



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 05:17 AM UTC

PDB ID : 1J8V / pdb_00001j8v
Title : Crystal structure of barley beta-D-glucan glucohydrolase isoenzyme Exo1 in complex with 4'-nitrophenyl 3I-thiolaminaritranside
Authors : Hrmova, M.; De Gori, R.; Smith, B.J.; Fairweather, J.K.; Driguez, H.; Varghese, J.N.; Fincher, G.B.
Deposited on : 2001-05-22
Resolution : 2.40 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

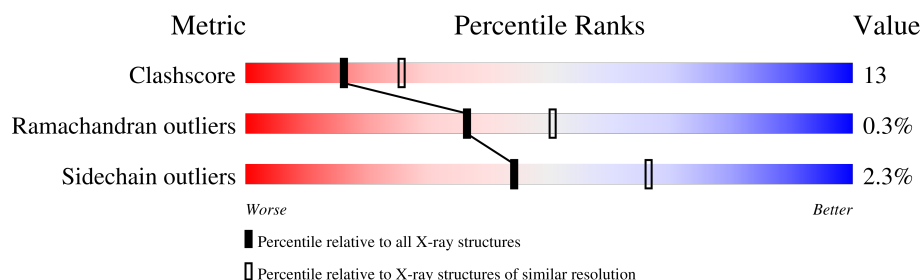
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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))
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	605	74% 23% .
2	B	3	33% 33% 33%
3	C	6	67% 17% 17%
4	D	2	100%

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 4999 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.

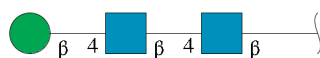
- Molecule 1 is a protein called Beta-D-glucan glucohydrolase isoenzyme EXO1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	602	Total	C	N	O	S	0	0	0
			4566	2891	787	862	26			

There is a discrepancy between the modelled and reference sequences:

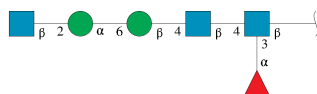
Chain	Residue	Modelled	Actual	Comment	Reference
A	320	LYS	ASN	SEE REMARK 999	GB 4566505

- Molecule 2 is an oligosaccharide called beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	3	Total	C	N	O	0	0	0
			39	22	2	15			

- Molecule 3 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose-(1-6)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-3)]2-acetamido-2-deoxy-beta-D-glucopyranose.



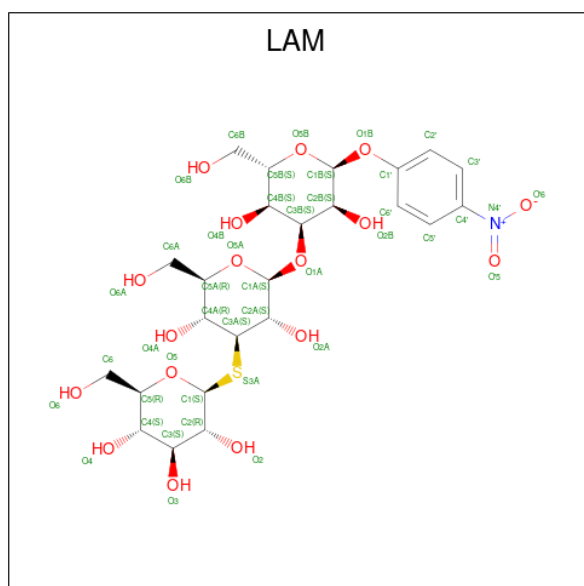
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	6	Total	C	N	O	0	0	0
			74	42	3	29			

- Molecule 4 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	D	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 5 is 4'-NITROPHENYL-S-(BETA-D-GLUCOPYRANOSYL)-(1-3)-(3-THIO-BETA-D-GLUCOPYRANOSYL)-(1-3)-BETA-D-GLUCOPYRANOSIDE (CCD ID: LAM) (formula: C₂₄H₃₅NO₁₇S).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	O	S	0	0
			23	12	10	1		

- Molecule 6 is water.

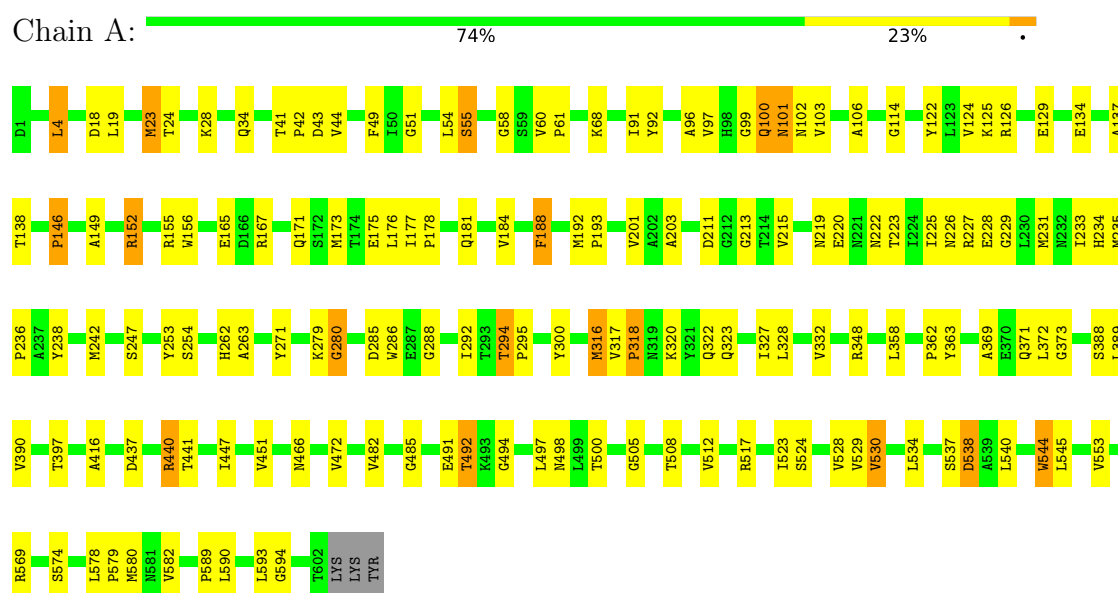
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	269	Total	O	0	0
			269	269		

