



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 20, 2024 – 07:05 AM EST

PDB ID : 4MM9  
Title : Crystal structure of LeuBAT (delta13 mutant) in complex with fluvoxamine  
Authors : Wang, H.; Gouaux, E.  
Deposited on : 2013-09-08  
Resolution : 2.90 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](mailto: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>.

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

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

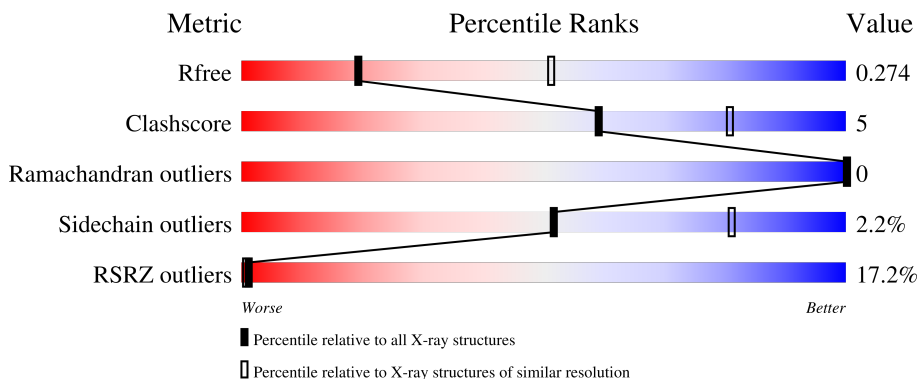
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.90 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))
$R_{free}$	130704	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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  $\geq 3$ , 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	519	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3989 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 Transporter.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	499	3964	2688	622	643	11	0	0	0

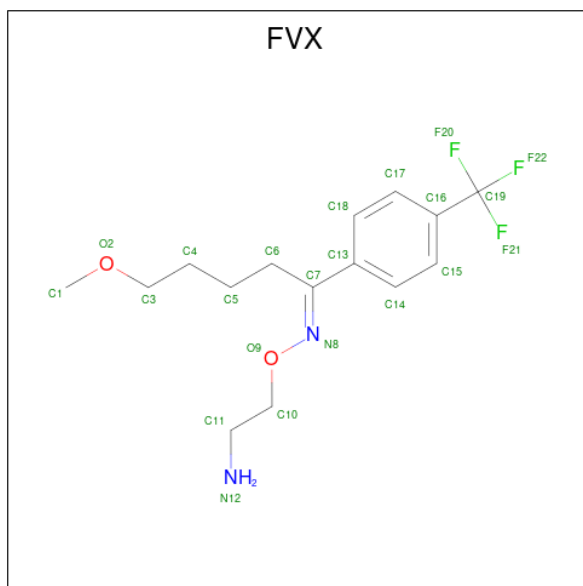
There are 19 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	21	TYR	ASN	engineered mutation	UNP O67854
A	24	ASP	GLY	engineered mutation	UNP O67854
A	106	SER	ILE	engineered mutation	UNP O67854
A	254	SER	THR	engineered mutation	UNP O67854
A	256	GLY	SER	engineered mutation	UNP O67854
A	261	VAL	ALA	engineered mutation	UNP O67854
A	262	LEU	ILE	engineered mutation	UNP O67854
A	265	PHE	TYR	engineered mutation	UNP O67854
A	290	SER	GLU	engineered mutation	UNP O67854
A	359	GLY	ILE	engineered mutation	UNP O67854
A	362	GLY	PRO	engineered mutation	UNP O67854
A	408	THR	GLY	engineered mutation	UNP O67854
A	409	GLY	THR	engineered mutation	UNP O67854
A	514	GLY	-	expression tag	UNP O67854
A	515	THR	-	expression tag	UNP O67854
A	516	LEU	-	expression tag	UNP O67854
A	517	VAL	-	expression tag	UNP O67854
A	518	PRO	-	expression tag	UNP O67854
A	519	ARG	-	expression tag	UNP O67854

- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Na	0	0
			2	2		

- Molecule 3 is Fluvoxamine (three-letter code: FVX) (formula:  $C_{15}H_{21}F_3N_2O_2$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	F	N	O		
3	A	1	22	15	3	2	2	0	0

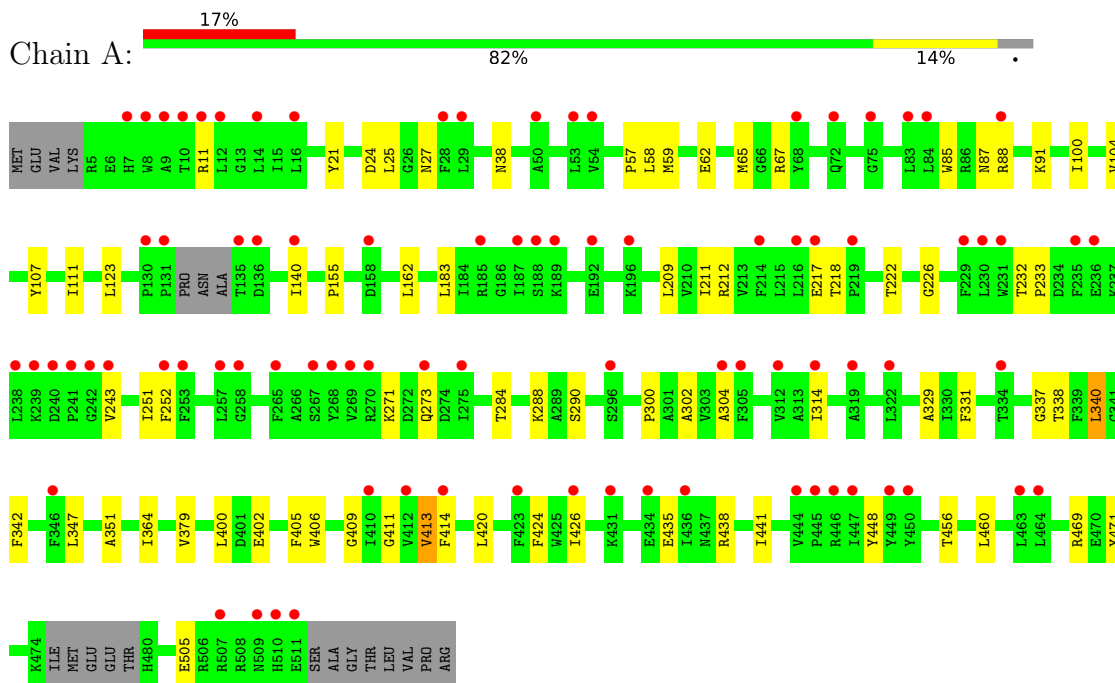
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	O	0	0
			1	1		

### 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: Transporter



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	90.81Å 88.07Å 81.50Å 90.00° 94.76° 90.00°	Depositor
Resolution (Å)	45.25 – 2.90 51.30 – 2.90	Depositor EDS
% Data completeness (in resolution range)	98.9 (45.25-2.90) 99.9 (51.30-2.90)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.87 (at 2.91Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, $R_{free}$	0.230 , 0.272 0.234 , 0.274	Depositor DCC
$R_{free}$ test set	718 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	75.3	Xtrriage
Anisotropy	0.794	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 58.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3989	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.35% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NA, FVX

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	0.25	0/4089	0.40	0/5566

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	3964	0	4038	38	0
2	A	2	0	0	0	0
3	A	22	0	21	1	0
4	A	1	0	0	0	0
All	All	3989	0	4059	38	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 5.

All (38) 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:24:ASP:HA	1:A:351:ALA:HB1	1.77	0.65
1:A:155:PRO:HD3	1:A:162:LEU:HD23	1.82	0.61
1:A:87:ASN:OD1	1:A:88:ARG:N	2.33	0.60
1:A:58:LEU:HD11	1:A:460:LEU:HD11	1.85	0.59
1:A:271:LYS:O	1:A:438:ARG:NH1	2.38	0.56
1:A:21:TYR:O	3:A:603:FVX:H13	2.06	0.55
1:A:337:GLY:HA2	1:A:340:LEU:HB2	1.88	0.55
1:A:38:ASN:HB3	1:A:243:VAL:HG13	1.92	0.52
1:A:67:ARG:NH2	1:A:435:GLU:O	2.41	0.52
1:A:226:GLY:HA3	1:A:300:PRO:HA	1.93	0.50
1:A:302:ALA:HB1	1:A:314:ILE:HD13	1.94	0.50
1:A:413:VAL:HG12	1:A:414:PHE:CD1	2.47	0.50
1:A:91:LYS:NZ	1:A:505:GLU:OE1	2.39	0.49
1:A:62:GLU:HA	1:A:65:MET:HE2	1.94	0.49
1:A:331:PHE:O	1:A:337:GLY:HA3	2.12	0.49
1:A:67:ARG:NH1	1:A:273:GLN:O	2.46	0.49
1:A:218:THR:OG1	1:A:304:ALA:O	2.29	0.48
1:A:364:ILE:HD13	1:A:379:VAL:HG22	1.95	0.48
1:A:104:VAL:HA	1:A:107:TYR:CE2	2.48	0.48
1:A:402:GLU:OE2	1:A:406:TRP:NE1	2.42	0.48
1:A:100:ILE:HD13	1:A:411:GLY:HA2	1.96	0.47
1:A:57:PRO:HD3	1:A:448:TYR:HE2	1.81	0.46
1:A:140:ILE:HG22	1:A:329:ALA:HB1	1.99	0.45
1:A:209:LEU:HD12	1:A:347:LEU:HD22	1.99	0.44
1:A:111:ILE:HD11	1:A:400:LEU:HD11	1.98	0.44
1:A:232:THR:HA	1:A:233:PRO:HD3	1.82	0.44
1:A:217:GLU:HG2	1:A:222:THR:HG22	1.99	0.44
1:A:25:LEU:H	1:A:25:LEU:HD12	1.83	0.44
1:A:11:ARG:NH1	1:A:441:ILE:HD11	2.32	0.43
1:A:409:GLY:O	1:A:413:VAL:HB	2.17	0.43
1:A:123:LEU:HB2	1:A:342:PHE:CD1	2.53	0.43
1:A:405:PHE:HE1	1:A:471:TYR:CD1	2.36	0.43
1:A:183:LEU:HD13	1:A:364:ILE:HD11	2.01	0.42
1:A:469:ARG:HA	1:A:469:ARG:HD3	1.59	0.42
1:A:284:THR:HG22	1:A:288:LYS:HE3	2.01	0.41
1:A:85:TRP:CG	1:A:426:ILE:HG21	2.56	0.41
1:A:27:ASN:ND2	1:A:290:SER:OG	2.53	0.41
1:A:420:LEU:HD11	1:A:456:THR:HG22	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	493/519 (95%)	479 (97%)	14 (3%)	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	401/419 (96%)	392 (98%)	9 (2%)	52 81

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	59	MET
1	A	211	ILE
1	A	212	ARG
1	A	251	ILE
1	A	252	PHE
1	A	338	THR
1	A	340	LEU
1	A	413	VAL
1	A	424	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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	FVX	A	603	-	22,22,22	3.85	6 (27%)	27,28,28	2.11	4 (14%)

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	FVX	A	603	-	-	8/21/21/21	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	603	FVX	C7-N8	15.34	1.40	1.28
3	A	603	FVX	C6-C7	5.96	1.58	1.51
3	A	603	FVX	C14-C13	4.14	1.46	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	603	FVX	O9-C10	-3.02	1.39	1.43
3	A	603	FVX	C17-C16	2.05	1.42	1.39
3	A	603	FVX	O9-N8	2.02	1.45	1.42

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	603	FVX	C6-C7-C13	-7.53	110.90	120.02
3	A	603	FVX	C6-C7-N8	-6.12	113.44	125.53
3	A	603	FVX	C10-O9-N8	3.01	110.92	108.36
3	A	603	FVX	C18-C13-C7	-2.27	118.08	120.84

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	603	FVX	C13-C7-N8-O9
3	A	603	FVX	C11-C10-O9-N8
3	A	603	FVX	O9-C10-C11-N12
3	A	603	FVX	C14-C13-C7-N8
3	A	603	FVX	C18-C13-C7-N8
3	A	603	FVX	C5-C6-C7-N8
3	A	603	FVX	O2-C3-C4-C5
3	A	603	FVX	C7-N8-O9-C10

