



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 29, 2025 – 08:33 am BST

PDB ID : 9FHX / pdb\_00009fhx  
Title : Bacteroides ovatus polysaccharide lyase family 38 (BoPL38) wild type in complex tetramannuronic acid at pH 8  
Authors : Tandrup, T.; Wilkens, C.  
Deposited on : 2024-05-28  
Resolution : 2.12 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4-5-2 with Phenix2.0rc1  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 2.0rc1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.44

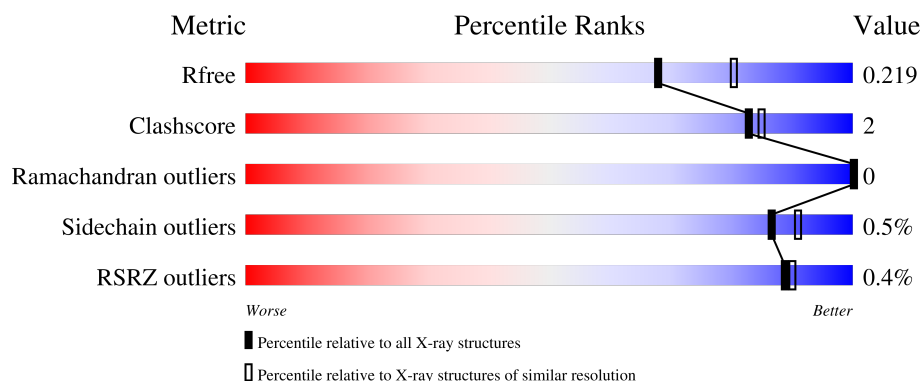
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*



The reported resolution of this entry is 2.12 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	7689 (2.14-2.10)
Clashscore	180529	8431 (2.14-2.10)
Ramachandran outliers	177936	8366 (2.14-2.10)
Sidechain outliers	177891	8367 (2.14-2.10)
RSRZ outliers	164620	7689 (2.14-2.10)

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	404	
1	B	404	
1	C	404	
1	D	404	
2	E	4	

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Mol	Chain	Length	Quality of chain	
2	F	4	<div><div></div></div>	75% 25%
2	G	4	<div><div></div></div>	75% 25%
2	H	4	<div><div></div></div>	50% 50%

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 13367 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 Alginate lyase family protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	380	Total	C	N	O	S	0	3	0
			3074	1967	521	573	13			
1	B	380	Total	C	N	O	S	0	4	0
			3070	1966	517	574	13			
1	C	380	Total	C	N	O	S	0	3	0
			3069	1964	518	573	14			
1	D	381	Total	C	N	O	S	0	2	0
			3070	1964	519	574	13			

There are 92 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP A0A5M5BWR5
A	2	GLY	-	expression tag	UNP A0A5M5BWR5
A	3	SER	-	expression tag	UNP A0A5M5BWR5
A	4	SER	-	expression tag	UNP A0A5M5BWR5
A	5	HIS	-	expression tag	UNP A0A5M5BWR5
A	6	HIS	-	expression tag	UNP A0A5M5BWR5
A	7	HIS	-	expression tag	UNP A0A5M5BWR5
A	8	HIS	-	expression tag	UNP A0A5M5BWR5
A	9	HIS	-	expression tag	UNP A0A5M5BWR5
A	10	HIS	-	expression tag	UNP A0A5M5BWR5
A	11	SER	-	expression tag	UNP A0A5M5BWR5
A	12	SER	-	expression tag	UNP A0A5M5BWR5
A	13	GLY	-	expression tag	UNP A0A5M5BWR5
A	14	LEU	-	expression tag	UNP A0A5M5BWR5
A	15	VAL	-	expression tag	UNP A0A5M5BWR5
A	16	PRO	-	expression tag	UNP A0A5M5BWR5
A	17	ARG	-	expression tag	UNP A0A5M5BWR5
A	18	GLY	-	expression tag	UNP A0A5M5BWR5
A	19	SER	-	expression tag	UNP A0A5M5BWR5
A	20	HIS	-	expression tag	UNP A0A5M5BWR5
A	21	MET	-	expression tag	UNP A0A5M5BWR5

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Chain	Residue	Modelled	Actual	Comment	Reference
A	22	ALA	-	expression tag	UNP A0A5M5BWR5
A	23	SER	-	expression tag	UNP A0A5M5BWR5
B	1	MET	-	initiating methionine	UNP A0A5M5BWR5
B	2	GLY	-	expression tag	UNP A0A5M5BWR5
B	3	SER	-	expression tag	UNP A0A5M5BWR5
B	4	SER	-	expression tag	UNP A0A5M5BWR5
B	5	HIS	-	expression tag	UNP A0A5M5BWR5
B	6	HIS	-	expression tag	UNP A0A5M5BWR5
B	7	HIS	-	expression tag	UNP A0A5M5BWR5
B	8	HIS	-	expression tag	UNP A0A5M5BWR5
B	9	HIS	-	expression tag	UNP A0A5M5BWR5
B	10	HIS	-	expression tag	UNP A0A5M5BWR5
B	11	SER	-	expression tag	UNP A0A5M5BWR5
B	12	SER	-	expression tag	UNP A0A5M5BWR5
B	13	GLY	-	expression tag	UNP A0A5M5BWR5
B	14	LEU	-	expression tag	UNP A0A5M5BWR5
B	15	VAL	-	expression tag	UNP A0A5M5BWR5
B	16	PRO	-	expression tag	UNP A0A5M5BWR5
B	17	ARG	-	expression tag	UNP A0A5M5BWR5
B	18	GLY	-	expression tag	UNP A0A5M5BWR5
B	19	SER	-	expression tag	UNP A0A5M5BWR5
B	20	HIS	-	expression tag	UNP A0A5M5BWR5
B	21	MET	-	expression tag	UNP A0A5M5BWR5
B	22	ALA	-	expression tag	UNP A0A5M5BWR5
B	23	SER	-	expression tag	UNP A0A5M5BWR5
C	1	MET	-	initiating methionine	UNP A0A5M5BWR5
C	2	GLY	-	expression tag	UNP A0A5M5BWR5
C	3	SER	-	expression tag	UNP A0A5M5BWR5
C	4	SER	-	expression tag	UNP A0A5M5BWR5
C	5	HIS	-	expression tag	UNP A0A5M5BWR5
C	6	HIS	-	expression tag	UNP A0A5M5BWR5
C	7	HIS	-	expression tag	UNP A0A5M5BWR5
C	8	HIS	-	expression tag	UNP A0A5M5BWR5
C	9	HIS	-	expression tag	UNP A0A5M5BWR5
C	10	HIS	-	expression tag	UNP A0A5M5BWR5
C	11	SER	-	expression tag	UNP A0A5M5BWR5
C	12	SER	-	expression tag	UNP A0A5M5BWR5
C	13	GLY	-	expression tag	UNP A0A5M5BWR5
C	14	LEU	-	expression tag	UNP A0A5M5BWR5
C	15	VAL	-	expression tag	UNP A0A5M5BWR5
C	16	PRO	-	expression tag	UNP A0A5M5BWR5
C	17	ARG	-	expression tag	UNP A0A5M5BWR5

