



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 02:09 am BST

PDB ID : 5I9H  
Title : Crystal structure of designed pentatricopeptide repeat protein dPPR-U8G2 in complex with its target RNA U8G2  
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Deposited on : 2016-02-20  
Resolution : 2.50 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](mailto: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.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
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)	:	2.11

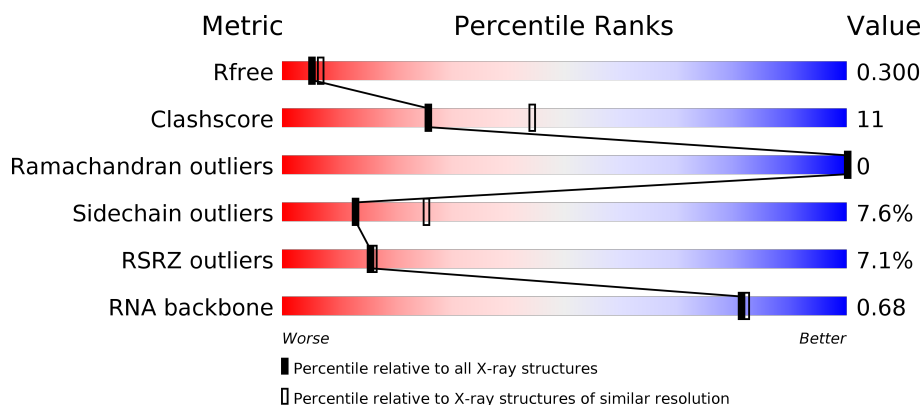
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)
RNA backbone	3102	1008 (2.84-2.16)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	460	
2	B	18	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3124 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 pentatricopeptide repeat protein dPPR-U8G2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	368	Total	C	N	O	S	0	0	0
			2850	1835	439	555	21			

- Molecule 2 is a RNA chain called RNA (5'-R(\*GP\*GP\*GP\*GP\*UP\*UP\*UP\*UP\*GP\*GP\*UP\*UP\*UP\*UP\*CP\*CP\*CP\*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	11	Total	C	N	O	P	0	0	0
			225	101	29	84	11			

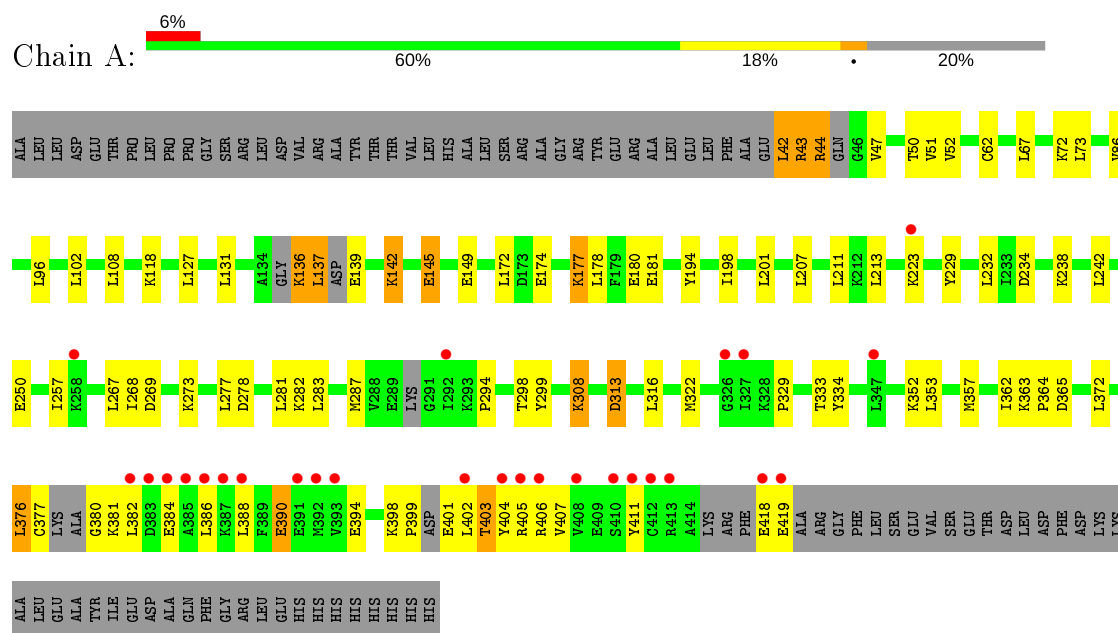
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	35	Total	O	0	0
			35	35		
3	B	14	Total	O	0	0
			14	14		

### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: pentatricopeptide repeat protein dPPR-U8G2



