



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 21, 2017 – 01:05 PM EST

PDB ID : 2Q21  
Title : CRYSTAL STRUCTURES AT 2.2 ANGSTROMS RESOLUTION OF THE CATALYTIC DOMAINS OF NORMAL RAS PROTEIN AND AN ONCOGENIC MUTANT COMPLEXED WITH GSP  
Authors : Kim, S.-H.  
Deposited on : unknown  
Resolution : 2.20 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Mogul : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20030345

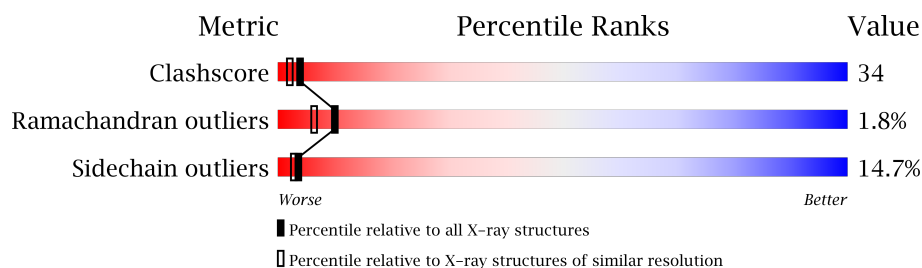
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 Å.

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)	Similar resolution (#Entries, resolution range(Å))
Clashscore	112137	4730 (2.20-2.20)
Ramachandran outliers	110173	4656 (2.20-2.20)
Sidechain outliers	110143	4657 (2.20-2.20)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	171	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 1440 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called C-H-RAS P21 PROTEIN CATALYTIC DOMAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	171	Total	C	N	O	S	0	0	0
			1371	857	238	269	7			

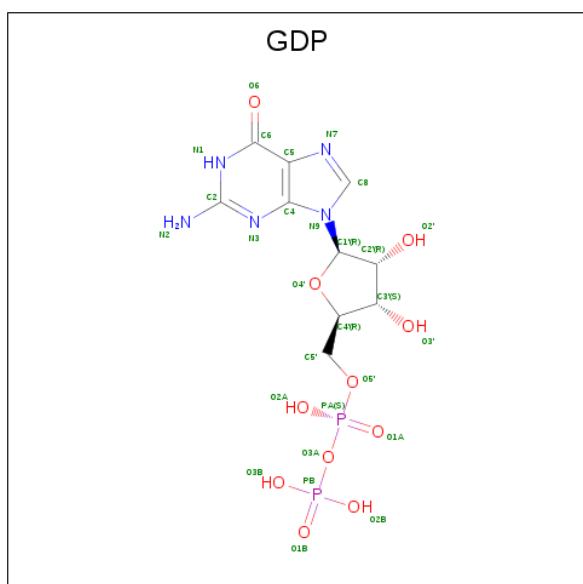
There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	12	VAL	GLY	ENGINEERED MUTATION	UNP P01112

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mg	0	0
			1	1		

- Molecule 3 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: C<sub>10</sub>H<sub>15</sub>N<sub>5</sub>O<sub>11</sub>P<sub>2</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			28	10	5	11	2		

- Molecule 4 is water.

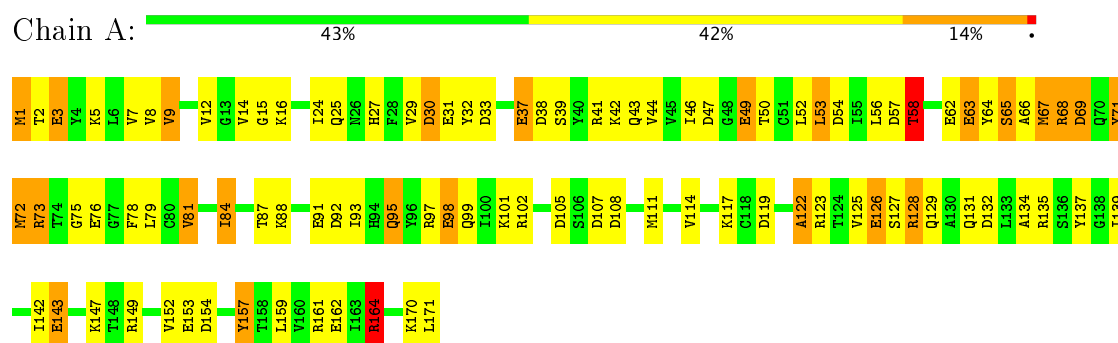
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	40	Total	O	0	0
			40	40		

### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

Note EDS was not executed.

