



wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 28, 2020 – 03:09 PM BST

PDB ID : 2XAL
Title : Lead derivative of Inositol 1,3,4,5,6-pentakisphosphate 2-kinase from *A. thaliana* in complex with ADP and IP6.
Authors : Gonzalez, B.; Banos-Sanz, J.I.; Villate, M.; Brearley, C.A.; Sanz-Aparicio, J.
Deposited on : 2010-03-31
Resolution : 3.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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 : 2.14.6
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) : 2.14.6

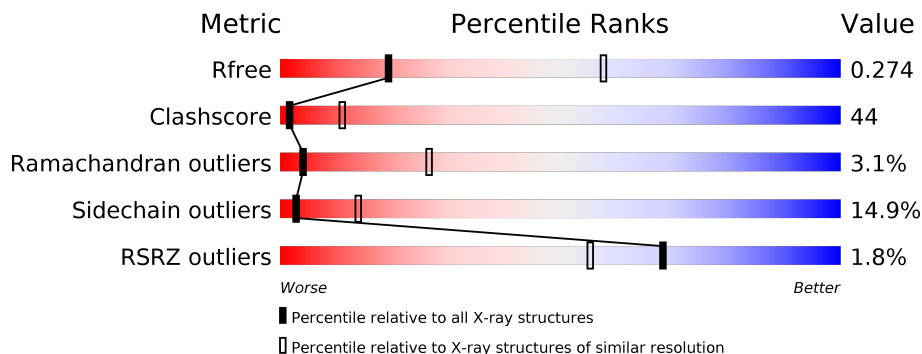
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.20 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))
R_{free}	130704	1133 (3.20-3.20)
Clashscore	141614	1253 (3.20-3.20)
Ramachandran outliers	138981	1234 (3.20-3.20)
Sidechain outliers	138945	1233 (3.20-3.20)
RSRZ outliers	127900	1095 (3.20-3.20)

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 ≥ 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 $\leq 5\%$. 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.

Mol	Chain	Length	Quality of chain
1	A	451	
1	B	451	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 6851 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.

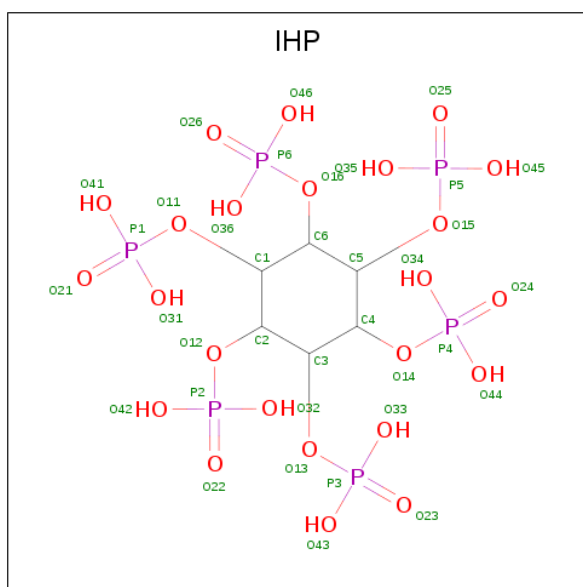
- Molecule 1 is a protein called INOSITOL-PENTAKISPHOSPHATE 2-KINASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	420	3338	2120	565	640	13	0	0	0
1	B	425	3381	2148	574	645	14	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	54	SER	ALA	conflict	UNP Q93YN9
A	90	GLN	LYS	conflict	UNP Q93YN9
A	157	THR	SER	conflict	UNP Q93YN9
A	204	ILE	ASN	conflict	UNP Q93YN9
A	224	ARG	SER	conflict	UNP Q93YN9
A	321	CYS	SER	conflict	UNP Q93YN9
A	325	ILE	LEU	conflict	UNP Q93YN9
A	337	ARG	LYS	conflict	UNP Q93YN9
B	54	SER	ALA	conflict	UNP Q93YN9
B	90	GLN	LYS	conflict	UNP Q93YN9
B	157	THR	SER	conflict	UNP Q93YN9
B	204	ILE	ASN	conflict	UNP Q93YN9
B	224	ARG	SER	conflict	UNP Q93YN9
B	321	CYS	SER	conflict	UNP Q93YN9
B	325	ILE	LEU	conflict	UNP Q93YN9
B	337	ARG	LYS	conflict	UNP Q93YN9

- Molecule 2 is INOSITOL HEXAKISPHOSPHATE (three-letter code: IHP) (formula: $C_6H_{18}O_{24}P_6$).

