



wwPDB EM Validation Summary Report i

Jul 16, 2025 – 02:03 AM JST

PDB ID : 9IX4 / pdb_00009ix4
EMDB ID : EMD-60964
Title : Cryo-EM structure of Lactobacillus casei DdmD dimer bound with DNA
Authors : Huang, P.P.; Chen, M.R.; Xiao, Y.B.
Deposited on : 2024-07-26
Resolution : 2.96 Å (reported)

This is a wwPDB EM Validation Summary 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 i symbol.

The types of validation reports are described at
<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references](#) ①) were used in the production of this report:

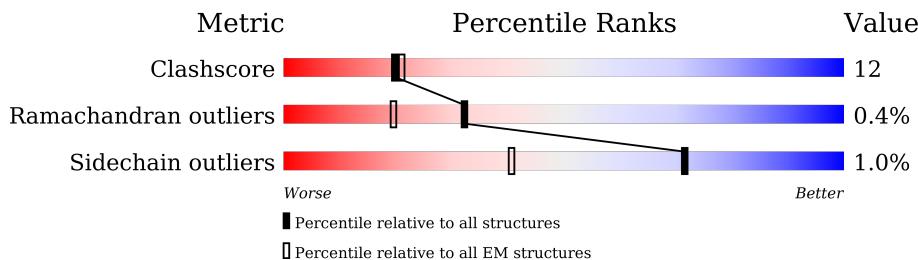
EMDB validation analysis	: FAILED
Mogul	: 1.8.5 (274361), CSD as541be (2020)
MolProbity	: 4-5-2 with Phenix2.0rc1
buster-report	: 1.1.7 (2018)
Percentile statistics	: 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ	: FAILED
Ideal geometry (proteins)	: Engh & Huber (2001)
Ideal geometry (DNA, RNA)	: Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	: 2.44

1 Overall quality at a glance

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

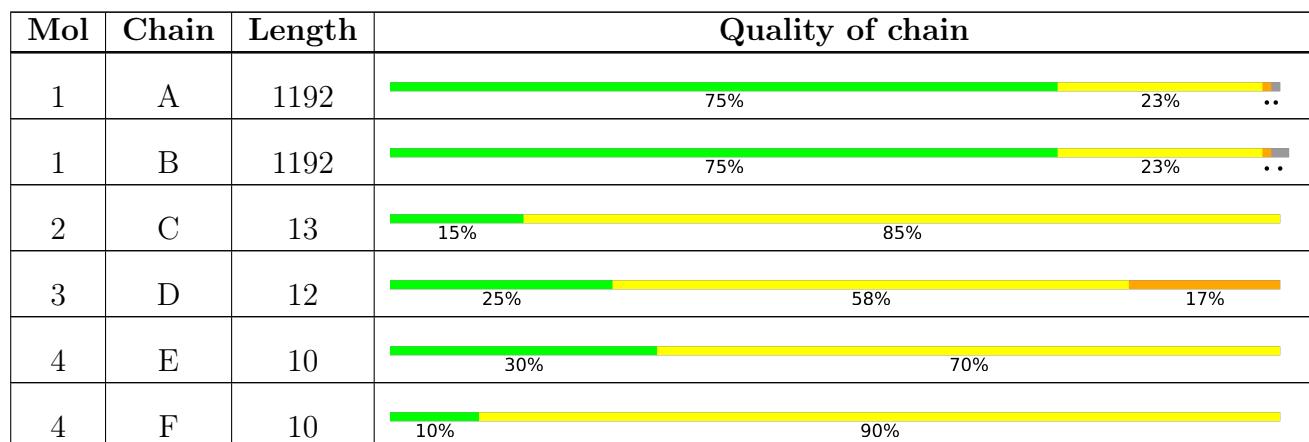
The reported resolution of this entry is 2.96 Å.

