



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 03:01 PM UTC

PDB ID : 4B3O / pdb_00004b3o
Title : Structures of HIV-1 RT and RNA-DNA Complex Reveal a Unique RT Con-
formation and Substrate Interface
Authors : Lapkouski, M.; Tian, L.; Miller, J.T.; Le Grice, S.F.J.; Yang, W.
Deposited on : 2012-07-25
Resolution : 3.30 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

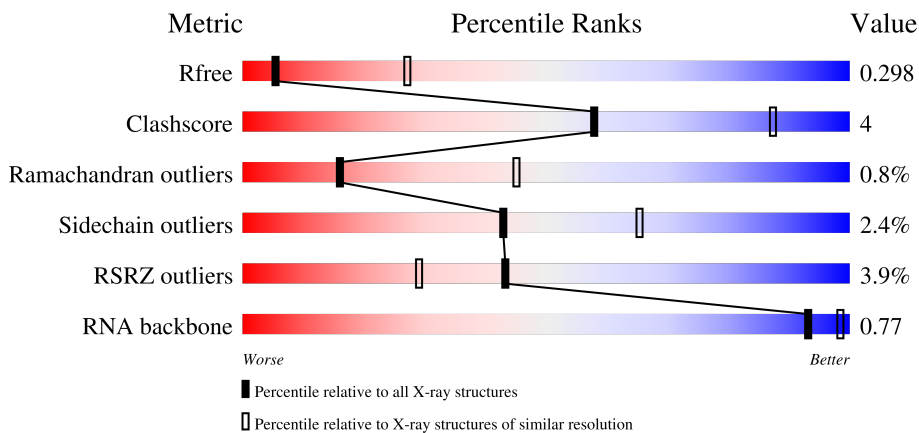
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.30 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	1169 (3.32-3.28)
Clashscore	190562	1209 (3.32-3.28)
Ramachandran outliers	187476	1188 (3.32-3.28)
Sidechain outliers	187428	1187 (3.32-3.28)
RSRZ outliers	180081	1169 (3.32-3.28)
RNA backbone	3983	1048 (3.60-3.00)

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	560	 5% 86% 9% . .
2	B	441	 3% 83% 10% 7%
3	D	24	 42% 50% 8%
4	R	27	 4% 44% 44% 11%

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 8513 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 REVERSE TRANSCRIPTASE/RIBONUCLEASE H.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	540	Total	C	N	O	S	0	0	0
			4255	2745	704	798	8			

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	68	GLY	SER	engineered mutation	UNP P04585
A	83	LYS	ARG	engineered mutation	UNP P04585
A	411	VAL	ILE	engineered mutation	UNP P04585
A	447	SER	ASN	engineered mutation	UNP P04585
A	461	LYS	ARG	engineered mutation	UNP P04585
A	483	HIS	TYR	engineered mutation	UNP P04585
A	559	ILE	VAL	engineered mutation	UNP P04585

- Molecule 2 is a protein called P51 RT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	410	Total	C	N	O	S	0	0	0
			3288	2140	533	608	7			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	0	GLY	-	expression tag	UNP P04585
B	68	GLY	SER	engineered mutation	UNP P04585
B	83	LYS	ARG	engineered mutation	UNP P04585
B	411	VAL	ILE	engineered mutation	UNP P04585

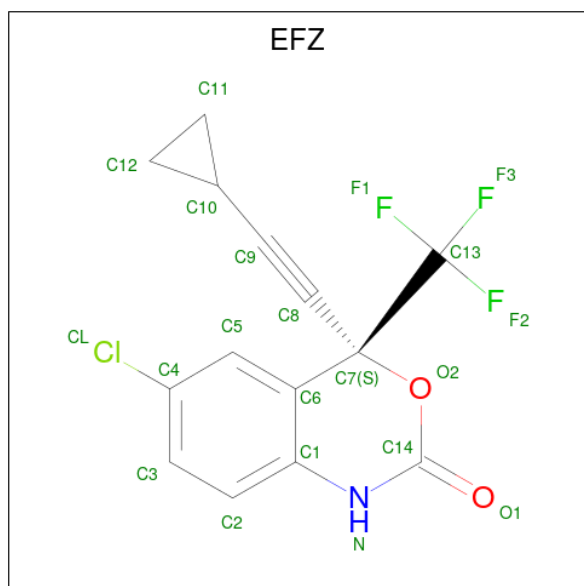
- Molecule 3 is a DNA chain called 5'-D(*CP*GP*TP*AP*TP*GP*CP*CP*TP*AP*TP*AP*GP*TP*TP*AP*TP*TP*GP*TP*GP*GP*CP*C)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	22	Total	C	N	O	P	0	0	0
			447	216	75	135	21			

