



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 07:44 AM UTC

PDB ID : 5AIT / pdb_00005ait
Title : A complex of of RNF4-RING domain, UbeV2, Ubc13-Ub (isopeptide crosslink)
Authors : Branigan, E.; Naismith, J.H.
Deposited on : 2015-02-17
Resolution : 3.40 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

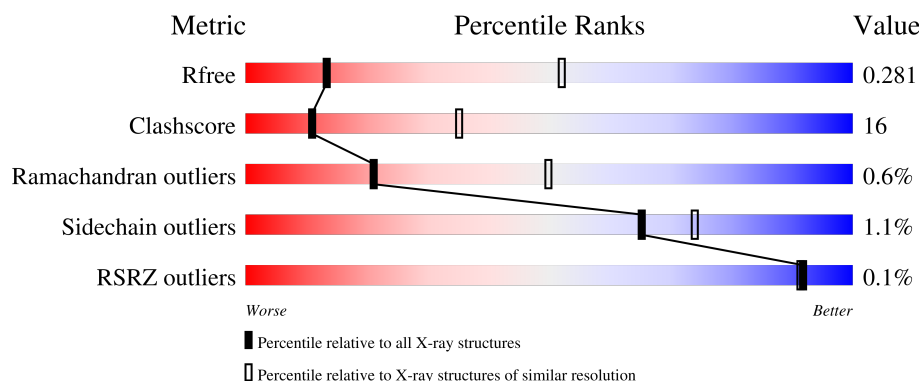
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.40 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	1001 (3.44-3.36)
Clashscore	190562	1022 (3.44-3.36)
Ramachandran outliers	187476	1012 (3.44-3.36)
Sidechain outliers	187428	1012 (3.44-3.36)
RSRZ outliers	180081	1001 (3.44-3.36)

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	133	
2	B	154	
2	E	154	
3	C	76	
3	F	76	

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Mol	Chain	Length	Quality of chain
4	D	147	% 67% 27% •• 5%
4	G	147	65% 27% • 6%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6742 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 E3 UBIQUITIN-PROTEIN LIGASE RNF4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	129	Total	C	N	O	S	0	0	0
			999	614	185	184	16			

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	127	GLY	-	expression tag	UNP O88846
A	128	ALA	-	expression tag	UNP O88846
A	129	MET	-	expression tag	UNP O88846
A	130	GLY	-	expression tag	UNP O88846
A	195	GLY	-	linker	UNP O88846

- Molecule 2 is a protein called UBIQUITIN-CONJUGATING ENZYME E2 N.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	147	Total	C	N	O	S	0	0	0
			1173	755	202	213	3			
2	E	147	Total	C	N	O	S	0	0	0
			1173	755	202	213	3			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-1	GLY	-	expression tag	UNP P61088
B	0	ALA	-	expression tag	UNP P61088
B	87	LYS	CYS	engineered mutation	UNP P61088
B	92	ALA	LYS	engineered mutation	UNP P61088
E	-1	GLY	-	expression tag	UNP P61088
E	0	ALA	-	expression tag	UNP P61088
E	87	LYS	CYS	engineered mutation	UNP P61088
E	92	ALA	LYS	engineered mutation	UNP P61088

- Molecule 3 is a protein called POLYUBIQUITIN-C.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	75	Total	C	N	O	0	0	0
			593	373	104	116			
3	F	75	Total	C	N	O	0	0	0
			593	373	104	116			

- Molecule 4 is a protein called UBIQUITIN-CONJUGATING ENZYME E2 VARIANT 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	140	Total	C	N	O	S	0	0	0
			1112	697	195	212	8			
4	G	138	Total	C	N	O	S	0	0	0
			1095	689	191	207	8			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	-1	GLY	-	expression tag	UNP Q15819
D	0	ALA	-	expression tag	UNP Q15819
G	-1	GLY	-	expression tag	UNP Q15819
G	0	ALA	-	expression tag	UNP Q15819

- Molecule 5 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	4	Total	Zn	0	0
			4	4		

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.

