



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 02:00 AM UTC

PDB ID : 1JEA / pdb_00001jea
Title : ALTERED TOPOLOGY AND FLEXIBILITY IN ENGINEERED SUBTIL-
ISIN
Authors : Bott, R.
Deposited on : 1997-05-20
Resolution : 2.00 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

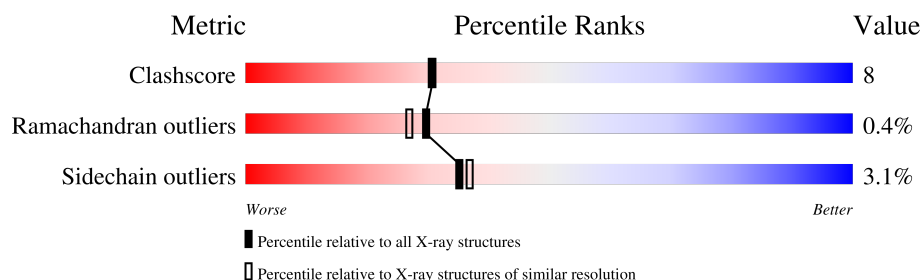
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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))
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	269	 64% 28% 6% •

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 1980 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.

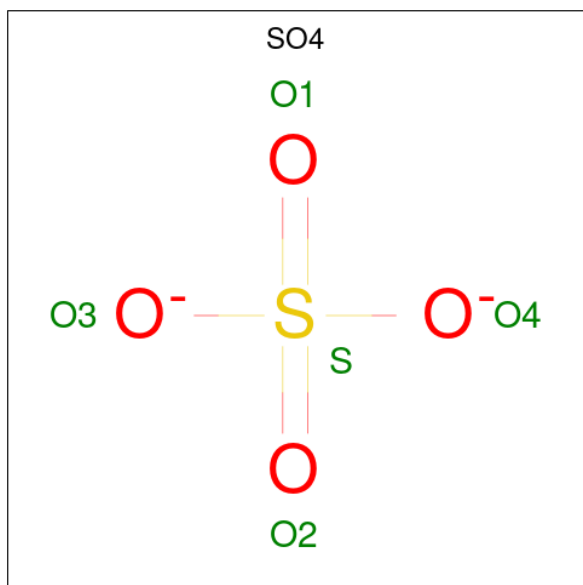
- Molecule 1 is a protein called SUBTILISIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	269	Total	C	N	O	S	0	0	0
			1880	1150	347	380	3			

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Ca	0	0
			2	2		

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	93	Total 93	O 93	0	0

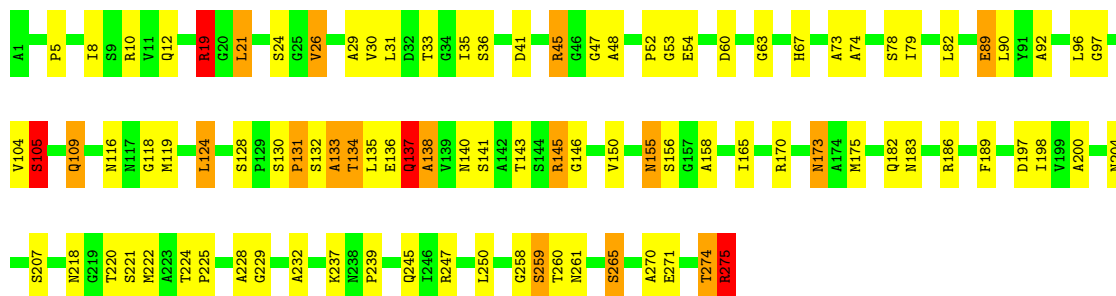
3 Residue-property plots

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. 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. 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.

Note EDS was not executed.

• Molecule 1: SUBTILISIN

Chain A: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	53.40Å 61.35Å 75.15Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.00	Depositor
% Data completeness (in resolution range)	68.6 (10.00-2.00)	Depositor
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.149 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1980	wwPDB-VP
Average B, all atoms (Å ²)	9.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CA, SO4

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	1.12	0/1914	2.21	99/2614 (3.8%)

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
1	A	0	1

There are no bond length outliers.

