



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 10, 2024 – 04:11 PM JST

PDB ID : 9J0U
Title : Crystal structure of monomeric PLP-dependent transaminase from *Desulfobacula toluolica* in F 41 3 2 space group
Authors : Matyuta, I.O.; Bakunova, A.K.; Nikolaeva, A.Y.; Rakitina, T.V.; Bezsudnova, E.Y.; Popov, V.O.; Boyko, K.M.
Deposited on : 2024-08-03
Resolution : 2.58 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 3.0
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4 : 9.0.002 (Gargrove)
Density-Fitness : 1.0.11
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.38.2

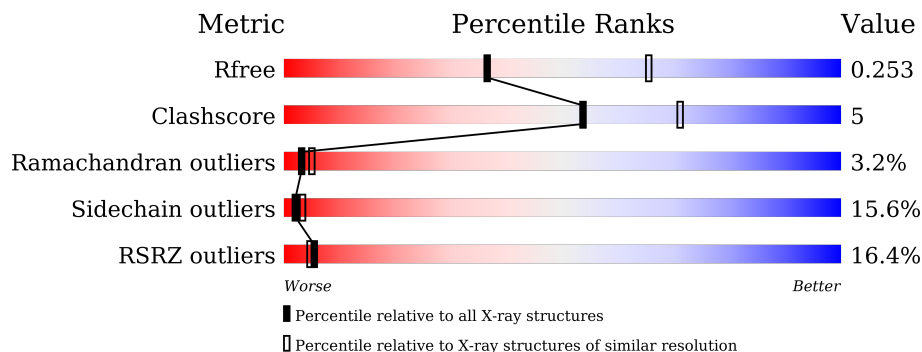
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.58 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	4456 (2.60-2.56)
Clashscore	180529	4905 (2.60-2.56)
Ramachandran outliers	177936	4847 (2.60-2.56)
Sidechain outliers	177891	4847 (2.60-2.56)
RSRZ outliers	164620	4456 (2.60-2.56)

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	286	

2 Entry composition [i](#)

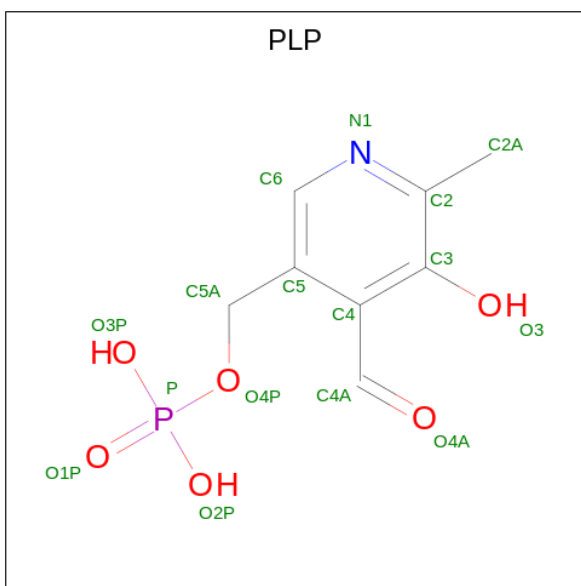
There are 3 unique types of molecules in this entry. The entry contains 2268 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Dat: predicted D-alanine aminotransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	286	2238	1423	395	410	10	0	0	0

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: C₈H₁₀NO₆P) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	15	8	1	5	1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	15	Total 15 O 15	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: Dat: predicted D-alanine aminotransferase



4 Data and refinement statistics

Property	Value	Source
Space group	F 41 3 2	Depositor
Cell constants a, b, c, α , β , γ	250.09Å 250.09Å 250.09Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	88.58 – 2.58 88.58 – 2.58	Depositor EDS
% Data completeness (in resolution range)	100.0 (88.58-2.58) 100.0 (88.58-2.58)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.21 (at 2.58Å)	Xtrriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.209 , 0.253 0.209 , 0.253	Depositor DCC
R_{free} test set	1096 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	87.9	Xtrriage
Anisotropy	0.000	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 53.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2268	wwPDB-VP
Average B, all atoms (Å ²)	98.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.97% 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: PLP

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	1.02	10/2275 (0.4%)	1.81	51/3068 (1.7%)

