



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 17, 2026 – 05:58 PM EDT

PDB ID : 7IM9 / pdb_00007im9
Title : Group deposition for crystallographic fragment screening of SARS-CoV-2 nucleocapsid protein (CTD) – Crystal Structure of SARS-CoV-2 nucleocapsid protein (CTD) in complex with Z19733482 (Nprot-x0361)
Authors : Aschenbrenner, J.C.; Luptak, J.; Balcomb, B.H.; Marples, P.G.; Bellini, D.; Yu, C.W.; Douangamath, A.; Dias, A.; Powell, A.; Fearon, D.; James, L.; von Delft, F.
Deposited on : 2025-08-11
Resolution : 1.79 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)

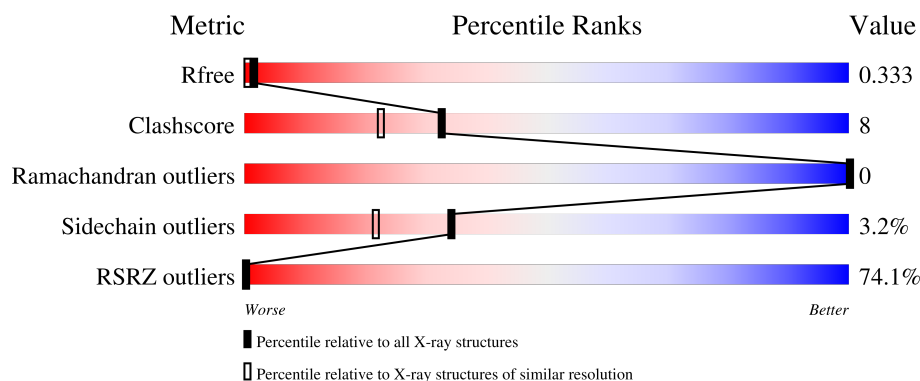
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.79 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}	180053	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	117	74% 80% 17% ..

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.50

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	A1AND	A	401[A]	-	-	-	X
2	A1AND	A	401[B]	-	-	-	X

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 1075 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.

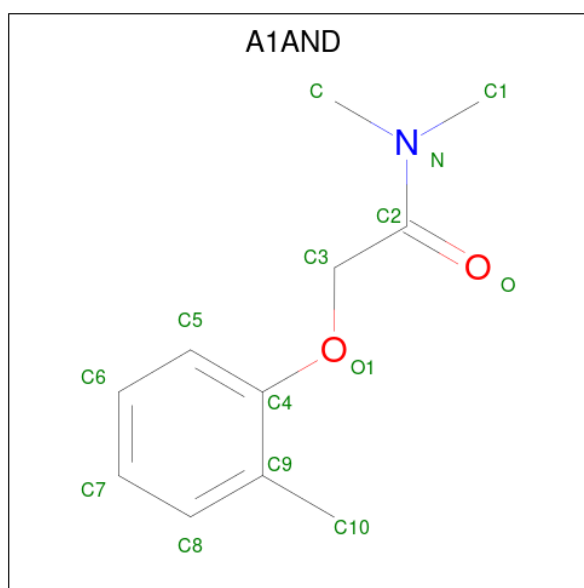
- Molecule 1 is a protein called Nucleoprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	116	927	586	165	173	3	0	1	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	248	SER	-	expression tag	UNP P0DTC9
A	249	MET	-	expression tag	UNP P0DTC9

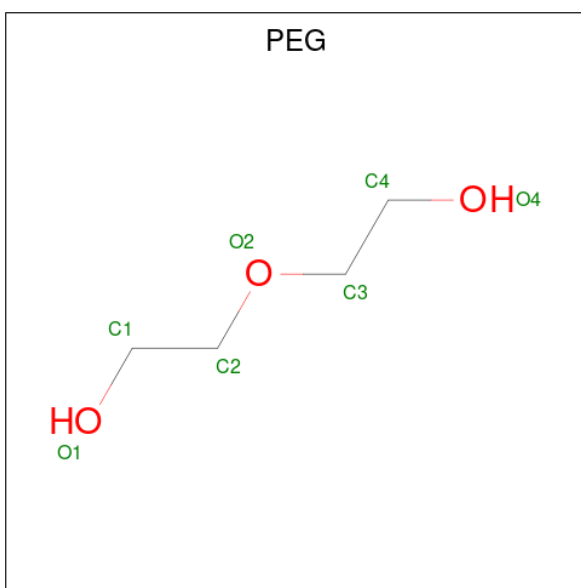
- Molecule 2 is N,N-dimethyl-2-(2-methylphenoxy)acetamide (CCD ID: A1AND) (formula: $C_{11}H_{15}NO_2$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	28	22	2	4	0	1