- Molecule 4 is a RNA chain called 5'-R(*AP*UP*GP*AP*3DRP*GP*GP*CP*CP*AP*CP*AP*AP*UP*AP *AP*CP*UP*AP*UP*AP*GP*GP*CP*AP*UP*A)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	R	24	Total	C	N	O	P	0	0	0
			500	226	93	158	23			

- Molecule 5 is (-)-6-CHLORO-4-CYCLOPROPYLETHYNYL-4-TRIFLUOROMETHYL-1,4-DIHYDRO-2H-3,1-BENZOXAZIN-2-ONE (CCD ID: EFZ) (formula: C₁₄H₉ClF₃NO₂).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
5	A	1	Total	C	Cl	F	N	O	0	0
			21	14	1	3	1	2		

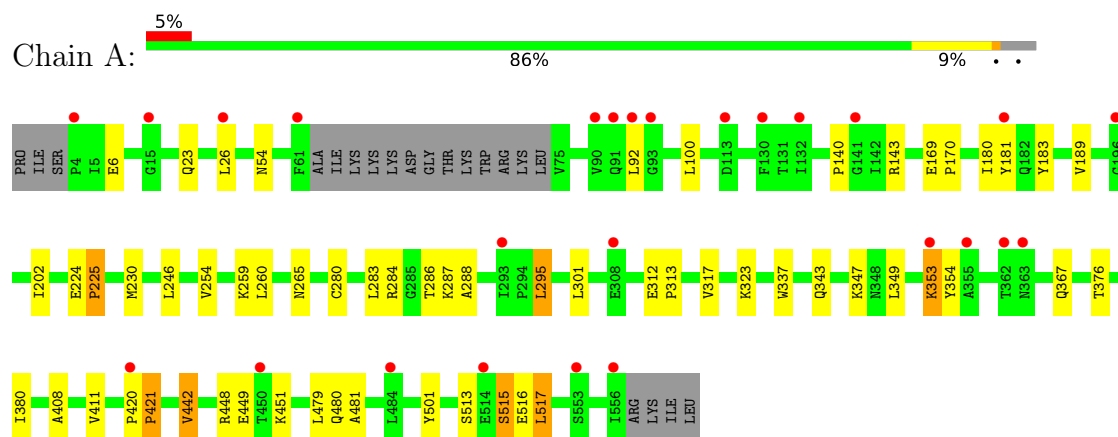
- Molecule 6 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	D	1	Total	Ca	0	0
			1	1		
6	R	1	Total	Ca	0	0
			1	1		

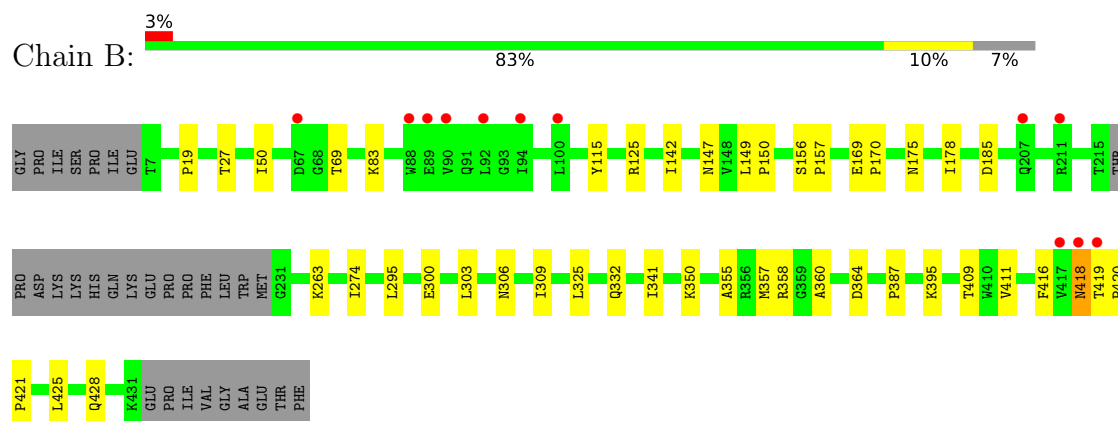
3 Residue-property plots [i](#)

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.

