



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 01:45 PM UTC

PDB ID : 5H2W / pdb_00005h2w
Title : Crystal structure of the karyopherin Kap60p bound to the SUMO protease Ulp1p (150-340)
Authors : Hirano, H.; Matsuura, Y.
Deposited on : 2016-10-18
Resolution : 2.50 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

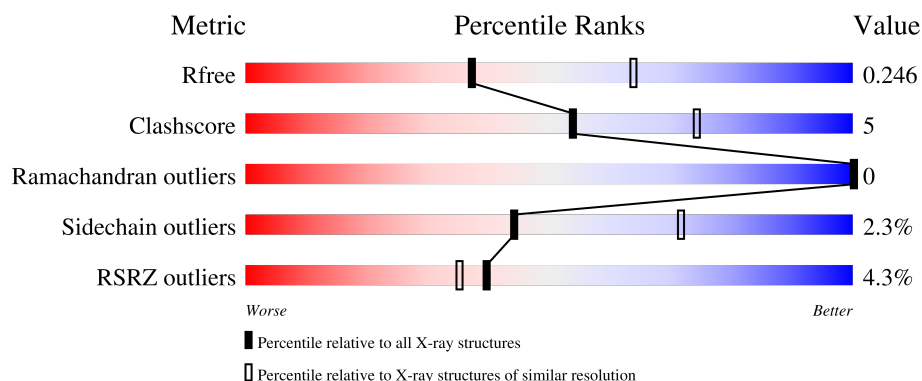
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	423	3% 85% 13% ..
1	C	423	4% 87% 11% .
2	B	191	2% 6% 91% .
2	D	191	3% 6% 90% .

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6752 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 Importin subunit alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	416	Total	C	N	O	S	0	0	0
			3171	2015	534	606	16			
1	C	414	Total	C	N	O	S	0	0	0
			3171	2011	529	615	16			

- Molecule 2 is a protein called Ubiquitin-like-specific protease 1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	17	Total	C	N	O	0	0	0
			155	99	36	20			
2	D	19	Total	C	N	O	0	0	0
			170	107	38	25			

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	30	Total	O	0	0
			30	30		
3	B	4	Total	O	0	0
			4	4		
3	C	48	Total	O	0	0
			48	48		
3	D	3	Total	O	0	0
			3	3		

ASN
ASP
ASP
ASP
LEU
VAL
PHE

● Molecule 2: Ubiquitin-like-specific protease 1



SER
SER
SER
THR
R154
D159
T160
S161
T162
W163
A164
L165
R171
I172
GLU
SER
GLU
GLY
VAL
GLY
THR
PRO
SER
THR
SER
PRO
ILE
SER
SER
SER
LEU
ALA
GLN
LYS
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ASN
CYS
ASP
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ASP
LEU
VAL
PHE

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	52.61Å 63.54Å 80.91Å 106.09° 107.72° 90.50°	Depositor
Resolution (Å)	27.03 – 2.50 27.03 – 2.50	Depositor EDS
% Data completeness (in resolution range)	90.5 (27.03-2.50) 90.5 (27.03-2.50)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.14 (at 2.50Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.213 , 0.247 0.216 , 0.246	Depositor DCC
R_{free} test set	1544 reflections (4.68%)	wwPDB-VP
Wilson B-factor (Å ²)	29.8	Xtriage
Anisotropy	0.633	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 32.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.028 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	6752	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.71% 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	0.33	0/3222	0.78	3/4392 (0.1%)
1	C	0.32	0/3221	0.76	0/4389
2	B	0.52	0/158	0.81	0/207
2	D	0.43	0/174	0.91	2/231 (0.9%)
All	All	0.33	0/6775	0.78	5/9219 (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
2	D	0	1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	D	159	ASP	N-CA-C	5.58	117.36	111.28
2	D	161	SER	N-CA-C	5.48	118.42	107.62
1	A	417	ARG	CA-C-N	5.20	124.86	119.56
1	A	417	ARG	C-N-CA	5.20	124.86	119.56
1	A	99	ASP	N-CA-C	-5.16	106.94	114.12

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	D	160	THR	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	3171	0	3198	34	0
1	C	3171	0	3191	29	0
2	B	155	0	167	8	0
2	D	170	0	179	5	0
3	A	30	0	0	0	0
3	B	4	0	0	0	0
3	C	48	0	0	1	0
3	D	3	0	0	0	0
All	All	6752	0	6735	66	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 5.

