



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 03:02 AM UTC

PDB ID : 4MSF / pdb_00004msf
Title : Crystal structure of the complex of goat lactoperoxidase with 3-hydroxymethyl phenol at 1.98 Angstrom resolution
Authors : Singh, A.; Singh, R.P.; Sinha, M.; Singh, A.K.; Bhushan, A.; Kaur, P.; Sharma, S.; Singh, T.P.
Deposited on : 2013-09-18
Resolution : 1.98 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)
Xtrriage (Phenix) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

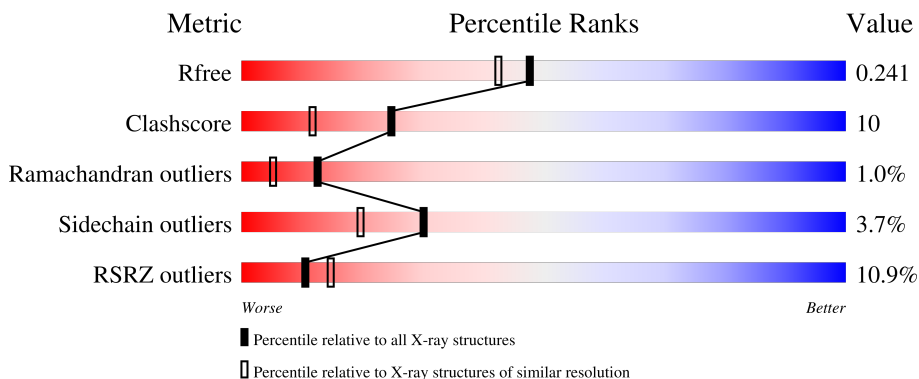
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.98 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}	180053	1506 (1.98-1.98)
Clashscore	190562	1534 (1.98-1.98)
Ramachandran outliers	187476	1518 (1.98-1.98)
Sidechain outliers	187428	1518 (1.98-1.98)
RSRZ outliers	180081	1506 (1.98-1.98)

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	595	

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
5	IOD	A	612	-	-	X	-
5	IOD	A	615	-	-	X	-
7	PEG	A	623	-	-	X	-
9	3HY	A	627	-	-	X	-

2 Entry composition [i](#)

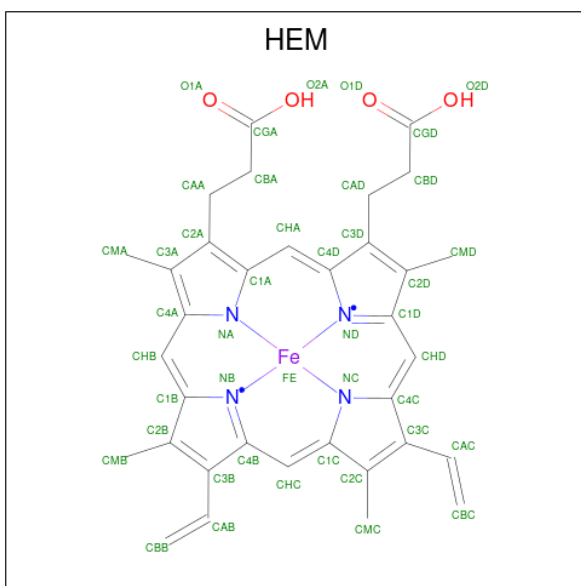
There are 10 unique types of molecules in this entry. The entry contains 5414 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Lactoperoxidase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	595	4757	3021	844	865	1	26	0	0	0

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	Fe	N	O		
2	A	1	43	34	1	4	4	0	0

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

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

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).

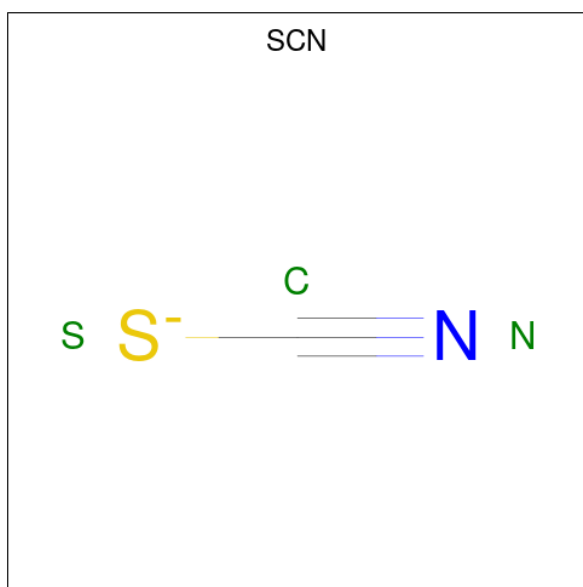


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
4	A	1	15	8	1	6	0	0
4	A	1	15	8	1	6	0	0
4	A	1	15	8	1	6	0	0
4	A	1	15	8	1	6	0	0

- Molecule 5 is IODIDE ION (CCD ID: IOD) (formula: I).

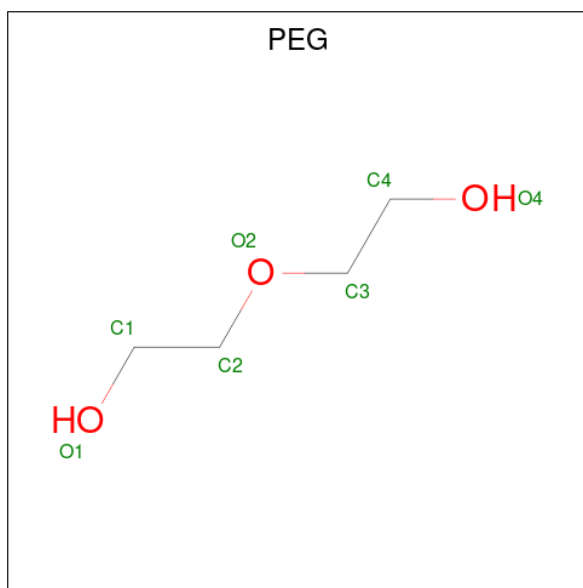
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	I		
5	A	15	15	15	0	0

- Molecule 6 is THIOCYANATE ION (CCD ID: SCN) (formula: CNS).



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

- Molecule 7 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: C₄H₁₀O₃).



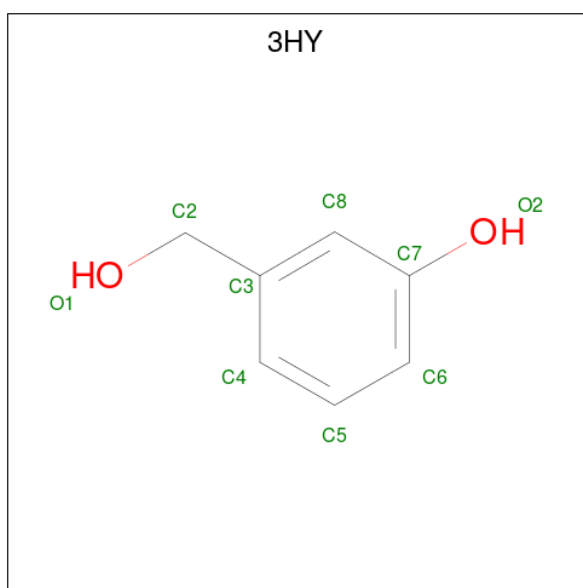
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
7	A	1	7	4	3	0	0
7	A	1	7	4	3	0	0

- Molecule 8 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total	C	O	0	0
			4	2	2		
8	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 9 is 3-(hydroxymethyl)phenol (CCD ID: 3HY) (formula: C₇H₈O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total	C	O	0	0
			9	7	2		

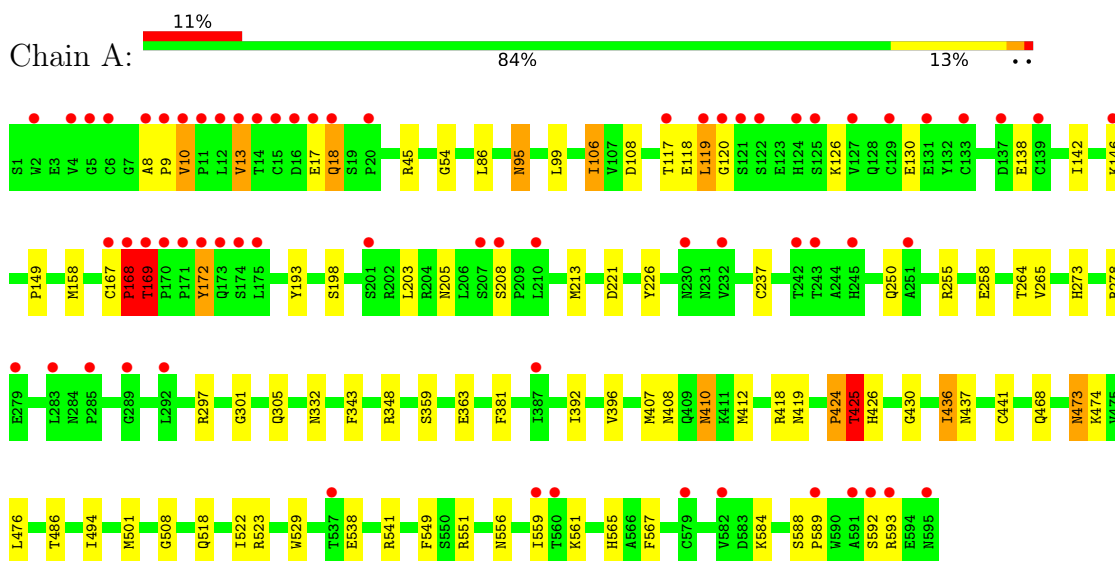
- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	504	Total 504	O 504	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 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: Lactoperoxidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	53.77Å 80.36Å 75.76Å 90.00° 102.71° 90.00°	Depositor
Resolution (Å)	54.39 – 1.98 54.39 – 1.98	Depositor EDS
% Data completeness (in resolution range)	97.4 (54.39-1.98) 97.4 (54.39-1.98)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.91 (at 1.98Å)	Xtrriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.192 , 0.238 0.201 , 0.241	Depositor DCC
R_{free} test set	2155 reflections (4.91%)	wwPDB-VP
Wilson B-factor (Å ²)	26.9	Xtrriage
Anisotropy	0.117	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 50.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	5414	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.54% 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: PEG, IOD, EDO, 3HY, SEP, NAG, CA, SCN, HEM

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	0.76	0/4875	0.95	14/6621 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	424	PRO	CA-C-O	-13.80	106.46	121.23
1	A	168	PRO	CB-CA-C	-11.15	93.17	111.56
1	A	412	MET	N-CA-C	7.62	119.28	110.97
1	A	424	PRO	O-C-N	6.71	130.72	123.01
1	A	95	ASN	N-CA-C	6.33	118.53	110.61
1	A	130	GLU	N-CA-C	6.20	117.83	111.14
1	A	426	HIS	N-CA-C	-5.92	101.25	110.42
1	A	508	GLY	CA-C-N	5.76	125.45	119.05
1	A	508	GLY	C-N-CA	5.76	125.45	119.05
1	A	486	THR	N-CA-CB	5.39	120.67	110.65
1	A	426	HIS	CB-CA-C	5.36	118.65	109.80
1	A	556	ASN	N-CA-C	5.13	119.08	112.41
1	A	426	HIS	CA-C-N	-5.11	114.13	122.26
1	A	426	HIS	C-N-CA	-5.11	114.13	122.26

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	167	CYS	Peptide
1	A	168	PRO	Peptide

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	4757	0	4648	83	0
2	A	43	0	30	12	0
3	A	1	0	0	0	0
4	A	60	0	59	13	0
5	A	15	0	0	8	0
6	A	3	0	0	0	0
7	A	14	0	20	7	0
8	A	8	0	12	1	0
9	A	9	0	7	7	0
10	A	504	0	0	12	0
All	All	5414	0	4776	95	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 10.

All (95) 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:108:ASP:OD2	2:A:601:HEM:CMD	1.74	1.35
1:A:258:GLU:OE2	2:A:601:HEM:HMB1	1.09	1.23
1:A:95:ASN:ND2	4:A:603:NAG:O1	1.72	1.20
1:A:258:GLU:OE2	2:A:601:HEM:CMB	1.90	1.19
1:A:205:ASN:CG	4:A:604:NAG:O1	1.97	1.07
1:A:95:ASN:ND2	4:A:603:NAG:C1	2.18	1.06
1:A:108:ASP:OD2	2:A:601:HEM:HMD1	0.88	1.05
5:A:614:IOD:I	10:A:723:HOH:O	2.53	0.97
5:A:615:IOD:I	10:A:807:HOH:O	2.54	0.94
1:A:332:ASN:ND2	4:A:606:NAG:O1	2.01	0.93

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:95:ASN:HD21	4:A:603:NAG:C1	1.86	0.86
1:A:205:ASN:ND2	4:A:604:NAG:O1	2.12	0.82
1:A:95:ASN:CG	4:A:603:NAG:O1	2.23	0.82
2:A:601:HEM:CMA	9:A:627:3HY:H1	2.10	0.80
1:A:332:ASN:HD21	4:A:606:NAG:C1	1.93	0.80
1:A:108:ASP:CG	2:A:601:HEM:HMD1	2.03	0.76
1:A:106:ILE:CD1	1:A:265:VAL:HG11	2.20	0.71
1:A:255:ARG:HG2	9:A:627:3HY:H4	1.74	0.70
5:A:616:IOD:I	10:A:1131:HOH:O	2.80	0.69
1:A:424:PRO:O	1:A:425:THR:HB	1.95	0.67
5:A:612:IOD:I	10:A:823:HOH:O	2.84	0.65
1:A:332:ASN:CG	4:A:606:NAG:O1	2.40	0.64
5:A:615:IOD:I	10:A:1003:HOH:O	2.83	0.64
1:A:538:GLU:HG3	1:A:541:ARG:NH2	2.13	0.64
1:A:106:ILE:HD13	1:A:265:VAL:HG11	1.79	0.63
1:A:551:ARG:HD3	1:A:584:LYS:HA	1.81	0.61
1:A:108:ASP:CG	2:A:601:HEM:CMD	2.68	0.61
1:A:264:THR:HG23	1:A:392:ILE:HG23	1.83	0.60
1:A:142:ILE:HD12	1:A:436:ILE:HD12	1.85	0.59
2:A:601:HEM:HMA2	9:A:627:3HY:H1	1.85	0.58
1:A:9:PRO:O	1:A:10:VAL:C	2.47	0.58
1:A:106:ILE:HD11	1:A:265:VAL:HG11	1.86	0.57
1:A:95:ASN:HD21	4:A:603:NAG:H1	1.69	0.57
2:A:601:HEM:HMA1	9:A:627:3HY:H1	1.85	0.56
1:A:565:HIS:HB3	5:A:612:IOD:I	2.75	0.56
1:A:142:ILE:CD1	1:A:436:ILE:HD12	2.35	0.56
1:A:213:MET:HG2	1:A:273:HIS:CD2	2.42	0.55
1:A:205:ASN:ND2	4:A:604:NAG:C1	2.70	0.55
1:A:95:ASN:ND2	4:A:603:NAG:O5	2.41	0.54
1:A:203:LEU:HD23	1:A:250:GLN:NE2	2.22	0.54
1:A:407:MET:HB3	1:A:501:MET:HE3	1.88	0.54
1:A:237:CYS:HA	1:A:381:PHE:O	2.08	0.53
1:A:119:LEU:HD12	1:A:138:GLU:HG3	1.91	0.53
2:A:601:HEM:HBC2	2:A:601:HEM:HMC1	1.91	0.52
1:A:523:ARG:HG3	1:A:529:TRP:CE2	2.45	0.51
1:A:348:ARG:HH11	1:A:437:ASN:ND2	2.08	0.51
8:A:626:EDO:H11	10:A:861:HOH:O	2.10	0.51
1:A:255:ARG:HG2	9:A:627:3HY:C8	2.40	0.51
1:A:348:ARG:HH11	1:A:437:ASN:HD22	1.58	0.51
1:A:567:PHE:HB2	5:A:612:IOD:I	2.81	0.50
1:A:419:ASN:HD21	7:A:623:PEG:H11	1.76	0.50

