



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 16, 2021 – 04:12 PM JST

PDB ID : 7EIQ  
Title : Crystal structure of chondroitin ABC lyase I in complex with chondroitin disaccharide 4S  
Authors : Takashima, M.; Miyanaga, A.; Eguchi, T.  
Deposited on : 2021-03-31  
Resolution : 1.80 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](mailto: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 ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) 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 : 2.23.1  
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) : 2.23.1

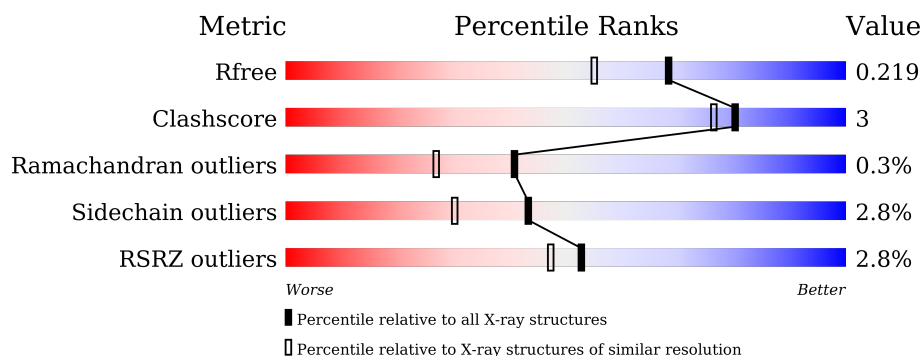
# 1 Overall quality at a glance

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	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  $\geq 3$ , 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  $\leq 5\%$ . 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	1021	<div> <div>3%</div> <div> <div></div> <div>85%</div> <div>9%</div> <div>• 5%</div> </div> </div>
2	B	2	<div> <div></div> <div>100%</div> </div>
2	C	2	<div> <div></div> <div>100%</div> </div>
2	D	2	<div> <div></div> <div>100%</div> </div>

## 2 Entry composition [i](#)

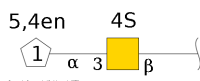
There are 4 unique types of molecules in this entry. The entry contains 8647 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Chondroitin sulfate ABC endolyase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	966	Total	C	N	O	S	0	3	0
			7733	4923	1318	1471	21			

- Molecule 2 is an oligosaccharide called 4-deoxy-alpha-L-threo-hex-4-enopyranuronic acid-(1-3)-2-acetamido-2-deoxy-4-O-sulfo-beta-D-galactopyranose.



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	2	Total	C	N	O	S	0	0	0
			30	14	1	14	1			
2	C	2	Total	C	N	O	S	0	0	0
			30	14	1	14	1			
2	D	2	Total	C	N	O	S	0	0	0
			30	14	1	14	1			

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Mg	0	0
			1	1		

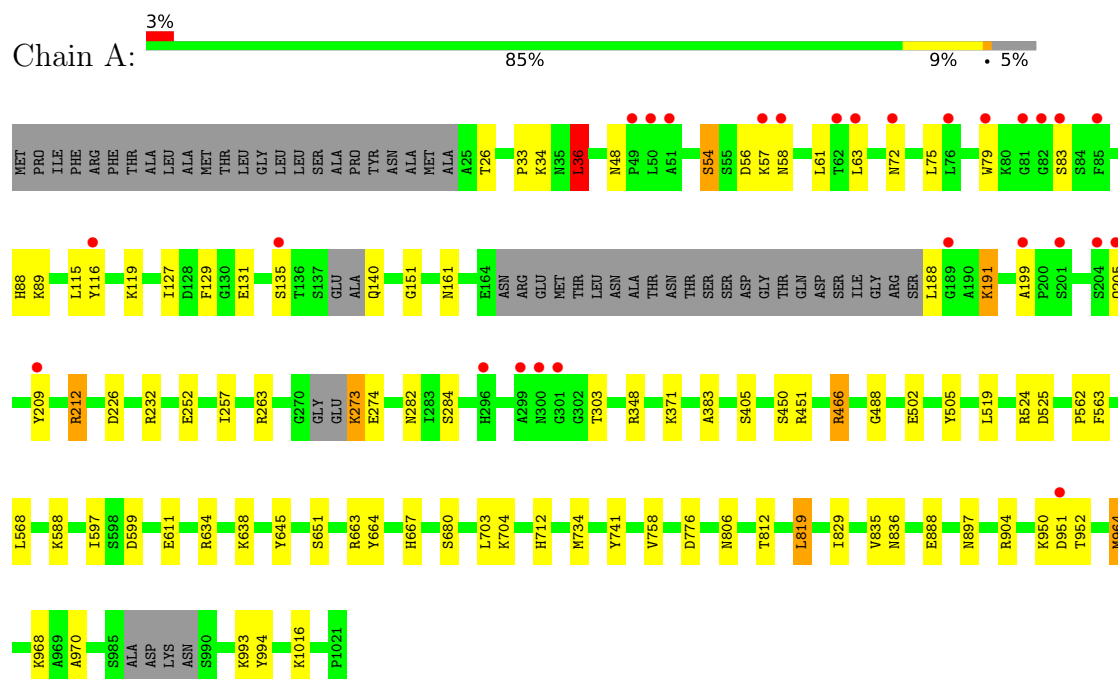
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	823	Total	O	0	0
			823	823		

### 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: Chondroitin sulfate ABC endolyase



- Molecule 2: 4-deoxy-alpha-L-threo-hex-4-enopyranuronic acid-(1-3)-2-acetamido-2-deoxy-4-O-sulfo-beta-D-galactopyranose

Chain B: 


ASG1  
GCD2

- Molecule 2: 4-deoxy-alpha-L-threo-hex-4-enopyranuronic acid-(1-3)-2-acetamido-2-deoxy-4-O-sulfo-beta-D-galactopyranose

Chain C: 

ASG1  
GCD2

- Molecule 2: 4-deoxy-alpha-L-threo-hex-4-enopyranuronic acid-(1-3)-2-acetamido-2-deoxy-4-O-sulfo-beta-D-galactopyranose

Chain D:  100%

ASG1  
GCD2

## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	49.27Å 94.53Å 229.23Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.05 – 1.80 49.01 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.9 (49.05-1.80) 99.9 (49.01-1.80)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.12 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, $R_{free}$	0.171 , 0.213 0.182 , 0.219	Depositor DCC
$R_{free}$ test set	5115 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	20.2	Xtriage
Anisotropy	0.370	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 42.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8647	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.53% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  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: GCD, MG, ASG

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	0.94	6/7931 (0.1%)	1.05	12/10756 (0.1%)

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	274	GLU	CD-OE1	-9.75	1.15	1.25
1	A	252	GLU	CD-OE2	8.30	1.34	1.25
1	A	888	GLU	CD-OE2	6.33	1.32	1.25
1	A	680	SER	CA-CB	-5.61	1.44	1.52
1	A	664	TYR	C-O	5.39	1.33	1.23

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	964	MET	CG-SD-CE	-8.05	87.32	100.20
1	A	466	ARG	NE-CZ-NH2	-7.76	116.42	120.30
1	A	524	ARG	NE-CZ-NH1	-7.74	116.43	120.30
1	A	348	ARG	NE-CZ-NH2	-7.28	116.66	120.30
1	A	904	ARG	NE-CZ-NH2	-6.92	116.84	120.30

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	7733	0	7580	39	0
2	B	30	0	12	0	0
2	C	30	0	12	2	0
2	D	30	0	14	0	0
3	A	1	0	0	0	0
4	A	823	0	0	4	0
All	All	8647	0	7618	41	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 3.

The worst 5 of 41 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:C:1:ASG:H4	2:C:2:GCD:O6B	1.86	0.76
1:A:568:LEU:HD23	1:A:597[B]:ILE:HD11	1.80	0.64
1:A:829:ILE:HD13	1:A:835:VAL:HG21	1.86	0.58
1:A:212:ARG:O	1:A:212:ARG:HD2	2.04	0.58
1:A:812:THR:HG22	1:A:836:ASN:HD22	1.69	0.57

There are no symmetry-related clashes.

## 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	959/1021 (94%)	924 (96%)	32 (3%)	3 (0%)	41 27

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	897	ASN
1	A	36	LEU

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Mol	Chain	Res	Type
1	A	48	ASN

### 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	850/890 (96%)	826 (97%)	24 (3%)	43 30

5 of 24 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	405	SER
1	A	599	ASP
1	A	505	TYR
1	A	667	HIS
1	A	127	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	325	GLN
1	A	806	ASN
1	A	836	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 ⓘ

6 monosaccharides are modelled in this entry.

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	ASG	B	1	2	19,19,19	1.34	2 (10%)	23,28,28	2.41	10 (43%)
2	GCD	B	2	2	7,11,12	4.05	3 (42%)	8,15,17	2.24	3 (37%)
2	ASG	C	1	2	19,19,19	1.44	3 (15%)	23,28,28	4.15	8 (34%)
2	GCD	C	2	2	7,11,12	3.66	5 (71%)	8,15,17	2.61	4 (50%)
2	ASG	D	1	2	19,19,19	1.76	3 (15%)	23,28,28	3.84	8 (34%)
2	GCD	D	2	2	7,11,12	4.60	4 (57%)	8,15,17	1.74	1 (12%)

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	ASG	B	1	2	-	7/11/31/31	0/1/1/1
2	GCD	B	2	2	-	0/0/17/20	0/1/1/1
2	ASG	C	1	2	-	1/11/31/31	0/1/1/1
2	GCD	C	2	2	-	0/0/17/20	0/1/1/1
2	ASG	D	1	2	-	0/11/31/31	0/1/1/1
2	GCD	D	2	2	-	0/0/17/20	0/1/1/1

The worst 5 of 20 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	2	GCD	C4-C5	8.51	1.42	1.32
2	C	2	GCD	O5-C5	8.25	1.49	1.37
2	D	2	GCD	O5-C5	7.18	1.47	1.37
2	D	2	GCD	C3-C4	7.10	1.59	1.50
2	D	2	GCD	C4-C5	5.66	1.39	1.32

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	1	ASG	C1-C2-C3	-15.19	89.82	110.54
2	D	1	ASG	C1-C2-C3	-10.31	96.48	110.54
2	D	1	ASG	C1-O5-C5	-10.00	94.80	113.66
2	C	1	ASG	C1-O5-C5	-9.82	95.14	113.66
2	D	1	ASG	O1-C1-C2	6.98	123.73	109.22

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

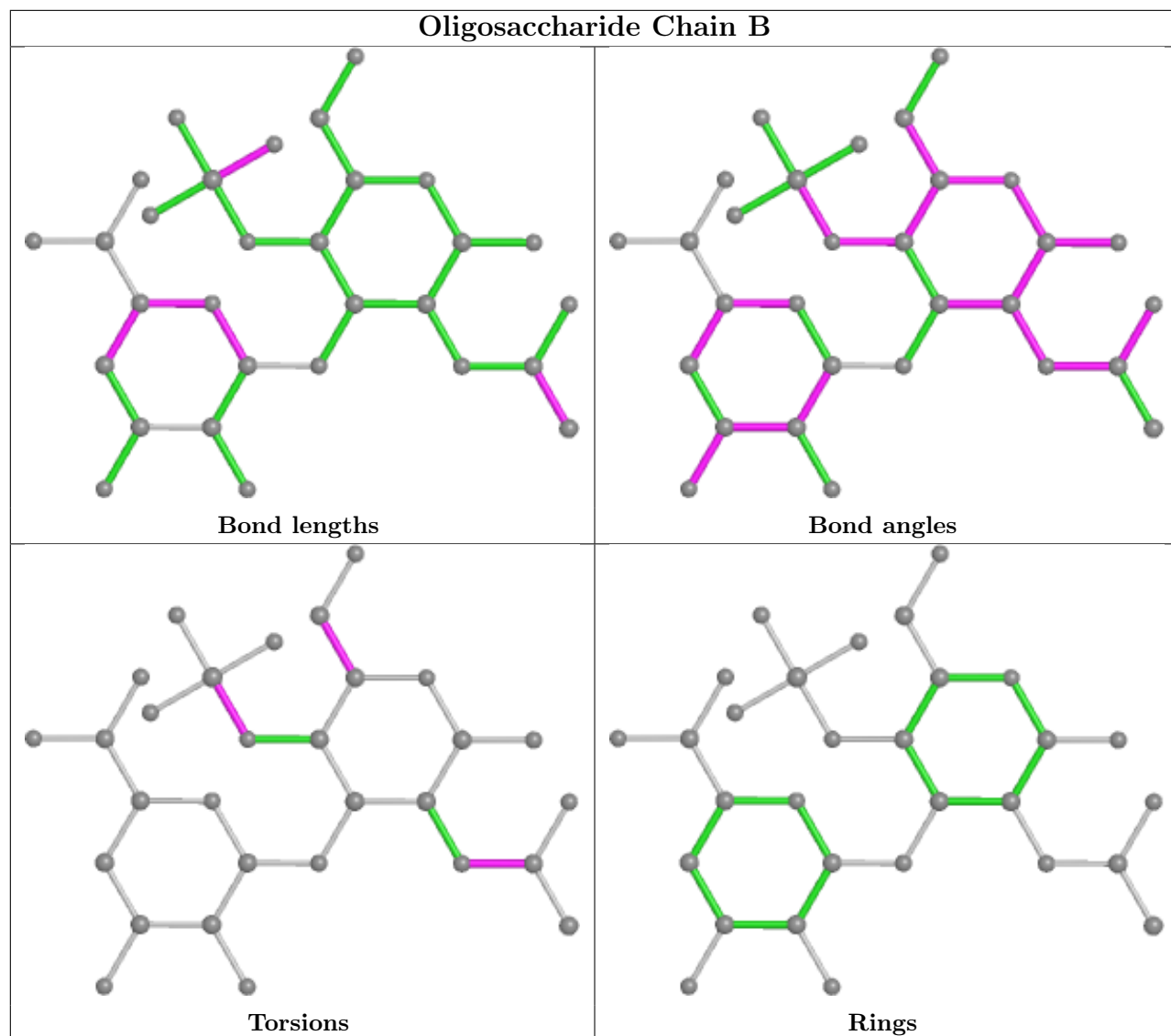
Mol	Chain	Res	Type	Atoms
2	B	1	ASG	C4-O4-S-OSA
2	B	1	ASG	C4-O4-S-OSB
2	B	1	ASG	C4-O4-S-OSC
2	B	1	ASG	C8-C7-N2-C2
2	B	1	ASG	O7-C7-N2-C2

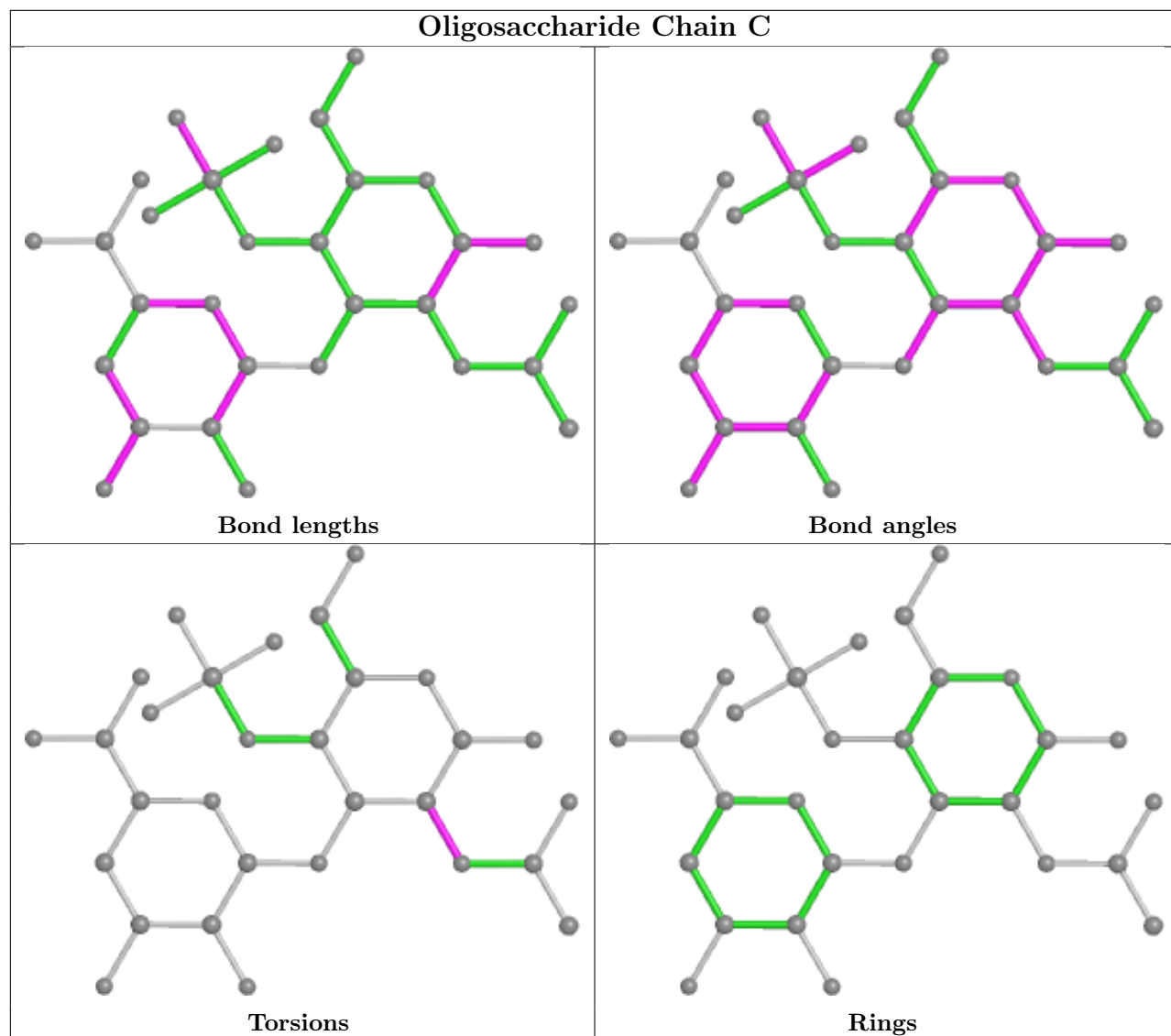
There are no ring outliers.

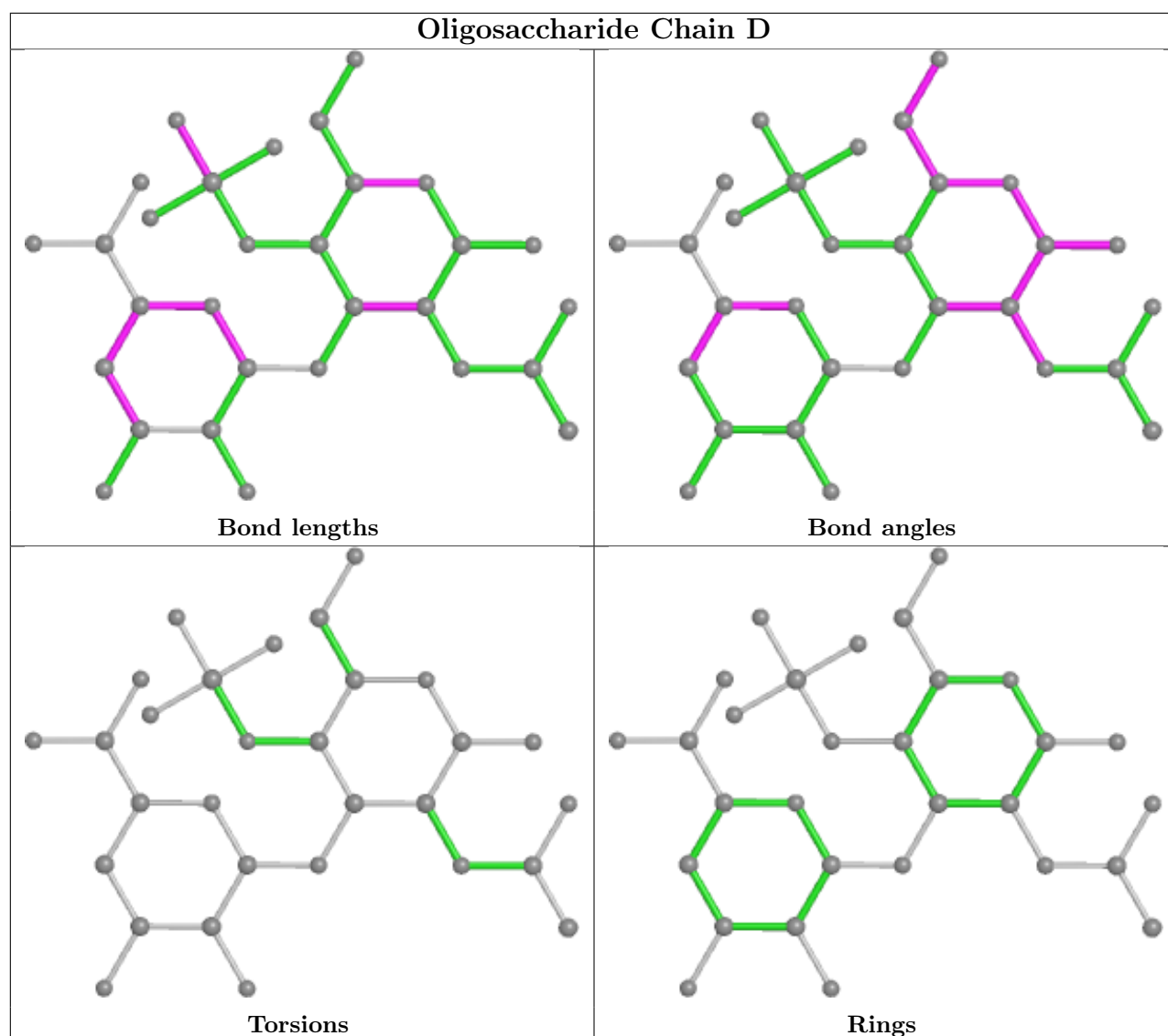
2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	1	ASG	2	0
2	C	2	GCD	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.







## 5.6 Ligand geometry [i](#)

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 [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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	966/1021 (94%)	-0.22	27 (2%) 53 47	12, 22, 53, 73	0

The worst 5 of 27 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	299	ALA	6.1
1	A	301	GLY	4.6
1	A	201	SER	3.3
1	A	49	PRO	3.1
1	A	135	SER	3.1

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

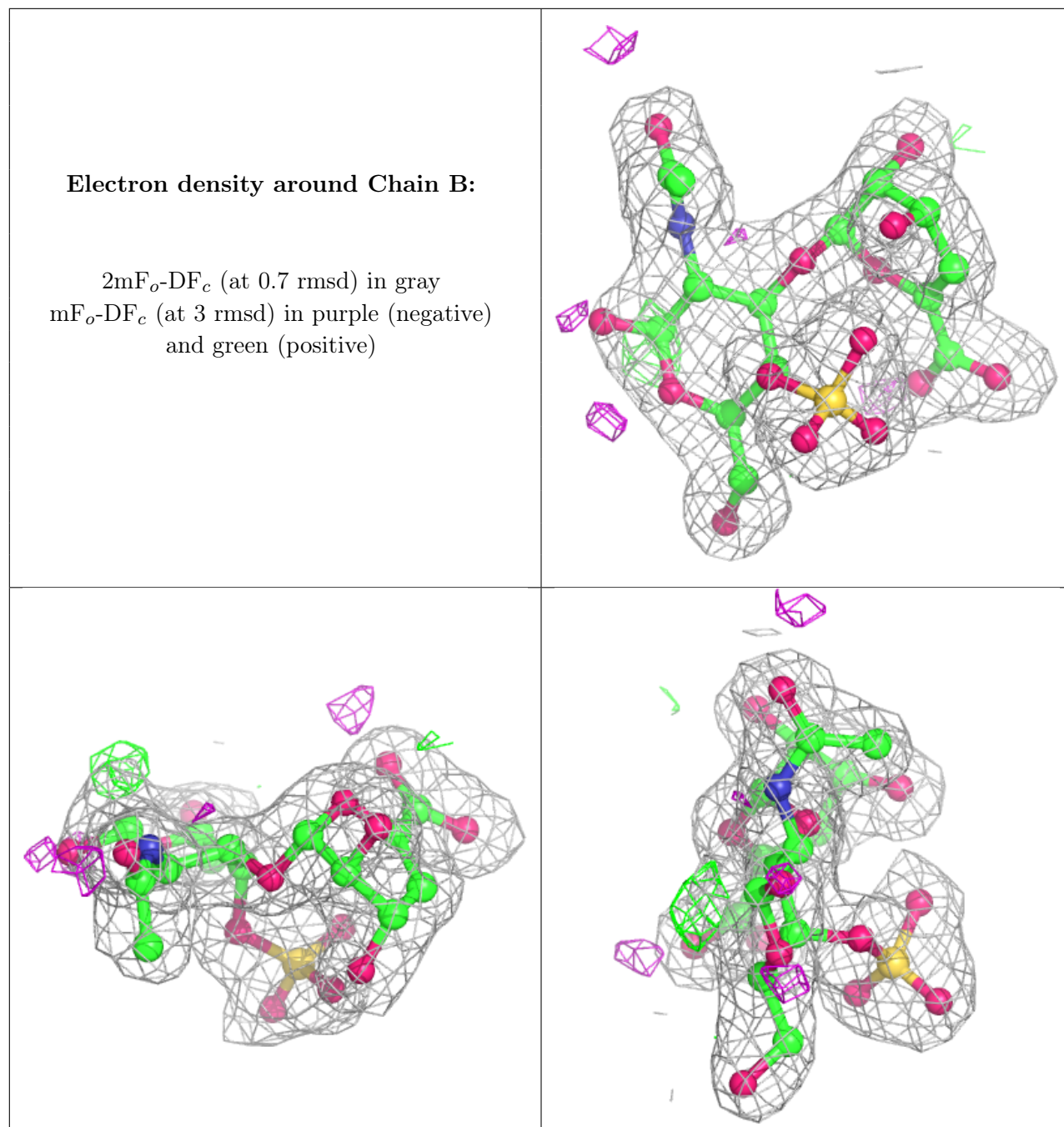
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	GCD	C	2	11/12	0.81	0.13	36,39,49,53	0
2	ASG	C	1	19/19	0.85	0.13	20,37,58,58	0
2	GCD	D	2	11/12	0.88	0.18	23,32,35,37	0
2	ASG	D	1	19/19	0.93	0.18	22,34,39,40	0
2	ASG	B	1	19/19	0.96	0.10	24,30,36,40	0
2	GCD	B	2	11/12	0.97	0.07	20,22,25,25	0

