



wwPDB X-ray Structure Validation Summary Report ⓘ

May 23, 2020 – 07:13 am BST

PDB ID : 4GX9
Title : Crystal structure of a DNA polymerase III alpha-epsilon chimera
Authors : Li, N.; Horan, N.; Xu, Z.-Q.; Jacques, D.; Dixon, N.E.; Oakley, A.J.
Deposited on : 2012-09-04
Resolution : 2.15 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.11
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) : 2.11

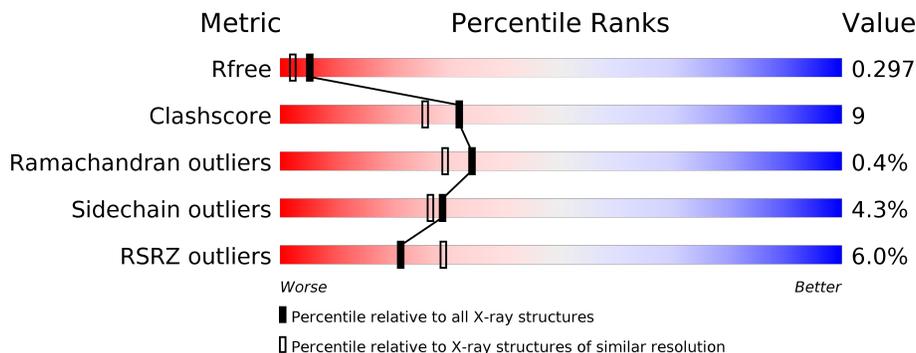
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	1479 (2.16-2.16)
Clashscore	141614	1585 (2.16-2.16)
Ramachandran outliers	138981	1560 (2.16-2.16)
Sidechain outliers	138945	1559 (2.16-2.16)
RSRZ outliers	127900	1456 (2.16-2.16)

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 on 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	324	 3% 79% 17% . .
1	B	324	 7% 77% 17% . .
1	C	324	 8% 82% 14% . .
1	D	324	 5% 77% 18% . .

2 Entry composition i

There are 2 unique types of molecules in this entry. The entry contains 10076 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 DNA polymerase III subunit epsilon, DNA polymerase III subunit alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	312	Total 2438	C 1536	N 426	O 463	S 13	0	6	0
1	B	313	Total 2440	C 1537	N 428	O 462	S 13	0	5	0
1	C	317	Total 2480	C 1562	N 435	O 470	S 13	0	6	0
1	D	312	Total 2441	C 1540	N 423	O 465	S 13	0	7	0

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-8	MET	-	initiating methionine	UNP P03007
A	37	THR	-	linker	UNP P03007
A	38	ARG	-	linker	UNP P03007
A	39	GLU	-	linker	UNP P03007
A	40	SER	-	linker	UNP P03007
A	41	GLY	-	linker	UNP P03007
A	42	SER	-	linker	UNP P03007
A	43	ILE	-	linker	UNP P03007
A	44	GLY	-	linker	UNP P03007
A	45	SER	-	linker	UNP P03007
A	66	PRO	LEU	engineered mutation	UNP P10443
B	-8	MET	-	initiating methionine	UNP P03007
B	37	THR	-	linker	UNP P03007
B	38	ARG	-	linker	UNP P03007
B	39	GLU	-	linker	UNP P03007
B	40	SER	-	linker	UNP P03007
B	41	GLY	-	linker	UNP P03007
B	42	SER	-	linker	UNP P03007
B	43	ILE	-	linker	UNP P03007
B	44	GLY	-	linker	UNP P03007

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Chain	Residue	Modelled	Actual	Comment	Reference
B	45	SER	-	linker	UNP P03007
B	66	PRO	LEU	engineered mutation	UNP P10443
C	-8	MET	-	initiating methionine	UNP P03007
C	37	THR	-	linker	UNP P03007
C	38	ARG	-	linker	UNP P03007
C	39	GLU	-	linker	UNP P03007
C	40	SER	-	linker	UNP P03007
C	41	GLY	-	linker	UNP P03007
C	42	SER	-	linker	UNP P03007
C	43	ILE	-	linker	UNP P03007
C	44	GLY	-	linker	UNP P03007
C	45	SER	-	linker	UNP P03007
C	66	PRO	LEU	engineered mutation	UNP P10443
D	-8	MET	-	initiating methionine	UNP P03007
D	37	THR	-	linker	UNP P03007
D	38	ARG	-	linker	UNP P03007
D	39	GLU	-	linker	UNP P03007
D	40	SER	-	linker	UNP P03007
D	41	GLY	-	linker	UNP P03007
D	42	SER	-	linker	UNP P03007
D	43	ILE	-	linker	UNP P03007
D	44	GLY	-	linker	UNP P03007
D	45	SER	-	linker	UNP P03007
D	66	PRO	LEU	engineered mutation	UNP P10443

