



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:06 AM UTC

PDB ID : 5BTD / pdb_00005btd
Title : Crystal structure of a topoisomerase II complex
Authors : Blower, T.R.; Williamson, B.H.; Kerns, R.J.; Berger, J.M.
Deposited on : 2015-06-03
Resolution : 2.50 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	:	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

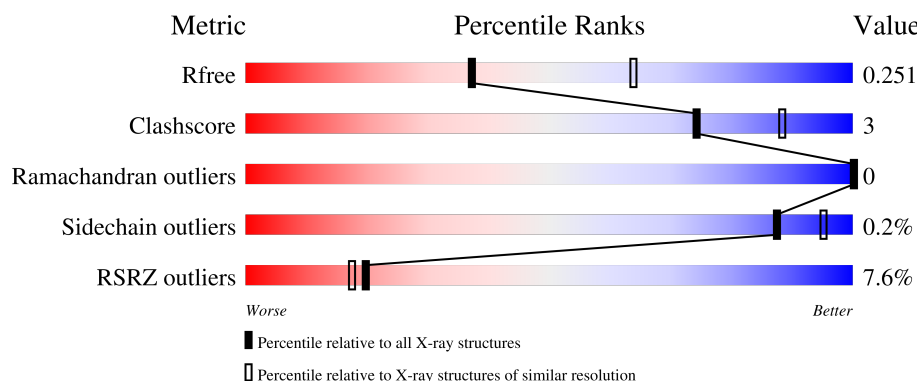
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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.



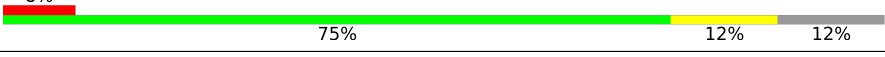
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	503	7% 91% 5%
1	C	503	5% 91% 5%
2	B	253	7% 91% 6%
2	D	253	8% 92% 6%
3	E	24	46% 75% 12% 12%

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
3	H	24	
4	F	24	
4	G	24	

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

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
1	PTR	A	129	-	-	X	-
1	PTR	C	129	-	-	X	-

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 25989 atoms, of which 12526 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 DNA gyrase subunit A.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
1	A	487	Total	C	H	N	O	P	S	0	1	0
			7692	2388	3854	704	732	1	13			
1	C	487	Total	C	H	N	O	P	S	0	1	0
			7689	2388	3851	704	732	1	13			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	501	ILE	-	expression tag	UNP P9WG47
A	502	GLY	-	expression tag	UNP P9WG47
A	503	SER	-	expression tag	UNP P9WG47
A	504	GLY	-	expression tag	UNP P9WG47
C	501	ILE	-	expression tag	UNP P9WG47
C	502	GLY	-	expression tag	UNP P9WG47
C	503	SER	-	expression tag	UNP P9WG47
C	504	GLY	-	expression tag	UNP P9WG47

- Molecule 2 is a protein called DNA gyrase subunit B.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	245	Total	C	H	N	O	S	0	0	0
			3906	1217	1974	348	360	7			
2	D	247	Total	C	H	N	O	S	0	0	0
			3930	1224	1984	351	364	7			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	423	SER	-	expression tag	UNP P9WG45
B	424	ASN	-	expression tag	UNP P9WG45
B	425	ALA	-	expression tag	UNP P9WG45
D	423	SER	-	expression tag	UNP P9WG45

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
D	424	ASN	-	expression tag	UNP P9WG45
D	425	ALA	-	expression tag	UNP P9WG45

- Molecule 3 is a DNA chain called DNA substrate 24-mer GGTCATGAATGACTATGCAC GTAA.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
3	E	21	Total	C	H	N	O	P	0	21	0
			615	196	205	74	120	20			
3	H	21	Total	C	H	N	O	P	0	21	0
			616	196	206	74	120	20			

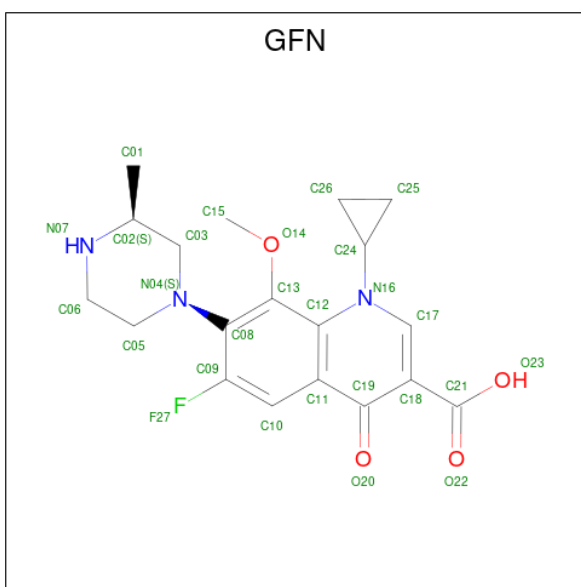
- Molecule 4 is a DNA chain called DNA substrate 24-mer TTACGTGCATAGTCATTCAT GACC.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
4	F	21	Total	C	H	N	O	P	0	21	0
			618	196	208	74	120	20			
4	G	21	Total	C	H	N	O	P	0	21	0
			612	196	202	74	120	20			

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	1	Total	Mg	0	0
			1	1		
5	D	1	Total	Mg	0	0
			1	1		
5	E	1	Total	Mg	0	0
			1	1		
5	F	1	Total	Mg	0	0
			1	1		