3 Residue-property plots

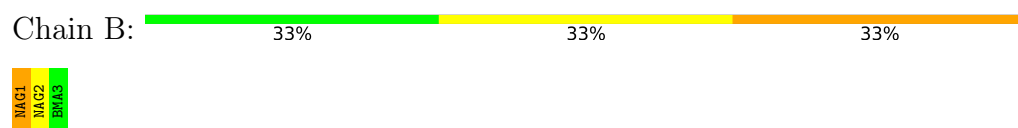
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

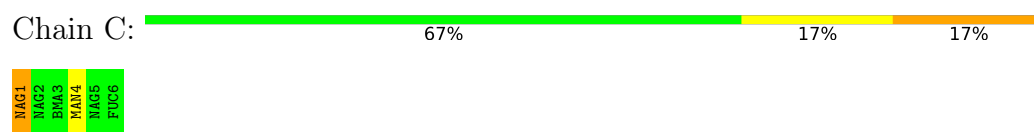
- Molecule 1: Beta-D-glucan glucohydrolase isoenzyme EXO1



- Molecule 2: beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose-(1-6)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-3)]2-acetamido-2-deoxy-beta-D-glucopyranose



- Molecule 4: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain D:

100%

MAG1
MAG2

4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	100.53Å 100.53Å 181.96Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.40	Depositor
% Data completeness (in resolution range)	(Not available) (10.00-2.40)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.201 , 0.250	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4999	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: LAM, MAN, BMA, FUC, 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	0.41	1/4663 (0.0%)	0.94	20/6334 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	316	MET	SD-CE	-5.42	1.66	1.79

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	101	ASN	N-CA-C	8.24	123.05	112.34
1	A	590	LEU	N-CA-C	-6.49	103.70	111.69
1	A	538	ASP	N-CA-C	-5.73	104.65	111.69
1	A	545	LEU	CA-C-N	5.72	126.10	119.47
1	A	545	LEU	C-N-CA	5.72	126.10	119.47
1	A	537	SER	N-CA-C	5.58	119.18	110.32
1	A	99	GLY	N-CA-C	-5.55	104.59	111.70
1	A	492	THR	N-CA-C	5.55	118.04	111.33
1	A	184	VAL	CA-C-N	5.42	125.42	119.89
1	A	184	VAL	C-N-CA	5.42	125.42	119.89
1	A	96	ALA	N-CA-C	-5.40	102.09	109.71
1	A	233	ILE	N-CA-C	5.38	116.54	111.48
1	A	280	GLY	N-CA-C	-5.26	103.30	112.55
1	A	544	TRP	CB-CA-C	-5.26	110.50	116.54
1	A	165	GLU	N-CA-C	-5.21	106.92	113.28
1	A	23	MET	N-CA-C	5.19	117.96	110.28
1	A	100	GLN	N-CA-C	-5.08	102.82	110.70
1	A	254	SER	N-CA-C	5.03	117.02	110.43
1	A	530	VAL	N-CA-C	5.01	117.96	113.10
1	A	234	HIS	N-CA-C	5.00	119.39	113.28

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	4566	0	4550	123	0
2	B	39	0	34	1	0
3	C	74	0	64	1	0
4	D	28	0	25	0	0
5	A	23	0	21	4	0
6	A	269	0	0	10	0
All	All	4999	0	4694	123	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 13.

All (123) 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:181:GLN:HE21	1:A:203:ALA:H	1.13	0.93
1:A:225:ILE:HD11	1:A:229:GLY:HA3	1.55	0.88
1:A:534:LEU:HD12	1:A:540:LEU:HD13	1.60	0.82
1:A:181:GLN:NE2	1:A:203:ALA:H	1.79	0.79
1:A:286:TRP:CA	1:A:316:MET:HE2	2.14	0.78
1:A:440:ARG:HB2	1:A:440:ARG:HH11	1.50	0.77
1:A:181:GLN:HE22	1:A:247:SER:H	1.33	0.76
1:A:226:ASN:OD1	1:A:228:GLU:HB2	1.87	0.74
1:A:222:ASN:HB2	2:B:1:NAG:H82	1.70	0.73
1:A:286:TRP:HA	1:A:316:MET:HE2	1.71	0.73
1:A:437:ASP:HB3	1:A:441:THR:HG21	1.71	0.71
1:A:530:VAL:HG22	1:A:534:LEU:HD13	1.71	0.71
1:A:122:TYR:CE2	1:A:126:ARG:HD2	2.27	0.70
1:A:97:VAL:H	1:A:101:ASN:HD21	1.42	0.68
1:A:146:PRO:HB3	1:A:176:LEU:HD23	1.75	0.67
1:A:177:ILE:HB	1:A:178:PRO:HD3	1.78	0.64
1:A:41:THR:HB	1:A:44:VAL:HG23	1.80	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:517:ARG:HG2	6:A:812:HOH:O	1.98	0.62
1:A:167:ARG:O	1:A:171:GLN:HG3	2.00	0.62
1:A:294:THR:HA	1:A:295:PRO:C	2.25	0.61
1:A:41:THR:HG22	1:A:43:ASP:H	1.65	0.61
1:A:286:TRP:HE3	1:A:316:MET:HE3	1.64	0.61
1:A:524:SER:O	1:A:544:TRP:HA	2.01	0.60
1:A:58:GLY:H	1:A:102:ASN:ND2	2.00	0.59
1:A:286:TRP:CE3	1:A:316:MET:HE3	2.40	0.57
1:A:106:ALA:HB2	1:A:372:LEU:HD11	1.86	0.56
1:A:181:GLN:HE22	1:A:247:SER:N	2.03	0.56
1:A:4:LEU:HB3	1:A:18:ASP:CG	2.31	0.56
1:A:322:GLN:HB2	6:A:830:HOH:O	2.05	0.56
1:A:317:VAL:HB	1:A:318:PRO:HA	1.88	0.56
1:A:149:ALA:HB2	1:A:211:ASP:OD2	2.07	0.55
1:A:580:MET:HE1	1:A:589:PRO:HA	1.88	0.55
1:A:491:GLU:OE2	5:A:621:LAM:S3A	2.64	0.55
1:A:578:LEU:HA	1:A:579:PRO:C	2.32	0.55
1:A:582:VAL:HG21	1:A:593:LEU:HB3	1.89	0.55
1:A:231:MET:HE1	1:A:271:TYR:CZ	2.43	0.53
1:A:124:VAL:HG21	1:A:173:MET:SD	2.49	0.53
1:A:238:TYR:O	1:A:242:MET:HG2	2.10	0.52
1:A:181:GLN:HE21	1:A:203:ALA:N	1.94	0.52
1:A:300:TYR:HD2	1:A:327:ILE:HD12	1.73	0.52
1:A:175:GLU:O	1:A:178:PRO:HD2	2.10	0.51
1:A:231:MET:HE1	1:A:271:TYR:CE1	2.45	0.51
1:A:262:HIS:HE1	1:A:285:ASP:H	1.56	0.51
1:A:485:GLY:HA3	1:A:523:ILE:O	2.11	0.51
1:A:41:THR:HG23	1:A:42:PRO:HD2	1.93	0.51
1:A:316:MET:HE1	5:A:621:LAM:H62	1.93	0.50
1:A:320:LYS:HB3	6:A:825:HOH:O	2.12	0.50
1:A:362:PRO:HG2	1:A:363:TYR:CD2	2.46	0.50
1:A:223:THR:HG22	1:A:225:ILE:HG22	1.94	0.49
1:A:530:VAL:HG22	1:A:534:LEU:CD1	2.39	0.49
1:A:97:VAL:HG11	6:A:710:HOH:O	2.12	0.49
1:A:167:ARG:NH1	1:A:171:GLN:HE22	2.11	0.49
1:A:97:VAL:N	1:A:101:ASN:HD21	2.11	0.48
1:A:593:LEU:HD23	1:A:594:GLY:N	2.29	0.48
1:A:262:HIS:CE1	1:A:288:GLY:HA3	2.49	0.48
1:A:193:PRO:HG3	1:A:280:GLY:CA	2.44	0.48
1:A:286:TRP:HB2	1:A:316:MET:CE	2.44	0.48
1:A:103:VAL:HG21	1:A:138:THR:HG21	1.96	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:91:ILE:O	1:A:91:ILE:HG23	2.14	0.47
1:A:498:ASN:CG	3:C:1:NAG:H82	2.39	0.47
1:A:500:THR:HG22	1:A:529:VAL:HG21	1.96	0.47
