



Full wwPDB X-ray Structure Validation Report ⓘ

Dec 12, 2022 – 03:33 pm GMT

PDB ID : 7QHE
Title : Human Butyrylcholinesterase in complex with (S)-1-(4-((naphthalen-1-yl)carbamoyl)benzyl)-N-(3-((1,2,3,4-tetrahydroacridin-9-yl)amino)propyl)piperidine-3-carboxamide
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Deposited on : 2021-12-12
Resolution : 2.47 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

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>.

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

MolProbity : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.31.3
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0267
CCP4 : 7.1.010 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.31.3

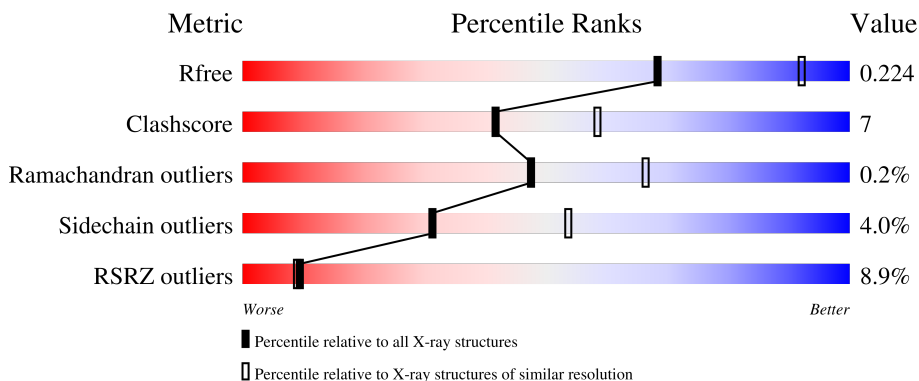
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.47 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	5857 (2.50-2.46)
Clashscore	141614	6594 (2.50-2.46)
Ramachandran outliers	138981	6469 (2.50-2.46)
Sidechain outliers	138945	6471 (2.50-2.46)
RSRZ outliers	127900	5738 (2.50-2.46)

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 $\leq 5\%$. 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	529	<div style="display: flex; align-items: center;"> <div style="width: 9%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 83%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 16%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 1%; height: 10px; background-color: orange; margin-right: 5px;"></div> <div style="width: 1%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 20px;">9% 83% 16% .</p>
2	B	3	<div style="display: flex; align-items: center;"> <div style="width: 67%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 33%; height: 10px; background-color: yellow; margin-right: 5px;"></div> </div> <p style="margin-left: 20px;">67% 33%</p>
2	C	3	<div style="display: flex; align-items: center;"> <div style="width: 33%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 33%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 33%; height: 10px; background-color: orange; margin-right: 5px;"></div> </div> <p style="margin-left: 20px;">33% 33% 33%</p>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	NAG	C	2	-	-	-	X
3	NAG	A	603	-	-	-	X
8	CL	A	615	-	-	-	X

2 Entry composition i

There are 9 unique types of molecules in this entry. The entry contains 4597 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.

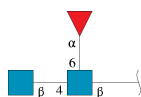
- Molecule 1 is a protein called Cholinesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	527	4245	2740	713	776	16	0	6	0

There are 4 discrepancies between the modelled and reference sequences:

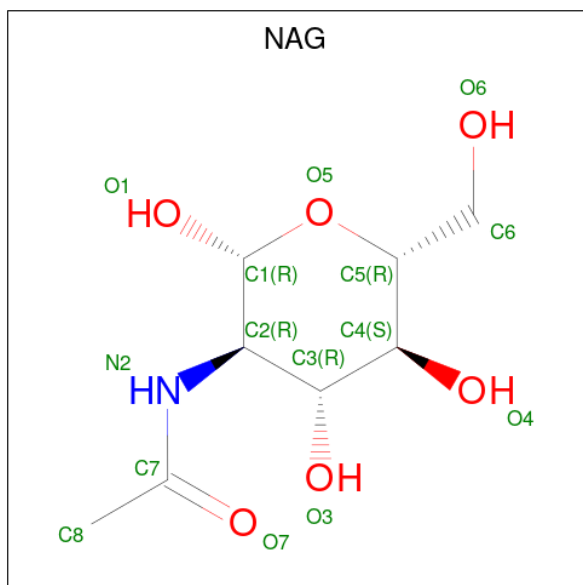
Chain	Residue	Modelled	Actual	Comment	Reference
A	17	GLN	ASN	engineered mutation	UNP P06276
A	455	GLN	ASN	engineered mutation	UNP P06276
A	481	GLN	ASN	engineered mutation	UNP P06276
A	486	GLN	ASN	engineered mutation	UNP P06276

- Molecule 2 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	3	38	22	2	14	0	0	0
2	C	3	38	22	2	14	0	0	0

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C₈H₁₅NO₆).



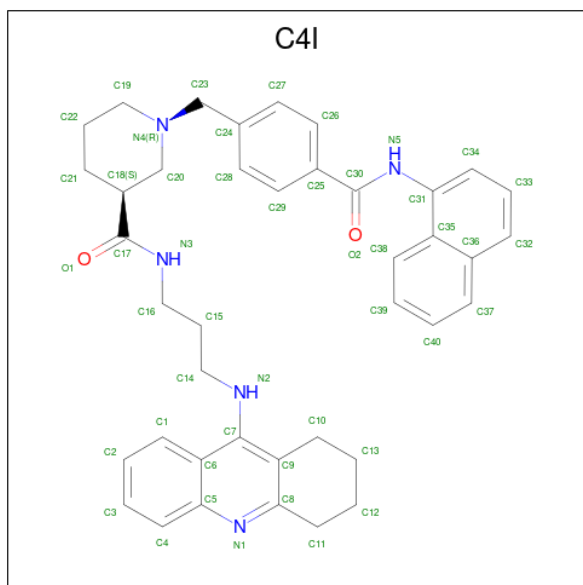
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	Total 14	C 8	N 1	O 5	0	0
3	A	1	Total 14	C 8	N 1	O 5	0	0
3	A	1	Total 14	C 8	N 1	O 5	0	0
3	A	1	Total 14	C 8	N 1	O 5	0	0

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: $C_6H_{13}NO_4S$).



