



wwPDB X-ray Structure Validation Summary Report ⓘ

May 26, 2020 – 03:58 am BST

PDB ID : 1DGS
Title : CRYSTAL STRUCTURE OF NAD⁺-DEPENDENT DNA LIGASE FROM
T. FILIFORMIS
Authors : Lee, J.Y.; Chang, C.; Song, H.K.; Kwon, S.T.; Suh, S.W.
Deposited on : 1999-11-25
Resolution : 2.90 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

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 : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.11
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.11

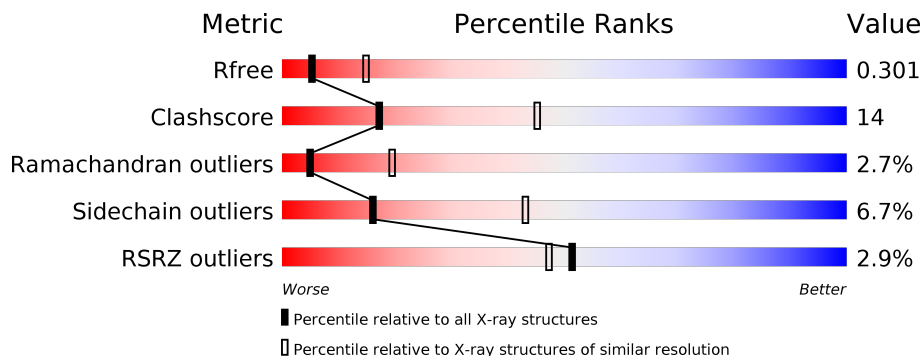
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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 ≥ 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 $\leq 5\%$. 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	667	<p>2% 58% 26% 13%</p>
1	B	667	<p>3% 59% 24% 13%</p>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 9674 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.

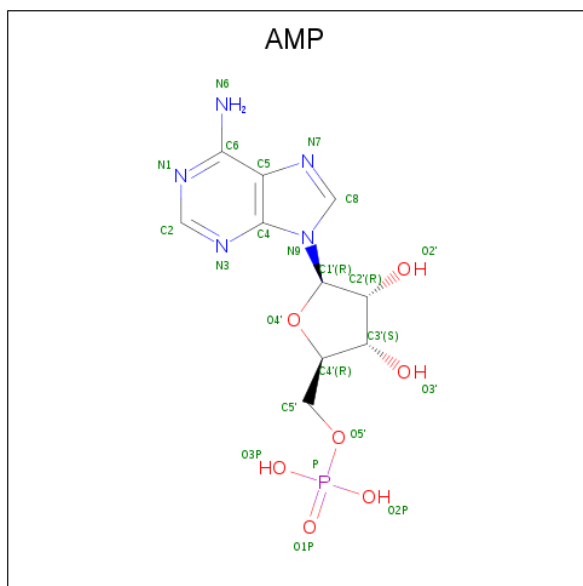
- Molecule 1 is a protein called DNA LIGASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	581	Total 4693	C 2965	N 845	O 871	S 12	0	0	0
1	B	581	Total 4693	C 2965	N 845	O 871	S 12	0	0	0

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total 1	Zn 1	0	0
2	A	1	Total 1	Zn 1	0	0

- Molecule 3 is ADENOSINE MONOPHOSPHATE (three-letter code: AMP) (formula: C₁₀H₁₄N₅O₇P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			22	10	5	6	1		
3	B	1	Total	C	N	O	P	0	0
			22	10	5	6	1		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	123	Total	O	0	0
			123	123		
4	B	119	Total	O	0	0
			119	119		

