Full wwPDB NMR Structure Validation Report (i)

Oct 30, 2024 – 07:02 AM EDT

PDB ID	:	2L4K
Title	:	Water refined solution structure of the human Grb7-SH2 domain in complex with the 10 amino acid peptide pY1139
Authors	:	Pias, S.C.; Ivancic, M.; Brescia, P.J.; Johnson, D.L.; Smith, D.E.; Daly, R.J.; Lyons, B.A.
Deposited on	:	2010-10-07

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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

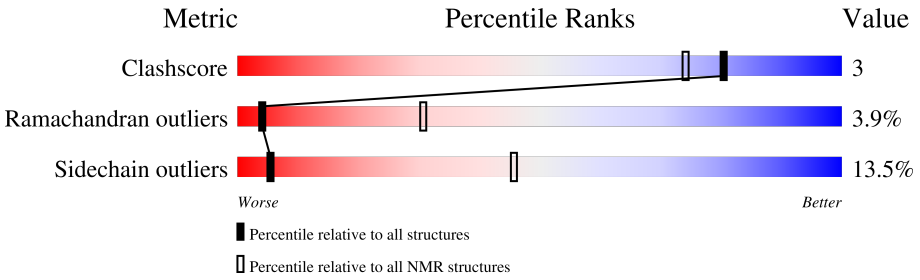
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

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	210492	14027
Ramachandran outliers	207382	12486
Sidechain outliers	206894	12463

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	120	68% 9% 5% • 18%
2	B	10	30% 20% 20% 30%

2 Ensemble composition and analysis

This entry contains 10 models. Model 2 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *best procheck statistics*.

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:19-A:117, B:1137-B:1138, B:1140-B:1144 (106)	1.24	2

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 2 clusters. No single-model clusters were found.

Cluster number	Models
1	2, 3, 4, 6, 9, 10
2	1, 5, 7, 8

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 2091 atoms, of which 1041 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Growth factor receptor-bound protein 7.

Mol	Chain	Residues	Atoms						Trace
1	A	120	Total	C	H	N	O	S	0
			1931	605	969	180	172	5	

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	expression tag	UNP Q14451
A	2	SER	-	expression tag	UNP Q14451

- Molecule 2 is a protein called Receptor tyrosine-protein kinase erbB-2.

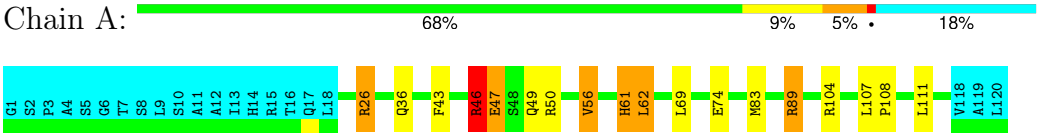
Mol	Chain	Residues	Atoms						Trace
2	B	10	Total	C	H	N	O	P	0
			160	52	72	13	22	1	

4 Residue-property plots

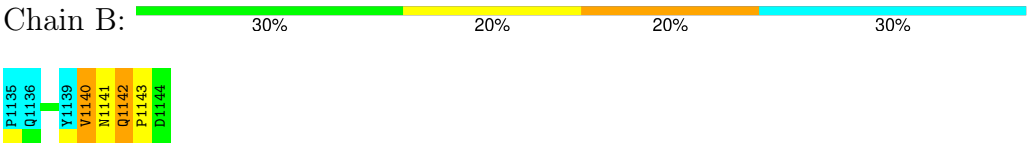
4.1 Average score per residue in the NMR ensemble

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: Growth factor receptor-bound protein 7



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

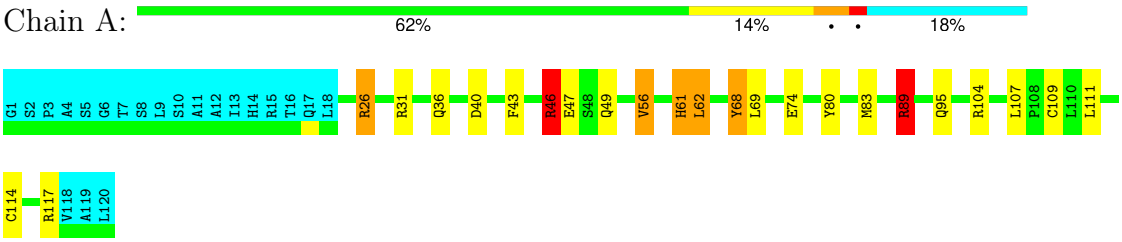


4.2 Scores per residue for each member of the ensemble

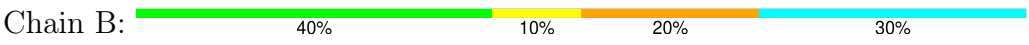
Colouring as in section 4.1 above.

