wwPDB X-ray Structure Validation Summary Report (i)

Feb 21, 2024 – 08:45 AM EST

PDB ID	:	4PYU
Title	:	The conserved ubiquitin-like protein hub1 plays a critical role in splicing in human cells
Authors	:	Ammon, T.; Mishra, S.K.; Kowalska, K.; Popowicz, G.M.; Holak, T.A.; Jentsch, S.
Deposited on	:	2014-03-28
Resolution	:	2.00 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 (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:

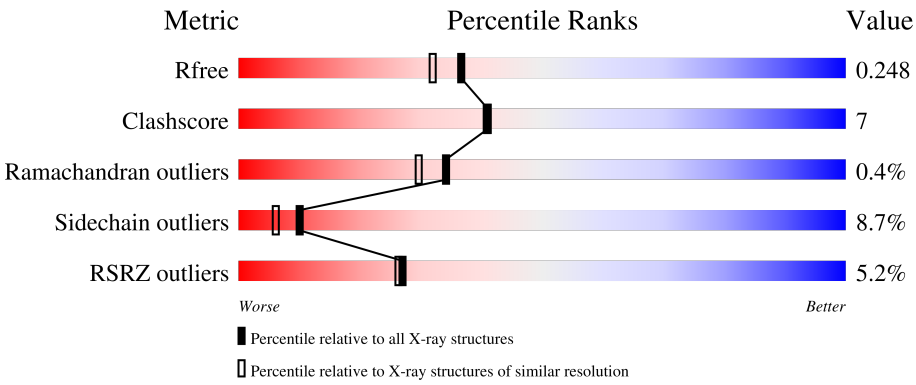
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 2.00 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}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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	76	4%, 84%, 9%, 7%
1	B	76	7%, 76%, 17%, 5%
1	G	76	3%, 71%, 21%, 5%
1	K	76	9%, 78%, 18%
1	O	76	3%, 86%, 11%

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Mol	Chain	Length	Quality of chain
1	S	76	11% 78% 16% 5%
2	C	19	5% 89% 5% 5%
2	D	19	89% 5% 5%
2	H	19	79% 5% 16%
2	L	19	5% 79% 16% 5%
2	P	19	74% 21% 5%
2	T	19	74% 16% 11%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4741 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 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	76	600	385	98	113	4	0	0	0
1	B	75	594	382	98	110	4	0	0	0
1	G	74	597	382	101	110	4	0	0	0
1	K	74	588	376	98	110	4	0	0	0
1	O	75	605	386	103	112	4	0	0	0
1	S	75	603	386	101	112	4	0	0	0

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP Q9BZL1
A	-1	SER	-	expression tag	UNP Q9BZL1
A	0	HIS	-	expression tag	UNP Q9BZL1
B	-2	GLY	-	expression tag	UNP Q9BZL1
B	-1	SER	-	expression tag	UNP Q9BZL1
B	0	HIS	-	expression tag	UNP Q9BZL1
G	-2	GLY	-	expression tag	UNP Q9BZL1
G	-1	SER	-	expression tag	UNP Q9BZL1
G	0	HIS	-	expression tag	UNP Q9BZL1
K	-2	GLY	-	expression tag	UNP Q9BZL1
K	-1	SER	-	expression tag	UNP Q9BZL1
K	0	HIS	-	expression tag	UNP Q9BZL1
O	-2	GLY	-	expression tag	UNP Q9BZL1
O	-1	SER	-	expression tag	UNP Q9BZL1
O	0	HIS	-	expression tag	UNP Q9BZL1
S	-2	GLY	-	expression tag	UNP Q9BZL1
S	-1	SER	-	expression tag	UNP Q9BZL1

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Chain	Residue	Modelled	Actual	Comment	Reference
S	0	HIS	-	expression tag	UNP Q9BZL1

- Molecule 2 is a protein called U4/U6.U5 tri-snRNP-associated protein 1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	19	146	92	26	28	0	0	0
2	D	19	145	92	25	28	0	0	0
2	H	19	144	92	24	28	0	0	0
2	L	19	146	93	25	28	0	0	0
2	P	19	142	92	24	26	0	0	0
2	T	19	144	92	24	28	0	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	44	44	44	0	0
3	B	24	24	24	0	0
3	C	14	14	14	0	0
3	D	9	9	9	0	0
3	G	34	34	34	0	0
3	H	19	19	19	0	0
3	K	27	27	27	0	0
3	L	15	15	15	0	0
3	O	41	41	41	0	0
3	P	10	10	10	0	0
3	S	41	41	41	0	0

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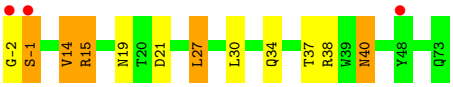
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	T	9	9	9	0	0

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.

