



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 30, 2026 – 10:17 am BST

PDB ID : 9TJW / pdb_00009tjw
Title : Ternary complex of E. coli leucyl-tRNA synthetase mutant R178A, tRNA(leu) and the leucyl adenylate analog LeuAMS in the aminoacyl transfer state
Authors : Hoffmann, G.; Palencia, A.
Deposited on : 2025-12-08
Resolution : 2.23 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	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

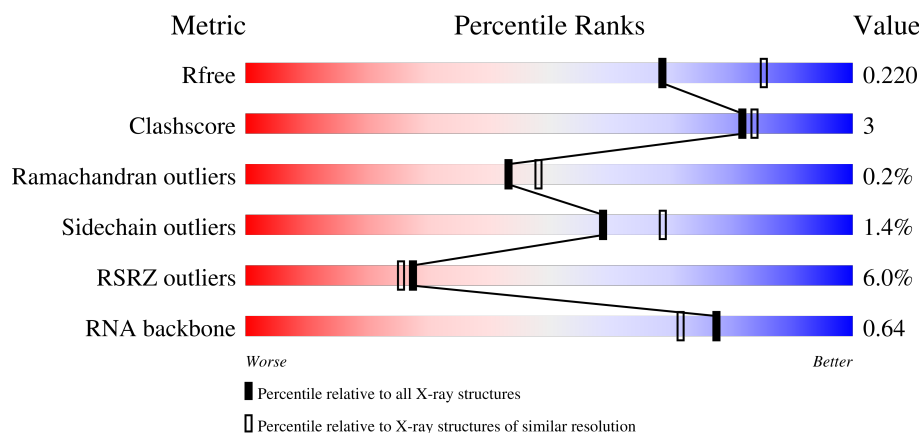
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.23 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	3416 (2.26-2.22)
Clashscore	190562	3556 (2.26-2.22)
Ramachandran outliers	187476	3500 (2.26-2.22)
Sidechain outliers	187428	3501 (2.26-2.22)
RSRZ outliers	180081	3415 (2.26-2.22)
RNA backbone	3983	1014 (2.54-1.94)

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	880	88% 9% . .
1	C	880	11% 87% 9% .
2	B	87	76% 15% . 8%
2	D	87	79% 10% 10%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 17627 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 Leucine-tRNA ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	852	Total	C	N	O	S	0	0	0
			6775	4305	1149	1279	42			
1	C	849	Total	C	N	O	S	0	0	0
			6748	4287	1143	1276	42			

There are 42 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP P07813
A	-18	GLY	-	expression tag	UNP P07813
A	-17	SER	-	expression tag	UNP P07813
A	-16	SER	-	expression tag	UNP P07813
A	-15	HIS	-	expression tag	UNP P07813
A	-14	HIS	-	expression tag	UNP P07813
A	-13	HIS	-	expression tag	UNP P07813
A	-12	HIS	-	expression tag	UNP P07813
A	-11	HIS	-	expression tag	UNP P07813
A	-10	HIS	-	expression tag	UNP P07813
A	-9	SER	-	expression tag	UNP P07813
A	-8	SER	-	expression tag	UNP P07813
A	-7	GLY	-	expression tag	UNP P07813
A	-6	LEU	-	expression tag	UNP P07813
A	-5	VAL	-	expression tag	UNP P07813
A	-4	PRO	-	expression tag	UNP P07813
A	-3	ARG	-	expression tag	UNP P07813
A	-2	GLY	-	expression tag	UNP P07813
A	-1	SER	-	expression tag	UNP P07813
A	0	HIS	-	expression tag	UNP P07813
A	178	ALA	ARG	engineered mutation	UNP P07813
C	-19	MET	-	initiating methionine	UNP P07813
C	-18	GLY	-	expression tag	UNP P07813
C	-17	SER	-	expression tag	UNP P07813
C	-16	SER	-	expression tag	UNP P07813

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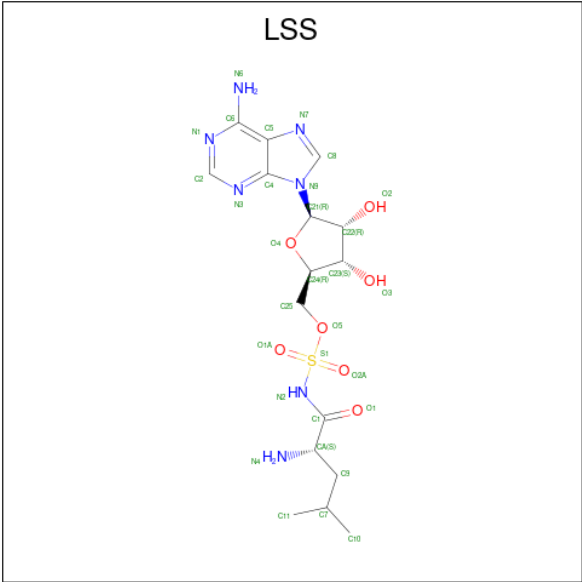
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Chain	Residue	Modelled	Actual	Comment	Reference
C	-15	HIS	-	expression tag	UNP P07813
C	-14	HIS	-	expression tag	UNP P07813
C	-13	HIS	-	expression tag	UNP P07813
C	-12	HIS	-	expression tag	UNP P07813
C	-11	HIS	-	expression tag	UNP P07813
C	-10	HIS	-	expression tag	UNP P07813
C	-9	SER	-	expression tag	UNP P07813
C	-8	SER	-	expression tag	UNP P07813
C	-7	GLY	-	expression tag	UNP P07813
C	-6	LEU	-	expression tag	UNP P07813
C	-5	VAL	-	expression tag	UNP P07813
C	-4	PRO	-	expression tag	UNP P07813
C	-3	ARG	-	expression tag	UNP P07813
C	-2	GLY	-	expression tag	UNP P07813
C	-1	SER	-	expression tag	UNP P07813
C	0	HIS	-	expression tag	UNP P07813
C	178	ALA	ARG	engineered mutation	UNP P07813

