



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 10:37 AM UTC

PDB ID : 5QQU / pdb_00005qqu
Title : PanDDA analysis group deposition – Crystal Structure of human ALAS2A in complex with Z1348371854
Authors : Bezerra, G.A.; Foster, W.; Bailey, H.; Shrestha, L.; Krojer, T.; Talon, R.; Brandao-Neto, J.; Douangamath, A.; Nicola, B.B.; von Delft, F.; Arrowsmith, C.H.; Edwards, A.; Bountra, C.; Brennan, P.E.; Yue, W.W.
Deposited on : 2019-05-22
Resolution : 1.55 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](#) ①) 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

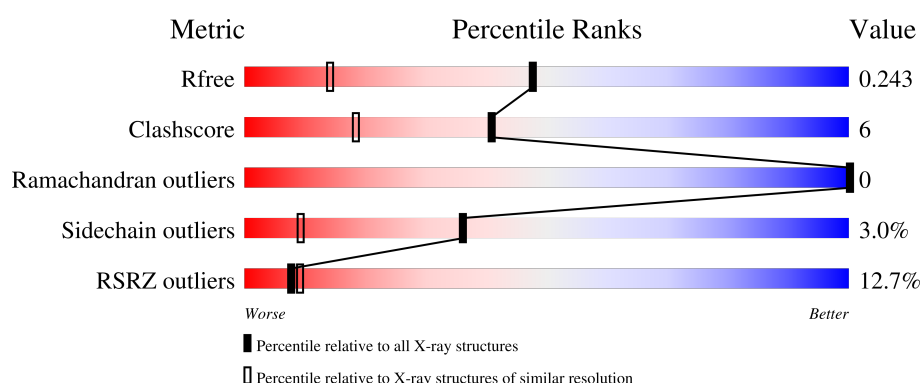
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.55 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	2145 (1.56-1.56)
Clashscore	190562	2189 (1.56-1.56)
Ramachandran outliers	187476	2153 (1.56-1.56)
Sidechain outliers	187428	2150 (1.56-1.56)
RSRZ outliers	180081	2146 (1.56-1.56)

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	469	12% 77% 13% • 9%
1	B	469	11% 79% 11% • 9%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6949 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 5-aminolevulinate synthase, erythroid-specific, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	428	Total	C	N	O	S	0	1	0
			3302	2102	577	601	22			
1	A	429	Total	C	N	O	S	0	1	0
			3322	2114	587	599	22			

There are 68 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	119	MET	-	initiating methionine	UNP P22557
B	120	GLY	-	expression tag	UNP P22557
B	121	HIS	-	expression tag	UNP P22557
B	122	HIS	-	expression tag	UNP P22557
B	123	HIS	-	expression tag	UNP P22557
B	124	HIS	-	expression tag	UNP P22557
B	125	HIS	-	expression tag	UNP P22557
B	126	HIS	-	expression tag	UNP P22557
B	127	SER	-	expression tag	UNP P22557
B	128	SER	-	expression tag	UNP P22557
B	129	GLY	-	expression tag	UNP P22557
B	130	VAL	-	expression tag	UNP P22557
B	131	ASP	-	expression tag	UNP P22557
B	132	LEU	-	expression tag	UNP P22557
B	133	GLY	-	expression tag	UNP P22557
B	134	THR	-	expression tag	UNP P22557
B	135	GLU	-	expression tag	UNP P22557
B	136	ASN	-	expression tag	UNP P22557
B	137	LEU	-	expression tag	UNP P22557
B	138	TYR	-	expression tag	UNP P22557
B	139	PHE	-	expression tag	UNP P22557
B	140	GLN	-	expression tag	UNP P22557
B	141	SER	-	expression tag	UNP P22557
B	142	MET	-	expression tag	UNP P22557
B	221	VAL	ALA	conflict	UNP P22557