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1	MET	N-CA	7.67	1.61	1.46
1	A	263	GLU	CD-OE1	7.28	1.33	1.25
1	A	111	GLU	CD-OE1	7.00	1.33	1.25
1	A	35	GLU	CD-OE2	6.78	1.33	1.25
1	A	265	GLU	CD-OE1	6.67	1.32	1.25
1	A	158	GLU	CD-OE2	6.46	1.32	1.25
1	A	215	GLU	CD-OE1	6.21	1.32	1.25
1	A	35	GLU	CD-OE1	6.03	1.32	1.25
1	A	172	SER	CA-CB	-5.24	1.45	1.52
1	A	71	GLU	CD-OE1	5.22	1.31	1.25

All (51) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	40	ARG	CB-CG-CD	-10.45	84.44	111.60
1	A	152	GLU	CB-CA-C	10.24	130.88	110.40
1	A	40	ARG	NE-CZ-NH1	-9.67	115.46	120.30
1	A	68	LYS	CB-CA-C	9.46	129.33	110.40
1	A	52	GLU	CB-CA-C	8.72	127.84	110.40
1	A	198	THR	CB-CA-C	8.57	134.74	111.60
1	A	135	ASN	CB-CG-OD1	-8.44	104.73	121.60
1	A	221	ARG	NE-CZ-NH2	-8.07	116.27	120.30
1	A	239	THR	CA-CB-OG1	-8.02	92.15	109.00
1	A	278	ARG	NE-CZ-NH1	7.94	124.27	120.30
1	A	250	ASP	CB-CA-C	7.62	125.63	110.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	144	ARG	NE-CZ-NH1	7.61	124.10	120.30
1	A	208	ARG	CD-NE-CZ	7.46	134.04	123.60
1	A	278	ARG	NE-CZ-NH2	-7.37	116.62	120.30
1	A	79	LEU	CB-CG-CD1	-7.34	98.52	111.00
1	A	40	ARG	CG-CD-NE	-7.25	96.58	111.80
1	A	275	ARG	NE-CZ-NH2	-7.16	116.72	120.30
1	A	144	ARG	NE-CZ-NH2	-7.07	116.76	120.30
1	A	263	GLU	CB-CA-C	6.93	124.27	110.40
1	A	221	ARG	NE-CZ-NH1	6.84	123.72	120.30
1	A	280	ARG	CB-CA-C	6.67	123.74	110.40
1	A	278	ARG	CD-NE-CZ	6.59	132.83	123.60
1	A	135	ASN	C-N-CA	6.59	138.17	121.70
1	A	281	LYS	N-CA-CB	6.40	122.12	110.60
1	A	63	THR	CA-CB-OG1	-6.39	95.59	109.00
1	A	266	LYS	CB-CA-C	6.29	122.97	110.40
1	A	157	TYR	CB-CG-CD2	-6.27	117.24	121.00
1	A	47	PHE	CB-CA-C	6.26	122.93	110.40
1	A	199	ARG	CG-CD-NE	-6.25	98.67	111.80
1	A	144	ARG	CD-NE-CZ	6.02	132.02	123.60
1	A	131	ARG	NE-CZ-NH2	-6.01	117.30	120.30
1	A	82	LYS	CB-CA-C	5.97	122.35	110.40
1	A	208	ARG	CB-CA-C	5.86	122.12	110.40
1	A	281	LYS	CB-CG-CD	5.82	126.74	111.60
1	A	131	ARG	CD-NE-CZ	5.78	131.69	123.60
1	A	161	LEU	CB-CG-CD1	-5.59	101.50	111.00
1	A	37	MET	CG-SD-CE	-5.48	91.44	100.20
1	A	143	PHE	CB-CA-C	5.47	121.33	110.40
1	A	30	ALA	CB-CA-C	5.43	118.25	110.10
1	A	53	ARG	CD-NE-CZ	5.40	131.16	123.60
1	A	151	ARG	NE-CZ-NH1	5.37	122.98	120.30
1	A	48	GLU	CB-CA-C	5.30	121.00	110.40
1	A	78	ASP	N-CA-CB	5.29	120.12	110.60
1	A	208	ARG	CA-CB-CG	5.26	124.97	113.40
1	A	151	ARG	CB-CG-CD	5.22	125.17	111.60
1	A	226	ILE	CA-CB-CG2	5.20	121.30	110.90
1	A	3	ARG	CG-CD-NE	-5.17	100.94	111.80
1	A	131	ARG	NE-CZ-NH1	5.16	122.88	120.30
1	A	71	GLU	CB-CA-C	5.12	120.64	110.40
1	A	273	SER	N-CA-CB	5.10	118.15	110.50
1	A	40	ARG	NE-CZ-NH2	5.06	122.83	120.30

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	2238	0	2292	22	0
2	A	15	0	7	0	0
3	A	15	0	0	0	0
All	All	2268	0	2299	22	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 5.

