Full wwPDB X-ray Structure Validation Report (i)

Jan 13, 2025 – 02:40 PM JST

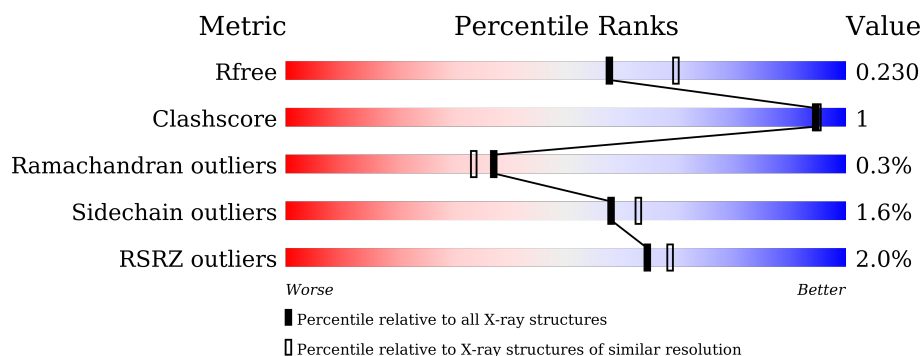|		
PDB ID	:	8XVQ
Title	:	Crystal structure of inulosucrase from Lactobacillus reuteri 121 in complex with fructose
Authors	:	Ni, D.; Hou, X.; Cheng, M.; Xu, W.; Rao, Y.; Mu, W.
Deposited on	:	2024-01-15
Resolution	:	2.14 Å(reported)

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1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.14 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		0.230
Clashscore		1
Ramachandran outliers		0.3%
Sidechain outliers		1.6%
RSRZ outliers		2.0%

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$_{free}$	164625	3336 (2.16-2.12)
Clashscore	180529	3585 (2.16-2.12)
Ramachandran outliers	177936	3554 (2.16-2.12)
Sidechain outliers	177891	3553 (2.16-2.12)
RSRZ outliers	164620	3337 (2.16-2.12)

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	798	.% 62% • 35%
1	B	798	.% 62% • 35%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8483 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 Inulosucrase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	520	Total	C	N	O	S	0	0	0
			4071	2554	686	818	13			
1	B	516	Total	C	N	O	S	0	1	0
			4049	2540	682	814	13			

- Molecule 2 is beta-D-fructofuranose (three-letter code: FRU) (formula: $C_6H_{12}O_6$) (labeled as "Ligand of Interest" by depositor).

FRU
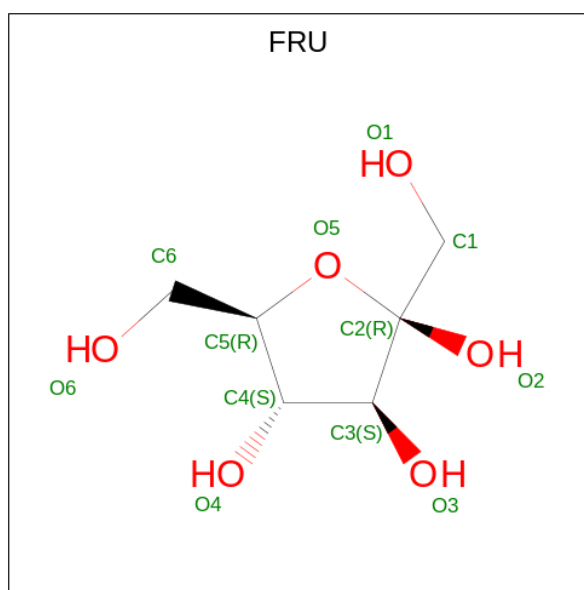
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			12	6	6		
2	B	1	Total	C	O	0	0
			12	6	6		

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total 2	Ca 2	0	0
3	B	2	Total 2	Ca 2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	169	Total 169	O 169	0	0
4	B	166	Total 166	O 166	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: Inulosucrase

Chain A:

• Molecule 1: Inulosucrase

Chain B:
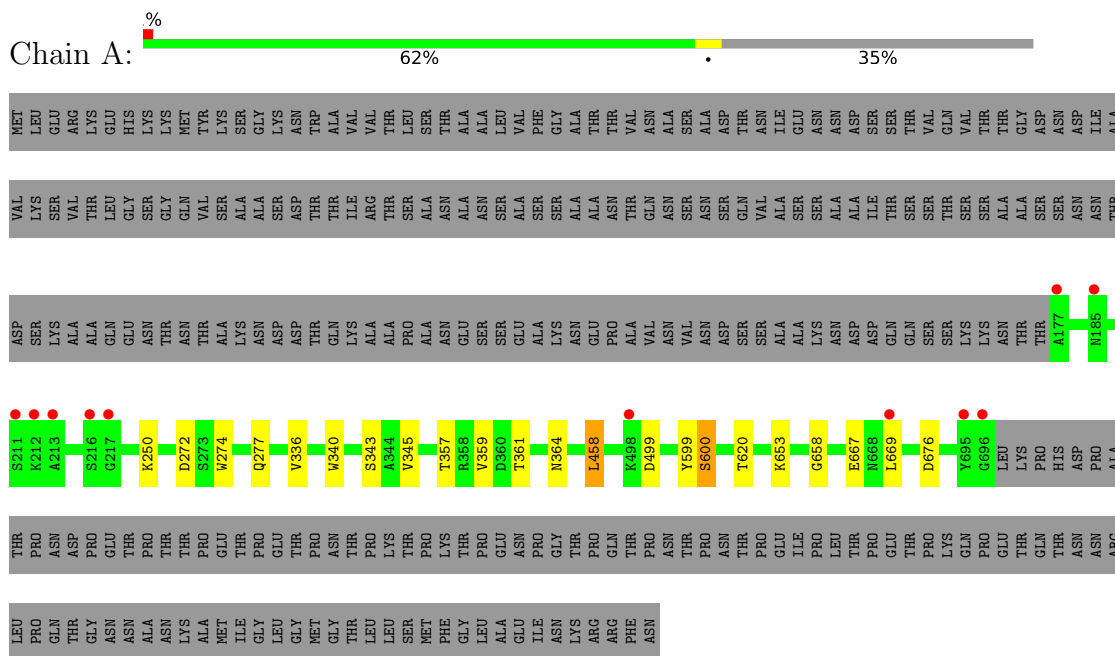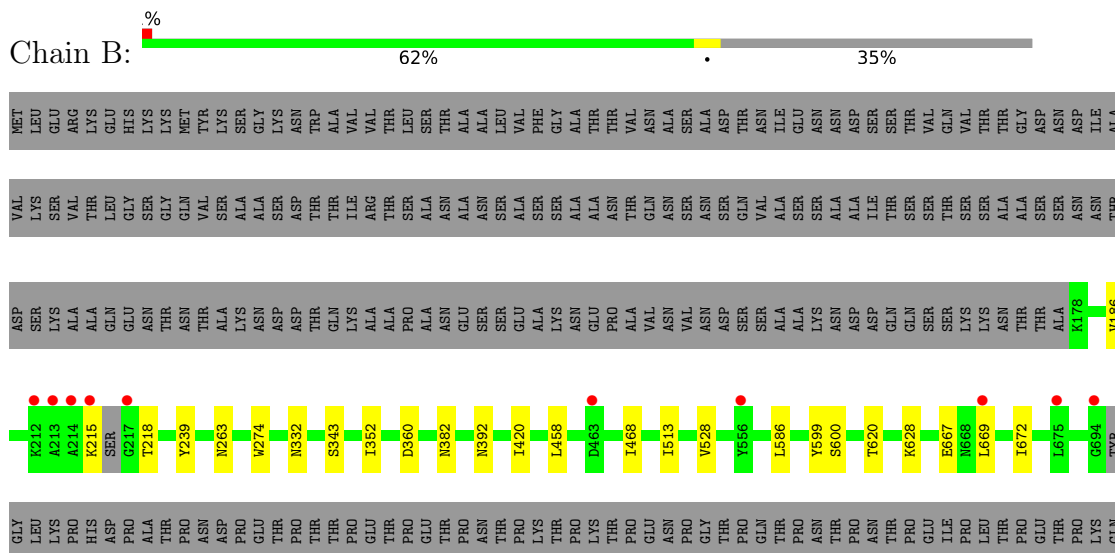
PRO GLU THR GLN THR ASN ASN ARG LEU PRO GLN THR GLY ASN ASN ALA ASN LYS ALA MET ILE GLY LEU GLY MET GLY THR LEU LEU SER MET PHE GLY LEU ALA GLU ILE ASN LYS ARG ARG PHE ASN

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	70.24Å 99.92Å 153.03Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.54 – 2.14 47.54 – 2.14	Depositor EDS
% Data completeness (in resolution range)	98.7 (47.54-2.14) 98.7 (47.54-2.14)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	7.39 (at 2.14Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.178 , 0.227 0.186 , 0.230	Depositor DCC
R_{free} test set	3050 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å^2)	22.9	Xtriage
Anisotropy	0.069	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 35.1	EDS
L-test for twinning[2]	$< |L| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	8483	wwPDB-VP
Average B, all atoms (Å^2)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.18% 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: CA, FRU

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	0.44	0/4161	0.63	0/5670
1	B	0.46	0/4140	0.67	0/5640
All	All	0.45	0/8301	0.65	0/11310

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	4071	0	3874	10	0
1	B	4049	0	3855	9	0
2	A	12	0	12	0	0
2	B	12	0	12	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	169	0	0	2	0
4	B	166	0	0	1	0
All	All	8483	0	7753	19	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 1.

