Full wwPDB X-ray Structure Validation Report (i)

Mar 20, 2025 – 10:09 AM EDT

PDB ID	:	4DHZ
Title	:	The structure of h/ceOTUB1-ubiquitin aldehyde-UBC13 Ub
Authors	:	Wiener, R.; Zhang, X.; Wang, T.; Wolberger, C.
Deposited on	:	2012-01-30
Resolution	:	3.11 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 (i) 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 (1)) were used in the production of this report:

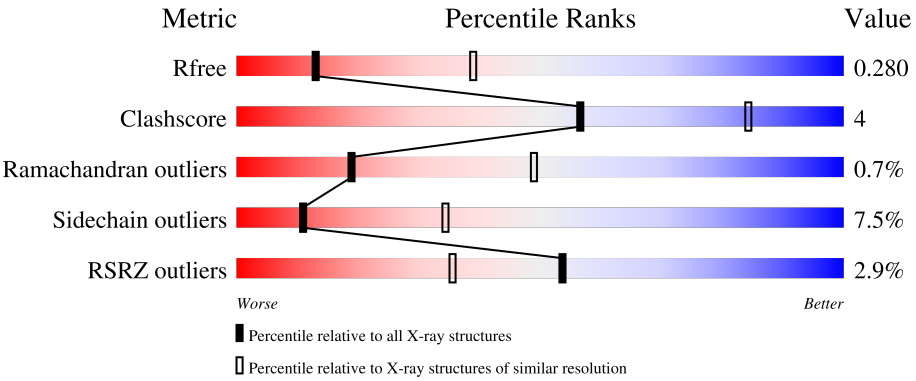
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

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 3.11 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}	164625	1668 (3.14-3.10)
Clashscore	180529	1788 (3.14-3.10)
Ramachandran outliers	177936	1696 (3.14-3.10)
Sidechain outliers	177891	1696 (3.14-3.10)
RSRZ outliers	164620	1668 (3.14-3.10)

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 <=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	288	77% 11% 11%
2	B	76	84% 14%
3	E	76	8% 76% 14% 5%
4	F	152	5% 75% 22%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 4370 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 thioesterase otubain-like.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	256	Total	C	N	O	S	0	0	0
			2034	1300	335	388	11			

- Molecule 2 is a protein called Ubiquitin aldehyde.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	76	Total	C	N	O	S	0	0	0
			597	376	104	116	1			

- Molecule 3 is a protein called Ubiquitin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	72	Total	C	N	O	S	0	0	0
			568	359	95	113	1			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	576	CYS	GLY	engineered mutation	UNP P0CG48

- Molecule 4 is a protein called Ubiquitin-conjugating enzyme E2 N.

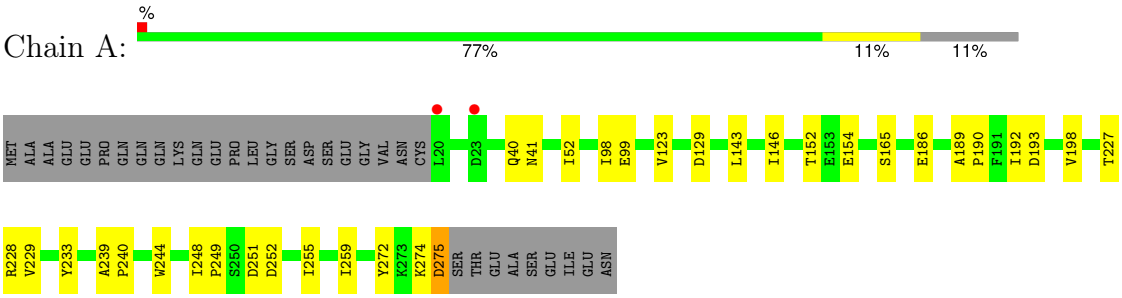
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	149	Total	C	N	O	S	0	0	0
			1171	753	202	212	4			

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.

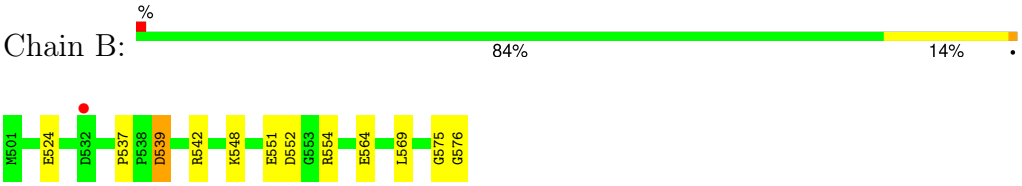
• Molecule 1: Ubiquitin thioesterase otubain-like

Chain A:



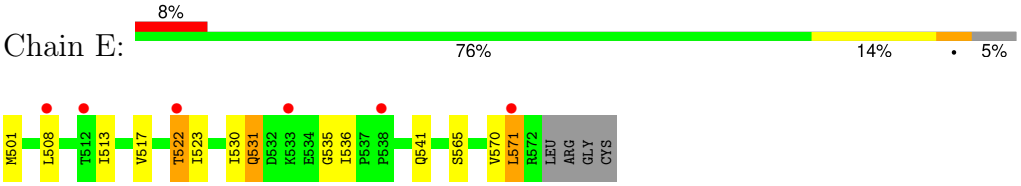
• Molecule 2: Ubiquitin aldehyde

Chain B:



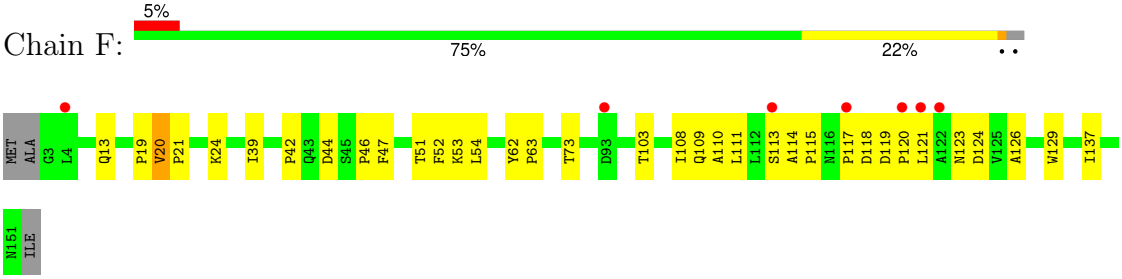
• Molecule 3: Ubiquitin

Chain E:



• Molecule 4: Ubiquitin-conjugating enzyme E2 N

Chain F:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α, β, γ	123.37Å 123.37Å 68.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.88 – 3.11 45.88 – 3.11	Depositor EDS
% Data completeness (in resolution range)	97.5 (45.88-3.11) 97.5 (45.88-3.11)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.49 (at 3.12Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.233 , 0.288 0.226 , 0.280	Depositor DCC
R_{free} test set	944 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å^2)	74.9	Xtriage
Anisotropy	0.205	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 24.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.029 for h,-k,-l	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	4370	wwPDB-VP
Average B, all atoms (Å^2)	73.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.65% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: GLZ

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	0.44	0/2081	0.55	0/2826
2	B	0.43	0/599	0.56	0/806
3	E	0.40	0/574	0.58	0/774
4	F	0.44	0/1201	0.61	0/1638
All	All	0.43	0/4455	0.57	0/6044

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
2	B	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	575	GLY	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	2034	0	1938	13	0
2	B	597	0	619	3	0
3	E	568	0	585	5	0
4	F	1171	0	1172	20	0
All	All	4370	0	4314	39	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 4.

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)
4:F:113:SER:HB2	4:F:114:ALA:HB3	1.66	0.78
4:F:118:ASP:H	4:F:119:ASP:HB3	1.51	0.76
3:E:531:GLN:HB2	3:E:536:ILE:O	1.89	0.73
4:F:110:ALA:HA	4:F:113:SER:HB2	1.72	0.71
4:F:118:ASP:N	4:F:119:ASP:HB3	2.07	0.69
4:F:113:SER:CB	4:F:114:ALA:HB3	2.24	0.67
4:F:108:ILE:HA	4:F:111:LEU:HD12	1.82	0.61
4:F:46:PRO:HG3	4:F:137:ILE:HG23	1.87	0.56
3:E:570:VAL:HG12	3:E:571:LEU:H	1.71	0.55
1:A:228:ARG:NH2	1:A:251:ASP:OD1	2.39	0.55
4:F:42:PRO:CG	4:F:113:SER:HA	2.39	0.53
4:F:42:PRO:HG3	4:F:113:SER:HA	1.91	0.53
4:F:118:ASP:HB3	4:F:119:ASP:HA	1.92	0.51
4:F:39:ILE:HD12	4:F:54:LEU:HD13	1.94	0.50
4:F:119:ASP:N	4:F:120:PRO:HD3	2.27	0.49
1:A:233:TYR:HB3	1:A:244:TRP:HB2	1.95	0.49
4:F:53:LYS:HG3	4:F:73:THR:OG1	2.13	0.49
4:F:47:PHE:HB3	4:F:52:PHE:CZ	2.50	0.46
2:B:539:ASP:OD1	2:B:539:ASP:N	2.48	0.46
1:A:143:LEU:HA	1:A:146:ILE:HD12	1.97	0.45
3:E:530:ILE:HD11	3:E:541:GLN:HE22	1.80	0.45
4:F:109:GLN:HG2	4:F:113:SER:OG	2.16	0.45
1:A:99:GLU:OE2	1:A:272:TYR:OH	2.35	0.44
4:F:47:PHE:HB3	4:F:52:PHE:HZ	1.82	0.44
1:A:189:ALA:N	1:A:190:PRO:HD2	2.32	0.44
3:E:501:MET:N	3:E:517:VAL:O	2.51	0.43
1:A:193:ASP:OD2	2:B:542:ARG:NH2	2.52	0.43
1:A:244:TRP:CH2	2:B:537:PRO:HG3	2.55	0.42
3:E:522:THR:HG22	3:E:523:ILE:H	1.83	0.42
4:F:62:TYR:CD1	4:F:63:PRO:HA	2.54	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:F:117:PRO:HB2	4:F:118:ASP:C	2.40	0.42
1:A:227:THR:OG1	1:A:228:ARG:N	2.45	0.42
1:A:274:LYS:O	1:A:275:ASP:HB2	2.20	0.42
1:A:192:ILE:CD1	1:A:198:VAL:HA	2.49	0.41
4:F:123:ASN:H	4:F:126:ALA:HB3	1.85	0.41
1:A:229:VAL:HG22	1:A:259:ILE:HB	2.02	0.41
1:A:248:ILE:HA	1:A:249:PRO:HA	1.84	0.41
4:F:20:VAL:HA	4:F:21:PRO:HD2	1.79	0.41
1:A:239:ALA:HB1	1:A:240:PRO:HD2	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	254/288 (88%)	243 (96%)	10 (4%)	1 (0%)	30 61
2	B	74/76 (97%)	73 (99%)	1 (1%)	0	100 100
3	E	70/76 (92%)	65 (93%)	4 (6%)	1 (1%)	9 32
4	F	147/152 (97%)	131 (89%)	14 (10%)	2 (1%)	9 32
All	All	545/592 (92%)	512 (94%)	29 (5%)	4 (1%)	19 49