All (22) 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:35:GLU:OE1	1:A:50:HIS:HD2	1.57	0.88
1:A:37:MET:HE3	1:A:47:PHE:HA	1.56	0.86
1:A:96:LEU:HD12	1:A:101:GLU:HB3	1.64	0.79
1:A:57:SER:O	1:A:61:VAL:HG13	1.92	0.68
1:A:37:MET:CE	1:A:47:PHE:HA	2.25	0.64
1:A:3:ARG:HG2	1:A:22:MET:HB3	1.80	0.64
1:A:136:ILE:HG22	1:A:138:THR:HG23	1.85	0.59
1:A:35:GLU:OE1	1:A:50:HIS:CD2	2.49	0.58
1:A:251:SER:N	1:A:252:PRO:HD2	2.25	0.52
1:A:123:HIS:HD2	1:A:243:SER:OG	1.94	0.51
1:A:174:SER:HB2	1:A:232:THR:O	2.12	0.48
1:A:178:PHE:HB2	1:A:186:TYR:HB2	1.98	0.46
1:A:10:PHE:HB2	1:A:106:TYR:HB3	1.97	0.45
1:A:277:LYS:HG2	1:A:280:ARG:NH1	2.32	0.44
1:A:230:PHE:HA	1:A:241:VAL:HG23	2.00	0.44
1:A:226:ILE:HG23	1:A:249:LEU:HD21	1.99	0.43
1:A:254:ILE:HG22	1:A:257:ILE:H	1.85	0.42
1:A:123:HIS:CD2	1:A:243:SER:OG	2.72	0.41
1:A:130:GLU:OE2	1:A:163:ASN:HB2	2.20	0.41
1:A:182:ASP:HB2	1:A:184:LYS:HG2	2.03	0.41
1:A:57:SER:HB3	1:A:136:ILE:HD12	2.03	0.41
1:A:186:TYR:HA	1:A:214:LEU:O	2.22	0.40

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	284/286 (99%)	245 (86%)	30 (11%)	9 (3%)	3 5

All (9) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	195	LYS
1	A	245	GLY
1	A	182	ASP
1	A	190	ALA
1	A	154	SER
1	A	98	ASN
1	A	247	THR
1	A	116	LYS
1	A	236	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	243/247 (98%)	205 (84%)	38 (16%)	2 3

All (38) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	GLN
1	A	18	SER
1	A	60	LEU
1	A	64	ARG
1	A	98	ASN
1	A	111	GLU
1	A	114	ASP
1	A	119	LEU
1	A	126	LEU
1	A	128	SER
1	A	130	GLU
1	A	131	ARG
1	A	140	LYS
1	A	144	ARG
1	A	148	LYS
1	A	150	VAL
1	A	152	GLU
1	A	164	GLU
1	A	165	SER
1	A	179	MET
1	A	182	ASP
1	A	204	GLN
1	A	208	ARG
1	A	216	LYS
1	A	221	ARG
1	A	225	ASP
1	A	226	ILE
1	A	227	GLN
1	A	240	PRO
1	A	242	ARG
1	A	247	THR
1	A	253	ASN
1	A	259	LYS
1	A	274	LYS
1	A	275	ARG
1	A	281	LYS
1	A	285	ASN
1	A	286	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	7	HIS

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Mol	Chain	Res	Type
1	A	50	HIS
1	A	123	HIS

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](#)

1 ligand is 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
2	PLP	A	301	1	15,15,16	1.82	4 (26%)	20,22,23	2.00	6 (30%)

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	PLP	A	301	1	-	0/6/6/8	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	301	PLP	C3-C2	4.65	1.45	1.40
2	A	301	PLP	C5-C4	3.06	1.43	1.40
2	A	301	PLP	O3-C3	2.62	1.43	1.37
2	A	301	PLP	P-O1P	2.40	1.58	1.50

