



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 21, 2023 – 10:42 am BST

PDB ID : 7Z6O  
Title : X-Ray studies of Ku70/80 reveal the binding site for IP6  
Authors : Varela, P.F.; Charbonnier, J.B.  
Deposited on : 2022-03-14  
Resolution : 3.70 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](mailto: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 types of validation reports are described at

<https://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4.02b-467  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.35  
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) : 2.35

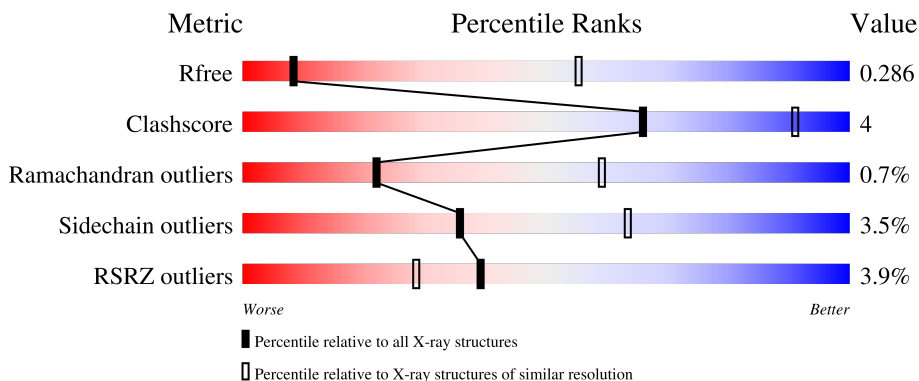
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.70 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	1049 (3.88-3.52)
Clashscore	141614	1027 (3.86-3.54)
Ramachandran outliers	138981	1069 (3.88-3.52)
Sidechain outliers	138945	1065 (3.88-3.52)
RSRZ outliers	127900	1578 (3.90-3.50)

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  $\geq 3$ , 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	609	 3% (red), 72% (green), 10% (yellow), 18% (grey)
2	B	732	 3% (red), 62% (green), 10% (yellow), 27% (grey)
3	C	21	 33% (green), 29% (yellow), 38% (grey)
4	D	34	 9% (red), 35% (green), 9% (yellow), 56% (grey)

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 8933 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 X-ray repair cross-complementing protein 6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	501	4048	2589	686	755	18	6	0	0

- Molecule 2 is a protein called X-ray repair cross-complementing protein 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	536	4278	2738	721	796	23	0	0	0

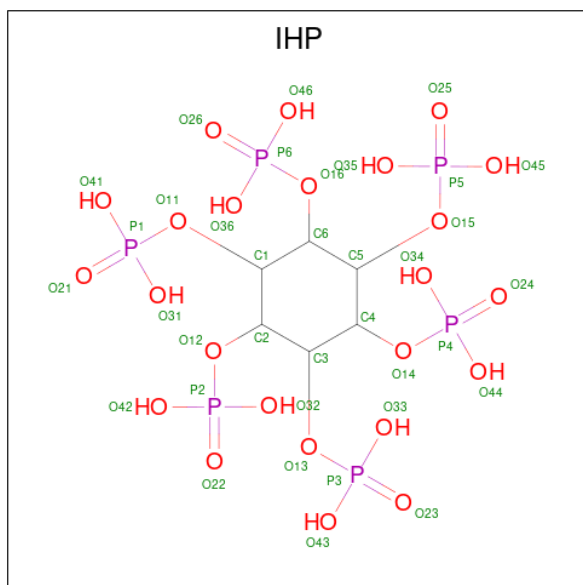
- Molecule 3 is a DNA chain called DNA (5'-D(\*GP\*TP\*TP\*TP\*TP\*TP\*AP\*GP\*TP\*TP\*TP\*AP\*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	C	13	263	130	38	83	12	19	0	0

- Molecule 4 is a DNA chain called DNA (5'-D(P\*AP\*AP\*AP\*TP\*AP\*AP\*AP\*CP\*TP\*AP\*AP\*AP\*AP\*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
4	D	15	308	148	62	83	15	0	0	0

- Molecule 5 is INOSITOL HEXAKISPHOSPHATE (three-letter code: IHP) (formula: C<sub>6</sub>H<sub>18</sub>O<sub>24</sub>P<sub>6</sub>) (labeled as "Ligand of Interest" by depositor).

