



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 28, 2026 – 06:06 PM UTC

PDB ID : 5H66 / pdb_00005h66
Title : Crystal structure of the Bacillus subtilis SMC head domain complexed with the cognate SepA C-terminal domain
Authors : Kamada, K.; Hirano, T.
Deposited on : 2016-11-11
Resolution : 1.82 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

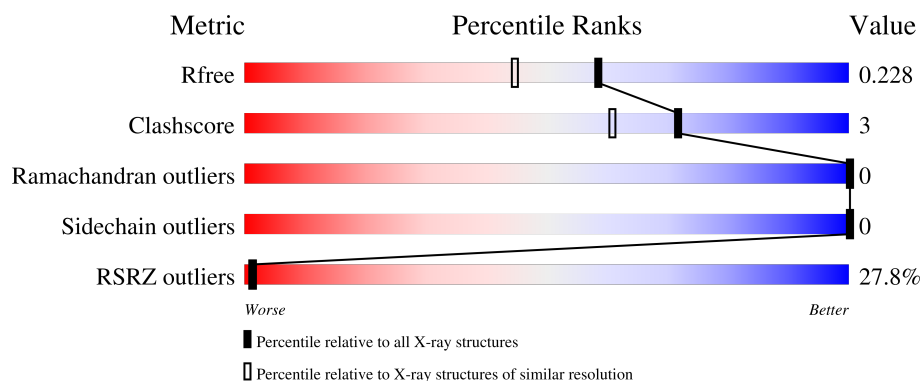
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.82 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	1112 (1.82-1.82)
Clashscore	190562	1148 (1.82-1.82)
Ramachandran outliers	187476	1140 (1.82-1.82)
Sidechain outliers	187428	1140 (1.82-1.82)
RSRZ outliers	180081	1112 (1.82-1.82)

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	199	18% 90% 6%
2	B	188	13% 90% 6%
3	C	80	76% 71% 12% 16%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3636 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 Chromosome partition protein Smc.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	187	Total	C	N	O	S	0	0	0
			1493	942	260	288	3			

- Molecule 2 is a protein called Chromosome partition protein Smc.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	181	Total	C	N	O	S	0	0	0
			1447	922	245	274	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	999	MET	-	expression tag	UNP P51834
B	1118	GLN	GLU	engineered mutation	UNP P51834

- Molecule 3 is a protein called Segregation and condensation protein A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	67	Total	C	N	O	S	0	0	0
			553	355	92	103	3			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	172	GLY	-	expression tag	UNP P35154
C	173	PRO	-	expression tag	UNP P35154
C	174	HIS	-	expression tag	UNP P35154
C	175	MET	-	expression tag	UNP P35154

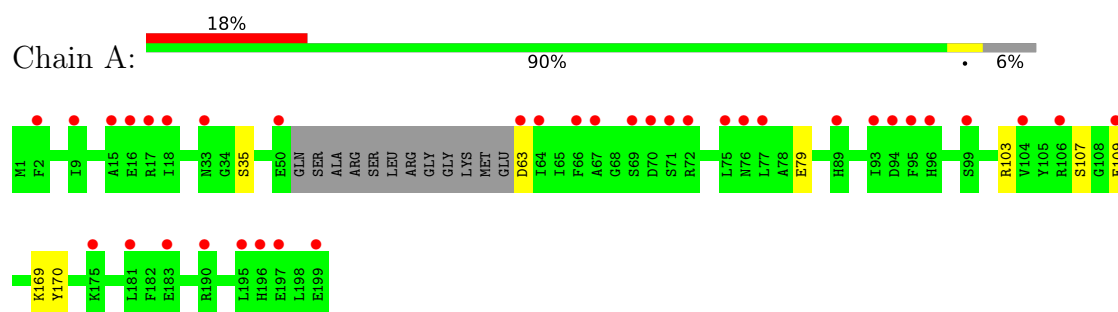
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	53	Total 53	O 53	0	0
4	B	90	Total 90	O 90	0	0

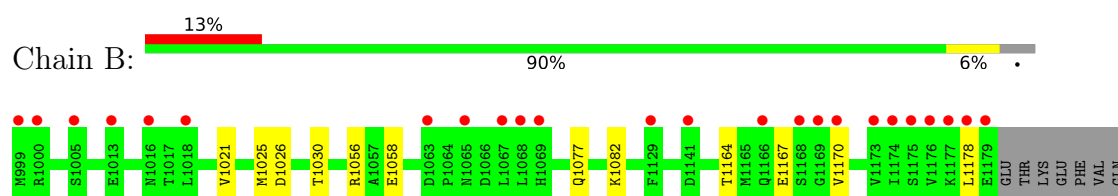
3 Residue-property plots

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.

