



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 02:43 AM UTC

PDB ID : 1X8L / pdb_00001x8l
Title : Crystal structure of retinol dehydratase in complex with all-trans-4-oxoretinol and inactive cofactor PAP
Authors : Pakhomova, S.; Buck, J.; Newcomer, M.E.
Deposited on : 2004-08-18
Resolution : 2.10 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

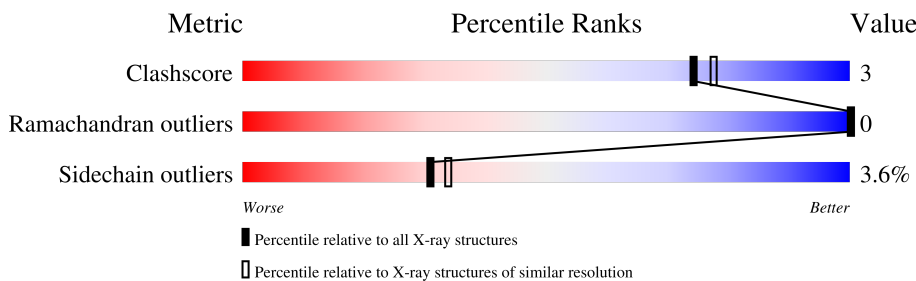
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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))
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	351	 87% 9% . .
1	B	351	 89% 9% .

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6088 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 retinol dehydratase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	342	Total	C	N	O	S	0	0	0
			2840	1835	469	521	15			
1	B	342	Total	C	N	O	S	0	0	0
			2845	1840	470	520	15			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	142	SER	PHE	SEE REMARK 999	UNP Q26490
A	258	SER	CYS	engineered mutation	UNP Q26490
A	279	SER	CYS	engineered mutation	UNP Q26490
B	142	SER	PHE	SEE REMARK 999	UNP Q26490
B	258	SER	CYS	engineered mutation	UNP Q26490
B	279	SER	CYS	engineered mutation	UNP Q26490

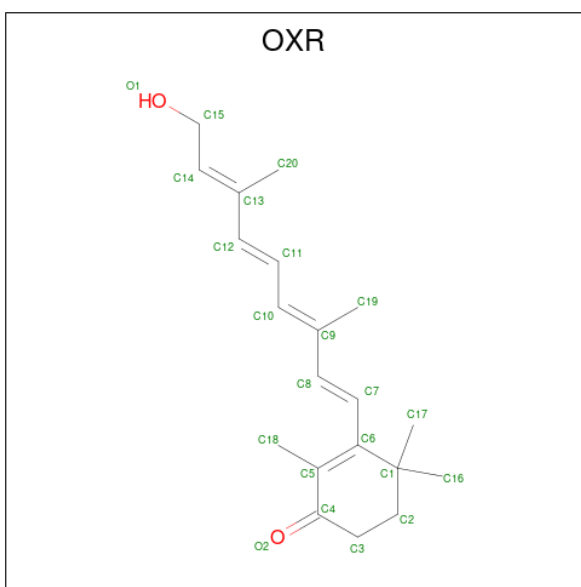
- Molecule 2 is MERCURY (II) ION (CCD ID: HG) (formula: Hg).

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

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

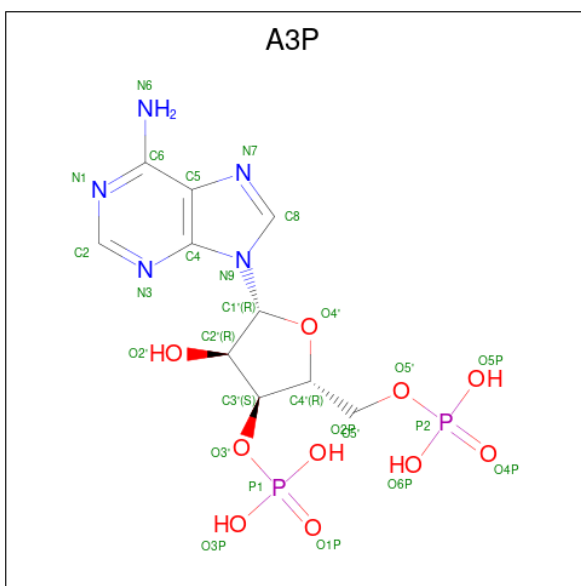
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Ca	0	0
			1	1		
3	B	1	Total	Ca	0	0
			1	1		

