



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 10:03 AM UTC

PDB ID : 6JSZ / pdb_00006jsz
Title : BACE2 xaperone complex with N-{3-[(5R)-3-amino-5-methyl-9,9-dioxo-2,9lambda6-dithia-4-azaspiro[5.5]undec-3-en-5-yl]-4-fluorophenyl}-5-(fluoromethoxy)pyrazine-2-carboxamide
Authors : Fujimoto, K.; Matsuoka, E.; Asada, N.; Tadano, G.; Yamamoto, T.; Nakahara, K.; Fuchino, K.; Ito, H.; Kanegawa, N.; Moechars, D.; Gijssen, H.J.M.; Kusakabe, K.I.
Deposited on : 2019-04-08
Resolution : 1.53 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	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)

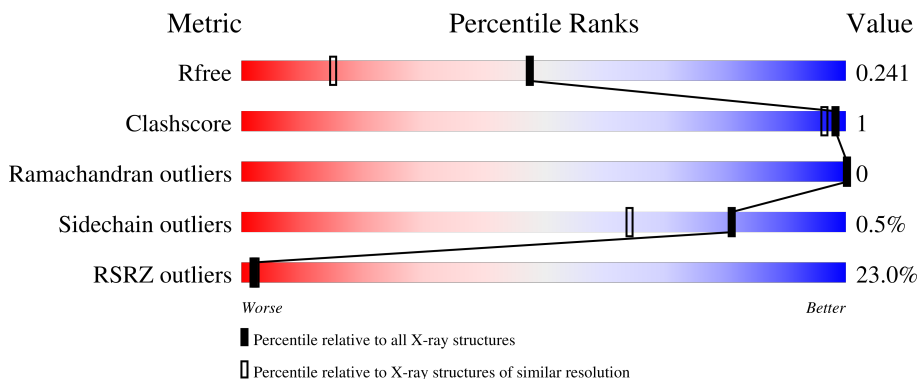
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.53 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	1003 (1.54-1.54)
Clashscore	190562	1025 (1.54-1.54)
Ramachandran outliers	187476	1007 (1.54-1.54)
Sidechain outliers	187428	1007 (1.54-1.54)
RSRZ outliers	180081	1002 (1.54-1.54)

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	386	26% 92% 6%
2	D	111	7% 97%

Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 3920 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.

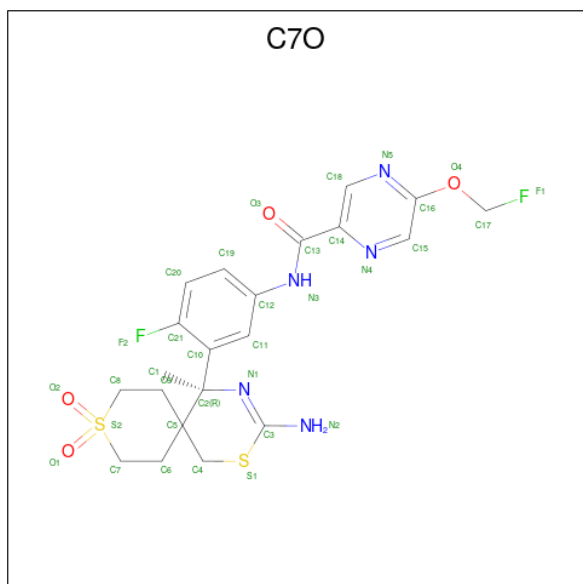
- Molecule 1 is a protein called Beta-secretase 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	363	Total	C	N	O	S	0	2	0
			2763	1786	440	525	12			

- Molecule 2 is a protein called XAPERONE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	D	111	Total	C	N	O	S	0	2	0
			823	506	147	165	5			

- Molecule 3 is N-[3-[(5R)-3-azanyl-5-methyl-9,9-bis(oxidanylidene)-2,9^l{6}-dithia-4-azaspiro[5.5]undec-3-en-5-yl]-4-fluoranyl-phenyl]-5-(fluoranylmethoxy)pyrazine-2-carboxamide (CCD ID: C7O) (formula: C₂₁H₂₃F₂N₅O₄S₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	F	N	O	0	0
			34	21	2	5	4		

