	ARG	2.1
1	D	69	ASP	2.1
1	D	136	LEU	2.1
2	I	43	LEU	2.1
2	G	53	GLY	2.1
1	C	48	GLU	2.1
2	I	16	GLU	2.1
1	D	154	ILE	2.0
2	G	3	ILE	2.0
2	G	14	THR	2.0
1	C	17	TYR	2.0
1	D	70	PHE	2.0
2	F	53	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.