



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 05:06 AM EDT

PDB ID : 2BWB / pdb_00002bwb
Title : Crystal structure of the UBA domain of Dsk2 from *S. cerevisiae*
Authors : Lowe, E.D.; Hasan, N.; Trempe, J.-F.; Fonso, L.; Noble, M.E.M.; Endicott, J.A.; Johnson, L.N.; Brown, N.R.
Deposited on : 2005-07-13
Resolution : 2.30 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

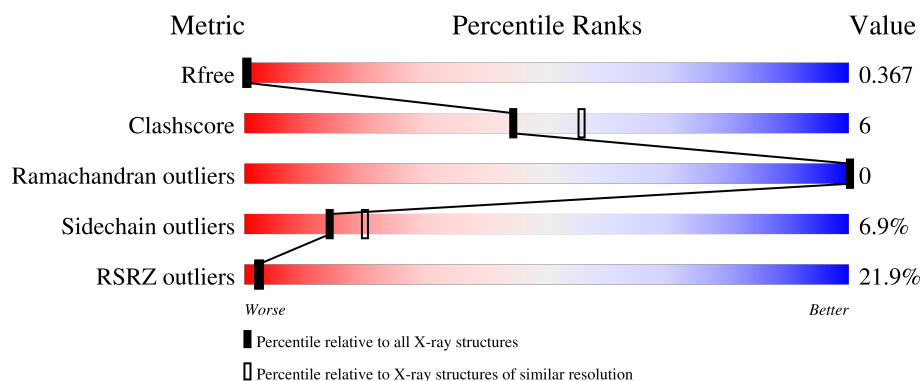
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	46	28% 74% 24% .
1	B	46	33% 80% 11% .
1	C	46	22% 98% .
1	D	46	20% 91% .
1	E	46	22% 78% 17% .

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Mol	Chain	Length	Quality of chain
1	F	46	20% 83% 9%
1	G	46	9% 83% 15%
1	H	46	13% 85% 9%
1	I	46	24% 59% 20% 9% 13%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3337 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 UBIQUITIN-LIKE PROTEIN DSK2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	46	Total	C	N	O	S	0	0	0
			366	224	69	72	1			
1	B	44	Total	C	N	O	S	0	0	0
			354	216	67	70	1			
1	C	46	Total	C	N	O	S	0	0	0
			366	224	69	72	1			
1	D	45	Total	C	N	O	S	0	0	0
			358	218	68	71	1			
1	E	44	Total	C	N	O	S	0	0	0
			354	216	67	70	1			
1	F	44	Total	C	N	O	S	0	0	0
			354	216	67	70	1			
1	G	45	Total	C	N	O	S	0	0	0
			358	218	68	71	1			
1	H	44	Total	C	N	O	S	0	0	0
			354	216	67	70	1			
1	I	40	Total	C	N	O		0	0	0
			323	196	63	64				

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	24	Total	O	0	0
			24	24		
2	B	28	Total	O	0	0
			28	28		
2	C	18	Total	O	0	0
			18	18		
2	D	19	Total	O	0	0
			19	19		
2	E	10	Total	O	0	0
			10	10		

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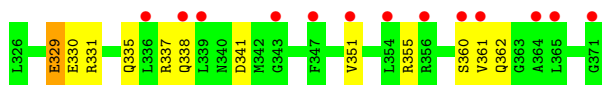
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	F	13	Total 13	O 13	0	0
2	G	15	Total 15	O 15	0	0
2	H	15	Total 15	O 15	0	0
2	I	8	Total 8	O 8	0	0

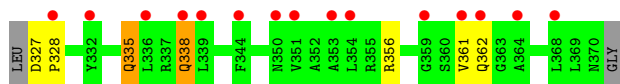
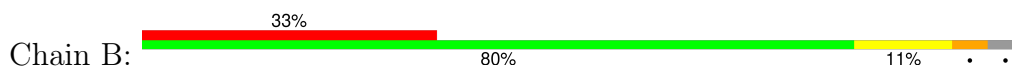
3 Residue-property plots [i](#)

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.

