



wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 4, 2026 – 06:23 PM EDT

PDB ID : 3LYA / pdb_00003lya
Title : Crystal structure of the periplasmic domain of CadC in the presence of K₂ReCl₆
Authors : Eichinger, A.; Skerra, A.
Deposited on : 2010-02-26
Resolution : 2.30 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

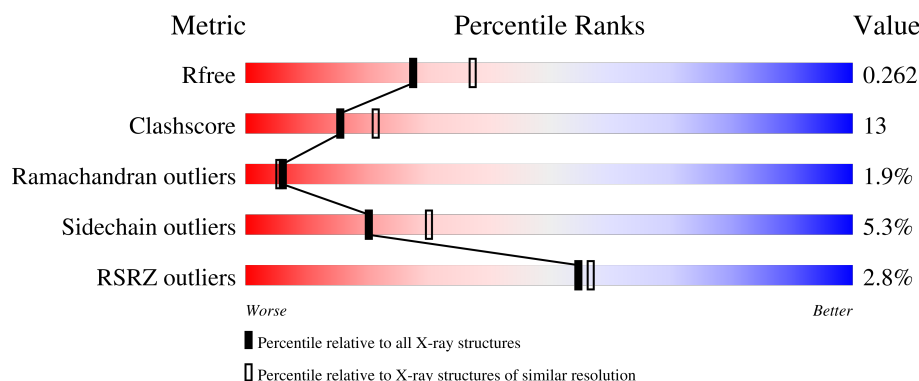
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	372	

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	RHE	A	1	-	-	X	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	RHE	A	16	-	-	X	-
2	RHE	A	3	-	-	X	-
2	RHE	A	9	-	-	X	-

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2674 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 Transcriptional activator cadC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	318	Total	C	N	O	S	431	0	0
			2528	1606	426	486	10			

There are 47 discrepancies between the modelled and reference sequences:

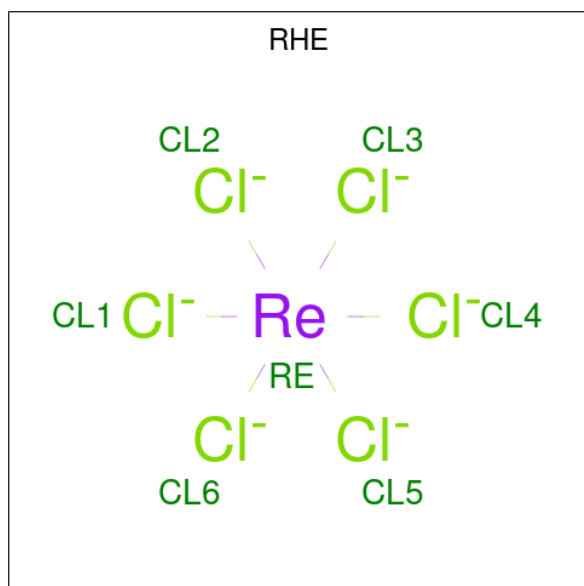
Chain	Residue	Modelled	Actual	Comment	Reference
A	141	GLY	-	expression tag	UNP P23890
A	142	SER	-	expression tag	UNP P23890
A	143	GLY	-	expression tag	UNP P23890
A	144	MET	-	expression tag	UNP P23890
A	145	LYS	-	expression tag	UNP P23890
A	146	GLU	-	expression tag	UNP P23890
A	147	THR	-	expression tag	UNP P23890
A	148	ALA	-	expression tag	UNP P23890
A	149	ALA	-	expression tag	UNP P23890
A	150	ALA	-	expression tag	UNP P23890
A	151	LYS	-	expression tag	UNP P23890
A	152	PHE	-	expression tag	UNP P23890
A	153	GLU	-	expression tag	UNP P23890
A	154	ARG	-	expression tag	UNP P23890
A	155	GLN	-	expression tag	UNP P23890
A	156	HIS	-	expression tag	UNP P23890
A	157	MET	-	expression tag	UNP P23890
A	158	ASP	-	expression tag	UNP P23890
A	159	SER	-	expression tag	UNP P23890
A	160	PRO	-	expression tag	UNP P23890
A	161	ASP	-	expression tag	UNP P23890
A	162	LEU	-	expression tag	UNP P23890
A	163	GLY	-	expression tag	UNP P23890
A	164	THR	-	expression tag	UNP P23890
A	165	ASP	-	expression tag	UNP P23890
A	166	ASP	-	expression tag	UNP P23890
A	167	ASP	-	expression tag	UNP P23890

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Chain	Residue	Modelled	Actual	Comment	Reference
A	168	ASP	-	expression tag	UNP P23890
A	169	LYS	-	expression tag	UNP P23890
A	170	ALA	-	expression tag	UNP P23890
A	171	MET	-	expression tag	UNP P23890
A	172	ALA	-	expression tag	UNP P23890
A	173	HIS	-	expression tag	UNP P23890
A	174	HIS	-	expression tag	UNP P23890
A	175	HIS	-	expression tag	UNP P23890
A	176	HIS	-	expression tag	UNP P23890
A	177	HIS	-	expression tag	UNP P23890
A	178	HIS	-	expression tag	UNP P23890
A	179	SER	-	expression tag	UNP P23890
A	180	SER	-	expression tag	UNP P23890
A	181	GLY	-	expression tag	UNP P23890
A	182	HIS	-	expression tag	UNP P23890
A	183	ILE	-	expression tag	UNP P23890
A	184	GLU	-	expression tag	UNP P23890
A	185	GLY	-	expression tag	UNP P23890
A	186	ARG	-	expression tag	UNP P23890
A	187	HIS	-	expression tag	UNP P23890

