



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 08:58 PM UTC

PDB ID : 2Q7E / pdb_00002q7e
Title : The structure of pyrrolysyl-tRNA synthetase bound to an ATP analogue
Authors : Kavran, J.M.; Steitz, T.A.
Deposited on : 2007-06-06
Resolution : 1.80 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

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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:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

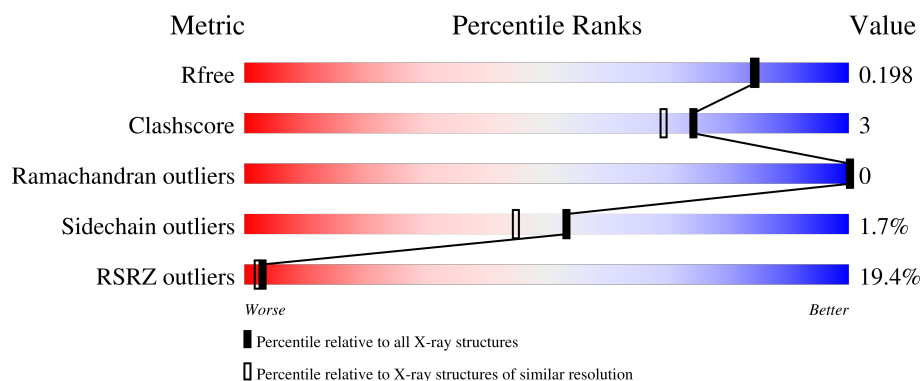
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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}	180053	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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 $\leq 5\%$. 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	291	17% 83% 11%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2442 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 Pyrrolysyl-tRNA synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	258	2154	1375	370	397	12	0	7	0

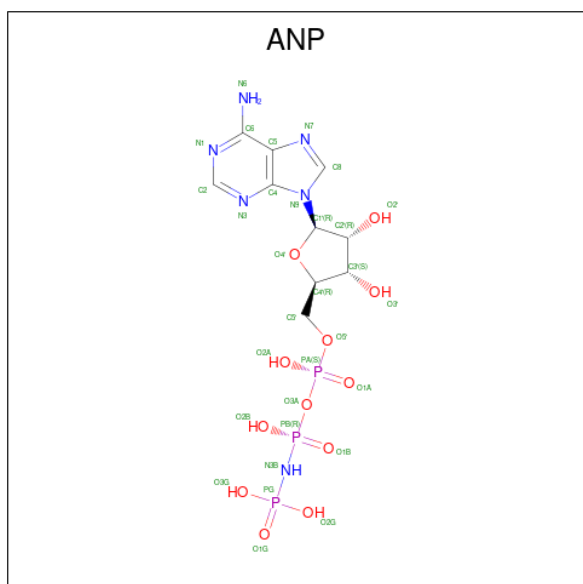
There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	164	MET	-	cloning artifact	UNP Q8PWY1
A	165	GLY	-	cloning artifact	UNP Q8PWY1
A	166	SER	-	cloning artifact	UNP Q8PWY1
A	167	SER	-	cloning artifact	UNP Q8PWY1
A	168	HIS	-	expression tag	UNP Q8PWY1
A	169	HIS	-	expression tag	UNP Q8PWY1
A	170	HIS	-	expression tag	UNP Q8PWY1
A	171	HIS	-	expression tag	UNP Q8PWY1
A	172	HIS	-	expression tag	UNP Q8PWY1
A	173	HIS	-	expression tag	UNP Q8PWY1
A	174	SER	-	cloning artifact	UNP Q8PWY1
A	175	SER	-	cloning artifact	UNP Q8PWY1
A	176	GLY	-	cloning artifact	UNP Q8PWY1
A	177	LEU	-	cloning artifact	UNP Q8PWY1
A	178	VAL	-	cloning artifact	UNP Q8PWY1
A	179	PRO	-	cloning artifact	UNP Q8PWY1
A	180	ARG	-	cloning artifact	UNP Q8PWY1
A	181	GLY	-	cloning artifact	UNP Q8PWY1
A	182	SER	-	cloning artifact	UNP Q8PWY1
A	183	HIS	-	cloning artifact	UNP Q8PWY1
A	184	MET	-	cloning artifact	UNP Q8PWY1

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

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

- Molecule 3 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (CCD ID: ANP) (formula: $C_{10}H_{17}N_6O_{12}P_3$).

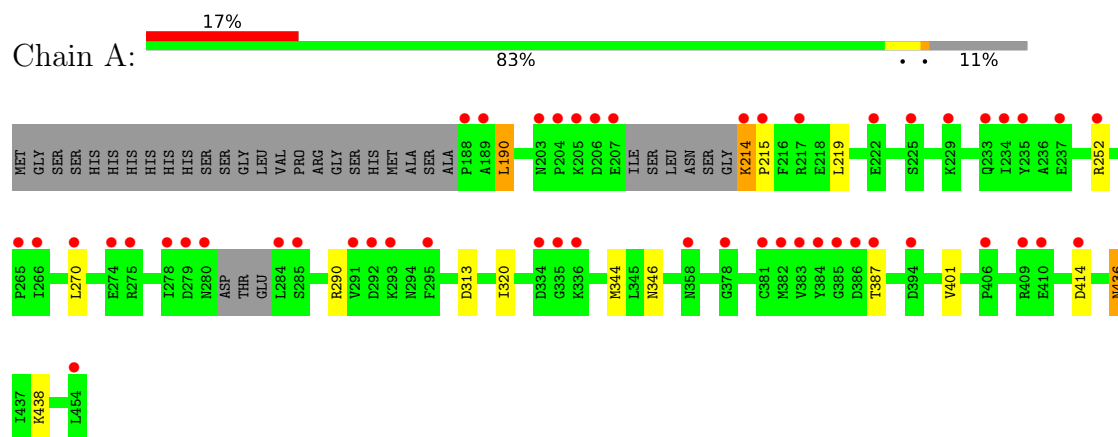


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0
4	A	1	Total C O 4 2 2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	211	Total O 211 211	0	0

- Molecule 1: Pyrrolysyl-tRNA synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 64	Depositor
Cell constants a, b, c, α , β , γ	105.12Å 105.12Å 70.31Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	34.40 – 1.80 34.40 – 1.80	Depositor EDS
% Data completeness (in resolution range)	98.8 (34.40-1.80) 98.7 (34.40-1.80)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.38 (at 1.81Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.166 , 0.191 0.172 , 0.198	Depositor DCC
R_{free} test set	2042 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å ²)	34.8	Xtriage
Anisotropy	0.018	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 51.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	0.025 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	2442	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.88% 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

5.1 Standard geometry

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

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	0.53	0/2206	0.71	0/2961

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

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	2154	0	2182	14	0
2	A	2	0	0	0	0
3	A	31	0	13	0	0
4	A	44	0	66	0	0
5	A	211	0	0	0	0
All	All	2442	0	2261	14	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 3.

All (14) 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:214:LYS:HB2	1:A:219:LEU:HD11	1.58	0.86
1:A:436:ASN:HD22	1:A:438:LYS:H	1.27	0.82
1:A:313:ASP:HA	1:A:320:ILE:HD11	1.71	0.72
1:A:214:LYS:N	1:A:215:PRO:CA	2.61	0.64
1:A:214:LYS:N	1:A:215:PRO:HA	2.15	0.62
1:A:313:ASP:HA	1:A:320:ILE:CD1	2.39	0.53
1:A:214:LYS:HB2	1:A:219:LEU:CD1	2.38	0.47
1:A:190:LEU:HD13	1:A:214:LYS:HD2	1.96	0.47
1:A:436:ASN:ND2	1:A:438:LYS:H	2.05	0.45
1:A:270:LEU:HD11	1:A:290[A]:ARG:NE	2.32	0.45
1:A:214:LYS:N	1:A:215:PRO:C	2.75	0.44
1:A:387:THR:HG22	1:A:401:VAL:HG22	1.99	0.43
1:A:344[B]:MET:SD	1:A:346:ASN:OD1	2.78	0.42
1:A:252:ARG:NE	1:A:252:ARG:HA	2.35	0.41

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	259/291 (89%)	255 (98%)	4 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	240/260 (92%)	236 (98%)	4 (2%)	53 45

