wwPDB X-ray Structure Validation Summary Report (i)

May 29, 2020 – 10:40 pm BST

PDB ID	:	3R7W
Title	:	Crystal Structure of Gtr1p-Gtr2p complex
Authors	:	Gong, R.; Li, L.; Liu, Y.; Wang, P.; Yang, H.; Wang, L.; Cheng, J.; Guan, K.L.; Xu, Y.
Deposited on	:	2011-03-23
Resolution	:	2.77 Å(reported)

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

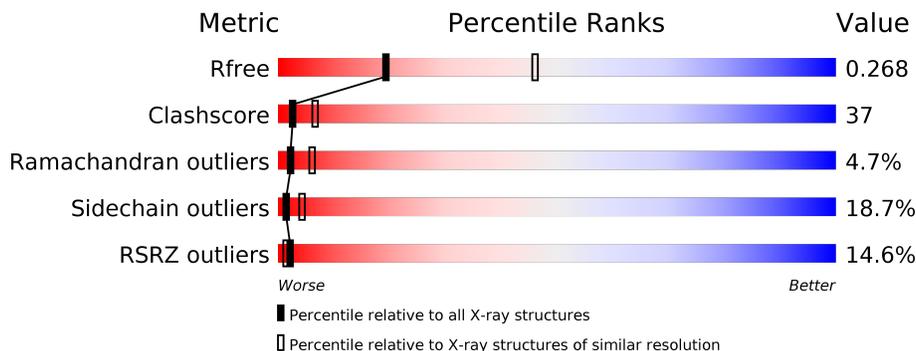|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & 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:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.77 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	Percentile Ranks	Value
Rfree		0.268
Clashscore		37
Ramachandran outliers		4.7%
Sidechain outliers		18.7%
RSRZ outliers		14.6%

Worse   *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4107 (2.80-2.76)
Clashscore	141614	4575 (2.80-2.76)
Ramachandran outliers	138981	4487 (2.80-2.76)
Sidechain outliers	138945	4489 (2.80-2.76)
RSRZ outliers	127900	4027 (2.80-2.76)

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 >=3, 2, 1 and 0 types of geometric quality criteria respectively. 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% 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.

Mol	Chain	Length	Quality of chain
1	A	307	4% — 40% / 42% / 12% / 6%
1	C	307	6% — 44% / 40% / 9% / • / 6%
2	B	331	20% — 34% / 40% / 14% / • / 11%
2	D	331	18% — 24% / 35% / 9% / • / 31%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 9011 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 GTP-binding protein GTR1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	289	Total	C	N	O	S	Se	0	0	0
			2344	1513	388	425	5	13			
1	C	290	Total	C	N	O	S	Se	0	0	0
			2353	1518	390	427	5	13			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	4	PRO	-	EXPRESSION TAG	UNP Q00582
A	5	LEU	-	EXPRESSION TAG	UNP Q00582
A	6	GLY	-	EXPRESSION TAG	UNP Q00582
A	7	SER	-	EXPRESSION TAG	UNP Q00582
C	4	PRO	-	EXPRESSION TAG	UNP Q00582
C	5	LEU	-	EXPRESSION TAG	UNP Q00582
C	6	GLY	-	EXPRESSION TAG	UNP Q00582
C	7	SER	-	EXPRESSION TAG	UNP Q00582

- Molecule 2 is a protein called GTP-binding protein GTR2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	294	Total	C	N	O	S	Se	0	0	0
			2348	1508	371	455	4	10			
2	D	229	Total	C	N	O	S	Se	0	0	0
			1830	1182	294	342	4	8			