#### • Molecule 1: C-H-RAS P21 PROTEIN CATALYTIC DOMAIN



## 4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 65 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	83.20 Å 83.20 Å 105.10 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	6.00 – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) (6.00-2.20)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, $R_{free}$	0.192 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1440	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	wwPDB-VP

## 5 Model quality

### 5.1 Standard geometry

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

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 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	1.46	14/1390 (1.0%)	1.47	27/1873 (1.4%)

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	91	GLU	CD-OE2	11.30	1.38	1.25
1	A	98	GLU	CD-OE2	9.25	1.35	1.25
1	A	153	GLU	CD-OE2	8.47	1.34	1.25
1	A	126	GLU	CD-OE2	8.34	1.34	1.25
1	A	63	GLU	CD-OE1	8.26	1.34	1.25
1	A	143	GLU	CD-OE1	8.07	1.34	1.25
1	A	31	GLU	CD-OE2	7.39	1.33	1.25
1	A	62	GLU	CD-OE1	7.30	1.33	1.25
1	A	37	GLU	CD-OE1	7.27	1.33	1.25
1	A	49	GLU	CD-OE1	6.89	1.33	1.25
1	A	76	GLU	CD-OE2	6.58	1.32	1.25
1	A	3	GLU	CD-OE2	6.38	1.32	1.25
1	A	162	GLU	CD-OE2	5.93	1.32	1.25
1	A	47	ASP	CG-OD2	5.59	1.38	1.25

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	164	ARG	NE-CZ-NH1	-9.30	115.65	120.30
1	A	69	ASP	CB-CG-OD1	-7.92	111.17	118.30
1	A	47	ASP	CB-CG-OD1	7.65	125.19	118.30
1	A	69	ASP	CB-CG-OD2	7.00	124.60	118.30
1	A	33	ASP	CB-CG-OD2	-6.93	112.06	118.30
1	A	38	ASP	CB-CG-OD1	6.85	124.47	118.30
1	A	54	ASP	CB-CG-OD1	-6.62	112.34	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	137	TYR	CB-CG-CD2	-6.60	117.04	121.00
1	A	149	ARG	NE-CZ-NH2	6.51	123.56	120.30
1	A	30	ASP	CB-CG-OD2	-6.49	112.46	118.30
1	A	47	ASP	CB-CG-OD2	-6.23	112.69	118.30
1	A	68	ARG	N-CA-CB	6.08	121.55	110.60
1	A	30	ASP	CB-CG-OD1	6.05	123.75	118.30
1	A	149	ARG	NE-CZ-NH1	-6.03	117.29	120.30
1	A	38	ASP	CB-CG-OD2	-5.98	112.92	118.30
1	A	105	ASP	CB-CG-OD1	-5.72	113.15	118.30
1	A	33	ASP	CB-CG-OD1	5.63	123.36	118.30
1	A	105	ASP	CB-CG-OD2	5.54	123.29	118.30
1	A	157	TYR	CB-CG-CD2	-5.33	117.80	121.00
1	A	57	ASP	CB-CG-OD2	-5.33	113.50	118.30
1	A	137	TYR	CB-CG-CD1	5.31	124.19	121.00
1	A	108	ASP	CB-CG-OD2	-5.31	113.52	118.30
1	A	161	ARG	NE-CZ-NH1	-5.31	117.64	120.30
1	A	132	ASP	CB-CG-OD1	-5.25	113.58	118.30
1	A	154	ASP	CB-CG-OD1	-5.25	113.58	118.30
1	A	58	THR	N-CA-CB	-5.22	100.38	110.30
1	A	9	VAL	N-CA-CB	-5.05	100.39	111.50

There are no chirality outliers.

There are no planarity outliers.

## 5.2 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 the 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 within the asymmetric unit, whereas Symm-Clashes lists symmetry related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1371	0	1363	93	0
2	A	1	0	0	0	0
3	A	28	0	12	4	0
4	A	40	0	0	7	0
All	All	1440	0	1375	93	0

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 34.

All (93) close contacts within the same asymmetric unit are listed below, sorted by their clash



magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:49:GLU:HB3	4:A:230:HOH:O	1.74	0.88
1:A:101:LYS:HE3	1:A:107:ASP:CG	1.99	0.82
1:A:1:MET:CE	1:A:43:GLN:HG2	2.12	0.80
1:A:65:SER:HB3	1:A:99:GLN:NE2	1.98	0.79
1:A:95:GLN:HA	1:A:95:GLN:HE21	1.46	0.77
1:A:1:MET:HE1	1:A:43:GLN:HG2	1.70	0.71
1:A:58:THR:HG21	4:A:231:HOH:O	1.92	0.70
1:A:46:ILE:O	4:A:230:HOH:O	2.11	0.69
1:A:122:ALA:O	1:A:123:ARG:HB2	1.91	0.69
1:A:127:SER:HB2	1:A:128:ARG:NH2	2.10	0.67
1:A:71:TYR:O	1:A:75:GLY:N	2.28	0.67
1:A:164:ARG:NH1	4:A:230:HOH:O	2.23	0.65
1:A:67:MET:SD	1:A:67:MET:N	2.67	0.64
1:A:88:LYS:NZ	1:A:92:ASP:OD2	2.29	0.64
1:A:99:GLN:OE1	1:A:102:ARG:NH2	2.31	0.63
1:A:81:VAL:HB	1:A:114:VAL:HB	1.80	0.63
1:A:123:ARG:HH22	1:A:143:GLU:CD	2.02	0.63
1:A:117:LYS:HG2	3:A:180:GDP:C6	2.34	0.62
1:A:123:ARG:HD3	1:A:125:VAL:O	1.98	0.62
1:A:41:ARG:NH1	1:A:52:LEU:HD21	2.14	0.62
1:A:65:SER:HA	1:A:99:GLN:CB	2.30	0.62
1:A:95:GLN:HE21	1:A:95:GLN:CA	2.13	0.62
1:A:164:ARG:NH2	4:A:230:HOH:O	2.31	0.61
1:A:170:LYS:O	1:A:171:LEU:HB2	2.01	0.61
1:A:79:LEU:HD13	1:A:159:LEU:HD22	1.82	0.60
1:A:56:LEU:HD21	1:A:68:ARG:HB3	1.82	0.60
1:A:3:GLU:HG2	1:A:5:LYS:NZ	2.18	0.58
1:A:24:ILE:HG22	1:A:25:GLN:HG3	1.85	0.58
1:A:63:GLU:HA	1:A:63:GLU:OE1	2.04	0.58
1:A:8:VAL:O	1:A:58:THR:HB	2.03	0.57
1:A:56:LEU:HD22	1:A:71:TYR:CG	2.40	0.56
1:A:84:ILE:HG12	1:A:123:ARG:CZ	2.35	0.56
1:A:101:LYS:HG2	1:A:107:ASP:HA	1.88	0.55
1:A:3:GLU:CG	1:A:5:LYS:HZ3	2.20	0.55
1:A:126:GLU:O	1:A:129:GLN:HG2	2.06	0.55
1:A:49:GLU:OE1	1:A:164:ARG:NH1	2.39	0.55
1:A:126:GLU:OE1	1:A:128:ARG:NH2	2.39	0.54
1:A:69:ASP:OD1	1:A:73:ARG:NH2	2.40	0.54
1:A:117:LYS:NZ	3:A:180:GDP:O4'	2.41	0.53
1:A:84:ILE:HG12	1:A:123:ARG:NH1	2.23	0.53
1:A:25:GLN:HB2	1:A:27:HIS:CE1	2.44	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:164:ARG:CZ	4:A:230:HOH:O	2.57	0.52
1:A:56:LEU:HD22	1:A:71:TYR:CB	2.41	0.51
1:A:98:GLU:O	1:A:102:ARG:HB2	2.11	0.51
1:A:135:ARG:HG3	1:A:135:ARG:HH11	1.77	0.50
1:A:3:GLU:HG2	1:A:5:LYS:HE2	1.93	0.49
1:A:79:LEU:CD1	1:A:159:LEU:HD22	2.42	0.49
1:A:117:LYS:O	1:A:119:ASP:N	2.45	0.49
1:A:66:ALA:N	1:A:99:GLN:HE21	2.11	0.49
1:A:24:ILE:HG22	1:A:25:GLN:CG	2.43	0.48
1:A:66:ALA:CB	1:A:99:GLN:HE21	2.26	0.48
1:A:3:GLU:CD	1:A:52:LEU:HD23	2.34	0.48
1:A:164:ARG:NH1	4:A:205:HOH:O	2.38	0.47
1:A:84:ILE:CG1	1:A:123:ARG:NH1	2.77	0.47
1:A:171:LEU:N	1:A:171:LEU:HD12	2.28	0.47
1:A:93:ILE:HD13	1:A:93:ILE:HA	1.63	0.47
1:A:42:LYS:HD3	1:A:44:VAL:CG1	2.45	0.47
1:A:65:SER:C	1:A:99:GLN:HG2	2.35	0.47
1:A:65:SER:H	1:A:67:MET:HE1	1.79	0.47
1:A:2:THR:HG22	1:A:3:GLU:N	2.28	0.47
1:A:3:GLU:HG2	1:A:5:LYS:CE	2.44	0.47
1:A:3:GLU:CG	1:A:5:LYS:NZ	2.77	0.46
1:A:24:ILE:HD12	1:A:42:LYS:HB2	1.97	0.46
1:A:65:SER:HA	1:A:99:GLN:HB3	1.98	0.46
1:A:127:SER:O	1:A:131:GLN:HG2	2.16	0.46
1:A:58:THR:CG2	1:A:67:MET:HG3	2.46	0.46
1:A:50:THR:O	1:A:50:THR:HG23	2.15	0.45
1:A:1:MET:N	1:A:1:MET:SD	2.85	0.45
1:A:117:LYS:C	1:A:119:ASP:H	2.20	0.45
1:A:7:VAL:HB	1:A:78:PHE:CD2	2.52	0.45
1:A:41:ARG:HA	1:A:53:LEU:O	2.17	0.45
1:A:65:SER:HB3	1:A:99:GLN:HE21	1.80	0.45
1:A:84:ILE:HG23	1:A:123:ARG:HG2	1.99	0.44
1:A:97:ARG:NH2	1:A:107:ASP:OD1	2.50	0.43
1:A:117:LYS:HG2	3:A:180:GDP:C5	2.53	0.43
1:A:126:GLU:OE1	1:A:128:ARG:NE	2.47	0.43
1:A:58:THR:HG23	1:A:67:MET:HG3	2.00	0.43
1:A:67:MET:O	1:A:72:MET:SD	2.77	0.43
1:A:101:LYS:HE3	1:A:107:ASP:OD2	2.20	0.42
1:A:37:GLU:HG2	1:A:68:ARG:NH2	2.35	0.42
1:A:1:MET:HE3	1:A:43:GLN:HG2	1.99	0.42
1:A:16:LYS:HG3	3:A:180:GDP:O1B	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:65:SER:O	1:A:67:MET:SD	2.78	0.42
1:A:84:ILE:O	1:A:84:ILE:HG23	2.18	0.41
1:A:157:TYR:N	1:A:157:TYR:CD1	2.89	0.41
1:A:14:VAL:HG23	1:A:15:GLY:N	2.35	0.41
1:A:24:ILE:HD13	1:A:24:ILE:N	2.36	0.41
1:A:68:ARG:O	1:A:72:MET:HG3	2.21	0.41
1:A:65:SER:OG	1:A:102:ARG:NH2	2.54	0.40
1:A:2:THR:CG2	1:A:3:GLU:N	2.84	0.40
1:A:134:ALA:HB1	1:A:139:ILE:O	2.22	0.40
1:A:126:GLU:CD	1:A:128:ARG:HH21	2.24	0.40
1:A:32:TYR:CD1	1:A:32:TYR:C	2.95	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 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 X-ray entries followed by that with respect to entries of similar resolution.

