Full wwPDB NMR Structure Validation Report (i)

May 28, 2020 – 11:35 pm BST

PDB ID	:	2M2D
Title	:	Human programmed cell death 1 receptor
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Deposited on	:	2012-12-18

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 (1)) were used in the production of this report:

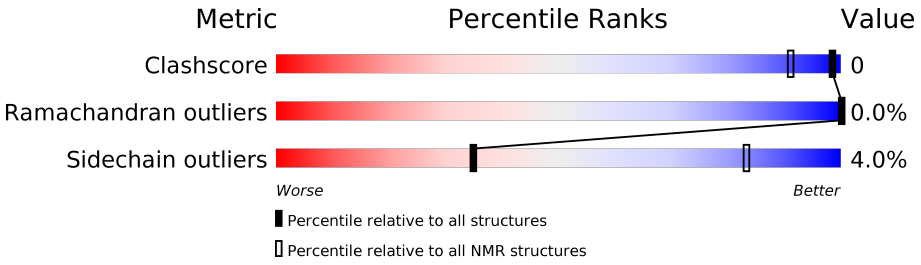
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.11
Ideal geometry (proteins)	:	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:
SOLUTION NMR

The overall completeness of chemical shifts assignment is 84%.

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	118	79% · 19%

2 Ensemble composition and analysis

This entry contains 35 models. Model 31 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *closest to the average*.

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:36-A:56, A:63-A:83, A:94-A:147 (96)	0.36	31

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 3 single-model clusters were found.

Cluster number	Models
1	1, 2, 3, 5, 8, 9, 10, 11, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35
2	7, 14, 33
3	4, 6
Single-model clusters	12; 18; 22

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1834 atoms, of which 905 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Programmed cell death protein 1.

Mol	Chain	Residues	Atoms						Trace
1	A	118	Total	C	H	N	O	S	0
			1834	573	905	171	180	5	

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	33	MET	-	EXPRESSION TAG	UNP Q15116
A	93	SER	CYS	CONFLICT	UNP Q15116

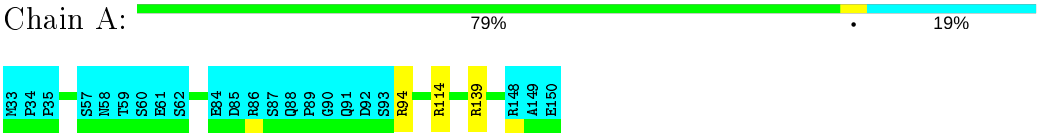
4 Residue-property plots

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: Programmed cell death protein 1

Chain A:



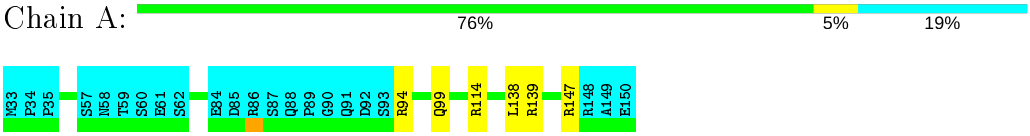
4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

• Molecule 1: Programmed cell death protein 1

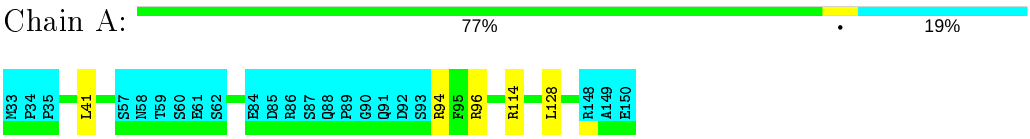
Chain A:



4.2.2 Score per residue for model 2

• Molecule 1: Programmed cell death protein 1

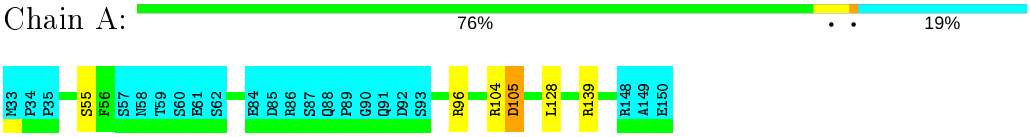
Chain A:



4.2.3 Score per residue for model 3

• Molecule 1: Programmed cell death protein 1

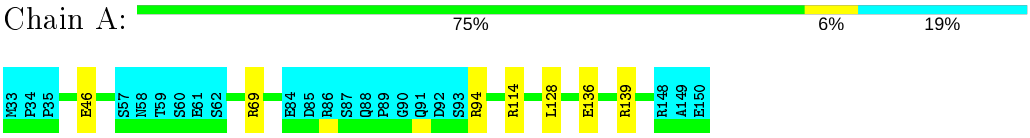
Chain A:



4.2.4 Score per residue for model 4

• Molecule 1: Programmed cell death protein 1

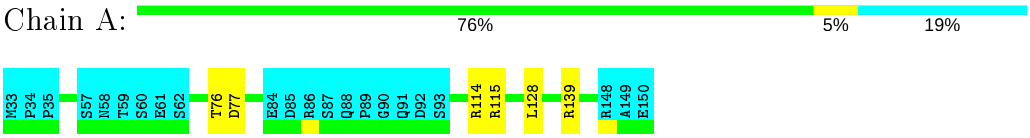
Chain A:



4.2.5 Score per residue for model 5

• Molecule 1: Programmed cell death protein 1

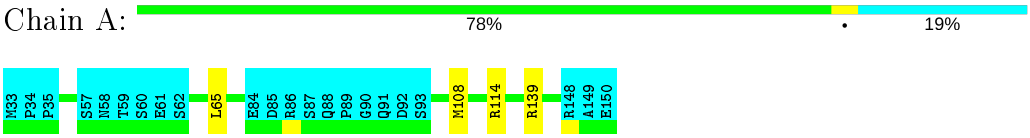
Chain A:



4.2.6 Score per residue for model 6

• Molecule 1: Programmed cell death protein 1

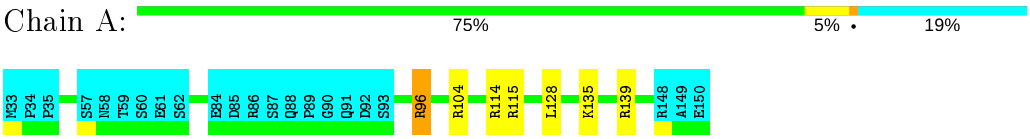
Chain A:



4.2.7 Score per residue for model 7

• Molecule 1: Programmed cell death protein 1

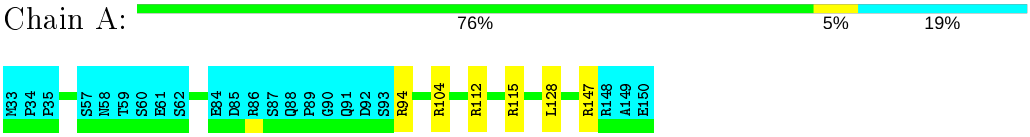
Chain A:



4.2.8 Score per residue for model 8

• Molecule 1: Programmed cell death protein 1

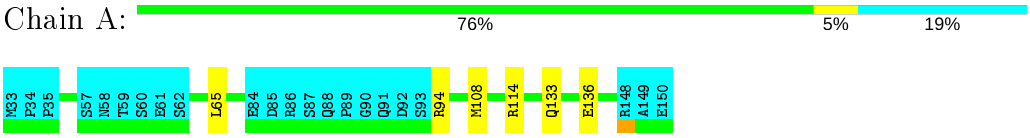
Chain A:



4.2.9 Score per residue for model 9

• Molecule 1: Programmed cell death protein 1

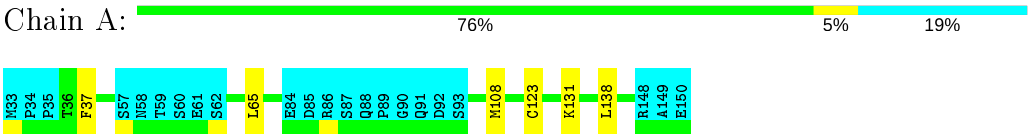
Chain A:



4.2.10 Score per residue for model 10

• Molecule 1: Programmed cell death protein 1

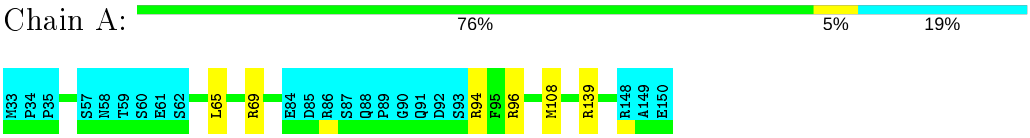
Chain A:



4.2.11 Score per residue for model 11

• Molecule 1: Programmed cell death protein 1

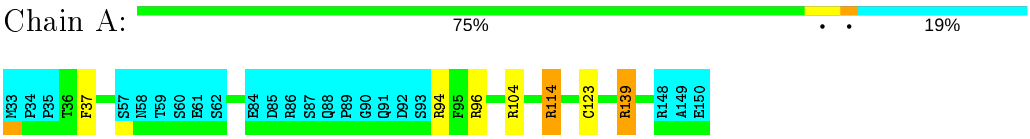
Chain A:



4.2.12 Score per residue for model 12

• Molecule 1: Programmed cell death protein 1

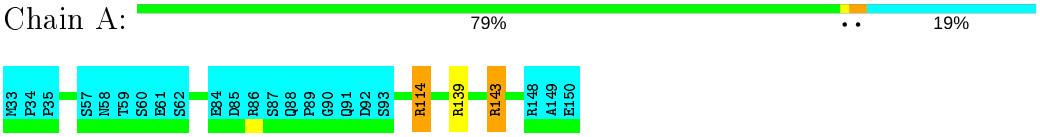
Chain A:



4.2.13 Score per residue for model 13

• Molecule 1: Programmed cell death protein 1

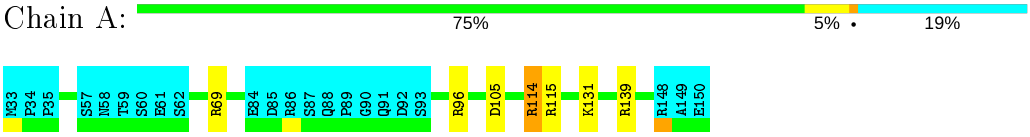
Chain A:



4.2.14 Score per residue for model 14

• Molecule 1: Programmed cell death protein 1

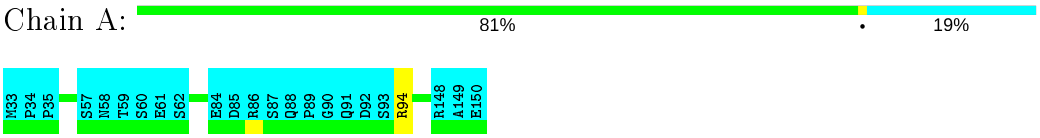
Chain A:



4.2.15 Score per residue for model 15

• Molecule 1: Programmed cell death protein 1

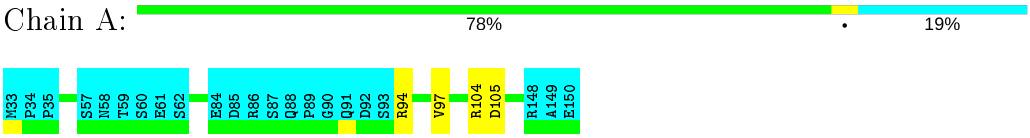
Chain A:



4.2.16 Score per residue for model 16

• Molecule 1: Programmed cell death protein 1

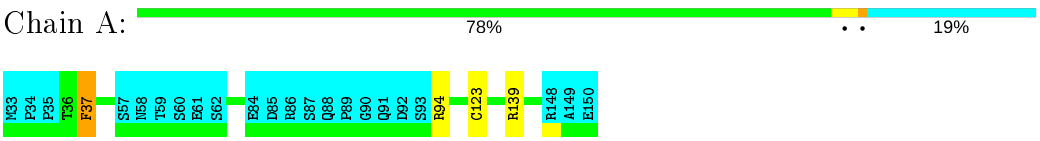
Chain A:



4.2.17 Score per residue for model 17

• Molecule 1: Programmed cell death protein 1

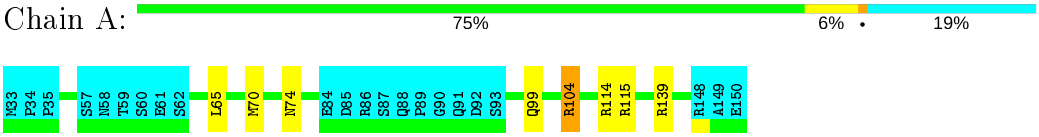
Chain A:



4.2.18 Score per residue for model 18

• Molecule 1: Programmed cell death protein 1

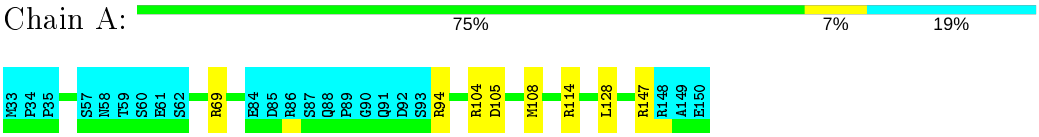
Chain A:



4.2.19 Score per residue for model 19

• Molecule 1: Programmed cell death protein 1

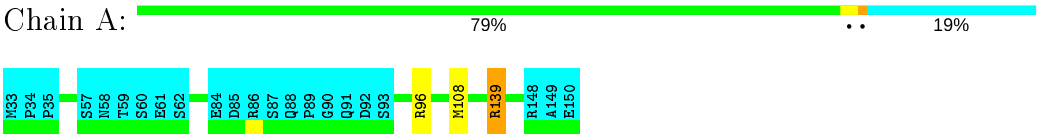
Chain A:



4.2.20 Score per residue for model 20

• Molecule 1: Programmed cell death protein 1

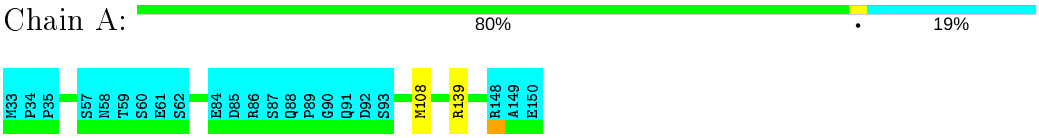
Chain A:



4.2.21 Score per residue for model 21

• Molecule 1: Programmed cell death protein 1

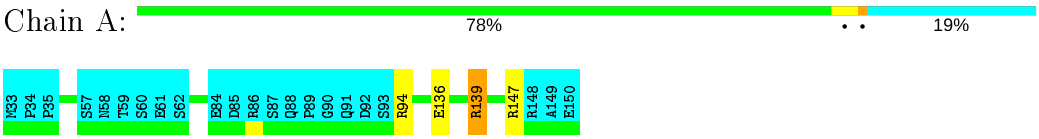
Chain A:



4.2.22 Score per residue for model 22

• Molecule 1: Programmed cell death protein 1

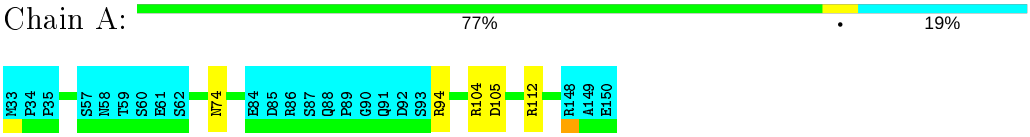
Chain A:



4.2.23 Score per residue for model 23

• Molecule 1: Programmed cell death protein 1

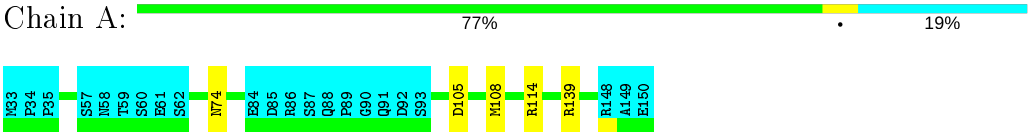
Chain A:



4.2.24 Score per residue for model 24

• Molecule 1: Programmed cell death protein 1

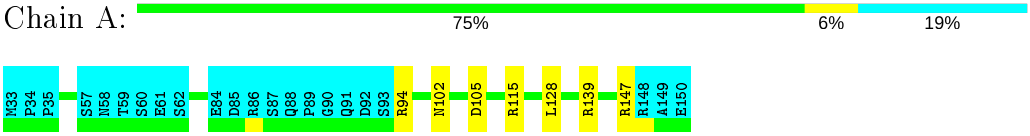
Chain A:



4.2.25 Score per residue for model 25

• Molecule 1: Programmed cell death protein 1

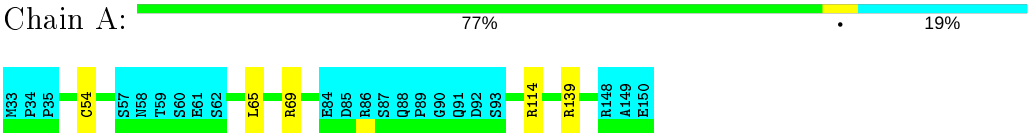
Chain A:



4.2.26 Score per residue for model 26

• Molecule 1: Programmed cell death protein 1

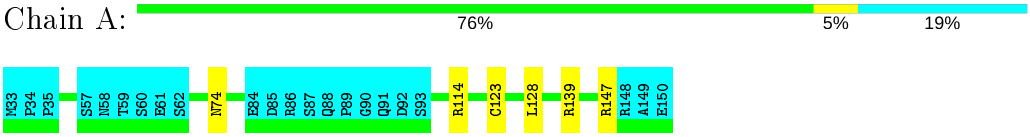
Chain A:



4.2.27 Score per residue for model 27

• Molecule 1: Programmed cell death protein 1

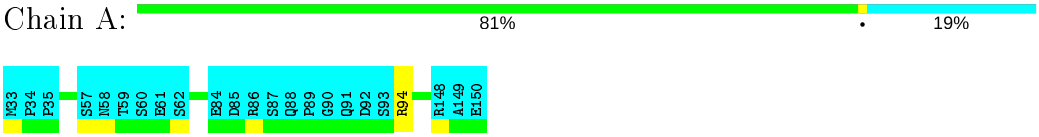
Chain A:



4.2.28 Score per residue for model 28

• Molecule 1: Programmed cell death protein 1

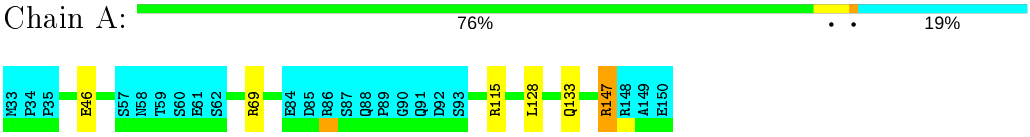
Chain A:



4.2.29 Score per residue for model 29

• Molecule 1: Programmed cell death protein 1

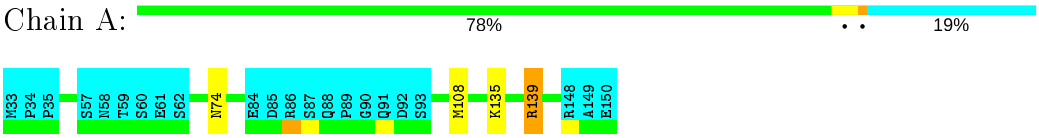
Chain A:



4.2.30 Score per residue for model 30

• Molecule 1: Programmed cell death protein 1

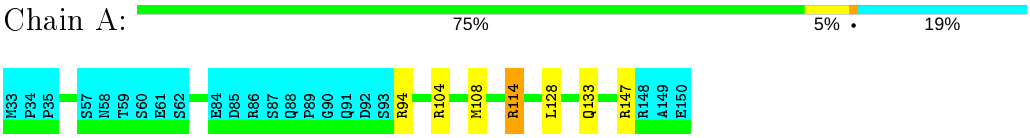
Chain A:



4.2.31 Score per residue for model 31 (medoid)

• Molecule 1: Programmed cell death protein 1

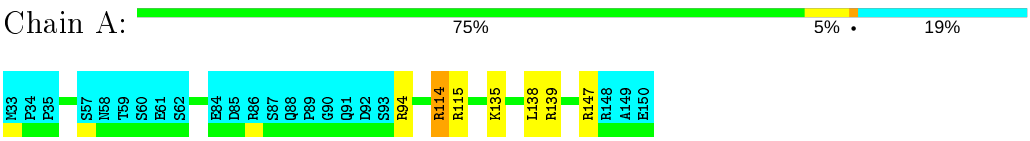
Chain A:



4.2.32 Score per residue for model 32

• Molecule 1: Programmed cell death protein 1

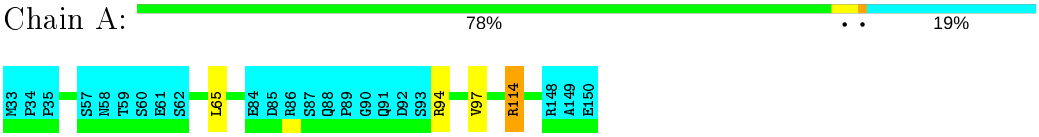
Chain A:



4.2.33 Score per residue for model 33

• Molecule 1: Programmed cell death protein 1

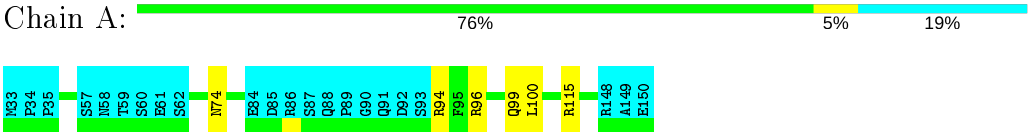
Chain A:



4.2.34 Score per residue for model 34

• Molecule 1: Programmed cell death protein 1

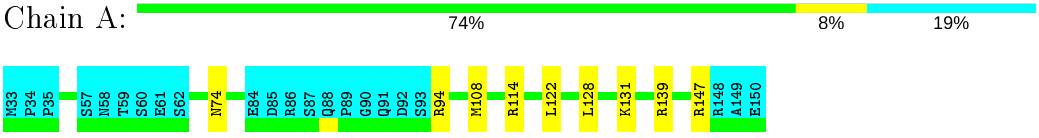
Chain A:



4.2.35 Score per residue for model 35

• Molecule 1: Programmed cell death protein 1

Chain A:



5 Refinement protocol and experimental data overview

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

Of the 100 calculated structures, 35 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
CYANA	structure solution	
AMBER	structure solution	
AMBER	refinement	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 6 of this report.

Chemical shift file(s)	input_cs.cif
Number of chemical shift lists	1
Total number of shifts	1346
Number of shifts mapped to atoms	1346
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	84%

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

COVALENT-GEOMETRY INFOmissingINFO

5.1 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 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	762	759	759	0±0
All	All	26670	26565	26565	3

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 0.

All unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:37:PHE:CE1	1:A:123:CYS:HB3	0.43	2.49	17	1
1:A:37:PHE:CD1	1:A:123:CYS:SG	0.41	3.13	10	1
1:A:65:LEU:HD11	1:A:108:MET:CE	0.41	2.45	11	1

5.2 Torsion angles (i)

5.2.1 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	96/118 (81%)	93±1 (97±1%)	3±1 (3±1%)	0±0 (0±0%)	100	100
All	All	3360/4130 (81%)	3255 (97%)	104 (3%)	1 (0%)	100	100

All 1 unique Ramachandran outliers are listed below.

Mol	Chain	Res	Type	Models (Total)
1	A	105	ASP	1

5.2.2 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	83/103 (81%)	80±1 (96±2%)	3±1 (4±2%)	35	83
All	All	2905/3605 (81%)	2789 (96%)	116 (4%)	35	83

All 30 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	139	ARG	18

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Mol	Chain	Res	Type	Models (Total)
1	A	128	LEU	12
1	A	114	ARG	11
1	A	108	MET	10
1	A	74	ASN	7
1	A	105	ASP	7
1	A	104	ARG	6
1	A	65	LEU	6
1	A	99	GLN	3
1	A	131	LYS	3
1	A	138	LEU	3
1	A	136	GLU	3
1	A	135	LYS	3
1	A	133	GLN	3
1	A	37	PHE	2
1	A	112	ARG	2
1	A	97	VAL	2
1	A	123	CYS	2
1	A	46	GLU	2
1	A	77	ASP	1
1	A	41	LEU	1
1	A	122	LEU	1
1	A	54	CYS	1
1	A	147	ARG	1
1	A	100	LEU	1
1	A	143	ARG	1
1	A	70	MET	1
1	A	76	THR	1
1	A	102	ASN	1
1	A	96	ARG	1

5.2.3 RNA

There are no RNA molecules in this entry.

5.3 Non-standard residues in protein, DNA, RNA chains

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

5.4 Carbohydrates

There are no carbohydrates in this entry.

5.5 Ligand geometry

There are no ligands in this entry.

5.6 Other polymers

There are no such molecules in this entry.

5.7 Polymer linkage issues

There are no chain breaks in this entry.

6 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 84% for the well-defined parts and 83% for the entire structure.

6.1 Chemical shift list 1

File name: input_cs.cif

Chemical shift list name: *assigned_chem_shift_list_1*

6.1.1 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	1346
Number of shifts mapped to atoms	1346
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

6.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	116	0.11 ± 0.10	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	111	-0.09 ± 0.17	None needed (< 0.5 ppm)
$^{13}C'$	109	0.43 ± 0.11	None needed (< 0.5 ppm)
^{15}N	109	-1.13 ± 0.23	Should be applied

6.1.3 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 84%, i.e. 1013 atoms were assigned a chemical shift out of a possible 1211. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	465/470 (99%)	187/187 (100%)	187/192 (97%)	91/91 (100%)
Sidechain	512/643 (80%)	317/379 (84%)	189/223 (85%)	6/41 (15%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	36/98 (37%)	35/53 (66%)	0/43 (0%)	1/2 (50%)
Overall	1013/1211 (84%)	539/619 (87%)	376/458 (82%)	98/134 (73%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 83%, i.e. 1210 atoms were assigned a chemical shift out of a possible 1463. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	559/574 (97%)	225/228 (99%)	225/236 (95%)	109/110 (99%)
Sidechain	615/791 (78%)	385/469 (82%)	221/272 (81%)	9/50 (18%)
Aromatic	36/98 (37%)	35/53 (66%)	0/43 (0%)	1/2 (50%)
Overall	1210/1463 (83%)	645/750 (86%)	446/551 (81%)	119/162 (73%)

6.1.4 Statistically unusual chemical shifts (i)

There are no statistically unusual chemical shifts.

6.1.5 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: