Full wwPDB X-ray Structure Validation Report ⓘ

May 22, 2020 – 05:04 am BST

PDB ID	:	4M3I
Title	:	X-ray crystal structure of the ruthenium complex [Ru(TAP)2(dppz-{Me2})]2 + bound to d(CCGGTACCGG)
Authors	:	Niyazi, H.; Teixeira, S.; Mitchell, E.; Forsyth, T.; Cardin, C.
Deposited on	:	2013-08-06
Resolution	:	2.10 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:

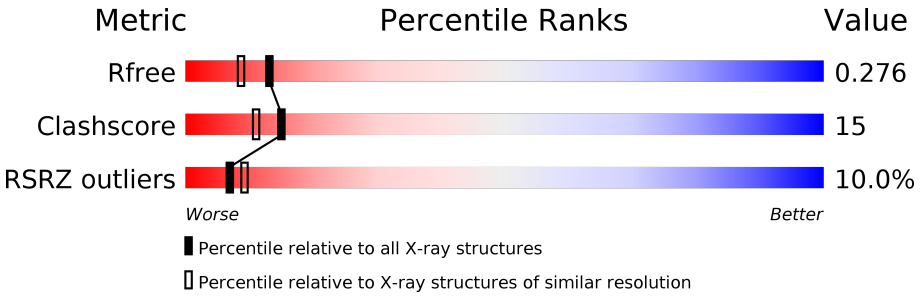
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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 <=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	10	10% 60% 20% 20%

2 Entry composition

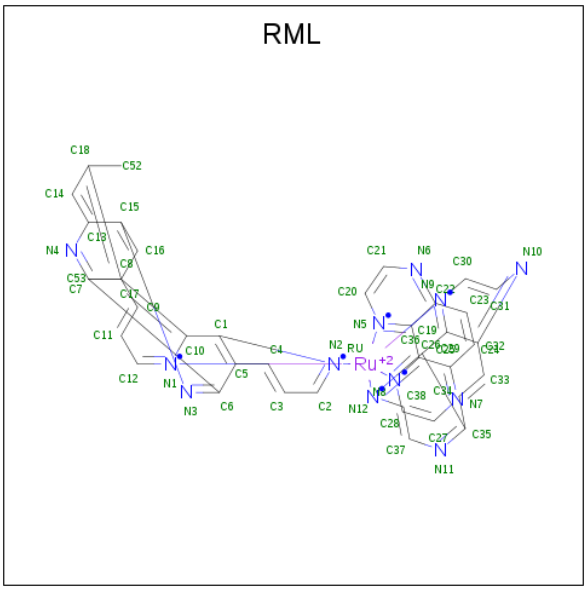
There are 4 unique types of molecules in this entry. The entry contains 318 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 DNA chain called Synthetic DNA CCGGTACCGG.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	10	Total	C	N	O	P	0	0	0
			198	94	39	56	9			

- Molecule 2 is (11,12-dimethyldipyrido[3,2-a:2',3'-c]phenazine-kappa 2 N 4 ,N 5)[bis(pyrazino[2,3-f]quinoxaline-kappa 2 N 1 ,N 10)]ruthenium(2+) (three-letter code: RML) (formula: $C_{40}H_{26}N_{12}Ru$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	Ru	0	0
			53	40	12	1		
2	A	1	Total	C	N	Ru	0	0
			53	40	12	1		

- Molecule 3 is BARIUM ION (three-letter code: BA) (formula: Ba).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Ba 1 1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	13	Total O 13 13	0	0

3 Residue-property plots (i)

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: Synthetic DNA CCGGTACCGG

Chain A:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α, β, γ	53.28Å 53.28Å 33.71Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.67 – 2.10 28.49 – 2.10	Depositor EDS
% Data completeness (in resolution range)	93.9 (37.67-2.10) 93.9 (28.49-2.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.77 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.251 , 0.277 0.244 , 0.276	Depositor DCC
R_{free} test set	129 reflections (4.45%)	wwPDB-VP
Wilson B-factor (Å^2)	58.3	Xtriage
Anisotropy	0.037	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 58.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	318	wwPDB-VP
Average B, all atoms (Å^2)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.60% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: BA, RML

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	1.18	2/221 (0.9%)	0.94	0/338

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	9	DG	O3'-P	-7.20	1.52	1.61
1	A	8	DC	O3'-P	-5.95	1.54	1.61

There are no bond angle outliers.

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	198	0	107	5	0
2	A	106	0	52	6	0
3	A	1	0	0	0	0
4	A	13	0	0	0	0
All	All	318	0	159	7	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 15.

All (7) 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:A:102:RML:C38	2:A:102:RML:H11	2.35	0.56
1:A:7:DC:H5'	2:A:102:RML:H25	1.96	0.48
2:A:102:RML:N12	2:A:102:RML:H11	2.31	0.45
1:A:7:DC:H5'	2:A:102:RML:C34	2.46	0.45
1:A:6:DA:H4'	2:A:102:RML:N11	2.33	0.44
1:A:7:DC:C4'	2:A:102:RML:H26	2.47	0.44
1:A:8:DC:H2'	1:A:9:DG:C8	2.55	0.41

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

There are no protein molecules in this entry.

5.3.2 Protein sidechains

There are no protein molecules in this entry.

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 carbohydrates in this entry.

5.6 Ligand geometry (i)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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	$\#\|Z\| > 2$
2	RML	A	101	-	66,66,66	2.85	24 (36%)	86,113,113	2.92	44 (51%)
2	RML	A	102	-	66,66,66	2.39	22 (33%)	86,113,113	1.98	28 (32%)

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	RML	A	101	-	-	-	0/14/14/14
2	RML	A	102	-	-	-	0/14/14/14

All (46) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	101	RML	RU-N2	-8.84	1.75	2.06
2	A	101	RML	RU-N5	-7.40	1.80	2.06
2	A	101	RML	RU-N9	-7.06	1.82	2.06
2	A	102	RML	RU-N2	-6.82	1.82	2.06
2	A	101	RML	RU-N8	-6.80	1.82	2.06
2	A	102	RML	RU-N5	-6.01	1.85	2.06
2	A	101	RML	RU-N12	-5.94	1.85	2.06
2	A	102	RML	RU-N9	-5.93	1.86	2.06
2	A	101	RML	C24-C25	-5.53	1.32	1.41
2	A	101	RML	RU-N1	-5.45	1.87	2.06
2	A	102	RML	RU-N1	-5.23	1.88	2.06
2	A	102	RML	RU-N8	-4.89	1.89	2.06
2	A	102	RML	C29-N9	4.16	1.46	1.37
2	A	102	RML	RU-N12	-4.03	1.92	2.06
2	A	101	RML	C23-C22	-3.99	1.34	1.41
2	A	101	RML	C30-N9	3.87	1.41	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	101	RML	C32-N10	-3.85	1.30	1.37
2	A	102	RML	C30-N9	3.80	1.41	1.33
2	A	102	RML	C33-C32	3.68	1.48	1.41
2	A	101	RML	C12-N1	3.63	1.41	1.33
2	A	101	RML	C14-C13	-3.62	1.36	1.41
2	A	102	RML	C24-C25	-3.48	1.35	1.41
2	A	101	RML	C25-N7	-3.40	1.31	1.37
2	A	102	RML	C32-N10	-3.33	1.31	1.37
2	A	102	RML	C7-N4	3.32	1.38	1.33
2	A	101	RML	C8-C7	-3.09	1.39	1.45
2	A	101	RML	C8-C10	3.03	1.45	1.40
2	A	102	RML	C31-N10	2.95	1.38	1.32
2	A	101	RML	C35-N11	-2.85	1.32	1.37
2	A	101	RML	C7-N4	2.82	1.37	1.33
2	A	102	RML	C8-C7	-2.82	1.39	1.45
2	A	102	RML	C15-N3	-2.71	1.30	1.35
2	A	101	RML	C1-N2	2.57	1.42	1.37
2	A	102	RML	C9-C8	-2.55	1.35	1.41
2	A	102	RML	C14-C13	-2.53	1.37	1.41
2	A	101	RML	C1-C10	-2.38	1.38	1.43
2	A	101	RML	C13-N4	-2.27	1.31	1.35
2	A	101	RML	C4-C5	-2.26	1.36	1.41
2	A	101	RML	C20-N5	2.21	1.38	1.33
2	A	101	RML	C15-N3	-2.17	1.31	1.35
2	A	102	RML	C30-C31	2.16	1.43	1.38
2	A	102	RML	C2-N2	2.08	1.37	1.33
2	A	101	RML	C26-C25	-2.07	1.35	1.40
2	A	102	RML	C20-N5	2.07	1.37	1.33
2	A	102	RML	C28-C27	2.03	1.42	1.38
2	A	102	RML	C19-N5	2.02	1.41	1.37

All (72) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	101	RML	C5-C1-N2	8.27	130.72	122.78
2	A	101	RML	C20-N5-C19	-7.05	102.01	117.51
2	A	101	RML	C5-C1-C10	-6.95	113.56	120.67
2	A	101	RML	C21-N6-C22	-6.30	107.18	116.93
2	A	101	RML	C1-C5-C6	6.14	126.10	119.14
2	A	101	RML	C28-N8-C26	-5.85	104.65	117.51
2	A	101	RML	C5-C6-N3	5.15	123.63	118.36
2	A	101	RML	C27-N7-C25	-5.04	109.13	116.93

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	101	RML	C8-C10-N1	4.57	127.17	122.78
2	A	102	RML	C12-C11-C9	4.52	125.74	119.39
2	A	102	RML	C29-C36-N12	-4.49	110.49	116.56
2	A	102	RML	C20-N5-C19	-4.45	107.73	117.51
2	A	101	RML	C30-N9-C29	-4.33	107.99	117.51
2	A	101	RML	C2-N2-C1	-4.31	108.03	117.51
2	A	102	RML	C8-C10-N1	4.19	126.81	122.78
2	A	102	RML	C28-N8-C26	-4.16	108.37	117.51
2	A	101	RML	C1-C10-N1	-4.10	111.01	116.56
2	A	101	RML	C7-C6-N3	-4.05	118.15	121.83
2	A	101	RML	C6-N3-C15	4.03	120.80	116.77
2	A	102	RML	C11-C9-C8	-3.99	114.15	120.86
2	A	101	RML	C21-C20-N5	3.97	128.66	121.58
2	A	102	RML	C30-N9-C29	-3.95	108.83	117.51
2	A	101	RML	C16-C15-N3	3.72	123.14	119.05
2	A	101	RML	C12-N1-C10	-3.67	109.44	117.51
2	A	101	RML	C26-C19-N5	-3.59	111.71	116.56
2	A	101	RML	C19-C22-N6	3.50	126.60	120.35
2	A	102	RML	C21-N6-C22	-3.47	111.56	116.93
2	A	101	RML	C24-C25-N7	-3.42	112.91	118.52
2	A	102	RML	C27-N7-C25	-3.20	111.98	116.93
2	A	101	RML	C27-C28-N8	3.17	127.25	121.58
2	A	101	RML	C4-C5-C6	-3.05	118.21	122.55
2	A	102	RML	C13-C15-N3	3.04	123.94	121.42
2	A	102	RML	C12-N1-C10	-3.04	110.82	117.51
2	A	101	RML	C38-N12-C36	-3.03	110.85	117.51
2	A	101	RML	C11-C9-C8	-2.96	115.89	120.86
2	A	102	RML	C7-C6-N3	-2.93	119.17	121.83
2	A	102	RML	C10-C8-C7	2.93	122.45	119.14
2	A	102	RML	C9-C8-C7	-2.92	118.40	122.55
2	A	102	RML	C38-N12-C36	-2.89	111.15	117.51
2	A	101	RML	C26-C25-N7	2.86	125.47	120.35
2	A	101	RML	C2-C3-C4	2.86	123.41	119.39
2	A	101	RML	C23-C22-N6	-2.84	113.86	118.52
2	A	101	RML	C9-C8-C7	-2.83	118.53	122.55
2	A	101	RML	C16-C15-C13	-2.81	116.46	119.51
2	A	102	RML	C21-C20-N5	2.81	126.60	121.58
2	A	101	RML	C10-C8-C7	2.79	122.30	119.14
2	A	101	RML	C14-C13-C15	2.71	122.45	119.51
2	A	102	RML	C15-C13-N4	-2.69	119.18	121.42
2	A	101	RML	C20-C21-N6	2.67	127.39	123.29
2	A	101	RML	C8-C7-N4	2.65	121.07	118.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	101	RML	C14-C13-N4	-2.48	116.31	119.05
2	A	102	RML	C8-C10-C1	-2.47	118.14	120.67
2	A	101	RML	C36-C29-N9	-2.34	113.39	116.56
2	A	102	RML	C36-C29-C32	-2.34	114.85	119.63
2	A	102	RML	C32-C29-N9	2.33	128.54	122.28
2	A	101	RML	C25-C26-N8	2.33	128.54	122.28
2	A	101	RML	C3-C4-C5	-2.29	117.02	120.86
2	A	101	RML	C33-C32-N10	-2.27	114.80	118.52
2	A	102	RML	C24-C25-N7	-2.26	114.82	118.52
2	A	102	RML	C2-N2-C1	-2.24	112.58	117.51
2	A	101	RML	C8-C7-C6	-2.23	118.01	120.04
2	A	102	RML	C29-C36-C35	2.20	124.12	119.63
2	A	101	RML	C22-C19-N5	2.15	128.07	122.28
2	A	101	RML	C35-C36-N12	2.15	128.06	122.28
2	A	101	RML	C36-C35-N11	-2.15	116.51	120.35
2	A	102	RML	C37-N11-C35	-2.11	113.67	116.93
2	A	101	RML	C4-C5-C1	-2.03	115.69	117.86
2	A	102	RML	C26-C19-N5	-2.03	113.82	116.56
2	A	102	RML	C6-N3-C15	2.03	118.80	116.77
2	A	102	RML	C3-C4-C5	-2.02	117.46	120.86
2	A	101	RML	C5-C6-C7	-2.02	118.21	120.04
2	A	102	RML	C33-C34-C35	-2.01	117.07	120.76

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

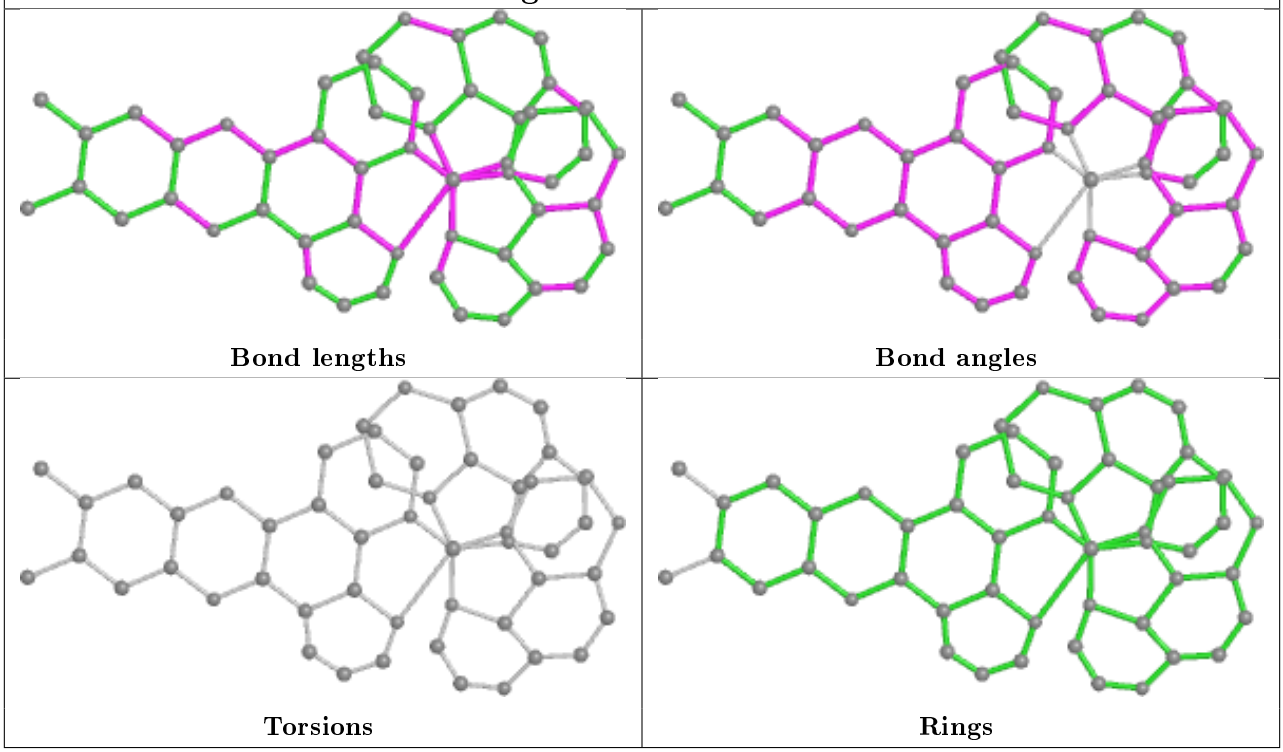
1 monomer is involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	102	RML	6	0

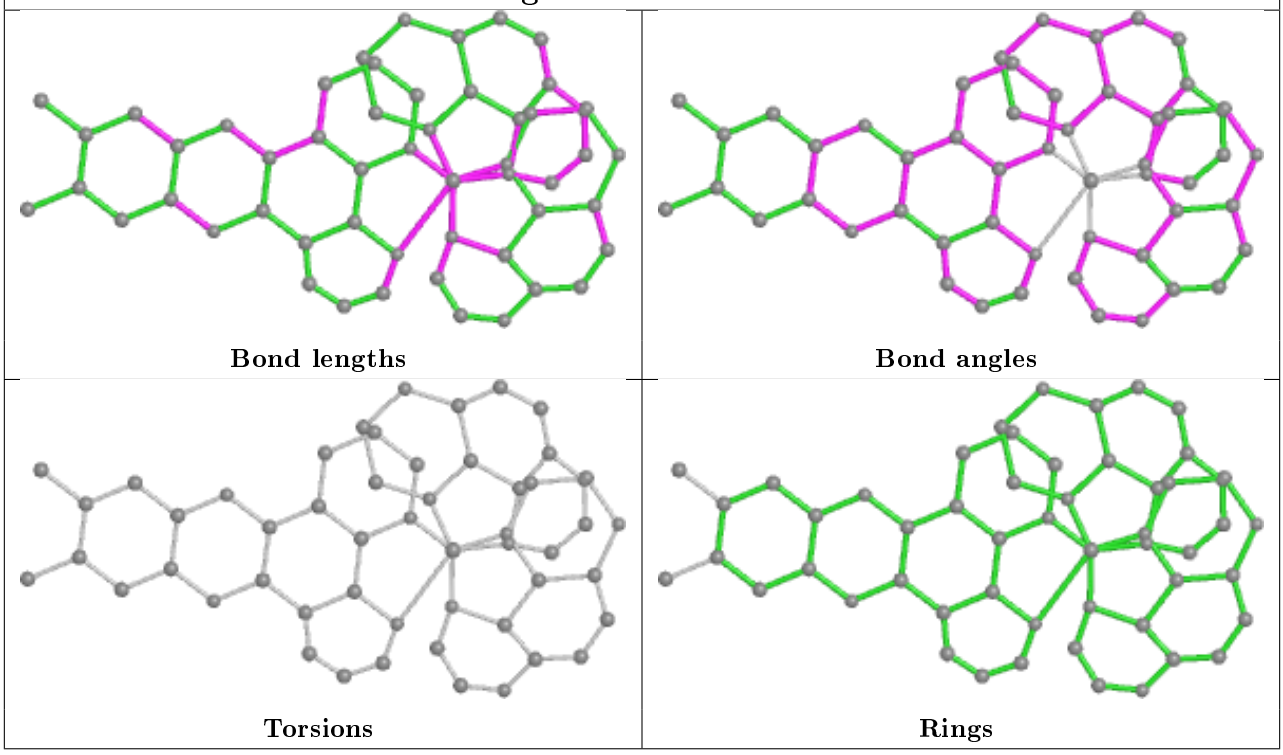
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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 RML A 101



Ligand RML A 102



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.

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, 95^{th} 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	10/10 (100%)	0.43	1 (10%) 7 9	50, 57, 65, 68	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	DC	2.6

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

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

6.3 Carbohydrates

There are no carbohydrates in this entry.

6.4 Ligands

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, 95^{th} 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.

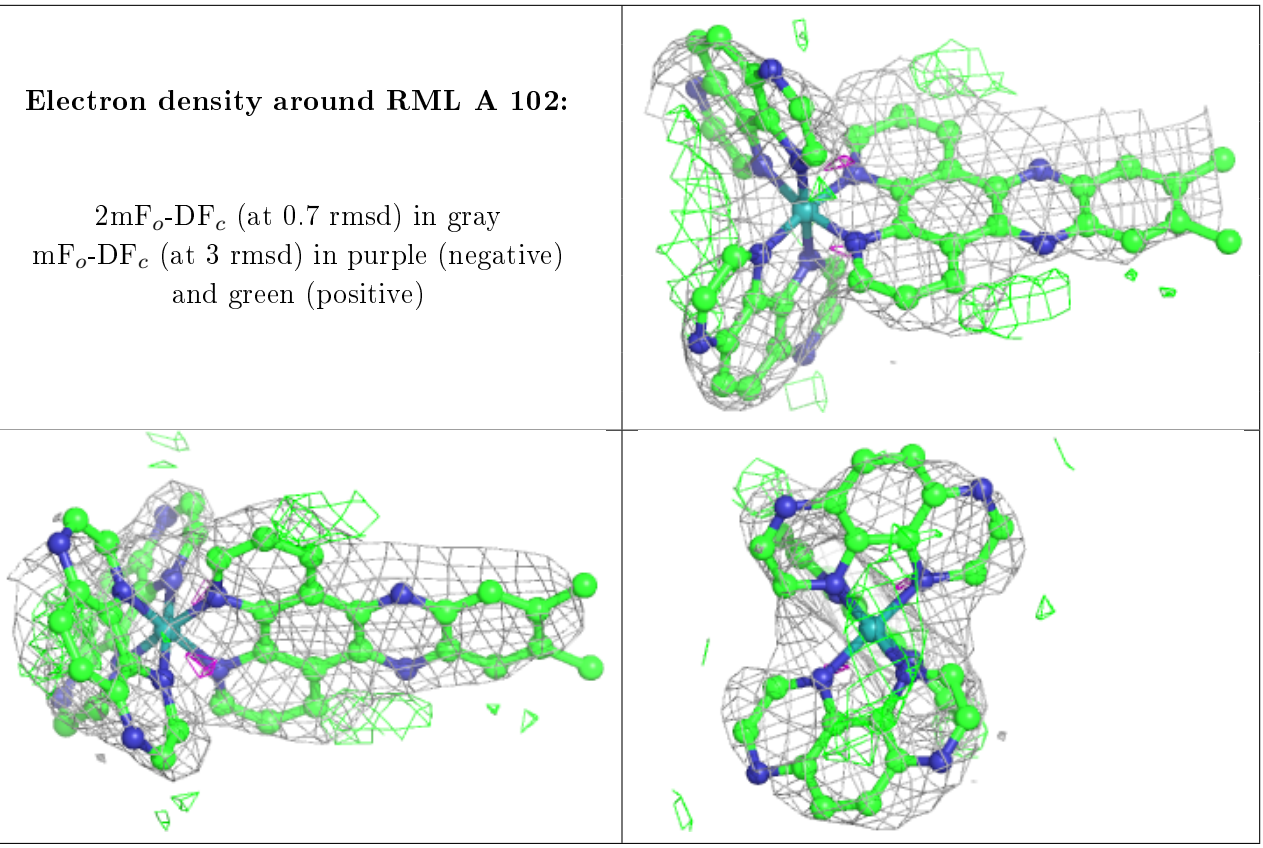
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	RML	A	102	53/53	0.96	0.19	39,56,68,84	53
2	RML	A	101	53/53	0.98	0.16	38,48,55,56	0
3	BA	A	103	1/1	0.99	0.24	57,57,57,57	0

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.

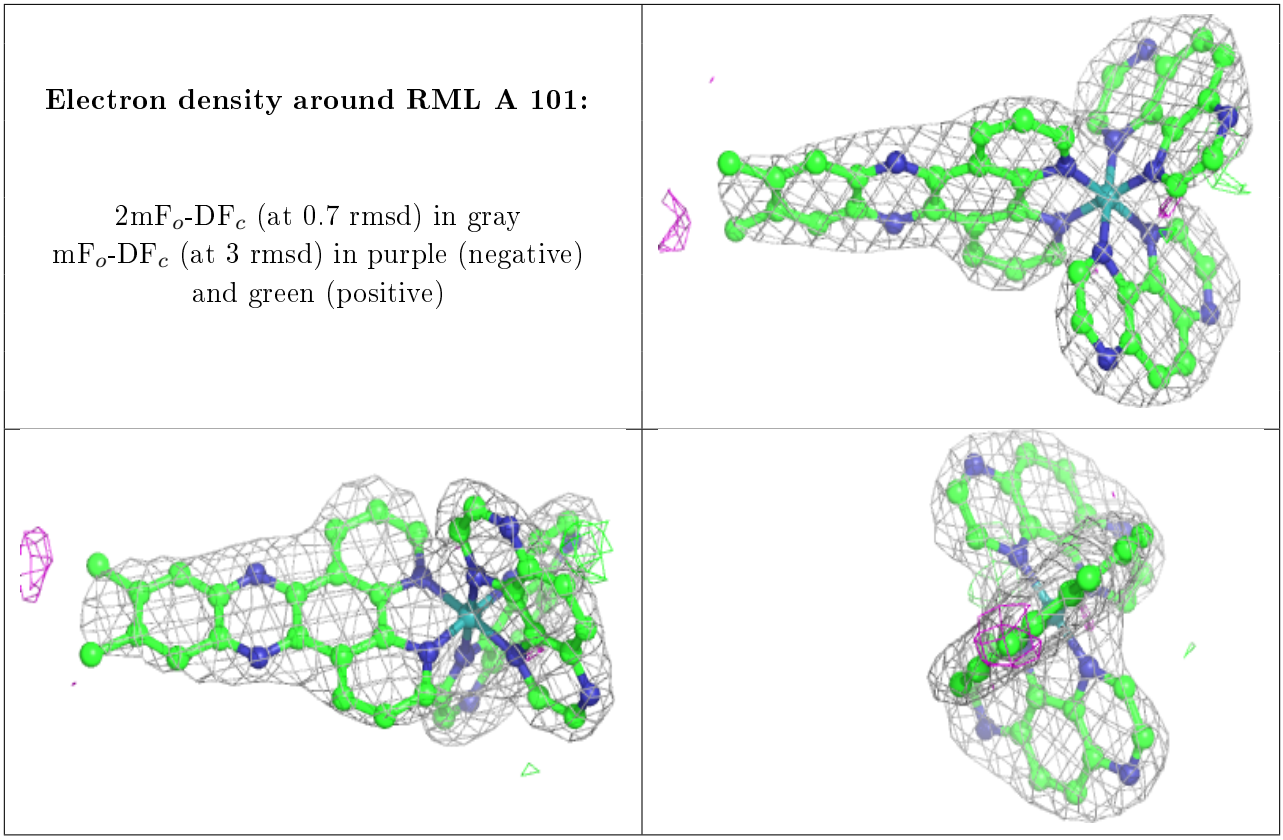
Electron density around RML A 102:

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



Electron density around RML A 101:

$2mF_o$-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)

There are no such residues in this entry.