



Full wwPDB X-ray Structure Validation Report ⓘ

May 13, 2020 – 05:58 pm BST

PDB ID : 5OJ0
Title : Penicillin-Binding Protein 2X (PBP2X) from *Streptococcus pneumoniae* in complex with Cefepime
Authors : Bernardo-Garcia, N.; Hermoso, J.A.
Deposited on : 2017-07-20
Resolution : 2.66 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 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 : 2.11
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) : 2.11

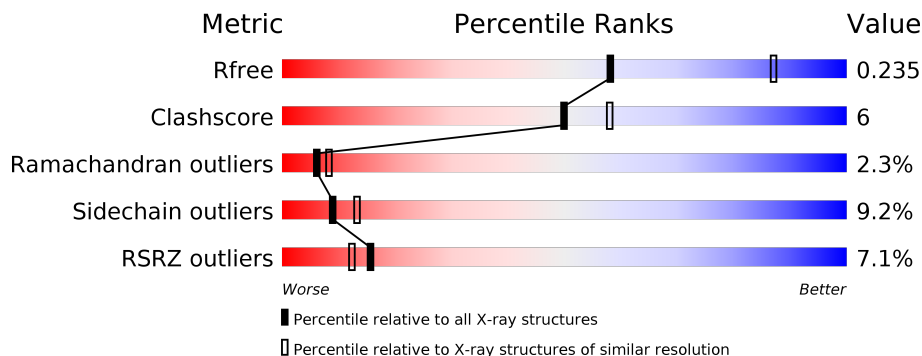
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.66 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	1332 (2.68-2.64)
Clashscore	141614	1374 (2.68-2.64)
Ramachandran outliers	138981	1349 (2.68-2.64)
Sidechain outliers	138945	1349 (2.68-2.64)
RSRZ outliers	127900	1318 (2.68-2.64)

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 on 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	702	

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:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	9WT	A	801	-	-	-	X

2 Entry composition [i](#)

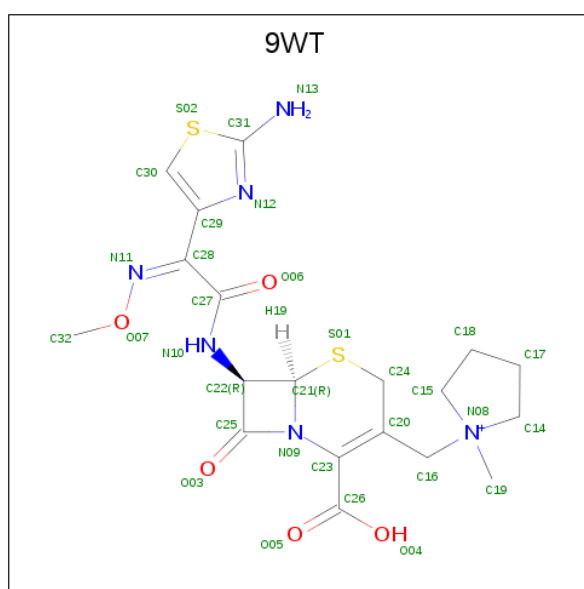
There are 3 unique types of molecules in this entry. The entry contains 5236 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Penicillin-binding protein 2X.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	658	5057	3168	844	1022	23	0	0	0

- Molecule 2 is Cefepime (three-letter code: 9WT) (formula: $C_{19}H_{25}N_6O_5S_2$) (labeled as "Ligand of Interest" by author).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
2	A	1	32	19	6	5	2	0	0