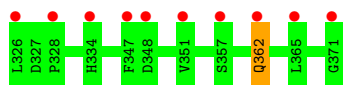
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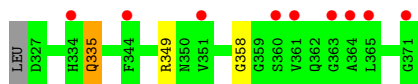
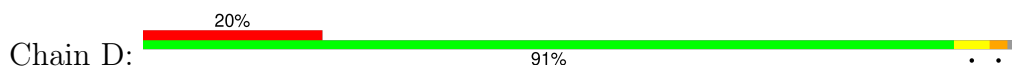
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



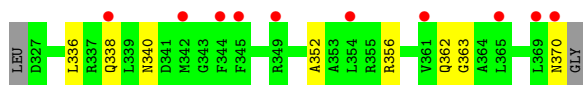
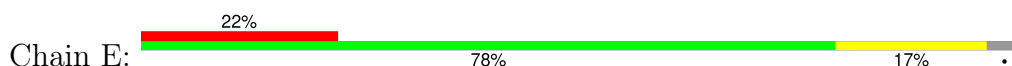
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



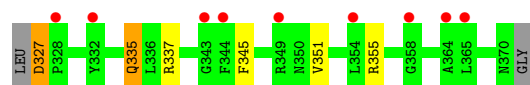
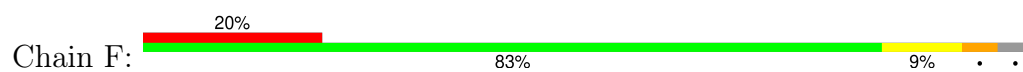
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



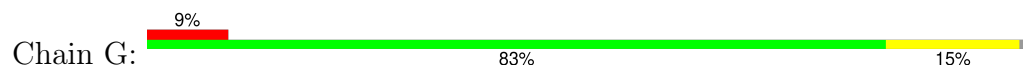
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



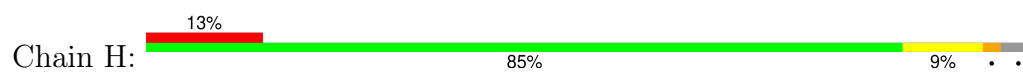
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



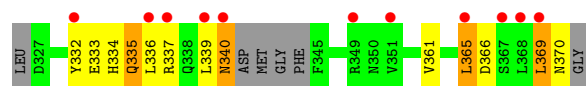
- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



- Molecule 1: UBIQUITIN-LIKE PROTEIN DSK2



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	116.31Å 44.07Å 111.53Å 90.00° 114.87° 90.00°	Depositor
Resolution (Å)	101.02 – 2.30 101.02 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.8 (101.02-2.30) 99.8 (101.02-2.30)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.28 (at 2.31Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.243 , 0.307 0.299 , 0.367	Depositor DCC
R_{free} test set	1127 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å ²)	48.5	Xtriage
Anisotropy	0.318	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 41.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	3337	wwPDB-VP
Average B, all atoms (Å ²)	77.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.16% 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	0.64	0/371	0.99	2/497 (0.4%)
1	B	0.64	0/359	0.80	0/481
1	C	0.63	0/371	0.82	0/497
1	D	0.53	0/363	0.86	0/486
1	E	1.18	2/359 (0.6%)	0.91	1/481 (0.2%)
1	F	0.54	0/359	0.99	3/481 (0.6%)
1	G	0.54	0/363	0.77	0/486
1	H	0.57	0/359	0.80	0/481
1	I	0.58	0/326	0.86	0/436
All	All	0.68	2/3230 (0.1%)	0.87	6/4326 (0.1%)

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	A	0	1
1	F	0	1
All	All	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	370	ASN	CG-OD1	15.39	1.52	1.23
1	E	370	ASN	CG-ND2	9.79	1.53	1.33

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	330	GLU	N-CA-C	9.36	122.44	111.02
1	F	327	ASP	CA-C-N	7.38	144.71	127.00
1	F	327	ASP	C-N-CA	7.38	144.71	127.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	327	ASP	C-N-CD	-7.24	104.68	120.60
1	E	370	ASN	OD1-CG-ND2	6.53	129.13	122.60
1	A	329	GLU	N-CA-C	6.42	118.35	111.36

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	329	GLU	Peptide
1	F	327	ASP	Peptide

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	366	0	343	4	0
1	B	354	0	329	4	0
1	C	366	0	343	1	0
1	D	358	0	332	7	0
1	E	354	0	329	3	0
1	F	354	0	329	3	0
1	G	358	0	332	3	0
1	H	354	0	329	3	0
1	I	323	0	303	15	0
2	A	24	0	0	2	0
2	B	28	0	0	1	0
2	C	18	0	0	2	0
2	D	19	0	0	0	0
2	E	10	0	0	0	0
2	F	13	0	0	0	0
2	G	15	0	0	0	0
2	H	15	0	0	0	0
2	I	8	0	0	1	0
All	All	3337	0	2969	37	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 6.

