



wwPDB NMR Structure Validation Summary Report ⓘ

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PDB ID : 2LWD / pdb_00002lwd
BMRB ID : 18622
Title : Solution structure of second CARD of human RIG-I
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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
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
wwPDB-RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
wwPDB-ShiftChecker : v1.2
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

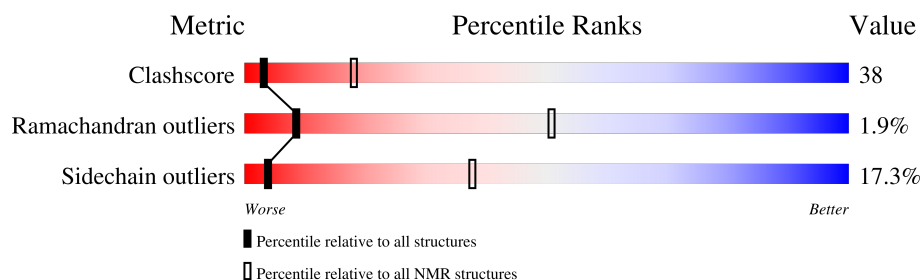
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 85%.

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)	NMR archive (#Entries)
Clashscore	229148	14424
Ramachandran outliers	224038	12848
Sidechain outliers	223484	12823

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	100	

2 Ensemble composition and analysis

This entry contains 20 models. Model 9 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	Residue range (total)	Backbone RMSD (Å)	Medoid model
1	A:98-A:188 (91)	0.24	9

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 3 clusters and 8 single-model clusters were found.

Cluster number	Models
1	4, 7, 11, 12, 14, 16, 18
2	3, 5, 17
3	1, 9
Single-model clusters	2; 6; 8; 10; 13; 15; 19; 20

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1473 atoms, of which 680 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Probable ATP-dependent RNA helicase DDX58.

Mol	Chain	Residues	Atoms						Trace
1	A	96	Total	C	H	N	O	S	0
			1473	506	680	132	149	6	

There are 4 discrepancies between the modelled and reference sequences:

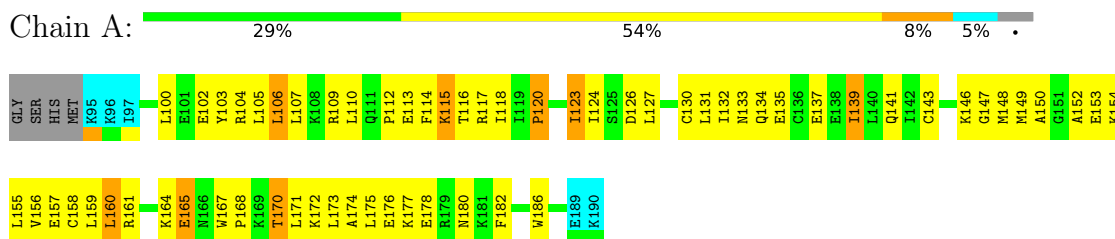
Chain	Residue	Modelled	Actual	Comment	Reference
A	91	GLY	-	expression tag	UNP O95786
A	92	SER	-	expression tag	UNP O95786
A	93	HIS	-	expression tag	UNP O95786
A	94	MET	-	expression tag	UNP O95786

4 Residue-property plots

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

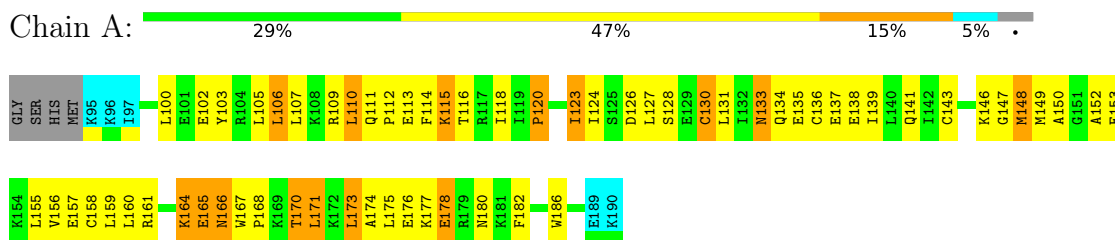
- Molecule 1: Probable ATP-dependent RNA helicase DDX58



4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 9. Colouring as in section 4.1 above.

- Molecule 1: Probable ATP-dependent RNA helicase DDX58



5 Refinement protocol and experimental data overview

The models were refined using the following method: *DGSA-distance geometry simulated annealing*.

Of the 2100 calculated structures, 20 were deposited, based on the following criterion: *structures with the least restraint violations*.

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
CNS	structure solution	1.2
CNS	refinement	1.2

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	1215
Number of shifts mapped to atoms	1103
Number of unparsed shifts	0
Number of shifts with mapping errors	112
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	85%

6 Model quality [i](#)

6.1 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 (average) 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	0.62±0.02	0±0/758 (0.0± 0.0%)	0.91±0.02	0±0/1018 (0.0± 0.0%)
All	All	0.62	0/15160 (0.0%)	0.91	1/20360 (0.0%)

There are no bond-length outliers.

