wwPDB X-ray Structure Validation Summary Report (i)

Nov 25, 2025 – 04:28 PM JST

PDB ID	:	9KRW / pdb_00009krw
Title	:	E. coli MaeB apo form
Authors	:	Sassa, M.; Yamato, H.; Tanino, H.; Fukuda, Y.; Inoue, T.
Deposited on	:	2024-11-28
Resolution	:	3.85 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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

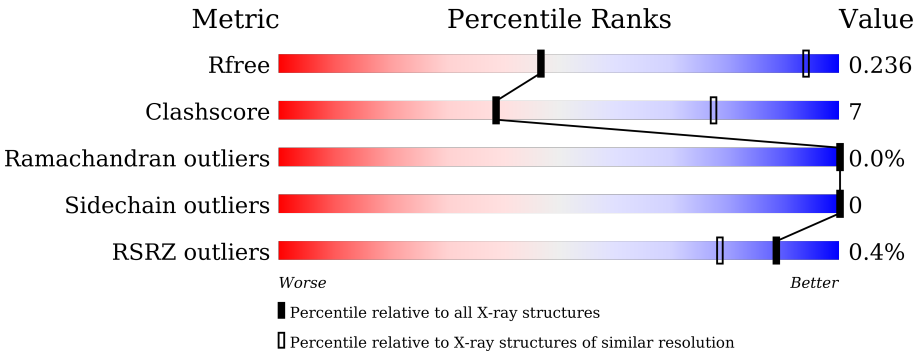
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

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 3.85 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}	164625	1056 (4.02-3.70)
Clashscore	180529	1117 (4.02-3.70)
Ramachandran outliers	177936	1077 (4.02-3.70)
Sidechain outliers	177891	1070 (4.02-3.70)
RSRZ outliers	164620	1056 (4.02-3.70)

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	765	83% 15%
1	B	765	81% 17%
1	C	765	83% 15%
1	D	765	80% 18%
1	E	765	83% 15%
1	F	765	83% 16%

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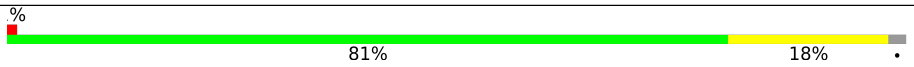
Mol	Chain	Length	Quality of chain
1	G	765	
1	H	765	
1	I	765	
1	J	765	
1	K	765	
1	L	765	

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 68719 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 NADP-dependent malic enzyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	748	Total 5701	C 3617	N 981	O 1069	S 34	0	0	0
1	B	751	Total 5718	C 3630	N 983	O 1071	S 34	0	0	0
1	C	750	Total 5718	C 3629	N 983	O 1072	S 34	0	0	0
1	D	753	Total 5740	C 3642	N 986	O 1078	S 34	0	0	0
1	E	748	Total 5704	C 3621	N 980	O 1069	S 34	0	0	0
1	F	753	Total 5738	C 3641	N 985	O 1078	S 34	0	0	0
1	G	750	Total 5721	C 3631	N 983	O 1072	S 35	0	0	0
1	H	755	Total 5755	C 3653	N 988	O 1080	S 34	0	0	0
1	I	757	Total 5765	C 3658	N 990	O 1083	S 34	0	0	0
1	J	751	Total 5724	C 3632	N 984	O 1074	S 34	0	0	0
1	K	749	Total 5713	C 3626	N 982	O 1071	S 34	0	0	0
1	L	750	Total 5720	C 3631	N 983	O 1072	S 34	0	0	0

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	760	HIS	-	expression tag	UNP P76558
A	761	HIS	-	expression tag	UNP P76558
A	762	HIS	-	expression tag	UNP P76558
A	763	HIS	-	expression tag	UNP P76558
A	764	HIS	-	expression tag	UNP P76558

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Chain	Residue	Modelled	Actual	Comment	Reference
A	765	HIS	-	expression tag	UNP P76558
B	760	HIS	-	expression tag	UNP P76558
B	761	HIS	-	expression tag	UNP P76558
B	762	HIS	-	expression tag	UNP P76558
B	763	HIS	-	expression tag	UNP P76558
B	764	HIS	-	expression tag	UNP P76558
B	765	HIS	-	expression tag	UNP P76558
C	760	HIS	-	expression tag	UNP P76558
C	761	HIS	-	expression tag	UNP P76558
C	762	HIS	-	expression tag	UNP P76558
C	763	HIS	-	expression tag	UNP P76558
C	764	HIS	-	expression tag	UNP P76558
C	765	HIS	-	expression tag	UNP P76558
D	760	HIS	-	expression tag	UNP P76558
D	761	HIS	-	expression tag	UNP P76558
D	762	HIS	-	expression tag	UNP P76558
D	763	HIS	-	expression tag	UNP P76558
D	764	HIS	-	expression tag	UNP P76558
D	765	HIS	-	expression tag	UNP P76558
E	760	HIS	-	expression tag	UNP P76558
E	761	HIS	-	expression tag	UNP P76558
E	762	HIS	-	expression tag	UNP P76558
E	763	HIS	-	expression tag	UNP P76558
E	764	HIS	-	expression tag	UNP P76558
E	765	HIS	-	expression tag	UNP P76558
F	760	HIS	-	expression tag	UNP P76558
F	761	HIS	-	expression tag	UNP P76558
F	762	HIS	-	expression tag	UNP P76558
F	763	HIS	-	expression tag	UNP P76558
F	764	HIS	-	expression tag	UNP P76558
F	765	HIS	-	expression tag	UNP P76558
G	760	HIS	-	expression tag	UNP P76558
G	761	HIS	-	expression tag	UNP P76558
G	762	HIS	-	expression tag	UNP P76558
G	763	HIS	-	expression tag	UNP P76558
G	764	HIS	-	expression tag	UNP P76558
G	765	HIS	-	expression tag	UNP P76558
H	760	HIS	-	expression tag	UNP P76558
H	761	HIS	-	expression tag	UNP P76558
H	762	HIS	-	expression tag	UNP P76558
H	763	HIS	-	expression tag	UNP P76558
H	764	HIS	-	expression tag	UNP P76558