1:A:137:ALA:HB2	1:A:371:GLN:HB2	1.96	0.47
1:A:152:ARG:HD3	6:A:863:HOH:O	2.15	0.47
1:A:574:SER:HA	6:A:801:HOH:O	2.14	0.47
1:A:114:GLY:O	1:A:388:SER:HB2	2.15	0.47
1:A:447:ILE:O	1:A:451:VAL:HG23	2.14	0.47
1:A:582:VAL:HG21	1:A:593:LEU:CB	2.45	0.47
1:A:19:LEU:O	1:A:23:MET:HG3	2.15	0.47
1:A:286:TRP:CB	1:A:316:MET:HE2	2.45	0.46
1:A:235:MET:N	1:A:236:PRO:CD	2.79	0.46
1:A:492:THR:C	1:A:494:GLY:H	2.23	0.46
1:A:175:GLU:C	1:A:178:PRO:HD2	2.41	0.46
1:A:498:ASN:O	1:A:500:THR:HG23	2.14	0.46
1:A:317:VAL:HB	1:A:318:PRO:CA	2.45	0.45
1:A:540:LEU:C	1:A:540:LEU:HD23	2.42	0.45
1:A:220:GLU:HG2	1:A:253:TYR:HB2	1.98	0.45
1:A:508:THR:O	1:A:512:VAL:HG23	2.16	0.45
1:A:517:ARG:HA	1:A:538:ASP:OD2	2.17	0.45
1:A:68:LYS:HE3	1:A:369:ALA:HB2	1.98	0.45
1:A:126:ARG:HA	1:A:129:GLU:HG3	1.98	0.45
1:A:253:TYR:OH	1:A:286:TRP:HB3	2.17	0.45
1:A:492:THR:C	1:A:494:GLY:N	2.74	0.45
1:A:4:LEU:C	1:A:4:LEU:HD13	2.41	0.45
1:A:100:GLN:HG3	1:A:103:VAL:CG2	2.47	0.45
1:A:593:LEU:HD23	1:A:593:LEU:C	2.41	0.45
1:A:416:ALA:O	1:A:482:VAL:HA	2.17	0.45
1:A:24:THR:O	1:A:28:LYS:HG3	2.16	0.45
1:A:227:ARG:O	1:A:231:MET:HG2	2.17	0.45
1:A:181:GLN:HG2	1:A:201:VAL:O	2.16	0.44
1:A:51:GLY:HA2	6:A:720:HOH:O	2.17	0.44
1:A:100:GLN:HA	1:A:100:GLN:OE1	2.17	0.44
1:A:125:LYS:O	1:A:129:GLU:HG3	2.18	0.44
1:A:440:ARG:HB2	1:A:440:ARG:NH1	2.27	0.44
1:A:213:GLY:O	1:A:223:THR:HG23	2.17	0.44
1:A:466:ASN:ND2	1:A:508:THR:OG1	2.51	0.44
1:A:146:PRO:HB3	1:A:176:LEU:CD2	2.44	0.43
1:A:225:ILE:HD11	1:A:229:GLY:CA	2.36	0.43
1:A:34:GLN:OE1	1:A:316:MET:HG3	2.18	0.43
1:A:528:VAL:O	1:A:529:VAL:C	2.58	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:155:ARG:HD2	1:A:497:LEU:HD23	1.99	0.43
1:A:173:MET:C	1:A:175:GLU:H	2.26	0.43
1:A:472:VAL:HG21	1:A:512:VAL:HA	2.01	0.43
1:A:220:GLU:HG2	1:A:253:TYR:CD2	2.53	0.43
1:A:500:THR:HG22	1:A:529:VAL:CG2	2.49	0.43
1:A:41:THR:HB	1:A:44:VAL:CG2	2.47	0.43
1:A:156:TRP:HE1	1:A:219:ASN:ND2	2.17	0.43
1:A:55:SER:HB2	1:A:92:TYR:HE1	1.83	0.42
1:A:389:LEU:HD11	1:A:553:VAL:HA	2.01	0.42
1:A:231:MET:HA	1:A:235:MET:HB3	2.01	0.42
1:A:286:TRP:N	1:A:316:MET:HE2	2.34	0.42
1:A:390:VAL:HA	6:A:769:HOH:O	2.18	0.42
1:A:100:GLN:HG3	1:A:103:VAL:HB	2.02	0.42
1:A:328:LEU:O	1:A:332:VAL:HG23	2.20	0.42
1:A:286:TRP:CD1	5:A:621:LAM:H1A1	2.54	0.41
1:A:188:PHE:HZ	1:A:192:MET:O	2.03	0.41
1:A:316:MET:CE	5:A:621:LAM:H62	2.50	0.41
1:A:134:GLU:CD	1:A:373:GLY:H	2.28	0.41
1:A:279:LYS:HA	1:A:348:ARG:HH12	1.86	0.41
1:A:49:PHE:HB3	6:A:706:HOH:O	2.21	0.40
1:A:300:TYR:CD2	1:A:323:GLN:HG2	2.57	0.40
1:A:60:VAL:HB	1:A:61:PRO:HD2	2.03	0.40
1:A:263:ALA:HB2	1:A:292:ILE:HD13	2.02	0.40
1:A:569:ARG:HD2	6:A:798:HOH:O	2.21	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	600/605 (99%)	563 (94%)	35 (6%)	2 (0%)	36 50

