



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 12:22 PM UTC

PDB ID : 4LDU / pdb_00004ldu
Title : Crystal structure of the DNA binding domain of Arabidopsis thaliana auxin response factor 5
Authors : Boer, D.R.; Freire-Rios, A.; van den Berg, W.M.A.; Weijers, D.; Coll, M.
Deposited on : 2013-06-25
Resolution : 2.15 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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

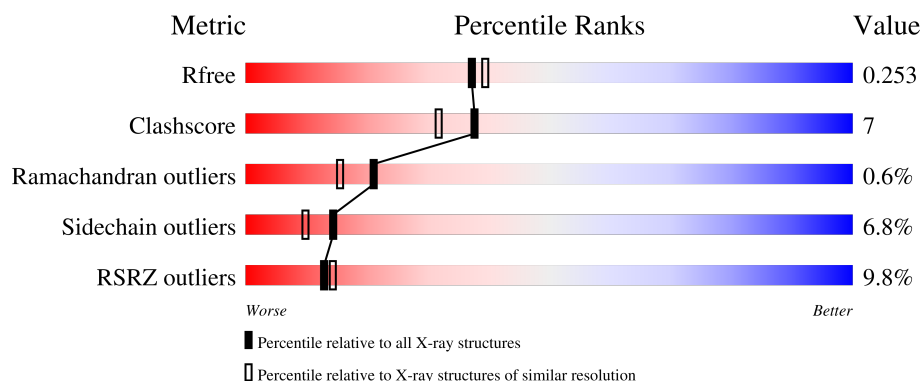
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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}	180053	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (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 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	397	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2842 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 Auxin response factor 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	336	Total	C	N	O	S	0	0	0
			2651	1678	475	482	16			

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	391	ASN	-	expression tag	UNP P93024
A	392	SER	-	expression tag	UNP P93024
A	393	TYR	-	expression tag	UNP P93024
A	394	SER	-	expression tag	UNP P93024
A	395	GLN	-	expression tag	UNP P93024
A	396	SER	-	expression tag	UNP P93024
A	397	MET	-	expression tag	UNP P93024

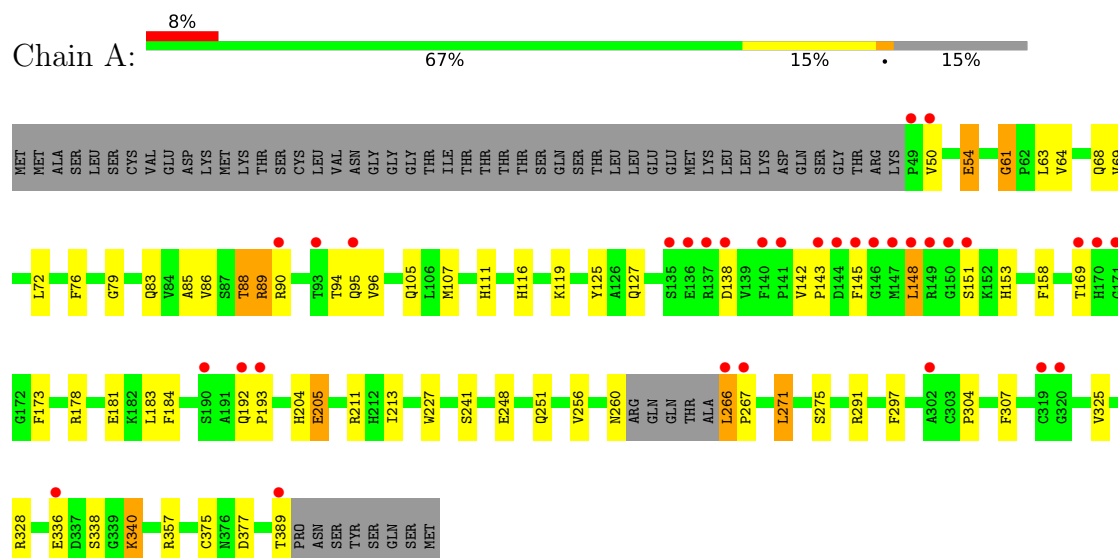
- Molecule 2 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Cl	0	0
			2	2		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	189	Total	O	0	0
			189	189		

- Molecule 1: Auxin response factor 5



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	69.61Å 91.50Å 77.18Å 90.00° 114.28° 90.00°	Depositor
Resolution (Å)	38.38 – 2.15 38.38 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.7 (38.38-2.15) 99.8 (38.38-2.15)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.92 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.195 , 0.252 0.198 , 0.253	Depositor DCC
R_{free} test set	1211 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	35.8	Xtriage
Anisotropy	0.006	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 32.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.030 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2842	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.72% 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

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

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	0.91	1/2725 (0.0%)	1.10	7/3705 (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

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	85	ALA	C-O	-7.33	1.15	1.24

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	184	PHE	CA-C-N	-7.65	114.15	119.66
1	A	184	PHE	C-N-CA	-7.65	114.15	119.66
1	A	61	GLY	CA-C-N	7.16	126.87	119.56
1	A	61	GLY	C-N-CA	7.16	126.87	119.56
1	A	266	LEU	CA-C-N	6.03	125.99	119.78
1	A	266	LEU	C-N-CA	6.03	125.99	119.78
1	A	54	GLU	N-CA-C	5.29	117.05	111.28

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	192	GLN	Peptide

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	2651	0	2602	37	0
2	A	2	0	0	0	0
3	A	189	0	0	4	0
All	All	2842	0	2602	37	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 7.