- Molecule 4 is 4-OXORETINOL (CCD ID: OXR) (formula: C₂₀H₂₈O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	O		0	0
			22	20	2			
4	B	1	Total	C	O		0	0
			22	20	2			

- Molecule 5 is ADENOSINE-3'-5'-DIPHOSPHATE (CCD ID: A3P) (formula: $C_{10}H_{15}N_5O_{10}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		
5	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		

- Molecule 6 is water.

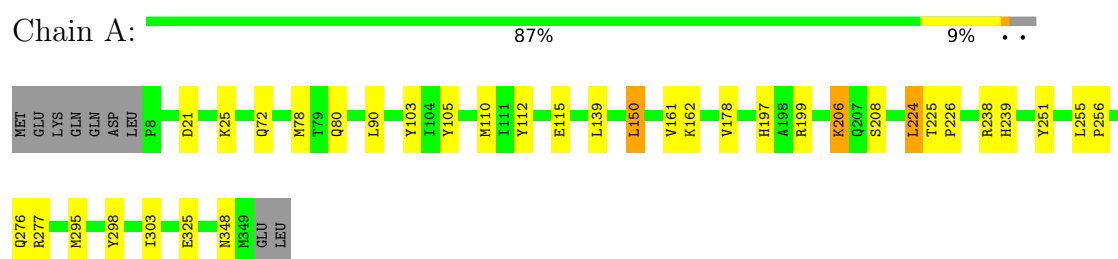
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	145	Total 145	O 145	0	0
6	B	156	Total 156	O 156	0	0

3 Residue-property plots [i](#)

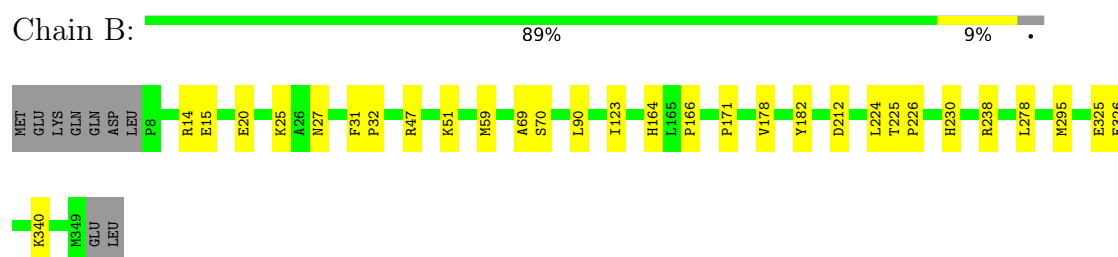
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

- Molecule 1: retinol dehydratase



- Molecule 1: retinol dehydratase



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	82.51Å 67.19Å 85.07Å 90.00° 111.85° 90.00°	Depositor
Resolution (Å)	15.00 – 2.10	Depositor
% Data completeness (in resolution range)	88.4 (15.00-2.10)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.196 , 0.231	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	6088	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

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: HG, A3P, CA, OXR

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	0.84	0/2921	0.95	0/3955
1	B	0.85	0/2926	0.94	0/3959
All	All	0.85	0/5847	0.94	0/7914

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	2840	0	2760	17	0
1	B	2845	0	2778	11	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	22	0	28	6	0
4	B	22	0	28	3	0
5	B	54	0	22	0	0
6	A	145	0	0	2	0
6	B	156	0	0	0	0
All	All	6088	0	5616	34	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 3.

