Full wwPDB X-ray Structure Validation Report (i)

Aug 23, 2023 – 12:44 PM EDT

PDB ID	:	3C4M
Title	:	Structure of human parathyroid hormone in complex with the extracellular domain of its G-protein-coupled receptor (PTH1R)
Authors	:	Pioszak, A.A.; Xu, H.E.
Deposited on	:	2008-01-30
Resolution	:	1.95 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 (i) 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 (i)) were used in the production of this report:

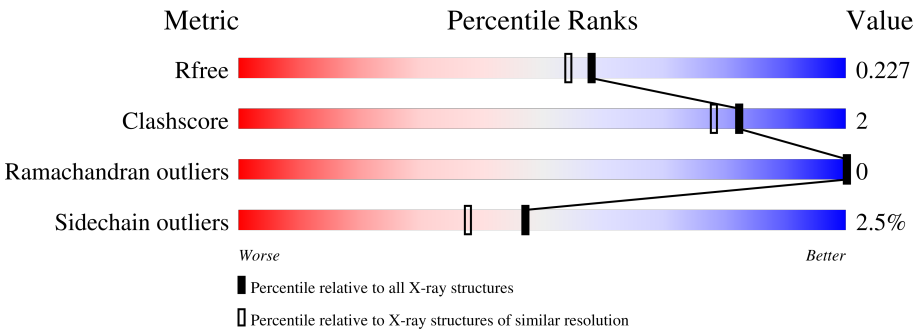
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

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 1.95 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5%

Mol	Chain	Length	Quality of chain
1	A	539	81% 5% • 13%
1	B	539	80% 6% • 13%
2	C	21	86% 14%
2	D	21	95% 5%
3	E	2	50% 50%
3	F	2	100%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8349 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 Fusion protein of Maltose-binding periplasmic protein and Parathyroid hormone/parathyroid hormone-related peptide receptor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	469	3684	2366	612	693	13	0	0	0
1	B	469	3681	2363	612	693	13	0	0	0

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-345	MET	-	initiating methionine	UNP P0AEX9
A	23	ASN	-	linker	UNP P0AEX9
A	24	ALA	-	linker	UNP P0AEX9
A	25	ALA	-	linker	UNP P0AEX9
A	26	ALA	-	linker	UNP P0AEX9
A	27	GLU	-	linker	UNP P0AEX9
A	28	PHE	-	linker	UNP P0AEX9
A	188	HIS	-	expression tag	UNP P0AEX9
A	189	HIS	-	expression tag	UNP P0AEX9
A	190	HIS	-	expression tag	UNP P0AEX9
A	191	HIS	-	expression tag	UNP P0AEX9
A	192	HIS	-	expression tag	UNP P0AEX9
A	193	HIS	-	expression tag	UNP P0AEX9
B	-345	MET	-	initiating methionine	UNP P0AEX9
B	23	ASN	-	linker	UNP P0AEX9
B	24	ALA	-	linker	UNP P0AEX9
B	25	ALA	-	linker	UNP P0AEX9
B	26	ALA	-	linker	UNP P0AEX9
B	27	GLU	-	linker	UNP P0AEX9
B	28	PHE	-	linker	UNP P0AEX9
B	188	HIS	-	expression tag	UNP P0AEX9
B	189	HIS	-	expression tag	UNP P0AEX9
B	190	HIS	-	expression tag	UNP P0AEX9
B	191	HIS	-	expression tag	UNP P0AEX9

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Chain	Residue	Modelled	Actual	Comment	Reference
B	192	HIS	-	expression tag	UNP P0AEX9
B	193	HIS	-	expression tag	UNP P0AEX9

- Molecule 2 is a protein called Parathyroid hormone.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	C	21	179	113	35	30	1	0	0	1
			Total	C	N	O	S			
2	D	21	179	113	35	30	1	0	0	1

- Molecule 3 is an oligosaccharide called alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
			Total	C	O			
3	E	2	23	12	11	0	0	0
			Total	C	O			
3	F	2	23	12	11	0	0	0

- Molecule 4 is water.