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Chain	Residue	Modelled	Actual	Comment	Reference
C	18	GLY	-	expression tag	UNP A0A5M5BWR5
C	19	SER	-	expression tag	UNP A0A5M5BWR5
C	20	HIS	-	expression tag	UNP A0A5M5BWR5
C	21	MET	-	expression tag	UNP A0A5M5BWR5
C	22	ALA	-	expression tag	UNP A0A5M5BWR5
C	23	SER	-	expression tag	UNP A0A5M5BWR5
D	1	MET	-	initiating methionine	UNP A0A5M5BWR5
D	2	GLY	-	expression tag	UNP A0A5M5BWR5
D	3	SER	-	expression tag	UNP A0A5M5BWR5
D	4	SER	-	expression tag	UNP A0A5M5BWR5
D	5	HIS	-	expression tag	UNP A0A5M5BWR5
D	6	HIS	-	expression tag	UNP A0A5M5BWR5
D	7	HIS	-	expression tag	UNP A0A5M5BWR5
D	8	HIS	-	expression tag	UNP A0A5M5BWR5
D	9	HIS	-	expression tag	UNP A0A5M5BWR5
D	10	HIS	-	expression tag	UNP A0A5M5BWR5
D	11	SER	-	expression tag	UNP A0A5M5BWR5
D	12	SER	-	expression tag	UNP A0A5M5BWR5
D	13	GLY	-	expression tag	UNP A0A5M5BWR5
D	14	LEU	-	expression tag	UNP A0A5M5BWR5
D	15	VAL	-	expression tag	UNP A0A5M5BWR5
D	16	PRO	-	expression tag	UNP A0A5M5BWR5
D	17	ARG	-	expression tag	UNP A0A5M5BWR5
D	18	GLY	-	expression tag	UNP A0A5M5BWR5
D	19	SER	-	expression tag	UNP A0A5M5BWR5
D	20	HIS	-	expression tag	UNP A0A5M5BWR5
D	21	MET	-	expression tag	UNP A0A5M5BWR5
D	22	ALA	-	expression tag	UNP A0A5M5BWR5
D	23	SER	-	expression tag	UNP A0A5M5BWR5

- Molecule 2 is an oligosaccharide called beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid.



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
2	E	4	Total	C	O	0	0	0
			49	24	25			
2	F	4	Total	C	O	0	0	0
			49	24	25			

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
2	G	4	Total	C	O	0	0	0
			49	24	25			
2	H	4	Total	C	O	0	0	0
			49	24	25			

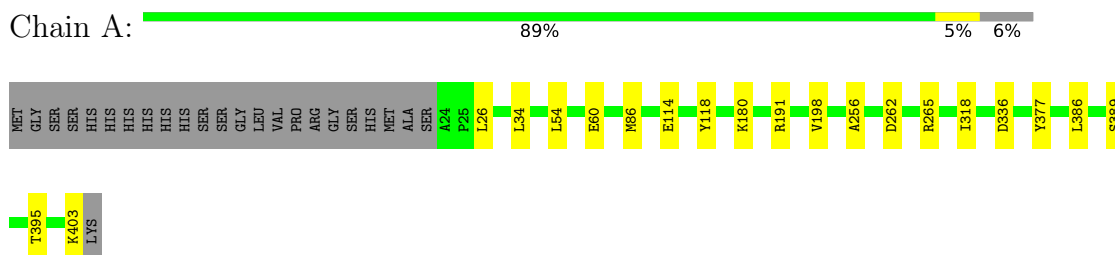
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	246	Total	O	0	1
			246	246		
3	B	238	Total	O	0	0
			238	238		
3	C	204	Total	O	0	0
			204	204		
3	D	200	Total	O	0	0
			200	200		

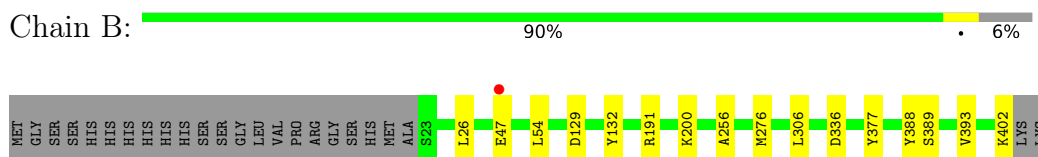
### 3 Residue-property plots

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.

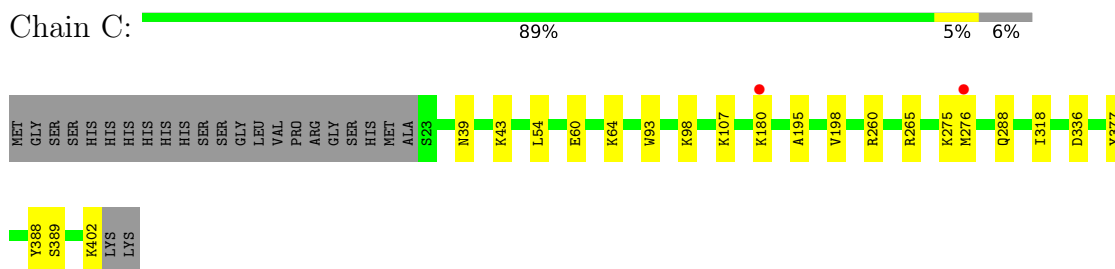
- Molecule 1: Alginate lyase family protein



