



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2018 – 03:59 am GMT

PDB ID : 4C9P  
Title : Structure of camphor bound T260A mutant of CYP101D1  
Authors : Batabyal, D.; L Poulos, T.  
Deposited on : 2013-10-02  
Resolution : 1.80 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

---

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

MolProbity : 4.02b-467  
Mogul : 1.7.3 (157068), CSD as539be (2018)  
Xtriage (Phenix) : 1.13  
EDS : trunk30967  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Refmac : 5.8.0158  
CCP4 : 7.0 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk30967

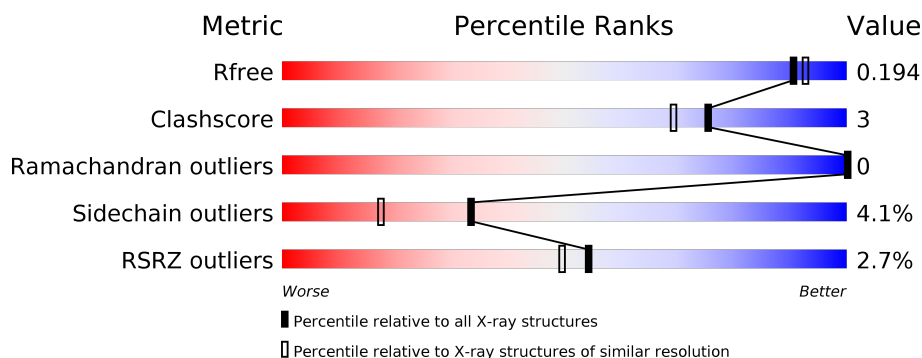
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.80 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))
$R_{free}$	111664	5253 (1.80-1.80)
Clashscore	122126	6077 (1.80-1.80)
Ramachandran outliers	120053	6011 (1.80-1.80)
Sidechain outliers	120020	6010 (1.80-1.80)
RSRZ outliers	108989	5157 (1.80-1.80)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	421	<div> <div>2%</div> <div> <div></div> <div>88%</div> <div>8%</div> <div>••</div> </div> </div>
1	B	421	<div> <div>3%</div> <div> <div></div> <div>88%</div> <div>7%</div> <div>••</div> </div> </div>

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 7378 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 CYTOCHROME P450.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	408	Total	C	N	O	S	0	0	0
			3238	2059	577	589	13			
1	B	407	Total	C	N	O	S	0	0	0
			3229	2054	575	587	13			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	260	ALA	THR	engineered mutation	UNP Q2GB12
B	260	ALA	THR	engineered mutation	UNP Q2GB12

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



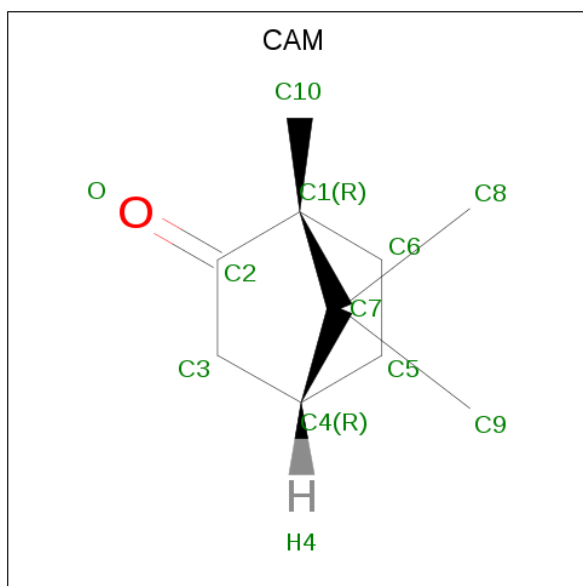
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

*Continued on next page...*

Continued from previous page...