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total 1	Cl 1	0	0

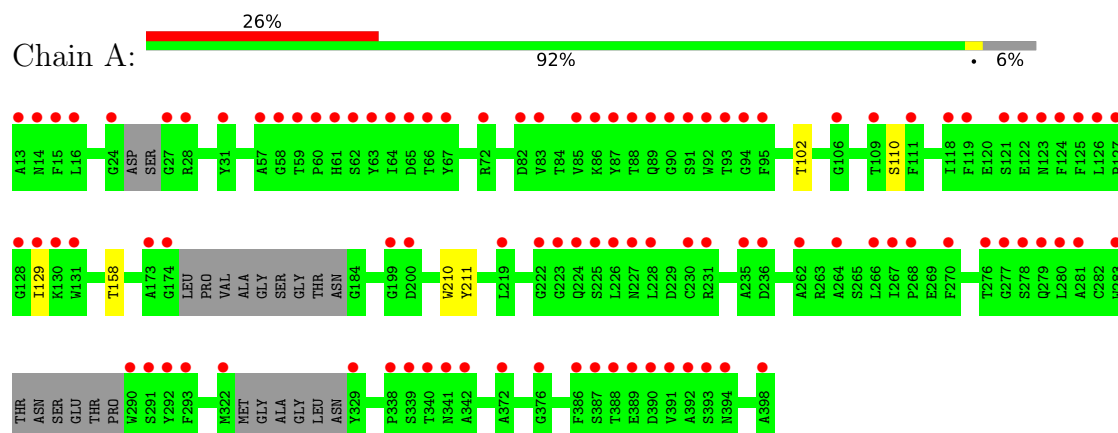
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	188	Total 188	O 188	0	0
5	D	111	Total 111	O 111	0	0

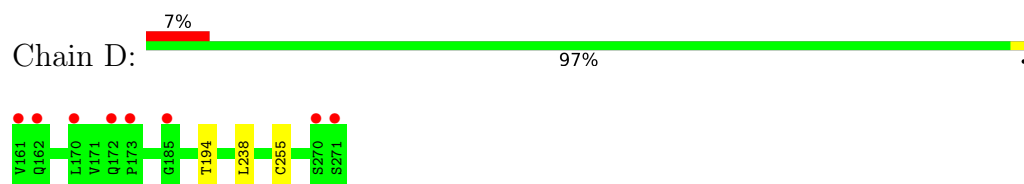
3 Residue-property plots [i](#)

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 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: Beta-secretase 2



• Molecule 2: XAPERONE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	63.54Å 74.47Å 109.14Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	61.51 – 1.53 61.51 – 1.53	Depositor EDS
% Data completeness (in resolution range)	99.7 (61.51-1.53) 99.7 (61.51-1.53)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.55 (at 1.53Å)	Xtriage
Refinement program	REFMAC 5.8.0151	Depositor
R, R_{free}	0.225 , 0.237 0.231 , 0.241	Depositor DCC
R_{free} test set	4099 reflections (5.21%)	wwPDB-VP
Wilson B-factor (Å ²)	22.1	Xtriage
Anisotropy	0.612	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 24.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3920	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.30% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CL, C7O

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	0/2827	0.88	1/3845 (0.0%)
2	D	0.64	0/837	0.81	0/1135
All	All	0.67	0/3664	0.86	1/4980 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	211	TYR	N-CA-C	-5.48	103.46	110.53

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	2763	0	2628	3	0
2	D	823	0	787	2	0
3	A	34	0	0	0	0
4	A	1	0	0	0	0
5	A	188	0	0	0	0
5	D	111	0	0	0	0
All	All	3920	0	3415	4	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 1.

All (4) 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:102[A]:THR:HG22	1:A:110[A]:SER:HA	1.72	0.71
1:A:102[A]:THR:HG22	1:A:110[A]:SER:CA	2.43	0.47
2:D:238:LEU:HD23	2:D:255[B]:CYS:SG	2.59	0.42
1:A:158:THR:HG22	2:D:194:THR:HG21	2.01	0.42

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	355/386 (92%)	346 (98%)	9 (2%)	0	100	100
2	D	111/111 (100%)	111 (100%)	0	0	100	100
All	All	466/497 (94%)	457 (98%)	9 (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	285/320 (89%)	283 (99%)	2 (1%)	76	55

