



wwPDB X-ray Structure Validation Summary Report

Mar 28, 2022 – 07:09 pm BST


PDB ID : 7QB4
Title : Mus Musculus Acetylcholinesterase in complex with 7-[(1-benzylpiperidin-3-yl)methoxy]-3,4-dimethyl-2H-chromen-2-one
Authors : Ekstrom, F.J.; Forsgren, N.
Deposited on : 2021-11-18
Resolution : 2.50 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

A user guide is available at

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

with specific help available everywhere you see the  symbol.

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 : 2.27
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0267
CCP4 : 7.1.010 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.27

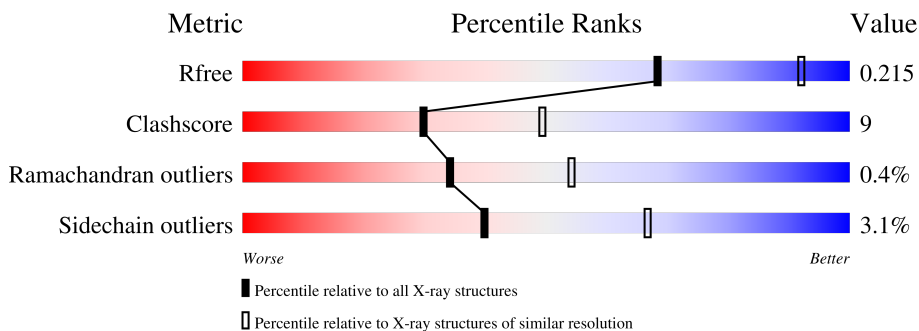
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)

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 ≥ 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	543	81% (green), 17% (yellow), .. (grey)
1	B	543	77% (green), 20% (yellow), .. (grey)

2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 8802 atoms, of which 48 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 Acetylcholinesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	537	Total	C	N	O	S	0	1	0
			4196	2691	728	763	14			
1	B	535	Total	C	N	O	S	0	4	0
			4202	2697	729	761	15			

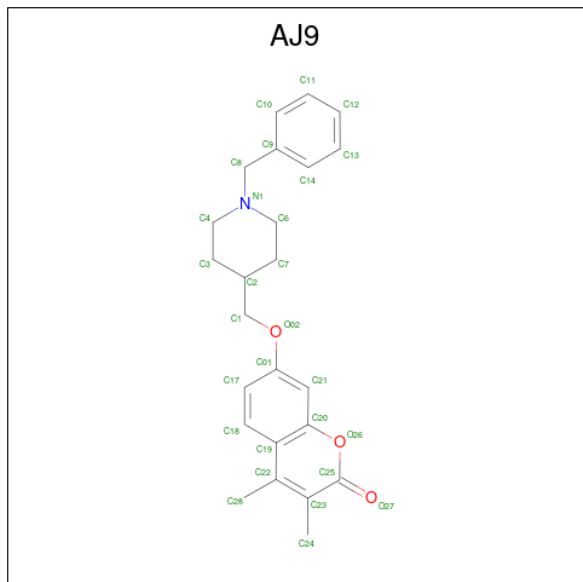
- Molecule 2 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	B	1	Total	C	N	O	0	0
			14	8	1	5		

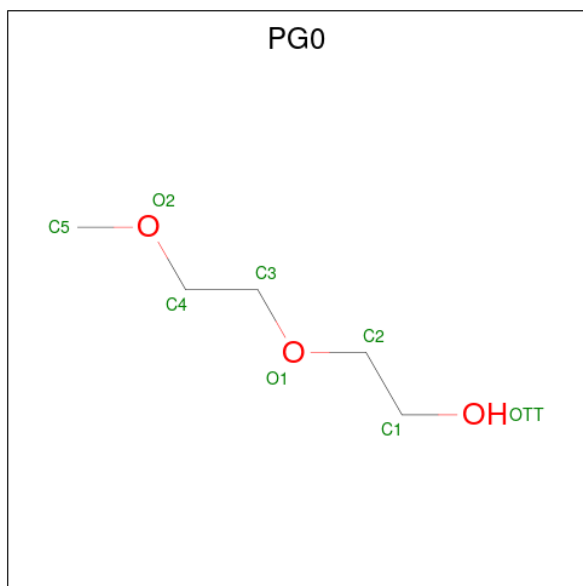
- Molecule 3 is 3,4-dimethyl-7-[[1-(phenylmethyl)piperidin-4-yl]methoxy]chromen-2

-one (three-letter code: AJ9) (formula: $C_{24}H_{27}NO_3$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			14	11	3		
3	B	1	Total	C	O	0	0
			14	11	3		

- Molecule 4 is 2-(2-METHOXYETHOXY)ETHANOL (three-letter code: PG0) (formula: $C_5H_{12}O_3$).