All (34) 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:B:27:ASN:HD21	1:B:212:ASP:HB3	1.47	0.78
4:B:2202:OXR:H181	4:B:2202:OXR:H8	1.68	0.75
4:A:1102:OXR:H8	4:A:1102:OXR:H181	1.71	0.73
4:B:2202:OXR:H8	4:B:2202:OXR:C18	2.32	0.59
1:A:199:ARG:CD	1:A:206:LYS:HZ1	2.16	0.58
1:B:225:THR:HB	1:B:226:PRO:HA	1.87	0.56
1:A:225:THR:HB	1:A:226:PRO:HA	1.86	0.56
4:A:1102:OXR:H8	4:A:1102:OXR:C18	2.35	0.55
1:A:298:TYR:HD2	1:A:303:ILE:HD11	1.73	0.52
1:A:238:ARG:HG2	1:A:239:HIS:CD2	2.45	0.52
1:A:72:GLN:NE2	6:A:1175:HOH:O	2.44	0.51
1:B:15:GLU:OE2	1:B:47:ARG:NH2	2.44	0.51
1:A:150:LEU:HD21	1:A:161:VAL:HG22	1.94	0.50
1:B:59:MET:HE2	1:B:171:PRO:HD3	1.93	0.49
4:A:1102:OXR:H181	4:A:1102:OXR:C8	2.40	0.48
1:A:197:HIS:NE2	4:A:1102:OXR:H14	2.28	0.48
1:B:69:ALA:O	1:B:182:TYR:HA	2.15	0.46
4:B:2202:OXR:H181	4:B:2202:OXR:C8	2.39	0.46
1:A:105:TYR:CE1	4:A:1102:OXR:H203	2.52	0.45
1:A:255:LEU:HB3	1:A:256:PRO:HD3	1.99	0.44
1:A:110:MET:HE1	1:A:224:LEU:HD22	1.99	0.44
1:A:208:SER:HB2	6:A:1222:HOH:O	2.17	0.44
1:A:80:GLN:HG2	1:A:103:TYR:CE2	2.54	0.43
1:B:31:PHE:HA	1:B:32:PRO:HD3	1.92	0.42
1:A:150:LEU:HD21	1:A:161:VAL:CG2	2.49	0.42
1:A:78:MET:HE1	1:A:251:TYR:HB3	2.00	0.42
1:B:70:SER:O	1:B:164:HIS:HA	2.19	0.42
1:B:90:LEU:HD22	1:B:278:LEU:HD21	2.02	0.41
1:A:206:LYS:HA	1:A:206:LYS:NZ	2.36	0.41
1:A:162:LYS:NZ	4:A:1102:OXR:H201	2.35	0.41
1:B:14:ARG:NH2	1:B:20:GLU:OE1	2.53	0.41
1:A:112:TYR:CE1	1:A:139:LEU:HD22	2.55	0.40
1:B:123:ILE:O	1:B:123:ILE:HG22	2.21	0.40
1:B:166:PRO:HB3	1:B:230:HIS:CD2	2.57	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	340/351 (97%)	335 (98%)	5 (2%)	0	100	100
1	B	340/351 (97%)	337 (99%)	3 (1%)	0	100	100
All	All	680/702 (97%)	672 (99%)	8 (1%)	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	305/316 (96%)	292 (96%)	13 (4%)	26	27
1	B	306/316 (97%)	297 (97%)	9 (3%)	37	42
All	All	611/632 (97%)	589 (96%)	22 (4%)	31	34

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	21	ASP
1	A	25	LYS
1	A	90	LEU
1	A	115	GLU
1	A	150	LEU
1	A	178	VAL
1	A	206	LYS
1	A	224	LEU

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Mol	Chain	Res	Type
1	A	276	GLN
1	A	277	ARG
1	A	295	MET
1	A	325	GLU
1	A	348	ASN
1	B	25	LYS
1	B	51	LYS
1	B	178	VAL
1	B	224	LEU
1	B	238	ARG
1	B	295	MET
1	B	325	GLU
1	B	326	GLU
1	B	340	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	72	GLN
1	A	239	HIS
1	B	80	GLN
1	B	207	GLN
1	B	239	HIS

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 [i](#)

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 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	$\# Z > 2$
4	OXR	A	1102	-	22,22,22	0.73	0	27,30,30	2.48	12 (44%)
4	OXR	B	2202	-	22,22,22	0.72	0	27,30,30	2.37	11 (40%)
5	A3P	B	1101	-	29,29,29	1.78	6 (20%)	44,45,45	2.14	19 (43%)
5	A3P	B	2201	-	29,29,29	1.79	9 (31%)	44,45,45	2.14	17 (38%)