All unique angle outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	177	LYS	N-CA-CB	-5.07	102.72	110.07	2	1

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	748	639	784	58±5
All	All	14960	12780	15680	1154

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 38.

5 of 271 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:130:CYS:SG	1:A:167:TRP:HB3	0.89	2.08	13	5

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:120:PRO:HB2	1:A:143:CYS:SG	0.89	2.07	19	17
1:A:107:LEU:HG	1:A:156:VAL:HG23	0.87	1.43	1	14
1:A:130:CYS:SG	1:A:166:ASN:HB3	0.84	2.13	19	4
1:A:155:LEU:HA	1:A:158:CYS:SG	0.84	2.12	19	4

6.3 Torsion angles [i](#)

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	91/100 (91%)	80±1 (88±2%)	9±1 (10±1%)	2±1 (2±1%)	8	51
All	All	1820/2000 (91%)	1607 (88%)	178 (10%)	35 (2%)	8	51

All 4 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	120	PRO	17
1	A	165	GLU	11
1	A	110	LEU	5
1	A	112	PRO	2

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	86/94 (91%)	71±2 (83±2%)	15±2 (17±2%)	4	38
All	All	1720/1880 (91%)	1423 (83%)	297 (17%)	4	38

5 of 39 unique residues with a non-rotameric sidechain are listed below. They are sorted by the

frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	106	LEU	20
1	A	115	LYS	20
1	A	123	ILE	20
1	A	124	ILE	20
1	A	148	MET	17

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

6.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.6 Ligand geometry [i](#)

There are no ligands in this entry.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 85% for the well-defined parts and 85% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

Chemical shift list name: *assigned_chem_shift_list_1*

7.1.1 Bookkeeping

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	1215
Number of shifts mapped to atoms	1103
Number of unparsed shifts	0
Number of shifts with mapping errors	112
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	2

The following assigned chemical shifts were not mapped to the molecules present in the coordinate file.

- No matching atom found in the structure. First 5 (of 112) occurrences are reported below.

List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	93	HIS	HA	4.654	0.03	1
1	A	93	HIS	HB2	3.12	0.03	2
1	A	93	HIS	HB3	3.201	0.03	2
1	A	93	HIS	HD2	7.1936	0.03	1
1	A	93	HIS	HE1	8.2733	0.03	1
1	A	93	HIS	C	175.1346	0.09	1
1	A	93	HIS	CA	56.4113	0.40	1
1	A	93	HIS	CB	30.1458	0.40	1
1	A	93	HIS	CD2	119.859	0.32	1
1	A	93	HIS	CE1	137.2654	0.32	1
1	A	94	MET	H	8.3202	0.01	1
1	A	94	MET	HA	4.403	0.03	1
1	A	94	MET	HB2	2.016	0.03	2
1	A	94	MET	HG2	2.516	0.03	2

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List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	94	MET	HG3	2.46	0.03	2
1	A	94	MET	C	176.2231	0.09	1
1	A	94	MET	CA	55.7959	0.40	1
1	A	94	MET	CB	32.9724	0.40	1
1	A	94	MET	CG	31.954	0.32	1
1	A	94	MET	N	121.5315	0.05	1
1	A	95	LYS	HD2	1.066	0.03	2
1	A	96	LYS	HD2	1.697	0.03	2
1	A	96	LYS	HG2	1.382	0.03	2
1	A	97	ILE	HG12	1.515	0.03	2
1	A	99	LYS	HG2	1.42	0.03	2
1	A	100	LEU	HB2	1.777	0.03	2
1	A	101	GLU	HB2	2.094	0.03	2
1	A	102	GLU	HB2	1.699	0.03	2
1	A	102	GLU	HG2	1.878	0.03	2
1	A	103	TYR	HB2	2.613	0.03	2
1	A	104	ARG	HB2	2.018	0.03	2
1	A	105	LEU	HB2	1.557	0.03	2
1	A	106	LEU	HB2	1.6	0.03	2
1	A	107	LEU	HB2	2.095	0.03	2
1	A	108	LYS	HG2	1.641	0.03	2
1	A	109	ARG	HB2	2.31	0.03	2
1	A	109	ARG	HD2	3.43	0.03	2
1	A	112	PRO	HB2	1.916	0.03	2
1	A	112	PRO	HG2	2.2	0.03	2
1	A	113	GLU	HB2	2.065	0.03	2
1	A	113	GLU	HG2	2.291	0.03	2
1	A	114	PHE	HB2	2.454	0.03	2
1	A	115	LYS	HB2	1.782	0.03	2
1	A	115	LYS	HD2	1.67	0.03	2
1	A	117	ARG	HB2	1.584	0.03	2
1	A	117	ARG	HD2	3.03	0.03	2
1	A	117	ARG	HG2	1.592	0.03	2
1	A	118	ILE	HG12	-0.45	0.03	2
1	A	119	ILE	HG12	1.2	0.03	2
1	A	120	PRO	HD2	4.304	0.03	2
1	A	120	PRO	HG2	1.505	0.03	2
1	A	123	ILE	HG12	1.505	0.03	2
1	A	124	ILE	HG12	1.37	0.03	2
1	A	126	ASP	HB2	2.667	0.03	2
1	A	127	LEU	HB2	1.714	0.03	2

