Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 02:20 AM UTC

PDB ID	:	1R8J / pdb_00001r8j
Title	:	Crystal Structure of Circadian Clock Protein KaiA from Synechococcus elongatus
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Deposited on	:	2003-10-26
Resolution	:	2.03 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:

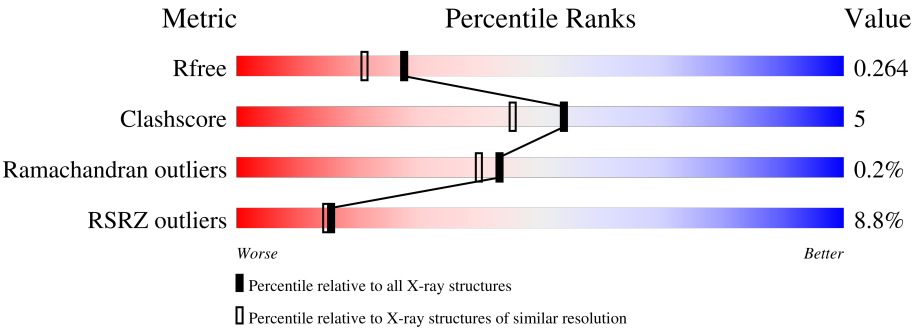
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.03 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	13299 (2.04-2.00)
Clashscore	190562	1022 (2.02-2.02)
Ramachandran outliers	187476	1014 (2.02-2.02)
RSRZ outliers	180081	13314 (2.04-2.00)

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	289	8% 83% 10% 6%
1	B	289	8% 83% 8% 9%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4577 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 KaiA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	272	Total	C	N	O	S	0	0	0
			2197	1392	380	410	15			
1	B	264	Total	C	N	O	S	0	1	0
			2134	1353	370	398	13			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-4	ALA	-	cloning artifact	UNP Q79PF6
A	-3	MET	-	cloning artifact	UNP Q79PF6
A	-2	ALA	-	cloning artifact	UNP Q79PF6
A	-1	ASP	-	cloning artifact	UNP Q79PF6
A	0	ILE	-	cloning artifact	UNP Q79PF6
A	1	VAL	-	cloning artifact	UNP Q79PF6
B	-4	ALA	-	cloning artifact	UNP Q79PF6
B	-3	MET	-	cloning artifact	UNP Q79PF6
B	-2	ALA	-	cloning artifact	UNP Q79PF6
B	-1	ASP	-	cloning artifact	UNP Q79PF6
B	0	ILE	-	cloning artifact	UNP Q79PF6
B	1	VAL	-	cloning artifact	UNP Q79PF6

- Molecule 2 is water.

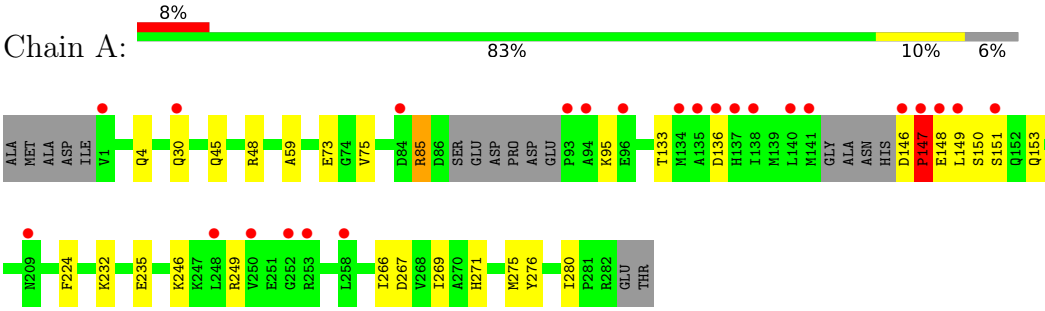
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	136	Total	O	0	0
			136	136		
2	B	110	Total	O	0	0
			110	110		

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.