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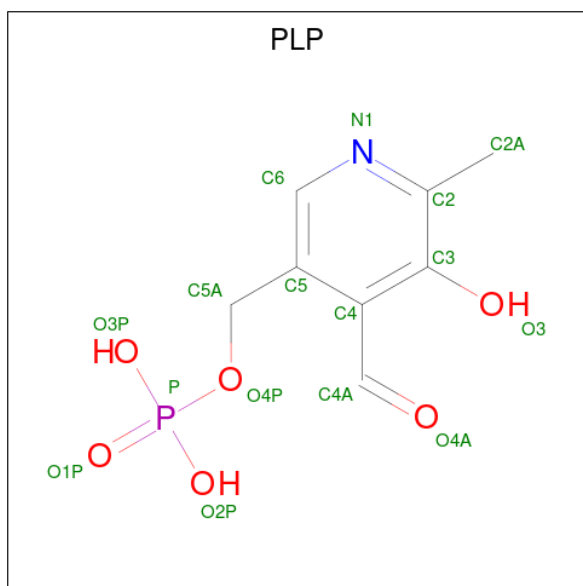
Chain	Residue	Modelled	Actual	Comment	Reference
B	579	GLY	-	expression tag	UNP P22557
B	580	PRO	-	expression tag	UNP P22557
B	581	GLN	-	expression tag	UNP P22557
B	582	TYR	-	expression tag	UNP P22557
B	583	VAL	-	expression tag	UNP P22557
B	584	THR	-	expression tag	UNP P22557
B	585	THR	-	expression tag	UNP P22557
B	586	TYR	-	expression tag	UNP P22557
B	587	ALA	-	expression tag	UNP P22557
A	119	MET	-	initiating methionine	UNP P22557
A	120	GLY	-	expression tag	UNP P22557
A	121	HIS	-	expression tag	UNP P22557
A	122	HIS	-	expression tag	UNP P22557
A	123	HIS	-	expression tag	UNP P22557
A	124	HIS	-	expression tag	UNP P22557
A	125	HIS	-	expression tag	UNP P22557
A	126	HIS	-	expression tag	UNP P22557
A	127	SER	-	expression tag	UNP P22557
A	128	SER	-	expression tag	UNP P22557
A	129	GLY	-	expression tag	UNP P22557
A	130	VAL	-	expression tag	UNP P22557
A	131	ASP	-	expression tag	UNP P22557
A	132	LEU	-	expression tag	UNP P22557
A	133	GLY	-	expression tag	UNP P22557
A	134	THR	-	expression tag	UNP P22557
A	135	GLU	-	expression tag	UNP P22557
A	136	ASN	-	expression tag	UNP P22557
A	137	LEU	-	expression tag	UNP P22557
A	138	TYR	-	expression tag	UNP P22557
A	139	PHE	-	expression tag	UNP P22557
A	140	GLN	-	expression tag	UNP P22557
A	141	SER	-	expression tag	UNP P22557
A	142	MET	-	expression tag	UNP P22557
A	221	VAL	ALA	conflict	UNP P22557
A	579	GLY	-	expression tag	UNP P22557
A	580	PRO	-	expression tag	UNP P22557
A	581	GLN	-	expression tag	UNP P22557
A	582	TYR	-	expression tag	UNP P22557
A	583	VAL	-	expression tag	UNP P22557
A	584	THR	-	expression tag	UNP P22557
A	585	THR	-	expression tag	UNP P22557
A	586	TYR	-	expression tag	UNP P22557

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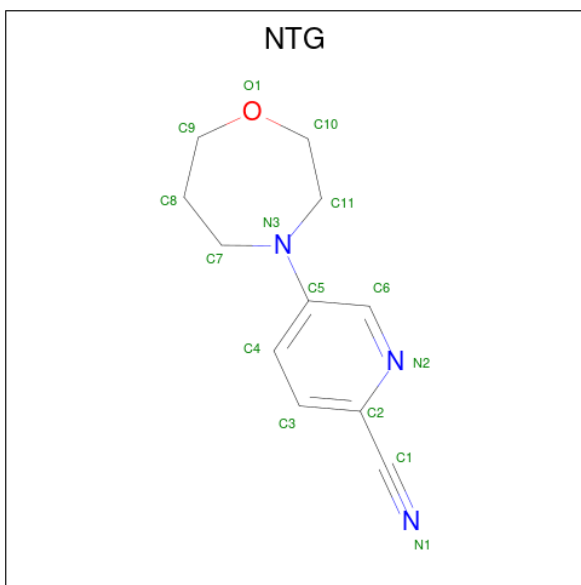
Chain	Residue	Modelled	Actual	Comment	Reference
A	587	ALA	-	expression tag	UNP P22557

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (CCD ID: PLP) (formula: $C_8H_{10}NO_6P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	N	O	P	0	0
			16	8	1	6	1		
2	A	1	Total	C	N	O	P	0	0
			16	8	1	6	1		

- Molecule 3 is 5-(1,4-oxazepan-4-yl)pyridine-2-carbonitrile (CCD ID: NTG) (formula: $C_{11}H_{13}N_3O$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total	C	N	O	0	0
			15	11	3	1		
3	A	1	Total	C	N	O	0	0
			15	11	3	1		
3	A	1	Total	C	N	O	0	0
			15	11	3	1		