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Chain	Residue	Modelled	Actual	Comment	Reference
H	765	HIS	-	expression tag	UNP P76558
I	760	HIS	-	expression tag	UNP P76558
I	761	HIS	-	expression tag	UNP P76558
I	762	HIS	-	expression tag	UNP P76558
I	763	HIS	-	expression tag	UNP P76558
I	764	HIS	-	expression tag	UNP P76558
I	765	HIS	-	expression tag	UNP P76558
J	760	HIS	-	expression tag	UNP P76558
J	761	HIS	-	expression tag	UNP P76558
J	762	HIS	-	expression tag	UNP P76558
J	763	HIS	-	expression tag	UNP P76558
J	764	HIS	-	expression tag	UNP P76558
J	765	HIS	-	expression tag	UNP P76558
K	760	HIS	-	expression tag	UNP P76558
K	761	HIS	-	expression tag	UNP P76558
K	762	HIS	-	expression tag	UNP P76558
K	763	HIS	-	expression tag	UNP P76558
K	764	HIS	-	expression tag	UNP P76558
K	765	HIS	-	expression tag	UNP P76558
L	760	HIS	-	expression tag	UNP P76558
L	761	HIS	-	expression tag	UNP P76558
L	762	HIS	-	expression tag	UNP P76558
L	763	HIS	-	expression tag	UNP P76558
L	764	HIS	-	expression tag	UNP P76558
L	765	HIS	-	expression tag	UNP P76558

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

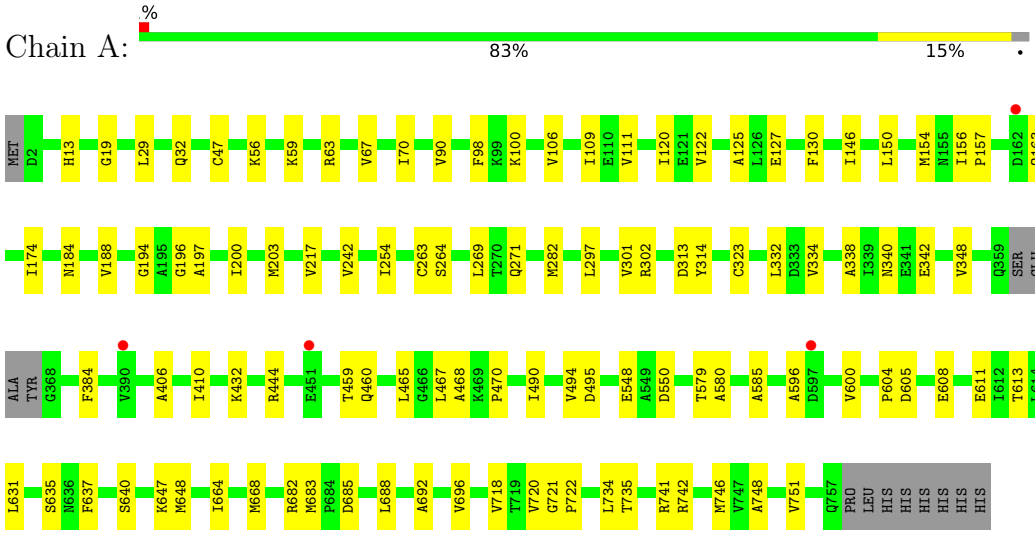
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	D	1	Total Mg 1 1	0	0
2	H	1	Total Mg 1 1	0	0

3 Residue-property plots (i)

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.

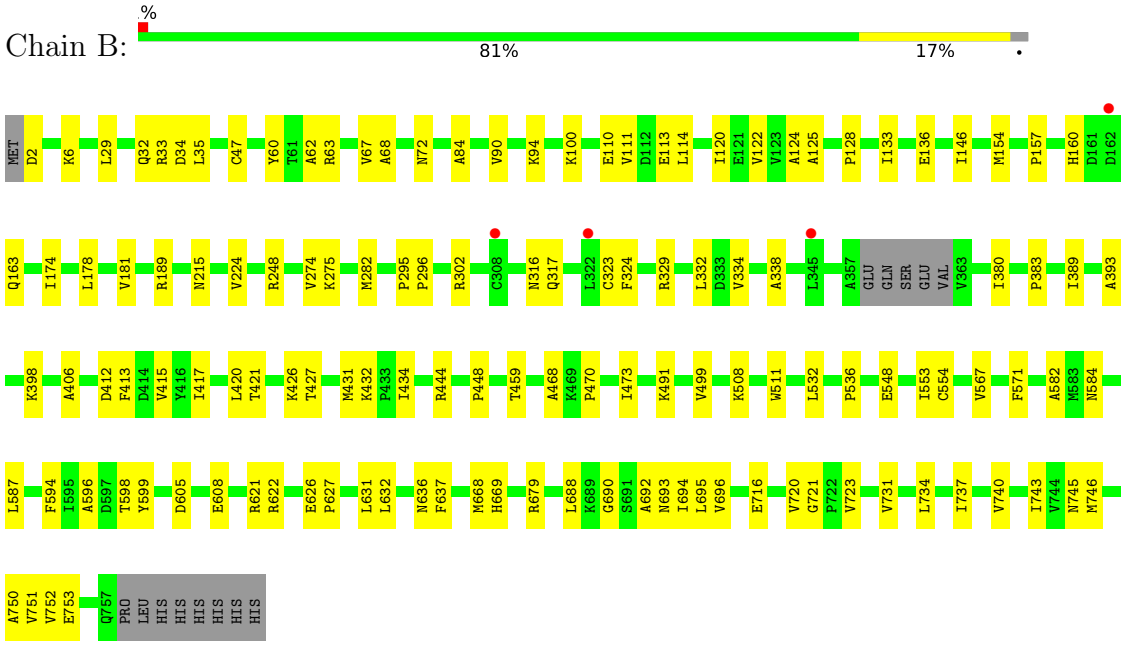
• Molecule 1: NADP-dependent malic enzyme

Chain A:



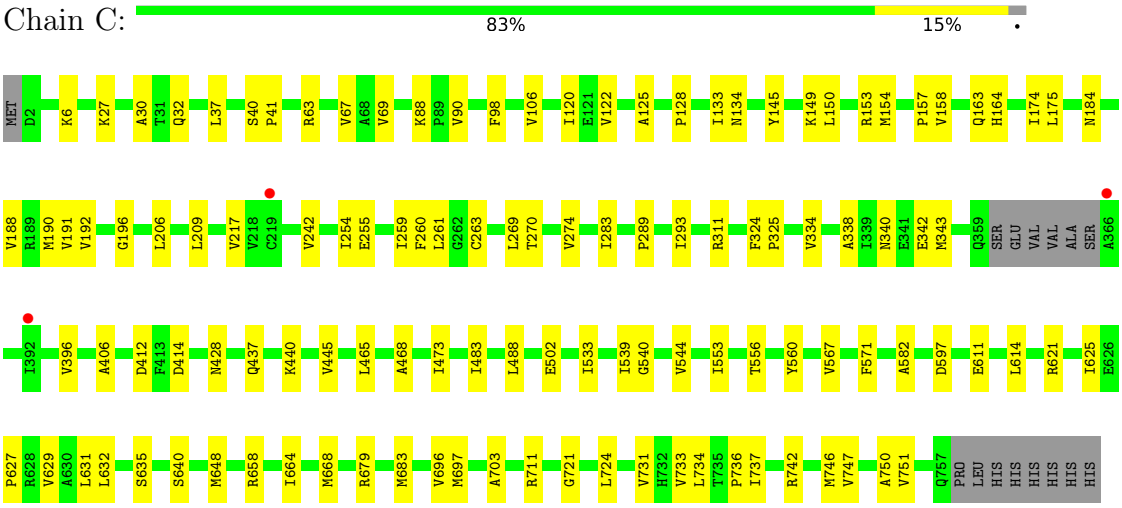
• Molecule 1: NADP-dependent malic enzyme

Chain B:



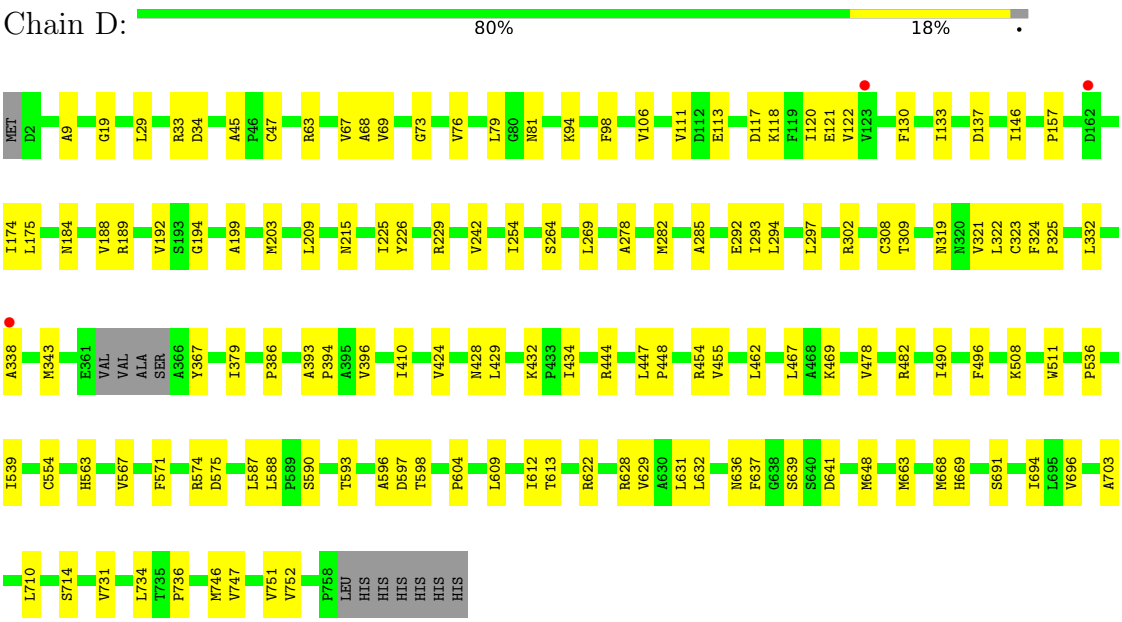
• Molecule 1: NADP-dependent malic enzyme

Chain C:



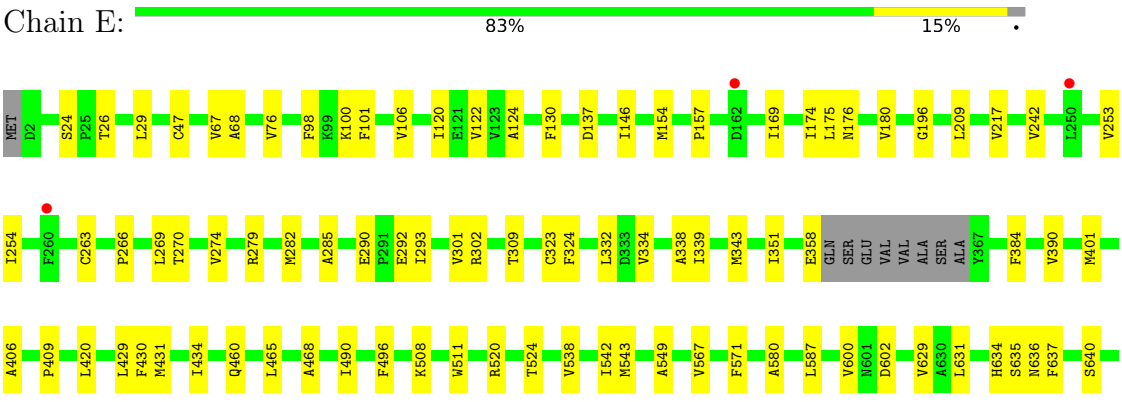
• Molecule 1: NADP-dependent malic enzyme

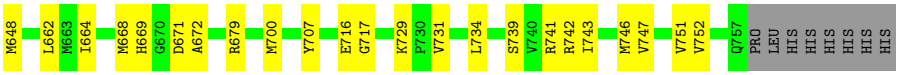
Chain D:



• Molecule 1: NADP-dependent malic enzyme

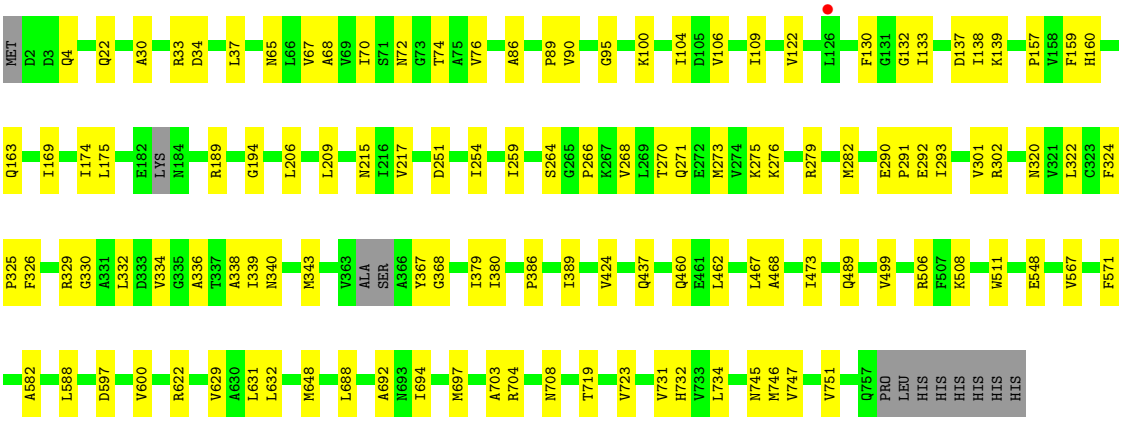
Chain E:





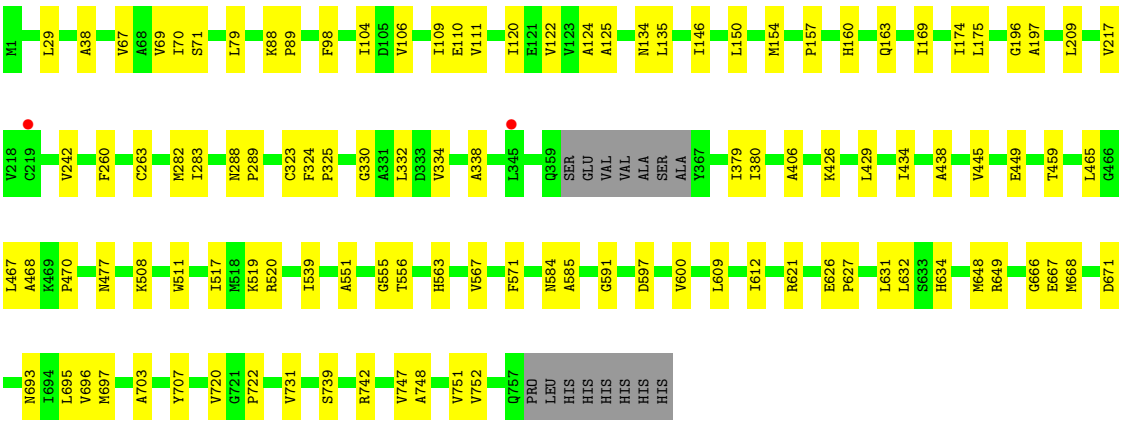
• Molecule 1: NADP-dependent malic enzyme

Chain F:



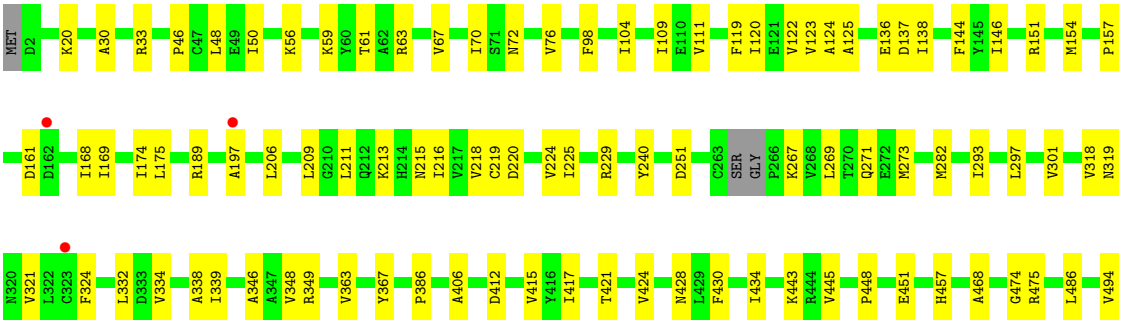
• Molecule 1: NADP-dependent malic enzyme