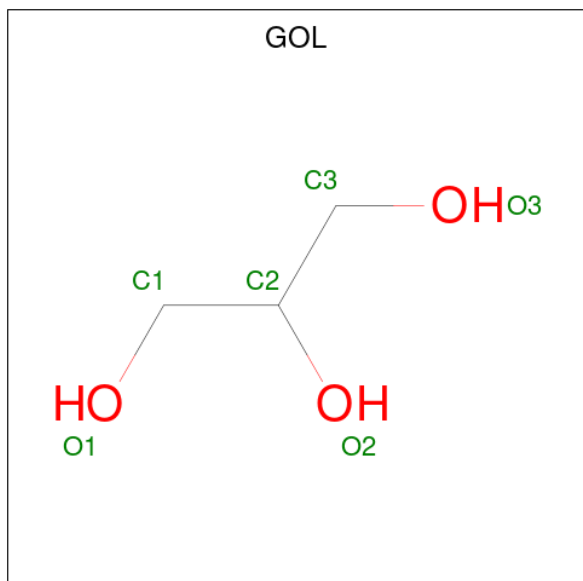
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	A	1	12	6	1	4	1	0	0

- Molecule 5 is (3 {S})-1-[[4-(naphthalen-1-ylcarbamoyl)phenyl]methyl]- {N}-[3-(1,2,3,4-tetrahydroacridin-9-ylamino)propyl]piperidine-3-carboxamide (three-letter code: C4I) (formula: C₄₀H₄₃N₅O₂) (labeled as "Ligand of Interest" by depositor).



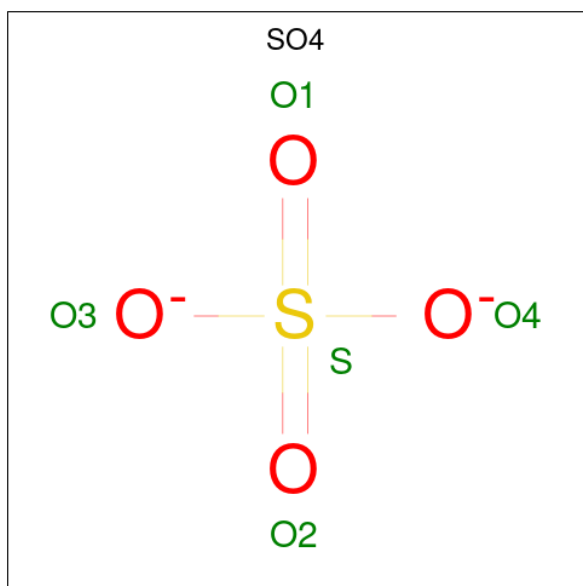
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
5	A	1	47	40	5	2		0	0

- Molecule 6 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 7 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	O	S	0	0
			5	4	1		
7	A	1	Total	O	S	0	0
			5	4	1		
7	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 8 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	7	Total	Cl	0	0
			7	7		

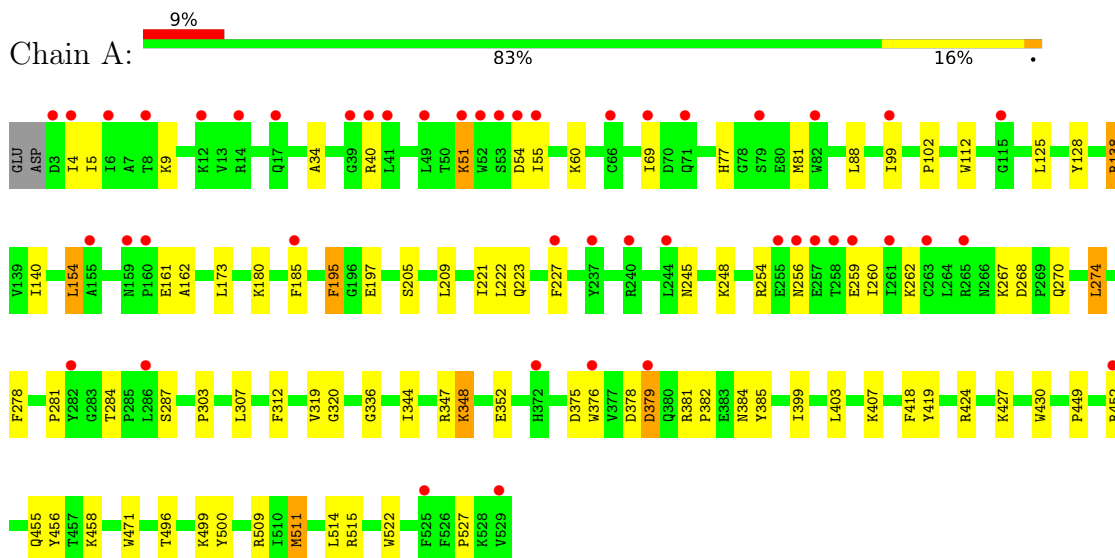
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	133	Total	O	0	0
			133	133		

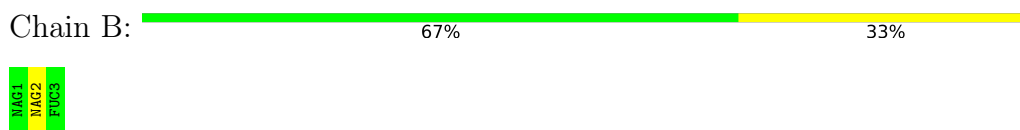
3 Residue-property plots [i](#)

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.

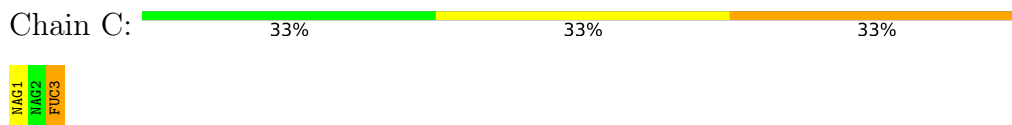
- Molecule 1: Cholinesterase



- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose



4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	154.50Å 154.50Å 127.52Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	55.07 – 2.47 55.07 – 2.47	Depositor EDS
% Data completeness (in resolution range)	97.2 (55.07-2.47) 97.2 (55.07-2.47)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.37 (at 2.48Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.178 , 0.224 0.176 , 0.224	Depositor DCC
R_{free} test set	1298 reflections (4.80%)	wwPDB-VP
Wilson B-factor (Å ²)	48.4	Xtriage
Anisotropy	0.484	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	(Not available) , (Not available)	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4597	wwPDB-VP
Average B, all atoms (Å ²)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.31% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: MES, FUC, C4I, GOL, CL, SO4, NAG

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	0.43	0/4375	0.60	1/5938 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	274	LEU	CA-CB-CG	5.75	128.54	115.30

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	4245	0	4143	60	0
2	B	38	0	34	1	0
2	C	38	0	34	2	0
3	A	56	0	52	0	0
4	A	12	0	12	5	0
5	A	47	0	0	0	0
6	A	6	0	8	0	0
7	A	15	0	0	0	0
8	A	7	0	0	1	0
9	A	133	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	4597	0	4283	61	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 7.

