



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 22, 2023 – 05:57 PM EDT

PDB ID : 3CW8  
Title : 4-Chlorobenzoyl-CoA Ligase/Synthetase, bound to 4CBA-Adenylate  
Authors : Reger, A.S.; Cao, J.; Wu, R.; Dunaway-Mariano, D.; Gulick, A.M.  
Deposited on : 2008-04-21  
Resolution : 2.25 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 : 2.35  
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) : 2.35

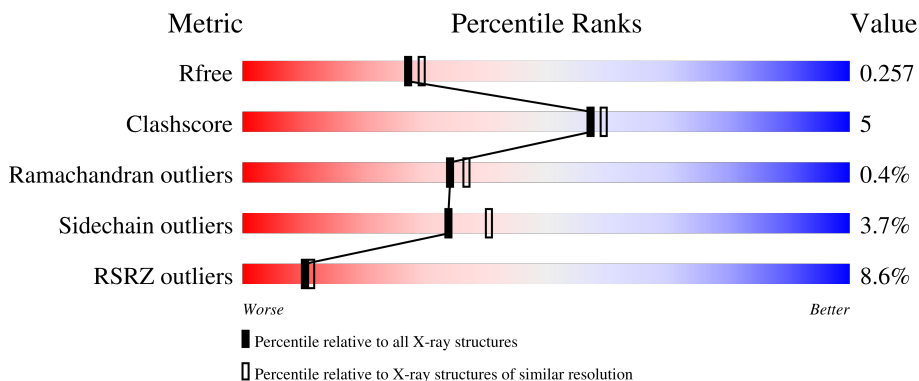
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

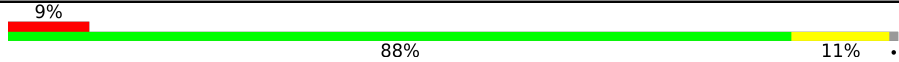
The reported resolution of this entry is 2.25 Å.

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	1377 (2.26-2.26)
Clashscore	141614	1487 (2.26-2.26)
Ramachandran outliers	138981	1449 (2.26-2.26)
Sidechain outliers	138945	1450 (2.26-2.26)
RSRZ outliers	127900	1356 (2.26-2.26)

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	X	504	

## 2 Entry composition [i](#)

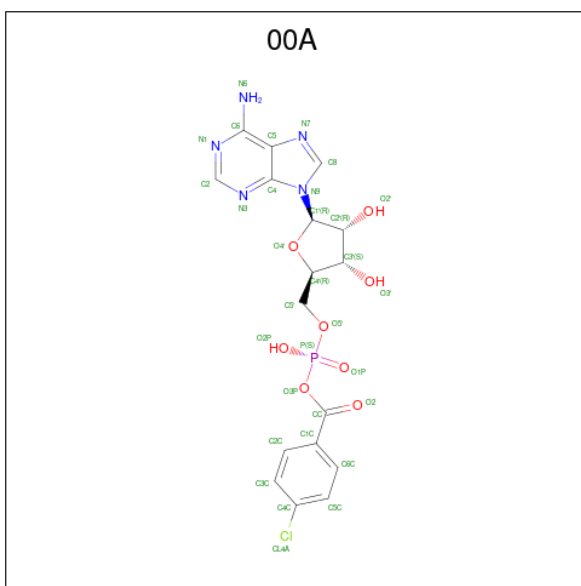
There are 4 unique types of molecules in this entry. The entry contains 3914 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 4-chlorobenzoyl CoA ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	X	501	3731	2355	671	692	13	0	1	0

- Molecule 2 is 5'-O-[(S)-{[(4-chlorophenyl)carbonyl]oxy}(hydroxy)phosphoryl]adenosine (three-letter code: 00A) (formula: C<sub>17</sub>H<sub>17</sub>ClN<sub>5</sub>O<sub>8</sub>P).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	Cl	N	O	P		
2	X	1	32	17	1	5	8	1	0	0

