



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 08:02 PM UTC

PDB ID : 5ST9 / pdb_00005st9
Title : PanDDA analysis group deposition – Aar2/RNaseH in complex with fragment P02F01 from the F2X-Universal Library
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Deposited on : 2022-08-26
Resolution : 1.40 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
Mogul	:	2022.3.0, CSD as543be (2022)
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

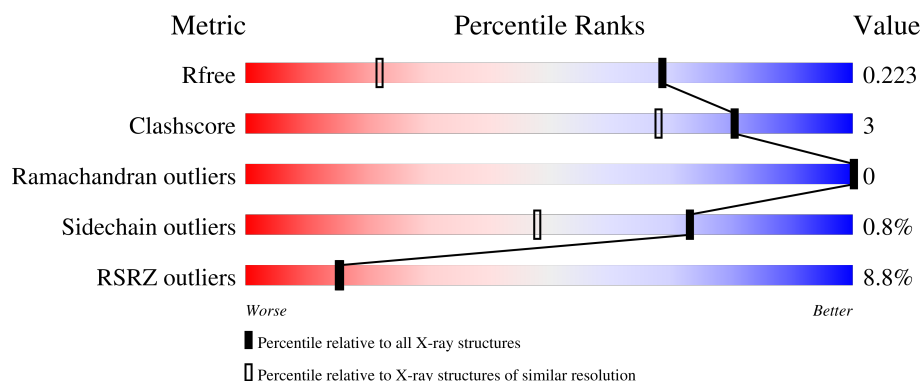
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.40 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	2563 (1.40-1.40)
Clashscore	190562	2660 (1.40-1.40)
Ramachandran outliers	187476	2611 (1.40-1.40)
Sidechain outliers	187428	2610 (1.40-1.40)
RSRZ outliers	180081	2561 (1.40-1.40)

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	258	5% 89% 8%
2	B	308	11% 89% 9%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 9366 atoms, of which 4524 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 Pre-mRNA-splicing factor 8.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	237	4068	1287	2060	336	373	12	0	21	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1833	GLY	-	expression tag	UNP P33334
A	1834	ALA	-	expression tag	UNP P33334
A	1835	MET	-	expression tag	UNP P33334

- Molecule 2 is a protein called A1 cistron-splicing factor AAR2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
2	B	300	5044	1654	2464	421	485	20	33	17	0

There are 20 discrepancies between the modelled and reference sequences:

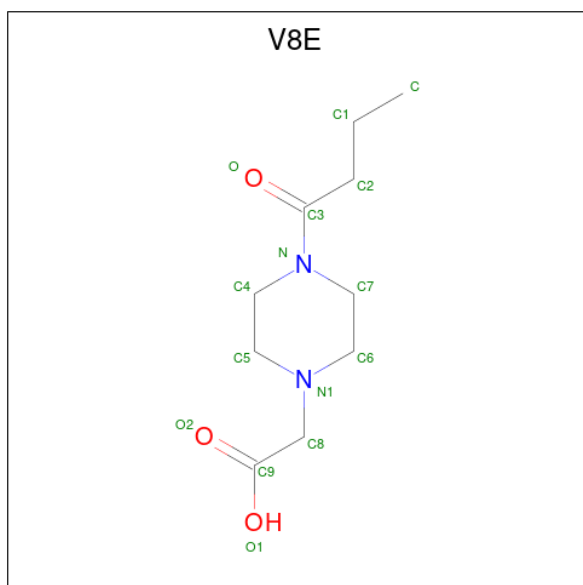
Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	GLY	-	expression tag	UNP P32357
B	-2	ALA	-	expression tag	UNP P32357
B	-1	MET	-	expression tag	UNP P32357
B	0	ALA	-	expression tag	UNP P32357
B	166	SER	LEU	conflict	UNP P32357
B	167	SER	LYS	conflict	UNP P32357
B	?	-	LEU	deletion	UNP P32357
B	?	-	GLN	deletion	UNP P32357
B	?	-	LYS	deletion	UNP P32357
B	?	-	ALA	deletion	UNP P32357
B	?	-	GLY	deletion	UNP P32357
B	?	-	SER	deletion	UNP P32357
B	?	-	LYS	deletion	UNP P32357

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Chain	Residue	Modelled	Actual	Comment	Reference
B	?	-	MET	deletion	UNP P32357
B	?	-	GLU	deletion	UNP P32357
B	?	-	ALA	deletion	UNP P32357
B	?	-	LYS	deletion	UNP P32357
B	?	-	ASN	deletion	UNP P32357
B	?	-	GLU	deletion	UNP P32357
B	170	SER	ASP	conflict	UNP P32357