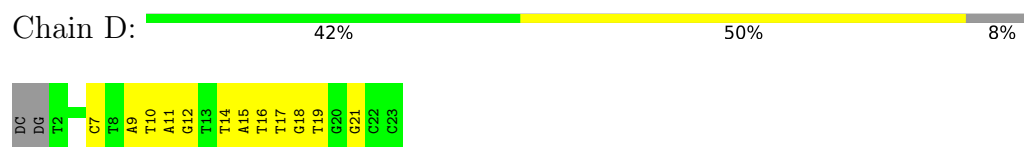
- Molecule 1: REVERSE TRANSCRIPTASE/RIBONUCLEASE H



- Molecule 2: P51 RT



- Molecule 3: 5'-D(*CP*GP*TP*AP*TP*GP*CP*CP*TP*AP*TP*AP*GP*TP *TP*AP*TP*TP*GP*TP*GP*GP*CP*C)-3'



- Molecule 4: 5'-R(*AP*UP*GP*AP*3DRP*GP*GP*CP*CP*AP*CP*AP*AP*UP*AP *AP*C P*UP*AP*UP*AP*GP*GP*CP*AP*UP*A)-3'



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	164.60Å 164.60Å 129.03Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.73 – 3.30 29.73 – 3.30	Depositor EDS
% Data completeness (in resolution range)	98.4 (29.73-3.30) 98.2 (29.73-3.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.39 (at 3.31Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.275 , 0.295 0.277 , 0.298	Depositor DCC
R_{free} test set	1516 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	100.1	Xtriage
Anisotropy	0.185	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 11.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.013 for -h,-k,l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	8513	wwPDB-VP
Average B, all atoms (Å ²)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.86% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 3DR, CA, EFZ

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	0.59	0/4363	0.79	3/5952 (0.1%)
2	B	0.57	0/3379	0.76	3/4606 (0.1%)
3	D	0.29	0/499	0.64	0/769
4	R	0.40	0/546	0.59	0/844
All	All	0.56	0/8787	0.76	6/12171 (0.0%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	225	PRO	N-CA-C	6.91	119.12	110.70
1	A	411	VAL	CA-C-N	6.38	125.61	118.97
1	A	411	VAL	C-N-CA	6.38	125.61	118.97
2	B	358	ARG	N-CA-C	5.32	118.06	110.24
2	B	419	THR	CA-C-N	5.05	123.35	119.66

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	4255	0	4168	34	0
2	B	3288	0	3244	25	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	447	0	253	16	0
4	R	500	0	260	13	0
5	A	21	0	9	5	0
6	D	1	0	0	0	0
6	R	1	0	0	0	0
All	All	8513	0	7934	74	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 4.

The worst 5 of 74 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:92:LEU:O	4:R:10:A:H5'	1.77	0.84
1:A:100:LEU:HD11	5:A:1557:EFZ:H111	1.62	0.82
1:A:259:LYS:HG2	3:D:18:DG:O3'	1.79	0.82
1:A:501:TYR:CE1	3:D:7:DC:H4'	2.21	0.75
1:A:283:LEU:O	4:R:14:U:H4'	1.86	0.74

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	536/560 (96%)	490 (91%)	40 (8%)	6 (1%)	11	39
2	B	406/441 (92%)	397 (98%)	7 (2%)	2 (0%)	24	55
All	All	942/1001 (94%)	887 (94%)	47 (5%)	8 (1%)	16	45

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	6	GLU
1	A	287	LYS
1	A	516	GLU
2	B	360	ALA
1	A	515	SER

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	450/499 (90%)	437 (97%)	13 (3%)	37	62
2	B	352/399 (88%)	346 (98%)	6 (2%)	53	71
All	All	802/898 (89%)	783 (98%)	19 (2%)	43	65

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	142	ILE
2	B	411	VAL
2	B	418	ASN
2	B	303	LEU
1	A	323	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	483	HIS
1	A	520	GLN
2	B	332	GLN
1	A	524	GLN
1	A	278	GLN

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
4	R	20/27 (74%)	0	0

There are no RNA backbone outliers to report.

There are no RNA pucker outliers to report.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
4	3DR	R	5	4	8,11,12	3.16	3 (37%)	7,14,17	1.46	2 (28%)

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
4	3DR	R	5	4	-	1/3/15/16	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	R	5	3DR	C2'-C3'	-7.58	1.39	1.52
4	R	5	3DR	O4'-C4'	-3.47	1.38	1.44
4	R	5	3DR	O5'-C5'	-2.35	1.37	1.44

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	R	5	3DR	C1'-C2'-C3'	2.39	105.82	103.26
4	R	5	3DR	O4'-C4'-C3'	2.35	107.18	103.73

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	R	5	3DR	C3'-C4'-C5'-O5'

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides 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	$\# Z > 2$
5	EFZ	A	1557	-	23,23,23	4.53	8 (34%)	36,36,36	4.00	13 (36%)