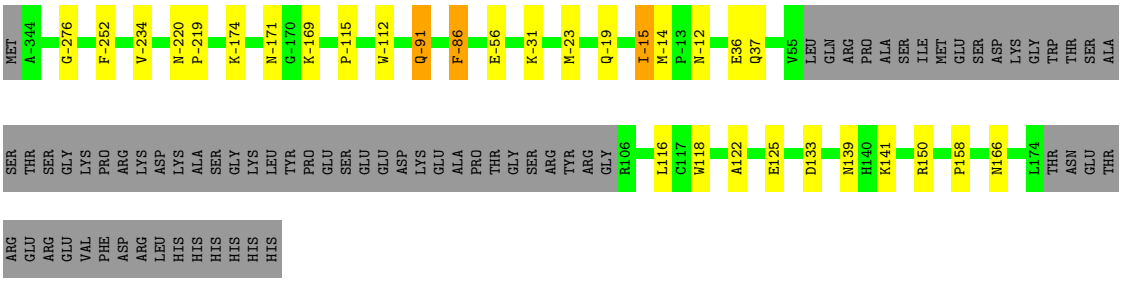
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	330	330	330	0	0
			Total	O		
4	B	230	230	230	0	0
			Total	O		
4	C	6	6	6	0	0
			Total	O		
4	D	14	14	14	0	0

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. 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.

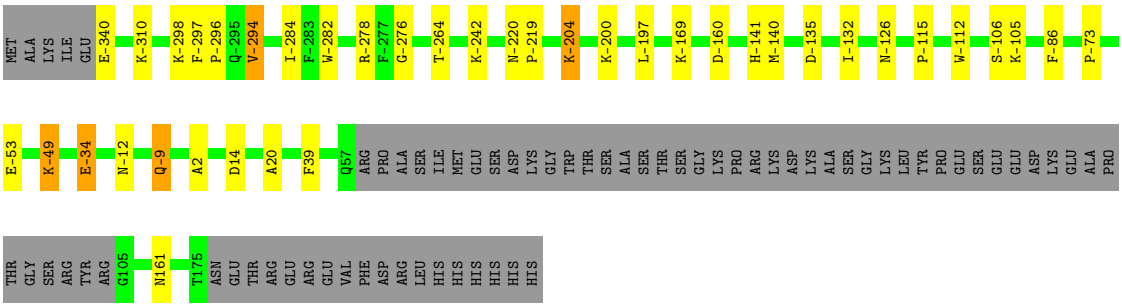
• Molecule 1: Fusion protein of Maltose-binding periplasmic protein and Parathyroid hormone/parathyroid hormone-related peptide receptor

Chain A:



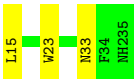
• Molecule 1: Fusion protein of Maltose-binding periplasmic protein and Parathyroid hormone/parathyroid hormone-related peptide receptor

Chain B:



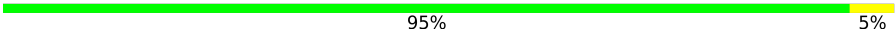
• Molecule 2: Parathyroid hormone

Chain C:



• Molecule 2: Parathyroid hormone

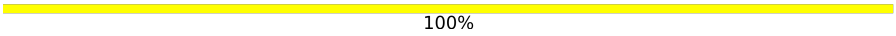
Chain D:



• Molecule 3: alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain E:

• Molecule 3: alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain F: 

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	62.92Å 116.79Å 78.42Å 90.00° 108.80° 90.00°	Depositor
Resolution (Å)	50.00 – 1.95 41.70 – 1.95	Depositor EDS
% Data completeness (in resolution range)	97.9 (50.00-1.95) 97.9 (41.70-1.95)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.43 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.186 , 0.227 0.187 , 0.227	Depositor DCC
R_{free} test set	3849 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	31.0	Xtriage
Anisotropy	0.347	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 39.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	8349	wwPDB-VP
Average B, all atoms (Å^2)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.80% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: GLC, NH2