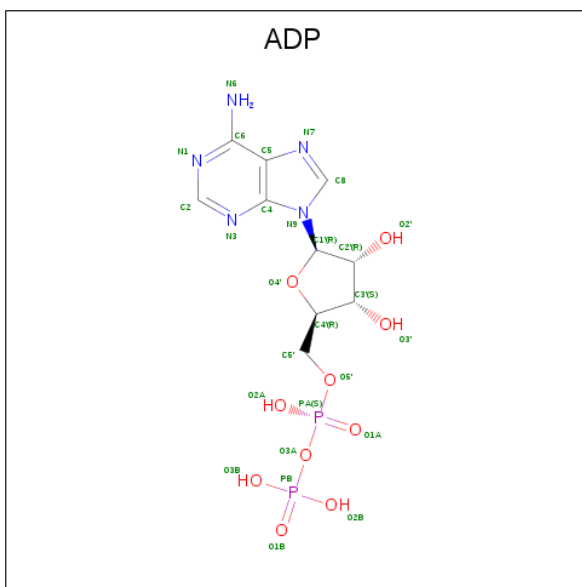


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
2	A	1	Total	C	O	P	0	0
			36	6	24	6		
2	B	1	Total	C	O	P	0	0
			36	6	24	6		

- Molecule 3 is LEAD (II) ION (three-letter code: PB) (formula: Pb).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total	Pb	0	0
			2	2		
3	A	2	Total	Pb	0	0
			2	2		

- Molecule 4 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
4	A	1	Total	C	N	O	P	0	0
			27	10	5	10	2		
4	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		

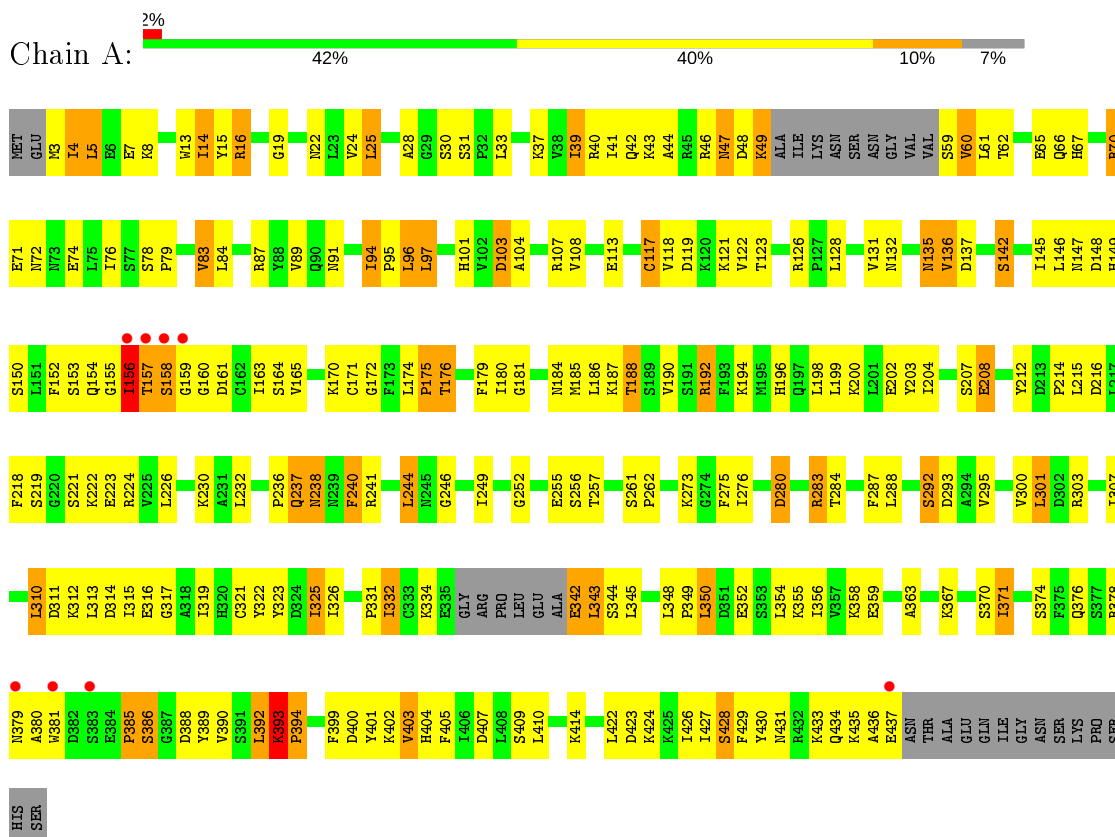
- Molecule 5 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	1	Total	Zn	0	0
			1	1		
5	A	1	Total	Zn	0	0
			1	1		

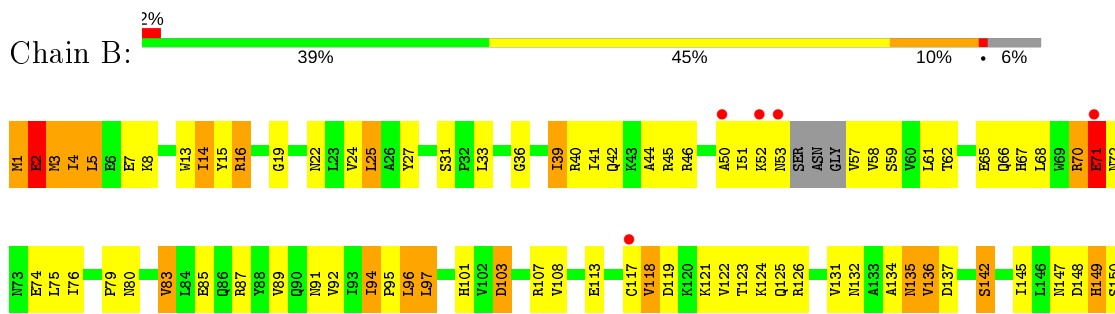
3 Residue-property plots

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: INOSITOL-PENTAKISPHOSPHATE 2-KINASE