- Molecule 2: RNA (5'-R(\*GP\*GP\*GP\*GP\*UP\*UP\*UP\*UP\*GP\*GP\*UP\*UP\*UP\*UP\*CP\*CP\*CP\*CP)-3')



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	52.06 Å 85.10 Å 95.40 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.70 – 2.50 47.70 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.7 (47.70-2.50) 96.3 (47.70-2.50)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.39 (at 2.51 Å)	Xtriage
Refinement program	PHENIX (1.10.1 _2155)	Depositor
R, $R_{free}$	0.223 , 0.296 0.224 , 0.300	Depositor DCC
$R_{free}$ test set	783 reflections (5.17%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	44.4	Xtriage
Anisotropy	0.591	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 64.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3124	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 13.33% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [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	0.37	0/2875	0.54	0/3856
2	B	0.61	0/248	1.31	5/381 (1.3%)
All	All	0.39	0/3123	0.65	5/4237 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	B	10	C	N1-C2-O2	10.35	125.11	118.90
2	B	10	C	C2-N1-C1'	7.92	127.51	118.80
2	B	10	C	N3-C2-O2	-7.26	116.82	121.90
2	B	10	C	C6-N1-C1'	-6.25	113.30	120.80
2	B	6	U	N3-C4-O4	-5.51	115.54	119.40

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	2850	0	2978	64	0
2	B	225	0	114	1	0
3	A	35	0	0	11	0
3	B	14	0	0	0	0
All	All	3124	0	3092	65	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 11.

All (65) 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:377:CYS:O	1:A:380:GLY:N	1.75	1.19
1:A:139:GLU:N	3:A:501:HOH:O	2.12	0.82
1:A:50:THR:HG22	1:A:52:VAL:H	1.46	0.79
1:A:136:LYS:N	3:A:505:HOH:O	2.22	0.72
1:A:329:PRO:HB3	1:A:333:THR:HG21	1.72	0.71
1:A:198:ILE:HG13	1:A:213:LEU:HD22	1.75	0.69
1:A:377:CYS:C	1:A:380:GLY:N	2.47	0.68
1:A:136:LYS:HG2	1:A:137:LEU:H	1.61	0.66
1:A:313:ASP:N	1:A:313:ASP:OD1	2.29	0.63
1:A:398:LYS:NZ	3:A:507:HOH:O	2.33	0.62
1:A:352:LYS:NZ	3:A:509:HOH:O	2.35	0.59
1:A:142:LYS:O	1:A:145:GLU:HG3	2.03	0.58
1:A:67:LEU:HD23	1:A:96:LEU:HD23	1.87	0.56
1:A:382:LEU:O	1:A:386:LEU:HG	2.06	0.56
1:A:43:ARG:NH2	3:A:510:HOH:O	2.39	0.55
1:A:211:LEU:HD23	1:A:232:LEU:HD22	1.90	0.54
1:A:229:TYR:CE2	1:A:257:ILE:HD12	2.44	0.53
1:A:299:TYR:CD1	1:A:322:MET:HB3	2.47	0.50
1:A:177:LYS:NZ	3:A:502:HOH:O	2.36	0.49
1:A:234:ASP:O	1:A:238:LYS:HG2	2.12	0.49
2:B:10:C:O2	2:B:10:C:H2'	2.13	0.48
1:A:268:ILE:HG13	1:A:283:LEU:HD23	1.96	0.48
1:A:102:LEU:HD21	1:A:131:LEU:HD23	1.96	0.48
1:A:294:PRO:HB3	1:A:298:THR:HG21	1.95	0.48
1:A:334:TYR:CD1	1:A:357:MET:HB2	2.49	0.48
1:A:181:GLU:OE1	3:A:502:HOH:O	2.20	0.47
1:A:403:THR:O	1:A:407:VAL:HG23	2.16	0.46
1:A:376:LEU:HD22	1:A:384:GLU:HB3	1.98	0.46
1:A:139:GLU:O	1:A:142:LYS:HG2	2.16	0.46
1:A:402:LEU:O	1:A:406:ARG:HG2	2.16	0.46
1:A:177:LYS:HD3	1:A:178:LEU:HD23	1.97	0.45
1:A:418:GLU:N	1:A:419:GLU:OE1	2.50	0.44
1:A:269:ASP:OD1	1:A:273:LYS:NZ	2.50	0.44
1:A:399:PRO:HB2	1:A:404:TYR:CZ	2.52	0.44
1:A:172:LEU:HD21	1:A:201:LEU:HD23	1.98	0.44
1:A:136:LYS:CG	1:A:137:LEU:H	2.30	0.43
1:A:278:ASP:OD1	1:A:278:ASP:N	2.51	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:282:LYS:HD2	1:A:282:LYS:HA	1.78	0.43
1:A:194:TYR:HD1	1:A:213:LEU:HD21	1.84	0.43
1:A:281:LEU:HD23	1:A:281:LEU:HA	1.81	0.43
1:A:283:LEU:O	1:A:287:MET:HB2	2.19	0.43
1:A:149:GLU:OE1	3:A:504:HOH:O	2.22	0.43
1:A:316:LEU:HA	1:A:316:LEU:HD23	1.88	0.43
1:A:72:LYS:NZ	3:A:511:HOH:O	2.42	0.43
1:A:267:LEU:HA	1:A:267:LEU:HD23	1.87	0.42
1:A:207:LEU:O	1:A:211:LEU:HG	2.19	0.42
1:A:108:LEU:HD23	1:A:108:LEU:HA	1.92	0.42
1:A:127:LEU:HD23	1:A:127:LEU:HA	1.82	0.42
1:A:308:LYS:HE3	3:A:508:HOH:O	2.20	0.42
1:A:381:LYS:HG2	1:A:381:LYS:H	1.65	0.41
1:A:44:ARG:HG2	1:A:47:VAL:HB	2.01	0.41
1:A:136:LYS:HE2	1:A:136:LYS:HB3	1.89	0.41
1:A:223:LYS:HB3	1:A:223:LYS:HE3	1.83	0.41
1:A:363:LYS:HE3	1:A:364:PRO:O	2.21	0.41
1:A:131:LEU:O	1:A:136:LYS:HA	2.21	0.41
1:A:390:GLU:O	1:A:394:GLU:HG3	2.20	0.41
1:A:62:CYS:HA	1:A:67:LEU:HD12	2.03	0.41
1:A:372:LEU:O	1:A:376:LEU:HD12	2.21	0.41
1:A:174:GLU:O	1:A:177:LYS:HB3	2.20	0.41
1:A:194:TYR:HD1	1:A:213:LEU:CD2	2.35	0.40
1:A:357:MET:HG3	1:A:362:ILE:HB	2.02	0.40
1:A:401:GLU:HG3	1:A:402:LEU:N	2.36	0.40
1:A:42:LEU:HD12	1:A:43:ARG:H	1.87	0.40
1:A:365:ASP:OD2	3:A:503:HOH:O	2.21	0.40
1:A:73:LEU:HA	1:A:73:LEU:HD23	1.92	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	352/460 (76%)	336 (96%)	16 (4%)	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	316/393 (80%)	292 (92%)	24 (8%)	13	25

All (24) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	42	LEU
1	A	43	ARG
1	A	44	ARG
1	A	51	VAL
1	A	86	VAL
1	A	118	LYS
1	A	136	LYS
1	A	137	LEU
1	A	142	LYS
1	A	145	GLU
1	A	177	LYS
1	A	180	GLU
1	A	242	LEU
1	A	250	GLU
1	A	277	LEU
1	A	308	LYS
1	A	313	ASP
1	A	353	LEU
1	A	376	LEU
1	A	388	LEU
1	A	390	GLU
1	A	403	THR
1	A	405	ARG

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Mol	Chain	Res	Type
1	A	411	TYR

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

### 5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	10/18 (55%)	1 (10%)	0

All (1) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	10	C

There are no RNA pucker outliers to report.

## 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 ⓘ

There are no ligands in this entry.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	368/460 (80%)	0.38	27 (7%) 15 15	29, 52, 85, 106	0
2	B	11/18 (61%)	-0.66	0 100 100	34, 42, 74, 89	0
All	All	379/478 (79%)	0.35	27 (7%) 16 16	29, 52, 86, 106	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	412	CYS	7.8
1	A	388	LEU	6.6
1	A	408	VAL	5.1
1	A	382	LEU	4.9
1	A	386	LEU	4.9
1	A	402	LEU	4.1
1	A	410	SER	3.9
1	A	418	GLU	3.7
1	A	404	TYR	3.7
1	A	393	VAL	3.5
1	A	406	ARG	3.4
1	A	413	ARG	3.1
1	A	223	LYS	2.8
1	A	387	LYS	2.8
1	A	411	TYR	2.8
1	A	292	ILE	2.7
1	A	383	ASP	2.7
1	A	405	ARG	2.4
1	A	385	ALA	2.4
1	A	384	GLU	2.4
1	A	391	GLU	2.4
1	A	347	LEU	2.3
1	A	258	LYS	2.2
1	A	326	GLY	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	327	ILE	2.2
1	A	392	MET	2.0
1	A	419	GLU	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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.