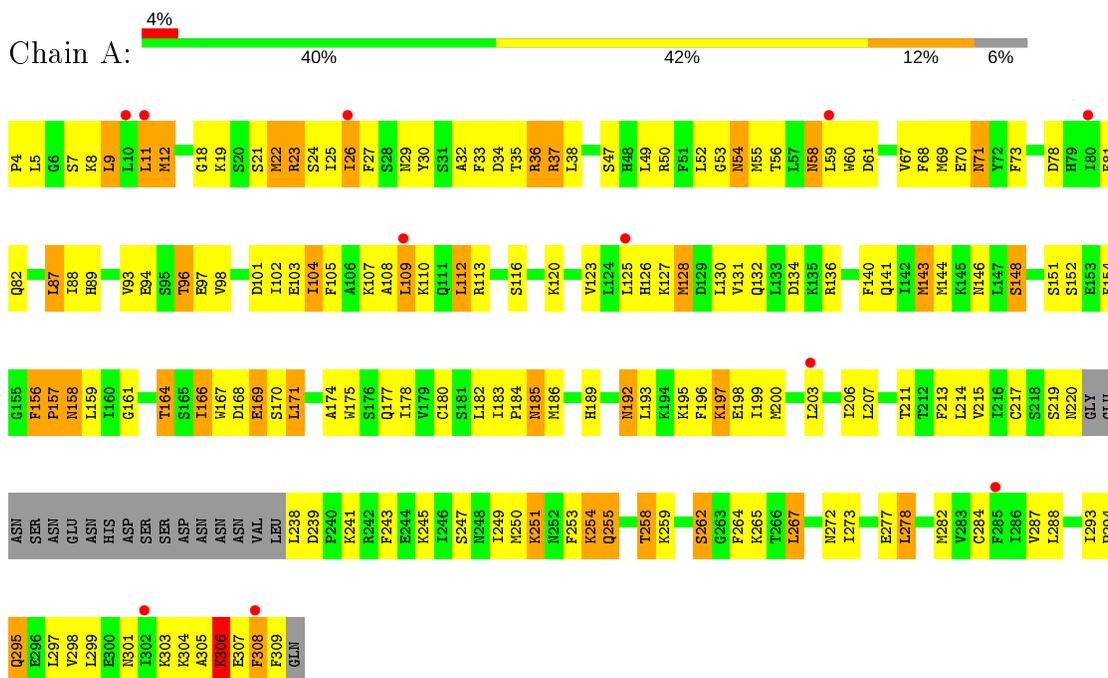- Molecule 3 is PHOSPHOAMINOPHOSPHONIC ACID-GUANYLATE ESTER (three-letter code: GNP) (formula: $C_{10}H_{17}N_6O_{13}P_3$).

GNP

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			32	10	6	13	3		
3	B	1	Total	C	N	O	P	0	0
			32	10	6	13	3		
3	C	1	Total	C	N	O	P	0	0
			32	10	6	13	3		
3	D	1	Total	C	N	O	P	0	0
			32	10	6	13	3		

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Mg	0	0
			1	1		
4	A	1	Total	Mg	0	0
			1	1		
4	D	1	Total	Mg	0	0
			1	1		
4	C	1	Total	Mg	0	0
			1	1		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	2	Total	O	0	0
			2	2		

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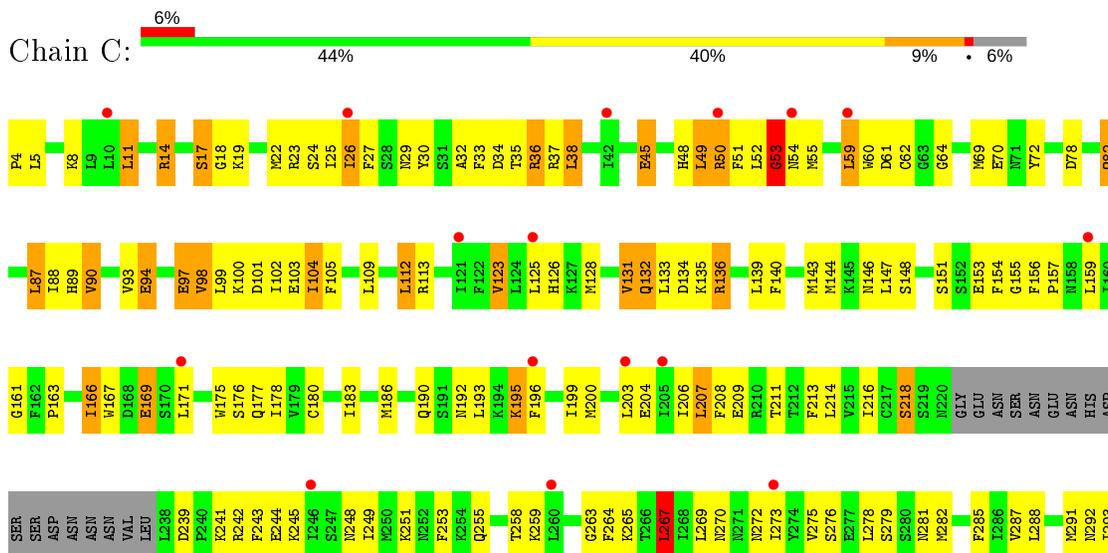| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	C	2	Total 2	O 2	0	0

3 Residue-property plots ⓘ

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.

- Molecule 1: GTP-binding protein GTR1

- Molecule 1: GTP-binding protein GTR1

P294 Q295 E296 L297 V298 N301 K304 F308 F309 Q310

● **Molecule 2: GTP-binding protein GTR2**

Chain B:

● **Molecule 2: GTP-binding protein GTR2**

Chain D:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	68.91Å 148.44Å 98.51Å 90.00° 100.61° 90.00°	Depositor
Resolution (Å)	44.06 – 2.77 74.22 – 2.77	Depositor EDS
% Data completeness (in resolution range)	95.0 (44.06-2.77) 95.2 (74.22-2.77)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	1.94 (at 2.77Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7_650)	Depositor
R, R_{free}	0.236 , 0.283 0.227 , 0.268	Depositor DCC
R_{free} test set	2290 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å^2)	73.4	Xtriage
Anisotropy	0.218	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 52.3	EDS
L-test for twinning[2]	$<|L|> = 0.49, <L^2> = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	9011	wwPDB-VP
Average B, all atoms (Å^2)	97.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 22.89 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 5.2042e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1] Intensities estimated from amplitudes.
[2] Theoretical values of $<|L|>$, $<L^2>$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: GNP, 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	0.62	0/2375	0.77	1/3165 (0.0%)
1	C	0.59	0/2384	0.76	1/3177 (0.0%)
2	B	0.46	0/2378	0.64	1/3205 (0.0%)
2	D	0.45	0/1847	0.68	1/2480 (0.0%)
All	All	0.54	0/8984	0.71	4/12027 (0.0%)

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 outliers	#Planarity outliers
1	C	0	1
2	B	0	1
2	D	0	1
All	All	0	3

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	283	LEU	CA-CB-CG	6.88	131.13	115.30
2	B	283	LEU	CA-CB-CG	6.74	130.79	115.30
1	C	267	LEU	CA-CB-CG	5.91	128.88	115.30
1	A	9	LEU	CA-CB-CG	5.37	127.66	115.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	268	GLU	Peptide
1	C	53	GLY	Peptide
2	D	208	PHE	Peptide

5.2 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 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	2344	0	2396	169	0
1	C	2353	0	2404	146	0
2	B	2348	0	2348	172	0
2	D	1830	0	1866	193	0
3	A	32	0	13	1	0
3	B	32	0	13	7	0
3	C	32	0	13	5	0
3	D	32	0	13	5	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
5	A	2	0	0	0	0
5	C	2	0	0	0	0
All	All	9011	0	9066	662	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 37.

The worst 5 of 662 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:C:131:VAL:HG12	1:C:132:GLN:H	1.05	1.13
2:D:238:THR:HB	2:D:271:ASN:HD22	1.11	1.08
2:D:212:SER:HA	2:D:213:LYS:HB2	1.36	1.07
2:B:70:PHE:HA	2:B:71:GLU:HB3	1.40	1.01
2:B:164:THR:HG22	2:B:171:ILE:HA	1.39	1.01

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	285/307 (93%)	247 (87%)	32 (11%)	6 (2%)	7	21
1	C	286/307 (93%)	245 (86%)	35 (12%)	6 (2%)	7	21
2	B	290/331 (88%)	225 (78%)	38 (13%)	27 (9%)	0	1
2	D	219/331 (66%)	170 (78%)	37 (17%)	12 (6%)	2	4
All	All	1080/1276 (85%)	887 (82%)	142 (13%)	51 (5%)	2	6

5 of 51 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	156	PHE
1	A	157	PRO
1	A	306	LYS
1	A	308	PHE
2	B	18	ARG

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	270/274 (98%)	209 (77%)	61 (23%)	1	2
1	C	271/274 (99%)	226 (83%)	45 (17%)	2	6
2	B	269/292 (92%)	221 (82%)	48 (18%)	2	5
2	D	208/292 (71%)	172 (83%)	36 (17%)	2	5
All	All	1018/1132 (90%)	828 (81%)	190 (19%)	1	4

5 of 190 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	166	ILE
2	B	292	LEU
2	D	207	LEU
2	B	171	ILE
2	B	207	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 31 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	274	GLN
1	C	89	HIS
2	D	195	ASN
1	C	29	ASN
1	C	126	HIS

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

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

5.5   Carbohydrates (i)

There are no carbohydrates in this entry.

5.6   Ligand geometry (i)

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 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	GNP	D	500	4	28,34,34	2.44	8 (28%)	30,54,54	2.19	8 (26%)
3	GNP	C	500	4	28,34,34	2.48	10 (35%)	30,54,54	2.11	9 (30%)
3	GNP	B	500	4	28,34,34	2.55	8 (28%)	30,54,54	2.23	9 (30%)
3	GNP	A	500	4	28,34,34	2.48	10 (35%)	30,54,54	2.54	11 (36%)

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	GNP	D	500	4	-	9/17/38/38	0/3/3/3
3	GNP	C	500	4	-	7/17/38/38	0/3/3/3
3	GNP	B	500	4	-	7/17/38/38	0/3/3/3
3	GNP	A	500	4	-	11/17/38/38	0/3/3/3

The worst 5 of 36 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	500	GNP	C4-N9	-7.75	1.37	1.47
3	A	500	GNP	C4-N9	-7.75	1.37	1.47
3	C	500	GNP	C4-N9	-7.21	1.38	1.47
3	C	500	GNP	C5-C6	-7.08	1.40	1.52
3	D	500	GNP	C4-N9	-6.82	1.38	1.47

The worst 5 of 37 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	500	GNP	C4-C5-N7	6.55	111.14	102.46
3	B	500	GNP	C4-C5-N7	6.36	110.89	102.46
3	D	500	GNP	C4-C5-N7	6.27	110.78	102.46
3	A	500	GNP	C4-C5-N7	6.15	110.61	102.46
3	A	500	GNP	O1G-PG-N3B	-5.21	104.10	111.77

There are no chirality outliers.