- Molecule 3 is (4-butanoylpiperazin-1-yl)acetic acid (CCD ID: V8E) (formula: C₁₀H₁₈N₂O₃).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			15	10	2	3		

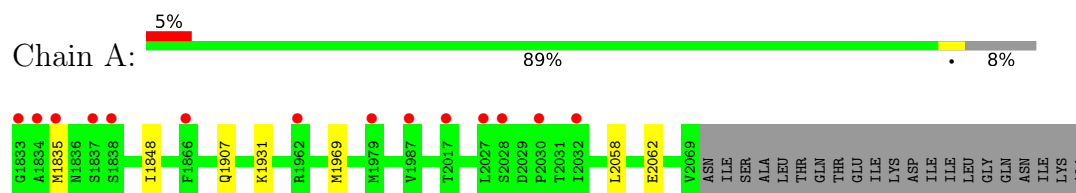
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	128	Total	O	0	0
			128	128		
4	B	111	Total	O	0	0
			111	111		

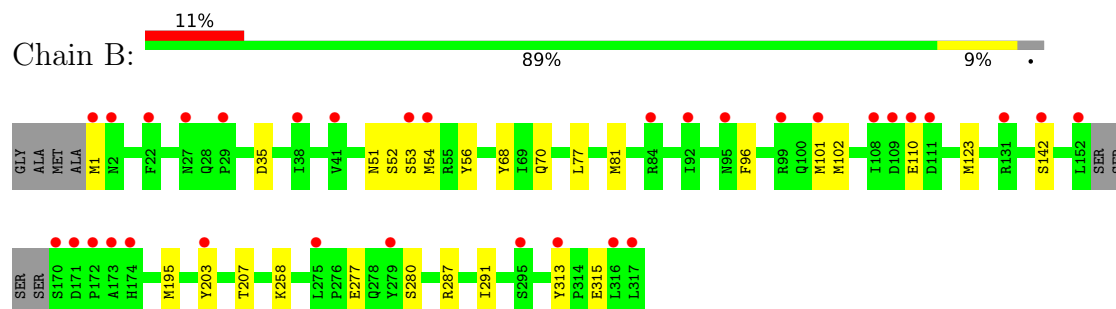
3 Residue-property plots [i](#)

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: Pre-mRNA-splicing factor 8



- Molecule 2: A1 cistron-splicing factor AAR2



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	89.15Å 81.78Å 93.92Å 90.00° 108.90° 90.00°	Depositor
Resolution (Å)	44.02 – 1.40 44.02 – 1.40	Depositor EDS
% Data completeness (in resolution range)	98.9 (44.02-1.40) 99.4 (44.02-1.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.00 (at 1.40Å)	Xtriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.192 , 0.223 0.196 , 0.223	Depositor DCC
R_{free} test set	2100 reflections (1.68%)	wwPDB-VP
Wilson B-factor (Å ²)	25.2	Xtriage
Anisotropy	0.344	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 33.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	9366	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 5.48% 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: V8E

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	0.41	0/2149	0.56	0/2911
2	B	0.36	0/2739	0.54	0/3699
All	All	0.38	0/4888	0.55	0/6610

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	2008	2060	1974	6	0
2	B	2580	2464	2398	19	0
3	A	15	0	0	0	0
4	A	128	0	0	1	0
4	B	111	0	0	2	0
All	All	4842	4524	4372	24	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 3.

All (24) 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)
2:B:54[B]:MET:SD	4:B:499:HOH:O	2.17	1.02
2:B:1:MET:SD	4:B:497:HOH:O	2.33	0.85
1:A:1848:ILE:H	1:A:1931[A]:LYS:HZ2	1.37	0.70
2:B:96:PHE:HB2	2:B:102:MET:HE3	1.80	0.63
2:B:51:ASN:OD1	2:B:53:SER:HB2	2.03	0.57
2:B:96:PHE:CB	2:B:102:MET:HE3	2.36	0.54
2:B:68:TYR:CE2	2:B:81:MET:HE3	2.42	0.54
1:A:2062:GLU:HG2	4:A:2228:HOH:O	2.10	0.52
2:B:277:GLU:CD	2:B:277:GLU:H	2.20	0.49
2:B:70:GLN:HB3	2:B:81:MET:CE	2.43	0.48
2:B:70:GLN:HB3	2:B:81:MET:HE2	1.96	0.48
1:A:1907:GLN:HG2	2:B:195:MET:HE3	1.95	0.48
1:A:2058:LEU:C	1:A:2058:LEU:HD23	2.40	0.47
2:B:280:SER:HB3	2:B:313:TYR:CE1	2.50	0.47
2:B:287:ARG:O	2:B:291:ILE:HD13	2.17	0.45
1:A:1969:MET:HA	1:A:1969:MET:HE2	1.99	0.44
2:B:56:TYR:CZ	2:B:77:LEU:HB2	2.54	0.43
2:B:77:LEU:N	2:B:77:LEU:HD23	2.35	0.42
2:B:203[A]:TYR:CZ	2:B:207:THR:HG21	2.55	0.42
2:B:1:MET:HB3	2:B:35:ASP:HA	2.02	0.42
2:B:258:LYS:H	2:B:258:LYS:HD2	1.85	0.42
2:B:110:GLU:O	2:B:110:GLU:HG2	2.22	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	258/258 (100%)	254 (98%)	4 (2%)	0	100	100
2	B	315/308 (102%)	306 (97%)	9 (3%)	0	100	100
All	All	573/566 (101%)	560 (98%)	13 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	237/233 (102%)	237 (100%)	0	100	100
2	B	294/284 (104%)	289 (98%)	5 (2%)	53	21
All	All	531/517 (103%)	526 (99%)	5 (1%)	73	44