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wwPDB
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All (19) 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:653:LYS:HD2	1:A:667:GLU:OE2	1.98	0.62
1:B:360:ASP:CG	4:B:901:HOH:O	2.43	0.56
1:A:340:TRP:HB2	1:A:357:THR:HB	1.87	0.55
1:B:274:TRP:CD1	1:B:343:SER:HA	2.42	0.54
1:A:599:TYR:CG	1:A:600:SER:N	2.81	0.49
1:A:667:GLU:OE2	1:A:669:LEU:HD21	2.14	0.47
1:B:667:GLU:OE2	1:B:669:LEU:HD21	2.15	0.47
1:A:277:GLN:O	1:A:345:VAL:HA	2.15	0.47
1:A:458:LEU:CD2	4:A:1064:HOH:O	2.63	0.46
1:B:186:VAL:HG23	1:B:468:ILE:HD11	1.97	0.46
1:B:352:ILE:HD12	1:B:352:ILE:N	2.33	0.44
1:A:274:TRP:CD1	1:A:343:SER:HA	2.53	0.44
1:B:239:TYR:O	1:B:586:LEU:HA	2.19	0.42
1:A:336:VAL:HA	1:A:361:THR:OG1	2.19	0.42
1:B:218:THR:HB	1:B:513:ILE:HD13	2.01	0.42
1:B:263:ASN:ND2	1:B:332:ASN:OD1	2.53	0.42
1:B:599:TYR:CG	1:B:600:SER:N	2.88	0.41
1:A:340:TRP:CD2	1:A:359:VAL:HG21	2.57	0.40
1:A:658:GLY:HA2	4:A:1054:HOH:O	2.20	0.40

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	518/798 (65%)	501 (97%)	15 (3%)	2 (0%)	30	26
1	B	513/798 (64%)	495 (96%)	17 (3%)	1 (0%)	44	43
All	All	1031/1596 (65%)	996 (97%)	32 (3%)	3 (0%)	37	33

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	499	ASP
1	A	620	THR
1	B	620	THR

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	437/671 (65%)	431 (99%)	6 (1%)	62	67
1	B	436/671 (65%)	428 (98%)	8 (2%)	54	57
All	All	873/1342 (65%)	859 (98%)	14 (2%)	58	63

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	250	LYS
1	A	272	ASP
1	A	364	ASN
1	A	458	LEU
1	A	600	SER
1	A	676	ASP
1	B	215	LYS
1	B	382	ASN
1	B	392	ASN
1	B	420	ILE
1	B	458	LEU
1	B	528	VAL
1	B	628	LYS
1	B	672	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	185	ASN
1	B	185	ASN
1	B	195	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 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 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	#$|Z| > 2$
2	FRU	A	801	-	11,12,12	0.94	1 (9%)	10,18,18	0.68	0
2	FRU	B	801	-	11,12,12	0.91	1 (9%)	10,18,18	0.74	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
2	FRU	A	801	-	-	3/5/24/24	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	FRU	B	801	-	-	3/5/24/24	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	801	FRU	O2-C2	2.29	1.44	1.40
2	B	801	FRU	O2-C2	2.18	1.44	1.40

There are no bond angle outliers.

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	FRU	O1-C1-C2-C3
2	A	801	FRU	O1-C1-C2-O2
2	B	801	FRU	O1-C1-C2-C3
2	B	801	FRU	O1-C1-C2-O2
2	B	801	FRU	O1-C1-C2-O5
2	A	801	FRU	O1-C1-C2-O5

There are no ring outliers.

No monomer is involved in short contacts.

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 FRU A 801

Bond lengths

Bond angles

Torsions

Rings

Ligand FRU B 801

Bond lengths

Bond angles

Torsions

Rings
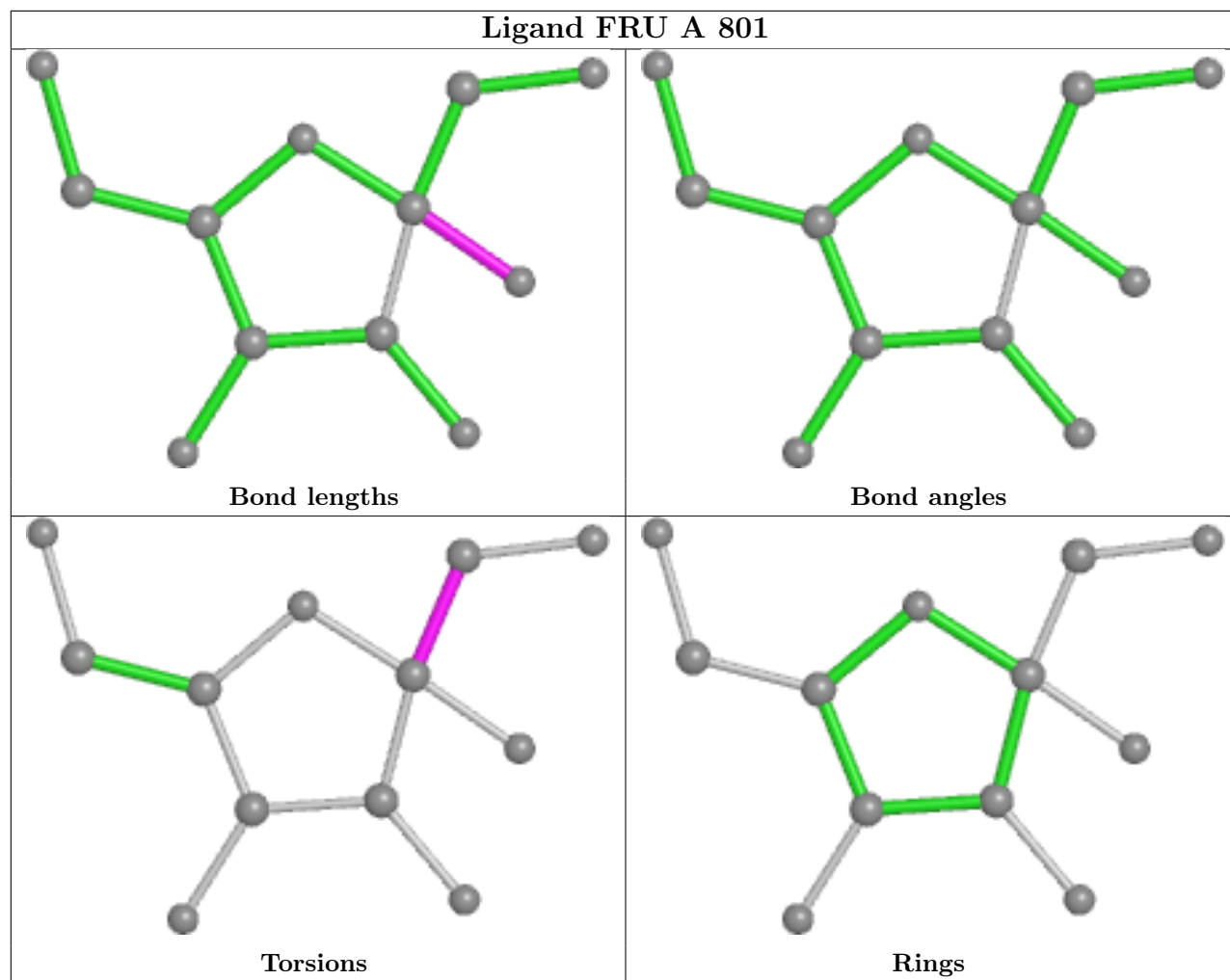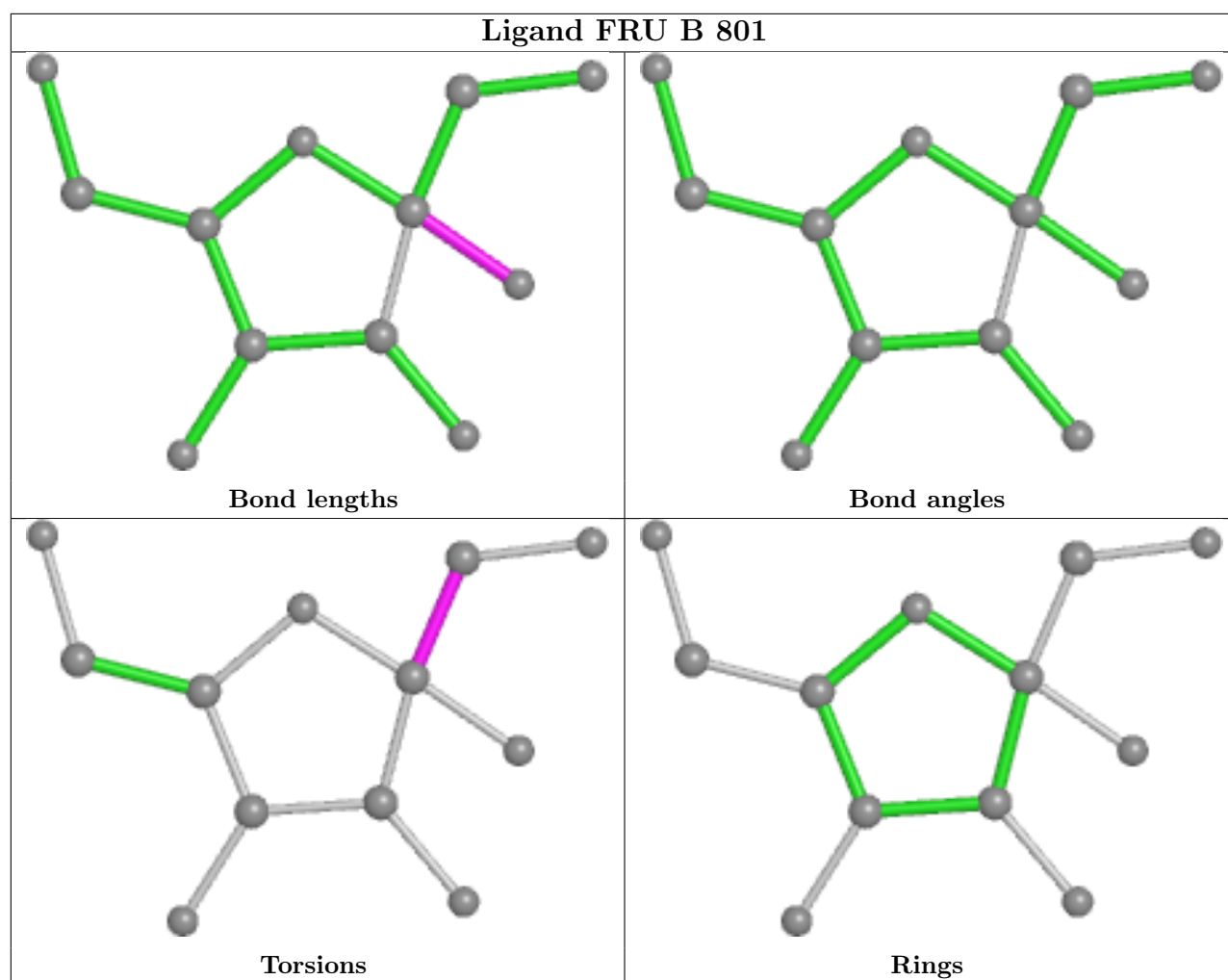
5.7 Other polymers ⓘ

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	520/798 (65%)	0.01	11 (2%)	63	67	14, 24, 43, 58	0
1	B	516/798 (64%)	-0.19	10 (1%)	66	70	14, 21, 37, 77	1 (0%)
All	All	1036/1596 (64%)	-0.09	21 (2%)	64	68	14, 23, 41, 77	1 (0%)

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	177	ALA	4.5
1	B	215	LYS	4.1
1	B	213	ALA	3.3
1	B	556	TYR	2.9
1	A	696	GLY	2.9
1	B	212	LYS	2.8
1	A	212	LYS	2.7
1	A	213	ALA	2.7
1	B	217	GLY	2.7
1	A	217	GLY	2.6
1	B	669	LEU	2.6
1	B	214	ALA	2.6
1	A	216	SER	2.5
1	B	675	LEU	2.4
1	A	695	TYR	2.4
1	A	669	LEU	2.3
1	B	463	ASP	2.2
1	A	211	SER	2.1
1	B	694	GLY	2.1
1	A	498	LYS	2.1
1	A	185	ASN	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 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
2	FRU	A	801	12/12	0.79	0.14	30,34,36,36	0
2	FRU	B	801	12/12	0.80	0.13	32,36,41,42	0
3	CA	A	802	1/1	0.98	0.05	18,18,18,18	0
3	CA	A	803	1/1	0.99	0.03	23,23,23,23	0
3	CA	B	803	1/1	0.99	0.04	17,17,17,17	0
3	CA	B	802	1/1	1.00	0.03	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.

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Electron density around FRU A 801:

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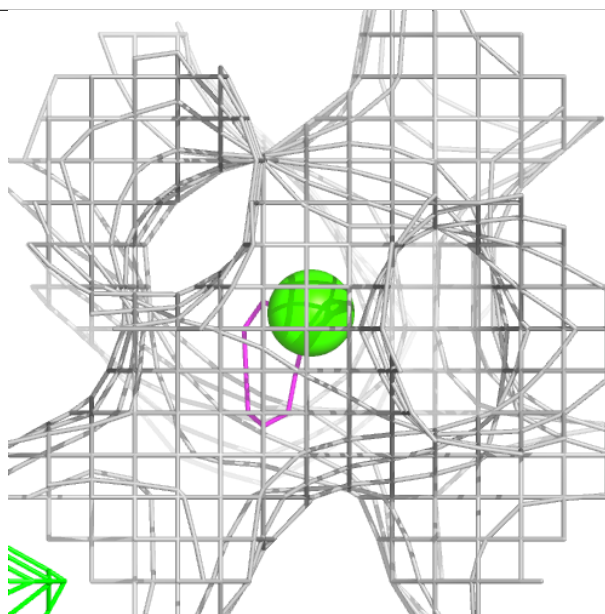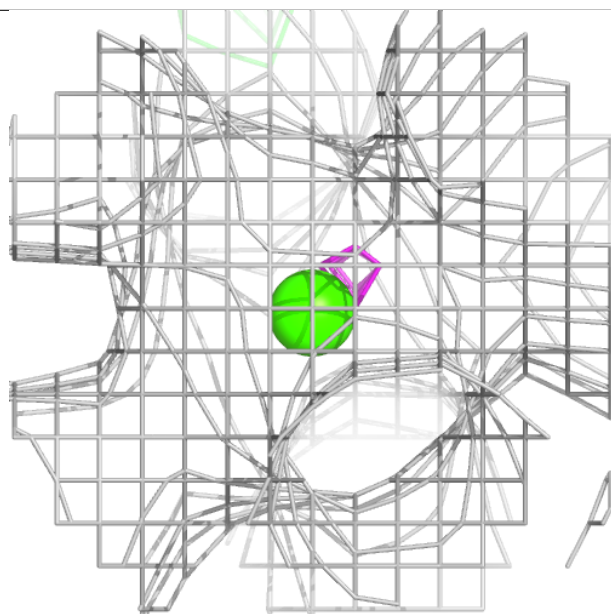$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
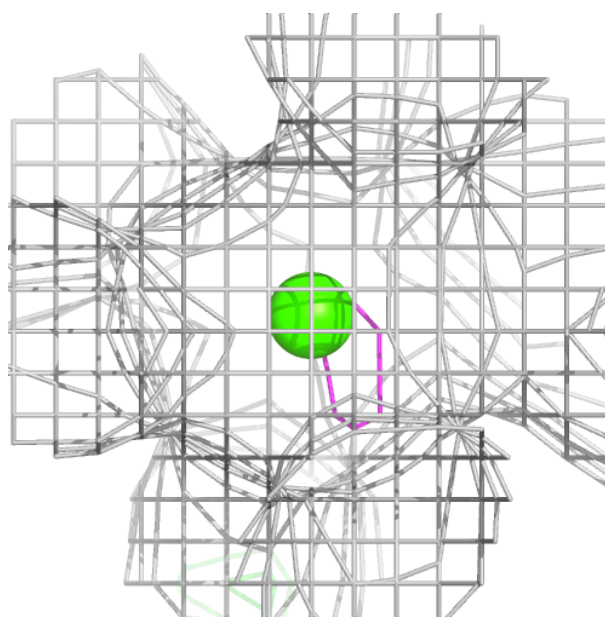and green (positive)

Electron density around FRU B 801:

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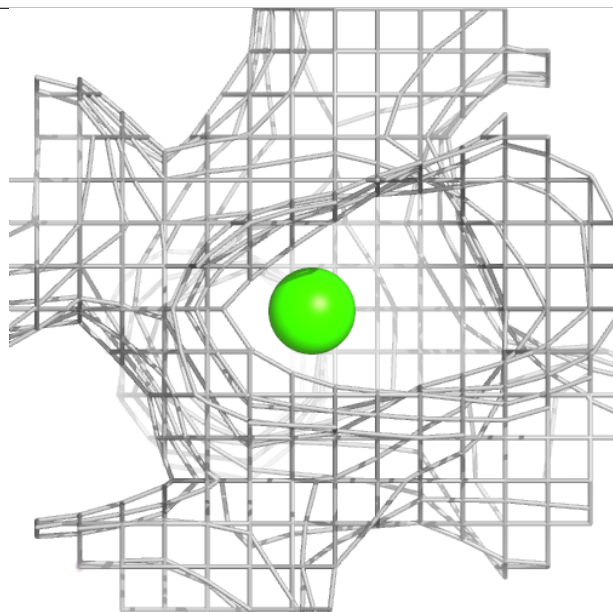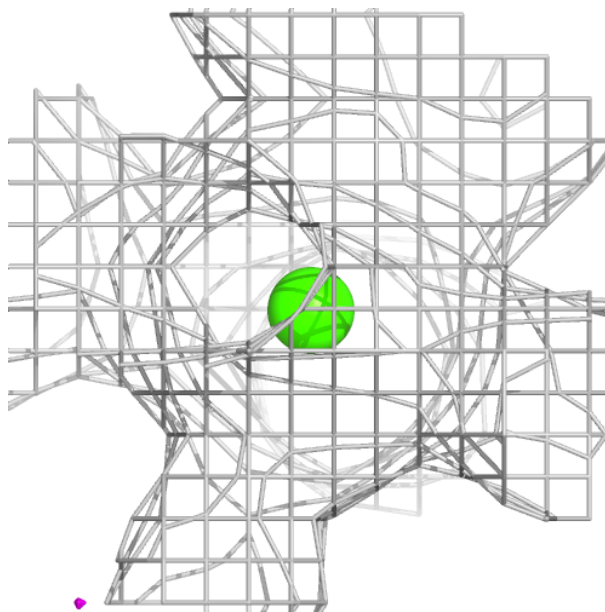$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around CA A 802:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
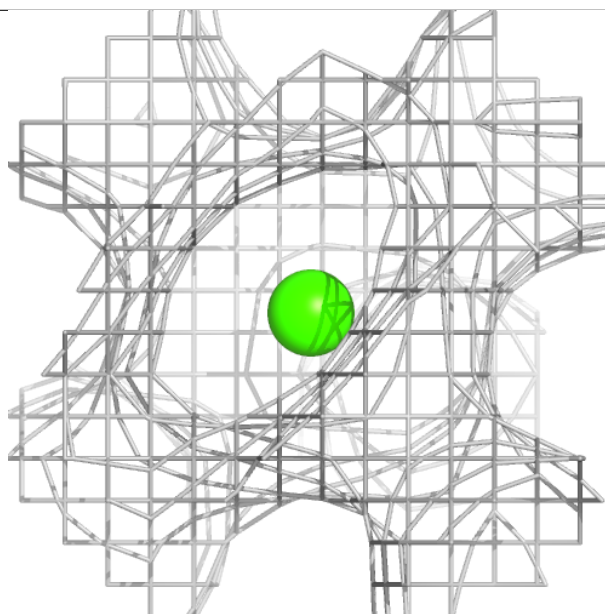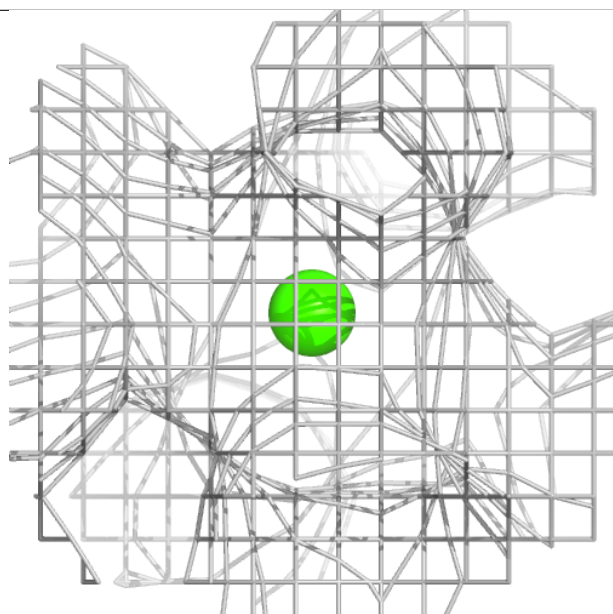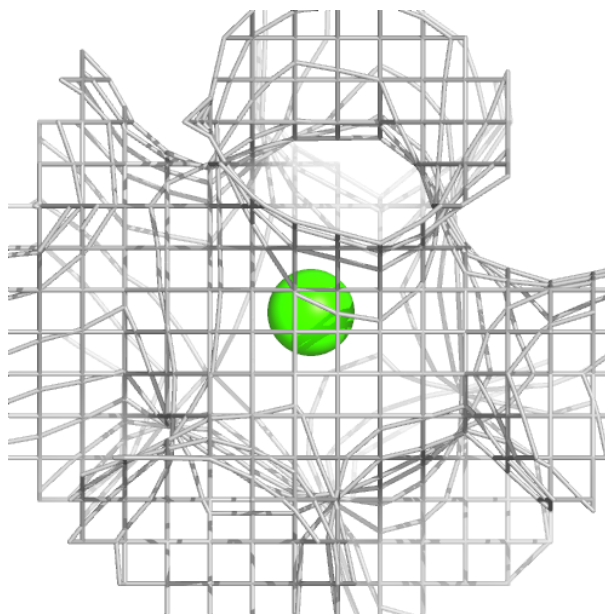mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around CA A 803:

2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative)
and green (positive)
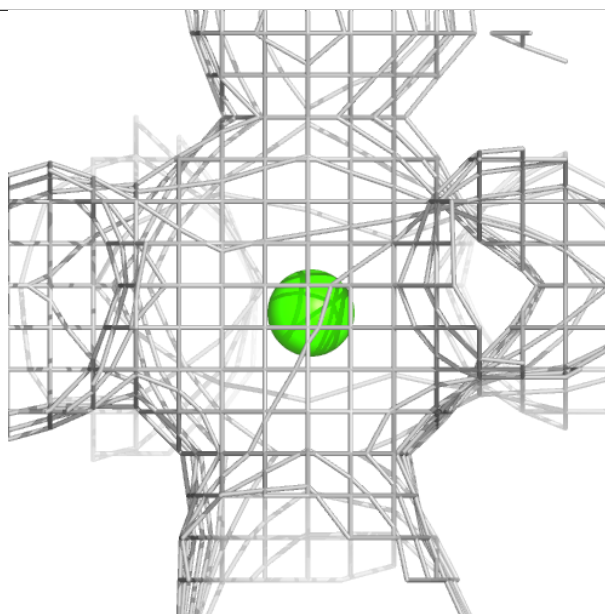
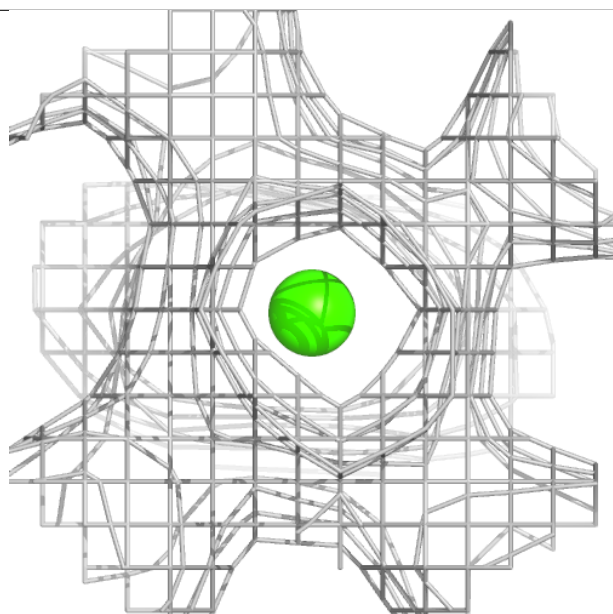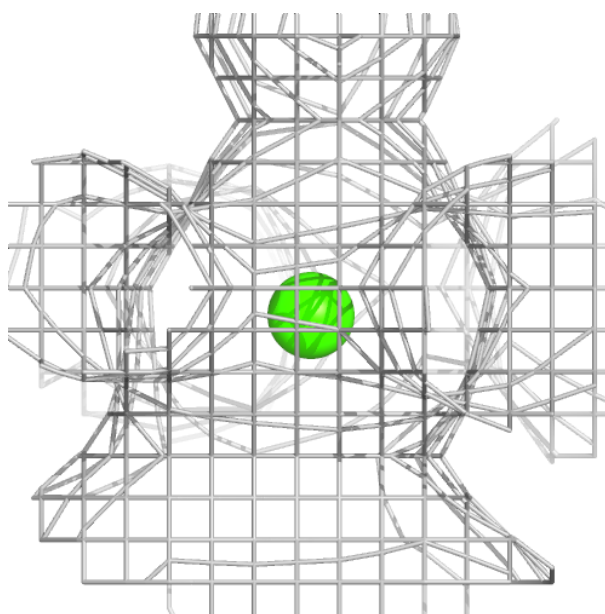**Electron density around CA B 803:**

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

Electron density around CA B 802:

$2mF_o$-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.