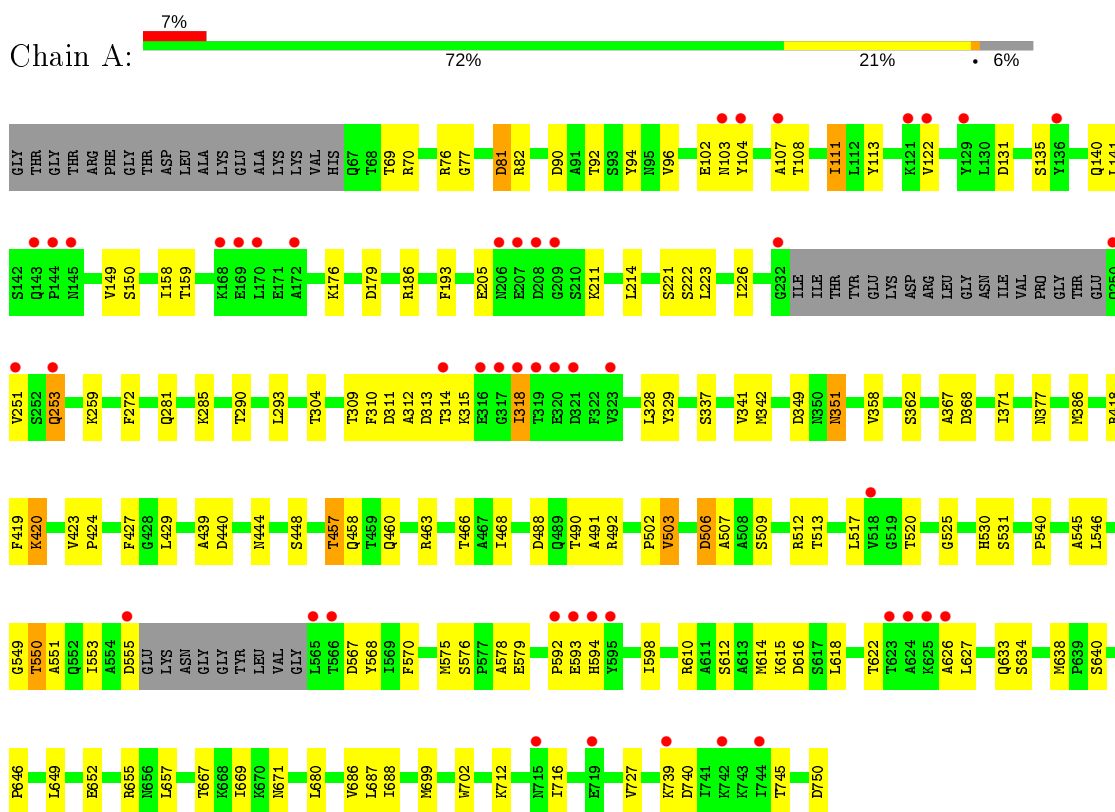
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	147	Total	O	0	0
			147	147		

3 Residue-property plots

These plots are drawn for all protein, RNA and DNA 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: Penicillin-binding protein 2X



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	99.55Å 99.55Å 189.66Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.24 – 2.66 39.24 – 2.66	Depositor EDS
% Data completeness (in resolution range)	99.9 (39.24-2.66) 100.0 (39.24-2.66)	Depositor EDS
R_{merge}	0.16	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	22.88 (at 2.65Å)	Xtrriage
Refinement program	REFMAC 5.8.0158	Depositor
R, R_{free}	0.172 , 0.231 0.185 , 0.235	Depositor DCC
R_{free} test set	1621 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	55.3	Xtrriage
Anisotropy	0.043	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 65.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.000 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5236	wwPDB-VP
Average B, all atoms (Å ²)	66.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.74% 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: 9WT

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	0.90	0/5144	0.98	8/6968 (0.1%)

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	81	ASP	CB-CG-OD1	6.93	124.54	118.30
1	A	82	ARG	NE-CZ-NH1	5.57	123.08	120.30
1	A	293	LEU	CA-CB-CG	5.51	127.96	115.30
1	A	525	GLY	N-CA-C	5.37	126.53	113.10
1	A	349	ASP	CB-CG-OD1	5.33	123.10	118.30
1	A	82	ARG	NE-CZ-NH2	-5.09	117.75	120.30
1	A	506	ASP	CB-CG-OD2	-5.06	113.74	118.30
1	A	90	ASP	CB-CG-OD1	-5.03	113.77	118.30

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	5057	0	4978	58	0
2	A	32	0	0	1	0
3	A	147	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	5236	0	4978	58	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 6.

