



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 21, 2022 – 10:18 AM EST

PDB ID : 8EXL
Title : Crystal structure of PI3K-alpha in complex with taselisib
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Deposited on : 2022-10-25
Resolution : 1.99 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

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 : 2.31.2
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) : 2.31.2

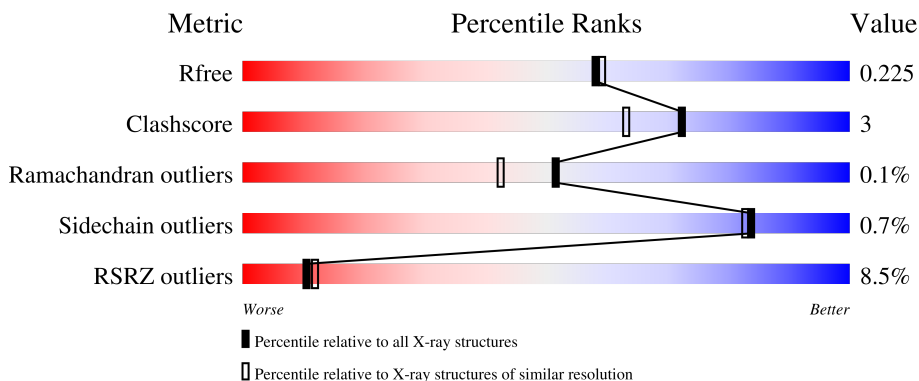
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.99 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	11647 (2.00-1.96)
Clashscore	141614	1014 (1.98-1.98)
Ramachandran outliers	138981	1006 (1.98-1.98)
Sidechain outliers	138945	1006 (1.98-1.98)
RSRZ outliers	127900	11410 (2.00-1.96)

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 $\leq 5\%$. 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	1080	

2 Entry composition i

There are 3 unique types of molecules in this entry. The entry contains 7425 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 Phosphatidylinositol 4,5-bisphosphate 3-kinase catalytic subunit alpha isoform.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	892	7109	4545	1204	1299	61	0	2	0

There are 34 discrepancies between the modelled and reference sequences:

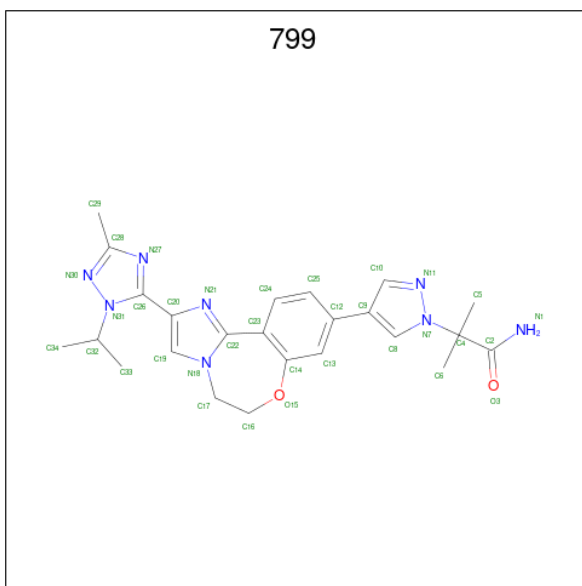
Chain	Residue	Modelled	Actual	Comment	Reference
A	-27	MET	-	initiating methionine	UNP P42336
A	-26	SER	-	expression tag	UNP P42336
A	-25	TYR	-	expression tag	UNP P42336
A	-24	TYR	-	expression tag	UNP P42336
A	-23	HIS	-	expression tag	UNP P42336
A	-22	HIS	-	expression tag	UNP P42336
A	-21	HIS	-	expression tag	UNP P42336
A	-20	HIS	-	expression tag	UNP P42336
A	-19	HIS	-	expression tag	UNP P42336
A	-18	HIS	-	expression tag	UNP P42336
A	-17	ASP	-	expression tag	UNP P42336
A	-16	TYR	-	expression tag	UNP P42336
A	-15	ASP	-	expression tag	UNP P42336
A	-14	ILE	-	expression tag	UNP P42336
A	-13	PRO	-	expression tag	UNP P42336
A	-12	THR	-	expression tag	UNP P42336
A	-11	THR	-	expression tag	UNP P42336
A	-10	GLU	-	expression tag	UNP P42336
A	-9	ASN	-	expression tag	UNP P42336
A	-8	LEU	-	expression tag	UNP P42336
A	-7	TYR	-	expression tag	UNP P42336
A	-6	PHE	-	expression tag	UNP P42336
A	-5	GLN	-	expression tag	UNP P42336
A	-4	GLY	-	expression tag	UNP P42336
A	-3	ALA	-	expression tag	UNP P42336
A	-2	MET	-	expression tag	UNP P42336

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP P42336
A	99	GLU	-	insertion	UNP P42336
A	100	ASN	-	insertion	UNP P42336
A	101	LEU	-	insertion	UNP P42336
A	102	TYR	-	insertion	UNP P42336
A	103	PHE	-	insertion	UNP P42336
A	104	GLN	-	insertion	UNP P42336
A	105	GLY	-	insertion	UNP P42336

- Molecule 2 is 2-methyl-2-(4-{2-[3-methyl-1-(propan-2-yl)-1H-1,2,4-triazol-5-yl]-5,6-dihydroimidazo[1,2-d][1,4]benzoxazepin-9-yl}-1H-pyrazol-1-yl)propanamide (three-letter code: 799) (formula: C₂₄H₂₈N₈O₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			34	24	8	2		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	277	Total	O	0	5
			282	282		

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	58.37Å 134.38Å 141.69Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.25 – 1.99 34.25 – 1.99	Depositor EDS
% Data completeness (in resolution range)	97.7 (34.25-1.99) 97.7 (34.25-1.99)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.75 (at 2.00Å)	Xtrriage
Refinement program	PHENIX 1.16_3549	Depositor
R, R_{free}	0.187 , 0.225 0.187 , 0.225	Depositor DCC
R_{free} test set	1939 reflections (2.56%)	wwPDB-VP
Wilson B-factor (Å ²)	38.6	Xtrriage
Anisotropy	0.146	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 48.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7425	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% 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: 799

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	0.39	0/7269	0.54	0/9857

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	7109	0	6886	48	0
2	A	34	0	0	0	0
3	A	282	0	0	5	0
All	All	7425	0	6886	48	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 3.

All (48) 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:728:GLN:HG2	1:A:777:ARG:HH22	1.30	0.94

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:585:CYS:HA	1:A:588:LYS:HG2	1.82	0.62
1:A:508:TYR:HA	1:A:519:ARG:HD2	1.81	0.62
1:A:728:GLN:HG2	1:A:777:ARG:NH2	2.09	0.62
1:A:228:LYS:O	1:A:231:SER:HB2	2.04	0.56
1:A:540:LEU:HB2	1:A:1023:ARG:HD2	1.89	0.55
1:A:354:ILE:HD11	1:A:422:LEU:CD1	2.40	0.52
1:A:808:ARG:HB3	1:A:1010:MET:HE2	1.91	0.52
1:A:588:LYS:HE2	1:A:589:ASP:OD2	2.10	0.51
1:A:975:ARG:HD2	1:A:978:GLU:OE1	2.10	0.51
1:A:728:GLN:CG	1:A:777:ARG:HH22	2.14	0.50
1:A:296:GLN:O	1:A:298:PRO:HD3	2.11	0.49
1:A:354:ILE:N	1:A:376:VAL:O	2.42	0.49
1:A:913:ILE:HD13	1:A:937:PHE:HB3	1.95	0.49
1:A:298:PRO:HG2	1:A:697:MET:HG2	1.96	0.48
1:A:191:ILE:CD1	1:A:210:LYS:HD3	2.44	0.48
1:A:354:ILE:HD11	1:A:422:LEU:HD11	1.96	0.47
1:A:697:MET:SD	1:A:700:LYS:HD2	2.55	0.47
1:A:510:HIS:HE1	3:A:1454:HOH:O	1.98	0.46
1:A:191:ILE:HD11	1:A:210:LYS:HD3	1.97	0.46
1:A:720:LYS:HB3	1:A:720:LYS:HE2	1.81	0.46
1:A:600:GLU:OE1	3:A:1201:HOH:O	2.21	0.46
1:A:546:GLN:H	1:A:546:GLN:CD	2.18	0.46
1:A:719:LEU:HD11	1:A:735:LEU:HD13	1.97	0.45
1:A:743:ASP:N	1:A:743:ASP:OD1	2.49	0.45
1:A:807:LEU:HD12	1:A:846:GLY:HA3	1.98	0.45
1:A:1027:ALA:HB1	1:A:1030:LYS:HD2	1.98	0.45
1:A:521:ASN:O	1:A:523:LEU:N	2.50	0.44
1:A:843:ASP:O	1:A:845:VAL:HG23	2.17	0.44
1:A:193:VAL:CG1	1:A:206:LYS:HG3	2.48	0.44
1:A:442:ALA:HB1	1:A:472:CYS:SG	2.58	0.44
1:A:152:ASP:OD1	3:A:1202:HOH:O	2.21	0.43
1:A:433:THR:O	1:A:485:LYS:HE3	2.18	0.43
1:A:175:PRO:HG3	1:A:269:GLN:OE1	2.19	0.43
1:A:809:GLN:HG3	3:A:1316:HOH:O	2.18	0.42
1:A:992:ARG:HD2	1:A:1026:LEU:O	2.19	0.42
1:A:1044:ASN:OD1	1:A:1051:TRP:N	2.51	0.42
1:A:328:TRP:HA	1:A:394:PRO:HB3	2.01	0.42
1:A:121:ILE:HG13	1:A:123:MET:HG2	2.01	0.42
1:A:193:VAL:HG13	1:A:206:LYS:HG3	2.02	0.42
1:A:525:GLU:O	1:A:529:GLU:HG2	2.19	0.42
1:A:573[B]:LYS:HD2	1:A:573[B]:LYS:HA	1.73	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:489:MET:HA	1:A:492:ILE:HD12	2.02	0.41
1:A:959:ASP:OD1	1:A:959:ASP:N	2.48	0.41
1:A:992:ARG:NH1	1:A:1027:ALA:O	2.53	0.41
1:A:494:GLU:OE2	3:A:1203:HOH:O	2.22	0.41
1:A:778:PRO:HB3	1:A:802:LYS:HG3	2.04	0.40
1:A:985:TYR:HB3	1:A:1036:LEU:HD21	2.03	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	878/1080 (81%)	850 (97%)	27 (3%)	1 (0%)	51 42

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	522	GLU

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	770/983 (78%)	764 (99%)	6 (1%)	81 80

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	155	ASP
1	A	174	SER
1	A	573[A]	LYS
1	A	573[B]	LYS
1	A	937	PHE
1	A	959	ASP

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

Mol	Chain	Res	Type
1	A	370	ASN
1	A	797	ASN
1	A	861	GLN
1	A	918	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](#)

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
2	799	A	1101	-	32,38,38	1.50	5 (15%)	38,58,58	2.62	7 (18%)

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
2	799	A	1101	-	-	0/15/34/34	0/4/5/5

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1101	799	C17-N18	-4.24	1.46	1.49
2	A	1101	799	C4-C2	-4.17	1.50	1.54
2	A	1101	799	O15-C14	-2.41	1.34	1.38
2	A	1101	799	C28-N30	-2.09	1.30	1.34
2	A	1101	799	C22-N21	-2.01	1.31	1.35

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1101	799	O15-C16-C17	-9.14	106.20	112.62
2	A	1101	799	C28-N27-C26	8.38	109.93	103.69
2	A	1101	799	C8-N7-N11	-5.01	108.69	111.69
2	A	1101	799	C28-N30-N31	4.89	107.29	104.17
2	A	1101	799	C10-N11-N7	4.17	108.57	104.23
2	A	1101	799	C32-N31-N30	2.81	125.58	119.21
2	A	1101	799	C29-C28-N27	2.26	126.14	120.49

There are no chirality outliers.

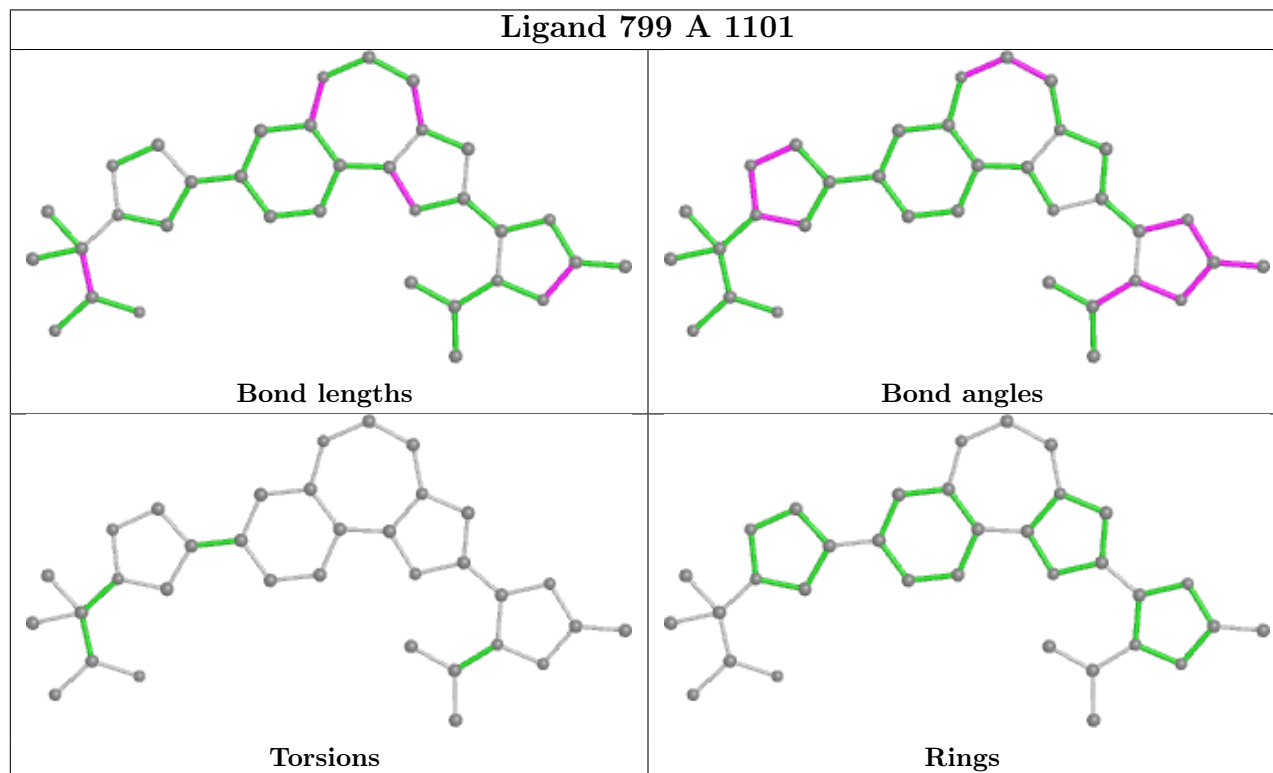
There are no torsion outliers.

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 [i](#)

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	892/1080 (82%)	0.53	76 (8%) 10 12	24, 46, 79, 108	7 (0%)

All (76) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	872	PHE	9.1
1	A	479	TRP	7.7
1	A	451	GLY	5.4
1	A	450	HIS	5.0
1	A	322	THR	4.9
1	A	449	PRO	4.7
1	A	483	VAL	4.5
1	A	452	LEU	4.4
1	A	299	MET	4.2
1	A	301	CYS	4.1
1	A	323	SER	4.0
1	A	873	ASN	4.0
1	A	182	TYR	3.9
1	A	725	ASP	3.7
1	A	179	LYS	3.6
1	A	198	VAL	3.5
1	A	941	LYS	3.5
1	A	695	CYS	3.4
1	A	351	ILE	3.3
1	A	178	PRO	3.2
1	A	296	GLN	3.2
1	A	834	LEU	3.1
1	A	225	ILE	3.0
1	A	521	ASN	2.9
1	A	817	ILE	2.9
1	A	850	VAL	2.9
1	A	520	ASP	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	453	GLU	2.8
1	A	839	LEU	2.8
1	A	838	CYS	2.8
1	A	448	VAL	2.8
1	A	324	THR	2.8
1	A	229	THR	2.7
1	A	213	HIS	2.7
1	A	755	LEU	2.7
1	A	354	ILE	2.7
1	A	930	PHE	2.7
1	A	814	LEU	2.7
1	A	378	CYS	2.7
1	A	188	GLY	2.6
1	A	310	ARG	2.6
1	A	481	SER	2.6
1	A	291	GLU	2.6
1	A	744	PHE	2.5
1	A	421	PRO	2.5
1	A	126	CYS	2.5
1	A	523	LEU	2.5
1	A	641	TYR	2.5
1	A	904	TYR	2.5
1	A	174	SER	2.5
1	A	232	MET	2.4
1	A	462	THR	2.4
1	A	886	LYS	2.4
1	A	399	ALA	2.3
1	A	742	PRO	2.3
1	A	427	ILE	2.3
1	A	445	LEU	2.3
1	A	425	GLY	2.3
1	A	939	ASP	2.3
1	A	429	LEU	2.2
1	A	347	ASN	2.2
1	A	883	ASP	2.2
1	A	518	ALA	2.2
1	A	775	ALA	2.2
1	A	180	HIS	2.2
1	A	183	ASN	2.2
1	A	454	ASP	2.2
1	A	639	LEU	2.1
1	A	669	TRP	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	666	PHE	2.1
1	A	375	ARG	2.1
1	A	400	ALA	2.1
1	A	325	LYS	2.1
1	A	848	ILE	2.0
1	A	687	LEU	2.0
1	A	888	GLU	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](#)

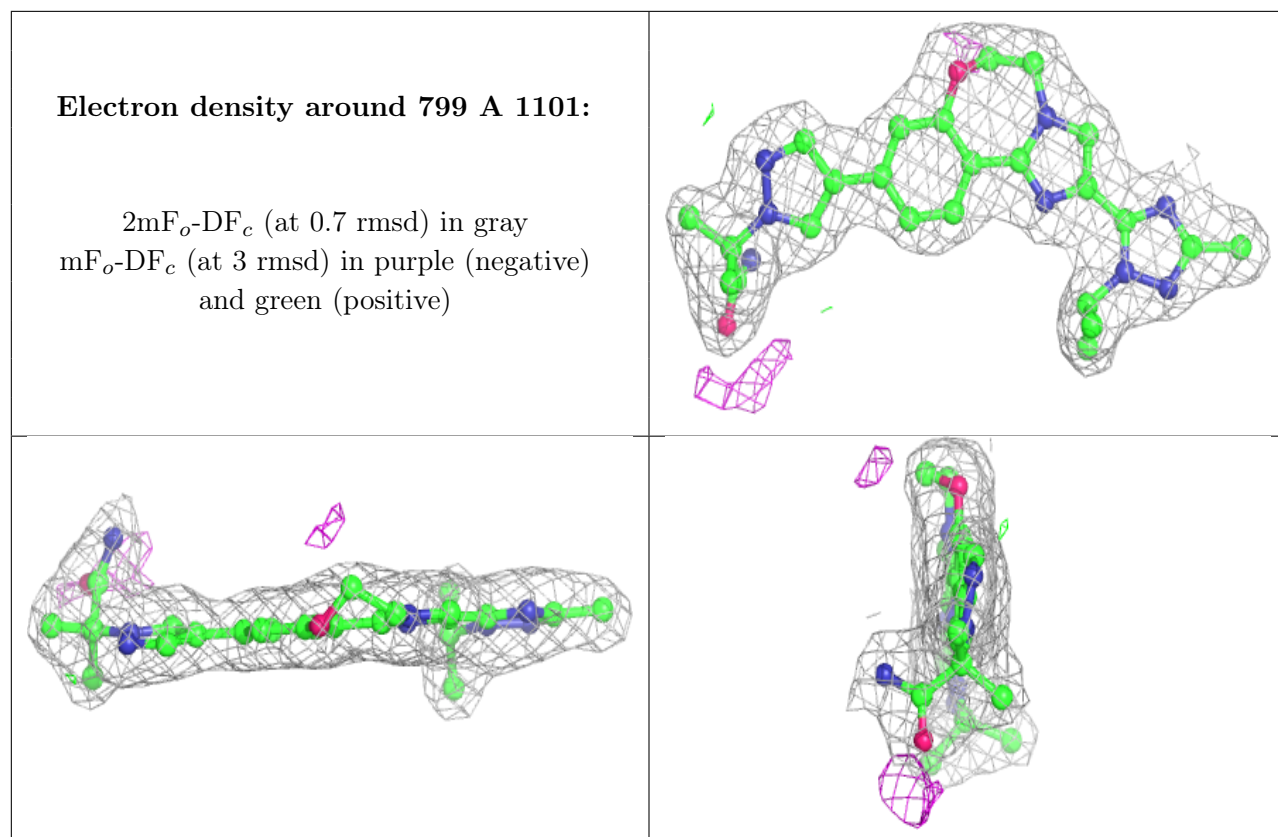
There are no monosaccharides in this entry.

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, 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	799	A	1101	34/34	0.96	0.12	25,37,49,54	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.