



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 02:39 AM UTC

PDB ID : 6XRQ / pdb_00006xrq
Title : Structural descriptions of ligand interactions to DNA and RNA quadruplexes folded from the non-coding region of Pseudorabies virus
Authors : Zhang, Y.S.; Parkinson, G.N.; Wei, D.G.
Deposited on : 2020-07-13
Resolution : 1.21 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

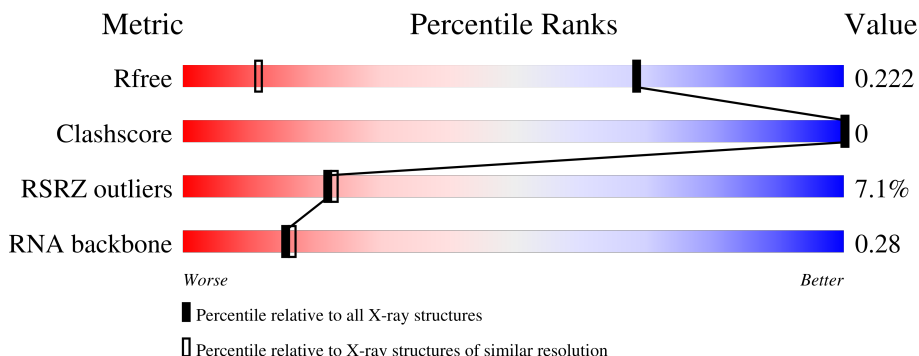
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.21 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	2002 (1.24-1.20)
Clashscore	190562	2061 (1.24-1.20)
RSRZ outliers	180081	2000 (1.24-1.20)
RNA backbone	3983	1020 (2.10-0.62)

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	14	7% 36% 64%
1	B	14	7% 71% 7% 21%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 845 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.

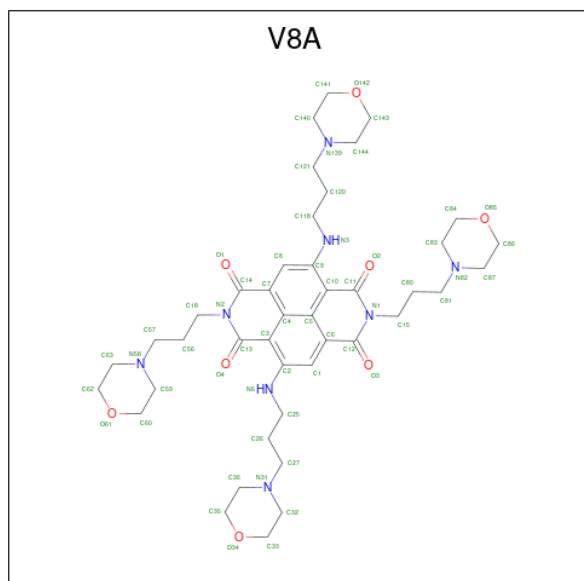
- Molecule 1 is a RNA chain called RNA (5' GP*GP*CP*UP*CP*GP*GP*CP*GP*GP*CP*GP*GP*A-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	14	Total	C	N	O	P	0	1	0
			326	145	64	103	14			
1	A	14	Total	C	N	O	P	0	0	0
			303	135	59	96	13			

- Molecule 2 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	2	Total	K	0	0
			2	2		
2	A	1	Total	K	0	0
			1	1		

- Molecule 3 is 2,7-bis[3-(morpholin-4-yl)propyl]-4,9-bis{[3-(morpholin-4-yl)propyl]amino}benzo[lmn][3,8]phenanthroline-1,3,6,8(2H,7H)-tetrone (CCD ID: V8A) (formula: C₄₂H₆₀N₈O₈) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			58	42	8	8		
3	A	1	Total	C	N	O	0	0
			58	42	8	8		

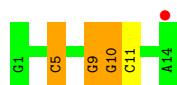
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	44	Total	O	0	0
			44	44		
4	A	53	Total	O	0	0
			53	53		

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: RNA (5' GP*GP*CP*UP*CP*GP*GP*CP*GP*GP*CP*GP*GP*A-3')



- Molecule 1: RNA (5' GP*GP*CP*UP*CP*GP*GP*CP*GP*GP*CP*GP*GP*A-3')