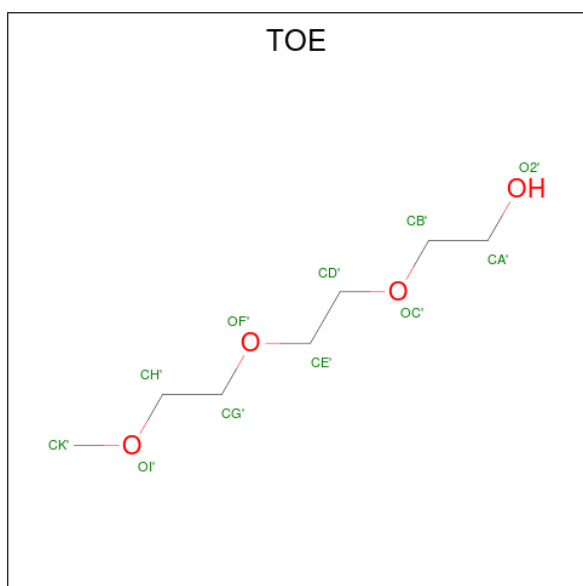
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 5 3 2	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C O 8 5 3	0	0
4	A	1	Total C H O 20 5 12 3	0	0
4	A	1	Total C H O 20 5 12 3	0	0
4	B	1	Total C O 8 5 3	0	0
4	B	1	Total C O 8 5 3	0	0
4	B	1	Total C H O 20 5 12 3	0	0
4	B	1	Total C H O 20 5 12 3	0	0

- Molecule 5 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



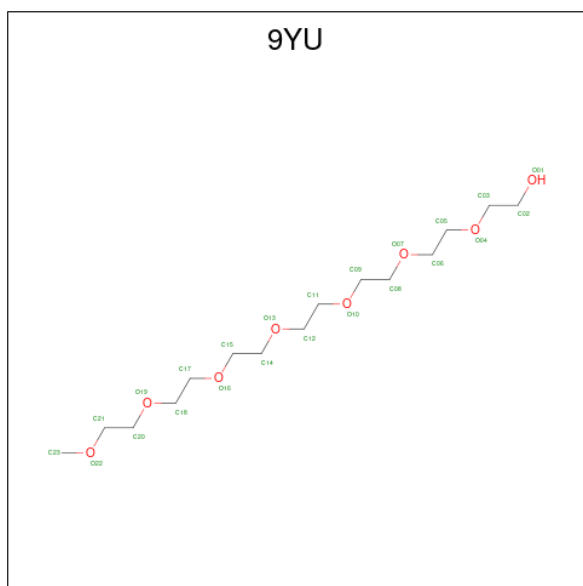
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	1	Total C O 4 2 2	0	0
5	B	1	Total C O 4 2 2	0	0
5	B	1	Total C O 4 2 2	0	0

- Molecule 6 is 2-[2-(2-METHOXY-ETHOXY)-ETHOXY]-ETHOXYL (three-letter code: TOE) (formula: C₇H₁₆O₄).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
6	B	1	Total	C	O	0	0
			11	7	4		

- Molecule 7 is 2-[2-[2-[2-[2-[2-(2-methoxyethoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol (three-letter code: 9YU) (formula: C₁₅H₃₂O₈).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
7	B	1	Total	C	O	0	0
			23	15	8		

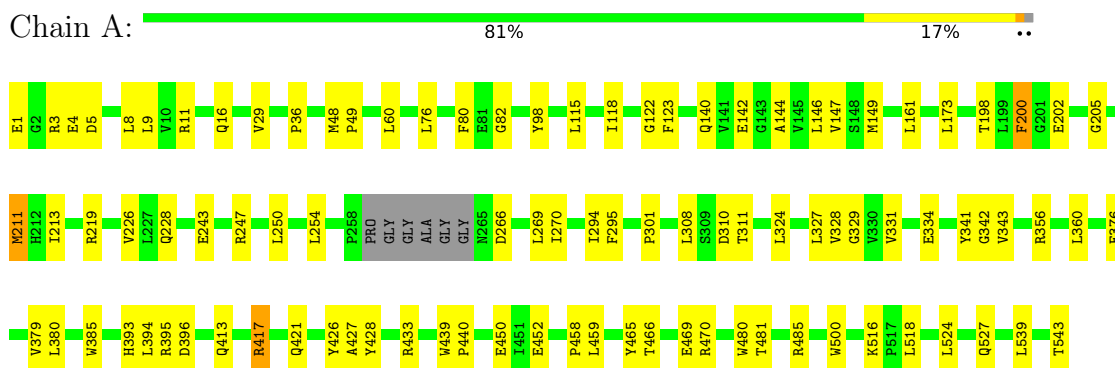
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	72	Total	O	0	0
			72	72		
8	B	51	Total	O	0	0
			51	51		