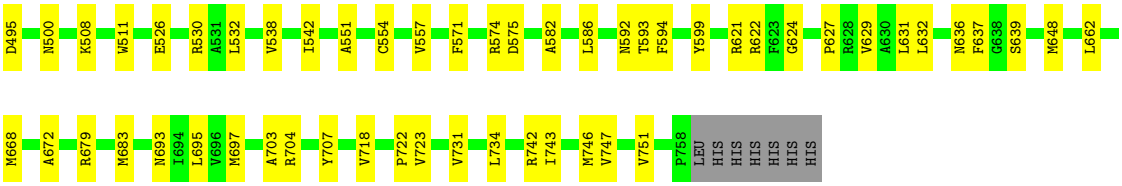
Chain G:



• Molecule 1: NADP-dependent malic enzyme

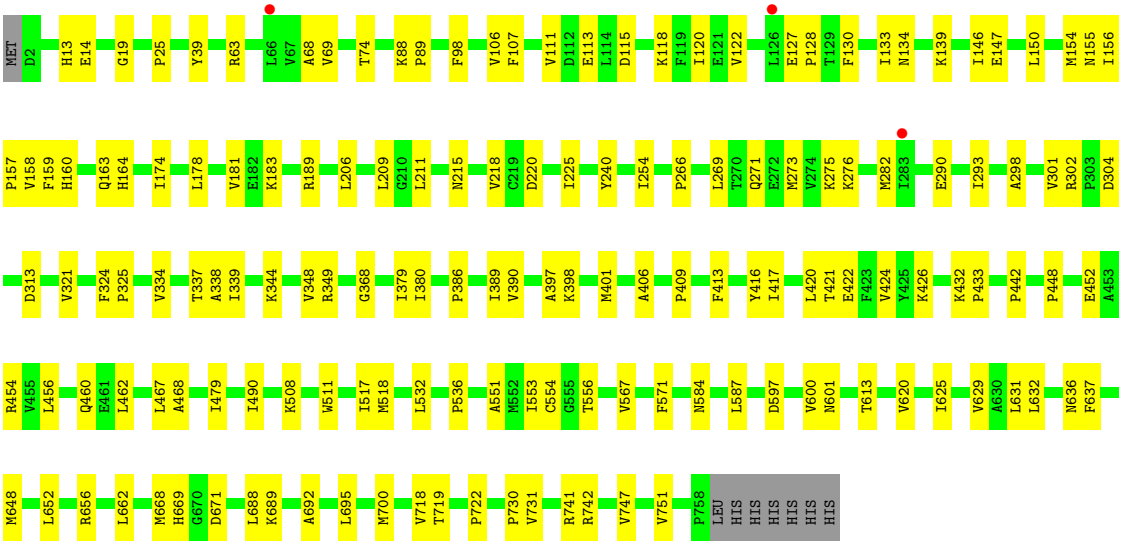
Chain H:





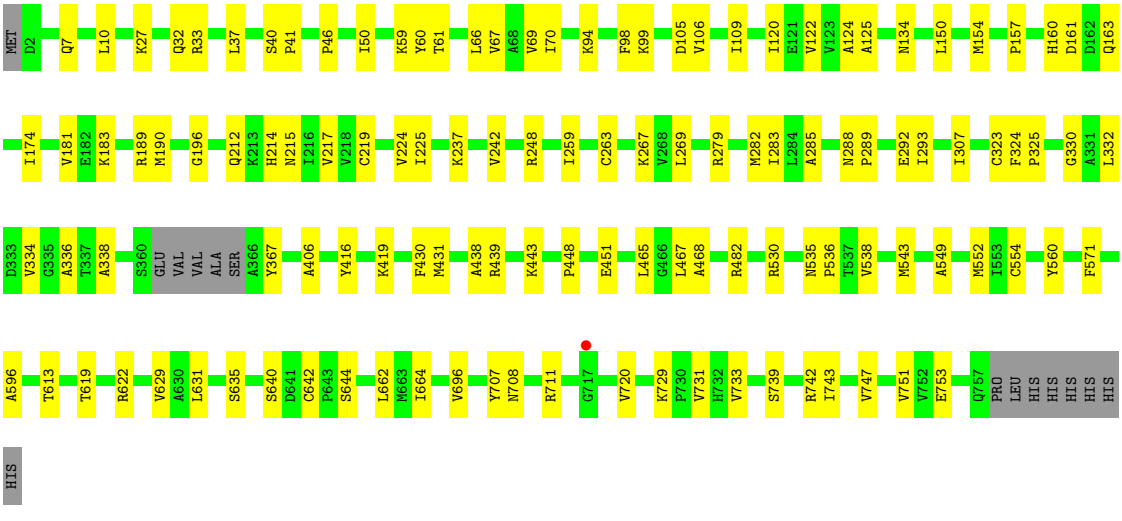
• Molecule 1: NADP-dependent malic enzyme

Chain I:



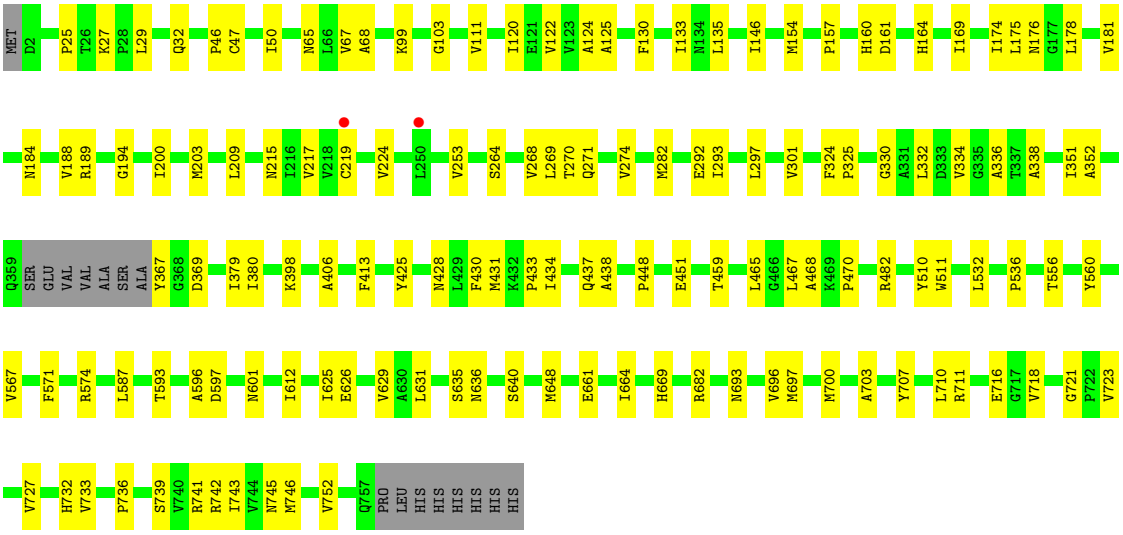
• Molecule 1: NADP-dependent malic enzyme

