



# Full wwPDB X-ray Structure Validation Report ⓘ

May 26, 2026 – 01:54 PM JST

PDB ID : 9V7M / pdb\_00009v7m  
Title : The complex structure of HnH6H and hyoscyamine  
Authors : Wu, L.; Zhou, J.H.  
Deposited on : 2025-05-28  
Resolution : 1.70 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 : 4-5-2 with Phenix2.0  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
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

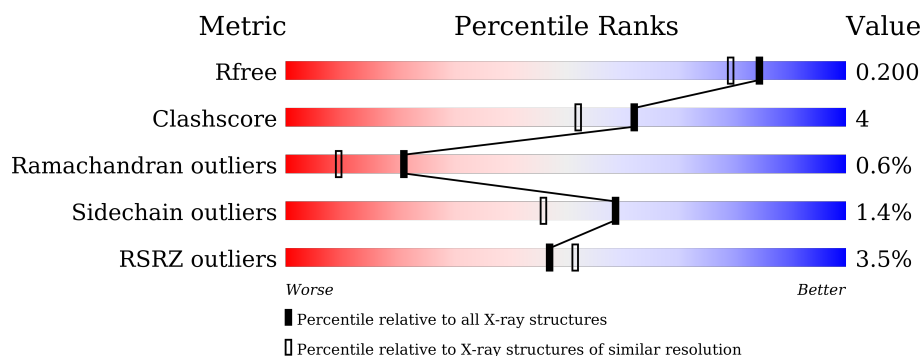
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.70 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	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (1.70-1.70)

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	386	<div> <div>3%</div> <div>72%</div> <div>10%</div> <div>18%</div> </div>

## 2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 2875 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 Hyoscyamine 6-dioxygenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	315	2547	1639	410	485	13	0	4	0

There are 43 discrepancies between the modelled and reference sequences:

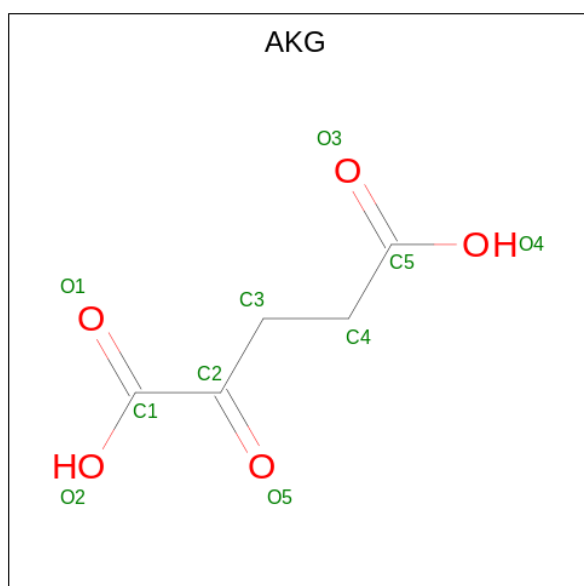
Chain	Residue	Modelled	Actual	Comment	Reference
A	115	ILE	VAL	conflict	UNP P24397
A	345	GLY	-	expression tag	UNP P24397
A	346	GLY	-	expression tag	UNP P24397
A	347	LYS	-	expression tag	UNP P24397
A	348	GLY	-	expression tag	UNP P24397
A	349	PRO	-	expression tag	UNP P24397
A	350	GLY	-	expression tag	UNP P24397
A	351	ASP	-	expression tag	UNP P24397
A	352	GLY	-	expression tag	UNP P24397
A	353	PRO	-	expression tag	UNP P24397
A	354	GLY	-	expression tag	UNP P24397
A	355	GLY	-	expression tag	UNP P24397
A	356	SER	-	expression tag	UNP P24397
A	357	GLY	-	expression tag	UNP P24397
A	358	GLY	-	expression tag	UNP P24397
A	359	PRO	-	expression tag	UNP P24397
A	360	ARG	-	expression tag	UNP P24397
A	361	GLY	-	expression tag	UNP P24397
A	362	GLY	-	expression tag	UNP P24397
A	363	GLU	-	expression tag	UNP P24397
A	364	ASN	-	expression tag	UNP P24397
A	365	LEU	-	expression tag	UNP P24397
A	366	TYR	-	expression tag	UNP P24397
A	367	PHE	-	expression tag	UNP P24397
A	368	GLN	-	expression tag	UNP P24397
A	369	SER	-	expression tag	UNP P24397
A	370	GLY	-	expression tag	UNP P24397