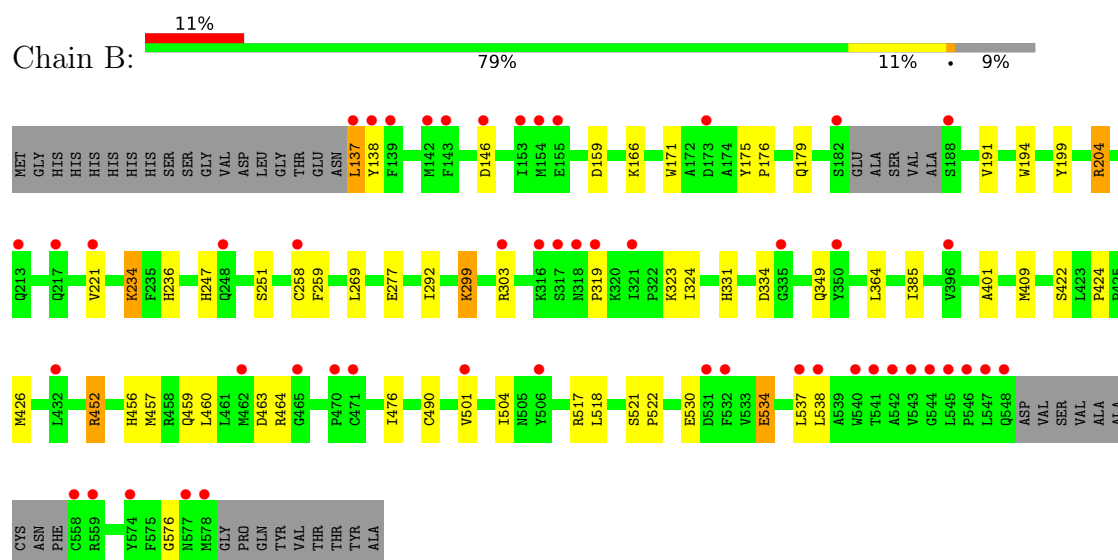
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	132	Total	O	0	0
			132	132		
4	A	116	Total	O	0	0
			116	116		

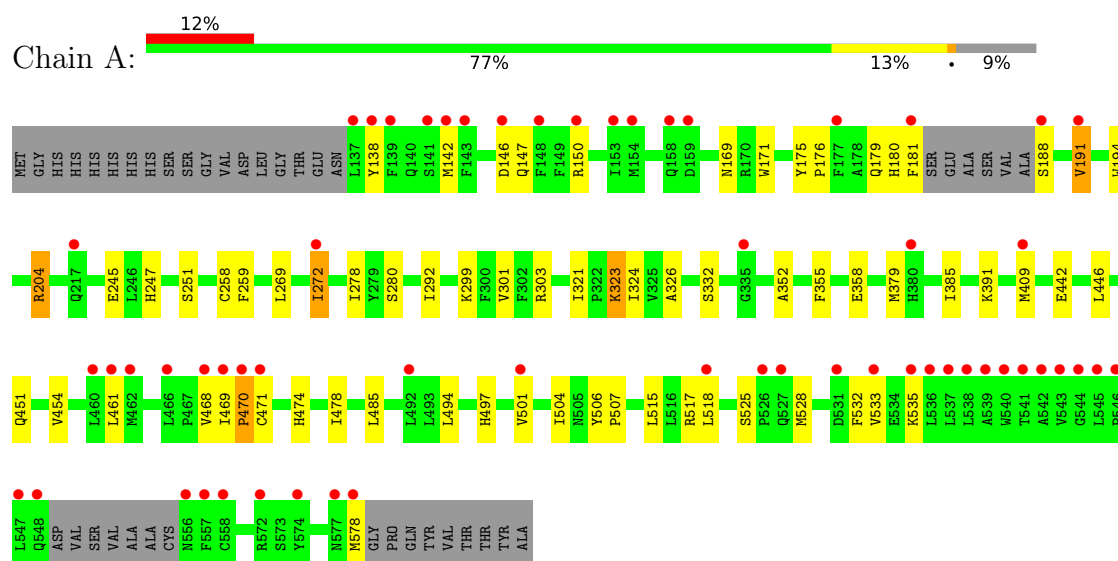
3 Residue-property plots [i](#)

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: 5-aminolevulinate synthase, erythroid-specific, mitochondrial



- Molecule 1: 5-aminolevulinate synthase, erythroid-specific, mitochondrial



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	126.10Å 108.53Å 75.72Å 90.00° 109.03° 90.00°	Depositor
Resolution (Å)	80.25 – 1.55 80.25 – 1.55	Depositor EDS
% Data completeness (in resolution range)	64.6 (80.25-1.55) 64.7 (80.25-1.55)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.60 (at 1.55Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.211 , 0.235 0.221 , 0.243	Depositor DCC
R_{free} test set	6856 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å ²)	19.3	Xtriage
Anisotropy	0.036	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 23.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6949	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.42% 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: PLP, NTG

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	1.06	0/3403	1.36	3/4608 (0.1%)
1	B	1.05	0/3381	1.36	3/4580 (0.1%)
All	All	1.06	0/6784	1.36	6/9188 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	B	452	ARG	CB-CA-C	5.66	119.77	110.88
1	B	259	PHE	N-CA-C	-5.51	105.18	111.07
1	A	138	TYR	CA-C-N	5.28	128.35	120.95
1	A	138	TYR	C-N-CA	5.28	128.35	120.95
1	B	576	GLY	CA-C-O	-5.15	117.83	122.57
1	A	470	PRO	CA-C-O	-5.09	115.61	121.11

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	137	LEU	Peptide

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	3322	0	3215	48	0
1	B	3302	0	3192	38	0
2	A	16	0	7	3	0
2	B	16	0	8	2	0
3	A	30	0	0	0	0
3	B	15	0	0	0	0
4	A	116	0	0	1	0
4	B	132	0	0	5	0
All	All	6949	0	6422	85	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 6.