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	0.58	3/3780 (0.1%)	0.59	1/5134 (0.0%)
1	B	0.47	0/3777	0.57	0/5131
2	C	1.47	2/181 (1.1%)	0.63	0/241
2	D	0.47	0/181	0.59	0/241
All	All	0.57	5/7919 (0.1%)	0.58	1/10747 (0.0%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	33	ASN	CG-OD1	15.13	1.57	1.24
2	C	33	ASN	CG-ND2	9.21	1.55	1.32
1	A	150	ARG	C-O	8.27	1.39	1.23
1	A	158	PRO	C-N	7.90	1.47	1.33
1	A	150	ARG	CZ-NH1	5.60	1.40	1.33

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	150	ARG	NE-CZ-NH2	-5.54	117.53	120.30

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	3684	0	3604	17	0
1	B	3681	0	3598	22	0
2	C	179	0	178	2	0
2	D	179	0	178	0	0
3	E	23	0	21	0	0
3	F	23	0	21	0	0
4	A	330	0	0	3	0
4	B	230	0	0	1	0
4	C	6	0	0	0	0
4	D	14	0	0	0	0
All	All	8349	0	7600	38	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 (38) 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:122:ALA:HB3	1:A:125:GLU:HG3	1.69	0.73
1:A:-23:MET:O	1:A:-19:GLN:HG2	1.90	0.71
1:B:-135:ASP:OD1	1:B:-132:ILE:HG12	1.99	0.63
1:B:-141:HIS:HE1	4:B:263:HOH:O	1.86	0.58
4:A:309:HOH:O	2:C:15:LEU:HB2	2.04	0.56
1:A:-276:GLY:HA3	1:A:-12:ASN:O	2.05	0.56
1:B:-53:GLU:O	1:B:-49:LYS:HG3	2.06	0.55
1:B:-197:LEU:HD23	1:B:-140:MET:CE	2.37	0.54
1:B:-276:GLY:HA3	1:B:-12:ASN:O	2.10	0.51
1:B:-282:TRP:CD1	1:B:-278:ARG:HG3	2.46	0.51
1:A:-115:PRO:HA	1:A:-112:TRP:CE2	2.46	0.49
1:A:-56:GLU:CD	1:A:-56:GLU:H	2.15	0.49
1:B:-106:SER:O	1:B:-105:LYS:HG3	2.13	0.49
1:A:-91:GLN:NE2	4:A:279:HOH:O	2.46	0.48
1:B:-297:PHE:HB3	1:B:-296:PRO:HD3	1.95	0.47
1:B:-204:LYS:HD2	1:B:-200:LYS:O	2.13	0.47
1:A:-23:MET:O	1:A:-19:GLN:CG	2.62	0.47
1:B:-9:GLN:NE2	1:B:-9:GLN:H	2.14	0.46
1:A:-15:ILE:HD13	4:A:272:HOH:O	2.15	0.46
1:B:-298:LYS:O	1:B:-294:VAL:HB	2.16	0.46
1:A:-171:ASN:OD1	1:B:-242:LYS:HE2	2.16	0.45
1:B:-9:GLN:H	1:B:-9:GLN:HE21	1.63	0.45
1:A:36:GLU:HA	1:B:39:PHE:CZ	2.52	0.45
1:B:-126:ASN:HD22	1:B:-126:ASN:N	2.12	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:-106:SER:O	1:B:-105:LYS:CG	2.65	0.44
1:A:37:GLN:HG3	2:C:23:TRP:CZ3	2.52	0.44
1:B:-197:LEU:HG	1:B:-140:MET:HE2	1.99	0.44
1:B:2:ALA:HB2	1:B:20:ALA:HB2	2.00	0.43
1:A:-252:PHE:CZ	1:A:-234:VAL:HG21	2.54	0.43
1:A:-86:PHE:CG	1:A:-14:MET:HG2	2.54	0.43
1:A:139:ASN:OD1	1:A:141:LYS:HG2	2.19	0.42
1:B:-115:PRO:HA	1:B:-112:TRP:CE2	2.55	0.41
1:A:-169:LYS:NZ	1:A:133:ASP:OD1	2.54	0.41
1:A:116:LEU:HD11	1:A:118:TRP:CE2	2.56	0.41
1:A:-220:ASN:HA	1:A:-219:PRO:HD2	1.91	0.41
1:B:-220:ASN:HA	1:B:-219:PRO:HD2	1.94	0.41
1:B:-340:GLU:HG2	1:B:-73:PRO:HG3	2.02	0.41
1:B:-34:GLU:H	1:B:-34:GLU:HG3	1.62	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	465/539 (86%)	454 (98%)	11 (2%)	0	100	100
1	B	465/539 (86%)	458 (98%)	7 (2%)	0	100	100
2	C	19/21 (90%)	19 (100%)	0	0	100	100
2	D	19/21 (90%)	19 (100%)	0	0	100	100
All	All	968/1120 (86%)	950 (98%)	18 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	381/442 (86%)	375 (98%)	6 (2%)	62	58
1	B	381/442 (86%)	368 (97%)	13 (3%)	37	25
2	C	20/20 (100%)	20 (100%)	0	100	100
2	D	20/20 (100%)	19 (95%)	1 (5%)	24	11
All	All	802/924 (87%)	782 (98%)	20 (2%)	47	38