- Molecule 2 is a RNA chain called tRNA(leu).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	80	Total	C	N	O	P	0	0	0
			1696	753	308	555	80			
2	D	78	Total	C	N	O	P	0	0	0
			1654	734	300	542	78			

- Molecule 3 is 5'-O-(L-leucylsulfamoyl)adenosine (CCD ID: LSS) (formula: C₁₆H₂₅N₇O₇S) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			31	16	7	7	1		
3	C	1	Total	C	N	O	S	0	0
			31	16	7	7	1		

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Mg	0	0
			1	1		

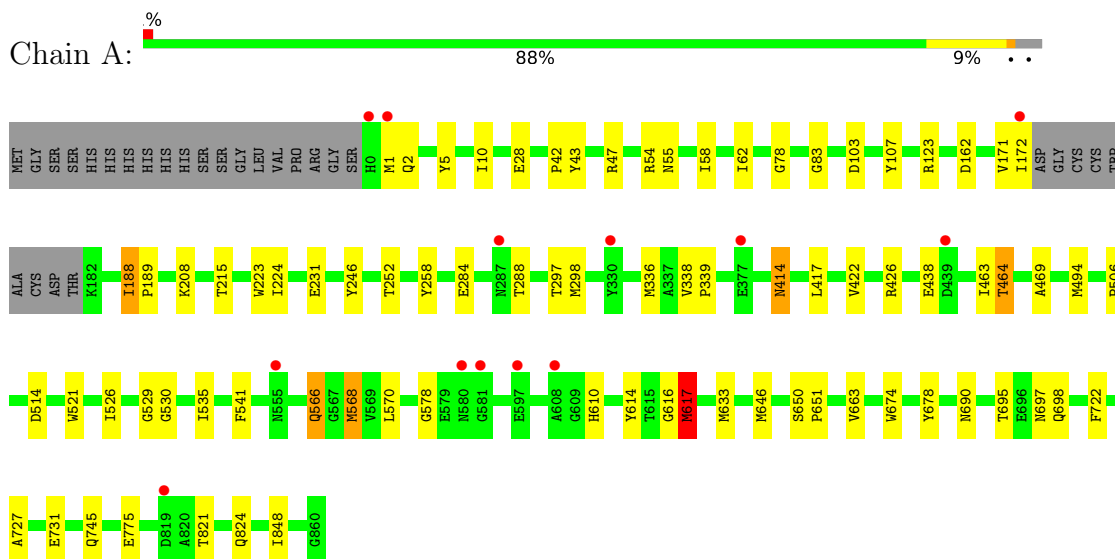
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	402	Total	O	0	1
			403	403		
5	B	173	Total	O	0	0
			173	173		
5	C	82	Total	O	0	0
			82	82		
5	D	33	Total	O	0	0
			33	33		

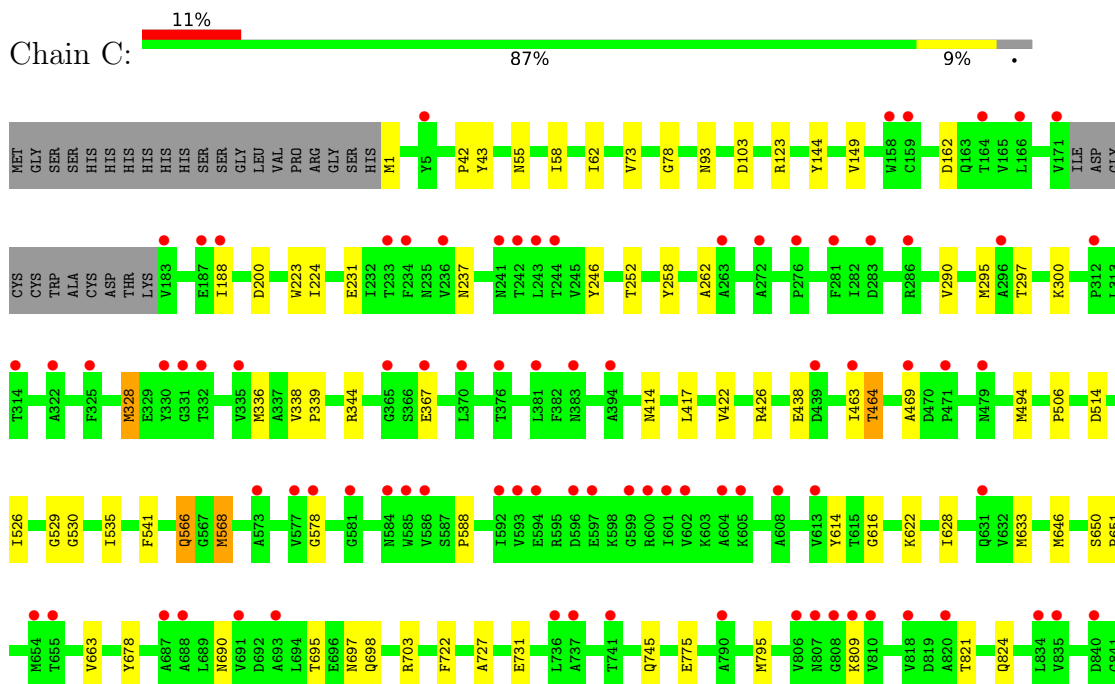
3 Residue-property plots [i](#)

