wwPDB X-ray Structure Validation Summary Report (i)

Oct 12, 2021 – 04:34 PM EDT

PDB ID	:	2EX5
Title	:	Group I Intron-encoded Homing Endonuclease I-CeuI Complexed With DNA
Authors	:	Spiegel, P.C.; Stoddard, B.L.
Deposited on	:	2005-11-07
Resolution	:	2.20 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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

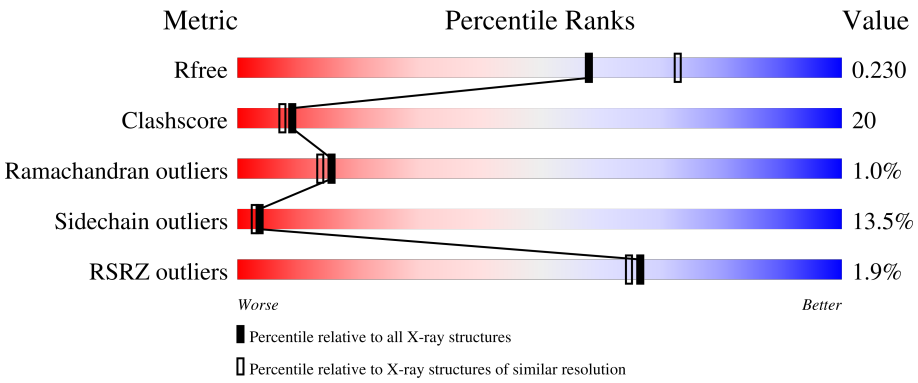
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 2.20 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}	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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	X	26	35% 65%
2	Y	26	4% • 27% 69%
3	A	207	2% 60% 33% 6%
3	B	207	2% 61% 29% 6% •

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 4664 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 DNA chain called I-CeuI DNA target site.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	X	26	535	254	106	150	25	0	0	0

- Molecule 2 is a DNA chain called I-CeuI DNA target site, complementary strand.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	Y	26	525	252	90	158	25	0	0	0

- Molecule 3 is a protein called DNA endonuclease I-CeuI.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	A	207	1669	1071	286	311	1	0	0	0
3	B	207	1669	1071	286	311	1	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	93	ARG	GLN	engineered mutation	UNP P32761
B	93	ARG	GLN	engineered mutation	UNP P32761

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
4	X	1	1	1	0	0
4	A	1	1	1	0	0
4	B	1	1	1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	X	27	27	27	0	0
			Total	O		
5	Y	40	40	40	0	0
			Total	O		
5	A	118	118	118	0	0
			Total	O		
5	B	78	78	78	0	0

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: I-CeuI DNA target site

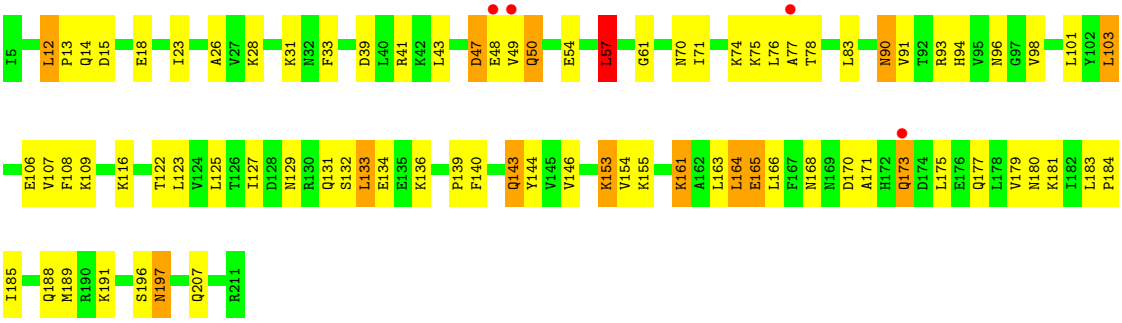
Chain X: 35% 65%

• Molecule 2: I-CeuI DNA target site, complementary strand

Chain Y: 4% 27% 69%

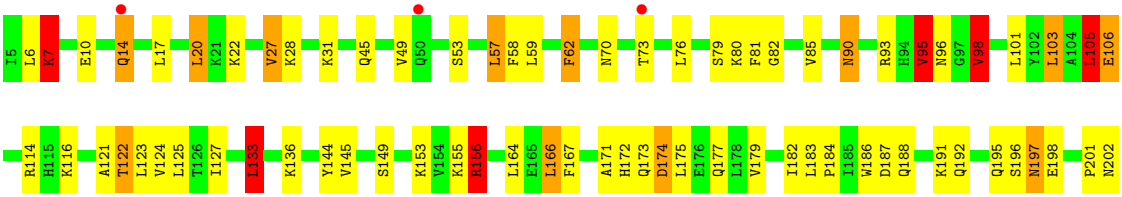
• Molecule 3: DNA endonuclease I-CeuI

Chain A: 2% 60% 33% 6%



• Molecule 3: DNA endonuclease I-CeuI

Chain B: 2% 61% 29% 6%



L203
E204
A205
A206
Q207
D208
F209
A210
R211

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	50.23Å 69.18Å 169.41Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20 19.83 – 2.20	Depositor EDS
% Data completeness (in resolution range)	96.0 (20.00-2.20) 96.4 (19.83-2.20)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	3.10 (at 2.21Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.219 , 0.231 0.218 , 0.230	Depositor DCC
R_{free} test set	3057 reflections (10.01%)	wwPDB-VP
Wilson B-factor (Å^2)	37.7	Xtriage
Anisotropy	0.445	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 45.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4664	wwPDB-VP
Average B, all atoms (Å^2)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.70% 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 (i)