- Molecule 1: INOSITOL-PENTAKISPHOSPHATE 2-KINASE



ASN SER LYS PRO SER HIS SER

Q376	S377	R378	R379	A380	TRP	ASP	S383	E384	D388	Y389	V390	S391	L392	K393	F394	T395	N396	Q397	T398	F399	D400	Y401	K402	V403	H404	F405	I406	D407	I408	S409	P412	L413	K414	R415	L422	D423	K424	K425	I426	I427	S428	F429	Y430	K433	Q434	K435	A436	E437	N438	THR	ALA	GLU	GLN	ILE	GLY
L340	D811	K312	L313	D814	I315	E316	G317	A318	I319	H320	C321	Y322	Y323	D824	I325	I326	C330	F331	I332	C333	K334	E335	G336	R337	P338	L339	E340	A341	E342	L343	S344	L345	H346	A347	L348	F349	L350	D851	E352	S353	L354	K355	I356	V357	K358	E359	I362	A363	K367	I371	K372	I373	S374	F375	
F218	S219	G220	S221	K222	E223	R224	Y225	L226	L232	P236	Q237	N238	F240	R241	L244	E255	S256	T257	E269	D270	K273	G274	F275	I276	Q277	S278	E279	D280	G281	H282	R283	T284	E285	C286	F287	L288	S292	V295	Y296	V300	L301	D302	R303	I307											
L151	F152	SER	GLN	GLY	ILE	THR	SER	GLY	GLY	D161	V165	K168	P169	K170	C171	G172	F173	L174	P175	T176	F179	L180	G181	K182	E183	M184	M185	L186	K187	T188	S189	V190	S191	R192	F193	K194	M195	H196	Q197	L198	L199	K200	E202	Y203	I204	S207	E208	Y212	D213	P214	L215	D216	L217		

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	58.06Å 110.97Å 138.69Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	86.71 – 3.20 86.65 – 3.20	Depositor EDS
% Data completeness (in resolution range)	100.0 (86.71-3.20) 99.9 (86.65-3.20)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.11 (at 3.19Å)	Xtrriage
Refinement program	REFMAC 5.5.0066	Depositor
R, R_{free}	0.210 , 0.268 0.214 , 0.274	Depositor DCC
R_{free} test set	768 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å ²)	42.9	Xtrriage
Anisotropy	0.201	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	6851	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 17.27% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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: PB, ZN, IHP, ADP

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	0.56	0/3400	0.66	0/4584
1	B	0.56	0/3441	0.65	0/4637
All	All	0.56	0/6841	0.66	0/9221

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 [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	3338	0	3344	263	3
1	B	3381	0	3406	358	4
2	A	36	0	6	1	0
2	B	36	0	6	5	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	27	0	12	4	0
4	B	27	0	12	4	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
All	All	6851	0	6786	604	4

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 44.

The worst 5 of 604 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:46:ARG:HH12	1:B:182:LYS:CG	1.14	1.58
1:B:52:LYS:HA	1:B:57:VAL:O	1.20	1.38
1:B:280:ASP:HB2	1:B:282:HIS:CD2	1.56	1.38
1:A:46:ARG:NH1	1:B:182:LYS:CG	1.86	1.37
1:A:46:ARG:NH1	1:B:182:LYS:HG3	1.36	1.37

All (4) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:312:LYS:NZ	1:B:202:GLU:CG[1_455]	1.84	0.36
1:B:124:LYS:NZ	1:B:273:LYS:O[4_556]	1.87	0.33
1:A:312:LYS:NZ	1:B:202:GLU:CD[1_455]	2.04	0.16
1:A:381:TRP:CE3	1:B:223:GLU:OE1[3_655]	2.15	0.05

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	414/451 (92%)	366 (88%)	34 (8%)	14 (3%)	3	24
1	B	417/451 (92%)	374 (90%)	31 (7%)	12 (3%)	4	28
All	All	831/902 (92%)	740 (89%)	65 (8%)	26 (3%)	4	26

5 of 26 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	156	ILE

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Mol	Chain	Res	Type
1	A	161	ASP
1	A	343	LEU
1	A	386	SER
1	A	393	LYS

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	374/399 (94%)	322 (86%)	52 (14%)	3 16
1	B	379/399 (95%)	319 (84%)	60 (16%)	2 12
All	All	753/798 (94%)	641 (85%)	112 (15%)	3 14

5 of 112 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	414	LYS
1	B	51	ILE
1	B	374	SER
1	B	1	MET
1	B	5	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 21 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	404	HIS
1	B	53	ASN
1	B	282	HIS
1	A	376	GLN
1	B	376	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 6 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
4	ADP	A	600	3	24,29,29	1.04	2 (8%)	29,45,45	1.39	4 (13%)
4	ADP	B	600	3	24,29,29	1.01	1 (4%)	29,45,45	1.51	6 (20%)
2	IHP	B	500	3	36,36,36	0.82	0	54,60,60	1.37	11 (20%)
2	IHP	A	500	3	36,36,36	0.73	0	54,60,60	1.23	7 (12%)