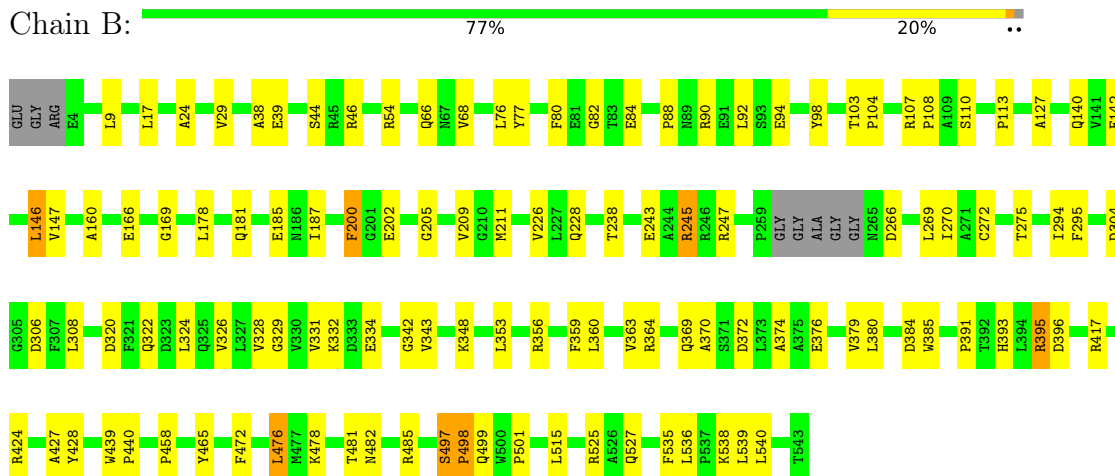
3 Residue-property plots [i](#)

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. 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. 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: Acetylcholinesterase



- Molecule 1: Acetylcholinesterase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	79.41Å 111.05Å 227.09Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.19 – 2.50 46.18 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.2 (46.19-2.50) 99.5 (46.18-2.50)	Depositor EDS
R_{merge}	0.27	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 2.51Å)	Xtrriage
Refinement program	PHENIX 1.12_2829, PHENIX 1.12_2829	Depositor
R, R_{free}	0.184 , 0.217 0.183 , 0.215	Depositor DCC
R_{free} test set	1405 reflections (2.01%)	wwPDB-VP
Wilson B-factor (Å ²)	53.9	Xtrriage
Anisotropy	0.817	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	(Not available) , (Not available)	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	8802	wwPDB-VP
Average B, all atoms (Å ²)	68.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.65% 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: PG0, AJ9, NAG, 9YU, TOE, EDO

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	0.31	0/4320	0.50	0/5904
1	B	0.31	0/4328	0.50	0/5917
All	All	0.31	0/8648	0.50	0/11821

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	4196	0	4078	79	0
1	B	4202	0	4078	87	0
2	A	28	0	26	0	0
2	B	14	0	13	0	0
3	A	14	0	0	0	0
3	B	14	0	0	0	0
4	A	85	24	124	7	0
4	B	32	24	48	6	0
5	B	12	0	18	1	0
6	B	11	0	16	0	0
7	B	23	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	A	72	0	0	2	0
8	B	51	0	0	0	0
All	All	8754	48	8401	160	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 9.

The worst 5 of 160 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:161:LEU:HD12	1:A:270:ILE:HD11	1.45	0.98
1:B:320:ASP:OD1	1:B:322:GLN:HG3	1.78	0.82
1:A:459:LEU:HD23	1:A:470:ARG:HG3	1.62	0.81
1:A:380:LEU:HD12	1:B:535:PHE:HB2	1.63	0.81
1:B:324:LEU:HD21	1:B:326:VAL:CG2	2.11	0.79

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	534/543 (98%)	515 (96%)	18 (3%)	1 (0%)	47 68
1	B	535/543 (98%)	508 (95%)	24 (4%)	3 (1%)	25 43
All	All	1069/1086 (98%)	1023 (96%)	42 (4%)	4 (0%)	34 54

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	498	PRO
1	B	497	SER

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Mol	Chain	Res	Type
1	A	342	GLY
1	B	342	GLY

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	441/443 (100%)	427 (97%)	14 (3%)	39 65
1	B	442/443 (100%)	429 (97%)	13 (3%)	42 69
All	All	883/886 (100%)	856 (97%)	27 (3%)	40 67

5 of 27 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	44	SER
1	B	200	PHE
1	B	476	LEU
1	B	146	LEU
1	B	245	ARG