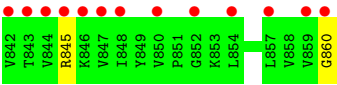
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Leucine-tRNA ligase

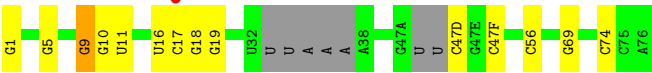
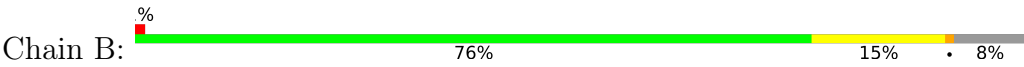


• Molecule 1: Leucine-tRNA ligase

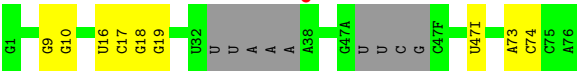
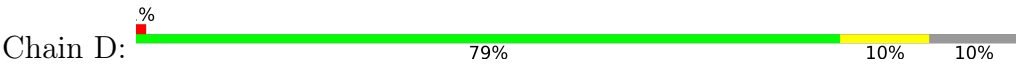




● Molecule 2: tRNA(leu)



● Molecule 2: tRNA(leu)



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	158.16Å 68.89Å 227.71Å 90.00° 104.61° 90.00°	Depositor
Resolution (Å)	220.35 – 2.23 220.35 – 2.23	Depositor EDS
% Data completeness (in resolution range)	70.7 (220.35-2.23) 70.7 (220.35-2.23)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.48 (at 2.22Å)	Xtriage
Refinement program	BUSTER 2.10.4	Depositor
R, R_{free}	0.193 , 0.229 0.188 , 0.220	Depositor DCC
R_{free} test set	4139 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	38.4	Xtriage
Anisotropy	0.027	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 52.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	17627	wwPDB-VP
Average B, all atoms (Å ²)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.00% 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, LSS

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	0.73	2/6934 (0.0%)	1.03	8/9411 (0.1%)
1	C	0.62	2/6906 (0.0%)	1.00	12/9374 (0.1%)
2	B	0.64	1/1893 (0.1%)	0.70	0/2944
2	D	0.51	0/1846	0.66	0/2872
All	All	0.65	5/17579 (0.0%)	0.95	20/24601 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	568	MET	SD-CE	-8.59	1.58	1.79
1	A	617	MET	SD-CE	-7.88	1.59	1.79
2	B	47(D)	C	C1'-N1	5.64	1.55	1.47
1	C	568	MET	SD-CE	-5.57	1.65	1.79
1	C	328	MET	SD-CE	-5.01	1.67	1.79

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	438	GLU	CA-C-N	8.77	132.39	120.38
1	A	438	GLU	C-N-CA	8.77	132.39	120.38
1	C	541	PHE	CA-CB-CG	7.93	121.73	113.80
1	A	541	PHE	CA-CB-CG	7.78	121.58	113.80
1	C	438	GLU	CA-C-N	7.30	131.04	120.38
1	C	438	GLU	C-N-CA	7.30	131.04	120.38
1	C	367	GLU	CB-CG-CD	5.95	122.72	112.60
1	A	10	ILE	N-CA-CB	-5.85	106.84	111.64
1	C	514	ASP	N-CA-C	-5.65	98.04	107.99
1	A	514	ASP	N-CA-C	-5.60	98.13	107.99
1	C	297	THR	CA-C-N	5.53	129.10	120.75
1	C	297	THR	C-N-CA	5.53	129.10	120.75