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	OXR	A	1102	-	-	3/14/34/34	0/1/1/1
4	OXR	B	2202	-	-	3/14/34/34	0/1/1/1
5	A3P	B	1101	-	-	3/15/31/31	0/3/3/3
5	A3P	B	2201	-	-	3/15/31/31	0/3/3/3

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	1101	A3P	C4-N3	5.91	1.45	1.34
5	B	2201	A3P	C4-N3	5.19	1.44	1.34
5	B	1101	A3P	C5-N7	-3.49	1.32	1.39
5	B	2201	A3P	C5-N7	-3.48	1.32	1.39
5	B	2201	A3P	C5-C6	2.94	1.49	1.41
5	B	2201	A3P	C4-N9	-2.79	1.31	1.37
5	B	1101	A3P	C4-N9	-2.62	1.32	1.37
5	B	1101	A3P	C5-C4	2.62	1.43	1.39
5	B	2201	A3P	C5-C4	2.54	1.43	1.39
5	B	2201	A3P	C8-N9	-2.42	1.33	1.37
5	B	1101	A3P	C5-C6	2.39	1.47	1.41
5	B	2201	A3P	P2-O4P	2.38	1.57	1.50
5	B	1101	A3P	C8-N7	2.35	1.36	1.31
5	B	2201	A3P	P1-O1P	2.09	1.57	1.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	2201	A3P	C8-N7	2.06	1.35	1.31

All (59) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	2202	OXR	C3-C2-C1	5.16	120.76	113.21
4	B	2202	OXR	C3-C4-C5	5.05	123.18	118.64
4	A	1102	OXR	C3-C4-C5	4.93	123.08	118.64
4	A	1102	OXR	C3-C2-C1	4.76	120.18	113.21
4	A	1102	OXR	C2-C1-C6	4.71	117.29	110.44
5	B	1101	A3P	N3-C2-N1	-4.67	121.51	128.58
4	B	2202	OXR	C2-C1-C6	4.52	117.00	110.44
4	A	1102	OXR	C19-C9-C8	4.51	124.97	118.09
5	B	2201	A3P	C4-C5-N7	-4.35	105.61	110.58
5	B	1101	A3P	O4'-C1'-N9	4.32	116.38	108.09
5	B	2201	A3P	C5-C4-N3	-4.07	121.11	126.72
5	B	2201	A3P	N3-C2-N1	-3.91	122.67	128.58
4	B	2202	OXR	C8-C9-C10	-3.86	112.94	119.01
5	B	2201	A3P	O4'-C1'-N9	3.84	115.46	108.09
5	B	2201	A3P	O3'-C3'-C4'	-3.75	96.82	110.03
5	B	1101	A3P	C5-C4-N3	-3.73	121.59	126.72
5	B	2201	A3P	C6-C5-N7	3.50	138.83	132.09
5	B	2201	A3P	C5-C4-N9	3.45	109.58	105.81
4	A	1102	OXR	C16-C1-C6	-3.41	104.90	110.24
4	B	2202	OXR	O2-C4-C3	-3.39	115.31	120.87
5	B	2201	A3P	C2'-C3'-C4'	3.20	108.84	103.24
5	B	1101	A3P	C2-N1-C6	3.18	123.95	118.73
5	B	2201	A3P	O2'-C2'-C3'	3.17	120.06	111.19
5	B	1101	A3P	C6-C5-N7	3.09	138.04	132.09
4	A	1102	OXR	C8-C9-C10	-3.03	114.24	119.01
5	B	1101	A3P	O2'-C2'-C1'	3.02	120.49	110.10
4	B	2202	OXR	C19-C9-C8	2.96	122.62	118.09
5	B	1101	A3P	C5-C6-N6	-2.95	115.99	123.29
4	A	1102	OXR	O2-C4-C3	-2.94	116.04	120.87
5	B	1101	A3P	C4-C5-N7	-2.93	107.24	110.58
5	B	1101	A3P	O3'-C3'-C4'	-2.91	99.78	110.03
4	B	2202	OXR	C10-C11-C12	-2.90	114.80	123.20
5	B	1101	A3P	O2'-C2'-C3'	2.87	119.21	111.19
5	B	2201	A3P	C2-N3-C4	2.85	118.79	111.83
5	B	1101	A3P	C2-N3-C4	2.74	118.52	111.83
5	B	1101	A3P	N6-C6-N1	2.66	124.30	118.38
4	A	1102	OXR	C10-C11-C12	-2.63	115.57	123.20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	2201	A3P	C2-N1-C6	2.62	123.03	118.73
5	B	1101	A3P	N9-C8-N7	-2.61	110.23	113.94
4	B	2202	OXR	C17-C1-C6	-2.58	106.20	110.24
4	A	1102	OXR	C7-C8-C9	-2.56	122.45	126.23
5	B	1101	A3P	O3'-C3'-C2'	-2.50	102.72	111.68
5	B	1101	A3P	C5-N7-C8	2.50	107.37	103.45
5	B	2201	A3P	C2'-C1'-N9	2.38	119.22	113.30
4	A	1102	OXR	C15-C14-C13	-2.37	122.76	126.61
4	B	2202	OXR	C7-C8-C9	-2.37	122.73	126.23
5	B	1101	A3P	O3P-P1-O2P	2.35	116.62	107.80
5	B	2201	A3P	O3P-P1-O3'	2.33	114.95	105.85
5	B	1101	A3P	C2'-C3'-C4'	2.32	107.30	103.24
5	B	2201	A3P	N6-C6-N1	2.30	123.51	118.38
5	B	2201	A3P	C5-C6-N6	-2.27	117.66	123.29
5	B	2201	A3P	C5-N7-C8	2.23	106.96	103.45
4	B	2202	OXR	C16-C1-C6	-2.23	106.74	110.24
5	B	2201	A3P	O2'-C2'-C1'	2.21	117.72	110.10
5	B	1101	A3P	C5'-C4'-C3'	-2.21	107.02	114.38
4	A	1102	OXR	C11-C10-C9	-2.20	124.19	127.28
5	B	1101	A3P	N3-C4-N9	2.20	130.90	127.17
4	A	1102	OXR	C17-C1-C6	-2.19	106.81	110.24
4	B	2202	OXR	C12-C13-C14	-2.17	115.47	118.49