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
4	ADP	A	600	3	-	0/12/32/32	0/3/3/3
4	ADP	B	600	3	-	4/12/32/32	0/3/3/3
2	IHP	B	500	3	-	10/30/54/54	0/1/1/1
2	IHP	A	500	3	-	8/30/54/54	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	600	ADP	C5-C4	2.64	1.47	1.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	600	ADP	C5-C4	2.58	1.47	1.40
4	A	600	ADP	C2'-C1'	-2.15	1.50	1.53

The worst 5 of 28 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	600	ADP	PA-O3A-PB	-3.50	120.82	132.83
4	A	600	ADP	N3-C2-N1	-3.42	123.33	128.68
4	B	600	ADP	N3-C2-N1	-3.01	123.97	128.68
4	A	600	ADP	C1'-N9-C4	-2.97	121.43	126.64
4	A	600	ADP	PA-O3A-PB	-2.77	123.33	132.83

There are no chirality outliers.

5 of 22 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	500	IHP	C3-O13-P3-O23
2	B	500	IHP	C6-O16-P6-O36
4	B	600	ADP	C5'-O5'-PA-O3A
2	A	500	IHP	C5-O15-P5-O25
2	A	500	IHP	C3-O13-P3-O23

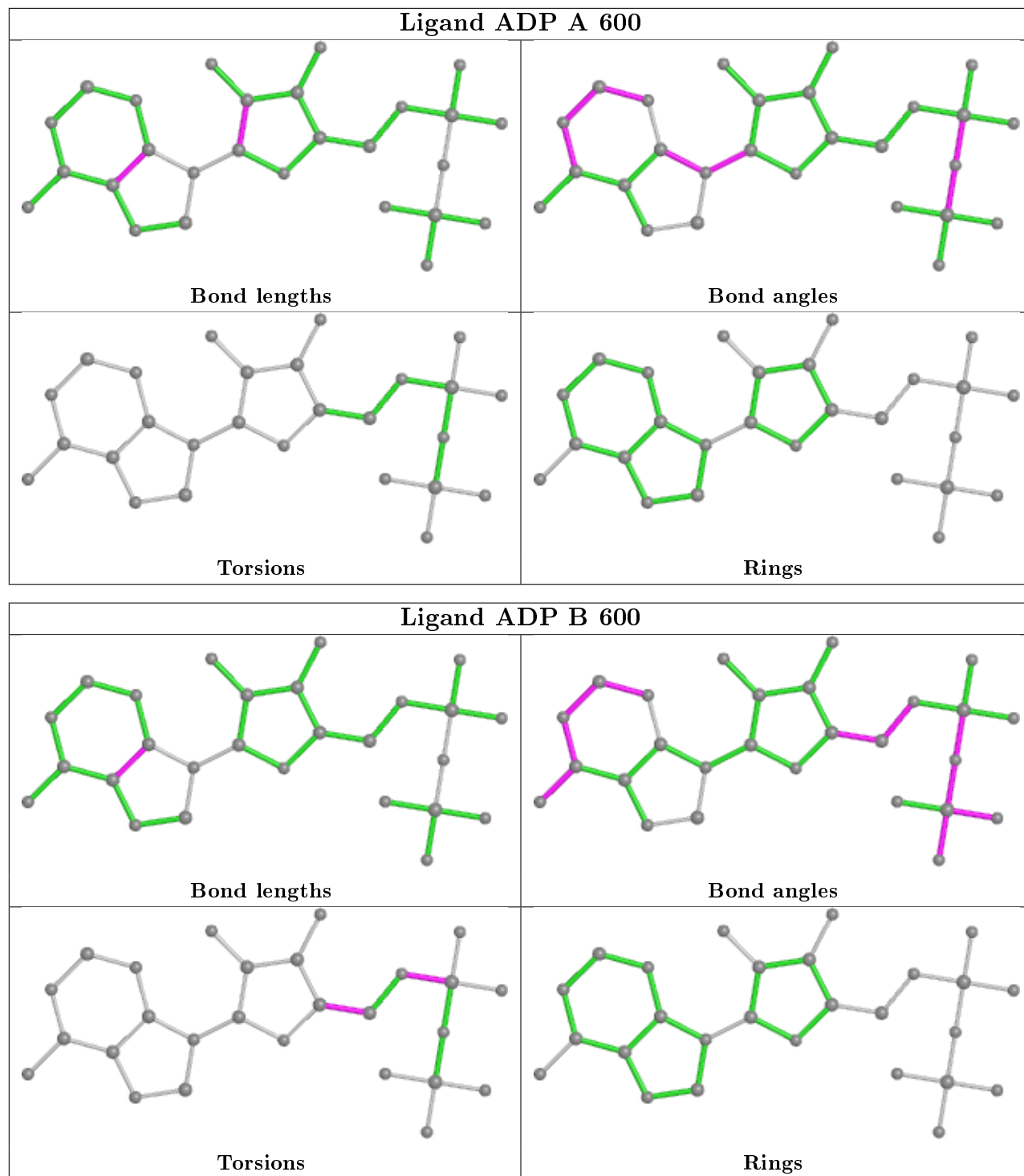
There are no ring outliers.