5 of 34 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	500	GNP	PB-N3B-PG-O1G
3	C	500	GNP	PG-N3B-PB-O1B

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wwPDB X-ray Structure Validation Summary Report

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Mol	Chain	Res	Type	Atoms
3	C	500	GNP	PG-N3B-PB-O3A
3	C	500	GNP	PA-O3A-PB-O1B
3	C	500	GNP	C2'-C1'-N9-C8

There are no ring outliers.

4 monomers are involved in 18 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	500	GNP	5	0
3	C	500	GNP	5	0
3	B	500	GNP	7	0
3	A	500	GNP	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand GNP D 500

Bond lengths

Bond angles

Torsions

Rings

Ligand GNP C 500

Bond lengths

Bond angles

Torsions

Rings

Ligand GNP B 500

Bond lengths

Bond angles

Torsions

Rings

Ligand GNP A 500

Bond lengths

Bond angles

Torsions

Rings
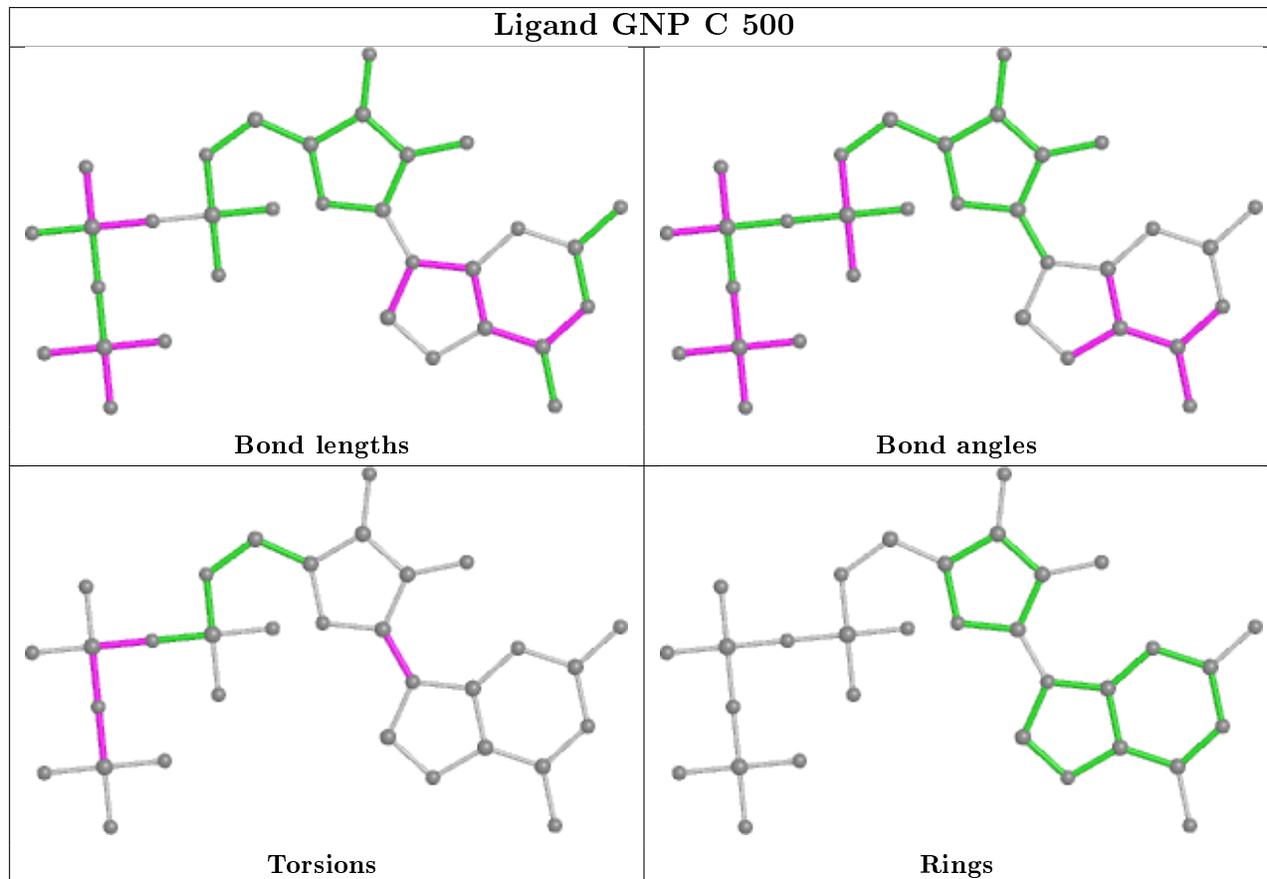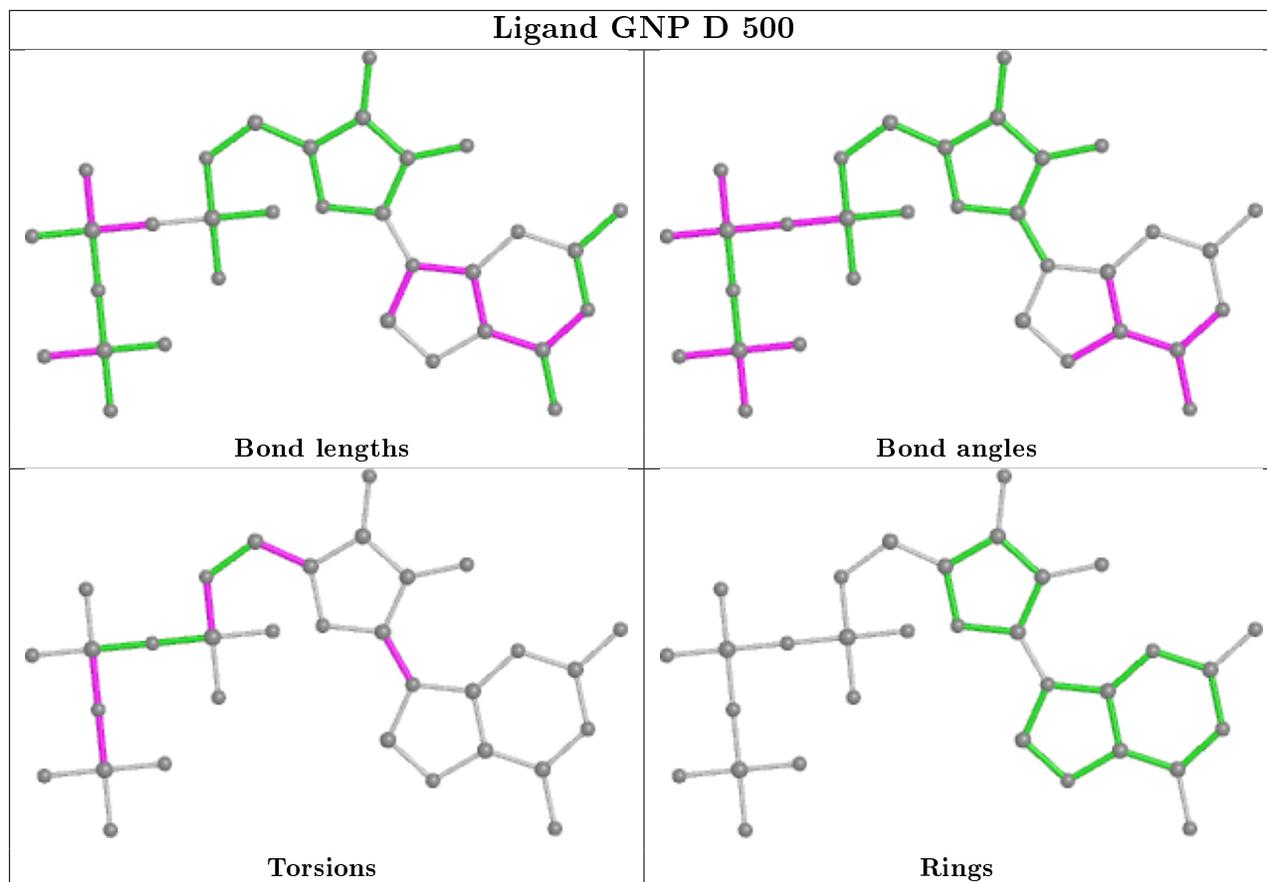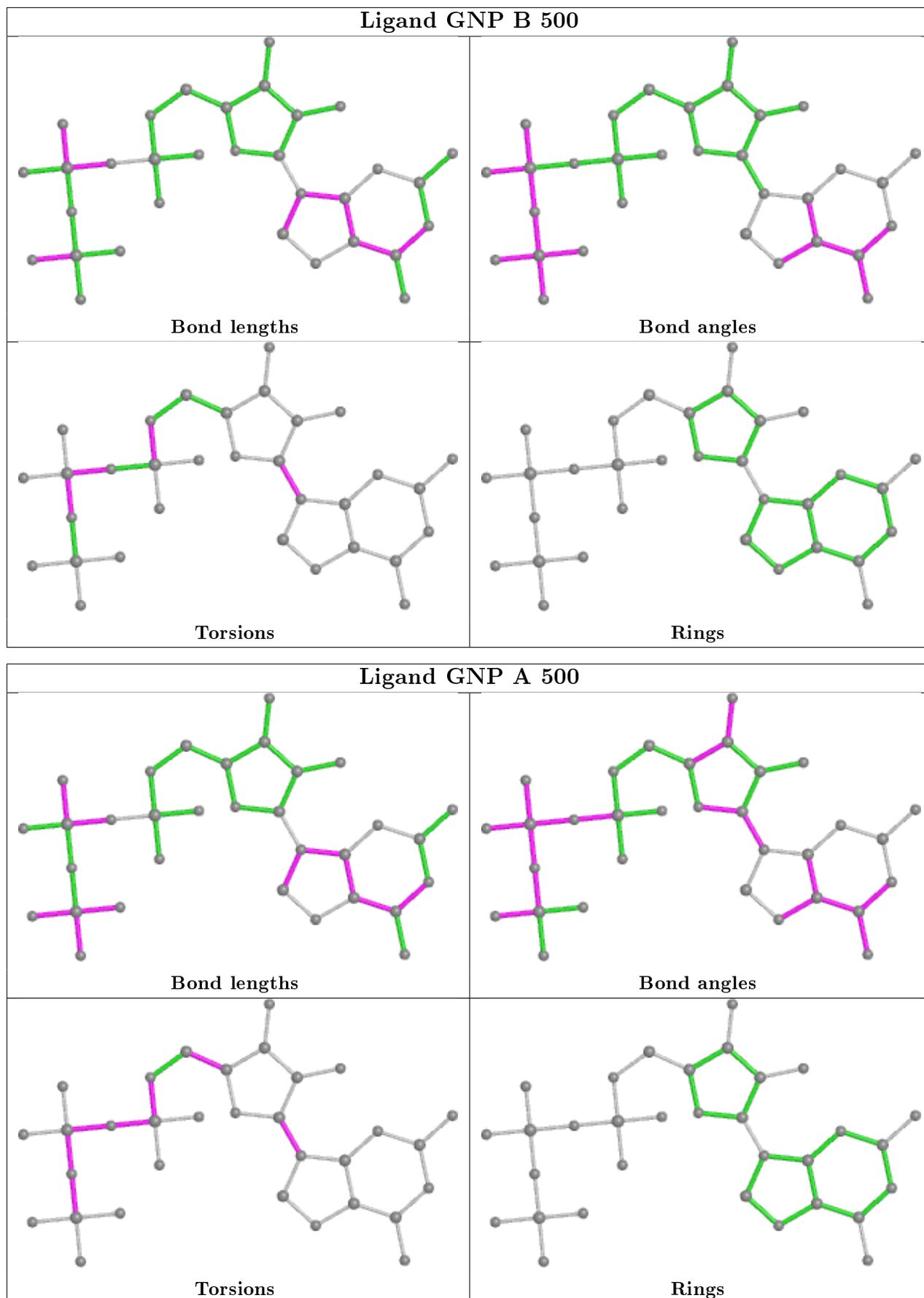
5.7 Other polymers (i)