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	190	LEU
1	A	214	LYS
1	A	414	ASP
1	A	436	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	203	ASN
1	A	304	ASN
1	A	346	ASN
1	A	436	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 14 ligands modelled in this entry, 2 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	$\# Z > 2$
4	EDO	A	910	-	3,3,3	0.35	0	2,2,2	0.18	0
4	EDO	A	911	-	3,3,3	0.48	0	2,2,2	0.13	0
4	EDO	A	906	-	3,3,3	0.47	0	2,2,2	0.36	0
4	EDO	A	908	-	3,3,3	0.43	0	2,2,2	0.31	0
4	EDO	A	902	-	3,3,3	0.31	0	2,2,2	0.55	0
4	EDO	A	904	-	3,3,3	0.38	0	2,2,2	0.33	0
4	EDO	A	905	-	3,3,3	0.34	0	2,2,2	0.34	0
4	EDO	A	903	-	3,3,3	0.32	0	2,2,2	0.51	0
4	EDO	A	901	-	3,3,3	0.42	0	2,2,2	0.13	0
3	ANP	A	900	2	33,33,33	2.11	10 (30%)	45,52,52	2.07	12 (26%)
4	EDO	A	909	-	3,3,3	0.43	0	2,2,2	0.32	0
4	EDO	A	907	-	3,3,3	0.42	0	2,2,2	0.45	0

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
4	EDO	A	910	-	-	0/1/1/1	-
4	EDO	A	911	-	-	1/1/1/1	-
4	EDO	A	906	-	-	0/1/1/1	-
4	EDO	A	908	-	-	1/1/1/1	-
4	EDO	A	902	-	-	0/1/1/1	-
4	EDO	A	904	-	-	0/1/1/1	-
4	EDO	A	905	-	-	1/1/1/1	-
4	EDO	A	903	-	-	0/1/1/1	-
4	EDO	A	901	-	-	0/1/1/1	-
3	ANP	A	900	2	-	6/18/38/38	0/3/3/3
4	EDO	A	909	-	-	1/1/1/1	-
4	EDO	A	907	-	-	1/1/1/1	-

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	900	ANP	PG-N3B	4.93	1.76	1.63
3	A	900	ANP	PB-N3B	4.71	1.75	1.63
3	A	900	ANP	C5-C4	4.48	1.47	1.39
3	A	900	ANP	PG-O1G	4.48	1.53	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	900	ANP	PB-O1B	3.54	1.51	1.46
3	A	900	ANP	C8-N7	2.57	1.36	1.31
3	A	900	ANP	PB-O2B	-2.43	1.50	1.56
3	A	900	ANP	PG-O3G	-2.39	1.50	1.56
3	A	900	ANP	C5-C6	2.34	1.47	1.41
3	A	900	ANP	PB-O3A	2.25	1.61	1.59

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	900	ANP	O1G-PG-N3B	-6.35	102.42	111.77
3	A	900	ANP	O2B-PB-O1B	4.61	119.77	109.87
3	A	900	ANP	C5-C4-N3	-4.53	120.48	126.72
3	A	900	ANP	N3-C4-N9	4.22	134.34	127.17
3	A	900	ANP	N3-C2-N1	-3.76	122.90	128.58
3	A	900	ANP	C4-N9-C8	3.46	109.37	105.74
3	A	900	ANP	O2G-PG-O3G	3.30	116.47	107.59
3	A	900	ANP	C2-N3-C4	3.09	119.39	111.83
3	A	900	ANP	C2-N1-C6	2.54	122.90	118.73
3	A	900	ANP	O1B-PB-N3B	-2.37	108.28	111.77
3	A	900	ANP	N6-C6-N1	2.11	123.07	118.38
3	A	900	ANP	C4-C5-N7	-2.04	108.25	110.58

There are no chirality outliers.

