



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 03:46 PM UTC

PDB ID : 3CO7 / pdb_00003co7
Title : Crystal Structure of FoxO1 DBD Bound to DBE2 DNA
Authors : Brent, M.M.; Anand, R.; Marmorstein, R.
Deposited on : 2008-03-27
Resolution : 2.91 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

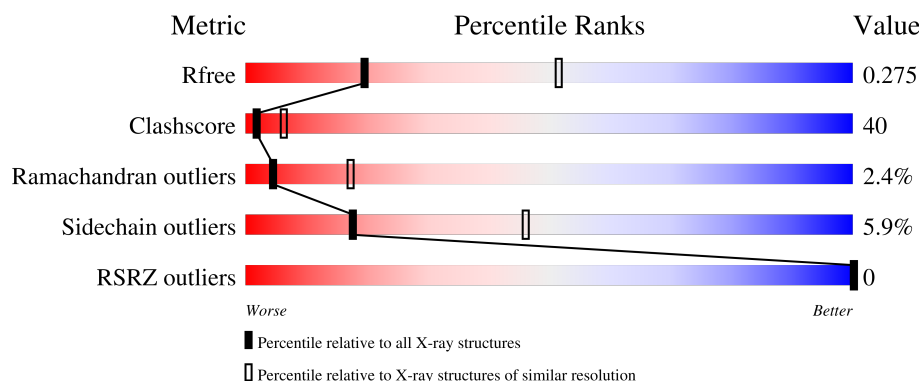
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.91 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	2995 (2.94-2.90)
Clashscore	190562	3213 (2.94-2.90)
Ramachandran outliers	187476	3128 (2.94-2.90)
Sidechain outliers	187428	3130 (2.94-2.90)
RSRZ outliers	180081	2995 (2.94-2.90)

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	16	94% 6%
1	D	16	6% 94%
2	B	16	19% 75% 6%
2	E	16	94% 6%
3	C	117	43% 24% 6% • 26%

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Mol	Chain	Length	Quality of chain
3	F	117	 A horizontal bar chart showing the quality of chain F. The bar is divided into four segments: green (43%), yellow (25%), orange (6%), and grey (26%). A small red dot is located on the orange segment. 43% 25% 6% • 26%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2656 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 DNA (5'-D(*DTP*DCP*DTP*DTP*DGP*DTP*DTP*DT*TP*DAP*DCP*DAP*DTP*DTP*DTP*DTP*DG)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	16	Total	C	N	O	P	0	0	0
			321	158	46	102	15			
1	D	16	Total	C	N	O	P	0	0	0
			321	158	46	102	15			

- Molecule 2 is a DNA chain called DNA (5'-D(*DCP*DAP*DAP*DAP*DAP*DTP*DGP*DT*TP*DAP*DAP*DAP*DAP*DCP*DAP*DAP*DGP*DA)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	16	Total	C	N	O	P	0	0	0
			329	158	70	86	15			
2	E	16	Total	C	N	O	P	0	0	0
			329	158	70	86	15			

- Molecule 3 is a protein called Forkhead box protein O1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	87	Total	C	N	O	S	0	0	0
			676	429	122	123	2			
3	F	87	Total	C	N	O	S	0	0	0
			676	429	122	123	2			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	150	SER	-	expression tag	UNP Q12778
F	150	SER	-	expression tag	UNP Q12778

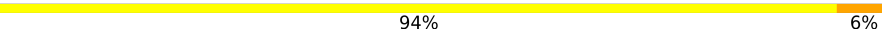
- Molecule 4 is water.

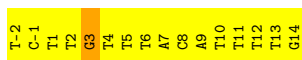
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total 1	O 1	0	0
4	D	1	Total 1	O 1	0	0
4	C	1	Total 1	O 1	0	0
4	F	1	Total 1	O 1	0	0

3 Residue-property plots

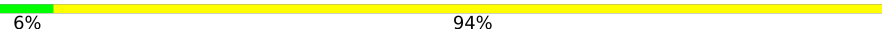
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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.

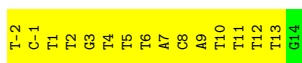
- Molecule 1: DNA (5'-D(*DTP*DCP*DTP*DTP*DGP*DTP*DTP*DTP*DAP*DCP*DAP*DTTP*DTP*DTP*DTP*DG)-3')

Chain A: 

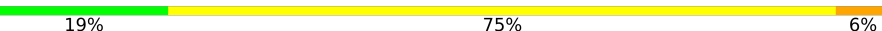


- Molecule 1: DNA (5'-D(*DTP*DCP*DTP*DTP*DGP*DTP*DTP*DTP*DAP*DCP*DAP*DTTP*DTP*DTP*DTP*DG)-3')

Chain D: 

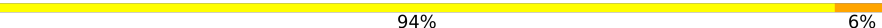


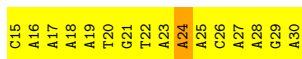
- Molecule 2: DNA (5'-D(*DCP*DAP*DAP*DAP*DAP*DTP*DGP*DTP*DAP*DAP*DAP*DCP*DAP*DAP*DGP*DA)-3')

Chain B: 

