



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 04:23 AM UTC

PDB ID : 2Z2M / pdb_00002z2m
Title : Cefditoren-Acylated Penicillin-Binding Protein 2X (PBP2X) from *Streptococcus pneumoniae*
Authors : Yamada, M.; Watanabe, T.; Takeuchi, Y.
Deposited on : 2007-05-23
Resolution : 2.60 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) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

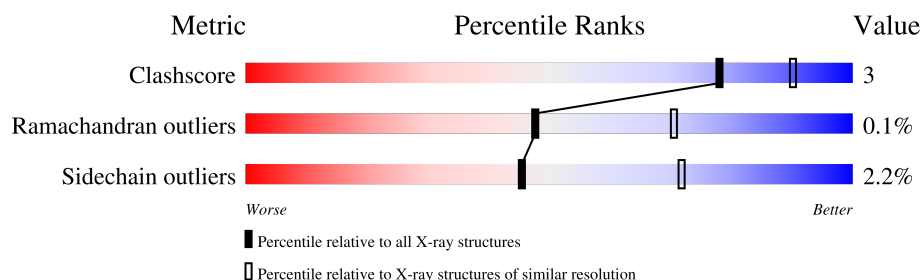
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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))
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	168	
1	D	168	
2	B	385	
2	E	385	
3	C	125	
3	F	125	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 9617 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
1	A	159	Total	C	N	O	S	0	0	0
			1224	766	204	250	4			
1	D	100	Total	C	N	O	S	0	0	0
			743	459	126	155	3			

- Molecule 2 is a protein called Penicillin-binding protein 2X.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	363	Total	C	N	O	S	0	0	0
			2784	1752	459	556	17			
2	E	362	Total	C	N	O	S	0	0	0
			2778	1748	459	554	17			

- Molecule 3 is a protein called Penicillin-binding protein 2X.

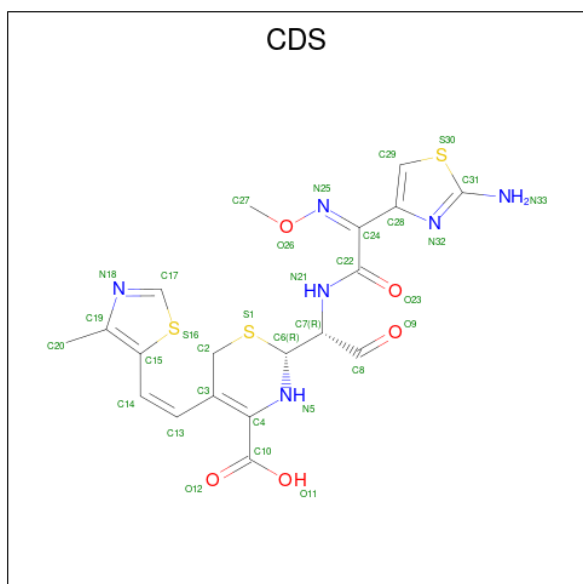
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	125	Total	C	N	O	S	0	0	0
			962	601	162	197	2			
3	F	125	Total	C	N	O	S	0	0	0
			962	601	162	197	2			

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

- Molecule 5 is (2R)-2-[(1R)-1-{[(2Z)-2-(2-AMINO-1,3-THIAZOL-4-YL)-2-(METHOXYIMINO)ACETYL]AMINO}-2-OXOETHYL]-5-[(Z)-2-(4-METHYL-1,3-THIAZOL-5-YL)VINY]-3,6-DIHYDRO-2H-1,3-THIAZINE-4-CARBOXYLIC ACID (CCD ID: CDS) (formula: $C_{19}H_{20}N_6O_5S_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total	C	N	O	S	
			33	19	6	5	3	

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	E	1	Total	C	N	O	S	0	0
			33	19	6	5	3		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	3	Total	O	0	0
			3	3		
6	B	30	Total	O	0	0
			30	30		
6	C	8	Total	O	0	0
			8	8		
6	D	13	Total	O	0	0
			13	13		
6	E	37	Total	O	0	0
			37	37		
6	F	2	Total	O	0	0
			2	2		

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.

Note EDS was not executed.

