



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 09:29 AM UTC

PDB ID : 4HCE / pdb_00004hce
Title : Crystal structure of the telomeric *Saccharomyces cerevisiae* Cdc13 OB2 domain
Authors : Mason, M.; Wannat, J.J.; Harper, S.; Schultz, D.C.; Speicher, D.W.; Johnson, F.B.; Skordalakes, E.
Deposited on : 2012-09-29
Resolution : 2.30 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

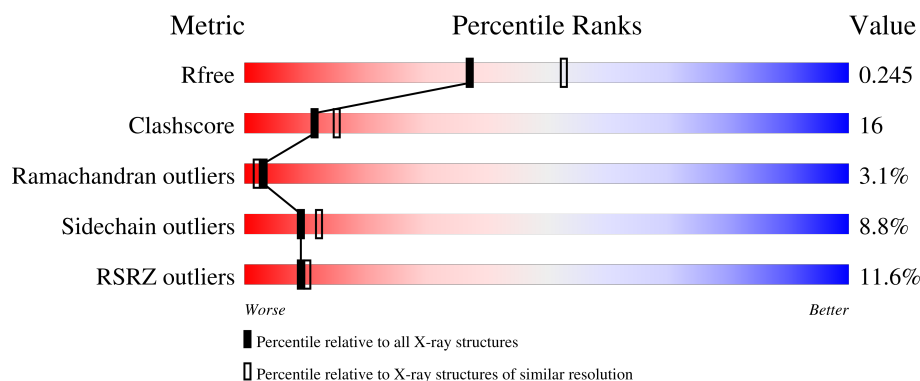
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	152	12% 60% 18% 7% 15%
1	B	152	8% 64% 14% 7% 14%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2140 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.

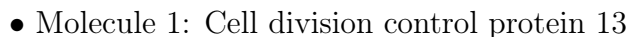
- Molecule 1 is a protein called Cell division control protein 13.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	129	Total	C	N	O	S	0	0	0
			1014	650	165	193	6			
1	B	130	Total	C	N	O	S	0	0	0
			1021	654	166	195	6			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	40	Total	O	0	0
			40	40		
2	B	65	Total	O	0	0
			65	65		

- Molecule 1: Cell division control protein 13



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	40.88Å 78.77Å 100.69Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 2.30 40.00 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.3 (40.00-2.30) 99.3 (40.00-2.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.01 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, R_{free}	0.202 , 0.247 0.204 , 0.245	Depositor DCC
R_{free} test set	757 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	35.1	Xtriage
Anisotropy	0.404	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 48.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2140	wwPDB-VP
Average B, all atoms (Å ²)	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.58% 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	0.65	0/1032	0.96	1/1402 (0.1%)
1	B	0.73	0/1039	0.97	0/1412
All	All	0.69	0/2071	0.97	1/2814 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	399	LYS	N-CA-C	5.39	122.29	110.80

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	1014	0	1039	42	0
1	B	1021	0	1046	27	0
2	A	40	0	0	5	0
2	B	65	0	0	8	0
All	All	2140	0	2085	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 16.