All (58) 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:111:ILE:CD1	1:A:113:TYR:CE1	2.69	0.76
1:A:341:VAL:HG12	1:A:468:ILE:HD13	1.74	0.69
1:A:550:THR:HG23	1:A:551:ALA:N	2.14	0.62
1:A:69:THR:O	1:A:69:THR:HG22	2.01	0.60
1:A:122:VAL:CG2	1:A:141:LEU:HD11	2.33	0.58
1:A:96:VAL:HG23	1:A:158:ILE:CD1	2.34	0.58
1:A:328:LEU:O	1:A:458:GLN:HB2	2.04	0.58
1:A:545:ALA:H	1:A:578:ALA:HB2	1.70	0.56
1:A:646:PRO:HD3	1:A:667:THR:O	2.08	0.54
1:A:419:PHE:O	1:A:420:LYS:HB2	2.05	0.54
1:A:491:ALA:O	1:A:633:GLN:HA	2.08	0.54
1:A:77:GLY:O	1:A:186:ARG:NH2	2.36	0.53
1:A:111:ILE:HD12	1:A:113:TYR:CE1	2.42	0.52
1:A:140:GLN:O	1:A:149:VAL:HG21	2.09	0.52
1:A:96:VAL:HG23	1:A:158:ILE:HD11	1.92	0.52
1:A:614:MET:O	1:A:616:ASP:N	2.43	0.52
1:A:568:TYR:CE1	1:A:594:HIS:HB3	2.45	0.52
1:A:107:ALA:O	1:A:108:THR:HG22	2.11	0.51
1:A:649:LEU:HD22	1:A:688:ILE:HD13	1.93	0.50
1:A:517:LEU:HA	1:A:520:THR:HB	1.95	0.49
1:A:626:ALA:HB3	1:A:627:LEU:HD12	1.93	0.49
1:A:223:LEU:HD23	1:A:655:ARG:CD	2.43	0.49
1:A:179:ASP:OD2	3:A:901:HOH:O	2.20	0.48
1:A:311:ASP:O	1:A:312:ALA:HB3	2.15	0.47
1:A:468:ILE:HG22	1:A:575:MET:HE3	1.97	0.47
1:A:423:VAL:HG12	1:A:424:PRO:O	2.15	0.46
1:A:492:ARG:HB2	1:A:657:LEU:HD12	1.98	0.46
1:A:418:ARG:NH1	1:A:502:PRO:HA	2.31	0.46
1:A:111:ILE:O	1:A:176:LYS:HE2	2.16	0.46
1:A:699:MET:HG2	1:A:702:TRP:CE3	2.51	0.45
1:A:545:ALA:N	1:A:578:ALA:HB2	2.31	0.45
1:A:253:GLN:NE2	3:A:903:HOH:O	2.49	0.45
1:A:337:SER:CB	1:A:549:GLY:HA3	2.46	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:77:GLY:HA3	1:A:259:LYS:O	2.17	0.45
1:A:457:THR:HG22	1:A:460:GLN:H	1.82	0.45
1:A:553:ILE:HG22	1:A:567:ASP:O	2.17	0.44
1:A:530:HIS:O	1:A:531:SER:OG	2.18	0.44
1:A:488:ASP:O	1:A:490:THR:HG23	2.18	0.44
1:A:649:LEU:CD2	1:A:688:ILE:HD13	2.48	0.44
1:A:122:VAL:HG21	1:A:141:LEU:HD11	2.00	0.44
1:A:94:TYR:CD1	1:A:94:TYR:N	2.86	0.44
1:A:638:MET:CE	1:A:680:LEU:HD11	2.48	0.43
1:A:439:ALA:HB3	1:A:444:ASN:HD22	1.84	0.43
1:A:310:PHE:HB2	1:A:318:ILE:HG12	2.01	0.42
1:A:512:ARG:HG2	1:A:575:MET:HE1	2.00	0.42
1:A:111:ILE:HD11	1:A:113:TYR:CE1	2.52	0.42
1:A:503:VAL:HG13	1:A:507:ALA:HB3	2.01	0.42
1:A:549:GLY:O	1:A:570:PHE:CD2	2.72	0.42
1:A:329:TYR:CZ	1:A:429:LEU:HD23	2.54	0.42
1:A:102:GLU:O	1:A:104:TYR:N	2.52	0.42
1:A:285:LYS:HE3	1:A:592:PRO:HD2	2.02	0.41
1:A:463:ARG:O	1:A:466:THR:OG1	2.36	0.41
1:A:272:PHE:CE2	1:A:610:ARG:HG3	2.55	0.41
1:A:290:THR:HG21	1:A:458:GLN:HE22	1.86	0.41
1:A:646:PRO:HA	1:A:669:ILE:HD11	2.03	0.41
1:A:377:ASN:HD22	2:A:801:9WT:C32	2.35	0.40
1:A:652:GLU:HA	1:A:655:ARG:NH1	2.36	0.40
1:A:205:GLU:HA	1:A:211:LYS:HA	2.04	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	652/702 (93%)	585 (90%)	52 (8%)	15 (2%)	6 8