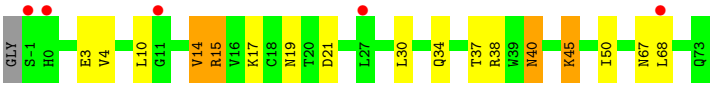
• Molecule 1: Ubiquitin-like protein 5

Chain A:



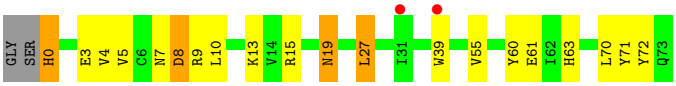
• Molecule 1: Ubiquitin-like protein 5

Chain B:



• Molecule 1: Ubiquitin-like protein 5

Chain G:



• Molecule 1: Ubiquitin-like protein 5

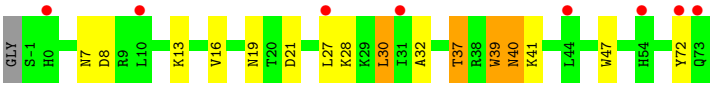
Chain K:

• Molecule 1: Ubiquitin-like protein 5

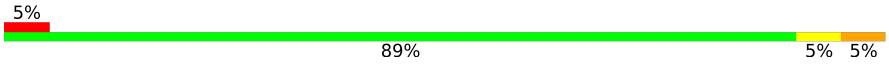
Chain O:

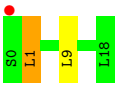
• Molecule 1: Ubiquitin-like protein 5

Chain S:



• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

Chain C: 



• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

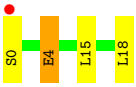
Chain D:

• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

Chain H:

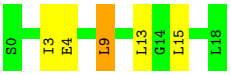
• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

Chain L:



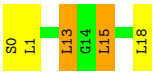
• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

Chain P:



• Molecule 2: U4/U6.U5 tri-snRNP-associated protein 1

Chain T:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α, β, γ	87.51Å 103.63Å 67.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.97 – 2.00 19.97 – 2.00	Depositor EDS
% Data completeness (in resolution range)	87.0 (19.97-2.00) 87.2 (19.97-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	5.24 (at 2.01Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.186 , 0.246 0.192 , 0.248	Depositor DCC
R_{free} test set	1839 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	29.6	Xtriage
Anisotropy	0.090	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 52.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	4741	wwPDB-VP
Average B, all atoms (Å^2)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 39.39 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 3.1981e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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 (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	0.81	0/611	1.12	4/826 (0.5%)
1	B	0.86	0/605	1.03	3/818 (0.4%)
1	G	0.79	0/608	1.00	2/821 (0.2%)
1	K	0.70	0/599	0.88	1/810 (0.1%)
1	O	0.80	0/616	0.90	1/830 (0.1%)
1	S	0.75	0/614	0.84	0/829
2	C	0.79	0/145	0.99	1/192 (0.5%)
2	D	0.71	0/145	0.99	1/192 (0.5%)
2	H	1.00	0/144	1.13	2/191 (1.0%)
2	L	0.77	0/146	0.94	0/193
2	P	0.78	0/141	0.89	0/187
2	T	0.85	0/144	1.07	0/191
All	All	0.79	0/4518	0.97	15/6080 (0.2%)

There are no bond length outliers.

The worst 5 of 15 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	15	ARG	NE-CZ-NH2	-11.41	114.60	120.30
1	A	15	ARG	NE-CZ-NH1	10.29	125.45	120.30
1	A	14	VAL	CB-CA-C	-9.17	93.97	111.40
1	B	15	ARG	NE-CZ-NH1	7.93	124.26	120.30
1	B	15	ARG	NE-CZ-NH2	-7.67	116.47	120.30

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	600	0	579	8	0
1	B	594	0	580	11	0
1	G	597	0	590	9	0
1	K	588	0	571	9	0
1	O	605	0	600	7	0
1	S	603	0	593	11	0
2	C	146	0	161	0	0
2	D	145	0	161	1	0
2	H	144	0	156	2	0
2	L	146	0	163	4	0
2	P	142	0	154	3	0
2	T	144	0	156	1	0
3	A	44	0	0	2	0
3	B	24	0	0	1	0
3	C	14	0	0	0	0
3	D	9	0	0	0	0
3	G	34	0	0	0	0
3	H	19	0	0	2	0
3	K	27	0	0	3	0
3	L	15	0	0	2	0
3	O	41	0	0	1	0
3	P	10	0	0	1	0
3	S	41	0	0	0	0
3	T	9	0	0	0	0
All	All	4741	0	4464	63	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.

