



Full wwPDB EM Validation Report ⓘ

Mar 3, 2025 – 12:22 pm GMT

PDB ID : 9GZ2
EMDB ID : EMD-51720
Title : Beta-cardiac heavy meromyosin motor domain in the primed state complexed to mavacamten
Authors : McMillan, S.N.; Pitts, J.R.T.; Barua, B.; Winkelmann, D.A.; Scarff, C.A.
Deposited on : 2024-10-03
Resolution : 2.90 Å(reported)
Based on initial model : .

This is a Full wwPDB EM 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/EMValidationReportHelp>
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:

EMDB validation analysis : **FAILED**
Mogul : 1.8.4, CSD as541be (2020)
MolProbity : 4.02b-467
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.41

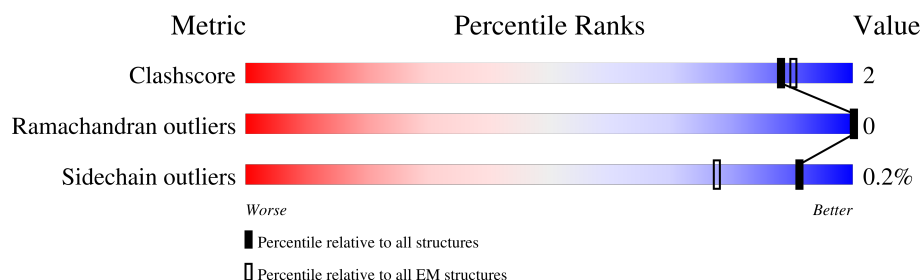
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.90 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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	1145	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6200 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Myosin-7.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	764	6147	3931	1046	1138	32	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1124	SER	ALA	variant	UNP P12883
A	1139	ASP	-	expression tag	UNP P12883
A	1140	TYR	-	expression tag	UNP P12883
A	1141	LYS	-	expression tag	UNP P12883
A	1142	ASP	-	expression tag	UNP P12883
A	1143	ASP	-	expression tag	UNP P12883
A	1144	ASP	-	expression tag	UNP P12883
A	1145	ASP	-	expression tag	UNP P12883
A	1146	LYS	-	expression tag	UNP P12883

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

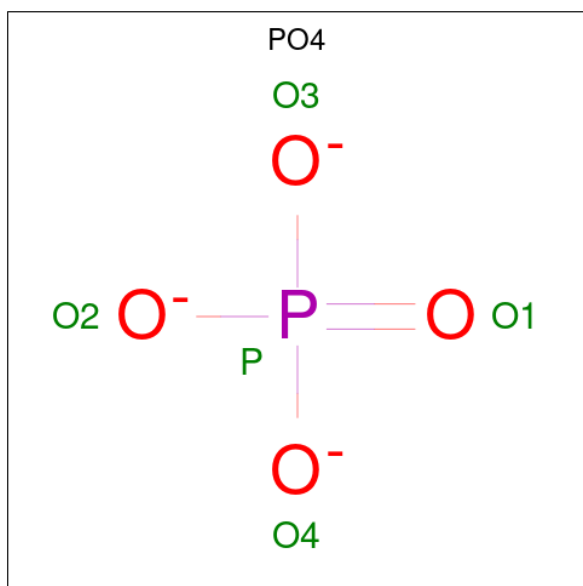
Mol	Chain	Residues	Atoms		AltConf
2	A	1	Total	Mg	0
			1	1	

- Molecule 3 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂).



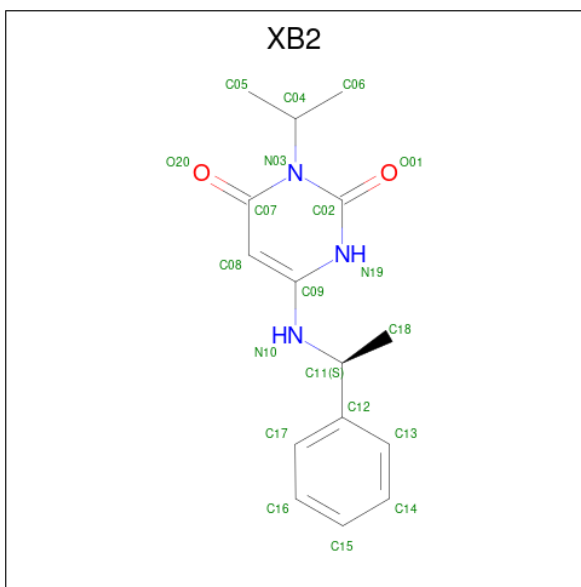
Mol	Chain	Residues	Atoms					AltConf
3	A	1	Total	C	N	O	P	0
			27	10	5	10	2	