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	290	VAL	N-CA-C	5.49	115.58	110.42
1	C	43	TYR	N-CA-C	-5.44	102.80	109.65
1	C	328	MET	CA-C-N	5.32	127.40	120.28
1	C	328	MET	C-N-CA	5.32	127.40	120.28
1	A	83	GLY	CA-C-N	5.26	127.30	120.26
1	A	83	GLY	C-N-CA	5.26	127.30	120.26
1	A	43	TYR	N-CA-C	-5.22	103.07	109.65
1	C	73	VAL	N-CA-C	5.06	115.86	108.58

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	6775	0	6638	42	0
1	C	6748	0	6607	39	0
2	B	1696	0	858	6	0
2	D	1654	0	836	2	0
3	A	31	0	25	0	0
3	C	31	0	25	1	0
4	B	1	0	0	0	0
5	A	403	0	0	1	0
5	B	173	0	0	0	0
5	C	82	0	0	0	0
5	D	33	0	0	0	0
All	All	17627	0	14989	80	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 (80) 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:570:LEU:HB2	1:A:617:MET:CE	2.14	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:54:ARG:HD3	1:A:566:GLN:NE2	2.10	0.67
1:A:821:THR:HB	1:A:824:GLN:HG3	1.77	0.67
1:C:821:THR:HB	1:C:824:GLN:HG3	1.77	0.66
1:A:171:VAL:O	1:A:172:ILE:HG13	1.97	0.65
1:C:300:LYS:HE2	1:C:344:ARG:HG3	1.79	0.63
1:C:223:TRP:CD2	1:C:535:ILE:HG21	2.34	0.63
1:A:288:THR:HG23	1:A:298:MET:HE1	1.82	0.61
1:A:426:ARG:NH1	2:B:74:C:O2	2.35	0.60
1:A:727:ALA:O	1:A:731:GLU:HG3	2.01	0.60
1:A:223:TRP:CD2	1:A:535:ILE:HG21	2.36	0.60
1:C:727:ALA:O	1:C:731:GLU:HG3	2.03	0.58
1:A:530:GLY:HA3	1:A:568:MET:HE1	1.86	0.58
1:A:54:ARG:HD3	1:A:566:GLN:HE21	1.67	0.57
1:A:47:ARG:HD2	1:A:107:TYR:CE2	2.40	0.56
1:A:55:ASN:HD21	1:A:529:GLY:HA2	1.71	0.56
1:C:588:PRO:HG2	1:C:628:ILE:HD11	1.88	0.56
1:C:530:GLY:HA3	1:C:568:MET:HE1	1.88	0.55
1:C:690:ASN:H	1:C:745:GLN:HE22	1.56	0.54
1:A:617:MET:O	2:B:69:G:H5''	2.08	0.53
1:C:809:LYS:NZ	2:D:47(I):U:OP2	2.41	0.53
1:A:690:ASN:H	1:A:745:GLN:HE22	1.56	0.52
1:A:848:ILE:HG13	2:B:56:C:C2	2.44	0.52
1:C:123:ARG:HA	1:C:506:PRO:HG3	1.92	0.52
1:C:845:ARG:HE	1:C:860:GLY:HA3	1.75	0.51
1:A:215:THR:HG22	2:B:5:G:H5'	1.92	0.51
1:A:28:GLU:OE2	1:A:521:TRP:NE1	2.40	0.50
1:C:695:THR:HB	1:C:698:GLN:HG3	1.94	0.50
1:A:284:GLU:HB2	5:A:1307:HOH:O	2.12	0.49
1:A:610:HIS:CE1	1:C:93:ASN:HB3	2.47	0.49
1:C:55:ASN:HD21	1:C:529:GLY:HA2	1.76	0.49
1:C:262:ALA:HB3	1:C:328:MET:HE2	1.94	0.49
1:A:1:MET:HE2	1:A:775:GLU:HG3	1.94	0.48
1:A:633:MET:HE3	1:A:663:VAL:HG21	1.96	0.48
1:C:162:ASP:HB3	1:C:463:ILE:HG23	1.96	0.48
1:C:566:GLN:NE2	3:C:901:LSS:N3	2.61	0.48
1:C:258:TYR:HE1	1:C:339:PRO:HG3	1.79	0.48
1:A:695:THR:HB	1:A:698:GLN:HG3	1.96	0.47
1:A:123:ARG:HA	1:A:506:PRO:HG3	1.96	0.47
1:A:162:ASP:HB3	1:A:463:ILE:HG23	1.97	0.46
1:C:58:ILE:HG23	1:C:722:PHE:HE2	1.79	0.46
1:A:297:THR:CG2	2:B:1:G:C8	2.98	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:258:TYR:HE1	1:A:339:PRO:HG3	1.79	0.46
1:C:262:ALA:HB3	1:C:328:MET:CE	2.46	0.46
1:A:1:MET:HE1	1:A:678:TYR:HA	1.97	0.46
1:C:62:ILE:HD13	1:C:526:ILE:HD13	1.99	0.45
1:A:695:THR:HG22	1:A:697:ASN:H	1.82	0.45
1:C:1:MET:HE2	1:C:775:GLU:HG3	1.98	0.45
1:A:58:ILE:HG23	1:A:722:PHE:HE2	1.82	0.45
1:C:426:ARG:NH1	2:D:74:C:O2	2.47	0.45
1:C:42:PRO:HD2	1:C:78:GLY:O	2.17	0.44
1:A:610:HIS:HE1	1:C:93:ASN:HB3	1.82	0.44
1:C:55:ASN:HD22	1:C:566:GLN:NE2	2.16	0.44
1:C:246:TYR:CZ	1:C:414:ASN:HB2	2.52	0.44
1:C:144:TYR:HA	1:C:149:VAL:HB	2.00	0.43
1:A:246:TYR:CZ	1:A:414:ASN:HB2	2.53	0.43
1:C:1:MET:HE1	1:C:678:TYR:HA	2.00	0.43
1:A:62:ILE:HD13	1:A:526:ILE:HD13	2.00	0.43
1:C:695:THR:HG22	1:C:697:ASN:H	1.84	0.43
1:A:42:PRO:HD2	1:A:78:GLY:O	2.18	0.43
1:A:224:ILE:HA	1:A:417:LEU:HB2	2.01	0.43
1:A:5:TYR:HB2	1:A:674:TRP:CG	2.54	0.42
2:B:9:G:H3'	2:B:11:U:OP2	2.20	0.42
1:C:650:SER:HB2	1:C:651:PRO:HD2	2.01	0.42
1:C:703:ARG:HG3	1:C:795:MET:HA	2.01	0.42
1:A:570:LEU:HB2	1:A:617:MET:HE3	1.96	0.42
1:C:464:THR:HG22	1:C:469:ALA:HB2	2.01	0.42
1:C:614:TYR:CZ	1:C:616:GLY:HA2	2.55	0.42
1:A:422:VAL:HG11	1:A:494:MET:HE1	2.02	0.42
1:C:224:ILE:HA	1:C:417:LEU:HB2	2.02	0.41
1:A:650:SER:HB2	1:A:651:PRO:HD2	2.01	0.41
1:C:633:MET:HE3	1:C:663:VAL:HG21	2.02	0.41
1:A:188:ILE:HA	1:A:189:PRO:HD3	1.96	0.41
1:C:252:THR:HB	1:C:338:VAL:HG11	2.03	0.41
1:A:464:THR:HG22	1:A:469:ALA:HB2	2.02	0.41
1:C:55:ASN:HD22	1:C:566:GLN:HE21	1.68	0.41
1:A:614:TYR:CZ	1:A:616:GLY:HA2	2.56	0.41
1:C:622:LYS:HD2	1:C:622:LYS:HA	1.94	0.40
1:A:252:THR:HB	1:A:338:VAL:HG11	2.02	0.40
1:C:422:VAL:HG11	1:C:494:MET:HE1	2.04	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	848/880 (96%)	835 (98%)	12 (1%)	1 (0%)	48	54
1	C	845/880 (96%)	828 (98%)	15 (2%)	2 (0%)	43	48
All	All	1693/1760 (96%)	1663 (98%)	27 (2%)	3 (0%)	43	48