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Chain	Residue	Modelled	Actual	Comment	Reference
A	371	HIS	-	expression tag	UNP P24397
A	372	HIS	-	expression tag	UNP P24397
A	373	HIS	-	expression tag	UNP P24397
A	374	HIS	-	expression tag	UNP P24397
A	375	HIS	-	expression tag	UNP P24397
A	376	HIS	-	expression tag	UNP P24397
A	377	HIS	-	expression tag	UNP P24397
A	378	HIS	-	expression tag	UNP P24397
A	379	GLY	-	expression tag	UNP P24397
A	380	GLY	-	expression tag	UNP P24397
A	381	ARG	-	expression tag	UNP P24397
A	382	GLY	-	expression tag	UNP P24397
A	383	GLY	-	expression tag	UNP P24397
A	384	ALA	-	expression tag	UNP P24397
A	385	ALA	-	expression tag	UNP P24397
A	386	ALA	-	expression tag	UNP P24397

- Molecule 2 is 2-OXOGLUTARIC ACID (CCD ID: AKG) (formula: C<sub>5</sub>H<sub>6</sub>O<sub>5</sub>).

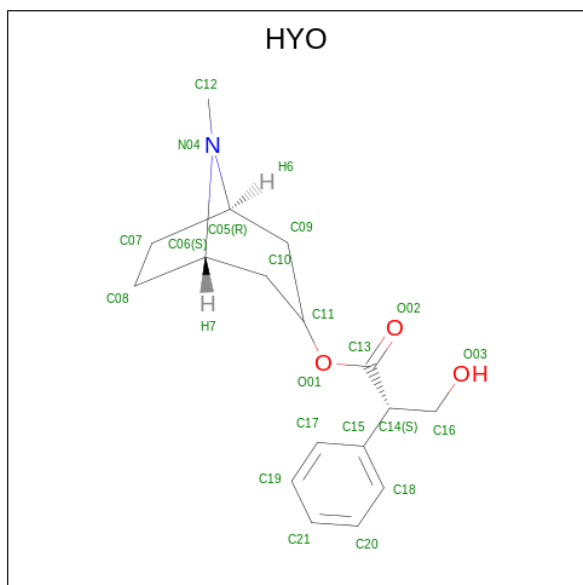


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	5	5		

- Molecule 3 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total Cl 2 2	0	0

- Molecule 4 is [(1S,5R)-8-methyl-8-azabicyclo[3.2.1]octan-3-yl] (2S)-3-hydroxy-2-phenylpropanoate (CCD ID: HYO) (formula:  $C_{17}H_{23}NO_3$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N O 21 17 1 3	0	0

- Molecule 5 is FE (II) ION (CCD ID: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Fe 1 1	0	0

- Molecule 6 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula:  $C_2H_6O_2$ ).



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

- Molecule 7 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	1	Total	Na	0	0
			1	1		