All (37) 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:64:VAL:O	1:A:153:HIS:HE1	1.70	0.73
1:A:72:LEU:HD13	1:A:107:MET:CE	2.22	0.69
1:A:178:ARG:NH2	1:A:181:GLU:OE1	2.25	0.69
1:A:158:PHE:HD1	1:A:183:LEU:CD1	2.06	0.68
1:A:138:ASP:OD1	1:A:291:ARG:HD2	2.01	0.61
1:A:158:PHE:HD1	1:A:183:LEU:HD12	1.67	0.59
1:A:54:GLU:HG3	3:A:551:HOH:O	2.04	0.56
1:A:88:THR:HG22	1:A:90:ARG:H	1.72	0.54
1:A:105:GLN:NE2	3:A:662:HOH:O	2.40	0.51
1:A:88:THR:CG2	1:A:88:THR:O	2.59	0.51
1:A:54:GLU:OE1	1:A:248:GLU:HG2	2.11	0.50
1:A:205:GLU:HA	1:A:205:GLU:OE1	2.11	0.50
1:A:375:CYS:SG	1:A:377:ASP:HB2	2.52	0.49
1:A:86:VAL:HG21	1:A:304:PRO:HD3	1.95	0.49
1:A:328:ARG:HH11	1:A:328:ARG:HG2	1.77	0.49
1:A:173:PHE:HB2	1:A:227:TRP:CE2	2.48	0.48
1:A:95:GLN:O	1:A:96:VAL:C	2.56	0.48
1:A:76:PHE:CE2	1:A:105:GLN:HB3	2.49	0.47
1:A:125:TYR:CE2	1:A:297:PHE:CD2	3.02	0.47
1:A:111:HIS:HA	1:A:145:PHE:HE2	1.80	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:204:HIS:O	1:A:205:GLU:HB2	2.16	0.46
1:A:116:HIS:CD2	1:A:127:GLN:HG3	2.50	0.46
1:A:79:GLY:HA3	1:A:307:PHE:HB3	1.98	0.45
1:A:119:LYS:HA	1:A:204:HIS:CE1	2.51	0.45
1:A:142:VAL:N	1:A:143:PRO:CD	2.79	0.45
1:A:260:ASN:C	3:A:664:HOH:O	2.61	0.43
1:A:63:LEU:HD21	1:A:340:LYS:HG2	2.00	0.43
1:A:72:LEU:HD13	1:A:107:MET:HE3	2.00	0.43
1:A:336:GLU:CD	3:A:603:HOH:O	2.62	0.43
1:A:88:THR:C	1:A:90:ARG:H	2.27	0.42
1:A:266:LEU:HA	1:A:267:PRO:HD2	1.78	0.41
1:A:83:GLN:O	1:A:83:GLN:HG2	2.20	0.41
1:A:69:VAL:HB	1:A:148:LEU:HD22	2.03	0.41
1:A:88:THR:HG22	1:A:88:THR:O	2.20	0.41
1:A:271:LEU:HD13	1:A:275:SER:HB3	2.02	0.41
1:A:61:GLY:O	1:A:153:HIS:NE2	2.54	0.40
1:A:328:ARG:HG2	1:A:328:ARG:NH1	2.37	0.40

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	332/397 (84%)	323 (97%)	7 (2%)	2 (1%)	21	15

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	89	ARG
1	A	193	PRO

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	
1	A	292/347 (84%)	272 (93%)	20 (7%)	14	10

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	50	VAL
1	A	68	GLN
1	A	88	THR
1	A	89	ARG
1	A	94	THR
1	A	148	LEU
1	A	151	SER
1	A	169	THR
1	A	205	GLU
1	A	211	ARG
1	A	213	ILE
1	A	241	SER
1	A	251	GLN
1	A	256	VAL
1	A	271	LEU
1	A	325	VAL
1	A	338	SER
1	A	340	LYS
1	A	357	ARG
1	A	389	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	105	GLN
1	A	134	HIS
1	A	153	HIS
1	A	170	HIS
1	A	251	GLN

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Mol	Chain	Res	Type
1	A	290	ASN
1	A	367	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	336/397 (84%)	0.62	33 (9%) 13 14	11, 23, 46, 66	0

All (33) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	147	MET	5.8
1	A	148	LEU	5.5
1	A	150	GLY	5.5
1	A	143	PRO	5.3
1	A	149	ARG	5.2
1	A	151	SER	5.1
1	A	144	ASP	4.7
1	A	319	CYS	4.5
1	A	146	GLY	4.4
1	A	171	GLY	4.1
1	A	137	ARG	4.1
1	A	145	PHE	3.8
1	A	95	GLN	3.6
1	A	192	GLN	3.6
1	A	267	PRO	3.5
1	A	140	PHE	3.4
1	A	266	LEU	3.4
1	A	49	PRO	3.2
1	A	136	GLU	3.1
1	A	320	GLY	3.0
1	A	93	THR	2.9
1	A	193	PRO	2.7
1	A	90	ARG	2.6
1	A	190	SER	2.5
1	A	50	VAL	2.4
1	A	169	THR	2.4
1	A	170	HIS	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	141	PRO	2.4
1	A	302	ALA	2.3
1	A	389	THR	2.2
1	A	336	GLU	2.0
1	A	135	SER	2.0
1	A	138	ASP	2.0

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](#)

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($\text{\AA}^2$)	Q<0.9
2	CL	A	401	1/1	0.76	0.21	84,84,84,84	0
2	CL	A	402	1/1	0.80	0.17	68,68,68,68	0

6.5 Other polymers [i](#)

There are no such residues in this entry.