- Molecule 6 is 1-cyclopropyl-6-fluoro-8-methoxy-7-[(3S)-3-methylpiperazin-1-yl]-4-oxo-1,4-dihydroquinoline-3-carboxylic acid (CCD ID: GFN) (formula: C₁₉H₂₂FN₃O₄).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
6	E	1	Total	C	F	H	N	O	0	0
			48	19	1	21	3	4		
6	G	1	Total	C	F	H	N	O	0	0
			48	19	1	21	3	4		

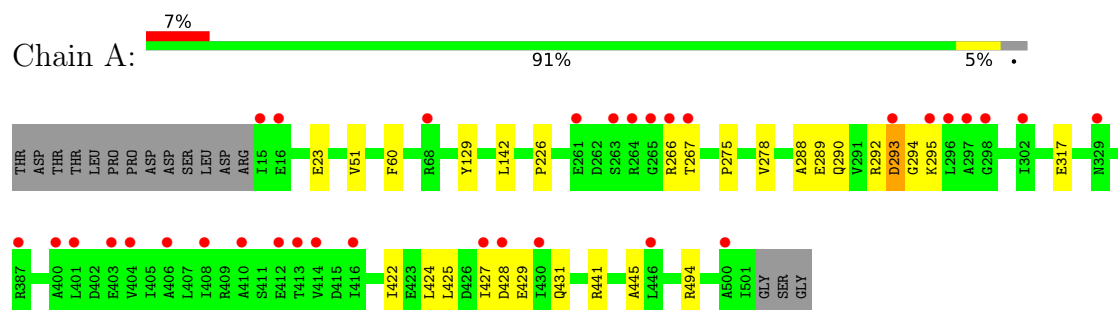
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	98	Total	O	0	0
			98	98		
7	B	33	Total	O	0	0
			33	33		
7	C	29	Total	O	0	0
			29	29		
7	D	25	Total	O	0	0
			25	25		
7	E	10	Total	O	0	0
			10	10		
7	F	7	Total	O	0	0
			7	7		
7	G	4	Total	O	0	0
			4	4		
7	H	5	Total	O	0	0
			5	5		

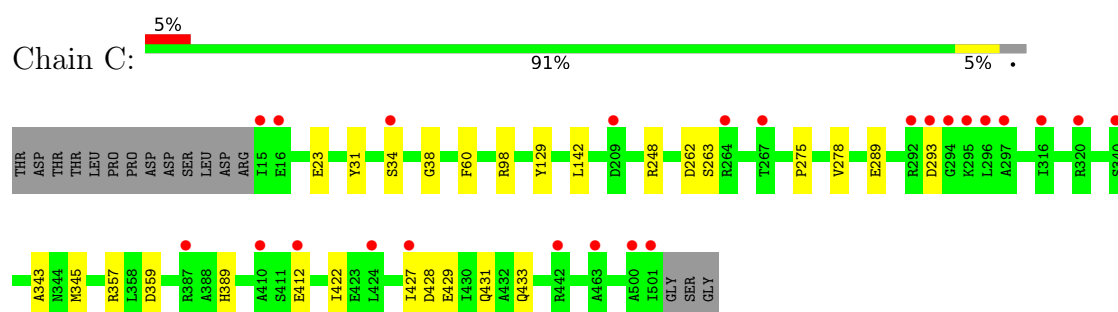
3 Residue-property plots [i](#)

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.

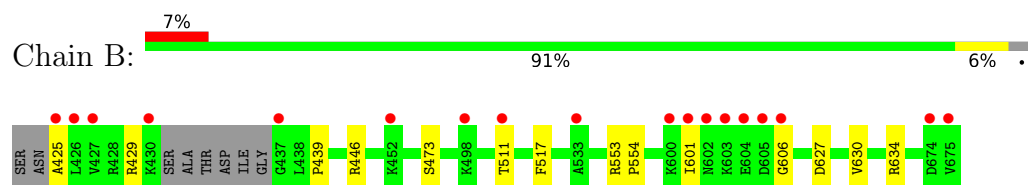
• Molecule 1: DNA gyrase subunit A



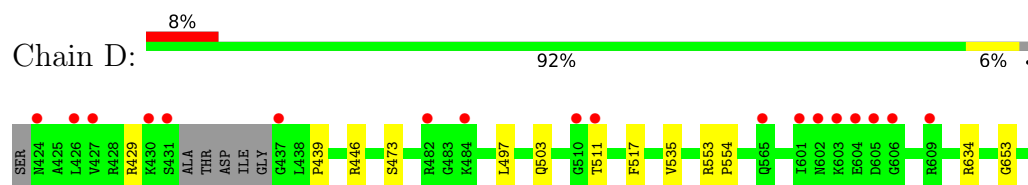
• Molecule 1: DNA gyrase subunit A



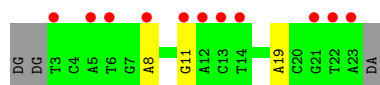
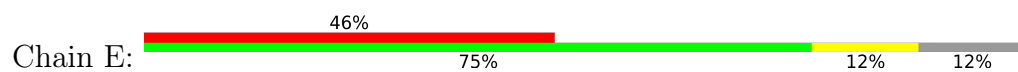
• Molecule 2: DNA gyrase subunit B



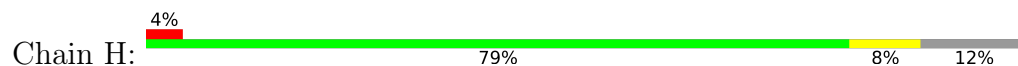
• Molecule 2: DNA gyrase subunit B



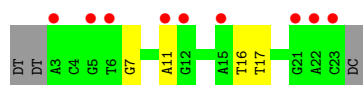
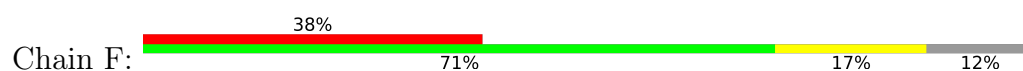
• Molecule 3: DNA substrate 24-mer GGTCATGAATGACTATGCACGTAA