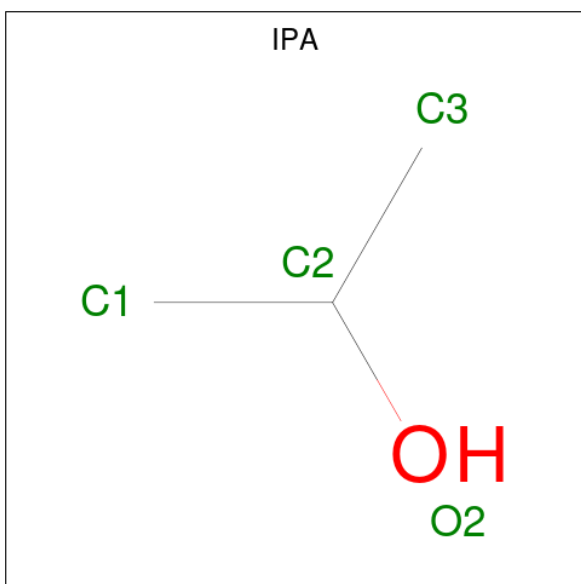
- Molecule 3 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$) (labeled

as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			7	4	3		

- Molecule 4 is ISOPROPYL ALCOHOL (CCD ID: IPA) (formula: C_3H_8O) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	3	1		

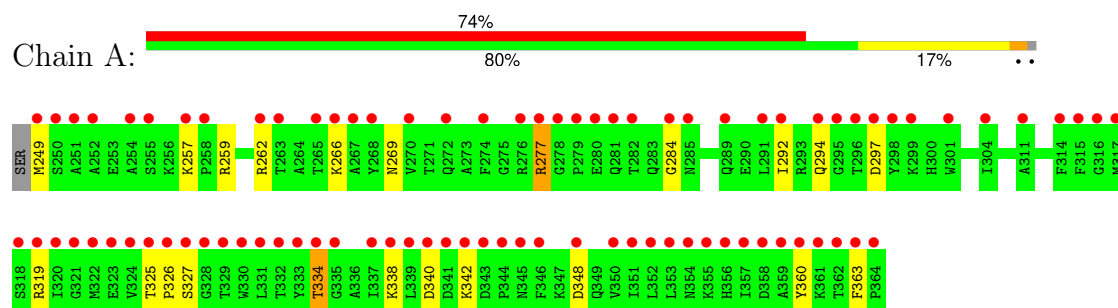
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	109	Total 109	O 109	0	0

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: Nucleoprotein



4 Data and refinement statistics

Property	Value	Source
Space group	I 41	Depositor
Cell constants a, b, c, α , β , γ	88.32Å 88.32Å 40.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.20 – 1.79 44.20 – 1.79	Depositor EDS
% Data completeness (in resolution range)	44.9 (44.20-1.79) 45.0 (44.20-1.79)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.71 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.203 , 0.276 0.257 , 0.333	Depositor DCC
R_{free} test set	783 reflections (5.24%)	wwPDB-VP
Wilson B-factor (Å ²)	28.6	Xtriage
Anisotropy	0.405	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 92.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.040 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	1075	wwPDB-VP
Average B, all atoms (Å ²)	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.54% 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: PEG, A1AND, IPA

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	1.01	0/950	1.37	0/1282

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	927	0	906	14	0
2	A	28	0	0	0	0
3	A	7	0	10	1	0
4	A	4	0	8	1	0
5	A	109	0	0	3	0
All	All	1075	0	924	15	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 8.

All (15) 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:319:ARG:HB2	1:A:334:THR:HG22	1.74	0.69
1:A:259:ARG:NH1	5:A:501:HOH:O	2.25	0.68
1:A:338:LYS:N	5:A:503:HOH:O	2.28	0.65
1:A:340:ASP:OD1	1:A:342:LYS:HB2	2.05	0.56
1:A:277:ARG:HA	1:A:284:GLY:O	2.16	0.46
1:A:269:ASN:HB2	1:A:292:ILE:O	2.16	0.46
1:A:325:THR:HB	1:A:326:PRO:HD2	1.97	0.46
1:A:259:ARG:HA	1:A:262:ARG:HD2	1.97	0.45
1:A:360:TYR:HA	1:A:363:PHE:CD2	2.53	0.43
1:A:294:GLN:O	1:A:297:ASP:HB2	2.20	0.42
1:A:348:ASP:HB3	4:A:403:IPA:H13	2.03	0.41
1:A:360:TYR:HA	1:A:363:PHE:CE2	2.56	0.41
1:A:266:LYS:HE2	1:A:294:GLN:HG2	2.02	0.41
3:A:402:PEG:H31	5:A:525:HOH:O	2.19	0.41
1:A:249:MET:HE1	1:A:257:LYS:NZ	2.36	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	115/117 (98%)	113 (98%)	2 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	96/96 (100%)	93 (97%)	3 (3%)	35	23