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
5	EFZ	A	1557	-	-	10/10/32/32	0/3/3/3

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	1557	EFZ	C1-C6	-12.26	1.26	1.40
5	A	1557	EFZ	C9-C8	11.39	1.51	1.19

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	1557	EFZ	O1-C14	10.00	1.39	1.21
5	A	1557	EFZ	O2-C7	-6.01	1.36	1.45
5	A	1557	EFZ	C13-C7	-4.25	1.44	1.53

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	1557	EFZ	C10-C9-C8	-13.46	118.06	176.07
5	A	1557	EFZ	C7-C8-C9	-12.85	118.18	174.77
5	A	1557	EFZ	O2-C14-O1	-5.83	108.98	117.97
5	A	1557	EFZ	F1-C13-C7	-5.59	105.05	111.80
5	A	1557	EFZ	O2-C14-N	-5.48	108.29	117.14

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

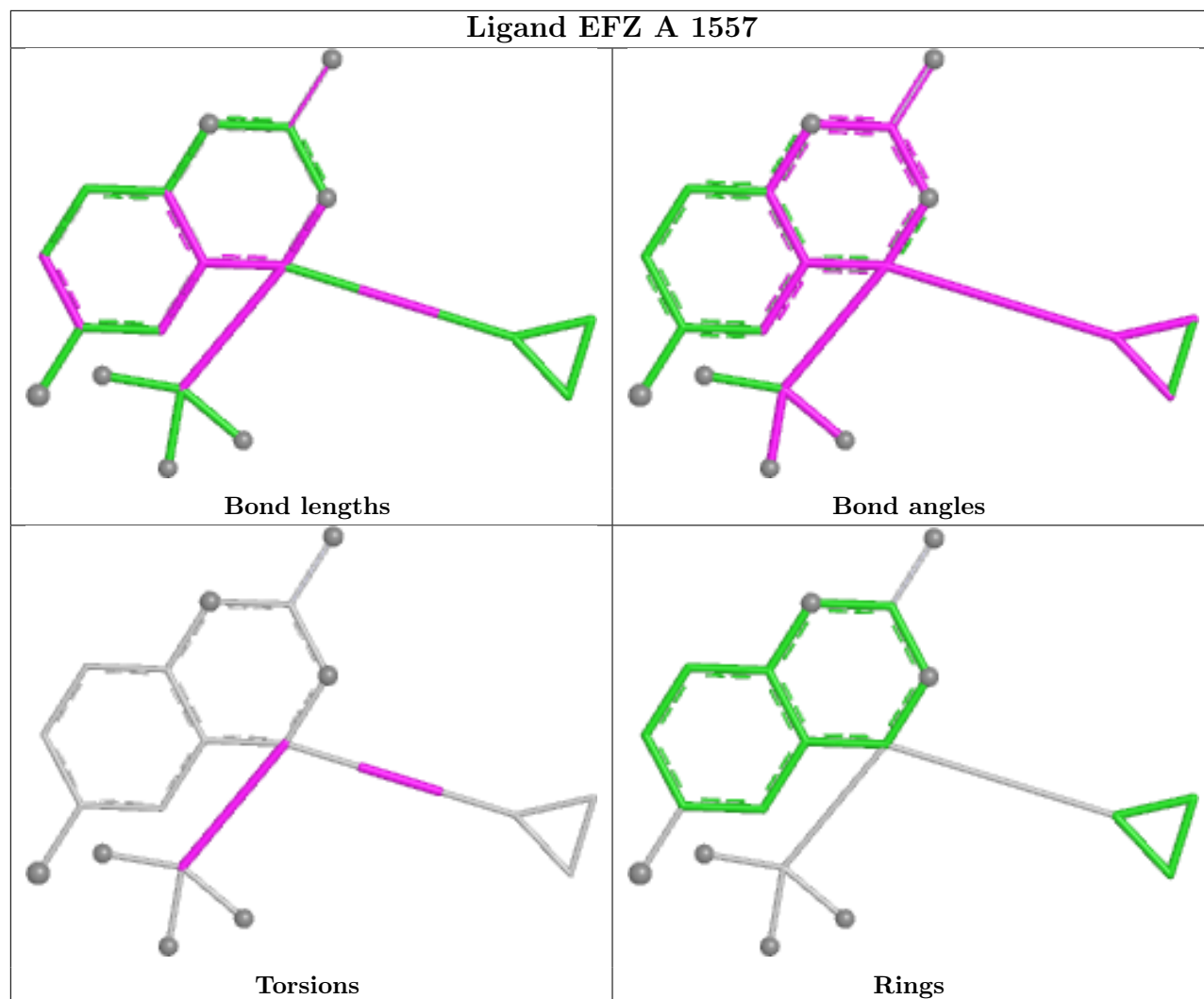
Mol	Chain	Res	Type	Atoms
5	A	1557	EFZ	F1-C13-C7-O2
5	A	1557	EFZ	F2-C13-C7-O2
5	A	1557	EFZ	F3-C13-C7-O2
5	A	1557	EFZ	F1-C13-C7-C6
5	A	1557	EFZ	F2-C13-C7-C6

