W O R L D W I D E
wwPDB
PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 3, 2024 – 08:30 PM EST

PDB ID	:	6MZE
Title	:	Structural Basis of Tubulin Recruitment and Assembly by Microtubule Polymerases with Tumor Overexpressed Gene (TOG) Domain Arrays
Authors	:	Nithianantham, S.; Al-Bassam, J.
Deposited on	:	2018-11-05
Resolution	:	3.60 Å(reported)

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

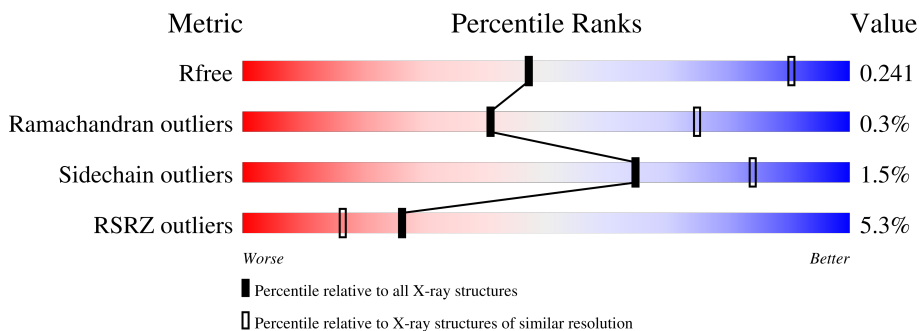|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 3.60 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		0.241
Ramachandran outliers		0.3%
Sidechain outliers		1.5%
RSRZ outliers		5.3%

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	1257 (3.70-3.50)
Ramachandran outliers	138981	1307 (3.70-3.50)
Sidechain outliers	138945	1307 (3.70-3.50)
RSRZ outliers	127900	1161 (3.70-3.50)

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 of 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	451	3% / 93% · 6%
1	C	451	2% / 93% · 6%
1	H	451	% / 92% · 6%
1	J	451	8% / 93% · 6%
1	O	451	12% / 93% · 6%
1	Q	451	93% · 6%

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Mol	Chain	Length	Quality of chain
1	V	451	4% 93% · 6%
1	X	451	9% 93% · 6%
2	B	445	94% · 5%
2	D	445	2% 93% · 5%
2	I	445	2% 93% · 5%
2	K	445	6% 94% · 5%
2	P	445	93% · 5%
2	R	445	% 94% · 5%
2	W	445	% 94% · 5%
2	Y	445	3% 94% · 5%
3	E	536	% 89% · 8%
3	L	536	2% 89% · 8%
3	S	536	3% 88% · 9%
3	Z	536	2% 89% · 8%
4	F	169	3% 92% 8%
4	G	169	4% 92% 8%
4	M	169	29% 92% 8%
4	N	169	31% 92% 8%
4	T	169	29% 92% 8%
4	U	169	92% 8%
4	a	169	32% 91% · 8%
4	b	169	12% 92% 8%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
6	MG	B	601	-	-	-	X
6	MG	R	601	-	-	-	X

2 Entry composition ⓘ

There are 7 unique types of molecules in this entry. The entry contains 77878 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 Tubulin alpha-1A chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	C	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	H	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	J	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	O	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	Q	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	V	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			
1	X	423	Total	C	N	O	S	0	0	0
			3265	2068	553	623	21			

- Molecule 2 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			
2	D	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			
2	I	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			
2	K	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			
2	P	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			
2	R	424	Total	C	N	O	S	0	0	0
			3308	2078	565	639	26			

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	W	424	Total 3308	C 2078	N 565	O 639	S 26	0	0	0
2	Y	424	Total 3308	C 2078	N 565	O 639	S 26	0	0	0

- Molecule 3 is a protein called Protein Stu2p/Alp14p.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	492	Total 3936	C 2521	N 665	O 734	S 16	0	0	0
3	L	491	Total 3924	C 2514	N 661	O 733	S 16	0	0	0
3	S	490	Total 3922	C 2513	N 662	O 731	S 16	0	0	0
3	Z	492	Total 3936	C 2521	N 665	O 734	S 16	0	0	0

- Molecule 4 is a protein called Designed ankyrin repeat protein (DARPIN) D1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	G	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	M	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	N	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	T	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	U	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	a	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0
4	b	155	Total 1135	C 713	N 195	O 224	S 3	0	0	0

- Molecule 5 is GUANOSINE-5'-TRIPHOSPHATE (three-letter code: GTP) (formula: $C_{10}H_{16}N_5O_{14}P_3$).

GTP
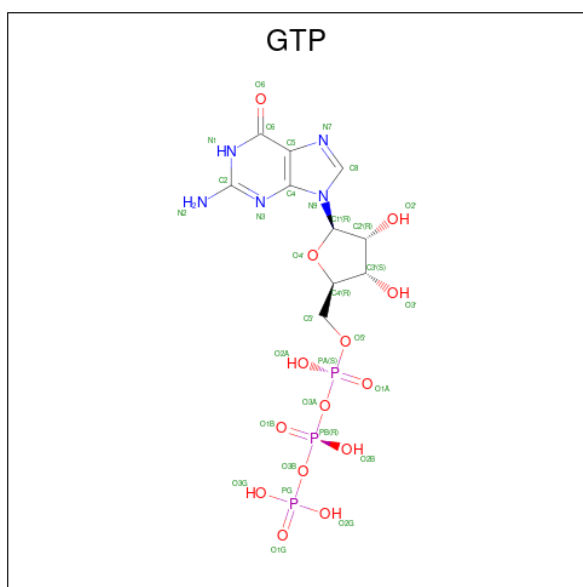
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	C	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	H	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	J	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	O	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	Q	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	V	1	Total	C	N	O	P	0	0
			32	10	5	14	3		
5	X	1	Total	C	N	O	P	0	0
			32	10	5	14	3		

- Molecule 6 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	H	1	Total 1	Mg 1	0	0
6	I	1	Total 1	Mg 1	0	0
6	J	1	Total 1	Mg 1	0	0
6	K	1	Total 1	Mg 1	0	0
6	O	1	Total 1	Mg 1	0	0
6	P	1	Total 1	Mg 1	0	0
6	Q	1	Total 1	Mg 1	0	0
6	R	1	Total 1	Mg 1	0	0
6	V	1	Total 1	Mg 1	0	0
6	W	1	Total 1	Mg 1	0	0
6	X	1	Total 1	Mg 1	0	0
6	Y	1	Total 1	Mg 1	0	0

- Molecule 7 is GUANOSINE-5'-DIPHOSPHATE (three-letter code: GDP) (formula: $C_{10}H_{15}N_5O_{11}P_2$).
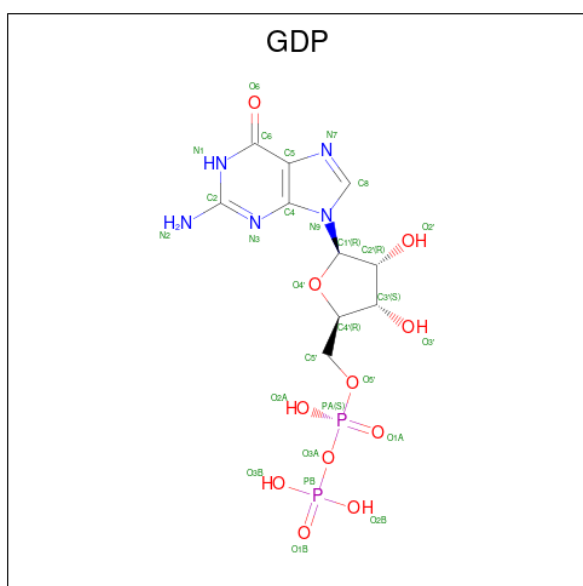
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	B	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	D	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	I	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	K	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	P	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	R	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	W	1	Total	C	N	O	P	0	0
			28	10	5	11	2		
7	Y	1	Total	C	N	O	P	0	0
			28	10	5	11	2		

3 Residue-property plots ⓘ

These plots are drawn for all protein, RNA, DNA and oligosaccharide 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: Tubulin alpha-1A chain
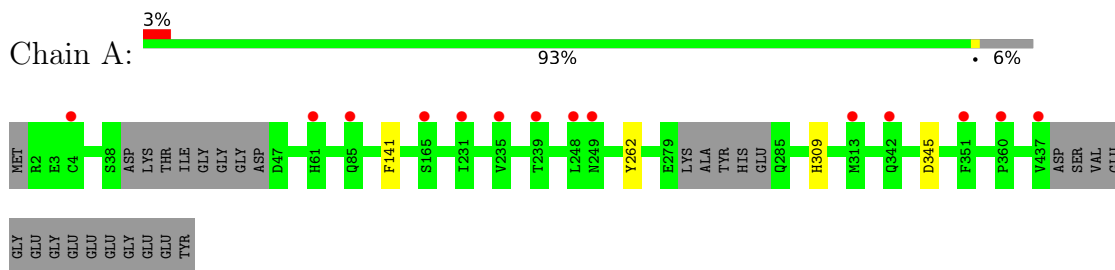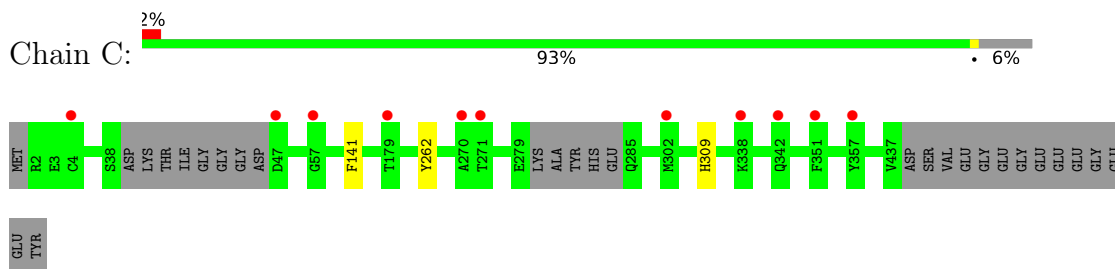
- Molecule 1: Tubulin alpha-1A chain

