Full wwPDB X-ray Structure Validation Report (i)

Feb 5, 2026 – 12:12 pm GMT

PDB ID	:	9QC1 / pdb_00009qc1
Title	:	Crystal structure of the neurotensin receptor 1 in complex with the small-molecule full agonist cp28a
Authors	:	Deluigi, M.; Hilge, M.; Plueckthun, A.
Deposited on	:	2025-03-04
Resolution	:	3.12 Å(reported)

The following versions of software and data (see references (i)) were used in the production of this report:

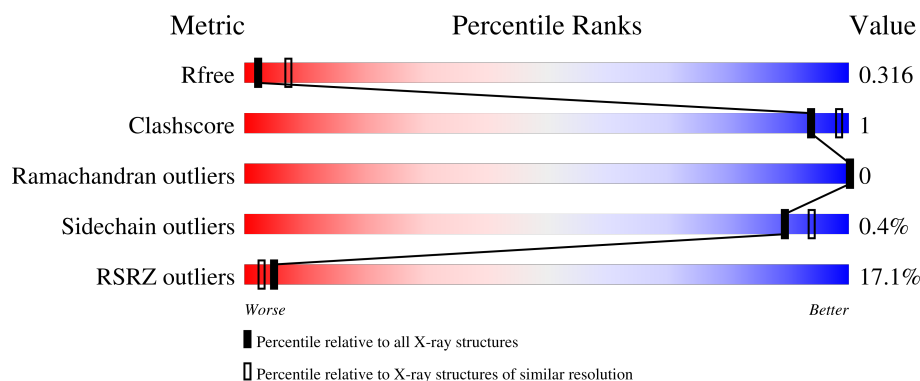|		
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.47

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 3.12 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	Percentile Ranks	Value
Rfree		0.316
Clashscore		1
Ramachandran outliers		0
Sidechain outliers		0.4%
RSRZ outliers		17.1%

■ Percentile relative to all X-ray structures
▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	164625	1668 (3.14-3.10)
Clashscore	180529	1788 (3.14-3.10)
Ramachandran outliers	177936	1696 (3.14-3.10)
Sidechain outliers	177891	1696 (3.14-3.10)
RSRZ outliers	164620	1668 (3.14-3.10)

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 <=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	500	16% ... 88% ... 9%

2 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 6263 atoms, of which 3070 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 Neurotensin receptor type 1, DARPin fusion.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	455	6153	2022	3026	524	570	11	182	0	0

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	46	GLY	-	expression tag	UNP P20789
A	47	PRO	-	expression tag	UNP P20789
A	48	GLY	-	expression tag	UNP P20789
A	49	SER	-	expression tag	UNP P20789
A	83	GLY	SER	engineered mutation	UNP P20789
A	86	LEU	ALA	engineered mutation	UNP P20789
A	101	ARG	THR	engineered mutation	UNP P20789
A	103	ASP	HIS	engineered mutation	UNP P20789
A	105	TYR	HIS	engineered mutation	UNP P20789
A	119	PHE	LEU	engineered mutation	UNP P20789
A	121	LEU	MET	engineered mutation	UNP P20789
A	124	ASP	GLU	engineered mutation	UNP P20789
A	143	LYS	ARG	engineered mutation	UNP P20789
A	150	GLU	ASP	engineered mutation	UNP P20789
A	161	VAL	ALA	engineered mutation	UNP P20789
A	167	LEU	ARG	engineered mutation	UNP P20789
A	213	LEU	ARG	engineered mutation	UNP P20789
A	234	LEU	VAL	engineered mutation	UNP P20789
A	235	ARG	LYS	engineered mutation	UNP P20789
A	240	LEU	VAL	engineered mutation	UNP P20789
A	253	ALA	ILE	engineered mutation	UNP P20789
A	260	ALA	ILE	engineered mutation	UNP P20789
A	262	ARG	ASN	engineered mutation	UNP P20789
A	263	ARG	LYS	engineered mutation	UNP P20789
A	305	ARG	HIS	engineered mutation	UNP P20789
A	332	VAL	CYS	engineered mutation	UNP P20789
A	342	ALA	PHE	engineered mutation	UNP P20789

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Chain	Residue	Modelled	Actual	Comment	Reference
A	354	SER	THR	engineered mutation	UNP P20789
A	358	VAL	PHE	engineered mutation	UNP P20789
A	362	ALA	SER	engineered mutation	UNP P20789

- Molecule 2 is (2 {S})-4-methyl-2-[[3-(5-methylthiophen-2-yl)-5-(5-thiophen-3-yl-1,2,3,4-tetrazol-1-yl)phenyl]carbonylamino]pentanoic acid (CCD ID: A1I5G) (formula: $C_{23}H_{23}N_5O_3S_2$).
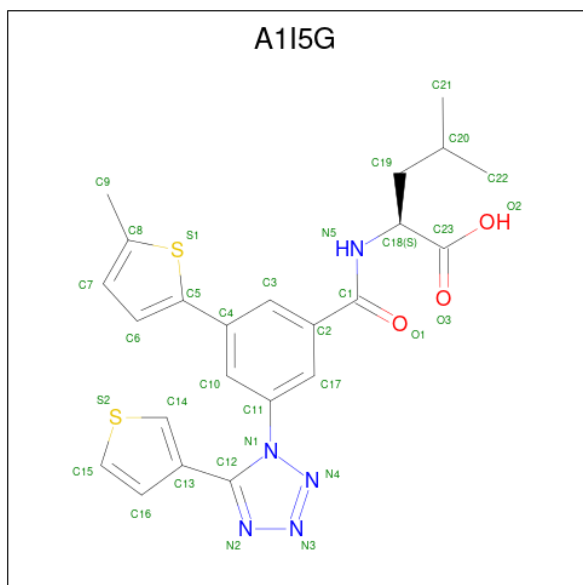

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	S	0	0
			55	23	22	5	3	2		
2	A	1	Total	C	H	N	O	S	0	0
			55	23	22	5	3	2		

3 Residue-property plots ⓘ

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: Neurotensin receptor type 1, DARPin fusion
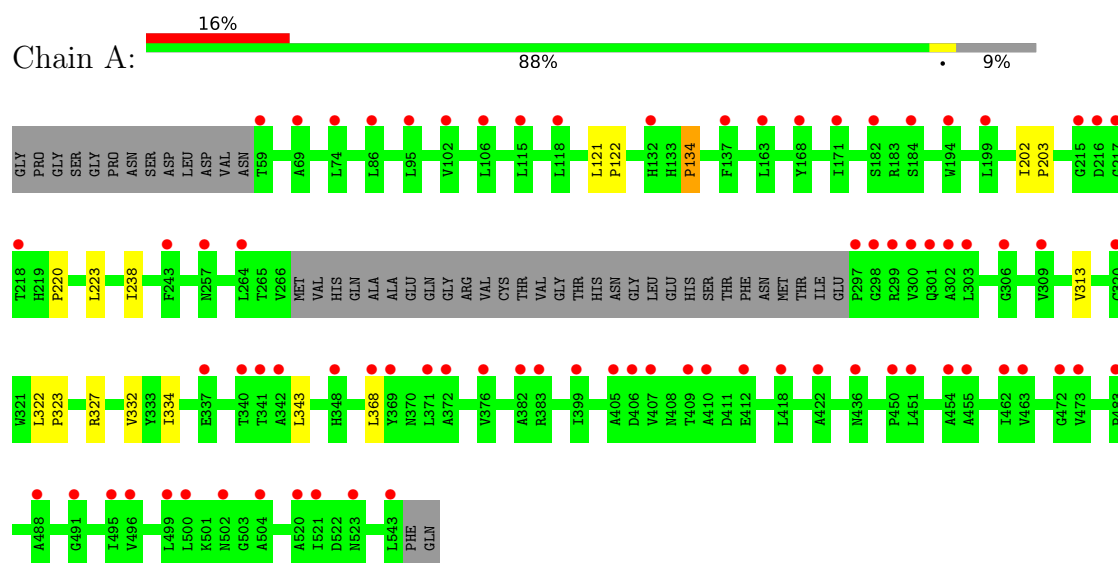
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	75.66Å 215.89Å 95.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	107.90 – 3.12 107.90 – 3.12	Depositor EDS
% Data completeness (in resolution range)	66.1 (107.90-3.12) 66.1 (107.90-3.12)	Depositor EDS
R_{merge}	0.22	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.34 (at 3.13Å)	Xtriage
Refinement program	REFMAC 5.8.0419	Depositor
R, R_{free}	0.300 , 0.322 0.301 , 0.316	Depositor DCC
R_{free} test set	462 reflections (3.23%)	wwPDB-VP
Wilson B-factor (Å^2)	106.9	Xtriage
Anisotropy	0.086	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 61.1	EDS
L-test for twinning[2]	$< |L| > = 0.46, < L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.88	EDS
Total number of atoms	6263	wwPDB-VP
Average B, all atoms (Å^2)	98.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.53% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: A1I5G