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	277	ARG
1	A	327	SER
1	A	334	THR

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	354	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 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
4	IPA	A	403	-	3,3,3	0.22	0	3,3,3	0.26	0
3	PEG	A	402	-	6,6,6	0.10	0	5,5,5	0.07	0
2	A1AND	A	401[A]	-	14,14,14	0.13	0	17,18,18	0.20	0
2	A1AND	A	401[B]	-	14,14,14	0.12	0	17,18,18	0.18	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
3	PEG	A	402	-	-	1/4/4/4	-
2	A1AND	A	401[A]	-	-	7/9/9/9	0/1/1/1
2	A1AND	A	401[B]	-	-	5/9/9/9	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (13) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401[A]	A1AND	O-C2-N-C
2	A	401[A]	A1AND	O-C2-N-C1
2	A	401[B]	A1AND	O-C2-N-C
2	A	401[B]	A1AND	O-C2-N-C1
2	A	401[A]	A1AND	C3-C2-N-C
2	A	401[A]	A1AND	C3-C2-N-C1
2	A	401[B]	A1AND	C3-C2-N-C
2	A	401[B]	A1AND	C3-C2-N-C1
3	A	402	PEG	C4-C3-O2-C2
2	A	401[A]	A1AND	C5-C4-O1-C3
2	A	401[A]	A1AND	C9-C4-O1-C3
2	A	401[B]	A1AND	N-C2-C3-O1
2	A	401[A]	A1AND	C2-C3-O1-C4

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	403	IPA	1	0

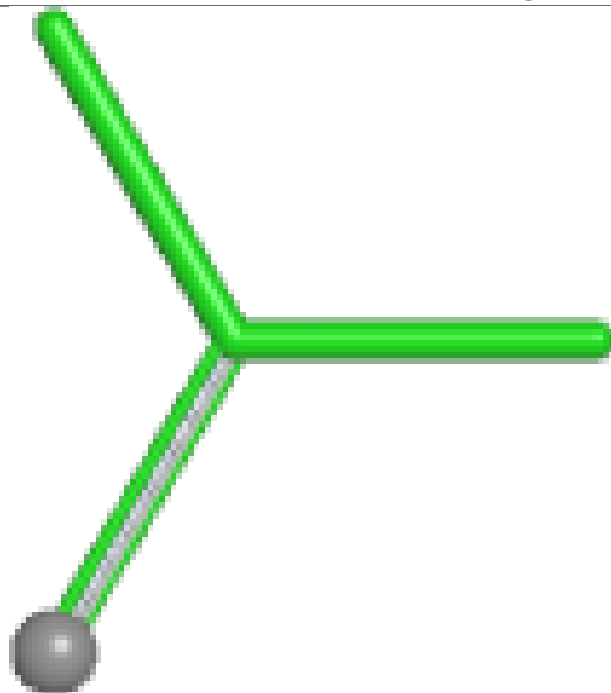
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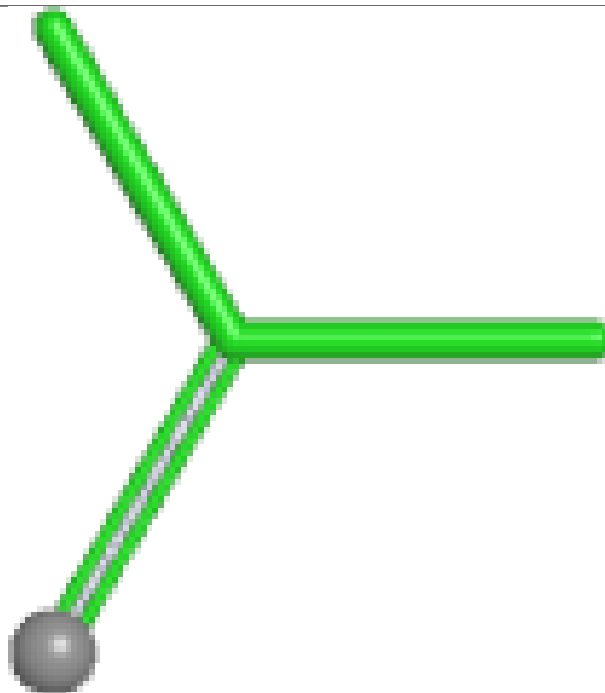
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	402	PEG	1	0

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.