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:454:ASP:HA	1:A:455:ASN:CB	1.82	1.10
1:A:397:PRO:HA	1:A:398:ASP:HB3	1.38	1.04
1:A:454:ASP:HA	1:A:455:ASN:HB2	1.04	1.03
1:A:454:ASP:CA	1:A:455:ASN:HB2	1.90	1.02
1:B:402:VAL:HG22	1:B:405:VAL:HG13	1.52	0.91
1:A:436:LEU:HB2	1:A:438:LEU:HD11	1.54	0.90
1:A:397:PRO:HA	1:A:398:ASP:CB	2.01	0.89
1:B:397:PRO:O	1:B:398:ASP:HB3	1.71	0.88
1:A:436:LEU:HB2	1:A:438:LEU:CD1	2.08	0.82
1:B:460:SER:HB3	2:B:564:HOH:O	1.81	0.81
1:A:381:LYS:HE2	2:A:540:HOH:O	1.86	0.75
1:A:436:LEU:CB	1:A:438:LEU:HD11	2.19	0.72
1:A:460:SER:HB2	2:A:536:HOH:O	1.92	0.69
1:B:460:SER:H	1:B:461:PRO:HA	1.57	0.69
1:A:374:PHE:HB2	1:A:379:GLU:OE1	1.94	0.68
1:A:402:VAL:HG22	1:A:405:VAL:HG13	1.76	0.68
1:B:460:SER:H	1:B:461:PRO:CA	2.08	0.66
1:A:397:PRO:CA	1:A:398:ASP:HB3	2.21	0.65
1:A:436:LEU:CB	1:A:438:LEU:CD1	2.76	0.64
1:A:463:MET:HG2	1:B:401:LEU:HB2	1.83	0.61
1:B:346:ILE:HD12	1:B:348:TYR:H	1.65	0.61
1:A:458:THR:C	1:A:460:SER:H	2.12	0.57
1:B:458:THR:O	1:B:459:ALA:HB3	2.06	0.55
1:A:386:LYS:CE	2:B:534:HOH:O	2.55	0.55
1:A:396:VAL:HG13	1:A:397:PRO:O	2.07	0.54
1:A:381:LYS:NZ	2:A:501:HOH:O	2.36	0.54
1:A:393:LEU:CB	1:A:396:VAL:HG12	2.37	0.54
1:A:444:ILE:HD12	2:A:502:HOH:O	2.09	0.53
1:B:473:THR:CG2	1:B:473:THR:O	2.58	0.52
1:A:373:GLN:HB2	1:B:456:ASP:OD2	2.09	0.52
1:A:393:LEU:HB2	1:A:396:VAL:HG12	1.91	0.52
1:A:459:ALA:HB3	2:B:521:HOH:O	2.09	0.51
1:A:460:SER:CB	2:A:536:HOH:O	2.53	0.51
1:B:386:LYS:HE3	2:B:525:HOH:O	2.12	0.50
1:B:396:VAL:HG23	1:B:399:LYS:HB3	1.94	0.50
1:A:428:GLN:OE1	1:A:431:LYS:HD2	2.13	0.49
1:B:374:PHE:HB2	1:B:379:GLU:HG3	1.94	0.49
1:B:376:SER:O	1:B:379:GLU:HG2	2.12	0.48
1:A:386:LYS:HE2	2:B:534:HOH:O	2.13	0.48
1:A:397:PRO:CA	1:A:398:ASP:CB	2.82	0.47
1:A:417:ARG:HH21	1:A:421:LEU:HD21	1.79	0.47
1:A:458:THR:C	1:A:460:SER:N	2.74	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:454:ASP:OD1	1:B:459:ALA:HB2	2.14	0.46
1:A:356:VAL:HA	1:A:450:ARG:HB3	1.96	0.46
1:A:455:ASN:C	1:A:457:LYS:H	2.24	0.46
1:A:458:THR:HG23	1:A:458:THR:O	2.16	0.45
1:B:455:ASN:HB2	2:B:564:HOH:O	2.16	0.45
1:B:459:ALA:HB1	1:B:461:PRO:HA	2.00	0.44
1:B:395:ASN:O	1:B:396:VAL:C	2.61	0.44
1:B:474:ASP:HB3	1:B:475:THR:HB	2.00	0.43
1:B:437:LEU:HD11	1:B:473:THR:HG23	2.00	0.43
1:A:392:LEU:HG	1:A:393:LEU:HD22	2.01	0.43
1:B:468:LEU:HD11	1:B:470:ASN:O	2.18	0.43
1:A:389:PHE:O	1:A:407:CYS:HB2	2.19	0.43
1:A:468:LEU:C	1:A:468:LEU:HD12	2.44	0.42
1:A:454:ASP:CA	1:A:455:ASN:CB	2.65	0.42
1:B:460:SER:N	1:B:461:PRO:HA	2.30	0.42
1:A:393:LEU:HD22	1:A:393:LEU:H	1.84	0.42
1:A:438:LEU:HD12	1:A:438:LEU:N	2.34	0.42
1:A:401:LEU:HB2	1:B:463:MET:HB3	2.02	0.42
1:B:455:ASN:ND2	2:B:564:HOH:O	2.51	0.42
1:B:458:THR:O	1:B:459:ALA:CB	2.67	0.41
1:A:435:ILE:O	1:A:437:LEU:CD1	2.69	0.41
1:B:396:VAL:HG23	1:B:396:VAL:O	2.21	0.41
1:B:460:SER:CB	2:B:564:HOH:O	2.52	0.41
1:A:436:LEU:O	1:A:444:ILE:HD11	2.20	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	127/152 (84%)	117 (92%)	6 (5%)	4 (3%)	3 2

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	128/152 (84%)	120 (94%)	4 (3%)	4 (3%)	3	2
All	All	255/304 (84%)	237 (93%)	10 (4%)	8 (3%)	3	2

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	399	LYS
1	A	455	ASN
1	B	459	ALA
1	B	460	SER
1	A	459	ALA
1	B	398	ASP
1	B	455	ASN
1	A	398	ASP

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	119/137 (87%)	110 (92%)	9 (8%)	12	16
1	B	120/137 (88%)	108 (90%)	12 (10%)	7	9
All	All	239/274 (87%)	218 (91%)	21 (9%)	9	12

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	393	LEU
1	A	396	VAL
1	A	402	VAL
1	A	405	VAL
1	A	430	ASP
1	A	450	ARG
1	A	468	LEU
1	A	472	SER

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Mol	Chain	Res	Type
1	A	473	THR
1	B	346	ILE
1	B	347	SER
1	B	379	GLU
1	B	392	LEU
1	B	398	ASP
1	B	402	VAL
1	B	405	VAL
1	B	428	GLN
1	B	444	ILE
1	B	456	ASP
1	B	468	LEU
1	B	473	THR

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

Mol	Chain	Res	Type
1	B	391	GLN
1	B	428	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](#)

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	129/152 (84%)	0.59	18 (13%) 6 7	31, 46, 91, 107	0
1	B	130/152 (85%)	0.19	12 (9%) 14 16	23, 34, 79, 122	0
All	All	259/304 (85%)	0.39	30 (11%) 9 10	23, 39, 90, 122	0

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	459	ALA	5.6
1	B	458	THR	5.2
1	A	460	SER	4.6
1	A	393	LEU	4.3
1	A	399	LYS	4.3
1	B	459	ALA	4.2
1	A	458	THR	3.7
1	B	460	SER	3.3
1	B	346	ILE	3.2
1	B	397	PRO	3.2
1	A	392	LEU	3.0
1	A	457	LYS	2.9
1	B	474	ASP	2.9
1	A	438	LEU	2.7
1	A	396	VAL	2.7
1	B	456	ASP	2.7
1	B	475	THR	2.6
1	A	394	PRO	2.6
1	B	457	LYS	2.6
1	A	346	ILE	2.6
1	A	474	ASP	2.5
1	A	473	THR	2.4
1	B	382	TYR	2.4
1	A	397	PRO	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	396	VAL	2.3
1	B	398	ASP	2.1
1	A	395	ASN	2.1
1	A	398	ASP	2.1
1	A	443	ARG	2.1
1	A	406	ASN	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.