wwPDB X-ray Structure Validation Summary Report (i)

Sep 22, 2025 – 12:21 PM EDT

PDB ID	:	9Y43 / pdb_00009y43
Title	:	3-hydroxypropionyl-CoA Synthetase (ADP-forming) from Nitrosopumilus maritimus.
Authors	:	Johnson, J.A.; Yilmaz, M.; Tosun, B.; Wakatsuki, S.; Demirci, H.
Deposited on	:	2025-09-02
Resolution	:	2.80 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 (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 (i)) were used in the production of this report:

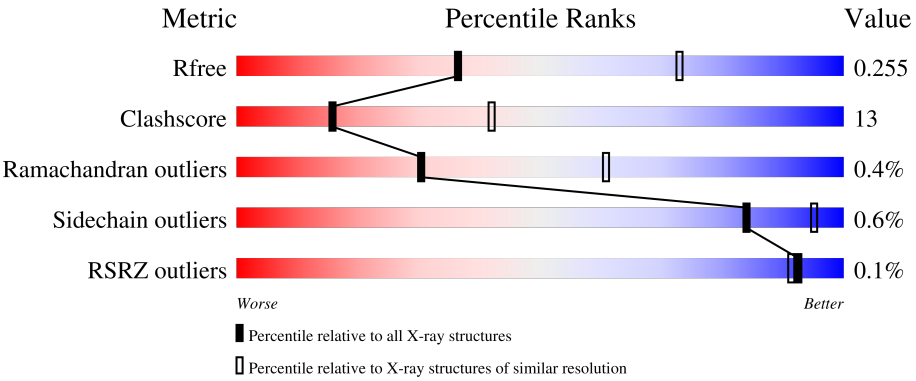
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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}	164625	3657 (2.80-2.80)
Clashscore	180529	4123 (2.80-2.80)
Ramachandran outliers	177936	4071 (2.80-2.80)
Sidechain outliers	177891	4073 (2.80-2.80)
RSRZ outliers	164620	3659 (2.80-2.80)

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 <=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	705	68% 29%
1	B	705	73% 27%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	3OH	A	802[A]	-	X	-	-
3	3OH	A	802[B]	-	X	-	-
3	3OH	B	801[A]	-	X	-	-
3	3OH	B	801[B]	-	X	-	-

2 Entry composition

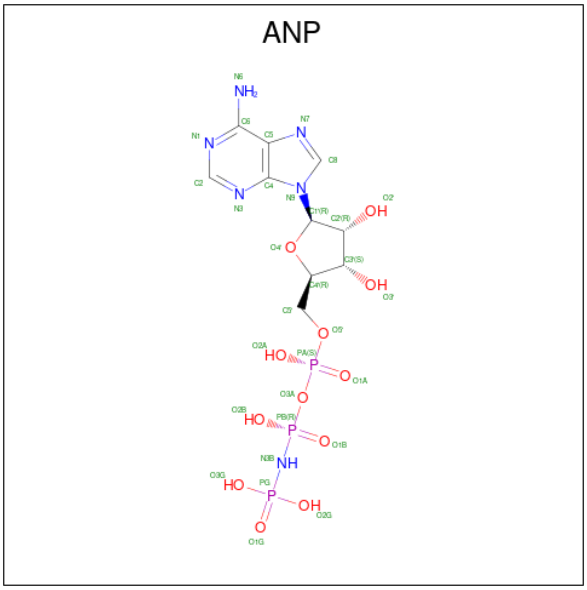
There are 6 unique types of molecules in this entry. The entry contains 10810 atoms, of which 13 are hydrogens and 0 are deuteriums.

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 3-hydroxypropionate--CoA ligase [ADP-forming].

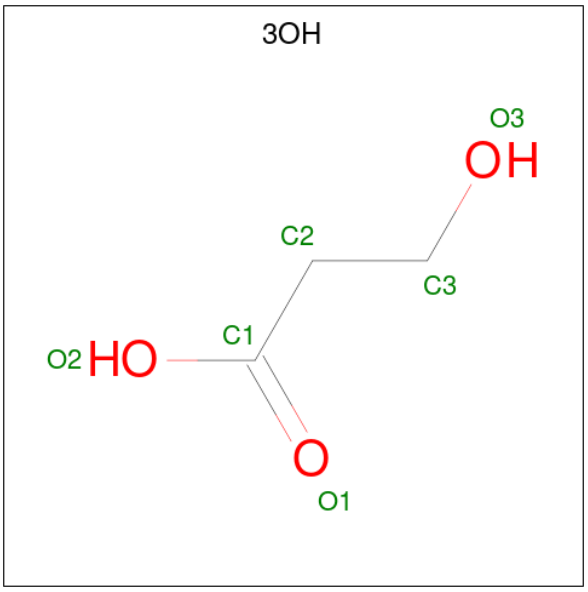
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	691	Total	C	N	O	S	0	1	0
			5255	3370	893	960	32			
1	B	703	Total	C	N	O	S	0	2	0
			5342	3422	905	983	32			

- Molecule 2 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (CCD ID: ANP) (formula: $C_{10}H_{17}N_6O_{12}P_3$).



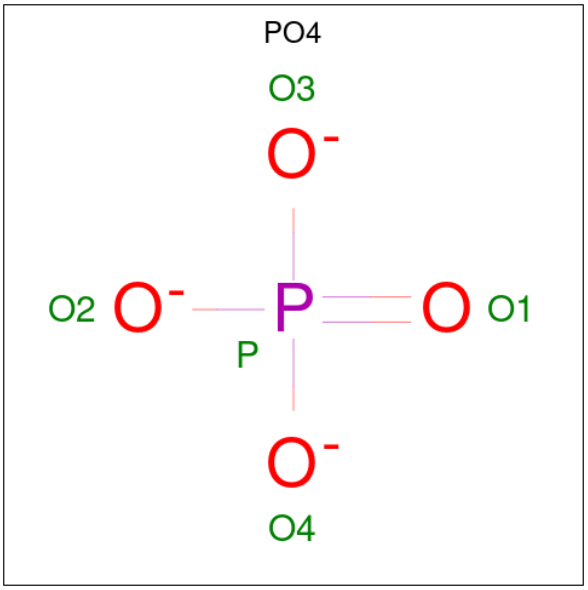
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	P	0	0
			44	10	13	6	12	3		

- Molecule 3 is 3-HYDROXY-PROPANOIC ACID (CCD ID: 3OH) (formula: $C_3H_6O_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 12 6 6	0	1
3	B	1	Total C O 12 6 6	0	1

- Molecule 4 is PHOSPHATE ION (CCD ID: PO4) (formula: O_4P).



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

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Mg 1 1	0	0

- Molecule 6 is water.

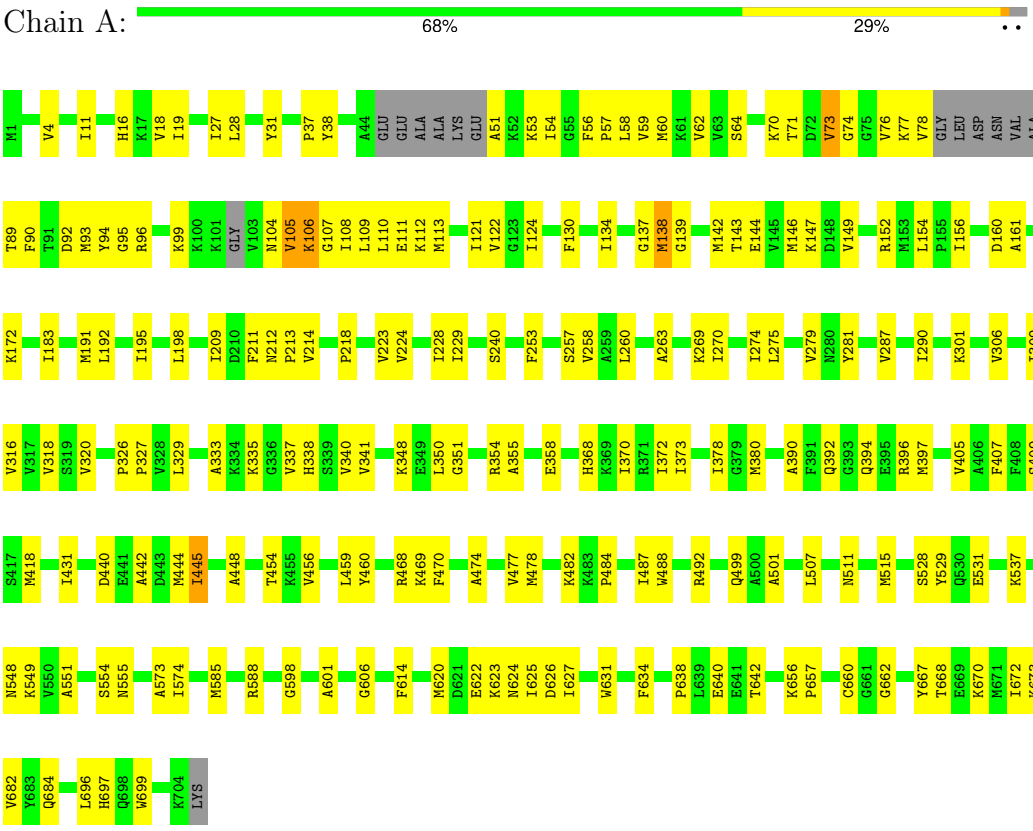
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	61	Total O 61 61	0	0
6	B	73	Total O 73 73	0	0

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). 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.

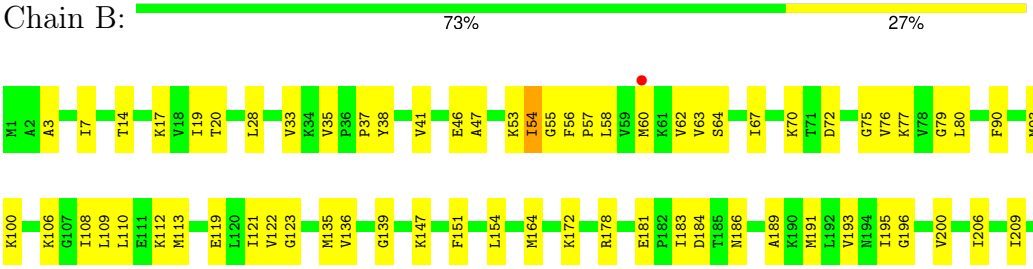
• Molecule 1: 3-hydroxypropionate--CoA ligase [ADP-forming]

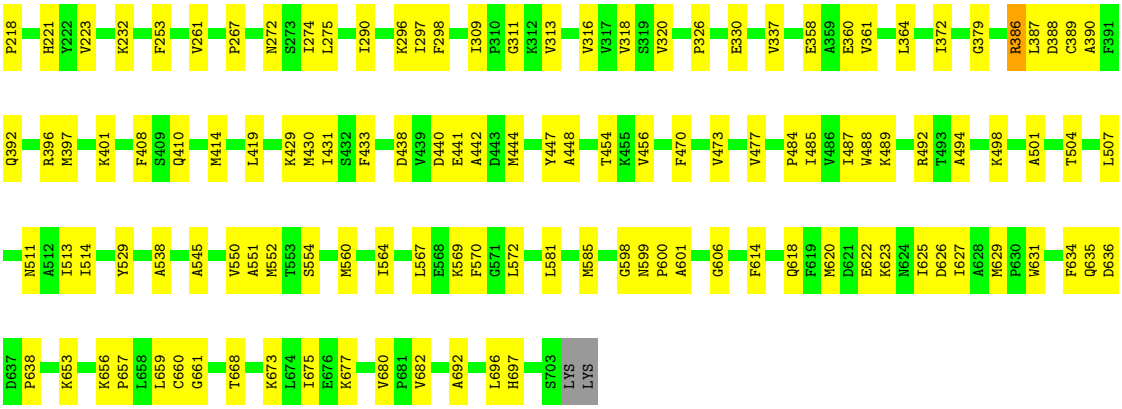
Chain A:



• Molecule 1: 3-hydroxypropionate--CoA ligase [ADP-forming]

Chain B:




P218 H221 Y222 V223 K232 F253 V261 P267 N272 S273 I274 L275 I290 K296 I297 F298 I309 P310 G311 K312 V313 V316 V317 V318 S319 V320 P326 E330 V337 E358 A359 E360 V361 L364 I372 G379 R386 L387 D388 C389 A390 F391
Q392 R396 M397 K401 F408 S409 Q410 M414 L419 K429 M430 I431 S432 F433 D438 V439 D440 E441 A442 D443 M444 Y447 A448 T454 K455 V456 F470 V473 V477 P484 I485 V486 I487 W488 K489 R492 T493 A494 K498 A501 T504 L507
N511 A512 I513 I514 Y529 A538 A545 V550 A551 M552 T553 S554 M560 I564 L567 E568 K569 F570 G571 L572 L581 M585 G598 N599 P600 A601 G606 F614 Q618 F619 M620 D621 E622 K623 N624 I625 D626 I627 A628 M629 P630 W631 F634 Q635 D636
D637 P638 K653 K656 P657 L658 L659 C660 G661 T668 K673 L674 I675 E676 K677 V680 P681 V682 A692 L696 H697 S703 LYS LYS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	81.88Å 127.59Å 137.76Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.72 – 2.80 48.72 – 2.80	Depositor EDS
% Data completeness (in resolution range)	73.2 (48.72-2.80) 73.3 (48.72-2.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.43 (at 2.81Å)	Xtriage
Refinement program	PHENIX 1.21.2_5419	Depositor
R, R_{free}	0.210 , 0.250 0.212 , 0.255	Depositor DCC
R_{free} test set	1296 reflections (3.57%)	wwPDB-VP
Wilson B-factor (Å^2)	55.8	Xtriage
Anisotropy	0.102	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 49.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.91	EDS
Total number of atoms	10810	wwPDB-VP
Average B, all atoms (Å^2)	53.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.39% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PO4, ANP, 3OH, MG

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	0.21	0/5351	0.66	5/7201 (0.1%)
1	B	0.19	0/5441	0.64	7/7329 (0.1%)
All	All	0.20	0/10792	0.65	12/14530 (0.1%)

There are no bond length outliers.

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	75	GLY	CA-C-N	6.79	134.19	121.97
1	B	75	GLY	C-N-CA	6.79	134.19	121.97
1	B	296	LYS	CA-C-N	6.08	132.92	121.97
1	B	296	LYS	C-N-CA	6.08	132.92	121.97
1	A	105	VAL	CA-C-N	5.99	132.58	122.15

There are no chirality outliers.

There are no planarity outliers.

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	5255	0	5467	155	0
1	B	5342	0	5544	133	0
2	A	31	13	13	2	0
3	A	12	0	3	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	12	0	3	0	0
4	A	5	0	0	0	0
4	B	5	0	0	0	0
5	A	1	0	0	0	0
6	A	61	0	0	1	0
6	B	73	0	0	0	0
All	All	10797	13	11030	284	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 13.

The worst 5 of 284 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:56:PHE:HB2	1:A:57:PRO:HD3	1.41	1.03
1:B:54:ILE:HG23	1:B:112:LYS:HD2	1.55	0.87
1:B:470:PHE:HZ	1:B:487:ILE:HD11	1.47	0.79
1:A:253:PHE:HZ	1:A:431:ILE:HD11	1.48	0.78
1:B:390:ALA:HB1	1:B:392:GLN:HE21	1.49	0.77

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	684/705 (97%)	673 (98%)	9 (1%)	2 (0%)	37	67
1	B	703/705 (100%)	685 (97%)	15 (2%)	3 (0%)	30	61
All	All	1387/1410 (98%)	1358 (98%)	24 (2%)	5 (0%)	30	61

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	73	VAL
1	B	178	ARG
1	A	71	THR
1	B	54	ILE
1	B	313	VAL

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	569/577 (99%)	566 (100%)	3 (0%)	86 95
1	B	577/577 (100%)	573 (99%)	4 (1%)	81 94
All	All	1146/1154 (99%)	1139 (99%)	7 (1%)	84 95

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	19	ILE
1	B	76	VAL
1	B	386	ARG
1	B	172	LYS
1	A	555	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	392	GLN
1	B	624	ASN
1	A	697	HIS
1	B	186	ASN
1	B	202	ASN

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 8 ligands modelled in this entry, 1 is monoatomic - leaving 7 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	ANP	A	801	-	29,33,33	1.25	5 (17%)	31,52,52	1.21	5 (16%)
3	3OH	A	802[A]	-	5,5,5	23.80	4 (80%)	5,5,5	30.02	5 (100%)
3	3OH	A	802[B]	-	5,5,5	23.93	4 (80%)	5,5,5	28.61	4 (80%)
4	PO4	A	803	-	4,4,4	1.44	1 (25%)	6,6,6	0.54	0
4	PO4	B	802	-	4,4,4	1.50	1 (25%)	6,6,6	0.39	0
3	3OH	B	801[A]	-	5,5,5	23.71	4 (80%)	5,5,5	28.54	4 (80%)
3	3OH	B	801[B]	-	5,5,5	23.87	4 (80%)	5,5,5	28.69	5 (100%)

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	ANP	A	801	-	-	8/14/38/38	0/3/3/3
3	3OH	A	802[A]	-	-	3/3/3/3	-
3	3OH	A	802[B]	-	-	3/3/3/3	-
3	3OH	B	801[A]	-	-	3/3/3/3	-
3	3OH	B	801[B]	-	-	2/3/3/3	-

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	802[B]	3OH	O1-C1	36.16	2.40	1.22
3	B	801[B]	3OH	O1-C1	36.06	2.39	1.22
3	A	802[A]	3OH	O1-C1	36.04	2.39	1.22
3	B	801[A]	3OH	O1-C1	35.57	2.38	1.22
3	A	802[B]	3OH	O2-C1	33.64	2.42	1.30

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	802[B]	3OH	C3-C2-C1	-56.94	34.96	113.11
3	B	801[B]	3OH	C3-C2-C1	-56.91	34.99	113.11
3	B	801[A]	3OH	C3-C2-C1	-56.80	35.14	113.11
3	A	802[A]	3OH	C3-C2-C1	-56.57	35.46	113.11
3	A	802[B]	3OH	O1-C1-C2	-28.28	33.38	123.09

There are no chirality outliers.

5 of 19 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	801	ANP	PB-N3B-PG-O1G
2	A	801	ANP	O4'-C4'-C5'-O5'
2	A	801	ANP	C3'-C4'-C5'-O5'
3	A	802[A]	3OH	C1-C2-C3-O3
3	A	802[B]	3OH	C1-C2-C3-O3

There are no ring outliers.

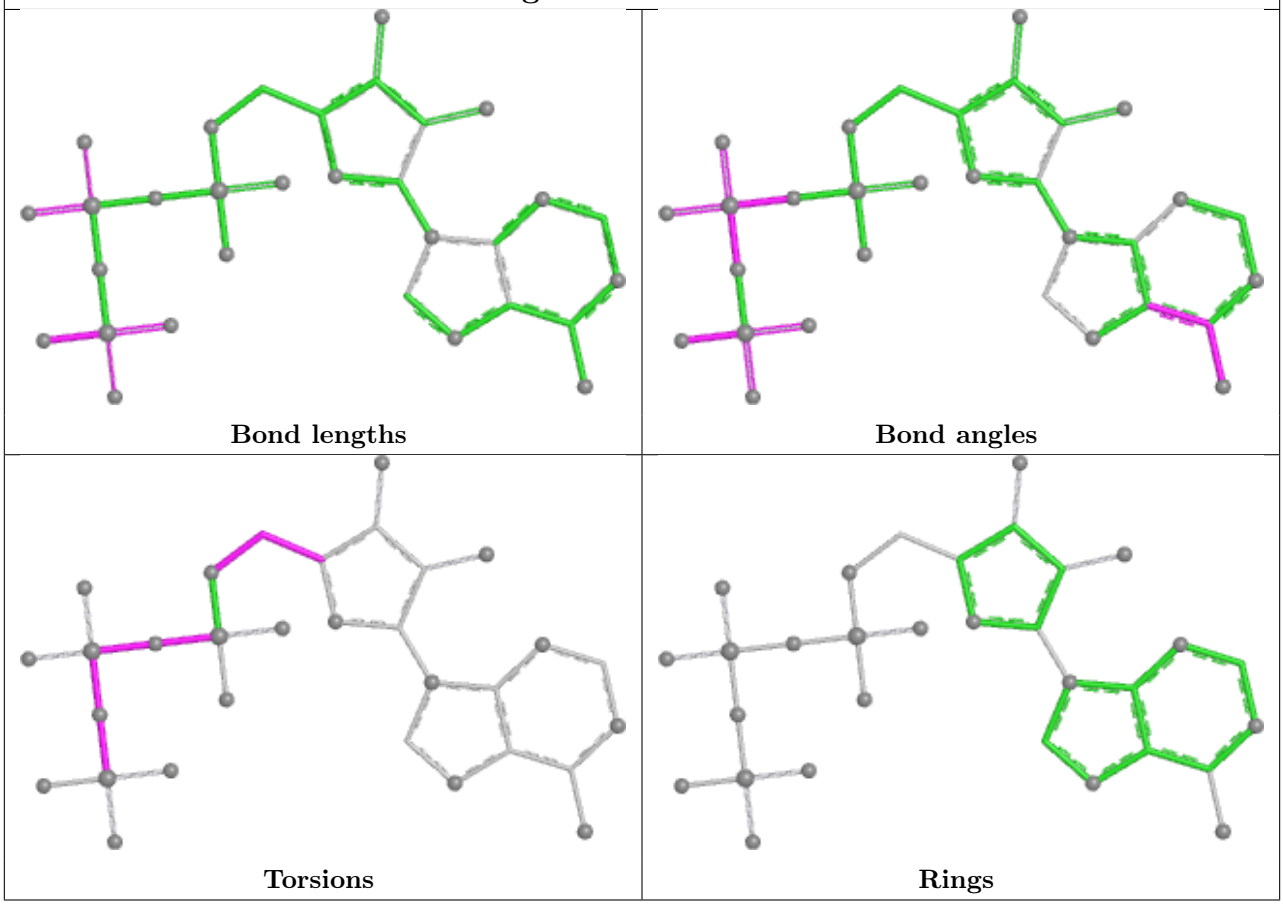
1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	801	ANP	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 then 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.