Chain J:



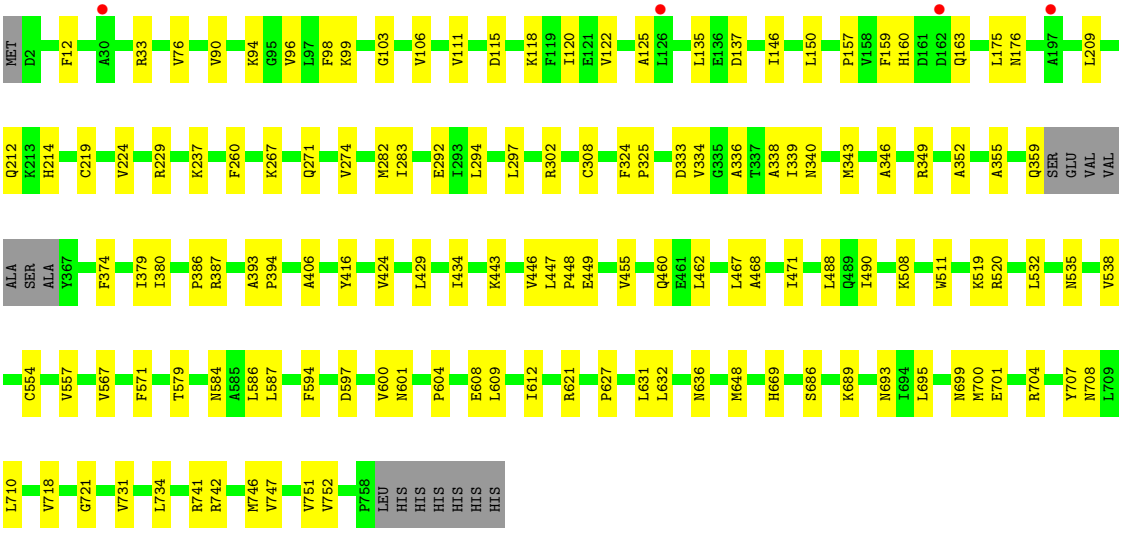
• Molecule 1: NADP-dependent malic enzyme

Chain K:



• Molecule 1: NADP-dependent malic enzyme

Chain L:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	347.71Å 200.29Å 201.82Å 90.00° 101.35° 90.00°	Depositor
Resolution (Å)	49.47 – 3.85 49.47 – 3.85	Depositor EDS
% Data completeness (in resolution range)	99.0 (49.47-3.85) 98.9 (49.47-3.85)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.82 (at 3.88Å)	Xtriage
Refinement program	REFMAC, PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.195 , 0.240 0.197 , 0.236	Depositor DCC
R_{free} test set	6299 reflections (4.91%)	wwPDB-VP
Wilson B-factor (Å^2)	138.0	Xtriage
Anisotropy	0.494	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.27 , 128.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.44$, $< L^2 > = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	68719	wwPDB-VP
Average B, all atoms (Å^2)	154.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.36% 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

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	0.13	0/5801	0.30	0/7866
1	B	0.13	0/5819	0.30	0/7892
1	C	0.13	0/5819	0.31	0/7891
1	D	0.12	0/5842	0.30	0/7923
1	E	0.13	0/5805	0.30	0/7872
1	F	0.12	0/5838	0.30	0/7917
1	G	0.13	0/5822	0.31	1/7894 (0.0%)
1	H	0.12	0/5857	0.29	0/7944
1	I	0.12	0/5868	0.30	0/7961
1	J	0.12	0/5825	0.29	0/7899
1	K	0.12	0/5814	0.29	0/7884
1	L	0.11	0/5822	0.28	0/7896
All	All	0.12	0/69932	0.30	1/94839 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	G	517	ILE	N-CA-C	-6.40	106.56	112.96

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	5701	0	5808	73	0
1	B	5718	0	5827	85	0
1	C	5718	0	5822	73	1
1	D	5740	0	5840	87	0
1	E	5704	0	5809	73	1
1	F	5738	0	5837	85	0
1	G	5721	0	5829	68	0
1	H	5755	0	5861	94	0
1	I	5765	0	5869	106	0
1	J	5724	0	5827	81	0
1	K	5713	0	5817	92	0
1	L	5720	0	5824	91	0
2	D	1	0	0	0	0
2	H	1	0	0	0	0
All	All	68719	0	69970	931	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 7.