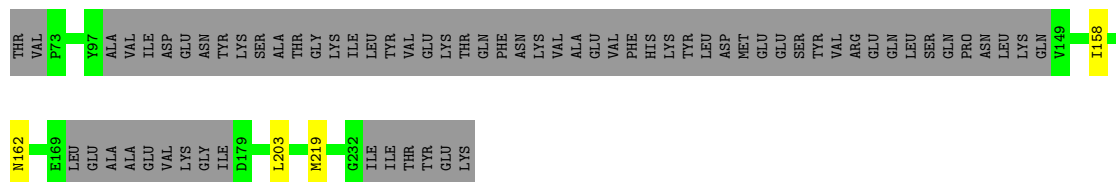
• Molecule 1: Penicillin-binding protein 2X

Chain A: 



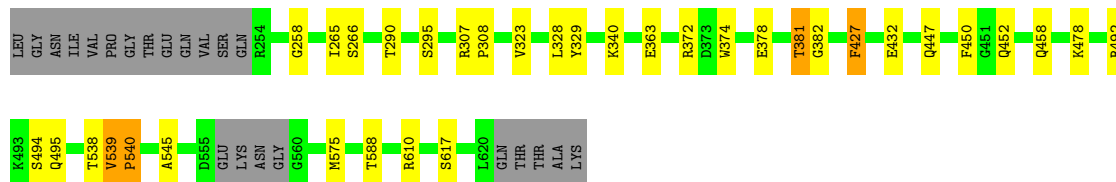
• Molecule 1: Penicillin-binding protein 2X

Chain D: 



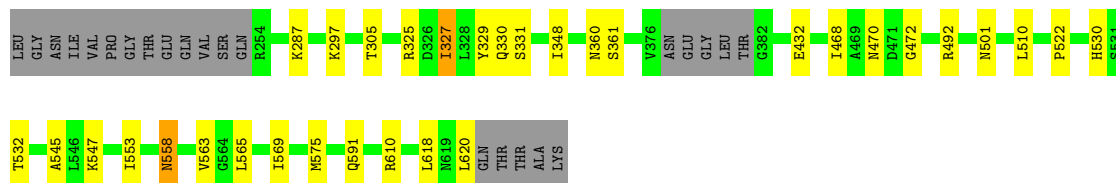
• Molecule 2: Penicillin-binding protein 2X

Chain B: 



• Molecule 2: Penicillin-binding protein 2X

Chain E: 



Chain C: 86% 13%



Chain F: 93% 7%



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	107.73Å 171.21Å 89.15Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.42 – 2.60	Depositor
% Data completeness (in resolution range)	89.8 (29.42-2.60)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.221 , 0.267	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	9617	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

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: SO4, CDS

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	0.44	0/1244	0.81	0/1676
1	D	0.45	0/754	0.84	0/1013
2	B	0.48	0/2837	0.76	2/3848 (0.1%)
2	E	0.46	0/2831	0.77	0/3838
3	C	0.44	0/975	0.73	0/1320
3	F	0.44	0/975	0.71	0/1320
All	All	0.46	0/9616	0.77	2/13015 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	539	VAL	CA-C-N	5.03	126.12	119.84
2	B	539	VAL	C-N-CA	5.03	126.12	119.84

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	1224	0	1191	8	0
1	D	743	0	708	1	0
2	B	2784	0	2717	18	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	E	2778	0	2712	17	0
3	C	962	0	975	11	0
3	F	962	0	975	5	0
4	B	5	0	0	0	0
5	B	33	0	18	0	0
5	E	33	0	18	0	0
6	A	3	0	0	0	0
6	B	30	0	0	0	0
6	C	8	0	0	0	0
6	D	13	0	0	0	0
6	E	37	0	0	0	0
6	F	2	0	0	0	0
All	All	9617	0	9314	53	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 3.

All (53) 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)
2:E:327:ILE:HG22	2:E:331:SER:HB2	1.59	0.84
2:E:492:ARG:NH2	3:F:656:ASN:O	2.11	0.83
2:B:492:ARG:NH1	3:C:680:LEU:O	2.28	0.66
3:F:728:GLN:HG3	3:F:749:GLY:HA3	1.77	0.66
2:B:492:ARG:NH2	3:C:656:ASN:O	2.28	0.65
3:F:673:SER:HB3	3:F:687:LEU:HB2	1.78	0.64
2:E:558:ASN:HD22	2:E:558:ASN:H	1.46	0.64
3:C:728:GLN:HG3	3:C:749:GLY:HA3	1.82	0.62
2:E:297:LYS:HA	2:E:470:ASN:HD21	1.64	0.61
2:E:492:ARG:NH1	3:F:680:LEU:O	2.34	0.61
3:C:671:ASN:HD22	3:C:672:SER:H	1.48	0.60
2:B:329:TYR:HB2	2:B:432:GLU:HG3	1.83	0.60
2:E:297:LYS:HA	2:E:470:ASN:ND2	2.20	0.55
1:A:135:SER:O	1:A:139:GLU:HG2	2.06	0.55
2:E:360:ASN:HD22	2:E:361:SER:N	2.05	0.55
3:F:667:THR:HG23	3:F:668:LYS:HG3	1.89	0.54
1:A:206:ASN:HD21	1:A:210:SER:HB3	1.72	0.53
2:B:328:LEU:O	2:B:458:GLN:HB2	2.09	0.52
2:E:329:TYR:HB2	2:E:432:GLU:HG3	1.92	0.52
1:A:227:LEU:O	2:B:258:GLY:HA3	2.10	0.52
2:E:553:ILE:CD1	2:E:569:ILE:HG13	2.40	0.51

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:C:658:VAL:O	3:C:660:PRO:HD3	2.11	0.50
2:E:348:ILE:HD13	2:E:510:LEU:HB3	1.92	0.50
2:B:478:LYS:HE3	2:B:495:GLN:O	2.12	0.49
3:C:661:ILE:HD12	3:C:706:THR:HG21	1.94	0.49
2:E:522:PRO:O	2:E:530:HIS:HE1	1.96	0.49
2:E:472:GLY:O	2:E:501:ASN:ND2	2.45	0.48
2:B:494:SER:HB3	3:C:657:LEU:HD22	1.95	0.48
2:E:618:LEU:O	2:E:620:LEU:HG	2.14	0.47
1:D:158:ILE:HG23	1:D:162:ASN:HB2	1.94	0.47
1:A:81:ASP:HB2	2:B:265:ILE:O	2.15	0.47
3:C:729:LYS:HB2	3:C:747:THR:HB	1.97	0.46
2:B:427:PHE:H	2:B:427:PHE:HD1	1.63	0.46
2:B:374:TRP:CE2	2:B:378:GLU:HG3	2.51	0.46
3:C:667:THR:HG23	3:C:668:LYS:HG3	1.97	0.46
3:C:671:ASN:HD22	3:C:672:SER:N	2.14	0.45
2:E:287:LYS:HD3	2:E:591:GLN:OE1	2.17	0.44
2:B:447:GLN:HB3	2:B:452:GLN:HB3	1.97	0.44
2:B:290:THR:OG1	2:B:588:THR:OG1	2.35	0.44
2:B:307:ARG:HA	2:B:308:PRO:C	2.41	0.44
2:B:363:GLU:HG2	2:B:372:ARG:HG2	1.99	0.44
2:B:539:VAL:HA	2:B:540:PRO:HD2	1.80	0.43
2:B:545:ALA:HB3	2:B:575:MET:HB2	1.99	0.43
2:E:325:ARG:HD3	2:E:330:GLN:O	2.19	0.43
2:E:327:ILE:HG22	2:E:331:SER:CB	2.42	0.43
2:B:381:THR:HG22	2:B:382:GLY:H	1.81	0.43
3:C:696:VAL:HG22	3:C:738:ILE:HD12	2.01	0.43
2:B:340:LYS:HE2	2:B:450:PHE:HB2	2.01	0.42
1:A:94:TYR:CD2	1:A:182:THR:HG22	2.56	0.41
2:E:545:ALA:HB3	2:E:575:MET:HB2	2.02	0.41
1:A:79:ILE:HB	1:A:88:ALA:HB3	2.03	0.41
1:A:81:ASP:OD1	1:A:81:ASP:C	2.64	0.41
1:A:206:ASN:ND2	1:A:210:SER:HB3	2.35	0.41

