



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 09:15 AM UTC

PDB ID : 5CPP / pdb_00005cpp
Title : THE STRUCTURAL BASIS FOR SUBSTRATE-INDUCED CHANGES IN REDOX POTENTIAL AND SPIN EQUILIBRIUM IN CYTOCHROME P-450(CAM)
Authors : Raag, R.; Poulos, T.L.
Deposited on : 1990-05-18
Resolution : 2.08 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

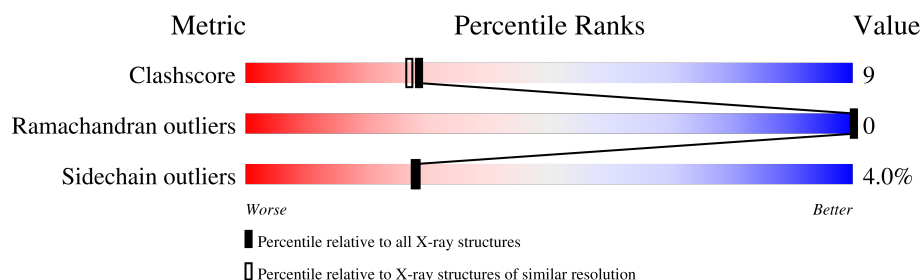
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.08 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	8714 (2.10-2.06)
Ramachandran outliers	187476	8641 (2.10-2.06)
Sidechain outliers	187428	8642 (2.10-2.06)

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	414	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3462 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-CAM.

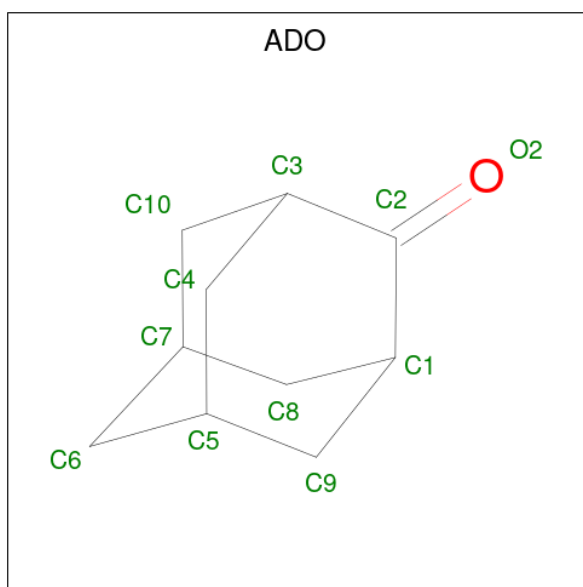
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	405	Total	C	N	O	S	0	0	0
			3204	2030	559	597	18			

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: 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		

- Molecule 3 is ADAMANTANONE (CCD ID: ADO) (formula: $C_{10}H_{14}O$).



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

- Molecule 4 is water.

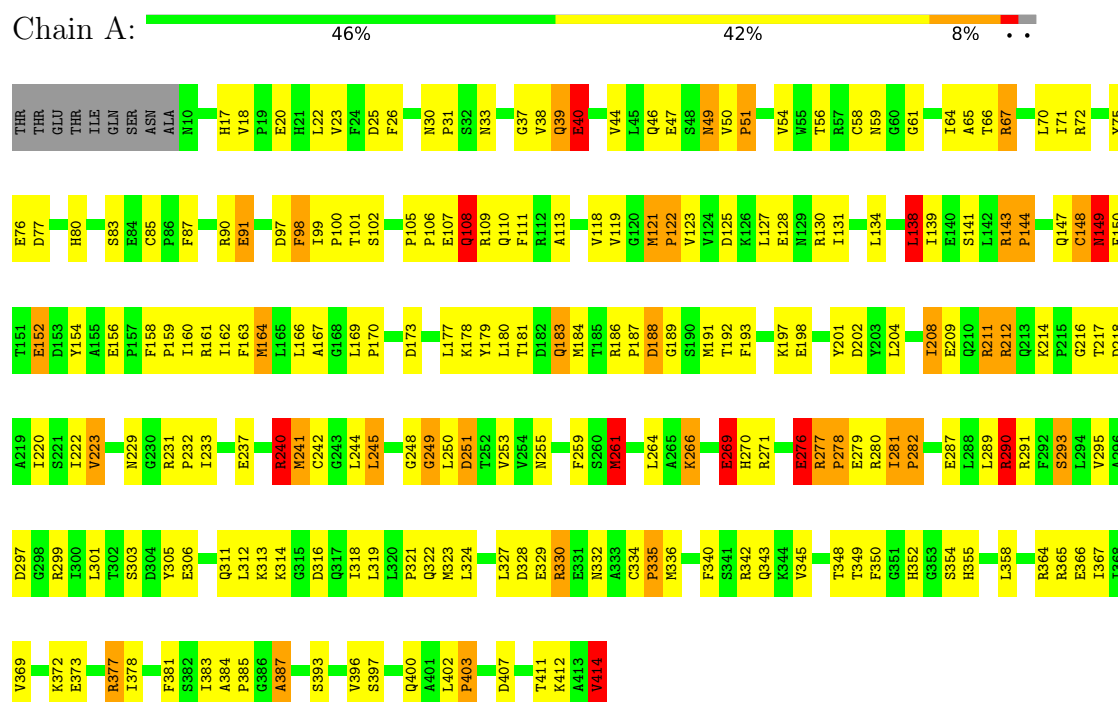
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	204	Total	O	0	0
			204	204		