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	29.18Å 43.97Å 30.78Å 90.00° 108.39° 90.00°	Depositor
Resolution (Å)	27.69 – 1.21 27.69 – 1.21	Depositor EDS
% Data completeness (in resolution range)	93.9 (27.69-1.21) 93.9 (27.69-1.21)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.66 (at 1.21Å)	Xtriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.199 , 0.217 0.202 , 0.222	Depositor DCC
R_{free} test set	1026 reflections (4.54%)	wwPDB-VP
Wilson B-factor (Å ²)	14.0	Xtriage
Anisotropy	0.523	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.43 , 45.5	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	0.96	EDS
Total number of atoms	845	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 15.87% 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: V8A, K

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	0.91	1/339 (0.3%)	1.07	0/529
1	B	0.88	1/365 (0.3%)	1.08	4/570 (0.7%)
All	All	0.89	2/704 (0.3%)	1.07	4/1099 (0.4%)

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	A	0	3
1	B	0	1
All	All	0	4

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	13	G	O3'-P	-6.13	1.51	1.61
1	B	5	C	P-OP2	-5.69	1.37	1.49

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	9	G	O4'-C1'-C2'	-6.57	99.23	105.80
1	B	10	G	O4'-C1'-C2'	-5.66	100.14	105.80
1	B	5	C	C1'-C2'-O2'	-5.43	103.65	111.80
1	B	9	G	P-O5'-C5'	5.09	128.53	120.90

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	12	G	Sidechain
1	A	2	G	Sidechain
1	A	5	C	Sidechain
1	B	5	C	Sidechain

5.2 Too-close contacts [i](#)

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	303	0	155	0	0
1	B	326	0	166	0	0
2	A	1	0	0	0	0
2	B	2	0	0	0	0
3	A	116	0	0	0	0
4	A	53	0	0	0	0
4	B	44	0	0	0	0
All	All	845	0	321	0	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 0.

There are no clashes within the asymmetric unit.

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

There are no protein molecules in this entry.

5.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	13/14 (92%)	5 (38%)	0
1	B	12/14 (85%)	3 (25%)	0
All	All	25/28 (89%)	8 (32%)	0

All (8) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	B	9	G
1	B	10	G
1	B	11	C
1	A	7	G
1	A	9	G
1	A	10	G
1	A	11	C
1	A	14	A

There are no RNA pucker outliers to report.

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](#)

Of 5 ligands modelled in this entry, 3 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	$\# Z > 2$
3	V8A	A	103	-	65,65,65	2.33	24 (36%)	88,90,90	1.91	26 (29%)
3	V8A	A	102	-	65,65,65	2.18	19 (29%)	88,90,90	1.70	22 (25%)

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	V8A	A	103	-	-	4/26/58/58	0/8/8/8
3	V8A	A	102	-	-	1/26/58/58	0/8/8/8

All (43) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	103	V8A	C121-N139	-7.38	1.30	1.47
3	A	103	V8A	O1-C14	6.15	1.34	1.22
3	A	102	V8A	C81-N82	-5.69	1.34	1.47
3	A	102	V8A	O4-C13	5.62	1.33	1.22
3	A	102	V8A	O3-C12	5.41	1.33	1.22
3	A	103	V8A	O2-C11	5.02	1.32	1.22
3	A	102	V8A	O1-C14	4.99	1.32	1.22
3	A	103	V8A	O4-C13	4.82	1.32	1.22
3	A	102	V8A	C57-N58	-4.21	1.37	1.47
3	A	103	V8A	C27-N31	-4.16	1.38	1.47
3	A	103	V8A	O3-C12	3.97	1.30	1.22
3	A	102	V8A	C27-N31	-3.88	1.38	1.47
3	A	103	V8A	C81-N82	-3.59	1.39	1.47
3	A	102	V8A	C121-N139	-3.48	1.39	1.47
3	A	103	V8A	C57-N58	-3.27	1.40	1.47
3	A	102	V8A	C13-N2	-3.24	1.33	1.40
3	A	103	V8A	C18-N2	3.15	1.54	1.47
3	A	103	V8A	C12-N1	-3.04	1.33	1.40
3	A	102	V8A	C32-N31	-2.83	1.39	1.46
3	A	103	V8A	C118-N3	2.76	1.51	1.45
3	A	103	V8A	C1-C6	2.68	1.42	1.38
3	A	103	V8A	C59-N58	-2.67	1.39	1.46
3	A	102	V8A	O2-C11	2.62	1.27	1.22
3	A	102	V8A	C15-N1	2.59	1.53	1.47
3	A	102	V8A	C59-N58	-2.50	1.40	1.46
3	A	103	V8A	C80-C15	2.47	1.61	1.51
3	A	102	V8A	C8-C7	2.47	1.42	1.38
3	A	103	V8A	C8-C7	2.46	1.42	1.38
3	A	102	V8A	C3-C13	-2.34	1.42	1.48
3	A	103	V8A	C11-N1	-2.34	1.34	1.40
3	A	103	V8A	C13-N2	-2.34	1.34	1.40
3	A	103	V8A	C63-N58	-2.33	1.40	1.46
3	A	102	V8A	C36-N31	-2.32	1.40	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	103	V8A	C32-N31	-2.31	1.40	1.46
3	A	103	V8A	C36-N31	-2.28	1.40	1.46
3	A	103	V8A	C80-C81	2.26	1.60	1.51
3	A	103	V8A	C83-C84	2.17	1.58	1.50
3	A	102	V8A	C56-C57	2.16	1.60	1.51
3	A	103	V8A	C140-N139	-2.15	1.41	1.46
3	A	102	V8A	C6-C12	-2.15	1.42	1.48
3	A	102	V8A	C14-N2	-2.11	1.35	1.40
3	A	103	V8A	C87-N82	-2.09	1.41	1.46
3	A	102	V8A	C12-N1	-2.08	1.35	1.40