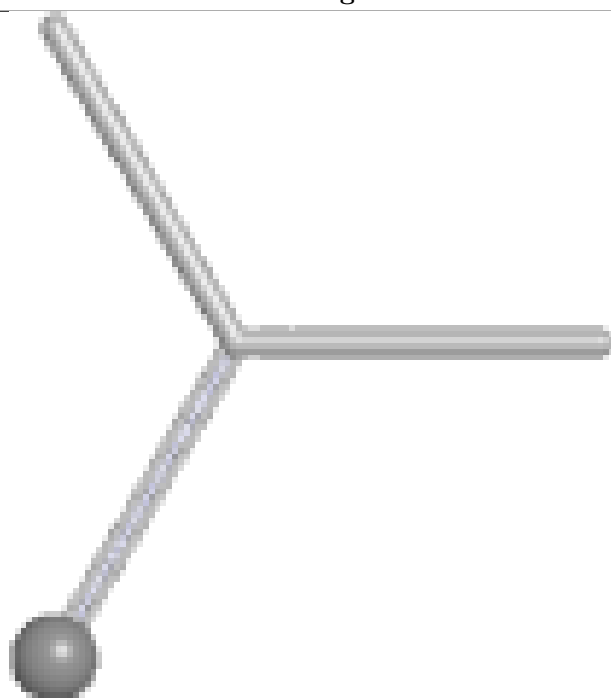
Ligand IPA A 403



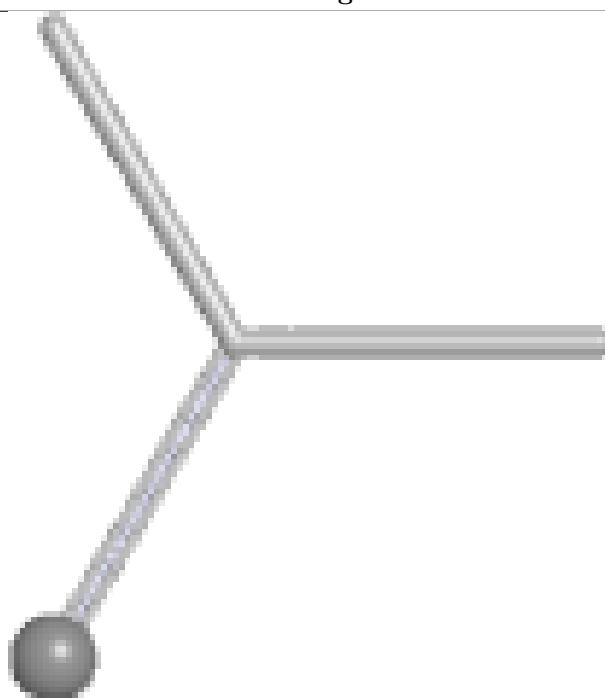