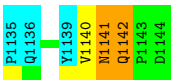
4.2.1 Score per residue for model 1

• Molecule 1: Growth factor receptor-bound protein 7



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

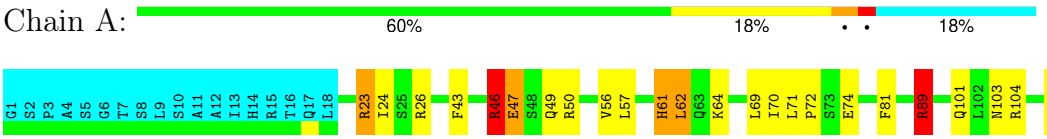




4.2.2 Score per residue for model 2 (medoid)

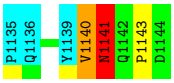
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

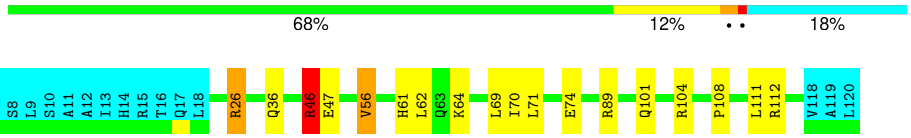
Chain B:



4.2.3 Score per residue for model 3

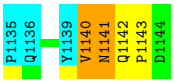
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

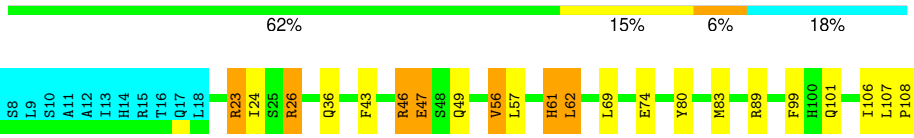
Chain B:



4.2.4 Score per residue for model 4

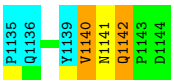
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

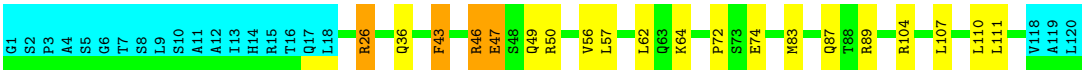
Chain B:



4.2.5 Score per residue for model 5

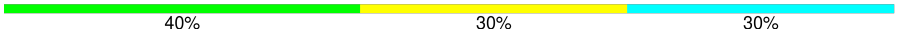
• Molecule 1: Growth factor receptor-bound protein 7

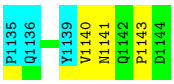
Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

Chain B:





4.2.6 Score per residue for model 6

• Molecule 1: Growth factor receptor-bound protein 7

Chain A:

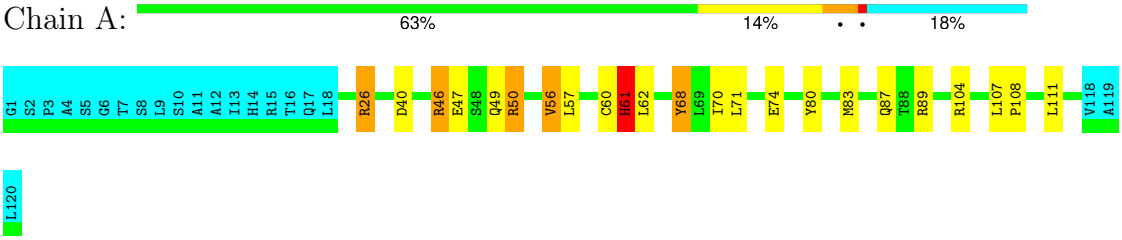
• Molecule 2: Receptor tyrosine-protein kinase erbB-2

Chain B:

4.2.7 Score per residue for model 7

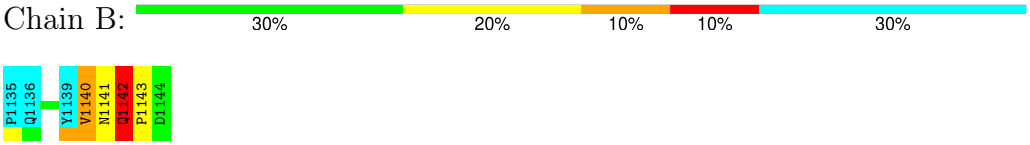
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