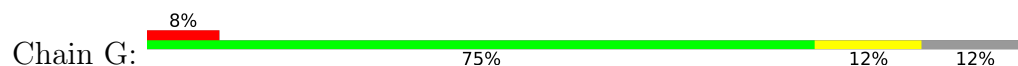
- Molecule 3: DNA substrate 24-mer GGTCATGAATGACTATGCACGTAA



- Molecule 4: DNA substrate 24-mer TTACGTGCATAGTCATTCATGACC



- Molecule 4: DNA substrate 24-mer TTACGTGCATAGTCATTCATGACC



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	107.91Å 83.16Å 129.20Å 90.00° 108.65° 90.00°	Depositor
Resolution (Å)	47.39 – 2.50 47.39 – 2.50	Depositor EDS
% Data completeness (in resolution range)	97.9 (47.39-2.50) 97.6 (47.39-2.50)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.18 (at 2.51Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.215 , 0.246 0.221 , 0.251	Depositor DCC
R_{free} test set	3700 reflections (4.33%)	wwPDB-VP
Wilson B-factor (Å ²)	46.2	Xtriage
Anisotropy	0.164	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 52.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	25989	wwPDB-VP
Average B, all atoms (Å ²)	69.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.94% 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: GFN, MG, PTR

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	0.34	0/3881	0.66	1/5253 (0.0%)
1	C	0.33	0/3881	0.64	0/5253
2	B	0.31	0/1960	0.62	0/2634
2	D	0.32	0/1974	0.61	0/2653
3	E	0.21	0/458	0.46	0/704
3	H	0.23	0/458	0.50	0/704
4	F	0.18	0/458	0.45	0/704
4	G	0.22	0/458	0.46	0/704
All	All	0.31	0/13528	0.62	1/18609 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	293	ASP	N-CA-C	-5.17	101.98	109.59

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	3838	3854	3853	27	0
1	C	3838	3851	3853	27	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	1932	1974	1973	8	0
2	D	1946	1984	1984	13	0
3	E	410	205	205	5	0
3	H	410	206	207	5	0
4	F	410	208	208	5	0
4	G	410	202	203	5	0
5	B	1	0	0	0	0
5	D	1	0	0	0	0
5	E	1	0	0	0	0
5	F	1	0	0	0	0
6	E	27	21	0	0	0
6	G	27	21	0	0	0
7	A	98	0	0	3	0
7	B	33	0	0	1	0
7	C	29	0	0	0	0
7	D	25	0	0	0	0
7	E	10	0	0	0	0
7	F	7	0	0	0	0
7	G	4	0	0	0	0
7	H	5	0	0	0	0
All	All	13463	12526	12486	68	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 (68) 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:129:PTR:O2P	3:H:11[B]:DG:C5'	1.68	1.39
1:A:129:PTR:O2P	4:F:11[A]:DA:C5'	1.73	1.35
1:C:289:GLU:O	1:C:293:ASP:OD2	1.63	1.14
1:A:129:PTR:O2P	3:H:11[B]:DG:C4'	2.09	0.99
1:A:267:THR:HG21	7:A:688:HOH:O	1.73	0.89
1:A:290:GLN:O	1:A:293:ASP:O	1.91	0.88
1:C:129:PTR:O2P	4:G:11[B]:DA:C5'	2.26	0.83
1:A:288:ALA:O	1:A:292:ARG:HG3	1.79	0.83
2:D:653:GLY:O	2:D:659:ARG:NH2	2.12	0.82
1:A:129:PTR:O2P	3:H:11[B]:DG:H4'	1.78	0.80
1:C:98:ARG:NH1	4:F:7[A]:DG:OP1	2.16	0.78
1:A:129:PTR:O2P	4:F:11[A]:DA:H4'	1.83	0.75
1:C:248:ARG:NH1	4:G:21[B]:DG:OP1	2.21	0.73