All (61) 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:378:ASP:H	1:A:381:ARG:HH21	1.24	0.84
1:A:378:ASP:HB3	1:A:381:ARG:HE	1.51	0.76
1:A:270:GLN:O	1:A:274:LEU:HD22	1.92	0.70
1:A:348:LYS:H	1:A:348:LYS:HE2	1.62	0.64
1:A:515:ARG:NH1	4:A:605:MES:H71	2.13	0.64
1:A:515:ARG:HH12	4:A:605:MES:H71	1.61	0.64
1:A:9:LYS:NZ	1:A:180:LYS:O	2.32	0.61
1:A:399:ILE:HG21	1:A:515:ARG:HG3	1.86	0.58
1:A:256:ASN:HB3	1:A:259:GLU:HB2	1.88	0.55
1:A:500:TYR:CZ	1:A:511[B]:MET:HB2	2.42	0.55
1:A:336:GLY:H	2:B:2:NAG:C8	2.19	0.55
1:A:254:ARG:HB2	1:A:260:ILE:HG13	1.89	0.54
1:A:348:LYS:H	1:A:348:LYS:CE	2.20	0.54
1:A:209:LEU:HD12	1:A:312:PHE:HB3	1.89	0.54
1:A:319:VAL:O	1:A:418:PHE:HA	2.08	0.54
1:A:381:ARG:NH1	1:A:384:ASN:OD1	2.41	0.53
1:A:522:TRP:O	1:A:527:PRO:HD3	2.08	0.53
1:A:99:ILE:HG22	1:A:140:ILE:HG12	1.91	0.52
1:A:154:LEU:HD23	1:A:162:ALA:HB1	1.92	0.52
1:A:77:HIS:O	1:A:81:MET:HG2	2.10	0.52
1:A:424:ARG:NH2	1:A:430:TRP:O	2.44	0.50
1:A:270:GLN:HB2	9:A:812:HOH:O	2.12	0.49
1:A:378:ASP:HB3	1:A:381:ARG:NE	2.24	0.49
1:A:378:ASP:N	1:A:381:ARG:HH21	2.03	0.49
1:A:427:LYS:HE3	1:A:455:GLN:H	1.77	0.49
1:A:54:ASP:OD1	1:A:54:ASP:N	2.42	0.49
1:A:161:GLU:OE2	1:A:161:GLU:HA	2.13	0.49
1:A:509:ARG:HH11	1:A:509:ARG:HG2	1.77	0.49
1:A:509:ARG:HG2	1:A:509:ARG:NH1	2.28	0.49
1:A:348:LYS:O	1:A:352:GLU:HG2	2.13	0.48
1:A:227:PHE:CD1	1:A:303:PRO:HB2	2.48	0.48
1:A:347:ARG:HB2	1:A:385:TYR:CZ	2.49	0.48
1:A:379:ASP:N	1:A:379:ASP:OD1	2.48	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:197:GLU:HA	1:A:223:GLN:O	2.15	0.46
1:A:514:LEU:HD12	4:A:605:MES:H52	1.96	0.46
1:A:125:LEU:HB2	1:A:128:TYR:CD2	2.51	0.46
1:A:375:ASP:OD1	1:A:375:ASP:N	2.47	0.46
1:A:515:ARG:H	4:A:605:MES:H52	1.81	0.46
1:A:4:ILE:HD13	1:A:4:ILE:HA	1.89	0.45
4:A:605:MES:H32	4:A:605:MES:H82	1.77	0.45
1:A:102:PRO:HD2	1:A:138:ARG:NH2	2.33	0.44
1:A:69:ILE:HD11	1:A:88:LEU:HD11	1.99	0.43
1:A:99:ILE:HG21	1:A:185:PHE:HB3	2.00	0.43
1:A:320:GLY:HA3	1:A:419:TYR:CE2	2.54	0.42
1:A:267:LYS:HD3	1:A:267:LYS:HA	1.74	0.42
1:A:51:LYS:H	1:A:51:LYS:HD2	1.84	0.42
1:A:245:ASN:ND2	2:C:3:FUC:H3	2.34	0.42
1:A:515:ARG:HH11	1:A:515:ARG:HG2	1.84	0.42
1:A:344:ILE:HG23	1:A:382:PRO:O	2.19	0.42
1:A:227:PHE:HZ	1:A:307:LEU:HB2	1.85	0.42
1:A:248:LYS:HE2	2:C:3:FUC:H61	2.02	0.42
1:A:403:LEU:O	1:A:407:LYS:HG3	2.21	0.41
1:A:112:TRP:HA	1:A:195:PHE:O	2.20	0.41
1:A:195:PHE:CB	1:A:221:ILE:HB	2.50	0.41
1:A:378:ASP:H	1:A:381:ARG:NH2	2.05	0.41
1:A:376:TRP:HB3	1:A:381:ARG:NH2	2.35	0.41
1:A:449:PRO:HA	1:A:456:TYR:CD2	2.56	0.41
1:A:499:LYS:NZ	8:A:615:CL:CL	2.69	0.41
1:A:5:ILE:HD13	1:A:55:ILE:HD13	2.03	0.41
1:A:34:ALA:HB2	1:A:173:LEU:HD23	2.03	0.41
1:A:205:SER:HB3	1:A:222:LEU:HD21	2.02	0.40

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	531/529 (100%)	506 (95%)	24 (4%)	1 (0%)	47 66

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	281	PRO

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	458/454 (101%)	439 (96%)	19 (4%)	30 53

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	ARG
1	A	51	LYS
1	A	60	LYS
1	A	138	ARG
1	A	154	LEU
1	A	195	PHE
1	A	262	LYS
1	A	268	ASP
1	A	278	PHE
1	A	284	THR
1	A	287	SER
1	A	348	LYS
1	A	379	ASP
1	A	452	ARG
1	A	458	LYS
1	A	471	TRP
1	A	496	THR
1	A	511[A]	MET
1	A	511[B]	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	245	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](#)

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	NAG	B	1	1,2	14,14,15	0.39	0	17,19,21	0.42	0
2	NAG	B	2	2	14,14,15	0.32	0	17,19,21	0.39	0
2	FUC	B	3	2	10,10,11	0.92	0	14,14,16	0.97	0
2	NAG	C	1	1,2	14,14,15	0.66	1 (7%)	17,19,21	1.22	1 (5%)
2	NAG	C	2	2	14,14,15	0.45	0	17,19,21	0.60	0
2	FUC	C	3	2	10,10,11	1.35	2 (20%)	14,14,16	1.24	2 (14%)

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	NAG	B	1	1,2	-	1/6/23/26	0/1/1/1
2	NAG	B	2	2	-	4/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	FUC	B	3	2	-	-	0/1/1/1
2	NAG	C	1	1,2	-	1/6/23/26	0/1/1/1
2	NAG	C	2	2	-	2/6/23/26	0/1/1/1
2	FUC	C	3	2	-	-	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	3	FUC	C1-C2	2.31	1.57	1.52
2	C	3	FUC	C2-C3	2.27	1.55	1.52
2	C	1	NAG	O5-C1	2.27	1.47	1.43

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	1	NAG	C1-O5-C5	3.71	117.22	112.19
2	C	3	FUC	O5-C5-C4	2.51	114.03	109.52
2	C	3	FUC	C1-C2-C3	2.08	112.22	109.67

There are no chirality outliers.

All (8) torsion outliers are listed below:

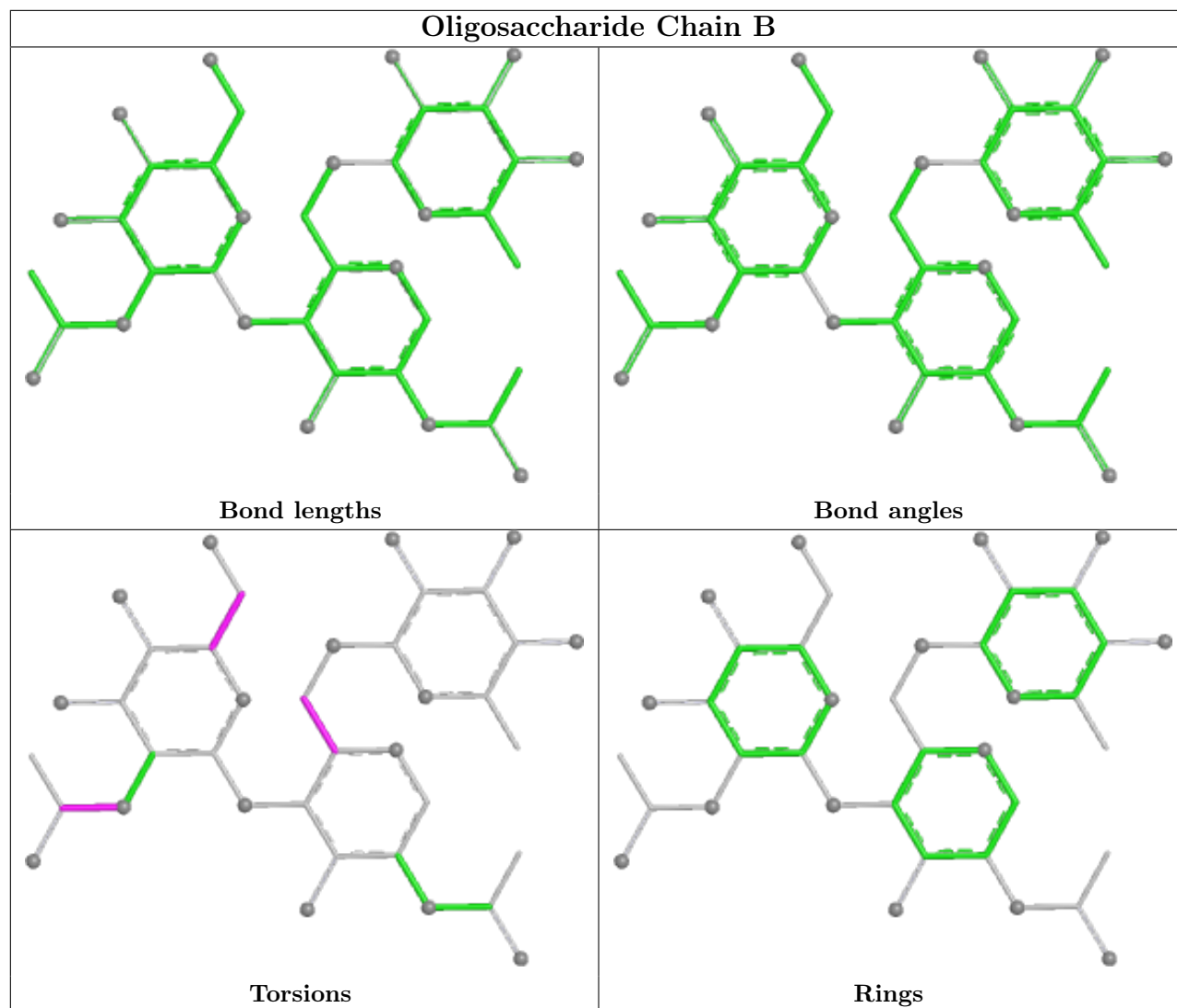
Mol	Chain	Res	Type	Atoms
2	B	2	NAG	O5-C5-C6-O6
2	C	2	NAG	O5-C5-C6-O6
2	B	2	NAG	C4-C5-C6-O6
2	B	2	NAG	C8-C7-N2-C2
2	B	2	NAG	O7-C7-N2-C2
2	C	2	NAG	C4-C5-C6-O6
2	C	1	NAG	C3-C2-N2-C7
2	B	1	NAG	C4-C5-C6-O6

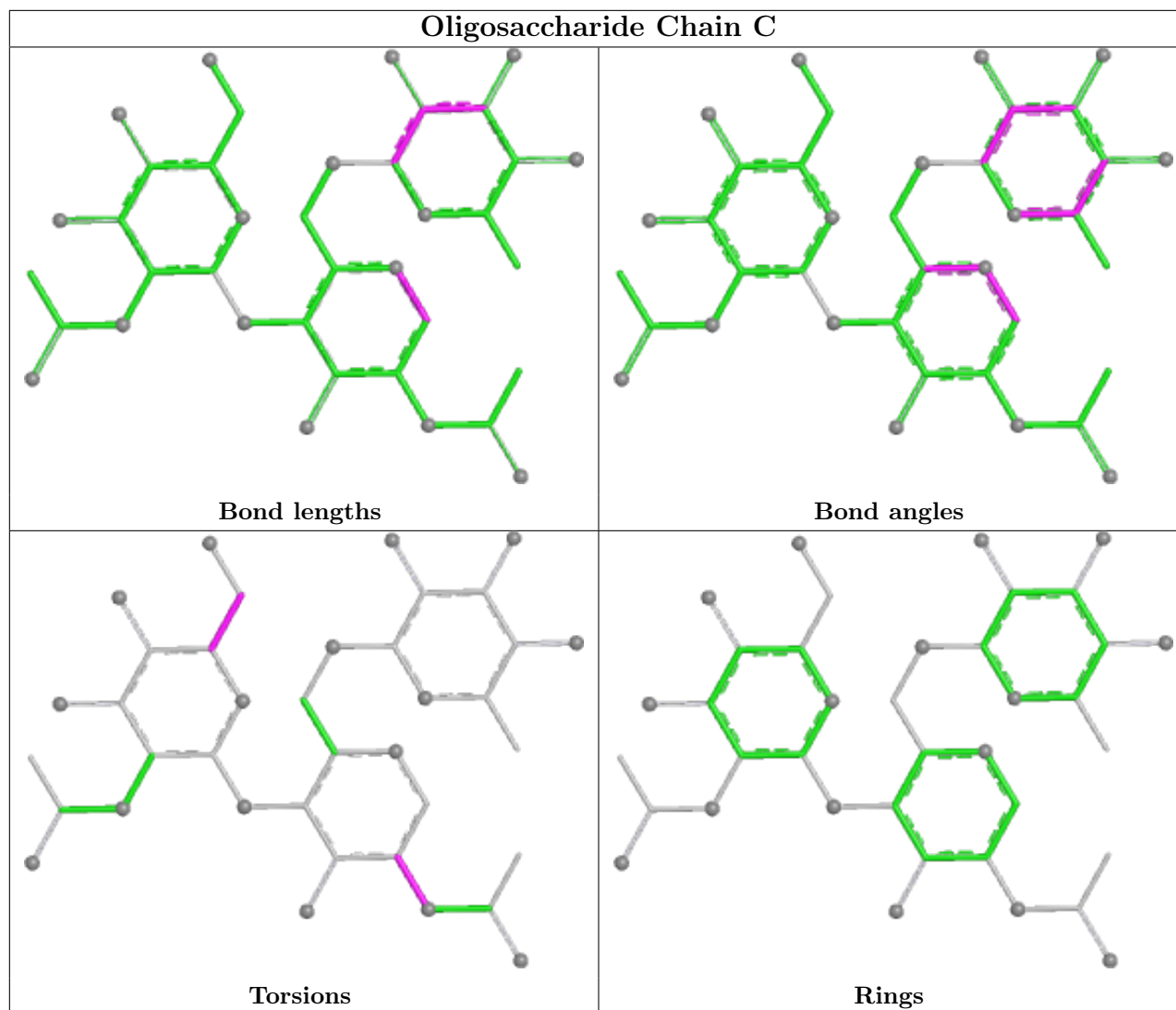
There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	3	FUC	2	0
2	B	2	NAG	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](#)

Of 17 ligands modelled in this entry, 7 are monoatomic - leaving 10 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
4	MES	A	605	-	12,12,12	1.97	1 (8%)	14,16,16	2.54	6 (42%)
5	C4I	A	606	-	53,53,53	1.31	6 (11%)	70,73,73	1.65	12 (17%)
7	SO4	A	608	-	4,4,4	0.16	0	6,6,6	0.11	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NAG	A	601	1	14,14,15	0.54	0	17,19,21	0.53	0
3	NAG	A	603	1	14,14,15	0.44	0	17,19,21	0.42	0
6	GOL	A	607	-	5,5,5	1.16	0	5,5,5	1.04	0
7	SO4	A	609	-	4,4,4	0.15	0	6,6,6	0.17	0
3	NAG	A	602	1	14,14,15	0.55	0	17,19,21	0.59	0
3	NAG	A	604	1	14,14,15	0.67	0	17,19,21	0.67	0
7	SO4	A	610	-	4,4,4	0.18	0	6,6,6	0.09	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
4	MES	A	605	-	-	1/6/14/14	0/1/1/1
5	C4I	A	606	-	-	6/24/41/41	0/7/7/7
3	NAG	A	601	1	-	2/6/23/26	0/1/1/1
3	NAG	A	603	1	-	1/6/23/26	0/1/1/1
6	GOL	A	607	-	-	2/4/4/4	-
3	NAG	A	602	1	-	2/6/23/26	0/1/1/1
3	NAG	A	604	1	-	2/6/23/26	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	605	MES	C8-S	-6.50	1.68	1.77
5	A	606	C4I	C31-C35	3.74	1.50	1.43
5	A	606	C4I	C20-N4	2.53	1.50	1.46
5	A	606	C4I	C4-C5	2.45	1.46	1.41
5	A	606	C4I	C3-C2	2.35	1.44	1.38
5	A	606	C4I	C30-N5	2.18	1.41	1.35
5	A	606	C4I	C21-C18	2.09	1.58	1.53

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	606	C4I	C18-C17-N3	5.51	123.14	115.99
5	A	606	C4I	C25-C30-N5	5.06	127.05	115.92
4	A	605	MES	C5-N4-C3	4.44	118.83	108.83
4	A	605	MES	C7-N4-C3	3.87	121.12	111.23
5	A	606	C4I	C35-C31-N5	3.70	124.60	118.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	605	MES	O1S-S-C8	3.54	111.18	106.92
5	A	606	C4I	C22-C19-N4	-3.52	105.68	111.33
5	A	606	C4I	C10-C9-C8	-3.23	118.06	121.08
5	A	606	C4I	O2-C30-N5	-3.03	116.79	123.71
4	A	605	MES	C7-N4-C5	3.02	118.97	111.23
4	A	605	MES	O2S-S-C8	2.82	110.31	106.92
4	A	605	MES	O3S-S-C8	2.81	110.31	105.77
5	A	606	C4I	O2-C30-C25	-2.70	116.13	120.94
5	A	606	C4I	O1-C17-N3	-2.59	117.43	122.99
5	A	606	C4I	C39-C38-C35	2.32	124.12	120.89
5	A	606	C4I	C38-C35-C36	-2.22	115.01	117.89
5	A	606	C4I	O1-C17-C18	-2.07	119.42	122.12
5	A	606	C4I	C6-C7-N2	-2.01	115.49	122.06

There are no chirality outliers.