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 $\leq 5\%$



2 Entry composition [\(i\)](#)

There are 5 unique types of molecules in this entry. The entry contains 20021 atoms, of which 24 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 DdmD.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	1178	Total	C	N	O	S	0	0
			9522	6067	1646	1779	30		
1	B	1170	Total	C	N	O	S	0	0
			9489	6049	1639	1771	30		

There are 38 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	SER	LEU	conflict	UNP A0A5R8LS59
A	46	ILE	VAL	conflict	UNP A0A5R8LS59
A	115	SER	ASN	conflict	UNP A0A5R8LS59
A	154	GLU	ASP	conflict	UNP A0A5R8LS59
A	174	LYS	ARG	conflict	UNP A0A5R8LS59
A	179	ALA	GLU	conflict	UNP A0A5R8LS59
A	187	ASP	ASN	conflict	UNP A0A5R8LS59
A	313	PHE	SER	conflict	UNP A0A5R8LS59
A	468	HIS	TYR	conflict	UNP A0A5R8LS59
A	575	GLU	GLN	conflict	UNP A0A5R8LS59
A	681	ASP	GLU	conflict	UNP A0A5R8LS59
A	704	ILE	VAL	conflict	UNP A0A5R8LS59
A	762	ARG	PRO	conflict	UNP A0A5R8LS59
A	859	PRO	THR	conflict	UNP A0A5R8LS59
A	1090	VAL	ALA	conflict	UNP A0A5R8LS59
A	1101	ASP	ASN	conflict	UNP A0A5R8LS59
A	1106	ALA	VAL	conflict	UNP A0A5R8LS59
A	1140	ARG	GLN	conflict	UNP A0A5R8LS59
A	1165	THR	MET	conflict	UNP A0A5R8LS59
B	7	SER	LEU	conflict	UNP A0A5R8LS59
B	46	ILE	VAL	conflict	UNP A0A5R8LS59
B	115	SER	ASN	conflict	UNP A0A5R8LS59
B	154	GLU	ASP	conflict	UNP A0A5R8LS59
B	174	LYS	ARG	conflict	UNP A0A5R8LS59
B	179	ALA	GLU	conflict	UNP A0A5R8LS59
B	187	ASP	ASN	conflict	UNP A0A5R8LS59

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Chain	Residue	Modelled	Actual	Comment	Reference
B	313	PHE	SER	conflict	UNP A0A5R8LS59
B	468	HIS	TYR	conflict	UNP A0A5R8LS59
B	575	GLU	GLN	conflict	UNP A0A5R8LS59
B	681	ASP	GLU	conflict	UNP A0A5R8LS59
B	704	ILE	VAL	conflict	UNP A0A5R8LS59
B	762	ARG	PRO	conflict	UNP A0A5R8LS59
B	859	PRO	THR	conflict	UNP A0A5R8LS59
B	1090	VAL	ALA	conflict	UNP A0A5R8LS59
B	1101	ASP	ASN	conflict	UNP A0A5R8LS59
B	1106	ALA	VAL	conflict	UNP A0A5R8LS59
B	1140	ARG	GLN	conflict	UNP A0A5R8LS59
B	1165	THR	MET	conflict	UNP A0A5R8LS59

- Molecule 2 is a DNA chain called DNA (5'-D(P*TP*AP*TP*GP*AP*GP*TP*AP*TP*AP*TP*CP*C)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	13	Total	C	N	O	P	0	0
			266	128	46	79	13		

- Molecule 3 is a DNA chain called DNA (5'-D(P*AP*TP*GP*AP*GP*TP*AP*TP*AP*TP*CP*C)-3').

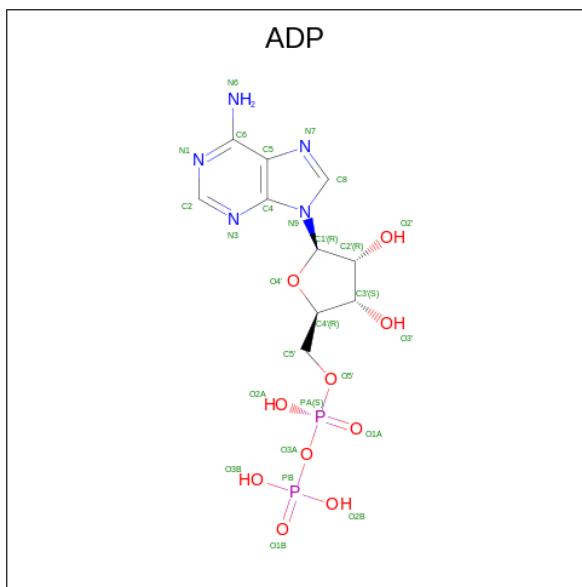
Mol	Chain	Residues	Atoms					AltConf	Trace
3	D	12	Total 246	C 118	N 44	O 72	P 12	0	0

- Molecule 4 is a DNA chain called DNA ($5'-D(P^*AP^*AP^*AP^*AP^*AP^*AP^*AP^*AP^*AP^*AP^*A)-3'$).