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

25 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	NAG	A	602	1	14,14,15	0.43	0	17,19,21	0.57	0
7	9YU	B	611	-	22,22,22	0.64	0	21,21,21	0.90	1 (4%)
4	PG0	A	613	-	7,7,7	0.59	0	6,6,6	0.97	1 (16%)
5	EDO	B	605	-	3,3,3	0.42	0	2,2,2	0.37	0
4	PG0	A	612	-	7,7,7	0.64	0	6,6,6	0.77	0
4	PG0	B	606	-	7,7,7	0.61	0	6,6,6	0.81	0
4	PG0	A	606	-	4,4,7	0.53	0	3,3,6	0.66	0
4	PG0	A	608	-	7,7,7	0.57	0	6,6,6	0.75	0
3	AJ9	B	602	-	13,15,31	1.43	3 (23%)	18,22,43	1.61	6 (33%)
4	PG0	A	611	-	7,7,7	0.58	0	6,6,6	0.79	0
4	PG0	A	614	-	7,7,7	0.55	0	6,6,6	0.82	0
3	AJ9	A	603	-	13,15,31	1.49	2 (15%)	18,22,43	1.58	4 (22%)
4	PG0	A	610	-	7,7,7	0.62	0	6,6,6	0.81	0
4	PG0	B	607	-	7,7,7	0.62	0	6,6,6	0.79	0
2	NAG	A	601	1	14,14,15	0.49	0	17,19,21	0.58	1 (5%)
5	EDO	B	604	-	3,3,3	0.48	0	2,2,2	0.24	0
4	PG0	A	609	-	7,7,7	0.60	0	6,6,6	0.77	0
4	PG0	A	605	-	7,7,7	0.61	0	6,6,6	0.73	0
4	PG0	A	607	-	7,7,7	0.57	0	6,6,6	0.74	0
5	EDO	B	603	-	3,3,3	0.42	0	2,2,2	0.39	0
4	PG0	B	608	-	7,7,7	0.63	0	6,6,6	1.15	1 (16%)
6	TOE	B	610	-	10,10,10	0.62	0	9,9,9	0.84	0
4	PG0	A	604	-	7,7,7	0.61	0	6,6,6	0.75	0
4	PG0	B	609	-	7,7,7	0.67	0	6,6,6	1.09	1 (16%)
2	NAG	B	601	1	14,14,15	0.63	0	17,19,21	0.67	1 (5%)

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	NAG	A	602	1	-	2/6/23/26	0/1/1/1
7	9YU	B	611	-	-	11/20/20/20	-
4	PG0	A	613	-	-	1/5/5/5	-
5	EDO	B	605	-	-	1/1/1/1	-
4	PG0	A	612	-	-	4/5/5/5	-
4	PG0	B	606	-	-	3/5/5/5	-
4	PG0	A	606	-	-	1/2/2/5	-
4	PG0	A	608	-	-	4/5/5/5	-
3	AJ9	B	602	-	-	-	0/2/2/4
4	PG0	A	611	-	-	4/5/5/5	-
4	PG0	A	614	-	-	1/5/5/5	-
3	AJ9	A	603	-	-	-	0/2/2/4
4	PG0	A	610	-	-	2/5/5/5	-
4	PG0	B	607	-	-	4/5/5/5	-
2	NAG	A	601	1	-	2/6/23/26	0/1/1/1
5	EDO	B	604	-	-	1/1/1/1	-
4	PG0	A	609	-	-	3/5/5/5	-
4	PG0	A	605	-	-	2/5/5/5	-
5	EDO	B	603	-	-	1/1/1/1	-
4	PG0	A	607	-	-	2/5/5/5	-
4	PG0	B	608	-	-	3/5/5/5	-
6	TOE	B	610	-	-	7/8/8/8	-
4	PG0	A	604	-	-	4/5/5/5	-
4	PG0	B	609	-	-	3/5/5/5	-
2	NAG	B	601	1	-	2/6/23/26	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	603	AJ9	C23-C25	2.82	1.49	1.40
3	A	603	AJ9	C17-C01	2.81	1.44	1.38
3	B	602	AJ9	C23-C25	2.51	1.48	1.40
3	B	602	AJ9	C21-C20	2.40	1.42	1.37
3	B	602	AJ9	C17-C01	2.15	1.43	1.38

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	602	AJ9	C17-C01-C21	-3.23	116.27	120.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	603	AJ9	C17-C01-C21	-3.09	116.44	120.39
3	A	603	AJ9	C28-C22-C23	-2.84	117.84	121.87
3	B	602	AJ9	C28-C22-C23	-2.64	118.12	121.87
3	B	602	AJ9	C24-C23-C22	2.62	125.59	121.87

There are no chirality outliers.