The following is a graphical depiction of the model fit to experimental electron density for oligosac-

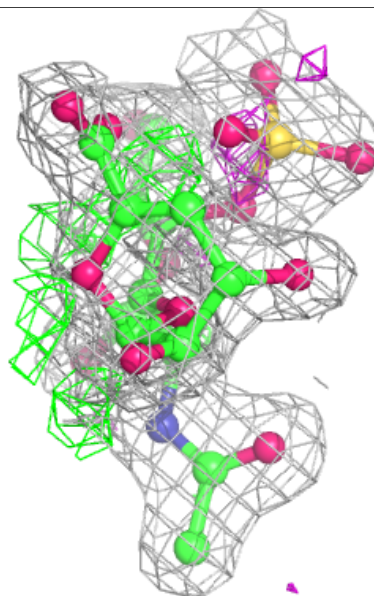
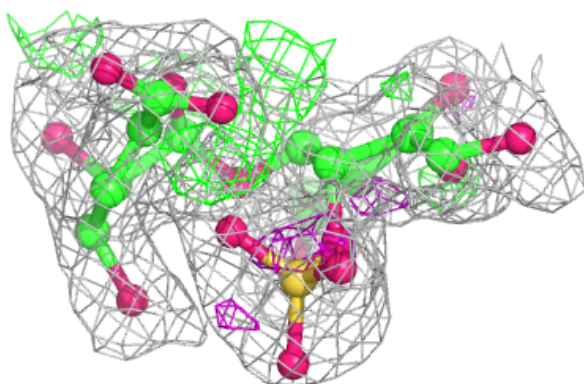
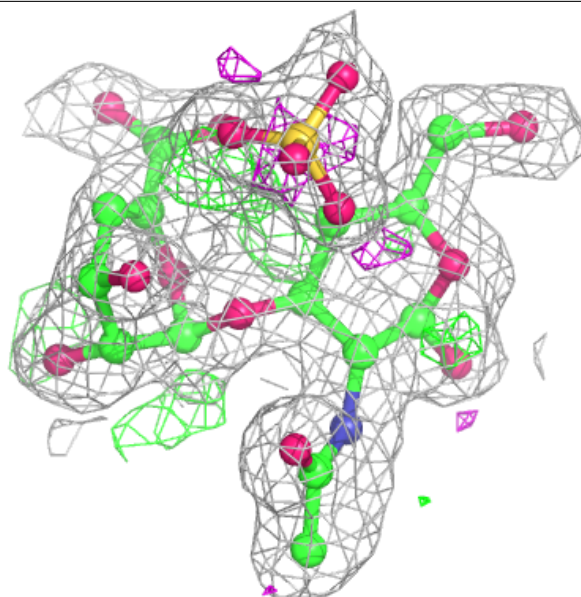