- Molecule 2 is rhenium (IV) hexachloride (CCD ID: RHE) (formula: Cl₆Re).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	Cl	Re	0	0
			7	6	1		

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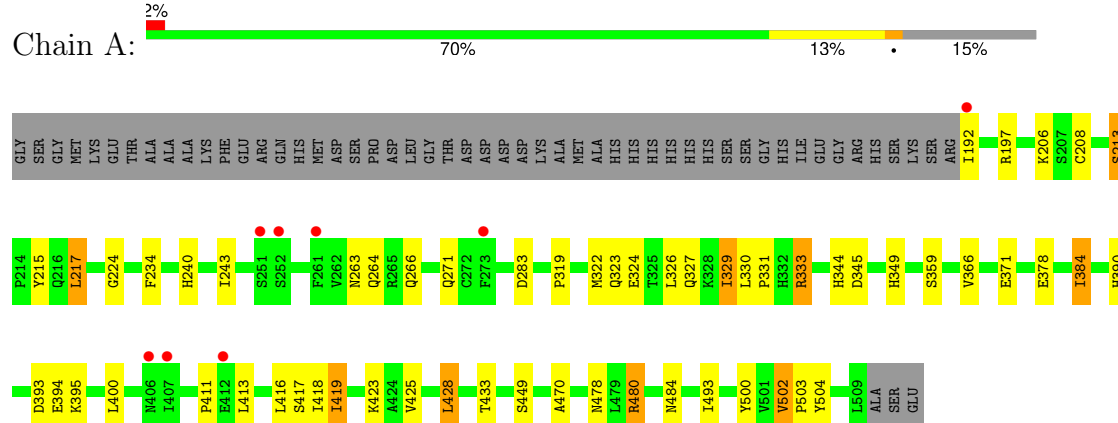
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		
2	A	1	Total	Cl	Re	0	0
			7	6	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	34	Total	O	0	0
			34	34		

i

- Molecule 1: Transcriptional activator cadC



4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	80.56Å 80.56Å 199.78Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	69.77 – 2.30 69.77 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.5 (69.77-2.30) 98.5 (69.77-2.30)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.90 (at 2.29Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.230 , 0.271 0.230 , 0.262	Depositor DCC
R_{free} test set	897 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å ²)	30.0	Xtriage
Anisotropy	0.044	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	2674	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.70% 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: RHE

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	1.05	1/2578 (0.0%)	1.07	3/3503 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	418	ILE	CA-CB	5.01	1.60	1.54

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	480	ARG	CG-CD-NE	-6.75	97.15	112.00
1	A	480	ARG	NE-CZ-NH2	-5.42	114.32	119.20
1	A	417	SER	N-CA-C	5.09	117.49	111.33

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	2528	0	2508	57	3
2	A	112	0	0	34	2
3	A	34	0	0	0	0
All	All	2674	0	2508	57	3

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 13.

The worst 5 of 57 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:470:ALA:HB1	2:A:9:RHE:CL6	1.91	1.07
1:A:470:ALA:CB	2:A:9:RHE:CL6	2.44	1.03
1:A:395:LYS:N	2:A:16:RHE:CL4	2.35	0.96
1:A:503:PRO:HG2	2:A:9:RHE:CL5	2.04	0.93
1:A:234:PHE:HB2	1:A:322:MET:HE2	1.53	0.90

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:324:GLU:OE1	1:A:500:TYR:OH[5_454]	2.03	0.17
1:A:359:SER:O	2:A:16:RHE:CL2[12_575]	2.05	0.15
1:A:283:ASP:OD2	2:A:9:RHE:CL1[12_565]	2.14	0.06

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	316/372 (85%)	296 (94%)	14 (4%)	6 (2%)	6 5

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	208	CYS
1	A	264	GLN
1	A	266	GLN
1	A	213	SER
1	A	271	GLN

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	281/324 (87%)	266 (95%)	15 (5%)	20	30

5 of 15 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	333	ARG
1	A	433	THR
1	A	378	GLU
1	A	502	VAL
1	A	419	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	387	HIS
1	A	396	GLN
1	A	484	ASN
1	A	332	HIS
1	A	240	HIS

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

16 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	RHE	A	10	-	6,6,6	0.92	0	-		
2	RHE	A	11	-	6,6,6	1.00	0	-		
2	RHE	A	3	3	6,6,6	2.42	3 (50%)	-		
2	RHE	A	13	-	6,6,6	0.65	0	-		
2	RHE	A	15	-	6,6,6	0.53	0	-		
2	RHE	A	16	-	6,6,6	0.58	0	-		
2	RHE	A	4	-	6,6,6	0.69	0	-		
2	RHE	A	1	-	6,6,6	1.67	1 (16%)	-		
2	RHE	A	6	-	6,6,6	0.70	0	-		
2	RHE	A	9	-	6,6,6	0.32	0	-		
2	RHE	A	12	-	6,6,6	0.60	0	-		
2	RHE	A	7	-	6,6,6	1.24	1 (16%)	-		
2	RHE	A	8	-	6,6,6	1.13	0	-		
2	RHE	A	5	-	6,6,6	1.13	0	-		
2	RHE	A	2	-	6,6,6	2.07	2 (33%)	-		
2	RHE	A	14	-	6,6,6	0.56	0	-		

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	3	RHE	RE-CL6	4.76	2.49	2.36
2	A	1	RHE	RE-CL2	-3.16	2.27	2.36
2	A	2	RHE	RE-CL1	-3.15	2.27	2.36
2	A	2	RHE	RE-CL3	-3.09	2.27	2.36
2	A	3	RHE	RE-CL5	-2.38	2.29	2.36

There are no bond angle outliers.