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:290:GLN:C	1:A:293:ASP:O	2.32	0.73
1:A:129:PTR:O2P	4:F:11[A]:DA:C4'	2.18	0.70
1:C:357:ARG:NH1	1:C:359:ASP:OD1	2.24	0.69
1:C:289:GLU:O	1:C:293:ASP:CG	2.38	0.67
1:A:266:ARG:HD3	1:A:317:GLU:OE2	1.94	0.67
2:D:429:ARG:NH1	2:D:439:PRO:O	2.29	0.66
2:D:659:ARG:NH1	3:E:19[A]:DA:OP1	2.28	0.66
1:A:289:GLU:HA	1:A:292:ARG:HD3	1.79	0.65
1:A:267:THR:CG2	7:A:688:HOH:O	2.39	0.64
1:C:129:PTR:O2P	3:E:11[A]:DG:H4'	1.99	0.63
2:B:429:ARG:NH1	2:B:439:PRO:O	2.33	0.62
1:C:262:ASP:OD1	1:C:263:SER:N	2.34	0.61
1:C:428:ASP:OD1	1:C:429:GLU:N	2.37	0.57
2:B:425:ALA:N	7:B:802:HOH:O	2.37	0.56
1:A:129:PTR:P	3:H:11[B]:DG:C5'	2.91	0.56
1:A:441:ARG:NH2	1:C:433:GLN:OE1	2.38	0.55
1:A:428:ASP:OD1	1:A:429:GLU:N	2.39	0.55
1:C:129:PTR:O2P	3:E:11[A]:DG:C5'	2.55	0.54
1:C:129:PTR:O2P	4:G:11[B]:DA:C4'	2.55	0.54
1:A:23:GLU:OE1	2:B:634:ARG:NH1	2.42	0.52
1:A:51:VAL:HG11	3:E:8[A]:DA:H5'	1.92	0.52
1:C:129:PTR:O2P	3:E:11[A]:DG:C4'	2.57	0.50
1:A:427:ILE:CG2	1:A:431:GLN:HB2	2.41	0.50
1:C:129:PTR:O2P	4:G:11[B]:DA:H4'	2.11	0.50
1:C:31:TYR:HA	2:D:535:VAL:CG1	2.42	0.49
1:A:226:PRO:O	1:A:494:ARG:NH2	2.46	0.49
2:D:497:LEU:O	2:D:503:GLN:NE2	2.45	0.48
2:B:511:THR:HG21	2:B:517:PHE:CE2	2.48	0.48
1:C:23:GLU:OE1	2:D:634:ARG:NH1	2.47	0.47
2:B:446:ARG:NH1	2:B:473:SER:OG	2.48	0.47
1:C:343:ALA:HB1	1:C:345:MET:HE3	1.97	0.47
2:B:627:ASP:HB3	2:B:630:VAL:HG22	1.97	0.46
1:C:31:TYR:HD1	2:D:535:VAL:HG12	1.81	0.46
1:C:60:PHE:HB2	1:C:142:LEU:HD13	1.98	0.46
1:C:34:SER:OG	2:D:535:VAL:HG11	2.15	0.45
1:C:389:HIS:O	1:C:431:GLN:NE2	2.46	0.44
2:D:511:THR:HG21	2:D:517:PHE:CE2	2.52	0.44
1:C:275:PRO:HG2	1:C:278:VAL:HG21	1.99	0.44
2:D:446:ARG:NH2	2:D:473:SER:OG	2.51	0.44
1:A:275:PRO:HG2	1:A:278:VAL:HG21	1.99	0.44
4:F:16[A]:DT:C6	4:F:17[A]:DT:H72	2.53	0.44

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:31:TYR:HA	2:D:535:VAL:HG13	2.01	0.43
1:C:98:ARG:NH1	3:H:7[B]:DG:OP1	2.52	0.42
2:B:553:ARG:N	2:B:554:PRO:CD	2.83	0.42
1:A:441:ARG:NH1	7:A:604:HOH:O	2.50	0.42
1:A:425:LEU:HB2	1:A:427:ILE:CD1	2.49	0.42
1:C:427:ILE:CG2	1:C:431:GLN:HB2	2.50	0.42
2:D:553:ARG:N	2:D:554:PRO:CD	2.83	0.42
1:A:445:ALA:HB3	1:C:412:GLU:HA	2.02	0.41
1:A:294:GLY:C	1:A:295:LYS:HG3	2.45	0.41
2:B:601:ILE:HG22	2:B:606:GLY:HA2	2.03	0.41
1:C:34:SER:O	1:C:38:GLY:N	2.47	0.41
1:A:60:PHE:HB2	1:A:142:LEU:HD13	2.02	0.40
2:D:659:ARG:NH1	4:G:19[B]:DA:OP1	2.54	0.40
1:A:424:LEU:HG	1:A:425:LEU:HG	2.04	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	485/503 (96%)	466 (96%)	19 (4%)	0	100	100
1	C	485/503 (96%)	469 (97%)	16 (3%)	0	100	100
2	B	241/253 (95%)	233 (97%)	8 (3%)	0	100	100
2	D	243/253 (96%)	235 (97%)	8 (3%)	0	100	100
All	All	1454/1512 (96%)	1403 (96%)	51 (4%)	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	407/420 (97%)	406 (100%)	1 (0%)	87	95
1	C	407/420 (97%)	406 (100%)	1 (0%)	87	95
2	B	205/211 (97%)	205 (100%)	0	100	100
2	D	207/211 (98%)	207 (100%)	0	100	100
All	All	1226/1262 (97%)	1224 (100%)	2 (0%)	87	95

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	422	ILE
1	C	422	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	161	GLN
1	A	207	ASN
1	A	277	GLN
1	A	431	GLN
1	A	449	GLN
2	B	666	ASN
1	C	161	GLN
1	C	207	ASN
1	C	277	GLN
1	C	336	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	PTR	C	129	1	15,16,17	0.75	0	17,22,24	1.01	0
1	PTR	A	129	1	15,16,17	0.74	0	17,22,24	0.91	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
1	PTR	C	129	1	-	0/10/11/13	0/1/1/1
1	PTR	A	129	1	-	0/10/11/13	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	C	129	PTR	6	0
1	A	129	PTR	7	0

5.5 Carbohydrates

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 6 ligands modelled in this entry, 4 are 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
6	GFN	G	101	5	30,30,30	1.46	6 (20%)	42,45,45	2.30	7 (16%)
6	GFN	E	101	5	30,30,30	1.45	5 (16%)	42,45,45	2.27	7 (16%)

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
6	GFN	G	101	5	-	5/14/26/26	0/4/4/4
6	GFN	E	101	5	-	1/14/26/26	0/4/4/4

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	E	101	GFN	C11-C19	-3.06	1.42	1.48
6	G	101	GFN	C11-C19	-2.94	1.42	1.48
6	G	101	GFN	C18-C21	2.43	1.52	1.48
6	E	101	GFN	C08-N04	2.26	1.47	1.40
6	E	101	GFN	C18-C21	2.24	1.52	1.48
6	G	101	GFN	C08-N04	2.24	1.47	1.40
6	E	101	GFN	C05-N04	-2.19	1.43	1.46
6	G	101	GFN	C05-N04	-2.18	1.43	1.46
6	E	101	GFN	C12-C13	2.12	1.43	1.40
6	G	101	GFN	C12-C13	2.12	1.43	1.40
6	G	101	GFN	C18-C19	-2.03	1.39	1.44