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



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

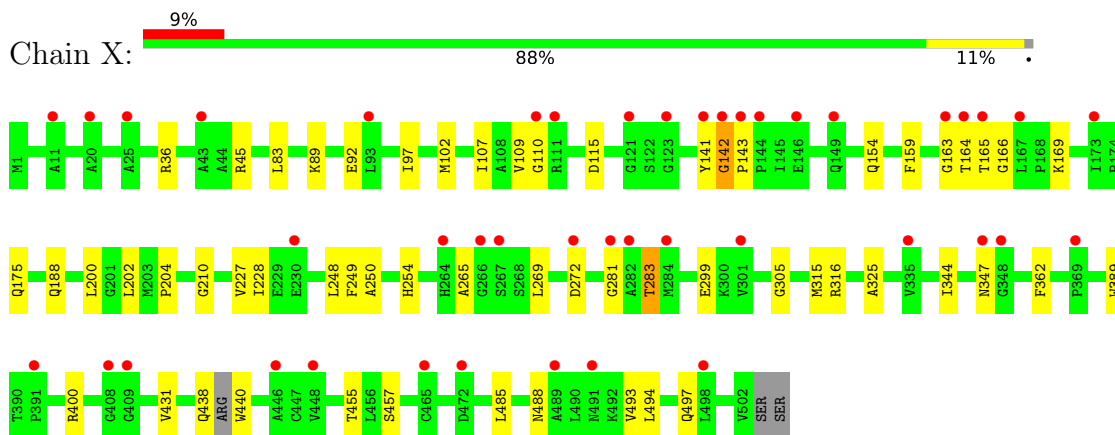
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	X	135	Total O 135 135	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 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: 4-chlorobenzoyl CoA ligase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	128.58Å 128.58Å 72.32Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	15.00 – 2.25 14.76 – 2.25	Depositor EDS
% Data completeness (in resolution range)	97.9 (15.00-2.25) 97.9 (14.76-2.25)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.95 (at 2.24Å)	Xtrriage
Refinement program	REFMAC 5.2	Depositor
R, $R_{free}$	0.196 , 0.258 0.195 , 0.257	Depositor DCC
$R_{free}$ test set	1608 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	54.4	Xtrriage
Anisotropy	0.083	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 55.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.021 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	3914	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	60.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.31% 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: 00A, EDO

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	X	0.71	3/3803 (0.1%)	0.70	1/5185 (0.0%)

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	X	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	X	115	ASP	CG-OD2	9.42	1.47	1.25
1	X	438	GLN	C-O	7.92	1.38	1.23
1	X	115	ASP	CG-OD1	6.43	1.40	1.25

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	248	LEU	CA-CB-CG	5.43	127.78	115.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	X	142	GLY	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	X	3731	0	3717	35	0
2	X	32	0	16	5	0
3	X	16	0	24	4	0
4	X	135	0	0	2	0
All	All	3914	0	3757	37	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 (37) 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:X:36:ARG:HB2	3:X:803:EDO:H12	1.61	0.83
1:X:109:VAL:HG12	1:X:110:GLY:H	1.50	0.76
1:X:305:GLY:HA3	2:X:909:00A:C4C	2.15	0.76
1:X:347:ASN:HB2	1:X:389:TRP:HB2	1.70	0.74
1:X:265:ALA:CB	1:X:269:LEU:HD12	2.20	0.71
2:X:909:00A:H5'	2:X:909:00A:O2	1.90	0.71
1:X:283:THR:HA	4:X:1119:HOH:O	1.90	0.70
1:X:431:VAL:HG21	1:X:493:VAL:HG21	1.72	0.69
1:X:200:LEU:HD11	1:X:228:ILE:HD11	1.75	0.67
1:X:200:LEU:CD1	1:X:228:ILE:HD11	2.25	0.67
3:X:802:EDO:H22	4:X:1050:HOH:O	1.95	0.66
1:X:265:ALA:HB1	1:X:269:LEU:HD12	1.81	0.62
1:X:305:GLY:HA3	2:X:909:00A:C5C	2.31	0.61
1:X:83:LEU:HD12	1:X:159:PHE:CE1	2.36	0.61
1:X:227:VAL:O	1:X:228:ILE:HD13	2.03	0.59
1:X:109:VAL:HG12	1:X:110:GLY:N	2.19	0.58
1:X:299:GLU:OE2	1:X:316[A]:ARG:HD2	2.06	0.56
1:X:142:GLY:N	1:X:143:PRO:HD3	2.21	0.55
1:X:227:VAL:C	1:X:228:ILE:HD13	2.27	0.55
1:X:250:ALA:HB1	1:X:254:HIS:HB2	1.90	0.53
1:X:89:LYS:O	1:X:92:GLU:HG2	2.10	0.51
1:X:154:GLN:NE2	1:X:175:GLN:HE21	2.10	0.50
1:X:281:GLY:HA2	2:X:909:00A:O2	2.13	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:X:141:TYR:C	1:X:143:PRO:HD3	2.34	0.48
1:X:83:LEU:HD12	1:X:159:PHE:CZ	2.49	0.48
1:X:431:VAL:HG23	1:X:485:LEU:HD13	1.95	0.48
1:X:97:ILE:O	1:X:102:MET:HG3	2.14	0.48
1:X:200:LEU:HD12	1:X:228:ILE:HD11	1.99	0.45
1:X:283:THR:HB	2:X:909:00A:H2	1.99	0.44
1:X:163:GLY:O	1:X:165:THR:N	2.51	0.43
1:X:488:ASN:HB3	1:X:494:LEU:HD21	2.01	0.43
1:X:315:MET:SD	3:X:804:EDO:H12	2.58	0.43
1:X:109:VAL:CG1	1:X:110:GLY:H	2.25	0.42
1:X:202:LEU:HD23	1:X:228:ILE:HG13	2.00	0.42
1:X:142:GLY:N	1:X:143:PRO:CD	2.84	0.41
1:X:325:ALA:HB3	3:X:804:EDO:O2	2.21	0.40
1:X:204:PRO:O	1:X:210:GLY:HA3	2.21	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	X	498/504 (99%)	477 (96%)	19 (4%)	2 (0%)	34 37