All (85) 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:147:GLN:OE1	1:A:150:ARG:NH1	2.09	0.85
1:B:194:TRP:HB2	1:B:501:VAL:CG1	2.15	0.77
1:A:461:LEU:HD12	1:A:533:VAL:HG12	1.71	0.72
1:A:497:HIS:ND1	1:A:535:LYS:HE2	2.05	0.71
1:A:146:ASP:O	1:A:150:ARG:HG2	1.93	0.69
1:B:460:LEU:O	1:B:464:ARG:HG2	1.93	0.68
1:A:299:LYS:HB3	1:A:578:MET:HE1	1.76	0.68
1:B:171:TRP:CZ2	1:B:179:GLN:HG3	2.30	0.66
1:A:169:ASN:HD21	1:A:181:PHE:HE2	1.44	0.66
1:A:504:ILE:HD12	1:A:517:ARG:HB2	1.78	0.65
1:A:461:LEU:HD21	1:A:478:ILE:HD11	1.80	0.64
1:A:442:GLU:O	1:A:446:LEU:HD23	1.98	0.63
1:B:349:GLN:OE1	4:B:701:HOH:O	2.16	0.62
1:B:319:PRO:O	1:A:142:MET:HB3	1.98	0.62
1:A:461:LEU:HD12	1:A:533:VAL:CG1	2.30	0.61
1:B:258:CYS:HB3	2:B:601:PLP:O4P	2.01	0.60
1:A:504:ILE:CD1	1:A:517:ARG:HB2	2.32	0.60
1:B:194:TRP:HB2	1:B:501:VAL:HG13	1.83	0.58
1:B:194:TRP:HB2	1:B:501:VAL:HG12	1.83	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:175:TYR:CB	1:B:204:ARG:HD2	2.35	0.57
1:A:269:LEU:HB3	1:A:324:ILE:HD11	1.88	0.56
1:A:272:ILE:HG21	1:A:409:MET:SD	2.46	0.56
1:A:451:GLN:O	1:A:454:VAL:HG12	2.06	0.56
1:A:391:LYS:CE	2:A:601:PLP:H4A	2.36	0.56
1:B:175:TYR:HB2	1:B:204:ARG:HD2	1.88	0.56
1:A:470:PRO:C	1:A:471:CYS:HG	2.14	0.56
1:A:191:VAL:HG21	1:A:494:LEU:CD1	2.36	0.55
1:B:137:LEU:HD12	1:B:137:LEU:N	2.22	0.54
1:B:456:HIS:HE1	4:B:767:HOH:O	1.89	0.54
1:B:221:VAL:HG13	1:B:426:MET:HE1	1.90	0.53
1:A:175:TYR:HB2	1:A:204:ARG:HD2	1.91	0.53
1:A:470:PRO:C	1:A:471:CYS:SG	2.91	0.53
1:A:247:HIS:HA	1:A:379:MET:CE	2.39	0.53
1:A:461:LEU:CD1	1:A:533:VAL:HG12	2.39	0.53
1:A:504:ILE:CD1	1:A:517:ARG:CB	2.86	0.53
1:B:459:GLN:NE2	1:B:463:ASP:OD1	2.42	0.52
1:A:194:TRP:HB2	1:A:501:VAL:CG1	2.40	0.52
2:B:601:PLP:O3P	4:B:702:HOH:O	2.19	0.52
1:A:258:CYS:HB3	2:A:601:PLP:O4P	2.10	0.51
1:B:221:VAL:O	1:B:424:PRO:HB3	2.10	0.51
1:A:194:TRP:HB2	1:A:501:VAL:HG12	1.92	0.51
1:B:269:LEU:HD23	1:B:409:MET:HE1	1.93	0.51
1:B:236:HIS:NE2	1:B:422:SER:OG	2.42	0.50
1:B:464:ARG:HB3	1:B:537:LEU:HD11	1.93	0.50
1:B:331:HIS:HB3	1:B:334:ASP:OD1	2.12	0.49
1:B:504:ILE:HD12	1:B:517:ARG:HB2	1.93	0.49
1:B:303:ARG:NH1	4:B:706:HOH:O	2.46	0.49
1:A:171:TRP:CZ2	1:A:179:GLN:HB2	2.48	0.49
1:B:534:GLU:O	1:B:538:LEU:HD23	2.12	0.49
1:B:521:SER:HB2	1:B:522:PRO:HD2	1.95	0.48
1:A:323:LYS:HG3	1:A:352:ALA:HB2	1.96	0.47
1:A:461:LEU:CD2	1:A:478:ILE:HD11	2.43	0.47
1:B:277:GLU:OE1	1:B:323:LYS:HE3	2.15	0.47
1:A:518:LEU:HD21	1:A:532:PHE:CZ	2.50	0.47
1:A:451:GLN:O	1:A:454:VAL:CG1	2.63	0.47
1:B:385:ILE:CG2	1:B:401:ALA:HB3	2.44	0.46
1:A:451:GLN:HA	1:A:454:VAL:HG12	1.97	0.46
1:A:469:ILE:HG22	1:A:471:CYS:SG	2.55	0.46
1:B:292:ILE:HG21	1:B:299:LYS:HG3	1.96	0.46
1:A:504:ILE:HD12	1:A:517:ARG:CB	2.44	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:234:LYS:HG2	1:A:169:ASN:ND2	2.30	0.45
1:A:179:GLN:HG3	1:A:188:SER:OG	2.15	0.45
1:A:303:ARG:NH1	4:A:704:HOH:O	2.49	0.45
1:B:504:ILE:CD1	1:B:517:ARG:HB2	2.47	0.45
1:B:175:TYR:HB3	1:B:204:ARG:HD2	1.99	0.44
1:B:269:LEU:HB3	1:B:324:ILE:HD11	1.99	0.44
1:B:476:ILE:HB	1:B:518:LEU:HB2	1.99	0.44
1:B:171:TRP:CZ2	1:B:179:GLN:CG	3.01	0.44
1:B:199:TYR:CD2	1:B:364:LEU:HD11	2.52	0.43
1:B:247:HIS:ND1	1:B:385:ILE:HD13	2.34	0.43
1:A:506:TYR:CG	1:A:507:PRO:HA	2.53	0.43
1:A:278:ILE:HG21	1:A:292:ILE:HG12	2.01	0.43
1:A:332:SER:HB3	2:A:601:PLP:H2A1	1.99	0.43
1:A:180:HIS:O	1:A:188:SER:HA	2.19	0.43
1:B:166:LYS:HE3	1:B:490:CYS:SG	2.59	0.42
1:A:358:GLU:HG3	1:A:385:ILE:HD11	2.01	0.42
1:B:194:TRP:CZ3	1:B:457:MET:HE1	2.54	0.42
1:A:280:SER:O	1:A:301:VAL:HA	2.19	0.42
1:A:259:PHE:C	1:A:259:PHE:CD1	2.98	0.42
1:A:525:SER:OG	1:A:528:MET:HG3	2.20	0.41
1:A:515:LEU:C	1:A:515:LEU:HD12	2.44	0.41
1:B:504:ILE:CD1	1:B:517:ARG:CB	2.99	0.41
1:B:452:ARG:NH1	4:B:713:HOH:O	2.54	0.41
1:A:326:ALA:HA	1:A:355:PHE:O	2.21	0.41
1:A:454:VAL:HG21	1:A:474:HIS:HA	2.01	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	424/469 (90%)	413 (97%)	11 (3%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	423/469 (90%)	408 (96%)	15 (4%)	0	100	100
All	All	847/938 (90%)	821 (97%)	26 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	347/396 (88%)	337 (97%)	10 (3%)	37	10
1	B	345/396 (87%)	334 (97%)	11 (3%)	34	8
All	All	692/792 (87%)	671 (97%)	21 (3%)	36	9

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	138	TYR
1	B	146	ASP
1	B	159	ASP
1	B	176	PRO
1	B	191	VAL
1	B	204	ARG
1	B	234	LYS
1	B	251	SER
1	B	299	LYS
1	B	530	GLU
1	B	534	GLU
1	A	176	PRO
1	A	191	VAL
1	A	204	ARG
1	A	245	GLU
1	A	251	SER
1	A	272	ILE
1	A	321	ILE

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Mol	Chain	Res	Type
1	A	323	LYS
1	A	468	VAL
1	A	485	LEU

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

Mol	Chain	Res	Type
1	B	180	HIS
1	B	459	GLN
1	A	217	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

5 ligands are 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	$\# Z > 2$
3	NTG	B	602	-	16,16,16	0.37	0	15,20,20	0.97	1 (6%)
2	PLP	A	601	-	16,16,16	0.81	1 (6%)	20,23,23	0.82	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NTG	A	602	-	16,16,16	0.56	0	15,20,20	0.93	1 (6%)
3	NTG	A	603	-	16,16,16	0.39	0	15,20,20	1.46	1 (6%)
2	PLP	B	601	-	16,16,16	0.87	1 (6%)	20,23,23	1.12	2 (10%)

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	NTG	B	602	-	-	0/4/15/15	0/1/2/2
2	PLP	A	601	-	-	3/8/8/8	0/1/1/1
3	NTG	A	602	-	-	0/4/15/15	0/1/2/2
3	NTG	A	603	-	-	0/4/15/15	0/1/2/2
2	PLP	B	601	-	-	3/8/8/8	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	601	PLP	P-O4P	2.23	1.67	1.60
2	A	601	PLP	P-O4P	2.15	1.67	1.60

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	603	NTG	C9-O1-C10	5.20	119.38	114.09
3	B	602	NTG	C9-O1-C10	3.02	117.17	114.09
2	B	601	PLP	C3-C4-C4A	-2.78	116.02	119.84
3	A	602	NTG	C9-O1-C10	2.56	116.69	114.09
2	B	601	PLP	O3P-P-O2P	2.01	115.33	107.80

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	601	PLP	C3-C4-C4A-O4A
2	B	601	PLP	C5A-O4P-P-O1P
2	B	601	PLP	C3-C4-C4A-O4A
2	A	601	PLP	C5-C4-C4A-O4A
2	B	601	PLP	C4-C5-C5A-O4P