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	G	101	GFN	C25-C24-N16	11.89	137.67	118.87
6	E	101	GFN	C25-C24-N16	11.66	137.32	118.87
6	G	101	GFN	C13-C08-C09	3.58	119.40	115.92
6	E	101	GFN	C13-C08-C09	3.51	119.34	115.92
6	E	101	GFN	C24-N16-C17	-3.18	115.07	119.74
6	G	101	GFN	C24-N16-C17	-3.09	115.21	119.74
6	G	101	GFN	C12-N16-C17	2.51	121.86	119.82
6	E	101	GFN	O23-C21-C18	2.38	121.25	115.69
6	G	101	GFN	C11-C19-C18	2.36	118.61	115.64
6	E	101	GFN	C12-N16-C17	2.28	121.67	119.82
6	E	101	GFN	O22-C21-C18	-2.09	118.34	122.67
6	G	101	GFN	C17-C18-C19	-2.06	118.42	119.94
6	E	101	GFN	C11-C19-C18	2.03	118.20	115.64
6	G	101	GFN	C10-C09-C08	-2.01	120.35	123.34

There are no chirality outliers.

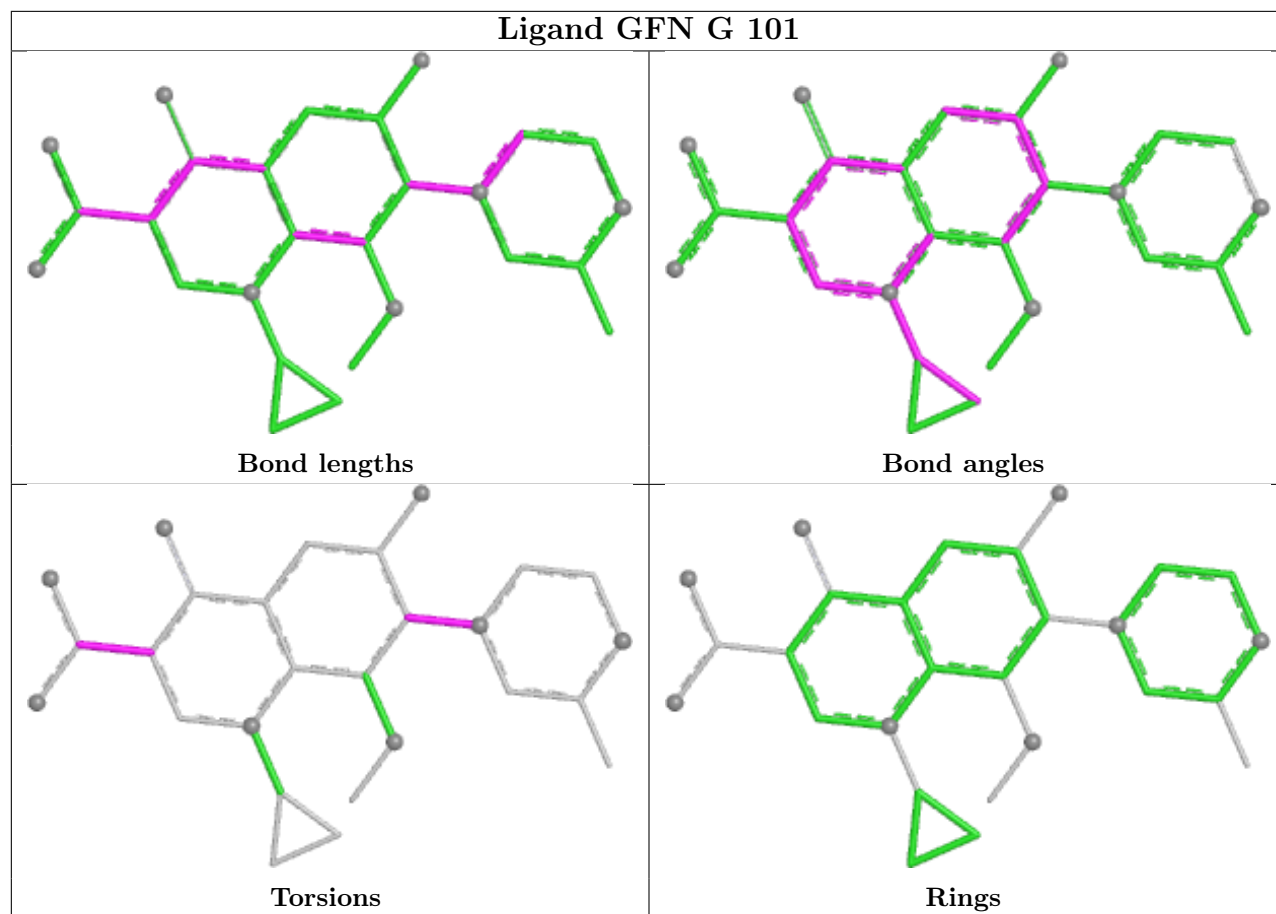
All (6) torsion outliers are listed below:

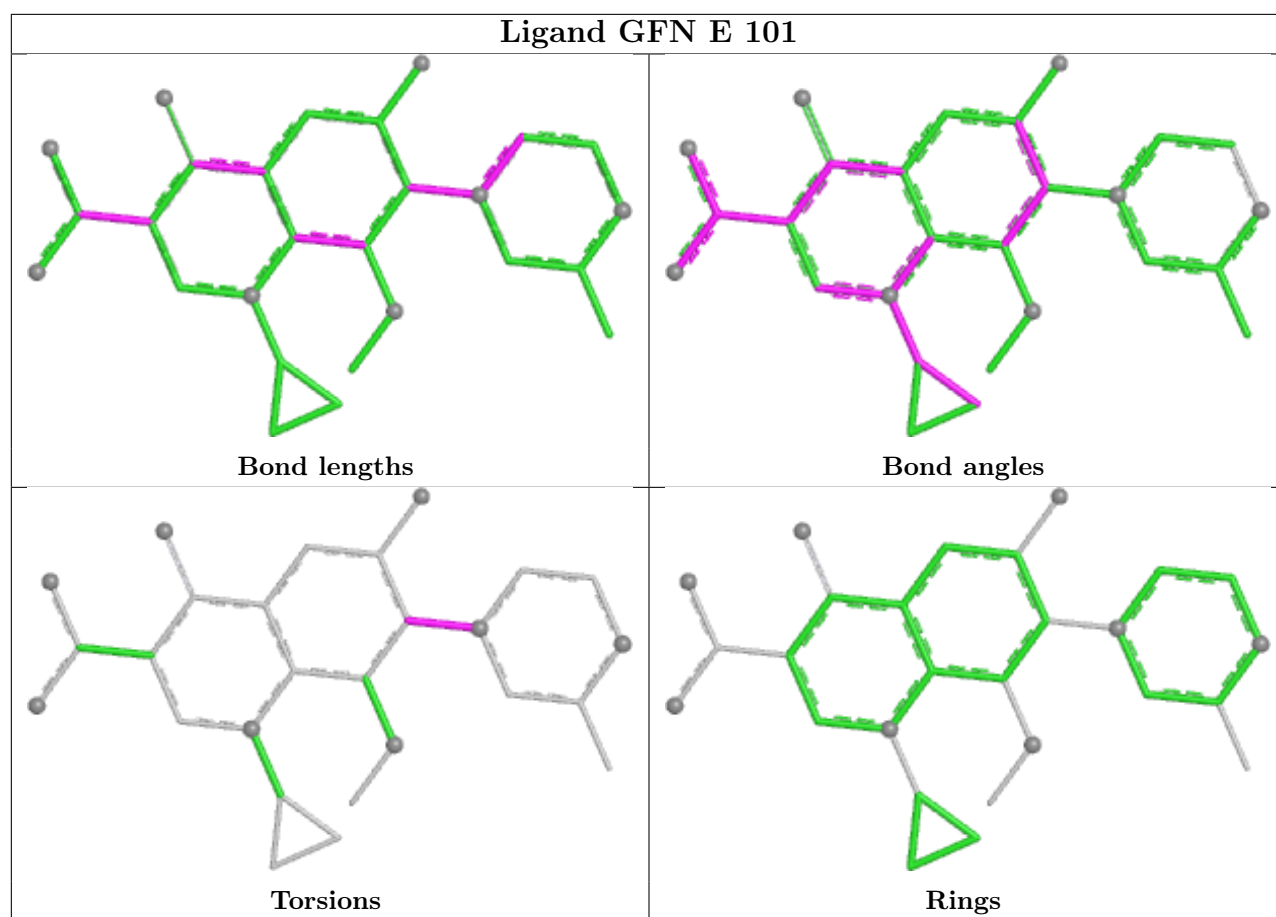
Mol	Chain	Res	Type	Atoms
6	G	101	GFN	C19-C18-C21-O22
6	G	101	GFN	C19-C18-C21-O23
6	G	101	GFN	C17-C18-C21-O22
6	G	101	GFN	C17-C18-C21-O23
6	E	101	GFN	C09-C08-N04-C05
6	G	101	GFN	C09-C08-N04-C05

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	486/503 (96%)	0.33	33 (6%) 23 20	22, 57, 114, 163	1 (0%)
1	C	486/503 (96%)	0.36	24 (4%) 35 31	25, 59, 112, 172	1 (0%)
2	B	245/253 (96%)	0.52	18 (7%) 21 19	42, 68, 105, 141	0
2	D	247/253 (97%)	0.50	20 (8%) 18 15	38, 64, 102, 144	0
3	E	21/24 (87%)	1.97	11 (52%) 0 0	28, 52, 93, 96	21 (100%)
3	H	21/24 (87%)	0.31	1 (4%) 35 31	11, 28, 58, 87	21 (100%)
4	F	21/24 (87%)	1.76	9 (42%) 0 0	33, 49, 98, 101	21 (100%)
4	G	21/24 (87%)	0.38	2 (9%) 14 12	15, 21, 67, 75	21 (100%)
All	All	1548/1608 (96%)	0.44	118 (7%) 20 17	11, 61, 111, 172	86 (5%)

All (118) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	E	22[A]	DT	5.6
2	D	426	LEU	5.1
2	B	430	LYS	4.5
2	D	605	ASP	4.3
2	D	437	GLY	4.2
1	A	413	THR	4.2
2	D	601	ILE	4.2
2	B	437	GLY	4.1
2	B	427	VAL	4.1
2	D	431	SER	4.1
2	B	426	LEU	4.1
1	A	265	GLY	4.0
2	B	602	ASN	3.9
2	B	601	ILE	3.8
2	B	605	ASP	3.8
3	E	8[A]	DA	3.8