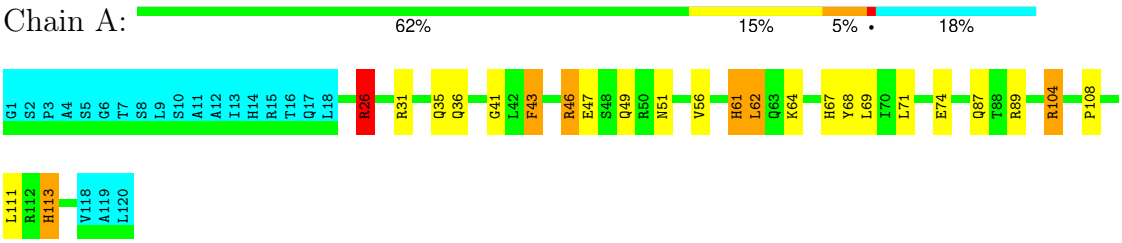
Chain B:



4.2.8 Score per residue for model 8

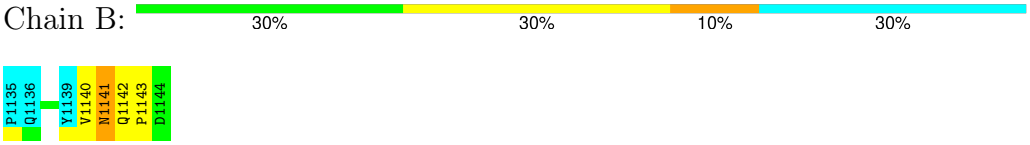
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

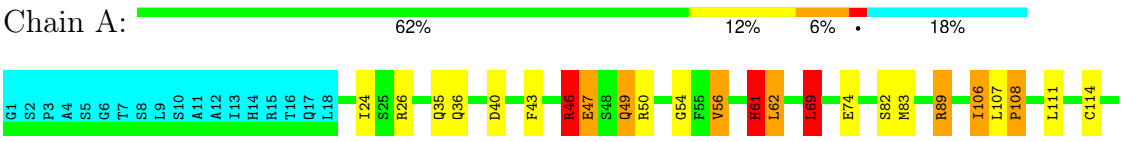
Chain B:



4.2.9 Score per residue for model 9

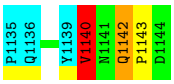
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

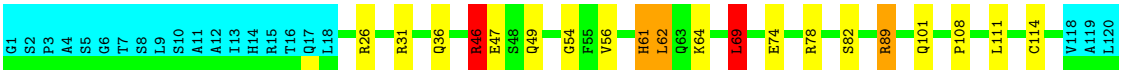
Chain B:



4.2.10 Score per residue for model 10

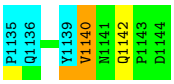
• Molecule 1: Growth factor receptor-bound protein 7

Chain A:



• Molecule 2: Receptor tyrosine-protein kinase erbB-2

Chain B:



5 Refinement protocol and experimental data overview

The models were refined using the following method: *molecular dynamics simulated annealing, simulated annealing.*

Of the 50 calculated structures, 10 were deposited, based on the following criterion: *structures with the lowest energy and the fewest restraint violations.*

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

Software name	Classification	Version
Amber	refinement	9
CNS	structure calculation	1.1

No chemical shift data was provided.

6 Model quality

6.1 Standard geometry

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

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	0.92±0.01	2±0/837 (0.2± 0.0%)	1.42±0.04	8±3/1127 (0.7± 0.2%)
2	B	0.86±0.04	0±0/56 (0.0± 0.0%)	2.03±0.19	3±1/73 (3.7± 1.4%)
All	All	0.92	20/8930 (0.2%)	1.46	104/12000 (0.9%)

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	1.1±0.7
2	B	0.0±0.0	0.5±0.5
All	All	0	16

All unique bond 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(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	47	GLU	CD-OE2	9.95	1.36	1.25	5	10
1	A	74	GLU	CD-OE2	9.84	1.36	1.25	8	10

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(°)	Ideal(°)	Models	
								Worst	Total
1	A	46	ARG	NE-CZ-NH1	13.15	126.87	120.30	1	9
1	A	69	LEU	CB-CG-CD1	9.51	127.16	111.00	10	3
2	B	1140	VAL	C-N-CA	9.12	144.50	121.70	2	2
1	A	26	ARG	NE-CZ-NH1	9.05	124.83	120.30	7	6