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:255:ARG:CG	9:A:627:3HY:H4	2.41	0.50
1:A:221:ASP:HB2	1:A:226:TYR:CZ	2.47	0.49
1:A:332:ASN:CG	4:A:606:NAG:HO1	2.21	0.49
1:A:149:PRO:HG2	7:A:623:PEG:H22	1.96	0.48
1:A:54:GLY:HA2	10:A:943:HOH:O	2.14	0.47
7:A:624:PEG:H11	10:A:777:HOH:O	2.13	0.47
1:A:501:MET:HE1	10:A:701:HOH:O	2.15	0.47
1:A:119:LEU:HG	1:A:169:THR:HG23	1.98	0.46
1:A:106:ILE:HD11	1:A:265:VAL:CG1	2.45	0.45
1:A:255:ARG:CB	9:A:627:3HY:H4	2.45	0.45
1:A:8:ALA:HB3	1:A:9:PRO:HD3	1.98	0.45
1:A:106:ILE:HD11	1:A:265:VAL:CB	2.47	0.45
1:A:119:LEU:HG	1:A:169:THR:CG2	2.46	0.45
1:A:468:GLN:HG2	1:A:474:LYS:HA	1.98	0.45
1:A:278:ARG:NH2	10:A:1005:HOH:O	2.50	0.45
2:A:601:HEM:HBB2	2:A:601:HEM:HMB2	1.99	0.44
1:A:203:LEU:CD2	1:A:250:GLN:NE2	2.80	0.44
1:A:45:ARG:HB3	7:A:624:PEG:H21	2.00	0.44
1:A:99:LEU:HD21	1:A:549:PHE:CD1	2.52	0.44
1:A:158:MET:HE2	1:A:430:GLY:O	2.17	0.44
1:A:418:ARG:HH22	7:A:623:PEG:H12	1.82	0.44
1:A:473:ASN:C	1:A:473:ASN:HD22	2.26	0.44
1:A:473:ASN:ND2	1:A:476:LEU:H	2.15	0.44
1:A:343:PHE:CD1	1:A:518:GLN:HG2	2.53	0.43
1:A:408:ASN:OD1	1:A:410:ASN:ND2	2.51	0.43
1:A:588:SER:N	1:A:589:PRO:CD	2.82	0.43
1:A:396:VAL:HB	1:A:559:ILE:HD11	2.01	0.42
1:A:538:GLU:HB2	10:A:1081:HOH:O	2.19	0.42
1:A:117:THR:HG21	1:A:138:GLU:CB	2.49	0.42
1:A:172:TYR:HD1	1:A:172:TYR:HA	1.71	0.42
1:A:494:ILE:HD12	1:A:494:ILE:HA	1.89	0.42
1:A:418:ARG:HH22	7:A:623:PEG:C1	2.32	0.42
1:A:301:GLY:O	1:A:305:GLN:HG3	2.20	0.42
1:A:118:GLU:O	1:A:120:GLY:N	2.53	0.42
1:A:193:TYR:CE2	1:A:297:ARG:HG3	2.55	0.42
1:A:8:ALA:N	1:A:9:PRO:CD	2.83	0.41
1:A:18:GLN:HB2	10:A:831:HOH:O	2.20	0.41
1:A:117:THR:HG21	1:A:138:GLU:HB3	2.00	0.41
1:A:45:ARG:CB	7:A:624:PEG:H21	2.50	0.41
1:A:142:ILE:HD12	1:A:436:ILE:CD1	2.51	0.41
1:A:258:GLU:CD	2:A:601:HEM:CMB	2.82	0.40

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:359:SER:OG	5:A:615:IOD:I	2.99	0.40
1:A:407:MET:HE3	1:A:407:MET:C	2.47	0.40
1:A:205:ASN:ND2	1:A:208:SER:OG	2.54	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	592/595 (100%)	563 (95%)	23 (4%)	6 (1%)	12 5

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	13	VAL
1	A	119	LEU
1	A	169	THR
1	A	425	THR
1	A	10	VAL
1	A	168	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	516/516 (100%)	497 (96%)	19 (4%)	30 20