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	188	PHE
1	A	505	GLY

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	485/488 (99%)	474 (98%)	11 (2%)	44 66

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	LEU
1	A	54	LEU
1	A	55	SER
1	A	146	PRO
1	A	152	ARG
1	A	215	VAL
1	A	294	THR
1	A	318	PRO
1	A	358	LEU
1	A	397	THR
1	A	440	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	101	ASN
1	A	102	ASN
1	A	171	GLN
1	A	181	GLN
1	A	199	ASN
1	A	219	ASN
1	A	262	HIS

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Mol	Chain	Res	Type
1	A	319	ASN
1	A	466	ASN
1	A	581	ASN
1	A	586	HIS

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 ⓘ

11 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	0.75	1 (7%)	17,19,21	0.68	1 (5%)
2	NAG	B	2	2	14,14,15	0.66	0	17,19,21	0.74	1 (5%)
2	BMA	B	3	2	11,11,12	0.71	0	15,15,17	0.37	0
3	NAG	C	1	1,3	14,14,15	0.49	0	17,19,21	0.83	1 (5%)
3	NAG	C	2	3	14,14,15	0.57	0	17,19,21	0.59	0
3	BMA	C	3	3	11,11,12	0.60	0	15,15,17	0.36	0
3	MAN	C	4	3	11,11,12	0.47	0	15,15,17	0.60	1 (6%)
3	NAG	C	5	3	14,14,15	0.67	0	17,19,21	0.70	0
3	FUC	C	6	3	10,10,11	0.55	0	14,14,16	0.41	0
4	NAG	D	1	1,4	14,14,15	0.81	0	17,19,21	0.95	1 (5%)
4	NAG	D	2	4	14,14,15	0.66	0	17,19,21	0.88	1 (5%)

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	-	2/6/23/26	0/1/1/1
2	NAG	B	2	2	-	3/6/23/26	0/1/1/1
2	BMA	B	3	2	-	2/2/19/22	0/1/1/1
3	NAG	C	1	1,3	-	3/6/23/26	0/1/1/1
3	NAG	C	2	3	-	4/6/23/26	0/1/1/1
3	BMA	C	3	3	-	1/2/19/22	0/1/1/1
3	MAN	C	4	3	-	0/2/19/22	0/1/1/1
3	NAG	C	5	3	-	2/6/23/26	0/1/1/1
3	FUC	C	6	3	-	-	0/1/1/1
4	NAG	D	1	1,4	-	0/6/23/26	0/1/1/1
4	NAG	D	2	4	-	2/6/23/26	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1	NAG	C1-C2	2.03	1.55	1.52

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	2	NAG	C2-N2-C7	-2.69	119.30	122.90
4	D	1	NAG	C2-N2-C7	-2.66	119.34	122.90
3	C	1	NAG	C2-N2-C7	-2.47	119.58	122.90
2	B	2	NAG	C2-N2-C7	-2.20	119.96	122.90
3	C	4	MAN	C1-O5-C5	2.05	114.94	112.19
2	B	1	NAG	C2-N2-C7	-2.00	120.22	122.90

There are no chirality outliers.

All (19) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	2	NAG	C8-C7-N2-C2
2	B	2	NAG	O7-C7-N2-C2
3	C	1	NAG	O7-C7-N2-C2
4	D	2	NAG	C8-C7-N2-C2
4	D	2	NAG	O7-C7-N2-C2
3	C	1	NAG	C8-C7-N2-C2