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	X	166	GLY
1	X	164	THR

### 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	X	378/400 (94%)	364 (96%)	14 (4%)	34 40

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	45	ARG
1	X	107	ILE
1	X	169	LYS
1	X	188	GLN
1	X	249	PHE
1	X	272	ASP
1	X	283	THR
1	X	344	ILE
1	X	362	PHE
1	X	400	ARG
1	X	440	TRP
1	X	455	THR
1	X	457	SER
1	X	497	GLN

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

Mol	Chain	Res	Type
1	X	18	HIS
1	X	54	GLN
1	X	154	GLN
1	X	188	GLN
1	X	367	ASN

### 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](#)

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
2	00A	X	909	-	32,35,35	2.89	6 (18%)	39,52,52	2.22	9 (23%)
3	EDO	X	802	-	3,3,3	0.84	0	2,2,2	0.21	0
3	EDO	X	804	-	3,3,3	0.28	0	2,2,2	0.49	0
3	EDO	X	803	-	3,3,3	0.69	0	2,2,2	0.17	0
3	EDO	X	801	-	3,3,3	0.64	0	2,2,2	0.10	0

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
2	00A	X	909	-	-	4/15/35/35	0/4/4/4
3	EDO	X	802	-	-	0/1/1/1	-
3	EDO	X	804	-	-	1/1/1/1	-
3	EDO	X	803	-	-	0/1/1/1	-
3	EDO	X	801	-	-	0/1/1/1	-

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	X	909	00A	O3P-CC	13.56	1.51	1.37
2	X	909	00A	C4C-CL4A	4.80	1.85	1.74
2	X	909	00A	P-O3P	4.05	1.68	1.60
2	X	909	00A	C5-C4	3.29	1.49	1.40
2	X	909	00A	C5C-C4C	2.73	1.43	1.38
2	X	909	00A	C3C-C2C	2.03	1.42	1.38

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	X	909	00A	O3P-CC-C1C	8.55	121.51	112.39
2	X	909	00A	P-O3P-CC	4.95	133.95	123.04
2	X	909	00A	N3-C2-N1	-4.43	121.76	128.68
2	X	909	00A	C6C-C5C-C4C	3.41	122.84	119.24
2	X	909	00A	C3'-C2'-C1'	2.96	105.44	100.98
2	X	909	00A	C5C-C4C-C3C	-2.79	117.63	121.24
2	X	909	00A	C2-N1-C6	2.66	123.30	118.75
2	X	909	00A	O2P-P-O3P	2.27	111.56	104.14
2	X	909	00A	O2-CC-C1C	-2.22	114.83	122.09

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	X	909	00A	O2-CC-O3P-P
2	X	909	00A	O4'-C4'-C5'-O5'
3	X	804	EDO	O1-C1-C2-O2
2	X	909	00A	CC-O3P-P-O5'
2	X	909	00A	CC-O3P-P-O1P