All (99) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	145	ARG	CD-NE-CZ	11.97	141.16	124.40
1	A	207	SER	CA-C-N	10.62	135.95	120.87
1	A	207	SER	C-N-CA	10.62	135.95	120.87
1	A	275	ARG	NE-CZ-NH2	9.17	127.45	119.20
1	A	19	ARG	CD-NE-CZ	8.95	136.93	124.40
1	A	275	ARG	NE-CZ-NH1	-8.67	112.83	121.50
1	A	275	ARG	CD-NE-CZ	-8.57	112.41	124.40
1	A	186	ARG	NE-CZ-NH1	8.54	130.03	121.50
1	A	109	GLN	OE1-CD-NE2	8.42	131.02	122.60
1	A	204	ASN	CA-CB-CG	-8.34	104.26	112.60
1	A	53	GLY	CA-C-N	8.13	131.80	122.85
1	A	53	GLY	C-N-CA	8.13	131.80	122.85
1	A	54	GLU	N-CA-CB	7.54	120.60	110.79
1	A	78	SER	CA-C-O	-7.49	110.80	119.56
1	A	104	VAL	CA-C-O	7.45	128.52	120.47
1	A	54	GLU	O-C-N	7.15	127.03	121.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	274	THR	CA-C-O	7.10	128.33	119.95
1	A	247	ARG	NE-CZ-NH1	-7.09	114.41	121.50
1	A	186	ARG	CD-NE-CZ	7.07	134.29	124.40
1	A	45	ARG	CA-C-N	6.99	132.23	121.12
1	A	45	ARG	C-N-CA	6.99	132.23	121.12
1	A	73	ALA	N-CA-CB	-6.86	100.95	111.66
1	A	90	LEU	N-CA-CB	-6.83	99.30	110.43
1	A	10	ARG	O-C-N	6.82	129.09	122.07
1	A	82	LEU	O-C-N	6.71	131.54	123.36
1	A	73	ALA	N-CA-C	6.59	120.54	111.71
1	A	116	ASN	CA-CB-CG	6.52	119.12	112.60
1	A	10	ARG	CD-NE-CZ	6.51	133.51	124.40
1	A	41	ASP	CA-CB-CG	-6.46	106.14	112.60
1	A	12	GLN	CG-CD-NE2	6.42	126.04	116.40
1	A	245	GLN	CA-C-O	-6.35	113.82	120.55
1	A	118	GLY	O-C-N	6.27	128.28	122.57
1	A	183	ASN	CA-CB-CG	-6.23	106.37	112.60
1	A	30	VAL	CA-C-O	-6.20	113.59	120.97
1	A	97	GLY	CA-C-N	6.20	128.88	120.38
1	A	97	GLY	C-N-CA	6.20	128.88	120.38
1	A	156	SER	CA-C-O	-6.17	112.51	119.79
1	A	8	ILE	CA-C-N	-6.15	110.38	121.14
1	A	8	ILE	C-N-CA	-6.15	110.38	121.14
1	A	260	THR	N-CA-C	-6.12	105.78	113.18
1	A	218	ASN	O-C-N	6.11	131.18	123.23
1	A	250	LEU	CA-C-N	6.08	128.43	120.28
1	A	250	LEU	C-N-CA	6.08	128.43	120.28
1	A	245	GLN	O-C-N	6.08	128.56	122.12
1	A	150	VAL	CA-C-O	-5.99	114.12	120.53
1	A	229	GLY	O-C-N	5.94	127.89	122.19
1	A	74	ALA	CA-C-O	-5.93	114.16	120.92
1	A	5	PRO	CB-CA-C	5.88	118.92	111.39
1	A	141	SER	N-CA-CB	-5.80	101.65	110.07
1	A	138	ALA	O-C-N	5.80	128.76	122.15
1	A	175	MET	CA-C-N	5.78	130.11	121.72
1	A	175	MET	C-N-CA	5.78	130.11	121.72
1	A	228	ALA	CA-C-O	5.78	126.88	120.63
1	A	221	SER	O-C-N	5.76	128.95	122.22
1	A	204	ASN	CA-C-N	-5.71	115.23	122.37
1	A	204	ASN	C-N-CA	-5.71	115.23	122.37
1	A	19	ARG	NE-CZ-NH2	-5.64	114.12	119.20
1	A	198	ILE	N-CA-CB	-5.61	101.97	111.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	143	THR	CA-C-N	-5.60	110.66	121.58
1	A	143	THR	C-N-CA	-5.60	110.66	121.58
1	A	200	ALA	O-C-N	5.57	127.07	121.56
1	A	54	GLU	CB-CA-C	-5.52	103.16	111.27
1	A	204	ASN	O-C-N	5.51	129.38	122.55
1	A	90	LEU	CB-CA-C	5.49	118.80	109.75
1	A	239	PRO	CB-CA-C	5.45	119.59	111.85
1	A	133	ALA	CA-C-N	5.37	127.42	120.44
1	A	133	ALA	C-N-CA	5.37	127.42	120.44
1	A	128	SER	CA-C-O	5.36	125.38	119.91
1	A	48	ALA	CA-C-O	-5.34	115.52	121.23
1	A	155	ASN	CA-C-O	-5.33	113.67	119.95
1	A	146	GLY	CA-C-O	-5.32	112.52	119.44
1	A	21	LEU	CA-C-O	5.29	126.04	120.54
1	A	204	ASN	OD1-CG-ND2	5.28	127.88	122.60
1	A	105	SER	CA-CB-OG	-5.27	100.57	111.10
1	A	12	GLN	OE1-CD-NE2	-5.26	117.33	122.60
1	A	158	ALA	CA-C-O	5.26	127.53	121.47
1	A	274	THR	CA-CB-OG1	-5.26	101.70	109.60
1	A	134	THR	CA-C-O	5.24	126.32	120.82
1	A	220	THR	N-CA-C	-5.23	106.16	112.54
1	A	136	GLU	CB-CG-CD	5.23	121.50	112.60
1	A	173	ASN	OD1-CG-ND2	5.23	127.83	122.60
1	A	182	GLN	CB-CG-CD	5.23	121.48	112.60
1	A	218	ASN	CA-C-O	-5.22	115.06	120.70
1	A	270	ALA	CA-C-O	5.22	125.81	119.38
1	A	89	GLU	CA-C-O	5.21	126.49	120.60
1	A	26	VAL	CB-CA-C	5.20	117.92	110.84
1	A	19	ARG	NE-CZ-NH1	5.16	126.66	121.50
1	A	67	HIS	CA-C-O	5.16	126.24	120.82
1	A	79	ILE	CA-C-N	5.15	128.36	120.07
1	A	79	ILE	C-N-CA	5.15	128.36	120.07
1	A	137	GLN	CB-CG-CD	5.15	121.35	112.60
1	A	222	MET	CA-C-O	5.12	125.59	119.60
1	A	218	ASN	CB-CG-ND2	-5.12	108.73	116.40
1	A	45	ARG	NE-CZ-NH1	-5.10	116.40	121.50
1	A	131	PRO	CB-CA-C	5.09	117.62	110.60
1	A	52	PRO	CA-C-N	-5.08	114.13	122.20
1	A	52	PRO	C-N-CA	-5.08	114.13	122.20
1	A	36	SER	CA-CB-OG	-5.06	100.98	111.10
1	A	261	ASN	CA-C-O	5.05	125.77	120.42