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1557	EFZ	5	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 [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	540/560 (96%)	0.57	26 (4%) 35 24	51, 77, 107, 118	0
2	B	410/441 (92%)	0.47	12 (2%) 53 35	51, 80, 111, 125	0
3	D	22/24 (91%)	0.06	0 100 100	56, 79, 94, 101	0
4	R	23/27 (85%)	0.00	1 (4%) 40 25	69, 79, 104, 125	0
All	All	995/1052 (94%)	0.50	39 (3%) 43 29	51, 78, 109, 125	0

The worst 5 of 39 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	92	LEU	4.4
2	B	211	ARG	3.6
1	A	181	TYR	3.5
1	A	355	ALA	3.4
1	A	353	LYS	3.1

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
4	3DR	R	5	11/12	0.42	0.15	109,119,143,153	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands

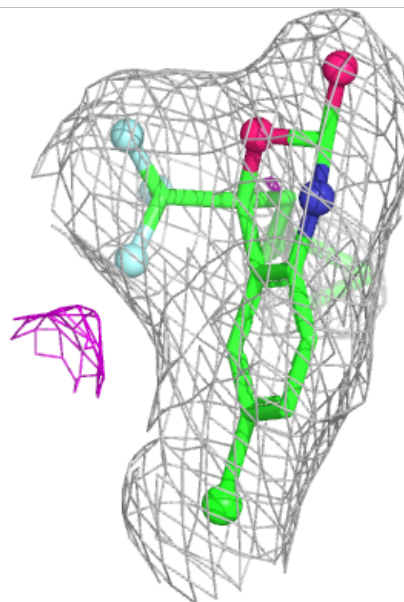
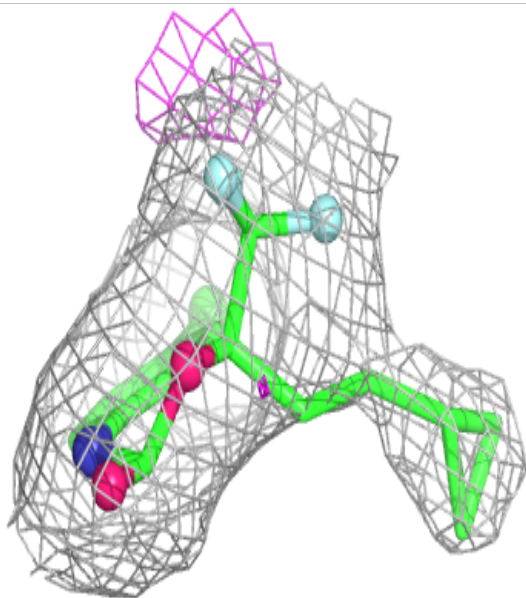
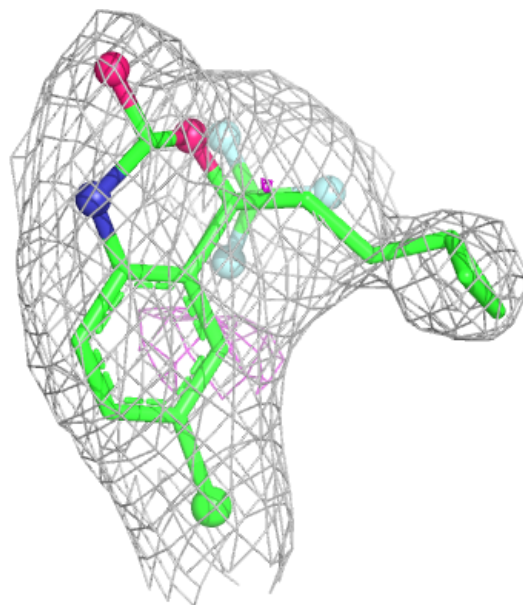
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
6	CA	R	100	1/1	0.92	0.23	85,85,85,85	0
6	CA	D	100	1/1	0.93	0.13	65,65,65,65	0
5	EFZ	A	1557	21/21	0.93	0.09	59,69,77,81	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 EFZ A 1557:

$2mF_o-DF_c$ (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.