Bond lengths



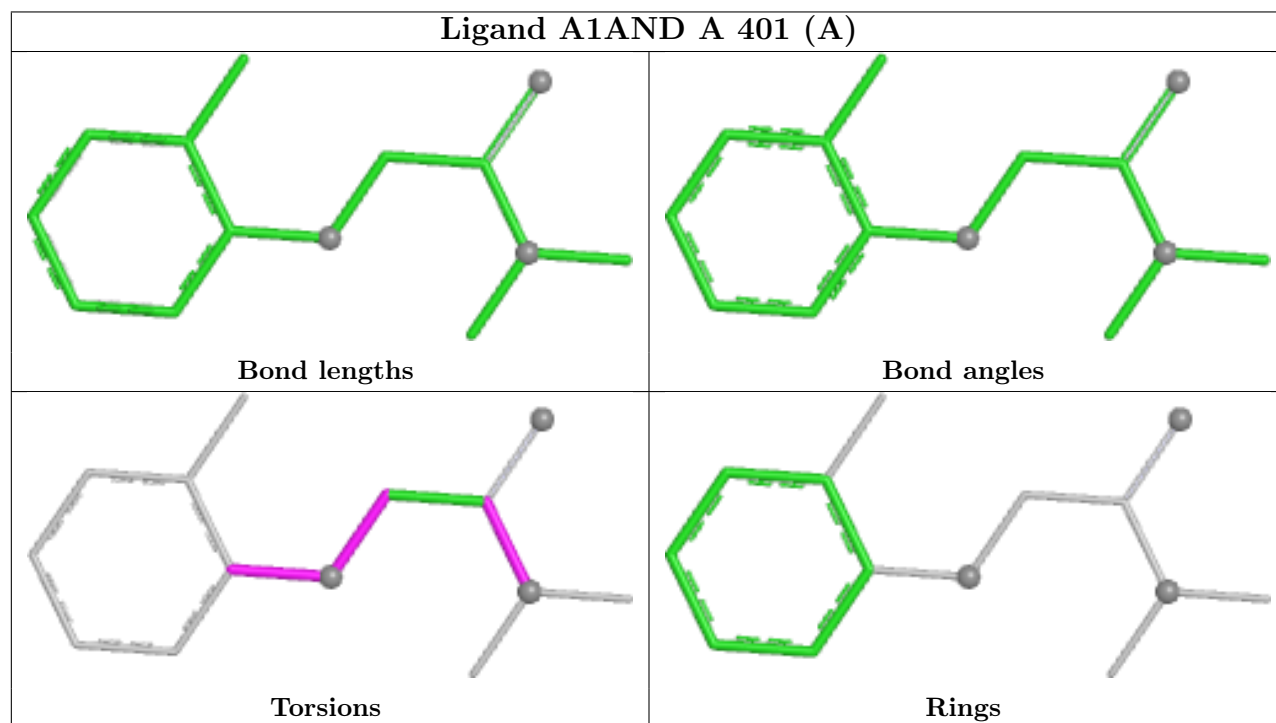
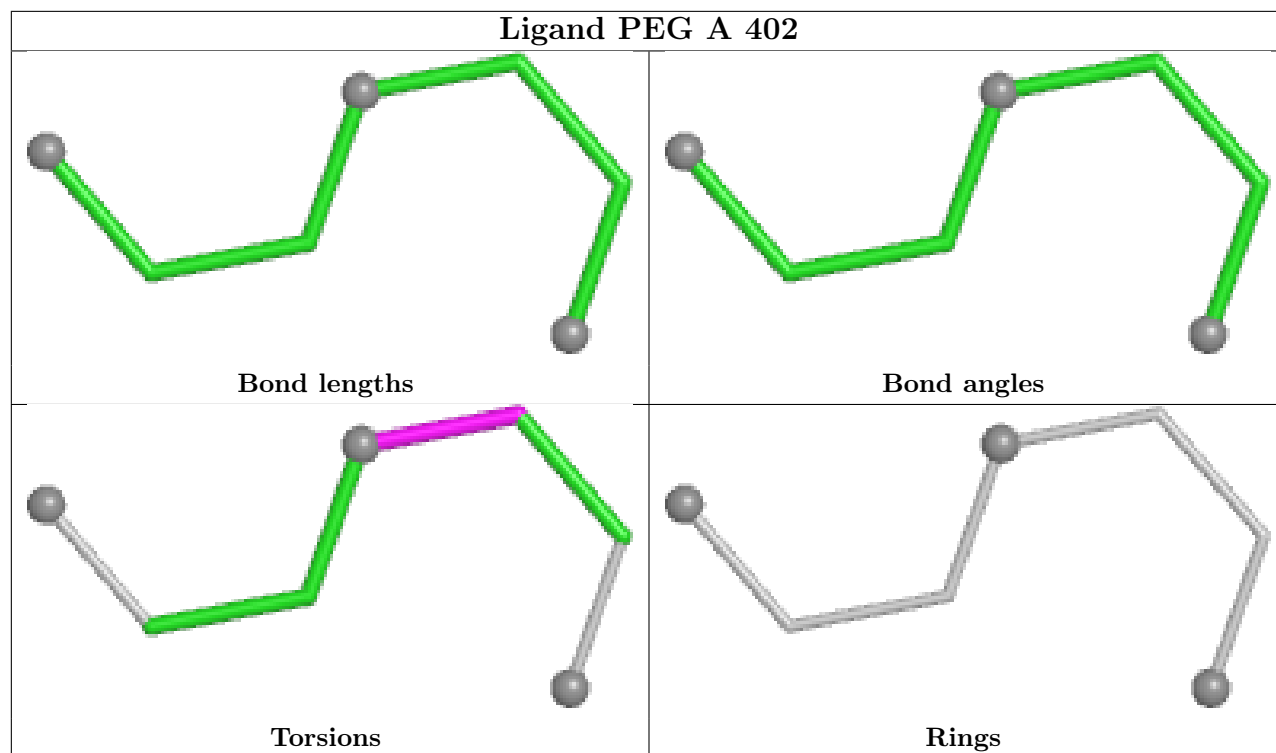
Bond angles

