



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 05:37 PM UTC

PDB ID : 1U4C / pdb_00001u4c
Title : Structure of spindle checkpoint protein Bub3
Authors : Larsen, N.A.; Harrison, S.C.
Deposited on : 2004-07-23
Resolution : 2.35 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
Mogul	:	2022.3.0, CSD as543be (2022)
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

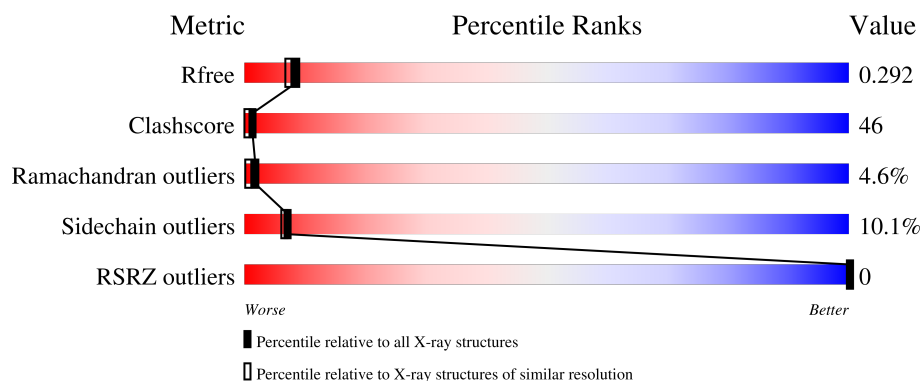
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.35 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	1596 (2.36-2.36)
Clashscore	190562	1663 (2.36-2.36)
Ramachandran outliers	187476	1646 (2.36-2.36)
Sidechain outliers	187428	1646 (2.36-2.36)
RSRZ outliers	180081	1598 (2.36-2.36)

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	349	
1	B	349	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5511 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 Cell cycle arrest protein BUB3.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	322	Total	C	N	O	S	Se	0	0	0
			2547	1619	428	487	10	3			
1	B	331	Total	C	N	O	S	Se	0	0	0
			2620	1662	439	506	10	3			

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MSE	MET	modified residue	UNP P26449
A	156	MSE	MET	modified residue	UNP P26449
A	167	MSE	MET	modified residue	UNP P26449
A	342	LEU	-	expression tag	UNP P26449
A	343	GLU	-	expression tag	UNP P26449
A	344	HIS	-	expression tag	UNP P26449
A	345	HIS	-	expression tag	UNP P26449
A	346	HIS	-	expression tag	UNP P26449
A	347	HIS	-	expression tag	UNP P26449
A	348	HIS	-	expression tag	UNP P26449
A	349	HIS	-	expression tag	UNP P26449
B	1	MSE	MET	modified residue	UNP P26449
B	156	MSE	MET	modified residue	UNP P26449
B	167	MSE	MET	modified residue	UNP P26449
B	342	LEU	-	expression tag	UNP P26449
B	343	GLU	-	expression tag	UNP P26449
B	344	HIS	-	expression tag	UNP P26449
B	345	HIS	-	expression tag	UNP P26449
B	346	HIS	-	expression tag	UNP P26449
B	347	HIS	-	expression tag	UNP P26449
B	348	HIS	-	expression tag	UNP P26449
B	349	HIS	-	expression tag	UNP P26449

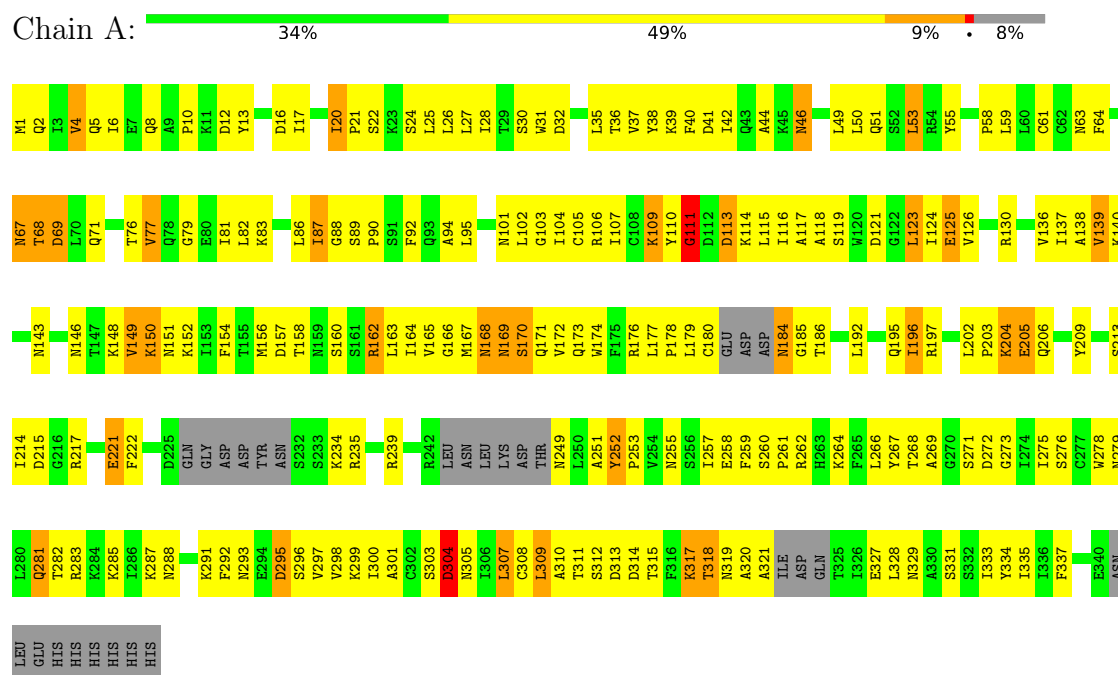
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	167	Total 167	O 167	0	0
2	B	177	Total 177	O 177	0	0