All (16) torsion outliers are listed below:

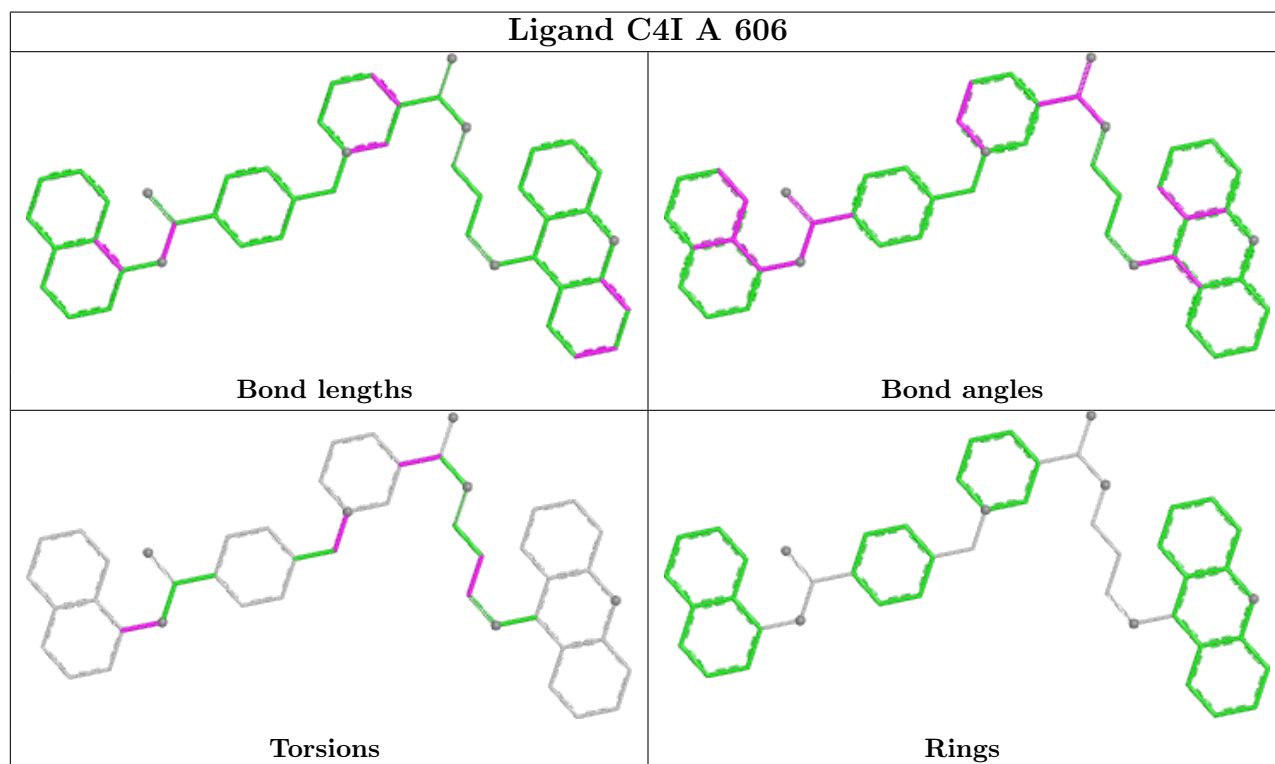
Mol	Chain	Res	Type	Atoms
4	A	605	MES	C8-C7-N4-C3
6	A	607	GOL	C1-C2-C3-O3
3	A	601	NAG	C4-C5-C6-O6
3	A	604	NAG	O5-C5-C6-O6
5	A	606	C4I	C24-C23-N4-C20
5	A	606	C4I	C24-C23-N4-C19
3	A	604	NAG	C4-C5-C6-O6
5	A	606	C4I	N3-C17-C18-C20
3	A	602	NAG	C8-C7-N2-C2
3	A	602	NAG	O7-C7-N2-C2
3	A	601	NAG	O5-C5-C6-O6
6	A	607	GOL	O2-C2-C3-O3
5	A	606	C4I	O1-C17-C18-C20
5	A	606	C4I	N2-C14-C15-C16
3	A	603	NAG	C1-C2-N2-C7
5	A	606	C4I	C34-C31-N5-C30

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	605	MES	5	0

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 than 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.



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, 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	527/529 (99%)	0.72	47 (8%) 9 9	37, 51, 83, 122	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	255	GLU	6.4
1	A	237	TYR	5.6
1	A	4	ILE	5.4
1	A	3	ASP	4.9
1	A	282	TYR	4.9
1	A	258	THR	4.5
1	A	53	SER	4.4
1	A	40	ARG	4.3
1	A	51	LYS	3.8
1	A	8	THR	3.4
1	A	12	LYS	3.4
1	A	17	GLN	3.4
1	A	54	ASP	3.1
1	A	244	LEU	3.1
1	A	49	LEU	3.0
1	A	69	ILE	2.9
1	A	379	ASP	2.8
1	A	376	TRP	2.8
1	A	41	LEU	2.8
1	A	259	GLU	2.7
1	A	14	ARG	2.7
1	A	286	LEU	2.7
1	A	240	ARG	2.7
1	A	256	ASN	2.6
1	A	263	CYS	2.6
1	A	39	GLY	2.5
1	A	160	PRO	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	52	TRP	2.5
1	A	257	GLU	2.4
1	A	265	ARG	2.3
1	A	525	PHE	2.3
1	A	71	GLN	2.3
1	A	185	PHE	2.3
1	A	159	ASN	2.3
1	A	372[A]	HIS	2.3
1	A	452	ARG	2.2
1	A	155	ALA	2.2
1	A	227	PHE	2.2
1	A	529	VAL	2.2
1	A	6	ILE	2.1
1	A	55	ILE	2.1
1	A	261	ILE	2.1
1	A	99	ILE	2.1
1	A	66	CYS	2.1
1	A	82	TRP	2.1
1	A	79	SER	2.0
1	A	115	GLY	2.0