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 (i)

6.1 Protein, DNA and RNA chains (i)

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å²)	Q<0.9
1	A	276/307 (89%)	0.67	11 (3%)	38	33	56, 72, 112, 132	0
1	C	277/307 (90%)	0.68	17 (6%)	21	16	55, 71, 98, 122	0
2	B	284/331 (85%)	1.14	67 (23%)	0	0	65, 120, 156, 164	0
2	D	221/331 (66%)	1.40	59 (26%)	0	0	62, 120, 181, 188	0
All	All	1058/1276 (82%)	0.95	154 (14%)	2	1	55, 85, 160, 188	0

The worst 5 of 154 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	112	LYS	7.3
2	B	14	LEU	6.5
2	D	152	LEU	6.5
2	D	157	VAL	6.4
2	D	268	GLU	5.9

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

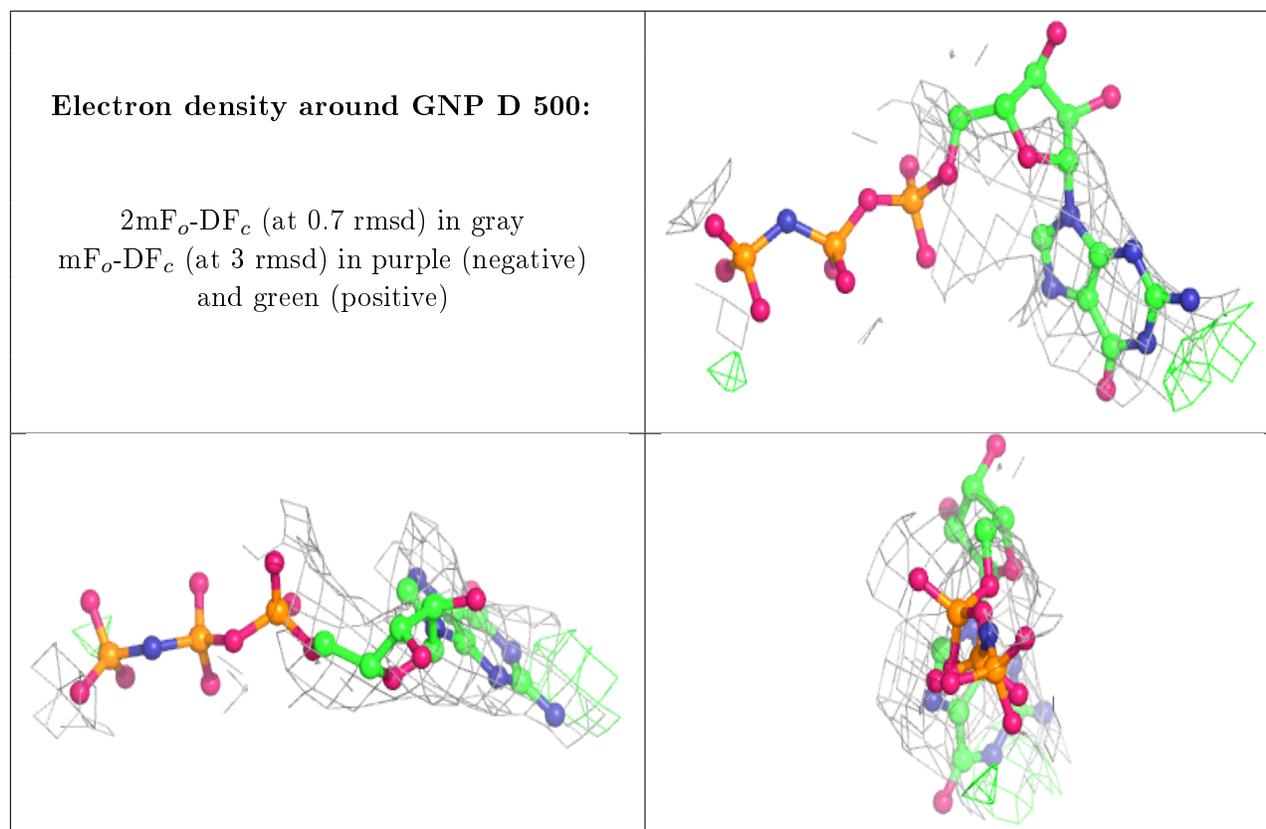There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

There are no carbohydrates in this entry.