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	-174	LYS
1	A	-91	GLN
1	A	-86	PHE
1	A	-31	LYS
1	A	-15	ILE
1	A	166	ASN
1	B	-310	LYS
1	B	-294	VAL
1	B	-284	ILE
1	B	-264	THR
1	B	-204	LYS
1	B	-169	LYS
1	B	-160	ASP
1	B	-86	PHE
1	B	-49	LYS
1	B	-34	GLU
1	B	-9	GLN
1	B	14	ASP
1	B	161	ASN
2	D	15	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	-295	GLN
1	A	-244	ASN
1	A	-126	ASN
1	A	-91	GLN
1	A	-9	GLN
1	A	166	ASN
1	B	-326	ASN
1	B	-141	HIS
1	B	-126	ASN
1	B	-9	GLN
1	B	23	ASN
2	D	33	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)

4 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	$\#\|Z\| > 2$
3	GLC	E	1	3	12,12,12	0.48	0	17,17,17	0.82	0
3	GLC	E	2	3	11,11,12	0.69	0	15,15,17	1.28	1 (6%)
3	GLC	F	1	3	12,12,12	0.49	0	17,17,17	0.87	1 (5%)
3	GLC	F	2	3	11,11,12	0.65	0	15,15,17	0.89	1 (6%)

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
3	GLC	E	1	3	-	0/2/22/22	0/1/1/1
3	GLC	E	2	3	-	0/2/19/22	0/1/1/1
3	GLC	F	1	3	-	0/2/22/22	0/1/1/1
3	GLC	F	2	3	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	E	2	GLC	C1-O5-C5	3.86	117.42	112.19
3	F	2	GLC	C1-O5-C5	2.53	115.62	112.19
3	F	1	GLC	O5-C1-C2	2.37	114.52	110.28

There are no chirality outliers.