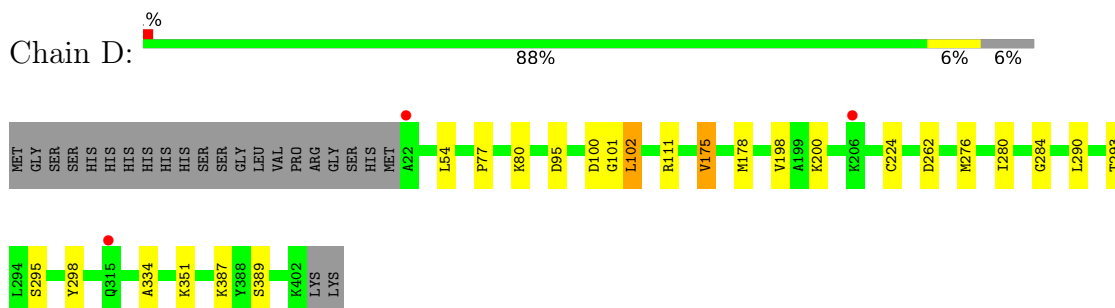
- Molecule 1: Alginate lyase family protein



- Molecule 1: Alginate lyase family protein




- Molecule 1: Alginate lyase family protein






- Molecule 2: beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid

Chain E:  75% 25%

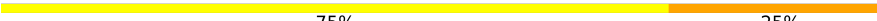
BEM1  
BEM2  
BEM3  
BEM4

- Molecule 2: beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid

Chain F:  75% 25%

BEM1  
BEM2  
BEM3  
BEM4

- Molecule 2: beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid

Chain G:  75% 25%

BEM1  
BEM2  
BEM3  
BEM4

- Molecule 2: beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid-(1-4)-beta-D-mannopyranuronic acid

Chain H:  50% 50%

BEM1  
BEM2  
BEM3  
BEM4

## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	197.33Å 89.36Å 146.51Å 90.00° 120.56° 90.00°	Depositor
Resolution (Å)	60.84 – 2.12 60.84 – 2.12	Depositor EDS
% Data completeness (in resolution range)	99.9 (60.84-2.12) 99.9 (60.84-2.12)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.26 (at 2.12Å)	Xtriage
Refinement program	PHENIX 1.21_5207	Depositor
R, $R_{free}$	0.176 , 0.219 0.176 , 0.219	Depositor DCC
$R_{free}$ test set	6172 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	29.8	Xtriage
Anisotropy	0.022	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 36.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	13367	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.59% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: BEM

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	0.34	0/3161	0.48	0/4282
1	B	0.33	0/3160	0.50	0/4284
1	C	0.33	0/3153	0.49	0/4273
1	D	0.32	0/3151	0.50	0/4271
All	All	0.33	0/12625	0.49	0/17110

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 [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	3074	0	3055	12	0
1	B	3070	0	3050	11	0
1	C	3069	0	3045	14	0
1	D	3070	0	3043	15	0
2	E	49	0	27	1	0
2	F	49	0	27	1	0
2	G	49	0	27	1	0
2	H	49	0	27	2	0
3	A	246	0	0	5	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	238	0	0	5	0
3	C	204	0	0	6	0
3	D	200	0	0	4	0
All	All	13367	0	12301	56	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.

All (56) 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:B:47:GLU:OE2	3:B:501:HOH:O	1.90	0.89
1:D:224:CYS:SG	3:D:667:HOH:O	2.46	0.74
1:B:336[B]:ASP:OD1	1:B:377:TYR:OH	2.04	0.73
1:C:336:ASP:OD1	1:C:377:TYR:OH	2.05	0.73
1:C:260:ARG:NH1	3:C:501:HOH:O	2.22	0.67
1:A:86:MET:HE3	1:A:118:TYR:HE2	1.60	0.66
1:D:111:ARG:NH1	3:D:501:HOH:O	2.29	0.65
3:C:544:HOH:O	2:G:4:BEM:O6B	2.15	0.63
1:A:180:LYS:H	1:A:180:LYS:HD2	1.64	0.61
3:A:583:HOH:O	2:E:4:BEM:O6A	2.16	0.60
3:D:501:HOH:O	2:H:4:BEM:O6B	2.16	0.59
1:B:191:ARG:O	3:B:502:HOH:O	2.17	0.58
1:A:265[A]:ARG:HG3	1:A:318:ILE:HD11	1.85	0.57
1:A:86:MET:HE3	1:A:118:TYR:CE2	2.40	0.57
1:A:336:ASP:OD1	1:A:377:TYR:OH	2.21	0.57
1:A:54:LEU:HD21	1:A:389:SER:HA	1.87	0.56
1:B:388:TYR:HA	1:B:402:LYS:HB3	1.89	0.54
1:A:191:ARG:O	3:A:501:HOH:O	2.18	0.54
1:D:293:THR:HG22	1:D:351:LYS:HE2	1.88	0.54
1:B:54:LEU:HD21	1:B:389:SER:HA	1.90	0.54
1:B:200:LYS:HE3	3:B:528:HOH:O	2.09	0.53
1:A:26:LEU:HG	1:A:256:ALA:HB1	1.91	0.51
1:A:262:ASP:OD1	3:A:502[B]:HOH:O	2.19	0.51
1:C:39[B]:ASN:ND2	3:C:506:HOH:O	2.36	0.50
1:C:195:ALA:O	1:C:198:VAL:HG12	2.12	0.50
1:D:54:LEU:HD21	1:D:389:SER:HA	1.94	0.49
1:D:276:MET:HE3	1:D:280:ILE:HD11	1.94	0.49
1:C:39[A]:ASN:HD21	1:C:43:LYS:HE3	1.79	0.48
1:C:265:ARG:HG3	1:C:318:ILE:HD11	1.95	0.48
1:A:60[B]:GLU:HG3	3:A:505:HOH:O	2.13	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:54:LEU:HD21	1:C:389:SER:HA	1.93	0.48
1:C:388:TYR:HA	1:C:402:LYS:HB3	1.95	0.48
1:A:386:LEU:HD13	1:A:395:THR:HB	1.96	0.47
1:D:175:VAL:HG22	1:D:178:MET:HB2	1.96	0.47
3:B:659:HOH:O	2:F:4:BEM:O6B	2.20	0.46
1:C:60:GLU:HG3	1:C:64:LYS:HE2	1.97	0.45
1:D:262:ASP:N	1:D:262:ASP:OD1	2.50	0.45
1:B:191:ARG:HD2	3:B:523:HOH:O	2.16	0.44
1:D:77:PRO:O	1:D:80:LYS:HE2	2.17	0.44
1:D:387:LYS:HA	1:D:387:LYS:HD3	1.72	0.43
1:C:288:GLN:NE2	3:C:505:HOH:O	2.34	0.43
1:D:200:LYS:HG3	3:D:596:HOH:O	2.18	0.43
1:B:132:TYR:HD2	1:B:393[B]:VAL:HG12	1.83	0.43
1:B:26:LEU:HG	1:B:256:ALA:HB1	2.01	0.43
1:B:129:ASP:HA	1:B:393[A]:VAL:HG21	2.00	0.43
1:C:98:LYS:NZ	3:C:516:HOH:O	2.51	0.42
1:D:298:TYR:OH	2:H:3:BEM:H5	2.19	0.42
1:D:95:ASP:O	1:D:101:GLY:HA2	2.20	0.41
1:C:180:LYS:H	1:C:180:LYS:CD	2.33	0.41
1:A:114:GLU:OE2	3:A:503:HOH:O	2.21	0.41
1:D:100:ASP:O	1:D:102:LEU:HD22	2.20	0.41
1:C:275:LYS:HG2	3:C:688:HOH:O	2.21	0.41
1:D:290:LEU:HA	1:D:295:SER:HB2	2.03	0.41
1:B:276:MET:SD	1:B:306:LEU:HD13	2.60	0.41
1:D:284:GLY:O	1:D:334:ALA:HA	2.20	0.41
1:C:93:TRP:CD1	1:C:107:LYS:HD3	2.56	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	381/404 (94%)	373 (98%)	8 (2%)	0	100	100
1	B	382/404 (95%)	374 (98%)	8 (2%)	0	100	100
1	C	381/404 (94%)	373 (98%)	8 (2%)	0	100	100
1	D	381/404 (94%)	373 (98%)	8 (2%)	0	100	100
All	All	1525/1616 (94%)	1493 (98%)	32 (2%)	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	327/344 (95%)	324 (99%)	3 (1%)	75	81
1	B	328/344 (95%)	328 (100%)	0	100	100
1	C	327/344 (95%)	325 (99%)	2 (1%)	84	89
1	D	326/344 (95%)	323 (99%)	3 (1%)	75	81
All	All	1308/1376 (95%)	1300 (99%)	8 (1%)	86	89

