wwPDB X-ray Structure Validation Summary Report (i)

May 21, 2020 – 08:27 pm BST

PDB ID	:	6IS2
Title	:	Crystal Structure of Staphylococcus aureus response regulator ArlR receiver domain in complex with Mg
Authors	:	Wen, Y.; Ouyang, Z.
Deposited on	:	2018-11-15
Resolution	:	1.59 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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

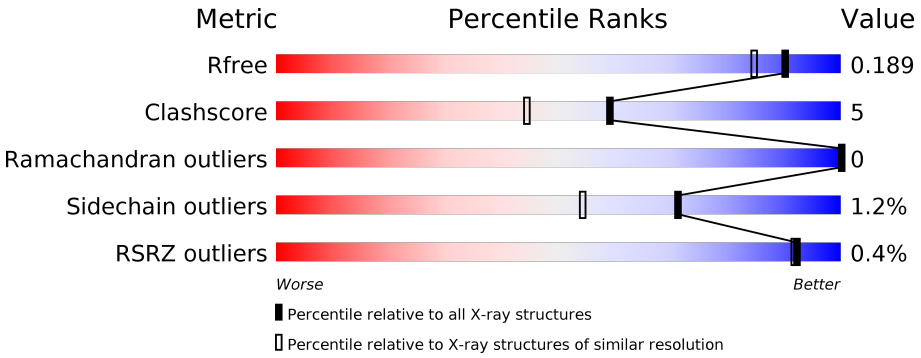
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (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 1.59 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	3398 (1.60-1.60)
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)
RSRZ outliers	127900	3321 (1.60-1.60)

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 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	128	85% 9% 5%
1	B	128	89% 5% 6%
1	C	128	81% 10% 9%
1	D	128	2% 88% 5% • 6%

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	SO4	A	302	-	-	X	-
4	EPE	C	302	-	-	X	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 8332 atoms, of which 3904 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 Response regulator ArlR.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	121	Total	C	H	N	O	S	0	0	0
			1959	623	977	164	193	2			
1	B	120	Total	C	H	N	O	S	0	0	0
			1942	617	970	161	192	2			
1	C	117	Total	C	H	N	O	S	0	1	0
			1922	609	965	158	188	2			
1	D	120	Total	C	H	N	O	S	0	0	0
			1942	617	970	161	192	2			

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP Q2YY03
A	-5	GLY	-	expression tag	UNP Q2YY03
A	-4	HIS	-	expression tag	UNP Q2YY03
A	-3	HIS	-	expression tag	UNP Q2YY03
A	-2	HIS	-	expression tag	UNP Q2YY03
A	-1	HIS	-	expression tag	UNP Q2YY03
A	0	HIS	-	expression tag	UNP Q2YY03
A	1	HIS	-	expression tag	UNP Q2YY03
B	-6	MET	-	initiating methionine	UNP Q2YY03
B	-5	GLY	-	expression tag	UNP Q2YY03
B	-4	HIS	-	expression tag	UNP Q2YY03
B	-3	HIS	-	expression tag	UNP Q2YY03
B	-2	HIS	-	expression tag	UNP Q2YY03
B	-1	HIS	-	expression tag	UNP Q2YY03
B	0	HIS	-	expression tag	UNP Q2YY03
B	1	HIS	-	expression tag	UNP Q2YY03
C	-6	MET	-	initiating methionine	UNP Q2YY03
C	-5	GLY	-	expression tag	UNP Q2YY03
C	-4	HIS	-	expression tag	UNP Q2YY03
C	-3	HIS	-	expression tag	UNP Q2YY03
C	-2	HIS	-	expression tag	UNP Q2YY03