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	0.45	0/3191	0.92	1/4399 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	134	PRO	N-CA-CB	-5.59	96.45	102.60

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	3127	3026	2815	8	0
2	A	66	44	0	0	0
All	All	3193	3070	2815	8	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 1.

All (8) 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:313:VAL:HG22	1:A:368:LEU:HD22	1.90	0.54
1:A:322:LEU:HB3	1:A:323:PRO:HD3	1.96	0.46
1:A:202:ILE:N	1:A:203:PRO:CD	2.80	0.44
1:A:327:ARG:HG2	1:A:327:ARG:HH21	1.84	0.42
1:A:334:ILE:HD13	1:A:343:LEU:HD21	2.02	0.41
1:A:121:LEU:HB3	1:A:122:PRO:HD3	2.02	0.41
1:A:220:PRO:O	1:A:223:LEU:HD23	2.21	0.40
1:A:238:ILE:HD12	1:A:332:VAL:HG11	2.03	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	451/500 (90%)	440 (98%)	11 (2%)	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	266/412 (65%)	265 (100%)	1 (0%)	89	94

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	134	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	82	ASN
1	A	127	ASN
1	A	159	ASN
1	A	239	GLN
1	A	443	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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 ⓘ

2 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	$\#|Z| > 2$
2	A1I5G	A	601	-	33,36,36	0.87	2 (6%)	35,51,51	0.81	1 (2%)
2	A1I5G	A	602	-	33,36,36	0.93	2 (6%)	35,51,51	0.88	2 (5%)

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	A1I5G	A	601	-	-	1/24/28/28	0/4/4/4
2	A1I5G	A	602	-	-	1/24/28/28	0/4/4/4

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	602	A1I5G	C14-C13	-2.74	1.35	1.37
2	A	601	A1I5G	C14-C13	-2.51	1.35	1.37
2	A	602	A1I5G	C14-S2	2.35	1.73	1.70
2	A	601	A1I5G	C14-S2	2.25	1.73	1.70

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	601	A1I5G	C12-N1-N4	-2.04	107.49	111.44
2	A	602	A1I5G	C12-N1-N4	-2.02	107.53	111.44
2	A	602	A1I5G	C12-N2-N3	2.02	106.31	104.56

There are no chirality outliers.