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	34	LEU
1	A	198	VAL
1	A	403	LYS
1	C	276[A]	MET
1	C	276[B]	MET
1	D	102	LEU
1	D	175	VAL
1	D	198	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	232	GLN
1	B	279	GLN
1	C	279	GLN
1	D	232	GLN
1	D	234	GLN
1	D	238	HIS
1	D	279	GLN
1	D	333	GLN

### 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 ⓘ

16 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	BEM	E	1	2	13,13,13	1.08	0	18,19,19	1.51	4 (22%)
2	BEM	E	2	2	12,12,13	0.99	1 (8%)	14,17,19	1.51	4 (28%)
2	BEM	E	3	2	12,12,13	1.30	1 (8%)	14,17,19	1.62	2 (14%)
2	BEM	E	4	2	12,12,13	1.10	1 (8%)	14,17,19	1.38	2 (14%)
2	BEM	F	1	2	13,13,13	1.05	1 (7%)	18,19,19	1.31	1 (5%)
2	BEM	F	2	2	12,12,13	1.02	0	14,17,19	1.31	2 (14%)
2	BEM	F	3	2	12,12,13	1.25	2 (16%)	14,17,19	1.64	2 (14%)
2	BEM	F	4	2	12,12,13	1.00	0	14,17,19	1.53	4 (28%)
2	BEM	G	1	2	13,13,13	1.07	1 (7%)	18,19,19	1.21	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	BEM	G	2	2	12,12,13	1.06	1 (8%)	14,17,19	1.38	1 (7%)
2	BEM	G	3	2	12,12,13	1.26	1 (8%)	14,17,19	1.67	2 (14%)
2	BEM	G	4	2	12,12,13	1.02	0	14,17,19	1.40	3 (21%)
2	BEM	H	1	2	13,13,13	1.06	1 (7%)	18,19,19	1.33	2 (11%)
2	BEM	H	2	2	12,12,13	1.03	1 (8%)	14,17,19	1.30	2 (14%)
2	BEM	H	3	2	12,12,13	1.24	1 (8%)	14,17,19	1.68	3 (21%)
2	BEM	H	4	2	12,12,13	0.99	0	14,17,19	1.46	3 (21%)

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	BEM	E	1	2	-	2/4/24/24	0/1/1/1
2	BEM	E	2	2	-	0/4/21/24	0/1/1/1
2	BEM	E	3	2	-	2/4/21/24	0/1/1/1
2	BEM	E	4	2	-	0/4/21/24	0/1/1/1
2	BEM	F	1	2	-	0/4/24/24	0/1/1/1
2	BEM	F	2	2	-	0/4/21/24	0/1/1/1
2	BEM	F	3	2	-	2/4/21/24	0/1/1/1
2	BEM	F	4	2	-	0/4/21/24	0/1/1/1
2	BEM	G	1	2	-	0/4/24/24	0/1/1/1
2	BEM	G	2	2	-	0/4/21/24	0/1/1/1
2	BEM	G	3	2	-	2/4/21/24	0/1/1/1
2	BEM	G	4	2	-	0/4/21/24	0/1/1/1
2	BEM	H	1	2	-	0/4/24/24	0/1/1/1
2	BEM	H	2	2	-	0/4/21/24	0/1/1/1
2	BEM	H	3	2	-	2/4/21/24	0/1/1/1
2	BEM	H	4	2	-	0/4/21/24	0/1/1/1

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	3	BEM	O5-C1	-2.57	1.39	1.43
2	H	3	BEM	O5-C1	-2.45	1.39	1.43
2	G	3	BEM	O5-C1	-2.32	1.40	1.43
2	F	3	BEM	O5-C1	-2.31	1.40	1.43
2	H	2	BEM	O6B-C6	-2.25	1.23	1.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	4	BEM	O6B-C6	-2.16	1.23	1.30
2	F	1	BEM	O6B-C6	-2.14	1.23	1.30
2	F	3	BEM	O6B-C6	-2.12	1.23	1.30
2	G	1	BEM	O6B-C6	-2.12	1.23	1.30
2	G	2	BEM	O6B-C6	-2.11	1.23	1.30
2	H	1	BEM	O6B-C6	-2.08	1.23	1.30
2	E	2	BEM	O6B-C6	-2.01	1.24	1.30