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	578	GLY
1	C	578	GLY
1	C	237	ASN

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	717/740 (97%)	706 (98%)	11 (2%)	57	66
1	C	714/740 (96%)	705 (99%)	9 (1%)	61	71
All	All	1431/1480 (97%)	1411 (99%)	20 (1%)	59	69

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	GLN
1	A	103	ASP
1	A	188	ILE

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Mol	Chain	Res	Type
1	A	208	LYS
1	A	231	GLU
1	A	336	MET
1	A	414	ASN
1	A	464	THR
1	A	566	GLN
1	A	617	MET
1	A	646	MET
1	C	103	ASP
1	C	188	ILE
1	C	200	ASP
1	C	231	GLU
1	C	295	MET
1	C	336	MET
1	C	464	THR
1	C	566	GLN
1	C	646	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (22) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	4	GLN
1	A	15	GLN
1	A	55	ASN
1	A	75	GLN
1	A	110	ASN
1	A	157	ASN
1	A	269	GLN
1	A	566	GLN
1	A	667	ASN
1	A	745	GLN
1	A	824	GLN
1	C	4	GLN
1	C	15	GLN
1	C	55	ASN
1	C	75	GLN
1	C	157	ASN
1	C	269	GLN
1	C	355	ASN
1	C	392	HIS
1	C	667	ASN
1	C	745	GLN

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Mol	Chain	Res	Type
1	C	824	GLN

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	76/87 (87%)	7 (9%)	0
2	D	74/87 (85%)	7 (9%)	0
All	All	150/174 (86%)	14 (9%)	0

All (14) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	9	G
2	B	10	G
2	B	16	U
2	B	17	C
2	B	18	G
2	B	19	G
2	B	47(F)	C
2	D	9	G
2	D	10	G
2	D	16	U
2	D	17	C
2	D	18	G
2	D	19	G
2	D	73	A

There are no RNA pucker outliers to report.

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 oligosaccharides in this entry.