There are no chirality outliers.

All (12) torsion outliers are listed below:

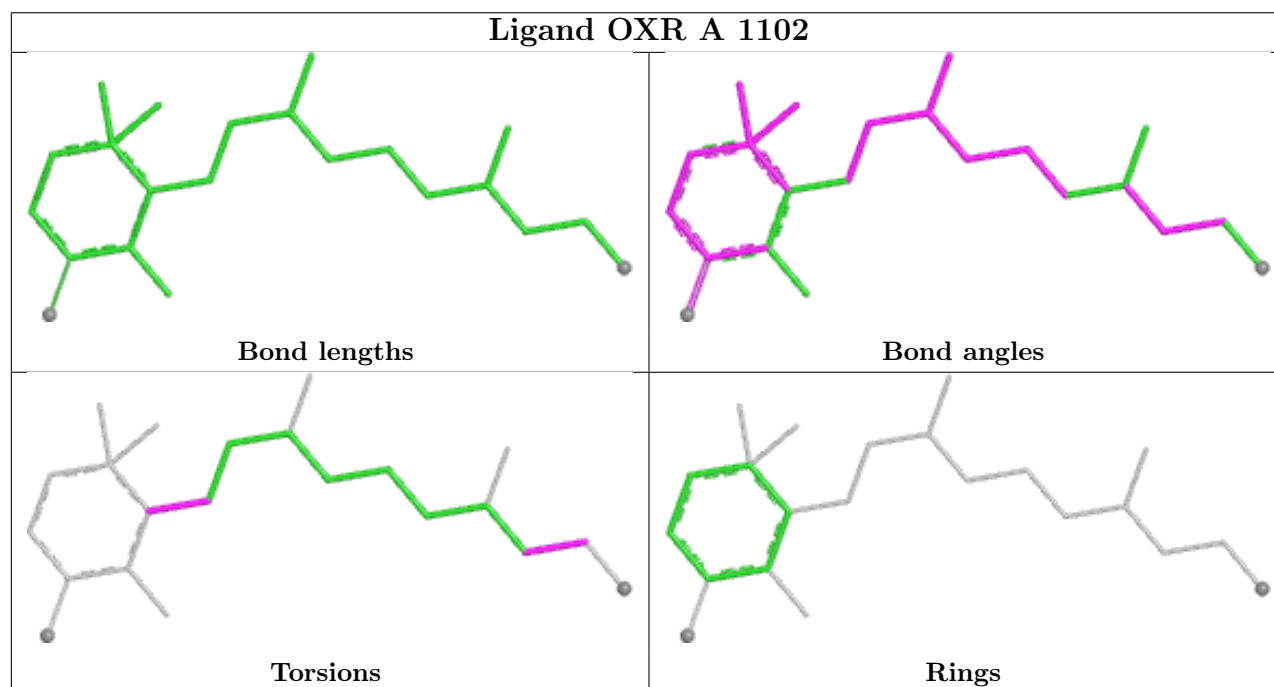
Mol	Chain	Res	Type	Atoms
4	A	1102	OXR	C5-C6-C7-C8
4	B	2202	OXR	C1-C6-C7-C8
4	B	2202	OXR	C5-C6-C7-C8
4	B	2202	OXR	C13-C14-C15-O1
5	B	1101	A3P	C5'-O5'-P2-O4P
5	B	1101	A3P	C5'-O5'-P2-O5P
5	B	2201	A3P	C5'-O5'-P2-O5P
4	A	1102	OXR	C1-C6-C7-C8
5	B	2201	A3P	C5'-O5'-P2-O4P
5	B	1101	A3P	C5'-O5'-P2-O6P
5	B	2201	A3P	C5'-O5'-P2-O6P
4	A	1102	OXR	C13-C14-C15-O1