LYS	R2217	R2217	LYS
THR	A2218	A2218	THR
SER	T2219	T2219	SER
TYR	F2220	F2220	TYR
LEU	Y2221	Y2221	LEU
VAL	A2222	A2222	VAL
VAL	L2223	L2223	VAL
GLY	G2224	G2224	GLY
GLU	L2225	L2225	GLU
ASN	E2226	E2226	ASN
PRO	L2227	L2227	PRO
GLY	G2228	G2228	GLY
SER	L2229	L2229	SER
LYS	E2230	E2230	LYS
LEU	E2231	E2231	LEU
GLU	S2232	S2232	GLU
LYS	Q2237	Q2237	LYS
ALA	L2241	L2241	ALA
ARG	F2249	F2249	ARG
ALA	P2250	P2250	ALA
LEU	G2254	G2254	LEU
LEU	Y2255	Y2255	LEU
THR	E2256	E2256	THR
GLU	L2259	L2259	GLU
GLU	E2266	E2266	GLU
TRP	L2278	L2278	TRP
ARG	A2282	A2282	ARG
GLY	L2287	L2287	GLY
PRO	G2288	G2288	PRO
ALA	L2289	L2289	ALA
VAL	D2290	D2290	VAL
PRO	D2291	D2291	PRO
PRO	Y2300	Y2300	PRO
ALA	T2301	T2301	ALA
ALA	A2302	A2302	ALA
LEU	R2303	R2303	LEU
LEU	A2304	A2304	LEU
GLY	P2305	P2305	GLY
LEU	K2312	K2312	LEU
LEU	L2322	L2322	LEU
VAL	V2325	V2325	VAL
THR	V2329	V2329	THR
SER	V2340	V2340	SER
SER	P2343	P2343	SER
LEU	I2346	I2346	LEU
LEU	E2347	E2347	LEU
LEU	G2348	G2348	LEU
VAL	S2349	S2349	VAL
VAL	L2356	L2356	VAL
GLY	R2357	R2357	GLY
GLU	H2358	H2358	GLU
ASN	E2359	E2359	ASN
PRO	S2360	S2360	PRO
GLY	Y2361	Y2361	GLY
SER	L2362	L2362	SER
LYS	E2363	E2363	LYS
LEU	E2364	E2364	LEU
GLU	I2367	I2367	GLU
LYS	R2368	R2368	LYS
ALA	L2369	L2369	ALA
ARG	V2375	V2375	ARG
ALA	H2376	H2376	ALA
LEU	K2377	K2377	LEU
LEU	G2380	G2380	LEU
THR	V2381	V2381	THR
GLY	I2382	I2382	GLY
GLU	P2383	P2383	GLU
THR	E2391	E2391	THR
PHE	T2394	T2394	PHE
LEU	G2395	G2395	LEU
TRP	K2396	K2396	TRP
ARG	E2397	E2397	ARG
PHE	R2401	R2401	PHE
LEU	V2402	V2402	LEU
LYS	G2406	G2406	LYS
LEU	L2413	L2413	LEU
LEU	V2414	V2414	LEU
LEU	K2415	K2415	LEU
LEU	E2416	E2416	LEU
LEU	G2417	G2417	LEU
LEU	K2418	K2418	LEU
GLY	V2419	V2419	GLY
ARG	H2420	H2420	ARG
LEU	R2421	R2421	LEU
LEU	C2422	C2422	LEU
LEU	P2423	P2423	LEU
ALA	H2424	H2424	ALA
LYS	P2425	P2425	LYS
VAL	L2426	L2426	VAL
THR	C2427	C2427	THR
ASP	P2428	P2428	ASP
SER	A2429	A2429	SER
VAL	K2430	K2430	VAL
SER	R2431	R2431	SER
ARG	L2435	L2435	ARG
THR	A2439	A2439	THR
SER	S2440	S2440	SER
LEU	K2441	K2441	LEU
VAL	K2442	K2442	VAL
VAL	A2443	A2443	VAL
VAL	M2444	M2444	VAL
GLY	D2445	D2445	GLY
GLU	L2446	L2446	GLU
ASN	E2447	E2447	ASN
PRO	G2448	G2448	PRO
GLY	L2449	L2449	GLY
SER	G2450	G2450	SER
LYS	E2451	E2451	LYS
LEU	E2455	E2455	LEU
LEU	R2456	R2456	LEU
GLY	R2464	R2464	GLY
VAL	D2465	D2465	VAL
VAL	V2466	V2466	VAL
ALA	L2469	L2469	ALA
VAL	L2472	L2472	VAL
LEU	D2476	D2476	LEU
LEU	E2481	E2481	LEU
THR	R2482	R2482	THR
THR	R2483	R2483	THR
GLY	G2484	G2484	GLY
LEU	E2485	E2485	LEU
LYS	R2493	R2493	LYS
LEU	Q2494	Q2494	LEU
SER	L2495	L2495	SER
ARG	E2496	E2496	ARG
ARG	E2497	E2497	ARG
GLU	S2498	S2498	GLU
VAL	R2501	R2501	VAL
PRO	G2502	G2502	PRO
VAL	L2503	L2503	VAL
VAL	E2504	E2504	VAL
VAL	A2509	A2509	VAL
PRO	L2510	L2510	PRO
ALA	G2511	G2511	ALA
LYS	L2512	L2512	LYS
ALA	V2515	V2515	ALA
VAL	G2516	G2516	VAL
THR	E2517	E2517	THR
ASP	V2518	V2518	ASP
SER	L2519	L2519	SER
VAL	L2523	L2523	VAL
ARG	L2523	L2523	ARG

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	89.21Å 117.33Å 97.48Å 90.00° 115.09° 90.00°	Depositor
Resolution (Å)	20.00 – 2.90 24.75 – 2.88	Depositor EDS
% Data completeness (in resolution range)	89.5 (20.00-2.90) 94.4 (24.75-2.88)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.48 (at 2.89Å)	Xtrriage
Refinement program	CNS 0.5	Depositor
R, R_{free}	0.228 , 0.298 0.234 , 0.301	Depositor DCC
R_{free} test set	3869 reflections (9.94%)	wwPDB-VP
Wilson B-factor (Å ²)	53.4	Xtrriage
Anisotropy	0.238	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 52.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.022 for h,-k,-h-l	Xtrriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	9674	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.58% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: AMP, ZN

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	0.38	0/4782	0.65	2/6451 (0.0%)
1	B	0.37	0/4782	0.65	0/6451
All	All	0.37	0/9564	0.65	2/12902 (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	A	224	GLY	N-CA-C	-5.08	100.39	113.10
1	A	64	VAL	N-CA-C	5.00	124.51	111.00

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	4693	0	4732	134	0
1	B	4693	0	4727	129	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	22	0	12	0	0
3	B	22	0	12	1	0
4	A	123	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	119	0	0	0	0
All	All	9674	0	9483	263	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 14.

The worst 5 of 263 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:115:HIS:ND1	1:A:254:CYS:SG	2.39	0.94
1:A:316:GLU:HG2	1:A:347:GLU:HG3	1.52	0.91
1:A:534:LEU:HD22	1:A:565:ARG:HE	1.40	0.86
1:B:2039:ARG:HG3	1:B:2042:ARG:HH21	1.40	0.85
1:B:2004:GLU:HG3	1:B:2007:ARG:HH21	1.44	0.82

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	579/667 (87%)	508 (88%)	56 (10%)	15 (3%)	5	20
1	B	579/667 (87%)	504 (87%)	59 (10%)	16 (3%)	5	19
All	All	1158/1334 (87%)	1012 (87%)	115 (10%)	31 (3%)	5	19

5 of 31 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	64	VAL
1	A	106	GLU
1	A	216	LEU

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Mol	Chain	Res	Type
1	B	2064	VAL
1	B	2106	GLU

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	495/566 (88%)	462 (93%)	33 (7%)	16	43
1	B	495/566 (88%)	462 (93%)	33 (7%)	16	43
All	All	990/1132 (88%)	924 (93%)	66 (7%)	16	43

5 of 66 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	472	LEU
1	B	2044	LEU
1	B	2493	ARG
1	A	492	LEU
1	B	2004	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	2145	GLN
1	B	2146	ASN
1	B	2237	GLN
1	B	2087	ASN
1	B	2205	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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
3	AMP	B	2700	1	18,24,25	1.03	2 (11%)	18,35,38	1.70	2 (11%)
3	AMP	A	700	1	18,24,25	0.95	2 (11%)	18,35,38	1.78	4 (22%)

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	AMP	B	2700	1	-	2/3/25/26	0/3/3/3
3	AMP	A	700	1	-	1/3/25/26	0/3/3/3

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	2700	AMP	O4'-C1'	2.86	1.45	1.41
3	B	2700	AMP	C5-N7	-2.30	1.31	1.39
3	A	700	AMP	C5-N7	-2.28	1.31	1.39
3	A	700	AMP	O4'-C1'	2.06	1.44	1.41

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
3	B	2700	AMP	N3-C2-N1	-6.01	119.28	128.68
3	A	700	AMP	N3-C2-N1	-5.92	119.42	128.68
3	A	700	AMP	C4-C5-N7	-2.28	107.02	109.40
3	B	2700	AMP	C4-C5-N7	-2.25	107.05	109.40
3	A	700	AMP	C3'-C2'-C1'	2.20	104.29	100.98

There are no chirality outliers.

All (3) torsion outliers are listed below:

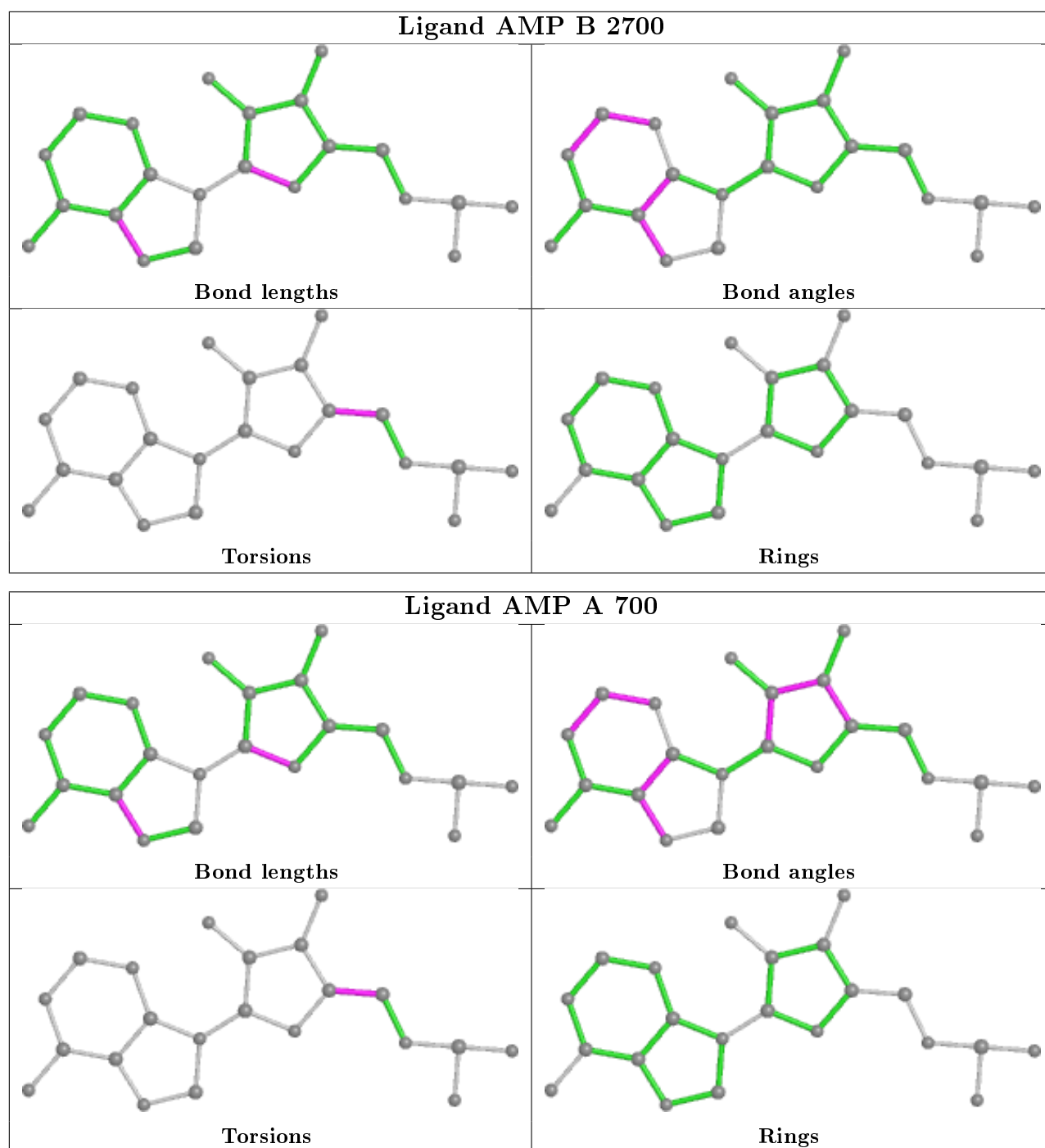
Mol	Chain	Res	Type	Atoms
3	B	2700	AMP	O4'-C4'-C5'-O5'
3	A	700	AMP	O4'-C4'-C5'-O5'
3	B	2700	AMP	C3'-C4'-C5'-O5'

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	2700	AMP	1	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.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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, 95th 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 ²)	Q<0.9
1	A	581/667 (87%)	-0.18	15 (2%) 56 52	11, 43, 87, 101	0
1	B	581/667 (87%)	-0.07	19 (3%) 46 41	11, 47, 89, 101	0
All	All	1162/1334 (87%)	-0.13	34 (2%) 51 47	11, 45, 89, 101	0

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	2348	GLY	5.1
1	B	2303	ARG	4.8
1	A	230	GLU	4.0
1	B	2035	ALA	3.9
1	A	106	GLU	3.8

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](#)

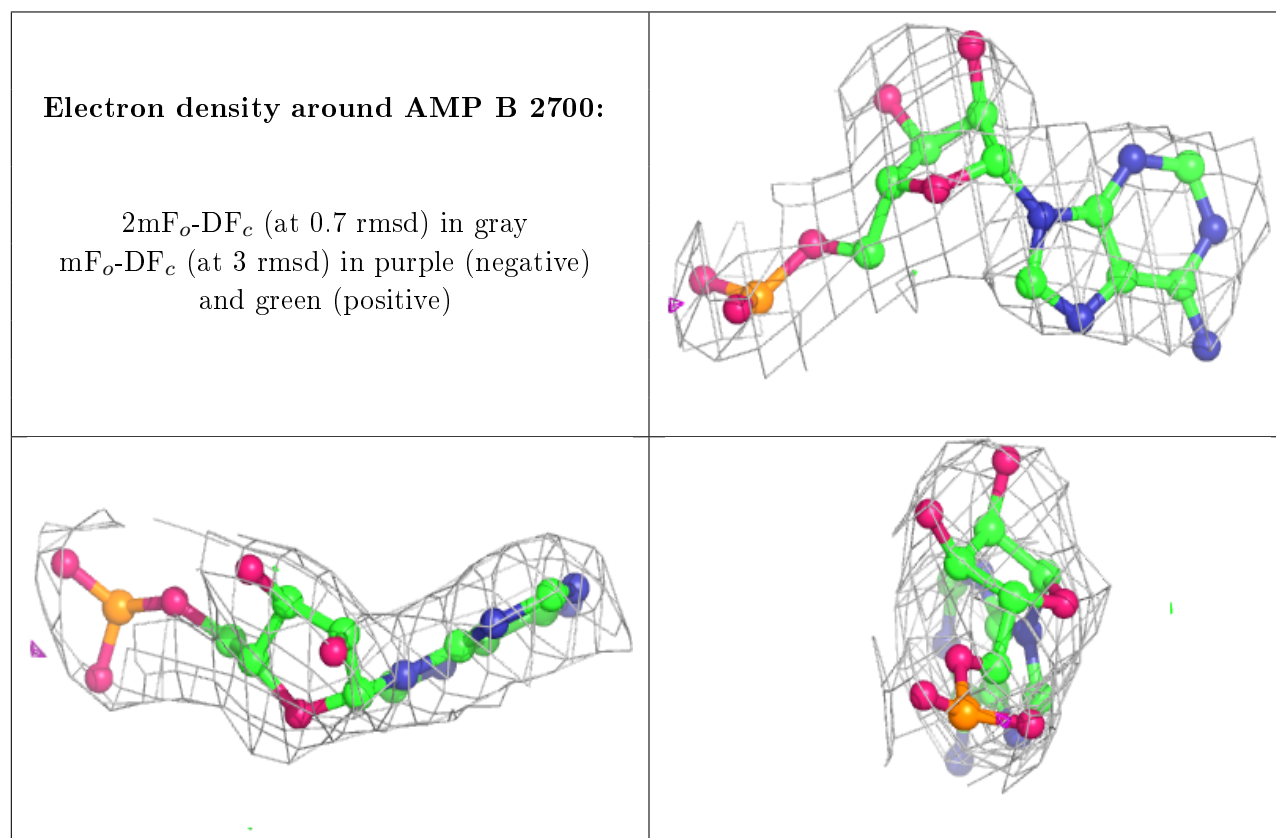
There are no carbohydrates in this entry.

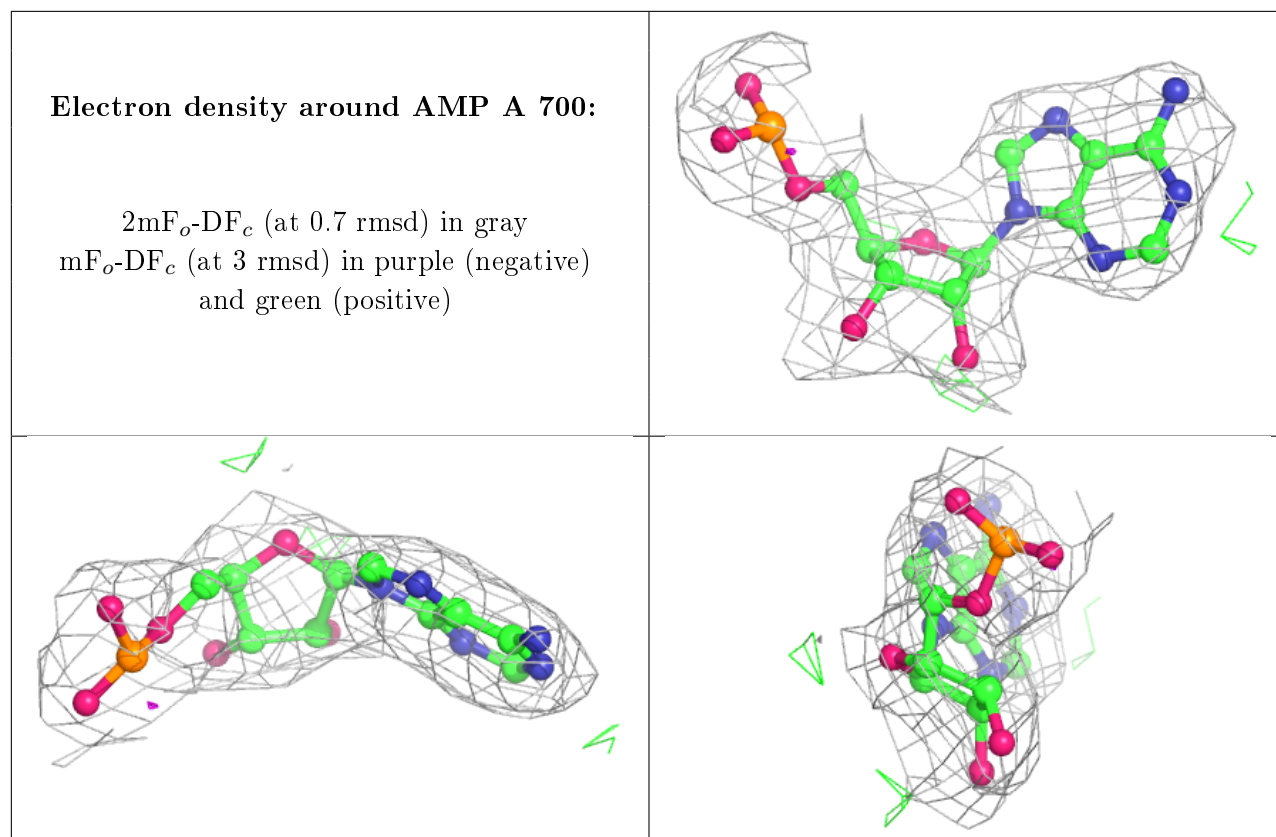
6.4 Ligands [i](#)

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, 95th 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(\AA^2)	$Q < 0.9$
3	AMP	B	2700	22/23	0.91	0.18	75,84,92,94	0
3	AMP	A	700	22/23	0.95	0.12	36,43,52,62	0
2	ZN	B	2701	1/1	0.97	0.14	33,33,33,33	0
2	ZN	A	701	1/1	0.99	0.10	20,20,20,20	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.





6.5 Other polymers [i](#)

There are no such residues in this entry.