There are no chirality outliers.

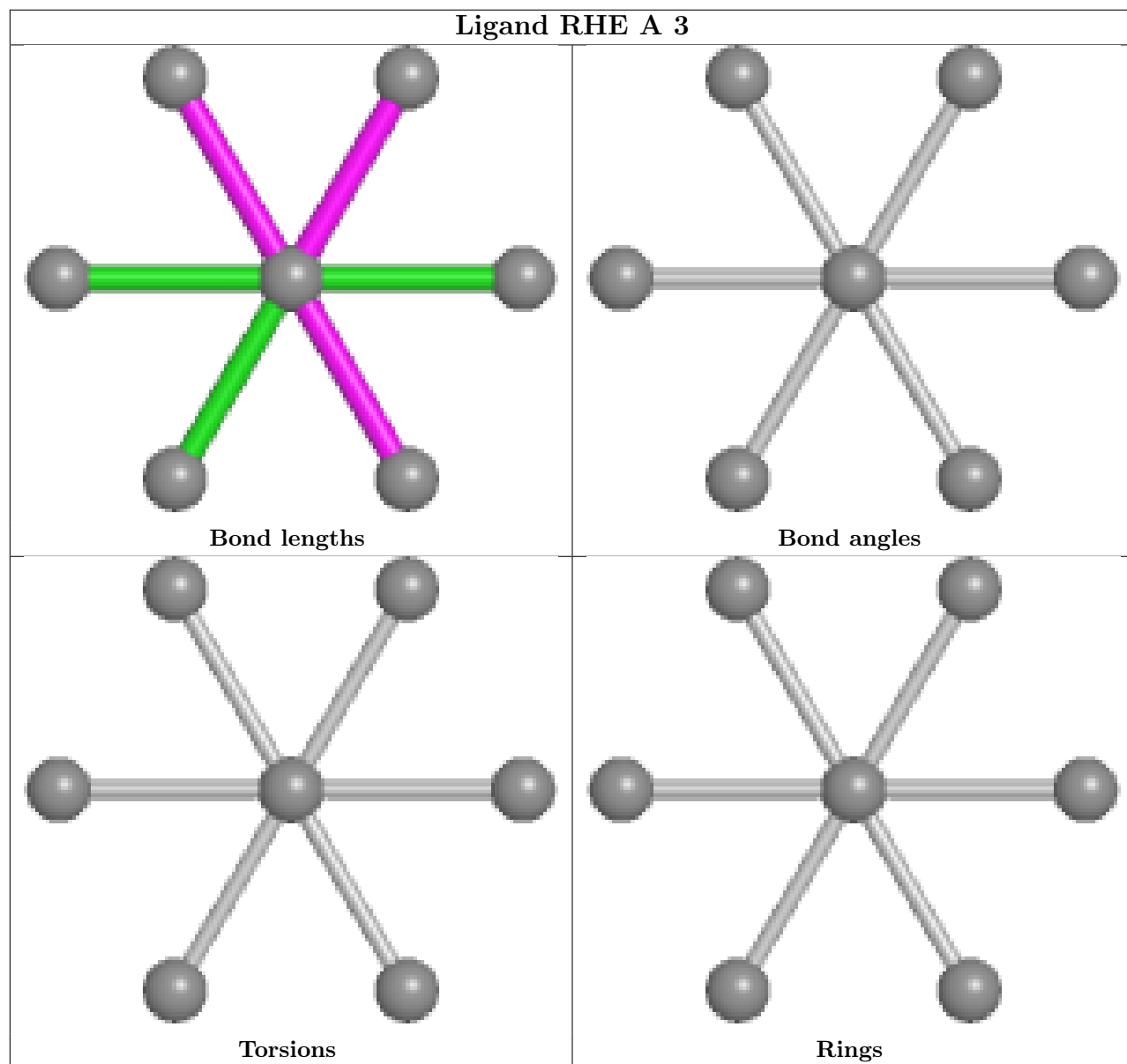
There are no torsion outliers.