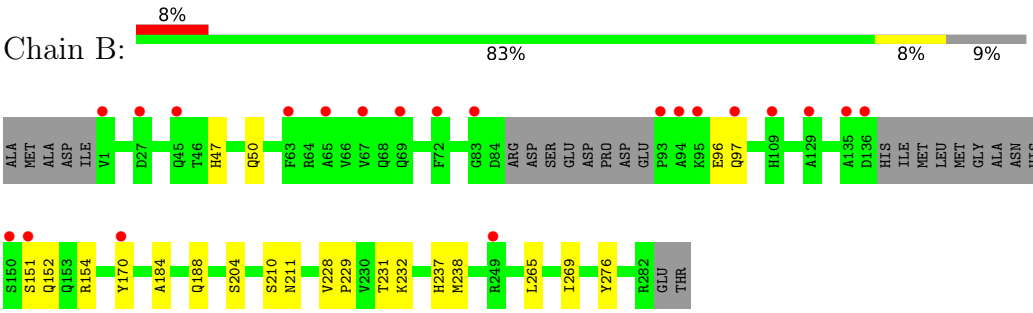
- Molecule 1: KaiA

Chain A:



- Molecule 1: KaiA

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	47.11Å 125.82Å 56.82Å 90.00° 114.90° 90.00°	Depositor
Resolution (Å)	20.00 – 2.03 20.00 – 2.03	Depositor EDS
% Data completeness (in resolution range)	98.9 (20.00-2.03) 99.2 (20.00-2.03)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	0.04	Depositor
$< I/\sigma(I) >$ [1]	2.93 (at 2.03Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.210 , 0.271 (Not available) , 0.264	Depositor DCC
R_{free} test set	1906 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å^2)	31.4	Xtriage
Anisotropy	0.464	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 46.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.027 for h,-k,-h-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	4577	wwPDB-VP
Average B, all atoms (Å^2)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.46% 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

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	0.56	0/2236	0.85	2/3027 (0.1%)
1	B	0.53	0/2177	0.87	1/2947 (0.0%)
All	All	0.55	0/4413	0.86	3/5974 (0.1%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	85	ARG	N-CA-C	-5.21	99.71	110.80
1	B	152	GLN	N-CA-C	-5.09	105.91	111.82
1	A	147	PRO	N-CA-C	5.08	122.93	112.47

There are no chirality outliers.

There are no planarity outliers.