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	301	PLP	O4P-P-O1P	4.30	118.53	106.47
2	A	301	PLP	O3P-P-O4P	-3.82	96.57	106.73
2	A	301	PLP	C2A-C2-C3	3.05	124.66	120.89
2	A	301	PLP	C5A-C5-C6	-2.79	114.78	119.37
2	A	301	PLP	C4A-C4-C5	2.35	123.36	120.94
2	A	301	PLP	C4A-C4-C3	-2.12	116.91	120.50

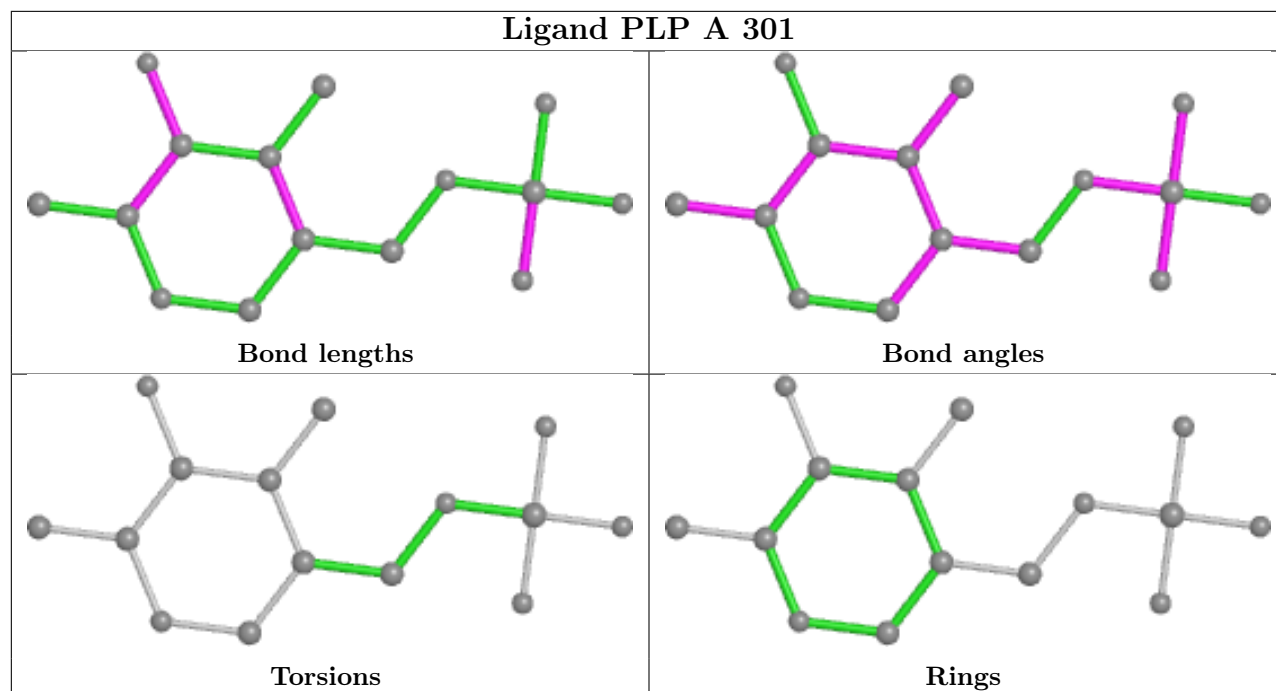
There are no chirality outliers.

There are no torsion outliers.

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	286/286 (100%)	0.86	47 (16%) 5 5	66, 95, 131, 165	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	9	PHE	6.7
1	A	16	ILE	5.2
1	A	24	ILE	4.9
1	A	245	GLY	4.3
1	A	21	ASP	4.2
1	A	20	ALA	4.0
1	A	128	SER	4.0
1	A	100	LYS	3.9
1	A	210	GLY	3.8
1	A	256	LEU	3.7
1	A	220	THR	3.7
1	A	209	LEU	3.6
1	A	107	PHE	3.6
1	A	15	ILE	3.5
1	A	149	ALA	3.5
1	A	162	VAL	3.3
1	A	25	PHE	3.2
1	A	8	ASN	3.2
1	A	260	ILE	3.1
1	A	230	PHE	3.1
1	A	90	VAL	3.1
1	A	18	SER	3.1
1	A	157	TYR	2.8
1	A	132	ILE	2.7
1	A	164	GLU	2.5
1	A	2	LYS	2.5
1	A	10	PHE	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	281	LYS	2.5
1	A	108	ILE	2.4
1	A	63	THR	2.3
1	A	186	TYR	2.3
1	A	224	ALA	2.3
1	A	1	MET	2.3
1	A	56	MET	2.3
1	A	129	GLY	2.3
1	A	244	ILE	2.3
1	A	223	LEU	2.2
1	A	153	SER	2.2
1	A	6	ILE	2.2
1	A	113	LEU	2.2
1	A	217	THR	2.1
1	A	169	THR	2.1
1	A	183	ASN	2.1
1	A	150	VAL	2.0
1	A	124	THR	2.0
1	A	127	PHE	2.0
1	A	89	ASN	2.0