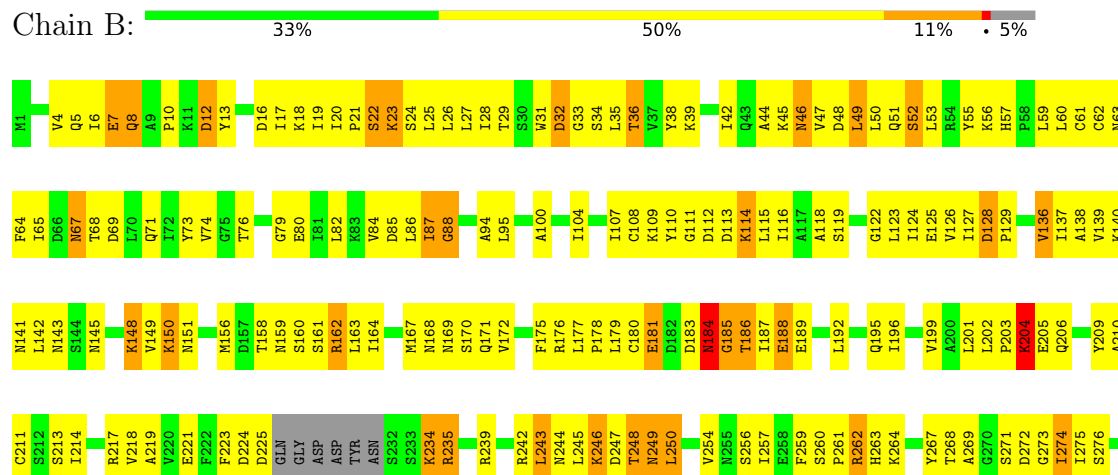
3 Residue-property plots

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: Cell cycle arrest protein BUB3



• Molecule 1: Cell cycle arrest protein BUB3



L280	Q281	T282	R283	K284	K287	N288	K291	F292	N293	F294	D295	S296	V297	V298	K299	D304	R305	I306	L307	G308	I309	A310	T311	S312	D313	D314	T315	F316	K317	T318	A321	ILF	ASP	GLN	T325	I326	E327	L328	S331	S332	I333	Y334	E340	ASN	LEU	GLU	HIS	HIS	HIS	HIS	HIS	HIS
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4 Data and refinement statistics

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	73.27Å 73.27Å 110.42Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	40.00 – 2.35 40.00 – 2.35	Depositor EDS
% Data completeness (in resolution range)	89.2 (40.00-2.35) 94.5 (40.00-2.35)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.62 (at 2.34Å)	Xtriage
Refinement program	CNS, SHELXL-97	Depositor
R, R_{free}	0.196 , 0.288 0.205 , 0.292	Depositor DCC
R_{free} test set	2142 reflections (4.14%)	wwPDB-VP
Wilson B-factor (Å ²)	53.5	Xtriage
Anisotropy	0.165	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 84.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.52$, $\langle L^2 \rangle = 0.36$	Xtriage
Estimated twinning fraction	0.016 for -h,-k,l 0.487 for h,-h-k,-l 0.015 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.98	EDS
Total number of atoms	5511	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.03% 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	0.53	0/2587	0.98	10/3492 (0.3%)
1	B	0.53	0/2662	1.00	14/3597 (0.4%)
All	All	0.53	0/5249	0.99	24/7089 (0.3%)

There are no bond length outliers.

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	20	ILE	CA-C-N	9.67	131.93	119.84
1	A	20	ILE	C-N-CA	9.67	131.93	119.84
1	B	12	ASP	N-CA-C	7.38	120.89	109.60
1	B	162	ARG	N-CA-C	7.25	120.37	108.99
1	B	111	GLY	N-CA-C	-7.00	101.41	112.61

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	2547	0	2546	229	0
1	B	2620	0	2614	246	0
2	A	167	0	0	13	0
2	B	177	0	0	14	0
All	All	5511	0	5160	474	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 46.

The worst 5 of 474 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:148:LYS:HG2	1:B:149:VAL:H	1.12	1.13
1:A:271:SER:HA	1:A:296:SER:HB2	1.38	1.06
1:A:148:LYS:HG2	1:A:149:VAL:H	1.14	1.04
1:B:28:ILE:HD13	1:B:333:ILE:HD13	1.46	0.98
1:B:18:LYS:HE2	1:B:18:LYS:HA	1.47	0.95

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	312/349 (89%)	268 (86%)	33 (11%)	11 (4%)	3	1
1	B	325/349 (93%)	266 (82%)	41 (13%)	18 (6%)	1	0
All	All	637/698 (91%)	534 (84%)	74 (12%)	29 (5%)	2	0

5 of 29 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	67	ASN
1	A	113	ASP
1	A	304	ASP
1	B	181	GLU
1	B	204	LYS

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	287/310 (93%)	259 (90%)	28 (10%)	7	7
1	B	296/310 (96%)	265 (90%)	31 (10%)	6	6
All	All	583/620 (94%)	524 (90%)	59 (10%)	7	6

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	4	VAL
1	B	311	THR
1	B	46	ASN
1	B	309	LEU
1	B	250	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 24 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	67	ASN
1	B	184	ASN
1	B	171	GLN
1	B	195	GLN
1	A	184	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 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 [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	319/349 (91%)	-1.17	0 100 100	38, 57, 85, 113	0
1	B	328/349 (93%)	-1.17	0 100 100	38, 57, 92, 117	0
All	All	647/698 (92%)	-1.17	0 100 100	38, 57, 90, 117	0

There are no RSRZ outliers to report.

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.