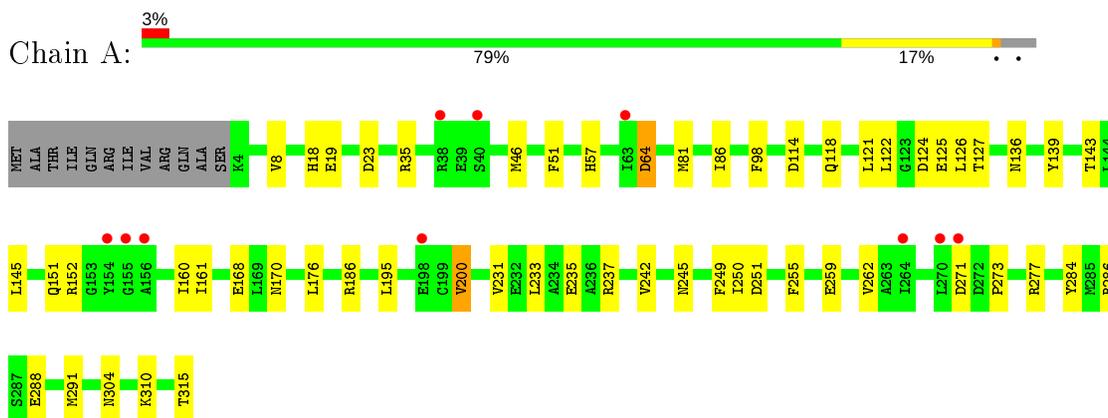
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	87	Total O 87 87	0	0
2	B	45	Total O 45 45	0	0
2	C	75	Total O 75 75	0	0
2	D	70	Total O 70 70	0	0

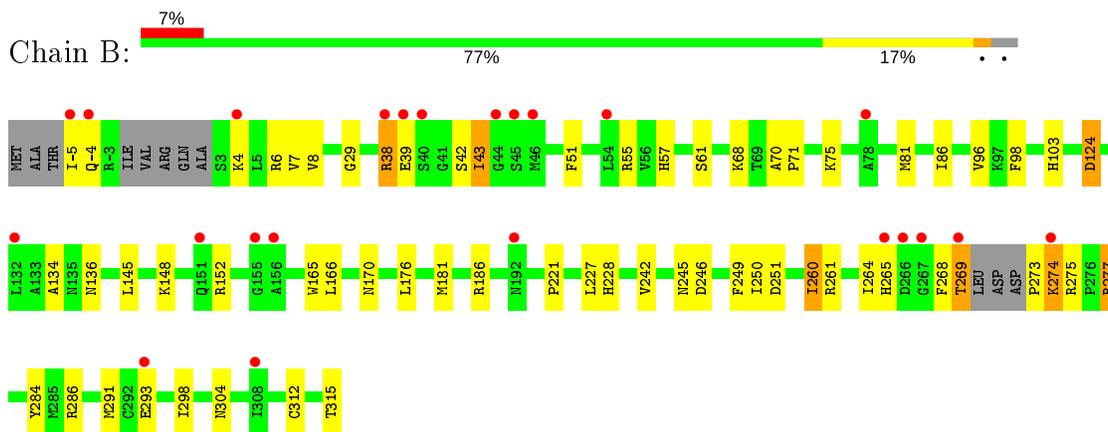
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

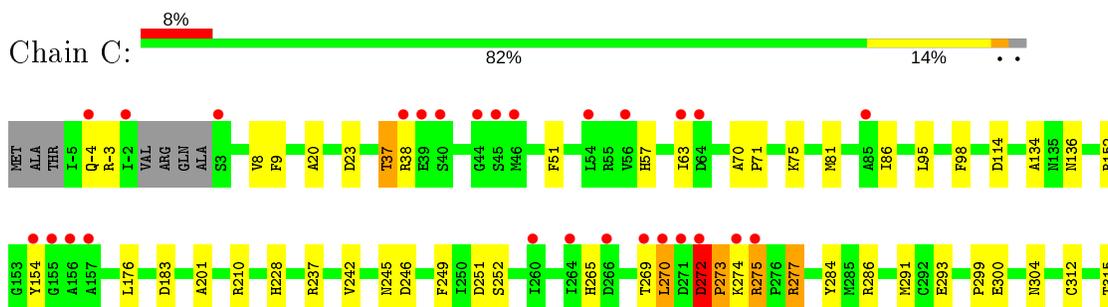
- Molecule 1: DNA polymerase III subunit epsilon,DNA polymerase III subunit alpha