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 monosaccharides in this entry.

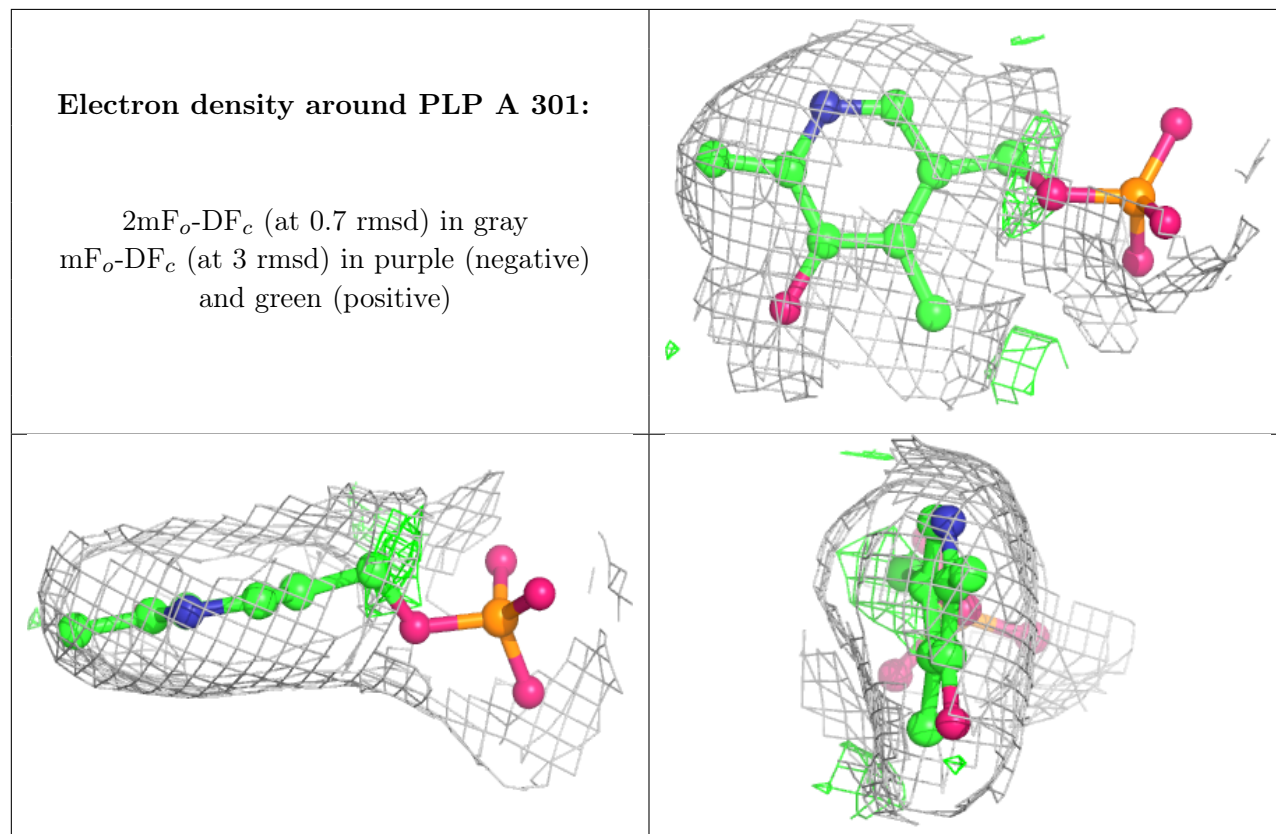
6.4 Ligands [i](#)

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(Å ²)	Q<0.9
2	PLP	A	301	15/16	0.97	0.06	63,73,83,87	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.