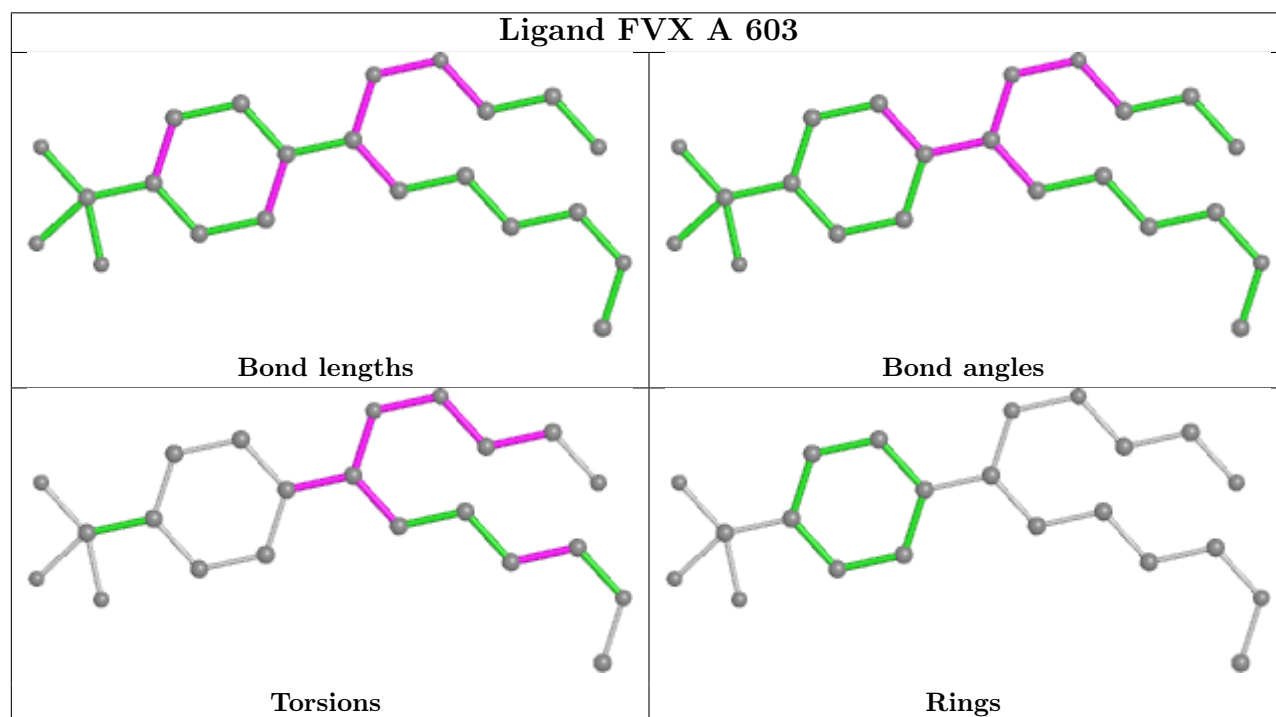
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	603	FVX	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier.

The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data

### 6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	499/519 (96%)	1.05	86 (17%) <b>1</b> <b>1</b>	15, 50, 87, 119	0

All (86) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	8	TRP	7.2
1	A	446	ARG	6.6
1	A	235	PHE	6.0
1	A	68	TYR	5.6
1	A	511	GLU	5.5
1	A	447	ILE	5.3
1	A	509	ASN	5.3
1	A	241	PRO	5.1
1	A	510	HIS	4.8
1	A	187	ILE	4.4
1	A	84	LEU	4.3
1	A	319	ALA	4.3
1	A	239	LYS	4.1
1	A	238	LEU	4.1
1	A	7	HIS	4.1
1	A	463	LEU	3.8
1	A	423	PHE	3.7
1	A	507	ARG	3.6
1	A	158	ASP	3.6
1	A	14	LEU	3.6
1	A	304	ALA	3.5
1	A	305	PHE	3.4
1	A	75	GLY	3.4
1	A	270	ARG	3.3
1	A	185	ARG	3.3
1	A	450	TYR	3.3
1	A	192	GLU	3.3

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	196	LYS	3.2
1	A	72	GLN	3.2
1	A	242	GLY	3.1
1	A	28	PHE	3.0
1	A	431	LYS	3.0
1	A	11	ARG	3.0
1	A	188	SER	2.9
1	A	236	GLU	2.9
1	A	296	SER	2.9
1	A	12	LEU	2.9
1	A	214	PHE	2.8
1	A	130	PRO	2.8
1	A	314	ILE	2.8
1	A	29	LEU	2.8
1	A	217	GLU	2.8
1	A	219	PRO	2.8
1	A	189	LYS	2.7
1	A	140	ILE	2.7
1	A	426	ILE	2.6
1	A	414	PHE	2.6
1	A	257	LEU	2.6
1	A	16	LEU	2.5
1	A	131	PRO	2.5
1	A	253	PHE	2.5
1	A	268	TYR	2.5
1	A	444	VAL	2.5
1	A	252	PHE	2.5
1	A	410	ILE	2.5
1	A	449	TYR	2.4
1	A	216	LEU	2.4
1	A	267	SER	2.3
1	A	312	VAL	2.3
1	A	275	ILE	2.3
1	A	229	PHE	2.3
1	A	230	LEU	2.3
1	A	464	LEU	2.3
1	A	434	GLU	2.3
1	A	243	VAL	2.2
1	A	88	ARG	2.2
1	A	334	THR	2.2
1	A	10	THR	2.2
1	A	53	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	83	LEU	2.2
1	A	265	PHE	2.2
1	A	240	ASP	2.2
1	A	231	TRP	2.2
1	A	9	ALA	2.2
1	A	50	ALA	2.2
1	A	136	ASP	2.1
1	A	258	GLY	2.1
1	A	322	LEU	2.1
1	A	135	THR	2.1
1	A	273	GLN	2.1
1	A	445	PRO	2.1
1	A	436	ILE	2.1
1	A	412	VAL	2.1
1	A	54	VAL	2.0
1	A	269	VAL	2.0
1	A	346	PHE	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 monosaccharides in this entry.