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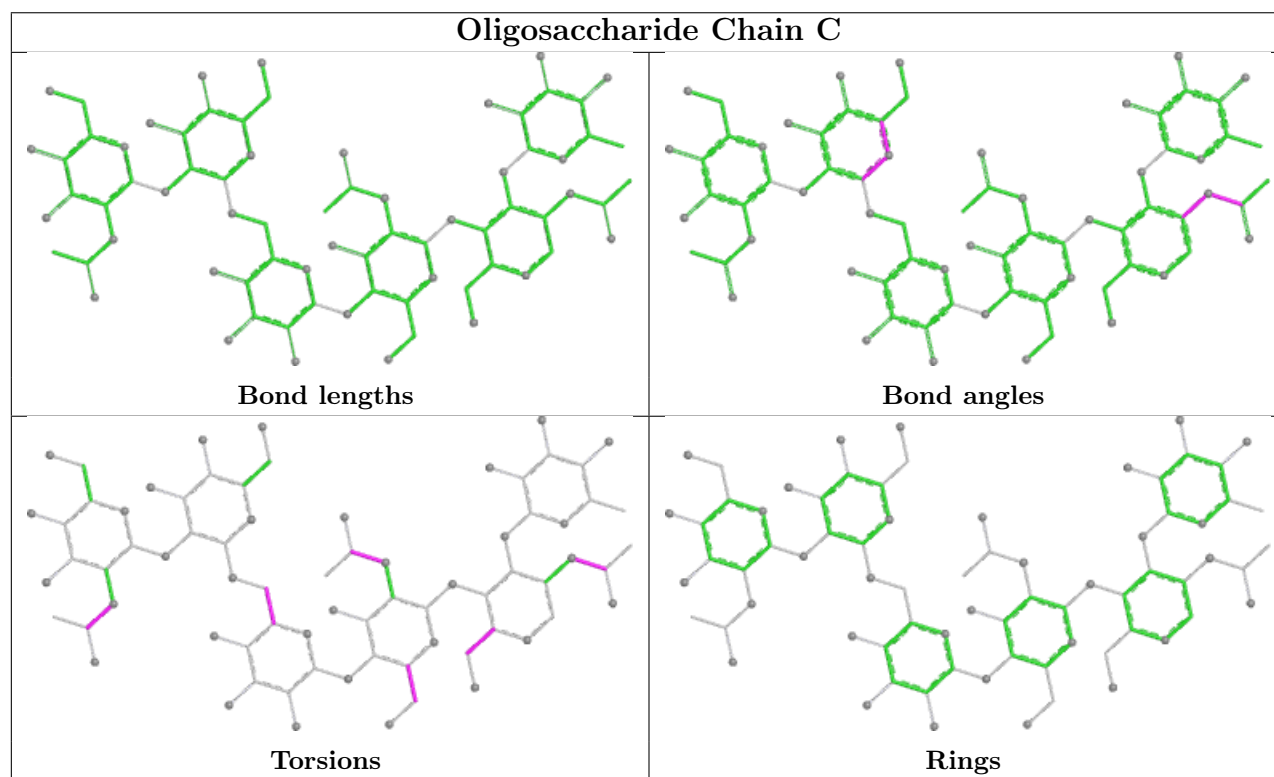
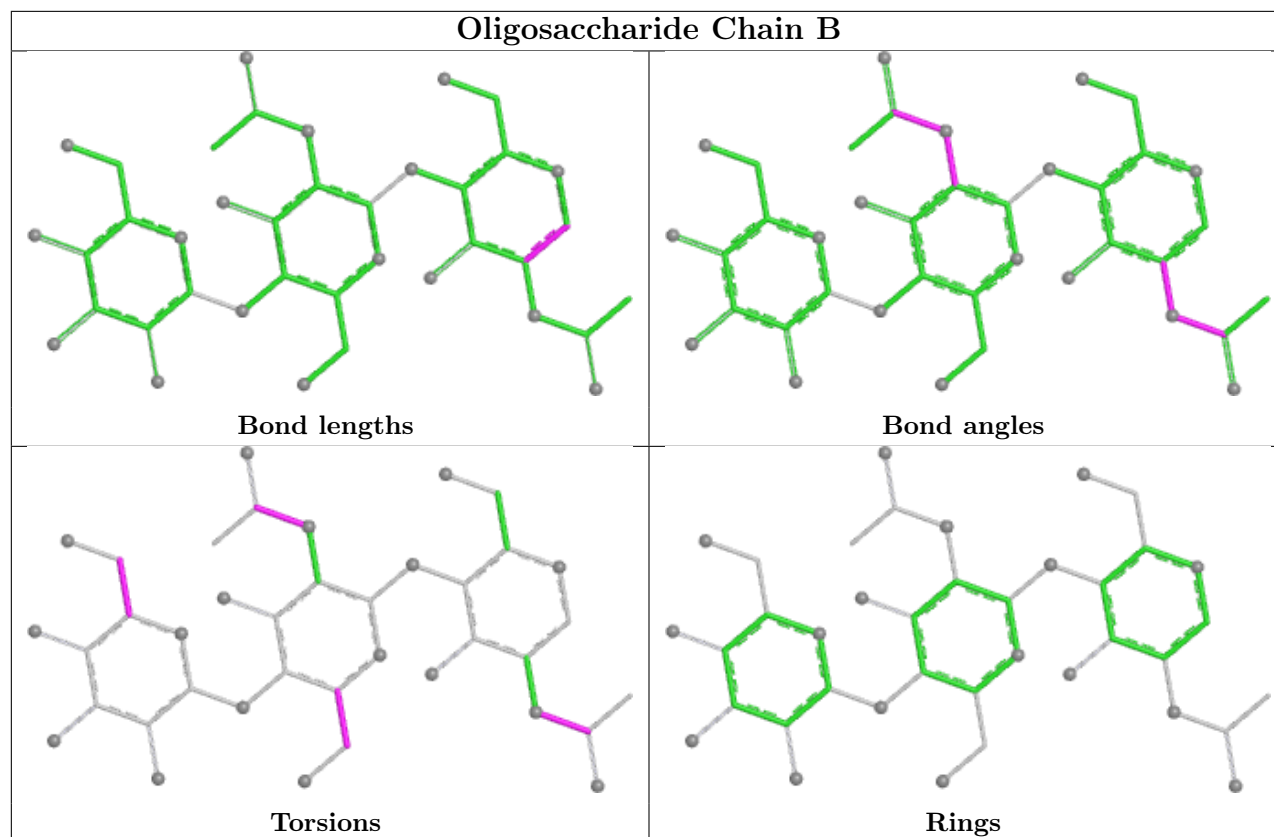
Mol	Chain	Res	Type	Atoms
3	C	5	NAG	C8-C7-N2-C2
3	C	5	NAG	O7-C7-N2-C2
3	C	2	NAG	O5-C5-C6-O6
3	C	2	NAG	C4-C5-C6-O6
2	B	3	BMA	O5-C5-C6-O6
3	C	2	NAG	C8-C7-N2-C2
2	B	1	NAG	C8-C7-N2-C2
3	C	2	NAG	O7-C7-N2-C2
2	B	2	NAG	O5-C5-C6-O6
2	B	1	NAG	O7-C7-N2-C2
2	B	3	BMA	C4-C5-C6-O6
3	C	3	BMA	O5-C5-C6-O6
3	C	1	NAG	C4-C5-C6-O6