All (66) 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:A:244:ARG:NH2	2:B:165:LEU:O	2.09	0.84
1:C:244:ARG:NH2	2:D:165:LEU:O	2.11	0.80
1:A:247:LYS:HB2	2:B:162:THR:HG21	1.65	0.78
1:A:95:GLN:HG3	1:A:103:GLU:HG2	1.64	0.77
1:A:192:GLN:HE21	2:B:171:ARG:HH11	1.32	0.76
1:C:95:GLN:NE2	1:C:103:GLU:OE1	2.25	0.69
1:C:310:HIS:HD2	1:C:312:SER:H	1.42	0.66
1:A:310:HIS:HD2	1:A:312:SER:H	1.43	0.66
1:C:463:LYS:HZ3	1:C:471:ASN:N	1.96	0.64
1:A:310:HIS:CD2	1:A:312:SER:H	2.20	0.60
1:A:460:GLU:O	1:A:463:LYS:HB2	2.02	0.58
1:C:310:HIS:CD2	1:C:312:SER:H	2.20	0.58
1:C:414:GLY:HA3	1:C:421:ILE:HG12	1.86	0.57
1:A:299:ARG:HH11	1:A:299:ARG:HG3	1.70	0.56
1:A:95:GLN:HG2	1:A:107:ALA:HB2	1.86	0.56
1:A:106:SER:OG	1:A:110:LYS:NZ	2.39	0.55
1:A:209:ASP:O	1:A:213:GLN:HG2	2.07	0.55
1:C:392:LEU:HD22	1:C:407:ILE:HD12	1.89	0.54
1:A:365:ILE:HG21	1:A:388:LEU:HD11	1.92	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:464:GLU:OE1	1:A:464:GLU:N	2.40	0.51
1:C:493:GLU:H	1:C:493:GLU:CD	2.18	0.51
1:C:450:ASP:OD1	1:C:500:LYS:NZ	2.35	0.50
1:A:192:GLN:HE21	2:B:171:ARG:NH1	2.05	0.50
1:A:392:LEU:HD22	1:A:407:ILE:HD12	1.93	0.50
2:B:163:TRP:HA	2:B:163:TRP:CE3	2.46	0.50
1:A:354:LYS:HE2	1:A:357:ILE:HG13	1.93	0.50
1:A:481:GLY:O	1:A:485:LYS:HG2	2.12	0.49
1:C:279:TRP:CD2	1:C:318:PRO:HB3	2.46	0.49
1:C:282:SER:HB2	1:C:321:ARG:HG3	1.95	0.48
1:C:247:LYS:HA	1:C:248:PRO:HA	1.66	0.48
1:C:471:ASN:HB3	1:C:474:ALA:HB3	1.96	0.47
1:C:138:PHE:HB3	1:C:147:LEU:HG	1.97	0.46
1:A:98:SER:O	1:A:134:ARG:NH2	2.48	0.46
1:C:365:ILE:HG21	1:C:388:LEU:HD11	1.98	0.46
1:C:493:GLU:OE1	1:C:493:GLU:N	2.46	0.46
1:A:187:VAL:HB	1:A:228:LYS:HD2	1.98	0.46
1:A:137:GLU:O	1:A:140:ARG:HG3	2.16	0.45
1:A:478:GLU:OE1	1:A:479:LYS:HD2	2.17	0.45
1:A:122:PRO:HB2	1:A:125:VAL:HG22	1.98	0.44
1:A:367:ASN:O	2:B:155:LYS:NZ	2.46	0.44
2:B:163:TRP:HA	2:B:163:TRP:HE3	1.82	0.44
1:A:246:LYS:HB2	2:B:162:THR:HG23	2.00	0.44
1:A:228:LYS:HD3	1:A:231:LEU:HB2	1.99	0.44
1:C:298:VAL:HG23	1:C:300:ILE:HG13	2.00	0.44
1:C:359:LYS:HD3	1:C:398:LYS:HG3	2.00	0.44
1:A:122:PRO:HB2	1:A:125:VAL:CG2	2.48	0.44
1:A:279:TRP:CD2	1:A:318:PRO:HB3	2.53	0.44
1:C:290:GLU:CD	1:C:290:GLU:H	2.26	0.44
1:C:226:SER:OG	1:C:228:LYS:HB2	2.18	0.43
1:A:463:LYS:HE3	1:A:471:ASN:N	2.33	0.43
1:C:192:GLN:HE21	2:D:171:ARG:NH1	2.16	0.43
2:D:162:THR:O	2:D:163:TRP:CD1	2.72	0.43
1:C:358:LYS:NZ	3:C:611:HOH:O	2.52	0.42
1:A:496:LYS:O	1:A:500:LYS:HB2	2.20	0.42
1:A:417:ARG:HA	1:A:418:PRO:HD2	1.88	0.42
1:A:138:PHE:HB3	1:A:147:LEU:HG	2.01	0.42
1:A:450:ASP:OD1	1:A:500:LYS:HE2	2.20	0.42
1:A:298:VAL:HG23	1:A:300:ILE:HG13	2.01	0.41
1:C:434:CYS:SG	1:C:482:GLY:HA3	2.61	0.41
1:C:397:TYR:CE2	1:C:401:LYS:HD2	2.56	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:431:LYS:HB3	1:C:432:PRO:HD3	2.03	0.41
1:C:452:LEU:HD13	1:C:486:ILE:HD11	2.03	0.41
1:C:192:GLN:NE2	2:D:171:ARG:HD3	2.37	0.40
1:A:127:ILE:HD13	1:A:168:VAL:HG21	2.02	0.40
1:C:354:LYS:HA	1:C:354:LYS:HD2	1.82	0.40
1:C:247:LYS:CB	2:D:162:THR:HG21	2.51	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	412/423 (97%)	403 (98%)	9 (2%)	0	100	100
1	C	410/423 (97%)	404 (98%)	6 (2%)	0	100	100
2	B	13/191 (7%)	13 (100%)	0	0	100	100
2	D	17/191 (9%)	15 (88%)	2 (12%)	0	100	100
All	All	852/1228 (69%)	835 (98%)	17 (2%)	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	344/364 (94%)	336 (98%)	8 (2%)	44	72
1	C	347/364 (95%)	340 (98%)	7 (2%)	48	75
2	B	16/178 (9%)	15 (94%)	1 (6%)	16	34
2	D	18/178 (10%)	17 (94%)	1 (6%)	19	39
All	All	725/1084 (67%)	708 (98%)	17 (2%)	44	72

