



Full wwPDB X-ray Structure Validation Report ⓘ

May 23, 2016 – 04:37 PM EDT

PDB ID : 4PJ3
Title : Structural insight into the function and evolution of the spliceosomal helicase Aquarius, Structure of Aquarius in complex with AMPPNP
Authors : De, I.; Bessonov, S.; Hofele, R.; dos Santos, K.F.; Will, C.L.; Urlaub, H.; Luhrmann, R.; Pena, V.
Deposited on : 2014-05-11
Resolution : 2.30 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
<http://wwpdb.org/validation/2016/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
Mogul : unknown
Xtriage (Phenix) : 1.9-1692
EDS : rb-20027674
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20027674

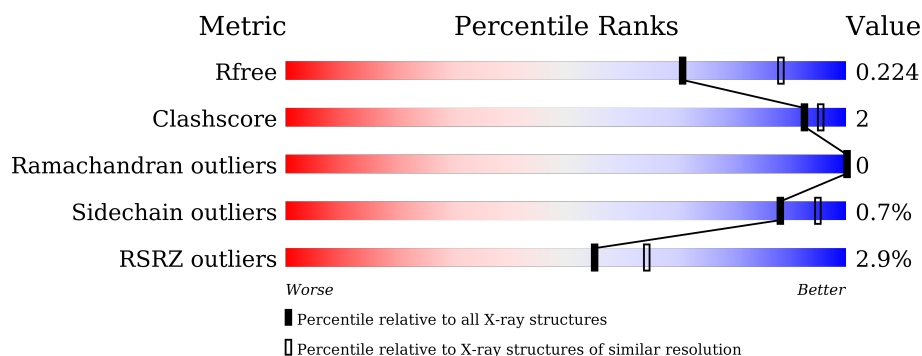
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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}	91344	3852 (2.30-2.30)
Clashscore	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)
RSRZ outliers	91569	3857 (2.30-2.30)

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. 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	1475	<div> <div>3%</div> <div>85%</div> <div>5%</div> <div>9%</div> </div>

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.

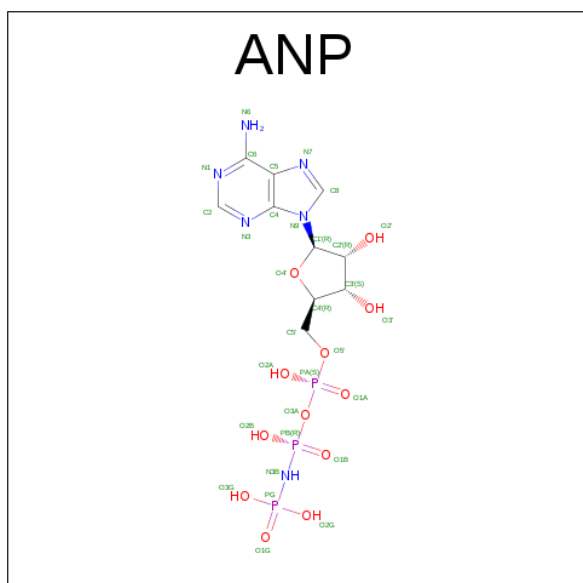
- Molecule 1 is a protein called Intron-binding protein aquarius.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	1335	Total	C	N	O	S	Se	211	6	0
			11010	7073	1895	1986	18	38			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1486	HIS	-	expression tag	UNP O60306
A	1487	HIS	-	expression tag	UNP O60306
A	1488	HIS	-	expression tag	UNP O60306
A	1489	HIS	-	expression tag	UNP O60306
A	1490	HIS	-	expression tag	UNP O60306
A	1491	HIS	-	expression tag	UNP O60306
A	1492	HIS	-	expression tag	UNP O60306
A	1493	HIS	-	expression tag	UNP O60306

- Molecule 2 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (three-letter code: ANP) (formula: $\text{C}_{10}\text{H}_{17}\text{N}_6\text{O}_{12}\text{P}_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			31	10	6	12	3		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Mg	0	0
			2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	555	Total	O	0	0
			555	555		