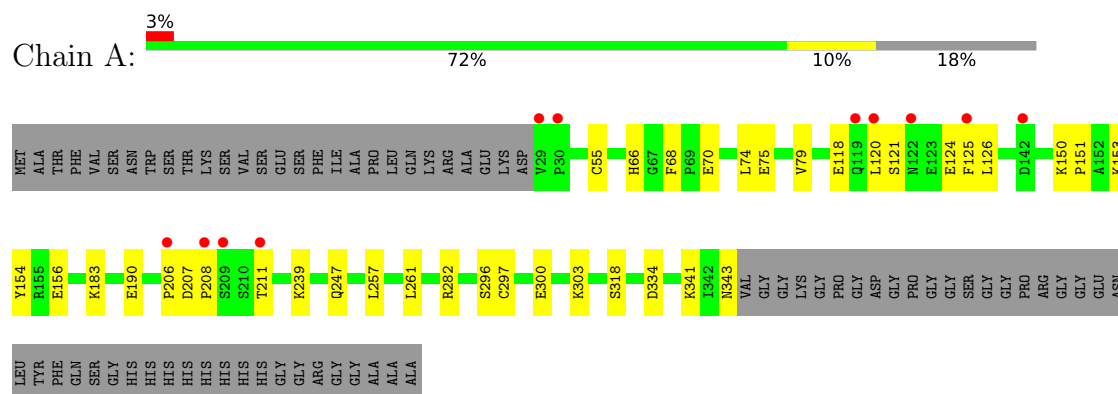
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	289	Total	O	0	0
			289	289		

### 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: Hyoscyamine 6-dioxygenase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	43.20Å 80.07Å 47.80Å 90.00° 98.12° 90.00°	Depositor
Resolution (Å)	19.57 – 1.70 19.57 – 1.70	Depositor EDS
% Data completeness (in resolution range)	99.7 (19.57-1.70) 99.8 (19.57-1.70)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.10 (at 1.70Å)	Xtriage
Refinement program	PHENIX 1.11.1_2575, PHENIX 1.11.1_2575	Depositor
R, $R_{free}$	0.167 , 0.199 0.167 , 0.200	Depositor DCC
$R_{free}$ test set	1810 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	17.8	Xtriage
Anisotropy	0.316	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 47.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	2875	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.48% 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: FE2, AKG, CL, NA, EDO, HYO

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	0.29	0/2615	0.49	0/3555

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	2547	0	2511	21	0
2	A	10	0	4	0	0
3	A	2	0	0	1	0
4	A	21	0	0	0	0
5	A	1	0	0	0	0
6	A	4	0	6	0	0
7	A	1	0	0	0	0
8	A	289	0	0	7	0
All	All	2875	0	2521	21	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.

All (21) 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:282:ARG:NH1	8:A:501:HOH:O	2.04	0.91
1:A:300:GLU:OE1	1:A:303:LYS:NZ	2.24	0.69
1:A:75:GLU:OE1	8:A:502:HOH:O	2.15	0.64
1:A:120:LEU:HD22	1:A:125:PHE:HE2	1.66	0.59
1:A:206:PRO:O	1:A:208:PRO:HD3	2.03	0.58
1:A:126:LEU:O	1:A:211:THR:HG21	2.07	0.55
1:A:124:GLU:O	8:A:505:HOH:O	2.18	0.54
1:A:190:GLU:HB3	1:A:297[A]:CYS:SG	2.52	0.50
1:A:79:VAL:HG11	1:A:154:TYR:HA	1.95	0.48
1:A:66:HIS:CE1	1:A:68:PHE:HB3	2.49	0.48
1:A:150:LYS:HA	1:A:151:PRO:C	2.40	0.46
1:A:334:ASP:OD2	1:A:341:LYS:NZ	2.47	0.46
1:A:257:LEU:HD22	1:A:261:LEU:HD23	2.00	0.44
1:A:55:CYS:SG	1:A:257:LEU:HD11	2.59	0.43
1:A:296:SER:OG	8:A:504:HOH:O	2.17	0.43
1:A:118:GLU:HB3	1:A:120:LEU:HD13	2.01	0.42
1:A:183:LYS:HG2	3:A:403:CL:CL	2.57	0.42
1:A:341:LYS:NZ	8:A:523:HOH:O	2.52	0.41
1:A:247:GLN:HG3	8:A:591:HOH:O	2.20	0.41
1:A:343:ASN:ND2	8:A:526:HOH:O	2.53	0.41
1:A:70:GLU:O	1:A:74:LEU:HG	2.22	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	317/386 (82%)	308 (97%)	7 (2%)	2 (1%)	21 9

