



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 21, 2023 – 05:43 AM JST

PDB ID : 7EXU  
Title : GH127 beta-L-arabinofuranosidase HypBA1 E322Q mutant complexed with p-nitrophenyl beta-L-arabinofuranoside  
Authors : Maruyama, S.; Arakawa, T.; Yamada, C.; Fujita, K.; Fushinobu, S.  
Deposited on : 2021-05-28  
Resolution : 2.30 Å(reported)

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

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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

---

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

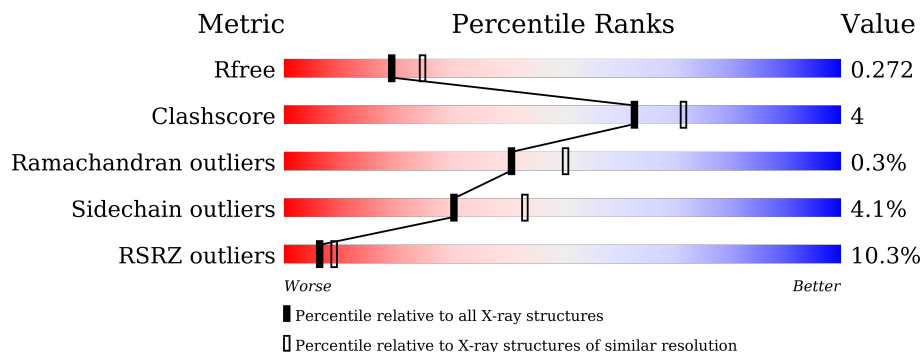
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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	669	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 5143 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 Non-reducing end beta-L-arabinofuranosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	651	5098	3212	876	987	23	0	0	0

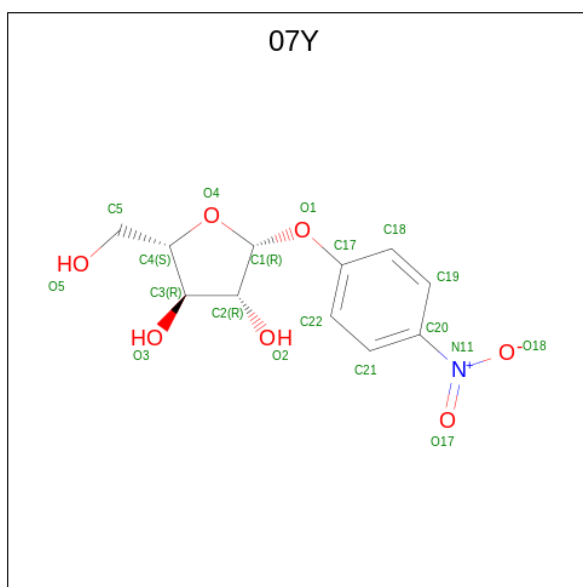
There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	322	GLN	GLU	engineered mutation	UNP E8MGH8
A	659	ALA	-	expression tag	UNP E8MGH8
A	660	ALA	-	expression tag	UNP E8MGH8
A	661	ALA	-	expression tag	UNP E8MGH8
A	662	LEU	-	expression tag	UNP E8MGH8
A	663	GLU	-	expression tag	UNP E8MGH8
A	664	HIS	-	expression tag	UNP E8MGH8
A	665	HIS	-	expression tag	UNP E8MGH8
A	666	HIS	-	expression tag	UNP E8MGH8
A	667	HIS	-	expression tag	UNP E8MGH8
A	668	HIS	-	expression tag	UNP E8MGH8
A	669	HIS	-	expression tag	UNP E8MGH8

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

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

- Molecule 3 is (2S,3R,4R,5R)-2-(hydroxymethyl)-5-(4-nitrophenoxy)oxolane-3,4-diol (three-letter code: 07Y) (formula: C<sub>11</sub>H<sub>13</sub>NO<sub>7</sub>) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	19	11	1	7	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	25	25	25	0	0



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	78.18Å 78.18Å 253.50Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	46.31 – 2.30 46.27 – 2.30	Depositor EDS
% Data completeness (in resolution range)	100.0 (46.31-2.30) 100.0 (46.27-2.30)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.86 (at 2.29Å)	Xtrriage
Refinement program	REFMAC 5.8.0267	Depositor
R, $R_{free}$	0.252 , 0.290 0.237 , 0.272	Depositor DCC
$R_{free}$ test set	2114 reflections (5.16%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	55.5	Xtrriage
Anisotropy	0.182	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 43.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.028 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5143	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	73.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.92% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, 07Y

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	0.68	0/5218	0.81	0/7095

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	5098	0	4867	43	0
2	A	1	0	0	0	0
3	A	19	0	0	0	0
4	A	25	0	0	0	0
All	All	5143	0	4867	43	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.

