



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:56 PM UTC

PDB ID : 9EYH / pdb_00009eyh
Title : Ubiquitin conjugating enzyme Ubc6 UBC domain with isopeptide-linked ubiquitin
Authors : Swarnkar, A.; Stein, A.
Deposited on : 2024-04-09
Resolution : 2.60 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

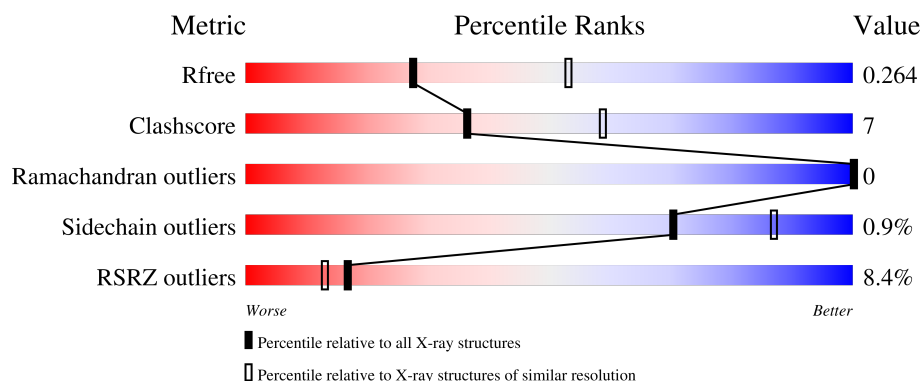
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	178	 2% 78% 17% 5%
1	B	178	 7% 80% 15% 5%
2	C	76	 4% 79% 18% .
2	D000	76	 29% 99% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3945 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-conjugating enzyme E2 6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	169	Total	C	N	O	S	0	1	0
			1375	879	236	256	4			
1	B	169	Total	C	N	O	S	0	1	0
			1378	880	236	258	4			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	87	LYS	CYS	engineered mutation	UNP A0A8H8ULW7
A	173	LEU	-	expression tag	UNP A0A8H8ULW7
A	174	PRO	-	expression tag	UNP A0A8H8ULW7
A	175	GLU	-	expression tag	UNP A0A8H8ULW7
A	176	THR	-	expression tag	UNP A0A8H8ULW7
A	177	GLY	-	expression tag	UNP A0A8H8ULW7
A	178	GLY	-	expression tag	UNP A0A8H8ULW7
B	87	LYS	CYS	engineered mutation	UNP A0A8H8ULW7
B	173	LEU	-	expression tag	UNP A0A8H8ULW7
B	174	PRO	-	expression tag	UNP A0A8H8ULW7
B	175	GLU	-	expression tag	UNP A0A8H8ULW7
B	176	THR	-	expression tag	UNP A0A8H8ULW7
B	177	GLY	-	expression tag	UNP A0A8H8ULW7
B	178	GLY	-	expression tag	UNP A0A8H8ULW7

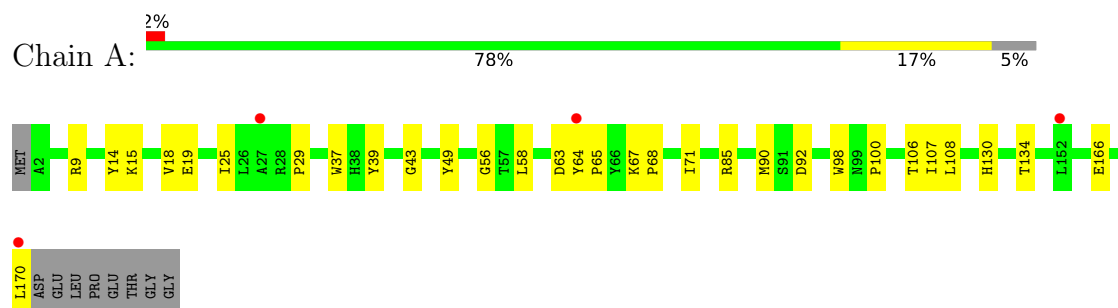
- Molecule 2 is a protein called Ubiquitin-40S ribosomal protein S31.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	76	Total	C	N	O	S	0	0	0
			600	375	105	119	1			
2	D000	75	Total	C	N	O		0	0	0
			592	370	104	118				

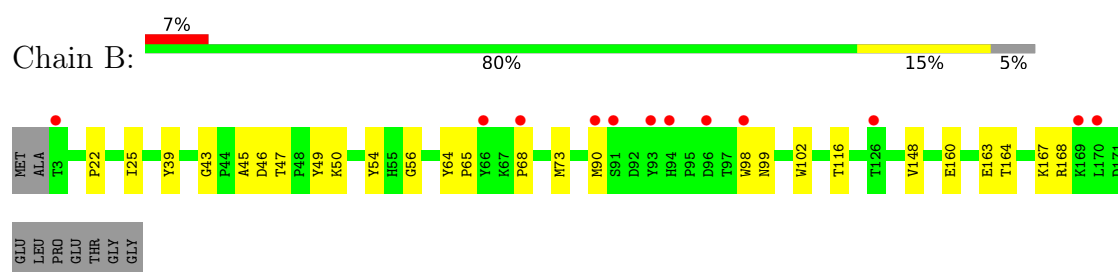
3 Residue-property plots [i](#)

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.