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	121	SER
1	A	207	ASP

### 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	286/331 (86%)	282 (99%)	4 (1%)	59 46

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

Mol	Chain	Res	Type
1	A	153	LYS
1	A	156	GLU
1	A	239	LYS
1	A	318	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	49	GLN
1	A	247	GLN

### 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 oligosaccharides in this entry.

## 5.6 Ligand geometry

Of 7 ligands modelled in this entry, 4 are monoatomic - leaving 3 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
6	EDO	A	406	-	3,3,3	0.39	0	2,2,2	0.45	0
4	HYO	A	404	-	23,23,23	5.20	15 (65%)	32,32,32	2.06	6 (18%)
2	AKG	A	401	5	9,9,9	1.96	1 (11%)	11,11,11	1.71	4 (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
6	EDO	A	406	-	-	0/1/1/1	-
4	HYO	A	404	-	-	1/14/35/35	0/4/3/3
2	AKG	A	401	5	-	0/9/9/9	-

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	404	HYO	C05-N04	-11.80	1.30	1.48
4	A	404	HYO	C06-N04	-8.52	1.35	1.48
4	A	404	HYO	C18-C15	8.36	1.52	1.39
4	A	404	HYO	C17-C15	7.91	1.51	1.39
4	A	404	HYO	O01-C11	-6.24	1.31	1.46
4	A	404	HYO	C20-C18	6.14	1.51	1.38
4	A	404	HYO	C19-C17	6.04	1.51	1.38
4	A	404	HYO	C09-C11	5.81	1.66	1.52
4	A	404	HYO	C12-N04	-5.61	1.38	1.47
4	A	404	HYO	C21-C20	5.25	1.51	1.38
4	A	404	HYO	C19-C21	5.13	1.51	1.38
2	A	401	AKG	C2-C1	-5.10	1.46	1.53
4	A	404	HYO	C10-C11	4.21	1.62	1.52
4	A	404	HYO	C08-C07	-3.17	1.45	1.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	404	HYO	O01-C13	2.87	1.41	1.34
4	A	404	HYO	C07-C05	2.29	1.59	1.53

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	404	HYO	C06-N04-C05	7.23	109.56	100.80
4	A	404	HYO	C10-C06-N04	4.68	114.22	107.53
4	A	404	HYO	C09-C05-N04	3.31	112.27	107.53
2	A	401	AKG	C4-C3-C2	-3.01	107.36	113.03
4	A	404	HYO	O01-C13-C14	2.89	114.20	111.16
4	A	404	HYO	C10-C06-C08	-2.56	106.14	113.01
2	A	401	AKG	O1-C1-C2	-2.44	118.46	121.72
4	A	404	HYO	C18-C15-C17	2.44	121.34	118.29
2	A	401	AKG	C3-C2-C1	2.43	120.48	115.97
2	A	401	AKG	O2-C1-C2	2.14	119.81	113.97

There are no chirality outliers.

