wwPDB X-ray Structure Validation Summary Report (i)

Sep 7, 2023 – 06:58 AM EDT

PDB ID	:	4FXD
Title	:	Crystal structure of yeast DNA polymerase alpha bound to DNA/RNA
Authors	:	Perera, R.L.; Torella, R.; Klinge, S.; Kilkenny, M.L.; Maman, J.D.; Pellegrini, L.
Deposited on	:	2012-07-03
Resolution	:	3.00 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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

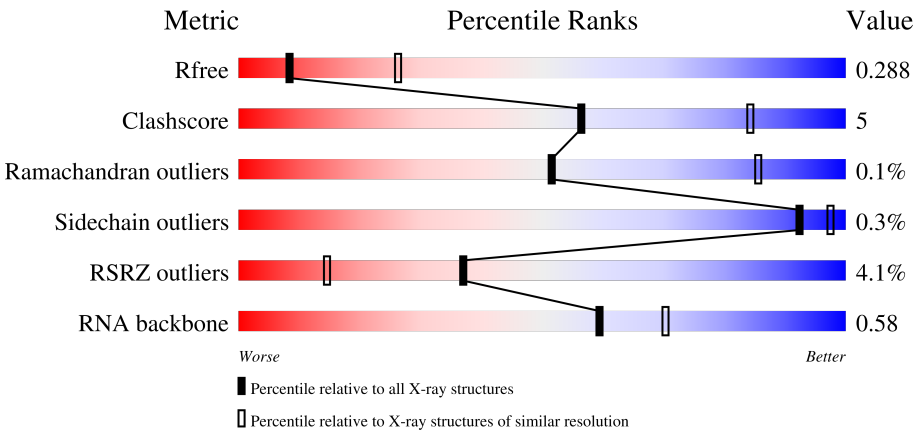
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

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 3.00 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))
R_{free}	130704	2092 (3.00-3.00)
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)
RSRZ outliers	127900	1990 (3.00-3.00)
RNA backbone	3102	1173 (3.30-2.70)

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 <=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	910	3%, 82%, 11%, 7%
1	B	910	4%, 76%, 13%, 11%
2	C	16	6%, 44%, 6%, 50%
2	D	16	12%, 50%, 50%

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Mol	Chain	Length	Quality of chain
3	E	10	20% 40% 30% 10% 20%
3	F	10	40% 40% 30% 10% 20%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 27701 atoms, of which 13791 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 alpha catalytic subunit A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	848	13647	4284	6879	1173	1264	47	0	0	0
1	B	807	13026	4100	6556	1113	1212	45	0	0	0

- Molecule 2 is a DNA chain called DNA (5'-D(*TP*TP*TP*TP*CP*GP*CP*TP*GP*CP*CP*CP*GP*CP*CP*T)-3').

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	P			
2	C	8	248	75	89	27	49	8	0	0	0
2	D	8	248	75	89	27	49	8	0	0	0

- Molecule 3 is a RNA chain called RNA (5'-R(*AP*GP*GP*CP*GP*GP*GP*CP*AP*G)-3').

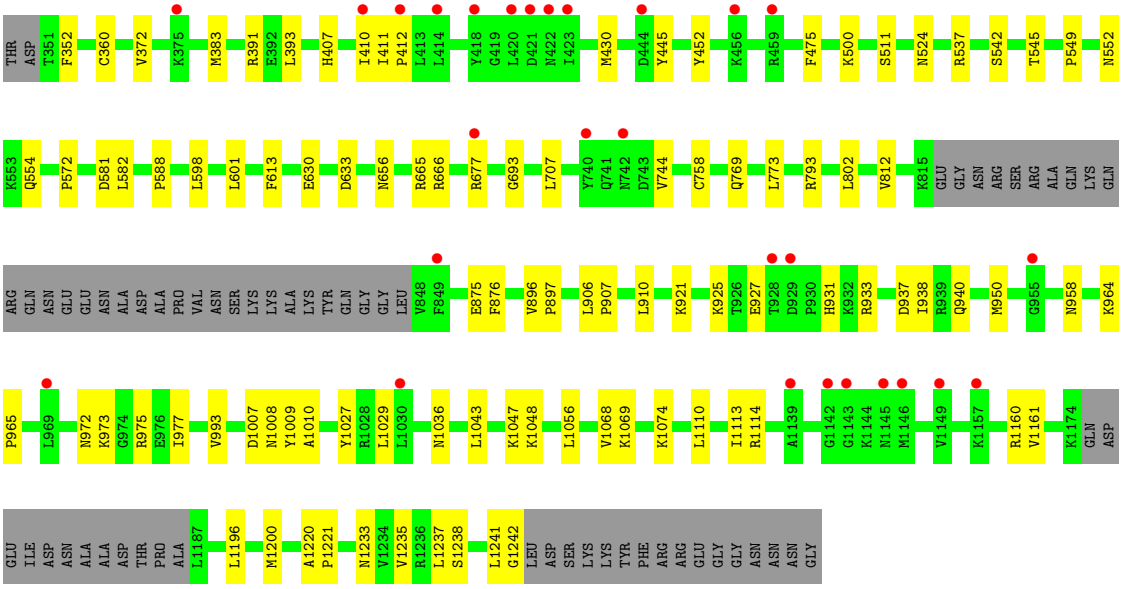
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	P			
3	E	8	266	78	89	36	55	8	0	0	0
3	F	8	266	78	89	36	55	8	0	0	0

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.