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

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

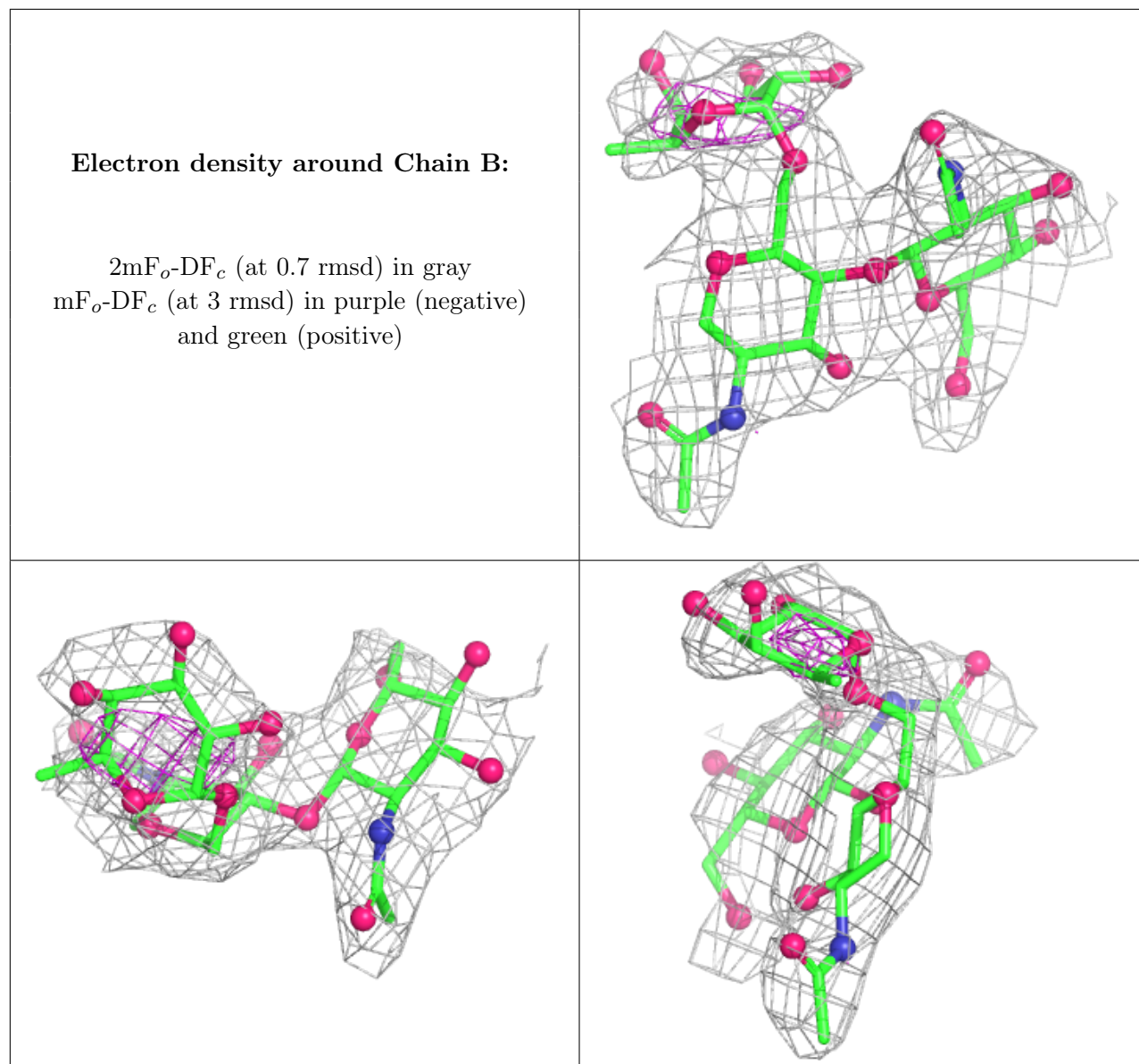
6.3 Carbohydrates [i](#)

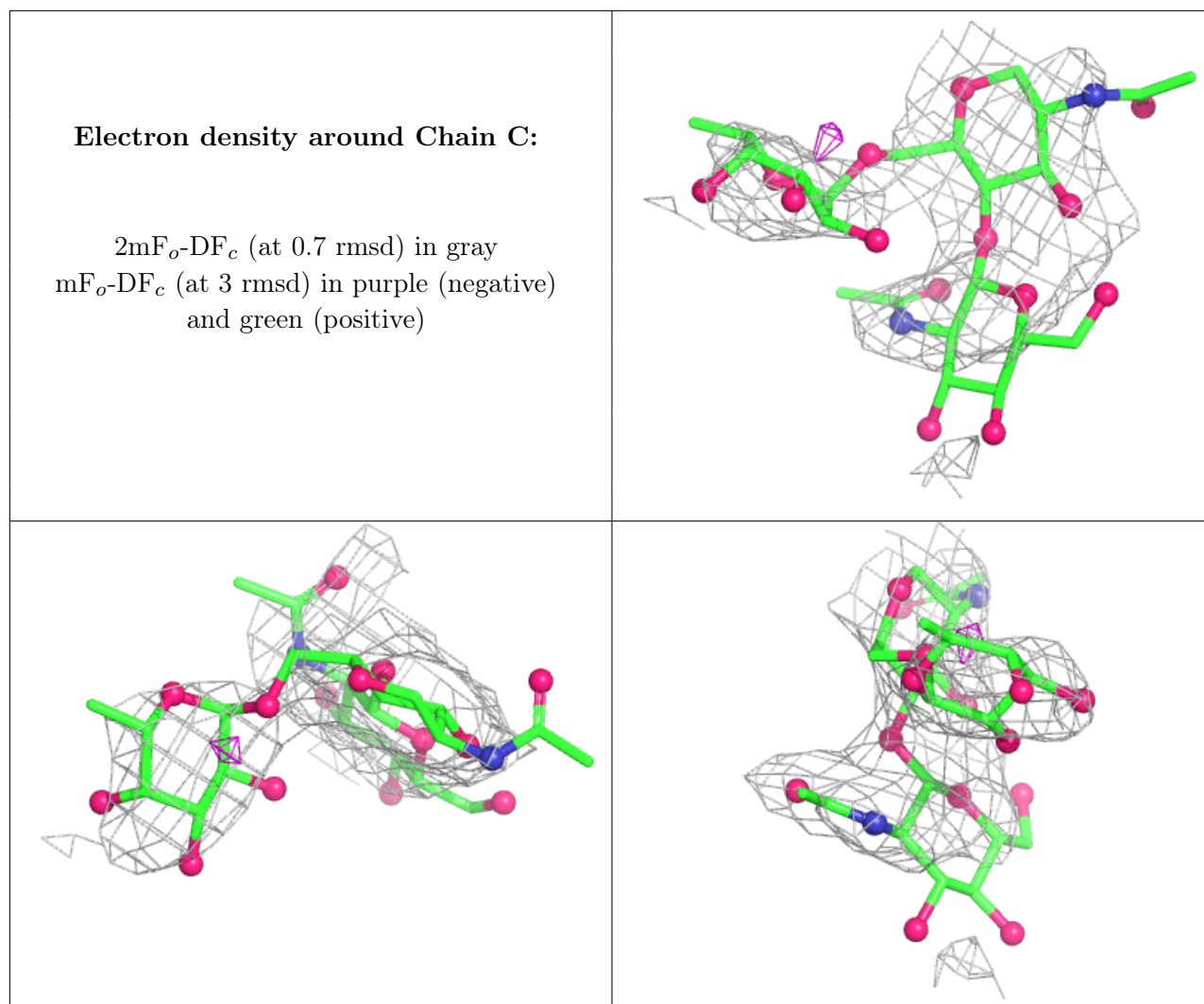
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists 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	NAG	C	1	14/15	0.73	0.32	113,123,126,132	0
2	NAG	C	2	14/15	0.76	0.43	126,131,134,135	0
2	FUC	C	3	10/11	0.87	0.53	93,106,117,121	0
2	FUC	B	3	10/11	0.88	0.35	64,75,81,83	0
2	NAG	B	2	14/15	0.88	0.17	80,95,105,114	0
2	NAG	B	1	14/15	0.93	0.17	67,70,77,82	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.