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
3	H	3[B]	DT	3.7
3	E	23[A]	DA	3.7
1	A	387	ARG	3.6
3	E	11[A]	DG	3.6
2	D	674	ASP	3.6
1	A	406	ALA	3.6
1	A	410	ALA	3.6
1	C	293	ASP	3.5
2	D	424	ASN	3.4
2	B	452	LYS	3.4
2	D	675	VAL	3.4
2	D	602	ASN	3.4
1	C	296	LEU	3.4
4	G	23[B]	DC	3.3
1	A	264	ARG	3.3
1	A	266	ARG	3.3
2	D	427	VAL	3.3
2	B	603	LYS	3.3
1	C	267	THR	3.1
1	A	412	GLU	3.1
4	F	22[A]	DA	3.1
2	B	511	THR	3.1
1	A	297	ALA	3.1
1	A	296	LEU	3.0
3	E	12[A]	DA	3.0
1	A	293	ASP	2.9
1	C	501	ILE	2.9
1	A	295	LYS	2.8
2	B	675	VAL	2.8
1	A	267	THR	2.8
1	A	15	ILE	2.8
1	C	295	LYS	2.8
2	B	533	ALA	2.7
2	B	606	GLY	2.7
2	D	511	THR	2.7
3	E	14[A]	DT	2.7
3	E	3[A]	DT	2.7
1	C	442	ARG	2.7
1	C	427	ILE	2.6
4	F	5[A]	DG	2.6
4	F	23[A]	DC	2.6
2	D	484	LYS	2.6

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	C	297	ALA	2.6
1	C	410	ALA	2.6
1	C	387	ARG	2.5
1	A	416	ILE	2.5
1	A	302	ILE	2.5
1	A	403	GLU	2.5
1	C	15	ILE	2.5
1	A	414	VAL	2.5
2	D	604	GLU	2.5
1	A	430	ILE	2.5
1	C	316	ILE	2.5
2	B	425	ALA	2.5
2	B	674	ASP	2.4
1	C	209	ASP	2.4
4	G	22[B]	DA	2.4
1	A	298	GLY	2.3
1	A	68	ARG	2.3
3	E	21[A]	DG	2.3
1	C	16	GLU	2.3
1	C	412	GLU	2.3
1	C	340	SER	2.3
4	F	21[A]	DG	2.3
1	A	446	LEU	2.3
1	A	329	ASN	2.2
1	C	463	ALA	2.2
1	A	401	LEU	2.2
1	A	261	GLU	2.2
1	C	320	ARG	2.2
3	E	13[A]	DC	2.2
1	C	294	GLY	2.2
1	C	500	ALA	2.2
1	A	408	ILE	2.2
1	C	292	ARG	2.2
2	D	609	ARG	2.2
1	A	404	VAL	2.2
3	E	6[A]	DT	2.2
2	D	430	LYS	2.2
1	C	424	LEU	2.1
2	D	606	GLY	2.1
1	A	263	SER	2.1
1	A	428	ASP	2.1
1	C	34	SER	2.1

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
2	D	565	GLN	2.1
1	A	400	ALA	2.1
1	A	427	ILE	2.1
2	B	600	LYS	2.1
4	F	12[A]	DG	2.1
4	F	15[A]	DA	2.1
2	D	510	GLY	2.1
1	C	264	ARG	2.1
2	D	603	LYS	2.1
2	B	604	GLU	2.1
4	F	6[A]	DT	2.1
3	E	5[A]	DA	2.0
4	F	3[A]	DA	2.0
1	A	500	ALA	2.0
2	D	482	ARG	2.0
4	F	11[A]	DA	2.0
1	A	16	GLU	2.0
2	B	498	LYS	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	PTR	A	129	16/17	0.90	0.13	37,42,52,63	0
1	PTR	C	129	16/17	0.92	0.12	43,50,60,83	0

6.3 Carbohydrates [i](#)

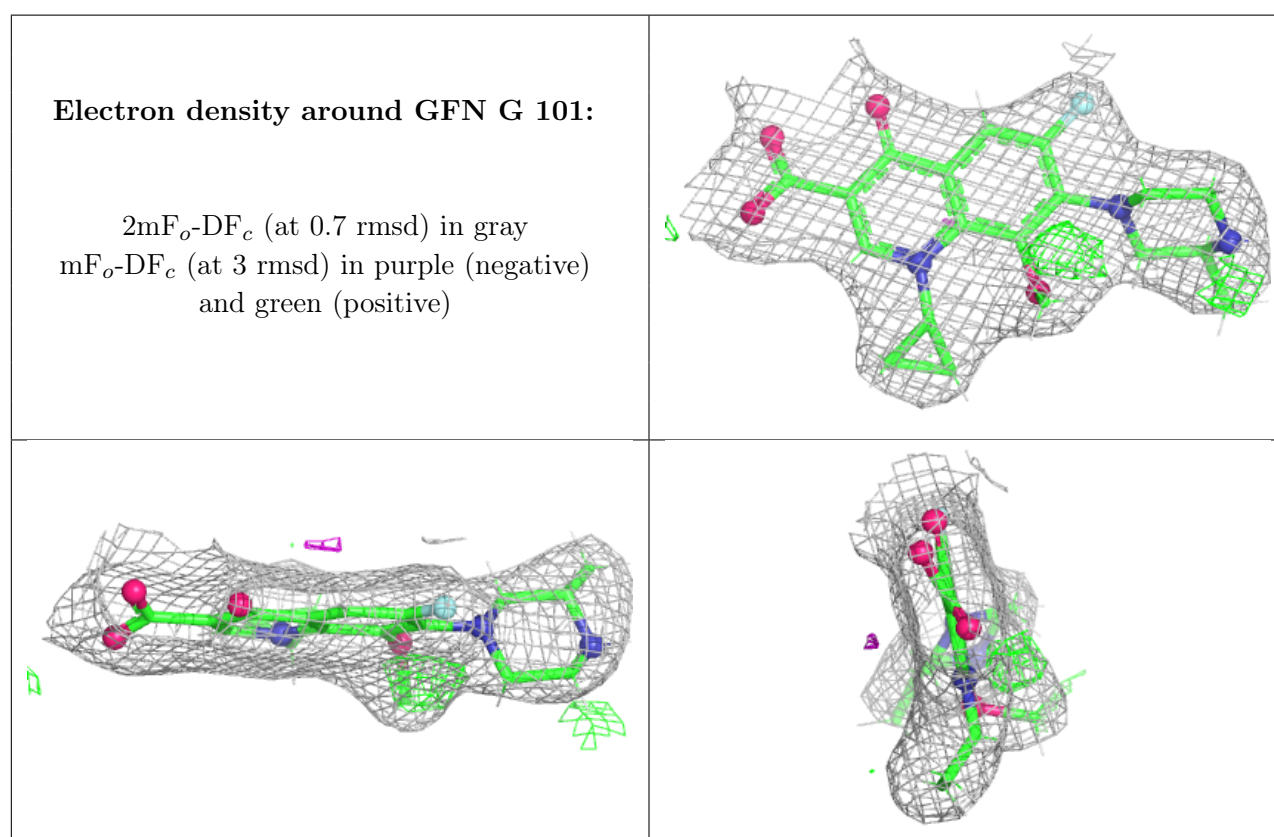
There are no oligosaccharides in this entry.