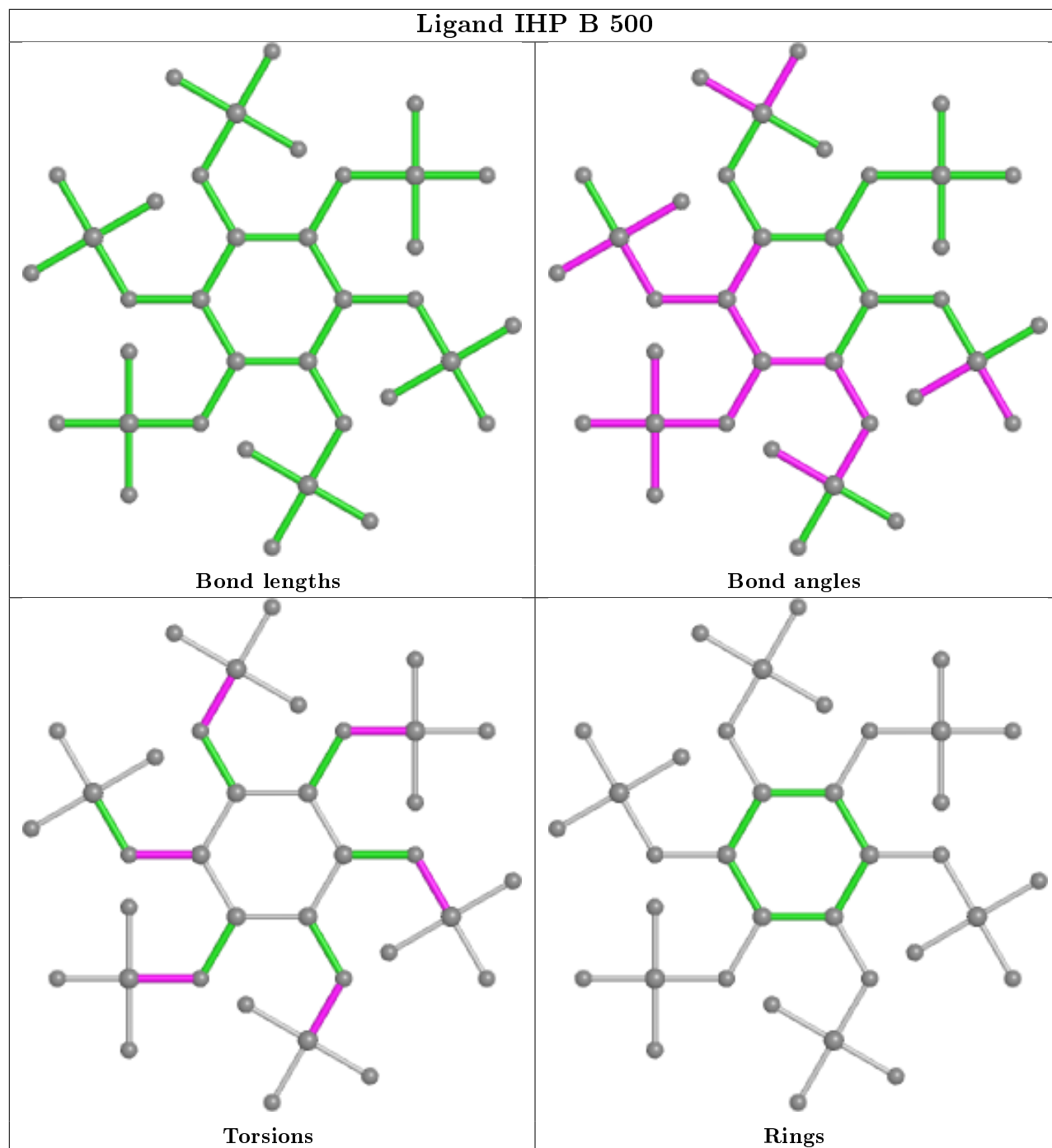
4 monomers are involved in 14 short contacts:

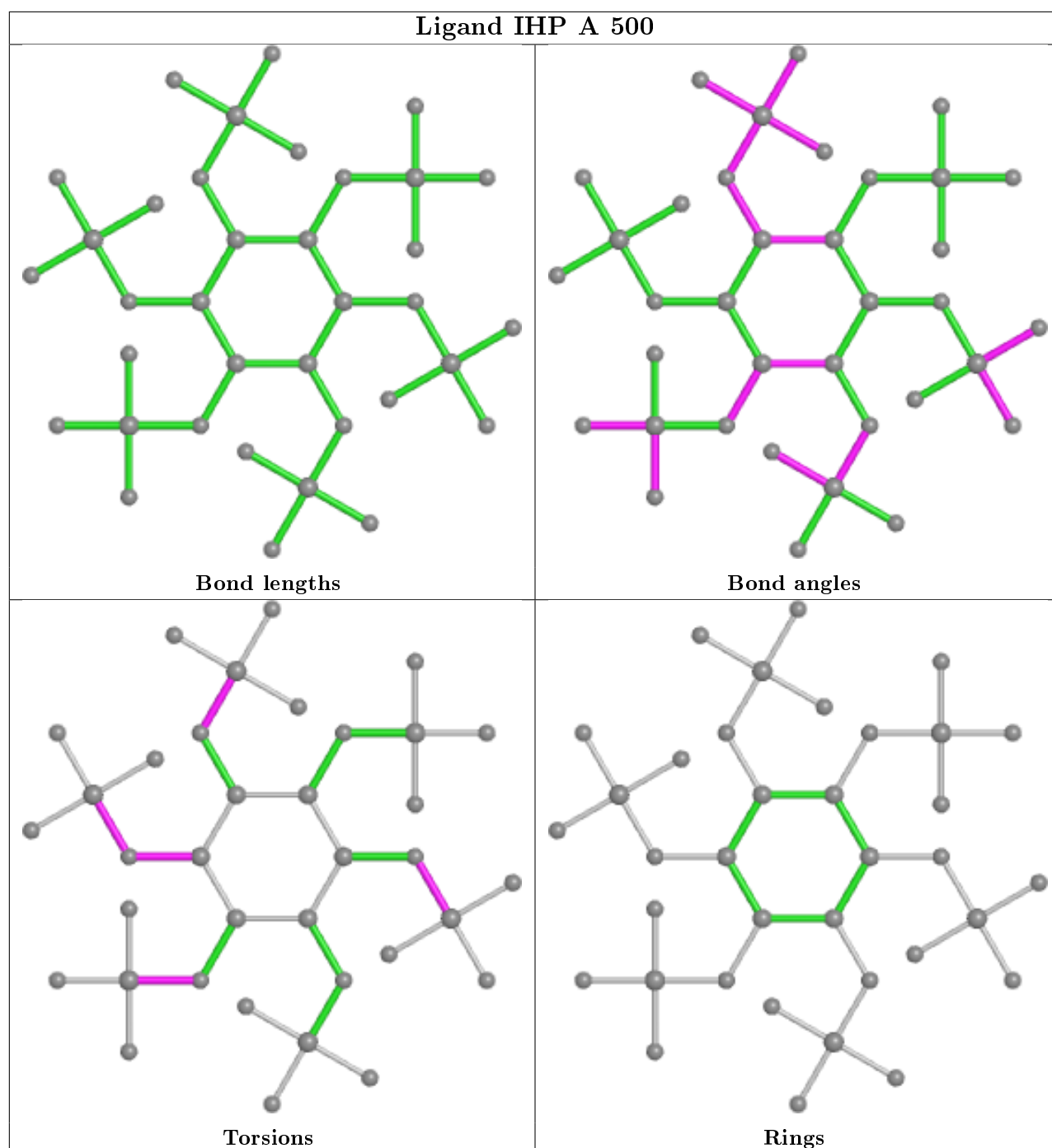
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	600	ADP	4	0
4	B	600	ADP	4	0
2	B	500	IHP	5	0
2	A	500	IHP	1	0

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 than 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.







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(Å ²)	Q<0.9
1	A	420/451 (93%)	-0.13	8 (1%) 66 53	9, 21, 41, 54	0
1	B	425/451 (94%)	0.02	7 (1%) 72 59	9, 20, 41, 62	0
All	All	845/902 (93%)	-0.05	15 (1%) 68 55	9, 21, 41, 62	0

The worst 5 of 15 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	159	GLY	3.1
1	A	383	SER	3.0
1	A	437	GLU	2.9
1	A	379	ASN	2.8
1	B	396	ASN	2.5

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 monosaccharides in this entry.