All (15) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	251	VAL
1	A	253	GLN
1	A	615	LYS
1	A	70	ARG
1	A	193	PHE
1	A	593	GLU
1	A	598	ILE
1	A	313	ASP
1	A	420	LYS
1	A	103	ASN
1	A	315	LYS
1	A	367	ALA
1	A	739	LYS
1	A	281	GLN
1	A	351	ASN

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	556/590 (94%)	505 (91%)	51 (9%)	9 13

All (51) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	76	ARG
1	A	81	ASP
1	A	92	THR
1	A	111	ILE
1	A	131	ASP
1	A	135	SER
1	A	150	SER
1	A	159	THR
1	A	214	LEU
1	A	221	SER

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Mol	Chain	Res	Type
1	A	222	SER
1	A	226	ILE
1	A	304	THR
1	A	309	THR
1	A	314	THR
1	A	318	ILE
1	A	342	MET
1	A	351	ASN
1	A	358	VAL
1	A	362	SER
1	A	368	ASP
1	A	371	ILE
1	A	386	MET
1	A	427	PHE
1	A	440	ASP
1	A	448	SER
1	A	457	THR
1	A	503	VAL
1	A	506	ASP
1	A	509	SER
1	A	513	THR
1	A	540	PRO
1	A	546	LEU
1	A	550	THR
1	A	555	ASP
1	A	576	SER
1	A	579	GLU
1	A	612	SER
1	A	618	LEU
1	A	622	THR
1	A	634	SER
1	A	640	SER
1	A	671	ASN
1	A	686	VAL
1	A	687	LEU
1	A	712	LYS
1	A	716	ILE
1	A	727	VAL
1	A	740	ASP
1	A	745	THR
1	A	750	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	95	ASN
1	A	377	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 carbohydrates 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	9WT	A	801	-	28,35,35	0.81	0	35,52,52	2.22	8 (22%)

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	9WT	A	801	-	-	9/14/62/62	0/4/4/4

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	801	9WT	C25-C22-N10	6.39	133.60	115.38
2	A	801	9WT	C22-N10-C27	6.17	134.46	121.56
2	A	801	9WT	O07-N11-C28	6.05	117.94	111.28
2	A	801	9WT	C20-C24-S01	3.05	120.74	115.08
2	A	801	9WT	C25-N09-C23	2.33	139.10	133.77
2	A	801	9WT	C15-N08-C14	-2.14	96.02	103.22
2	A	801	9WT	C14-N08-C16	2.08	116.55	111.69
2	A	801	9WT	C22-C21-S01	-2.07	112.67	116.51

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	9WT	C28-N11-O07-C32
2	A	801	9WT	C20-C16-N08-C14
2	A	801	9WT	C20-C16-N08-C15
2	A	801	9WT	C20-C16-N08-C19
2	A	801	9WT	C25-C22-N10-C27
2	A	801	9WT	O06-C27-C28-N11
2	A	801	9WT	N10-C27-C28-N11
2	A	801	9WT	N10-C27-C28-C29
2	A	801	9WT	O06-C27-C28-C29