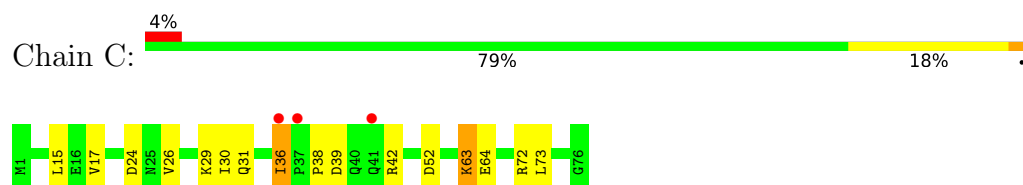
- Molecule 1: Ubiquitin-conjugating enzyme E2 6



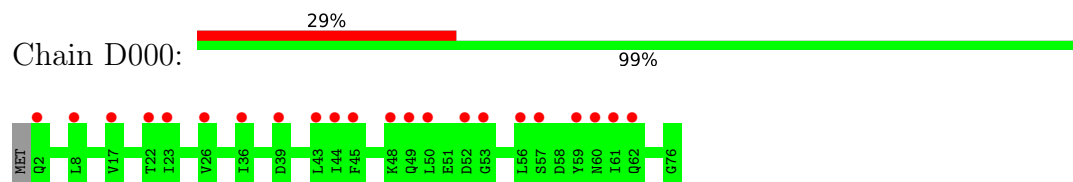
- Molecule 1: Ubiquitin-conjugating enzyme E2 6



- Molecule 2: Ubiquitin-40S ribosomal protein S31



- Molecule 2: Ubiquitin-40S ribosomal protein S31



4 Data and refinement statistics

Property	Value	Source
Space group	I 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	105.75Å 53.49Å 111.80Å 90.00° 103.15° 90.00°	Depositor
Resolution (Å)	48.01 – 2.60 48.01 – 2.60	Depositor EDS
% Data completeness (in resolution range)	99.7 (48.01-2.60) 99.7 (48.01-2.60)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.67 (at 2.61Å)	Xtriage
Refinement program	PHENIX 1.19.1_4122	Depositor
R, R_{free}	0.234 , 0.266 0.234 , 0.264	Depositor DCC
R_{free} test set	898 reflections (4.72%)	wwPDB-VP
Wilson B-factor (Å ²)	63.2	Xtriage
Anisotropy	0.311	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 57.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3945	wwPDB-VP
Average B, all atoms (Å ²)	85.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.39% 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	0.08	0/1415	0.26	0/1926
1	B	0.09	0/1418	0.25	0/1930
2	C	0.19	0/605	0.30	0/812
2	D000	0.20	0/597	0.27	0/802
All	All	0.13	0/4035	0.27	0/5470