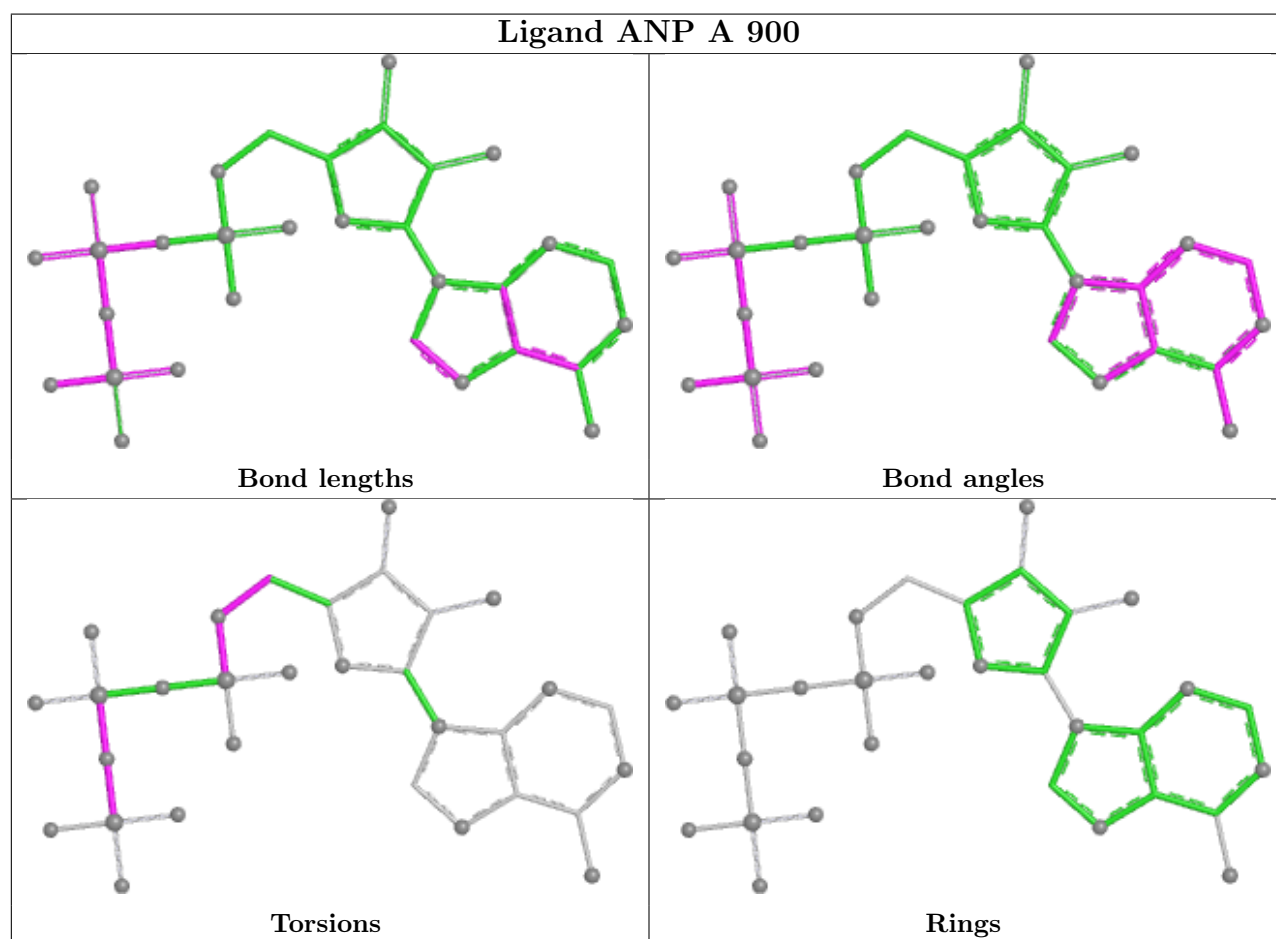
All (11) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	900	ANP	PB-N3B-PG-O1G
3	A	900	ANP	PG-N3B-PB-O1B
3	A	900	ANP	C5'-O5'-PA-O2A
4	A	908	EDO	O1-C1-C2-O2
4	A	909	EDO	O1-C1-C2-O2
3	A	900	ANP	C5'-O5'-PA-O1A
3	A	900	ANP	C5'-O5'-PA-O3A
3	A	900	ANP	C4'-C5'-O5'-PA
4	A	907	EDO	O1-C1-C2-O2
4	A	911	EDO	O1-C1-C2-O2
4	A	905	EDO	O1-C1-C2-O2

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.

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, 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	258/291 (88%)	1.28	50 (19%) 3 2	22, 42, 68, 86	7 (2%)

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	378	GLY	5.7
1	A	385	GLY	5.3
1	A	383	VAL	5.1
1	A	293	LYS	4.4
1	A	334	ASP	4.3
1	A	381	CYS	4.1
1	A	295	PHE	3.9
1	A	335	GLY	3.7
1	A	279	ASP	3.6
1	A	406	PRO	3.5
1	A	189	ALA	3.5
1	A	292	ASP	3.4
1	A	382	MET	3.3
1	A	384	TYR	3.2
1	A	386	ASP	3.2
1	A	285	SER	3.2
1	A	387	THR	3.2
1	A	394	ASP	3.0
1	A	270	LEU	3.0
1	A	278	ILE	3.0
1	A	214	LYS	2.9
1	A	188	PRO	2.9
1	A	291	VAL	2.8
1	A	252	ARG	2.8
1	A	237	GLU	2.7
1	A	409	ARG	2.7
1	A	229	LYS	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	234	ILE	2.6
1	A	215	PRO	2.6
1	A	414	ASP	2.5
1	A	217	ARG	2.5
1	A	275[A]	ARG	2.4
1	A	265	PRO	2.4
1	A	203	ASN	2.3
1	A	454	LEU	2.3
1	A	205	LYS	2.3
1	A	206	ASP	2.3
1	A	204	PRO	2.3
1	A	222[A]	GLU	2.3
1	A	207	GLU	2.2
1	A	235	TYR	2.2
1	A	266	ILE	2.2
1	A	280	ASN	2.2
1	A	358	ASN	2.1
1	A	225	SER	2.1
1	A	284	LEU	2.1
1	A	336	LYS	2.1
1	A	410	GLU	2.1
1	A	274	GLU	2.1
1	A	233	GLN	2.1