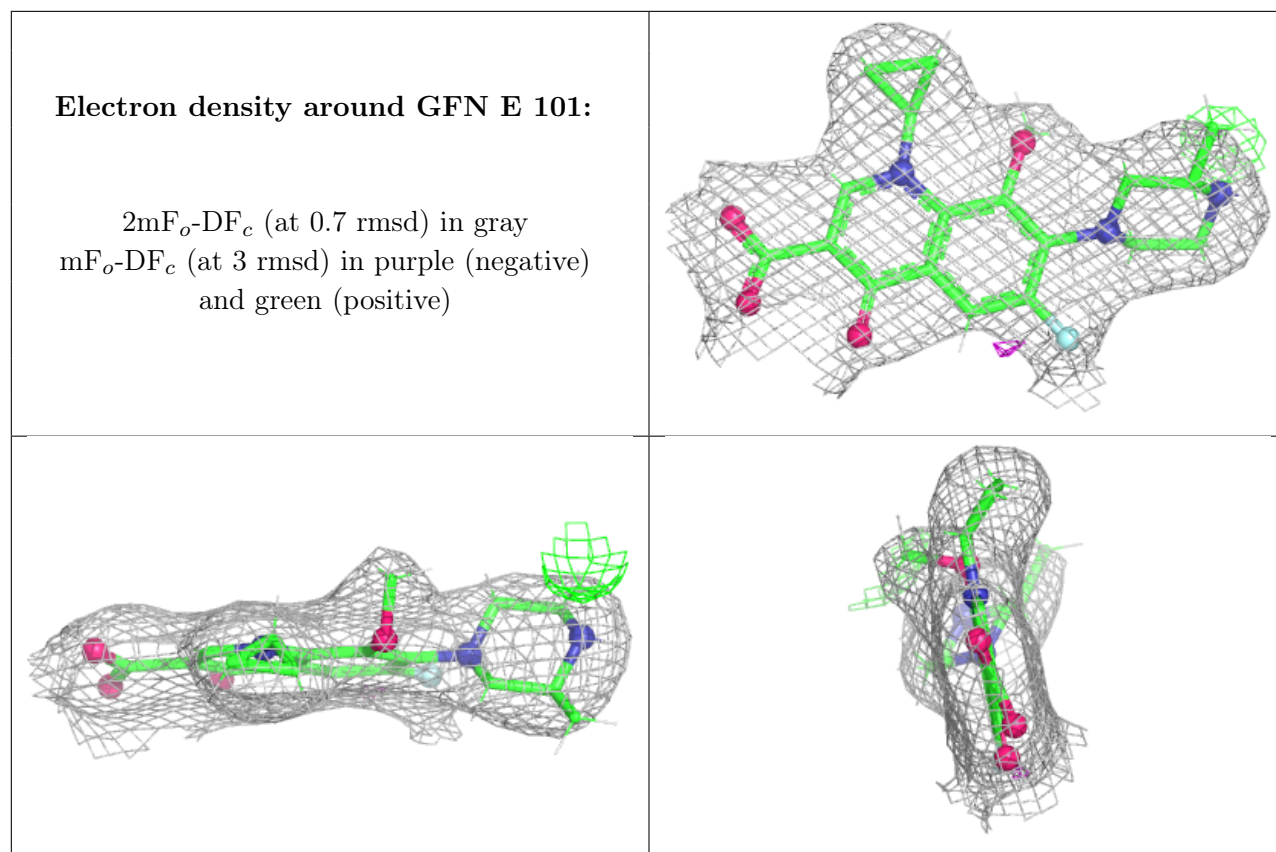
6.4 Ligands [i](#)

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
6	GFN	G	101	27/27	0.94	0.10	38,49,62,63	0
6	GFN	E	101	27/27	0.95	0.09	35,46,58,59	0
5	MG	D	701	1/1	0.97	0.04	31,31,31,31	0
5	MG	E	102	1/1	0.98	0.04	40,40,40,40	0
5	MG	F	101	1/1	0.98	0.04	48,48,48,48	0
5	MG	B	701	1/1	0.99	0.03	34,34,34,34	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.