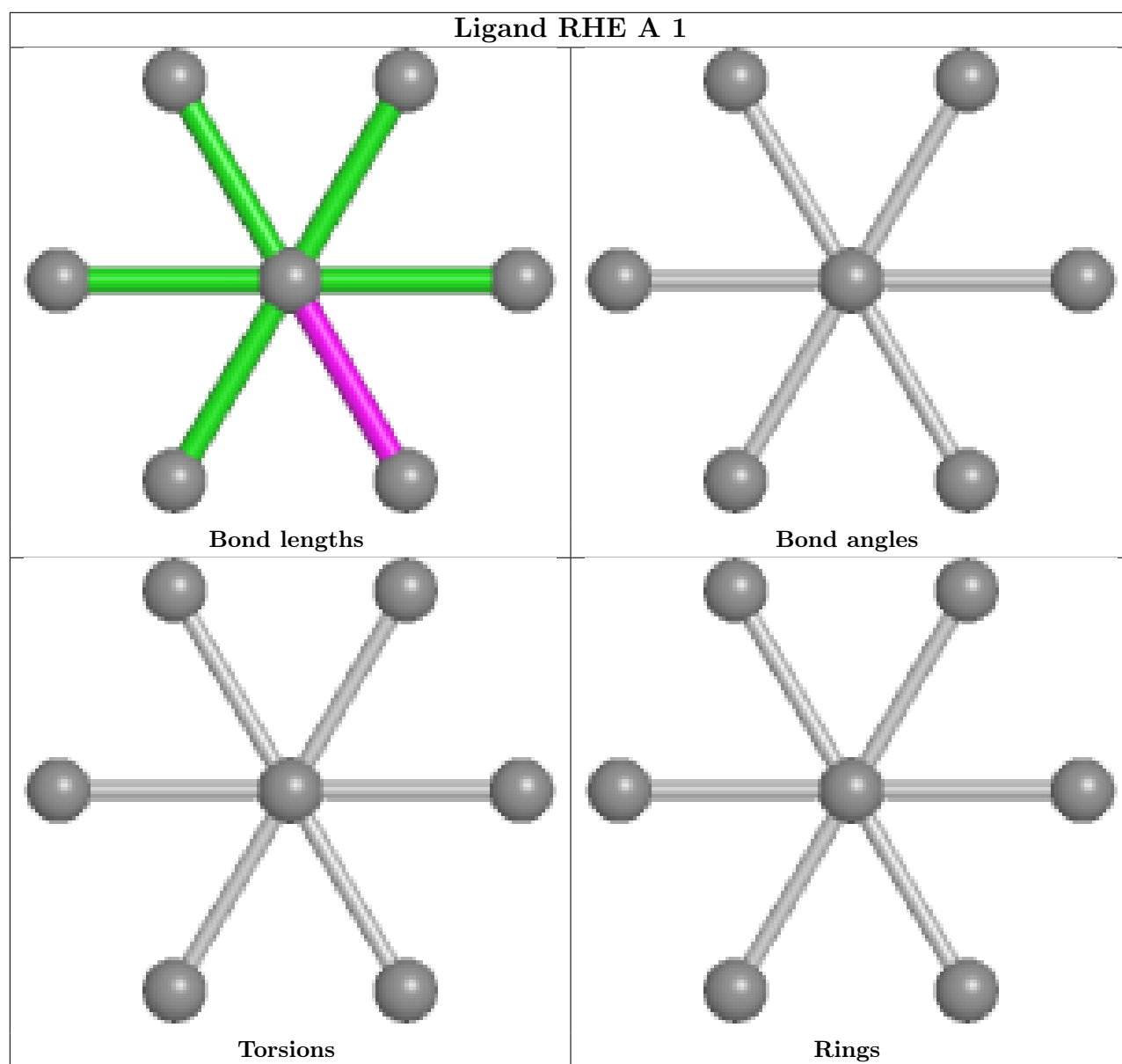
There are no ring outliers.

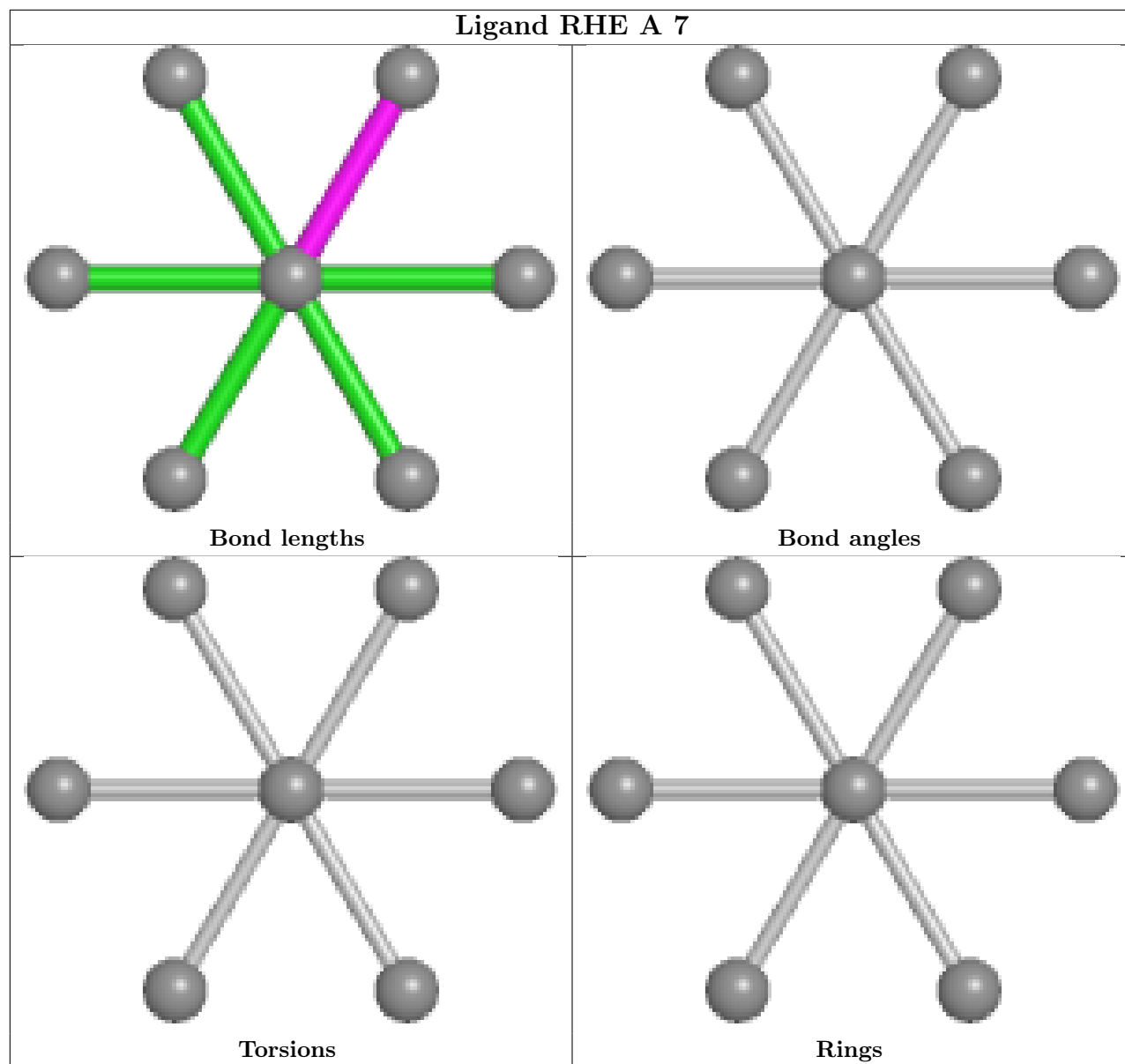
6 monomers are involved in 36 short contacts:

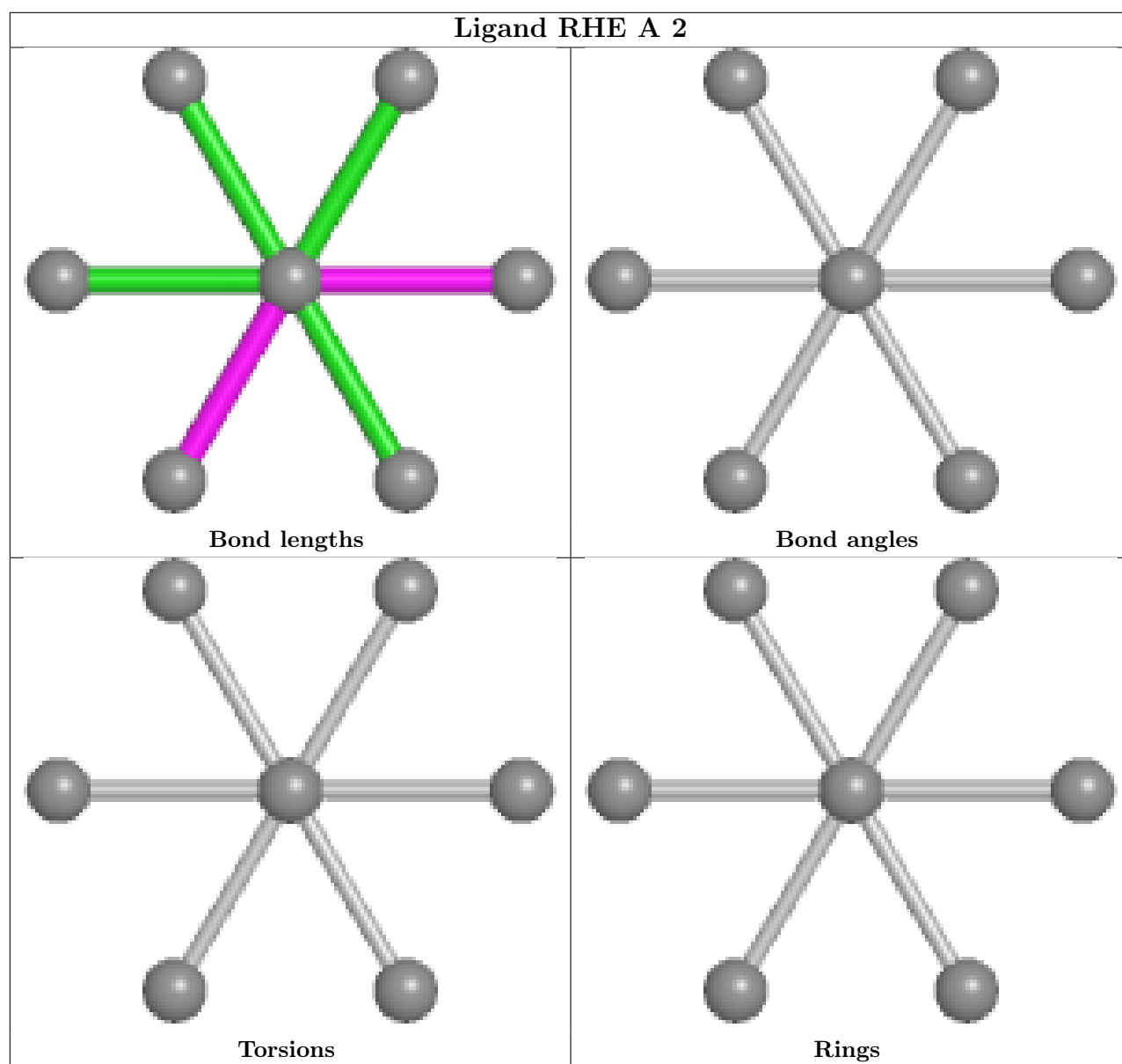
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	3	RHE	3	0
2	A	16	RHE	7	1
2	A	4	RHE	1	0
2	A	1	RHE	7	0
2	A	6	RHE	1	0
2	A	9	RHE	15	1