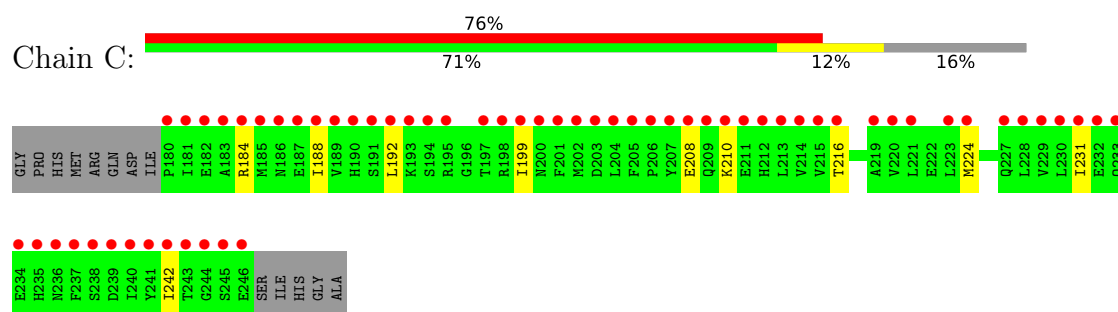
• Molecule 1: Chromosome partition protein Smc



• Molecule 2: Chromosome partition protein Smc



• Molecule 3: Segregation and condensation protein A



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	88.15Å 46.91Å 97.19Å 90.00° 112.65° 90.00°	Depositor
Resolution (Å)	34.60 – 1.82 34.60 – 1.82	Depositor EDS
% Data completeness (in resolution range)	99.6 (34.60-1.82) 99.6 (34.60-1.82)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.94 (at 1.82Å)	Xtriage
Refinement program	PHENIX 1.11.1_2575	Depositor
R, R_{free}	0.211 , 0.228 0.213 , 0.228	Depositor DCC
R_{free} test set	3341 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å ²)	23.5	Xtriage
Anisotropy	0.393	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 40.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3636	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.27% 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	0.28	0/1513	0.43	0/2028
2	B	0.36	0/1470	0.50	0/1979
3	C	0.15	0/563	0.36	0/758
All	All	0.30	0/3546	0.45	0/4765

There are no bond length outliers.

There are no bond angle outliers.

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	1493	0	1505	6	0
2	B	1447	0	1462	8	0
3	C	553	0	554	11	0
4	A	53	0	0	0	0
4	B	90	0	0	1	0
All	All	3636	0	3521	23	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 3.

All (23) 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)
2:B:1058:GLU:OE1	4:B:1201:HOH:O	1.93	0.86
3:C:184:ARG:O	3:C:188:ILE:HD12	1.82	0.79
3:C:184:ARG:O	3:C:188:ILE:CD1	2.30	0.79
3:C:199:ILE:HG13	3:C:242:ILE:HB	1.82	0.61
3:C:188:ILE:HD12	3:C:188:ILE:H	1.67	0.59
1:A:79:GLU:HG3	1:A:103:ARG:HG2	1.83	0.59
3:C:224:MET:SD	3:C:231:ILE:HG13	2.44	0.58
2:B:1167:GLU:HG3	2:B:1170:VAL:HB	1.86	0.57
2:B:1056:ARG:NH1	2:B:1077:GLN:OE1	2.37	0.57
3:C:188:ILE:HD12	3:C:188:ILE:N	2.20	0.57
3:C:184:ARG:HG3	3:C:188:ILE:HD11	1.88	0.54
1:A:35:SER:HB3	2:B:1164:THR:HA	1.89	0.54
2:B:1178:LEU:HB3	3:C:210:LYS:HE3	1.92	0.51
3:C:208:GLU:OE2	3:C:216:THR:OG1	2.25	0.50
1:A:79:GLU:CD	1:A:103:ARG:HH11	2.21	0.48
2:B:1026:ASP:O	2:B:1030:THR:HG23	2.14	0.47
1:A:107:SER:OG	1:A:109:GLU:OE2	2.29	0.47
3:C:184:ARG:O	3:C:188:ILE:HD13	2.13	0.45
3:C:192:LEU:HD21	3:C:242:ILE:HG22	1.99	0.45
1:A:63:ASP:OD2	1:A:63:ASP:N	2.51	0.43
2:B:1021:VAL:O	2:B:1025:MET:HG2	2.20	0.41
2:B:1082:LYS:HB2	2:B:1082:LYS:HE3	1.82	0.41
1:A:169:LYS:HE3	1:A:170:TYR:CZ	2.56	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	183/199 (92%)	178 (97%)	5 (3%)	0	100	100
2	B	179/188 (95%)	178 (99%)	1 (1%)	0	100	100
3	C	65/80 (81%)	62 (95%)	3 (5%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	427/467 (91%)	418 (98%)	9 (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	165/174 (95%)	165 (100%)	0	100	100
2	B	160/167 (96%)	160 (100%)	0	100	100
3	C	63/73 (86%)	63 (100%)	0	100	100
All	All	388/414 (94%)	388 (100%)	0	100	100