5 of 68 torsion outliers are listed below:

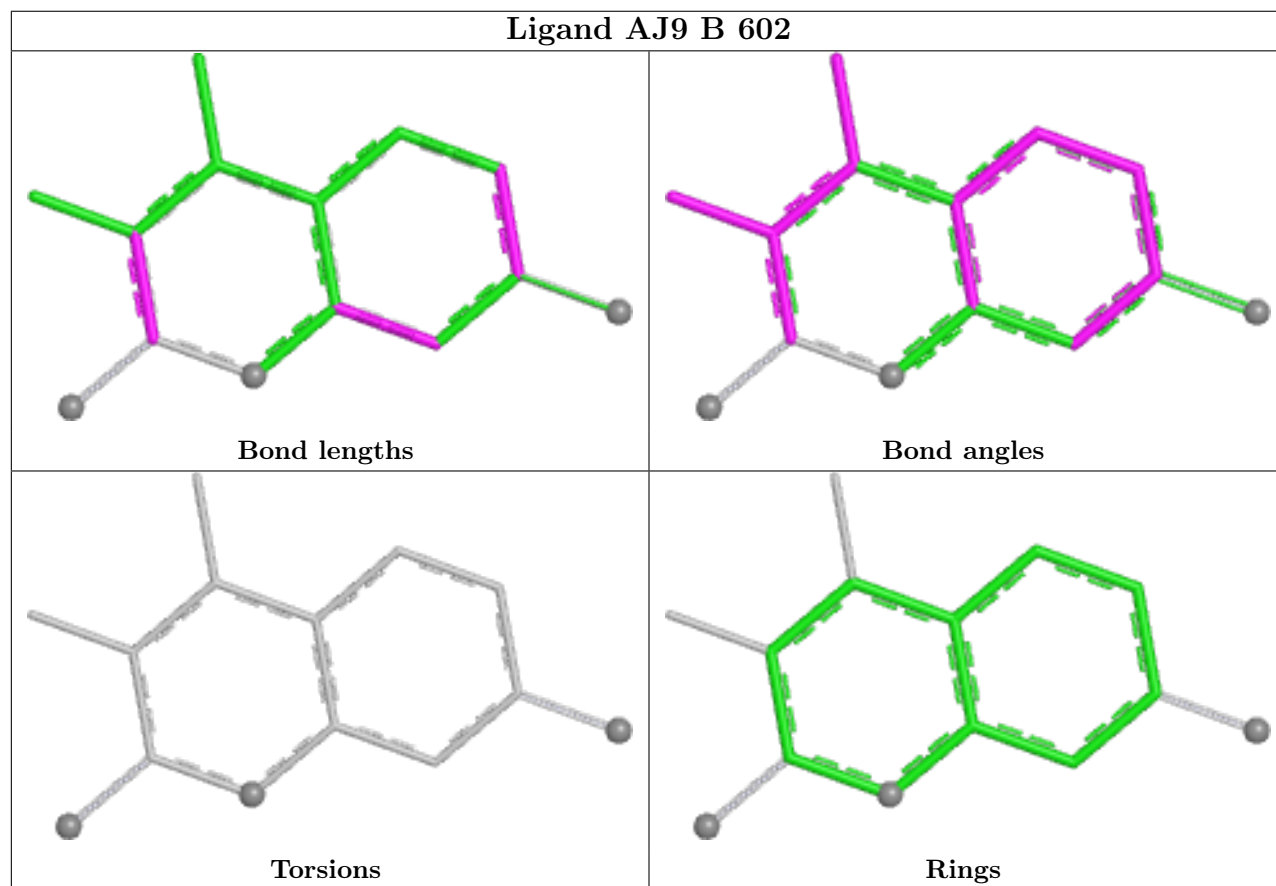
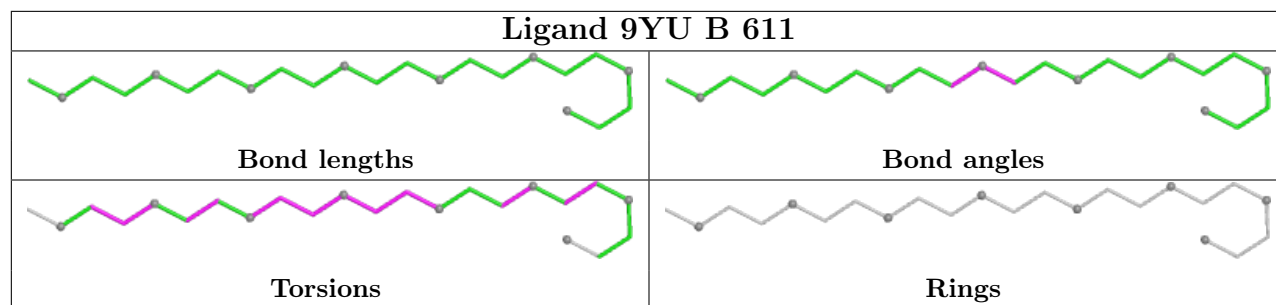
Mol	Chain	Res	Type	Atoms
4	A	609	PG0	C1-C2-O1-C3
4	B	608	PG0	OTT-C1-C2-O1
2	B	601	NAG	O5-C5-C6-O6
4	A	604	PG0	O1-C3-C4-O2
6	B	610	TOE	OF'-CG'-CH'-OI'

