



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 01:28 pm BST

PDB ID : 4FAL  
Title : Crystal structure of human 17beta-hydroxysteroid dehydrogenase type 5 in complex with 3-((3,4-dihydroisoquinolin-2(1H)-yl)sulfonyl)-N-methylbenzamide (80)  
Authors : Turnbull, A.P.; Jamieson, S.M.F.; Brooke, D.G.; Heinrich, D.; Atwell, G.J.; Silva, S.; Hamilton, E.J.; Rigoreau, L.J.M.; Trivier, E.; Soudy, C.; Samlal, S.S.; Owen, P.J.; Schroeder, E.; Raynham, T.; Flanagan, J.U.; Denny, W.A.  
Deposited on : 2012-05-22  
Resolution : 2.00 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.

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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 : 2.11  
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) : 2.11

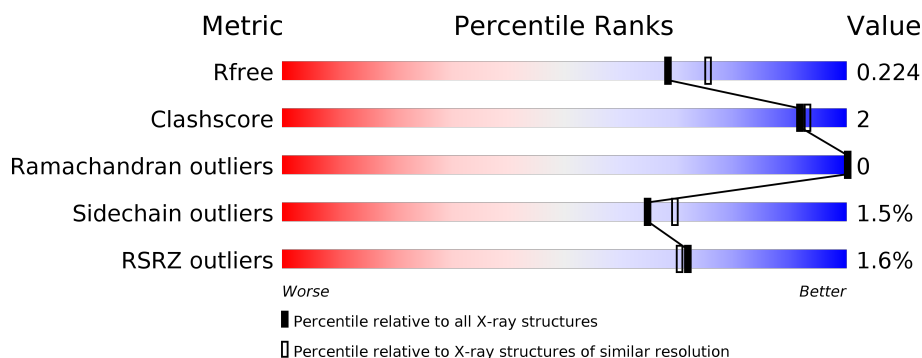
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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 on 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	331	<div> <div>2%</div> <div> <div></div> <div>88%</div> <div>• • 8%</div> </div> </div>

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 2691 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 Aldo-keto reductase family 1 member C3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	306	2447	1569	419	446	13	0	2	0

There are 8 discrepancies between the modelled and reference sequences:

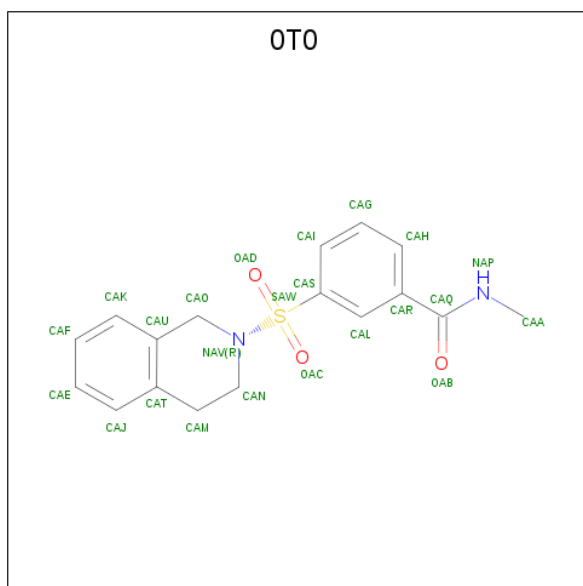
Chain	Residue	Modelled	Actual	Comment	Reference
A	324	LEU	-	EXPRESSION TAG	UNP P42330
A	325	GLU	-	EXPRESSION TAG	UNP P42330
A	326	HIS	-	EXPRESSION TAG	UNP P42330
A	327	HIS	-	EXPRESSION TAG	UNP P42330
A	328	HIS	-	EXPRESSION TAG	UNP P42330
A	329	HIS	-	EXPRESSION TAG	UNP P42330
A	330	HIS	-	EXPRESSION TAG	UNP P42330
A	331	HIS	-	EXPRESSION TAG	UNP P42330