All (43) 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:67:GLU:HG3	1:A:126:SER:HB2	1.59	0.84
1:A:362:ALA:HB3	1:A:493:ARG:HD3	1.78	0.64
1:A:366:GLU:CD	1:A:493:ARG:HH22	2.08	0.58
1:A:120:THR:N	1:A:121:PRO:HD2	2.22	0.55
1:A:571:ASP:HB3	1:A:637:ARG:HG2	1.91	0.53
1:A:448:PHE:HB2	1:A:467:PHE:CD2	2.46	0.50
1:A:363:ASP:OD1	1:A:493:ARG:NH1	2.42	0.50
1:A:278:CYS:HB3	1:A:348:PHE:CE1	2.47	0.49
1:A:278:CYS:HB3	1:A:348:PHE:CZ	2.48	0.48
1:A:437:ARG:HD2	1:A:444:LEU:HD11	1.95	0.48
1:A:72:VAL:HG23	1:A:129:TRP:CH2	2.49	0.48
1:A:475:TYR:HB2	1:A:532:ILE:HB	1.96	0.47
1:A:484:THR:O	1:A:485:ASP:HB2	2.14	0.47
1:A:88:ALA:HA	1:A:91:TYR:CE1	2.51	0.46
1:A:525:ASN:O	1:A:528:ASP:HB2	2.16	0.45
1:A:352:MET:HB3	1:A:361:TYR:CE2	2.52	0.45
1:A:83:GLU:HG2	1:A:87:TYR:CE2	2.52	0.45
1:A:67:GLU:HG3	1:A:126:SER:CB	2.41	0.44
1:A:270:HIS:O	1:A:274:VAL:HG23	2.17	0.44
1:A:362:ALA:CB	1:A:493:ARG:HD3	2.45	0.44
1:A:338:GLU:HA	1:A:386:TYR:O	2.18	0.44
1:A:473:VAL:HG12	1:A:475:TYR:CE1	2.52	0.44
1:A:424:ARG:HG2	1:A:425:LEU:N	2.33	0.44
1:A:352:MET:HB3	1:A:361:TYR:CD2	2.53	0.43
1:A:310:TYR:HB2	1:A:314:ALA:HB3	2.01	0.43
1:A:497:TRP:CZ3	1:A:561:GLY:HA2	2.53	0.43
1:A:87:TYR:CD2	1:A:428:SER:HB3	2.54	0.43
1:A:472:HIS:ND1	1:A:535:GLU:OE2	2.40	0.43
1:A:555:GLN:HA	1:A:656:GLN:O	2.19	0.42
1:A:331:PRO:O	1:A:335:MET:HB3	2.19	0.42
1:A:364:VAL:O	1:A:368:GLU:HG2	2.19	0.42
1:A:319:HIS:HA	1:A:336:TYR:CD1	2.55	0.42
1:A:378:SER:OG	1:A:380:ASP:OD1	2.31	0.42
1:A:333:ASP:HB2	1:A:402:ARG:HD3	2.02	0.42
1:A:150:TYR:CE2	1:A:169:VAL:HG12	2.55	0.41
1:A:13:ARG:O	1:A:17:ILE:HG12	2.21	0.41
1:A:434:TYR:HA	1:A:444:LEU:O	2.21	0.41
1:A:73:PHE:CD2	1:A:142:HIS:CD2	3.09	0.41
1:A:245:HIS:CG	1:A:245:HIS:O	2.75	0.40
1:A:139:GLN:O	1:A:193:GLY:HA3	2.20	0.40
1:A:21:VAL:O	1:A:25:GLN:HG3	2.22	0.40
1:A:446:HIS:HA	1:A:493:ARG:HB3	2.02	0.40

*Continued on next page...*



*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:55:ALA:O	1:A:59:VAL:HG23	2.22	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	645/669 (96%)	613 (95%)	30 (5%)	2 (0%)	41 50

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	196	GLU
1	A	485	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	532/546 (97%)	510 (96%)	22 (4%)	30 43