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	1375	0	1359	18	0
1	B	1378	0	1358	16	0
2	C	600	0	625	10	0
2	D000	592	0	0	0	0
All	All	3945	0	3342	44	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 (44) 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:22:PRO:HG2	1:B:25:ILE:HB	1.82	0.60
1:A:68:PRO:HG3	1:A:98:TRP:HB2	1.86	0.57
1:A:9:ARG:NH2	1:A:100:PRO:O	2.37	0.56
2:C:42:ARG:HG3	2:C:72:ARG:HB2	1.88	0.56
1:B:68:PRO:HG3	1:B:98:TRP:HB2	1.88	0.55
1:B:64:TYR:CD1	1:B:65:PRO:HA	2.43	0.54
2:C:30:ILE:HG22	2:C:36:ILE:HG13	1.90	0.54
1:A:64:TYR:CD1	1:A:65:PRO:HA	2.43	0.54
1:A:63:ASP:OD2	1:A:67:LYS:HE2	2.09	0.53
1:A:64:TYR:CG	1:A:65:PRO:HA	2.43	0.52
1:A:29:PRO:HG3	1:A:37:TRP:CE2	2.45	0.52
1:B:160:GLU:O	1:B:164:THR:OG1	2.27	0.51
1:A:130:HIS:O	1:A:134:THR:OG1	2.22	0.50
1:B:64:TYR:CG	1:B:65:PRO:HA	2.47	0.50
2:C:24:ASP:HB2	2:C:52:ASP:HB3	1.93	0.49
1:A:90:MET:HE1	1:A:106:THR:HG22	1.94	0.49
2:C:31:GLN:HG3	2:C:36:ILE:H	1.77	0.49
1:B:99:ASN:HB3	1:B:102:TRP:CD2	2.49	0.48
1:A:43:GLY:HA3	1:A:49:TYR:O	2.13	0.47
2:C:26:VAL:O	2:C:30:ILE:HG13	2.14	0.47
1:A:39:TYR:CZ	1:A:56:GLY:HA3	2.50	0.47
2:C:15:LEU:HD11	2:C:30:ILE:HG12	1.97	0.47
1:B:164:THR:O	1:B:168:ARG:HG3	2.15	0.47
1:B:90:MET:HG2	1:B:102:TRP:HH2	1.80	0.46
1:A:25:ILE:HD13	1:A:108:LEU:HB3	1.97	0.46
1:A:29:PRO:HA	1:A:37:TRP:HA	1.98	0.46
1:B:163:GLU:O	1:B:167:LYS:HG2	2.16	0.46
1:B:47:THR:HG21	1:B:116:THR:HG22	1.97	0.46
1:A:15:LYS:HE2	1:A:19:GLU:OE2	2.17	0.46
1:B:39:TYR:CZ	1:B:56:GLY:HA3	2.50	0.46
1:A:58:LEU:HD22	1:A:71:ILE:HG12	1.99	0.45
1:B:46:ASP:OD1	1:B:46:ASP:N	2.48	0.45
1:B:43:GLY:HA3	1:B:49:TYR:O	2.18	0.44
1:A:166:GLU:O	1:A:170:LEU:HG	2.18	0.44
1:A:85:ARG:HH21	1:A:92:ASP:CG	2.26	0.44
2:C:63:LYS:HE2	2:C:64:GLU:HG3	1.99	0.44
2:C:39:ASP:N	2:C:39:ASP:OD1	2.51	0.44
1:A:14:TYR:O	1:A:18:VAL:HG23	2.19	0.43
1:A:98:TRP:HH2	1:A:107:ILE:HD11	1.83	0.42
1:B:45:ALA:HA	1:B:50:LYS:HG3	2.01	0.42
1:B:90:MET:HG2	1:B:102:TRP:CH2	2.53	0.42
2:C:36:ILE:O	2:C:38:PRO:HD3	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:17:VAL:HG12	2:C:29:LYS:HD2	2.02	0.40
1:B:54:TYR:HB3	1:B:73:MET:HE3	2.02	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	168/178 (94%)	168 (100%)	0	0	100	100
1	B	168/178 (94%)	163 (97%)	5 (3%)	0	100	100
2	C	74/76 (97%)	69 (93%)	5 (7%)	0	100	100
2	D000	73/76 (96%)	70 (96%)	3 (4%)	0	100	100
All	All	483/508 (95%)	470 (97%)	13 (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	154/161 (96%)	154 (100%)	0	100	100
1	B	155/161 (96%)	154 (99%)	1 (1%)	78	91
2	C	69/69 (100%)	66 (96%)	3 (4%)	26	51

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	D000	68/69 (99%)	68 (100%)	0	100	100
All	All	446/460 (97%)	442 (99%)	4 (1%)	70	87

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	148	VAL
2	C	36	ILE
2	C	63	LYS
2	C	73	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	C	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 ⓘ

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	169/178 (94%)	0.35	4 (2%) 59 54	29, 65, 92, 101	1 (0%)
1	B	169/178 (94%)	0.72	12 (7%) 22 17	37, 77, 117, 161	1 (0%)
2	C	76/76 (100%)	0.86	3 (3%) 43 38	63, 92, 135, 145	0
2	D000	75/76 (98%)	1.58	22 (29%) 1 1	89, 122, 157, 167	0
All	All	489/508 (96%)	0.75	41 (8%) 17 13	29, 78, 141, 167	2 (0%)

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	3	THR	4.6
1	B	96	ASP	3.9
2	D000	36	ILE	3.8
2	D000	45	PHE	3.4
2	C	41	GLN	3.1
2	D000	56	LEU	3.0
2	D000	59	TYR	3.0
1	B	94	HIS	2.9
2	C	36	ILE	2.9
2	D000	53	GLY	2.9
2	D000	26	VAL	2.8
1	B	90	MET	2.8
2	D000	61	ILE	2.6
1	A	152	LEU	2.6
1	A	170	LEU	2.6
1	B	170	LEU	2.6
2	D000	48	LYS	2.5
1	A	27	ALA	2.5
2	D000	52	ASP	2.4
1	B	93	TYR	2.4
1	B	98	TRP	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	126	THR	2.4
2	D000	17	VAL	2.4
2	D000	22	THR	2.3
2	D000	23	ILE	2.3
2	D000	44	ILE	2.3
2	C	37	PRO	2.3
2	D000	49	GLN	2.3
2	D000	57	SER	2.2
2	D000	43	LEU	2.2
2	D000	50	LEU	2.2
2	D000	39	ASP	2.2
2	D000	2	GLN	2.2
2	D000	60	ASN	2.1
2	D000	62	GLN	2.1
2	D000	8	LEU	2.1
1	B	68	PRO	2.1
1	A	64	TYR	2.0
1	B	169	LYS	2.0
1	B	91	SER	2.0
1	B	66	TYR	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.