



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 1, 2026 – 08:41 AM UTC

PDB ID : 4QDL / pdb_00004qdl
Title : Crystal structure of E.coli Cas1-Cas2 complex
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Deposited on : 2014-05-14
Resolution : 2.70 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
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

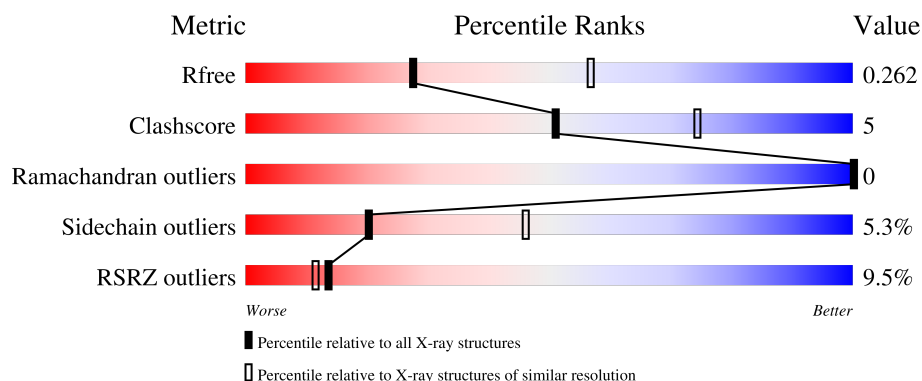
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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	305	11% 72% 12% 15%
1	B	305	3% 77% 11% 11%
1	C	305	16% 61% 16% 22%
1	D	305	5% 75% 13% 11%
2	E	104	3% 69% 18% 11%

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Mol	Chain	Length	Quality of chain
2	F	104	4% 79% 11% • 10%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 9133 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 CRISPR-associated endonuclease Cas1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	258	Total	C	N	O	S	0	0	0
			1817	1176	308	326	7			
1	B	272	Total	C	N	O	S	0	1	0
			2071	1330	368	366	7			
1	C	239	Total	C	N	O	S	0	0	0
			1702	1107	285	303	7			
1	D	271	Total	C	N	O	S	0	0	0
			2030	1307	356	360	7			

- Molecule 2 is a protein called CRISPR-associated endoribonuclease Cas2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	93	Total	C	N	O	S	0	0	0
			731	470	127	131	3			
2	F	94	Total	C	N	O	S	0	0	0
			726	469	124	130	3			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	95	LEU	-	expression tag	UNP P45956
E	96	GLU	-	expression tag	UNP P45956
E	97	SER	-	expression tag	UNP P45956
E	98	GLY	-	expression tag	UNP P45956
E	99	HIS	-	expression tag	UNP P45956
E	100	HIS	-	expression tag	UNP P45956
E	101	HIS	-	expression tag	UNP P45956
E	102	HIS	-	expression tag	UNP P45956
E	103	HIS	-	expression tag	UNP P45956
E	104	HIS	-	expression tag	UNP P45956
F	95	LEU	-	expression tag	UNP P45956
F	96	GLU	-	expression tag	UNP P45956

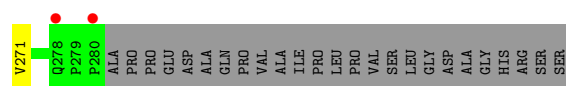
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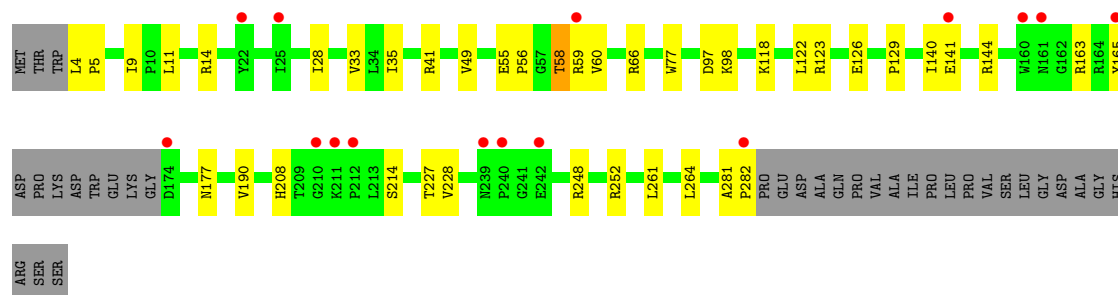
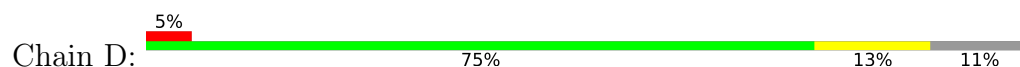
Chain	Residue	Modelled	Actual	Comment	Reference
F	97	SER	-	expression tag	UNP P45956
F	98	GLY	-	expression tag	UNP P45956
F	99	HIS	-	expression tag	UNP P45956
F	100	HIS	-	expression tag	UNP P45956
F	101	HIS	-	expression tag	UNP P45956
F	102	HIS	-	expression tag	UNP P45956
F	103	HIS	-	expression tag	UNP P45956
F	104	HIS	-	expression tag	UNP P45956

- Molecule 3 is water.

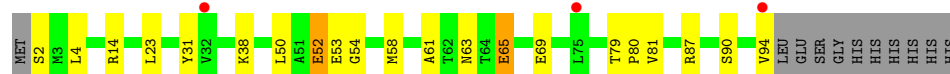
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	O	0	0
			1	1		
3	B	25	Total	O	0	0
			25	25		
3	D	6	Total	O	0	0
			6	6		
3	E	8	Total	O	0	0
			8	8		
3	F	16	Total	O	0	0
			16	16		



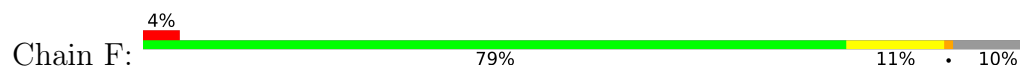
- Molecule 1: CRISPR-associated endonuclease Cas1



- Molecule 2: CRISPR-associated endoribonuclease Cas2



- Molecule 2: CRISPR-associated endoribonuclease Cas2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	92.76Å 127.40Å 96.64Å 90.00° 100.89° 90.00°	Depositor
Resolution (Å)	47.45 – 2.70 47.45 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.0 (47.45-2.70) 100.0 (47.45-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.13 (at 2.69Å)	Xtriage
Refinement program	PHENIX 1.8.3_1479	Depositor
R, R_{free}	0.227 , 0.261 0.230 , 0.262	Depositor DCC
R_{free} test set	5949 reflections (9.82%)	wwPDB-VP
Wilson B-factor (Å ²)	56.6	Xtriage
Anisotropy	0.456	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 42.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.023 for l,-k,h	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	9133	wwPDB-VP
Average B, all atoms (Å ²)	64.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.32% 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	0.49	0/1850	0.85	2/2526 (0.1%)
1	B	0.50	0/2093	0.84	1/2842 (0.0%)
1	C	0.46	0/1729	0.86	0/2355
1	D	0.42	0/2070	0.83	1/2817 (0.0%)
2	E	0.45	0/745	0.89	1/1014 (0.1%)
2	F	0.48	0/740	0.82	0/1010
All	All	0.47	0/9227	0.85	5/12564 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	54	GLY	N-CA-C	9.30	124.44	112.54
1	A	239	ASN	CA-C-N	-6.79	113.66	120.31
1	A	239	ASN	C-N-CA	-6.79	113.66	120.31
1	D	228	VAL	N-CA-C	5.40	115.60	110.42
1	B	228	VAL	N-CA-C	5.30	115.51	110.42

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	1817	0	1773	17	0
1	B	2071	0	2135	20	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	1702	0	1686	26	0
1	D	2030	0	2072	21	0
2	E	731	0	744	10	0
2	F	726	0	731	7	0
3	A	1	0	0	0	0
3	B	25	0	0	0	0
3	D	6	0	0	0	0
3	E	8	0	0	0	0
3	F	16	0	0	0	0
All	All	9133	0	9141	94	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.

The worst 5 of 94 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:55:GLU:OE2	1:A:252:ARG:NH2	2.11	0.83
2:F:69:GLU:OE2	2:F:87:ARG:NH1	2.15	0.79
1:D:28:ILE:HD11	1:D:35:ILE:HD11	1.70	0.74
1:D:4:LEU:HD12	1:D:5:PRO:HD2	1.74	0.70
1:C:20:LEU:HD22	1:C:34:LEU:HD22	1.75	0.69

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	254/305 (83%)	246 (97%)	8 (3%)	0	100	100
1	B	269/305 (88%)	266 (99%)	3 (1%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	231/305 (76%)	228 (99%)	3 (1%)	0	100	100
1	D	267/305 (88%)	263 (98%)	4 (2%)	0	100	100
2	E	91/104 (88%)	90 (99%)	1 (1%)	0	100	100
2	F	92/104 (88%)	90 (98%)	2 (2%)	0	100	100
All	All	1204/1428 (84%)	1183 (98%)	21 (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	166/245 (68%)	157 (95%)	9 (5%)	20	45
1	B	211/245 (86%)	199 (94%)	12 (6%)	18	43
1	C	159/245 (65%)	145 (91%)	14 (9%)	9	23
1	D	205/245 (84%)	199 (97%)	6 (3%)	37	67
2	E	78/88 (89%)	74 (95%)	4 (5%)	21	48
2	F	76/88 (86%)	74 (97%)	2 (3%)	40	70
All	All	895/1156 (77%)	848 (95%)	47 (5%)	20	46

5 of 47 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	60	VAL
1	D	11	LEU
1	C	99	LEU
1	C	186	CYS
1	D	49	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	E	10	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	258/305 (84%)	0.89	34 (13%) 7 6	48, 73, 99, 108	0
1	B	272/305 (89%)	0.28	10 (3%) 45 41	40, 56, 86, 115	1 (0%)
1	C	239/305 (78%)	1.10	50 (20%) 2 2	52, 74, 100, 124	0
1	D	271/305 (88%)	0.39	15 (5%) 30 27	42, 58, 88, 99	0
2	E	93/104 (89%)	0.04	3 (3%) 50 46	26, 50, 68, 78	1 (1%)
2	F	94/104 (90%)	0.03	4 (4%) 40 36	37, 48, 66, 80	1 (1%)
All	All	1227/1428 (85%)	0.56	116 (9%) 14 11	26, 63, 95, 124	3 (0%)

The worst 5 of 116 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	135	GLU	6.0
1	B	210	GLY	4.9
1	D	210	GLY	4.7
1	A	240	PRO	4.4
1	C	14	ARG	4.4

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.