Mol	Chain	Residues	Atoms					AltConf	Trace
4	E	10	Total	C	N	O	P	0	0
			210	100	50	50	10		

Mol	Chain	Residues	Atoms					AltConf	Trace
4	F	10	Total	C	N	O	P	0	0
			210	100	50	50	10		

- Molecule 5 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: $C_{10}H_{15}N_5O_{10}P_2$) (labeled as "Ligand of Interest" by depositor).

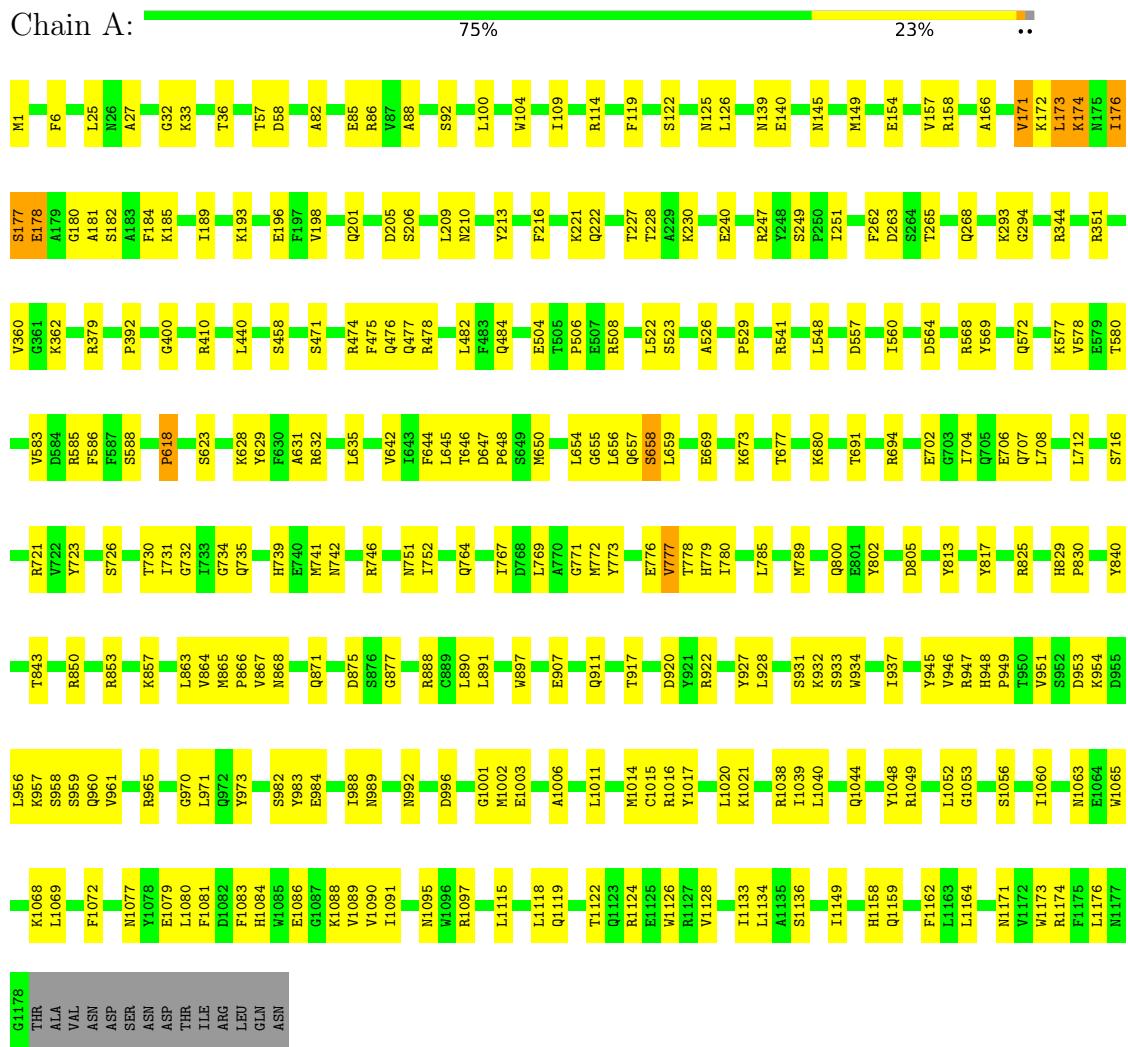


Mol	Chain	Residues	Atoms						AltConf
5	A	1	Total		C	H	N	O	P
			39		10	12	5	10	2
5	B	1	Total		C	H	N	O	P
			39		10	12	5	10	2

