



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 31, 2016 – 07:44 PM GMT

PDB ID : 1GZ3  
Title : MOLECULAR MECHANISM FOR THE REGULATION OF HUMAN MITOCHONDRIAL NAD(P)<sup>+</sup>-DEPENDENT MALIC ENZYME BY ATP AND FUMARATE  
Authors : Yang, Z.; Lanks, C.W.; Tong, L.  
Deposited on : 2002-05-14  
Resolution : 2.30 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

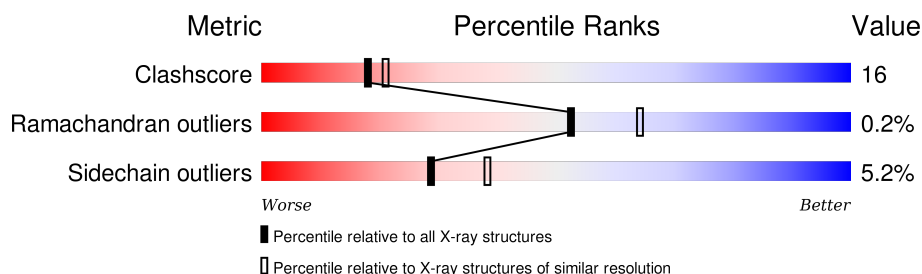
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	554	 70% 27% .
1	B	554	 68% 29% .
1	C	554	 71% 27% .
1	D	554	 71% 27% .

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 18818 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 NAD-DEPENDENT MALIC ENZYME.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	554	Total	C	N	O	S	0	0	0
			4369	2799	740	807	23			
1	B	554	Total	C	N	O	S	0	0	0
			4369	2799	740	807	23			
1	C	554	Total	C	N	O	S	0	0	0
			4369	2799	740	807	23			
1	D	554	Total	C	N	O	S	0	0	0
			4370	2799	740	808	23			

There are 12 discrepancies between the modelled and reference sequences:

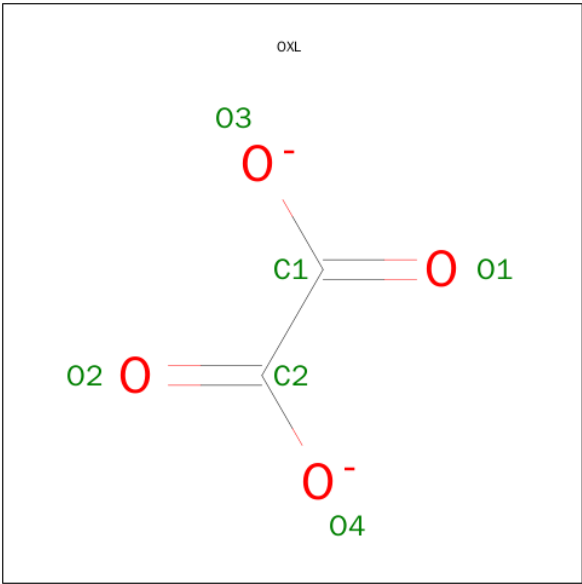
Chain	Residue	Modelled	Actual	Comment	Reference
A	197	GLN	ARG	ENGINEERED MUTATION	UNP P23368
A	542	VAL	ARG	ENGINEERED MUTATION	UNP P23368
A	556	GLN	ARG	ENGINEERED MUTATION	UNP P23368
B	197	GLN	ARG	ENGINEERED MUTATION	UNP P23368
B	542	VAL	ARG	ENGINEERED MUTATION	UNP P23368
B	556	GLN	ARG	ENGINEERED MUTATION	UNP P23368
C	197	GLN	ARG	ENGINEERED MUTATION	UNP P23368
C	542	VAL	ARG	ENGINEERED MUTATION	UNP P23368
C	556	GLN	ARG	ENGINEERED MUTATION	UNP P23368
D	197	GLN	ARG	ENGINEERED MUTATION	UNP P23368
D	542	VAL	ARG	ENGINEERED MUTATION	UNP P23368
D	556	GLN	ARG	ENGINEERED MUTATION	UNP P23368

- Molecule 2 is ADENOSINE-5'-TRIPHOSPHATE (three-letter code: ATP) (formula:  $C_{10}H_{16}N_5O_{13}P_3$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
2	B	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
2	C	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
2	D	1	Total	C	N	O	P	0	0
			31	10	5	13	3		

- Molecule 3 is OXALATE ION (three-letter code: OXL) (formula: C<sub>2</sub>O<sub>4</sub>).