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

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	33	ASN
1	A	89	HIS
2	B	1034	ASN
2	B	1087	ASN
2	B	1118	GLN
2	B	1166	GLN
3	C	186	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

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	187/199 (93%)	1.05	36 (19%) 3 3	15, 33, 50, 61	0
2	B	181/188 (96%)	0.53	24 (13%) 7 7	13, 25, 48, 67	0
3	C	67/80 (83%)	3.61	61 (91%) 0 0	40, 67, 87, 93	0
All	All	435/467 (93%)	1.23	121 (27%) 1 1	13, 34, 73, 93	0

All (121) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	230	LEU	8.3
3	C	180	PRO	8.1
3	C	231	ILE	7.0
3	C	207	TYR	6.6
3	C	241	TYR	6.2
3	C	199	ILE	5.8
3	C	206	PRO	5.7
3	C	244	GLY	5.6
3	C	242	ILE	5.5
3	C	240	ILE	5.2
3	C	194	SER	5.2
3	C	229	VAL	5.1
2	B	1179	GLU	5.0
3	C	228	LEU	4.9
3	C	192	LEU	4.8
3	C	197	THR	4.5
3	C	235	HIS	4.4
1	A	76	ASN	4.4
3	C	243	THR	4.4
3	C	189	VAL	4.2
3	C	232	GLU	4.2
3	C	223	LEU	4.0
3	C	193	LYS	4.0

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Mol	Chain	Res	Type	RSRZ
3	C	188	ILE	4.0
3	C	198	ARG	3.9
3	C	190	HIS	3.8
1	A	71	SER	3.8
3	C	212	HIS	3.7
1	A	18	ILE	3.7
3	C	210	LYS	3.7
3	C	202	MET	3.7
3	C	201	PHE	3.6
2	B	1168	SER	3.5
3	C	245	SER	3.4
3	C	246	GLU	3.4
2	B	1129	PHE	3.3
3	C	237	PHE	3.3
3	C	186	ASN	3.3
3	C	238	SER	3.3
1	A	95	PHE	3.3
3	C	233	GLN	3.2
2	B	1177	LYS	3.2
1	A	63	ASP	3.2
3	C	184	ARG	3.2
3	C	209	GLN	3.2
3	C	182	GLU	3.2
3	C	205	PHE	3.1
3	C	183	ALA	3.1
3	C	239	ASP	3.0
2	B	1170	VAL	3.0
3	C	195	ARG	3.0
3	C	203	ASP	3.0
3	C	181	ILE	3.0
1	A	70	ASP	2.9
1	A	93	ILE	2.9
1	A	50	GLU	2.9
3	C	191	SER	2.8
3	C	219	ALA	2.8
3	C	187	GLU	2.8
3	C	215	VAL	2.8
2	B	1178	LEU	2.7
1	A	190	ARG	2.7
1	A	196	HIS	2.7
1	A	181	LEU	2.7
3	C	236	ASN	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	109	GLU	2.7
2	B	1173	VAL	2.7
1	A	96	HIS	2.7
2	B	1141	ASP	2.7
3	C	204	LEU	2.7
1	A	2	PHE	2.6
1	A	9	ILE	2.6
1	A	94	ASP	2.6
1	A	89	HIS	2.5
1	A	66	PHE	2.5
1	A	69	SER	2.5
1	A	33	ASN	2.5
2	B	1166	GLN	2.5
3	C	211	GLU	2.5
1	A	104	VAL	2.5
3	C	220	VAL	2.5
2	B	1069	HIS	2.4
3	C	234	GLU	2.4
1	A	67	ALA	2.4
3	C	216	THR	2.4
3	C	227	GLN	2.4
1	A	99	SER	2.4
1	A	183	GLU	2.4
2	B	999	MET	2.4
2	B	1063	ASP	2.4
3	C	208	GLU	2.4
2	B	1169	GLY	2.4
3	C	213	LEU	2.3
3	C	221	LEU	2.3
3	C	200	ASN	2.3
1	A	15	ALA	2.3
1	A	64	ILE	2.3
1	A	175	LYS	2.3
1	A	197	GLU	2.3
2	B	1065	ASN	2.3
2	B	1176	VAL	2.2
1	A	72	ARG	2.2
2	B	1005	SER	2.2
2	B	1016	ASN	2.2
3	C	185	MET	2.2
3	C	224	MET	2.2
1	A	16	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
2	B	1175	SER	2.2
3	C	214	VAL	2.2
1	A	195	LEU	2.2
2	B	1000	ARG	2.2
2	B	1174	ILE	2.1
1	A	75	LEU	2.1
2	B	1018	LEU	2.1
1	A	199	GLU	2.1
1	A	77	LEU	2.1
2	B	1067	LEU	2.1
2	B	1068	LEU	2.1
1	A	106	ARG	2.1
2	B	1013	GLU	2.0
1	A	17	ARG	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

There are no ligands in this entry.

6.5 Other polymers ⓘ

There are no such residues in this entry.