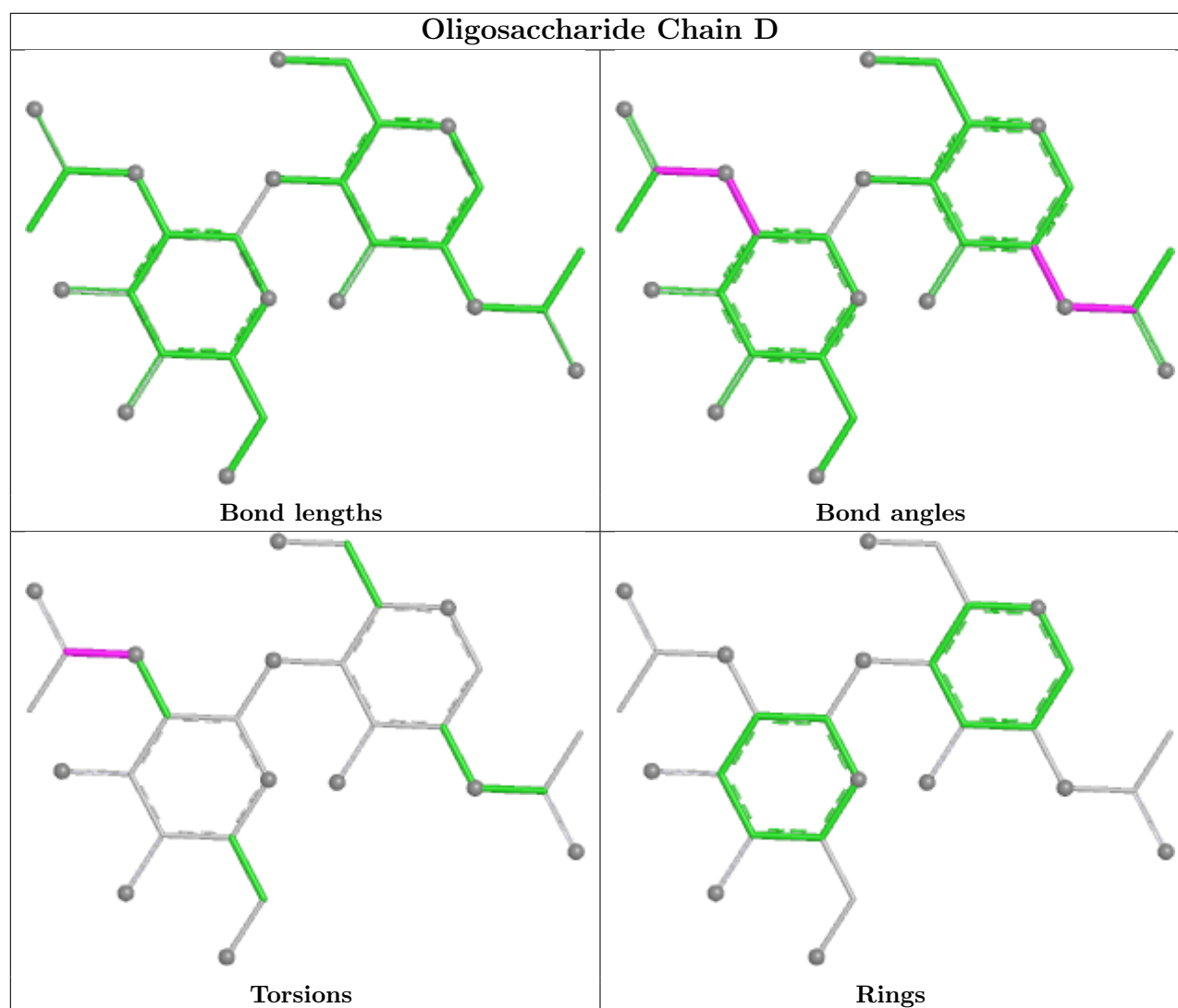
There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	1	NAG	1	0
2	B	1	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](#)

1 ligand is 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	$\# Z > 2$
5	LAM	A	621	-	24,24,46	5.74	19 (79%)	27,35,67	1.67	7 (25%)

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
5	LAM	A	621	-	-	3/8/48/82	0/2/2/4

All (19) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	621	LAM	C2A-C3A	14.64	1.67	1.53
5	A	621	LAM	C4A-C3A	10.53	1.63	1.53
5	A	621	LAM	C4A-C5A	9.37	1.73	1.53
5	A	621	LAM	C1A-C2A	7.44	1.69	1.52
5	A	621	LAM	O5A-C1A	6.49	1.58	1.42
5	A	621	LAM	C1-C2	6.27	1.64	1.53
5	A	621	LAM	C4-C5	6.08	1.66	1.53
5	A	621	LAM	O5A-C5A	6.06	1.59	1.44
5	A	621	LAM	O4A-C4A	5.88	1.57	1.43
5	A	621	LAM	O2A-C2A	5.18	1.55	1.43
5	A	621	LAM	O1A-C1A	4.64	1.54	1.39
5	A	621	LAM	C3-C2	4.03	1.62	1.52
5	A	621	LAM	C4-C3	3.79	1.62	1.52
5	A	621	LAM	O5-C5	3.71	1.53	1.44
5	A	621	LAM	O2-C2	3.20	1.50	1.43
5	A	621	LAM	C6A-C5A	2.96	1.61	1.51
5	A	621	LAM	O5-C1	2.64	1.46	1.42
5	A	621	LAM	O3-C3	2.04	1.48	1.43
5	A	621	LAM	C6-C5	2.03	1.58	1.51