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

Mol	Chain	Res	Type
1	A	13	VAL
1	A	17	GLU
1	A	18	GLN
1	A	86	LEU
1	A	106	ILE
1	A	126	LYS
1	A	146	LYS
1	A	169	THR
1	A	172	TYR
1	A	363	GLU
1	A	410	ASN
1	A	425	THR
1	A	436	ILE
1	A	441	CYS
1	A	473	ASN
1	A	522	ILE
1	A	561	LYS
1	A	592	SER
1	A	593	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	94	GLN
1	A	95	ASN
1	A	124	HIS
1	A	147	ASN
1	A	205	ASN
1	A	245	HIS
1	A	410	ASN
1	A	419	ASN
1	A	437	ASN
1	A	468	GLN
1	A	473	ASN
1	A	497	ASN
1	A	556	ASN
1	A	570	ASN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	571	ASN
1	A	574	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue 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
1	SEP	A	198	1	8,9,10	1.57	2 (25%)	7,12,14	6.75	3 (42%)

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
1	SEP	A	198	1	-	4/6/8/10	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	198	SEP	P-O1P	-2.85	1.41	1.50
1	A	198	SEP	P-O2P	-2.79	1.44	1.54

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	198	SEP	OG-CB-CA	16.78	124.48	108.14

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	198	SEP	OG-P-O1P	-4.65	93.87	106.44
1	A	198	SEP	O2P-P-O1P	2.32	119.87	110.83

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	198	SEP	N-CA-CB-OG
1	A	198	SEP	CB-OG-P-O1P
1	A	198	SEP	CB-OG-P-O2P
1	A	198	SEP	CA-CB-OG-P

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 27 ligands modelled in this entry, 16 are monoatomic - leaving 11 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	NAG	A	603	-	15,15,15	0.47	0	21,21,21	2.57	2 (9%)
4	NAG	A	605	-	15,15,15	0.70	1 (6%)	21,21,21	1.94	3 (14%)
8	EDO	A	626	-	3,3,3	0.35	0	2,2,2	0.35	0
6	SCN	A	622	-	1,2,2	0.39	0	0,1,1	-	-
4	NAG	A	604	-	15,15,15	0.81	1 (6%)	21,21,21	1.59	3 (14%)
9	3HY	A	627	-	9,9,9	1.99	2 (22%)	11,11,11	2.02	5 (45%)
8	EDO	A	625	-	3,3,3	0.40	0	2,2,2	0.25	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	NAG	A	606	-	15,15,15	0.58	0	21,21,21	1.89	4 (19%)
7	PEG	A	623	-	6,6,6	0.34	0	5,5,5	0.40	0
2	HEM	A	601	1,10	50,50,50	1.82	11 (22%)	67,82,82	1.65	13 (19%)
7	PEG	A	624	-	6,6,6	0.50	0	5,5,5	0.38	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	NAG	A	603	-	-	0/6/26/26	0/1/1/1
4	NAG	A	605	-	-	2/6/26/26	0/1/1/1
8	EDO	A	626	-	-	1/1/1/1	-
4	NAG	A	604	-	-	0/6/26/26	0/1/1/1
9	3HY	A	627	-	-	0/2/2/2	0/1/1/1
8	EDO	A	625	-	-	1/1/1/1	-
4	NAG	A	606	-	-	3/6/26/26	0/1/1/1
7	PEG	A	623	-	-	1/4/4/4	-
2	HEM	A	601	1,10	-	4/14/54/54	-
7	PEG	A	624	-	-	3/4/4/4	-

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	HEM	C1B-NB	-4.44	1.32	1.40
2	A	601	HEM	FE-NB	4.16	2.07	1.94
2	A	601	HEM	C4D-ND	-4.10	1.33	1.40
2	A	601	HEM	FE-NC	3.93	2.08	1.95
9	A	627	3HY	C4-C3	-3.80	1.31	1.38
9	A	627	3HY	C5-C4	-3.34	1.33	1.38
2	A	601	HEM	C1C-C2C	-3.33	1.38	1.45
2	A	601	HEM	C4D-C3D	3.14	1.50	1.45
2	A	601	HEM	C1C-NC	-2.93	1.34	1.39
2	A	601	HEM	C1D-ND	-2.63	1.33	1.38
2	A	601	HEM	C4B-NB	-2.51	1.33	1.38
4	A	604	NAG	C1-C2	-2.44	1.50	1.52
2	A	601	HEM	C4C-NC	-2.41	1.35	1.39
4	A	605	NAG	C1-C2	-2.35	1.50	1.52
2	A	601	HEM	C1A-C2A	-2.34	1.39	1.44