All (38) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	3	BEM	O4-C4-C5	-4.32	100.05	109.74
2	G	3	BEM	O4-C4-C5	-3.92	100.94	109.74
2	F	3	BEM	O4-C4-C5	-3.91	100.97	109.74
2	H	3	BEM	O4-C4-C5	-3.55	101.78	109.74
2	H	3	BEM	C1-C2-C3	3.44	113.89	109.67
2	G	3	BEM	O5-C1-C2	3.19	115.69	110.77
2	F	3	BEM	O5-C1-C2	3.16	115.65	110.77
2	F	4	BEM	O6A-C6-C5	-2.70	110.92	120.81
2	G	4	BEM	O6A-C6-C5	-2.67	111.03	120.81
2	E	1	BEM	O4-C4-C5	-2.62	103.86	109.74
2	H	4	BEM	O6A-C6-C5	-2.56	111.41	120.81
2	E	3	BEM	O5-C1-C2	2.56	114.73	110.77
2	E	1	BEM	O5-C5-C6	2.53	112.68	105.88
2	F	1	BEM	O5-C5-C6	2.52	112.65	105.88
2	G	2	BEM	O3-C3-C4	2.51	116.15	110.35
2	F	2	BEM	O6B-C6-O6A	2.51	129.79	124.09
2	E	4	BEM	O6B-C6-O6A	2.49	129.73	124.09
2	E	2	BEM	O3-C3-C4	2.46	116.04	110.35
2	H	1	BEM	C4-C3-C2	2.40	115.02	110.82
2	E	2	BEM	O6B-C6-O6A	2.39	129.51	124.09
2	H	3	BEM	O5-C1-C2	2.38	114.44	110.77
2	E	2	BEM	O6A-C6-C5	-2.35	112.17	120.81
2	G	4	BEM	O6B-C6-O6A	2.34	129.40	124.09
2	E	1	BEM	O5-C5-C4	2.25	113.59	109.57
2	E	2	BEM	O4-C4-C3	2.24	115.54	110.35
2	F	4	BEM	C1-C2-C3	2.21	112.38	109.67
2	F	4	BEM	O6B-C6-O6A	2.20	129.08	124.09
2	H	4	BEM	O6B-C6-O6A	2.19	129.07	124.09
2	H	1	BEM	O5-C5-C6	2.19	111.76	105.88
2	H	4	BEM	C1-C2-C3	2.18	112.34	109.67
2	H	2	BEM	O3-C3-C4	2.14	115.31	110.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	2	BEM	O6A-C6-C5	-2.14	112.97	120.81
2	E	4	BEM	O3-C3-C4	2.14	115.28	110.35
2	E	1	BEM	C4-C3-C2	2.11	114.50	110.82
2	F	4	BEM	O3-C3-C4	2.10	115.19	110.35
2	G	4	BEM	O3-C3-C4	2.06	115.12	110.35
2	H	2	BEM	C1-C2-C3	2.03	112.16	109.67
2	G	1	BEM	O5-C5-C6	2.02	111.31	105.88

There are no chirality outliers.

All (10) torsion outliers are listed below:

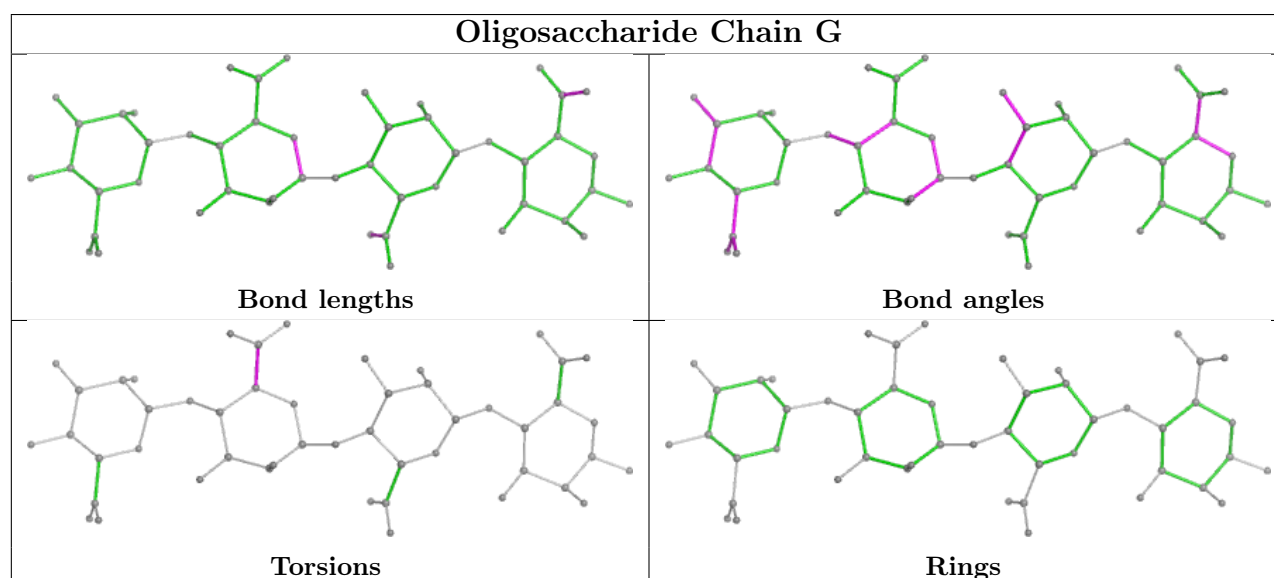
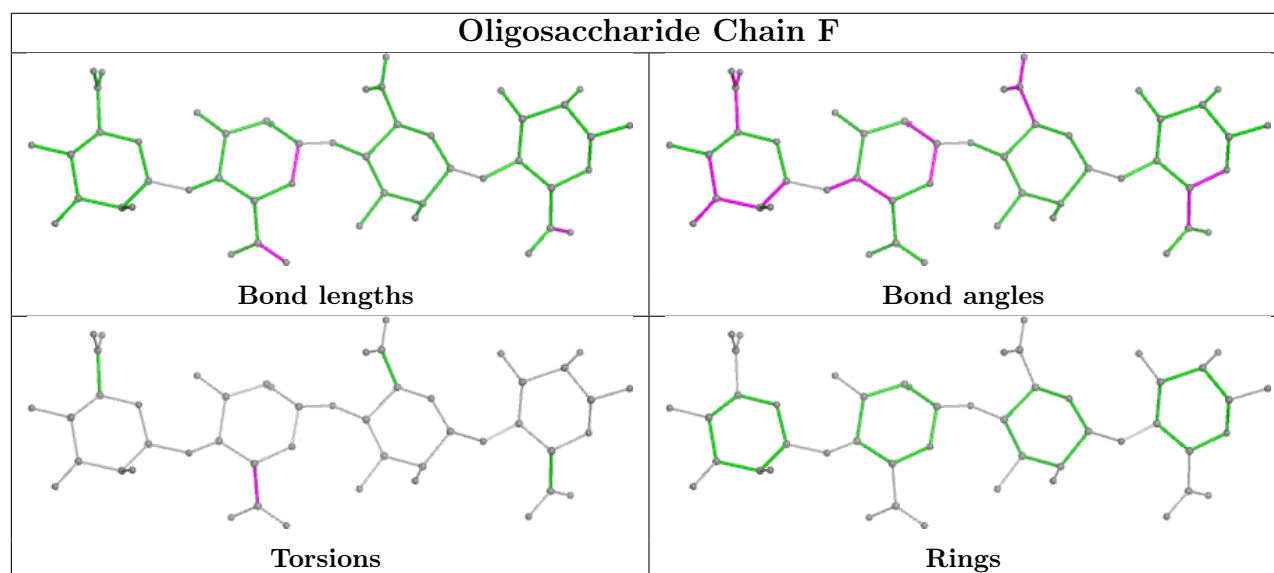
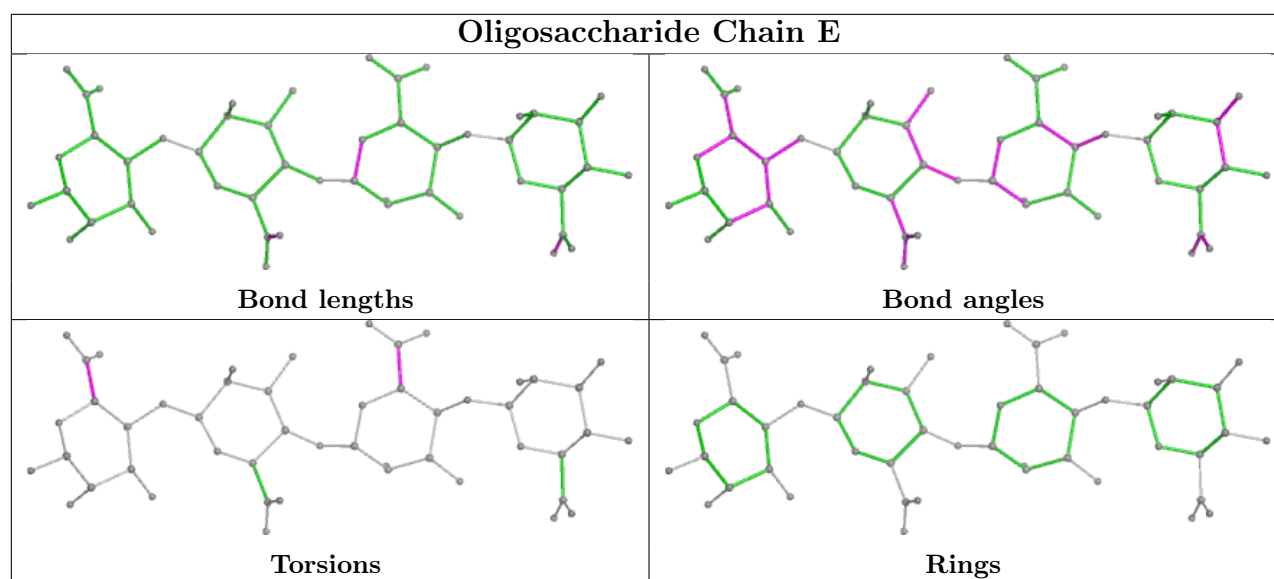
Mol	Chain	Res	Type	Atoms
2	E	1	BEM	C4-C5-C6-O6B
2	E	1	BEM	C4-C5-C6-O6A
2	E	3	BEM	C4-C5-C6-O6B
2	E	3	BEM	C4-C5-C6-O6A
2	F	3	BEM	C4-C5-C6-O6B
2	F	3	BEM	C4-C5-C6-O6A
2	G	3	BEM	C4-C5-C6-O6B
2	G	3	BEM	C4-C5-C6-O6A
2	H	3	BEM	C4-C5-C6-O6B
2	H	3	BEM	C4-C5-C6-O6A

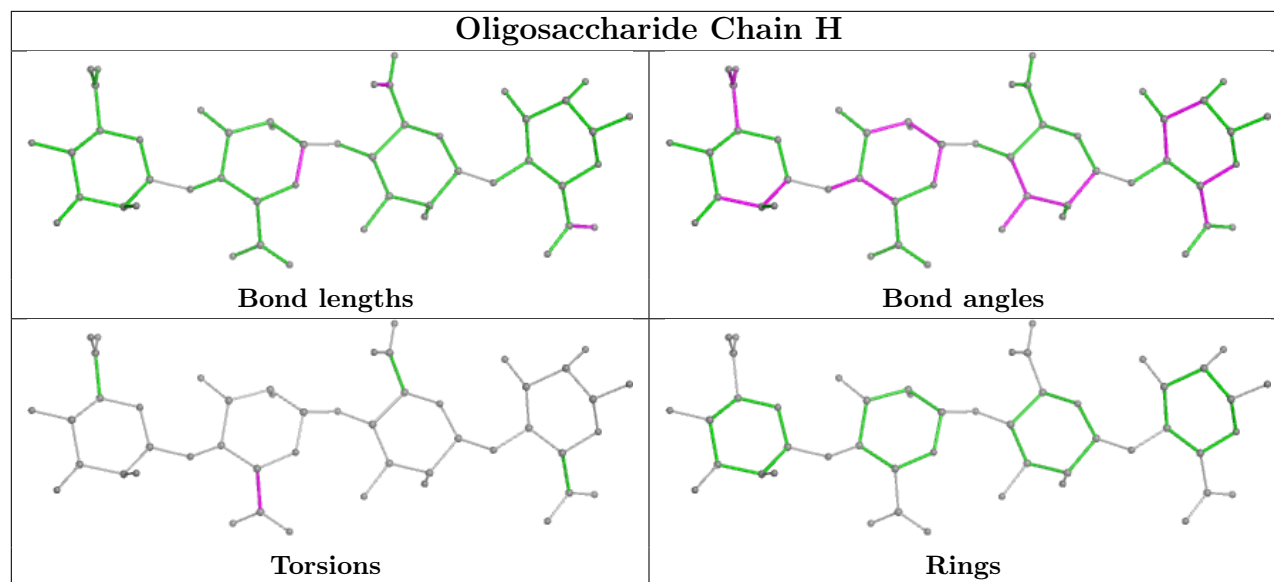
There are no ring outliers.