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	286/372 (76%)	0.14	8 (2%) 55 57	8, 18, 33, 42	49 (17%)

The worst 5 of 8 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	192	ILE	3.6
1	A	273	PHE	3.0
1	A	412	GLU	2.9
1	A	407	ILE	2.5
1	A	251	SER	2.2

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
2	RHE	A	16	7/7	0.65	0.34	67,68,70,71	7
2	RHE	A	15	7/7	0.75	0.29	91,91,92,92	7

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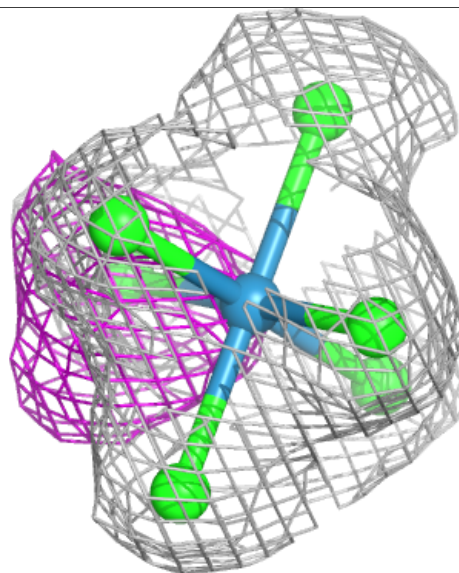
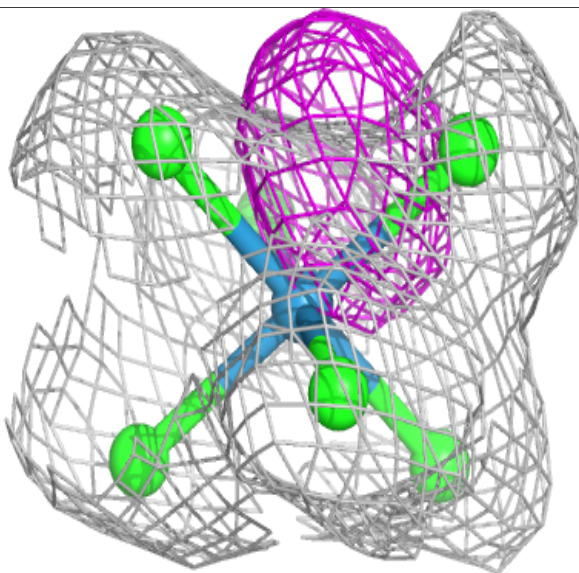
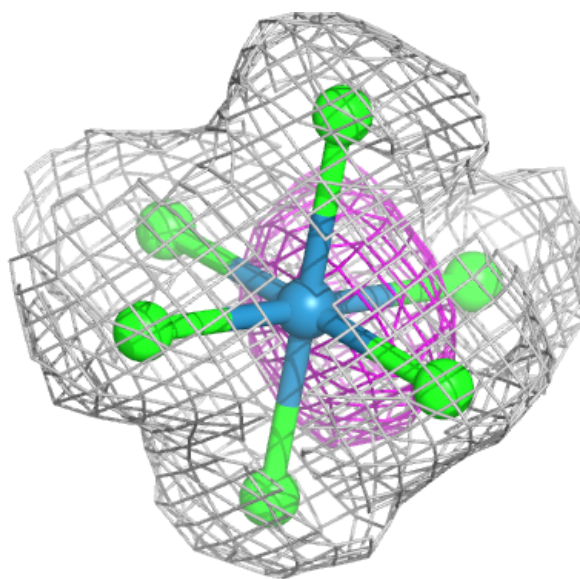
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	RHE	A	13	7/7	0.84	0.18	68,72,74,75	7
2	RHE	A	8	7/7	0.90	0.21	36,40,44,44	7
2	RHE	A	12	7/7	0.91	0.15	49,49,56,57	7
2	RHE	A	11	7/7	0.93	0.17	42,44,44,46	7
2	RHE	A	10	7/7	0.94	0.14	29,31,35,36	7
2	RHE	A	14	7/7	0.94	0.13	79,81,82,82	7
2	RHE	A	9	7/7	0.95	0.13	44,57,61,61	7
2	RHE	A	7	7/7	0.96	0.10	56,59,62,62	0
2	RHE	A	6	7/7	0.97	0.12	49,55,56,60	0
2	RHE	A	3	7/7	0.98	0.07	29,31,35,40	0
2	RHE	A	5	7/7	0.99	0.11	31,36,38,38	7
2	RHE	A	4	7/7	0.99	0.09	28,32,36,38	7
2	RHE	A	1	7/7	1.00	0.04	13,21,25,27	0
2	RHE	A	2	7/7	1.00	0.03	11,18,19,20	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.