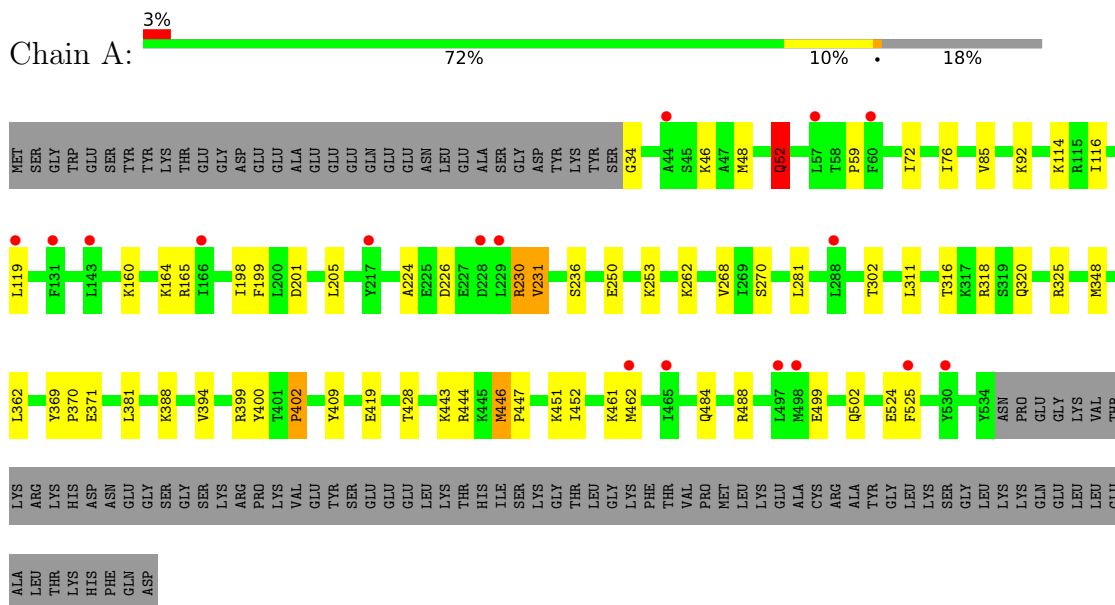


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	P		
5	A	1	36	6	24	6	0	0

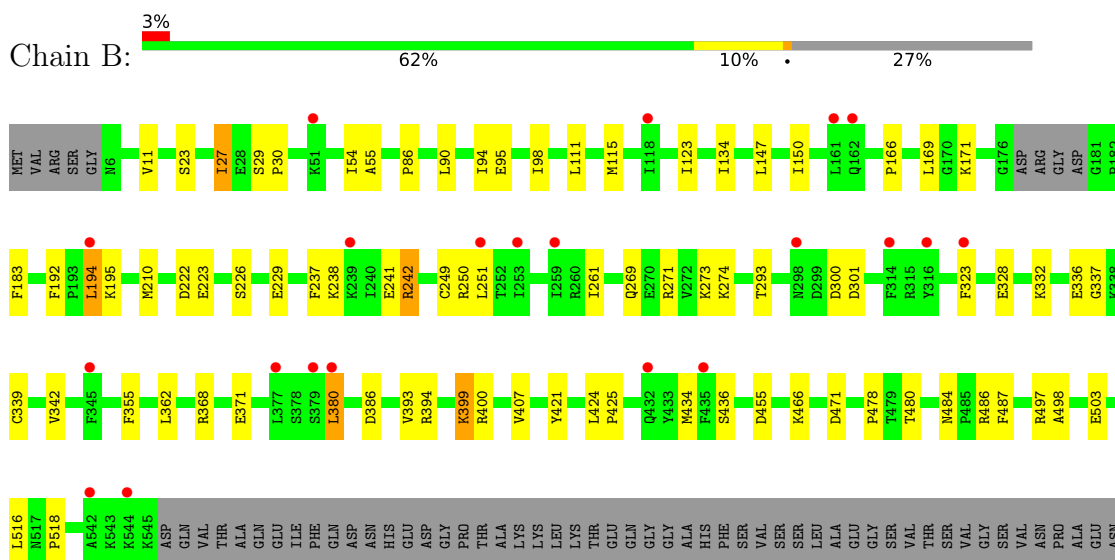
### 3 Residue-property plots [i](#)