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	94.99 Å 140.44 Å 144.76 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.49 – 2.30 100.80 – 1.87	Depositor EDS
% Data completeness (in resolution range)	97.1 (47.49-2.30) 83.8 (100.80-1.87)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.52 (at 1.87 Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.4_1496)	Depositor
R, R_{free}	0.191 , 0.226 0.190 , 0.224	Depositor DCC
R_{free} test set	4093 reflections (4.90%)	DCC
Wilson B-factor (Å ²)	23.9	Xtriage
Anisotropy	0.217	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 40.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.017 for -h,l,k	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	11598	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.19% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: MG, ANP

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	0/11256	0.41	0/15185

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	11010	0	10974	43	0
2	A	31	0	13	0	0
3	A	2	0	0	0	0
4	A	555	0	0	0	0
All	All	11598	0	10987	43	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 2.

All (43) 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:1059:ILE:HG13	1:A:1088:LEU:HD11	1.72	0.71
1:A:323:GLU:HA	1:A:326[A]:MSE:HE3	1.75	0.67
1:A:362:ARG:NH2	1:A:405:GLU:OE1	2.35	0.58
1:A:867:MSE:HE1	1:A:889:GLU:HB3	1.86	0.58
1:A:204:ASP:HA	1:A:207:MSE:HE2	1.87	0.56
1:A:571:LYS:HD2	1:A:586:GLN:O	2.07	0.55
1:A:913:LYS:HD2	1:A:917:LYS:HE2	1.90	0.54
1:A:673:ILE:HG22	1:A:677:MSE:HE2	1.90	0.53
1:A:1027:LEU:HA	1:A:1031:GLU:HB3	1.90	0.53
1:A:814:MSE:SE	1:A:839:ASN:HD22	2.43	0.52
1:A:225:LEU:HG	1:A:253:PHE:HE1	1.74	0.51
1:A:19:ASN:HB3	1:A:22:PHE:HB3	1.94	0.50
1:A:204:ASP:O	1:A:212:ARG:NH1	2.45	0.50
1:A:748:ARG:NH1	1:A:780:GLU:OE1	2.43	0.48
1:A:830:THR:HG22	1:A:865:LYS:HD2	1.94	0.48
1:A:1355:ILE:HG21	1:A:1361:MSE:HB2	1.96	0.48
1:A:1237:ILE:O	1:A:1241:ILE:HG12	2.14	0.47
1:A:790:TYR:OH	1:A:976:ASN:ND2	2.47	0.47
1:A:790:TYR:HB3	1:A:792:TYR:CE2	2.51	0.46
1:A:509:ARG:HG3	1:A:549:ILE:HD12	1.97	0.46
1:A:444:TYR:CZ	1:A:446:GLY:HA2	2.51	0.45
1:A:987:TYR:CZ	1:A:991:MSE:HE3	2.51	0.45
1:A:1220:PRO:HD3	1:A:1338:PHE:CE2	2.52	0.45
1:A:1284:LEU:HD23	1:A:1310:PHE:CE1	2.51	0.45
1:A:1208:VAL:HG13	1:A:1241:ILE:HD13	2.00	0.44
1:A:1021:LEU:HD22	1:A:1021:LEU:HA	1.85	0.43
1:A:987:TYR:CE1	1:A:991:MSE:HE3	2.53	0.43
1:A:61:ILE:O	1:A:65:MSE:HG3	2.19	0.43
1:A:941:MSE:SE	1:A:998:PHE:HZ	2.52	0.43
1:A:163:ARG:O	1:A:167:GLN:HG2	2.19	0.42
1:A:1358:MSE:HB3	1:A:1359:PRO:HD3	2.01	0.42
1:A:173:PRO:HG3	1:A:200:ILE:HD13	2.01	0.42
1:A:961:VAL:HG12	1:A:987:TYR:N	2.34	0.42
1:A:565:ILE:HB	1:A:655:ILE:HB	2.02	0.42
1:A:1248:ASN:HA	1:A:1249:PRO:HD3	1.90	0.41
1:A:676:LEU:HA	1:A:676:LEU:HD23	1.96	0.41
1:A:902:LEU:O	1:A:906:ILE:HG12	2.21	0.41
1:A:109:TRP:CD2	1:A:162:ILE:HD11	2.56	0.41
1:A:735:VAL:HG11	1:A:743:GLN:HG2	2.02	0.41
1:A:1138:ARG:NE	1:A:1267:GLN:OE1	2.48	0.40
1:A:140:LEU:HD12	1:A:140:LEU:HA	1.87	0.40
1:A:748:ARG:HG3	1:A:782:HIS:CD2	2.57	0.40