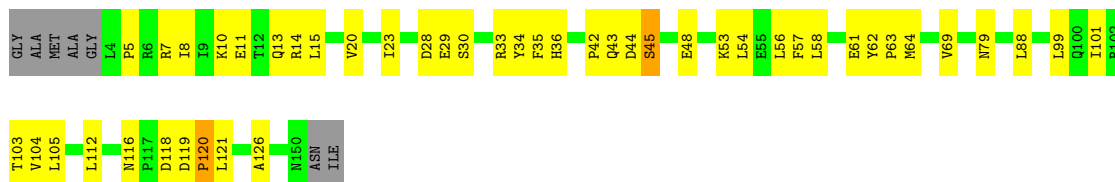
- Molecule 1: E3 UBIQUITIN-PROTEIN LIGASE RNF4

Chain A: 



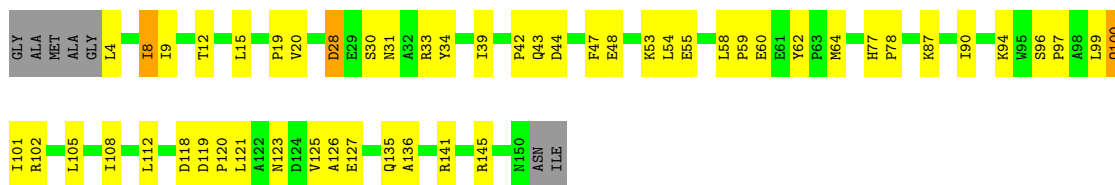
- Molecule 2: UBIQUITIN-CONJUGATING ENZYME E2 N

Chain B: 



- Molecule 2: UBIQUITIN-CONJUGATING ENZYME E2 N

Chain E: 



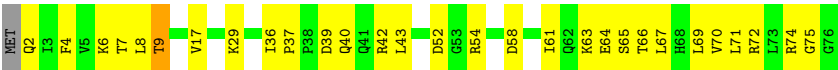
- Molecule 3: POLYUBIQUITIN-C

Chain C: 

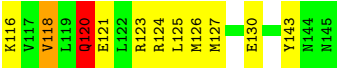
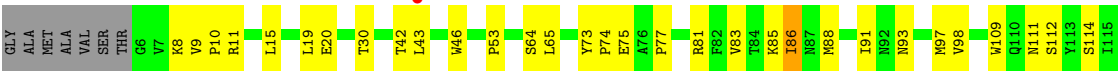


- Molecule 3: POLYUBIQUITIN-C

Chain F: 



● Molecule 4: UBIQUITIN-CONJUGATING ENZYME E2 VARIANT 2



● Molecule 4: UBIQUITIN-CONJUGATING ENZYME E2 VARIANT 2



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	77.58Å 77.58Å 328.84Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	67.19 – 3.40 67.19 – 3.40	Depositor EDS
% Data completeness (in resolution range)	89.0 (67.19-3.40) 89.0 (67.19-3.40)	Depositor EDS
R_{merge}	0.03	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.46 (at 3.41Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.208 , 0.286 (Not available) , 0.281	Depositor DCC
R_{free} test set	753 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	139.6	Xtriage
Anisotropy	0.118	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 94.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.038 for -h,-k,l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	6742	wwPDB-VP
Average B, all atoms (Å ²)	140.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.57% 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

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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	0.90	0/1018	1.10	2/1372 (0.1%)
2	B	1.01	0/1203	1.04	3/1639 (0.2%)
2	E	0.91	0/1203	1.06	2/1639 (0.1%)
3	C	0.94	1/599 (0.2%)	1.06	1/806 (0.1%)
3	F	0.93	1/599 (0.2%)	1.17	3/806 (0.4%)
4	D	1.00	0/1135	1.09	7/1534 (0.5%)
4	G	1.00	0/1118	1.17	5/1512 (0.3%)
All	All	0.96	2/6875 (0.0%)	1.10	23/9308 (0.2%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	48	LYS	CA-C	-5.23	1.46	1.52
3	F	37	PRO	CA-C	5.22	1.54	1.51

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	9	THR	N-CA-C	8.17	119.88	110.97
4	G	53	PRO	O-C-N	6.66	124.28	121.15
4	D	118	VAL	CB-CA-C	-6.50	103.56	111.88
4	D	53	PRO	O-C-N	6.28	124.10	121.15
2	E	8	ILE	CB-CA-C	-6.25	103.97	111.97

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	999	0	980	25	0
2	B	1173	0	1185	55	0
2	E	1173	0	1186	42	0
3	C	593	0	617	19	2
3	F	593	0	617	27	0
4	D	1112	0	1111	40	0
4	G	1095	0	1099	33	0
5	A	4	0	0	0	0
All	All	6742	0	6795	223	2

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 16.