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 oligosaccharides 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.

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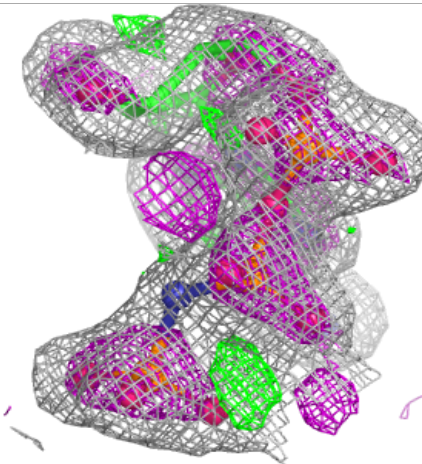
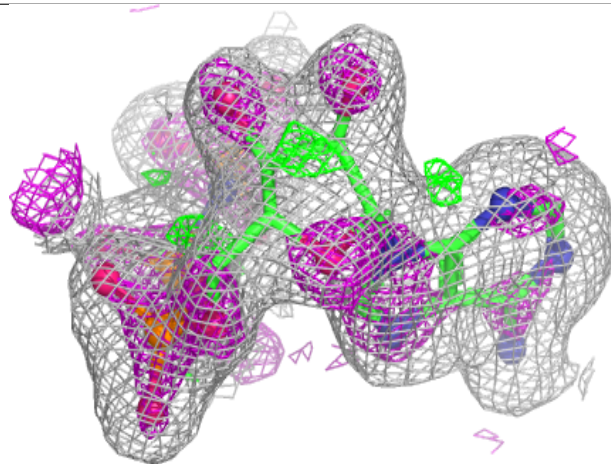
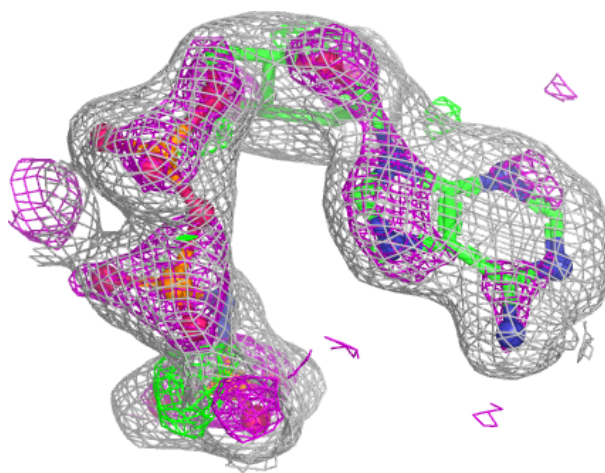
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	EDO	A	911	4/4	0.79	0.20	77,81,83,83	0
4	EDO	A	908	4/4	0.81	0.18	57,57,64,71	0
4	EDO	A	907	4/4	0.81	0.18	68,70,71,76	0
4	EDO	A	909	4/4	0.82	0.18	71,72,74,78	0
4	EDO	A	903	4/4	0.82	0.17	55,58,60,64	0
4	EDO	A	902	4/4	0.86	0.15	42,44,44,50	0
4	EDO	A	905	4/4	0.86	0.18	57,57,59,59	0
4	EDO	A	910	4/4	0.91	0.16	54,58,60,61	0
4	EDO	A	904	4/4	0.91	0.16	61,64,66,67	0
4	EDO	A	901	4/4	0.95	0.13	33,37,39,40	0
4	EDO	A	906	4/4	0.96	0.14	41,42,43,46	0
3	ANP	A	900	31/31	0.97	0.11	29,32,38,41	0
2	MG	A	501	1/1	0.98	0.10	37,37,37,37	0
2	MG	A	502	1/1	0.98	0.17	40,40,40,40	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 ANP A 900:

$2mF_o-DF_c$ (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.