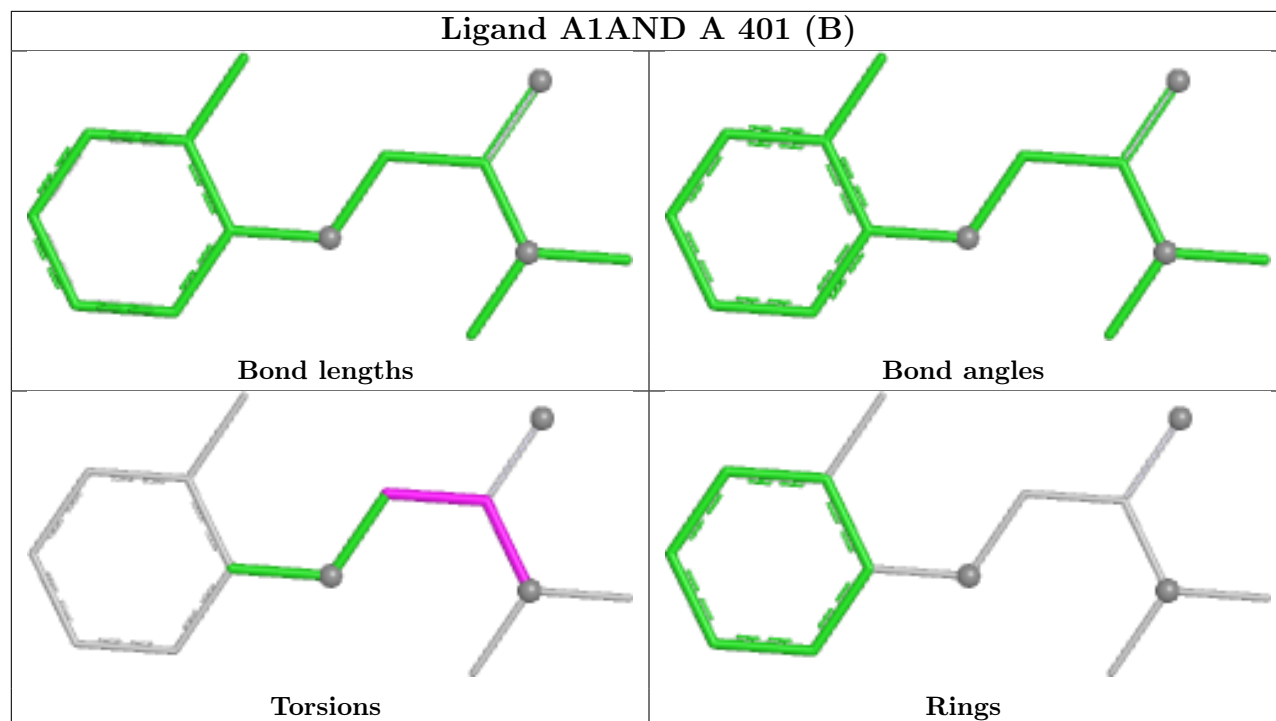


Torsions



Rings





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	116/117 (99%)	3.05	86 (74%) 0 0	11, 21, 39, 49	89 (76%)

All (86) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	324	VAL	9.8
1	A	360	TYR	7.1
1	A	330	TRP	6.1
1	A	363	PHE	6.0
1	A	314	PHE	5.9
1	A	281[A]	GLN	5.6
1	A	326	PRO	5.5
1	A	358	ASP	5.5
1	A	321	GLY	5.4
1	A	334	THR	5.3
1	A	267	ALA	5.3
1	A	364	PRO	5.0
1	A	344	PRO	4.9
1	A	252	ALA	4.8
1	A	254	ALA	4.8
1	A	251	ALA	4.8
1	A	339	LEU	4.8
1	A	327	SER	4.7
1	A	320	ILE	4.7
1	A	325	THR	4.7
1	A	359	ALA	4.6
1	A	361	LYS	4.5
1	A	341	ASP	4.5
1	A	328	GLY	4.3
1	A	332	THR	4.3
1	A	337	ILE	4.2
1	A	276	ARG	4.2

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Mol	Chain	Res	Type	RSRZ
1	A	279	PRO	4.1
1	A	298	TYR	4.1
1	A	331	LEU	4.1
1	A	280	GLU	4.1
1	A	282	THR	4.1
1	A	346	PHE	4.0
1	A	278	GLY	3.9
1	A	284	GLY	3.9
1	A	342	LYS	3.9
1	A	249	MET	3.9
1	A	338	LYS	3.8
1	A	315	PHE	3.8
1	A	362	THR	3.8
1	A	322	MET	3.7
1	A	340	ASP	3.5
1	A	292	ILE	3.4
1	A	329	THR	3.4
1	A	294	GLN	3.3
1	A	353	LEU	3.3
1	A	274	PHE	3.3
1	A	354	ASN	3.2
1	A	345	ASN	3.0
1	A	316	GLY	2.9
1	A	343	ASP	2.9
1	A	357	ILE	2.9
1	A	289	GLN	2.8
1	A	323	GLU	2.8
1	A	266	LYS	2.8
1	A	319	ARG	2.8
1	A	355	LYS	2.8
1	A	296	THR	2.8
1	A	356	HIS	2.8
1	A	270	VAL	2.7
1	A	299	LYS	2.7
1	A	268	TYR	2.6
1	A	335	GLY	2.6
1	A	297	ASP	2.6
1	A	333	TYR	2.6
1	A	301	TRP	2.6
1	A	285	ASN	2.6
1	A	265	THR	2.5
1	A	255	SER	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	352	LEU	2.5
1	A	295	GLY	2.4
1	A	311	ALA	2.4
1	A	351	ILE	2.4
1	A	277	ARG	2.3
1	A	263	THR	2.3
1	A	317	MET	2.3
1	A	304	ILE	2.2
1	A	318	SER	2.2
1	A	250	SER	2.2
1	A	272	GLN	2.1
1	A	348	ASP	2.1
1	A	258	PRO	2.1
1	A	262	ARG	2.1
1	A	350	VAL	2.1
1	A	291	LEU	2.0
1	A	257	LYS	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

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.