6.4 Ligands [i](#)

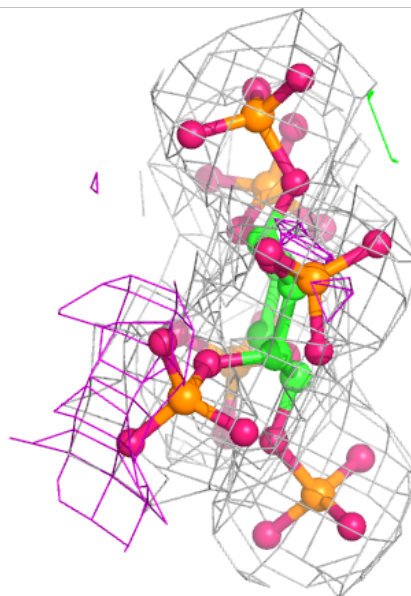
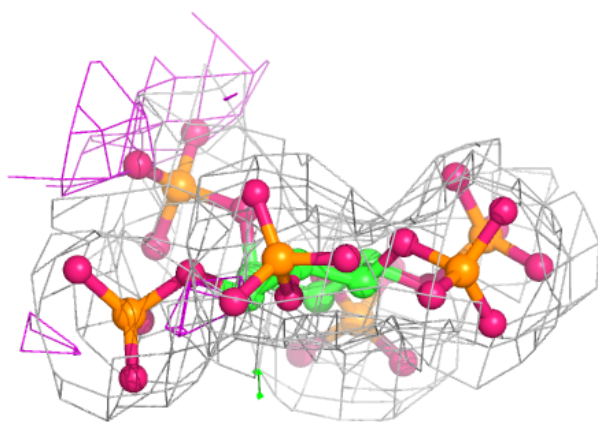
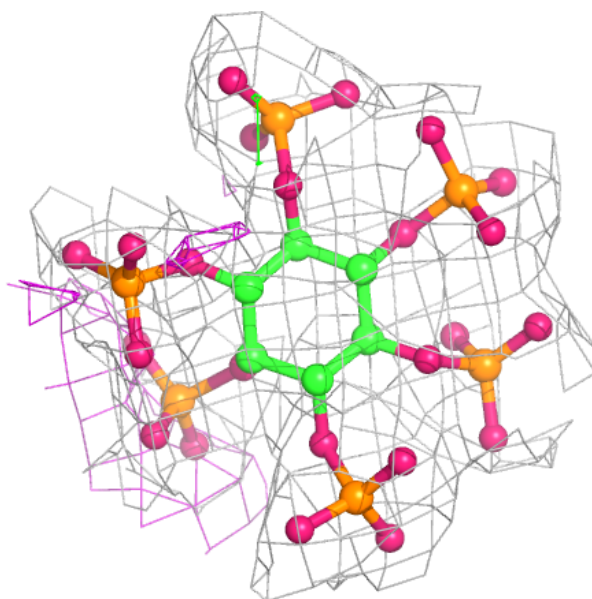
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists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

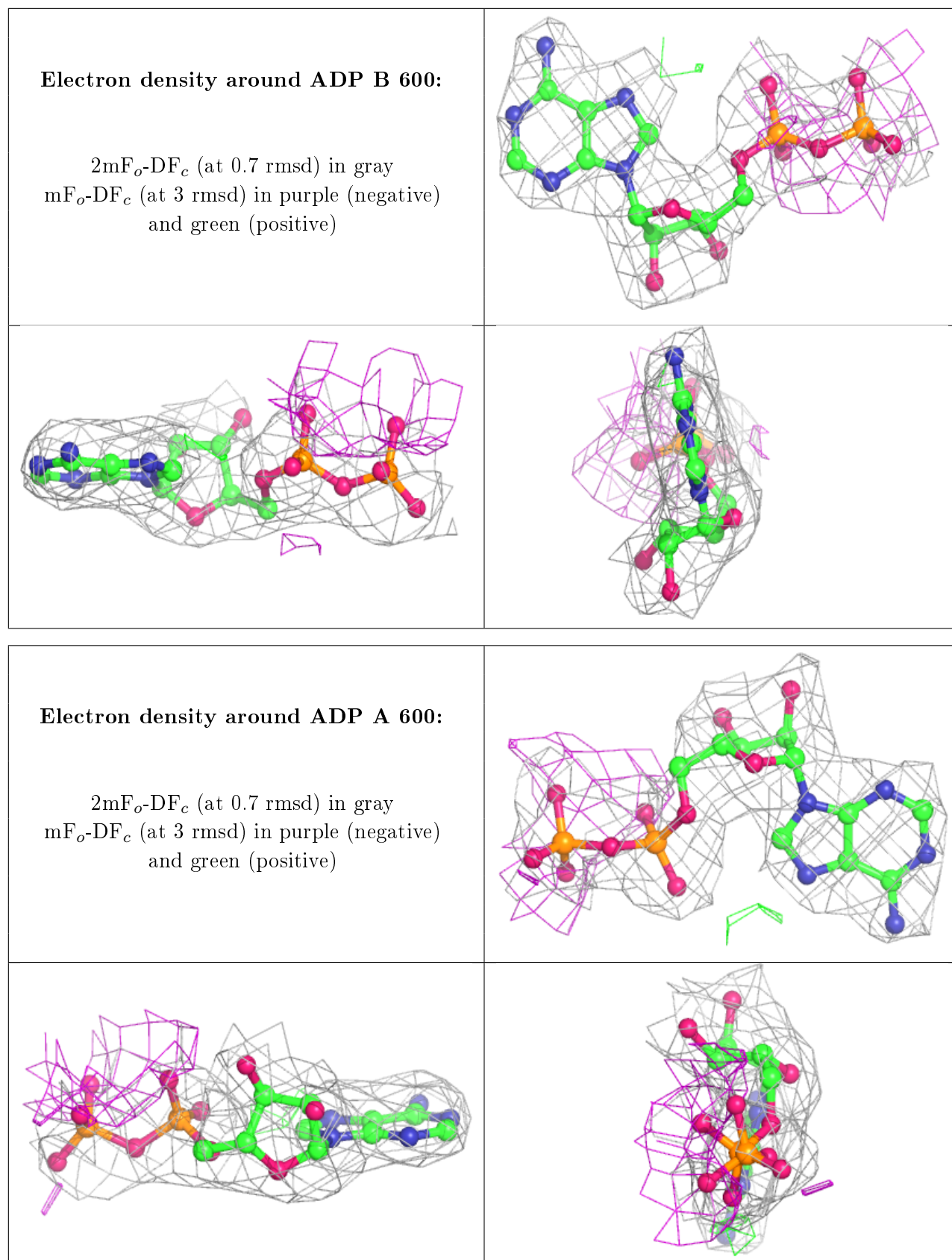
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	IHP	B	500	36/36	0.97	0.11	11,14,18,18	0
4	ADP	B	600	27/27	0.97	0.14	4,8,11,11	0
5	ZN	A	700	1/1	0.98	0.06	33,33,33,33	0
4	ADP	A	600	27/27	0.98	0.13	9,12,23,24	0
5	ZN	B	700	1/1	0.98	0.06	56,56,56,56	0
2	IHP	A	500	36/36	0.98	0.11	9,12,22,24	0
3	PB	B	503	1/1	0.99	0.03	30,30,30,30	0
3	PB	A	501	1/1	0.99	0.04	27,27,27,27	0
3	PB	A	502	1/1	0.99	0.02	20,20,20,20	0
3	PB	B	504	1/1	1.00	0.01	22,22,22,22	0