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: X-ray repair cross-complementing protein 6



- Molecule 2: X-ray repair cross-complementing protein 5



PHE ARG  
LEU VAL  
LYS LEU  
ALA VAL  
LEU VAL  
LYS GLN  
GLN LYS  
LYS VAL  
LYS ALA  
ALA SER  
SER PHE  
PHE LEU  
GLU LEU  
GLU LEU  
ALA ALA  
ASN HIS  
SER PHE  
ASN TRP  
GLN LEU  
LEU ILE  
ILE ASN  
ASN VAL  
VAL HIS  
HIS GLN  
GLN ASP  
ASP GLU  
GLY ILE  
PHE LEU  
LEU THR  
THR ASP  
ASP THR  
ASN THR  
LYS GLU  
THR GLU  
PRO GLU  
TYR PHE  
SER PHE  
MET GLY  
LYS SER  
SER SER  
SER ILE  
ILE THR  
THR ASP  
ALA CYS  
CYS ILE  
ILE ARG  
ARG ALA  
ALA PHE  
PHE ARG  
ARG GLU  
GLU LEU  
LEU ALA  
ALA PRO  
PRO ILE  
ILE LYS  
LYS PHE  
PHE SER  
SER GLU  
GLU GLN  
GLN ARG  
ARG PHE  
PHE ASN  
ASN ALA  
ALA

PHE LEU  
LYS VAL  
ALA VAL  
LEU ILE  
LYS LEU  
GLN LEU  
LEU ASN  
ASN HIS  
SER PHE  
ASN TRP  
GLN LEU  
LEU ILE  
ILE VAL  
VAL HIS  
HIS GLN  
GLN ASP  
ASP GLU  
GLY ILE  
PHE LEU  
LEU THR  
THR ASP  
ASP THR  
ASN THR  
LYS GLU  
THR GLU  
PRO GLU  
TYR PHE  
SER PHE  
MET GLY  
LYS SER  
SER SER  
SER ILE  
ILE THR  
THR ASP  
ALA CYS  
CYS ILE  
ILE ARG  
ARG ALA  
ALA PHE  
PHE ARG  
ARG GLU  
GLU LEU  
LEU ALA  
ALA PRO  
PRO ILE  
ILE LYS  
LYS PHE  
PHE SER  
SER GLU  
GLU GLN  
GLN ARG  
ARG PHE  
PHE ASN  
ASN ALA  
ALA


VAL PHE  
PHE GLU  
GLU GLY  
GLY GLY  
ASP ASP  
VAL VAL  
ASP ASP  
ASP LEU  
LEU LEU  
LEU ASP  
MET MET  
ILE ILE

- Molecule 3: DNA (5'-D(\*GP\*TP\*TP\*TP\*TP\*TP\*AP\*GP\*TP\*TP\*TP\*AP\*T)-3')

Chain C:  33% 29% 38%

G1  
T6  
A7  
G8  
T9  
T10  
T11  
A12  
T13  
DT  
DG  
DG  
DG  
DC  
DC  
DC  
DG

- Molecule 4: DNA (5'-D(P\*AP\*AP\*AP\*TP\*AP\*AP\*AP\*CP\*TP\*AP\*AP\*AP\*AP\*AP\*C)-3')

Chain D:  9% 35% 9% 56%

DC  
DG  
DC  
DC  
DC  
DC  
DC  
DC  
DA  
DA  
DG  
DC  
DC  
DT  
DT  
DT  
DT  
DC  
DC  
DC  
DA  
DA  
DG  
DC  
T20  
A21  
A22  
T23  
A24  
A25  
C34

## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	125.15Å 125.15Å 319.70Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.30 – 3.70 48.30 – 3.70	Depositor EDS
% Data completeness (in resolution range)	40.1 (48.30-3.70) 40.1 (48.30-3.70)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.13 (at 3.67Å)	Xtrriage
Refinement program	BUSTER, PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.218 , 0.271 0.230 , 0.286	Depositor DCC
$R_{free}$ test set	655 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	115.4	Xtrriage
Anisotropy	0.209	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 179.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.41$ , $\langle L^2 \rangle = 0.24$	Xtrriage
Estimated twinning fraction	0.179 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	8933	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	209.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.25% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

### 5.1 Standard geometry

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

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	0/4127	0.46	0/5560
2	B	0.24	0/4365	0.44	0/5885
3	C	0.43	0/292	1.10	0/450
4	D	0.46	0/347	0.85	0/532
All	All	0.26	0/9131	0.51	0/12427

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

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	4048	0	4125	35	0
2	B	4278	0	4323	43	0
3	C	263	0	154	4	0
4	D	308	0	169	3	0
5	A	36	0	6	0	0
All	All	8933	0	8777	71	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 4.



The worst 5 of 71 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:165:ARG:HG2	1:A:199:PHE:HB2	1.79	0.64
3:C:8:DG:H2''	3:C:9:DT:H5''	1.79	0.64
2:B:23:SER:HB2	2:B:29:SER:HA	1.80	0.64
2:B:337:GLY:HA2	2:B:399:LYS:HA	1.80	0.63
2:B:223:GLU:OE2	2:B:238:LYS:NZ	2.34	0.60

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	499/609 (82%)	472 (95%)	22 (4%)	5 (1%)	15	51
2	B	532/732 (73%)	508 (96%)	22 (4%)	2 (0%)	34	69
All	All	1031/1341 (77%)	980 (95%)	44 (4%)	7 (1%)	22	59

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	451	LYS
1	A	231	VAL
1	A	52	GLN
2	B	192	PHE
2	B	301	ASP

### 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	455/548 (83%)	441 (97%)	14 (3%)	40	65
2	B	479/649 (74%)	460 (96%)	19 (4%)	31	60
All	All	934/1197 (78%)	901 (96%)	33 (4%)	36	63

5 of 33 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	336	GLU
2	B	380	LEU
2	B	478	PRO
1	A	499	GLU
1	A	446	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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](#)

1 ligand is modelled in this entry.

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	$\# Z  > 2$
5	IHP	A	701	-	36,36,36	0.76	2 (5%)	54,60,60	0.41	0

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
5	IHP	A	701	-	-	8/30/54/54	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	701	IHP	P3-O13	3.19	1.65	1.59
5	A	701	IHP	P1-O11	2.02	1.63	1.59

There are no bond angle outliers.