5 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	4	BEM	1	0
2	H	3	BEM	1	0
2	H	4	BEM	1	0
2	E	4	BEM	1	0
2	G	4	BEM	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 oligosaccharide.





## 5.6 Ligand geometry [i](#)

There are no ligands in this entry.

## 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	380/404 (94%)	-0.40	0 100 100	18, 29, 44, 55	3 (0%)
1	B	380/404 (94%)	-0.35	1 (0%) 90 91	15, 30, 43, 54	4 (1%)
1	C	380/404 (94%)	-0.31	2 (0%) 87 88	15, 30, 44, 58	3 (0%)
1	D	381/404 (94%)	-0.20	3 (0%) 82 84	14, 33, 48, 70	2 (0%)
All	All	1521/1616 (94%)	-0.31	6 (0%) 89 90	14, 30, 45, 70	12 (0%)

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	22	ALA	4.4
1	C	276[A]	MET	2.7
1	D	315[A]	GLN	2.4
1	B	47	GLU	2.3
1	C	180	LYS	2.2
1	D	206	LYS	2.1

### 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.

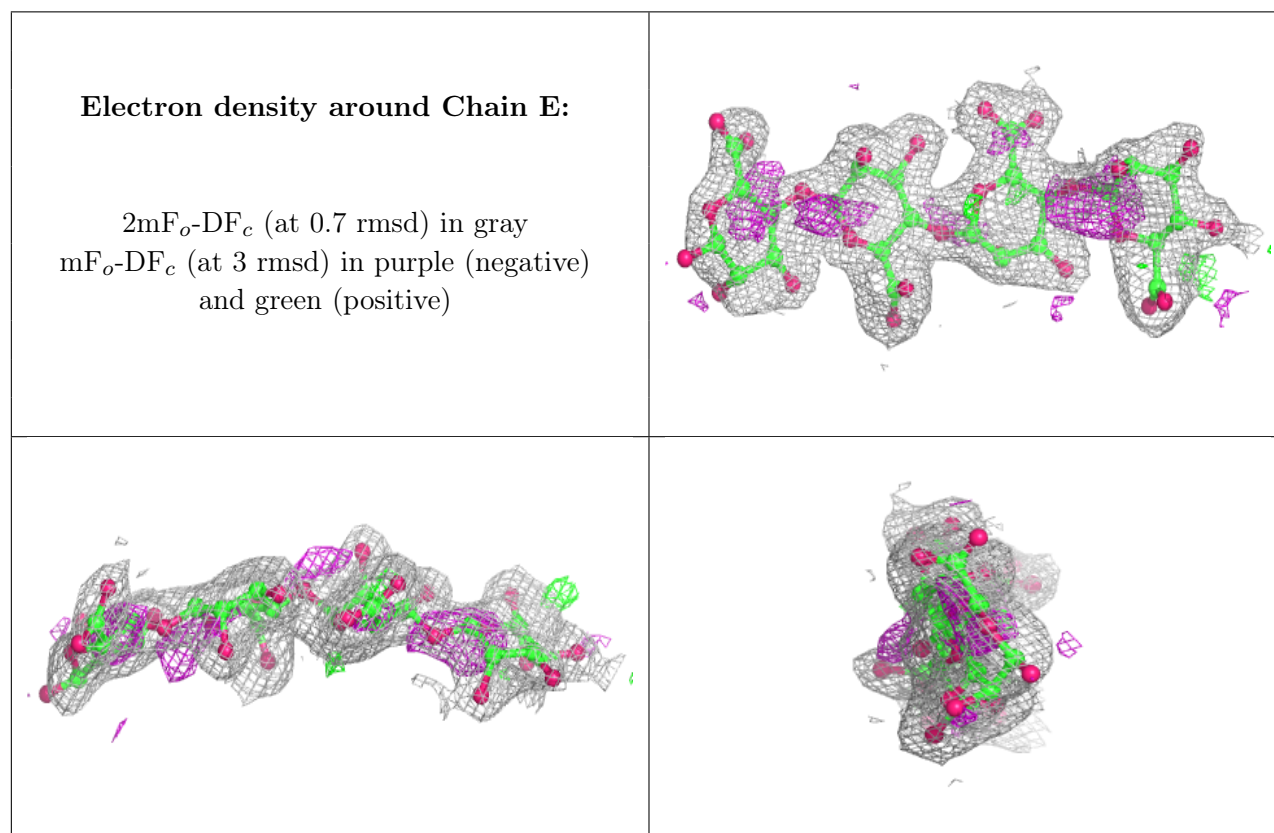
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	BEM	F	1	13/13	0.69	0.14	55,64,74,79	0