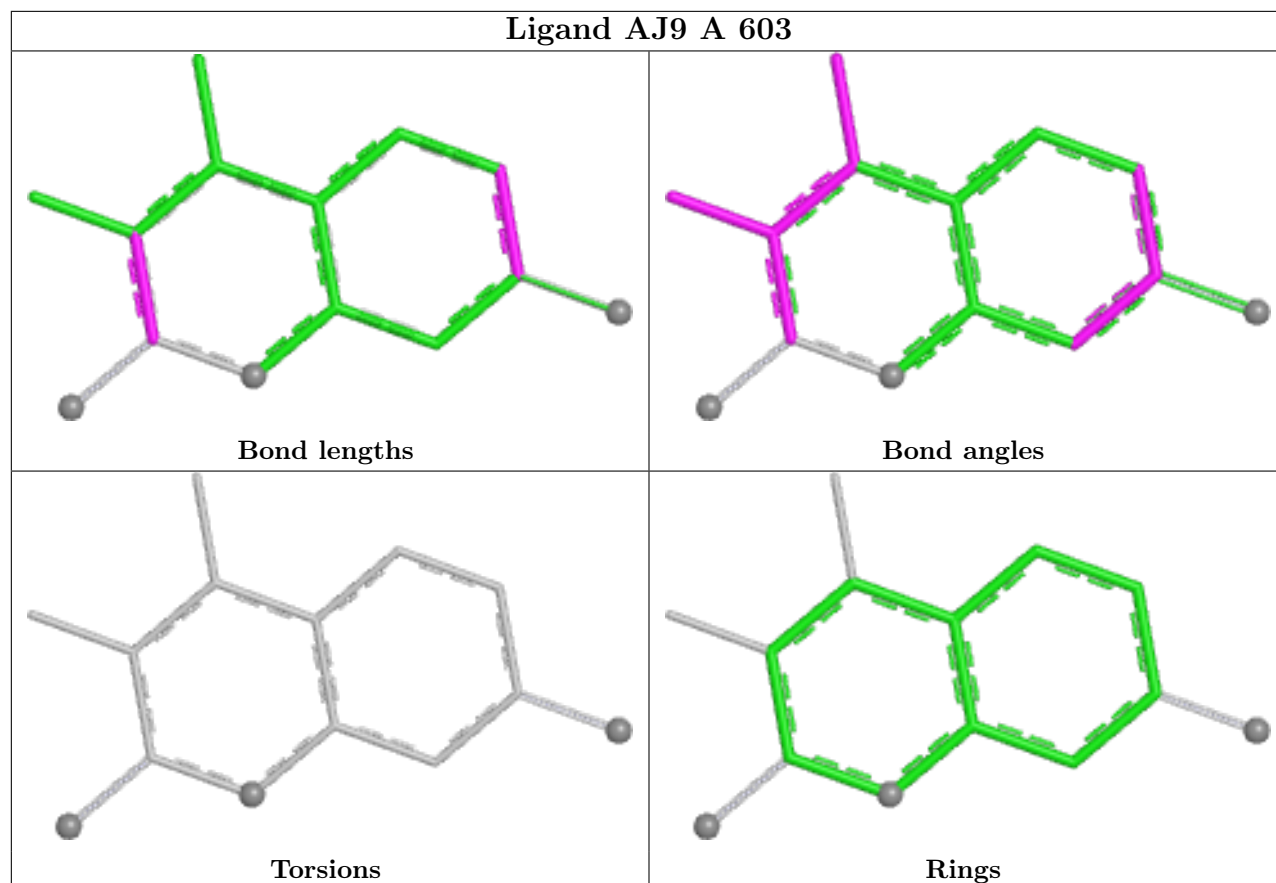
There are no ring outliers.

6 monomers are involved in 14 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	606	PG0	3	0
4	A	611	PG0	1	0
4	A	614	PG0	3	0
5	B	604	EDO	1	0
4	A	609	PG0	3	0
4	B	609	PG0	3	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.