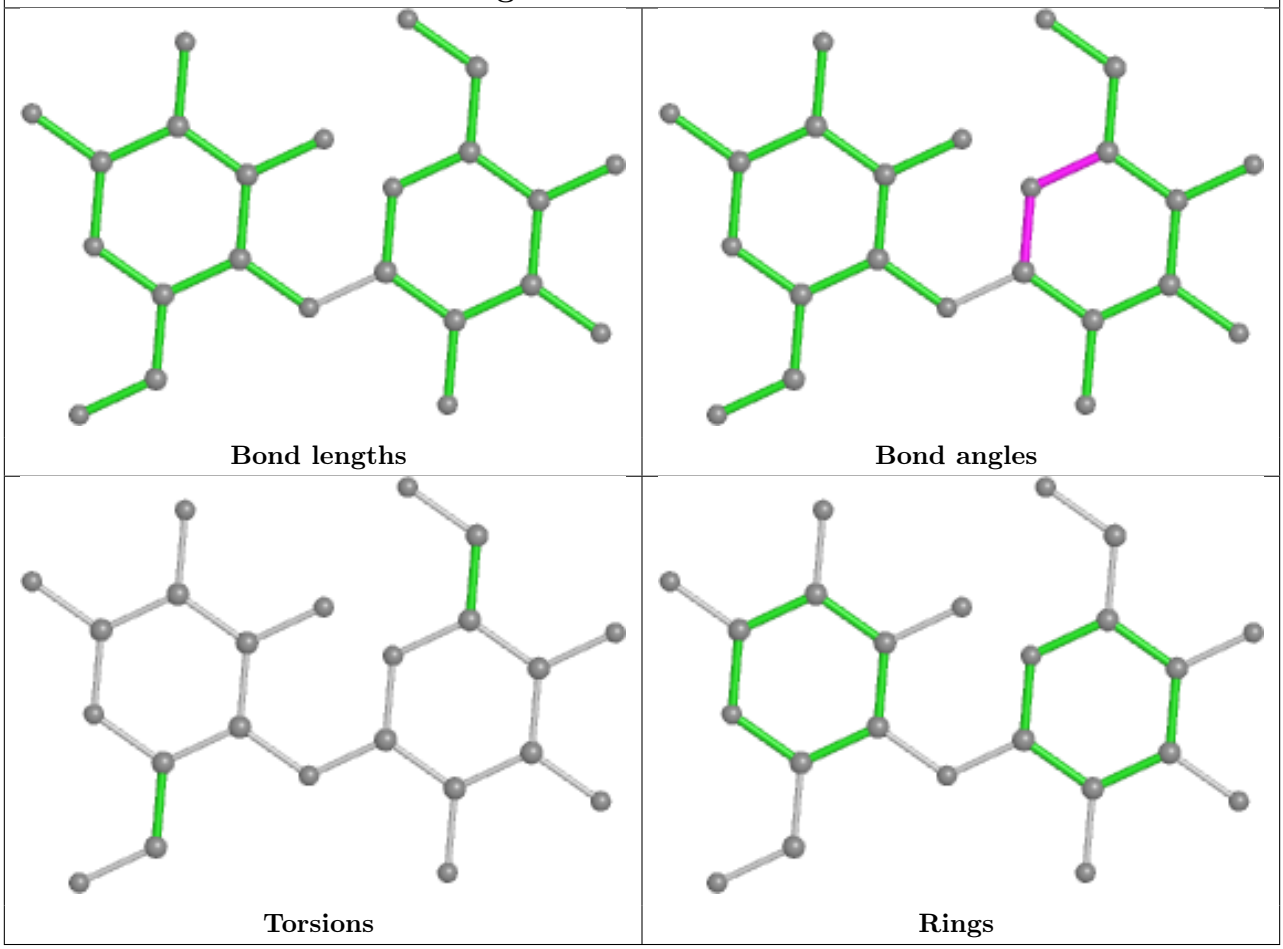
There are no torsion outliers.

There are no ring outliers.