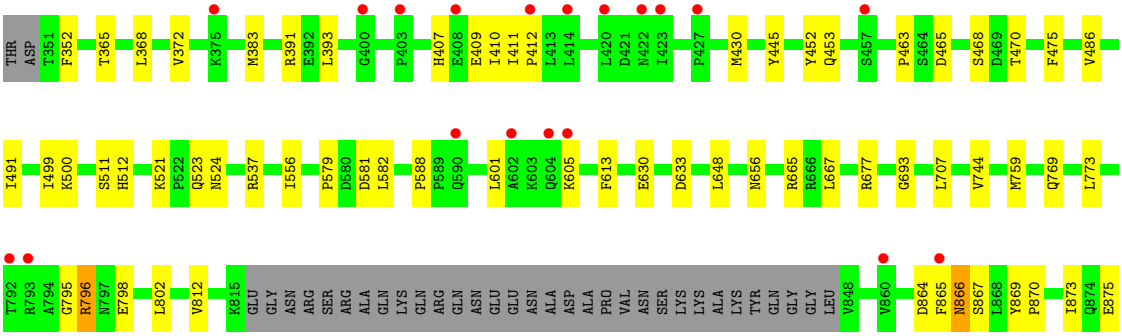
• Molecule 1: DNA polymerase alpha catalytic subunit A

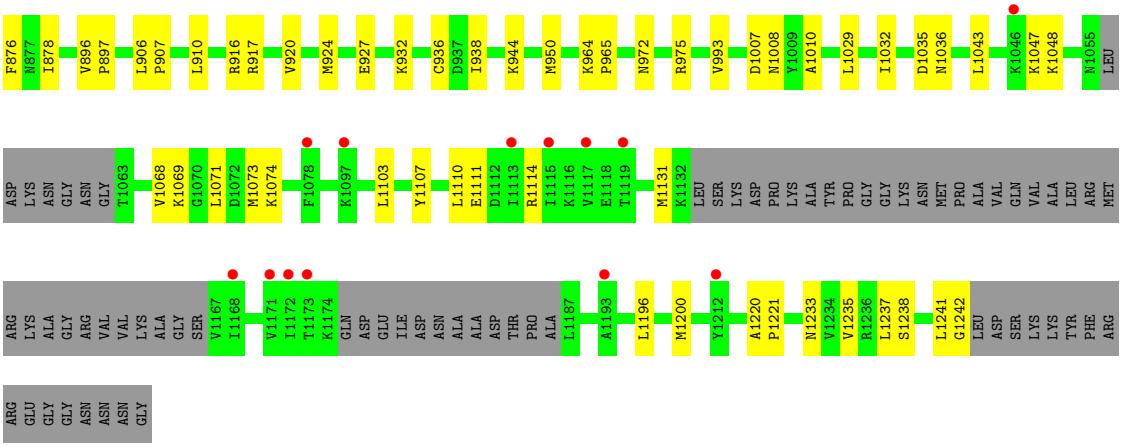
Chain A:



• Molecule 1: DNA polymerase alpha catalytic subunit A

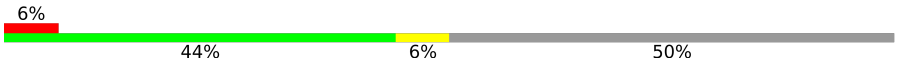
Chain B:

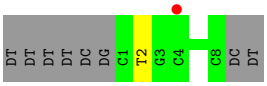




• Molecule 2: DNA (5'-D(*TP*TP*TP*TP*CP*GP*CP*TP*GP*CP*CP*CP*GP*CP*CP*T)-3')

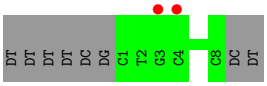
Chain C:





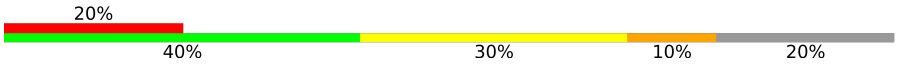
• Molecule 2: DNA (5'-D(*TP*TP*TP*TP*CP*GP*CP*TP*GP*CP*CP*CP*GP*CP*CP*T)-3')