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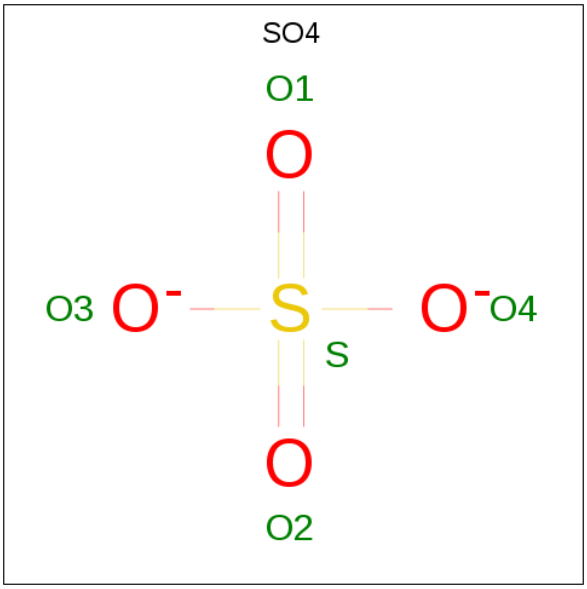
Chain	Residue	Modelled	Actual	Comment	Reference
C	-1	HIS	-	expression tag	UNP Q2YY03
C	0	HIS	-	expression tag	UNP Q2YY03
C	1	HIS	-	expression tag	UNP Q2YY03
D	-6	MET	-	initiating methionine	UNP Q2YY03
D	-5	GLY	-	expression tag	UNP Q2YY03
D	-4	HIS	-	expression tag	UNP Q2YY03
D	-3	HIS	-	expression tag	UNP Q2YY03
D	-2	HIS	-	expression tag	UNP Q2YY03
D	-1	HIS	-	expression tag	UNP Q2YY03
D	0	HIS	-	expression tag	UNP Q2YY03
D	1	HIS	-	expression tag	UNP Q2YY03

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg) (labeled as "Ligand of Interest" by author).

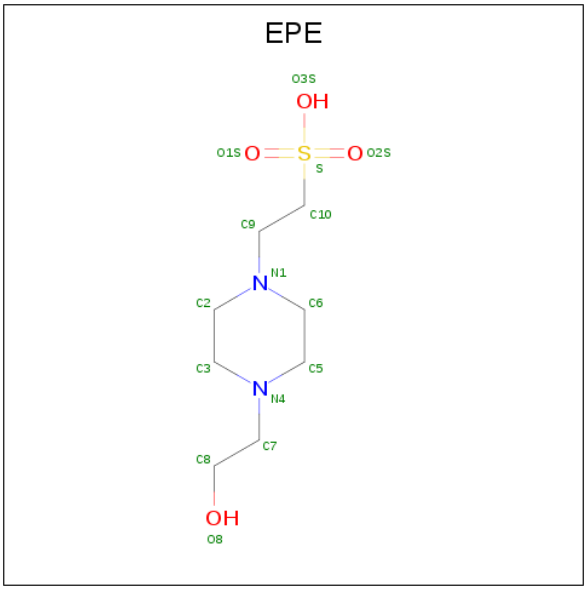
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Mg 1 1	0	0
2	A	1	Total Mg 1 1	0	0
2	D	1	Total Mg 1 1	0	0
2	C	1	Total Mg 1 1	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



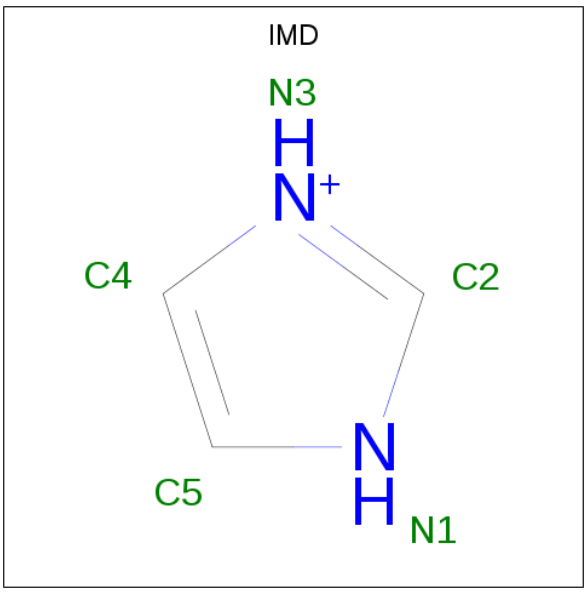
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0

- Molecule 4 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: $C_8H_{18}N_2O_4S$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	C	1	Total C H N O S 32 8 17 2 4 1	0	0

- Molecule 5 is IMIDAZOLE (three-letter code: IMD) (formula: $C_3H_5N_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	D	1	Total	C	H	N	0	0
			10	3	5	2		

- Molecule 6 is water.

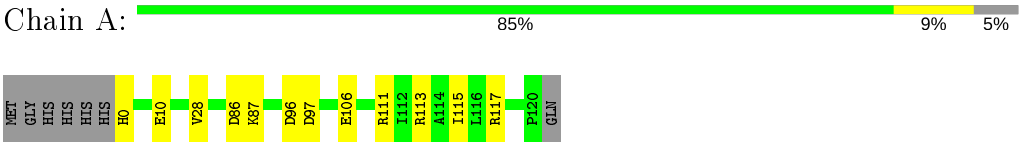
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	155	Total	O	0	0
			155	155		
6	B	135	Total	O	0	0
			135	135		
6	C	114	Total	O	0	0
			114	114		
6	D	112	Total	O	0	0
			112	112		

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.

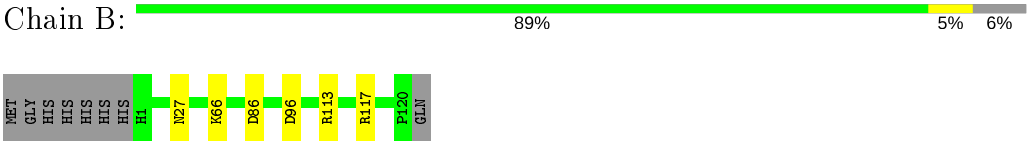
- Molecule 1: Response regulator ArlR

Chain A:



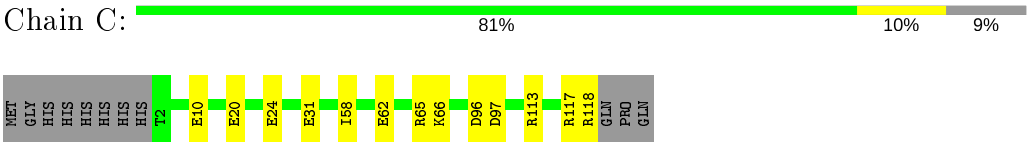
- Molecule 1: Response regulator ArlR

Chain B:



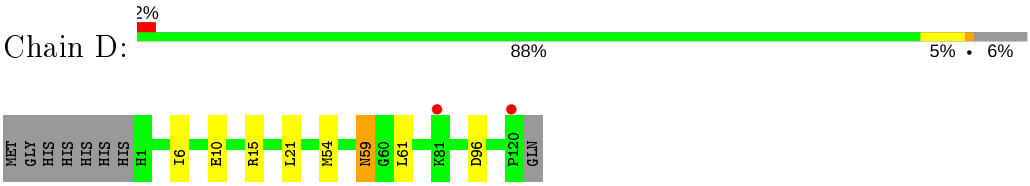
- Molecule 1: Response regulator ArlR

Chain C:



- Molecule 1: Response regulator ArlR

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	43.59Å 45.80Å 61.85Å 99.72° 102.26° 86.50°	Depositor
Resolution (Å)	31.70 – 1.59 45.12 – 1.59	Depositor EDS
% Data completeness (in resolution range)	94.2 (31.70-1.59) 94.2 (45.12-1.59)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.86 (at 1.59Å)	Xtriage
Refinement program	PHENIX (1.11.1_2575: ???)	Depositor
R, R_{free}	0.155 , 0.188 0.155 , 0.189	Depositor DCC
R_{free} test set	2008 reflections (3.44%)	wwPDB-VP
Wilson B-factor (Å^2)	18.8	Xtriage
Anisotropy	0.042	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 47.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	8332	wwPDB-VP
Average B, all atoms (Å^2)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.35% 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: MG, EPE, IMD, SO4

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	0.43	0/997	0.66	0/1352
1	B	0.46	0/986	0.67	0/1337
1	C	0.40	0/973	0.64	0/1317
1	D	0.43	0/986	0.60	0/1337
All	All	0.43	0/3942	0.64	0/5343

There are no bond length outliers.

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	982	977	979	13	0
1	B	972	970	972	5	0
1	C	957	965	965	12	0
1	D	972	970	972	5	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	5	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	C	15	17	17	14	0
5	D	5	5	5	2	0
6	A	155	0	0	6	0
6	B	135	0	0	2	0
6	C	114	0	0	4	1
6	D	112	0	0	2	1
All	All	4428	3904	3910	37	1

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.

The worst 5 of 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:A:0:HIS:N	6:A:401:HOH:O	1.97	0.83
1:C:96:ASP:O	4:C:302:EPE:O3S	2.06	0.74
1:B:86:ASP:OD2	6:B:402:HOH:O	2.08	0.71
1:A:96:ASP:O	4:C:302:EPE:H102	1.91	0.70
1:B:66:LYS:NZ	6:B:401:HOH:O	1.94	0.69

All (1) 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)
6:C:440:HOH:O	6:D:438:HOH:O[1_456]	1.87	0.33

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	119/128 (93%)	118 (99%)	1 (1%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	118/128 (92%)	117 (99%)	1 (1%)	0	100	100
1	C	116/128 (91%)	115 (99%)	1 (1%)	0	100	100
1	D	118/128 (92%)	117 (99%)	1 (1%)	0	100	100
All	All	471/512 (92%)	467 (99%)	4 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	108/115 (94%)	107 (99%)	1 (1%)	78	65
1	B	107/115 (93%)	107 (100%)	0	100	100
1	C	106/115 (92%)	104 (98%)	2 (2%)	57	34
1	D	107/115 (93%)	105 (98%)	2 (2%)	57	34
All	All	428/460 (93%)	423 (99%)	5 (1%)	71	54

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	10	GLU
1	C	10	GLU
1	C	58	ILE
1	D	10	GLU
1	D	59	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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)

Of 7 ligands modelled in this entry, 4 are monoatomic - leaving 3 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	$\#\|Z\| > 2$
5	IMD	D	302	-	3,5,5	0.45	0	4,5,5	0.44	0
4	EPE	C	302	-	15,15,15	0.69	0	18,20,20	2.24	6 (33%)
3	SO4	A	302	-	4,4,4	0.17	0	6,6,6	0.50	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	IMD	D	302	-	-	-	0/1/1/1
4	EPE	C	302	-	-	5/9/19/19	0/1/1/1

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	C	302	EPE	O3S-S-C10	-4.64	98.26	105.77
4	C	302	EPE	O1S-S-C10	4.40	112.22	106.92
4	C	302	EPE	C7-N4-C3	3.43	120.02	111.23
4	C	302	EPE	O2S-S-C10	3.33	110.92	106.92

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	C	302	EPE	C9-N1-C2	3.09	119.13	111.23

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	302	EPE	C10-C9-N1-C6
4	C	302	EPE	C9-C10-S-O2S
4	C	302	EPE	C9-C10-S-O3S
4	C	302	EPE	C10-C9-N1-C2
4	C	302	EPE	C9-C10-S-O1S

There are no ring outliers.

3 monomers are involved in 18 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	D	302	IMD	2	0
4	C	302	EPE	14	0
3	A	302	SO4	2	0

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, 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	121/128 (94%)	-0.57	0	100	100	12, 19, 48, 63	0
1	B	120/128 (93%)	-0.60	0	100	100	12, 19, 41, 55	0
1	C	117/128 (91%)	-0.53	0	100	100	14, 25, 47, 53	0
1	D	120/128 (93%)	-0.43	2 (1%)	70	69	14, 28, 56, 65	0
All	All	478/512 (93%)	-0.53	2 (0%)	92	92	12, 23, 48, 65	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	120	PRO	2.4
1	D	81	LYS	2.2

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

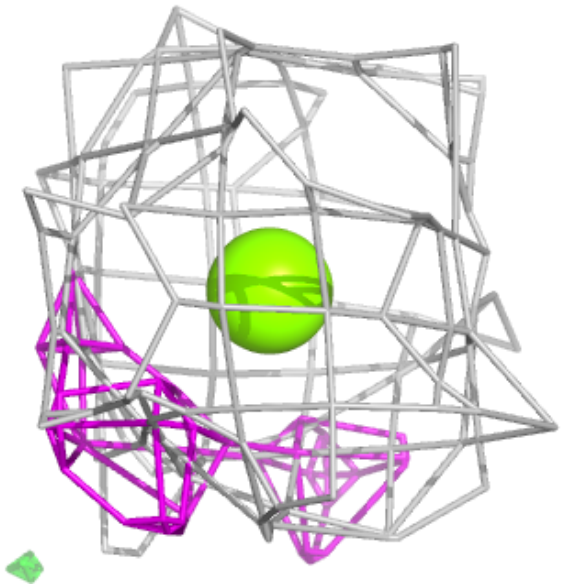
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

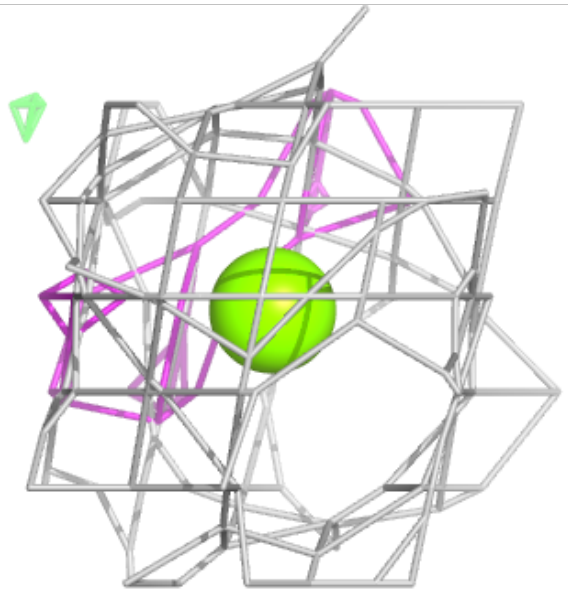
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
5	IMD	D	302	5/5	0.42	0.22	25,35,43,46	0
3	SO4	A	302	5/5	0.63	0.20	35,55,69,135	0
4	EPE	C	302	15/15	0.78	0.33	26,65,168,206	0
2	MG	D	301	1/1	0.97	0.12	38,38,38,38	0
2	MG	C	301	1/1	0.99	0.03	26,26,26,26	0
2	MG	B	301	1/1	0.99	0.10	22,22,22,22	0
2	MG	A	301	1/1	1.00	0.02	17,17,17,17	0

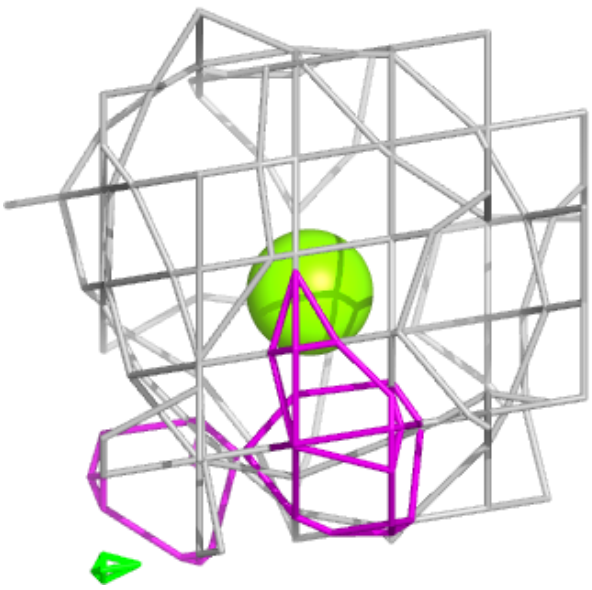
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around MG D 301:

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

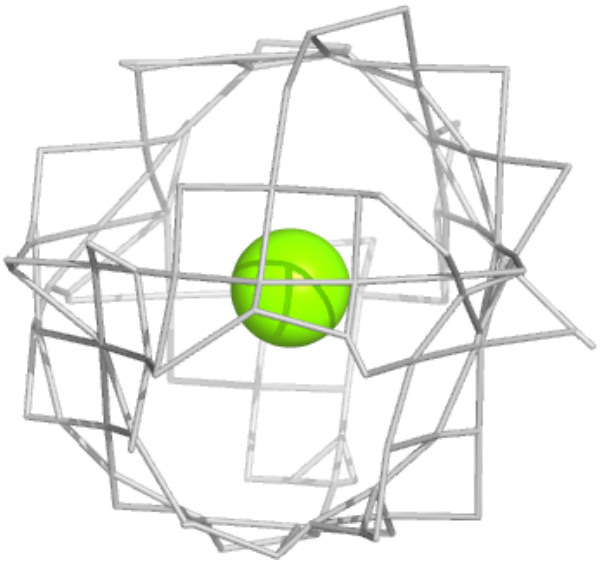


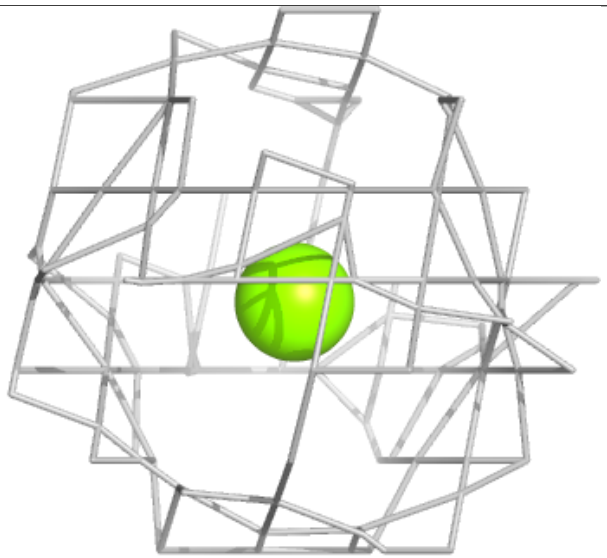


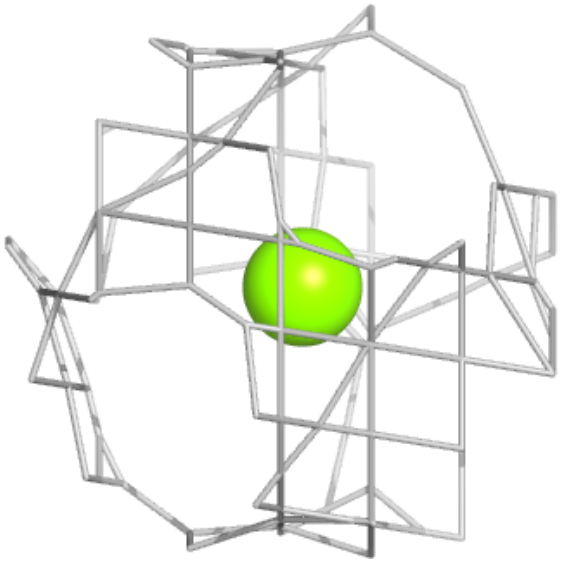


Electron density around MG C 301:

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

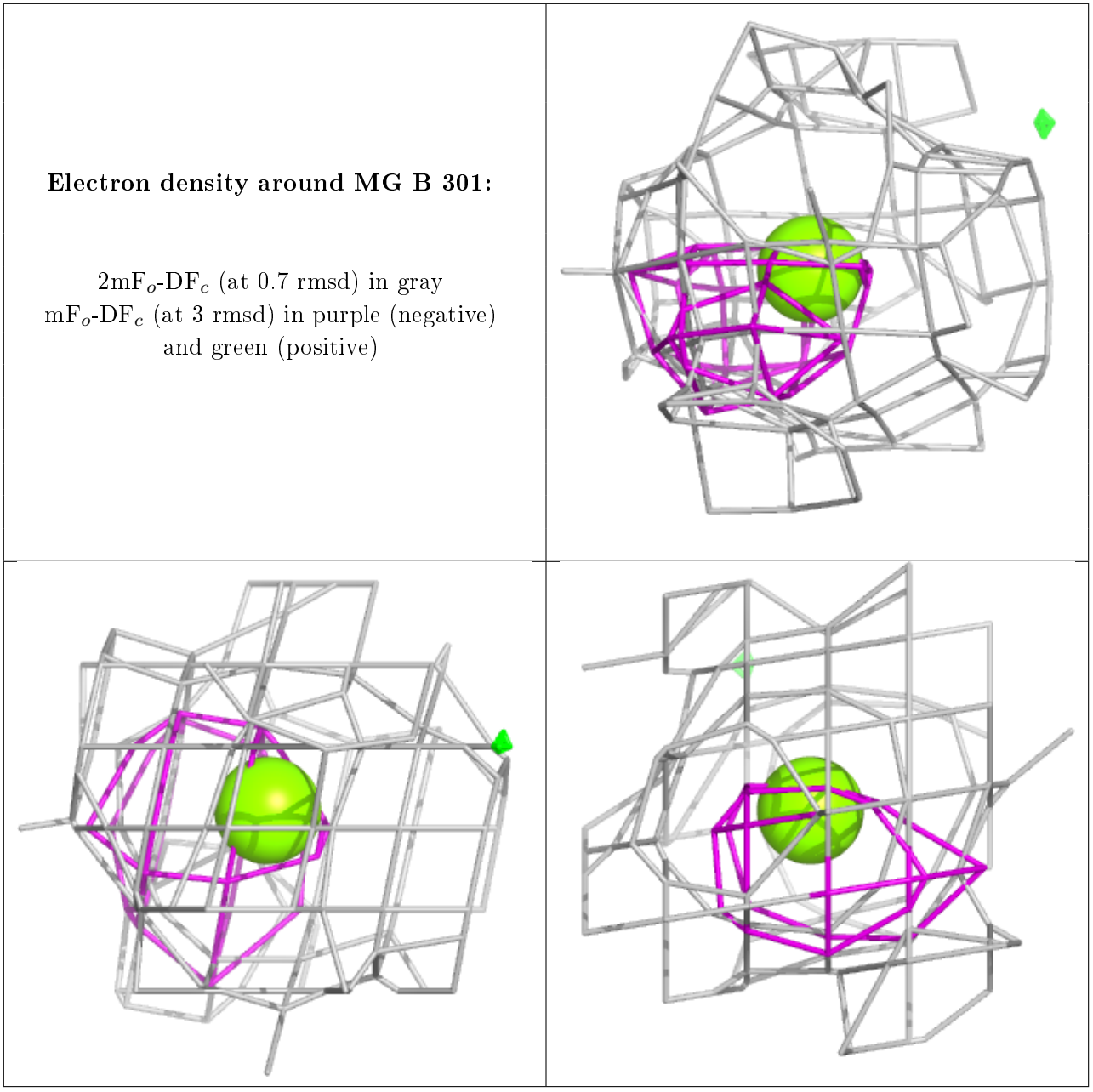






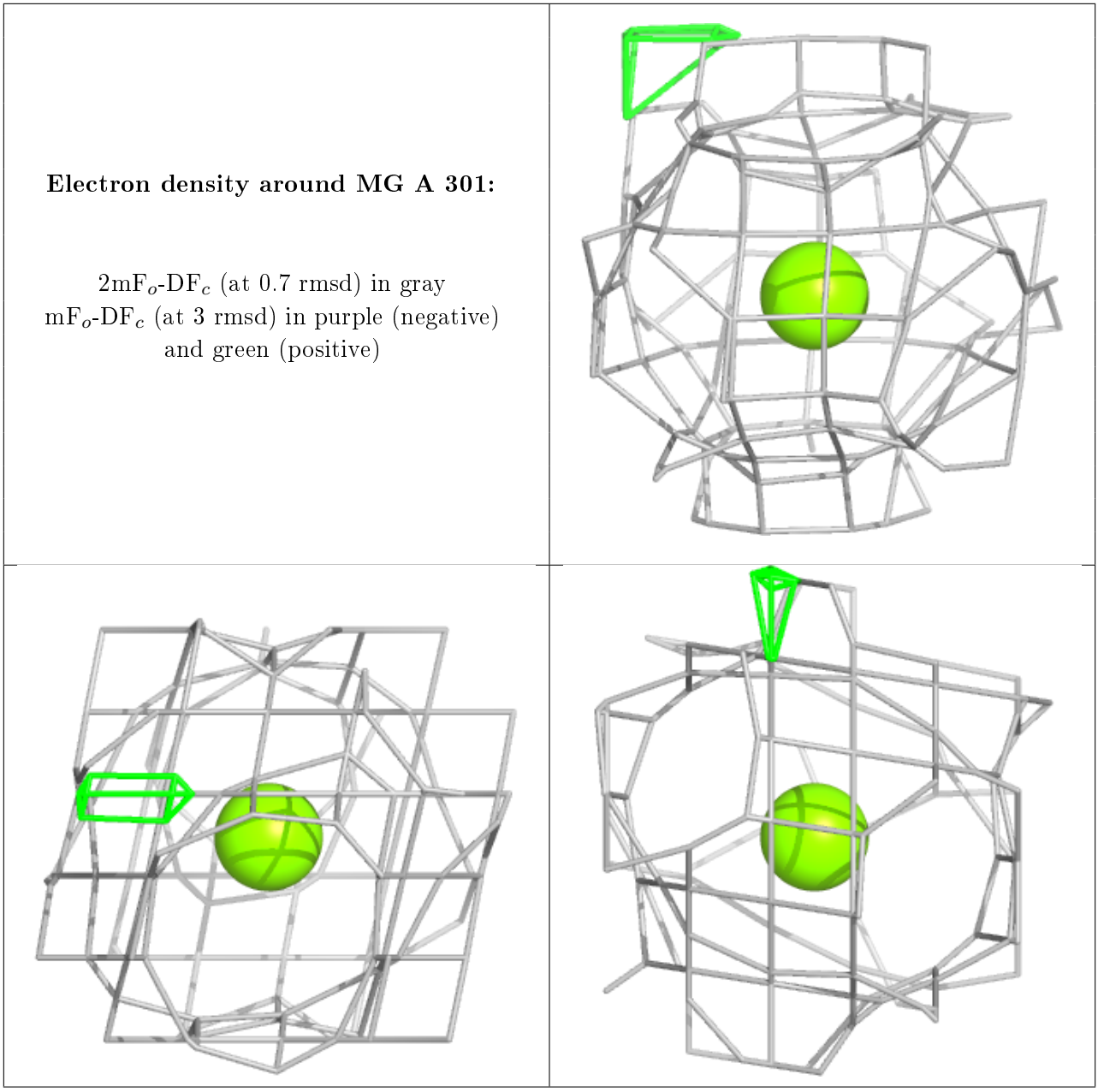
Electron density around MG B 301:

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



Electron density around MG A 301:

$2mF_o$-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.