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	603	NAG	C1-C2-N2	-9.49	99.74	110.73
4	A	605	NAG	C1-C2-N2	-6.68	102.98	110.73
4	A	603	NAG	O5-C1-C2	6.14	115.69	109.52
4	A	606	NAG	C3-C4-C5	5.22	119.69	110.23
4	A	604	NAG	C1-C2-N2	-5.08	104.84	110.73
2	A	601	HEM	C1B-NB-C4B	4.74	110.83	105.21
2	A	601	HEM	CHC-C4B-NB	4.69	129.47	124.42
4	A	606	NAG	O5-C1-C2	-4.23	105.27	109.52
2	A	601	HEM	CHA-C4D-C3D	-3.50	118.78	125.23
4	A	606	NAG	C1-C2-C3	-3.49	105.79	110.54
2	A	601	HEM	C4B-C3B-C2B	-3.46	104.10	107.28
4	A	605	NAG	C1-O5-C5	-3.30	107.28	113.65
2	A	601	HEM	CHA-C4D-ND	3.19	128.32	124.37
9	A	627	3HY	C7-C8-C3	3.01	122.55	120.35
9	A	627	3HY	C6-C7-C8	-2.87	117.04	120.19
4	A	604	NAG	O1-C1-C2	-2.86	103.27	109.22
9	A	627	3HY	C5-C4-C3	2.80	124.55	120.61
2	A	601	HEM	CHD-C1D-ND	2.63	127.25	124.42
2	A	601	HEM	CHD-C1D-C2D	-2.62	120.89	125.03
2	A	601	HEM	CAD-C3D-C4D	2.60	129.24	124.70
9	A	627	3HY	O1-C2-C3	2.58	121.14	112.07
2	A	601	HEM	O2D-CGD-O1D	-2.56	116.74	123.33
4	A	605	NAG	O1-C1-C2	-2.49	104.05	109.22
9	A	627	3HY	C2-C3-C8	2.48	125.80	120.24
2	A	601	HEM	C4D-C3D-C2D	-2.39	103.41	106.89
2	A	601	HEM	C3D-C4D-ND	2.39	112.79	110.17
4	A	604	NAG	C1-O5-C5	-2.32	109.16	113.65
4	A	606	NAG	O5-C5-C4	2.30	113.84	109.70
2	A	601	HEM	C3B-C2B-C1B	2.28	108.12	106.41
2	A	601	HEM	O2A-CGA-CBA	2.06	120.51	114.00

There are no chirality outliers.

All (15) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	606	NAG	O5-C5-C6-O6
4	A	606	NAG	C4-C5-C6-O6
7	A	623	PEG	O1-C1-C2-O2
4	A	605	NAG	O5-C5-C6-O6
4	A	605	NAG	C4-C5-C6-O6
8	A	626	EDO	O1-C1-C2-O2

Continued on next page...

Continued from previous page...

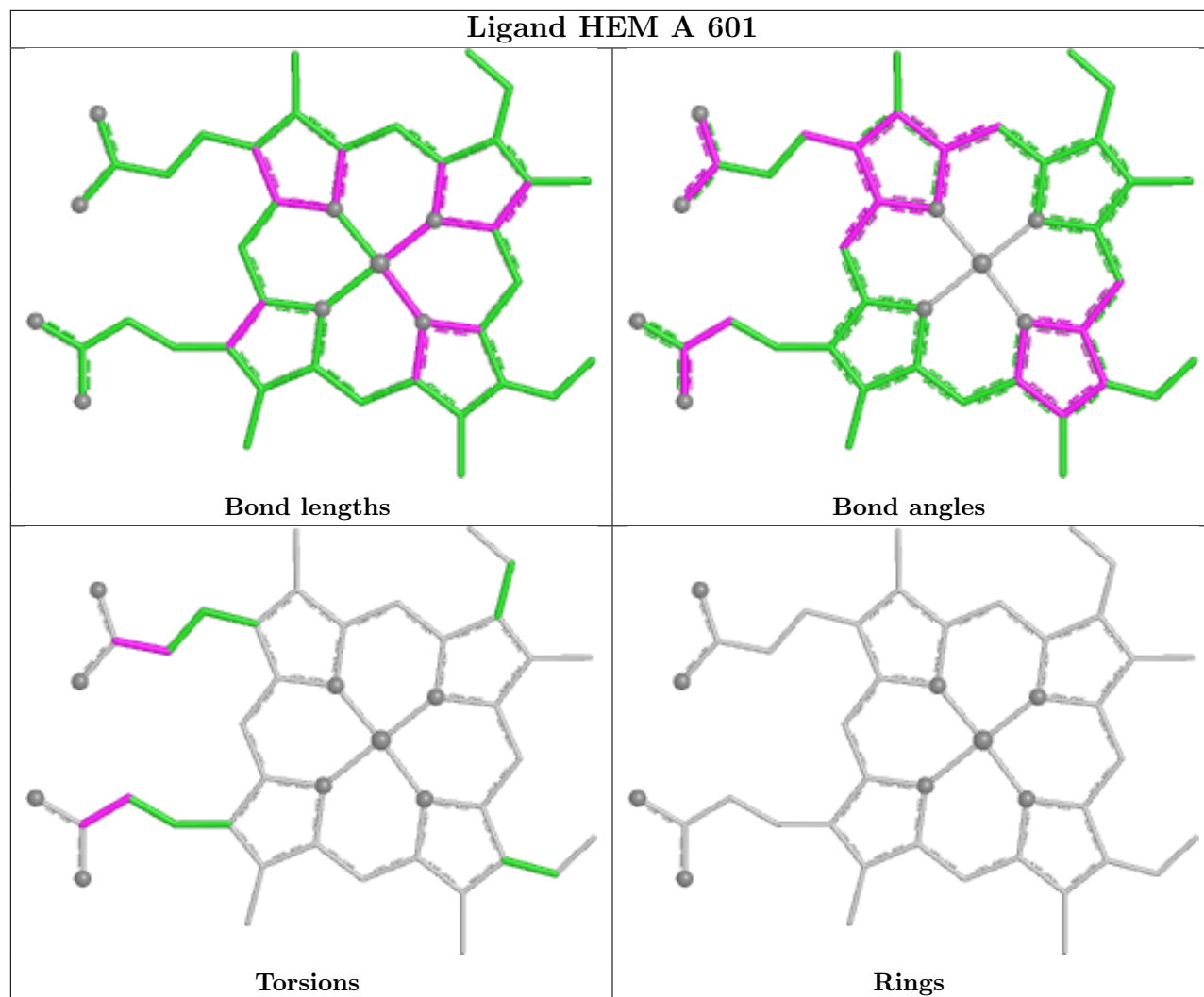
Mol	Chain	Res	Type	Atoms
7	A	624	PEG	O1-C1-C2-O2
8	A	625	EDO	O1-C1-C2-O2
7	A	624	PEG	C1-C2-O2-C3
7	A	624	PEG	C4-C3-O2-C2
2	A	601	HEM	CAA-CBA-CGA-O2A
2	A	601	HEM	CAA-CBA-CGA-O1A
2	A	601	HEM	CAD-CBD-CGD-O2D
2	A	601	HEM	CAD-CBD-CGD-O1D
4	A	606	NAG	C3-C2-N2-C7

