wwPDB NMR Structure Validation Summary Report (i)

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PDB ID	:	1CF4
Title	:	CDC42/ACK GTPASE-BINDING DOMAIN COMPLEX
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This is a wwPDB NMR Structure Validation Summary 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/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:

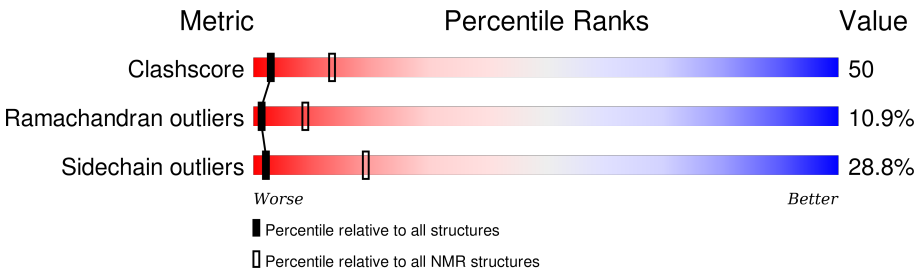
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	1.7.1 (RC1), CSD as537be (2016)
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	rb-20027457
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20027457

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 is 63%.

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	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

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	184	28% 58% 13% •
2	B	44	20% 70% 9%

2 Ensemble composition and analysis (i)

This entry contains 20 models. Model 19 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:1-A:184, B:502-B:545 (228)	0.85	19

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. No single-model clusters were found.

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

3 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 3602 atoms, of which 1789 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called PROTEIN (CDC42 HOMOLOG).

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	184	2899	926	1463	228	275	7	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	61	LEU	GLN	CONFLICT	UNP P60953
A	?	-	LYS	DELETION	UNP P60953
A	?	-	LYS	DELETION	UNP P60953
A	?	-	SER	DELETION	UNP P60953
A	?	-	ARG	DELETION	UNP P60953
A	?	-	ARG	DELETION	UNP P60953
A	?	-	CYS	DELETION	UNP P60953
A	?	-	VAL	DELETION	UNP P60953

- Molecule 2 is a protein called PROTEIN (ACTIVATED P21CDC42HS KINASE).

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
2	B	44	651	210	309	62	69	1	0

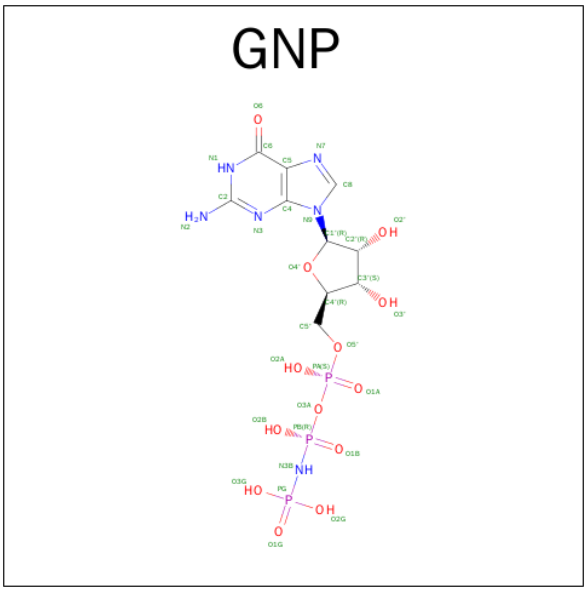
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	502	GLY	VAL	CONFLICT	UNP Q07912
B	503	SER	ALA	CONFLICT	UNP Q07912

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

Mol	Chain	Residues	Atoms	
			Total	Mg
3	A	1	1	1

- Molecule 4 is PHOSPHOAMINOPHOSPHONIC ACID-GUANYLATE ESTER (three-letter code: GNP) (formula: $C_{10}H_{17}N_6O_{13}P_3$).



Mol	Chain	Residues	Atoms					
			Total	C	H	N	O	P
4	A	1	45	10	13	6	13	3

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		
			Total	H	O
5	A	2	6	4	2

4 Residue-property plots (i)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA 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: PROTEIN (CDC42 HOMOLOG)

Chain A: 28% 58% 13%

- Molecule 2: PROTEIN (ACTIVATED P21CDC42HS KINASE)

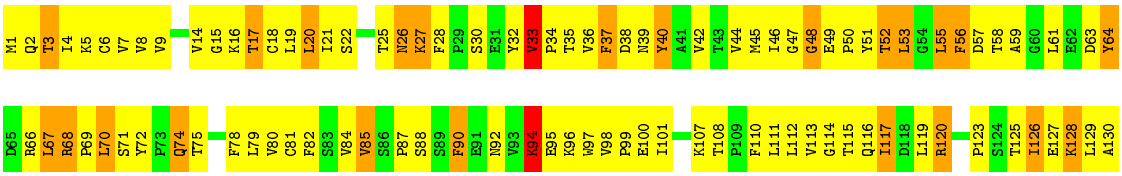
Chain B: 20% 70% 9%

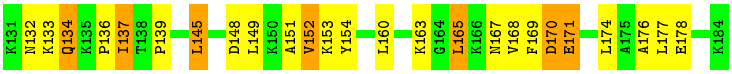
4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 19. Colouring as in section 4.1 above.

