Full wwPDB X-ray Structure Validation Report ⓘ

May 5, 2026 – 12:08 AM JST

PDB ID	:	9VGA / pdb_00009vga
Title	:	Crystal structure of Phaeodactylibacter sp. phosphoglucomutase in complex with manganese ion
Authors	:	Shen, Y.W.; Tu, T.
Deposited on	:	2025-06-13
Resolution	:	1.82 Å(reported)

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

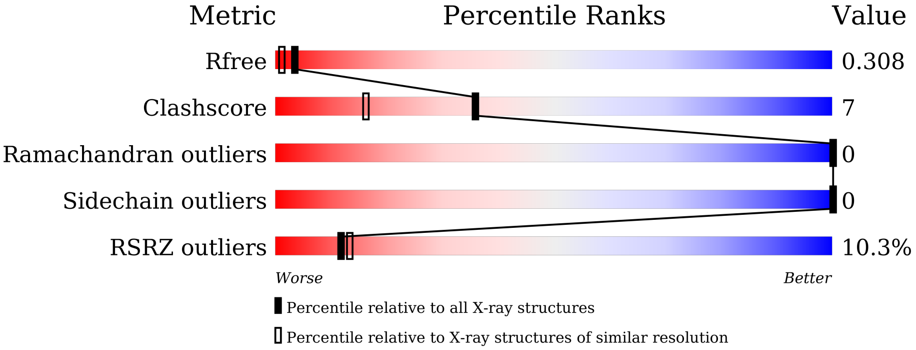
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

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 1.82 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	1112 (1.82-1.82)
Clashscore	190562	1148 (1.82-1.82)
Ramachandran outliers	187476	1140 (1.82-1.82)
Sidechain outliers	187428	1140 (1.82-1.82)
RSRZ outliers	180081	1112 (1.82-1.82)

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	546	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4478 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 Phosphoglucomutase (Alpha-D-glucose-1,6-bisphosphate-dependent).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	545	4181	2627	743	798	13	0	0	0

- Molecule 2 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mn		
2	A	1	1	1	0	0

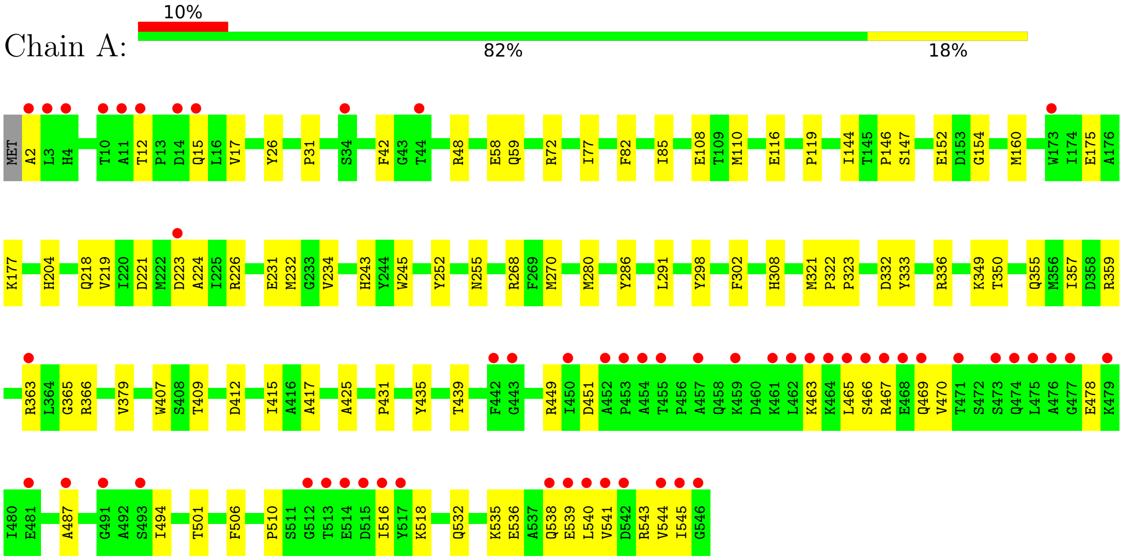
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	296	296	296	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: Phosphoglucomutase (Alpha-D-glucose-1,6-bisphosphate-dependent)



4 Data and refinement statistics ⓘ

Property	**Value**	**Source**
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	61.66Å 101.71Å 168.36Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	52.73 – 1.82 52.73 – 1.82	Depositor EDS
% Data completeness (in resolution range)	90.0 (52.73-1.82) 90.0 (52.73-1.82)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.85 (at 1.82Å)	Xtriage
Refinement program	PHENIX 1.14_3260	Depositor
R, R_{free}	0.249 , 0.310 0.249 , 0.308	Depositor DCC
R_{free} test set	2027 reflections (4.23%)	wwPDB-VP
Wilson B-factor (Å^2)	8.8	Xtriage
Anisotropy	0.979	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 49.8	EDS
L-test for twinning[2]	$< \vert L \vert > = 0.48$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.028 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.039 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtriage
F_o,F_c correlation	0.87	EDS
Total number of atoms	4478	wwPDB-VP
Average B, all atoms (Å^2)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 13.08% 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 $< |L| >$, $< L^2 >$ 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: MN

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	0.32	0/4275	0.53	0/5796

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	4181	0	4094	60	1
2	A	1	0	0	0	0
3	A	296	0	0	4	0
All	All	4478	0	4094	60	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.

All (60) 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:218:GLN:NE2	3:A:702:HOH:O	2.22	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:12:THR:HG22	1:A:15:GLN:CD	2.22	0.65
1:A:232:MET:HE2	1:A:302:PHE:HZ	1.64	0.62
1:A:48:ARG:HH21	1:A:147:SER:HB3	1.63	0.61
1:A:42:PHE:HB3	1:A:175:GLU:HB2	1.85	0.59
1:A:17:VAL:HG21	1:A:152:GLU:HB3	1.85	0.58
1:A:412:ASP:CG	1:A:415:ILE:HG12	2.30	0.56
1:A:72:ARG:HB2	1:A:77:ILE:HB	1.88	0.56
1:A:221:ASP:OD1	1:A:223:ASP:HB2	2.04	0.56
1:A:48:ARG:NH2	1:A:147:SER:HB3	2.21	0.56
1:A:449:ARG:HH21	1:A:518:LYS:HE2	1.70	0.55
1:A:231:GLU:HG3	1:A:298:TYR:HD1	1.72	0.55
1:A:234:VAL:HG21	1:A:245:TRP:CD2	2.44	0.52
1:A:466:SER:OG	1:A:467:ARG:N	2.41	0.51
1:A:85:ILE:HG22	1:A:144:ILE:HB	1.94	0.50
1:A:268:ARG:NH2	3:A:719:HOH:O	2.38	0.49
1:A:270:MET:HE2	1:A:280:MET:HA	1.93	0.49
1:A:116:GLU:CD	1:A:243:HIS:HD1	2.20	0.49
1:A:451:ASP:HB3	1:A:516:ILE:HD12	1.94	0.49
1:A:463:LYS:HB2	1:A:510:PRO:HG3	1.94	0.49
1:A:226:ARG:HD3	1:A:252:TYR:O	2.13	0.48
1:A:108:GLU:OE2	1:A:204:HIS:NE2	2.42	0.48
1:A:365:GLY:HA2	3:A:898:HOH:O	2.13	0.48
1:A:302:PHE:CD1	1:A:417:ALA:HB1	2.49	0.47
1:A:82:PHE:CE1	1:A:110:MET:HG3	2.48	0.47
1:A:234:VAL:HG21	1:A:245:TRP:CE2	2.50	0.47
1:A:232:MET:HE2	1:A:302:PHE:CZ	2.49	0.47
1:A:469:GLN:O	1:A:543:ARG:NH2	2.48	0.46
1:A:321:MET:SD	1:A:431:PRO:HB2	2.56	0.46
1:A:366:ARG:NH1	3:A:734:HOH:O	2.50	0.45
1:A:332:ASP:OD1	1:A:336:ARG:NE	2.37	0.45
1:A:541:VAL:O	1:A:545:ILE:HG12	2.16	0.45
1:A:231:GLU:OE1	1:A:255:ASN:HB3	2.17	0.44
1:A:470:VAL:HG22	1:A:540:LEU:HD21	2.00	0.44
1:A:532:GLN:O	1:A:536:GLU:HG3	2.17	0.44
1:A:538:GLN:O	1:A:538:GLN:NE2	2.51	0.44
1:A:379:VAL:HG13	1:A:409:THR:HB	1.99	0.44
1:A:291:LEU:HD12	1:A:291:LEU:HA	1.72	0.43
1:A:333:TYR:CD1	1:A:333:TYR:C	2.96	0.43
1:A:355:GLN:O	1:A:359:ARG:HG2	2.19	0.43
1:A:467:ARG:HE	1:A:467:ARG:HB2	1.65	0.42
1:A:478:GLU:OE1	1:A:501:THR:OG1	2.25	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:349:LYS:HG3	1:A:357:ILE:HD13	2.02	0.42
1:A:160:MET:HE2	1:A:160:MET:HB3	1.90	0.42
1:A:435:TYR:O	1:A:439:THR:HG23	2.20	0.42
1:A:487:ALA:HB2	1:A:494:ILE:HD11	2.02	0.42
1:A:146:PRO:HB3	1:A:154:GLY:C	2.45	0.41
1:A:349:LYS:HG2	1:A:350:THR:O	2.21	0.41
1:A:31:PRO:HD2	1:A:59:GLN:OE1	2.21	0.41
1:A:535:LYS:O	1:A:539:GLU:HG3	2.20	0.41
1:A:322:PRO:HA	1:A:323:PRO:HD3	1.96	0.41
1:A:85:ILE:HG22	1:A:144:ILE:HD12	2.03	0.41
1:A:177:LYS:HA	1:A:177:LYS:HD3	1.93	0.41
1:A:219:VAL:HG21	1:A:407:TRP:CG	2.56	0.40
1:A:26:TYR:CZ	1:A:58:GLU:HA	2.56	0.40
1:A:465:LEU:HD13	1:A:544:VAL:HG21	2.03	0.40
1:A:119:PRO:HB3	1:A:308:HIS:HB2	2.02	0.40
1:A:224:ALA:O	1:A:425:ALA:HB1	2.22	0.40
1:A:2:ALA:HB2	1:A:286:TYR:CE2	2.56	0.40
1:A:506:PHE:CD1	1:A:506:PHE:C	2.98	0.40

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:A:223:ASP:OD2	1:A:363:ARG:NH1[8_545]	2.06	0.14

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	543/546 (100%)	524 (96%)	19 (4%)	0	100 100

There are no Ramachandran outliers to report.

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	430/431 (100%)	430 (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. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	6	GLN
1	A	218	GLN
1	A	247	HIS
1	A	255	ASN
1	A	405	ASN

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 ⓘ

Of 1 ligands modelled in this entry, 1 is 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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 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	545/546 (99%)	0.72	56 (10%)	12	13	3, 13, 33, 53	0

All (56) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	544	VAL	5.6
1	A	516	ILE	5.3
1	A	513	THR	5.3
1	A	2	ALA	5.2
1	A	3	LEU	5.0
1	A	453	PRO	4.7
1	A	515	ASP	4.6
1	A	223	ASP	4.5
1	A	514	GLU	4.2
1	A	44	THR	4.2
1	A	517	TYR	4.1
1	A	454	ALA	3.9
1	A	452	ALA	3.7
1	A	545	ILE	3.7
1	A	462	LEU	3.6
1	A	10	THR	3.6
1	A	541	VAL	3.5
1	A	12	THR	3.5
1	A	539	GLU	3.4
1	A	11	ALA	3.3
1	A	542	ASP	3.3
1	A	465	LEU	3.2
1	A	512	GLY	3.2
1	A	450	ILE	3.1
1	A	468	GLU	3.1
1	A	546	GLY	3.1
1	A	14	ASP	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	471	THR	2.9
1	A	469	GLN	2.9
1	A	461	LYS	2.9
1	A	540	LEU	2.9
1	A	15	GLN	2.8
1	A	476	ALA	2.8
1	A	493	SER	2.7
1	A	173	TRP	2.7
1	A	491	GLY	2.7
1	A	459	LYS	2.7
1	A	34	SER	2.5
1	A	481	GLU	2.5
1	A	442	PHE	2.5
1	A	464	LYS	2.5
1	A	473	SER	2.5
1	A	477	GLY	2.3
1	A	363	ARG	2.3
1	A	479	LYS	2.2
1	A	455	THR	2.2
1	A	466	SER	2.2
1	A	443	GLY	2.2
1	A	4	HIS	2.2
1	A	487	ALA	2.2
1	A	463	LYS	2.2
1	A	474	GLN	2.1
1	A	475	LEU	2.1
1	A	467	ARG	2.1
1	A	457	ALA	2.0
1	A	538	GLN	2.0

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 ⓘ

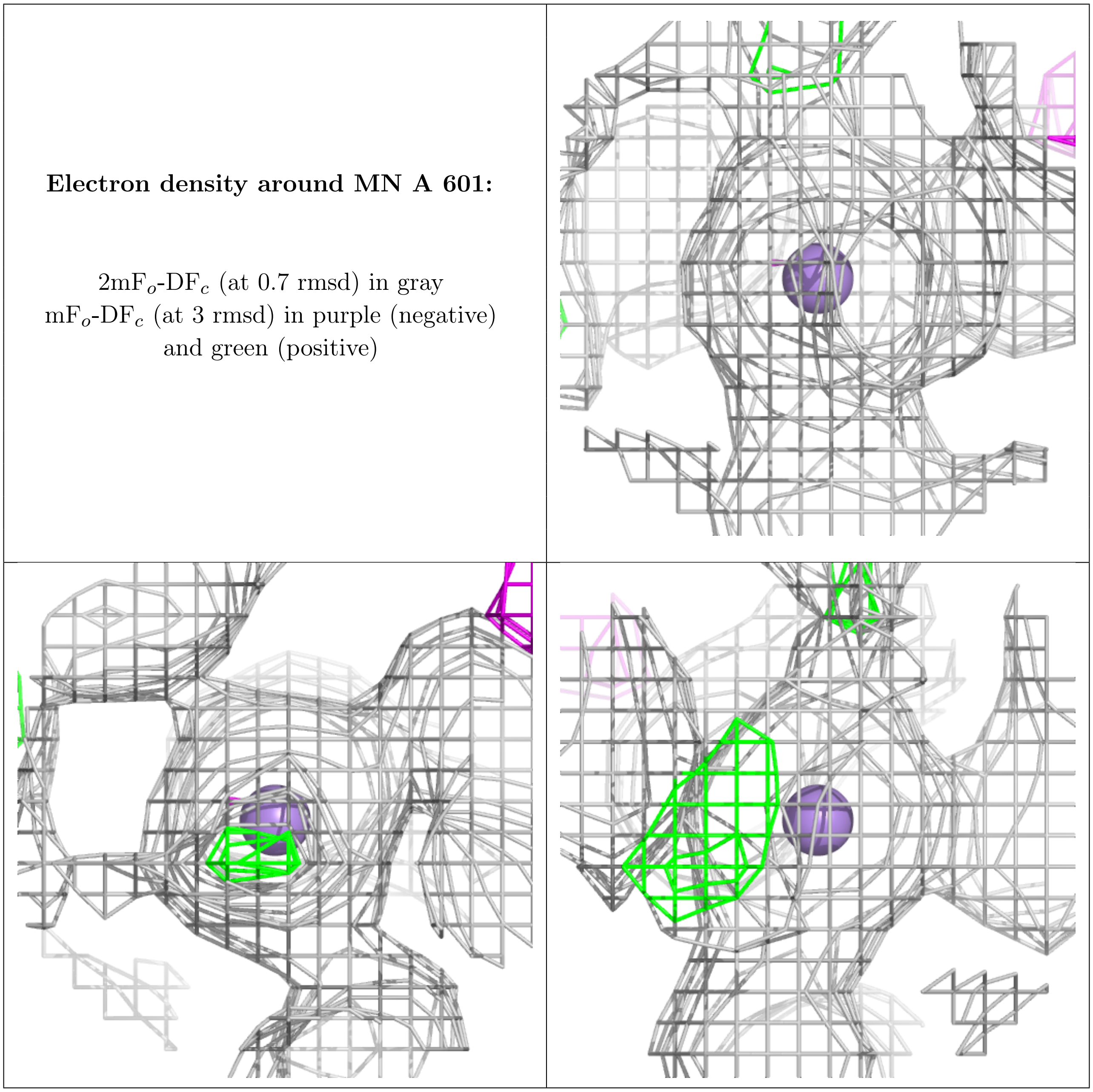
There are no oligosaccharides in this entry.

6.4 Ligands

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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($Å^2$)	Q<0.9
2	MN	A	601	1/1	0.99	0.07	12,12,12,12	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 MN A 601:

$2mF_o$-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.