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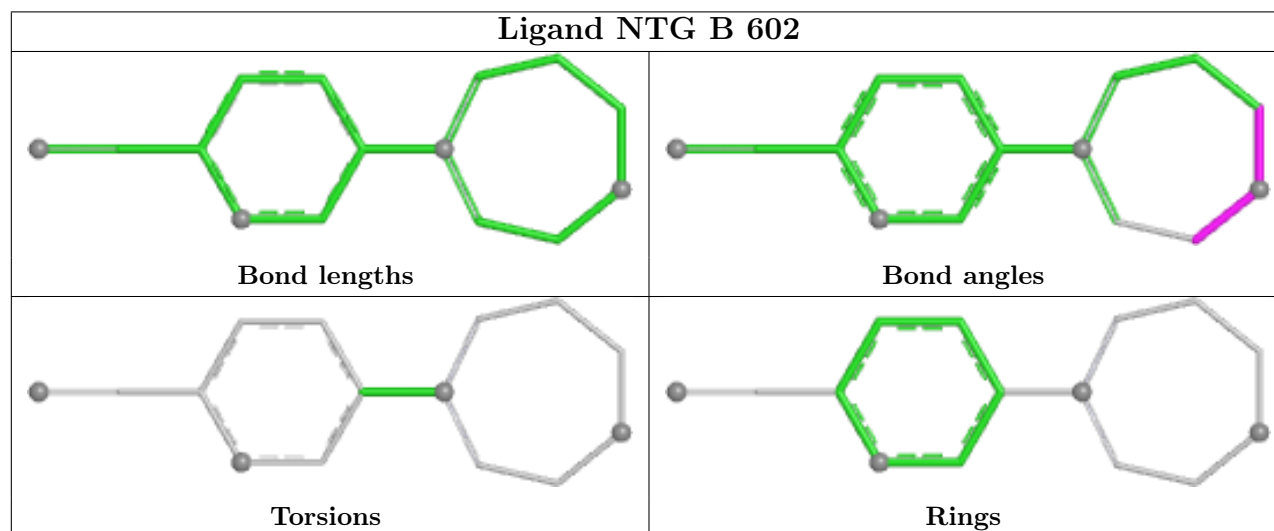
Mol	Chain	Res	Type	Atoms
2	A	601	PLP	C5A-O4P-P-O2P

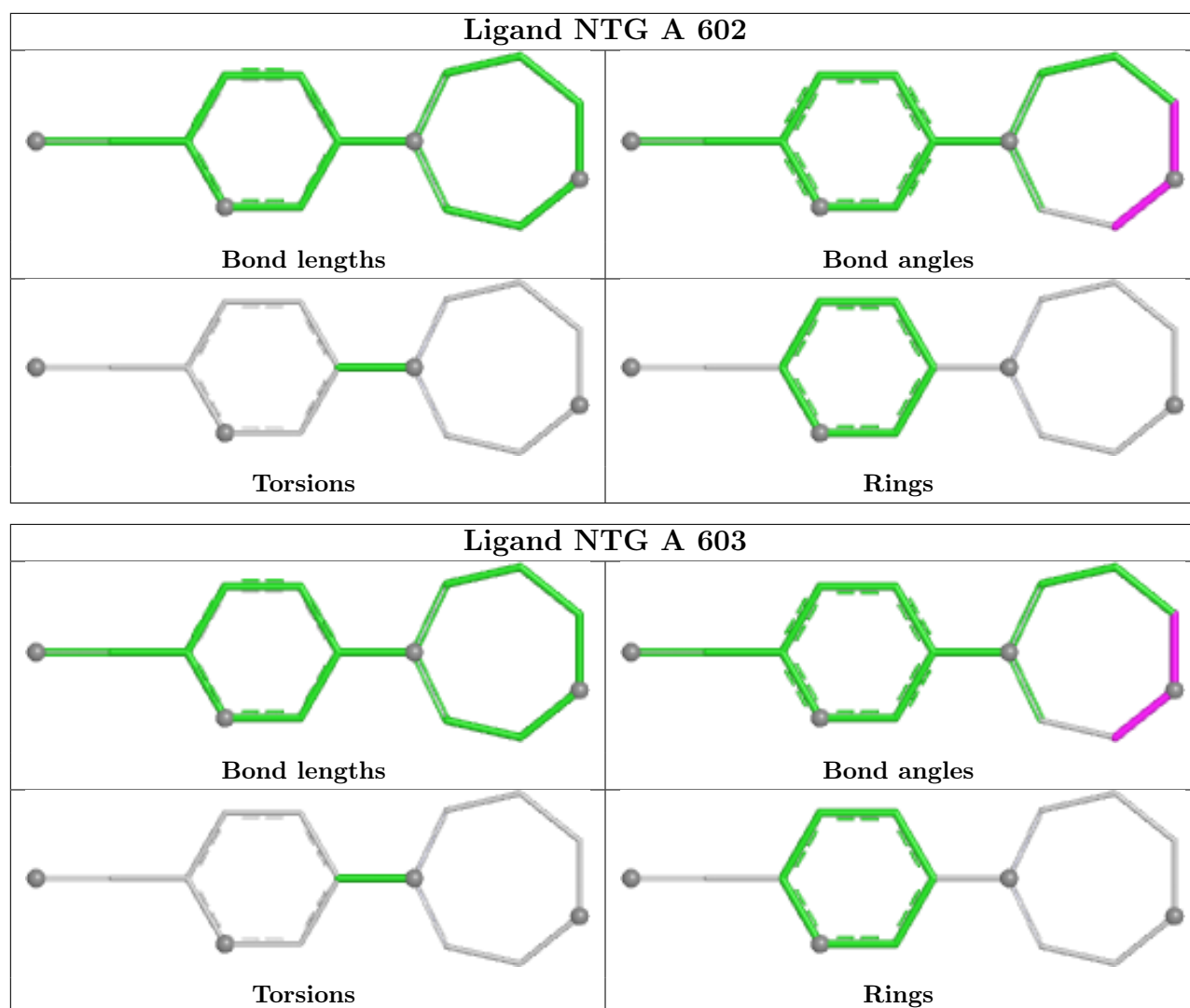
There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	601	PLP	3	0
2	B	601	PLP	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 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	429/469 (91%)	0.70	58 (13%) 7 8	4, 20, 41, 72	4 (0%)
1	B	428/469 (91%)	0.79	51 (11%) 9 10	5, 20, 39, 66	7 (1%)
All	All	857/938 (91%)	0.75	109 (12%) 8 9	4, 20, 39, 72	11 (1%)