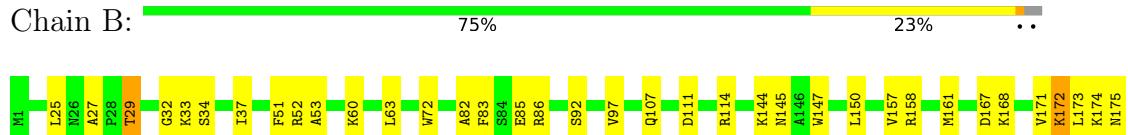
3 Residue-property plots [i](#)

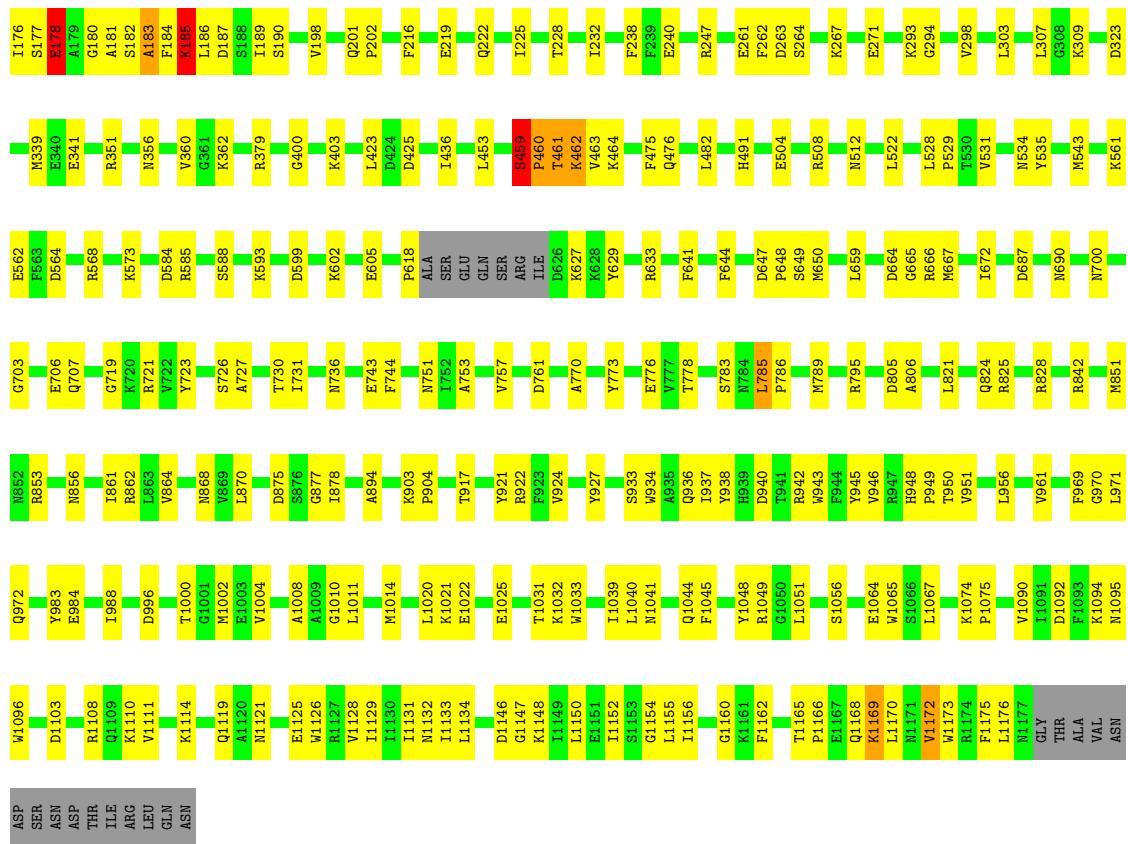
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: DdmD



- Molecule 1: DdmD





- Molecule 2: DNA (5'-D(P*TP*AP*TP*GP*AP*GP*TP*AP*TP*AP*TP*CP*C)-3')

Chain C: 15% 85%

A horizontal progress bar for 'Chain C'. The bar is divided into two segments: a green segment on the left representing 15% completion, and a grey segment on the right representing 85% completion. The percentage values are displayed in white text inside their respective segments.

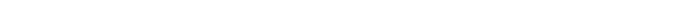


- Molecule 3: DNA (5'-D(P*AP*TP*GP*AP*GP*TP*AP*TP*AP*TP*CP*C)-3')

Chain D: 25% 58% 17%

A horizontal progress bar for Chain D. The bar is divided into three segments: a green segment on the left labeled '25%', a yellow segment in the middle labeled '58%', and a blue segment on the right labeled '17%'. The segments are separated by thin black vertical lines.



Chain E:  30% 70%



Chain F: 10%  90%



4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	122811	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	45	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor

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: 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	0.24	0/9718	0.40	4/13112 (0.0%)
1	B	0.25	0/9685	0.42	5/13064 (0.0%)
2	C	0.71	0/297	1.02	1/456 (0.2%)
3	D	0.73	1/275 (0.4%)	0.98	3/422 (0.7%)
4	E	0.24	0/239	0.29	0/366
4	F	0.25	0/239	0.30	0/366
All	All	0.27	1/20453 (0.0%)	0.44	13/27786 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	31	DA	O3'-P	-5.90	1.52	1.61

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	181	ALA	N-CA-C	-9.06	101.75	113.17
1	A	618	PRO	N-CA-CB	7.13	110.74	103.25
1	A	181	ALA	N-CA-CB	6.84	120.62	110.49
2	C	35	DT	C2'-C3'-O3'	-6.76	101.37	111.50
1	A	866	PRO	N-CA-CB	6.68	110.39	103.38

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	9522	0	9446	229	0
1	B	9489	0	9442	226	0
2	C	266	0	149	39	0
3	D	246	0	137	20	0
4	E	210	0	111	10	0
4	F	210	0	111	12	0
5	A	27	12	12	2	0
5	B	27	12	12	2	0
All	All	19997	24	19420	481	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 12.

The worst 5 of 481 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:1065:TRP:CD1	1:B:1172:VAL:HG11	1.66	1.29
1:A:629:TYR:CE2	2:C:31:DA:C8	2.28	1.20
1:A:659:LEU:HD21	2:C:32:DG:OP1	1.41	1.17
1:A:656:LEU:HD21	1:A:731:ILE:HD11	1.34	1.06
1:B:1065:TRP:NE1	1:B:1172:VAL:HG11	1.73	1.01

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 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	1176/1192 (99%)	1107 (94%)	64 (5%)	5 (0%)	30 54
1	B	1166/1192 (98%)	1099 (94%)	62 (5%)	5 (0%)	30 54

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	2342/2384 (98%)	2206 (94%)	126 (5%)	10 (0%)	32 54

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	618	PRO
1	A	177	SER
1	B	183	ALA
1	A	172	LYS
1	A	180	GLY

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 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	1027/1054 (97%)	1019 (99%)	8 (1%)	79 88
1	B	1029/1054 (98%)	1016 (99%)	13 (1%)	65 80
All	All	2056/2108 (98%)	2035 (99%)	21 (1%)	71 85

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	462	LYS
1	B	1169	LYS
1	B	1173	TRP
1	B	1170	LEU
1	B	785	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 26 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1123	GLN
1	B	418	GLN
1	B	1168	GLN

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Mol	Chain	Res	Type
1	B	175	ASN
1	B	572	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 [\(i\)](#)

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	$\# Z > 2$
5	ADP	A	1201	-	24,29,29	0.95	1 (4%)	29,45,45	1.37	3 (10%)
5	ADP	B	1201	-	24,29,29	1.00	0	29,45,45	1.53	5 (17%)

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	ADP	A	1201	-	-	4/12/32/32	0/3/3/3

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	ADP	B	1201	-	-	4/12/32/32	0/3/3/3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	1201	ADP	C5-C4	2.12	1.46	1.40

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	1201	ADP	PA-O3A-PB	-4.15	118.57	132.83
5	A	1201	ADP	N3-C2-N1	-3.67	122.94	128.68
5	B	1201	ADP	N3-C2-N1	-3.31	123.51	128.68
5	A	1201	ADP	PA-O3A-PB	-3.04	122.38	132.83
5	A	1201	ADP	C4-C5-N7	-2.57	106.72	109.40