- Molecule 1: PROTEIN (CDC42 HOMOLOG)

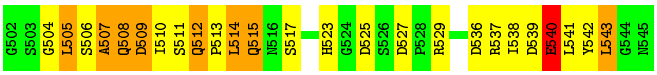
Chain A: 33% 49% 16%





• Molecule 2: PROTEIN (ACTIVATED P21CDC42HS KINASE)

Chain B:



5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *DISTANCE GEOMETRY, SIMULATED ANNEALING*.

Of the 100 calculated structures, 20 were deposited, based on the following criterion: *LOWEST ENERGY*.

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

Software name	Classification	Version
X-PLOR	refinement	3.851
ANSIG	structure solution	
XPLOR	structure solution	

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)	BMRB entry 4700
Number of chemical shift lists	2
Total number of shifts	2515
Number of shifts mapped to atoms	1988
Number of unparsed shifts	0
Number of shifts with mapping errors	527
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	63%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality (i)

6.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: GNP, MG

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

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	1436	1463	1461	166±12
2	B	342	309	303	38±8
4	A	32	13	13	12±3
5	A	2	4	0	0±0
All	All	36260	35780	35540	3580

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 50.

5 of 1850 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:44:VAL:HG13	1:A:52:THR:HG21	1.03	1.26	12	1
1:A:113:VAL:HG13	1:A:168:VAL:HG21	1.01	1.33	20	12
1:A:8:VAL:HG11	1:A:14:VAL:HG13	1.01	1.20	3	1
1:A:44:VAL:HG22	1:A:52:THR:HG23	1.00	1.30	19	2
1:A:14:VAL:HG23	1:A:19:LEU:HD21	1.00	1.27	4	1

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	182/184 (99%)	127±4 (70±2%)	40±5 (22±3%)	16±3 (9±2%)	2 13
2	B	42/44 (95%)	19±2 (45±5%)	15±2 (35±6%)	9±2 (21±5%)	0 2
All	All	4480/4560 (98%)	2907 (65%)	1086 (24%)	487 (11%)	1 9

5 of 96 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	152	VAL	20
1	A	134	GLN	18
1	A	47	GLY	18
1	A	50	PRO	17
1	A	33	VAL	17

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	164/164 (100%)	118±5 (72±3%)	46±5 (28±3%)	2 20
2	B	37/37 (100%)	25±3 (68±9%)	12±3 (32±9%)	1 14
All	All	4020/4020 (100%)	2861 (71%)	1159 (29%)	2 19

5 of 168 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	126	ILE	20
1	A	117	ILE	20

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Mol	Chain	Res	Type	Models (Total)
1	A	70	LEU	19
1	A	167	ASN	17
1	A	88	SER	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 carbohydrates in this entry.

6.6 Ligand geometry (i)

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

In the following table, the Counts columns list the number of bonds for which Mogul statistics could be retrieved, the number of bonds that are observed in the model and the number of bonds 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 is the number of standard deviations the observed value is removed from the expected value. A bond length with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond lengths.

Mol	Type	Chain	Res	Link	Bond lengths		
					Counts	RMSZ	#Z>2
4	GNP	A	185	3	29,34,34	1.65±0.01	0±0 (0±0%)

In the following table, the Counts columns list the number of angles for which Mogul statistics could be retrieved, the number of angles that are observed in the model and the number of 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 angle is the number of standard deviations the observed value is removed from the expected value. A bond angle with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond angles.

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
4	GNP	A	185	3	26,54,54	1.37±0.01	0±0 (0±0%)

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
4	GNP	A	185	3	-	0±0,13,38,38	0±0,3,3,3

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

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

Mol	Chain	Res	Type	Atoms	Models (Total)
4	A	185	GNP	O1G-PG-N3B-PB	3
4	A	185	GNP	O1B-PB-N3B-PG	2

There are no ring outliers.

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)

The completeness of assignment taking into account all chemical shift lists is 63% for the well-defined parts and 63% for the entire structure.