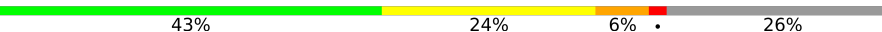


- Molecule 2: DNA (5'-D(*DCP*DAP*DAP*DAP*DAP*DTP*DGP*DTP*DAP*DAP*DAP*DCP*DAP*DAP*DGP*DA)-3')

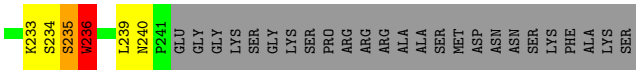
Chain E: 



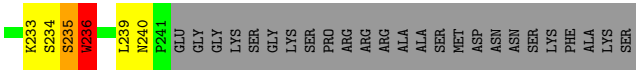
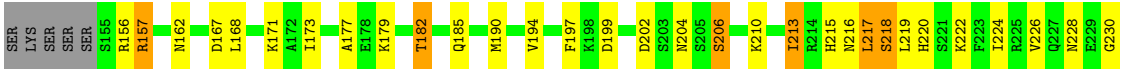
- Molecule 3: Forkhead box protein O1

Chain C: 





● Molecule 3: Forkhead box protein O1



4 Data and refinement statistics

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	99.64Å 99.64Å 98.47Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.91 30.00 – 2.91	Depositor EDS
% Data completeness (in resolution range)	96.5 (30.00-2.91) 97.9 (30.00-2.91)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.19 (at 2.72Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.267 , 0.276 0.270 , 0.275	Depositor DCC
R_{free} test set	5752 reflections (9.82%)	wwPDB-VP
Wilson B-factor (Å ²)	71.0	Xtriage
Anisotropy	0.206	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 37.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.339 for -h,-k,l 0.456 for h,-h-k,-l 0.339 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	2656	wwPDB-VP
Average B, all atoms (Å ²)	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.23% 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

5.1 Standard geometry

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	0.39	0/356	0.88	0/548
1	D	0.40	0/356	0.88	0/548
2	B	0.36	0/372	0.74	0/572
2	E	0.37	0/372	0.74	0/572
3	C	0.51	0/693	0.98	5/939 (0.5%)
3	F	0.50	0/693	0.96	3/939 (0.3%)
All	All	0.45	0/2842	0.89	8/4118 (0.2%)

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
2	B	0	2
2	E	0	2
All	All	0	5

There are no bond length outliers.

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
3	F	157	ARG	N-CA-C	-6.41	105.59	113.41
3	C	157	ARG	N-CA-C	-6.24	105.80	113.41
3	C	206	SER	N-CA-C	5.25	116.73	109.54
3	C	182	THR	N-CA-C	-5.19	102.37	110.42
3	C	236	TRP	N-CA-C	-5.11	103.78	110.53

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	3	DG	Sidechain
2	B	23	DA	Sidechain
2	B	24	DA	Sidechain
2	E	23	DA	Sidechain
2	E	24	DA	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	321	0	188	42	0
1	D	321	0	188	42	0
2	B	329	0	180	14	0
2	E	329	0	180	18	0
3	C	676	0	637	39	0
3	F	676	0	637	38	0
4	A	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
4	F	1	0	0	0	0
All	All	2656	0	2010	185	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 40.

The worst 5 of 185 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:2:DT:H2''	1:A:3:DG:H5''	1.12	1.08
1:D:2:DT:H2''	1:D:3:DG:H5''	1.11	1.07
1:D:2:DT:H2''	1:D:3:DG:C5'	1.89	1.01
1:A:2:DT:H2''	1:A:3:DG:C5'	1.91	0.99
1:D:2:DT:C2'	1:D:3:DG:H5''	1.90	0.99

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	
3	C	85/117 (73%)	68 (80%)	15 (18%)	2 (2%)	4	17
3	F	85/117 (73%)	68 (80%)	15 (18%)	2 (2%)	4	17
All	All	170/234 (73%)	136 (80%)	30 (18%)	4 (2%)	4	17

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	F	217	LEU
3	F	218	SER
3	C	217	LEU
3	C	218	SER

5.3.2 Protein sidechains

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	C	68/101 (67%)	64 (94%)	4 (6%)	18	46
3	F	68/101 (67%)	64 (94%)	4 (6%)	18	46
All	All	136/202 (67%)	128 (94%)	8 (6%)	18	46

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	F	236	TRP
3	F	235	SER

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Mol	Chain	Res	Type
3	F	182	THR
3	C	236	TRP
3	F	213	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
3	C	215	HIS
3	F	215	HIS

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	16/16 (100%)	-2.03	0 100 100	58, 67, 71, 75	0
1	D	16/16 (100%)	-2.01	0 100 100	57, 67, 71, 76	0
2	B	16/16 (100%)	-2.09	0 100 100	57, 68, 88, 93	0
2	E	16/16 (100%)	-2.08	0 100 100	56, 68, 87, 93	0
3	C	87/117 (74%)	-1.41	0 100 100	53, 70, 85, 90	0
3	F	87/117 (74%)	-1.38	0 100 100	52, 70, 85, 89	0
All	All	238/298 (79%)	-1.57	0 100 100	52, 69, 86, 93	0

There are no RSRZ outliers to report.

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.