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: CYTOCHROME P450-CAM



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	108.67Å 103.90Å 36.38Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 2.08	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.08)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROFFT	Depositor
R, R_{free}	0.190 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3462	wwPDB-VP
Average B, all atoms (Å ²)	17.0	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: ADO, 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	1.95	63/3283 (1.9%)	2.47	199/4461 (4.5%)

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	18

All (63) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	251	ASP	C-O	10.73	1.38	1.24
1	A	367	ILE	CA-CB	10.09	1.66	1.54
1	A	64	ILE	C-O	10.01	1.35	1.24
1	A	39	GLN	CA-C	8.97	1.64	1.52
1	A	51	PRO	CA-C	7.61	1.62	1.52
1	A	211	ARG	CD-NE	-7.43	1.35	1.46
1	A	248	GLY	C-N	7.33	1.42	1.33
1	A	393	SER	CA-CB	6.61	1.64	1.53
1	A	342	ARG	NE-CZ	6.55	1.40	1.33
1	A	160	ILE	CA-C	6.53	1.61	1.52
1	A	289	LEU	CA-C	6.39	1.61	1.52
1	A	105	PRO	CA-CB	-6.25	1.48	1.53
1	A	301	LEU	N-CA	6.25	1.53	1.46
1	A	350	PHE	C-N	6.07	1.44	1.33
1	A	352	HIS	CA-CB	6.03	1.63	1.53
1	A	335	PRO	N-CD	5.98	1.56	1.47
1	A	328	ASP	CG-OD2	5.97	1.36	1.25
1	A	131	ILE	CA-CB	5.97	1.61	1.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	278	PRO	CA-CB	5.96	1.62	1.53
1	A	154	TYR	C-N	5.95	1.41	1.33
1	A	299	ARG	NE-CZ	5.91	1.39	1.33
1	A	211	ARG	NE-CZ	-5.85	1.26	1.33
1	A	178	LYS	CA-CB	-5.83	1.44	1.53
1	A	38	VAL	C-N	-5.83	1.26	1.33
1	A	70	LEU	CA-C	5.70	1.60	1.52
1	A	39	GLN	N-CA	-5.67	1.39	1.46
1	A	149	ASN	C-N	-5.63	1.25	1.33
1	A	411	THR	CB-OG1	5.63	1.52	1.43
1	A	322	GLN	CA-CB	5.62	1.62	1.53
1	A	354	SER	C-O	5.62	1.31	1.24
1	A	212	ARG	NE-CZ	-5.61	1.26	1.33
1	A	316	ASP	CA-C	5.60	1.60	1.52
1	A	369	VAL	CA-CB	5.60	1.61	1.54
1	A	181	THR	C-N	-5.59	1.26	1.33
1	A	397	SER	N-CA	5.52	1.52	1.45
1	A	237	GLU	CD-OE2	5.50	1.35	1.25
1	A	66	THR	CA-CB	5.49	1.63	1.53
1	A	64	ILE	C-N	-5.47	1.25	1.33
1	A	37	GLY	N-CA	5.43	1.53	1.45
1	A	148	CYS	C-O	5.43	1.30	1.24
1	A	38	VAL	CA-CB	5.43	1.61	1.54
1	A	403	PRO	C-O	5.36	1.29	1.23
1	A	39	GLN	C-O	-5.35	1.18	1.24
1	A	72	ARG	C-O	5.35	1.30	1.24
1	A	312	LEU	N-CA	5.31	1.52	1.46
1	A	87	PHE	C-N	-5.30	1.28	1.32
1	A	328	ASP	C-N	5.23	1.41	1.34
1	A	26	PHE	CA-C	5.17	1.59	1.52
1	A	33	ASN	N-CA	5.16	1.52	1.46
1	A	358	LEU	N-CA	5.14	1.53	1.46
1	A	270	HIS	CD2-NE2	5.13	1.43	1.37
1	A	297	ASP	CG-OD2	5.13	1.35	1.25
1	A	46	GLN	C-N	-5.11	1.26	1.33
1	A	139	ILE	C-O	5.09	1.29	1.24
1	A	70	LEU	CB-CG	5.08	1.63	1.53
1	A	149	ASN	C-O	5.07	1.30	1.24
1	A	150	PHE	CA-CB	5.06	1.62	1.53
1	A	223	VAL	C-N	-5.03	1.27	1.33
1	A	259	PHE	N-CA	5.03	1.52	1.46
1	A	289	LEU	CB-CG	5.02	1.63	1.53

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	348	THR	N-CA	5.02	1.53	1.46
1	A	80	HIS	CA-CB	5.02	1.61	1.53
1	A	266	LYS	C-O	5.01	1.30	1.24

All (199) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	211	ARG	CD-NE-CZ	33.42	171.19	124.40
1	A	212	ARG	CD-NE-CZ	21.14	153.99	124.40
1	A	118	VAL	N-CA-C	12.03	124.11	111.00
1	A	209	GLU	CA-C-N	11.40	136.00	120.38
1	A	209	GLU	C-N-CA	11.40	136.00	120.38
1	A	327	LEU	CA-C-N	10.61	136.51	121.24
1	A	327	LEU	C-N-CA	10.61	136.51	121.24
1	A	241	MET	N-CA-CB	9.12	123.29	110.07
1	A	38	VAL	CA-C-N	8.94	132.06	120.44
1	A	38	VAL	C-N-CA	8.94	132.06	120.44
1	A	251	ASP	CA-C-O	-8.94	109.10	119.56
1	A	340	PHE	CA-CB-CG	8.91	122.71	113.80
1	A	299	ARG	NE-CZ-NH2	-8.77	111.31	119.20
1	A	349	THR	CA-CB-OG1	-8.70	96.55	109.60
1	A	18	VAL	O-C-N	8.62	128.18	121.46
1	A	39	GLN	N-CA-CB	8.43	122.24	110.01
1	A	407	ASP	CA-C-O	8.21	124.63	119.29
1	A	366	GLU	CB-CG-CD	8.13	126.43	112.60
1	A	181	THR	CA-C-N	8.11	131.15	120.28
1	A	181	THR	C-N-CA	8.11	131.15	120.28
1	A	149	ASN	CA-C-O	-8.05	109.00	120.51
1	A	125	ASP	CA-CB-CG	8.02	120.61	112.60
1	A	251	ASP	O-C-N	-7.93	112.82	122.34
1	A	189	GLY	N-CA-C	-7.93	105.25	114.69
1	A	278	PRO	CB-CA-C	-7.90	100.63	111.85
1	A	80	HIS	CA-CB-CG	-7.86	105.94	113.80
1	A	51	PRO	CA-C-N	7.83	131.56	120.28
1	A	51	PRO	C-N-CA	7.83	131.56	120.28
1	A	44	VAL	N-CA-CB	7.70	120.10	110.47
1	A	211	ARG	NE-CZ-NH2	7.68	126.11	119.20
1	A	75	TYR	CA-C-N	7.68	131.19	120.29
1	A	75	TYR	C-N-CA	7.68	131.19	120.29
1	A	67	ARG	O-C-N	7.63	132.58	123.27
1	A	39	GLN	O-C-N	7.61	129.90	122.07
1	A	169	LEU	O-C-N	7.60	128.94	121.57

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	180	LEU	CA-C-O	-7.60	112.37	120.42
1	A	255	ASN	OD1-CG-ND2	7.59	130.19	122.60
1	A	149	ASN	N-CA-CB	7.48	123.13	110.49
1	A	65	ALA	CB-CA-C	7.47	122.01	109.84
1	A	130	ARG	CD-NE-CZ	7.35	134.69	124.40
1	A	329	GLU	CB-CG-CD	7.34	125.08	112.60
1	A	324	LEU	N-CA-C	7.31	119.33	111.36
1	A	295	VAL	O-C-N	7.26	130.55	123.14
1	A	193	PHE	O-C-N	7.22	129.50	122.07
1	A	108	GLN	CB-CG-CD	7.12	124.70	112.60
1	A	183	GLN	N-CA-CB	7.11	121.17	110.22
1	A	348	THR	CA-CB-CG2	7.08	122.53	110.50
1	A	40	GLU	CA-C-O	-7.02	113.11	120.55
1	A	106	PRO	CA-C-N	6.93	129.88	120.38
1	A	106	PRO	C-N-CA	6.93	129.88	120.38
1	A	364	ARG	CD-NE-CZ	6.87	134.01	124.40
1	A	299	ARG	NH1-CZ-NH2	6.75	128.08	119.30
1	A	67	ARG	CD-NE-CZ	6.72	133.81	124.40
1	A	156	GLU	CB-CG-CD	6.63	123.86	112.60
1	A	281	ILE	CA-C-N	6.58	125.82	118.97
1	A	281	ILE	C-N-CA	6.58	125.82	118.97
1	A	289	LEU	O-C-N	6.58	129.09	122.12
1	A	121	MET	CA-C-N	6.57	126.81	119.32
1	A	121	MET	C-N-CA	6.57	126.81	119.32
1	A	343	GLN	N-CA-CB	6.56	119.77	110.12
1	A	312	LEU	CB-CA-C	6.56	121.19	109.38
1	A	25	ASP	CA-C-N	6.55	131.43	122.19
1	A	25	ASP	C-N-CA	6.55	131.43	122.19
1	A	67	ARG	NE-CZ-NH2	-6.54	113.32	119.20
1	A	150	PHE	CA-CB-CG	-6.54	107.26	113.80
1	A	108	GLN	CA-CB-CG	6.52	127.14	114.10
1	A	160	ILE	O-C-N	6.43	128.46	121.83
1	A	266	LYS	CB-CG-CD	6.43	126.10	111.30
1	A	282	PRO	CA-C-N	6.42	129.21	120.54
1	A	282	PRO	C-N-CA	6.42	129.21	120.54
1	A	164	MET	CA-C-N	6.40	131.53	120.58
1	A	164	MET	C-N-CA	6.40	131.53	120.58
1	A	118	VAL	CA-C-N	6.38	129.22	122.14
1	A	118	VAL	C-N-CA	6.38	129.22	122.14
1	A	18	VAL	N-CA-C	6.36	114.89	107.77
1	A	372	LYS	N-CA-CB	6.36	119.23	110.01
1	A	23	VAL	N-CA-CB	6.33	118.09	110.31

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	98	PHE	CA-CB-CG	6.33	120.13	113.80
1	A	212	ARG	NE-CZ-NH1	6.33	127.83	121.50
1	A	290	ARG	CD-NE-CZ	6.33	133.26	124.40
1	A	161	ARG	NE-CZ-NH2	-6.31	113.52	119.20
1	A	208	ILE	O-C-N	6.30	127.98	121.87
1	A	71	ILE	CA-C-N	6.19	128.49	120.44
1	A	71	ILE	C-N-CA	6.19	128.49	120.44
1	A	107	GLU	CB-CG-CD	6.17	123.09	112.60
1	A	123	VAL	CA-CB-CG1	6.17	120.89	110.40
1	A	334	CYS	CA-C-N	6.16	125.89	119.05
1	A	334	CYS	C-N-CA	6.16	125.89	119.05
1	A	148	CYS	CA-C-N	6.16	133.31	121.54
1	A	148	CYS	C-N-CA	6.16	133.31	121.54
1	A	373	GLU	CB-CG-CD	6.15	123.05	112.60
1	A	291	ARG	N-CA-C	6.14	117.98	111.28
1	A	130	ARG	NE-CZ-NH2	6.13	124.72	119.20
1	A	279	GLU	CA-CB-CG	6.11	126.32	114.10
1	A	214	LYS	CA-C-N	6.09	126.29	119.90
1	A	214	LYS	C-N-CA	6.09	126.29	119.90
1	A	255	ASN	CA-CB-CG	-6.08	106.52	112.60
1	A	188	ASP	N-CA-CB	-6.07	101.61	110.53
1	A	348	THR	N-CA-C	-6.05	103.04	110.61
1	A	163	PHE	O-C-N	6.03	128.60	122.09
1	A	204	LEU	N-CA-C	6.01	117.63	111.14
1	A	381	PHE	O-C-N	6.01	129.57	123.26
1	A	253	VAL	O-C-N	6.01	127.70	121.87
1	A	342	ARG	N-CA-CB	5.99	118.88	109.83
1	A	397	SER	O-C-N	5.99	129.65	122.94
1	A	187	PRO	CA-C-O	5.98	128.12	121.36
1	A	76	GLU	CB-CG-CD	5.96	122.73	112.60
1	A	318	ILE	CA-C-N	5.91	129.96	121.50
1	A	318	ILE	C-N-CA	5.91	129.96	121.50
1	A	407	ASP	CB-CA-C	5.90	116.87	110.08
1	A	414	VAL	CB-CA-C	5.90	122.61	111.40
1	A	287	GLU	CG-CD-OE2	-5.89	104.84	118.40
1	A	290	ARG	CA-C-N	5.86	128.13	120.28
1	A	290	ARG	C-N-CA	5.86	128.13	120.28
1	A	306	GLU	O-C-N	5.86	130.85	123.12
1	A	216	GLY	N-CA-C	-5.85	104.24	112.60
1	A	343	GLN	CB-CG-CD	5.80	122.47	112.60
1	A	109	ARG	O-C-N	5.78	128.02	122.07
1	A	25	ASP	CA-CB-CG	5.77	118.37	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	105	PRO	N-CA-CB	5.77	106.42	103.19
1	A	400	GLN	CA-CB-CG	5.77	125.65	114.10
1	A	270	HIS	O-C-N	5.77	128.73	122.15
1	A	181	THR	N-CA-CB	5.76	118.59	110.12
1	A	130	ARG	NE-CZ-NH1	-5.76	115.74	121.50
1	A	242	CYS	O-C-N	5.76	128.23	122.12
1	A	156	GLU	CA-C-N	5.74	125.21	119.24
1	A	156	GLU	C-N-CA	5.74	125.21	119.24
1	A	316	ASP	O-C-N	5.69	129.58	122.86
1	A	329	GLU	CA-CB-CG	5.68	125.46	114.10
1	A	143	ARG	NE-CZ-NH2	-5.66	114.10	119.20
1	A	90	ARG	CD-NE-CZ	5.65	132.31	124.40
1	A	202	ASP	CA-C-N	5.65	128.10	120.65
1	A	202	ASP	C-N-CA	5.65	128.10	120.65
1	A	108	GLN	CA-C-N	5.64	127.77	120.44
1	A	108	GLN	C-N-CA	5.64	127.77	120.44
1	A	31	PRO	CA-C-O	5.64	128.55	121.67
1	A	305	TYR	O-C-N	5.64	129.70	123.33
1	A	113	ALA	CA-C-O	-5.61	114.57	120.63
1	A	54	VAL	CA-CB-CG2	5.61	119.93	110.40
1	A	276	GLU	N-CA-CB	5.60	118.93	110.30
1	A	330	ARG	NE-CZ-NH1	5.58	127.08	121.50
1	A	208	ILE	CA-C-O	-5.58	115.15	120.95
1	A	178	LYS	N-CA-CB	5.56	118.29	110.12
1	A	47	GLU	CB-CG-CD	5.54	122.01	112.60
1	A	201	TYR	CA-C-N	5.52	128.13	120.29
1	A	201	TYR	C-N-CA	5.52	128.13	120.29
1	A	141	SER	CA-C-O	5.52	126.32	119.97
1	A	269	GLU	CG-CD-OE2	-5.52	105.70	118.40
1	A	152	GLU	N-CA-CB	5.49	118.28	110.16
1	A	364	ARG	NE-CZ-NH2	5.47	124.13	119.20
1	A	180	LEU	O-C-N	5.47	128.39	122.15
1	A	365	ARG	CA-C-O	-5.46	114.76	120.55
1	A	152	GLU	CA-C-O	-5.46	114.64	120.42
1	A	58	CYS	O-C-N	5.42	129.03	122.85
1	A	87	PHE	CA-CB-CG	5.42	119.22	113.80
1	A	85	CYS	N-CA-CB	-5.40	103.27	111.21
1	A	178	LYS	CA-CB-CG	5.38	124.87	114.10
1	A	20	GLU	CA-CB-CG	5.38	124.86	114.10
1	A	209	GLU	CA-CB-CG	5.37	124.84	114.10
1	A	138	LEU	N-CA-CB	-5.35	102.24	110.16
1	A	109	ARG	N-CA-C	5.35	116.79	111.07

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	156	GLU	CA-CB-CG	5.33	124.77	114.10
1	A	192	THR	CA-C-N	5.33	127.37	120.44
1	A	192	THR	C-N-CA	5.33	127.37	120.44
1	A	59	ASN	OD1-CG-ND2	-5.30	117.30	122.60
1	A	311	GLN	CA-C-N	-5.27	115.29	122.93
1	A	311	GLN	C-N-CA	-5.27	115.29	122.93
1	A	85	CYS	CB-CA-C	5.25	121.38	111.29
1	A	217	THR	CA-CB-OG1	-5.23	101.76	109.60
1	A	270	HIS	N-CA-CB	5.21	117.87	110.16
1	A	412	LYS	O-C-N	5.20	129.36	123.27
1	A	187	PRO	N-CA-CB	5.19	107.81	103.25
1	A	277	ARG	CA-C-N	5.19	124.85	119.56
1	A	277	ARG	C-N-CA	5.19	124.85	119.56
1	A	237	GLU	N-CA-CB	5.16	117.49	110.01
1	A	365	ARG	CA-C-N	5.16	127.19	120.28
1	A	365	ARG	C-N-CA	5.16	127.19	120.28
1	A	249	GLY	CA-C-O	-5.14	115.21	120.66
1	A	64	ILE	CA-C-N	5.13	128.84	121.50
1	A	64	ILE	C-N-CA	5.13	128.84	121.50
1	A	396	VAL	O-C-N	5.13	128.74	123.20
1	A	122	PRO	CA-C-N	5.11	127.68	120.42
1	A	122	PRO	C-N-CA	5.11	127.68	120.42
1	A	198	GLU	N-CA-C	5.11	116.92	111.36
1	A	240	ARG	NE-CZ-NH2	-5.09	114.61	119.20
1	A	102	SER	CA-C-N	5.07	130.54	122.94
1	A	102	SER	C-N-CA	5.07	130.54	122.94
1	A	387	ALA	N-CA-C	-5.06	101.45	109.96
1	A	245	LEU	CA-C-N	5.06	127.32	120.44
1	A	245	LEU	C-N-CA	5.06	127.32	120.44
1	A	335	PRO	N-CA-CB	5.04	108.88	103.33
1	A	22	LEU	CA-C-N	5.04	127.83	120.98
1	A	22	LEU	C-N-CA	5.04	127.83	120.98
1	A	378	ILE	CA-C-N	5.02	124.63	119.56
1	A	378	ILE	C-N-CA	5.02	124.63	119.56
1	A	38	VAL	CA-C-O	-5.02	115.53	120.85
1	A	144	PRO	CA-C-N	5.02	127.42	120.29
1	A	144	PRO	C-N-CA	5.02	127.42	120.29
1	A	261	MET	CG-SD-CE	5.01	111.91	100.90

There are no chirality outliers.

All (18) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	119	VAL	Mainchain
1	A	147	GLN	Mainchain
1	A	148	CYS	Mainchain
1	A	149	ASN	Mainchain
1	A	167	ALA	Mainchain
1	A	186	ARG	Sidechain
1	A	240	ARG	Sidechain
1	A	249	GLY	Mainchain
1	A	250	LEU	Mainchain
1	A	251	ASP	Mainchain
1	A	271	ARG	Sidechain
1	A	280	ARG	Sidechain
1	A	290	ARG	Sidechain
1	A	330	ARG	Sidechain
1	A	377	ARG	Sidechain
1	A	40	GLU	Mainchain
1	A	67	ARG	Sidechain
1	A	77	ASP	Mainchain

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	3204	0	3145	57	0
2	A	43	0	30	0	0
3	A	11	0	14	0	0
4	A	204	0	0	4	0
All	All	3462	0	3189	57	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 9.

All (57) 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:183:GLN:HE22	1:A:188:ASP:HB2	1.30	0.97
1:A:40:GLU:HG3	1:A:336:MET:HE2	1.67	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:208:ILE:O	1:A:212:ARG:HG3	1.91	0.69
1:A:127:LEU:HD11	1:A:166:LEU:HD13	1.75	0.69
1:A:231:ARG:HB2	1:A:232:PRO:HD2	1.76	0.66
1:A:121:MET:HB2	1:A:122:PRO:HD3	1.79	0.64
1:A:183:GLN:NE2	1:A:188:ASP:HB2	2.08	0.63
1:A:184:MET:HE2	1:A:197:LYS:HA	1.81	0.63
1:A:261:MET:HE2	1:A:264:LEU:HD12	1.81	0.61
1:A:40:GLU:HG3	1:A:336:MET:CE	2.33	0.58
1:A:111:PHE:HD2	1:A:241:MET:HE2	1.69	0.57
1:A:149:ASN:ND2	1:A:402:LEU:H	2.02	0.56
1:A:184:MET:CE	1:A:197:LYS:HA	2.35	0.56
1:A:49:ASN:HD22	1:A:49:ASN:H	1.57	0.53
1:A:164:MET:HE1	1:A:177:LEU:HD12	1.92	0.52
1:A:152:GLU:HB3	4:A:563:HOH:O	2.10	0.51
1:A:98:PHE:HB3	1:A:244:LEU:HB2	1.92	0.51
1:A:387:ALA:HB1	1:A:403:PRO:HG2	1.92	0.50
1:A:122:PRO:HD2	4:A:701:HOH:O	2.10	0.50
1:A:290:ARG:HD3	1:A:345:VAL:HG13	1.93	0.50
1:A:121:MET:CB	1:A:122:PRO:HD3	2.42	0.50
1:A:30:ASN:ND2	4:A:555:HOH:O	2.44	0.49
1:A:56:THR:O	1:A:61:GLY:HA2	2.13	0.49
1:A:277:ARG:N	1:A:278:PRO:HD3	2.29	0.48
1:A:138:LEU:HD23	1:A:158:PHE:HB2	1.95	0.48
1:A:303:SER:HA	1:A:314:LYS:HG3	1.96	0.47
1:A:223:VAL:O	1:A:233:ILE:HG21	2.14	0.47
1:A:387:ALA:CB	1:A:403:PRO:HG2	2.45	0.47
1:A:319:LEU:C	1:A:321:PRO:HD3	2.40	0.47
1:A:110:GLN:NE2	1:A:229:ASN:HA	2.30	0.47
1:A:108:GLN:HG3	1:A:355:HIS:CE1	2.51	0.46
1:A:30:ASN:ND2	4:A:556:HOH:O	2.49	0.46
1:A:158:PHE:CE1	1:A:162:ILE:HD11	2.50	0.46
1:A:110:GLN:CD	1:A:229:ASN:H	2.24	0.45
1:A:91:GLU:H	1:A:91:GLU:CD	2.24	0.45
1:A:276:GLU:C	1:A:278:PRO:HD3	2.41	0.45
1:A:158:PHE:HB3	1:A:159:PRO:HD3	1.98	0.45
1:A:97:ASP:O	1:A:240:ARG:HD2	2.16	0.44
1:A:266:LYS:HD3	1:A:383:ILE:CD1	2.48	0.44
1:A:281:ILE:N	1:A:282:PRO:CD	2.80	0.44
1:A:170:PRO:HG2	1:A:173:ASP:OD1	2.18	0.44
1:A:266:LYS:HD3	1:A:383:ILE:HD11	2.00	0.44
1:A:17:HIS:CD2	1:A:313:LYS:HG3	2.53	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:384:ALA:HA	1:A:385:PRO:HD3	1.86	0.43
1:A:134:LEU:O	1:A:138:LEU:HB2	2.18	0.43
1:A:293:SER:HB3	1:A:323:MET:HA	2.01	0.43
1:A:183:GLN:HE22	1:A:188:ASP:CB	2.14	0.43
1:A:332:ASN:O	1:A:335:PRO:HD3	2.19	0.43
1:A:99:ILE:HG23	1:A:100:PRO:HA	2.01	0.42
1:A:83:SER:HB3	1:A:101:THR:O	2.19	0.42
1:A:143:ARG:HB3	1:A:144:PRO:HD3	2.01	0.42
1:A:269:GLU:CD	1:A:269:GLU:H	2.27	0.42
1:A:377:ARG:HH21	1:A:414:VAL:HG12	1.85	0.41
1:A:179:TYR:HE2	1:A:191:MET:HE3	1.85	0.41
1:A:319:LEU:O	1:A:321:PRO:HD3	2.21	0.41
1:A:218:ASP:O	1:A:222:ILE:HG12	2.21	0.41
1:A:50:VAL:HA	1:A:51:PRO:HD3	1.90	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	403/414 (97%)	387 (96%)	16 (4%)	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	349/358 (98%)	335 (96%)	14 (4%)	28	28