- Molecule 1: DNA polymerase III subunit epsilon,DNA polymerase III subunit alpha



- Molecule 1: DNA polymerase III subunit epsilon,DNA polymerase III subunit alpha



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	83.02Å 56.98Å 135.07Å 90.00° 93.78° 90.00°	Depositor
Resolution (Å)	35.28 – 2.15 35.28 – 2.15	Depositor EDS
% Data completeness (in resolution range)	96.9 (35.28-2.15) 96.9 (35.28-2.15)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.19 (at 2.16Å)	Xtrriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.226 , 0.291 0.231 , 0.297	Depositor DCC
R_{free} test set	3384 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	31.4	Xtrriage
Anisotropy	0.161	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 42.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10076	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 59.60 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.7219e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² Theoretical 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	0.94	1/2503 (0.0%)	0.88	1/3389 (0.0%)
1	B	0.89	0/2500	0.87	2/3380 (0.1%)
1	C	0.90	0/2544	0.89	3/3442 (0.1%)
1	D	0.97	0/2509	0.91	3/3399 (0.1%)
All	All	0.93	1/10056 (0.0%)	0.89	9/13610 (0.1%)

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	C	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	168	GLU	CB-CG	5.63	1.62	1.52

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	35	ARG	NE-CZ-NH2	-6.64	116.98	120.30
1	D	270	LEU	CA-CB-CG	6.59	130.45	115.30
1	D	35	ARG	NE-CZ-NH1	6.43	123.52	120.30
1	B	124	ASP	CB-CG-OD1	5.43	123.18	118.30
1	C	210	ARG	NE-CZ-NH1	5.39	123.00	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	272	ASP	Peptide

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	2438	0	2419	41	0
1	B	2440	0	2426	40	0
1	C	2480	0	2469	40	0
1	D	2441	0	2423	60	0
2	A	87	0	0	3	0
2	B	45	0	0	5	0
2	C	75	0	0	4	0
2	D	70	0	0	5	0
All	All	10076	0	9737	174	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 9.

The worst 5 of 174 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:B:260:ILE:HD12	1:C:201:ALA:HB2	1.46	0.95
1:B:268:PHE:HE1	1:B:274:LYS:HD2	1.34	0.93
1:C:269:THR:HG23	1:C:272:ASP:HB3	1.49	0.92
1:D:280:SER:H	1:D:283:GLN:HE21	1.20	0.85
1:D:72:LEU:HD12	1:D:86:ILE:CD1	2.08	0.83

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	316/324 (98%)	305 (96%)	11 (4%)	0	100	100
1	B	312/324 (96%)	294 (94%)	15 (5%)	3 (1%)	15	9
1	C	319/324 (98%)	303 (95%)	14 (4%)	2 (1%)	25	18
1	D	317/324 (98%)	302 (95%)	15 (5%)	0	100	100
All	All	1264/1296 (98%)	1204 (95%)	55 (4%)	5 (0%)	34	29

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	272	ASP
1	C	273	PRO
1	B	264	ILE
1	B	42	SER
1	B	38	ARG

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	259/263 (98%)	251 (97%)	8 (3%)	40	39
1	B	259/263 (98%)	243 (94%)	16 (6%)	18	14
1	C	264/263 (100%)	254 (96%)	10 (4%)	33	31
1	D	260/263 (99%)	250 (96%)	10 (4%)	33	31
All	All	1042/1052 (99%)	998 (96%)	44 (4%)	29	28

5 of 44 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	260	ILE
1	C	-3	ARG
1	D	260	ILE

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Mol	Chain	Res	Type
1	B	269	THR
1	B	277	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 24 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	258	HIS
1	C	-4	GLN
1	D	283	GLN
1	B	265	HIS
1	B	304	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 carbohydrates 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	312/324 (96%)	0.13	10 (3%) 47 56	8, 20, 31, 47	0
1	B	313/324 (96%)	0.31	23 (7%) 15 21	14, 20, 42, 62	0
1	C	317/324 (97%)	0.42	27 (8%) 10 15	13, 20, 41, 59	0
1	D	312/324 (96%)	0.19	15 (4%) 30 39	13, 20, 33, 48	0
All	All	1254/1296 (96%)	0.26	75 (5%) 21 29	8, 20, 36, 62	0

The worst 5 of 75 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	45	SER	10.9
1	C	40	SER	8.9
1	C	-2	ILE	8.4
1	C	271	ASP	7.1
1	B	39	GLU	6.4

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 carbohydrates in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.