- Molecule 1: Tubulin alpha-1A chain

- Molecule 1: Tubulin alpha-1A chain
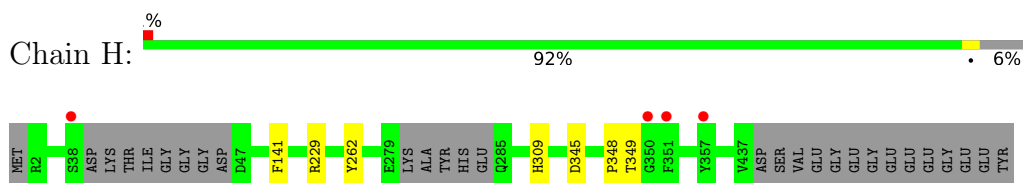
• Molecule 1: Tubulin alpha-1A chain
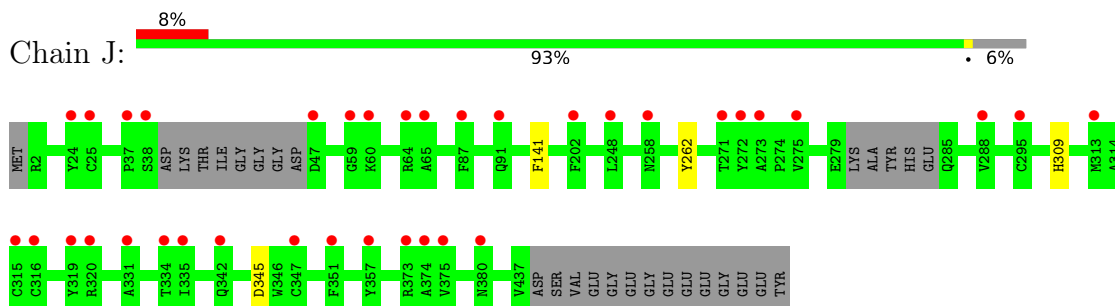
Chain O:

• Molecule 1: Tubulin alpha-1A chain
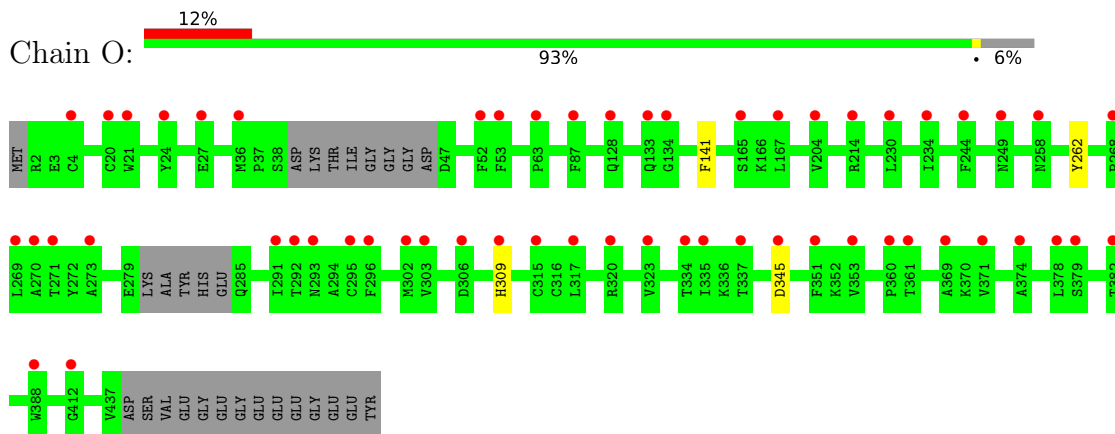
Chain Q:

• Molecule 1: Tubulin alpha-1A chain
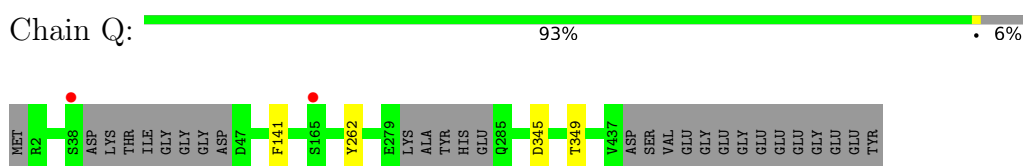
Chain V:
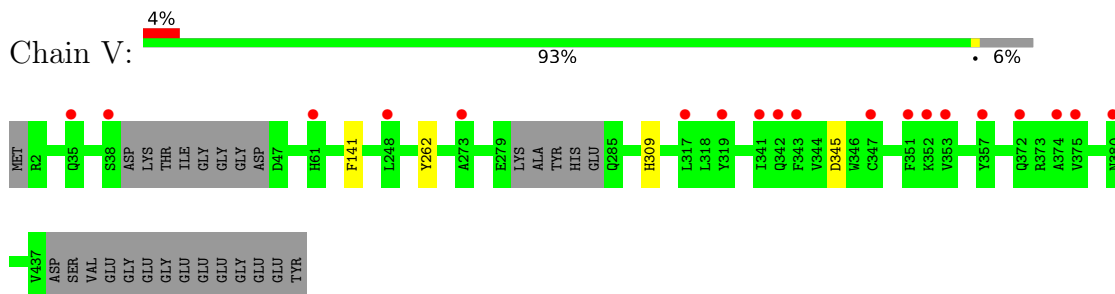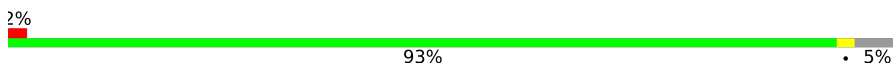
• Molecule 1: Tubulin alpha-1A chain
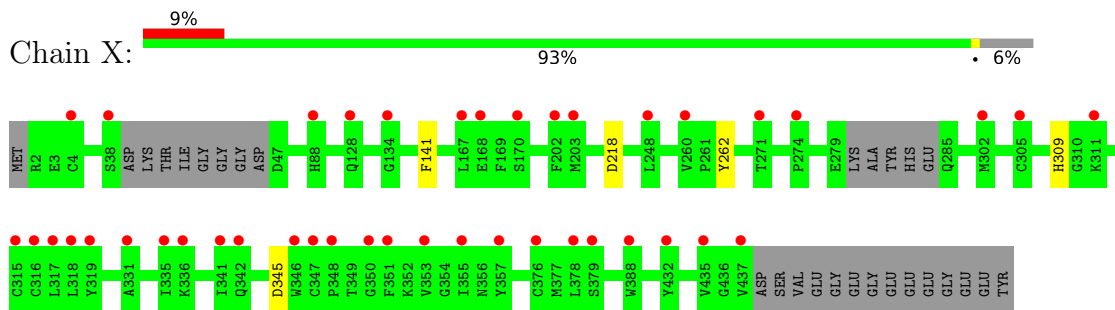
Chain X:

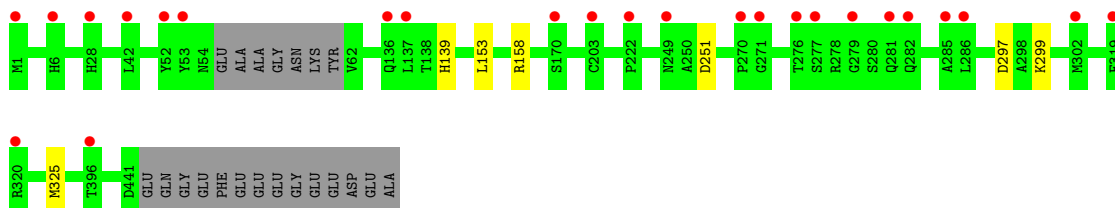• Molecule 2: Tubulin beta chain
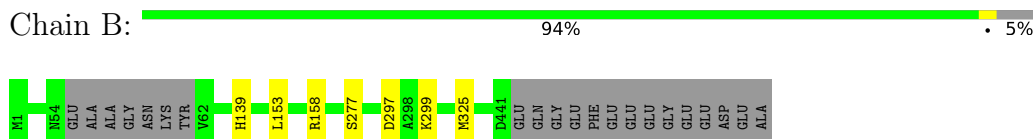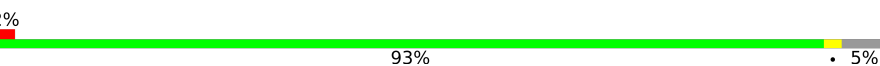
Chain B:

- Molecule 2: Tubulin beta chain

Chain D:

- Molecule 2: Tubulin beta chain
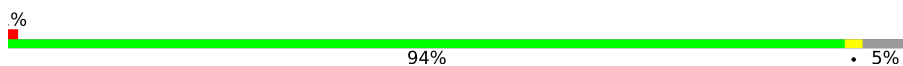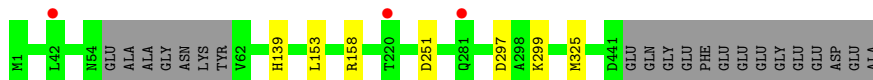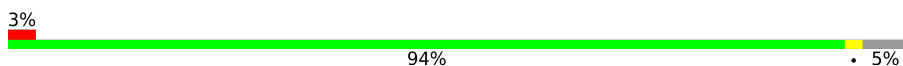
Chain I:

- Molecule 2: Tubulin beta chain

Chain K:

- Molecule 2: Tubulin beta chain
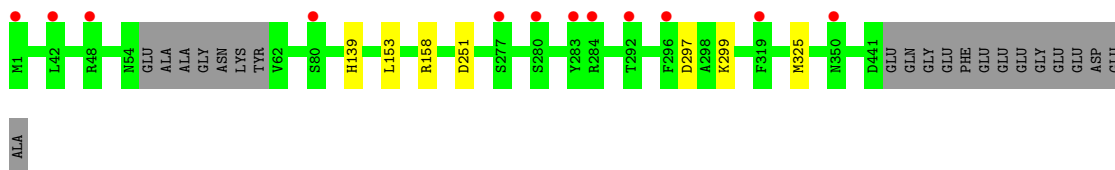
Chain P:

- Molecule 2: Tubulin beta chain
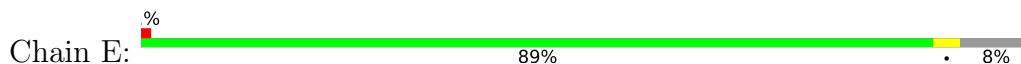
Chain R:

- Molecule 2: Tubulin beta chain

Chain W:

- Molecule 2: Tubulin beta chain

Chain Y:

M1 L42 R48 N54 GLU ALA ALA GLY ASN LYS TYR V62 S80 H139 L153 R158 D251 S277 S280 Y283 R284 T292 F296 D297 A298 K299 F319 M325 N350 D441 GLU GLN GLY PHE GLU GLU GLY GLU GLU ASP GLU

ALA

• **Molecule 3: Protein Stu2p/Alp14p**

Chain E:

%
89%   ·   8%

MET ALA ASP GLN ASP ASP VAL ASP PHE THR THR LEU PRO L14 N35 I43 SER PRO P46 F59 A60 S61 R151 C156 L160 Q207 L217 L221 Q248 Q249 P258 A259 Q260 SER ASP ASN ASN SER THR LEU GLN THR ASP LYS ASP GLY ASP THR LEU