All (37) 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:335:GLN:HE21	1:D:335:GLN:H	1.16	0.90
1:I:335:GLN:HE21	1:I:335:GLN:H	1.35	0.75
1:A:338:GLN:NE2	2:A:2007:HOH:O	2.16	0.72
1:B:335:GLN:HE21	1:B:335:GLN:H	1.43	0.66
1:F:335:GLN:HE21	1:F:335:GLN:H	1.45	0.62
1:I:334:HIS:HA	1:I:337:ARG:HG3	1.82	0.61
1:I:340:ASN:N	1:I:340:ASN:HD22	1.99	0.59
1:E:363:GLY:HA2	1:F:345:PHE:CD2	2.38	0.58
1:I:366:ASP:HA	1:I:369:LEU:HD12	1.86	0.57
1:F:351:VAL:O	1:F:355:ARG:HG3	2.07	0.55
1:D:358:GLY:O	1:I:337:ARG:HG2	2.07	0.54
1:I:365:LEU:HD23	1:I:369:LEU:HD11	1.90	0.54
1:A:351:VAL:O	1:A:355:ARG:HG3	2.09	0.52
1:D:335:GLN:H	1:D:335:GLN:NE2	1.97	0.51
1:I:332:TYR:O	1:I:333:GLU:C	2.54	0.50
1:C:362:GLN:HB2	2:C:2017:HOH:O	2.11	0.49
1:D:358:GLY:O	1:I:337:ARG:CG	2.61	0.49
1:H:328:PRO:HA	1:H:331:ARG:HG2	1.94	0.48
1:B:338:GLN:NE2	1:B:361:VAL:HG21	2.28	0.48
1:I:335:GLN:HE21	1:I:335:GLN:N	2.08	0.47
1:A:341:ASP:HA	2:A:2009:HOH:O	2.14	0.47
1:D:335:GLN:HE21	1:D:335:GLN:N	1.98	0.46
1:D:358:GLY:O	1:I:337:ARG:CD	2.64	0.46
1:I:336:LEU:O	1:I:340:ASN:ND2	2.49	0.46
1:D:358:GLY:O	1:I:337:ARG:NE	2.50	0.44
2:C:2001:HOH:O	1:H:362:GLN:HG2	2.17	0.44
1:A:335:GLN:HB3	1:A:361:VAL:HG23	1.99	0.44
1:I:340:ASN:N	1:I:340:ASN:ND2	2.65	0.44
1:E:352:ALA:O	1:E:356:ARG:HG3	2.18	0.43
1:G:363:GLY:HA3	1:H:340:ASN:HD22	1.84	0.43
1:G:370:ASN:O	1:G:371:GLY:C	2.61	0.43
1:I:370:ASN:ND2	2:I:2008:HOH:O	2.50	0.43
1:B:356:ARG:NH2	2:B:2024:HOH:O	2.51	0.43
1:G:338:GLN:NE2	1:G:361:VAL:HG21	2.35	0.42
1:E:336:LEU:O	1:E:340:ASN:ND2	2.39	0.42
1:B:327:ASP:N	1:B:328:PRO:CD	2.84	0.40
1:I:339:LEU:CD2	1:I:365:LEU:HD12	2.51	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	44/46 (96%)	43 (98%)	1 (2%)	0	100	100
1	B	42/46 (91%)	42 (100%)	0	0	100	100
1	C	44/46 (96%)	44 (100%)	0	0	100	100
1	D	43/46 (94%)	42 (98%)	1 (2%)	0	100	100
1	E	42/46 (91%)	42 (100%)	0	0	100	100
1	F	42/46 (91%)	42 (100%)	0	0	100	100
1	G	43/46 (94%)	43 (100%)	0	0	100	100
1	H	42/46 (91%)	42 (100%)	0	0	100	100
1	I	36/46 (78%)	35 (97%)	1 (3%)	0	100	100
All	All	378/414 (91%)	375 (99%)	3 (1%)	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	38/38 (100%)	34 (90%)	4 (10%)	6	8
1	B	37/38 (97%)	34 (92%)	3 (8%)	11	14
1	C	38/38 (100%)	37 (97%)	1 (3%)	40	59
1	D	37/38 (97%)	35 (95%)	2 (5%)	20	29
1	E	37/38 (97%)	35 (95%)	2 (5%)	20	29

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	F	37/38 (97%)	35 (95%)	2 (5%)	20	29
1	G	37/38 (97%)	35 (95%)	2 (5%)	20	29
1	H	37/38 (97%)	35 (95%)	2 (5%)	20	29
1	I	34/38 (90%)	29 (85%)	5 (15%)	3	3
All	All	332/342 (97%)	309 (93%)	23 (7%)	14	20

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	331	ARG
1	A	337	ARG
1	A	360	SER
1	A	362	GLN
1	B	335	GLN
1	B	338	GLN
1	B	362	GLN
1	C	362	GLN
1	D	335	GLN
1	D	349	ARG
1	E	338	GLN
1	E	362	GLN
1	F	335	GLN
1	F	337	ARG
1	G	329	GLU
1	G	356	ARG
1	H	331	ARG
1	H	355	ARG
1	I	335	GLN
1	I	340	ASN
1	I	361	VAL
1	I	365	LEU
1	I	369	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	335	GLN
1	B	338	GLN
1	D	335	GLN
1	E	338	GLN