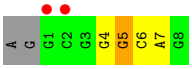
Chain D:



• Molecule 3: RNA (5'-R(*AP*GP*GP*CP*GP*GP*GP*CP*AP*G)-3')

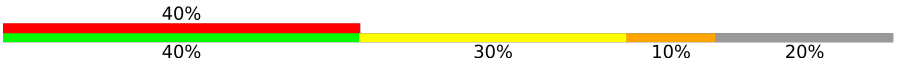
Chain E:

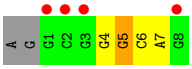




• Molecule 3: RNA (5'-R(*AP*GP*GP*CP*GP*GP*GP*CP*AP*G)-3')

Chain F:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	72.14Å 74.77Å 116.99Å 82.26° 72.57° 82.40°	Depositor
Resolution (Å)	55.53 – 3.00 55.53 – 3.00	Depositor EDS
% Data completeness (in resolution range)	97.8 (55.53-3.00) 97.8 (55.53-3.00)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$< I/\sigma(I) >$ [1]	1.82 (at 3.01Å)	Xtriage
Refinement program	PHENIX (phenix.refine: dev_1078)	Depositor
R, R_{free}	0.254 , 0.285 0.259 , 0.288	Depositor DCC
R_{free} test set	2265 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	91.5	Xtriage
Anisotropy	0.102	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 62.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	27701	wwPDB-VP
Average B, all atoms (Å^2)	117.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.99% 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)

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	0.23	0/6892	0.44	0/9320
1	B	0.23	0/6588	0.44	1/8911 (0.0%)
2	C	0.41	0/176	0.85	0/268
2	D	0.46	0/176	0.87	0/268
3	E	0.17	0/198	0.67	0/308
3	F	0.18	0/198	0.70	0/308
All	All	0.24	0/14228	0.47	1/19383 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	795	GLY	N-CA-C	-5.39	99.63	113.10

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	6768	6879	6865	57	1
1	B	6470	6556	6542	74	1
2	C	159	89	90	1	0
2	D	159	89	90	0	0
3	E	177	89	89	4	0
3	F	177	89	89	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	13910	13791	13765	137	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 5.

The worst 5 of 137 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:1114:ARG:HD3	1:B:1241:LEU:HA	1.61	0.81
1:A:958:ASN:ND2	2:C:2:DT:OP2	2.19	0.74
1:A:1114:ARG:HD2	1:A:1241:LEU:HA	1.76	0.68
1:A:927:GLU:O	1:A:933:ARG:NH2	2.28	0.67
1:A:906:LEU:HB3	1:A:907:PRO:HD3	1.78	0.66

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)
1:A:1114:ARG:NH2	1:B:677:ARG:O[1_564]	1.84	0.36

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	842/910 (92%)	810 (96%)	32 (4%)	0	100 100
1	B	797/910 (88%)	769 (96%)	27 (3%)	1 (0%)	51 85
All	All	1639/1820 (90%)	1579 (96%)	59 (4%)	1 (0%)	51 85

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	866	ASN

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	769/818 (94%)	766 (100%)	3 (0%)	91	97
1	B	739/818 (90%)	737 (100%)	2 (0%)	92	97
All	All	1508/1636 (92%)	1503 (100%)	5 (0%)	92	97

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	793	ARG
1	A	1036	ASN
1	A	1113	ILE
1	B	796	ARG
1	B	1036	ASN

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	407	HIS
1	A	684	HIS
1	A	958	ASN
1	B	407	HIS
1	B	684	HIS

5.3.3 RNA (i)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
3	E	7/10 (70%)	1 (14%)	0
3	F	7/10 (70%)	1 (14%)	0
All	All	14/20 (70%)	2 (14%)	0

All (2) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
3	E	5	G
3	F	5	G

There are no RNA pucker outliers to report.

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)

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	848/910 (93%)	0.30	28 (3%)	46	20	56, 98, 139, 198	0
1	B	807/910 (88%)	0.36	32 (3%)	38	15	66, 107, 141, 177	0
2	C	8/16 (50%)	0.41	1 (12%)	3	1	154, 164, 170, 171	0
2	D	8/16 (50%)	1.48	2 (25%)	0	0	162, 174, 181, 181	0
3	E	8/10 (80%)	1.57	2 (25%)	0	0	132, 149, 188, 199	0
3	F	8/10 (80%)	1.83	4 (50%)	0	0	149, 161, 189, 198	0
All	All	1687/1872 (90%)	0.35	69 (4%)	37	14	56, 104, 145, 199	0

The worst 5 of 69 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	E	1	G	5.0
1	B	403	PRO	4.7
1	B	375	LYS	4.3
1	B	1046	LYS	4.0
1	B	590	GLN	3.8

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)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.