WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

Nov 20, 2023 – 01:36 AM JST

PDB ID : 7CE5

Title : Methanol-PQQ bound methanol dehydrogenase (MDH) from Methylococcus capsulatus (Bath)

Authors : Chuankhayan, P.; Chan, S.I.; Nareddy, P.K.R.; Tsai, I.K.; Tsai, Y.F.; Chen, K.H.-C.; Yu, S.S.-F.; Chen, C.J.

Deposited on : 2020-06-22

Resolution : 1.80 Å(reported)

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

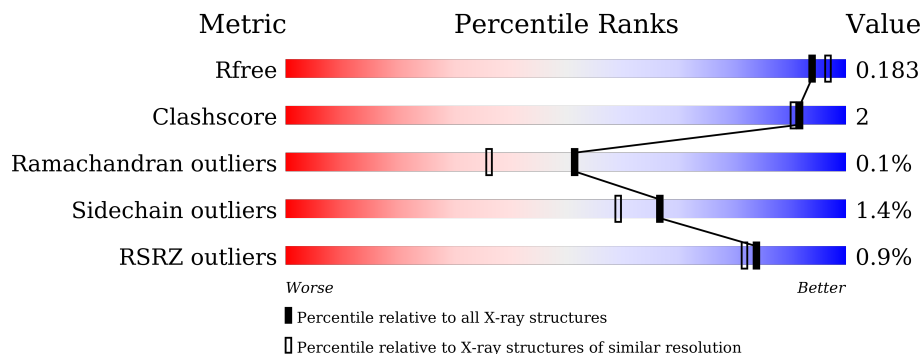|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 1.80 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.
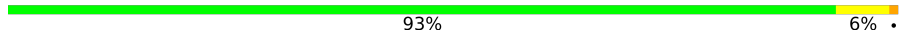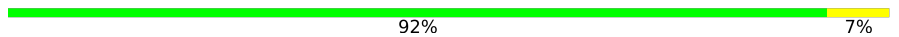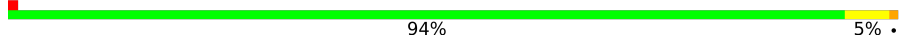
Metric	Percentile Ranks	Value
Rfree		0.183
Clashscore		2
Ramachandran outliers		0.1%
Sidechain outliers		1.4%
RSRZ outliers		0.9%

Worse   *Better*

▌Percentile relative to all X-ray structures

▯Percentile relative to X-ray structures of similar resolution
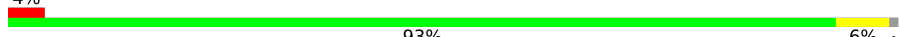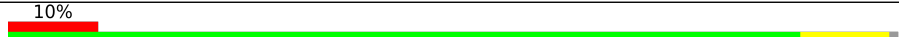
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	130704	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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 <=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	573	94% 6%
1	B	573	93% 6%
1	C	573	92% 7%
1	D	573	94% 5% •
1	G	573	94% 6%

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Mol	Chain	Length	Quality of chain
1	H	573	93% 6% ·
1	M	573	92% 7%
1	N	573	.% 94% 5% ·
2	E	72	.% 88% 11% ·
2	F	72	6% 90% 6% ··
2	I	72	4% 93% 6% ·
2	J	72	14% 93% 6% ·
2	K	72	3% 96% ··
2	L	72	.% 92% 6% ··
2	O	72	10% 85% 12% ··
2	P	72	10% 89% 10% ·

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
4	MOH	A	702	-	-	X	X
4	MOH	B	702	-	-	X	X
4	MOH	C	703	-	-	-	X
4	MOH	D	702	-	-	X	-
4	MOH	G	702	-	-	X	X
4	MOH	H	702	-	-	X	X
4	MOH	N	702	-	-	X	-

2 Entry composition ⓘ

There are 6 unique types of molecules in this entry. The entry contains 46034 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 Methanol dehydrogenase protein, large subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	573	Total 4491	C 2871	N 765	O 832	S 23	0	0	0
1	B	573	Total 4490	C 2871	N 765	O 831	S 23	0	0	0
1	C	573	Total 4491	C 2871	N 765	O 832	S 23	0	0	0
1	D	573	Total 4490	C 2871	N 765	O 831	S 23	0	0	0
1	G	573	Total 4491	C 2871	N 765	O 832	S 23	0	0	0
1	H	573	Total 4490	C 2871	N 765	O 831	S 23	0	0	0
1	M	573	Total 4491	C 2871	N 765	O 832	S 23	0	0	0
1	N	573	Total 4490	C 2871	N 765	O 831	S 23	0	0	0

- Molecule 2 is a protein called Methanol dehydrogenase [cytochrome c] subunit 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	F	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	I	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	J	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	K	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	L	71	Total 568	C 356	N 100	O 109	S 3	0	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	O	71	Total 568	C 356	N 100	O 109	S 3	0	0	0
2	P	71	Total 568	C 356	N 100	O 109	S 3	0	0	0

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total 1	Ca 1	0	0
3	B	1	Total 1	Ca 1	0	0
3	C	1	Total 1	Ca 1	0	0
3	D	1	Total 1	Ca 1	0	0
3	G	1	Total 1	Ca 1	0	0
3	H	1	Total 1	Ca 1	0	0
3	M	1	Total 1	Ca 1	0	0
3	N	1	Total 1	Ca 1	0	0

- Molecule 4 is METHANOL (three-letter code: MOH) (formula: CH_4O) (labeled as "Ligand of Interest" by depositor).
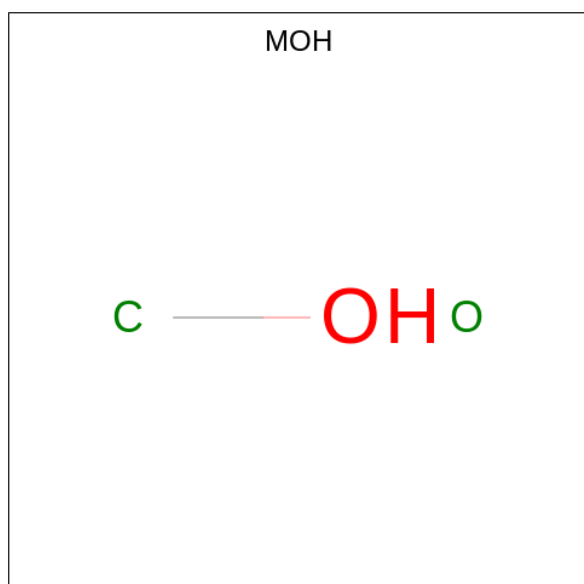
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total 2	C 1	O 1	0	0
4	B	1	Total 2	C 1	O 1	0	0
4	C	1	Total 2	C 1	O 1	0	0
4	D	1	Total 2	C 1	O 1	0	0
4	G	1	Total 2	C 1	O 1	0	0
4	H	1	Total 2	C 1	O 1	0	0
4	M	1	Total 2	C 1	O 1	0	0
4	N	1	Total 2	C 1	O 1	0	0

- Molecule 5 is PYRROLOQUINOLINE QUINONE (three-letter code: PQQ) (formula: $C_{14}H_6N_2O_8$) (labeled as "Ligand of Interest" by depositor).

PQQ
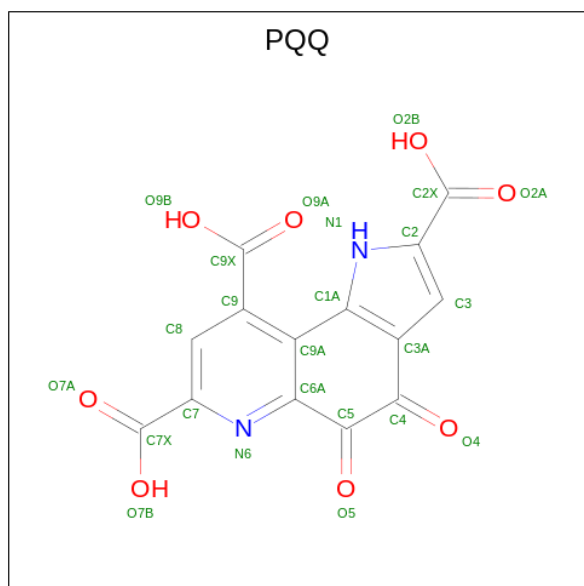
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total 24	C 14	N 2	O 8	0	0
5	B	1	Total 24	C 14	N 2	O 8	0	0
5	C	1	Total 24	C 14	N 2	O 8	0	0

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	D	1	Total	C	N	O	0	0
			24	14	2	8		
5	G	1	Total	C	N	O	0	0
			24	14	2	8		
5	H	1	Total	C	N	O	0	0
			24	14	2	8		
5	M	1	Total	C	N	O	0	0
			24	14	2	8		
5	N	1	Total	C	N	O	0	0
			24	14	2	8		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	580	Total	O	0	0
			580	580		
6	B	585	Total	O	0	0
			585	585		
6	C	590	Total	O	0	0
			590	590		
6	D	567	Total	O	0	0
			567	567		
6	E	113	Total	O	0	0
			113	113		
6	F	104	Total	O	0	0
			104	104		
6	G	598	Total	O	0	0
			598	598		
6	H	491	Total	O	0	0
			491	491		
6	I	106	Total	O	0	0
			106	106		
6	J	74	Total	O	0	0
			74	74		
6	K	109	Total	O	0	0
			109	109		
6	L	114	Total	O	0	0
			114	114		
6	M	590	Total	O	0	0
			590	590		
6	N	545	Total	O	0	0
			545	545		

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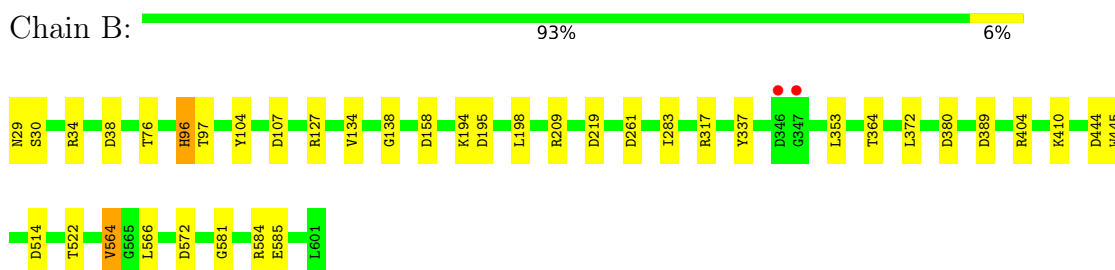| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	O	94	Total 94	O 94	0	0
6	P	90	Total 90	O 90	0	0

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 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.
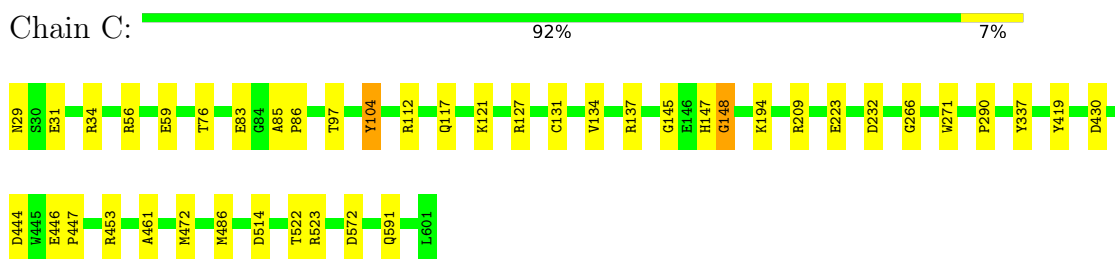
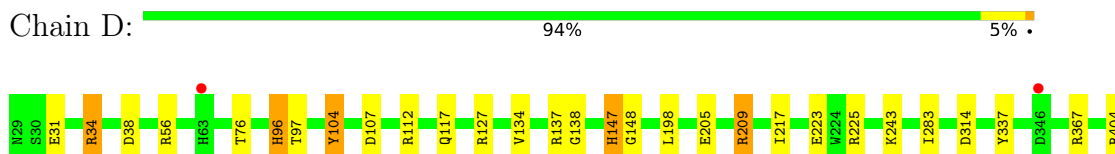• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain A:

• Molecule 1: Methanol dehydrogenase protein, large subunit
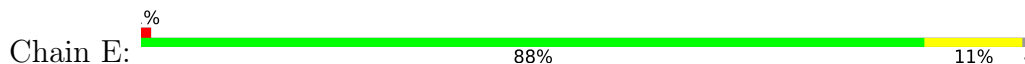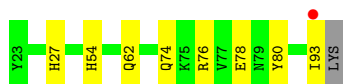
Chain B:

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain C:

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain D:

D444 D514 D569 D572 R584 Q591 L601

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain G: 94% 6%

N29 S30 D38 D39 R40 T76 E83 H96 T97 D110 K119 R127 V134 R137 G138 E170 K196 E223 W271 Y274 M282 R298 D314 R317 Y337 D346 G347 L353 T364 R367 D380 K386 R404 M405

D406 E425 D444 M472 D514 D572 E585 L601

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain H: 93% 6%

N29 R34 D38 R56 T76 G81 H96 T97 D110 R127 C131 V134 G145 E146 H147 G148 D158 L198 I217 D232 D240 K243 W271 K279 D314 Y337 D346 L353 R358 T364 D380 K387

K410 G418 D444 W445 M472 E489 R520 I538 K571 D572 R584 L601

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain M: 92% 7%

N29 S30 D38 R56 T76 T97 D107 D110 T111 R112 K113 M114 R127 R137 E146 K194 D195 D219 E233 K239 K243 W271 M282 R298 R317 A333 Y337 D346 L353 R358 T364 R367 K386

R404 D444 R453 M472 D514 R520 D521 T522 R523 K528 W561 V564 D572 R584 L601

• Molecule 1: Methanol dehydrogenase protein, large subunit

Chain N: % 94% 5%

N29 S30 E31 R34 L74 S75 T76 H96 T97 P98 V106 D107 R127 V134 R137 D179 L198 D232 K243 W271 K279 I283 R298 Y337 D346 G347 K348 L349 D380 K391 R404 K410 E425 D444 R453
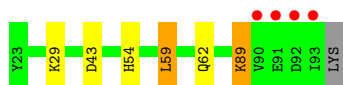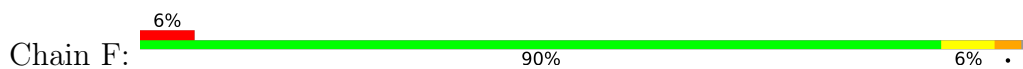
M472 D514 R520 K571 L601

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2
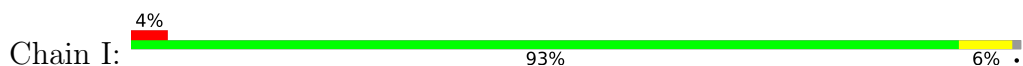
Chain E: % 88% 11%

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

Chain F:

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

Chain I:

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

Chain J:

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

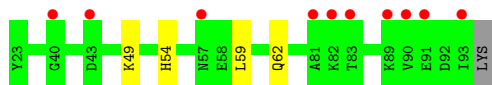
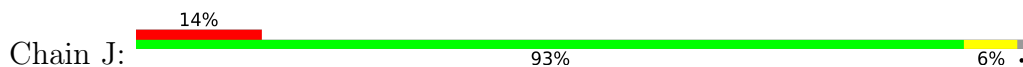
Chain K:

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2
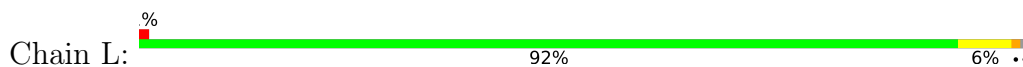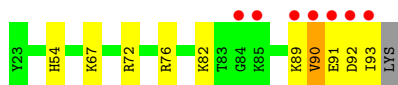

Chain L:
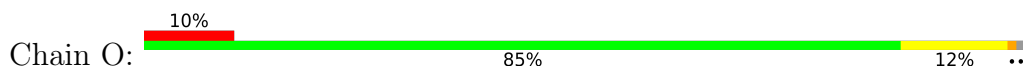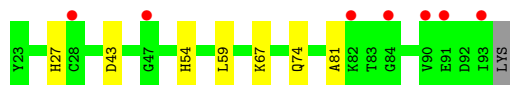

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

Chain O:

• Molecule 2: Methanol dehydrogenase [cytochrome c] subunit 2

Chain P:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	128.61Å 211.83Å 223.91Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	153.00 – 1.80 29.72 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.8 (153.00-1.80) 99.9 (29.72-1.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.10 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, R_{free}	0.140 , 0.170 0.154 , 0.183	Depositor DCC
R_{free} test set	27905 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å^2)	17.9	Xtriage
Anisotropy	0.028	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 45.4	EDS
L-test for twinning[2]	$< \lvert L \rvert > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	46034	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 1.75% 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 $< \lvert L \rvert >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5   Model quality (i)

5.1   Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: CA, PQQ, MOH

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	1.01	4/4622 (0.1%)	1.06	18/6281 (0.3%)
1	B	1.03	4/4621 (0.1%)	1.06	26/6281 (0.4%)
1	C	1.04	8/4622 (0.2%)	1.05	18/6281 (0.3%)
1	D	1.01	4/4621 (0.1%)	1.04	20/6281 (0.3%)
1	G	1.03	5/4622 (0.1%)	1.06	23/6281 (0.4%)
1	H	1.02	3/4621 (0.1%)	1.05	19/6281 (0.3%)
1	M	0.99	3/4622 (0.1%)	1.05	25/6281 (0.4%)
1	N	0.98	1/4621 (0.0%)	1.00	16/6281 (0.3%)
2	E	1.04	1/583 (0.2%)	0.97	1/785 (0.1%)
2	F	1.01	1/583 (0.2%)	0.99	2/785 (0.3%)
2	I	1.12	1/583 (0.2%)	0.97	2/785 (0.3%)
2	J	0.89	0/583	0.92	1/785 (0.1%)
2	K	1.09	2/583 (0.3%)	0.95	0/785
2	L	1.10	2/583 (0.3%)	0.96	0/785
2	O	1.02	0/583	1.04	2/785 (0.3%)
2	P	1.01	0/583	0.95	0/785
All	All	1.02	39/41636 (0.1%)	1.04	173/56528 (0.3%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	C	0	2
1	D	0	1
1	G	0	1
1	H	0	1
1	M	0	1
1	N	0	1

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Mol	Chain	#Chirality outliers	#Planarity outliers
2	O	0	1
All	All	0	9

The worst 5 of 39 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	104	TYR	CB-CG	-9.63	1.37	1.51
1	A	104	TYR	CE1-CZ	9.12	1.50	1.38
1	G	170	GLU	CD-OE1	8.97	1.35	1.25
1	C	148	GLY	N-CA	-8.96	1.32	1.46
1	B	104	TYR	CE1-CZ	8.77	1.50	1.38

The worst 5 of 173 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	147	HIS	C-N-CA	13.79	151.26	122.30
1	D	147	HIS	CA-C-N	12.30	140.80	116.20
1	D	147	HIS	C-N-CA	11.69	146.86	122.30
1	C	147	HIS	CA-C-N	11.65	139.51	116.20
1	H	147	HIS	CA-C-N	11.47	139.14	116.20

There are no chirality outliers.

5 of 9 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	137	ARG	Sidechain
1	C	131	CYS	Peptide
1	C	137	ARG	Sidechain
1	D	137	ARG	Sidechain
1	G	137	ARG	Sidechain

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	4491	0	4320	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	4490	0	4320	6	0
1	C	4491	0	4319	15	0
1	D	4490	0	4320	14	0
1	G	4491	0	4320	10	0
1	H	4490	0	4320	9	0
1	M	4491	0	4320	18	0
1	N	4490	0	4320	8	0
2	E	568	0	545	5	0
2	F	568	0	545	3	0
2	I	568	0	545	2	0
2	J	568	0	545	3	0
2	K	568	0	545	2	0
2	L	568	0	545	4	0
2	O	568	0	545	6	0
2	P	568	0	545	6	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	G	1	0	0	0	0
3	H	1	0	0	0	0
3	M	1	0	0	0	0
3	N	1	0	0	0	0
4	A	2	0	0	2	0
4	B	2	0	0	3	0
4	C	2	0	0	1	0
4	D	2	0	0	2	0
4	G	2	0	0	2	0
4	H	2	0	0	2	0
4	M	2	0	0	1	0
4	N	2	0	0	2	0
5	A	24	0	3	3	0
5	B	24	0	3	3	0
5	C	24	0	3	2	0
5	D	24	0	3	2	0
5	G	24	0	3	3	0
5	H	24	0	3	3	0
5	M	24	0	3	3	0
5	N	24	0	3	3	0
6	A	580	0	0	2	0
6	B	585	0	0	2	0
6	C	590	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	D	567	0	0	3	0
6	E	113	0	0	2	0
6	F	104	0	0	0	0
6	G	598	0	0	4	0
6	H	491	0	0	2	0
6	I	106	0	0	0	0
6	J	74	0	0	1	0
6	K	109	0	0	0	0
6	L	114	0	0	0	0
6	M	590	0	0	8	0
6	N	545	0	0	7	0
6	O	94	0	0	2	0
6	P	90	0	0	3	0
All	All	46034	0	38943	125	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 2.

The worst 5 of 125 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:P:74:GLN:HG2	6:P:174:HOH:O	1.49	1.10
4:M:702:MOH:O	5:M:703:PQQ:C5	2.06	1.03
1:M:114:MET:HE2	6:M:856:HOH:O	1.62	1.00
4:B:702:MOH:O	5:B:703:PQQ:C5	2.11	0.99
4:H:702:MOH:O	5:H:703:PQQ:C5	2.11	0.99

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	571/573 (100%)	543 (95%)	28 (5%)	0	100	100
1	B	571/573 (100%)	546 (96%)	24 (4%)	1 (0%)	47	33
1	C	571/573 (100%)	543 (95%)	27 (5%)	1 (0%)	47	33
1	D	571/573 (100%)	541 (95%)	29 (5%)	1 (0%)	47	33
1	G	571/573 (100%)	546 (96%)	24 (4%)	1 (0%)	47	33
1	H	571/573 (100%)	541 (95%)	29 (5%)	1 (0%)	47	33
1	M	571/573 (100%)	542 (95%)	29 (5%)	0	100	100
1	N	571/573 (100%)	540 (95%)	30 (5%)	1 (0%)	47	33
2	E	69/72 (96%)	69 (100%)	0	0	100	100
2	F	69/72 (96%)	69 (100%)	0	0	100	100
2	I	69/72 (96%)	69 (100%)	0	0	100	100
2	J	69/72 (96%)	68 (99%)	1 (1%)	0	100	100
2	K	69/72 (96%)	69 (100%)	0	0	100	100
2	L	69/72 (96%)	69 (100%)	0	0	100	100
2	O	69/72 (96%)	67 (97%)	2 (3%)	0	100	100
2	P	69/72 (96%)	69 (100%)	0	0	100	100
All	All	5120/5160 (99%)	4891 (96%)	223 (4%)	6 (0%)	51	36

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	134	VAL
1	D	134	VAL
1	N	134	VAL
1	B	134	VAL
1	C	134	VAL

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	464/464 (100%)	456 (98%)	8 (2%)	60	51
1	B	464/464 (100%)	458 (99%)	6 (1%)	69	62
1	C	464/464 (100%)	459 (99%)	5 (1%)	73	68
1	D	464/464 (100%)	460 (99%)	4 (1%)	78	75
1	G	464/464 (100%)	462 (100%)	2 (0%)	91	89
1	H	464/464 (100%)	457 (98%)	7 (2%)	65	56
1	M	464/464 (100%)	458 (99%)	6 (1%)	69	62
1	N	464/464 (100%)	457 (98%)	7 (2%)	65	56
2	E	60/61 (98%)	59 (98%)	1 (2%)	60	51
2	F	60/61 (98%)	56 (93%)	4 (7%)	16	5
2	I	60/61 (98%)	59 (98%)	1 (2%)	60	51
2	J	60/61 (98%)	59 (98%)	1 (2%)	60	51
2	K	60/61 (98%)	60 (100%)	0	100	100
2	L	60/61 (98%)	58 (97%)	2 (3%)	38	23
2	O	60/61 (98%)	57 (95%)	3 (5%)	24	10
2	P	60/61 (98%)	58 (97%)	2 (3%)	38	23
All	All	4192/4200 (100%)	4133 (99%)	59 (1%)	67	59

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	337	TYR
2	O	91	GLU
1	H	445	TRP
2	O	89	LYS
1	N	337	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 33 such sidechains are listed below:

Mol	Chain	Res	Type
1	N	216	ASN
1	N	464	ASN
2	P	54	HIS
2	E	74	GLN
2	E	54	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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 24 ligands modelled in this entry, 8 are monoatomic - leaving 16 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	$\#|Z| > 2$
4	MOH	N	702	-	1,1,1	0.05	0	-		
5	PQQ	C	702	3	23,26,26	1.85	6 (26%)	29,40,40	2.21	7 (24%)
5	PQQ	H	703	3	23,26,26	1.71	7 (30%)	29,40,40	2.17	9 (31%)
5	PQQ	A	703	3	23,26,26	1.66	5 (21%)	29,40,40	2.32	7 (24%)
4	MOH	A	702	-	1,1,1	0.04	0	-		
4	MOH	G	702	-	1,1,1	0.07	0	-		
4	MOH	D	702	-	1,1,1	0.01	0	-		
5	PQQ	G	703	3	23,26,26	1.41	5 (21%)	29,40,40	2.51	12 (41%)
5	PQQ	B	703	3	23,26,26	1.45	3 (13%)	29,40,40	2.19	11 (37%)
4	MOH	H	702	-	1,1,1	0.09	0	-		
4	MOH	B	702	-	1,1,1	0.15	0	-		
4	MOH	M	702	-	1,1,1	0.30	0	-		
5	PQQ	M	703	3	23,26,26	1.78	4 (17%)	29,40,40	2.04	4 (13%)
5	PQQ	N	703	3	23,26,26	2.23	8 (34%)	29,40,40	2.26	9 (31%)
5	PQQ	D	703	3	23,26,26	1.84	5 (21%)	29,40,40	2.36	8 (27%)
4	MOH	C	703	-	1,1,1	0.02	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	PQQ	C	702	3	-	0/10/28/28	0/3/3/3
5	PQQ	H	703	3	-	0/10/28/28	0/3/3/3
5	PQQ	A	703	3	-	0/10/28/28	0/3/3/3
5	PQQ	G	703	3	-	4/10/28/28	0/3/3/3
5	PQQ	B	703	3	-	4/10/28/28	0/3/3/3
5	PQQ	M	703	3	-	0/10/28/28	0/3/3/3
5	PQQ	N	703	3	-	4/10/28/28	0/3/3/3
5	PQQ	D	703	3	-	0/10/28/28	0/3/3/3

The worst 5 of 43 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	N	703	PQQ	C6A-N6	6.40	1.37	1.32
5	M	703	PQQ	C6A-C9A	4.96	1.48	1.42
5	N	703	PQQ	C6A-C9A	4.48	1.47	1.42
5	H	703	PQQ	C6A-N6	4.35	1.36	1.32
5	D	703	PQQ	C2-C2X	-4.20	1.44	1.50

The worst 5 of 67 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	D	703	PQQ	C9-C9A-C1A	8.28	129.68	122.88
5	A	703	PQQ	C9-C9A-C1A	7.85	129.32	122.88
5	C	702	PQQ	C9-C9A-C1A	7.09	128.69	122.88
5	M	703	PQQ	C9-C9A-C1A	7.05	128.66	122.88
5	G	703	PQQ	C9-C9A-C1A	6.44	128.16	122.88

There are no chirality outliers.

5 of 12 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	B	703	PQQ	C9A-C9-C9X-O9B
5	G	703	PQQ	C9A-C9-C9X-O9B
5	N	703	PQQ	C9A-C9-C9X-O9B
5	B	703	PQQ	C9A-C9-C9X-O9A
5	G	703	PQQ	C9A-C9-C9X-O9A

There are no ring outliers.

16 monomers are involved in 22 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	N	702	MOH	2	0
5	C	702	PQQ	2	0
5	H	703	PQQ	3	0
5	A	703	PQQ	3	0
4	A	702	MOH	2	0
4	G	702	MOH	2	0
4	D	702	MOH	2	0
5	G	703	PQQ	3	0
5	B	703	PQQ	3	0
4	H	702	MOH	2	0
4	B	702	MOH	3	0
4	M	702	MOH	1	0
5	M	703	PQQ	3	0
5	N	703	PQQ	3	0
5	D	703	PQQ	2	0
4	C	703	MOH	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 MOH N 702

Bond lengths   Bond angles

Torsions   Rings

Ligand PQQ C 702

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ H 703

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ A 703

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH A 702

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH G 702

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH D 702

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ G 703

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ B 703

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH H 702

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH B 702

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH M 702

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ M 703

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ N 703

Bond lengths

Bond angles

Torsions

Rings

Ligand PQQ D 703

Bond lengths

Bond angles

Torsions

Rings

Ligand MOH C 703

Bond lengths

Bond angles

Torsions

Rings

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, 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	573/573 (100%)	-0.48	1 (0%)	95	93	11, 16, 28, 45	0
1	B	573/573 (100%)	-0.44	2 (0%)	94	92	11, 15, 28, 43	0
1	C	573/573 (100%)	-0.51	0	100	100	11, 15, 25, 43	0
1	D	573/573 (100%)	-0.46	2 (0%)	94	92	11, 16, 27, 48	0
1	G	573/573 (100%)	-0.51	2 (0%)	94	92	11, 15, 25, 40	0
1	H	573/573 (100%)	-0.36	2 (0%)	94	92	12, 20, 32, 52	0
1	M	573/573 (100%)	-0.50	1 (0%)	95	93	11, 15, 26, 42	0
1	N	573/573 (100%)	-0.40	3 (0%)	91	89	12, 19, 30, 46	0
2	E	71/72 (98%)	-0.05	1 (1%)	75	72	16, 22, 38, 49	0
2	F	71/72 (98%)	-0.14	4 (5%)	24	19	14, 21, 47, 90	0
2	I	71/72 (98%)	-0.14	3 (4%)	36	30	14, 20, 40, 51	0
2	J	71/72 (98%)	0.58	10 (14%)	2	1	23, 32, 51, 65	0
2	K	71/72 (98%)	-0.16	2 (2%)	53	47	14, 20, 34, 46	0
2	L	71/72 (98%)	-0.18	1 (1%)	75	72	16, 22, 36, 51	0
2	O	71/72 (98%)	0.16	7 (9%)	7	5	15, 22, 65, 95	0
2	P	71/72 (98%)	0.37	7 (9%)	7	5	21, 28, 47, 57	0
All	All	5152/5160 (99%)	-0.40	48 (0%)	84	82	11, 17, 32, 95	0

The worst 5 of 48 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	93	ILE	7.7
2	O	92	ASP	7.3
2	O	93	ILE	6.8
2	O	90	VAL	6.2
2	F	92	ASP	4.5

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 monosaccharides 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, 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
4	MOH	H	702	2/2	0.34	0.66	64,64,64,72	0
4	MOH	G	702	2/2	0.42	0.57	43,43,43,54	0
4	MOH	B	702	2/2	0.57	0.74	50,50,50,56	0
4	MOH	A	702	2/2	0.61	0.54	67,67,67,74	0
4	MOH	D	702	2/2	0.70	0.36	56,56,56,59	0
4	MOH	M	702	2/2	0.72	0.39	42,42,42,45	0
4	MOH	C	703	2/2	0.73	0.41	44,44,44,53	0
4	MOH	N	702	2/2	0.74	0.27	48,48,48,49	0
5	PQQ	H	703	24/24	0.96	0.07	16,18,21,22	0
5	PQQ	A	703	24/24	0.97	0.07	12,15,19,21	0
5	PQQ	C	702	24/24	0.97	0.07	13,15,19,22	0
5	PQQ	D	703	24/24	0.97	0.06	13,14,17,19	0
5	PQQ	G	703	24/24	0.97	0.07	13,15,18,20	0
3	CA	H	701	1/1	0.97	0.10	45,45,45,45	0
5	PQQ	M	703	24/24	0.97	0.07	12,15,17,19	0
5	PQQ	N	703	24/24	0.97	0.07	14,16,19,20	0
3	CA	M	701	1/1	0.98	0.15	40,40,40,40	0
5	PQQ	B	703	24/24	0.98	0.07	12,14,16,17	0
3	CA	G	701	1/1	0.98	0.15	44,44,44,44	0
3	CA	A	701	1/1	0.98	0.16	41,41,41,41	0
3	CA	C	701	1/1	0.99	0.21	42,42,42,42	0
3	CA	D	701	1/1	0.99	0.13	43,43,43,43	0
3	CA	B	701	1/1	0.99	0.12	42,42,42,42	0
3	CA	N	701	1/1	1.00	0.16	51,51,51,51	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.
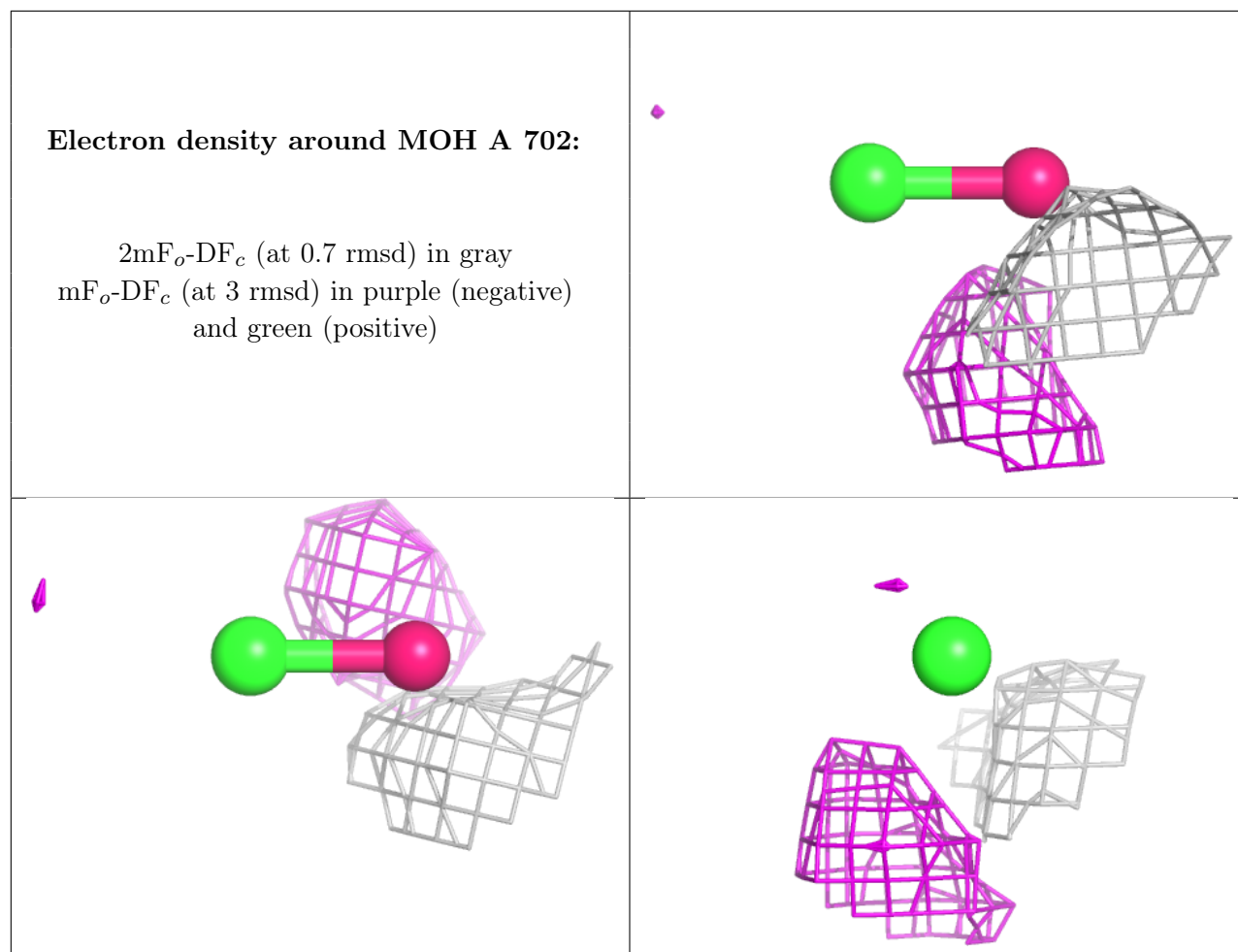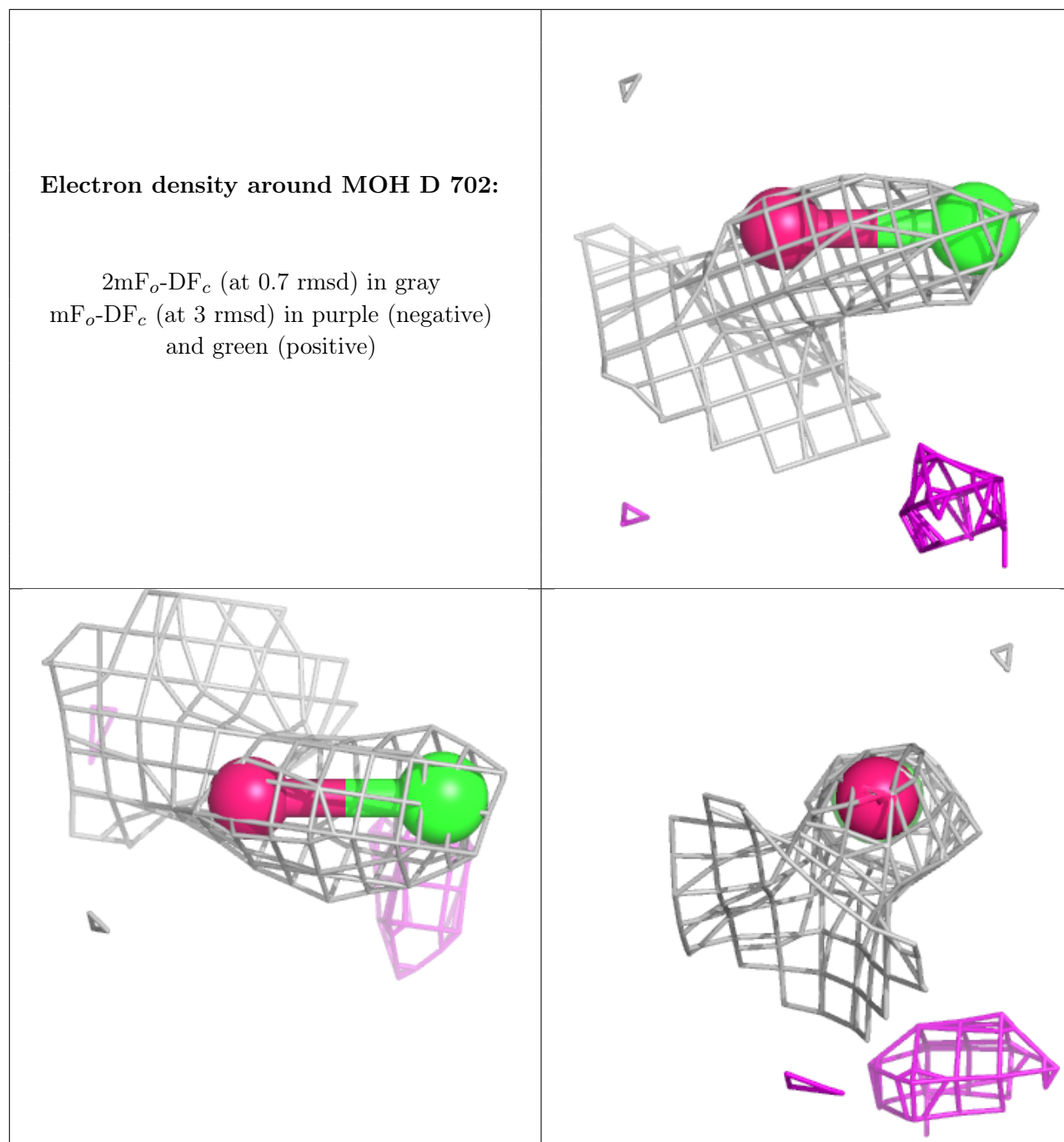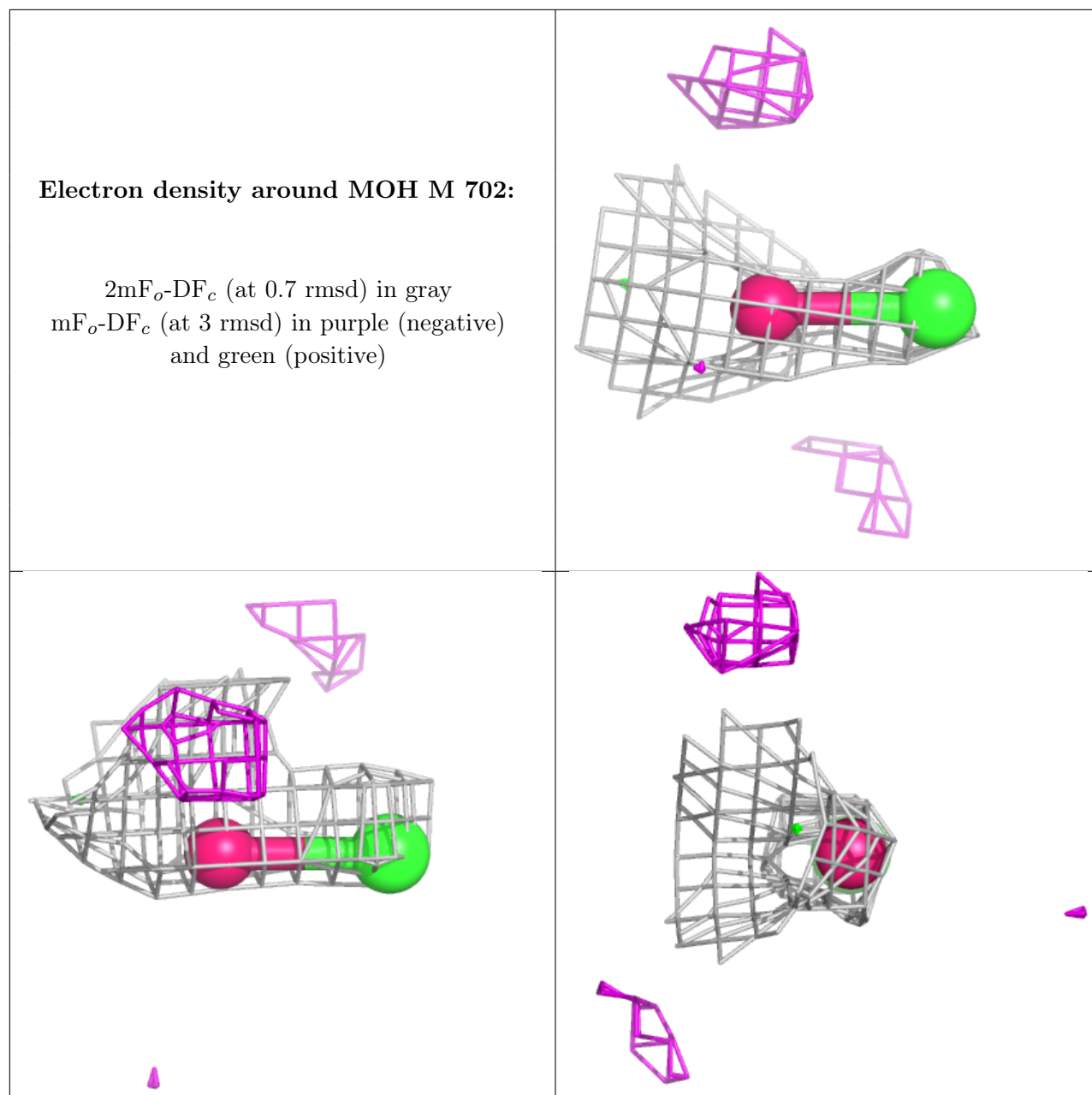

Electron density around MOH H 702:

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

Electron density around MOH G 702:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
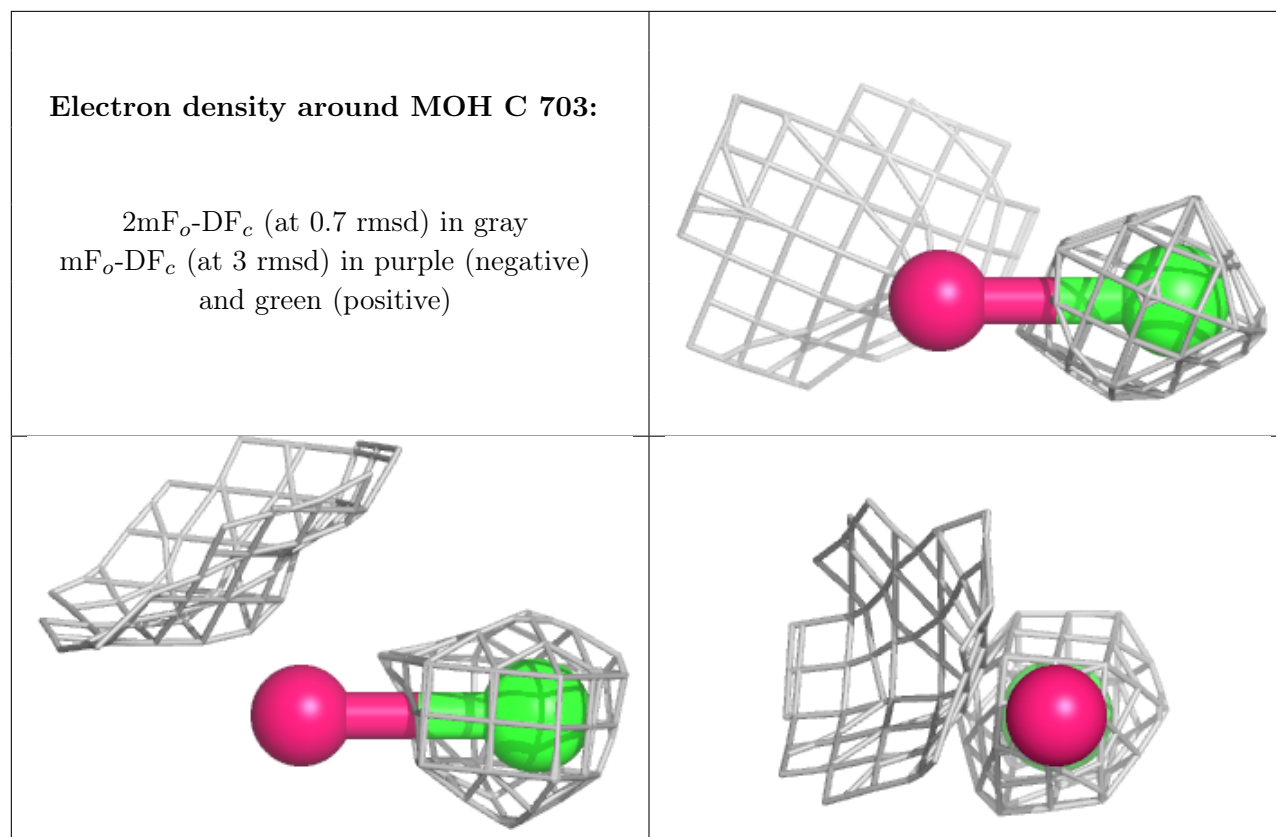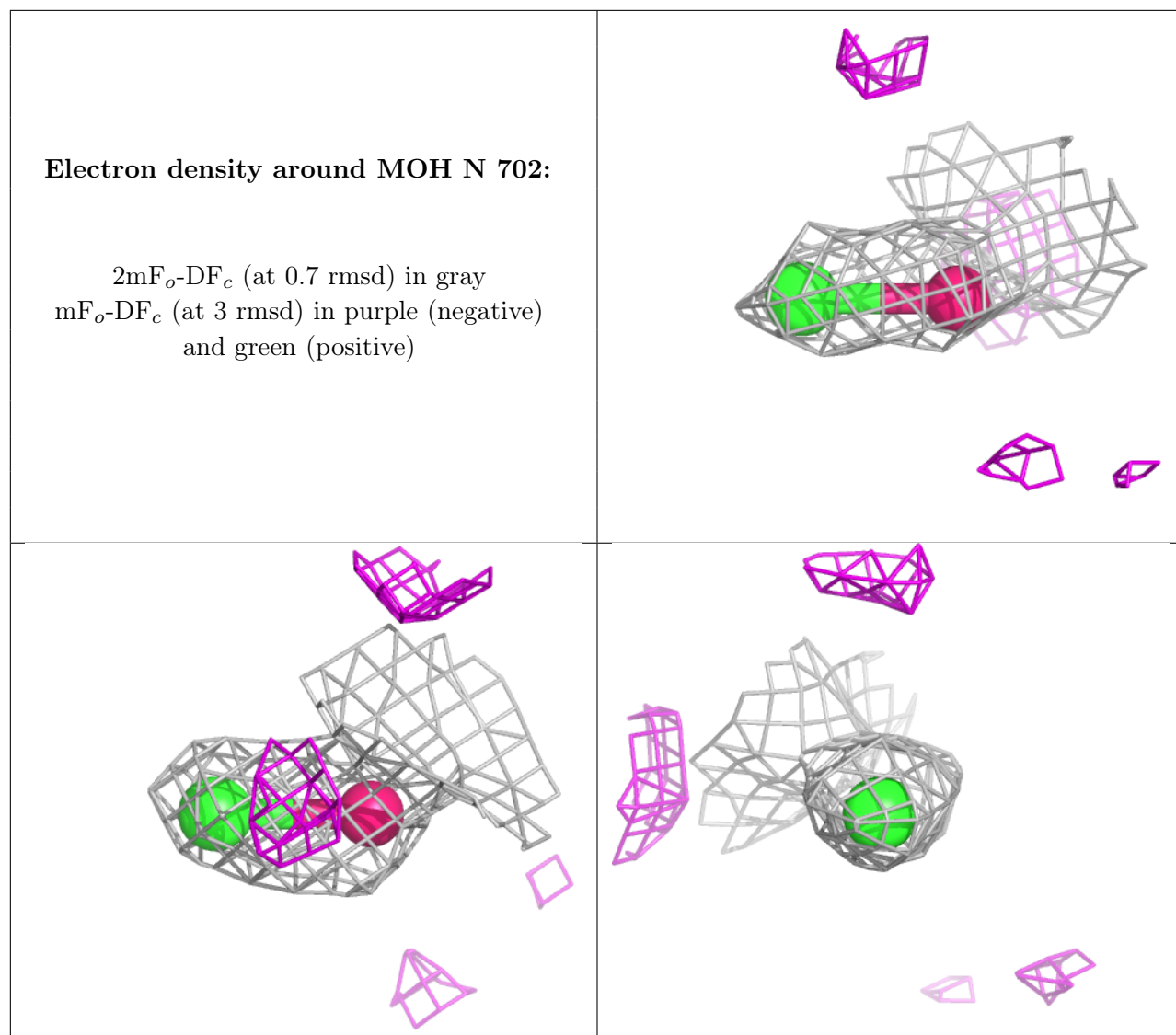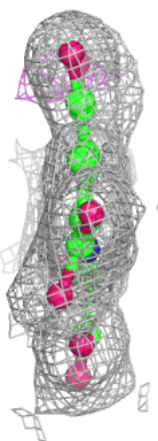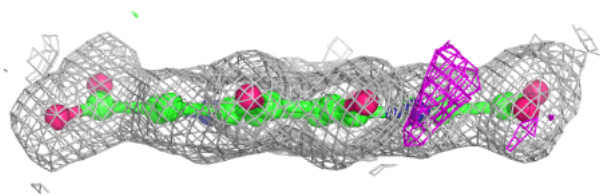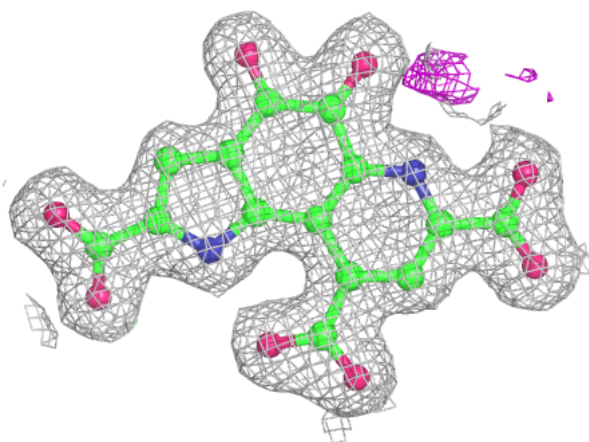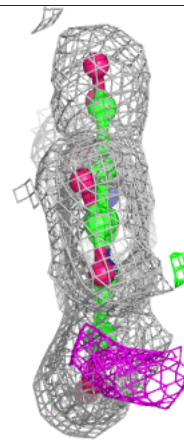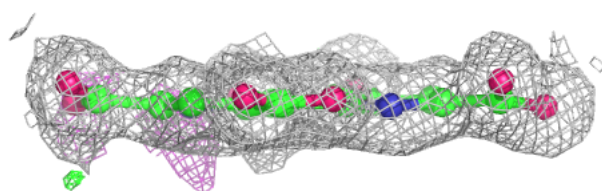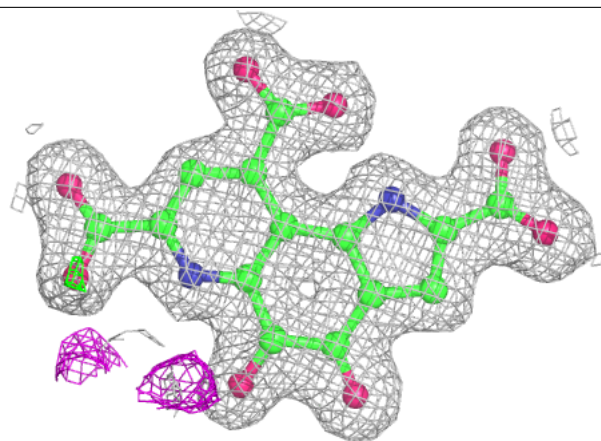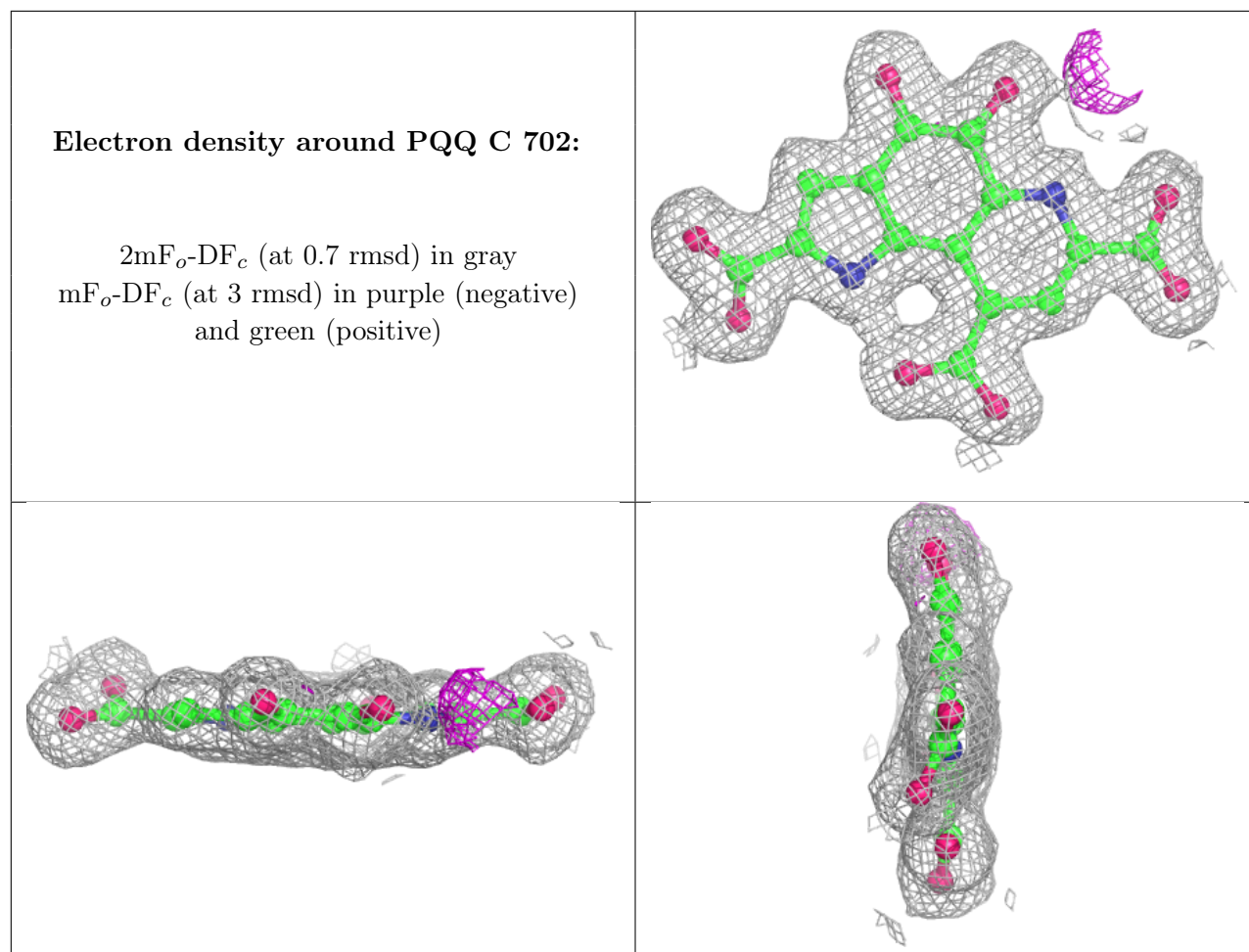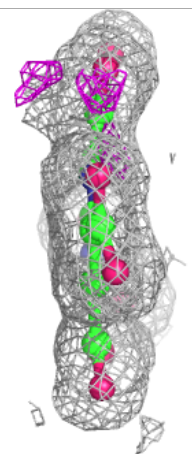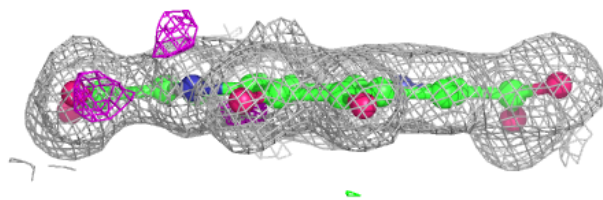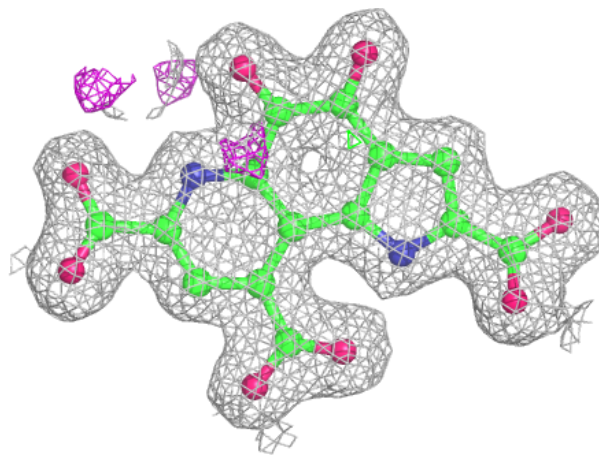mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
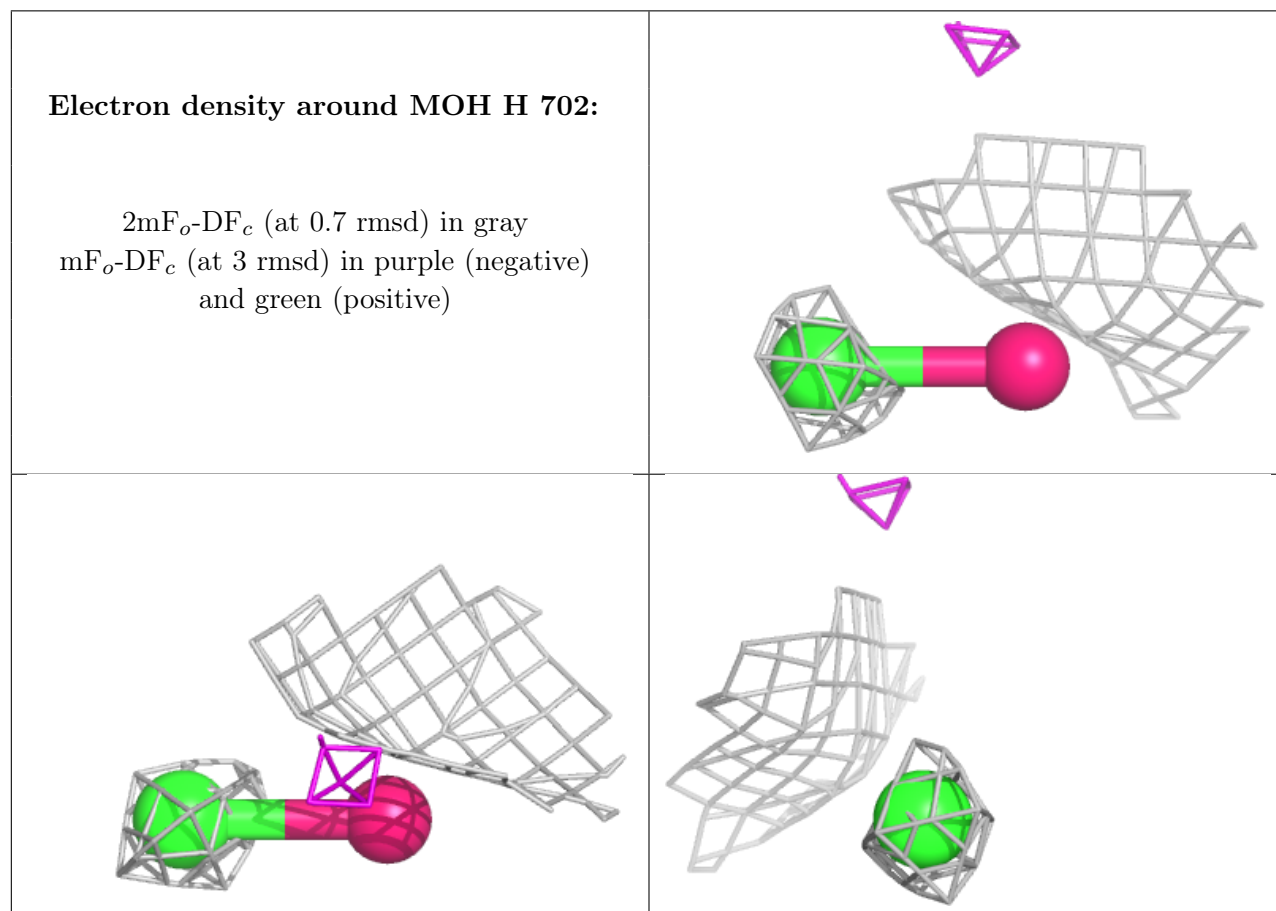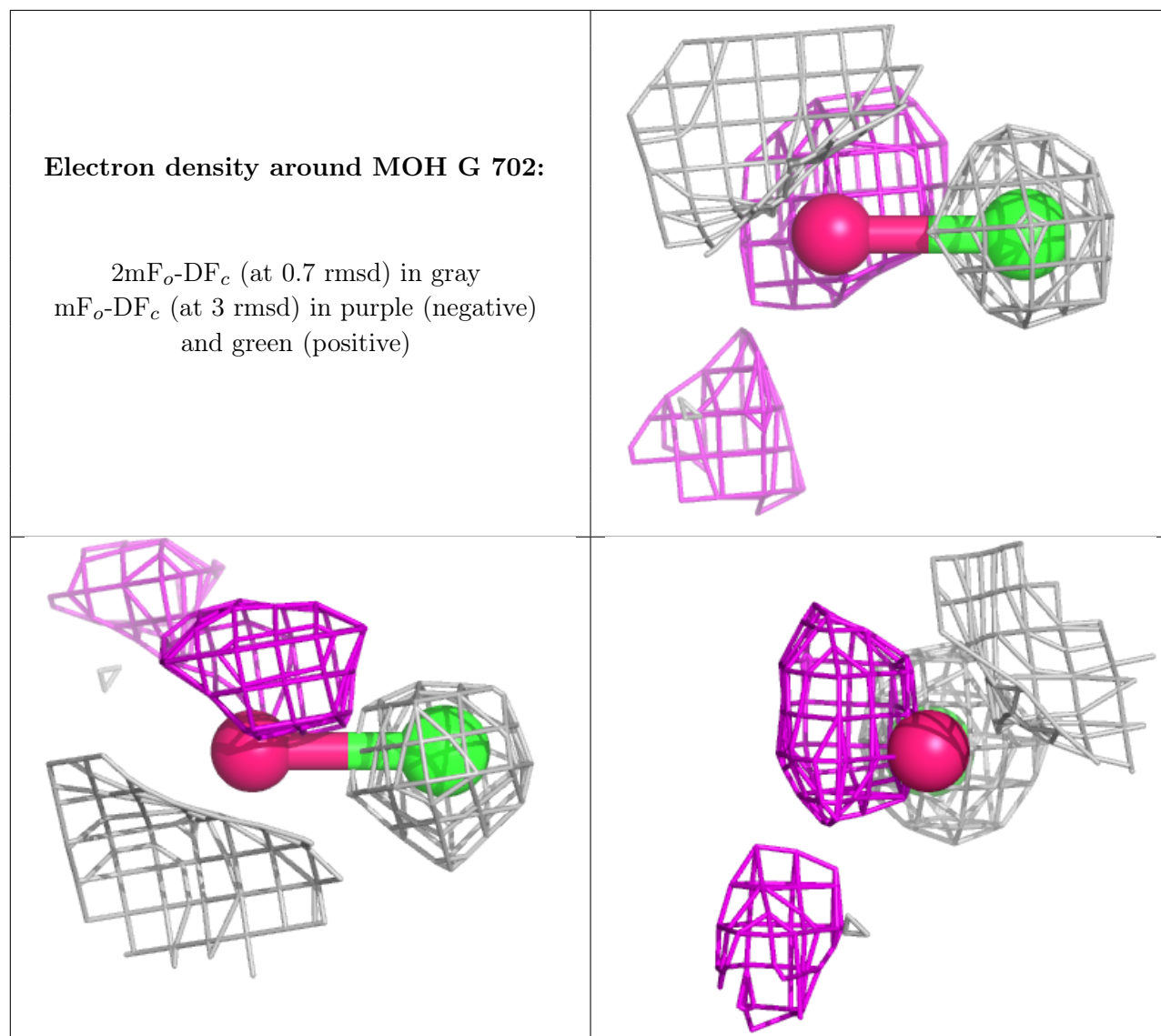
Electron density around MOH B 702:

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

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Electron density around MOH A 702:

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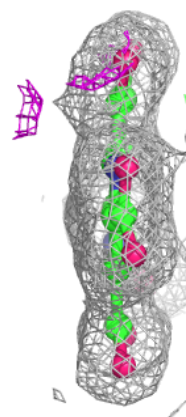mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around MOH D 702:

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

Electron density around MOH M 702:

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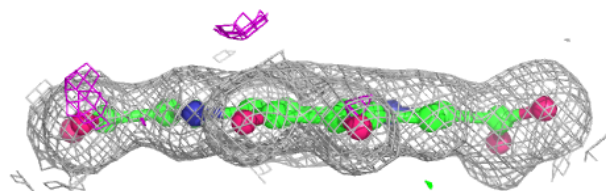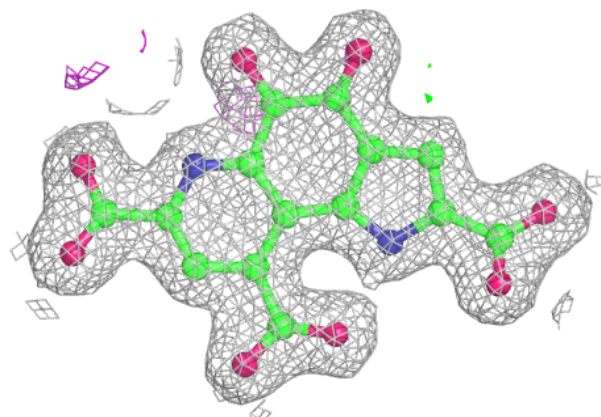and green (positive)

Electron density around MOH C 703:

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

Electron density around MOH N 702:

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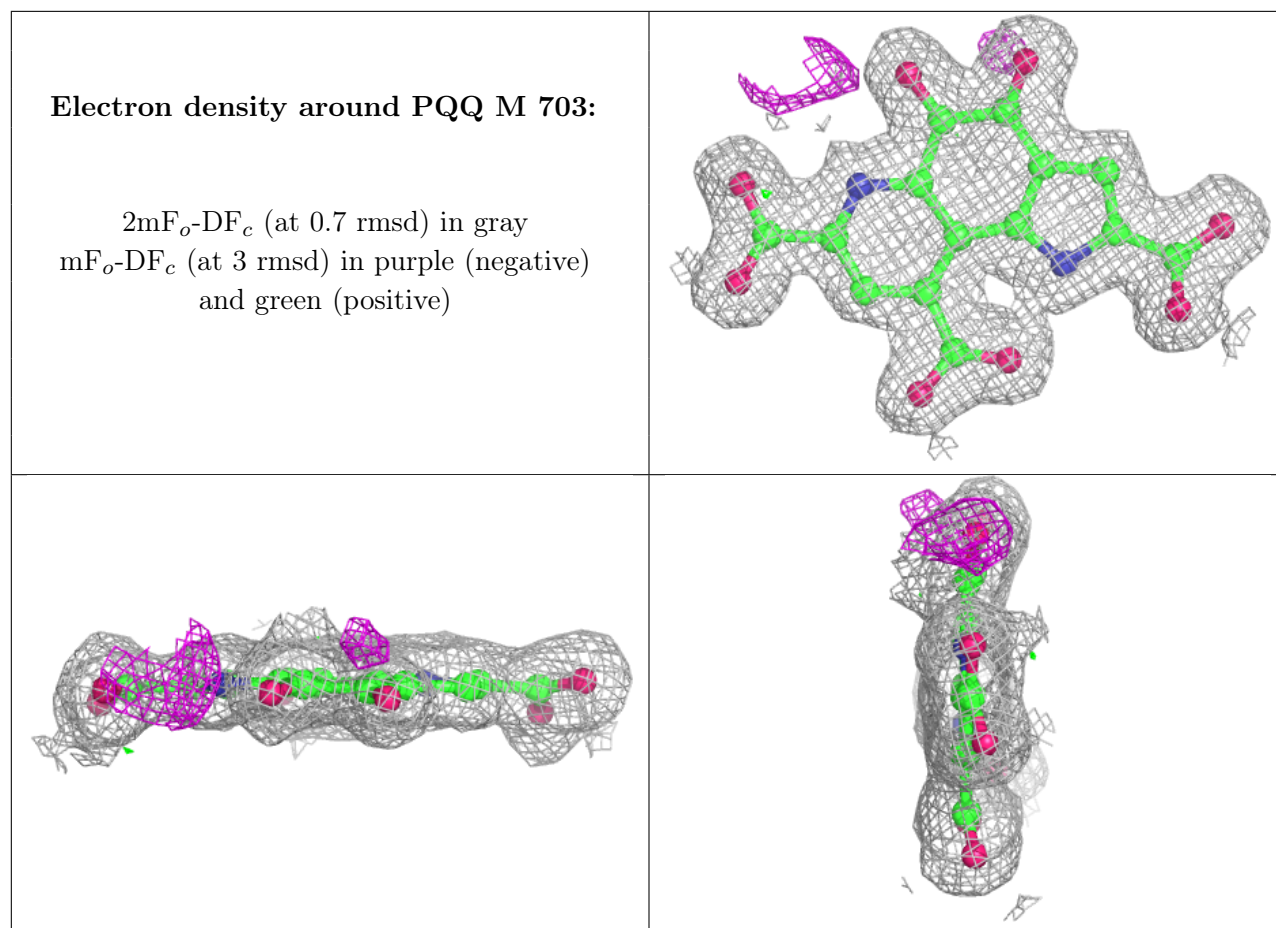and green (positive)

Electron density around PQQ H 703:

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

Electron density around PQQ A 703:

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

Electron density around PQQ C 702:

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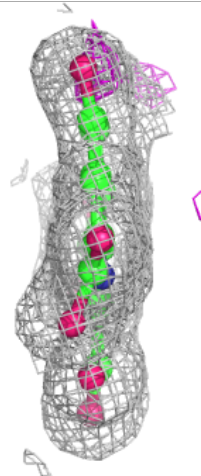mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around PQQ D 703:

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

Electron density around PQQ G 703:

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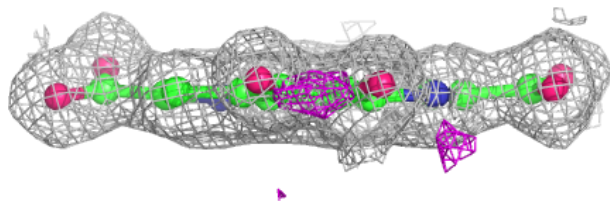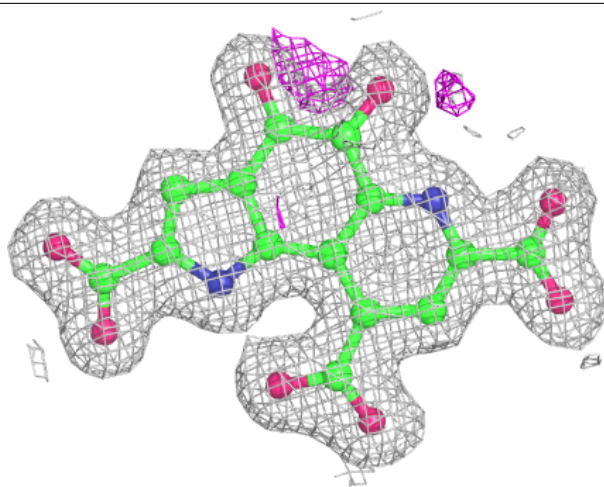and green (positive)

Electron density around PQQ M 703:

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

Electron density around PQQ N 703:

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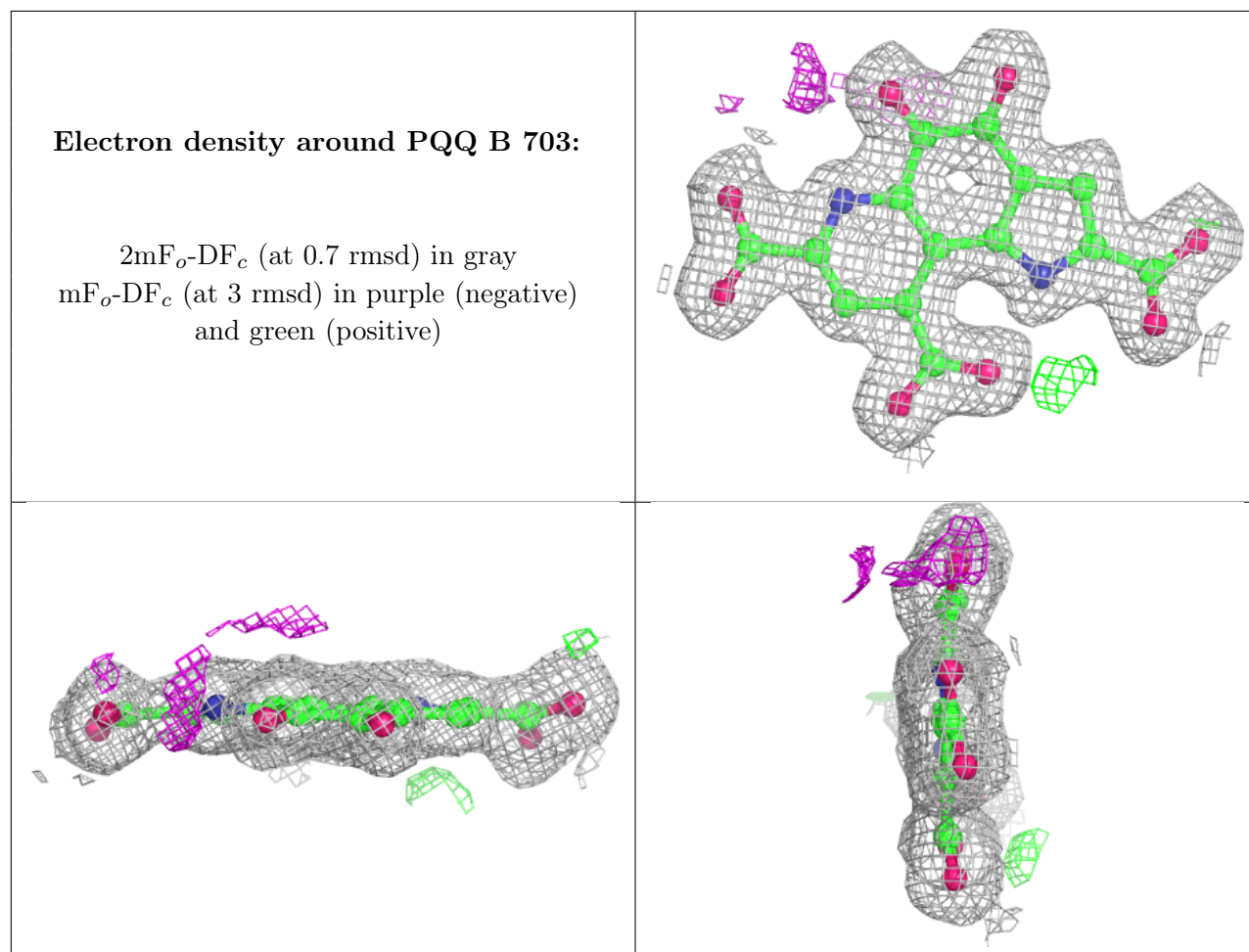mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around PQQ B 703:

$2mF_o$-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.