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
2	B	1141	ASN	CB-CA-C	8.79	127.98	110.40	1	3
1	A	68	TYR	CB-CG-CD2	-8.73	115.76	121.00	1	2
1	A	104	ARG	NE-CZ-NH1	8.48	124.54	120.30	7	5
2	B	1140	VAL	CA-CB-CG1	8.29	123.33	110.90	7	7
1	A	46	ARG	NE-CZ-NH2	-8.22	116.19	120.30	7	2
1	A	117	ARG	NE-CZ-NH1	8.04	124.32	120.30	4	2
2	B	1140	VAL	CG1-CB-CG2	-7.81	98.40	110.90	3	1
1	A	50	ARG	NE-CZ-NH1	7.31	123.95	120.30	9	5
1	A	89	ARG	NE-CZ-NH1	7.18	123.89	120.30	9	4
2	B	1141	ASN	N-CA-C	-6.96	92.22	111.00	2	2
1	A	82	SER	C-N-CA	6.90	138.95	121.70	10	3
1	A	23	ARG	NE-CZ-NH1	6.65	123.63	120.30	2	2
1	A	61	HIS	CB-CA-C	6.47	123.35	110.40	7	3
1	A	46	ARG	CD-NE-CZ	6.40	132.56	123.60	7	6
1	A	112	ARG	NE-CZ-NH1	6.21	123.40	120.30	4	2
2	B	1141	ASN	C-N-CA	6.21	137.22	121.70	8	5
1	A	78	ARG	NE-CZ-NH1	5.83	123.22	120.30	10	1
1	A	49	GLN	CB-CA-C	5.81	122.03	110.40	9	5
1	A	56	VAL	CG1-CB-CG2	-5.79	101.64	110.90	3	3
2	B	1143	PRO	C-N-CA	5.69	135.92	121.70	2	5
1	A	31	ARG	NE-CZ-NH1	5.62	123.11	120.30	1	4
1	A	68	TYR	CB-CG-CD1	5.55	124.33	121.00	1	1
1	A	61	HIS	CA-CB-CG	5.51	122.96	113.60	7	1
1	A	68	TYR	CA-CB-CG	5.46	123.78	113.40	1	1
2	B	1142	GLN	N-CA-C	5.37	125.51	111.00	7	1
1	A	60	CYS	N-CA-C	-5.37	96.51	111.00	7	1
1	A	26	ARG	NE-CZ-NH2	-5.26	117.67	120.30	4	1
1	A	46	ARG	NH1-CZ-NH2	-5.22	113.66	119.40	2	1
1	A	117	ARG	NH1-CZ-NH2	-5.14	113.74	119.40	4	1
1	A	43	PHE	CB-CG-CD1	5.11	124.38	120.80	8	1
2	B	1142	GLN	CB-CA-C	-5.08	100.24	110.40	8	1
1	A	23	ARG	CA-CB-CG	5.05	124.52	113.40	2	1
1	A	61	HIS	N-CA-CB	-5.01	101.58	110.60	7	1

There are no chirality outliers.

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

Mol	Chain	Res	Type	Group	Models (Total)
1	A	46	ARG	Sidechain	7
2	B	1142	GLN	Peptide	5

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Mol	Chain	Res	Type	Group	Models (Total)
1	A	107	LEU	Peptide	2
1	A	26	ARG	Sidechain	1
1	A	68	TYR	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
1	A	819	819	816	4±2
2	B	56	47	47	1±1
All	All	8750	8660	8629	44

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 3.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:47:GLU:HA	1:A:56:VAL:HG13	0.67	1.65	9	3
1:A:70:ILE:HD12	2:B:1141:ASN:HB2	0.56	1.78	2	3
1:A:83:MET:HA	2:B:1140:VAL:HG12	0.52	1.80	6	2
1:A:61:HIS:CG	1:A:62:LEU:H	0.51	2.24	7	7
1:A:46:ARG:C	1:A:46:ARG:HD2	0.48	2.29	5	1
1:A:106:ILE:HD13	1:A:107:LEU:H	0.47	1.69	9	1
1:A:61:HIS:CG	1:A:62:LEU:N	0.47	2.82	2	8
1:A:41:GLY:HA2	1:A:113:HIS:CD2	0.47	2.44	8	1
1:A:69:LEU:C	1:A:69:LEU:HD13	0.46	2.29	3	5
2:B:1140:VAL:C	2:B:1142:GLN:N	0.44	2.71	6	5
1:A:106:ILE:HD13	1:A:107:LEU:N	0.43	2.28	9	1
1:A:54:GLY:HA3	1:A:69:LEU:HD22	0.43	1.91	10	2
1:A:81:PHE:H	1:A:89:ARG:HA	0.41	1.75	2	1
1:A:43:PHE:CG	1:A:57:LEU:HD21	0.41	2.50	5	1
1:A:54:GLY:CA	1:A:69:LEU:HD22	0.41	2.46	10	1
1:A:107:LEU:CB	1:A:108:PRO:HD3	0.41	2.46	9	1
1:A:26:ARG:HB2	1:A:67:HIS:CD2	0.40	2.51	8	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	99/120 (82%)	74±3 (75±3%)	22±3 (22±3%)	3±1 (3±1%)	5 36
2	B	6/10 (60%)	3±1 (57±13%)	2±0 (28±8%)	1±1 (15±14%)	0 4
All	All	1050/1300 (81%)	777 (74%)	232 (22%)	41 (4%)	4 31