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

- Molecule 3 is CAMPHOR (three-letter code: CAM) (formula:  $C_{10}H_{16}O$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			11	10	1		
3	B	1	Total	C	O	0	0
			11	10	1		

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



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

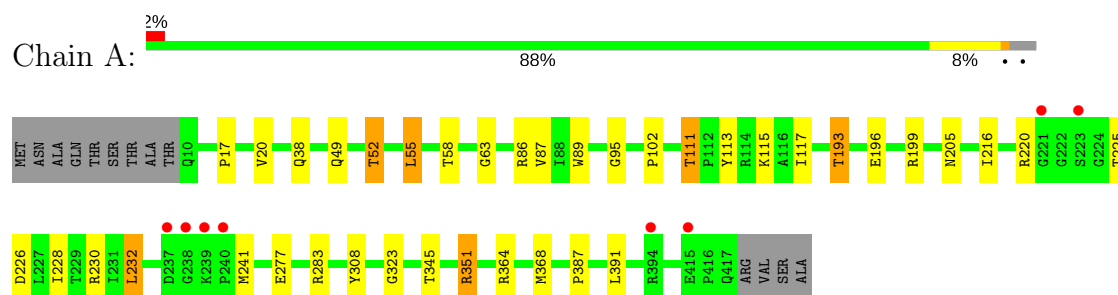
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	434	Total	O	0	0
			434	434		
5	B	357	Total	O	0	0
			357	357		

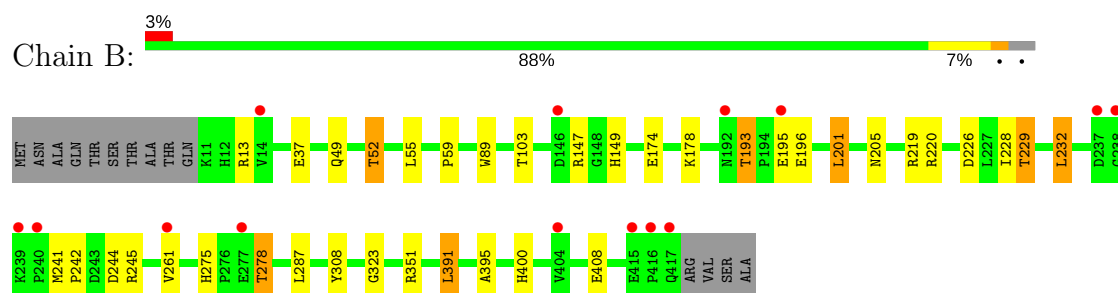
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: CYTOCHROME P450



#### • Molecule 1: CYTOCHROME P450



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 64 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	151.70Å 151.70Å 196.64Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.58 – 1.80 39.58 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.7 (39.58-1.80) 93.0 (39.58-1.80)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	0.65 (at 1.79Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, $R_{free}$	0.169 , 0.194 0.169 , 0.194	Depositor DCC
$R_{free}$ test set	6229 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.9	Xtriage
Anisotropy	0.220	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 48.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7378	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.89% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

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

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, CAM, 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	0.35	0/3320	0.57	1/4511 (0.0%)
1	B	0.33	0/3311	0.55	1/4499 (0.0%)
All	All	0.34	0/6631	0.56	2/9010 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	201	LEU	CA-CB-CG	5.83	128.70	115.30
1	A	55	LEU	CA-CB-CG	5.34	127.57	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	3238	0	3213	20	0
1	B	3229	0	3205	20	0
2	A	43	0	30	2	0
2	B	43	0	30	3	0
3	A	11	0	16	0	0
3	B	11	0	16	1	0
4	A	12	0	16	1	0

*Continued on next page...*



*Continued from previous page...*

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	434	0	0	4	0
5	B	357	0	0	2	0
All	All	7378	0	6526	45	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 3.