6.4 Ligands (i)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($Å^2$)	Q<0.9
4	MG	D	600	1/1	0.30	0.11	198,198,198,198	0
4	MG	B	600	1/1	0.42	0.21	154,154,154,154	0
3	GNP	D	500	32/32	0.74	0.22	165,189,200,203	0
3	GNP	B	500	32/32	0.93	0.13	125,142,154,156	0
4	MG	A	600	1/1	0.94	0.28	62,62,62,62	0
3	GNP	A	500	32/32	0.97	0.23	59,68,73,74	0
4	MG	C	600	1/1	0.98	0.21	63,63,63,63	0
3	GNP	C	500	32/32	0.98	0.23	58,66,74,76	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.
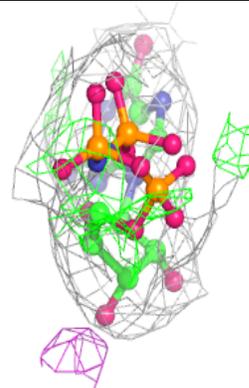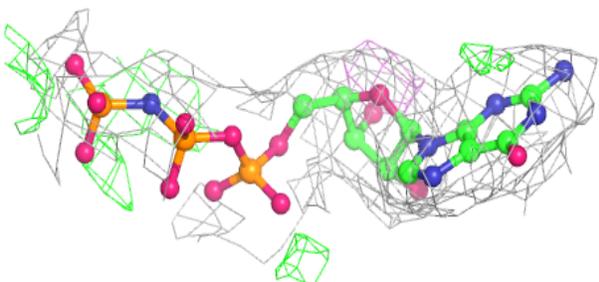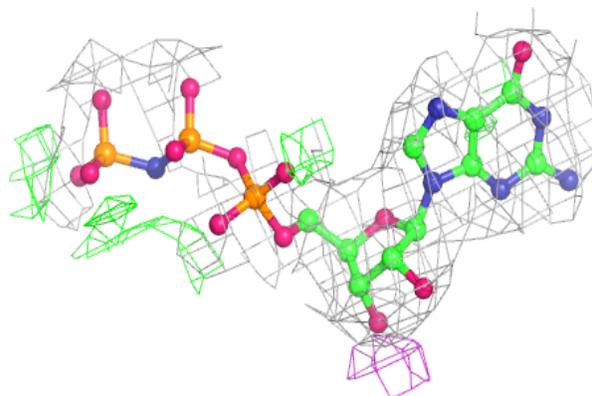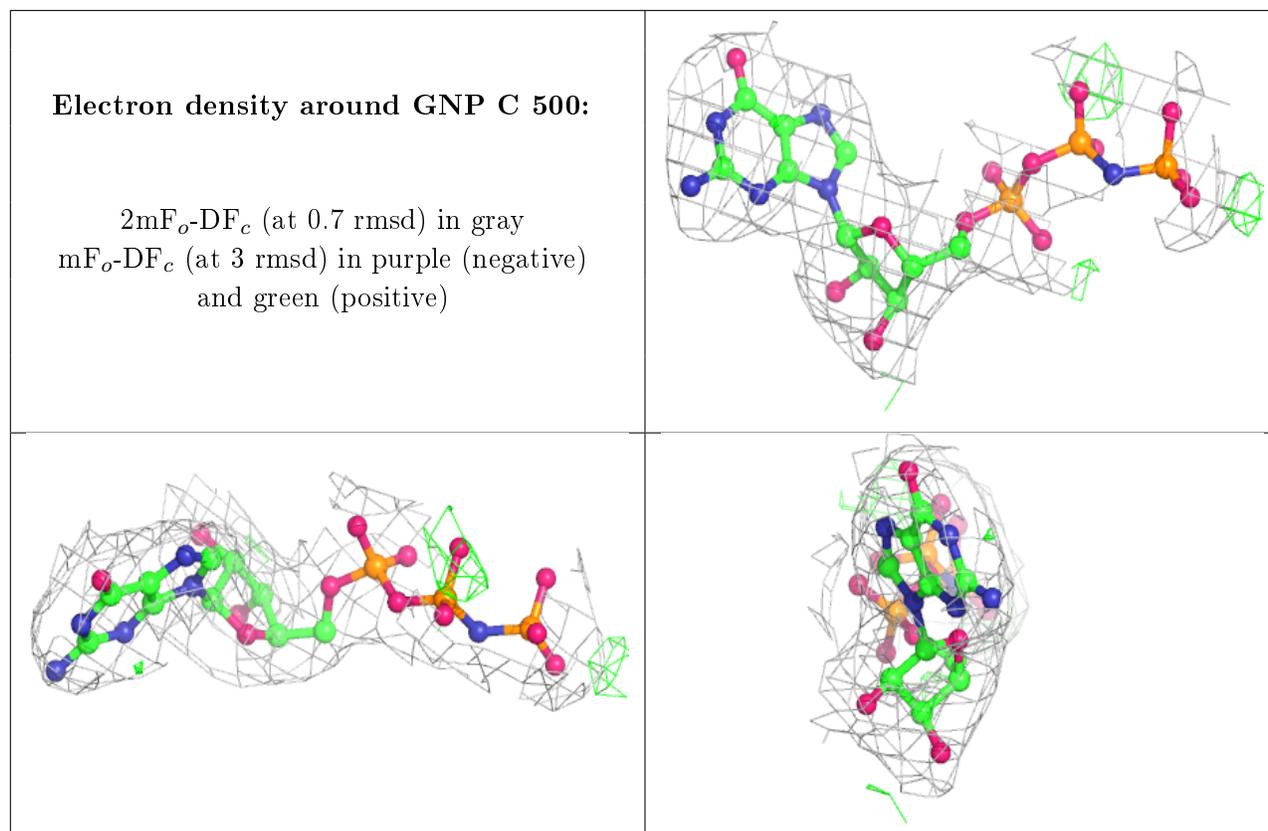