All 13 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	89	ARG	10
1	A	108	PRO	8
1	A	83	MET	4
1	A	40	ASP	3
1	A	24	ILE	3
2	B	1141	ASN	2
2	B	1142	GLN	2
1	A	72	PRO	2
2	B	1143	PRO	2
2	B	1140	VAL	2
1	A	99	PHE	1
1	A	97	VAL	1
2	B	1138	GLU	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	91/106 (86%)	78±2 (86±2%)	13±2 (14±2%)	5 44
2	B	7/9 (78%)	7±0 (96±7%)	0±0 (4±7%)	27 80

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	980/1150 (85%)	848 (87%)	132 (13%)	5 46

All 37 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	26	ARG	10
1	A	111	LEU	10
1	A	46	ARG	9
1	A	56	VAL	9
1	A	36	GLN	8
1	A	62	LEU	8
1	A	43	PHE	7
1	A	61	HIS	7
1	A	49	GLN	5
1	A	64	LYS	5
1	A	114	CYS	4
1	A	71	LEU	4
1	A	101	GLN	4
1	A	87	GLN	4
1	A	80	TYR	3
1	A	57	LEU	3
1	A	107	LEU	3
1	A	106	ILE	3
1	A	69	LEU	3
1	A	68	TYR	2
1	A	23	ARG	2
1	A	47	GLU	2
1	A	104	ARG	2
1	A	35	GLN	2
1	A	89	ARG	1
1	A	95	GLN	1
1	A	109	CYS	1
1	A	103	ASN	1
2	B	1140	VAL	1
1	A	110	LEU	1
1	A	48	SER	1
1	A	102	LEU	1
2	B	1142	GLN	1
1	A	50	ARG	1
1	A	51	ASN	1
1	A	113	HIS	1

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Mol	Chain	Res	Type	Models (Total)
2	B	1141	ASN	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)

1 non-standard protein/DNA/RNA residue is modelled in this entry.

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
2	PTR	B	1139	2	15,16,17	1.87±0.06	5±1 (33±6%)

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
2	PTR	B	1139	2	17,22,24	1.25±0.17	2±1 (12±4%)

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
2	PTR	B	1139	2	-	0±0,10,11,13	0±0,1,1,1

All unique bond 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(Å)	Ideal(Å)	Models	
								Worst	Total
2	B	1139	PTR	OH-CZ	4.04	1.31	1.40	5	10
2	B	1139	PTR	CE2-CD2	2.87	1.43	1.38	8	9
2	B	1139	PTR	P-O2P	2.68	1.44	1.54	7	8
2	B	1139	PTR	P-O3P	2.66	1.44	1.54	9	10
2	B	1139	PTR	CD2-CG	2.41	1.43	1.38	8	4
2	B	1139	PTR	CE1-CD1	2.34	1.42	1.38	2	2
2	B	1139	PTR	CD1-CG	2.28	1.43	1.38	3	3
2	B	1139	PTR	CB-CG	2.16	1.56	1.51	4	4
2	B	1139	PTR	CE1-CZ	2.11	1.42	1.38	9	1

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
2	B	1139	PTR	OH-CZ-CE1	3.26	128.99	119.22	2	3
2	B	1139	PTR	OH-P-O1P	3.17	98.92	109.48	6	4
2	B	1139	PTR	CD1-CE1-CZ	2.83	122.96	119.73	3	6
2	B	1139	PTR	OH-CZ-CE2	2.82	127.66	119.22	6	4
2	B	1139	PTR	O2P-P-OH	2.74	97.21	105.32	10	2
2	B	1139	PTR	O3P-P-O2P	2.45	117.00	107.80	3	2

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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

No chemical shift data were provided