All (45) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:193:THR:HG22	1:B:196:GLU:H	1.33	0.89
1:A:193:THR:HG22	1:A:196:GLU:H	1.40	0.84
1:A:225:THR:O	1:A:230:ARG:NH1	2.09	0.84
1:A:220:ARG:NH2	1:A:241:MET:O	2.11	0.82
1:B:13:ARG:HG3	1:B:59:PRO:HB2	1.74	0.69
1:A:283:ARG:NH2	5:A:2323:HOH:O	2.33	0.62
1:B:219:ARG:HD3	1:B:229:THR:HG22	1.86	0.58
2:B:422:HEM:HHD	2:B:422:HEM:HBC2	1.86	0.56
2:A:422:HEM:HHD	2:A:422:HEM:HBC2	1.88	0.56
2:A:422:HEM:HBB2	2:A:422:HEM:HMB1	1.86	0.55
1:A:364:ARG:HG2	1:A:368:MET:HE1	1.89	0.54
1:B:278:THR:HG21	5:B:2267:HOH:O	2.08	0.54
1:A:49:GLN:HB2	1:A:52:THR:HG22	1.90	0.54
1:B:49:GLN:HB2	1:B:52:THR:HG22	1.88	0.53
4:A:1418:GOL:H12	5:A:2432:HOH:O	2.08	0.53
1:B:226:ASP:OD1	1:B:229:THR:HG23	2.09	0.52
1:A:216:ILE:O	1:A:220:ARG:HG3	2.10	0.52
1:A:228:ILE:O	1:A:232:LEU:HB2	2.09	0.52
1:B:229:THR:HG21	5:B:2246:HOH:O	2.09	0.52
2:B:422:HEM:HBB2	2:B:422:HEM:HMB1	1.91	0.51
1:A:351:ARG:NH1	5:A:2391:HOH:O	2.43	0.50
1:B:400:HIS:NE2	1:B:408:GLU:OE2	2.42	0.50
1:B:103:THR:HG21	3:B:423:CAM:H31	1.94	0.49
1:B:275:HIS:HB3	1:B:278:THR:HG23	1.94	0.48
1:B:261:VAL:HG22	2:B:422:HEM:HAB	1.97	0.47
1:A:113:TYR:HE1	1:A:241:MET:HG3	1.80	0.46
1:A:111:THR:O	1:A:115:LYS:HG2	2.16	0.45
1:A:17:PRO:HG2	1:A:20:VAL:HG23	1.99	0.45
1:A:351:ARG:O	1:A:351:ARG:HD3	2.17	0.44
1:A:226:ASP:O	1:A:230:ARG:HG3	2.17	0.44
1:A:102:PRO:HD3	1:A:117:ILE:HD11	1.99	0.43

*Continued on next page...*

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:199:ARG:NH1	5:A:2279:HOH:O	2.50	0.43
1:B:220:ARG:NH2	1:B:241:MET:O	2.47	0.43
1:B:391:LEU:CD1	1:B:395:ALA:HB3	2.49	0.42
1:A:308:TYR:CZ	1:A:323:GLY:HA2	2.55	0.42
1:B:244:ASP:OD1	1:B:245:ARG:N	2.53	0.42
1:B:147:ARG:HG2	1:B:149:HIS:CE1	2.55	0.42
1:A:58:THR:O	1:A:63:GLY:HA2	2.20	0.41
1:B:37:GLU:CD	1:B:37:GLU:H	2.23	0.41
1:B:228:ILE:O	1:B:232:LEU:HB2	2.19	0.41
1:B:49:GLN:HB2	1:B:52:THR:CG2	2.51	0.41
1:B:241:MET:HA	1:B:242:PRO:HD3	1.95	0.40
1:B:308:TYR:CZ	1:B:323:GLY:HA2	2.56	0.40
1:A:283:ARG:NE	1:A:387:PRO:O	2.54	0.40
1:A:87:VAL:HG13	1:A:95:GLY:HA3	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	406/421 (96%)	397 (98%)	9 (2%)	0	100	100
1	B	405/421 (96%)	394 (97%)	11 (3%)	0	100	100
All	All	811/842 (96%)	791 (98%)	20 (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	345/355 (97%)	332 (96%)	13 (4%)	36	20
1	B	344/355 (97%)	329 (96%)	15 (4%)	31	15
All	All	689/710 (97%)	661 (96%)	28 (4%)	33	17

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	38	GLN
1	A	52	THR
1	A	55	LEU
1	A	86	ARG
1	A	89	TRP
1	A	111	THR
1	A	193	THR
1	A	205	ASN
1	A	232	LEU
1	A	277	GLU
1	A	345	THR
1	A	351	ARG
1	A	391	LEU
1	B	52	THR
1	B	55	LEU
1	B	89	TRP
1	B	174	GLU
1	B	178	LYS
1	B	193	THR
1	B	195	GLU
1	B	201	LEU
1	B	205	ASN
1	B	229	THR
1	B	232	LEU
1	B	278	THR
1	B	287	LEU
1	B	351	ARG
1	B	391	LEU

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

Mol	Chain	Res	Type
1	B	149	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](#)