- Molecule 2 is NADP NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NAP) (formula: C<sub>21</sub>H<sub>28</sub>N<sub>7</sub>O<sub>17</sub>P<sub>3</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 3 is 3-(3,4-dihydroisoquinolin-2(1H)-ylsulfonyl)-N-methylbenzamide (three-letter code: OT0) (formula:  $C_{17}H_{18}N_2O_3S$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			23	17	2	3	1		

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula:  $C_2H_6O_2$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		

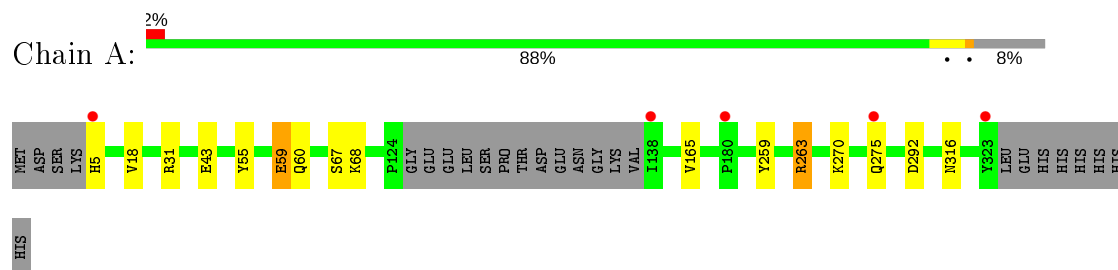
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	161	Total	O	0	1
			161	161		

### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: Aldo-keto reductase family 1 member C3



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	58.69Å 64.70Å 96.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	18.65 – 2.00 18.65 – 2.00	Depositor EDS
% Data completeness (in resolution range)	97.7 (18.65-2.00) 97.9 (18.65-2.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.57 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, $R_{free}$	0.182 , 0.221 0.186 , 0.224	Depositor DCC
$R_{free}$ test set	1275 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	29.8	Xtriage
Anisotropy	0.117	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 52.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.52$ , $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	2691	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.23% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NAP, EDO, OT0

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	1.05	1/2510 (0.0%)	0.90	4/3400 (0.1%)

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	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	165	VAL	CB-CG1	5.96	1.65	1.52

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	263	ARG	NE-CZ-NH1	8.71	124.65	120.30
1	A	263	ARG	NE-CZ-NH2	-7.04	116.78	120.30
1	A	59	GLU	CA-CB-CG	6.22	127.09	113.40
1	A	292	ASP	CB-CG-OD2	-5.56	113.30	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	5	HIS	Peptide



## 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	2447	0	2417	7	0
2	A	48	0	25	2	0
3	A	23	0	18	1	0
4	A	12	0	18	2	0
5	A	161	0	0	0	0
All	All	2691	0	2478	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 2.

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:31:ARG:O	1:A:60:GLN:HG2	1.92	0.69
1:A:259:TYR:O	1:A:263:ARG:HG3	2.01	0.61
1:A:43:GLU:OE2	1:A:68:LYS:NZ	2.39	0.55
1:A:55:TYR:CE1	3:A:402:OT0:H17	2.44	0.52
1:A:18:VAL:HG12	4:A:405:EDO:H12	1.92	0.52
1:A:18:VAL:CG1	4:A:405:EDO:H12	2.40	0.52
2:A:401:NAP:H6N	2:A:401:NAP:H3D	1.99	0.44
1:A:270:LYS:O	2:A:401:NAP:H8A	2.21	0.41

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	304/331 (92%)	297 (98%)	7 (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	263/295 (89%)	259 (98%)	4 (2%)	65	69

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	59	GLU
1	A	67	SER
1	A	275	GLN
1	A	316	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	101	ASN
1	A	107	GLN
1	A	287	GLN
1	A	316	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 [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