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

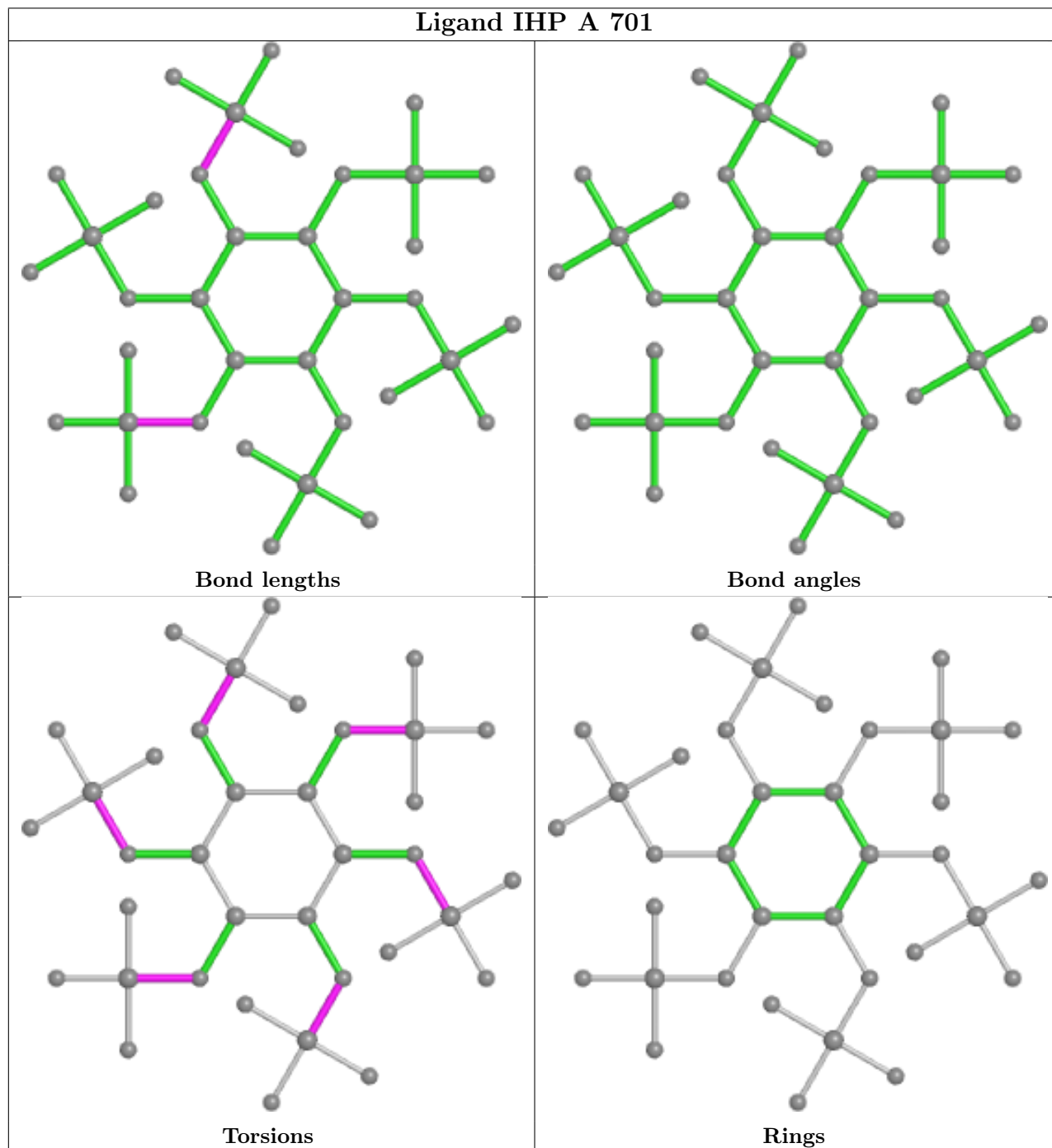
Mol	Chain	Res	Type	Atoms
5	A	701	IHP	C5-O15-P5-O25
5	A	701	IHP	C1-O11-P1-O21
5	A	701	IHP	C2-O12-P2-O22
5	A	701	IHP	C3-O13-P3-O23
5	A	701	IHP	C3-O13-P3-O43

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 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

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	501/609 (82%)	0.29	17 (3%) 45 34	105, 201, 282, 398	2 (0%)
2	B	536/732 (73%)	0.40	21 (3%) 39 28	101, 187, 275, 312	0
3	C	12/21 (57%)	-0.36	0 100 100	322, 366, 401, 428	0
4	D	15/34 (44%)	0.26	3 (20%) 1 0	337, 364, 435, 497	0
All	All	1064/1396 (76%)	0.34	41 (3%) 39 28	101, 195, 289, 497	2 (0%)

The worst 5 of 41 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	228	ASP	4.3
2	B	379	SER	4.2
4	D	20	DT	3.9
2	B	298	ASN	3.5
2	B	542	ALA	3.3