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	103	GLU
1	A	145	GLU
1	A	390	LYS
1	A	393	GLU
1	A	431	LYS
1	A	457	LYS
1	A	463	LYS
1	A	491	GLN
2	B	157	LYS
1	C	125	VAL
1	C	141	GLU
1	C	188	GLU
1	C	290	GLU
1	C	438	GLU
1	C	493	GLU
1	C	503	LYS
2	D	154	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	95	GLN
1	A	119	HIS
1	A	192	GLN
1	A	310	HIS
1	A	494	ASN
1	C	95	GLN
1	C	142	ASN
1	C	192	GLN
1	C	213	GLN
1	C	310	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 [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	416/423 (98%)	0.45	12 (2%) 53 49	27, 39, 60, 74	0
1	C	414/423 (97%)	0.44	17 (4%) 41 37	25, 36, 60, 80	0
2	B	17/191 (8%)	1.05	3 (17%) 4 3	31, 39, 77, 84	0
2	D	19/191 (9%)	1.23	5 (26%) 1 1	32, 46, 83, 84	0
All	All	866/1228 (70%)	0.47	37 (4%) 40 35	25, 37, 62, 84	0

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	465	ALA	4.6
2	B	161	SER	4.0
1	C	463	LYS	3.9
2	D	163	TRP	3.9
2	B	162	THR	3.7
1	C	188	GLU	3.7
2	B	163	TRP	3.4
2	D	162	THR	3.4
1	C	493	GLU	3.4
1	C	89	LEU	3.3
1	C	494	ASN	3.1
1	C	91	GLN	3.0
1	A	118	GLU	2.8
1	C	415	LEU	2.7
1	C	122	PRO	2.6
1	A	124	ASP	2.5
1	A	415	LEU	2.5
2	D	172	ILE	2.5
1	C	227	ASN	2.5
1	A	464	GLU	2.4
1	C	146	MET	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	426	SER	2.4
1	C	286	ASP	2.4
1	C	142	ASN	2.3
2	D	164	ALA	2.2
1	C	246	LYS	2.2
1	C	119	HIS	2.2
2	D	160	THR	2.2
1	A	89	LEU	2.1
1	A	446	GLU	2.1
1	A	142	ASN	2.1
1	C	93	THR	2.1
1	C	404	CYS	2.1
1	A	227	ASN	2.1
1	C	103	GLU	2.1
1	A	383	ASN	2.1
1	A	493	GLU	2.1

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.