5 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$
4	EDO	A	404	-	3,3,3	0.61	0	2,2,2	0.12	0
2	NAP	A	401	-	45,52,52	2.22	7 (15%)	56,80,80	2.14	11 (19%)
4	EDO	A	405	-	3,3,3	0.56	0	2,2,2	0.15	0
4	EDO	A	403	-	3,3,3	0.94	0	2,2,2	0.21	0
3	0T0	A	402	-	25,25,25	3.08	6 (24%)	34,36,36	3.60	18 (52%)

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	EDO	A	404	-	-	1/1/1/1	-
2	NAP	A	401	-	-	2/31/67/67	0/5/5/5
4	EDO	A	405	-	-	1/1/1/1	-
4	EDO	A	403	-	-	0/1/1/1	-
3	0T0	A	402	-	-	6/18/27/27	0/3/3/3

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402	0T0	SAW-NAV	12.21	1.80	1.63
2	A	401	NAP	C2A-N3A	7.79	1.44	1.32
2	A	401	NAP	C2A-N1A	7.32	1.47	1.33
2	A	401	NAP	P2B-O2B	5.66	1.70	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402	OT0	OAD-SAW	5.15	1.49	1.43
3	A	402	OT0	OAC-SAW	4.61	1.48	1.43
2	A	401	NAP	C4A-N3A	3.08	1.39	1.35
2	A	401	NAP	C5B-C4B	2.96	1.60	1.51
3	A	402	OT0	CAM-CAT	-2.70	1.46	1.51
3	A	402	OT0	CAA-NAP	2.66	1.50	1.45
2	A	401	NAP	O4D-C1D	2.63	1.44	1.41
2	A	401	NAP	C6N-N1N	2.49	1.41	1.35
3	A	402	OT0	OAB-CAQ	2.12	1.27	1.23

All (29) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	NAP	N3A-C2A-N1A	-11.10	111.33	128.68
3	A	402	OT0	OAD-SAW-NAV	9.77	115.60	106.69
3	A	402	OT0	CAS-SAW-NAV	-8.73	96.91	107.30
3	A	402	OT0	CAA-NAP-CAQ	-8.58	112.18	121.89
3	A	402	OT0	OAC-SAW-NAV	6.83	112.92	106.69
3	A	402	OT0	OAD-SAW-OAC	-6.05	109.71	119.52
2	A	401	NAP	C2A-N1A-C6A	4.35	126.20	118.75
2	A	401	NAP	C3D-C2D-C1D	-4.14	94.75	100.98
2	A	401	NAP	C6N-N1N-C2N	-3.70	118.60	121.97
3	A	402	OT0	CAO-NAV-SAW	-3.45	111.44	116.94
3	A	402	OT0	CAK-CAU-CAT	3.12	122.82	118.98
3	A	402	OT0	CAU-CAO-NAV	3.09	115.21	110.58
2	A	401	NAP	C5N-C4N-C3N	-3.07	116.71	120.34
3	A	402	OT0	CAE-CAJ-CAT	-2.99	116.44	120.89
2	A	401	NAP	O5D-C5D-C4D	2.97	119.21	108.99
3	A	402	OT0	CAF-CAK-CAU	-2.95	116.49	120.89
2	A	401	NAP	C3N-C7N-N7N	-2.93	114.24	117.75
3	A	402	OT0	CAG-CAI-CAS	-2.68	116.17	118.95
3	A	402	OT0	CAI-CAS-CAL	2.49	123.68	120.62
3	A	402	OT0	CAF-CAE-CAJ	2.48	123.97	120.19
3	A	402	OT0	CAR-CAQ-NAP	-2.47	113.62	116.89
3	A	402	OT0	CAM-CAT-CAJ	-2.32	116.11	120.98
2	A	401	NAP	O3X-P2B-O2X	2.28	116.36	107.64
2	A	401	NAP	O4D-C1D-C2D	2.27	110.24	106.93
3	A	402	OT0	OAC-SAW-CAS	2.19	110.82	108.05
2	A	401	NAP	C1B-N9A-C4A	-2.18	122.82	126.64
3	A	402	OT0	CAH-CAR-CAL	-2.17	116.67	119.24
2	A	401	NAP	C6N-C5N-C4N	2.14	122.54	119.44
3	A	402	OT0	CAL-CAS-SAW	-2.05	117.06	119.34

There are no chirality outliers.