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	D	86/89 (97%)	86 (100%)	0	100	100
All	All	371/409 (91%)	369 (100%)	2 (0%)	81	64

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	129	ILE
1	A	210	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
2	D	198	GLN
2	D	241	GLN
2	D	243	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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	C7O	A	401	-	33,37,37	1.58	4 (12%)	41,56,56	2.29	13 (31%)

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	C7O	A	401	-	-	0/15/51/51	0/4/4/4

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	401	C7O	C7-S2	5.06	1.81	1.76
3	A	401	C7O	C8-S2	4.81	1.81	1.76
3	A	401	C7O	C10-C21	2.61	1.42	1.39
3	A	401	C7O	C6-C5	2.19	1.57	1.54

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	401	C7O	C1-C2-N1	-5.64	103.22	108.81
3	A	401	C7O	C15-C16-N5	-5.53	119.05	123.16
3	A	401	C7O	C18-N5-C16	5.38	121.61	116.72
3	A	401	C7O	F2-C21-C10	4.08	123.50	119.01
3	A	401	C7O	C2-N1-C3	4.04	131.47	120.51
3	A	401	C7O	S1-C3-N1	-3.36	123.39	129.31
3	A	401	C7O	C12-C11-C10	2.86	124.38	120.82
3	A	401	C7O	O2-S2-O1	2.84	120.25	117.89
3	A	401	C7O	C15-N4-C14	2.52	121.41	117.46
3	A	401	C7O	O4-C16-N5	2.52	123.47	119.48
3	A	401	C7O	C6-C7-S2	-2.52	108.62	111.40
3	A	401	C7O	C18-C14-N4	-2.24	118.97	121.60
3	A	401	C7O	C18-C14-C13	2.00	122.27	119.71

There are no chirality outliers.

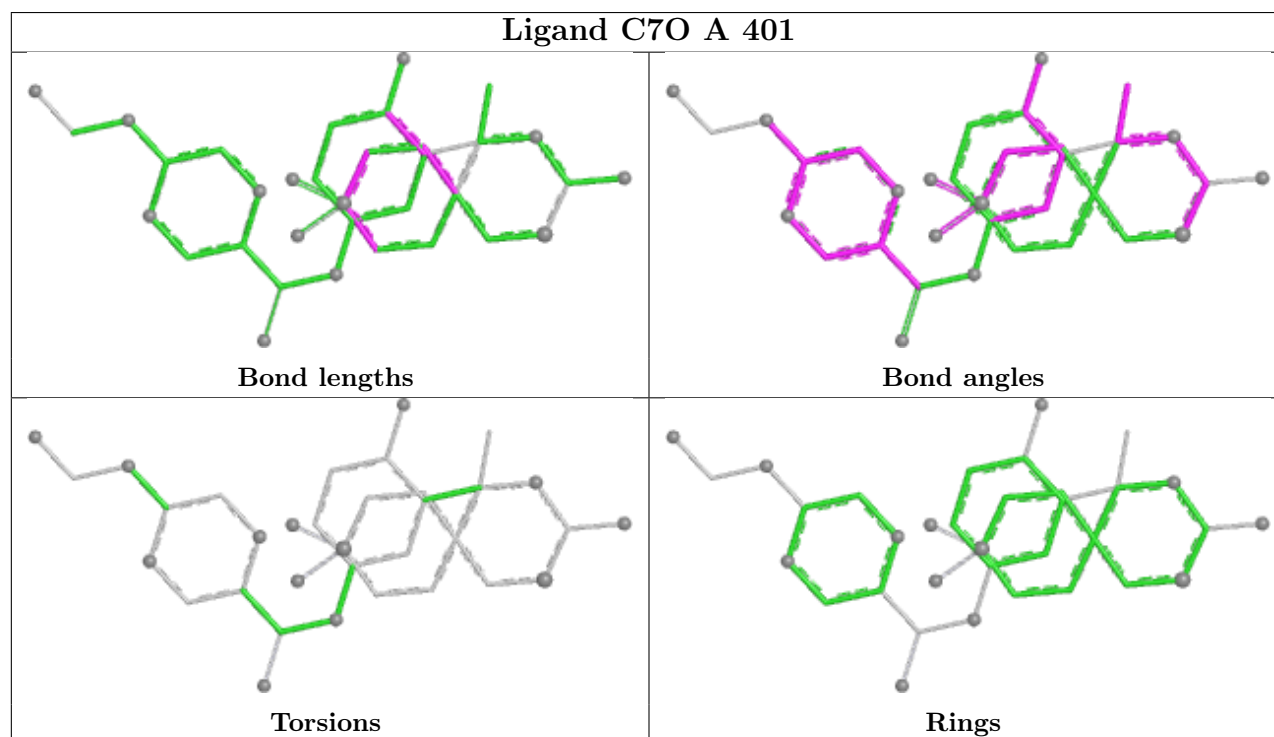
There are no torsion outliers.