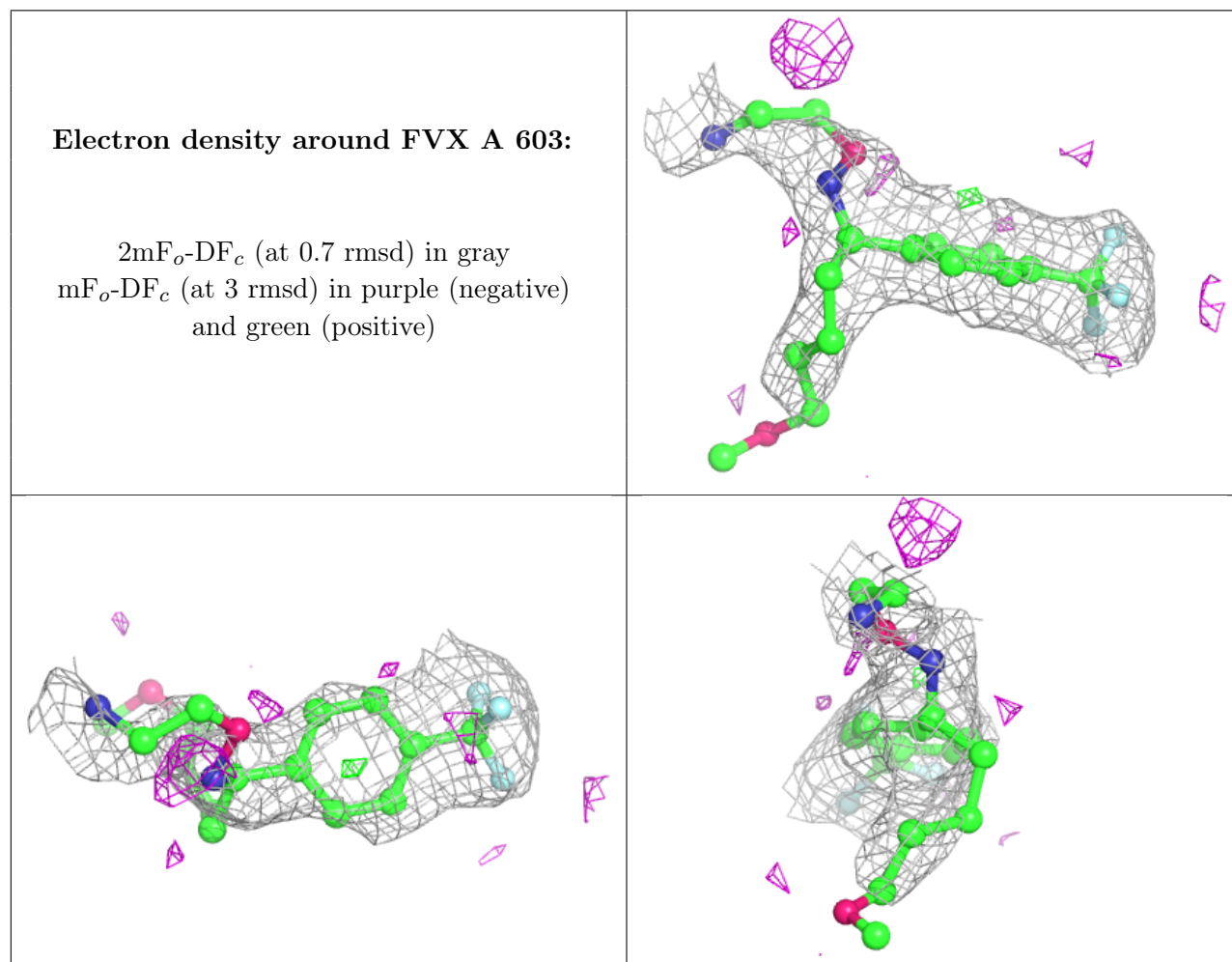
## 6.4 Ligands [i](#)

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	NA	A	602	1/1	0.75	0.30	65,65,65,65	0
2	NA	A	601	1/1	0.83	0.08	41,41,41,41	0
3	FVX	A	603	22/22	0.89	0.45	22,39,55,67	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.