5.6 Ligand geometry

Of 3 ligands modelled in this entry, 1 is 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	LSS	A	1001	-	33,33,33	0.21	0	46,49,49	0.34	0
3	LSS	C	901	-	33,33,33	0.15	0	46,49,49	0.31	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
3	LSS	A	1001	-	-	4/22/39/39	0/3/3/3
3	LSS	C	901	-	-	0/22/39/39	0/3/3/3

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

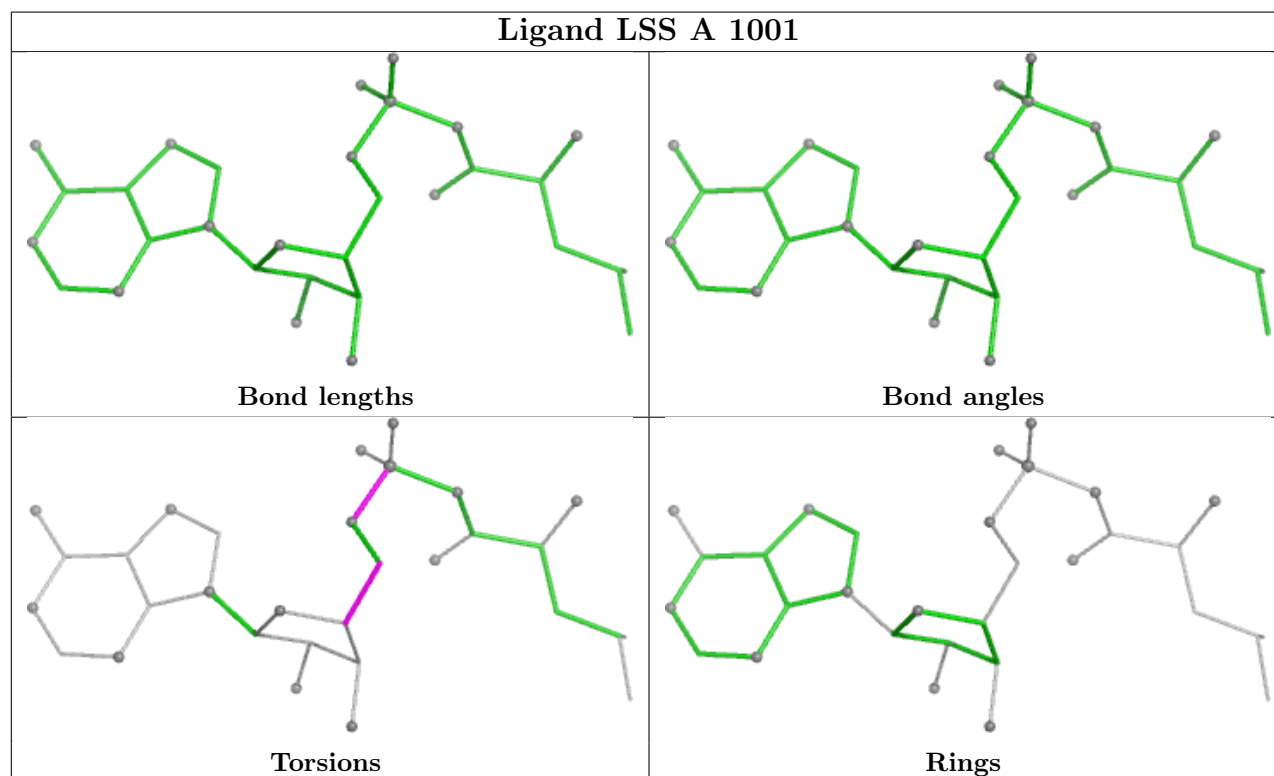
Mol	Chain	Res	Type	Atoms
3	A	1001	LSS	C25-O5-S1-N2
3	A	1001	LSS	C23-C24-C25-O5
3	A	1001	LSS	O4-C24-C25-O5
3	A	1001	LSS	C25-O5-S1-O2A

