Full wwPDB NMR Structure Validation Report (i)

Feb 12, 2022 – 05:58 PM EST

PDB ID	:	1GHU
Title	:	NMR solution structure of growth factor receptor-bound protein 2 (GRB2) SH2 domain, 24 structures
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Deposited on	:	1996-08-05

This is a Full wwPDB NMR 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/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

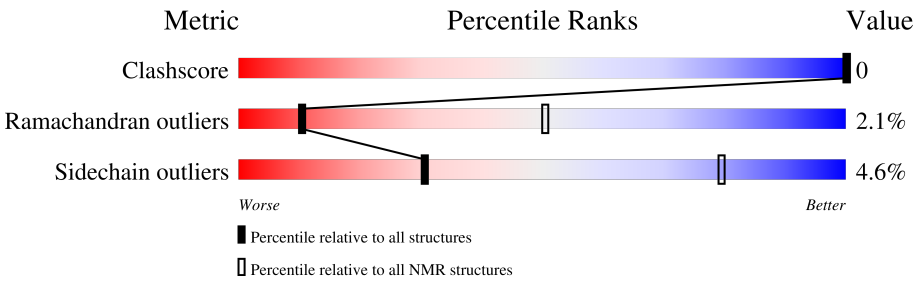
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.26
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.26

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
SOLUTION NMR

The overall completeness of chemical shifts assignment was not calculated.

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	158937	12864
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428

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 <=5%

Mol	Chain	Length	Quality of chain
1	A	107	75% 12% • 11%

2 Ensemble composition and analysis (i)

This entry contains 24 models. Model 24 is the overall representative, medoid model (most similar to other models).

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:60-A:152 (93)	0.54	24

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 4 clusters and 9 single-model clusters were found.

Cluster number	Models
1	2, 7, 9, 19, 24
2	4, 14, 15, 21
3	11, 12, 16, 22
4	13, 23
Single-model clusters	1; 3; 5; 6; 8; 10; 17; 18; 20

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 1538 atoms, of which 760 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called GRB2.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	95	1538	498	760	139	140	1	0

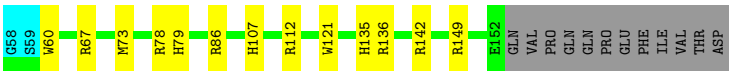
4 Residue-property plots (i)

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: GRB2

Chain A: 75% 12% • 11%



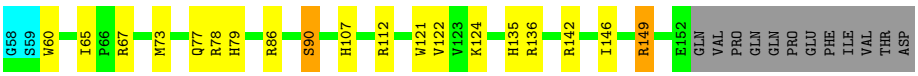
4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

• Molecule 1: GRB2

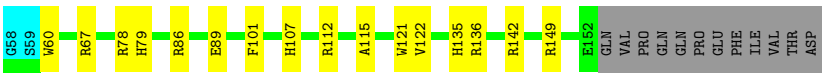
Chain A: 69% 16% • • 11%



4.2.2 Score per residue for model 2

• Molecule 1: GRB2

Chain A: 72% 15% • 11%



4.2.3 Score per residue for model 3

- Molecule 1: GRB2

Chain A: 70% 15% • • 11%

G58 S59 W60 R67 M73 R78 H79 R86 H107 L111 R112 L120 W121 K124 N129 H135 R136 V140 S141 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.4 Score per residue for model 4

- Molecule 1: GRB2

Chain A: 72% 13% • • 11%

G58 S59 W60 R67 M73 R78 H79 R86 H107 R112 K117 W121 H135 R136 V140 S141 R142 I146 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.5 Score per residue for model 5

- Molecule 1: GRB2

Chain A: 70% 17% • 11%

G58 S59 W60 R67 M73 K76 Q77 R78 H79 D80 R86 E89 K100 H107 R112 W121 V122 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.6 Score per residue for model 6

- Molecule 1: GRB2

Chain A: 72% 14% • • 11%

G58 S59 W60 G63 R67 R78 H79 F83 R86 F95 H107 R112 W121 K124 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.7 Score per residue for model 7

- Molecule 1: GRB2

Chain A: 72% 14% • • 11%

G58 S59 W60 R67 M73 R78 H79 R86 F95 H107 R112 L120 W121 K124 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.8 Score per residue for model 8

- Molecule 1: GRB2

Chain A: 71% 16% • 11%

G58 S59 W60 G63 R67 R78 H79 D80 R86 H107 R112 D113 G114 A115 G116 W121 V122 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.9 Score per residue for model 9