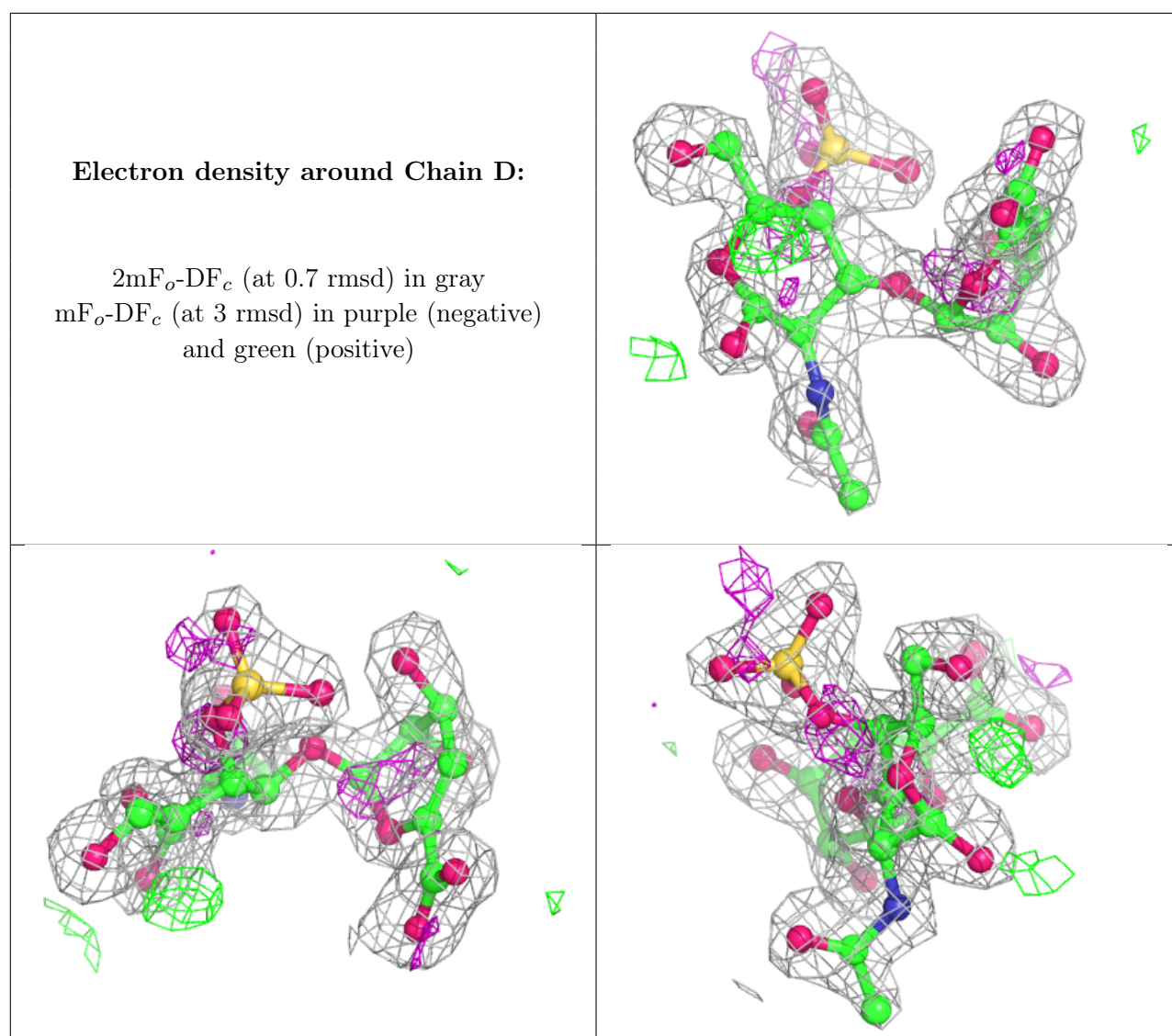
charide. Each fit is shown from different orientation to approximate a three-dimensional view.



**Electron density around Chain C:**

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





## 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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
3	MG	A	1201	1/1	0.97	0.23	31,31,31,31	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.