MET GLY N297 D300 C386 D434 D435 C436 L480 L510 K533 V543 ALA THR GLY LEU GLU HIS HIS HIS HIS HIS HIS
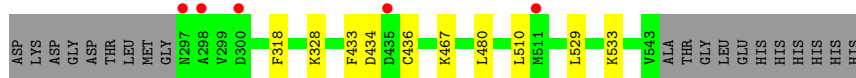
• **Molecule 3: Protein Stu2p/Alp14p**

Chain L:

2%
89%   ·   8%

MET ALA ASP GLN ASP ASP VAL ASP PHE THR THR LEU PRO L14 I43 SER PRO P46 F59 V91 G108 R151 C156 L160 Q207 F212 G213 K214 L252 P258 A259 GLN SER ASP ASN ASN SER THR LEU GLN THR ASP LYS ASP GLY ASP THR LEU MET

GLY N297 V403 D434 D435 C436 Q475 L480 L510 L519 K533 E536 V541 E542 V543 ALA THR GLY LEU GLU HIS HIS HIS HIS HIS HIS

• **Molecule 3: Protein Stu2p/Alp14p**

Chain S:

3%
88%   ·   9%

MET ALA ASP GLN ASP ASP VAL ASP PHE THR THR LEU PRO L14 N35 I43 SER PRO P46 F59 L82 N90 V91 R151 C156 L160 I175 N176 L183 Q207 L217 Q254 W255 A256 V257 P258 ALA GLN SER ASP ASN ASN SER THR LEU GLN THR

ASP LYS ASP GLY ASP THR LEU MET GLY N297 A298 V299 D300 F318 K328 F433 D434 D435 C436 K467 L480 L510 M511 L529 K533 V543 ALA THR GLY LEU GLU HIS HIS HIS HIS HIS HIS

• **Molecule 3: Protein Stu2p/Alp14p**

Chain Z:

2%
89%   ·   8%

MET ALA ASP GLN ASP ASP VAL ASP PHE THR THR LEU PRO L14 A18 A25 Y30 N35 L36 F37 I43 SER PRO P46 F59 L82 N90 R151 C156 L160 S180 Q207 A259 Q260 SER ASP ASN ASN SER THR LEU GLN THR ASP LYS ASP

GLY ASP THR LEU MET GLY N297 A298 V299 D300 R390 G432 G470 L480 L510 L529 K533 E536 V543 ALA THR GLY LEU GLU HIS HIS HIS HIS HIS HIS

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1

Chain F:

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1

Chain G:

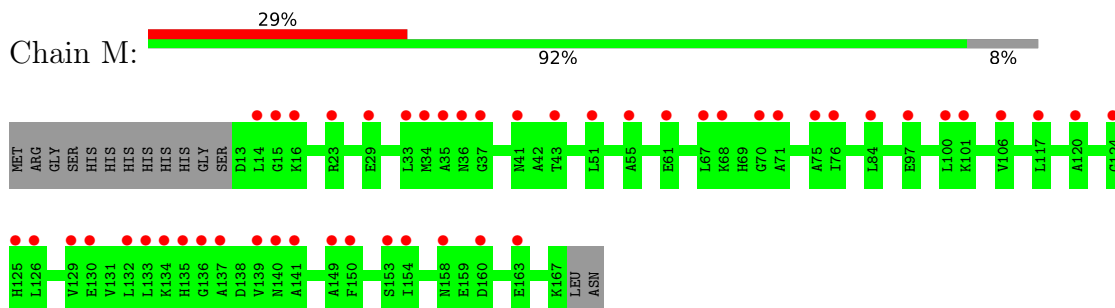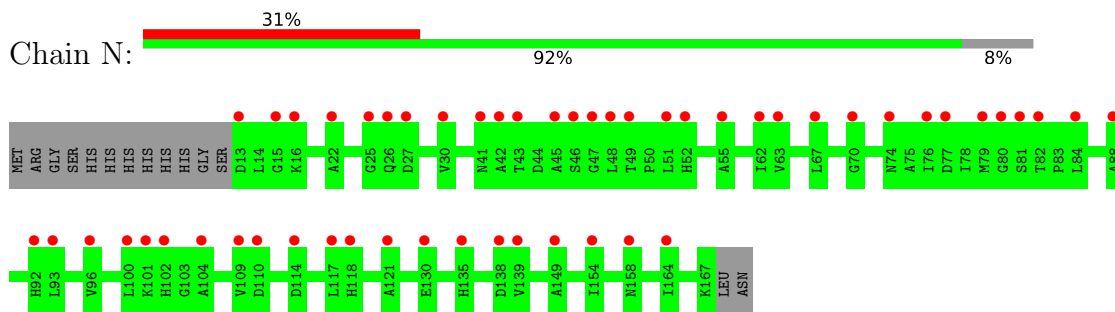• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1
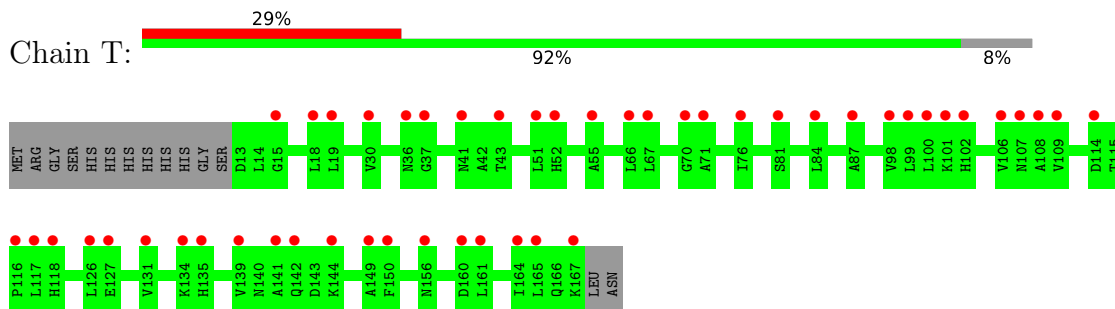
Chain M:

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1
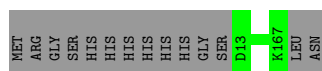
Chain N:

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1

Chain T:

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1

Chain U:

92%   8%

MET ARG GLY SER HIS HIS HIS HIS HIS GLY SER D13 K167 LEU ASN

• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1

Chain a:

32%
91%   8%

MET ARG GLY SER HIS HIS HIS HIS HIS GLY SER D13 L14 G15 L18 A21 A22 R23 Q26 E29 T32 L33 M34 A35 N36 G37 A38 D39 V40 N41 A42 T43 L51 H52 L60 E64 V65 L66 L67 K68 H69 N74 A75 I76 L84 V96 E97

N107 A108 D114 L117 E130 G136 A137 D138 V139 N140 A141 Q142 F150 S153 N158 E159 D160 L161 A162 E163 I164 L165 Q166 K167 LEU ASN
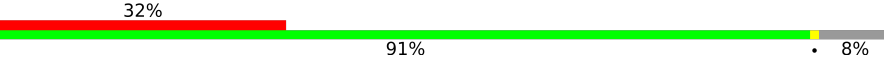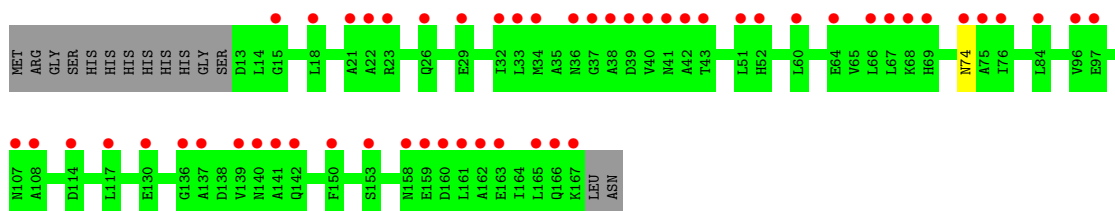
• Molecule 4: Designed ankyrin repeat protein (DARPIN) D1
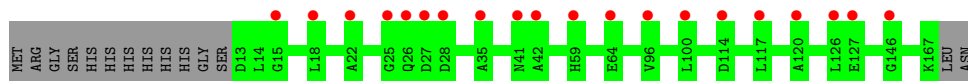
Chain b:

12%
92%   8%

MET ARG GLY SER HIS HIS HIS HIS HIS GLY SER D13 L14 G15 L18 A22 G25 Q26 D27 D28 A35 N41 A42 H59 E64 V96 L100 D114 L117 A120 L126 E127 G146 K167 LEU ASN

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	218.48Å 106.15Å 282.23Å 90.00° 90.39° 90.00°	Depositor
Resolution (Å)	59.45 – 3.60 59.45 – 3.58	Depositor EDS
% Data completeness (in resolution range)	79.4 (59.45-3.60) 79.4 (59.45-3.58)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$< I/\sigma(I) >$ [1]	2.96 (at 3.57Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.202 , 0.245 0.199 , 0.241	Depositor DCC
R_{free} test set	5975 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å^2)	81.4	Xtriage
Anisotropy	0.046	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 92.8	EDS
L-test for twinning[2]	$< |L| > = 0.47, < L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.004 for h,-k,-l	Xtriage
Reported twinning fraction	0.010 for h,-k,-l	Depositor
Outliers	1 of 121943 reflections (0.001%)	Xtriage
F_o,F_c correlation	0.91	EDS
Total number of atoms	77878	wwPDB-VP
Average B, all atoms (Å^2)	98.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.49% of the height of the origin peak. No significant pseudotranslation is detected.*

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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 ⓘ

5.1 Standard geometry ⓘ

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

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	0.24	0/3339	0.41	0/4539
1	C	0.24	0/3339	0.41	0/4539
1	H	0.26	0/3339	0.42	0/4539
1	J	0.24	0/3339	0.41	0/4539
1	O	0.24	0/3339	0.41	0/4539
1	Q	0.24	0/3339	0.41	0/4539
1	V	0.24	0/3339	0.41	0/4539
1	X	0.24	0/3339	0.41	0/4539
2	B	0.26	0/3380	0.43	0/4581
2	D	0.25	0/3380	0.43	0/4581
2	I	0.25	0/3380	0.43	0/4581
2	K	0.25	0/3380	0.43	0/4581
2	P	0.25	0/3380	0.43	0/4581
2	R	0.25	0/3380	0.43	0/4581
2	W	0.26	0/3380	0.44	0/4581
2	Y	0.25	0/3380	0.42	0/4581
3	E	0.28	0/4009	0.50	0/5438
3	L	0.27	0/3997	0.50	0/5423
3	S	0.27	0/3995	0.49	0/5419
3	Z	0.28	0/4009	0.48	0/5438
4	F	0.24	0/1150	0.41	0/1565
4	G	0.24	0/1150	0.41	0/1565
4	M	0.24	0/1150	0.41	0/1565
4	N	0.25	0/1150	0.43	0/1565
4	T	0.23	0/1150	0.41	0/1565
4	U	0.24	0/1150	0.41	0/1565
4	a	0.26	0/1150	0.51	0/1565
4	b	0.24	0/1150	0.41	0/1565
All	All	0.25	0/78962	0.44	0/107198