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	363/386 (94%)	1.53	101 (27%) 1 2	14, 28, 58, 79	2 (0%)
2	D	111/111 (100%)	0.72	8 (7%) 21 27	10, 22, 34, 51	2 (1%)
All	All	474/497 (95%)	1.34	109 (22%) 2 2	10, 26, 57, 79	4 (0%)

All (109) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	266	LEU	8.8
1	A	398	ALA	7.8
1	A	85	VAL	5.8
1	A	64	ILE	5.6
1	A	173	ALA	5.5
1	A	60	PRO	5.5
1	A	329	TYR	5.5
1	A	235	ALA	5.5
1	A	126	LEU	5.4
1	A	63	TYR	5.4
1	A	124	PHE	5.4
1	A	267	ILE	5.3
1	A	127	PRO	5.3
1	A	65	ASP	5.2
1	A	125	PHE	5.2
1	A	24	GLY	5.0
1	A	340	THR	5.0
1	A	270	PHE	5.0
1	A	67	TYR	4.8
1	A	290	TRP	4.8
1	A	268	PRO	4.6
1	A	95	PHE	4.6
1	A	27	GLY	4.6
2	D	170	LEU	4.6

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
2	D	161	VAL	4.5
1	A	66	THR	4.4
1	A	15	PHE	4.4
1	A	292	TYR	4.3
1	A	391	VAL	4.3
1	A	128	GLY	4.3
1	A	87	TYR	4.3
1	A	88	THR	4.3
1	A	123	ASN	4.3
1	A	90	GLY	4.3
1	A	119	PHE	4.3
1	A	61	HIS	4.2
1	A	293	PHE	4.2
1	A	279	GLN	4.1
1	A	86	LYS	4.0
1	A	283	TRP	4.0
1	A	227	ASN	4.0
1	A	129	ILE	4.0
1	A	93	THR	4.0
1	A	278	SER	3.8
1	A	62	SER	3.7
1	A	341	ASN	3.6
1	A	91	SER	3.5
1	A	59	THR	3.5
1	A	121	SER	3.4
1	A	228	LEU	3.4
1	A	92	TRP	3.3
1	A	72	ARG	3.3
1	A	236	ASP	3.2
1	A	264	ALA	3.2
1	A	226	LEU	3.2
1	A	390	ASP	3.2
1	A	174	GLY	3.2
1	A	13	ALA	3.1
1	A	58	GLY	3.0
2	D	162	GLN	3.0
1	A	339	SER	3.0
1	A	393	SER	2.9
1	A	111	PHE	2.8
1	A	131	TRP	2.8
1	A	322	MET	2.8
1	A	83	VAL	2.8

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	89	GLN	2.8
1	A	106	GLY	2.8
1	A	277	GLY	2.8
1	A	224	GLN	2.8
1	A	281	ALA	2.7
1	A	392	ALA	2.7
1	A	280	LEU	2.7
1	A	223	GLY	2.7
1	A	16	LEU	2.7
1	A	199	GLY	2.7
1	A	14	ASN	2.7
1	A	386	PHE	2.7
1	A	262	ALA	2.6
1	A	122	GLU	2.6
1	A	291	SER	2.6
1	A	376	GLY	2.6
1	A	82	ASP	2.5
2	D	172	GLN	2.4
1	A	28	ARG	2.4
1	A	388	THR	2.4
1	A	338	PRO	2.4
1	A	372	ALA	2.3
1	A	225	SER	2.3
1	A	118	ILE	2.3
1	A	109	THR	2.3
2	D	270	SER	2.3
1	A	342	ALA	2.2
1	A	200	ASP	2.2
2	D	173	PRO	2.2
1	A	389	GLU	2.2
1	A	130	LYS	2.2
1	A	230	CYS	2.2
1	A	222	GLY	2.1
1	A	231	ARG	2.1
1	A	94	GLY	2.1
1	A	276	THR	2.1
1	A	394	ASN	2.1
1	A	57	ALA	2.1
1	A	31	TYR	2.1
2	D	185	GLY	2.1
1	A	219	LEU	2.0
1	A	387	SER	2.0