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

Mol	Chain	Res	Type
2	B	52	SER
2	B	101	MET
2	B	123[A]	MET
2	B	123[B]	MET
2	B	315	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	259	HIS

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 oligosaccharides in this entry.

5.6 Ligand geometry

1 ligand is modelled in this entry.

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
3	V8E	A	2101	-	15,15,15	1.71	4 (26%)	19,19,19	1.55	4 (21%)

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
3	V8E	A	2101	-	-	5/11/21/21	1/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	2101	V8E	C8-C9	3.47	1.58	1.51
3	A	2101	V8E	O1-C9	-2.96	1.21	1.30
3	A	2101	V8E	C3-N	2.73	1.40	1.35
3	A	2101	V8E	C8-N1	2.06	1.51	1.47

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	2101	V8E	O1-C9-O2	3.02	131.11	123.33
3	A	2101	V8E	C1-C2-C3	-2.93	108.69	113.14
3	A	2101	V8E	C9-C8-N1	-2.85	104.73	113.77
3	A	2101	V8E	O2-C9-C8	-2.41	112.31	122.38

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	2101	V8E	C-C1-C2-C3
3	A	2101	V8E	O-C3-N-C7
3	A	2101	V8E	N1-C8-C9-O1
3	A	2101	V8E	N1-C8-C9-O2
3	A	2101	V8E	C2-C3-N-C7

All (1) ring outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	2101	V8E	C4-C5-C6-C7-N-N1

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 [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	237/258 (91%)	0.29	14 (5%)	28 30	11, 31, 52, 71	12 (5%)
2	B	300/308 (97%)	0.67	33 (11%)	10 10	12, 35, 64, 93	9 (3%)
All	All	537/566 (94%)	0.50	47 (8%)	15 15	11, 33, 61, 93	21 (3%)

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	170	SER	8.0
2	B	152	LEU	7.4
2	B	54[A]	MET	6.9
2	B	1	MET	5.6
1	A	1979[A]	MET	5.3
2	B	317	LEU	4.0
2	B	173	ALA	3.9
2	B	316	LEU	3.6
2	B	172	PRO	3.6
2	B	174	HIS	3.6
1	A	1834	ALA	3.4
2	B	38	ILE	3.4
2	B	41[A]	VAL	3.3
1	A	1835	MET	3.3
2	B	279	TYR	3.3
1	A	2027	LEU	3.2
2	B	2	ASN	3.2
1	A	1837	SER	3.2
2	B	110	GLU	3.1
2	B	101	MET	3.1
2	B	275	LEU	3.0
2	B	171	ASP	3.0
1	A	1833	GLY	2.8
2	B	108	ILE	2.8

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Mol	Chain	Res	Type	RSRZ
2	B	295	SER	2.7
2	B	22	PHE	2.7
2	B	84	ARG	2.7
1	A	1962	ARG	2.7
2	B	313	TYR	2.5
1	A	1838	SER	2.5
2	B	53	SER	2.5
2	B	131	ARG	2.5
1	A	2032	ILE	2.4
1	A	2030	PRO	2.4
1	A	2017[A]	THR	2.3
2	B	92	ILE	2.3
2	B	111	ASP	2.2
2	B	203[A]	TYR	2.2
2	B	29	PRO	2.2
2	B	142	SER	2.2
1	A	2028	SER	2.2
2	B	95	ASN	2.1
2	B	99	ARG	2.1
2	B	109	ASP	2.1
2	B	27	ASN	2.1
1	A	1866	PHE	2.0
1	A	1987	VAL	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.

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	V8E	A	2101	15/15	0.50	0.34	20,20,20,20	15

6.5 Other polymers [i](#)

There are no such residues in this entry.