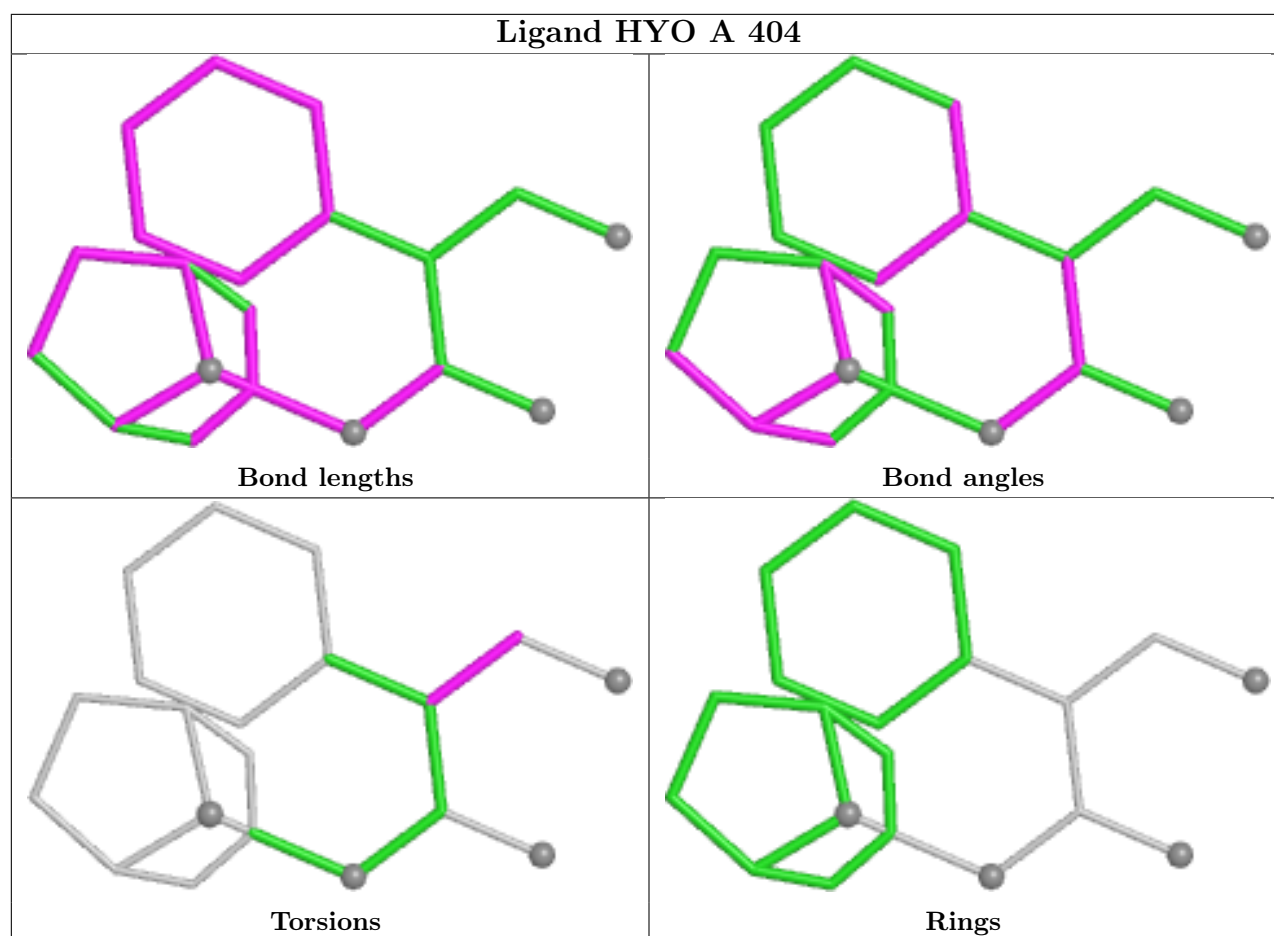
All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	404	HYO	C13-C14-C16-O03

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, 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	315/386 (81%)	-0.16	11 (3%)	47 52	6, 17, 45, 65	9 (2%)

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	208	PRO	3.7
1	A	120	LEU	3.7
1	A	29	VAL	3.0
1	A	142	ASP	2.9
1	A	125	PHE	2.9
1	A	211	THR	2.8
1	A	206	PRO	2.6
1	A	119	GLN	2.6
1	A	122	ASN	2.6
1	A	209	SER	2.2
1	A	30	PRO	2.1