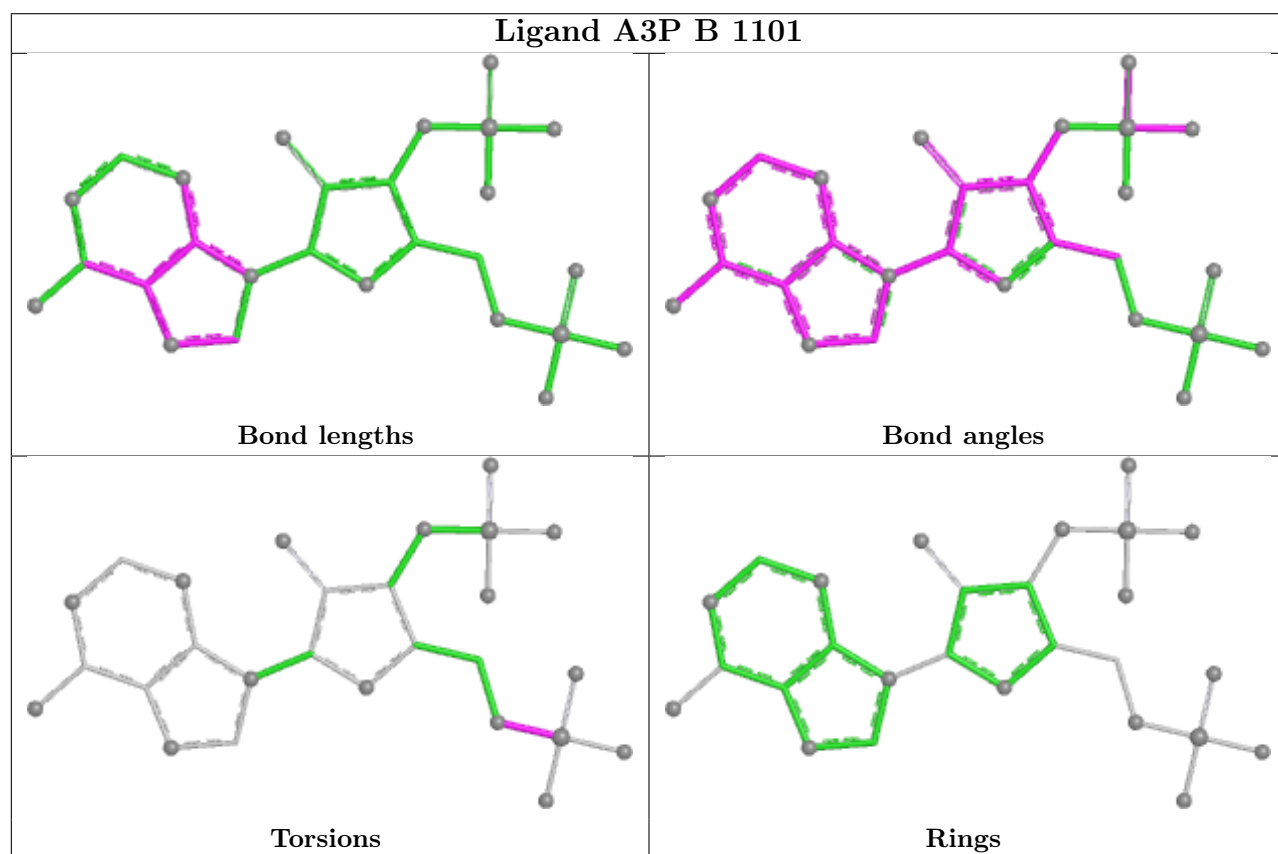