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, 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.

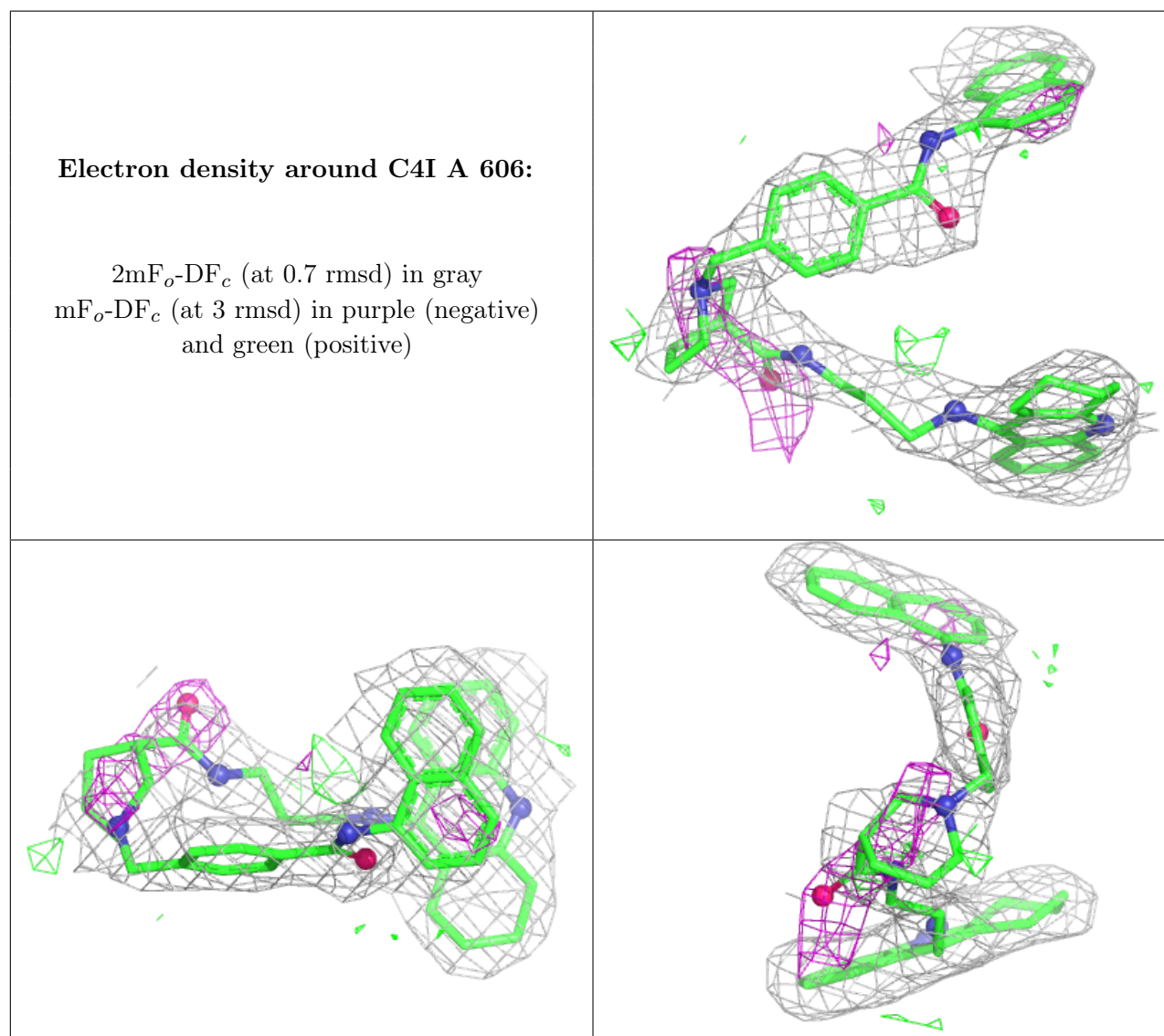
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
8	CL	A	614	1/1	0.55	0.14	85,85,85,85	0
8	CL	A	615	1/1	0.57	0.46	84,84,84,84	0
3	NAG	A	604	14/15	0.67	0.34	72,89,100,102	0
3	NAG	A	603	14/15	0.76	0.47	125,135,144,149	0
8	CL	A	617	1/1	0.76	0.37	77,77,77,77	0
3	NAG	A	602	14/15	0.77	0.23	73,83,89,90	0
3	NAG	A	601	14/15	0.79	0.27	90,95,102,104	0
8	CL	A	612	1/1	0.83	0.13	88,88,88,88	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
4	MES	A	605	12/12	0.84	0.20	87,93,115,118	0
8	CL	A	616	1/1	0.86	0.44	82,82,82,82	0
7	SO4	A	610	5/5	0.87	0.36	86,87,95,96	0
5	C4I	A	606	47/47	0.88	0.23	37,56,67,71	0
6	GOL	A	607	6/6	0.88	0.20	67,69,71,72	0
8	CL	A	611	1/1	0.89	0.10	69,69,69,69	0
8	CL	A	613	1/1	0.92	0.11	70,70,70,70	0
7	SO4	A	608	5/5	0.93	0.21	67,70,76,80	0
7	SO4	A	609	5/5	0.97	0.32	56,67,72,79	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.



6.5 Other polymers [i](#)

There are no such residues in this entry.