The worst 5 of 931 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:K:428:ASN:HD21	1:K:625:ILE:HG12	1.42	0.83
1:K:636:ASN:HB2	1:K:669:HIS:HD2	1.44	0.82
1:K:425:TYR:OH	1:K:693:ASN:ND2	2.14	0.78
1:I:390:VAL:HA	1:I:420:LEU:HD13	1.64	0.78
1:F:157:PRO:HA	1:F:338:ALA:HA	1.66	0.78

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)
1:C:255:GLU:OE2	1:E:279:ARG:NH2[4_455]	2.16	0.04

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	744/765 (97%)	716 (96%)	28 (4%)	0	100	100
1	B	747/765 (98%)	722 (97%)	25 (3%)	0	100	100
1	C	746/765 (98%)	723 (97%)	23 (3%)	0	100	100
1	D	749/765 (98%)	706 (94%)	43 (6%)	0	100	100
1	E	744/765 (97%)	715 (96%)	28 (4%)	1 (0%)	48	80
1	F	747/765 (98%)	731 (98%)	16 (2%)	0	100	100
1	G	746/765 (98%)	719 (96%)	27 (4%)	0	100	100
1	H	751/765 (98%)	735 (98%)	16 (2%)	0	100	100
1	I	755/765 (99%)	723 (96%)	32 (4%)	0	100	100
1	J	747/765 (98%)	720 (96%)	27 (4%)	0	100	100
1	K	745/765 (97%)	718 (96%)	27 (4%)	0	100	100
1	L	746/765 (98%)	721 (97%)	25 (3%)	0	100	100
All	All	8967/9180 (98%)	8649 (96%)	317 (4%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	430	PHE

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	611/626 (98%)	611 (100%)	0	100	100
1	B	612/626 (98%)	612 (100%)	0	100	100
1	C	612/626 (98%)	612 (100%)	0	100	100
1	D	615/626 (98%)	615 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	611/626 (98%)	611 (100%)	0	100	100
1	F	615/626 (98%)	615 (100%)	0	100	100
1	G	613/626 (98%)	613 (100%)	0	100	100
1	H	617/626 (99%)	617 (100%)	0	100	100
1	I	618/626 (99%)	618 (100%)	0	100	100
1	J	613/626 (98%)	613 (100%)	0	100	100
1	K	612/626 (98%)	612 (100%)	0	100	100
1	L	613/626 (98%)	613 (100%)	0	100	100
All	All	7362/7512 (98%)	7362 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 93 such sidechains are listed below:

Mol	Chain	Res	Type
1	H	428	ASN
1	I	708	ASN
1	H	545	GLN
1	I	359	GLN
1	J	745	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	748/765 (97%)	-0.21	4 (0%)	87	75	86, 135, 181, 216	0
1	B	751/765 (98%)	-0.22	4 (0%)	87	75	84, 138, 198, 237	0
1	C	750/765 (98%)	-0.28	3 (0%)	89	79	85, 134, 178, 218	0
1	D	753/765 (98%)	-0.27	3 (0%)	89	79	86, 133, 213, 268	0
1	E	748/765 (97%)	-0.25	3 (0%)	89	79	82, 142, 178, 215	0
1	F	753/765 (98%)	-0.21	1 (0%)	92	89	92, 155, 283, 314	0
1	G	750/765 (98%)	-0.27	2 (0%)	90	81	90, 147, 185, 221	0
1	H	755/765 (98%)	-0.19	3 (0%)	89	79	103, 161, 285, 313	0
1	I	757/765 (98%)	-0.20	3 (0%)	89	79	101, 159, 271, 322	0
1	J	751/765 (98%)	-0.27	1 (0%)	92	89	94, 151, 194, 244	0
1	K	749/765 (97%)	-0.21	2 (0%)	90	81	84, 159, 202, 248	0
1	L	750/765 (98%)	-0.18	4 (0%)	87	75	93, 169, 296, 335	0
All	All	9015/9180 (98%)	-0.23	33 (0%)	89	79	82, 147, 247, 335	0

The worst 5 of 33 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	L	162	ASP	3.6
1	L	126	LEU	3.2
1	F	126	LEU	3.1
1	I	283	ILE	2.8
1	A	162	ASP	2.8

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 (i)

There are no oligosaccharides in this entry.

6.4 Ligands (i)

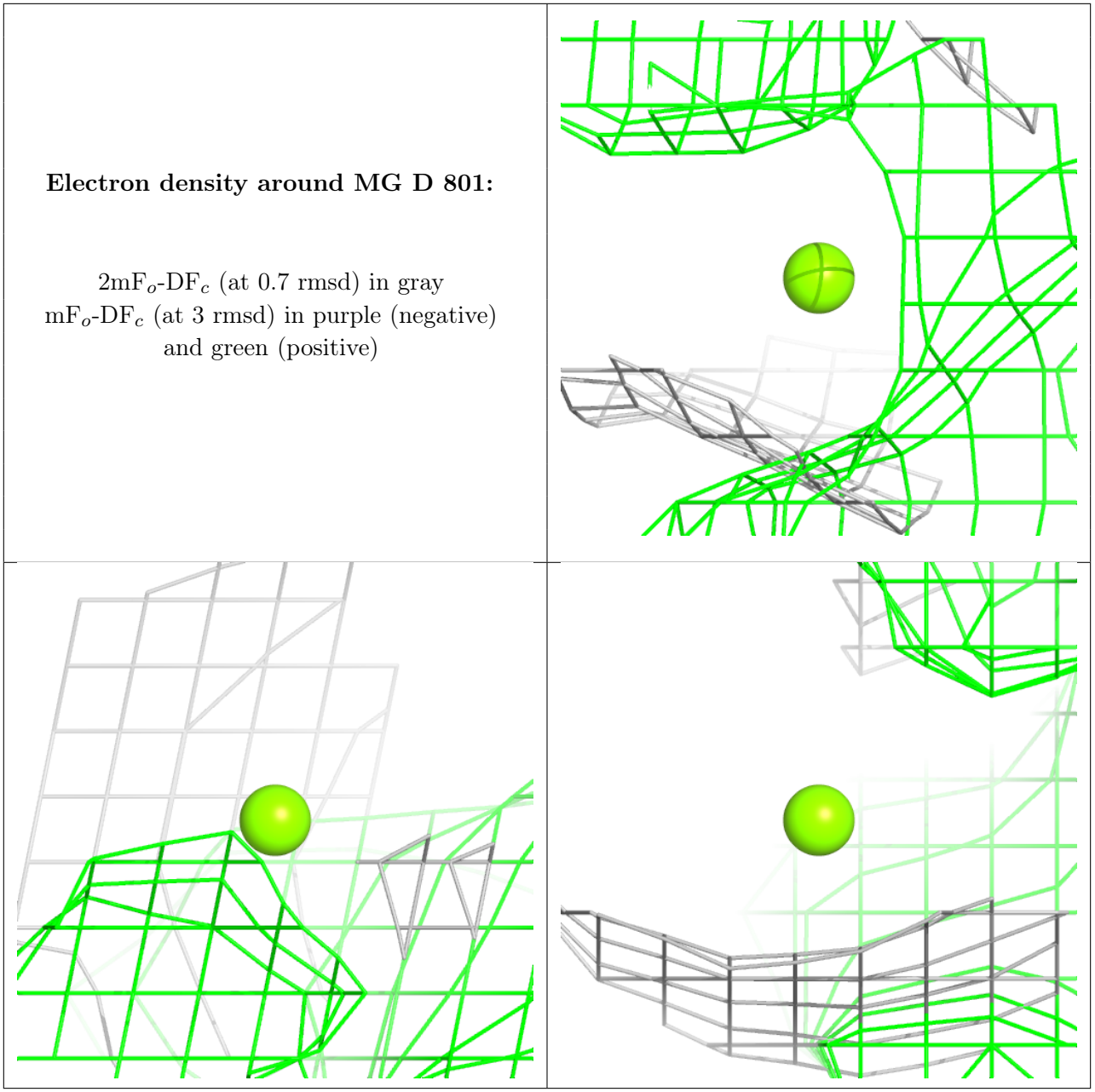
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' 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	MG	D	801	1/1	0.62	0.17	168,168,168,168	1
2	MG	H	801	1/1	0.76	0.11	209,209,209,209	1