All (10) torsion outliers are listed below:

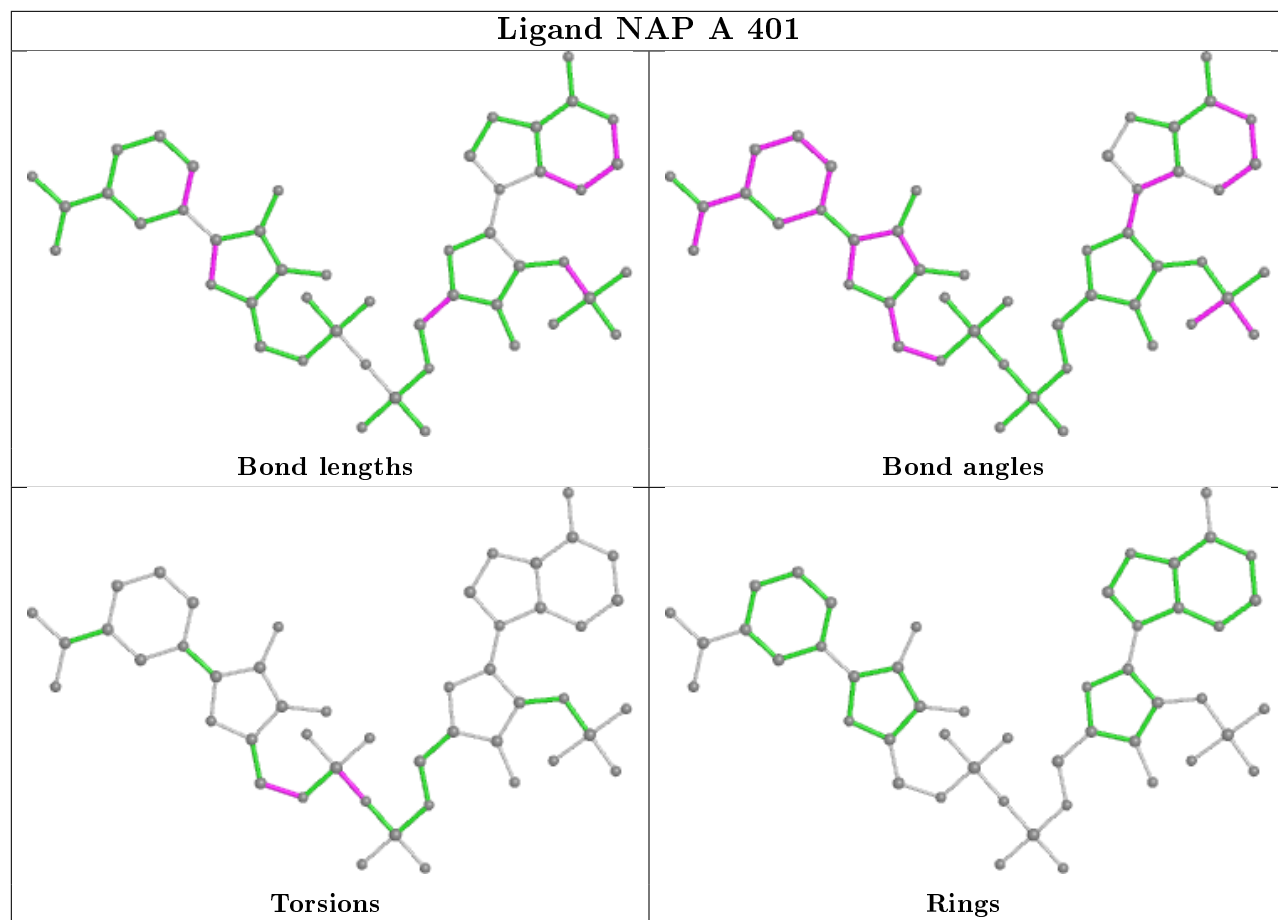
Mol	Chain	Res	Type	Atoms
3	A	402	0T0	CAN-NAV-SAW-OAD
3	A	402	0T0	CAN-NAV-SAW-OAC
3	A	402	0T0	CAN-NAV-SAW-CAS
3	A	402	0T0	CAO-NAV-SAW-OAC
3	A	402	0T0	CAO-NAV-SAW-OAD
3	A	402	0T0	CAO-NAV-SAW-CAS
2	A	401	NAP	C4D-C5D-O5D-PN
2	A	401	NAP	PA-O3-PN-O5D
4	A	404	EDO	O1-C1-C2-O2
4	A	405	EDO	O1-C1-C2-O2