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	157/168 (94%)	151 (96%)	6 (4%)	0	100	100
1	D	94/168 (56%)	90 (96%)	4 (4%)	0	100	100
2	B	359/385 (93%)	347 (97%)	11 (3%)	1 (0%)	36	58
2	E	358/385 (93%)	344 (96%)	14 (4%)	0	100	100
3	C	123/125 (98%)	122 (99%)	1 (1%)	0	100	100
3	F	123/125 (98%)	118 (96%)	5 (4%)	0	100	100
All	All	1214/1356 (90%)	1172 (96%)	41 (3%)	1 (0%)	48	70

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	540	PRO

5.3.2 Protein sidechains ⓘ

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	132/141 (94%)	130 (98%)	2 (2%)	57	80
1	D	80/141 (57%)	78 (98%)	2 (2%)	42	69
2	B	304/322 (94%)	296 (97%)	8 (3%)	40	68
2	E	303/322 (94%)	294 (97%)	9 (3%)	36	64
3	C	108/108 (100%)	107 (99%)	1 (1%)	70	87
3	F	108/108 (100%)	107 (99%)	1 (1%)	70	87
All	All	1035/1142 (91%)	1012 (98%)	23 (2%)	45	72

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	168	LYS
1	A	204	HIS
2	B	266	SER
2	B	295	SER
2	B	323	VAL
2	B	381	THR
2	B	427	PHE
2	B	538	THR
2	B	610	ARG
2	B	617	SER
3	C	738	ILE
1	D	203	LEU
1	D	219	MET
2	E	305	THR
2	E	327	ILE
2	E	468	ILE
2	E	532	THR
2	E	547	LYS
2	E	558	ASN
2	E	563	VAL
2	E	565	LEU
2	E	610	ARG
3	F	689	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	120	ASN
1	A	206	ASN
2	B	458	GLN
2	B	487	ASN
2	B	514	ASN
3	C	671	ASN
1	D	162	ASN
1	D	202	GLN
2	E	360	ASN
2	E	452	GLN
2	E	458	GLN
2	E	470	ASN
2	E	530	HIS
2	E	552	GLN
2	E	558	ASN
3	F	671	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
3	F	715	ASN
3	F	721	GLN

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 ⓘ

3 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$
5	CDS	B	901	2	32,35,35	1.81	3 (9%)	35,48,48	2.12	10 (28%)
5	CDS	E	901	2	32,35,35	1.71	4 (12%)	35,48,48	2.12	9 (25%)
4	SO4	B	801	-	4,4,4	0.28	0	6,6,6	0.12	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
5	CDS	B	901	2	-	4/24/43/43	0/2/3/3

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	CDS	E	901	2	-	5/24/43/43	0/2/3/3

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	901	CDS	C4-C10	8.33	1.61	1.48
5	E	901	CDS	C4-C10	7.44	1.59	1.48
5	E	901	CDS	O11-C10	-2.52	1.23	1.30
5	B	901	CDS	O11-C10	-2.37	1.24	1.30
5	E	901	CDS	C19-N18	2.04	1.40	1.38
5	B	901	CDS	C19-N18	2.03	1.40	1.38
5	E	901	CDS	C31-N32	-2.02	1.28	1.31

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	901	CDS	C14-C13-C3	5.89	133.56	125.69
5	E	901	CDS	C8-C7-N21	-4.95	101.99	109.80
5	E	901	CDS	C6-C7-N21	4.90	120.31	109.93
5	E	901	CDS	C14-C13-C3	4.84	132.15	125.69
5	E	901	CDS	O12-C10-C4	-4.54	112.30	120.20
5	B	901	CDS	C6-C7-N21	4.47	119.40	109.93
5	B	901	CDS	C2-S1-C6	4.32	102.27	94.36
5	B	901	CDS	O12-C10-C4	-4.28	112.74	120.20
5	B	901	CDS	C8-C7-N21	-3.46	104.35	109.80
5	E	901	CDS	C2-S1-C6	3.38	100.55	94.36
5	B	901	CDS	C10-C4-C3	3.32	128.92	123.88
5	E	901	CDS	O23-C22-C24	3.15	126.66	121.60
5	E	901	CDS	O23-C22-N21	-3.12	117.60	123.09
5	E	901	CDS	C10-C4-C3	2.93	128.32	123.88
5	B	901	CDS	O23-C22-N21	-2.76	118.23	123.09
5	B	901	CDS	O23-C22-C24	2.66	125.88	121.60
5	E	901	CDS	O11-C10-O12	2.60	130.10	123.90
5	B	901	CDS	C13-C3-C4	-2.23	120.24	122.02
5	B	901	CDS	O11-C10-O12	2.04	128.76	123.90

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	B	901	CDS	O11-C10-C4-N5

Continued on next page...

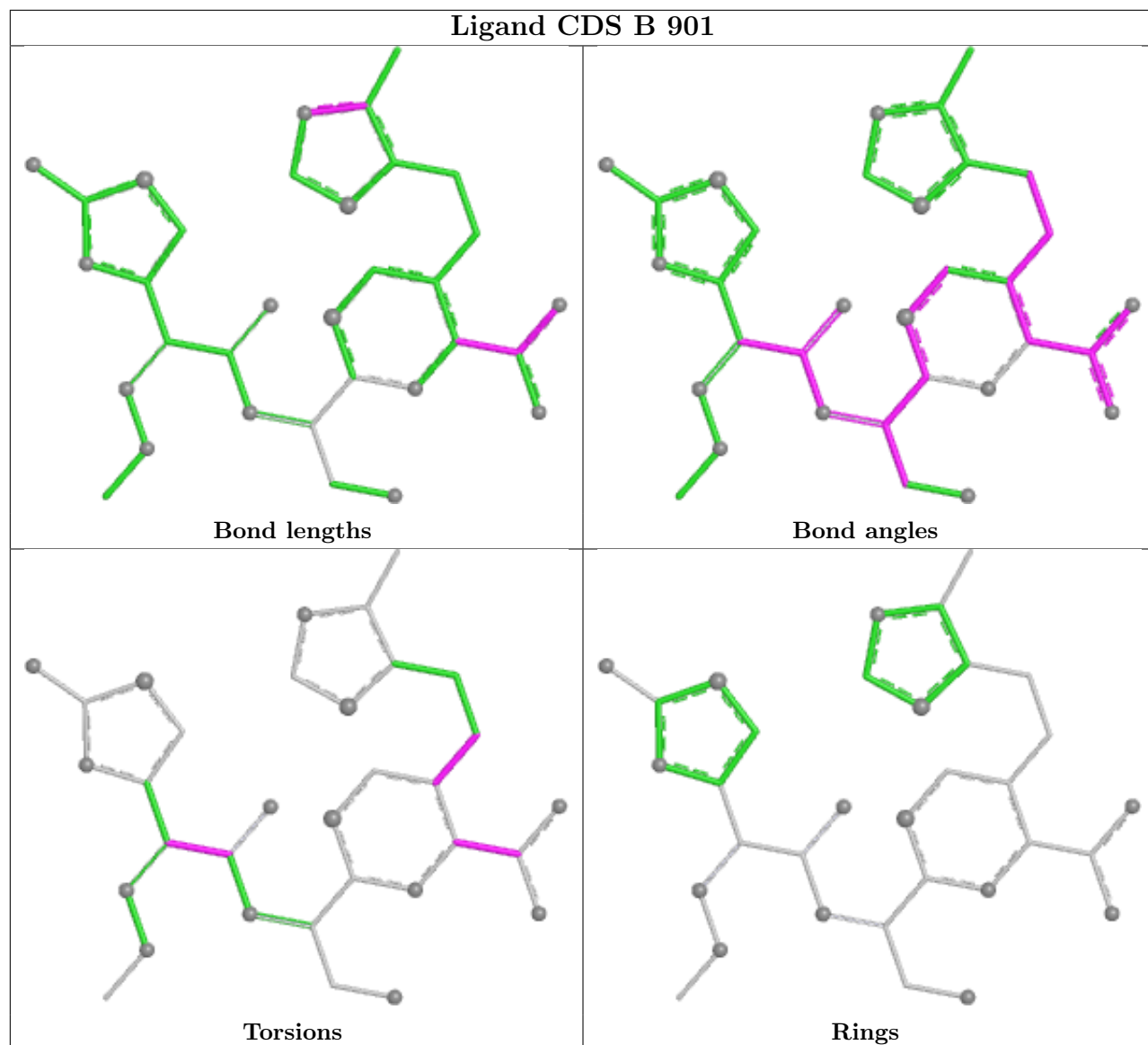
Continued from previous page...