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Mol	Chain	Res	Type
1	F	335	GLN
1	F	350	ASN
1	G	338	GLN
1	H	340	ASN
1	I	335	GLN
1	I	338	GLN
1	I	340	ASN
1	I	350	ASN
1	I	370	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	46/46 (100%)	1.56	13 (28%)  	76, 78, 82, 83	0
1	B	44/46 (95%)	1.79	15 (34%)  	76, 78, 80, 83	0
1	C	46/46 (100%)	1.59	10 (21%)  	74, 78, 80, 84	0
1	D	45/46 (97%)	1.30	9 (20%)  	76, 78, 80, 83	0
1	E	44/46 (95%)	1.55	10 (22%)  	76, 78, 80, 84	0
1	F	44/46 (95%)	1.38	9 (20%)  	76, 78, 81, 83	0
1	G	45/46 (97%)	1.15	4 (8%)  	76, 78, 81, 82	0
1	H	44/46 (95%)	1.24	6 (13%)  	76, 78, 80, 83	0
1	I	40/46 (86%)	1.87	11 (27%)  	69, 77, 84, 86	0
All	All	398/414 (96%)	1.49	87 (21%)  	69, 78, 81, 86	0

All (87) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	351	VAL	6.4
1	I	365	LEU	4.9
1	C	326	LEU	3.8
1	B	336	LEU	3.6
1	I	369	LEU	3.5
1	B	354	LEU	3.5
1	F	354	LEU	3.5
1	B	350	ASN	3.4
1	D	371	GLY	3.4
1	H	370	ASN	3.4
1	I	340	ASN	3.3
1	A	361	VAL	3.1
1	I	332	TYR	3.0
1	A	343	GLY	3.0
1	G	330	GLU	3.0

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Mol	Chain	Res	Type	RSRZ
1	E	370	ASN	3.0
1	B	332	TYR	2.9
1	E	344	PHE	2.9
1	B	351	VAL	2.9
1	B	361	VAL	2.9
1	A	339	LEU	2.9
1	H	354	LEU	2.9
1	G	332	TYR	2.9
1	I	337	ARG	2.9
1	E	345	PHE	2.9
1	E	338	GLN	2.8
1	I	339	LEU	2.8
1	A	365	LEU	2.8
1	G	368	LEU	2.8
1	E	349	ARG	2.8
1	C	348	ASP	2.8
1	B	353	ALA	2.7
1	B	339	LEU	2.7
1	B	328	PRO	2.6
1	A	354	LEU	2.6
1	D	361	VAL	2.6
1	F	343	GLY	2.6
1	H	344	PHE	2.6
1	E	361	VAL	2.6
1	A	356	ARG	2.5
1	I	368	LEU	2.5
1	C	328	PRO	2.5
1	E	365	LEU	2.5
1	C	334	HIS	2.5
1	I	351	VAL	2.4
1	E	354	LEU	2.4
1	I	336	LEU	2.4
1	D	334	HIS	2.4
1	D	351	VAL	2.4
1	H	336	LEU	2.4
1	I	349	ARG	2.4
1	F	358	GLY	2.4
1	A	360	SER	2.4
1	C	347	PHE	2.4
1	F	344	PHE	2.3
1	F	328	PRO	2.3
1	F	332	TYR	2.3

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Mol	Chain	Res	Type	RSRZ
1	E	342	MET	2.3
1	A	338	GLN	2.3
1	B	362	GLN	2.3
1	B	344	PHE	2.2
1	D	365	LEU	2.2
1	F	365	LEU	2.2
1	C	371	GLY	2.2
1	F	349	ARG	2.2
1	D	364	ALA	2.2
1	I	367	SER	2.2
1	E	369	LEU	2.2
1	H	332	TYR	2.1
1	H	361	VAL	2.1
1	A	347	PHE	2.1
1	B	364	ALA	2.1
1	F	364	ALA	2.1
1	B	368	LEU	2.1
1	D	360	SER	2.1
1	A	364	ALA	2.1
1	G	365	LEU	2.1
1	D	363	GLY	2.1
1	B	338	GLN	2.0
1	C	362	GLN	2.0
1	A	351	VAL	2.0
1	A	371	GLY	2.0
1	B	359	GLY	2.0
1	D	344	PHE	2.0
1	C	357	SER	2.0
1	A	336	LEU	2.0
1	C	365	LEU	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 [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.