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

## 5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

6 ligands 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	$\# Z  > 2$
4	GOL	A	1418	-	5,5,5	0.39	0	5,5,5	1.37	0
4	GOL	A	1419	-	5,5,5	0.43	0	5,5,5	0.40	0
2	HEM	A	422	1	27,50,50	2.11	6 (22%)	17,82,82	1.31	1 (5%)
3	CAM	A	423	-	12,12,12	2.31	2 (16%)	20,21,21	0.76	0
2	HEM	B	422	1	27,50,50	2.13	6 (22%)	17,82,82	1.44	3 (17%)
3	CAM	B	423	-	12,12,12	2.32	3 (25%)	20,21,21	0.87	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	GOL	A	1418	-	-	0/4/4/4	0/0/0/0
4	GOL	A	1419	-	-	0/4/4/4	0/0/0/0
2	HEM	A	422	1	-	0/6/54/54	0/0/8/8
3	CAM	A	423	-	-	0/0/31/31	0/3/2/2
2	HEM	B	422	1	-	0/6/54/54	0/0/8/8
3	CAM	B	423	-	-	0/0/31/31	0/3/2/2

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	422	HEM	C3C-C2C	-4.47	1.34	1.40
2	B	422	HEM	C3C-C2C	-4.40	1.34	1.40
3	A	423	CAM	C1-C2	-4.09	1.48	1.52
3	B	423	CAM	C1-C2	-3.93	1.48	1.52
2	B	422	HEM	C3B-C2B	-3.56	1.35	1.40
2	A	422	HEM	C3B-C2B	-3.46	1.35	1.40
3	B	423	CAM	C7-C1	-2.08	1.50	1.56
2	A	422	HEM	CAA-C2A	2.06	1.55	1.52
2	B	422	HEM	C1D-ND	2.26	1.40	1.36
2	B	422	HEM	C3B-CAB	3.74	1.55	1.47
2	A	422	HEM	C3C-CAC	3.86	1.55	1.47
2	A	422	HEM	C3B-CAB	3.98	1.55	1.47
2	B	422	HEM	C3C-CAC	3.99	1.55	1.47
3	A	423	CAM	O-C2	5.02	1.29	1.21
2	B	422	HEM	C3D-C2D	5.03	1.52	1.37
2	A	422	HEM	C3D-C2D	5.09	1.52	1.37
3	B	423	CAM	O-C2	5.27	1.30	1.21

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	422	HEM	CMA-C3A-C4A	-2.57	124.52	128.46
2	B	422	HEM	C3C-C4C-NC	-2.05	107.08	110.94
2	B	422	HEM	C4C-C3C-C2C	2.01	108.30	106.90
2	A	422	HEM	C4A-C3A-C2A	2.18	108.51	107.00

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1418	GOL	1	0
2	A	422	HEM	2	0
2	B	422	HEM	3	0
3	B	423	CAM	1	0

## 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, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	408/421 (96%)	-0.17	8 (1%) 65 61	16, 25, 44, 62	0
1	B	407/421 (96%)	0.04	14 (3%) 45 40	17, 28, 48, 74	0
All	All	815/842 (96%)	-0.06	22 (2%) 54 49	16, 27, 47, 74	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	417	GLN	5.3
1	B	238	GLY	5.0
1	B	237	ASP	4.4
1	B	239	LYS	4.3
1	A	239	LYS	4.1
1	A	238	GLY	3.9
1	B	416	PRO	3.0
1	A	221	GLY	2.9
1	A	237	ASP	2.9
1	B	195	GLU	2.7
1	A	223	SER	2.7
1	A	240	PRO	2.7
1	B	415	GLU	2.6
1	B	192	ASN	2.4
1	B	261	VAL	2.4
1	B	14	VAL	2.2
1	B	404	VAL	2.2
1	B	277	GLU	2.1
1	B	240	PRO	2.1
1	B	146	ASP	2.1
1	A	394	ARG	2.0
1	A	415	GLU	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](#)

There are no carbohydrates 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, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
4	GOL	A	1418	6/6	0.80	0.22	20,34,40,46	0
4	GOL	A	1419	6/6	0.85	0.24	31,40,57,59	0
3	CAM	A	423	11/11	0.92	0.12	21,26,29,34	0
3	CAM	B	423	11/11	0.92	0.16	22,28,31,31	0
2	HEM	B	422	43/43	0.98	0.16	14,19,24,30	0
2	HEM	A	422	43/43	0.99	0.11	14,18,23,34	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.