7.1 Chemical shift list 1

File name: BMRB entry 4700

Chemical shift list name: *assigned_ chem_ shift_ list_ 1*

7.1.1 Bookkeeping (i)

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	1988
Number of shifts mapped to atoms	1988
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	3

7.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	184	-0.23 ± 0.14	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	150	0.53 ± 0.13	Should be applied
$^{13}C'$	0	—	—
^{15}N	165	2.23 ± 0.49	Should be applied

7.1.3 Completeness of resonance assignments (i)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 63%, i.e. 1729 atoms were assigned a chemical shift out of a possible 2752. 0 out of 40 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	689/1104 (62%)	340/438 (78%)	184/456 (40%)	165/210 (79%)
Sidechain	927/1430 (65%)	585/839 (70%)	333/541 (62%)	9/50 (18%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	113/218 (52%)	66/114 (58%)	46/92 (50%)	1/12 (8%)
Overall	1729/2752 (63%)	991/1391 (71%)	563/1089 (52%)	175/272 (64%)

7.1.4 Statistically unusual chemical shifts (i)

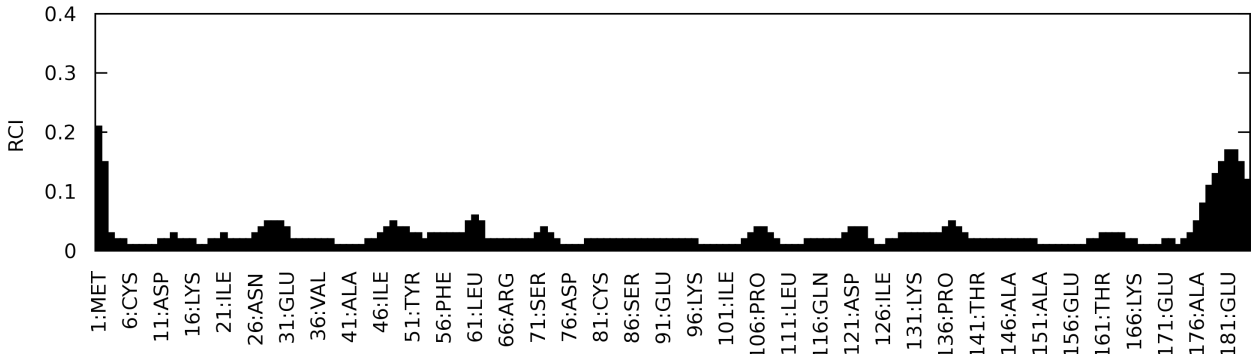
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	92	ASN	HD22	10.33	9.59 – 4.69	6.5
1	A	10	GLY	HA3	1.71	5.80 – 2.00	-5.8
1	A	63	ASP	HB3	1.16	4.07 – 1.27	-5.4

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.

Random coil index (RCI) for chain A:



7.2 Chemical shift list 2

File name: BMRB entry 4700

Chemical shift list name: *assigned_chem_shift_list_2*

7.2.1 Bookkeeping (i)

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	527
Number of shifts mapped to atoms	0
Number of unparsed shifts	0
Number of shifts with mapping errors	527
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

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

- Chain not found in structure. First 5 (of 527) occurences are reported below.

Chain	Res	Type	Atom	Shift Data		
				Value	Uncertainty	Ambiguity
UNMAPPED	30	GLN	HE21	6.991	0.005	2
UNMAPPED	39	ASN	HA	4.798	0.012	1
UNMAPPED	42	LYS	HE2	3.048	0.018	1
UNMAPPED	27	MET	HG2	2.593	0.017	2
UNMAPPED	42	LYS	HD3	1.729	0.018	1

7.2.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	46	0.00 ± 0.00	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	42	0.00 ± 0.00	None needed (< 0.5 ppm)
$^{13}C'$	0	—	—
^{15}N	43	0.00 ± 0.00	None needed (< 0.5 ppm)

7.2.3 Completeness of resonance assignments (i)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 0%, i.e. 0 atoms were assigned a chemical shift out of a possible 2752. 0 out of 40 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	0/1104 (0%)	0/438 (0%)	0/456 (0%)	0/210 (0%)

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	Total	^{1}H	^{13}C	^{15}N
Sidechain	0/1430 (0%)	0/839 (0%)	0/541 (0%)	0/50 (0%)
Aromatic	0/218 (0%)	0/114 (0%)	0/92 (0%)	0/12 (0%)
Overall	0/2752 (0%)	0/1391 (0%)	0/1089 (0%)	0/272 (0%)

7.2.4 Statistically unusual chemical shifts (i)

There are no statistically unusual chemical shifts.

7.2.5 Random Coil Index (RCI) plots (i)

No *random coil index* (RCI) plot could be generated from the current chemical shift list (assigned_chem_shift_list_2). RCI is only applicable to proteins.