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

Mol	Chain	Res	Type
1	A	36	THR

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
1	A	50	LYS
1	A	64	LEU
1	A	65	ASP
1	A	67	GLU
1	A	114	SER
1	A	134	ARG
1	A	185	GLU
1	A	233	LYS
1	A	236	LYS
1	A	380	ASP
1	A	405	VAL
1	A	424	ARG
1	A	460	THR
1	A	467	PHE
1	A	484	THR
1	A	498	SER
1	A	509	LYS
1	A	512	VAL
1	A	585	VAL
1	A	649	ILE
1	A	658	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	578	ASN

### 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 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	07Y	A	702	-	19,20,20	3.20	4 (21%)	26,28,28	1.20	3 (11%)

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	07Y	A	702	-	-	3/7/26/26	0/2/2/2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	702	07Y	O17-N11	11.73	1.42	1.22
3	A	702	07Y	C20-N11	-5.24	1.32	1.45
3	A	702	07Y	O2-C2	3.47	1.51	1.43
3	A	702	07Y	O4-C1	2.54	1.46	1.41

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	702	07Y	O4-C1-C2	2.91	108.73	104.98
3	A	702	07Y	O4-C1-O1	2.38	114.38	109.39
3	A	702	07Y	O1-C1-C2	-2.25	102.97	106.78

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	702	07Y	O4-C1-O1-C17

*Continued on next page...*

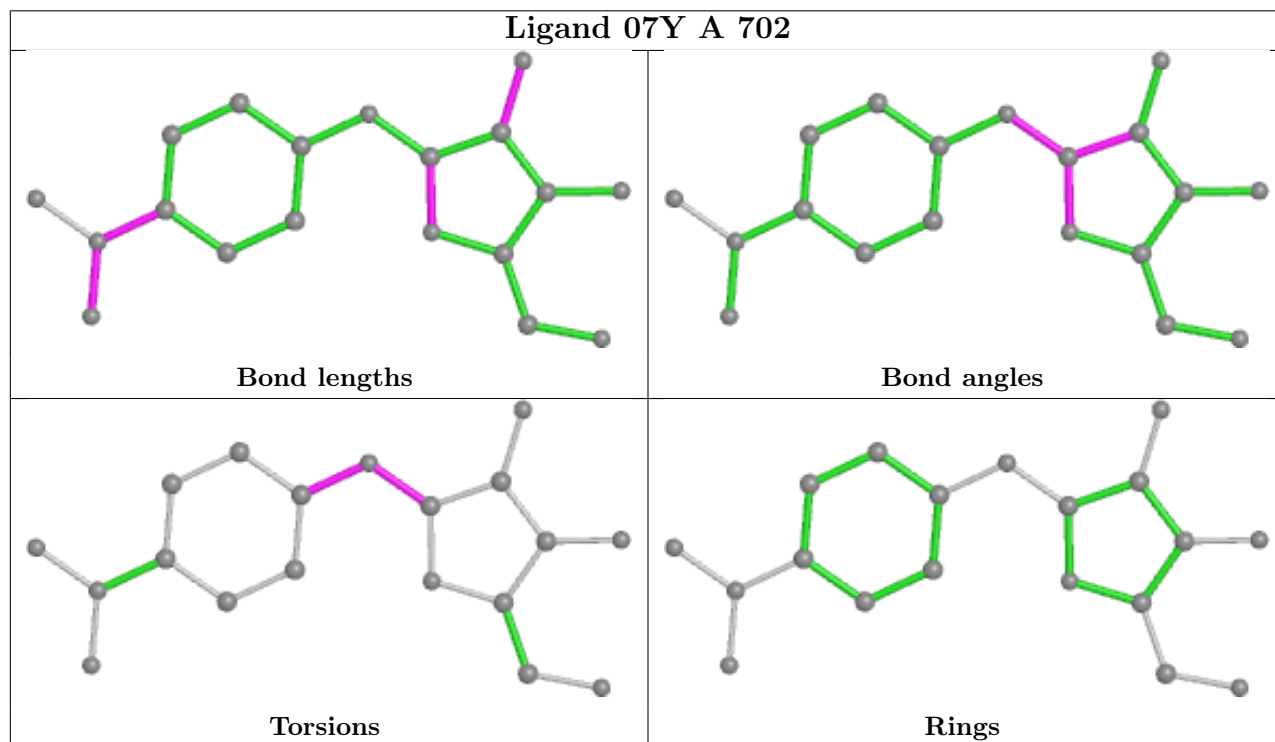
Continued from previous page...