Electron density around GNP D 500:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around GNP B 500:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)
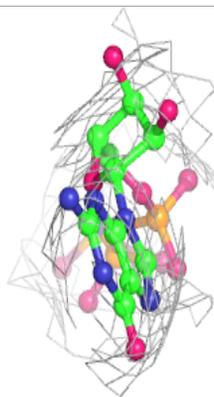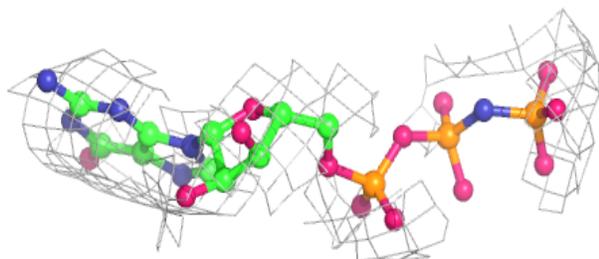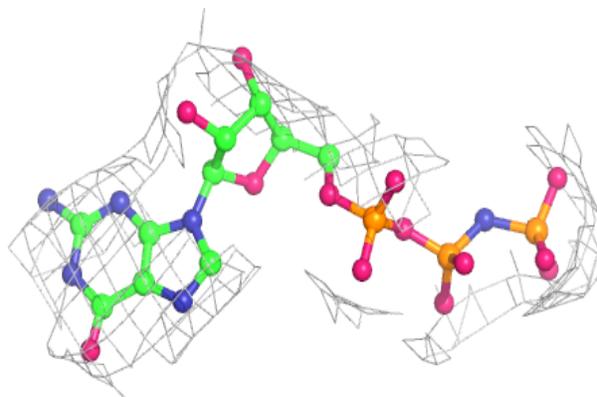
Electron density around GNP A 500:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around GNP C 500:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

6.5 Other polymers ⓘ

There are no such residues in this entry.