All (2) torsion outliers are listed below:

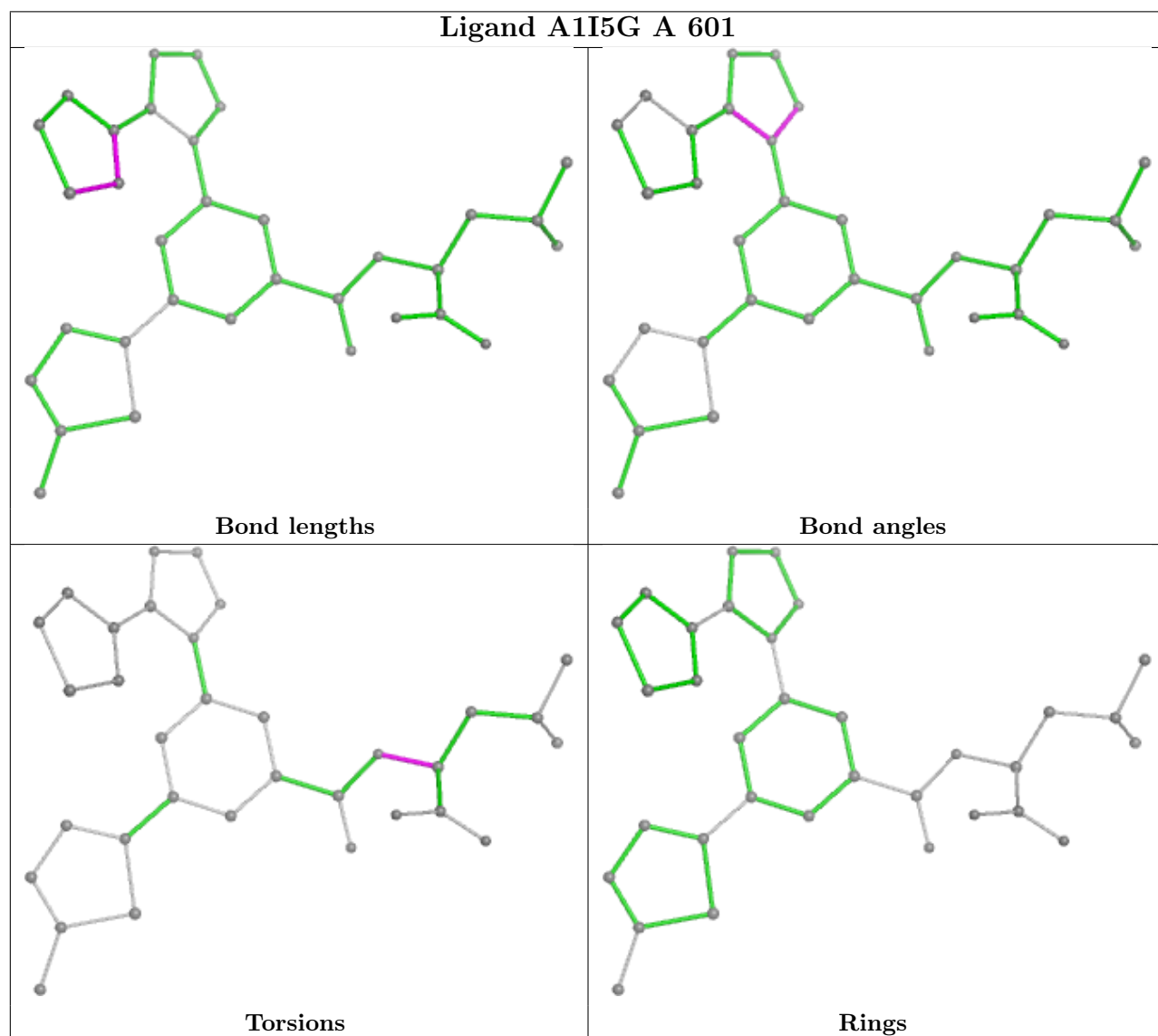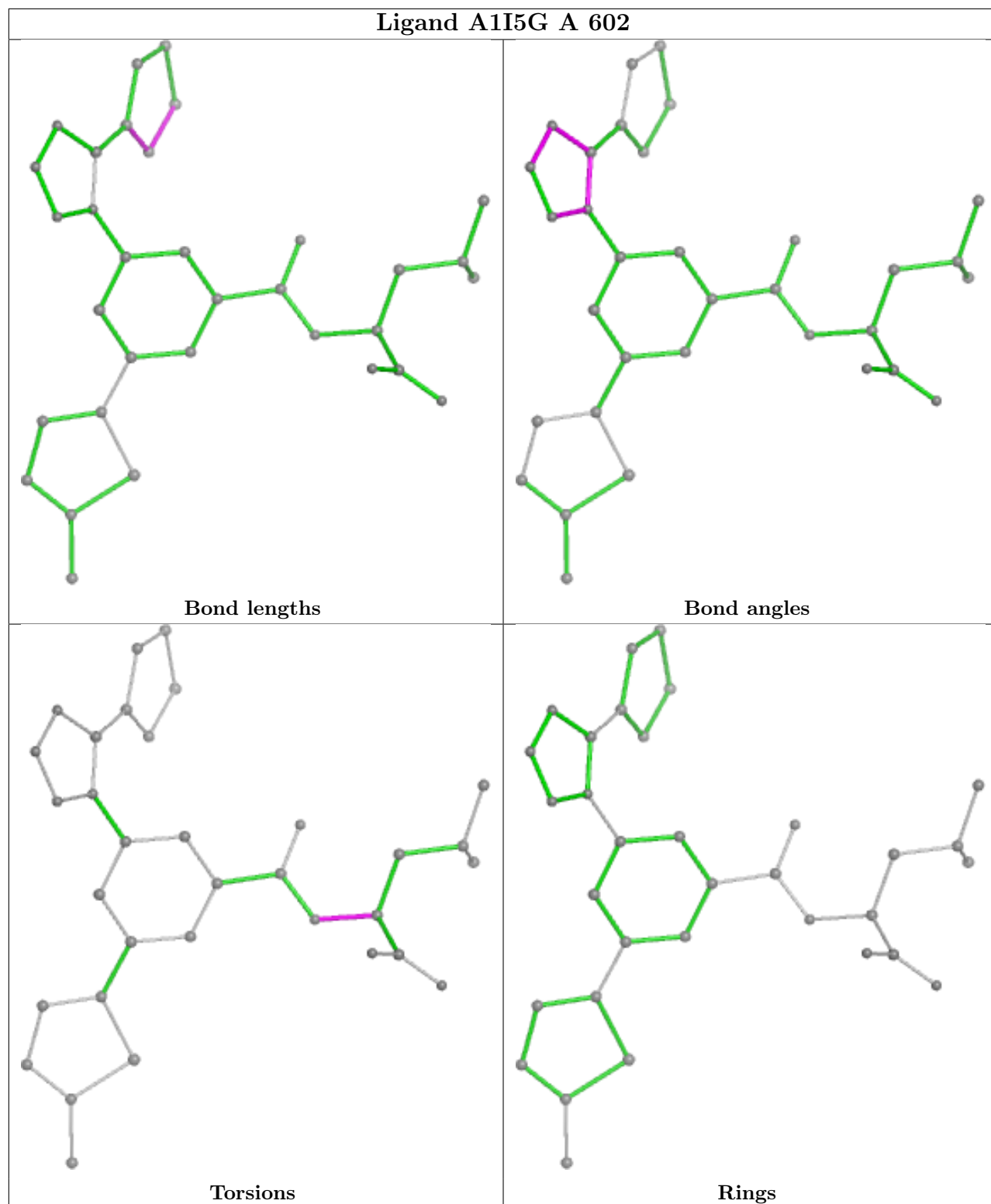| Mol	Chain	Res	Type	Atoms
2	A	602	A1I5G	C19-C18-N5-C1
2	A	601	A1I5G	C23-C18-N5-C1

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 then 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.

Ligand A1I5G A 601

Bond lengths

Bond angles

Torsions

Rings

Ligand A1I5G A 602

Bond lengths

Bond angles

Torsions

Rings

5.7 Other polymers ⓘ

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	455/500 (91%)	0.93	78 (17%) 5 3		58, 96, 136, 175	0

All (78) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	298	GLY	12.4
1	A	455	ALA	6.3
1	A	451	LEU	6.1
1	A	302	ALA	5.5
1	A	406	ASP	5.5
1	A	412	GLU	4.9
1	A	303	LEU	4.9
1	A	171	ILE	4.8
1	A	218	THR	4.8
1	A	301	GLN	4.7
1	A	299	ARG	4.4
1	A	499	LEU	4.3
1	A	543	LEU	4.2
1	A	409	THR	4.2
1	A	376	VAL	4.0
1	A	495	ILE	3.9
1	A	163	LEU	3.9
1	A	405	ALA	3.8
1	A	215	GLY	3.7
1	A	297	PRO	3.6
1	A	472	GLY	3.5
1	A	106	LEU	3.5
1	A	463	VAL	3.5
1	A	243	PHE	3.5
1	A	483	PRO	3.4
1	A	371	LEU	3.3
1	A	137	PHE	3.3

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Mol	Chain	Res	Type	RSRZ
1	A	523	ASN	3.3
1	A	337	GLU	3.2
1	A	473	VAL	3.2
1	A	342	ALA	3.2
1	A	309	VAL	3.1
1	A	300	VAL	3.1
1	A	382	ALA	3.1
1	A	257	ASN	3.0
1	A	216	ASP	3.0
1	A	182	SER	2.9
1	A	488	ALA	2.9
1	A	59	THR	2.9
1	A	410	ALA	2.9
1	A	521	ILE	2.9
1	A	306	GLY	2.8
1	A	422	ALA	2.8
1	A	115	LEU	2.8
1	A	102	VAL	2.8
1	A	454	ALA	2.8
1	A	418	LEU	2.8
1	A	491	GLY	2.8
1	A	500	LEU	2.7
1	A	369	TYR	2.7
1	A	199	LEU	2.6
1	A	132	HIS	2.6
1	A	383	ARG	2.6
1	A	450	PRO	2.6
1	A	69	ALA	2.5
1	A	348	HIS	2.4
1	A	372	ALA	2.4
1	A	168	TYR	2.4
1	A	320	CYS	2.4
1	A	86	LEU	2.4
1	A	341	THR	2.4
1	A	520	ALA	2.4
1	A	118	LEU	2.4
1	A	264	LEU	2.4
1	A	436	ASN	2.3
1	A	407	VAL	2.3
1	A	496	VAL	2.3
1	A	95	LEU	2.3
1	A	74	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	399	ILE	2.2
1	A	217	GLY	2.2
1	A	462	ILE	2.1
1	A	504	ALA	2.1
1	A	194	TRP	2.1
1	A	340	THR	2.1
1	A	184	SER	2.1
1	A	368	LEU	2.1
1	A	502	ASN	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

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	A1I5G	A	602	33/33	0.78	0.20	106,114,119,120	55
2	A1I5G	A	601	33/33	0.82	0.19	101,108,117,119	55