All (109) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	143	PHE	13.8
1	A	557	PHE	13.5
1	B	350	TYR	12.8
1	A	177	PHE	12.4
1	B	143	PHE	12.3
1	B	574	TYR	11.6
1	B	532	PHE	11.4
1	B	506	TYR	10.5
1	A	181	PHE	9.9
1	A	380[A]	HIS	9.8
1	A	137	LEU	9.5
1	B	248[A]	GLN	9.2
1	B	558	CYS	8.5
1	B	138	TYR	7.9
1	B	137	LEU	7.6
1	B	531	ASP	7.5
1	B	547	LEU	7.3
1	A	545	LEU	6.9
1	A	139	PHE	6.4
1	A	547	LEU	6.2
1	B	548	GLN	6.0
1	A	537	LEU	6.0
1	B	538	LEU	5.6
1	B	221	VAL	5.1

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Mol	Chain	Res	Type	RSRZ
1	A	548	GLN	5.1
1	B	545	LEU	5.1
1	A	191	VAL	4.8
1	B	541	THR	4.8
1	B	577	ASN	4.1
1	A	470	PRO	4.0
1	A	154	MET	4.0
1	B	146	ASP	3.9
1	B	546	PRO	3.9
1	A	578	MET	3.9
1	A	542	ALA	3.9
1	B	153	ILE	3.8
1	B	471	CYS	3.7
1	B	537	LEU	3.7
1	A	535	LYS	3.7
1	A	556	ASN	3.6
1	A	546	PRO	3.5
1	B	188	SER	3.5
1	A	538	LEU	3.5
1	B	542	ALA	3.5
1	A	153	ILE	3.5
1	B	182	SER	3.4
1	A	335	GLY	3.4
1	B	335	GLY	3.3
1	B	559	ARG	3.2
1	B	154	MET	3.1
1	A	558	CYS	3.0
1	B	540	TRP	3.0
1	A	540	TRP	3.0
1	A	158	GLN	3.0
1	A	577	ASN	2.9
1	A	461	LEU	2.9
1	A	541	THR	2.9
1	A	188	SER	2.9
1	A	138	TYR	2.9
1	A	543	VAL	2.9
1	B	317	SER	2.7
1	A	142	MET	2.7
1	A	539	ALA	2.7
1	A	533	VAL	2.7
1	B	142	MET	2.7
1	B	316	LYS	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	146	ASP	2.7
1	B	139	PHE	2.7
1	B	544	GLY	2.6
1	B	543	VAL	2.6
1	A	468	VAL	2.6
1	A	574	TYR	2.5
1	A	150	ARG	2.5
1	A	471	CYS	2.5
1	A	527	GLN	2.5
1	B	319	PRO	2.5
1	B	213	GLN	2.5
1	B	465	GLY	2.4
1	A	409	MET	2.4
1	A	462	MET	2.4
1	A	159	ASP	2.4
1	A	518	LEU	2.4
1	B	470	PRO	2.4
1	A	526	PRO	2.4
1	B	501	VAL	2.3
1	A	466	LEU	2.3
1	A	536	LEU	2.3
1	A	141	SER	2.3
1	B	321	ILE	2.3
1	A	501	VAL	2.2
1	A	217	GLN	2.2
1	B	432	LEU	2.2
1	A	148	PHE	2.2
1	A	460	LEU	2.1
1	B	173	ASP	2.1
1	A	531	ASP	2.1
1	B	155	GLU	2.1
1	A	272	ILE	2.1
1	B	303	ARG	2.1
1	B	217	GLN	2.1
1	B	396	VAL	2.1
1	A	492	LEU	2.1
1	A	469	ILE	2.0
1	B	462	MET	2.0
1	A	544	GLY	2.0
1	A	572	ARG	2.0
1	B	258	CYS	2.0
1	B	578	MET	2.0