There are no ring outliers.

8 monomers are involved in 37 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	603	NAG	6	0
8	A	626	EDO	1	0
4	A	604	NAG	3	0
9	A	627	3HY	7	0
4	A	606	NAG	4	0
7	A	623	PEG	4	0
2	A	601	HEM	12	0
7	A	624	PEG	3	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

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	594/595 (99%)	0.71	65 (10%) 10 15	13, 34, 82, 145	0

All (65) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	10	VAL	6.5
1	A	2	TRP	5.8
1	A	172	TYR	5.8
1	A	168	PRO	5.7
1	A	171	PRO	5.1
1	A	170	PRO	4.9
1	A	167	CYS	4.9
1	A	175	LEU	4.6
1	A	169	THR	4.5
1	A	8	ALA	4.4
1	A	4	VAL	4.2
1	A	11	PRO	4.2
1	A	9	PRO	4.2
1	A	283	LEU	3.9
1	A	127	VAL	3.9
1	A	12	LEU	3.8
1	A	119	LEU	3.8
1	A	6	CYS	3.8
1	A	117	THR	3.7
1	A	208	SER	3.6
1	A	120	GLY	3.5
1	A	174	SER	3.5
1	A	579	CYS	3.4
1	A	16	ASP	3.1
1	A	15	CYS	3.0
1	A	20	PRO	2.9
1	A	13	VAL	2.9

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	173	GLN	2.9
1	A	14	THR	2.8
1	A	124	HIS	2.8
1	A	289	GLY	2.8
1	A	121	SER	2.7
1	A	593	ARG	2.7
1	A	125	SER	2.6
1	A	122	SER	2.6
1	A	243	THR	2.6
1	A	139	CYS	2.5
1	A	210	LEU	2.5
1	A	201	SER	2.4
1	A	592	SER	2.4
1	A	131	GLU	2.4
1	A	595	ASN	2.4
1	A	146	LYS	2.3
1	A	137	ASP	2.3
1	A	17	GLU	2.3
1	A	589	PRO	2.3
1	A	129	CYS	2.3
1	A	18	GLN	2.2
1	A	387	ILE	2.2
1	A	245	HIS	2.2
1	A	232	VAL	2.2
1	A	582	VAL	2.2
1	A	242	THR	2.2
1	A	560	THR	2.2
1	A	5	GLY	2.2
1	A	537	THR	2.2
1	A	133	CYS	2.2
1	A	285	PRO	2.2
1	A	591	ALA	2.2
1	A	207	SER	2.1
1	A	292	LEU	2.1
1	A	251	ALA	2.1
1	A	279	GLU	2.1
1	A	559	ILE	2.0
1	A	230	ASN	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	SEP	A	198	10/11	0.83	0.18	43,46,48,49	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

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.