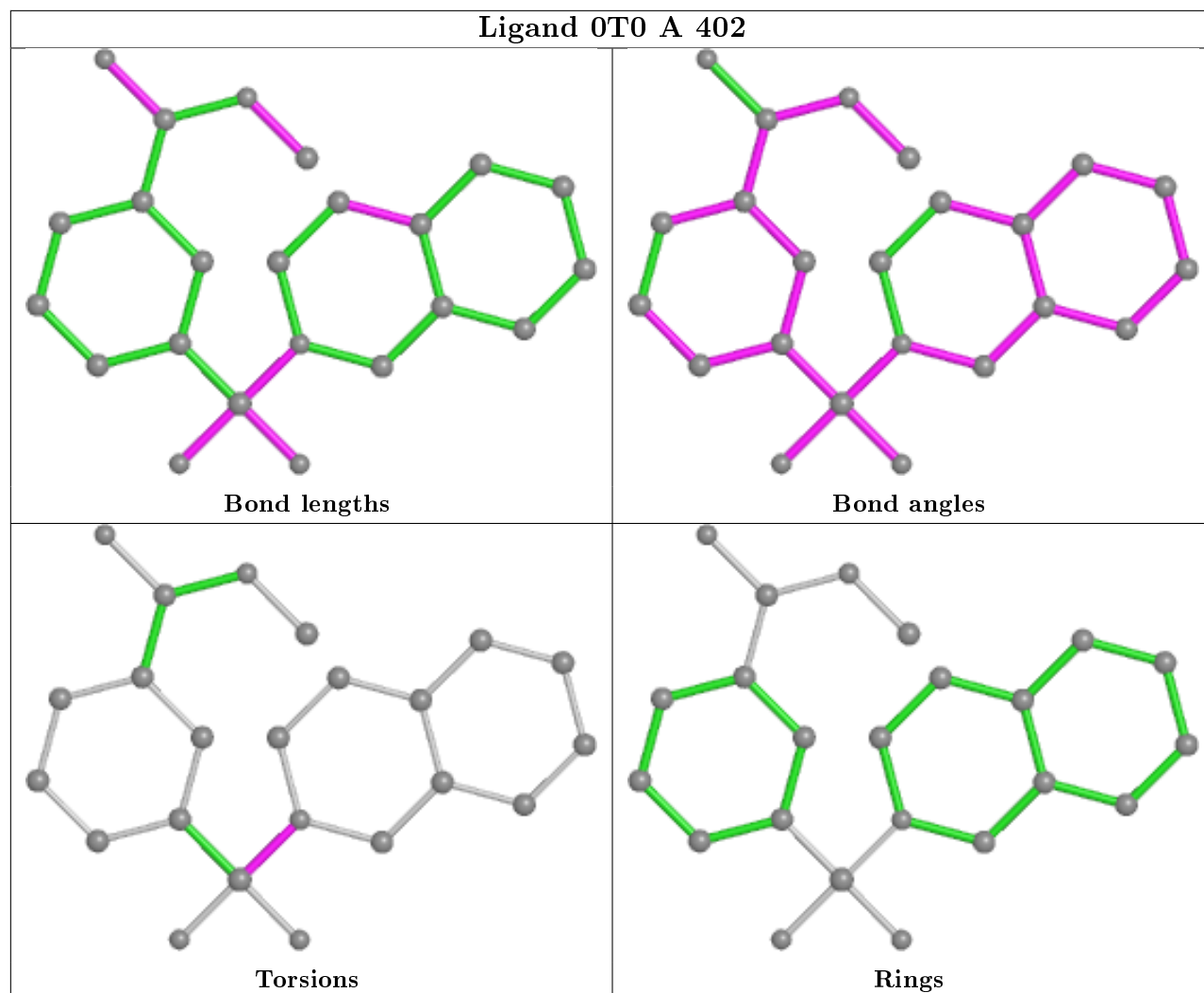
There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	NAP	2	0
4	A	405	EDO	2	0
3	A	402	0T0	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 [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, 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	306/331 (92%)	-0.09	5 (1%) 72 70	18, 26, 40, 51	3 (0%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	5	HIS	6.7
1	A	323	TYR	3.4
1	A	180	PRO	2.3
1	A	275	GLN	2.2
1	A	138	ILE	2.2