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts ⓘ

Due to software issues we are unable to calculate clashes - this section is therefore empty.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	417/451 (92%)	389 (93%)	28 (7%)	0	100	100
1	C	417/451 (92%)	389 (93%)	28 (7%)	0	100	100
1	H	417/451 (92%)	387 (93%)	28 (7%)	2 (0%)	29	68
1	J	417/451 (92%)	389 (93%)	28 (7%)	0	100	100
1	O	417/451 (92%)	387 (93%)	30 (7%)	0	100	100
1	Q	417/451 (92%)	388 (93%)	28 (7%)	1 (0%)	47	79
1	V	417/451 (92%)	389 (93%)	28 (7%)	0	100	100
1	X	417/451 (92%)	389 (93%)	28 (7%)	0	100	100
2	B	420/445 (94%)	403 (96%)	16 (4%)	1 (0%)	47	79
2	D	420/445 (94%)	403 (96%)	15 (4%)	2 (0%)	29	68
2	I	420/445 (94%)	402 (96%)	16 (4%)	2 (0%)	29	68
2	K	420/445 (94%)	403 (96%)	16 (4%)	1 (0%)	47	79
2	P	420/445 (94%)	403 (96%)	16 (4%)	1 (0%)	47	79
2	R	420/445 (94%)	404 (96%)	15 (4%)	1 (0%)	47	79
2	W	420/445 (94%)	402 (96%)	16 (4%)	2 (0%)	29	68
2	Y	420/445 (94%)	404 (96%)	15 (4%)	1 (0%)	47	79
3	E	486/536 (91%)	448 (92%)	36 (7%)	2 (0%)	34	71

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
3	L	485/536 (90%)	448 (92%)	35 (7%)	2 (0%)	34	71
3	S	484/536 (90%)	449 (93%)	30 (6%)	5 (1%)	15	55
3	Z	486/536 (91%)	453 (93%)	29 (6%)	4 (1%)	19	59
4	F	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	G	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	M	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	N	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	T	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	U	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
4	a	153/169 (90%)	140 (92%)	12 (8%)	1 (1%)	22	61
4	b	153/169 (90%)	145 (95%)	8 (5%)	0	100	100
All	All	9861/10664 (92%)	9284 (94%)	549 (6%)	28 (0%)	41	75

5 of 28 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	349	THR
2	I	283	TYR
2	W	284	ARG
2	D	284	ARG
3	S	467	LYS

5.3.2   Protein sidechains ⓘ

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	346/377 (92%)	342 (99%)	4 (1%)	71	87
1	C	346/377 (92%)	343 (99%)	3 (1%)	78	90
1	H	346/377 (92%)	341 (99%)	5 (1%)	67	85
1	J	346/377 (92%)	342 (99%)	4 (1%)	71	87
1	O	346/377 (92%)	342 (99%)	4 (1%)	71	87

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	Q	346/377 (92%)	343 (99%)	3 (1%)	78	90
1	V	346/377 (92%)	342 (99%)	4 (1%)	71	87
1	X	346/377 (92%)	341 (99%)	5 (1%)	67	85
2	B	361/381 (95%)	355 (98%)	6 (2%)	60	82
2	D	361/381 (95%)	355 (98%)	6 (2%)	60	82
2	I	361/381 (95%)	355 (98%)	6 (2%)	60	82
2	K	361/381 (95%)	355 (98%)	6 (2%)	60	82
2	P	361/381 (95%)	354 (98%)	7 (2%)	57	80
2	R	361/381 (95%)	355 (98%)	6 (2%)	60	82
2	W	361/381 (95%)	356 (99%)	5 (1%)	67	85
2	Y	361/381 (95%)	355 (98%)	6 (2%)	60	82
3	E	448/488 (92%)	436 (97%)	12 (3%)	44	73
3	L	447/488 (92%)	435 (97%)	12 (3%)	44	73
3	S	447/488 (92%)	436 (98%)	11 (2%)	47	75
3	Z	448/488 (92%)	437 (98%)	11 (2%)	47	75
4	F	116/132 (88%)	116 (100%)	0	100	100
4	G	116/132 (88%)	116 (100%)	0	100	100
4	M	116/132 (88%)	116 (100%)	0	100	100
4	N	116/132 (88%)	116 (100%)	0	100	100
4	T	116/132 (88%)	116 (100%)	0	100	100
4	U	116/132 (88%)	116 (100%)	0	100	100
4	a	116/132 (88%)	116 (100%)	0	100	100
4	b	116/132 (88%)	116 (100%)	0	100	100
All	All	8374/9072 (92%)	8248 (98%)	126 (2%)	65	84

5 of 126 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	L	212	PHE
2	Y	153	LEU
2	P	251	ASP
2	Y	139	HIS
3	Z	156	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
3	E	90	ASN
1	O	216	ASN
3	S	90	ASN
3	Z	249	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 32 ligands modelled in this entry, 16 are monoatomic - leaving 16 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	$\#|Z| > 2$
7	GDP	B	600	6	24,30,30	0.93	1 (4%)	30,47,47	1.11	3 (10%)
5	GTP	J	600	6	26,34,34	1.12	2 (7%)	32,54,54	1.58	7 (21%)
5	GTP	X	600	6	26,34,34	1.13	2 (7%)	32,54,54	1.57	7 (21%)
5	GTP	O	600	6	26,34,34	1.12	2 (7%)	32,54,54	1.58	7 (21%)
5	GTP	C	600	6	26,34,34	1.12	2 (7%)	32,54,54	1.59	7 (21%)
5	GTP	A	600	6	26,34,34	1.13	2 (7%)	32,54,54	1.60	7 (21%)
7	GDP	K	600	6	24,30,30	0.94	1 (4%)	30,47,47	1.09	3 (10%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#|Z| > 2	Counts	RMSZ	#|Z| > 2
7	GDP	D	600	6	24,30,30	0.93	1 (4%)	30,47,47	1.08	3 (10%)
5	GTP	H	600	6	26,34,34	1.18	2 (7%)	32,54,54	2.08	7 (21%)
7	GDP	W	600	6	24,30,30	0.92	1 (4%)	30,47,47	1.08	3 (10%)
5	GTP	V	600	6	26,34,34	1.12	2 (7%)	32,54,54	1.57	7 (21%)
7	GDP	Y	600	6	24,30,30	0.95	1 (4%)	30,47,47	1.08	3 (10%)
7	GDP	R	600	6	24,30,30	0.93	1 (4%)	30,47,47	1.13	3 (10%)
5	GTP	Q	600	6	26,34,34	1.13	2 (7%)	32,54,54	1.60	7 (21%)
7	GDP	I	600	6	24,30,30	0.93	1 (4%)	30,47,47	1.10	3 (10%)
7	GDP	P	600	6	24,30,30	0.92	1 (4%)	30,47,47	1.12	3 (10%)

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
7	GDP	B	600	6	-	3/12/32/32	0/3/3/3
5	GTP	J	600	6	-	2/18/38/38	0/3/3/3
5	GTP	X	600	6	-	3/18/38/38	0/3/3/3
5	GTP	O	600	6	-	3/18/38/38	0/3/3/3
5	GTP	C	600	6	-	2/18/38/38	0/3/3/3
5	GTP	A	600	6	-	2/18/38/38	0/3/3/3
7	GDP	K	600	6	-	3/12/32/32	0/3/3/3
7	GDP	D	600	6	-	3/12/32/32	0/3/3/3
5	GTP	H	600	6	-	2/18/38/38	0/3/3/3
7	GDP	W	600	6	-	4/12/32/32	0/3/3/3
5	GTP	V	600	6	-	1/18/38/38	0/3/3/3
7	GDP	Y	600	6	-	3/12/32/32	0/3/3/3
7	GDP	R	600	6	-	3/12/32/32	0/3/3/3
5	GTP	Q	600	6	-	2/18/38/38	0/3/3/3
7	GDP	I	600	6	-	4/12/32/32	0/3/3/3
7	GDP	P	600	6	-	3/12/32/32	0/3/3/3

The worst 5 of 24 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	600	GTP	C5-C6	-4.03	1.39	1.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	X	600	GTP	C5-C6	-3.99	1.39	1.47
5	V	600	GTP	C5-C6	-3.97	1.39	1.47
5	Q	600	GTP	C5-C6	-3.95	1.39	1.47
5	O	600	GTP	C5-C6	-3.95	1.39	1.47

The worst 5 of 80 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	H	600	GTP	C2-N1-C6	-5.76	114.49	125.10
5	H	600	GTP	C5-C6-N1	4.75	122.34	113.95
5	H	600	GTP	PA-O3A-PB	-4.16	118.57	132.83
5	H	600	GTP	O6-C6-C5	-4.03	116.49	124.37
5	V	600	GTP	PA-O3A-PB	-3.79	119.82	132.83

There are no chirality outliers.

5 of 43 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	600	GTP	PB-O3B-PG-O2G
5	C	600	GTP	PB-O3B-PG-O2G
5	J	600	GTP	PB-O3B-PG-O2G
5	O	600	GTP	PB-O3B-PG-O2G
5	Q	600	GTP	PB-O3B-PG-O2G

There are no ring outliers.

No monomer is involved in short contacts.