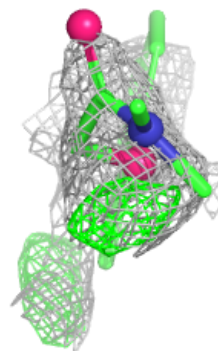
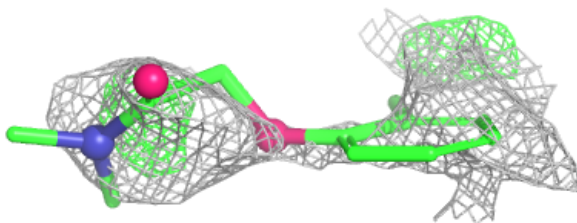
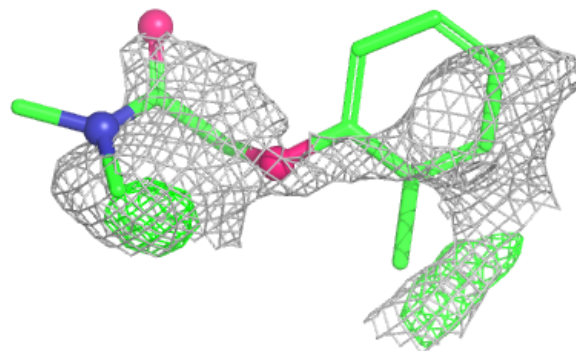
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	A1AND	A	401[A]	14/14	0.60	0.47	54,58,60,60	14
2	A1AND	A	401[B]	14/14	0.60	0.47	48,49,52,52	14
3	PEG	A	402	7/7	0.66	0.22	59,62,79,80	7
4	IPA	A	403	4/4	0.72	0.27	32,32,32,33	4

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.

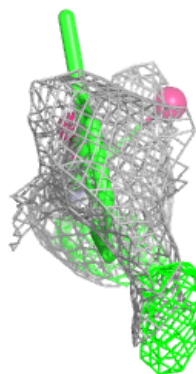
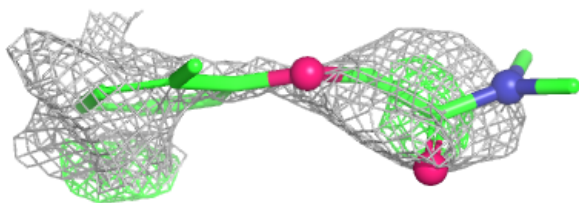
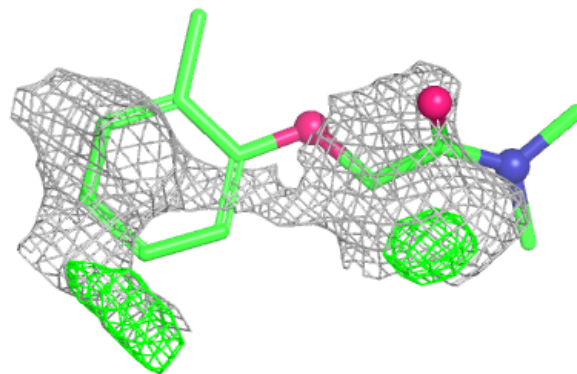
Electron density around A1AND A 401 (A):