### 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.

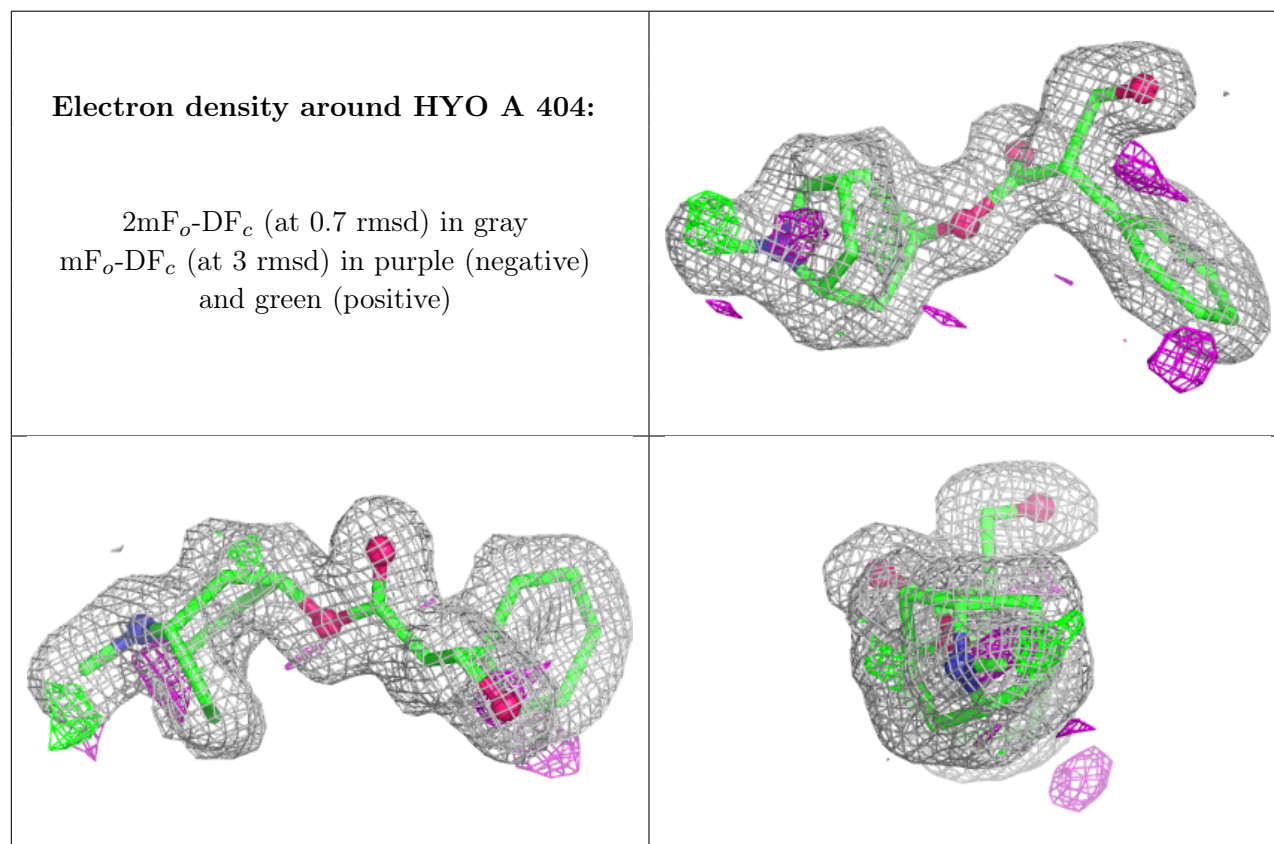
### 6.4 Ligands [i](#)

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, 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
6	EDO	A	406	4/4	0.88	0.09	22,28,31,34	0
4	HYO	A	404	21/21	0.94	0.06	9,12,16,20	0
2	AKG	A	401	10/10	0.96	0.05	10,15,20,25	0
3	CL	A	403	1/1	0.96	0.14	36,36,36,36	0
3	CL	A	402	1/1	0.97	0.08	24,24,24,24	0
7	NA	A	407	1/1	0.99	0.04	15,15,15,15	0
5	FE2	A	405	1/1	1.00	0.02	9,9,9,9	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 ⓘ

There are no such residues in this entry.