The worst 5 of 63 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:O:32:ALA:HA	1:O:37:THR:HG22	1.54	0.89
2:L:4:GLU:HG3	3:L:111:HOH:O	1.72	0.89
1:B:45:LYS:HD2	1:B:50:ILE:HG12	1.56	0.87
2:P:4:GLU:CG	3:P:108:HOH:O	2.24	0.85
3:K:119:HOH:O	2:L:0:SER:HA	1.79	0.82

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	74/76 (97%)	72 (97%)	2 (3%)	0	100	100
1	B	73/76 (96%)	71 (97%)	2 (3%)	0	100	100
1	G	72/76 (95%)	70 (97%)	2 (3%)	0	100	100
1	K	72/76 (95%)	67 (93%)	4 (6%)	1 (1%)	11	5
1	O	73/76 (96%)	72 (99%)	1 (1%)	0	100	100
1	S	73/76 (96%)	72 (99%)	0	1 (1%)	11	5
2	C	17/19 (90%)	17 (100%)	0	0	100	100
2	D	17/19 (90%)	17 (100%)	0	0	100	100
2	H	17/19 (90%)	17 (100%)	0	0	100	100
2	L	17/19 (90%)	17 (100%)	0	0	100	100
2	P	17/19 (90%)	17 (100%)	0	0	100	100
2	T	17/19 (90%)	17 (100%)	0	0	100	100
All	All	539/570 (95%)	526 (98%)	11 (2%)	2 (0%)	34	30

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	K	39	TRP
1	S	47	TRP

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	61/68 (90%)	57 (93%)	4 (7%)	16	12
1	B	62/68 (91%)	58 (94%)	4 (6%)	17	12
1	G	63/68 (93%)	56 (89%)	7 (11%)	6	3
1	K	62/68 (91%)	61 (98%)	1 (2%)	62	67
1	O	65/68 (96%)	62 (95%)	3 (5%)	27	23
1	S	64/68 (94%)	58 (91%)	6 (9%)	8	5
2	C	16/17 (94%)	14 (88%)	2 (12%)	4	2
2	D	16/17 (94%)	15 (94%)	1 (6%)	18	13
2	H	15/17 (88%)	11 (73%)	4 (27%)	0	0
2	L	16/17 (94%)	14 (88%)	2 (12%)	4	2
2	P	14/17 (82%)	12 (86%)	2 (14%)	3	1
2	T	15/17 (88%)	10 (67%)	5 (33%)	0	0
All	All	469/510 (92%)	428 (91%)	41 (9%)	10	6

5 of 41 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	P	9	LEU
1	S	40	ASN
2	P	15	LEU
1	S	30	LEU
2	T	1	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	67	ASN
1	G	63	HIS
1	S	40	ASN
1	O	73	GLN
1	S	19	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 monosaccharides 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 (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	76/76 (100%)	-0.03	3 (3%)	39	38	22, 30, 40, 65	0
1	B	75/76 (98%)	0.05	5 (6%)	17	17	25, 31, 44, 58	0
1	G	74/76 (97%)	-0.05	2 (2%)	54	53	21, 32, 50, 71	0
1	K	74/76 (97%)	0.38	7 (9%)	8	7	28, 37, 55, 68	0
1	O	75/76 (98%)	-0.05	2 (2%)	54	53	22, 30, 45, 68	0
1	S	75/76 (98%)	0.31	8 (10%)	6	5	24, 36, 53, 61	0
2	C	19/19 (100%)	-0.38	1 (5%)	26	25	20, 27, 37, 41	0
2	D	19/19 (100%)	-0.36	0	100	100	26, 34, 46, 49	0
2	H	19/19 (100%)	-0.28	0	100	100	24, 30, 43, 48	0
2	L	19/19 (100%)	-0.21	1 (5%)	26	25	29, 32, 44, 52	0
2	P	19/19 (100%)	-0.11	0	100	100	27, 36, 46, 57	0
2	T	19/19 (100%)	-0.02	0	100	100	25, 38, 49, 55	0
All	All	563/570 (98%)	0.04	29 (5%)	27	26	20, 32, 50, 71	0

The worst 5 of 29 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	S	10	LEU	3.7
1	K	27	LEU	3.2
1	B	27	LEU	3.2
1	S	73	GLN	3.1
1	A	-1	SER	3.0

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 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.