All (48) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	103	V8A	C33-C32-N31	4.87	117.52	110.12
3	A	103	V8A	C62-C63-N58	4.80	117.41	110.12
3	A	103	V8A	C87-N82-C83	4.34	118.19	108.84
3	A	102	V8A	C33-C32-N31	4.09	116.33	110.12
3	A	102	V8A	C143-C144-N139	3.99	116.18	110.12
3	A	102	V8A	C62-C63-N58	3.82	115.92	110.12
3	A	102	V8A	O34-C35-C36	-3.82	103.55	111.77
3	A	103	V8A	C62-O61-C60	3.79	122.12	109.88
3	A	103	V8A	C5-C10-C11	-3.63	114.42	119.44
3	A	102	V8A	C7-C14-N2	3.62	122.17	117.09
3	A	103	V8A	C84-C83-N82	3.58	115.56	110.12
3	A	102	V8A	C36-N31-C32	3.43	116.23	108.84
3	A	103	V8A	C10-C11-N1	3.29	121.72	117.18
3	A	103	V8A	O85-C86-C87	3.21	118.69	111.77
3	A	103	V8A	C143-C144-N139	3.21	115.00	110.12
3	A	103	V8A	C8-C9-N3	-3.12	116.23	121.49
3	A	103	V8A	O2-C11-C10	-3.12	117.57	122.90
3	A	102	V8A	C35-C36-N31	2.93	114.58	110.12
3	A	102	V8A	C18-N2-C13	2.86	121.85	117.53
3	A	102	V8A	O1-C14-C7	-2.84	117.59	122.65
3	A	102	V8A	C3-C13-N2	2.83	121.09	117.18
3	A	102	V8A	C56-C18-N2	-2.82	105.67	112.36
3	A	102	V8A	O61-C62-C63	-2.79	105.75	111.77
3	A	103	V8A	C57-N58-C63	-2.75	103.90	111.24
3	A	103	V8A	C56-C18-N2	2.74	118.85	112.36
3	A	103	V8A	C3-C13-N2	2.72	120.93	117.18
3	A	102	V8A	C141-C140-N139	2.72	114.25	110.12
3	A	103	V8A	C1-C2-N6	-2.70	116.93	121.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	103	V8A	C4-C7-C14	-2.56	116.36	120.01
3	A	103	V8A	C86-O85-C84	2.56	118.16	109.88
3	A	103	V8A	C26-C25-N6	-2.50	104.70	111.46
3	A	103	V8A	C141-C140-N139	2.48	113.90	110.12
3	A	102	V8A	C62-O61-C60	-2.48	101.85	109.88
3	A	102	V8A	C10-C11-N1	2.46	120.58	117.18
3	A	103	V8A	O85-C84-C83	-2.43	106.54	111.77
3	A	102	V8A	C14-N2-C13	-2.35	121.14	124.71
3	A	102	V8A	C5-C10-C11	-2.33	116.22	119.44
3	A	102	V8A	O61-C60-C59	2.32	116.77	111.77
3	A	103	V8A	O142-C141-C140	2.26	116.65	111.77
3	A	103	V8A	C144-N139-C140	2.21	113.60	108.84
3	A	103	V8A	C7-C14-N2	2.19	120.17	117.09
3	A	103	V8A	O3-C12-C6	-2.17	118.78	122.65
3	A	103	V8A	C4-C3-C13	-2.16	116.46	119.44
3	A	102	V8A	C27-N31-C32	2.06	116.73	111.24
3	A	102	V8A	C10-C9-N3	-2.05	118.56	121.24
3	A	102	V8A	C84-C83-N82	2.04	113.21	110.12
3	A	103	V8A	C7-C4-C3	2.02	123.21	120.40
3	A	102	V8A	C81-N82-C83	-2.00	105.90	111.24

There are no chirality outliers.

All (5) torsion outliers are listed below:

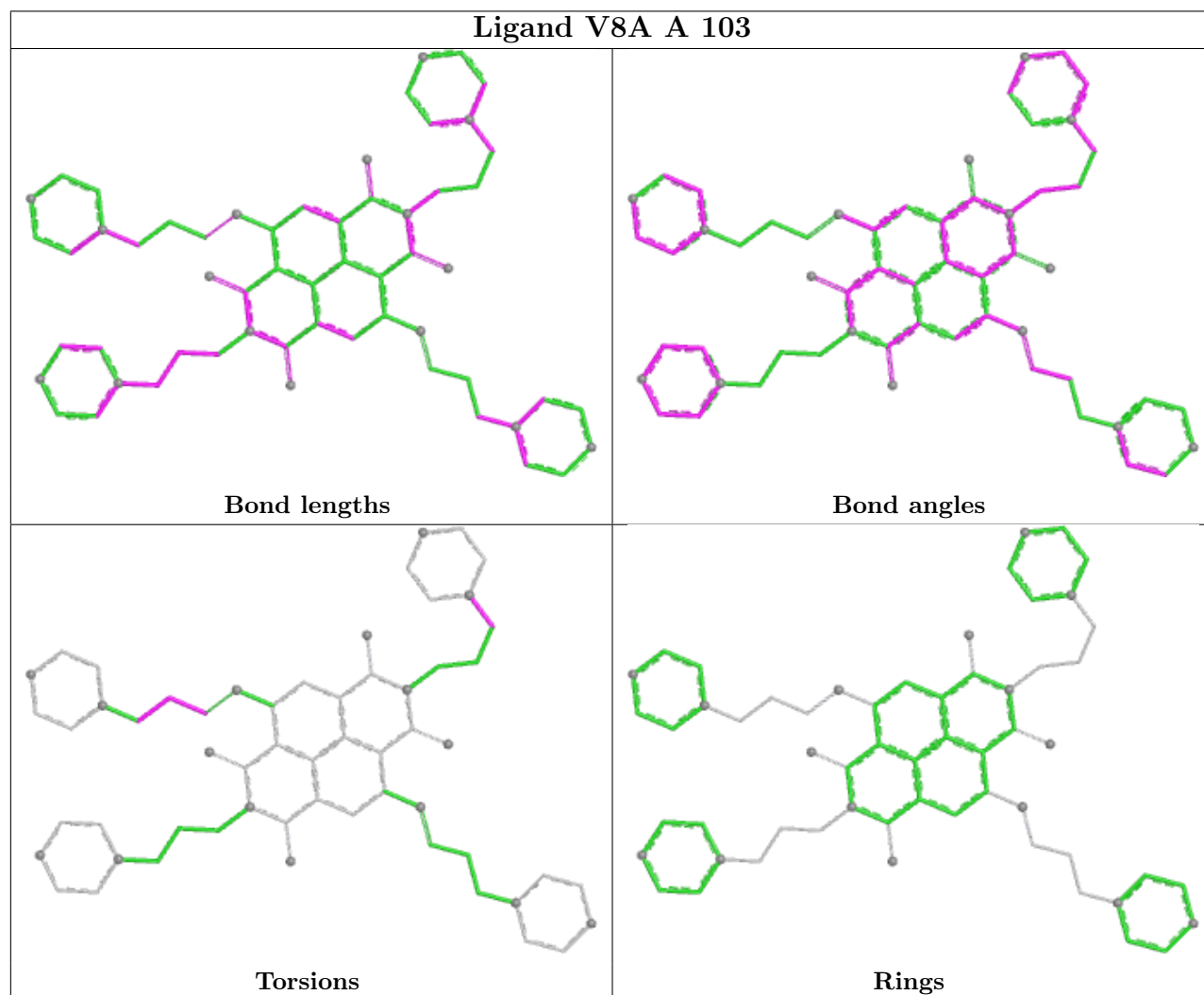
Mol	Chain	Res	Type	Atoms
3	A	103	V8A	C118-C120-C121-N139
3	A	103	V8A	N3-C118-C120-C121
3	A	102	V8A	C56-C57-N58-C59
3	A	103	V8A	C56-C57-N58-C59
3	A	103	V8A	C56-C57-N58-C63