The worst 5 of 223 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:E:87:LYS:HE3	2:E:121:LEU:HD21	1.13	1.12
4:D:30:THR:HG21	4:D:123:ARG:HH12	1.16	1.08
3:F:42:ARG:HD2	3:F:72:ARG:HE	1.25	1.00
3:C:39:ASP:O	3:C:72:ARG:HD3	1.62	0.99
4:G:35:LEU:HD12	4:G:45:ARG:O	1.63	0.99

All (2) 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)
3:C:57:SER:OG	3:C:57:SER:OG[5_675]	1.70	0.50
3:C:57:SER:CB	3:C:57:SER:OG[5_675]	1.96	0.24

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	127/133 (96%)	110 (87%)	15 (12%)	2 (2%)	7	29
2	B	145/154 (94%)	138 (95%)	6 (4%)	1 (1%)	18	47
2	E	145/154 (94%)	133 (92%)	10 (7%)	2 (1%)	9	31
3	C	73/76 (96%)	71 (97%)	2 (3%)	0	100	100
3	F	73/76 (96%)	70 (96%)	3 (4%)	0	100	100
4	D	138/147 (94%)	136 (99%)	2 (1%)	0	100	100
4	G	136/147 (92%)	132 (97%)	4 (3%)	0	100	100
All	All	837/887 (94%)	790 (94%)	42 (5%)	5 (1%)	21	50

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	120	PRO
1	A	246	ARG
1	A	186	HIS
2	E	100	GLN
2	E	19	PRO

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	118/119 (99%)	117 (99%)	1 (1%)	73	77
2	B	125/128 (98%)	124 (99%)	1 (1%)	73	77

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	E	125/128 (98%)	122 (98%)	3 (2%)	43	62
3	C	67/68 (98%)	67 (100%)	0	100	100
3	F	67/68 (98%)	67 (100%)	0	100	100
4	D	125/129 (97%)	124 (99%)	1 (1%)	73	77
4	G	123/129 (95%)	121 (98%)	2 (2%)	55	68
All	All	750/769 (98%)	742 (99%)	8 (1%)	65	74

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	G	95	SER
4	G	16	LEU
2	E	44	ASP
2	E	28	ASP
2	E	105	LEU

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

Mol	Chain	Res	Type
1	A	214	ASN
2	B	36	HIS
3	F	49	GLN
4	G	141	GLN

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

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	129/133 (96%)	-0.58	0	100 100	88, 134, 180, 231	0
2	B	147/154 (95%)	-0.38	0	100 100	89, 136, 184, 194	0
2	E	147/154 (95%)	-0.41	0	100 100	96, 157, 204, 251	0
3	C	75/76 (98%)	-0.48	0	100 100	97, 145, 187, 213	0
3	F	75/76 (98%)	-0.33	0	100 100	95, 167, 203, 280	0
4	D	140/147 (95%)	-0.53	1 (0%)	84 73	89, 122, 161, 219	0
4	G	138/147 (93%)	-0.64	0	100 100	83, 124, 158, 203	0
All	All	851/887 (95%)	-0.49	1 (0%)	92 91	83, 136, 190, 280	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	D	43	LEU	2.3

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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	ZN	A	1260	1/1	1.00	0.03	115,115,115,115	0
5	ZN	A	1261	1/1	1.00	0.04	102,102,102,102	0
5	ZN	A	1262	1/1	1.00	0.02	113,113,113,113	0
5	ZN	A	1263	1/1	1.00	0.03	118,118,118,118	0

6.5 Other polymers [i](#)

There are no such residues in this entry.