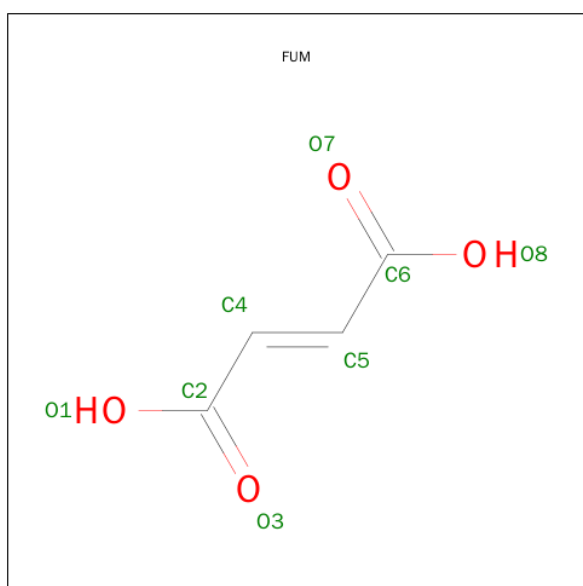


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	2	4		
3	B	1	Total	C	O	0	0
			6	2	4		
3	C	1	Total	C	O	0	0
			6	2	4		
3	D	1	Total	C	O	0	0
			6	2	4		

- Molecule 4 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Mn	0	0
			1	1		
4	A	1	Total	Mn	0	0
			1	1		
4	D	1	Total	Mn	0	0
			1	1		
4	C	1	Total	Mn	0	0
			1	1		

- Molecule 5 is FUMARIC ACID (three-letter code: FUM) (formula: C<sub>4</sub>H<sub>4</sub>O<sub>4</sub>).



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

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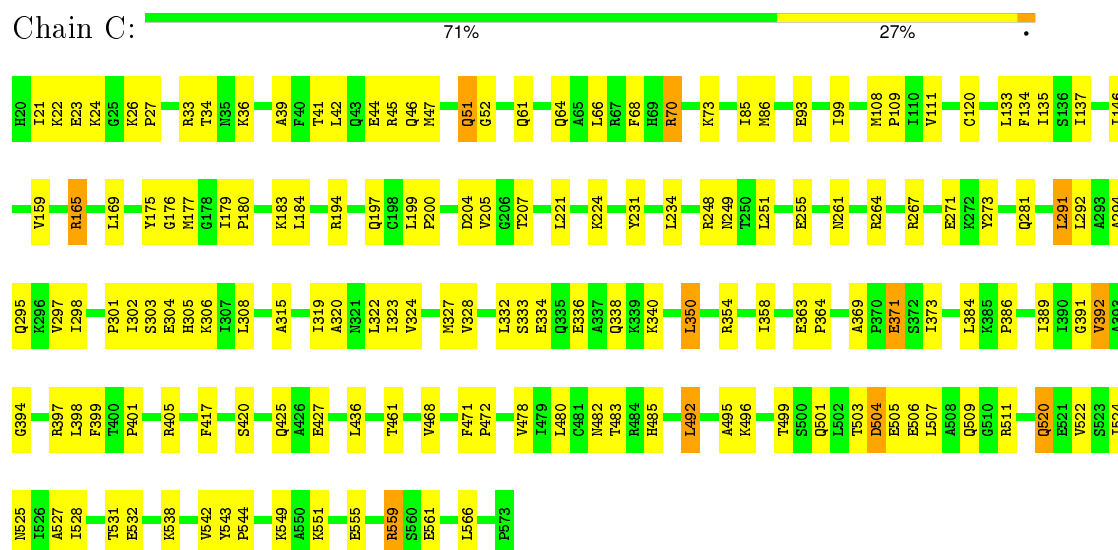
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	C	1	Total	C	O	0	0
			8	4	4		
5	D	1	Total	C	O	0	0
			8	4	4		

- Molecule 6 is water.

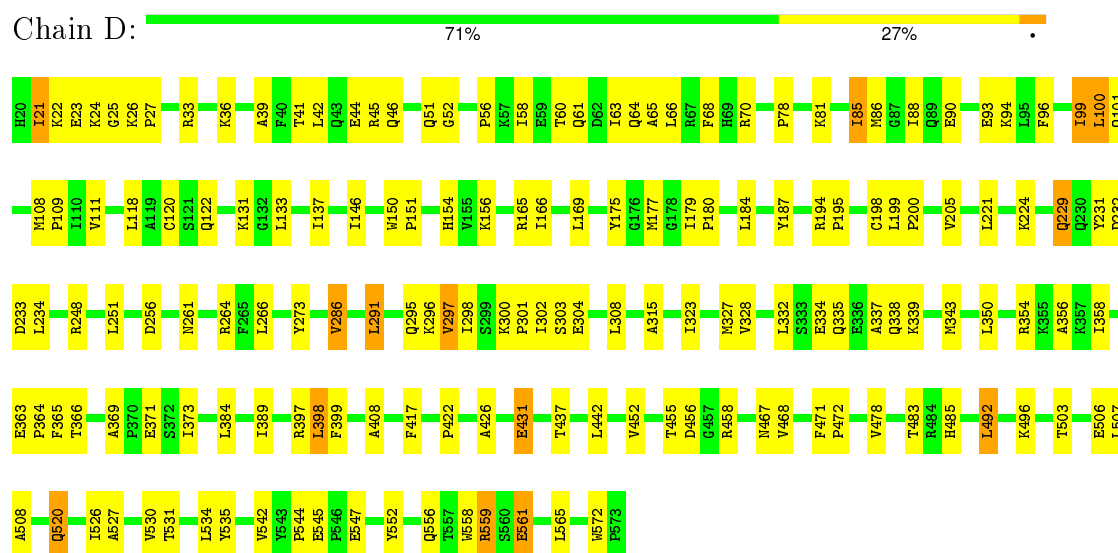
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	267	Total	O	0	0
			267	267		
6	B	290	Total	O	0	0
			290	290		
6	C	300	Total	O	0	0
			300	300		
6	D	300	Total	O	0	0
			300	300		



• Molecule 1: NAD-DEPENDENT MALIC ENZYME



• Molecule 1: NAD-DEPENDENT MALIC ENZYME





## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	71.81Å 192.65Å 110.16Å 90.00° 89.77° 90.00°	Depositor
Resolution (Å)	20.00 – 2.30	Depositor
% Data completeness (in resolution range)	91.0 (20.00-2.30)	Depositor
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.194 , 0.233	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	18818	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

## 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: OXL, FUM, ATP, MN

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	0/4464	0.60	0/6047
1	B	0.35	0/4464	0.59	0/6047
1	C	0.35	0/4464	0.59	0/6047
1	D	0.35	0/4465	0.58	0/6047
All	All	0.35	0/17857	0.59	0/24188

There are no bond length outliers.

There are no bond angle outliers.

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	4369	0	4400	151	0
1	B	4369	0	4400	147	0
1	C	4369	0	4400	145	0
1	D	4370	0	4400	130	0
2	A	31	0	12	1	0
2	B	31	0	12	3	0
2	C	31	0	12	1	0
2	D	31	0	12	1	0
3	A	6	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	6	0	0	0	0
3	C	6	0	0	0	0
3	D	6	0	0	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
5	A	8	0	2	0	0
5	B	8	0	2	1	0
5	C	8	0	2	1	0
5	D	8	0	2	1	0
6	A	267	0	0	5	0
6	B	290	0	0	9	0
6	C	300	0	0	12	0
6	D	300	0	0	9	0
All	All	18818	0	17656	555	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 16.

The worst 5 of 555 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:C:302:ILE:HD11	1:C:327:MET:HG2	1.39	1.04
1:B:332:LEU:HG	1:B:336:GLU:HG3	1.44	1.00
1:B:515:PRO:HG2	1:B:518:ASN:HD22	1.29	0.98
1:B:286:VAL:HG21	1:B:467:ASN:HA	1.46	0.94
1:D:520:GLN:HE21	1:D:520:GLN:H	1.20	0.89

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	552/554 (100%)	536 (97%)	15 (3%)	1 (0%)	52	64
1	B	552/554 (100%)	536 (97%)	15 (3%)	1 (0%)	52	64
1	C	552/554 (100%)	538 (98%)	12 (2%)	2 (0%)	39	48
1	D	552/554 (100%)	540 (98%)	11 (2%)	1 (0%)	52	64
All	All	2208/2216 (100%)	2150 (97%)	53 (2%)	5 (0%)	52	64

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	397	ARG
1	B	397	ARG
1	A	392	VAL
1	D	21	ILE
1	C	392	VAL

### 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 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	470/470 (100%)	440 (94%)	30 (6%)	22	28
1	B	470/470 (100%)	445 (95%)	25 (5%)	28	37
1	C	470/470 (100%)	452 (96%)	18 (4%)	40	54
1	D	470/470 (100%)	446 (95%)	24 (5%)	29	39
All	All	1880/1880 (100%)	1783 (95%)	97 (5%)	29	38

5 of 97 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	291	LEU
1	B	543	TYR
1	D	398	LEU
1	B	300	LYS
1	B	371	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 57 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	425	GLN
1	C	51	GLN
1	D	482	ASN
1	B	482	ASN
1	B	509	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 16 ligands modelled in this entry, 4 are monoatomic - leaving 12 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	$\# Z  > 2$
2	ATP	A	601	-	24,33,33	1.66	5 (20%)	31,52,52	2.30	3 (9%)
3	OXL	A	603	4	0,5,5	0.00	-	0,6,6	0.00	-
5	FUM	A	605	-	1,7,7	1.45	0	0,8,8	0.00	-
2	ATP	B	601	-	24,33,33	1.56	4 (16%)	31,52,52	2.41	4 (12%)
3	OXL	B	603	4	0,5,5	0.00	-	0,6,6	0.00	-
5	FUM	B	605	-	1,7,7	1.85	0	0,8,8	0.00	-

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	ATP	C	601	-	24,33,33	1.69	5 (20%)	31,52,52	2.26	3 (9%)
3	OXL	C	603	4	0,5,5	0.00	-	0,6,6	0.00	-
5	FUM	C	605	-	1,7,7	1.84	0	0,8,8	0.00	-
2	ATP	D	601	-	24,33,33	1.63	4 (16%)	31,52,52	2.31	4 (12%)
3	OXL	D	603	4	0,5,5	0.00	-	0,6,6	0.00	-
5	FUM	D	605	-	1,7,7	1.58	0	0,8,8	0.00	-

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
2	ATP	A	601	-	-	0/18/38/38	0/3/3/3
3	OXL	A	603	4	-	0/0/4/4	0/0/0/0
5	FUM	A	605	-	-	0/0/5/5	0/0/0/0
2	ATP	B	601	-	-	0/18/38/38	0/3/3/3
3	OXL	B	603	4	-	0/0/4/4	0/0/0/0
5	FUM	B	605	-	-	0/0/5/5	0/0/0/0
2	ATP	C	601	-	-	0/18/38/38	0/3/3/3
3	OXL	C	603	4	-	0/0/4/4	0/0/0/0
5	FUM	C	605	-	-	0/0/5/5	0/0/0/0
2	ATP	D	601	-	-	0/18/38/38	0/3/3/3
3	OXL	D	603	4	-	0/0/4/4	0/0/0/0
5	FUM	D	605	-	-	0/0/5/5	0/0/0/0

The worst 5 of 18 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	601	ATP	C5-C4	-3.17	1.33	1.40
2	D	601	ATP	C5-C4	-3.15	1.33	1.40
2	C	601	ATP	C5-C4	-2.92	1.33	1.40
2	A	601	ATP	C5-C4	-2.89	1.34	1.40
2	C	601	ATP	C5-N7	-2.37	1.31	1.39

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	601	ATP	N3-C2-N1	-11.11	120.39	128.89
2	D	601	ATP	N3-C2-N1	-10.82	120.61	128.89
2	A	601	ATP	N3-C2-N1	-10.78	120.64	128.89
2	C	601	ATP	N3-C2-N1	-10.61	120.77	128.89

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Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	B	601	ATP	C4'-O4'-C1'	-2.27	107.22	109.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

8 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	601	ATP	1	0
3	A	603	OXL	1	0
2	B	601	ATP	3	0
5	B	605	FUM	1	0
2	C	601	ATP	1	0
5	C	605	FUM	1	0
2	D	601	ATP	1	0
5	D	605	FUM	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 ⓘ

EDS was not executed - this section will therefore be empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section will therefore be empty.

### 6.3 Carbohydrates ⓘ

EDS was not executed - this section will therefore be empty.

### 6.4 Ligands ⓘ

EDS was not executed - this section will therefore be empty.

### 6.5 Other polymers ⓘ

EDS was not executed - this section will therefore be empty.