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

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

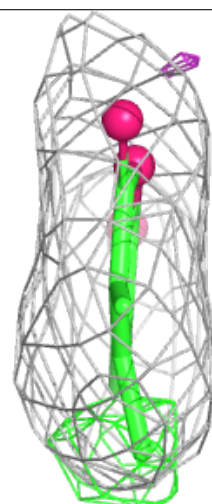
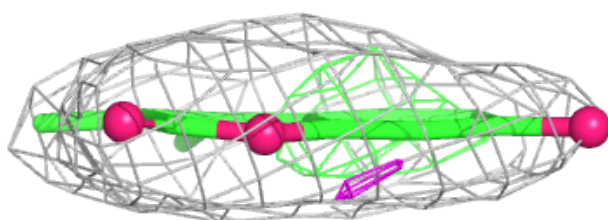
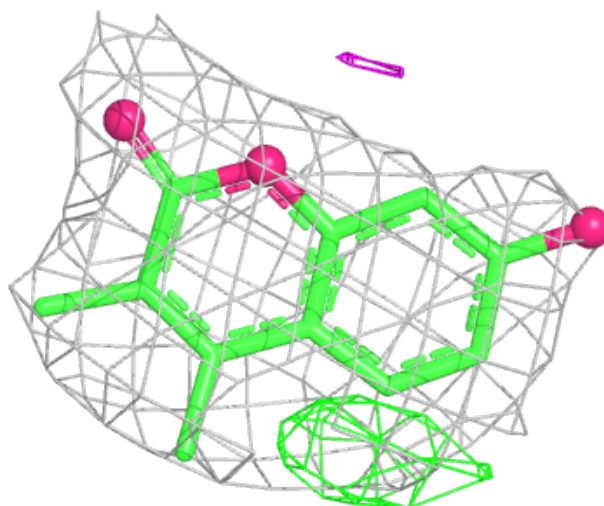
6.4 Ligands

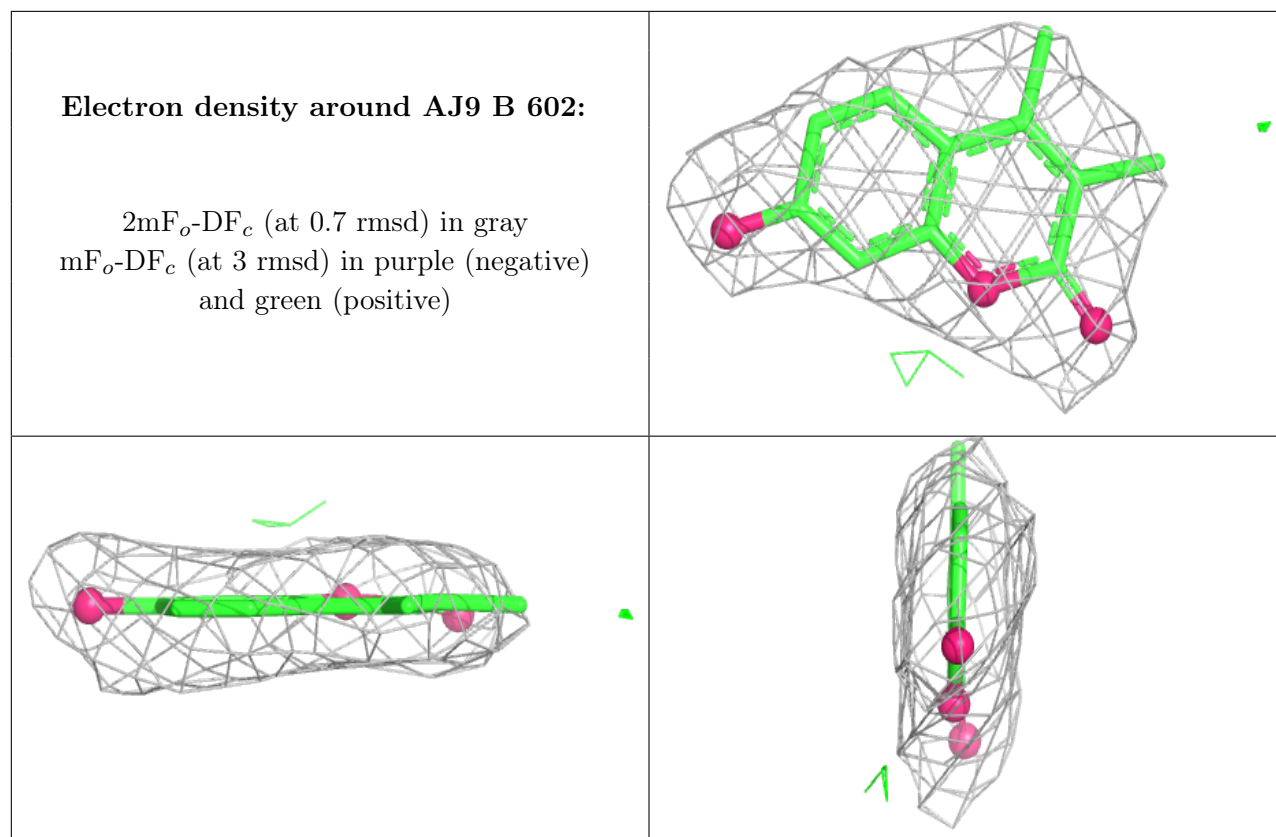
Unable to reproduce the depositors R factor - this section is therefore empty.