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.
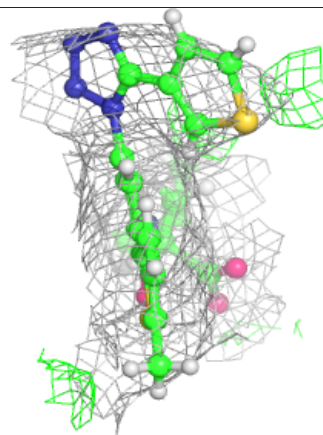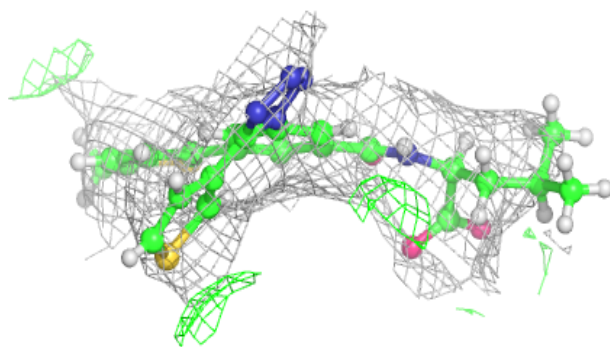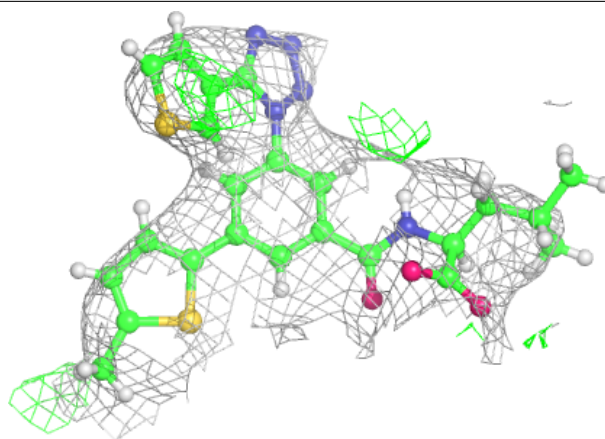
Electron density around A1I5G A 602:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)
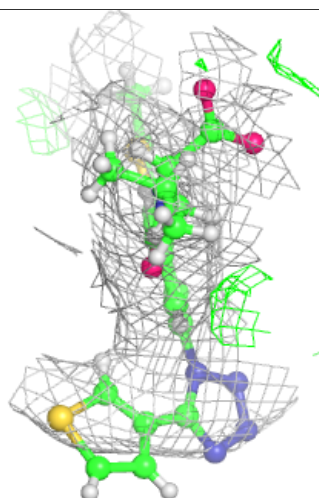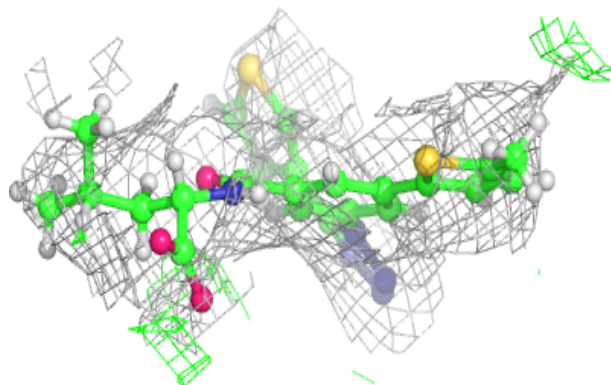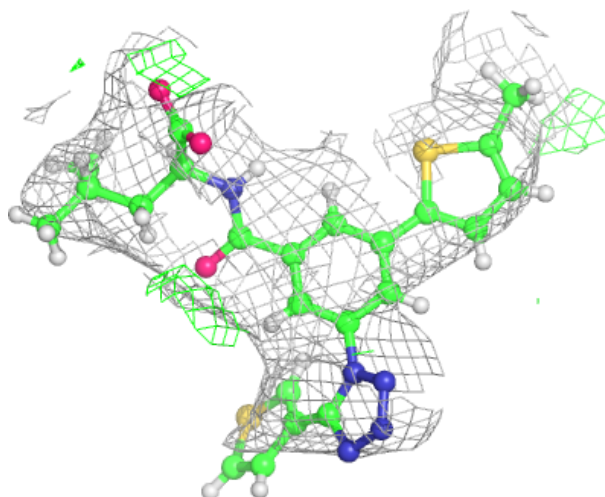
Electron density around A1I5G A 601:

$2mF_o$-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.