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	169/171 (99%)	150 (89%)	16 (10%)	3 (2%)	<b>10</b> <b>6</b>

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	64	TYR
1	A	122	ALA
1	A	65	SER

### 5.3.2 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 X-ray entries followed by that with respect to entries of similar resolution.

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	150/150 (100%)	128 (85%)	22 (15%)	<b>3</b> <b>3</b>

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	9	VAL
1	A	12	VAL
1	A	29	VAL
1	A	30	ASP
1	A	39	SER
1	A	53	LEU
1	A	58	THR
1	A	67	MET
1	A	71	TYR
1	A	72	MET
1	A	73	ARG
1	A	81	VAL
1	A	84	ILE
1	A	87	THR
1	A	95	GLN
1	A	111	MET
1	A	128	ARG
1	A	142	ILE
1	A	147	LYS
1	A	152	VAL
1	A	164	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	25	GLN
1	A	26	ASN
1	A	27	HIS
1	A	95	GLN
1	A	116	ASN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# $ Z  > 2$	Counts	RMSZ	# $ Z  > 2$
3	GDP	A	180	2	25,30,30	1.82	5 (20%)	26,47,47	2.47	6 (23%)

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
3	GDP	A	180	2	-	0/12/32/32	0/3/3/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	180	GDP	C6-C5	-4.27	1.33	1.41
3	A	180	GDP	C2'-C1'	-2.29	1.50	1.53
3	A	180	GDP	C2-N1	2.25	1.39	1.35
3	A	180	GDP	PB-O3B	3.28	1.68	1.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	180	GDP	C6-N1	4.96	1.42	1.33

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	180	GDP	C5-C6-N1	-8.46	111.43	123.48
3	A	180	GDP	N3-C2-N1	-4.07	121.52	127.46
3	A	180	GDP	C2-N3-C4	-2.00	112.82	115.16
3	A	180	GDP	C6-C5-C4	2.30	123.13	120.84
3	A	180	GDP	N2-C2-N3	2.80	122.91	117.75
3	A	180	GDP	C6-N1-C2	6.70	125.70	116.06

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	180	GDP	4	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

### 6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.