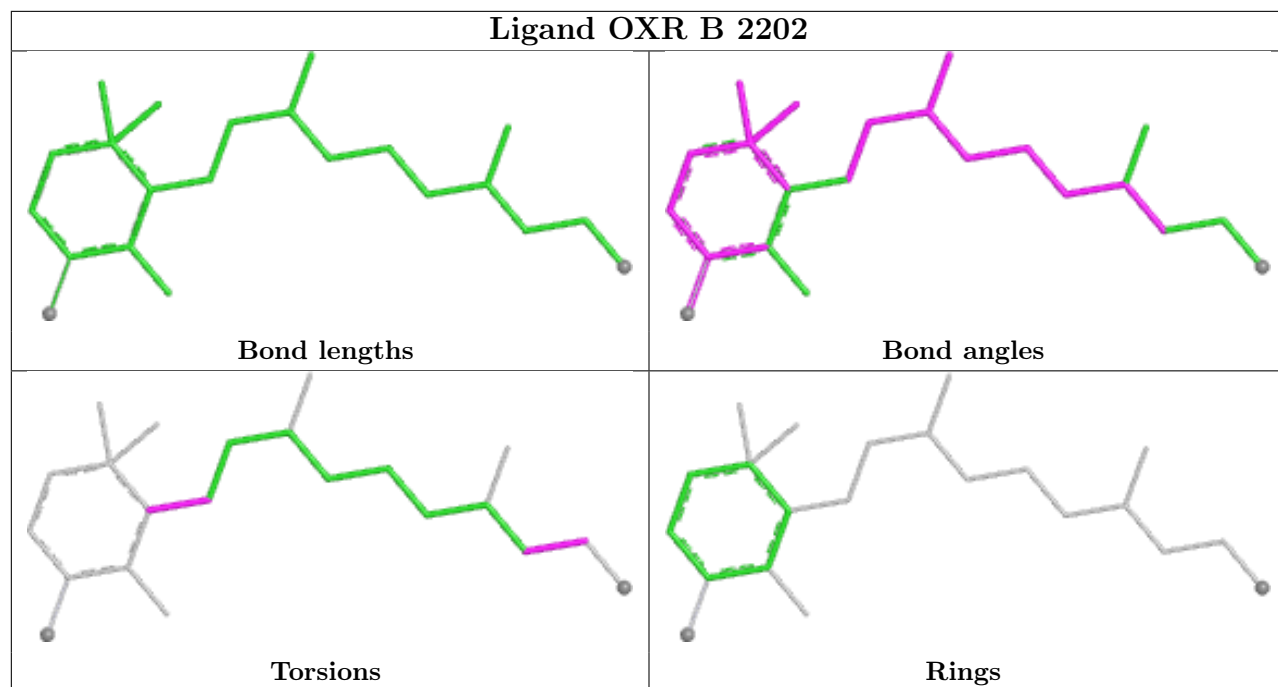
There are no ring outliers.