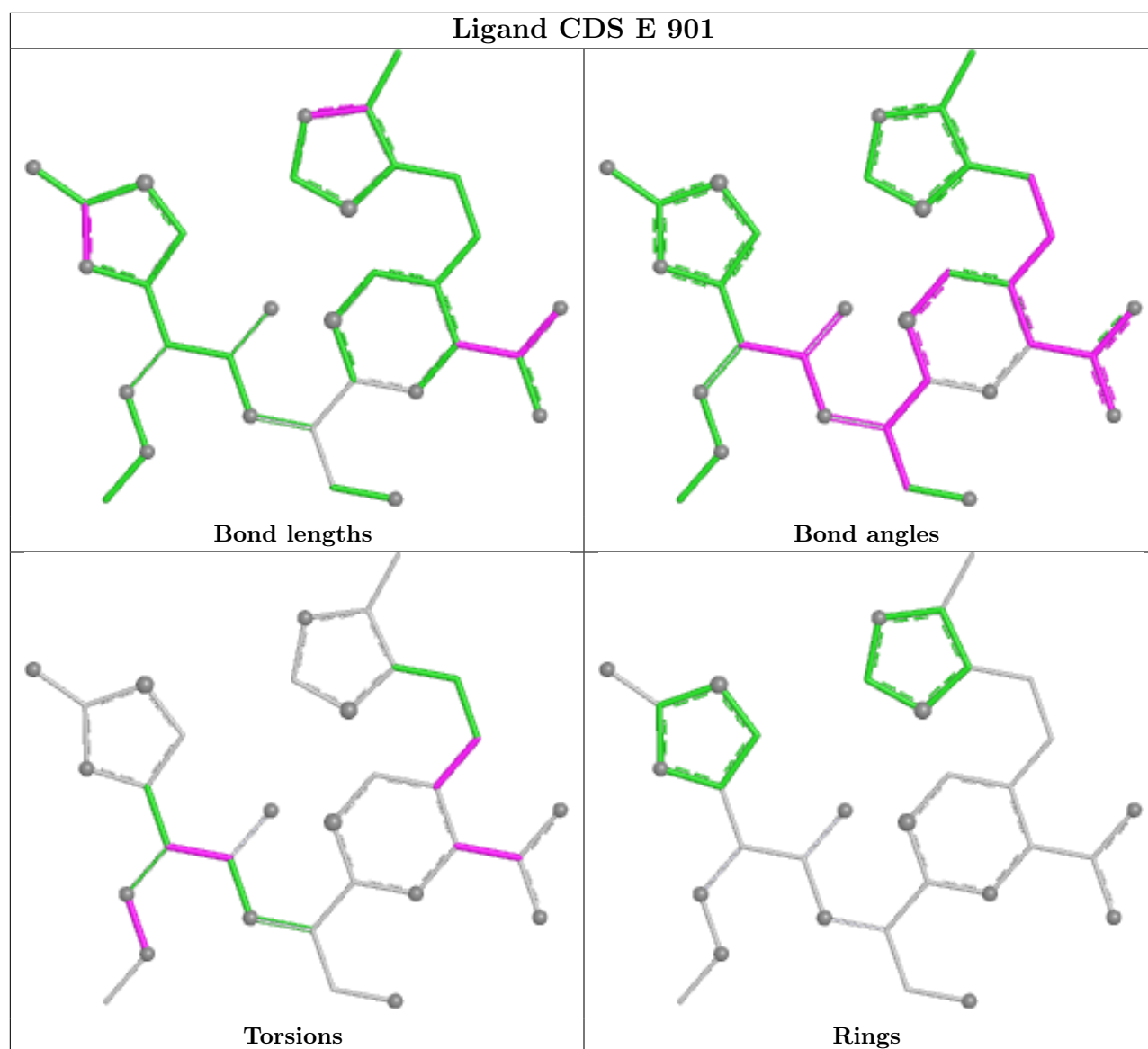
Mol	Chain	Res	Type	Atoms
5	B	901	CDS	C14-C13-C3-C4
5	B	901	CDS	C14-C13-C3-C2
5	E	901	CDS	C24-N25-O26-C27
5	E	901	CDS	O11-C10-C4-N5
5	E	901	CDS	C14-C13-C3-C4
5	E	901	CDS	C14-C13-C3-C2
5	E	901	CDS	O23-C22-C24-N25
5	B	901	CDS	N21-C22-C24-N25

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.