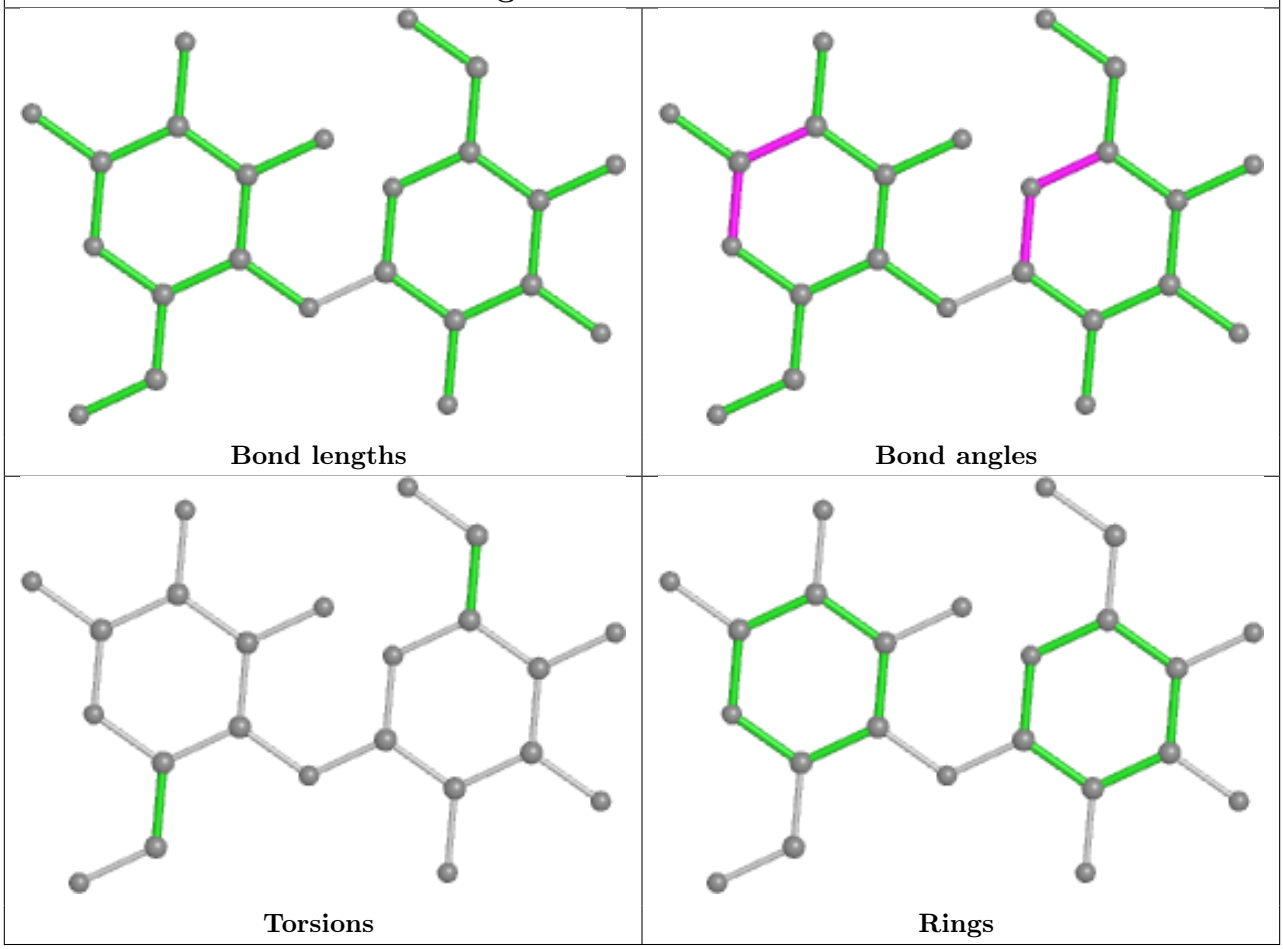
No monomer is involved in short contacts.

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

Oligosaccharide Chain E



Oligosaccharide Chain F



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)