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
2	D	271	SER	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](#)

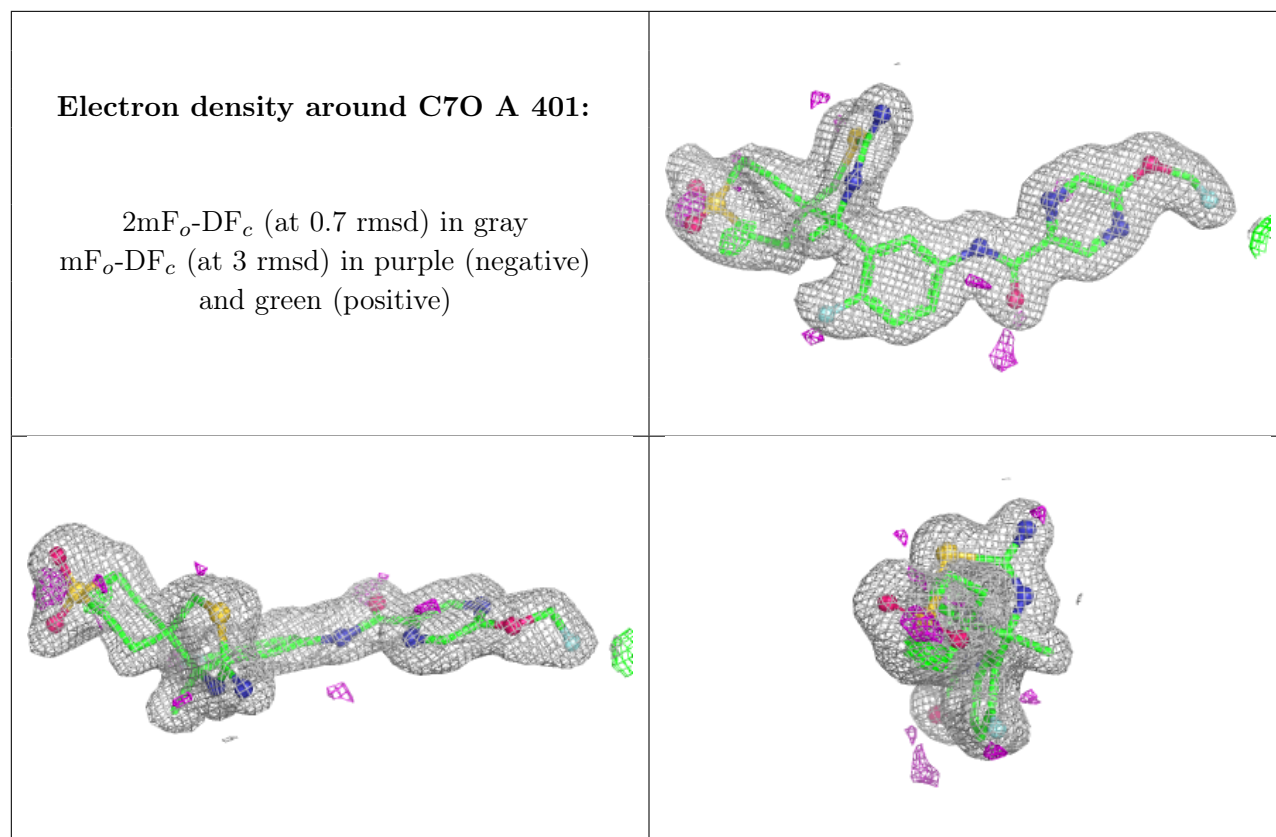
There are no oligosaccharides in this entry.

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(Å ²)	Q<0.9
3	C7O	A	401	34/34	0.92	0.11	23,29,40,41	0
4	CL	A	402	1/1	0.97	0.10	26,26,26,26	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.