### 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 carbohydrates 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
4	EDO	A	405	4/4	0.76	0.26	53,53,54,54	0
4	EDO	A	404	4/4	0.83	0.14	60,61,62,63	0

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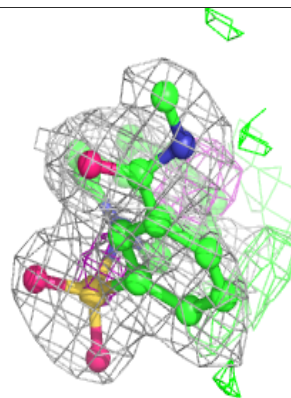
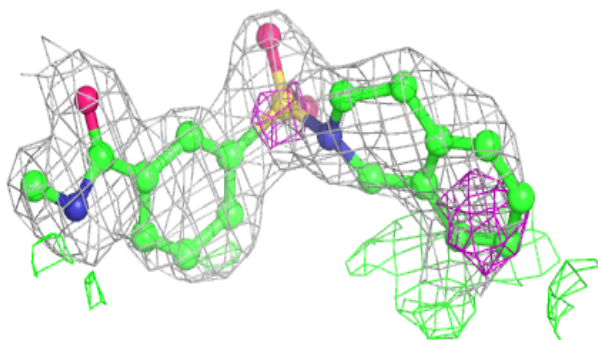
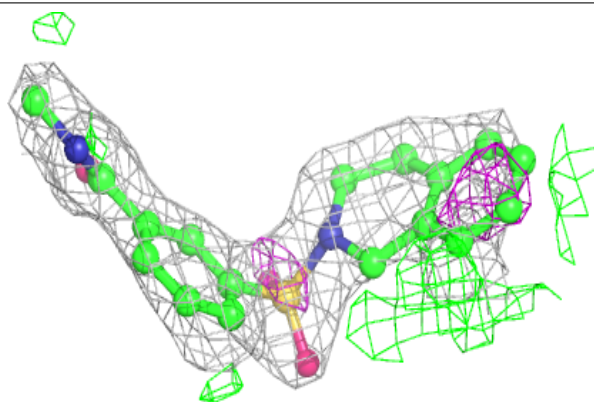
*Continued from previous page...*