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Mol	Chain	Res	Type	RSRZ
1	B	318	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](#)

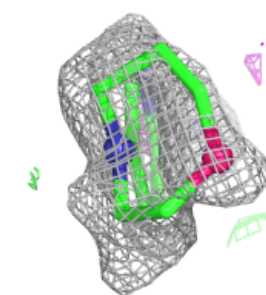
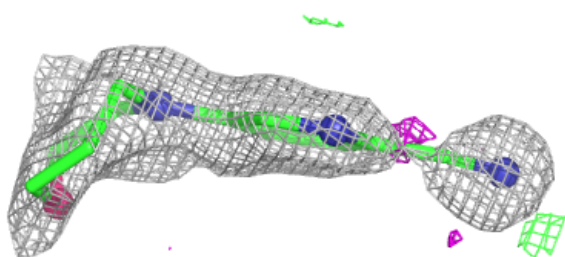
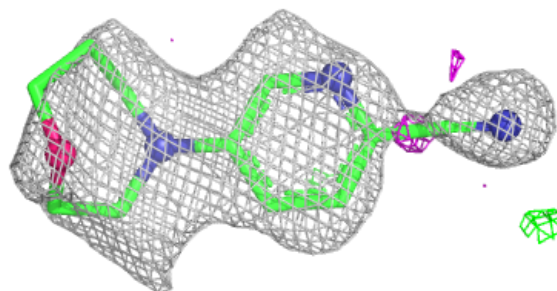
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists 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
3	NTG	A	602	15/15	0.69	0.24	38,51,62,62	0
3	NTG	A	603	15/15	0.80	0.18	33,40,50,51	0
3	NTG	B	602	15/15	0.82	0.17	34,41,45,46	0
2	PLP	B	601	16/16	0.88	0.13	18,25,32,39	0
2	PLP	A	601	16/16	0.91	0.10	19,25,31,41	0

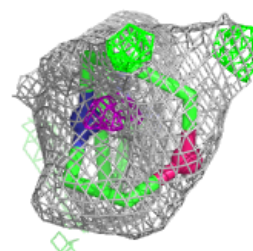
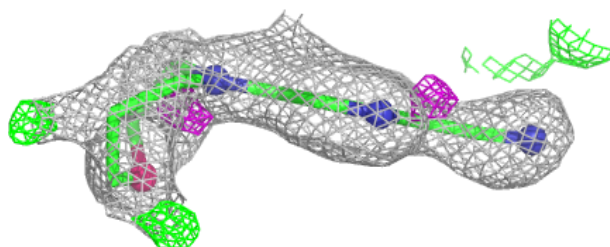
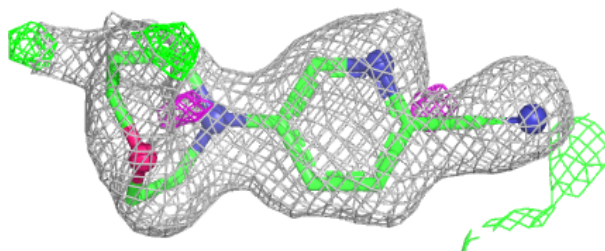
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around NTG A 602:

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

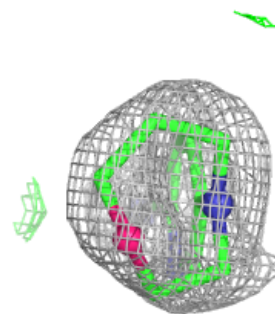
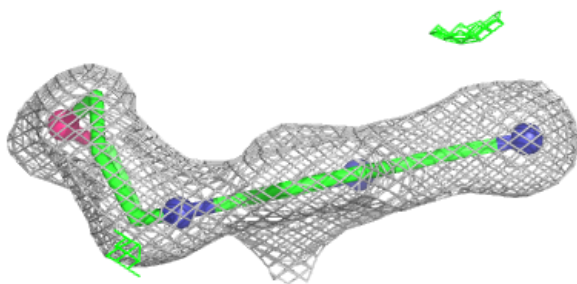
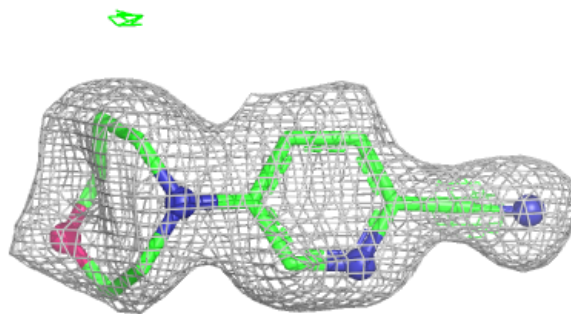
**Electron density around NTG A 603:**

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



Electron density around NTG B 602:

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



6.5 Other polymers ⓘ

There are no such residues in this entry.