- Molecule 1: GRB2

Chain A: 70% 16% • • 11%

G58 S59 W60 R67 M73 R78 H79 R86 H107 R112 D113 G114 A115 G116 W121 H135 R136 R142 N143 F147 L148 R149 D150 I151 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.10 Score per residue for model 10

- Molecule 1: GRB2

Chain A: 72% 13% • • 11%

G58 S59 W60 G63 R67 R78 H79 R86 H107 L111 R112 W121 V122 N129 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.11 Score per residue for model 11

- Molecule 1: GRB2

Chain A: 74% 13% • 11%

G58 S59 W60 R67 R78 H79 R86 H107 R112 K117 W121 V122 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.12 Score per residue for model 12

- Molecule 1: GRB2

Chain A: 71% 15% • • 11%

G58 S59 W60 R67 M73 R78 H79 R86 S90 H107 R112 D113 G114 W121 V122 H135 R136 R142 N143 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.13 Score per residue for model 13

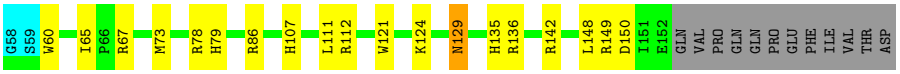
- Molecule 1: GRB2

Chain A: 71% 15% • • 11%

4.2.14 Score per residue for model 14

- Molecule 1: GRB2

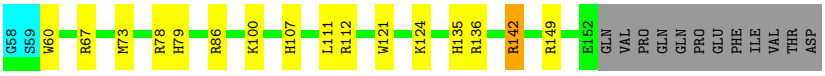
Chain A: 69% 17% • • 11%



4.2.15 Score per residue for model 15

- Molecule 1: GRB2

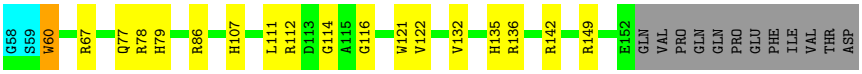
Chain A: 72% 14% • • 11%



4.2.16 Score per residue for model 16

- Molecule 1: GRB2

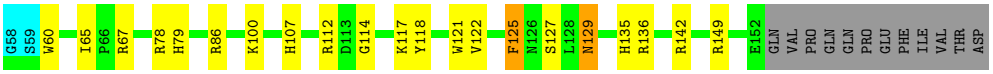
Chain A: 70% 16% • • 11%



4.2.17 Score per residue for model 17

- Molecule 1: GRB2

Chain A: 67% 18% • • 11%



4.2.18 Score per residue for model 18

- Molecule 1: GRB2

Chain A: 72% 12% • • 11%

G58 S59 W60 I65 P66 R67 M73 Q77 R78 H79 R86 H107 R112 W121 K124 R136 R142 I146 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.19 Score per residue for model 19

- Molecule 1: GRB2

Chain A: 70% 17% • 11%

G58 S59 W60 R67 R78 H79 R86 F95 H107 R112 A115 W121 K124 E130 H135 R136 R142 N143 Q144 Q145 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.20 Score per residue for model 20

- Molecule 1: GRB2

Chain A: 71% 14% • • 11%

G58 S59 W60 I65 P66 R67 Q77 R78 H79 R86 F101 H107 R112 W121 V122 V123 K124 N129 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.21 Score per residue for model 21

- Molecule 1: GRB2

Chain A: 70% 16% • • 11%

G58 S59 W60 R67 M73 L74 Q77 R78 H79 R86 E87 H107 R112 W121 V122 V123 K124 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.22 Score per residue for model 22

- Molecule 1: GRB2

Chain A: 70% 17% • 11%

G58 S59 W60 I65 P66 R67 R78 H79 R86 S90 H107 F108 K109 V110 L111 R112 A115 L120 W121 H135 R136 R142 R149 E152 GLN VAL PRO GLN GLN PRO GLU PHE ILE VAL THR ASP

4.2.23 Score per residue for model 23

- Molecule 1: GRB2

Chain A: 72% 13% • • 11%

4.2.24 Score per residue for model 24 (medoid)

- Molecule 1: GRB2

Chain A: 73% 13% • • 11%

5 Refinement protocol and experimental data overview (i)

Of the ? calculated structures, 24 were deposited, based on the following criterion: *?*.

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

Software name	Classification	Version
DGII	refinement	

No chemical shift data was provided.