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O_4P).



Mol	Chain	Residues	Atoms			AltConf
4	A	1	Total	O	P	0
			5	4	1	

- Molecule 5 is 6-[[[(1 {S})-1-phenylethyl]amino]-3-propan-2-yl]-1 {H}-pyrimidine-2,4-dione (three-letter code: XB2) (formula: C₁₅H₁₉N₃O₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				AltConf
			Total	C	N	O	
5	A	1	20	15	3	2	0

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	200487	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	43.4	Depositor
Minimum defocus (nm)	1500	Depositor
Maximum defocus (nm)	3000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, PO4, XB2, ADP

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	0.36	0/6277	0.63	1/8462 (0.0%)

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	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	461	ASP	CB-CG-OD1	5.06	122.86	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	567	ARG	Sidechain

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	6147	0	6126	22	0
2	A	1	0	0	0	0
3	A	27	0	12	0	0
4	A	5	0	0	0	0
5	A	20	0	0	0	0
All	All	6200	0	6138	22	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 (22) 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:576:HIS:HD2	1:A:590:ILE:H	1.45	0.63
1:A:577:PHE:HE1	1:A:590:ILE:HD11	1.65	0.61
1:A:725:LEU:HB3	1:A:749:LEU:HD11	1.82	0.61
1:A:404:VAL:HG11	1:A:413:LYS:HE3	1.86	0.57
1:A:671:ARG:NH1	1:A:696:ASN:O	2.40	0.55
1:A:723:ARG:NH2	1:A:730:ILE:O	2.40	0.54
1:A:234:LYS:HB3	1:A:281:ARG:HB2	1.92	0.52
1:A:229:ALA:HB2	1:A:332:THR:HG21	1.92	0.51
1:A:434:ARG:NH2	1:A:620:LEU:O	2.42	0.50
1:A:564:GLN:HG3	1:A:580:ILE:HD11	1.93	0.50
1:A:288:GLN:HA	1:A:325:ASP:HB3	1.95	0.47
1:A:234:LYS:NZ	1:A:317:GLU:OE1	2.39	0.47
1:A:371:GLU:OE2	1:A:416:ASN:ND2	2.48	0.47
1:A:692:GLN:O	1:A:696:ASN:ND2	2.45	0.47
1:A:292:ASN:HD22	1:A:326:ALA:HB1	1.80	0.45
1:A:278:LYS:HA	1:A:316:GLY:HA2	2.00	0.44
1:A:568:ASN:HD21	1:A:575:ALA:H	1.67	0.42
1:A:367:LYS:NZ	1:A:374:GLU:OE2	2.51	0.42
1:A:568:ASN:ND2	1:A:575:ALA:H	2.18	0.42
1:A:36:ASP:OD1	1:A:50:LYS:NZ	2.47	0.40
1:A:246:LYS:HB3	1:A:246:LYS:HE2	1.83	0.40
1:A:320:VAL:HG11	1:A:323:ILE:HD12	2.04	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

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	758/1145 (66%)	728 (96%)	30 (4%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

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	663/1001 (66%)	662 (100%)	1 (0%)	92	98

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	27	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	79	GLN
1	A	419	GLN
1	A	437	ASN
1	A	568	ASN
1	A	576	HIS
1	A	654	ASN
1	A	661	ASN

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Mol	Chain	Res	Type
1	A	686	ASN
1	A	754	ASN
1	A	789	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 1 is monoatomic - leaving 3 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	$\# Z > 2$
5	XB2	A	1204	-	19,21,21	0.86	0	23,29,29	0.93	2 (8%)
4	PO4	A	1203	2	4,4,4	1.05	0	6,6,6	0.43	0
3	ADP	A	1202	2	24,29,29	0.97	1 (4%)	29,45,45	1.20	3 (10%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	XB2	A	1204	-	-	0/10/12/12	0/2/2/2
3	ADP	A	1202	2	-	1/12/32/32	0/3/3/3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1202	ADP	C5-C4	2.27	1.46	1.40

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1202	ADP	N3-C2-N1	-2.97	124.03	128.68
5	A	1204	XB2	O20-C07-N03	2.65	123.70	119.62
3	A	1202	ADP	C4-C5-N7	-2.59	106.70	109.40
3	A	1202	ADP	C2'-C3'-C4'	-2.34	98.09	102.64
5	A	1204	XB2	O20-C07-C08	-2.33	119.76	125.72

There are no chirality outliers.

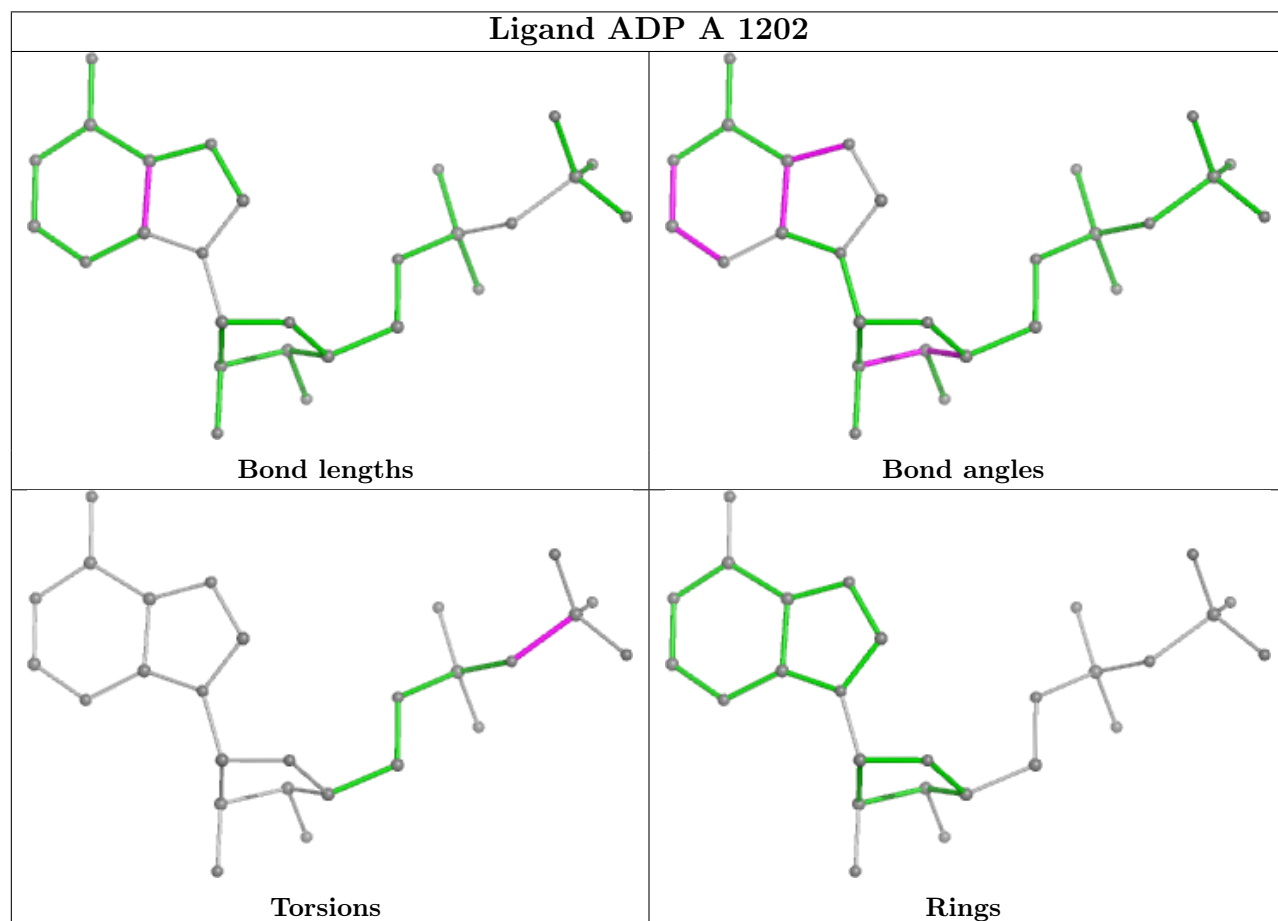
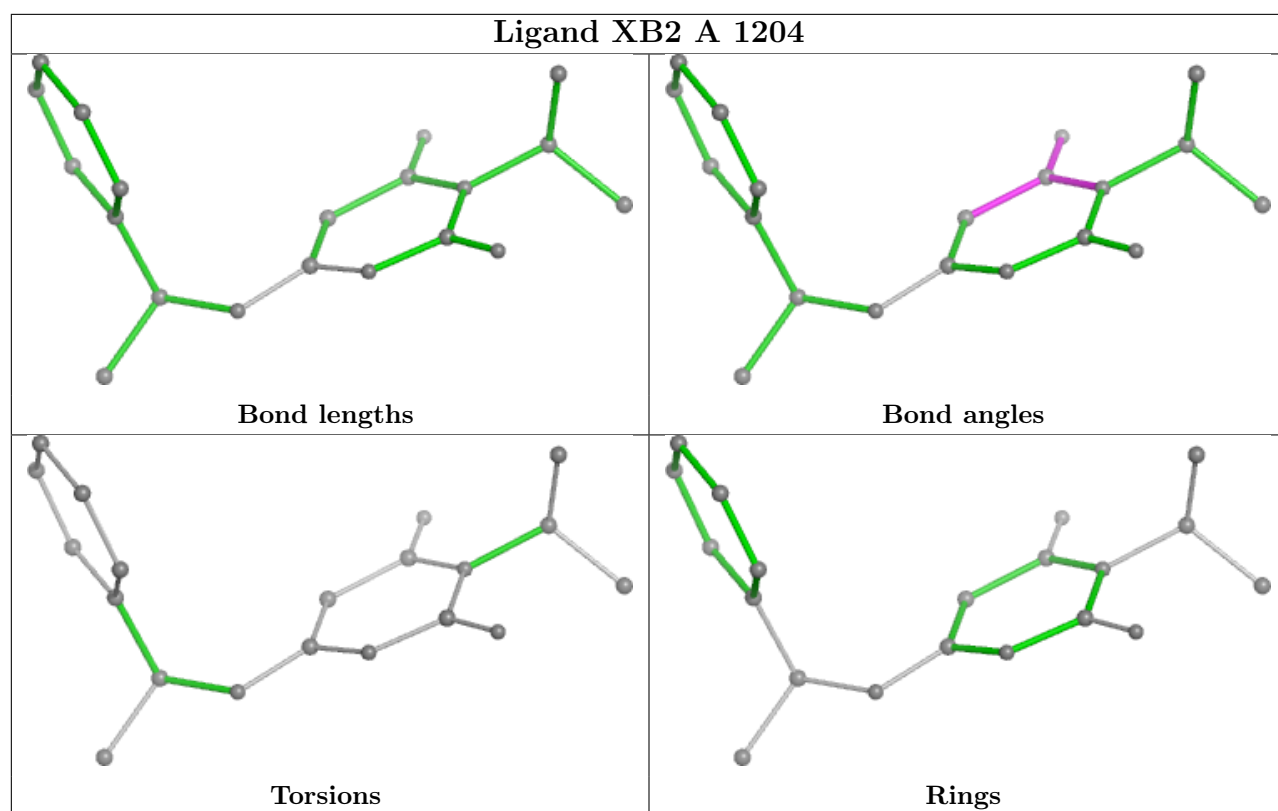
All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1202	ADP	PA-O3A-PB-O3B

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.