Ligand ANP A 801



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

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, 95^{th} 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	691/705 (98%)	-0.09	1 (0%)	92	91	21, 52, 88, 123	1 (0%)
1	B	703/705 (99%)	-0.24	1 (0%)	92	91	18, 48, 74, 95	2 (0%)
All	All	1394/1410 (98%)	-0.17	2 (0%)	92	91	18, 50, 81, 123	3 (0%)

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	86	VAL	2.4
1	B	60	MET	2.4

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

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

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands

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, 95^{th} 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(Å^2)	Q<0.9
5	MG	A	804	1/1	0.65	0.17	108,108,108,108	0
2	ANP	A	801	31/31	0.67	0.12	64,86,128,181	0
3	3OH	B	801[B]	6/6	0.88	0.12	39,41,44,44	6

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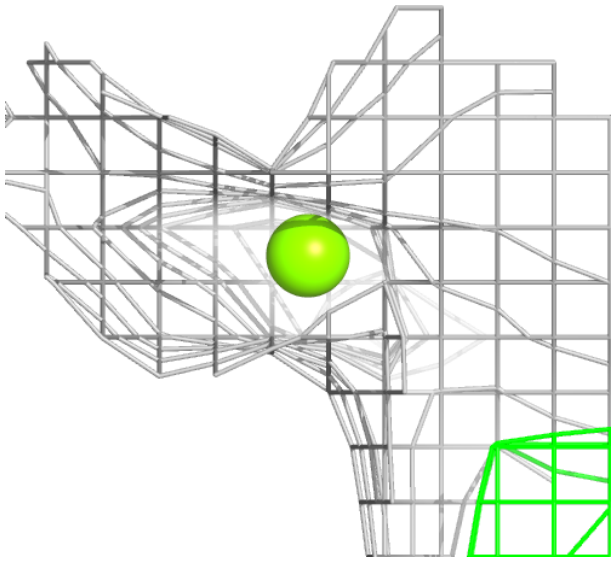
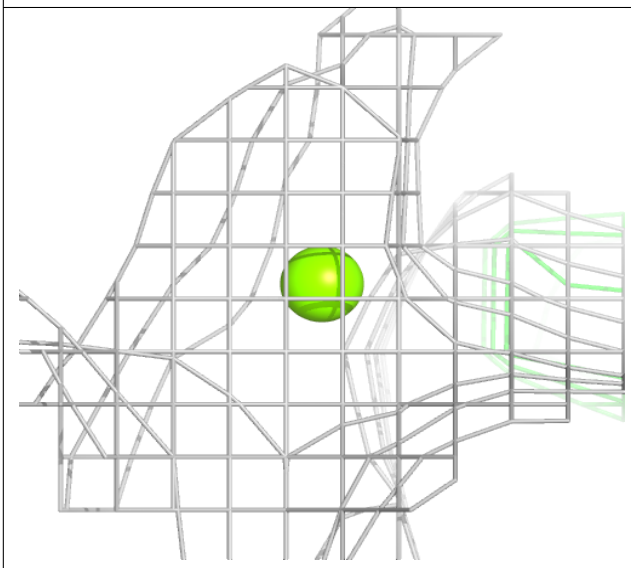
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	3OH	B	801[A]	6/6	0.88	0.12	38,42,49,49	0
3	3OH	A	802[B]	6/6	0.93	0.09	55,57,58,60	6
3	3OH	A	802[A]	6/6	0.93	0.09	57,57,58,58	6
4	PO4	B	802	5/5	0.95	0.09	38,46,47,61	0
4	PO4	A	803	5/5	0.98	0.06	27,33,43,50	0

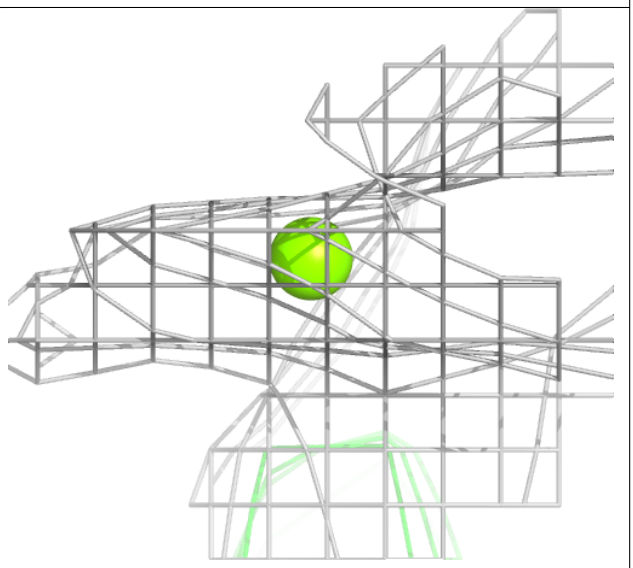
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around MG A 804:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

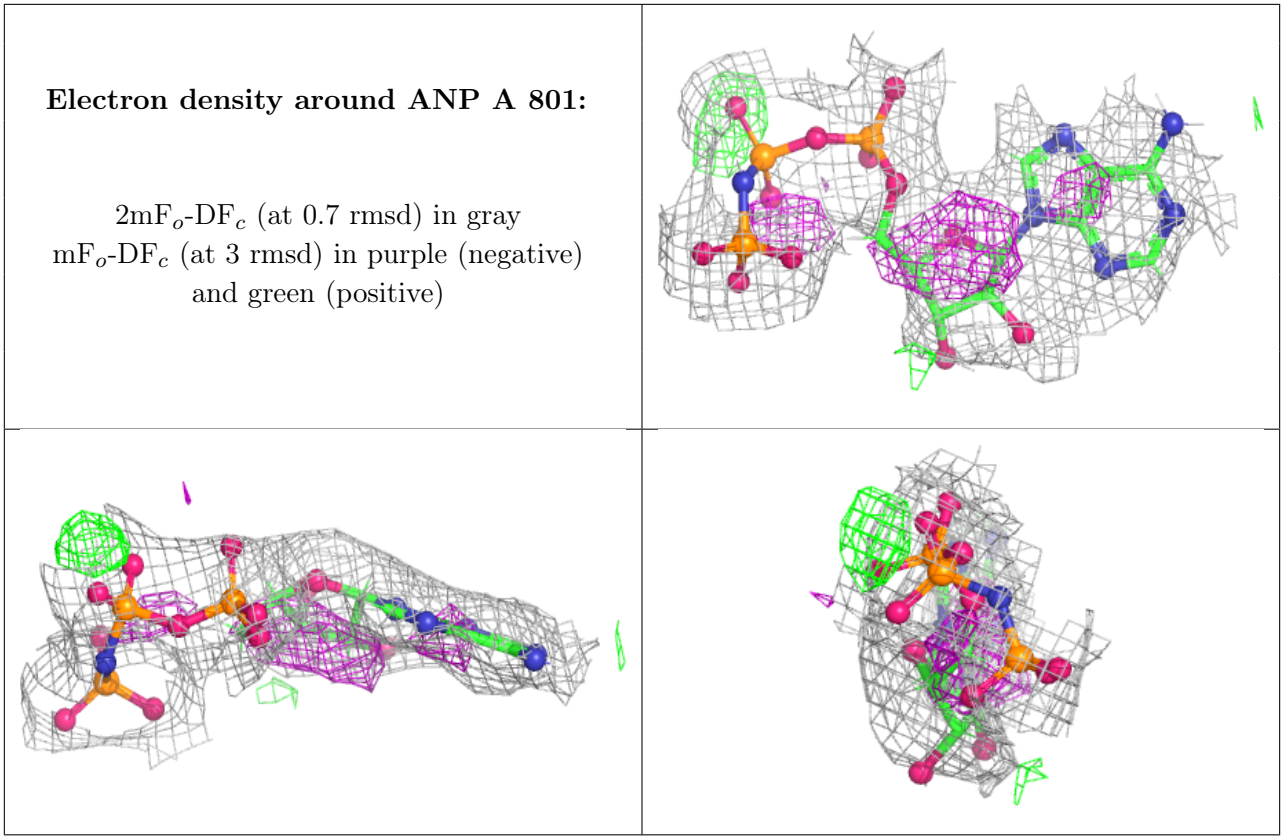






Electron density around ANP A 801:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



6.5 Other polymers (i)

There are no such residues in this entry.