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.

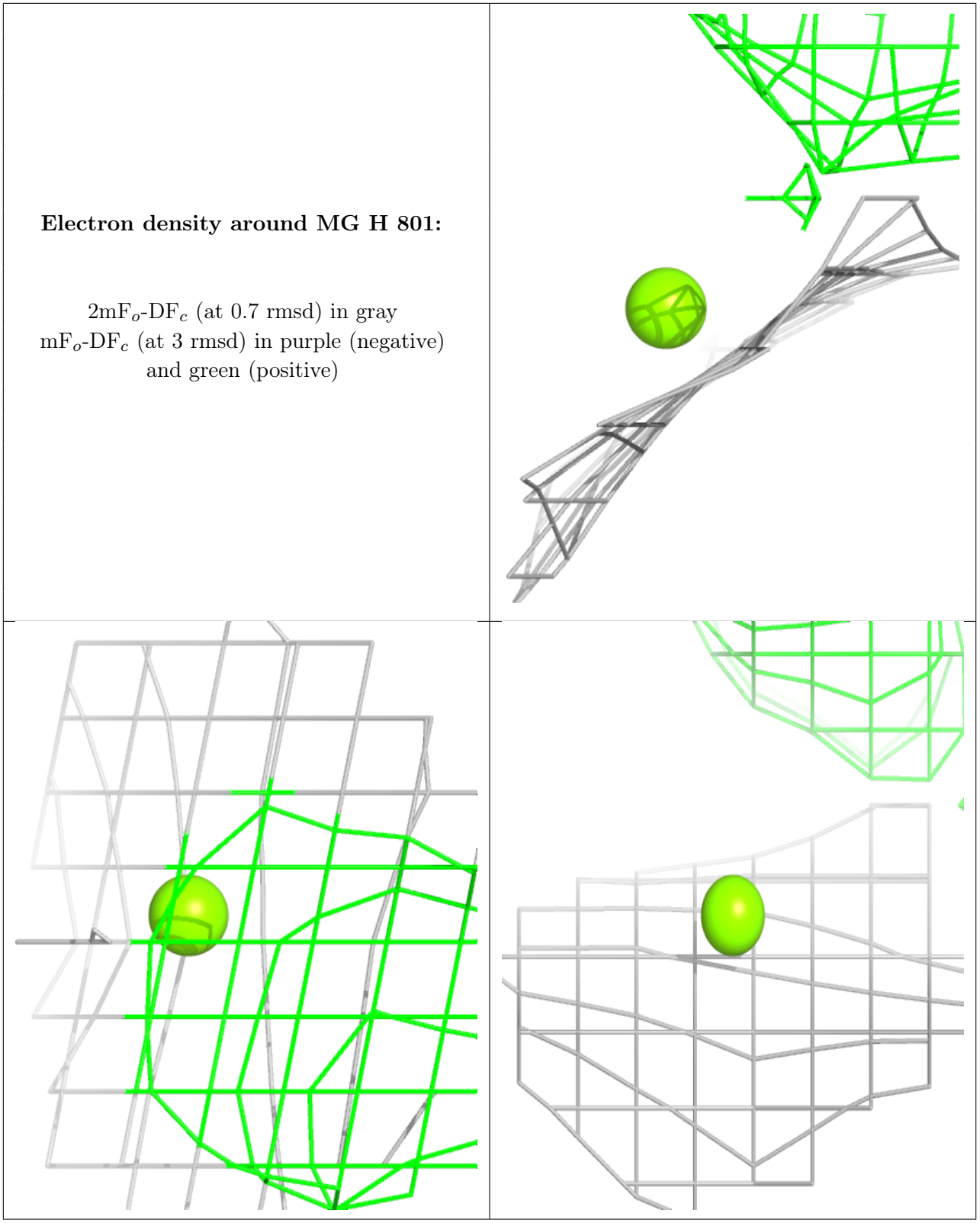
Electron density around MG D 801:

$2mF_o$-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 H 801:

$2mF_o$-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.