Full wwPDB EM Validation Report ⓘ

Jun 9, 2025 – 10:24 AM EDT

PDB ID	:	9ORL / pdb_00009orl
Title	:	MicroED structure of CTX-M-14 beta-lactamase soaked with avibactam
Authors	:	Vlahakis, N.W.; Rodriguez, J.A.; Jacobs, L.M.C.; Chen, Y.
Deposited on	:	2025-05-22
Resolution	:	2.30 Å(reported)
Based on initial model	:	1YLT

The following versions of software and data (see references ⓘ) were used in the production of this report:

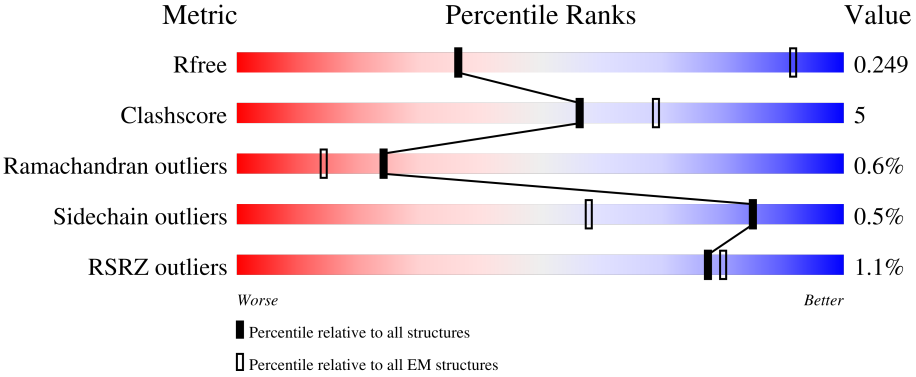
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	2022.3.0, CSD as543be (2022)
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.43.1

1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
ELECTRON CRYSTALLOGRAPHY

The reported resolution of this entry is 2.30 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)	EM structures (#Entries)
R_{free}	164678	53
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415
RSRZ outliers	164674	54

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 <=5%

Mol	Chain	Length	Quality of chain
1	A	263	
1	B	263	

2 Entry composition ⓘ

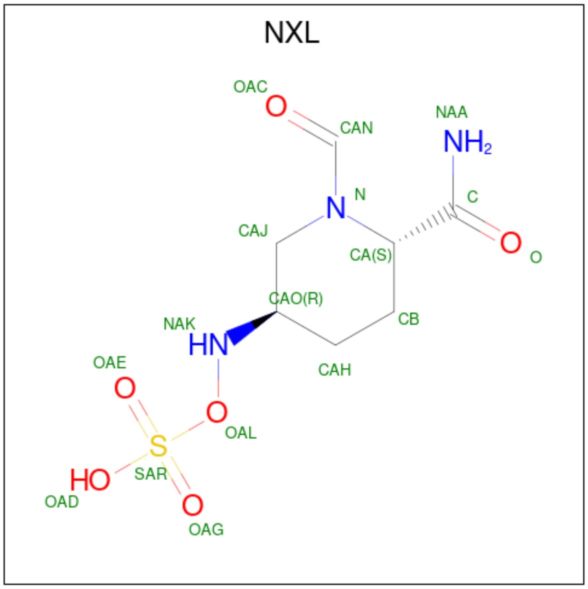
There are 3 unique types of molecules in this entry. The entry contains 3983 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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-lactamase.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	261	1949	1208	351	384	6	0	0
1	B	263	1973	1221	356	390	6	1	0

- Molecule 2 is (2S,5R)-1-formyl-5-[(sulfooxy)amino]piperidine-2-carboxamide (CCD ID: NXL) (formula: $C_7H_{13}N_3O_6S$).



Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	S	
2	A	1	17	7	3	6	1	0
2	B	1	17	7	3	6	1	0

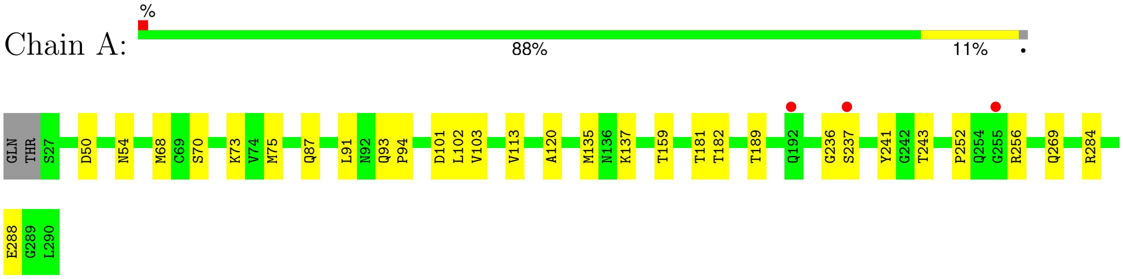
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		AltConf
			Total	O	
3	A	15	15	15	0
			Total	O	
3	B	12	12	12	0

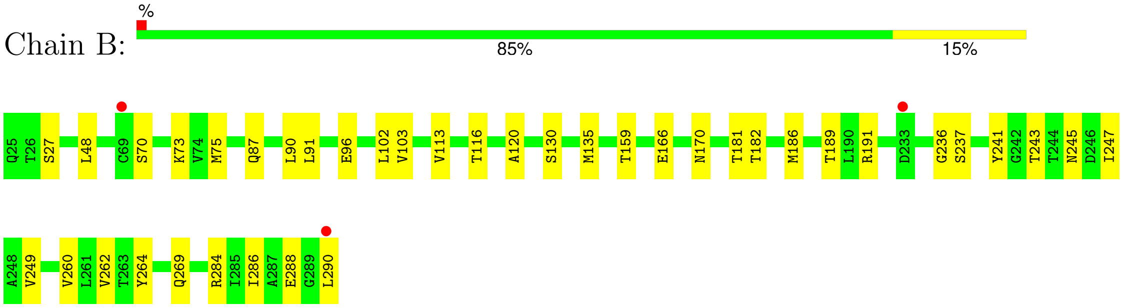
3 Residue-property plots ⓘ

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. 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: Beta-lactamase



- Molecule 1: Beta-lactamase



4 Data and refinement statistics ⓘ

Property	**Value**	**Source**
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	44.99Å 105.70Å 47.49Å 90.00° 100.95° 90.00°	Depositor
Resolution (Å)	46.63 – 2.30 46.63 – 2.30	Depositor EDS
% Data completeness (in resolution range)	96.8 (46.63-2.30) 96.8 (46.63-2.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.11 (at 2.29Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.172 , 0.222 0.205 , 0.249	Depositor DCC
R_{free} test set	2485 reflections (9.99%)	wwPDB-VP
Wilson B-factor (Å^2)	22.1	Xtriage
Anisotropy	0.067	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 26.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.46$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.90	EDS
Total number of atoms	3983	wwPDB-VP
Average B, all atoms (Å^2)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.42% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: NXL

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	0.24	0/1978	0.60	1/2691 (0.0%)
1	B	0.24	0/2002	0.58	0/2724
All	All	0.24	0/3980	0.59	1/5415 (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	87	GLN	N-CA-C	-6.37	94.19	107.37

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	1949	0	1964	17	0
1	B	1973	0	1984	18	0
2	A	17	0	11	1	0
2	B	17	0	11	2	0
3	A	15	0	0	0	0
3	B	12	0	0	0	0
All	All	3983	0	3970	37	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 5.

All (37) 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:B:75:MET:HE1	1:B:189:THR:HG21	1.54	0.89
1:A:252:PRO:HB2	1:A:256:ARG:HG2	1.68	0.75
1:B:181:THR:HG21	1:B:186:MET:HE2	1.74	0.68
1:B:166:GLU:OE1	1:B:170:ASN:ND2	2.27	0.67
1:A:256:ARG:HG3	1:A:256:ARG:HH11	1.59	0.67
1:B:73:LYS:HE2	1:B:135:MET:HB2	1.84	0.58
1:A:50:ASP:O	1:A:54:ASN:N	2.38	0.55
1:A:75:MET:HE1	1:A:189:THR:HG21	1.89	0.54
1:B:91:LEU:HB3	1:B:120:ALA:HB2	1.91	0.52
1:A:91:LEU:HB3	1:A:120:ALA:HB2	1.92	0.51
1:A:70:SER:HB2	1:A:236:GLY:HA2	1.91	0.51
1:A:241:TYR:HA	1:A:269:GLN:O	2.12	0.50
2:B:301:NXL:H7	2:B:301:NXL:OAL	2.11	0.49
1:A:252:PRO:HB2	1:A:256:ARG:CG	2.41	0.48
1:B:70:SER:HB2	1:B:236:GLY:HA2	1.95	0.48
1:A:68:MET:HG2	1:A:181:THR:HG22	1.97	0.47
1:B:284:ARG:O	1:B:288:GLU:HG2	2.14	0.47
1:A:237:SER:HA	1:A:243:THR:O	2.15	0.47
1:A:284:ARG:O	1:A:288:GLU:HG3	2.16	0.46
1:A:50:ASP:OD1	1:A:256:ARG:NH2	2.48	0.46
2:A:301:NXL:H7	2:A:301:NXL:OAL	2.16	0.46
1:B:247:ILE:HG22	1:B:262:VAL:HG13	1.97	0.45
1:B:96:GLU:HA	1:B:116:THR:HG22	1.99	0.45
1:B:87:GLN:HB3	1:B:90:LEU:HB2	1.99	0.44
1:B:102:LEU:HD11	1:B:113:VAL:HG21	2.00	0.44
1:B:237:SER:HA	1:B:243:THR:O	2.18	0.44
1:B:159:THR:HG21	1:B:182:THR:HG23	2.00	0.43
1:A:102:LEU:HD11	1:A:113:VAL:HG21	2.01	0.43
1:B:130:SER:HG	2:B:301:NXL:H12	1.66	0.43
1:B:191:ARG:HB2	1:B:260:VAL:HG21	1.99	0.43
1:A:101:ASP:OD2	1:A:137:LYS:NZ	2.48	0.42
1:B:245:ASN:CG	1:B:264:TYR:HD1	2.27	0.42
1:B:48:LEU:HD22	1:B:286:ILE:HG23	2.01	0.42
1:A:93:GLN:HA	1:A:94:PRO:HD3	1.95	0.41
1:B:241:TYR:HA	1:B:269:GLN:O	2.19	0.41
1:A:159:THR:HG21	1:A:182:THR:HG23	2.03	0.41
1:A:73:LYS:HE2	1:A:135:MET:HB2	2.03	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 PDB entries followed by that with respect to all EM entries.

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	259/263 (98%)	254 (98%)	4 (2%)	1 (0%)	30	39
1	B	262/263 (100%)	254 (97%)	6 (2%)	2 (1%)	16	20
All	All	521/526 (99%)	508 (98%)	10 (2%)	3 (1%)	24	27

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	27	SER
1	A	103	VAL
1	B	103	VAL

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 PDB entries followed by that with respect to all EM entries.

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	204/206 (99%)	204 (100%)	0	100	100
1	B	207/206 (100%)	205 (99%)	2 (1%)	73	85
All	All	411/412 (100%)	409 (100%)	2 (0%)	85	93

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

Mol	Chain	Res	Type
1	B	249	VAL
1	B	290	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	30	GLN
1	A	89	GLN
1	A	188	GLN
1	A	206	GLN
1	B	56	GLN
1	B	89	GLN
1	B	128	GLN
1	B	141	GLN
1	B	270	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 ⓘ

2 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	NXL	B	301	1	14,17,17	0.53	0	16,24,24	1.94	3 (18%)
2	NXL	A	301	1	14,17,17	0.50	0	16,24,24	1.90	3 (18%)

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	NXL	B	301	1	-	1/5/25/25	0/1/1/1
2	NXL	A	301	1	-	1/5/25/25	0/1/1/1

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	301	NXL	CAO-CAJ-N	-4.78	103.64	110.11
2	A	301	NXL	CAH-CAO-CAJ	-4.71	103.59	109.71
2	B	301	NXL	CAH-CAO-NAK	3.74	117.67	110.08
2	A	301	NXL	CAO-CAJ-N	-3.70	105.11	110.11
2	B	301	NXL	CAH-CAO-CAJ	-3.23	105.50	109.71
2	A	301	NXL	CAH-CAO-NAK	3.13	116.43	110.08

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	301	NXL	OAC-CAN-N-CAJ
2	A	301	NXL	OAC-CAN-N-CAJ

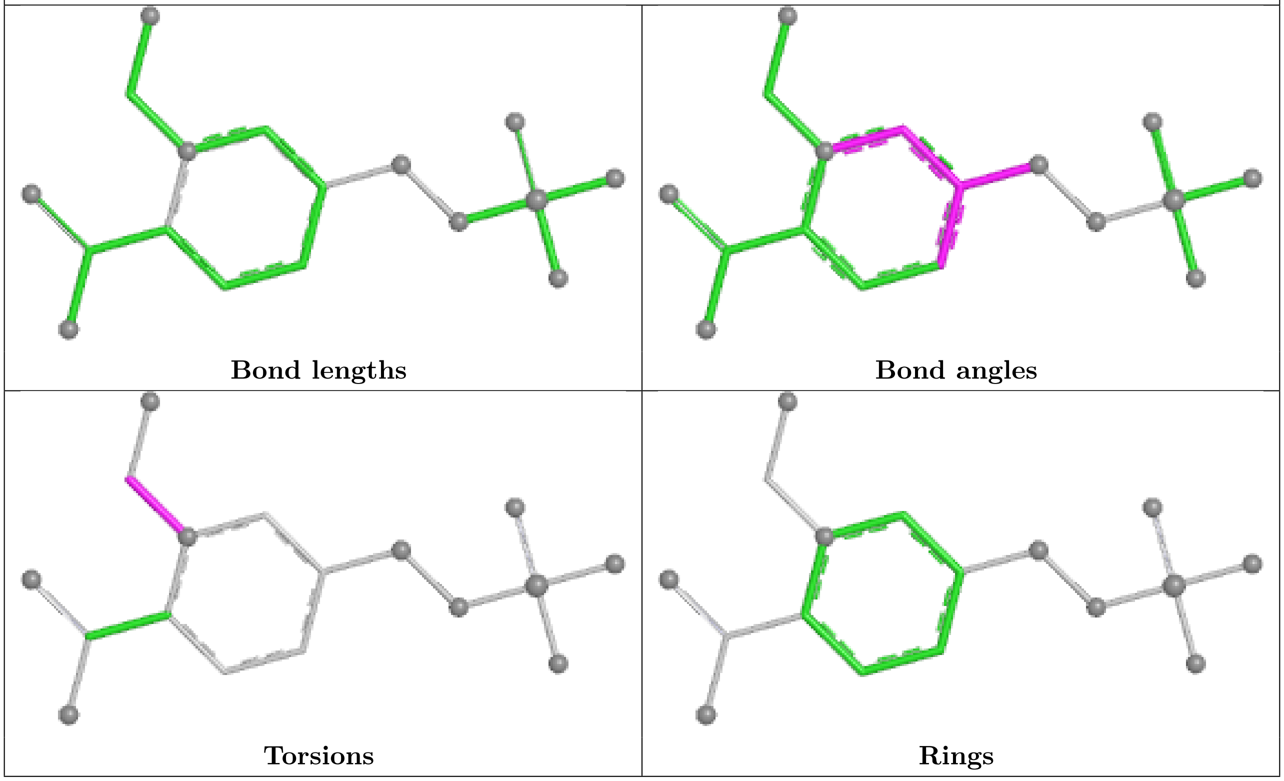
There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	301	NXL	2	0
2	A	301	NXL	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 then 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 NXL B 301

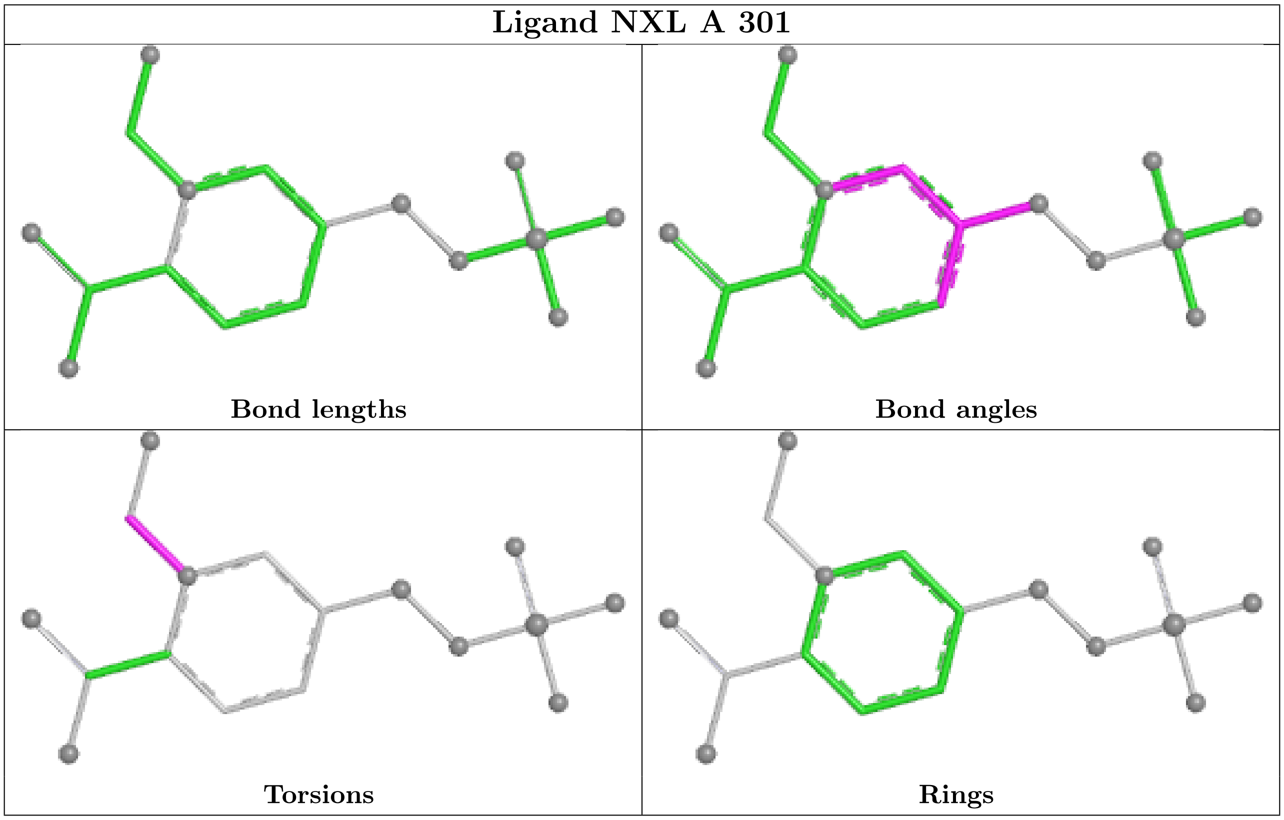


Bond lengths

Bond angles

Torsions

Rings



Ligand NXL A 301

Bond lengths

Bond angles

Torsions

Rings

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.