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.
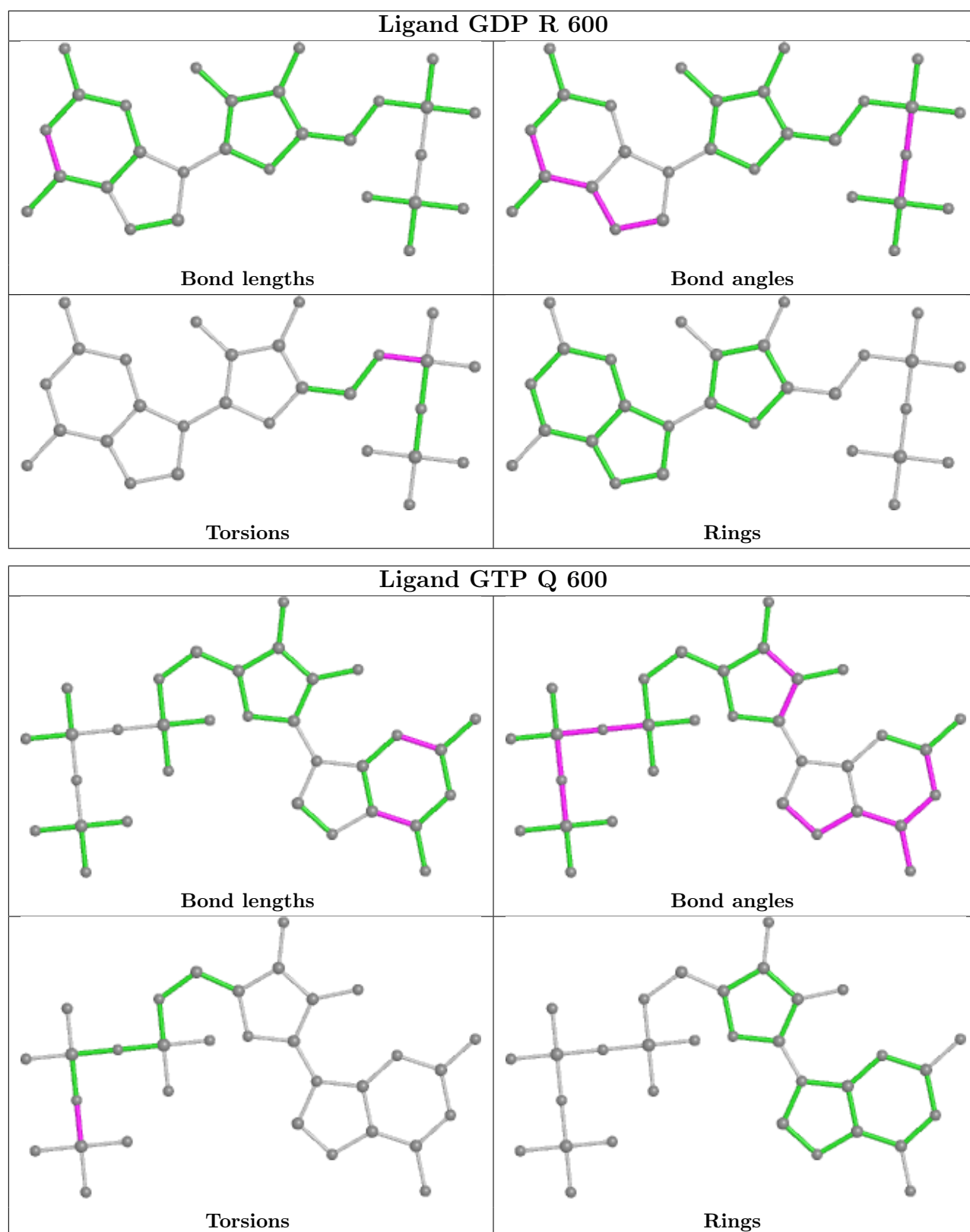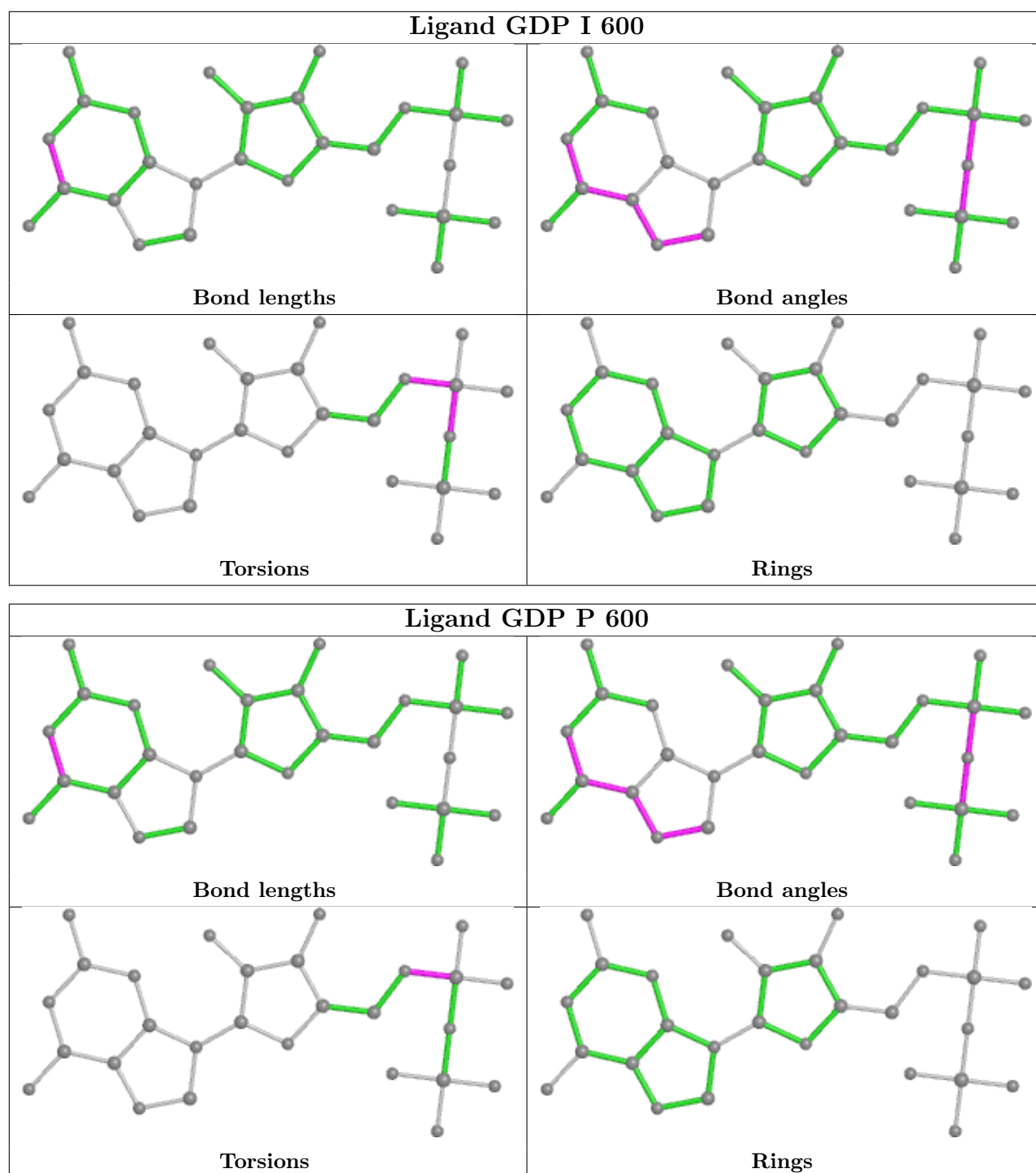
Ligand GDP B 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP J 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP X 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP O 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP C 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP A 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP K 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP D 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP H 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP W 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP V 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP Y 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP R 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GTP Q 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP I 600

Bond lengths

Bond angles

Torsions

Rings

Ligand GDP P 600

Bond lengths

Bond angles

Torsions

Rings

5.7　Other polymers ⓘ

There are no such residues in this entry.

5.8　Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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(Å^2)	Q<0.9
1	A	423/451 (93%)	0.19	14 (3%)	46	31	33, 103, 160, 243	0
1	C	423/451 (93%)	0.15	11 (2%)	56	40	41, 86, 135, 174	0
1	H	423/451 (93%)	-0.08	4 (0%)	84	73	37, 89, 136, 211	0
1	J	423/451 (93%)	0.43	36 (8%)	10	6	55, 131, 206, 260	0
1	O	423/451 (93%)	0.72	56 (13%)	3	2	58, 133, 192, 267	0
1	Q	423/451 (93%)	0.01	2 (0%)	91	83	29, 75, 133, 178	0
1	V	423/451 (93%)	0.14	19 (4%)	33	21	37, 100, 150, 208	0
1	X	423/451 (93%)	0.54	42 (9%)	7	4	45, 116, 179, 304	0
2	B	424/445 (95%)	-0.35	0	100	100	18, 46, 85, 125	0
2	D	424/445 (95%)	-0.03	7 (1%)	70	55	32, 69, 130, 173	0
2	I	424/445 (95%)	0.13	8 (1%)	66	51	50, 101, 146, 187	0
2	K	424/445 (95%)	0.39	25 (5%)	22	13	72, 122, 170, 283	0
2	P	424/445 (95%)	-0.20	1 (0%)	95	91	42, 82, 125, 176	0
2	R	424/445 (95%)	-0.16	3 (0%)	87	78	24, 57, 119, 221	0
2	W	424/445 (95%)	0.11	5 (1%)	79	66	50, 98, 153, 177	0
2	Y	424/445 (95%)	0.16	12 (2%)	53	37	45, 96, 149, 181	0
3	E	492/536 (91%)	0.00	7 (1%)	75	61	27, 72, 123, 153	0
3	L	491/536 (91%)	0.09	10 (2%)	65	49	45, 82, 133, 190	0
3	S	490/536 (91%)	0.10	16 (3%)	46	31	26, 83, 136, 170	0
3	Z	492/536 (91%)	0.16	11 (2%)	62	45	38, 86, 144, 175	0
4	F	155/169 (91%)	0.17	5 (3%)	47	32	44, 75, 132, 171	0
4	G	155/169 (91%)	0.06	6 (3%)	39	25	52, 90, 126, 170	0
4	M	155/169 (91%)	1.50	49 (31%)	0	0	121, 181, 223, 280	0
4	N	155/169 (91%)	1.70	53 (34%)	0	0	103, 129, 145, 158	0

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Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å²)	Q<0.9
4	T	155/169 (91%)	1.46	49 (31%)	0	0	97, 156, 203, 265	0
4	U	155/169 (91%)	-0.17	0	100	100	25, 64, 101, 126	0
4	a	155/169 (91%)	1.67	54 (34%)	0	0	120, 166, 215, 302	0
4	b	155/169 (91%)	0.74	20 (12%)	3	2	89, 148, 200, 245	0
All	All	9981/10664 (93%)	0.22	525 (5%)	26	16	18, 93, 170, 304	0

The worst 5 of 525 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	a	75	ALA	11.0
4	a	76	ILE	9.2
1	X	317	LEU	9.1
4	a	64	GLU	8.3
1	J	59	GLY	6.8