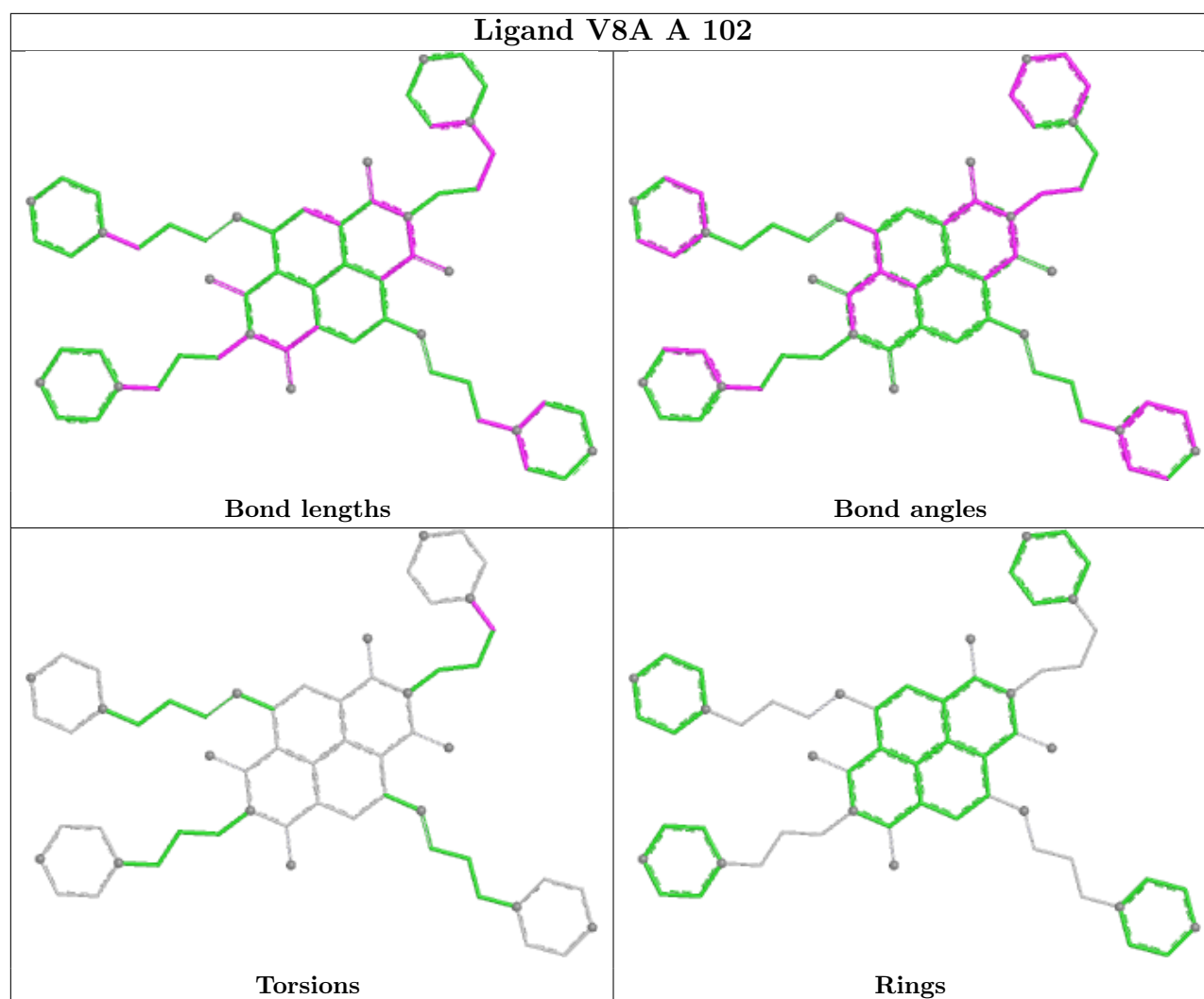
There are no ring outliers.