### 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](#)

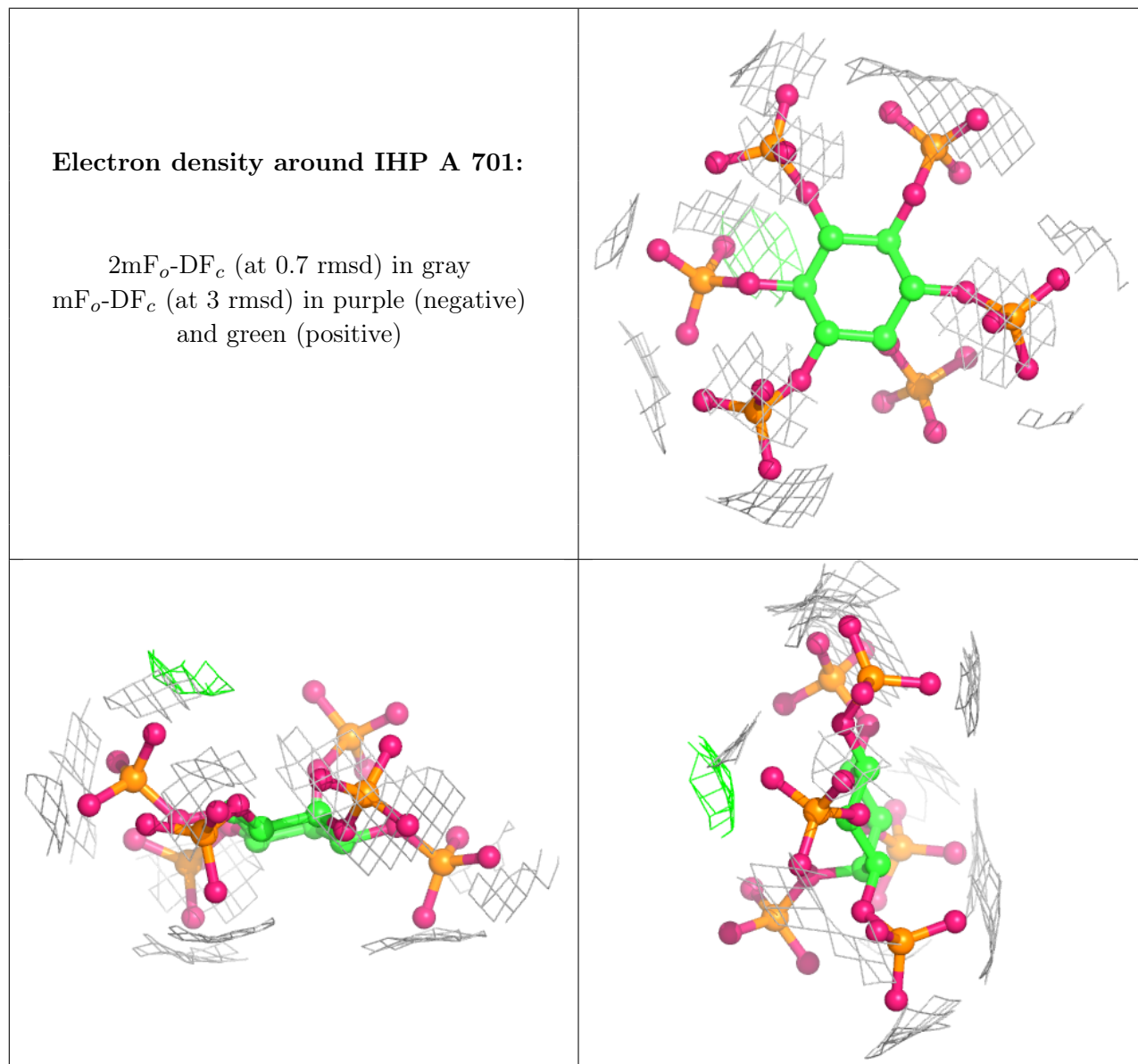
There are no monosaccharides in this entry.

### 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, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
5	IHP	A	701	36/36	0.86	0.25	220,281,341,357	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.



## 6.5 Other polymers [i](#)

There are no such residues in this entry.