Mol	Chain	Res	Type	Atoms
3	A	702	07Y	C18-C17-O1-C1
3	A	702	07Y	C22-C17-O1-C1

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

### 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, 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	651/669 (97%)	0.63	67 (10%) <b>6</b> <b>9</b>	49, 72, 99, 140	0

All (67) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	42	ALA	7.5
1	A	249	PHE	5.7
1	A	483	ALA	5.6
1	A	41	PRO	4.3
1	A	584	GLY	4.3
1	A	64	LEU	4.1
1	A	65	ASP	3.6
1	A	485	ASP	3.5
1	A	484	THR	3.5
1	A	61	ALA	3.5
1	A	386	TYR	3.4
1	A	315	ILE	3.4
1	A	343	VAL	3.3
1	A	511	ALA	3.2
1	A	372	GLY	3.2
1	A	67	GLU	3.2
1	A	387	VAL	3.1
1	A	482	SER	3.1
1	A	344	ALA	3.0
1	A	512	VAL	2.9
1	A	31	ASP	2.9
1	A	341	ALA	2.8
1	A	425	LEU	2.8
1	A	127	GLY	2.8
1	A	186	GLY	2.8
1	A	480	PRO	2.7
1	A	69	HIS	2.7

*Continued on next page...*

*Continued from previous page...*

<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	365	LEU	2.7
1	A	124	ILE	2.6
1	A	236	LYS	2.6
1	A	375	ALA	2.6
1	A	390	LEU	2.5
1	A	374	ILE	2.5
1	A	389	ALA	2.4
1	A	369	LEU	2.4
1	A	311	VAL	2.4
1	A	405	VAL	2.4
1	A	250	TYR	2.4
1	A	335	MET	2.4
1	A	631	GLY	2.4
1	A	340	CYS	2.4
1	A	272	VAL	2.4
1	A	346	SER	2.3
1	A	35	THR	2.3
1	A	33	ILE	2.3
1	A	336	TYR	2.3
1	A	593	ALA	2.3
1	A	309	MET	2.3
1	A	388	ASN	2.3
1	A	40	ASP	2.3
1	A	222	ASP	2.3
1	A	128	VAL	2.3
1	A	342	SER	2.3
1	A	481	ALA	2.2
1	A	426	ILE	2.2
1	A	62	GLY	2.2
1	A	364	VAL	2.2
1	A	613	HIS	2.1
1	A	310	TYR	2.1
1	A	347	MET	2.1
1	A	318	THR	2.1
1	A	59	VAL	2.1
1	A	373	SER	2.1
1	A	371	ASN	2.1
1	A	345	MET	2.0
1	A	248	GLY	2.0
1	A	526	ALA	2.0

## 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.

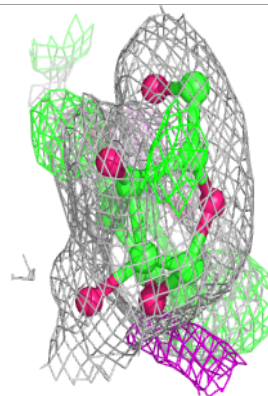
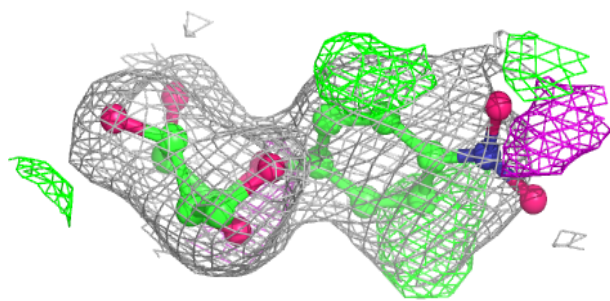
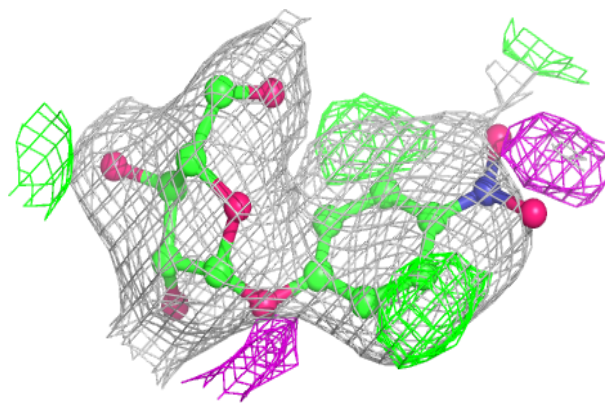
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
3	07Y	A	702	19/19	0.82	0.24	62,74,102,108	0
2	ZN	A	701	1/1	0.97	0.15	62,62,62,62	0