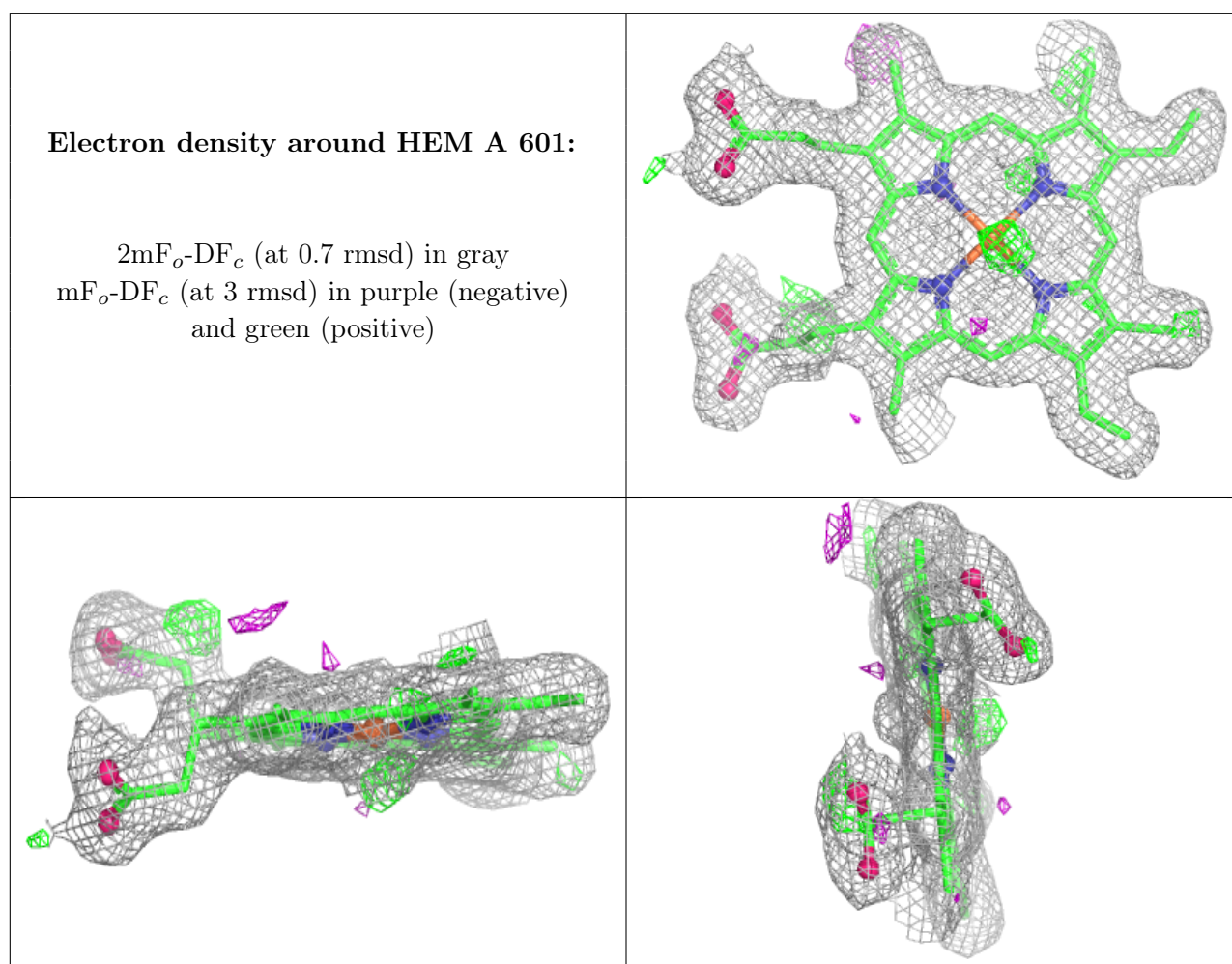
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
4	NAG	A	606	15/15	0.76	0.17	49,55,59,61	14
4	NAG	A	603	15/15	0.78	0.13	51,54,59,60	0
4	NAG	A	604	15/15	0.80	0.13	43,44,46,46	0
4	NAG	A	605	15/15	0.82	0.12	31,37,41,45	0
9	3HY	A	627	9/9	0.82	0.19	19,33,40,44	0
7	PEG	A	624	7/7	0.83	0.13	28,32,35,37	0
8	EDO	A	626	4/4	0.84	0.14	38,43,46,48	0
6	SCN	A	622	3/3	0.85	0.13	56,56,61,62	0
8	EDO	A	625	4/4	0.86	0.13	32,34,38,42	0
5	IOD	A	614	1/1	0.87	0.18	66,66,66,66	1
7	PEG	A	623	7/7	0.91	0.14	24,29,30,34	0
5	IOD	A	618	1/1	0.93	0.10	45,45,45,45	1
5	IOD	A	612	1/1	0.94	0.08	57,57,57,57	1
5	IOD	A	608	1/1	0.94	0.11	42,42,42,42	0
5	IOD	A	609	1/1	0.94	0.09	55,55,55,55	1
5	IOD	A	617	1/1	0.95	0.07	41,41,41,41	1
5	IOD	A	613	1/1	0.95	0.09	65,65,65,65	1
5	IOD	A	611	1/1	0.96	0.10	45,45,45,45	0
5	IOD	A	610	1/1	0.96	0.07	40,40,40,40	0
5	IOD	A	615	1/1	0.97	0.13	47,47,47,47	1
5	IOD	A	616	1/1	0.97	0.07	45,45,45,45	0

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	CA	A	602	1/1	0.97	0.10	12,12,12,12	0
2	HEM	A	601	43/43	0.97	0.07	13,13,16,20	0
5	IOD	A	619	1/1	0.97	0.14	56,56,56,56	1
5	IOD	A	621	1/1	0.97	0.06	46,46,46,46	1
5	IOD	A	620	1/1	0.98	0.15	51,51,51,51	1
5	IOD	A	607	1/1	1.00	0.02	18,18,18,18	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.