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	1333/1475 (90%)	1308 (98%)	25 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	1217/1292 (94%)	1209 (99%)	8 (1%)	88	95

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	90	TYR
1	A	881	HIS
1	A	960	ASP
1	A	986	SER
1	A	1021	LEU
1	A	1206	TYR
1	A	1283	HIS
1	A	1343	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# $ Z > 2$	Counts	RMSZ	# $ Z > 2$
2	ANP	A	1501	-	29,33,33	2.05	11 (37%)	26,52,52	2.59	8 (30%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	ANP	A	1501	-	-	0/13/38/38	0/3/3/3

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1501	ANP	C2'-C1'	-3.46	1.48	1.53
2	A	1501	ANP	C2'-C3'	-2.85	1.45	1.53
2	A	1501	ANP	PG-O2G	-2.55	1.49	1.56
2	A	1501	ANP	PB-O2B	-2.45	1.50	1.56

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1501	ANP	O2'-C2'	-2.24	1.37	1.43
2	A	1501	ANP	O3'-C3'	-2.13	1.37	1.43
2	A	1501	ANP	C3'-C4'	-2.07	1.47	1.53
2	A	1501	ANP	C6-N6	2.89	1.46	1.34
2	A	1501	ANP	C4-N3	3.35	1.40	1.35
2	A	1501	ANP	PB-O1B	4.02	1.50	1.46
2	A	1501	ANP	PG-O1G	4.41	1.50	1.46

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1501	ANP	N3-C2-N1	-8.68	122.05	128.87
2	A	1501	ANP	O2G-PG-O1G	-4.67	101.28	113.58
2	A	1501	ANP	O2B-PB-O1B	-4.08	101.98	110.02
2	A	1501	ANP	C1'-N9-C4	-4.05	122.29	126.81
2	A	1501	ANP	PA-O3A-PB	-2.40	123.99	132.71
2	A	1501	ANP	O2A-PA-O1A	-2.30	100.60	112.56
2	A	1501	ANP	O4'-C1'-N9	2.04	111.96	108.11
2	A	1501	ANP	O3A-PB-N3B	2.72	113.56	106.07

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	1295/1475 (87%)	-0.34	38 (2%) 55 64	17, 32, 68, 107	30 (2%)

All (38) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1380	HIS	7.7
1	A	1381	GLN	5.9
1	A	1374	GLN	4.9
1	A	1247	ASN	4.7
1	A	1246	GLY	4.5
1	A	500	GLY	4.4
1	A	36	LYS	4.3
1	A	618	LEU	4.1
1	A	527	ILE	3.8
1	A	614	PRO	3.5
1	A	1376	THR	3.5
1	A	19	ASN	3.2
1	A	443	TYR	3.1
1	A	507	TRP	3.0
1	A	34	HIS	3.0
1	A	1245	CYS	2.9
1	A	960	ASP	2.9
1	A	1231	ASN	2.9
1	A	544	ASN	2.8
1	A	1373	ILE	2.7
1	A	1197	PHE	2.7
1	A	1188	VAL	2.6
1	A	617	ASN	2.6
1	A	22	PHE	2.6
1	A	528	GLY	2.5
1	A	531	TRP	2.5
1	A	791	PRO	2.4

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	792	TYR	2.4
1	A	530	ASN	2.4
1	A	1018	ARG	2.3
1	A	1372	LEU	2.3
1	A	1369	TYR	2.2
1	A	615	ARG	2.1
1	A	35	ILE	2.1
1	A	1375	THR	2.1
1	A	616	PRO	2.1
1	A	1187	GLY	2.1
1	A	1253	ARG	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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
2	ANP	A	1501	31/31	0.96	0.11	0.98	22,29,39,42	0
3	MG	A	1503	1/1	0.87	0.41	-	66,66,66,66	0
3	MG	A	1502	1/1	0.89	0.15	-	47,47,47,47	0

6.5 Other polymers [i](#)

There are no such residues in this entry.