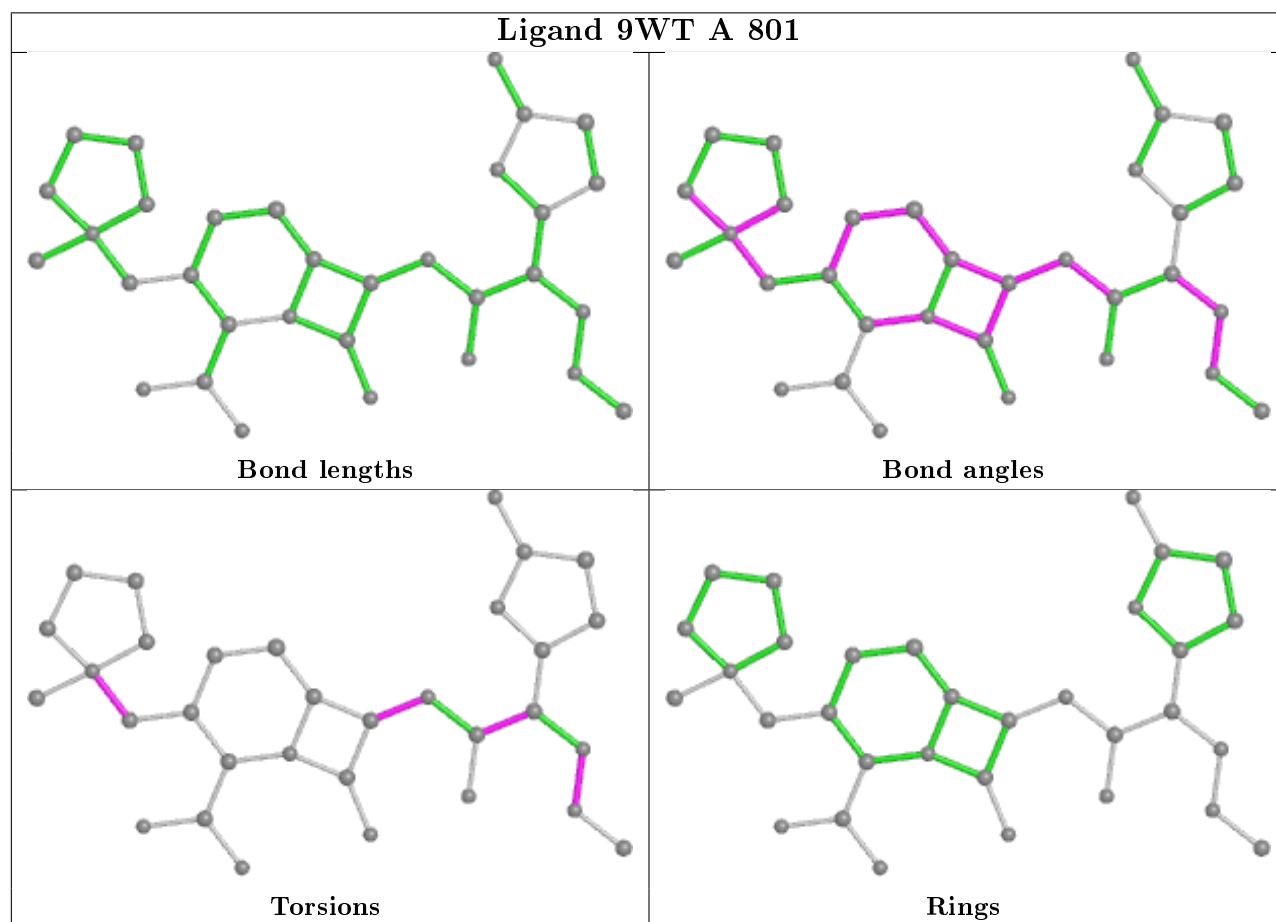
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	801	9WT	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.



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	658/702 (93%)	0.11	47 (7%) 16 12	33, 56, 125, 172	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	319	THR	10.6
1	A	320	GLU	8.2
1	A	323	VAL	5.8
1	A	593	GLU	5.6
1	A	250	GLN	5.3
1	A	314	THR	4.9
1	A	565	LEU	4.9
1	A	318	ILE	4.8
1	A	206	ASN	4.8
1	A	251	VAL	4.7
1	A	742	LYS	4.6
1	A	209	GLY	4.6
1	A	207	GLU	4.4
1	A	316	GLU	3.9
1	A	208	ASP	3.8
1	A	107	ALA	3.7
1	A	555	ASP	3.7
1	A	136	TYR	3.7
1	A	715	ASN	3.6
1	A	623	THR	3.6
1	A	144	PRO	3.2
1	A	168	LYS	3.1
1	A	122	VAL	3.1
1	A	172	ALA	3.1
1	A	169	GLU	3.1
1	A	145	ASN	3.1
1	A	253	GLN	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	129	TYR	2.9
1	A	103	ASN	2.9
1	A	104	TYR	2.8
1	A	232	GLY	2.8
1	A	595	TYR	2.7
1	A	625	LYS	2.6
1	A	626	ALA	2.4
1	A	744	ILE	2.4
1	A	121	LYS	2.4
1	A	317	GLY	2.4
1	A	566	THR	2.3
1	A	594	HIS	2.3
1	A	321	ASP	2.3
1	A	143	GLN	2.2
1	A	719	GLU	2.2
1	A	624	ALA	2.2
1	A	518	VAL	2.1
1	A	739	LYS	2.1
1	A	592	PRO	2.0
1	A	170	LEU	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 carbohydrates in this entry.