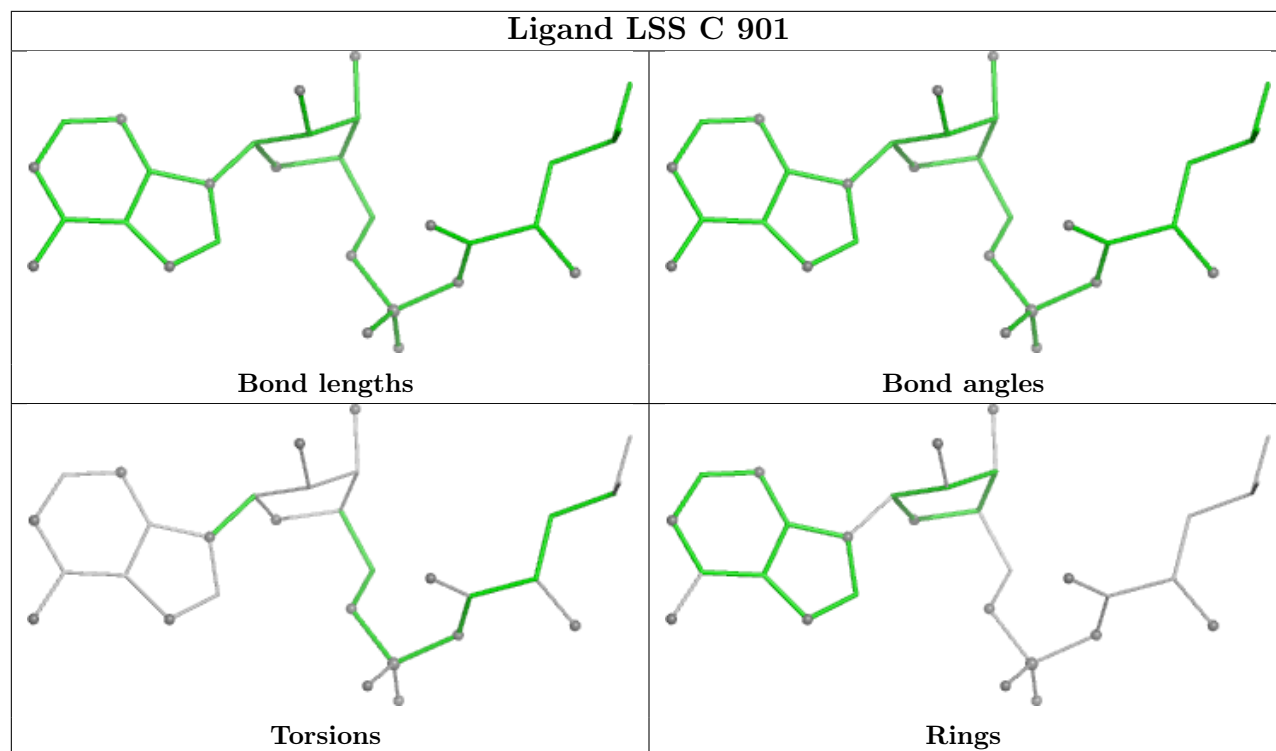
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	901	LSS	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

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	852/880 (96%)	-0.19	13 (1%) 72 73	18, 34, 57, 86	0
1	C	849/880 (96%)	0.91	97 (11%) 10 9	39, 70, 104, 119	0
2	B	80/87 (91%)	-0.70	1 (1%) 75 77	22, 40, 83, 99	0
2	D	78/87 (89%)	0.40	1 (1%) 75 77	53, 93, 126, 141	0
All	All	1859/1934 (96%)	0.31	112 (6%) 27 25	18, 50, 101, 141	0

All (112) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	860	GLY	5.3
1	C	737	ALA	4.6
1	C	852	GLY	4.1
1	C	171	VAL	3.9
1	C	844	VAL	3.9
2	B	17	C	3.5
1	A	0	HIS	3.4
1	A	581	GLY	3.4
1	C	857	LEU	3.4
1	C	578	GLY	3.3
1	C	183	VAL	3.3
1	A	580	ASN	3.3
1	C	601	ILE	3.3
1	C	613	VAL	3.2
1	C	608	ALA	3.1
1	A	819	ASP	3.1
1	C	859	VAL	3.1
1	C	808	GLY	3.0
1	C	272	ALA	2.9
1	C	233	THR	2.9
1	C	843	THR	2.9

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Mol	Chain	Res	Type	RSRZ
1	C	688	ALA	2.9
1	C	691	VAL	2.9
1	C	847	VAL	2.9
1	C	159	CYS	2.9
1	C	581	GLY	2.8
1	C	263	ALA	2.8
1	C	469	ALA	2.8
1	C	693	ALA	2.8
1	C	602	VAL	2.8
1	C	842	VAL	2.8
1	C	599	GLY	2.8
1	C	809	LYS	2.8
1	C	850	VAL	2.8
1	C	593	VAL	2.8
1	A	287	ASN	2.7
1	C	188	ILE	2.7
1	C	854	LEU	2.7
1	C	471	PRO	2.7
1	C	604	ALA	2.7
1	C	335	VAL	2.6
1	C	806	VAL	2.6
1	C	463	ILE	2.6
1	A	1	MET	2.6
1	C	687	ALA	2.6
1	C	244	THR	2.6
1	C	330	TYR	2.6
1	C	848	ILE	2.6
1	C	322	ALA	2.6
1	C	573	ALA	2.6
1	C	241	ASN	2.6
1	C	810	VAL	2.6
1	C	600	ARG	2.5
1	C	845	ARG	2.5
1	C	584	ASN	2.5
1	C	242	THR	2.5
1	C	367	GLU	2.5
1	C	286	ARG	2.5
1	C	835	VAL	2.5
1	C	236	VAL	2.4
1	A	172	ILE	2.4
1	C	605	LYS	2.4
1	C	439	ASP	2.3