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	GLN
1	A	49	ASN
1	A	91	GLU
1	A	108	GLN
1	A	128	GLU
1	A	138	LEU
1	A	211	ARG
1	A	220	ILE
1	A	245	LEU
1	A	261	MET
1	A	269	GLU
1	A	276	GLU
1	A	293	SER
1	A	414	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	HIS
1	A	30	ASN
1	A	39	GLN
1	A	46	GLN
1	A	49	ASN
1	A	59	ASN
1	A	69	GLN
1	A	108	GLN
1	A	149	ASN
1	A	225	ASN
1	A	227	GLN
1	A	337	HIS
1	A	388	GLN

5.3.3 RNA ⓘ

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

2 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	$\# Z > 2$
3	ADO	A	422	-	13,13,13	2.47	7 (53%)	20,20,20	1.05	1 (5%)
2	HEM	A	417	1	50,50,50	2.35	17 (34%)	67,82,82	1.81	16 (23%)

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	ADO	A	422	-	-	-	0/4/3/3
2	HEM	A	417	1	-	2/14/54/54	-

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	FE-NC	5.65	2.13	1.95
3	A	422	ADO	C8-C1	5.01	1.64	1.53
2	A	417	HEM	FE-NA	4.98	2.11	1.95
2	A	417	HEM	C4C-NC	-4.79	1.30	1.39
2	A	417	HEM	CMD-C2D	4.75	1.60	1.50
2	A	417	HEM	C4A-C3A	4.68	1.54	1.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	CMB-C2B	4.60	1.60	1.50
2	A	417	HEM	C4A-NA	-4.59	1.31	1.39
3	A	422	ADO	C4-C3	3.78	1.61	1.53
2	A	417	HEM	C1D-ND	3.49	1.45	1.38
2	A	417	HEM	C3B-C2B	-3.07	1.30	1.37
3	A	422	ADO	C6-C5	3.02	1.61	1.52
2	A	417	HEM	CAC-C3C	2.72	1.54	1.47
3	A	422	ADO	C10-C7	2.71	1.60	1.52
2	A	417	HEM	C1C-NC	-2.66	1.34	1.39
2	A	417	HEM	FE-NB	2.54	2.02	1.94
3	A	422	ADO	C3-C2	2.51	1.58	1.51
2	A	417	HEM	C1A-NA	-2.47	1.35	1.39
2	A	417	HEM	C3C-C4C	2.43	1.50	1.46
2	A	417	HEM	C3D-C2D	-2.35	1.31	1.36
2	A	417	HEM	CAB-C3B	2.32	1.53	1.47
2	A	417	HEM	CHD-C1D	-2.28	1.34	1.39
3	A	422	ADO	C9-C5	2.10	1.58	1.52
3	A	422	ADO	C1-C2	2.01	1.56	1.51