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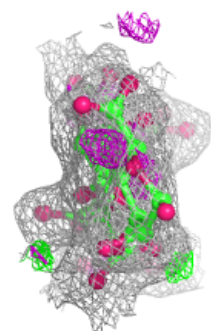
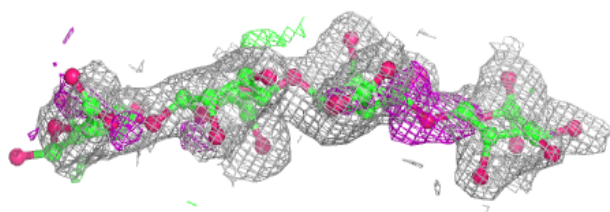
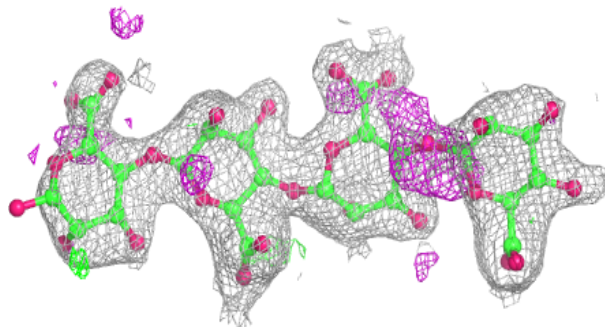
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	BEM	H	1	13/13	0.72	0.15	54,69,79,84	0
2	BEM	G	1	13/13	0.78	0.12	54,64,75,81	0
2	BEM	H	4	12/13	0.79	0.14	44,51,57,59	0
2	BEM	E	1	13/13	0.83	0.12	48,59,68,74	0
2	BEM	E	4	12/13	0.84	0.14	38,45,51,52	0
2	BEM	G	4	12/13	0.84	0.13	41,47,51,52	0
2	BEM	F	4	12/13	0.85	0.13	39,46,51,59	0
2	BEM	E	3	12/13	0.89	0.11	27,35,38,45	0
2	BEM	F	3	12/13	0.89	0.12	33,36,39,50	0
2	BEM	G	3	12/13	0.89	0.11	32,36,39,50	0
2	BEM	H	3	12/13	0.90	0.10	33,41,49,53	0
2	BEM	F	2	12/13	0.90	0.11	32,41,48,49	0
2	BEM	G	2	12/13	0.91	0.10	32,39,47,48	0
2	BEM	E	2	12/13	0.92	0.10	28,34,44,47	0
2	BEM	H	2	12/13	0.92	0.10	34,41,52,53	0

The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

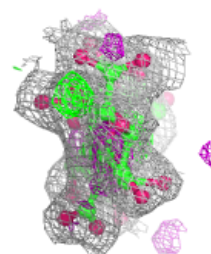
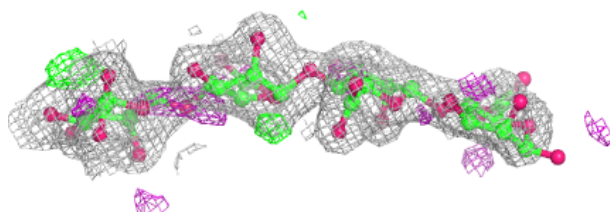
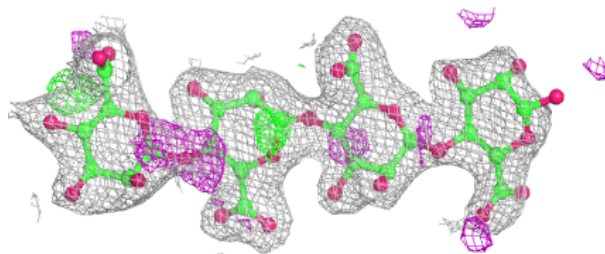


**Electron density around Chain F:**

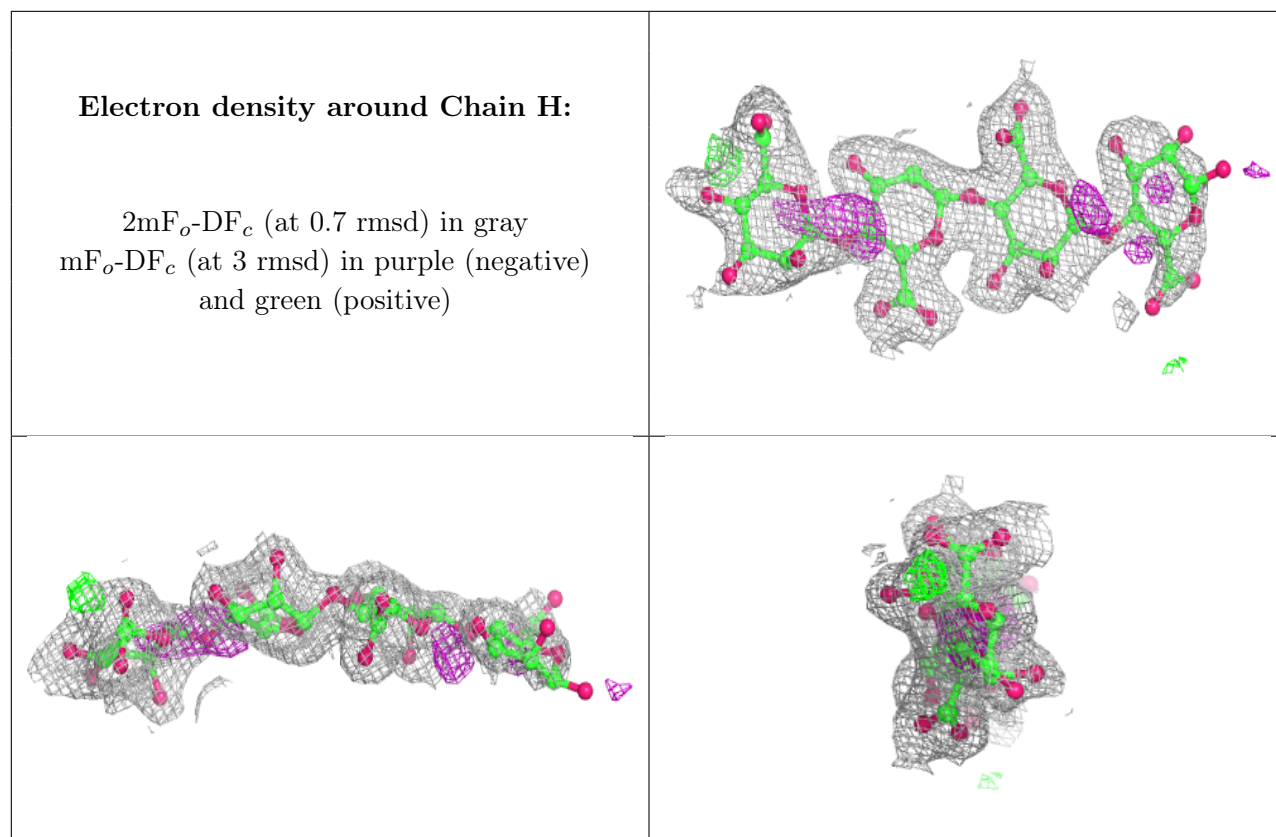
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around Chain G:**

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







## 6.4 Ligands [i](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.