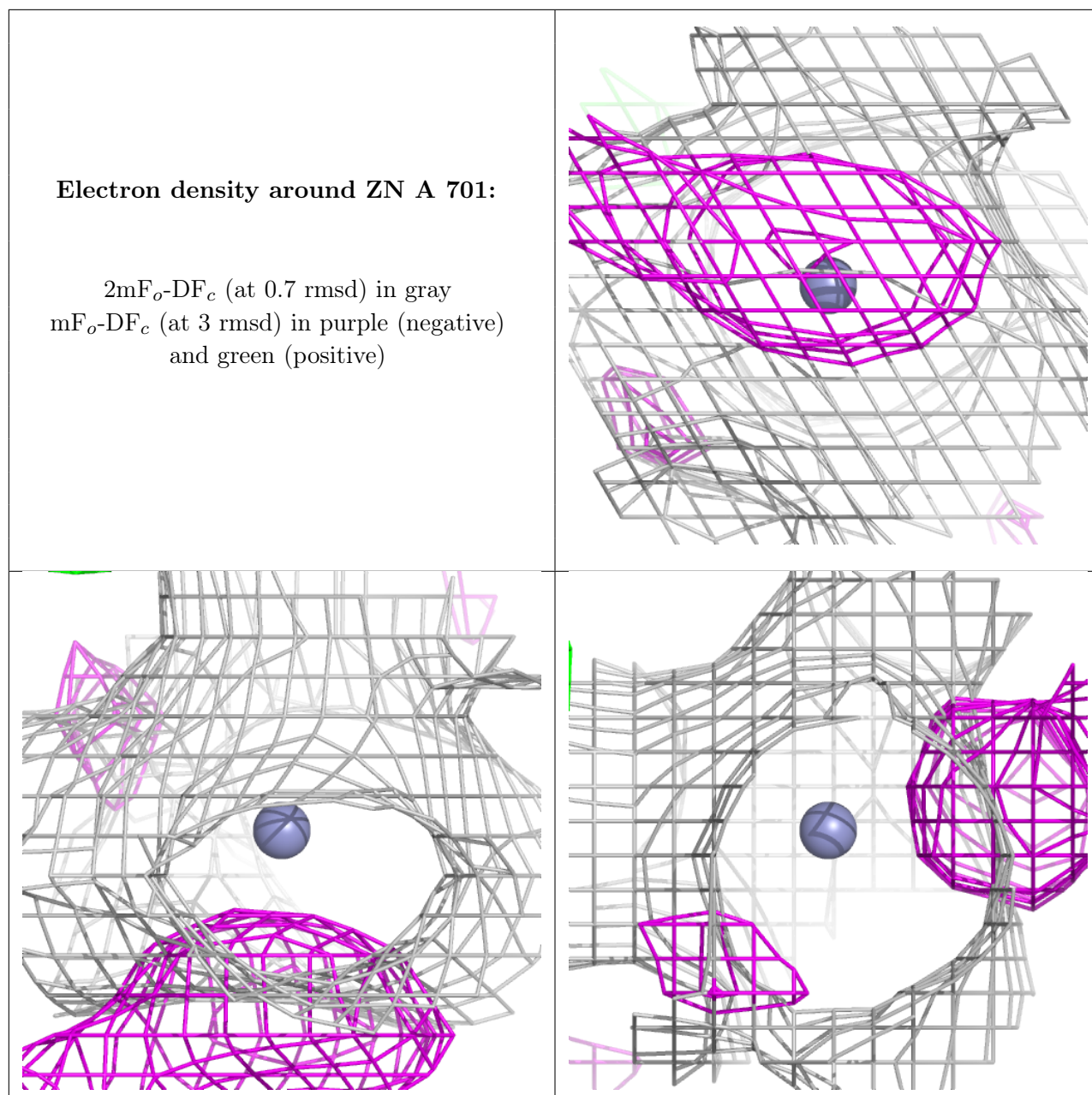
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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



**Electron density around 07Y A 702:**

$2mF_o-DF_c$  (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.