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	2197	0	2188	27	0
1	B	2134	0	2130	20	0
2	A	136	0	0	0	0
2	B	110	0	0	0	0
All	All	4577	0	4318	42	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 (42) 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:4:GLN:NE2	1:A:30:GLN:OE1	2.21	0.74
1:A:146:ASP:N	1:A:147:PRO:CD	2.53	0.71
1:B:96:GLU:HB2	1:B:97:GLN:HE21	1.57	0.69
1:B:237:HIS:HD2	1:B:238:MET:HE2	1.58	0.68
1:B:204:SER:HB2	1:B:210:SER:HB2	1.75	0.67
1:B:148:GLU:HG3	1:B:149:LEU:N	2.11	0.65
1:B:184:ALA:O	1:B:188:GLN:HG2	1.99	0.62
1:B:237:HIS:CD2	1:B:238:MET:HE2	2.38	0.59
1:A:192:GLN:HA	1:A:195:GLN:HE21	1.69	0.57
1:A:246:LYS:HA	1:A:249:ARG:HD2	1.88	0.54
1:A:276:TYR:HB3	1:B:276:TYR:HB3	1.93	0.51
1:B:229:PRO:HB2	1:B:231:THR:HG22	1.92	0.51
1:A:146:ASP:N	1:A:147:PRO:HD2	2.26	0.50
1:A:146:ASP:O	1:A:148:GLU:N	2.45	0.49
1:A:267:ASP:O	1:A:271:HIS:HD2	1.95	0.49
1:A:269:ILE:HG22	1:B:269:ILE:HG22	1.95	0.49
1:A:232:LYS:HA	1:A:235:GLU:HG2	1.95	0.48
1:A:266:ILE:HD13	1:B:265:LEU:HD23	1.96	0.48
1:B:228:VAL:CG1	1:B:232:LYS:HB2	2.43	0.47
1:B:204:SER:HB2	1:B:210:SER:CB	2.46	0.45
1:A:133:THR:OG1	1:A:136:ASP:HB2	2.17	0.45
1:A:147:PRO:HA	1:A:150:SER:HB2	1.99	0.45
1:B:229:PRO:HD2	1:B:232:LYS:HG3	1.98	0.45
1:A:59:ALA:HA	1:A:85:ARG:HB2	1.99	0.44
1:A:147:PRO:HA	1:A:150:SER:CB	2.47	0.44
1:A:224:PHE:CD1	1:A:275:MET:HE2	2.52	0.44
1:A:280:ILE:HD12	1:B:170:TYR:CE1	2.52	0.44
1:A:73:GLU:HG3	1:A:75:VAL:HG23	2.00	0.44
1:A:147:PRO:N	1:A:150:SER:HB2	2.33	0.44
1:A:149:LEU:C	1:A:151:SER:H	2.25	0.43
1:B:151:SER:OG	1:B:154:ARG:NH2	2.52	0.43
1:B:96:GLU:HB2	1:B:97:GLN:H	1.47	0.43
1:B:96:GLU:HB2	1:B:97:GLN:NE2	2.29	0.43
1:A:146:ASP:N	1:A:147:PRO:HD3	2.32	0.43
1:B:47:HIS:HB3	1:B:50:GLN:HB2	1.99	0.43
1:A:146:ASP:C	1:A:150:SER:HB2	2.44	0.42
1:A:45:GLN:HG2	1:A:48:ARG:HH21	1.84	0.41
1:A:151:SER:C	1:A:153:GLN:N	2.78	0.41
1:A:95:LYS:HG2	1:B:211:ASN:HD21	1.85	0.41
1:A:146:ASP:N	1:A:146:ASP:OD2	2.54	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:149:LEU:C	1:B:151:SER:H	2.29	0.40
1:A:149:LEU:C	1:A:151:SER:N	2.77	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	266/289 (92%)	257 (97%)	8 (3%)	1 (0%)	30 22
1	B	259/289 (90%)	250 (96%)	9 (4%)	0	100 100
All	All	525/578 (91%)	507 (97%)	17 (3%)	1 (0%)	43 40

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	147	PRO

5.3.2 Protein sidechains (i)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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, 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	272/289 (94%)	0.36	24 (8%)	15	15	17, 33, 68, 77	0
1	B	264/289 (91%)	0.49	23 (8%)	16	15	20, 39, 66, 76	1 (0%)
All	All	536/578 (92%)	0.42	47 (8%)	15	15	17, 36, 68, 77	1 (0%)

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	138	ILE	6.0
1	A	93	PRO	5.3
1	A	140	LEU	5.0
1	A	94	ALA	4.8
1	A	1	VAL	4.4
1	B	97	GLN	4.1
1	A	151	SER	4.1
1	B	149	LEU	4.0
1	A	147	PRO	3.9
1	B	93	PRO	3.8
1	B	170	TYR	3.7
1	B	72	PHE	3.6
1	A	146	ASP	3.5
1	A	149	LEU	3.4
1	B	147	PRO	3.4
1	A	148	GLU	3.3
1	A	141	MET	3.2
1	B	83	GLY	3.2
1	A	84	ASP	3.1
1	A	135	ALA	3.1
1	B	151	SER	2.8
1	B	27	ASP	2.8
1	A	137	HIS	2.8
1	A	253	ARG	2.7

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Mol	Chain	Res	Type	RSRZ
1	B	67	VAL	2.7
1	A	209	ASN	2.6
1	A	136	ASP	2.6
1	B	136	ASP	2.6
1	B	1	VAL	2.6
1	B	45	GLN	2.5
1	B	150	SER	2.5
1	A	258	LEU	2.4
1	A	96	GLU	2.4
1	A	30	GLN	2.4
1	B	65	ALA	2.3
1	B	69	GLN	2.3
1	A	252	GLY	2.3
1	B	95	LYS	2.3
1	B	135	ALA	2.3
1	B	249	ARG	2.2
1	B	129	ALA	2.2
1	A	248	LEU	2.2
1	A	250	VAL	2.2
1	B	63	PHE	2.1
1	A	134	MET	2.1
1	B	109	HIS	2.1
1	B	94	ALA	2.0

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 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.