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1201	ADP	C5'-O5'-PA-O2A
5	B	1201	ADP	C5'-O5'-PA-O2A
5	B	1201	ADP	C5'-O5'-PA-O3A
5	B	1201	ADP	O4'-C4'-C5'-O5'
5	A	1201	ADP	C5'-O5'-PA-O3A

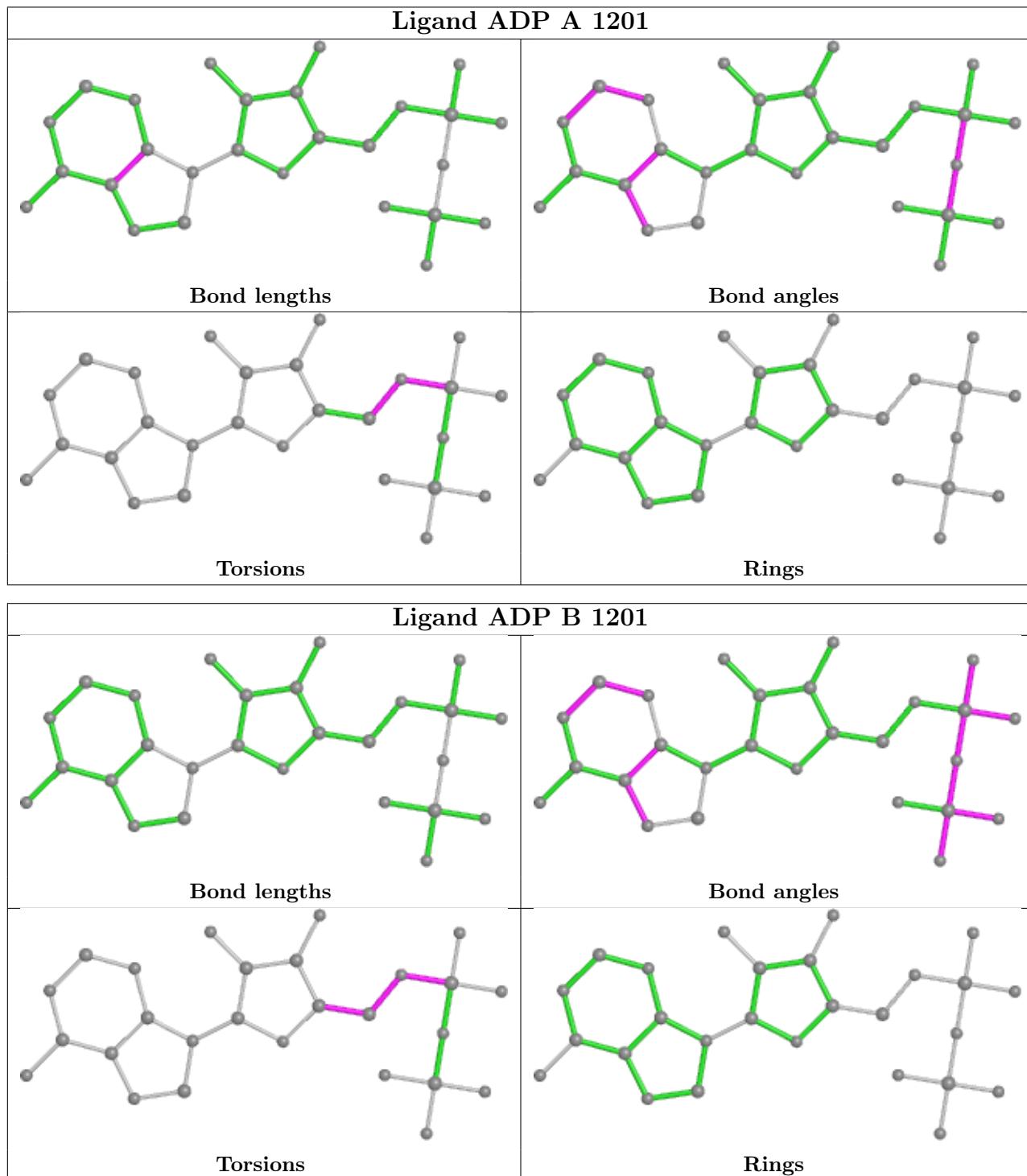
There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1201	ADP	2	0
5	B	1201	ADP	2	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.