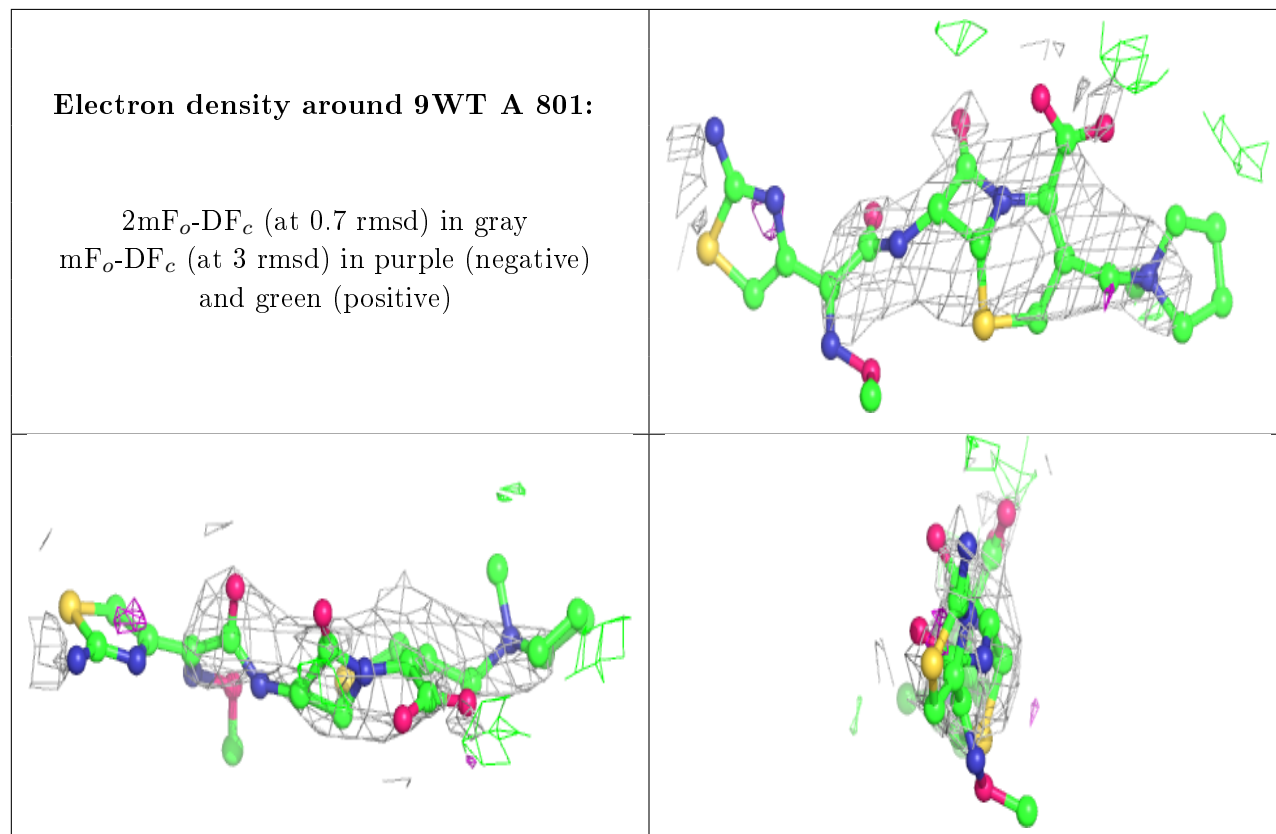
6.4 Ligands [i](#)

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
2	9WT	A	801	32/32	0.71	0.41	134,161,175,176	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.