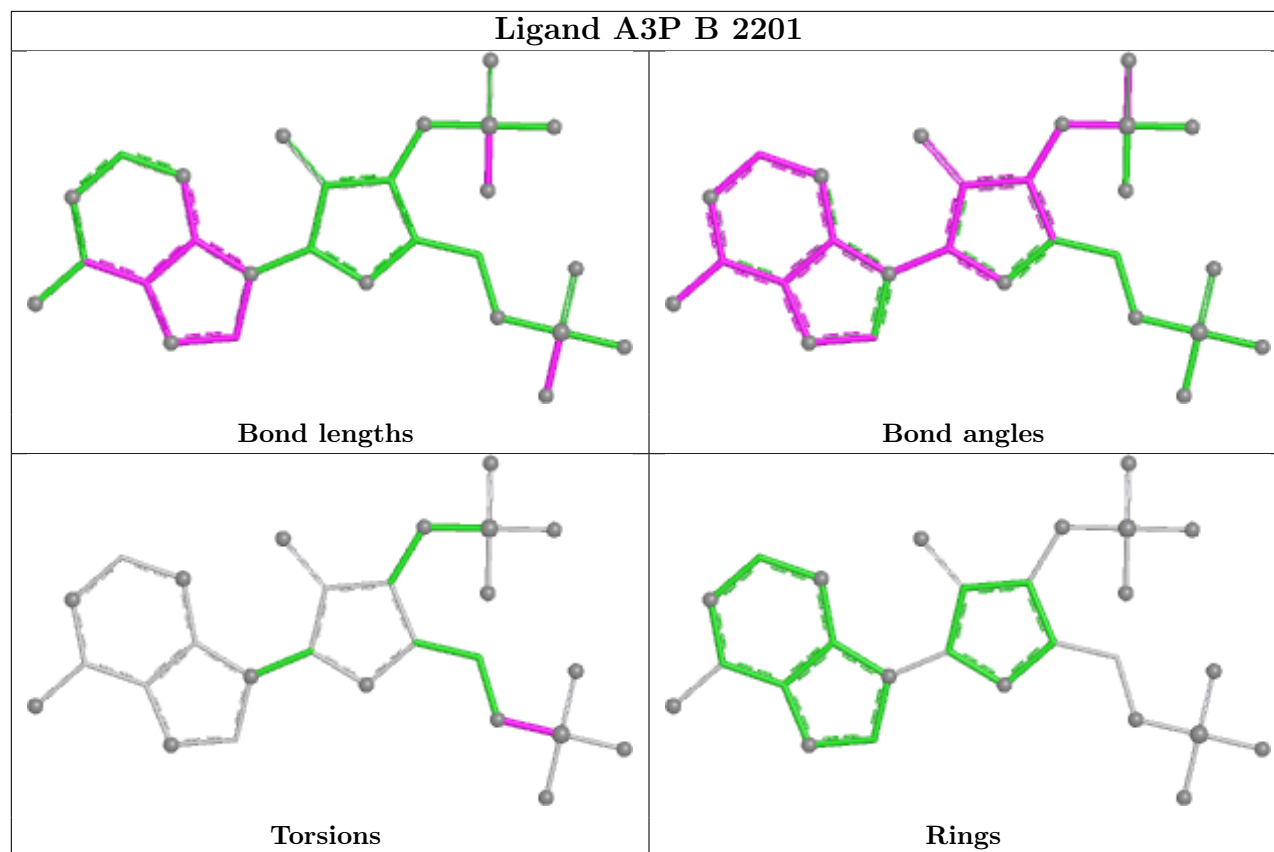
2 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1102	OXR	6	0
4	B	2202	OXR	3	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

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.