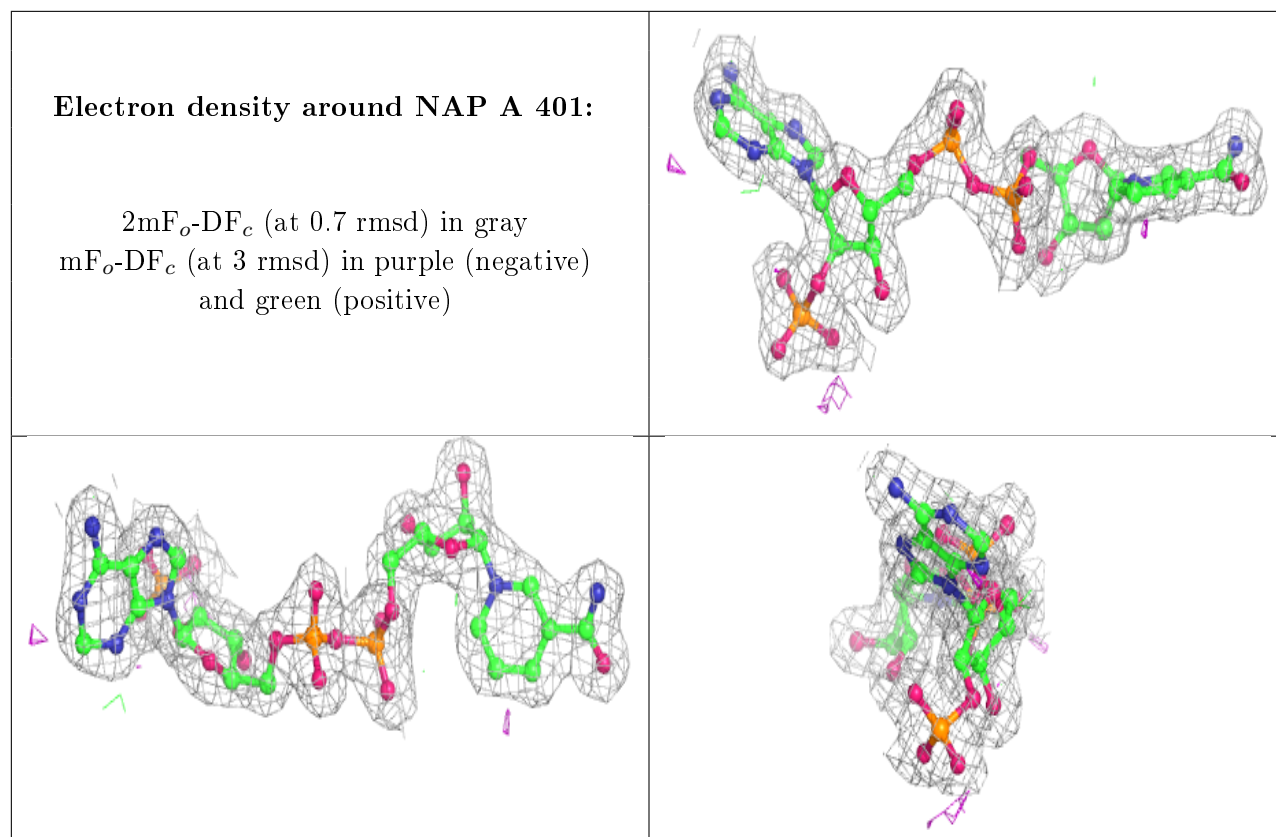
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	OT0	A	402	23/23	0.90	0.20	25,35,43,45	0
4	EDO	A	403	4/4	0.95	0.12	28,28,30,30	0
2	NAP	A	401	48/48	0.98	0.08	15,20,25,28	0

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 OT0 A 402:**

2mF<sub>o</sub>-DF<sub>c</sub> (at 0.7 rmsd) in gray  
mF<sub>o</sub>-DF<sub>c</sub> (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.