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	129	ASP
3	E	535	GLY
4	F	115	PRO
4	F	19	PRO

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	210/246 (85%)	198 (94%)	12 (6%)	17 44
2	B	67/68 (98%)	59 (88%)	8 (12%)	4 16
3	E	65/69 (94%)	59 (91%)	6 (9%)	7 26
4	F	123/129 (95%)	114 (93%)	9 (7%)	11 35
All	All	465/512 (91%)	430 (92%)	35 (8%)	11 34

All (35) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	GLN
1	A	41	ASN
1	A	52	ILE
1	A	98	ILE
1	A	123	VAL
1	A	152	THR
1	A	154	GLU
1	A	165	SER
1	A	186	GLU
1	A	252	ASP
1	A	255	ILE
1	A	275	ASP
2	B	524	GLU
2	B	539	ASP
2	B	548	LYS
2	B	551	GLU
2	B	552	ASP
2	B	554	ARG
2	B	564	GLU
2	B	569	LEU
3	E	508	LEU
3	E	513	ILE
3	E	522	THR
3	E	531	GLN

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Mol	Chain	Res	Type
3	E	565	SER
3	E	571	LEU
4	F	13	GLN
4	F	20	VAL
4	F	24	LYS
4	F	44	ASP
4	F	51	THR
4	F	103	THR
4	F	121	LEU
4	F	124	ASP
4	F	129	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	525	ASN
3	E	540	GLN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

1 non-standard protein/DNA/RNA residue is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	GLZ	B	576	2,1	3,3,3	2.34	1 (33%)	1,2,2	1.25	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns.

'-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	GLZ	B	576	2,1	-	0/0/1/1	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	576	GLZ	O-C	4.02	1.42	1.20

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.

5.5 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, 95^{th} 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	256/288 (88%)	-0.25	2 (0%)	82	68	43, 61, 88, 105	0
2	B	75/76 (98%)	0.12	1 (1%)	74	58	50, 77, 90, 93	0
3	E	72/76 (94%)	0.72	6 (8%)	19	11	70, 106, 115, 116	0
4	F	149/152 (98%)	0.23	7 (4%)	37	23	53, 78, 109, 113	0
All	All	552/592 (93%)	0.06	16 (2%)	54	35	43, 70, 111, 116	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	F	113	SER	4.6
4	F	121	LEU	3.2
4	F	117	PRO	3.2
4	F	93	ASP	3.0
3	E	571	LEU	2.8
3	E	538	PRO	2.6
3	E	512	THR	2.6
4	F	4	LEU	2.4
1	A	20	LEU	2.4
3	E	508	LEU	2.2
3	E	533	LYS	2.1
3	E	522	THR	2.1
4	F	122	ALA	2.1
2	B	532	ASP	2.1
4	F	120	PRO	2.1
1	A	23	ASP	2.0

6.2 Non-standard residues in protein, DNA, RNA chains

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, 95^{th} 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(Å^2)	Q<0.9
2	GLZ	B	576	4/4	0.95	0.09	48,48,48,49	0

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.