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	14/14 (100%)	0.70	1 (7%) 22 23	14, 16, 23, 42	0
1	B	14/14 (100%)	1.22	1 (7%) 22 23	6, 14, 21, 23	2 (14%)
All	All	28/28 (100%)	0.96	2 (7%) 22 23	6, 16, 23, 42	2 (7%)

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	14	A	11.0
1	A	8	C	2.7

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.

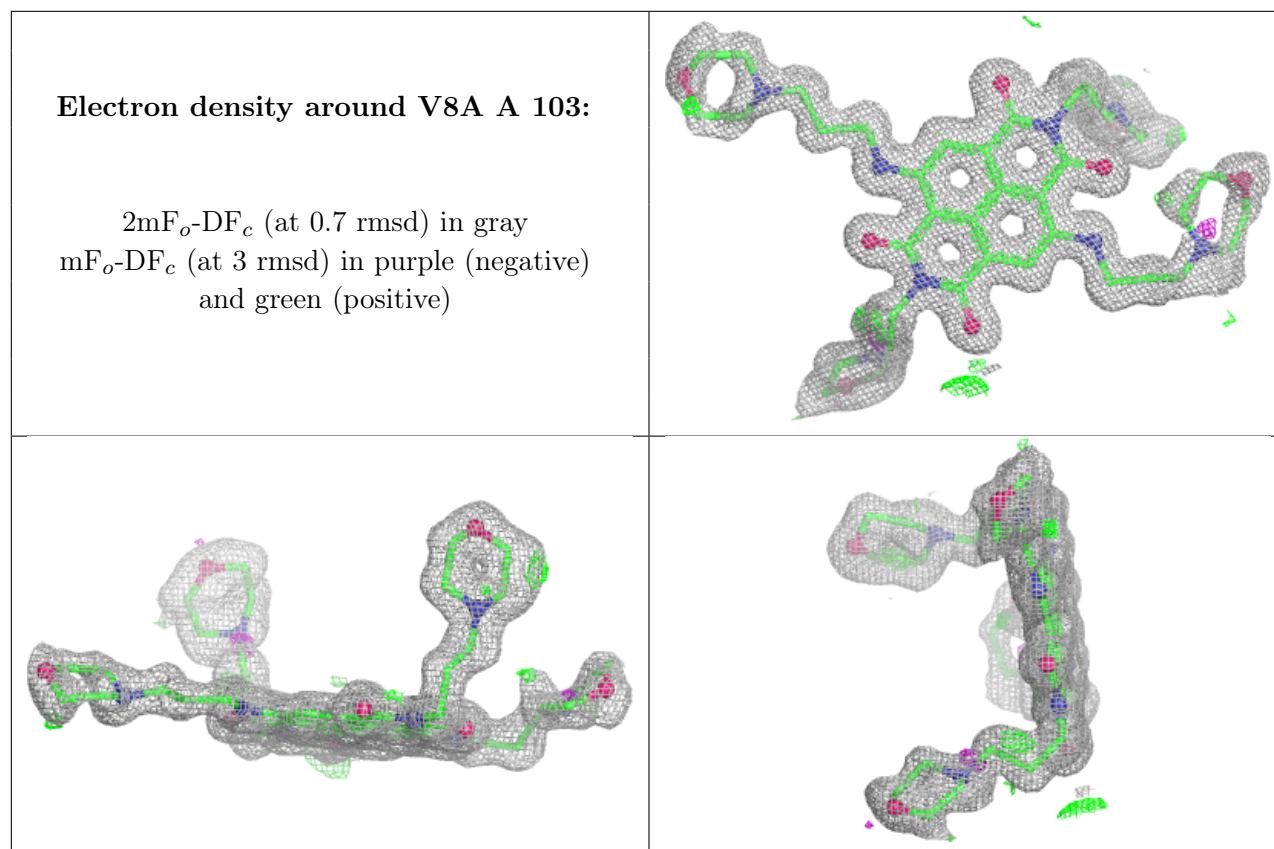
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	V8A	A	103	58/58	0.94	0.10	11,16,36,41	0
3	V8A	A	102	58/58	0.95	0.08	10,15,27,31	0
2	K	A	101	1/1	1.00	0.02	10,10,10,10	0