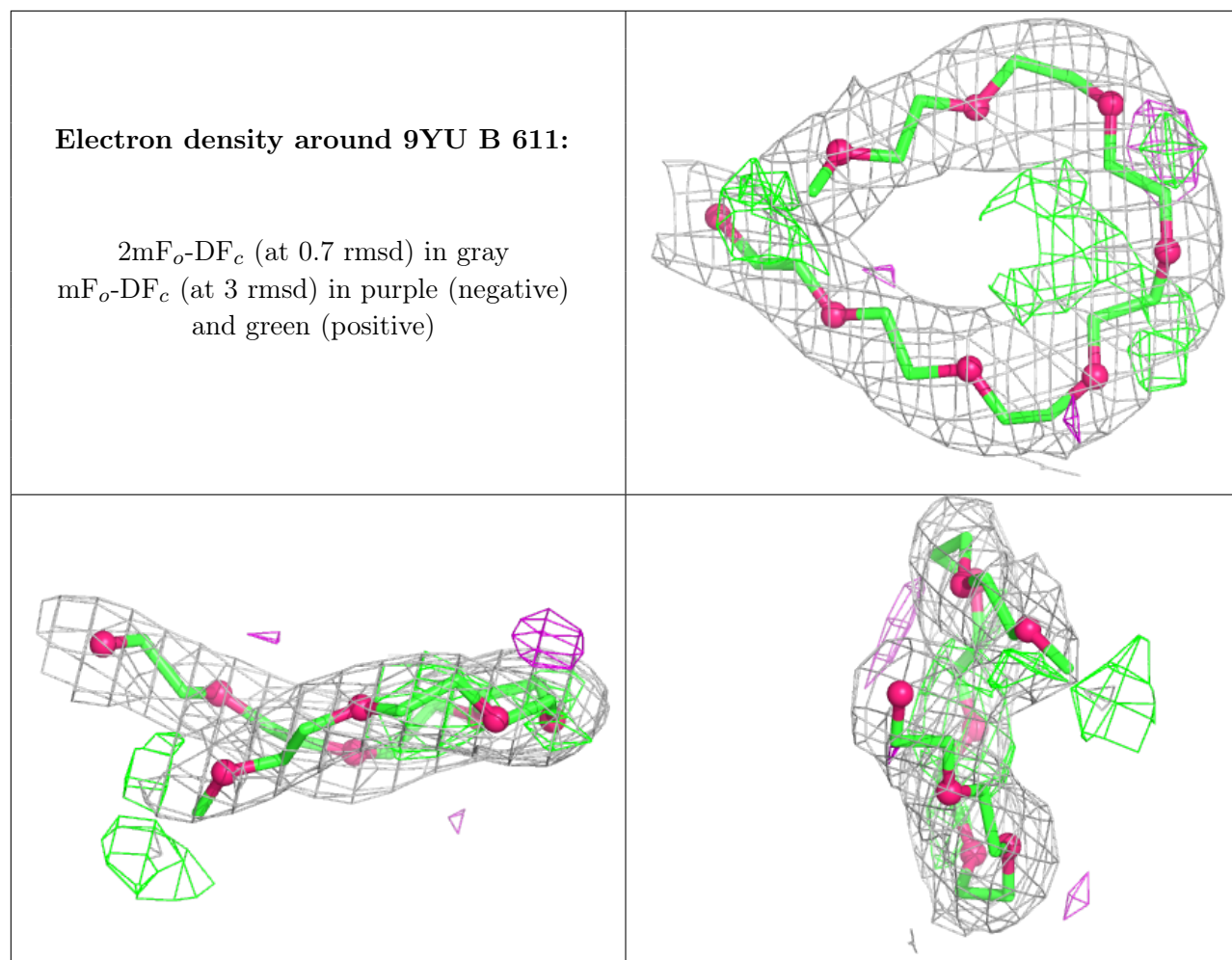
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around AJ9 A 603:

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







6.5 Other polymers [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.