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	275	ARG	Sidechain

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	1880	0	1838	31	0
2	A	2	0	0	0	0
3	A	5	0	0	0	0
4	A	93	0	0	1	0
All	All	1980	0	1838	31	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 8.

All (31) 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:134:THR:O	1:A:137:GLN:HG3	1.84	0.77
1:A:105:SER:O	1:A:109:GLN:HG3	1.86	0.75
1:A:134:THR:O	1:A:137:GLN:CG	2.43	0.66
1:A:132:SER:HB3	1:A:135:LEU:HB3	1.81	0.61
1:A:21:LEU:CD1	1:A:274:THR:HB	2.32	0.59
1:A:137:GLN:HG3	1:A:138:ALA:H	1.69	0.57
1:A:21:LEU:HD13	1:A:274:THR:HB	1.89	0.55
1:A:173:ASN:HB2	4:A:370:HOH:O	2.10	0.52
1:A:137:GLN:HG3	1:A:138:ALA:N	2.24	0.52
1:A:47:GLY:HA3	1:A:92:ALA:O	2.09	0.52
1:A:133:ALA:O	1:A:137:GLN:HG2	2.10	0.51
1:A:145:ARG:NE	1:A:145:ARG:HA	2.26	0.51
1:A:165:ILE:HD11	1:A:170:ARG:HA	1.93	0.51
1:A:140:ASN:ND2	1:A:173:ASN:OD1	2.44	0.50
1:A:197:ASP:O	1:A:265:SER:HB2	2.12	0.49
1:A:19:ARG:NH2	1:A:271:GLU:O	2.45	0.48
1:A:275:ARG:HH11	1:A:275:ARG:HD2	1.41	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:31:LEU:HB2	1:A:124:LEU:HD22	1.98	0.45
1:A:33:THR:HA	1:A:96:LEU:O	2.17	0.45
1:A:155:ASN:HA	1:A:189:PHE:O	2.17	0.44
1:A:35:ILE:HD12	1:A:92:ALA:HB2	2.00	0.44
1:A:258:GLY:O	1:A:259:SER:C	2.61	0.44
1:A:29:ALA:HB2	1:A:119:MET:HG3	2.00	0.43
1:A:224:THR:N	1:A:225:PRO:HD2	2.33	0.42
1:A:21:LEU:HD11	1:A:237:LYS:HD3	2.01	0.42
1:A:134:THR:O	1:A:137:GLN:NE2	2.52	0.42
1:A:26:VAL:HG11	1:A:232:ALA:HA	2.02	0.42
1:A:45:ARG:HG3	1:A:89:GLU:HB3	2.03	0.41
1:A:60:ASP:CG	1:A:63:GLY:H	2.29	0.41
1:A:130:SER:HA	1:A:131:PRO:HD3	1.95	0.40
1:A:145:ARG:HA	1:A:145:ARG:CZ	2.52	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	267/269 (99%)	261 (98%)	5 (2%)	1 (0%)	30 27

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	259	SER

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	194/194 (100%)	188 (97%)	6 (3%)	35 37

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	ARG
1	A	24	SER
1	A	105	SER
1	A	124	LEU
1	A	137	GLN
1	A	265	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	117	ASN
1	A	140	ASN
1	A	173	ASN
1	A	206	GLN
1	A	261	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](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
3	SO4	A	278	-	4,4,4	0.79	0	6,6,6	0.23	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 ⓘ

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.