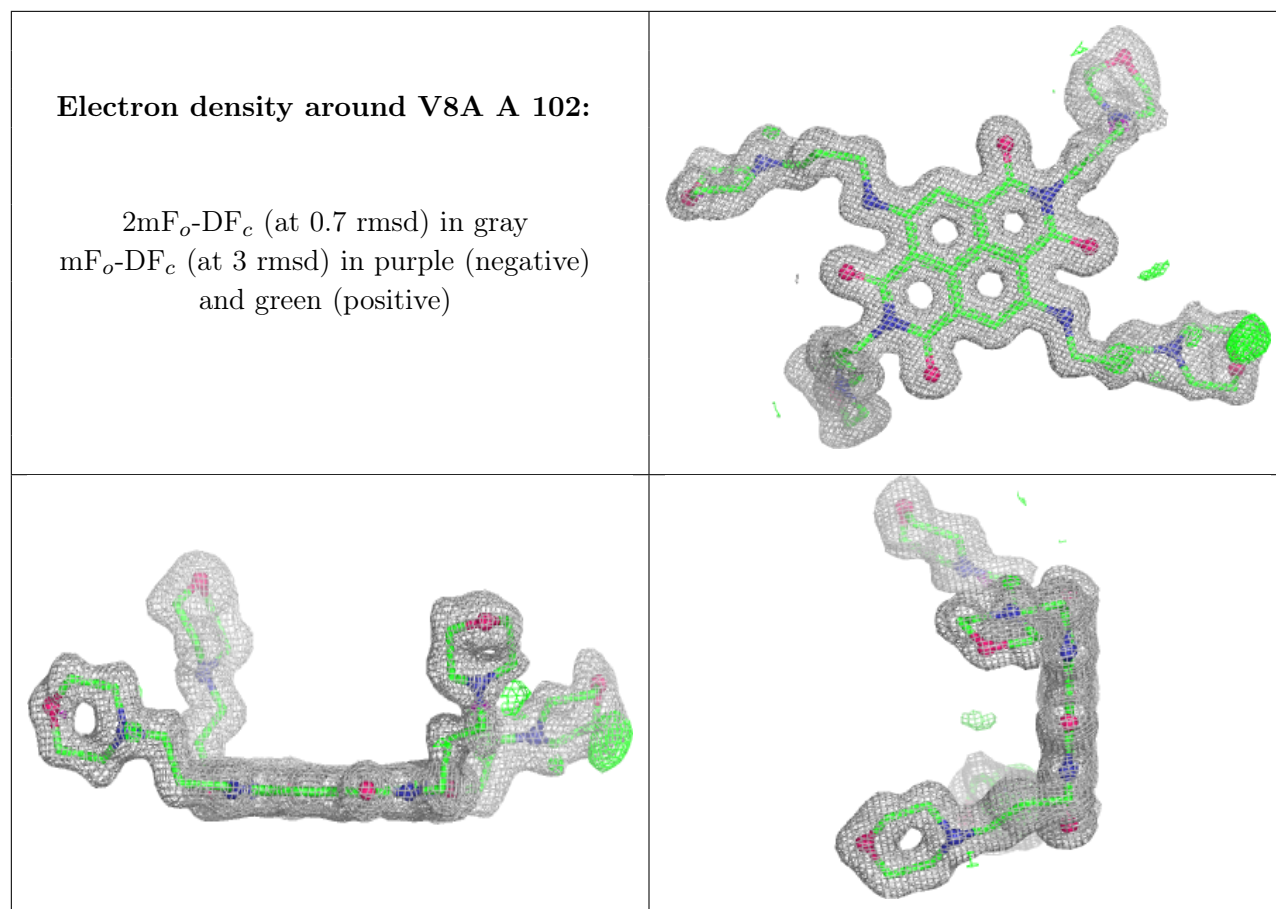
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	K	B	101	1/1	1.00	0.01	10,10,10,10	0
2	K	B	102	1/1	1.00	0.03	10,10,10,10	0

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.