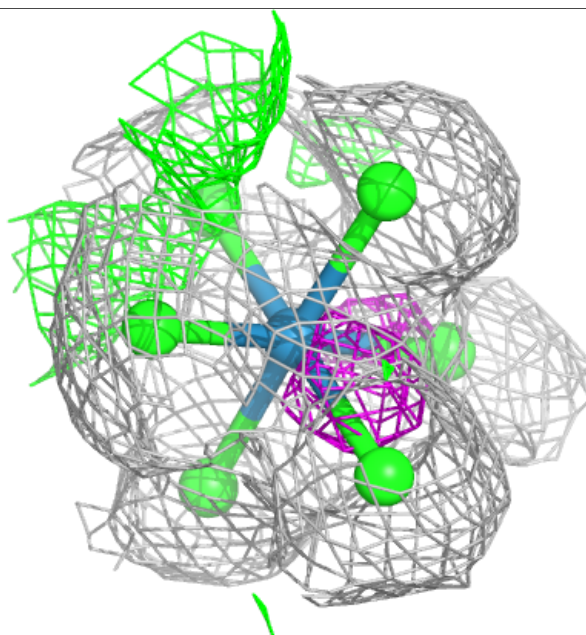
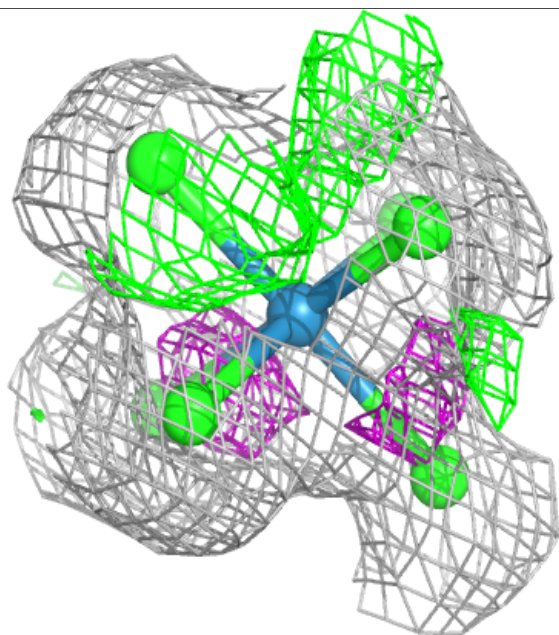
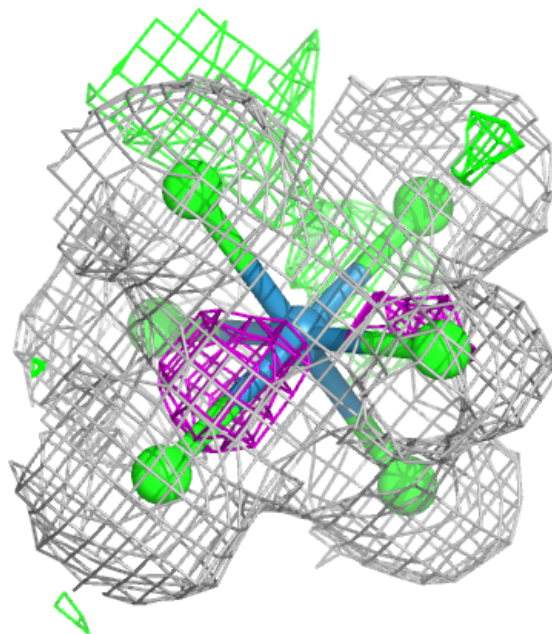
Electron density around RHE A 7:

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



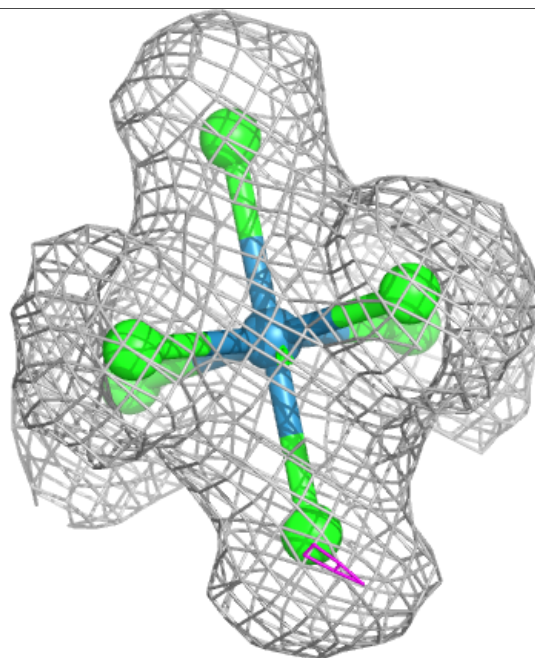
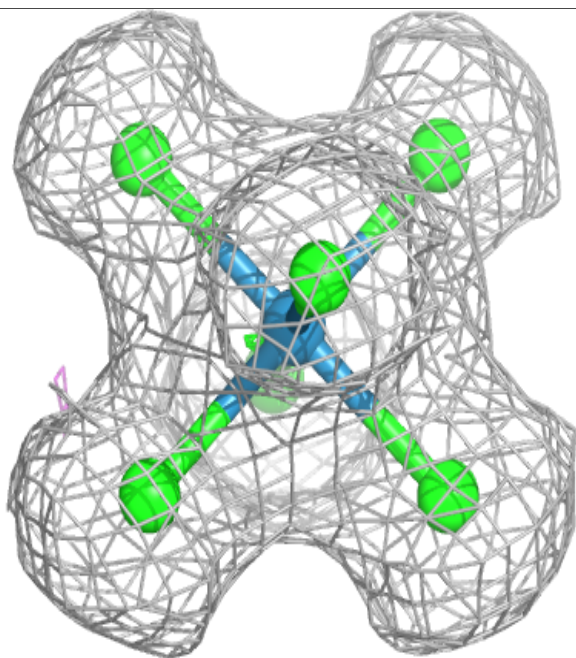
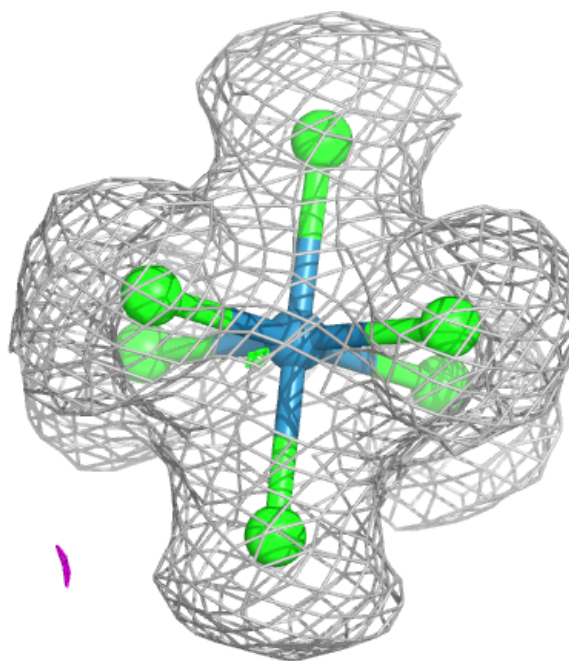
Electron density around RHE A 3:

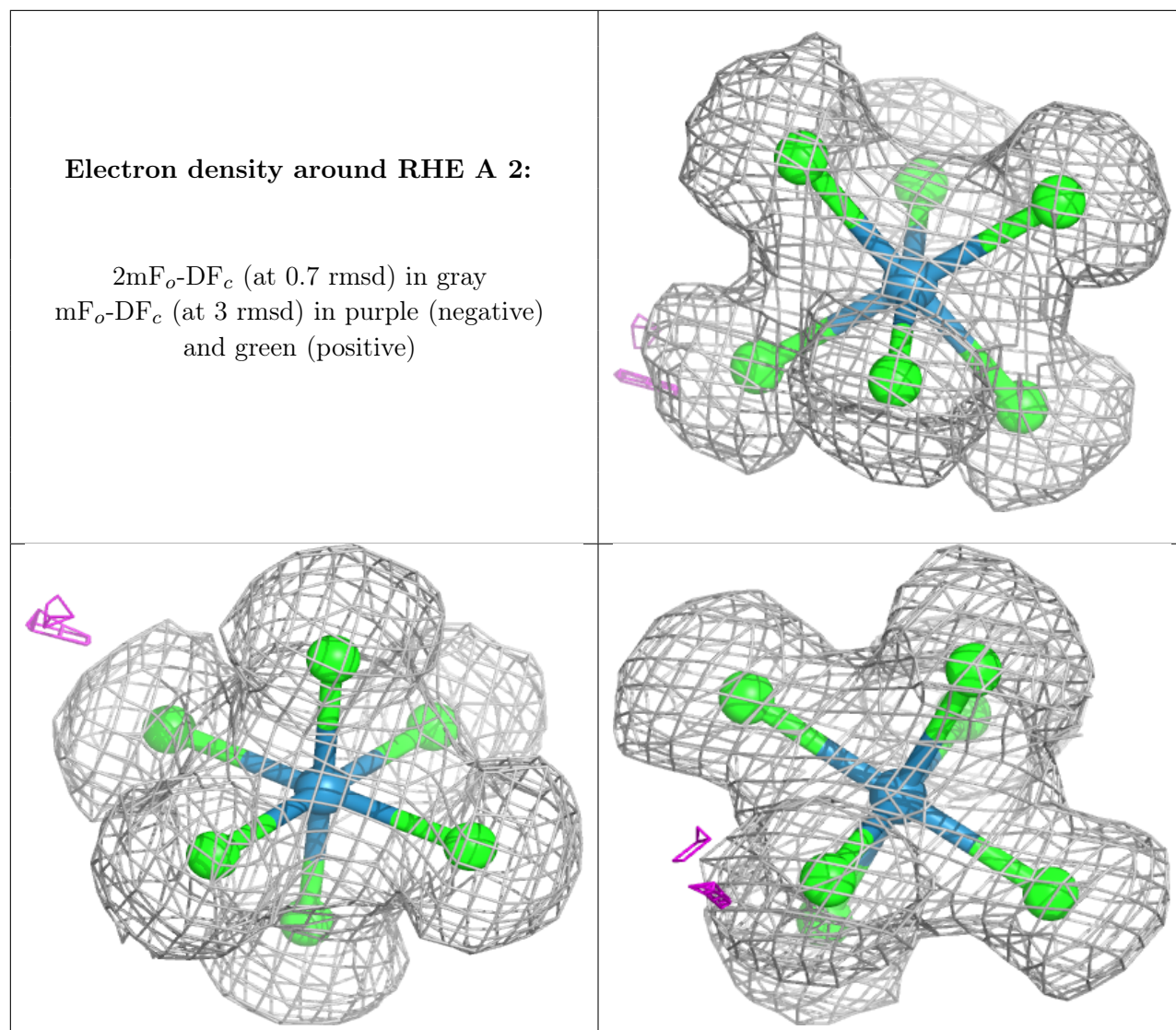
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around RHE A 1:

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





6.5 Other polymers ⓘ

There are no such residues in this entry.