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

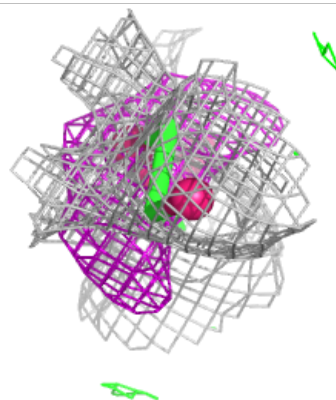
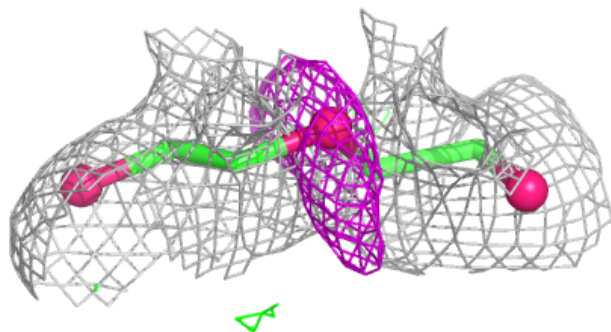
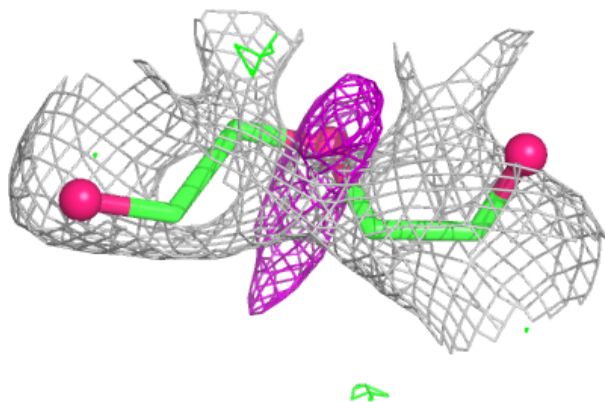


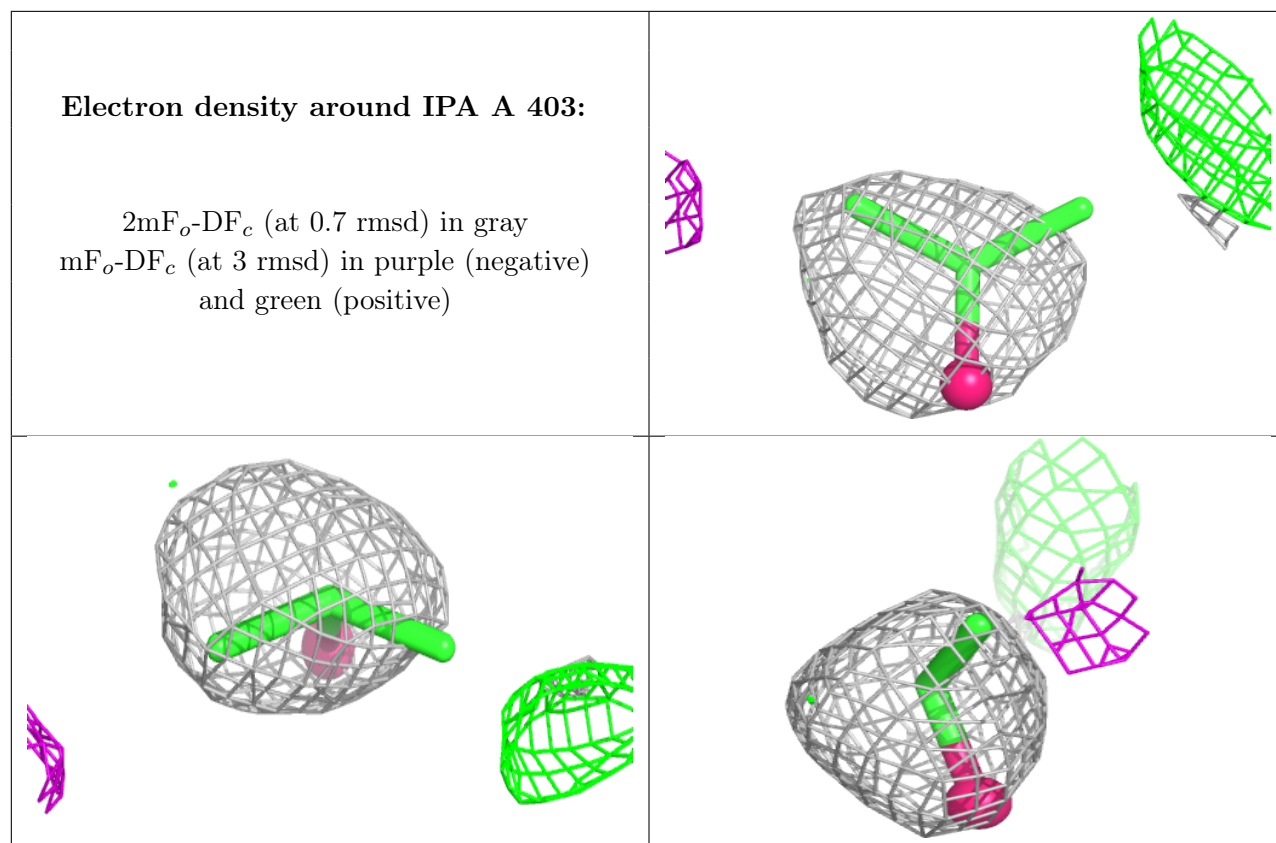
Electron density around A1AND A 401 (B):

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

**Electron density around PEG A 402:**

$2mF_o-DF_c$ (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.