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	621	LAM	C6-C5-C4	3.62	121.90	113.02
5	A	621	LAM	C1-O5-C5	3.38	118.62	112.56
5	A	621	LAM	O4A-C4A-C5A	2.91	116.48	109.32
5	A	621	LAM	O5A-C5A-C4A	2.85	114.83	109.70
5	A	621	LAM	O5-C5-C4	-2.54	105.13	109.70
5	A	621	LAM	C3-C4-C5	-2.39	105.90	110.23
5	A	621	LAM	O5-C1-C2	2.05	113.15	110.32

There are no chirality outliers.

All (3) torsion outliers are listed below:

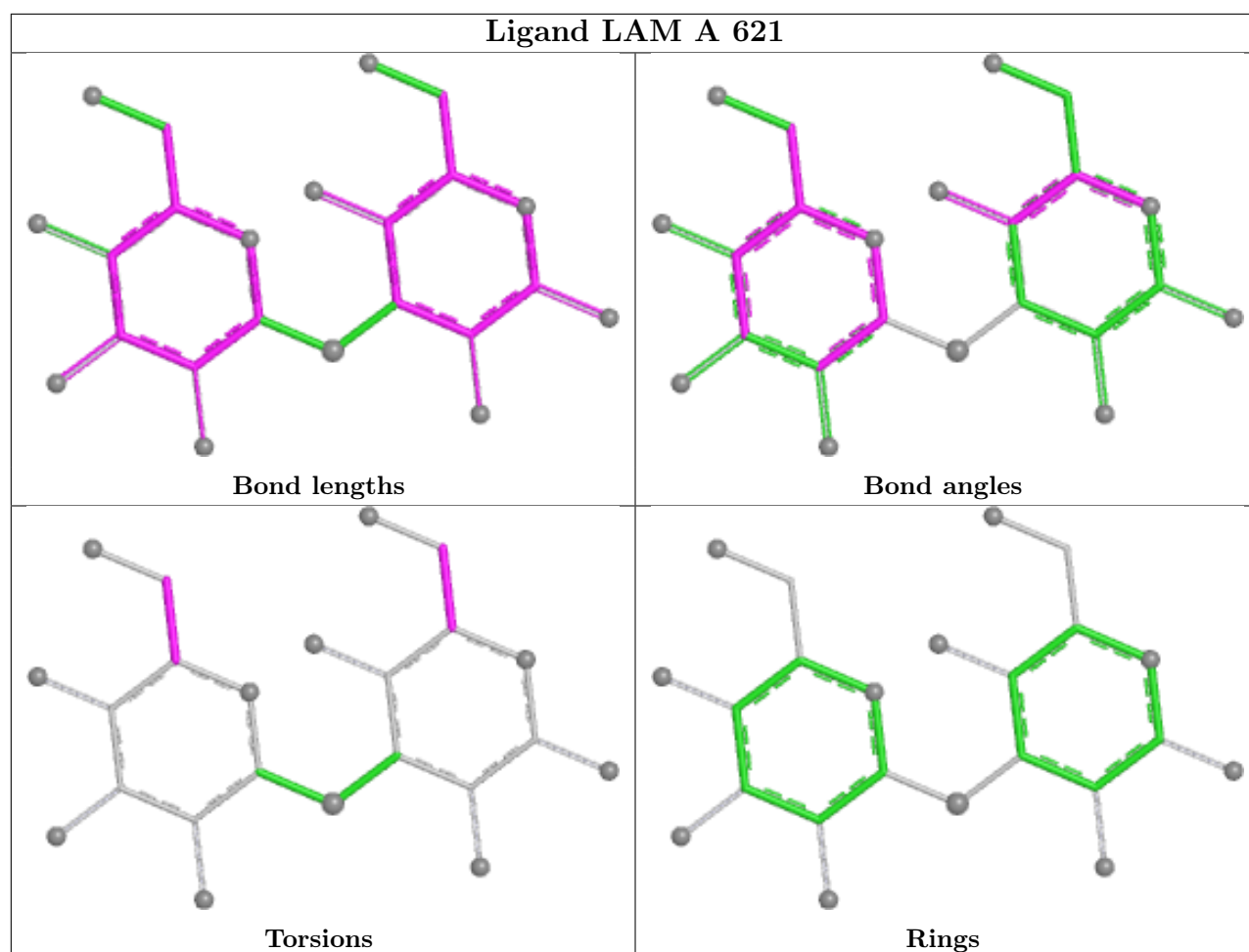
Mol	Chain	Res	Type	Atoms
5	A	621	LAM	O5-C5-C6-O6
5	A	621	LAM	C4-C5-C6-O6
5	A	621	LAM	O5A-C5A-C6A-O6A

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	621	LAM	4	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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.