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

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

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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(Å²)	Q<0.9
6	MG	W	601	1/1	0.47	0.20	71,71,71,71	0
6	MG	K	601	1/1	0.48	0.20	72,72,72,72	0
6	MG	R	601	1/1	0.59	0.44	53,53,53,53	0
6	MG	B	601	1/1	0.66	0.54	30,30,30,30	0
6	MG	I	601	1/1	0.70	0.39	89,89,89,89	0
6	MG	D	601	1/1	0.87	0.47	85,85,85,85	0
7	GDP	K	600	28/28	0.87	0.21	94,122,145,151	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å²)	Q<0.9
7	GDP	I	600	28/28	0.90	0.25	70,99,114,116	0
7	GDP	B	600	28/28	0.91	0.31	38,62,78,89	0
5	GTP	O	600	32/32	0.91	0.24	78,99,116,120	0
5	GTP	X	600	32/32	0.91	0.24	58,94,107,113	0
7	GDP	P	600	28/28	0.91	0.25	72,97,119,129	0
6	MG	H	601	1/1	0.92	0.33	64,64,64,64	0
5	GTP	C	600	32/32	0.92	0.24	64,88,100,104	0
5	GTP	J	600	32/32	0.92	0.20	102,113,137,152	0
7	GDP	W	600	28/28	0.92	0.22	81,99,113,120	0
7	GDP	Y	600	28/28	0.92	0.22	76,102,123,125	0
5	GTP	A	600	32/32	0.93	0.24	68,86,100,107	0
6	MG	P	601	1/1	0.93	0.39	83,83,83,83	0
6	MG	Y	601	1/1	0.93	0.17	74,74,74,74	0
5	GTP	Q	600	32/32	0.94	0.23	51,77,95,97	0
5	GTP	V	600	32/32	0.94	0.25	55,88,102,107	0
5	GTP	H	600	32/32	0.94	0.24	58,89,113,117	0
7	GDP	D	600	28/28	0.95	0.23	59,69,102,108	0
7	GDP	R	600	28/28	0.95	0.24	51,72,85,89	0
6	MG	O	601	1/1	0.96	0.30	56,56,56,56	0
6	MG	J	601	1/1	0.97	0.29	95,95,95,95	0
6	MG	C	601	1/1	0.97	0.37	74,74,74,74	0
6	MG	X	601	1/1	0.97	0.33	83,83,83,83	0
6	MG	V	601	1/1	0.98	0.45	52,52,52,52	0
6	MG	Q	601	1/1	0.98	0.32	27,27,27,27	0
6	MG	A	601	1/1	0.98	0.33	62,62,62,62	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.