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Mol	Chain	Res	Type	RSRZ
1	C	158	TRP	2.3
1	C	394	ALA	2.3
1	C	834	LEU	2.3
1	C	596	ASP	2.3
1	C	314	THR	2.3
1	C	383	ASN	2.3
1	C	276	PRO	2.3
1	C	577	VAL	2.3
1	C	332	THR	2.2
1	C	840	ASP	2.2
1	C	370	LEU	2.2
1	C	234	PHE	2.2
1	C	631	GLN	2.2
1	A	330	TYR	2.2
1	C	5	TYR	2.2
1	C	592	ILE	2.2
1	C	736	LEU	2.2
1	A	555	ASN	2.2
1	C	187	GLU	2.2
1	C	597	GLU	2.2
1	C	376	THR	2.2
1	C	818	VAL	2.1
1	C	331	GLY	2.1
1	C	296	ALA	2.1
1	C	243	LEU	2.1
1	A	439	ASP	2.1
1	C	283	ASP	2.1
1	C	594	GLU	2.1
1	A	608	ALA	2.1
1	C	654	MET	2.1
1	A	597	GLU	2.1
1	C	281	PHE	2.1
1	C	655	THR	2.1
1	C	741	THR	2.1
1	A	377	GLU	2.1
1	C	807	ASN	2.1
1	C	312	PRO	2.1
1	C	586	VAL	2.1
1	C	325	PHE	2.1
1	C	585	TRP	2.1
1	C	846	LYS	2.0
1	C	164	THR	2.0

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Mol	Chain	Res	Type	RSRZ
1	C	790	ALA	2.0
1	C	166	LEU	2.0
1	C	381	LEU	2.0
1	C	365	GLY	2.0
1	C	820	ALA	2.0
2	D	38	A	2.0
1	C	479	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 oligosaccharides in this entry.

6.4 Ligands [i](#)

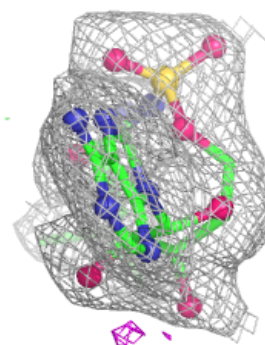
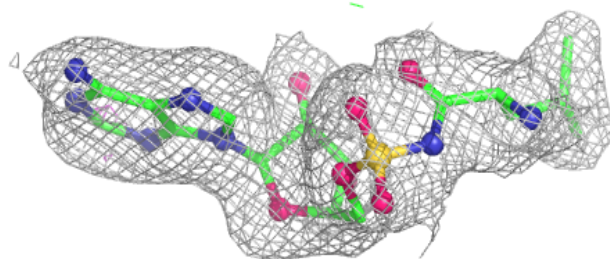
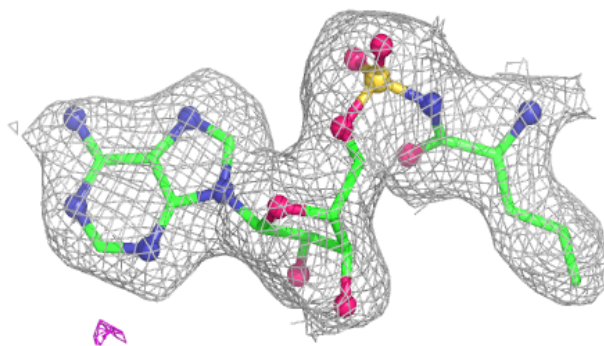
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	MG	B	101	1/1	0.88	0.27	54,54,54,54	0
3	LSS	C	901	31/31	0.96	0.07	40,42,42,43	0
3	LSS	A	1001	31/31	0.98	0.05	18,21,23,23	0

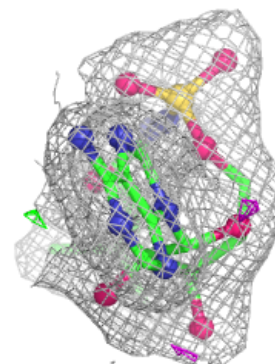
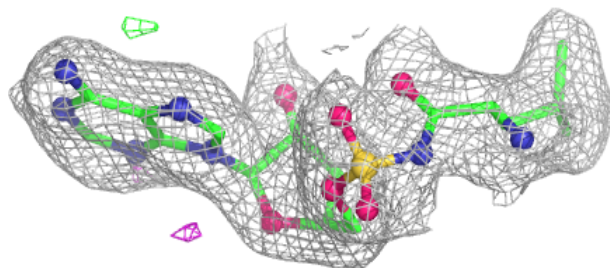
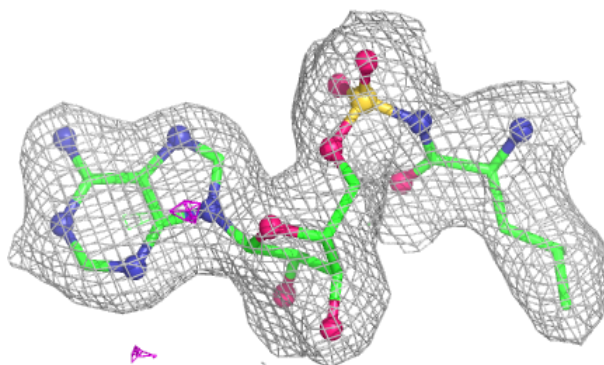
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around LSS C 901:

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

**Electron density around LSS A 1001:**

$2mF_o-DF_c$ (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.