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

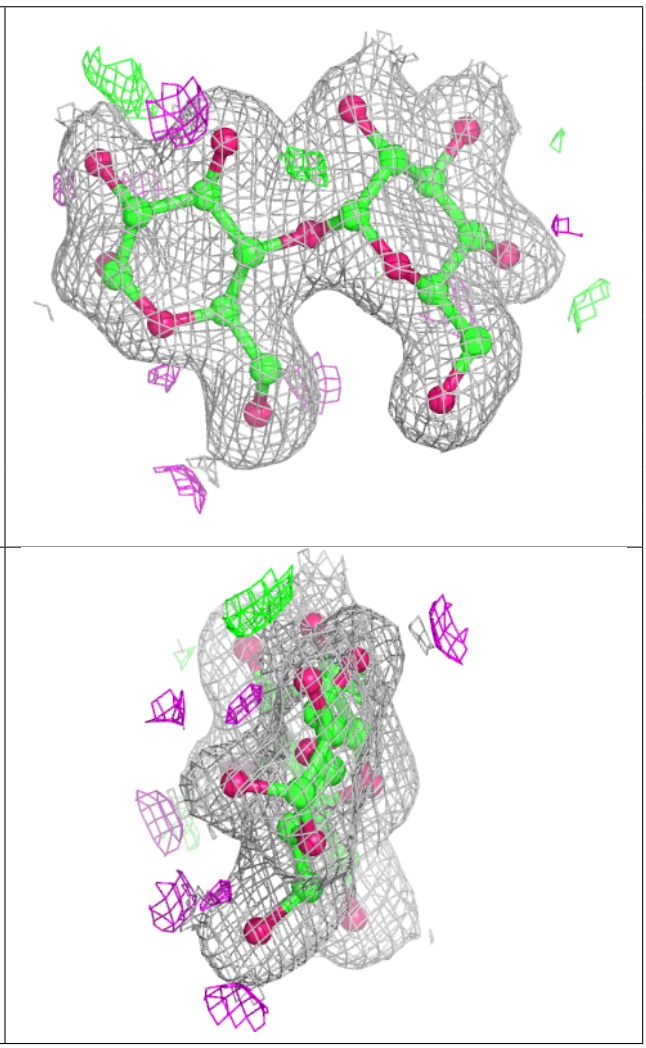
6.3 Carbohydrates (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

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.

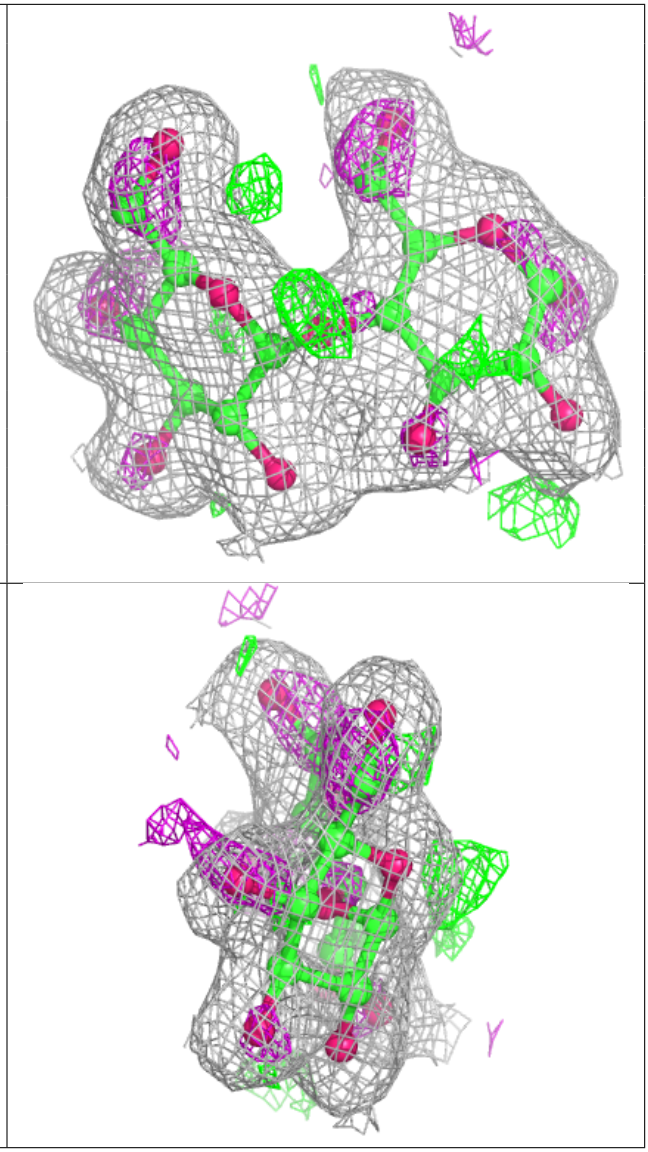
Electron density around Chain E:

$2mF_o$-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 F:

$2mF_o$-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)

Unable to reproduce the depositors R factor - this section is therefore empty.

6.5 Other polymers (i)

Unable to reproduce the depositors R factor - this section is therefore empty.