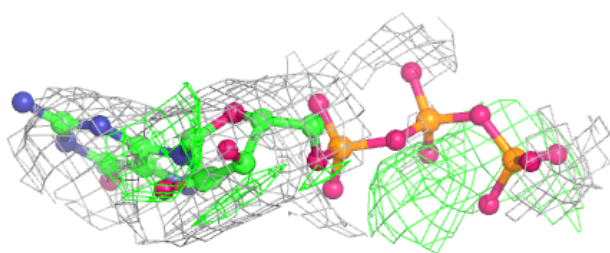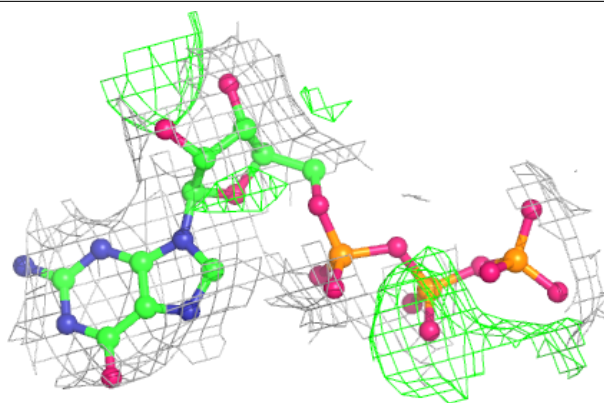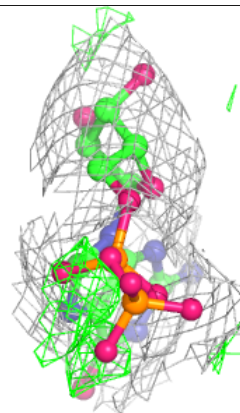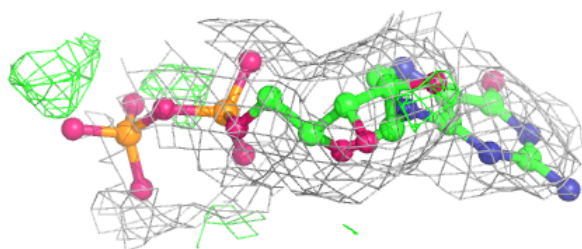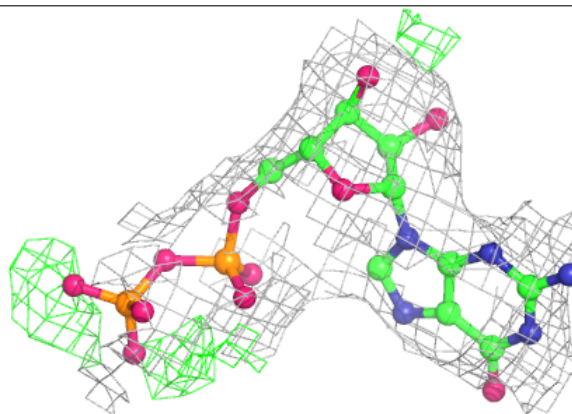
Electron density around GDP K 600:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
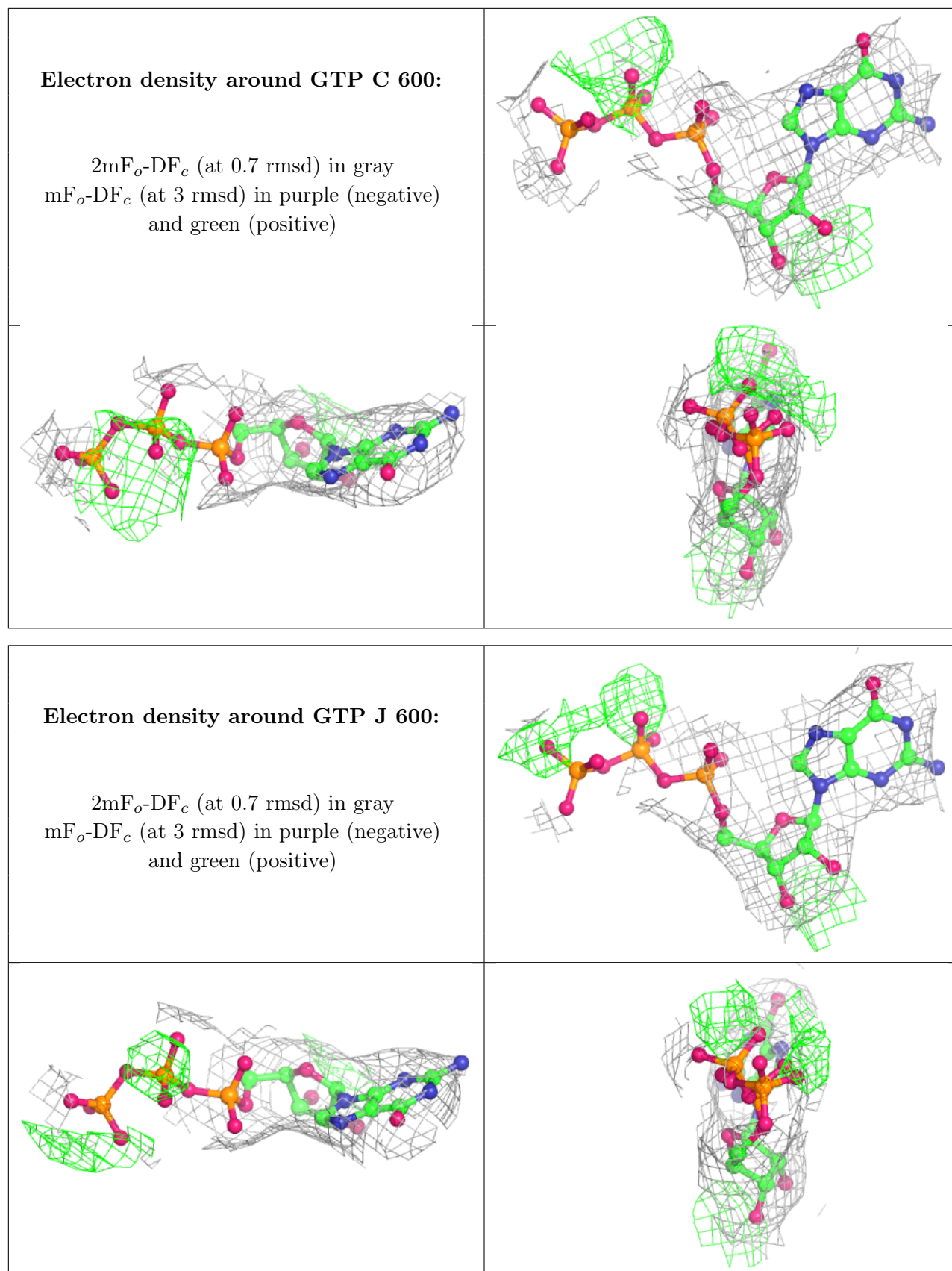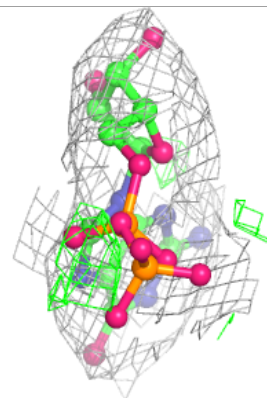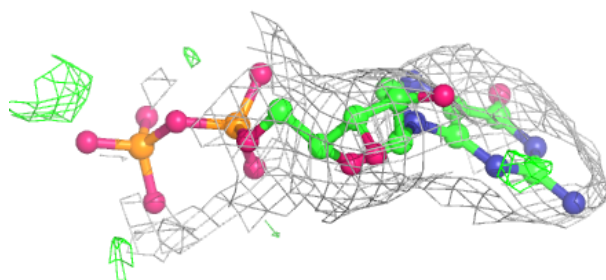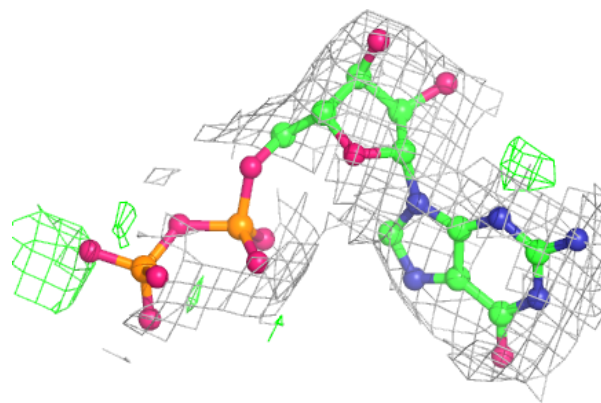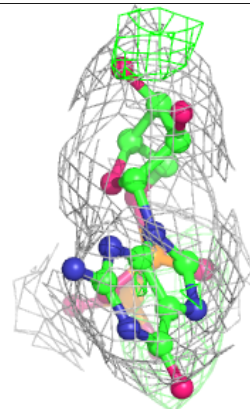mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
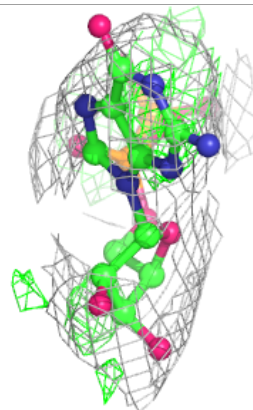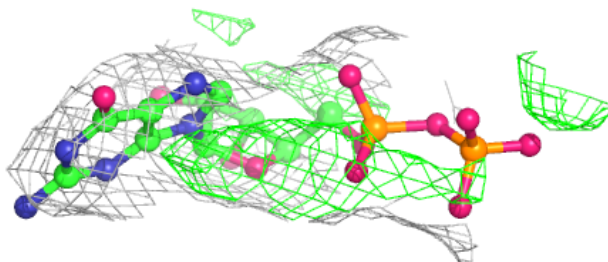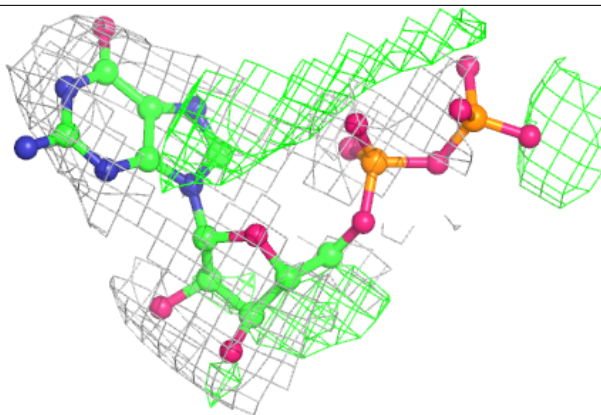
Electron density around GDP I 600:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
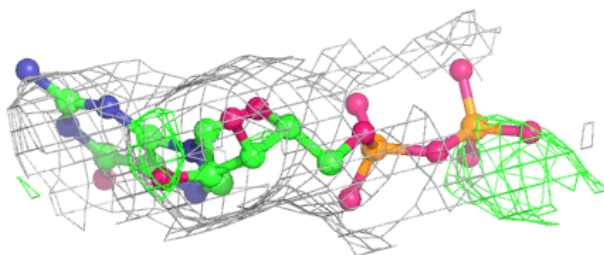mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
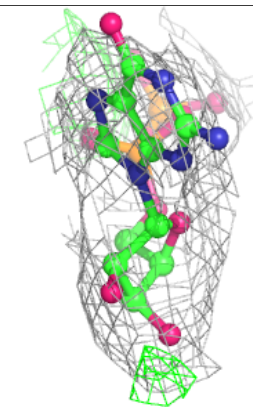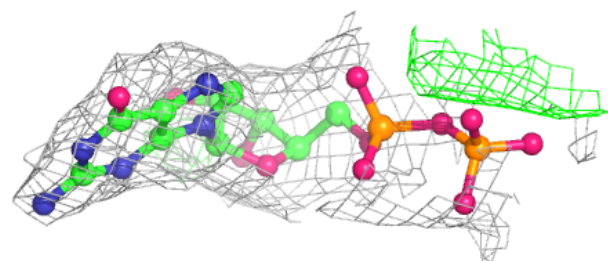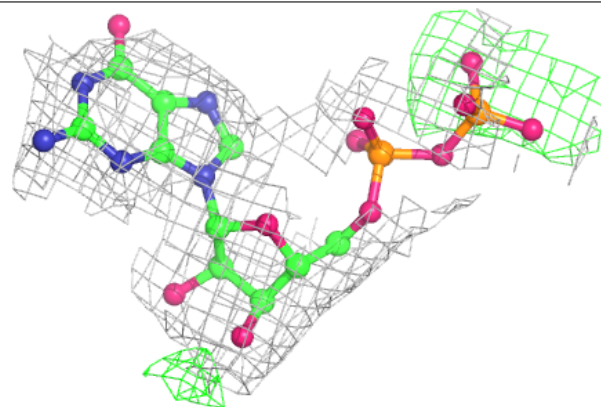
Electron density around GDP B 600:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
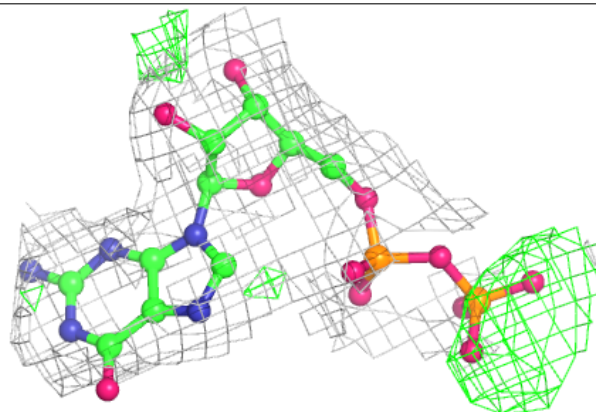and green (positive)
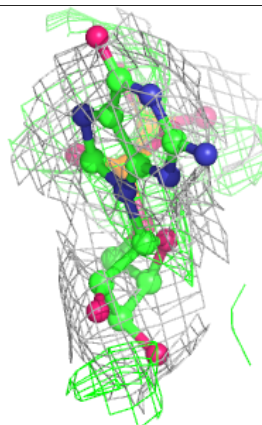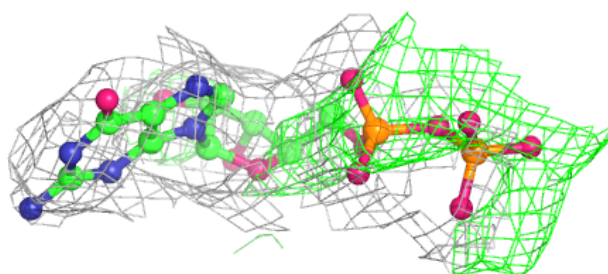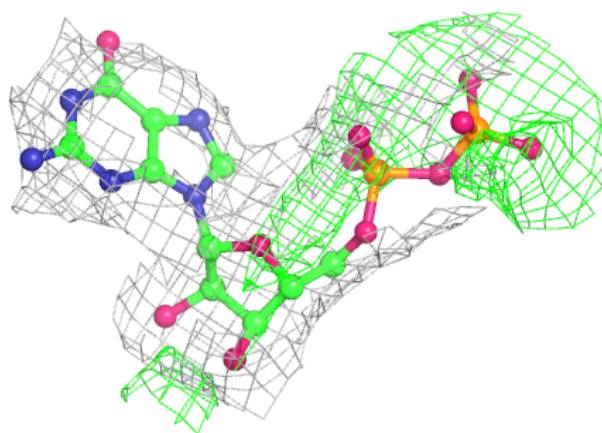
Electron density around GTP O 600:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
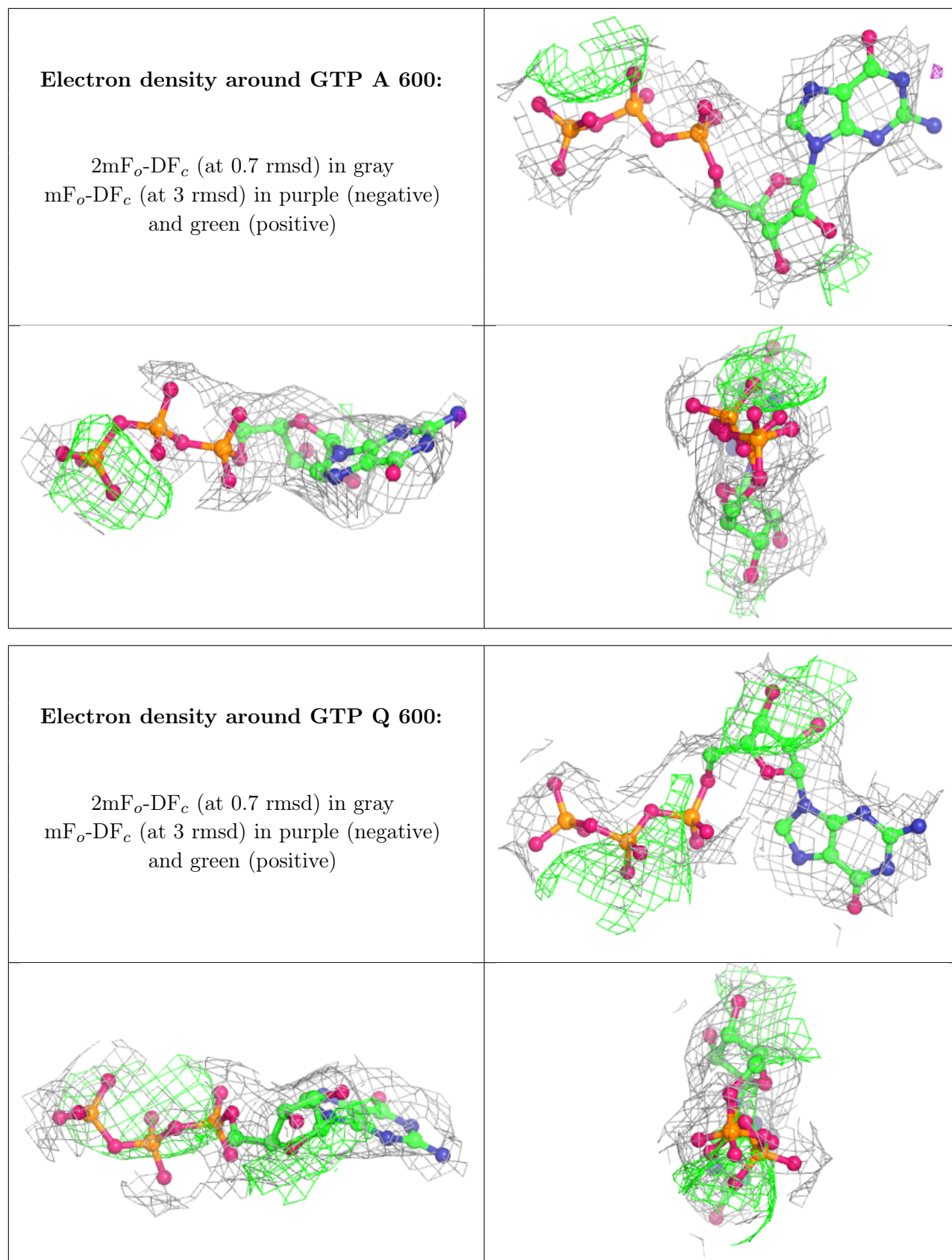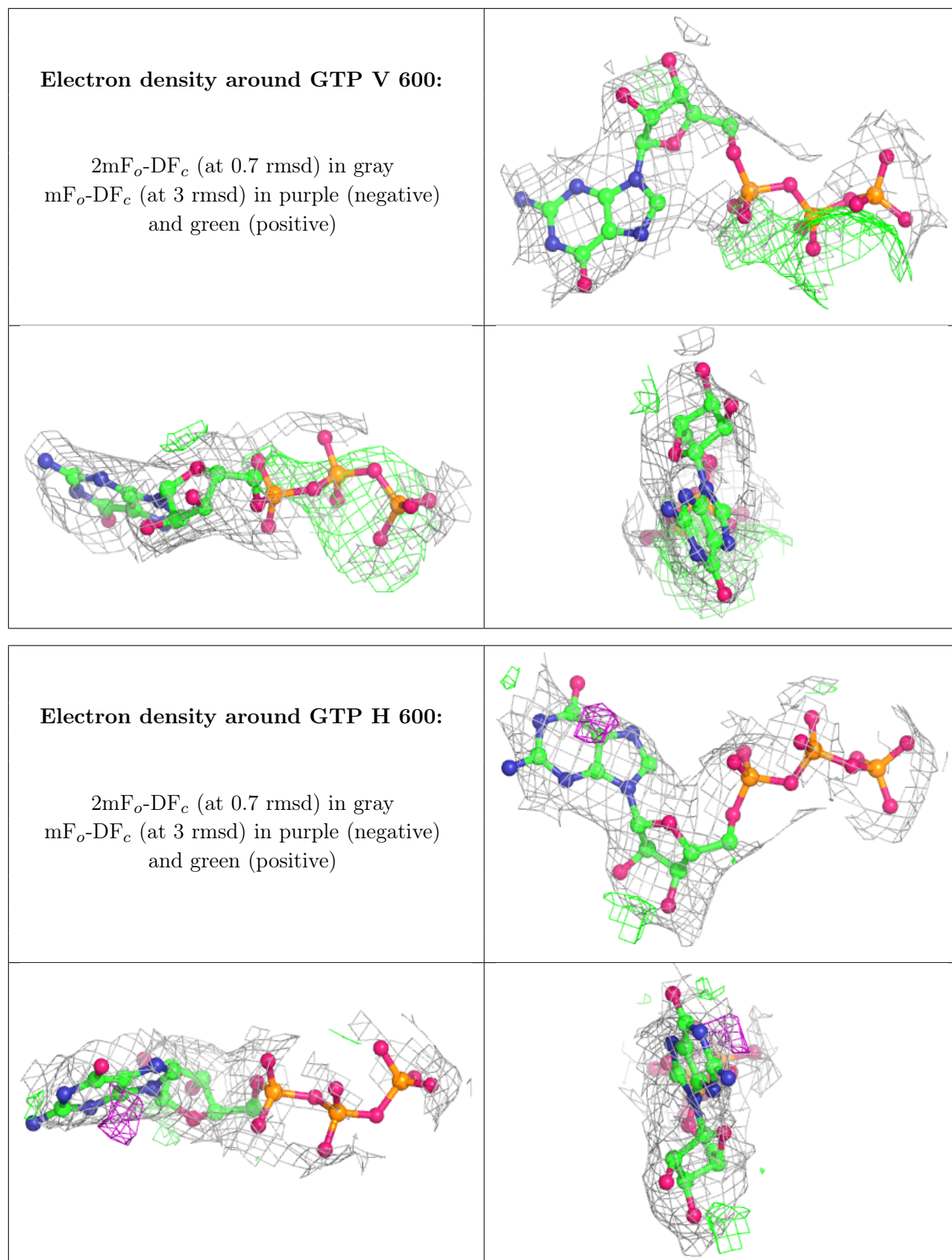mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
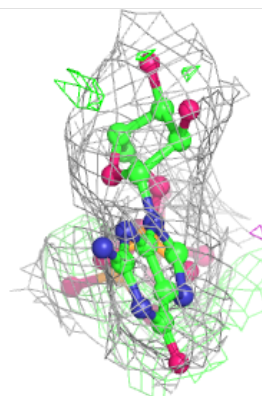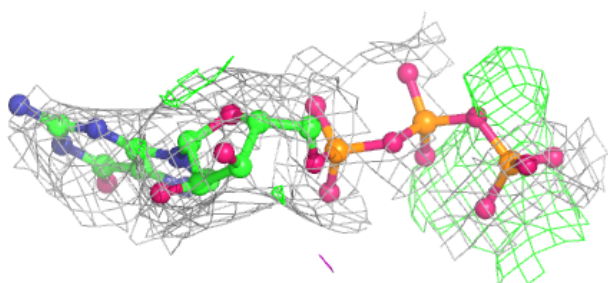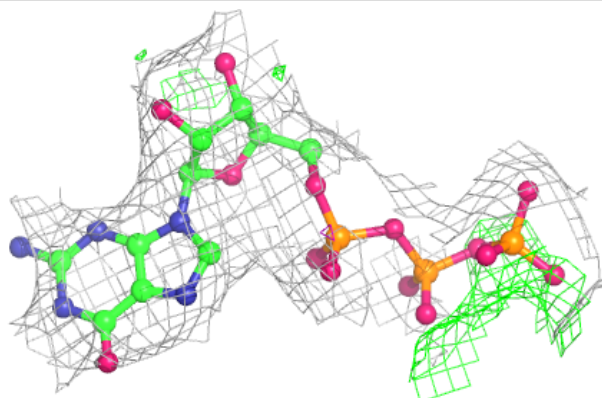
Electron density around GTP X 600:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
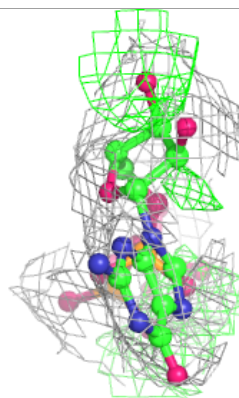
Electron density around GDP P 600:

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

Electron density around GTP C 600:

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

Electron density around GTP J 600:

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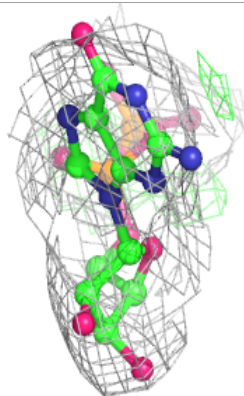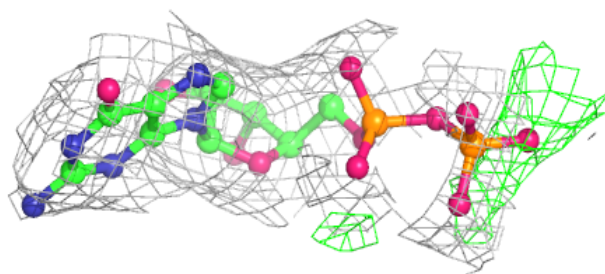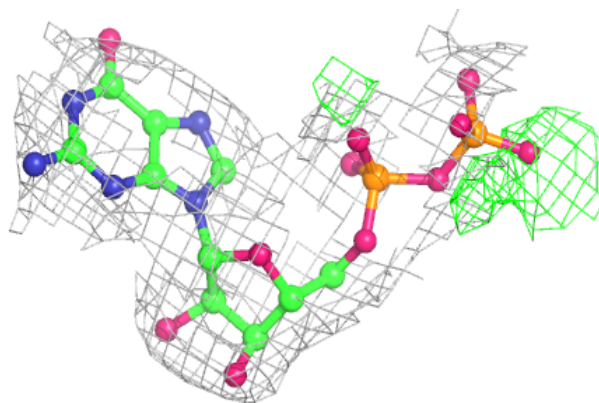and green (positive)

Electron density around GDP W 600:

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

Electron density around GDP Y 600:

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

Electron density around GTP A 600:

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

Electron density around GTP Q 600:

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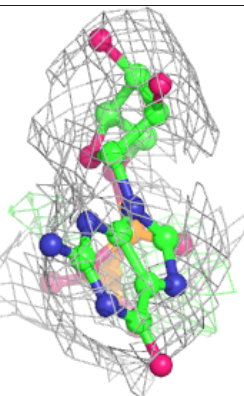$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

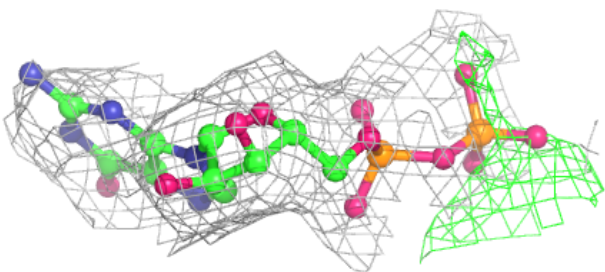**Electron density around GTP V 600:**

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

Electron density around GTP H 600:

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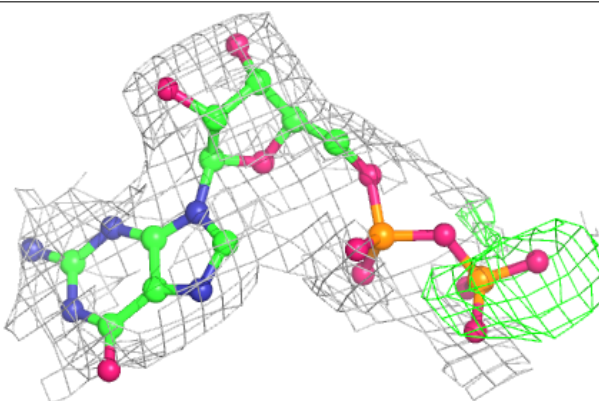$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around GDP D 600:

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

Electron density around GDP R 600:

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

6.5 Other polymers ⓘ

There are no such residues in this entry.