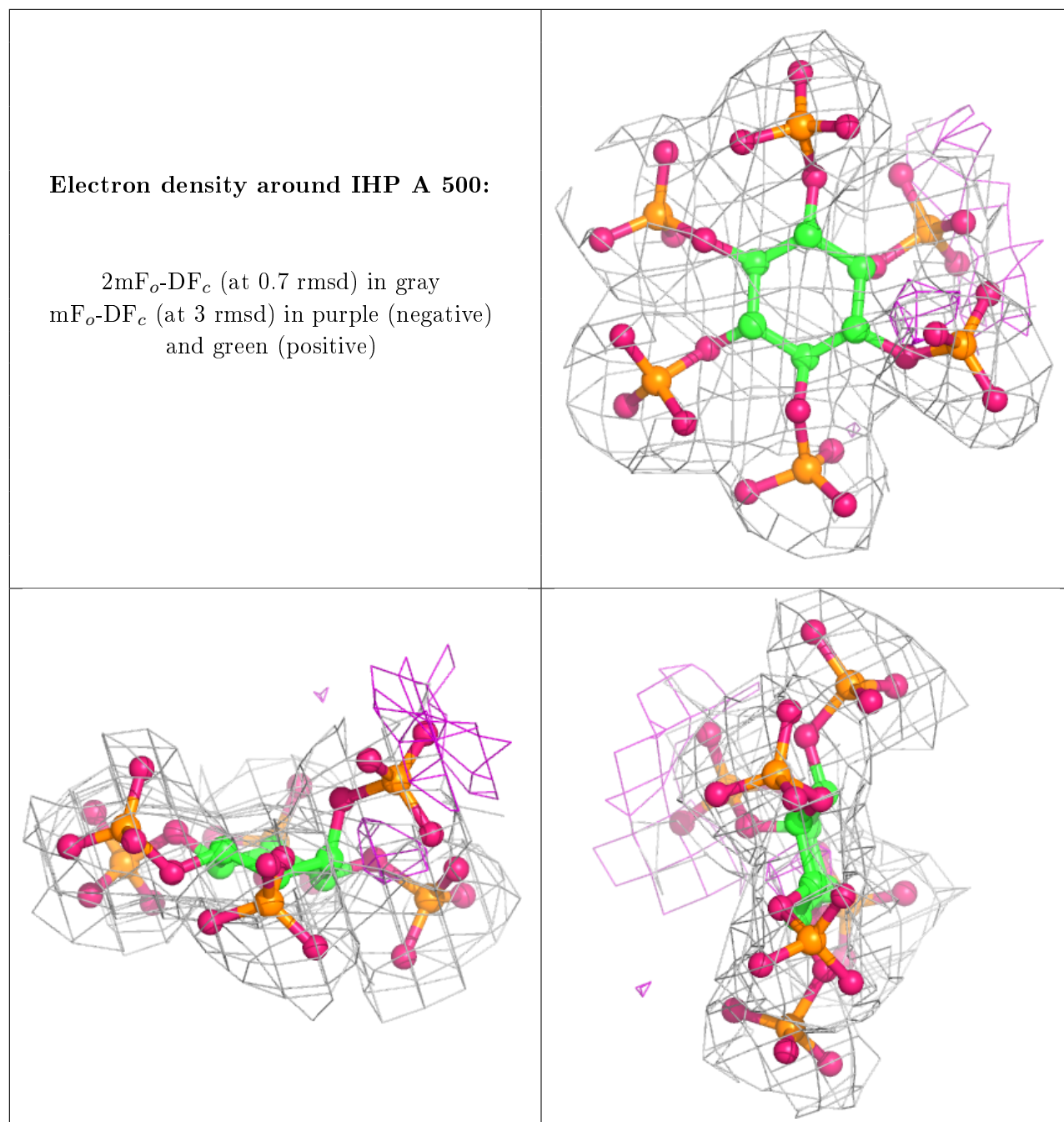
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around IHP 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)







6.5 Other polymers [i](#)

There are no such residues in this entry.