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	417	HEM	CMA-C3A-C2A	4.99	136.21	125.62
2	A	417	HEM	CMA-C3A-C4A	-4.45	118.64	125.42
2	A	417	HEM	C3B-C2B-C1B	4.39	109.71	106.41
2	A	417	HEM	C4A-NA-C1A	3.58	111.66	105.82
2	A	417	HEM	CHB-C4A-NA	3.45	130.12	123.86
2	A	417	HEM	C3B-C4B-NB	3.43	111.93	109.47
2	A	417	HEM	CHD-C4C-NC	3.31	128.05	124.45
2	A	417	HEM	C1D-C2D-C3D	3.24	110.39	106.98
2	A	417	HEM	CBD-CAD-C3D	3.22	121.42	112.53
2	A	417	HEM	C4C-NC-C1C	2.97	110.67	105.82
2	A	417	HEM	CHC-C1C-NC	2.62	127.30	124.45
2	A	417	HEM	C1B-NB-C4B	-2.39	102.38	105.21
2	A	417	HEM	O1A-CGA-CBA	-2.23	116.02	123.09
2	A	417	HEM	C2A-C1A-NA	-2.19	107.72	110.15
2	A	417	HEM	CHA-C1A-NA	2.17	127.80	123.86
3	A	422	ADO	O2-C2-C1	2.13	127.01	123.47
2	A	417	HEM	O2A-CGA-O1A	2.00	128.48	123.33

There are no chirality outliers.

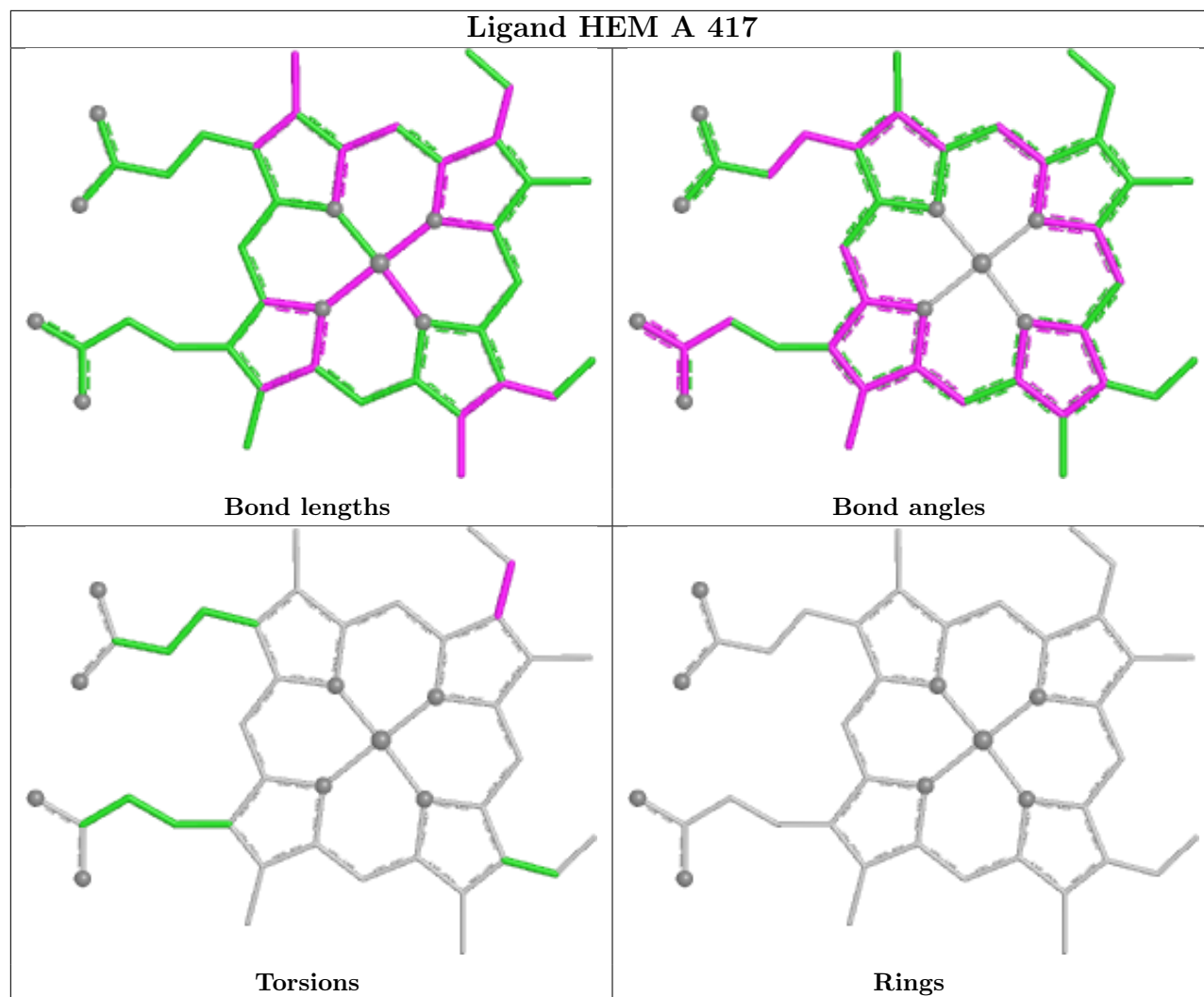
All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	417	HEM	C2C-C3C-CAC-CBC
2	A	417	HEM	C4C-C3C-CAC-CBC

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 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.