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	1.10±0.00	0±0/787 (0.0± 0.0%)	1.36±0.02	13±1/1056 (1.2± 0.1%)
All	All	1.10	0/18888 (0.0%)	1.36	306/25344 (1.2%)

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	Planarity
1	A	0.0±0.0	0.0±0.2
All	All	0	1

There are no bond-length outliers.

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	86	ARG	NE-CZ-NH1	8.73	124.66	120.30	18	24
1	A	127	SER	N-CA-CB	-8.44	97.84	110.50	17	1
1	A	78	ARG	NE-CZ-NH1	8.06	124.33	120.30	18	24
1	A	149	ARG	NE-CZ-NH1	8.01	124.31	120.30	11	24
1	A	112	ARG	NE-CZ-NH1	7.96	124.28	120.30	17	24
1	A	136	ARG	NE-CZ-NH1	7.92	124.26	120.30	10	24
1	A	142	ARG	NE-CZ-NH1	7.78	124.19	120.30	3	24
1	A	67	ARG	NE-CZ-NH1	7.70	124.15	120.30	10	24
1	A	101	PHE	CB-CG-CD2	-6.54	116.22	120.80	2	2
1	A	86	ARG	NE-CZ-NH2	-6.46	117.07	120.30	18	1
1	A	125	PHE	CB-CG-CD2	-5.99	116.61	120.80	17	1
1	A	125	PHE	CB-CG-CD1	5.94	124.95	120.80	17	1
1	A	60	TRP	CD1-NE1-CE2	-5.93	103.66	109.00	6	24
1	A	101	PHE	CB-CG-CD1	5.85	124.89	120.80	2	2
1	A	129	ASN	N-CA-CB	5.75	120.95	110.60	10	3

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	121	TRP	CD1-NE1-CE2	-5.73	103.84	109.00	13	24
1	A	90	SER	N-CA-CB	5.68	119.03	110.50	1	1
1	A	107	HIS	CG-ND1-CE1	-5.48	98.57	105.70	19	24
1	A	135	HIS	CG-ND1-CE1	-5.48	98.57	105.70	19	22
1	A	79	HIS	CG-ND1-CE1	-5.42	98.66	105.70	1	24
1	A	95	PHE	CB-CG-CD2	-5.35	117.06	120.80	7	4
1	A	147	PHE	CB-CG-CD2	-5.17	117.18	120.80	9	1
1	A	136	ARG	NE-CZ-NH2	-5.12	117.74	120.30	9	3

There are no chirality outliers.

All unique planar outliers are listed below.

Mol	Chain	Res	Type	Group	Models (Total)
1	A	83	PHE	Sidechain	1

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
All	All	18432	18024	18024	-

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 -.

There are no clashes.

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	92/107 (86%)	81±2 (88±2%)	9±2 (10±3%)	2±1 (2±1%)	10 50
All	All	2208/2568 (86%)	1943 (88%)	218 (10%)	47 (2%)	10 50

All 12 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	122	VAL	12
1	A	129	ASN	5
1	A	114	GLY	5
1	A	115	ALA	4
1	A	142	ARG	4
1	A	143	ASN	4
1	A	90	SER	3
1	A	63	GLY	3
1	A	116	GLY	3
1	A	60	TRP	2
1	A	89	GLU	1
1	A	121	TRP	1

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	82/95 (86%)	78±2 (95±2%)	4±2 (5±2%)	31 79
All	All	1968/2280 (86%)	1878 (95%)	90 (5%)	31 79

All 28 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	73	MET	13
1	A	124	LYS	11
1	A	65	ILE	7
1	A	111	LEU	6
1	A	78	ARG	6
1	A	77	GLN	5

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Mol	Chain	Res	Type	Models (Total)
1	A	136	ARG	5
1	A	120	LEU	4
1	A	117	LYS	4
1	A	146	ILE	3
1	A	80	ASP	3
1	A	100	LYS	3
1	A	149	ARG	2
1	A	140	VAL	2
1	A	142	ARG	2
1	A	151	ILE	2
1	A	89	GLU	1
1	A	76	LYS	1
1	A	148	LEU	1
1	A	150	ASP	1
1	A	132	VAL	1
1	A	118	TYR	1
1	A	125	PHE	1
1	A	130	GLU	1
1	A	145	GLN	1
1	A	74	LEU	1
1	A	87	GLU	1
1	A	109	LYS	1

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 monosaccharides 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 (i)

No chemical shift data were provided