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List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	129	GLU	HB2	2.0	0.03	2
1	A	130	CYS	HB2	2.915	0.03	2
1	A	131	LEU	HB2	1.436	0.03	2
1	A	133	ASN	HB2	2.776	0.03	2
1	A	135	GLU	HB2	2.08	0.03	2
1	A	135	GLU	HG2	2.25	0.03	2
1	A	136	CYS	HB2	2.71	0.03	2
1	A	137	GLU	HB2	2.208	0.03	2
1	A	138	GLU	HB2	2.018	0.03	2
1	A	138	GLU	HG2	2.124	0.03	2
1	A	140	LEU	HB2	1.475	0.03	2
1	A	141	GLN	HG2	2.34	0.03	2
1	A	142	ILE	HG12	1.068	0.03	2
1	A	143	CYS	HB2	2.858	0.03	2
1	A	146	LYS	HB2	1.748	0.03	2
1	A	146	LYS	HD2	1.522	0.03	2
1	A	146	LYS	HG2	1.23	0.03	2
1	A	148	MET	HB2	2.025	0.03	2
1	A	148	MET	HG2	2.85	0.03	2
1	A	149	MET	HB2	1.901	0.03	2
1	A	149	MET	HG2	2.591	0.03	2
1	A	153	GLU	HG2	2.09	0.03	2
1	A	154	LYS	HB2	1.85	0.03	2
1	A	154	LYS	HD2	1.563	0.03	2
1	A	154	LYS	HE2	2.53	0.03	2
1	A	155	LEU	HB2	1.802	0.03	2
1	A	157	GLU	HG2	2.084	0.03	2
1	A	158	CYS	HB2	2.68	0.03	2
1	A	159	LEU	HB2	-0.54	0.03	2
1	A	160	LEU	HB2	1.365	0.03	2
1	A	161	ARG	HB2	1.762	0.03	2
1	A	161	ARG	HG2	1.687	0.03	2
1	A	162	SER	HB2	3.694	0.03	2
1	A	163	ASP	HB2	2.743	0.03	2
1	A	164	LYS	HG2	1.581	0.03	2
1	A	165	GLU	HB2	2.093	0.03	2
1	A	166	ASN	HB2	2.807	0.03	2
1	A	167	TRP	HB2	3.631	0.03	2
1	A	168	PRO	HB2	0.88	0.03	2
1	A	168	PRO	HD2	2.23	0.03	2
1	A	171	LEU	HB2	1.494	0.03	2

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List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	172	LYS	HB2	2.074	0.03	2
1	A	172	LYS	HG2	1.61	0.03	2
1	A	173	LEU	HB2	1.616	0.03	2
1	A	175	LEU	HB2	1.45	0.03	2
1	A	176	GLU	HB2	2.312	0.03	2
1	A	176	GLU	HG2	2.112	0.03	2
1	A	177	LYS	HE2	3.123	0.03	2
1	A	178	GLU	HB2	1.857	0.03	2
1	A	178	GLU	HG2	2.393	0.03	2
1	A	179	ARG	HB2	1.912	0.03	2
1	A	182	PHE	HB2	2.717	0.03	2
1	A	185	LEU	HB2	1.107	0.03	2
1	A	186	TRP	HB2	2.726	0.03	2
1	A	187	ILE	HG12	1.04	0.03	2
1	A	189	GLU	HB2	1.847	0.03	2
1	A	190	LYS	HB2	1.652	0.03	2

7.1.2 Chemical shift referencing ⓘ

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	98	-0.74 ± 0.17	Should be checked
$^{13}\text{C}_\beta$	96	0.31 ± 0.17	None needed (< 0.5 ppm)
$^{13}\text{C}'$	94	-0.56 ± 0.09	Should be applied
^{15}N	94	0.63 ± 0.43	None needed (imprecise)

7.1.3 Completeness of resonance assignments ⓘ

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 85%, i.e. 1128 atoms were assigned a chemical shift out of a possible 1329. 0 out of 17 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	448/451 (99%)	181/181 (100%)	179/182 (98%)	88/88 (100%)
Sidechain	647/825 (78%)	425/533 (80%)	222/261 (85%)	0/31 (0%)
Aromatic	33/53 (62%)	18/26 (69%)	13/25 (52%)	2/2 (100%)
Overall	1128/1329 (85%)	624/740 (84%)	414/468 (88%)	90/121 (74%)

7.1.4 Statistically unusual chemical shifts [i](#)

The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	168	PRO	HG3	-0.58	0.33 – 3.48	-7.9
1	A	159	LEU	HB2	-0.54	-0.07 – 3.30	-6.4

7.1.5 Random Coil Index (RCI) plots [i](#)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition. If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:

