



Full wwPDB X-ray Structure Validation Report i

Jan 7, 2026 – 12:11 AM JST

PDB ID : 9M6U / pdb_00009m6u
Title : Crystal structure of SARS-CoV-2 main protease M49I mutant in complex with Pomotrelvir
Authors : Li, W.W.; Zhang, J.; Li, J.
Deposited on : 2025-03-07
Resolution : 1.95 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 i 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](#) i) were used in the production of this report:

MolProbity	: FAILED
Mogul	: 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	: 2.0
EDS	: 3.0
buster-report	: 1.1.7 (2018)
Percentile statistics	: 20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	: 9.0.010 (Gargrove)
Density-Fitness	: 1.0.12
Ideal geometry (proteins)	: Engh & Huber (2001)
Ideal geometry (DNA, RNA)	: Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	: 2.47

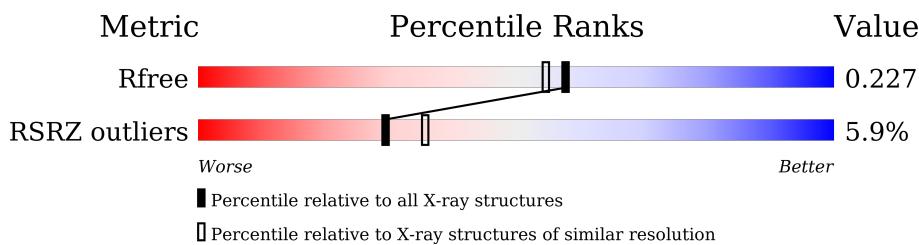
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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}	164625	3187 (1.96-1.96)
RSRZ outliers	164620	3186 (1.96-1.96)

MolProbity failed to run properly - the sequence quality summary graphics cannot be shown.

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4970 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.

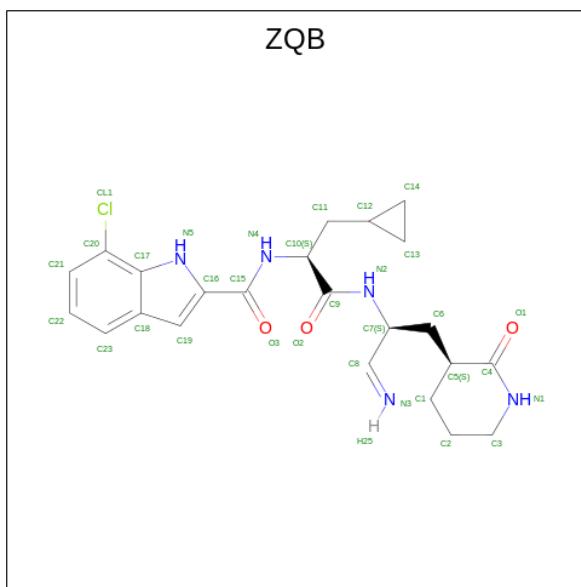
- Molecule 1 is a protein called 3C-like proteinase nsp5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	299	Total	C	N	O	S	0	0	0
			2284	1444	387	433	20			
1	B	299	Total	C	N	O	S	0	0	0
			2265	1437	380	427	21			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	49	ILE	MET	engineered mutation	UNP P0DTD1
B	49	ILE	MET	engineered mutation	UNP P0DTD1

- Molecule 2 is Pomotrelvir bound form (CCD ID: ZQB) (formula: C₂₃H₂₈ClN₅O₃) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Cl	N	O	0	0
			32	23	1	5	3		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	Cl	N	O	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	185	Total	O	0	0
			185	185		
3	B	172	Total	O	0	0
			172	172		

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3 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.21Å 98.61Å 59.15Å 90.00° 108.07° 90.00°	Depositor
Resolution (Å)	27.24 – 1.95 27.24 – 1.95	Depositor EDS
% Data completeness (in resolution range)	98.9 (27.24-1.95) 98.8 (27.24-1.95)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle^1$	7.91 (at 1.95Å)	Xtriage
Refinement program	PHENIX 1.12_2829, PHENIX 1.12_2829	Depositor
R , R_{free}	0.182 , 0.227 0.182 , 0.227	Depositor DCC
R_{free} test set	2161 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	19.8	Xtriage
Anisotropy	0.180	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 41.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4970	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.86% 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.

4 Model quality [\(i\)](#)

4.1 Standard geometry [\(i\)](#)

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4.2 Too-close contacts [\(i\)](#)

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4.3 Torsion angles [\(i\)](#)

4.3.1 Protein backbone [\(i\)](#)

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4.3.2 Protein sidechains [\(i\)](#)

MolProbity failed to run properly - this section is therefore empty.

4.3.3 RNA [\(i\)](#)

MolProbity failed to run properly - this section is therefore empty.

4.4 Non-standard residues in protein, DNA, RNA chains [\(i\)](#)

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

4.5 Carbohydrates [\(i\)](#)

There are no oligosaccharides in this entry.

4.6 Ligand geometry [\(i\)](#)

2 ligands are 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	ZQB	B	401	1	31,35,35	2.92	10 (32%)	34,49,49	2.43	6 (17%)
2	ZQB	A	401	1	31,35,35	2.95	10 (32%)	34,49,49	3.09	13 (38%)

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	ZQB	B	401	1	-	1/21/39/39	0/4/4/4
2	ZQB	A	401	1	-	1/21/39/39	0/4/4/4

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	ZQB	C4-N1	9.11	1.49	1.33
2	A	401	ZQB	C4-N1	8.26	1.48	1.33
2	A	401	ZQB	O1-C4	8.16	1.39	1.23
2	B	401	ZQB	O1-C4	7.66	1.38	1.23
2	A	401	ZQB	C9-N2	5.87	1.47	1.34
2	B	401	ZQB	C9-N2	5.67	1.46	1.34
2	B	401	ZQB	C15-N4	5.12	1.45	1.34
2	A	401	ZQB	O3-C15	-4.38	1.14	1.23
2	A	401	ZQB	C21-C20	3.85	1.44	1.36
2	A	401	ZQB	C5-C4	3.49	1.55	1.50
2	B	401	ZQB	C18-C17	-3.10	1.38	1.43
2	A	401	ZQB	C15-N4	3.09	1.40	1.34
2	B	401	ZQB	C5-C4	2.98	1.54	1.50
2	B	401	ZQB	O3-C15	-2.44	1.18	1.23
2	A	401	ZQB	C14-C13	-2.35	1.39	1.48
2	B	401	ZQB	C14-C13	-2.34	1.39	1.48
2	A	401	ZQB	C20-CL1	2.31	1.80	1.74
2	A	401	ZQB	C6-C5	2.14	1.58	1.53
2	B	401	ZQB	C6-C5	2.13	1.58	1.53
2	B	401	ZQB	C13-C12	-2.00	1.38	1.48

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	401	ZQB	O1-C4-N1	-8.62	110.37	122.38
2	A	401	ZQB	O1-C4-C5	-8.09	111.00	122.85
2	A	401	ZQB	O1-C4-N1	-8.00	111.23	122.38
2	B	401	ZQB	O1-C4-C5	-7.85	111.37	122.85
2	A	401	ZQB	C3-N1-C4	-5.79	109.00	125.79
2	A	401	ZQB	C12-C11-C10	-5.05	107.73	114.52
2	A	401	ZQB	C22-C21-C20	4.63	124.99	119.65
2	B	401	ZQB	C12-C11-C10	-4.61	108.33	114.52
2	A	401	ZQB	C16-C15-N4	4.59	123.72	115.20
2	A	401	ZQB	O3-C15-N4	-4.24	114.65	122.45
2	A	401	ZQB	C8-C7-N2	-4.24	102.75	110.54
2	A	401	ZQB	C21-C20-C17	-3.92	118.13	121.03
2	A	401	ZQB	C23-C22-C21	-3.60	115.26	120.99
2	B	401	ZQB	C3-N1-C4	-3.39	115.96	125.79
2	A	401	ZQB	C19-C18-C17	-2.54	104.07	106.36
2	A	401	ZQB	C2-C1-C5	2.45	115.98	111.33
2	B	401	ZQB	C11-C10-N4	-2.43	104.99	110.58
2	B	401	ZQB	C16-N5-C17	2.39	108.81	103.90
2	A	401	ZQB	C1-C2-C3	2.02	115.24	110.61

There are no chirality outliers.

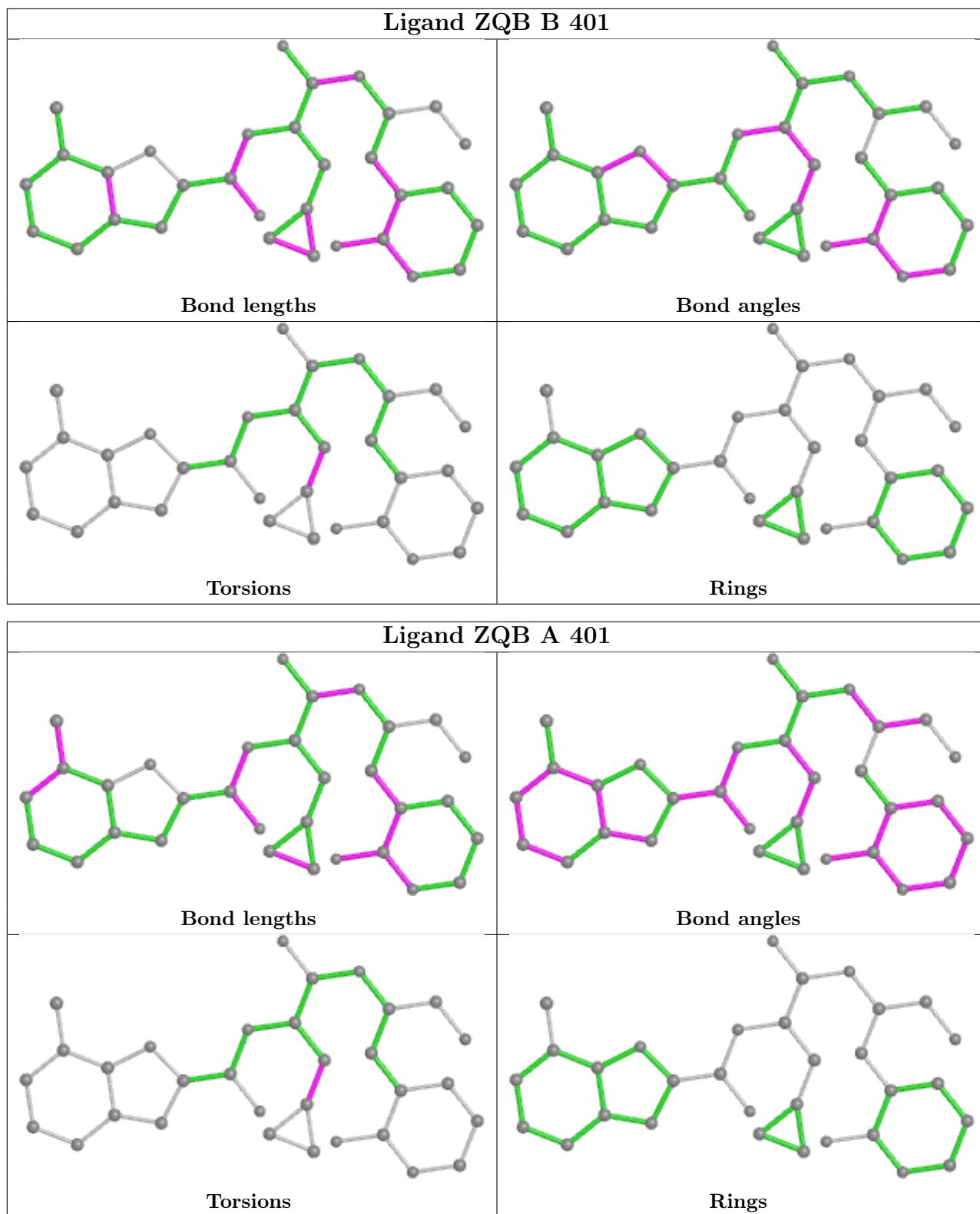
All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	ZQB	C10-C11-C12-C14
2	B	401	ZQB	C10-C11-C12-C14

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.



4.7 Other polymers [\(i\)](#)

There are no such residues in this entry.

4.8 Polymer linkage issues [\(i\)](#)

There are no chain breaks in this entry.

5 Fit of model and data i

5.1 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	299/299 (100%)	-0.01	20 (6%) 25 30	10, 20, 40, 54	0
1	B	299/299 (100%)	0.18	15 (5%) 35 42	10, 23, 42, 54	0
All	All	598/598 (100%)	0.08	35 (5%) 29 36	10, 21, 41, 54	0

All (35) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	223	PHE	5.6
1	A	191	ALA	4.4
1	B	155	ASP	3.5
1	A	190	THR	3.4
1	A	153	ASP	3.4
1	B	301	SER	3.3
1	B	72	ASN	3.1
1	A	301	SER	3.1
1	A	276	MET	2.9
1	A	194	ALA	2.6
1	A	50	LEU	2.6
1	A	46	SER	2.6
1	A	189	GLN	2.6
1	A	298	ARG	2.5
1	B	154	TYR	2.5
1	A	48	ASP	2.4
1	A	24	THR	2.4
1	A	195	GLY	2.4
1	B	153	ASP	2.3
1	A	278	GLY	2.3
1	A	3	PHE	2.3
1	B	274	ASN	2.2
1	B	216	ASP	2.2
1	A	277	ASN	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	60	ARG	2.2
1	B	212	VAL	2.1
1	A	49	ILE	2.1
1	A	284	SER	2.1
1	B	62	SER	2.1
1	B	254	SER	2.1
1	B	222	ARG	2.1
1	A	280	THR	2.1
1	B	218	TRP	2.1
1	B	300	CYS	2.0
1	B	298	ARG	2.0

5.2 Non-standard residues in protein, DNA, RNA chains [\(i\)](#)

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

5.3 Carbohydrates [\(i\)](#)

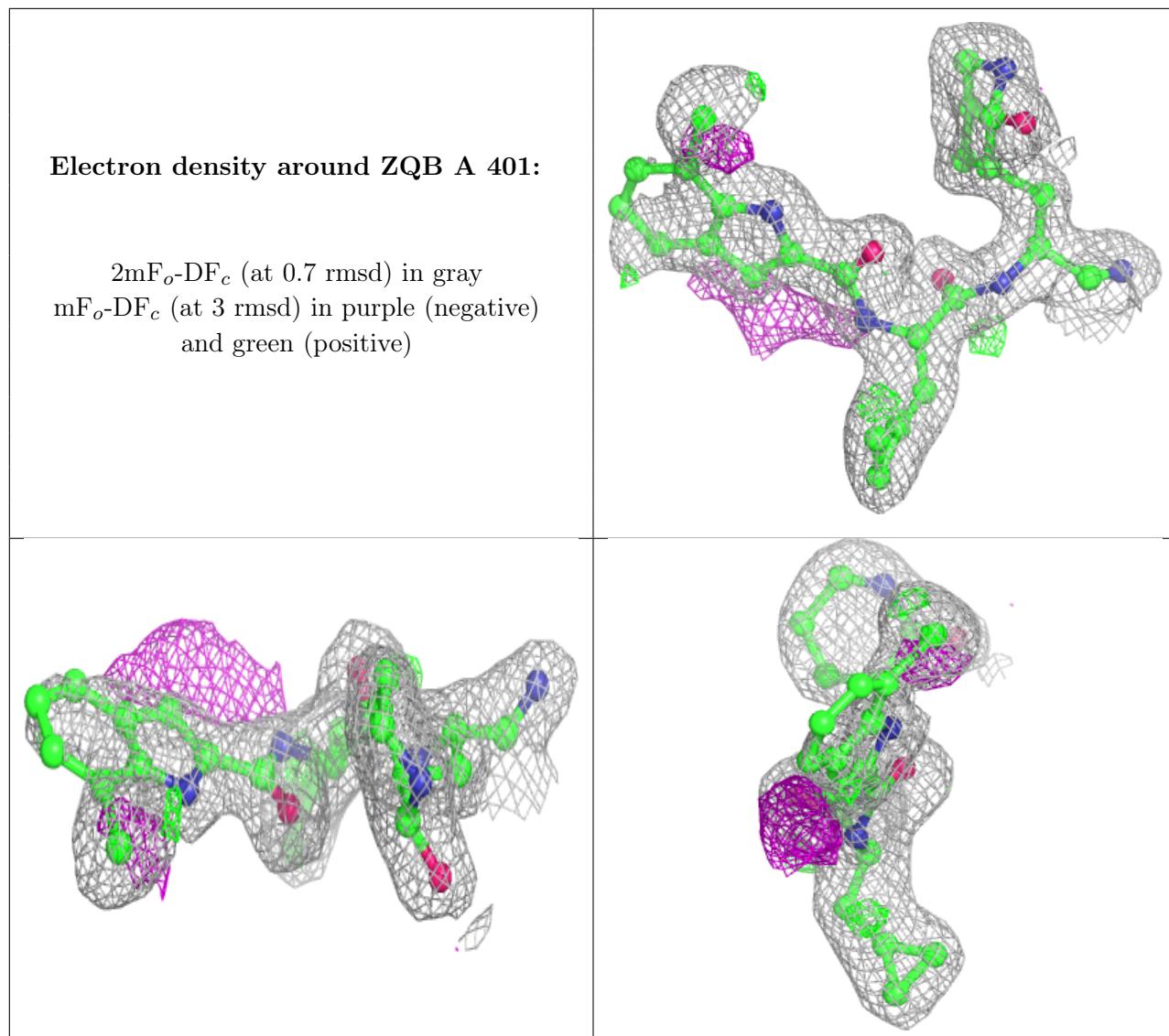
There are no oligosaccharides in this entry.

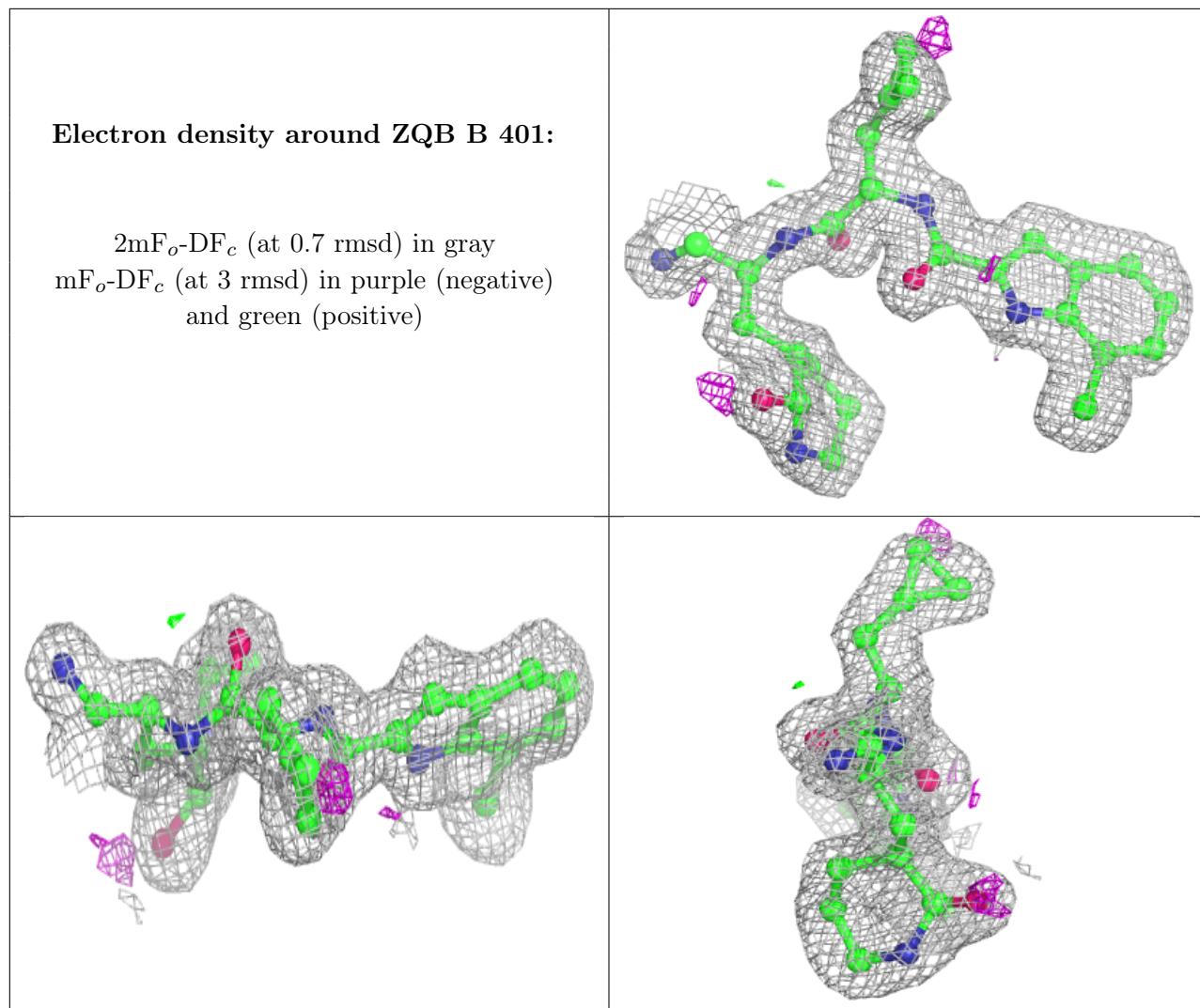
5.4 Ligands [\(i\)](#)

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(Å ²)	Q<0.9
2	ZQB	A	401	32/32	0.90	0.11	14,27,42,44	0
2	ZQB	B	401	32/32	0.94	0.08	11,18,25,28	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.





5.5 Other polymers [\(i\)](#)

There are no such residues in this entry.