5.1 Standard geometry (i)

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

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	X	2.23	24/602 (4.0%)	3.33	122/928 (13.1%)
2	Y	2.41	29/586 (4.9%)	3.54	135/902 (15.0%)
3	A	1.46	12/1697 (0.7%)	1.21	9/2283 (0.4%)
3	B	1.24	4/1697 (0.2%)	1.15	9/2283 (0.4%)
All	All	1.66	69/4582 (1.5%)	2.09	275/6396 (4.3%)

The worst 5 of 69 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	X	606	DA	N7-C5	9.68	1.45	1.39
2	Y	714	DA	N3-C4	9.52	1.40	1.34
1	X	609	DG	C6-N1	8.65	1.45	1.39
2	Y	701	DG	C8-N7	8.27	1.35	1.30
1	X	618	DT	N1-C6	8.00	1.43	1.38

The worst 5 of 275 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	Y	708	DT	C6-C5-C7	-16.84	112.80	122.90
1	X	607	DC	O4'-C1'-N1	16.67	119.67	108.00
1	X	601	DC	O4'-C1'-N1	-15.76	96.97	108.00
2	Y	704	DT	O4'-C1'-N1	12.31	116.62	108.00
1	X	603	DA	O4'-C1'-N9	12.20	116.54	108.00

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	X	535	0	292	20	0
2	Y	525	0	295	30	1
3	A	1669	0	1717	58	0
3	B	1669	0	1717	73	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	X	1	0	0	0	0
5	A	118	0	0	11	0
5	B	78	0	0	11	0
5	X	27	0	0	2	0
5	Y	40	0	0	6	1
All	All	4664	0	4021	166	1

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 20.

The worst 5 of 166 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)
3:B:22:LYS:HD3	5:B:1213:HOH:O	1.40	1.20
2:Y:721:DT:H2"	2:Y:722:DT:H5'	1.21	1.11
3:B:73:THR:HG22	3:B:85:VAL:HG22	1.40	1.01
2:Y:722:DT:O4	5:Y:1236:HOH:O	1.84	0.95
3:B:53:SER:O	3:B:57:LEU:HD22	1.70	0.92

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:Y:701:DG:O5'	5:Y:1234:HOH:O[2_674]	1.80	0.40

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	
3	A	205/207 (99%)	198 (97%)	7 (3%)	0	100	100
3	B	205/207 (99%)	185 (90%)	16 (8%)	4 (2%)	7	4
All	All	410/414 (99%)	383 (93%)	23 (6%)	4 (1%)	15	14

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	B	204	GLU
3	B	203	LEU
3	B	96	ASN
3	B	184	PRO

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	
3	A	185/185 (100%)	159 (86%)	26 (14%)	3	2
3	B	185/185 (100%)	161 (87%)	24 (13%)	4	3
All	All	370/370 (100%)	320 (86%)	50 (14%)	4	3

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	B	20	LEU
3	B	95	VAL

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Mol	Chain	Res	Type
3	B	197	ASN
3	B	27	VAL
3	B	57	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 21 such sidechains are listed below:

Mol	Chain	Res	Type
3	B	168	ASN
3	B	180	ASN
3	B	202	ASN
3	B	195	GLN
3	B	173	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 3 ligands modelled in this entry, 3 are monoatomic - leaving 0 for Mogul analysis.

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 (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	X	26/26 (100%)	-0.15	0	100	100	38, 48, 71, 86	0
2	Y	26/26 (100%)	-0.14	1 (3%)	40	38	28, 49, 61, 62	0
3	A	207/207 (100%)	-0.29	4 (1%)	66	65	21, 34, 53, 62	0
3	B	207/207 (100%)	0.05	4 (1%)	66	65	20, 44, 72, 77	0
All	All	466/466 (100%)	-0.12	9 (1%)	66	65	20, 40, 66, 86	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	49	VAL	2.6
3	A	173	GLN	2.4
3	B	50	GLN	2.4
3	B	204	GLU	2.3
3	A	48	GLU	2.2

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 monosaccharides in this entry.

6.4 Ligands (i)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	CA	B	803	1/1	0.96	0.13	51,51,51,51	0
4	CA	X	802	1/1	0.98	0.06	36,36,36,36	0
4	CA	A	801	1/1	0.99	0.06	34,34,34,34	0

6.5 Other polymers (i)

There are no such residues in this entry.