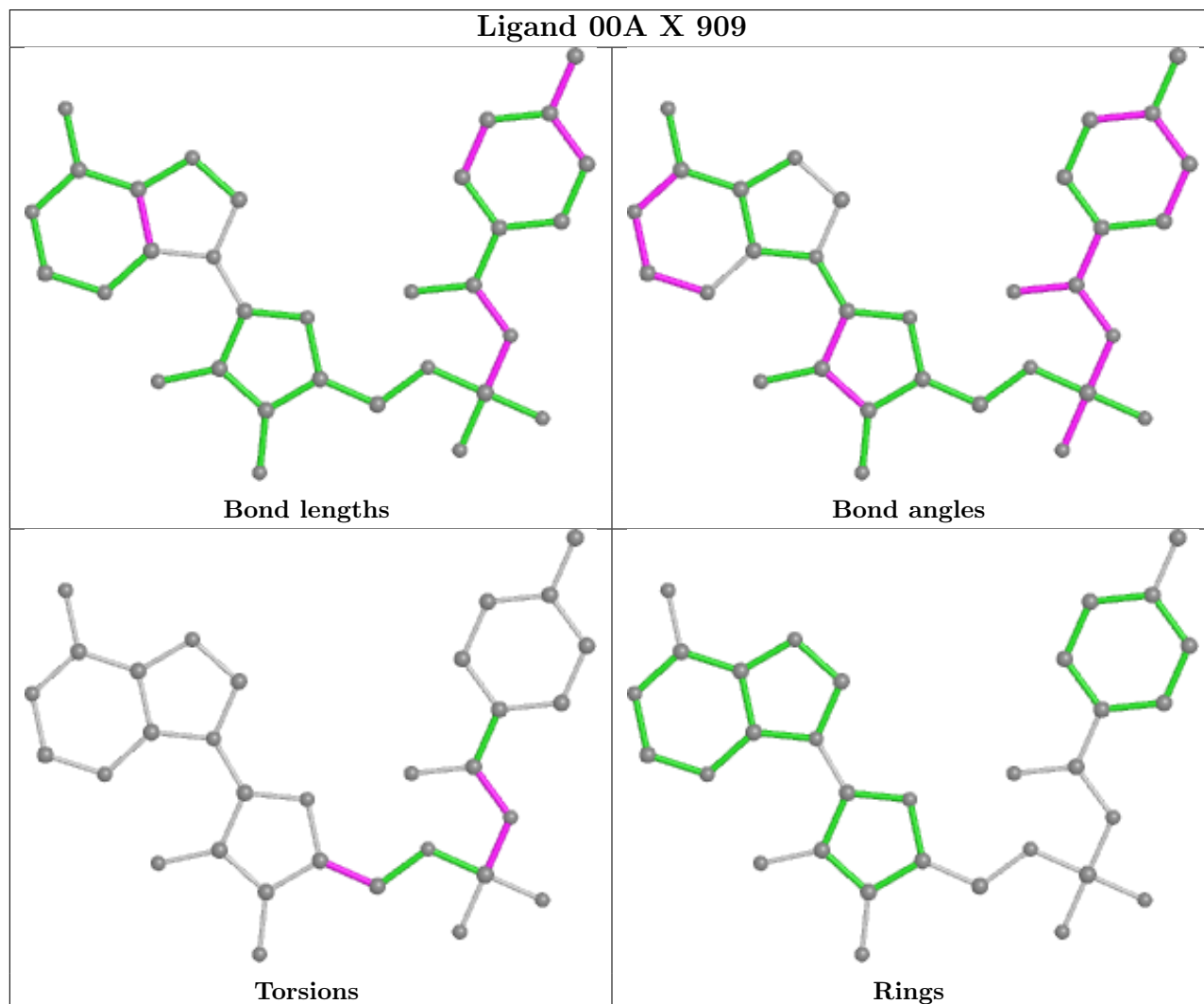
There are no ring outliers.

4 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	X	909	00A	5	0
3	X	802	EDO	1	0
3	X	804	EDO	2	0
3	X	803	EDO	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	X	501/504 (99%)	0.38	43 (8%) <b>10</b> <b>11</b>	40, 59, 74, 91	0

All (43) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	X	164	THR	7.1
1	X	281	GLY	5.8
1	X	163	GLY	5.4
1	X	165	THR	5.3
1	X	489	ALA	5.1
1	X	143	PRO	5.0
1	X	409	GLY	4.6
1	X	347	ASN	4.0
1	X	408	GLY	3.8
1	X	144	PRO	3.7
1	X	491	ASN	3.7
1	X	264	HIS	3.5
1	X	266	GLY	3.4
1	X	335	VAL	3.3
1	X	93	LEU	3.3
1	X	141	TYR	3.2
1	X	121	GLY	3.2
1	X	142	GLY	3.2
1	X	25	ALA	3.1
1	X	43	ALA	3.0
1	X	369	PRO	3.0
1	X	498	LEU	3.0
1	X	391	PRO	2.7
1	X	267	SER	2.6
1	X	282	ALA	2.6
1	X	301	VAL	2.6
1	X	284	MET	2.6

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Mol	Chain	Res	Type	RSRZ
1	X	20	ALA	2.5
1	X	448	VAL	2.4
1	X	123	GLY	2.3
1	X	110	GLY	2.2
1	X	230	GLU	2.2
1	X	149	GLN	2.2
1	X	167	LEU	2.2
1	X	11	ALA	2.2
1	X	111	ARG	2.2
1	X	272	ASP	2.2
1	X	146	GLU	2.2
1	X	472	ASP	2.2
1	X	465	CYS	2.1
1	X	348	GLY	2.1
1	X	173	ILE	2.0
1	X	446	ALA	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.

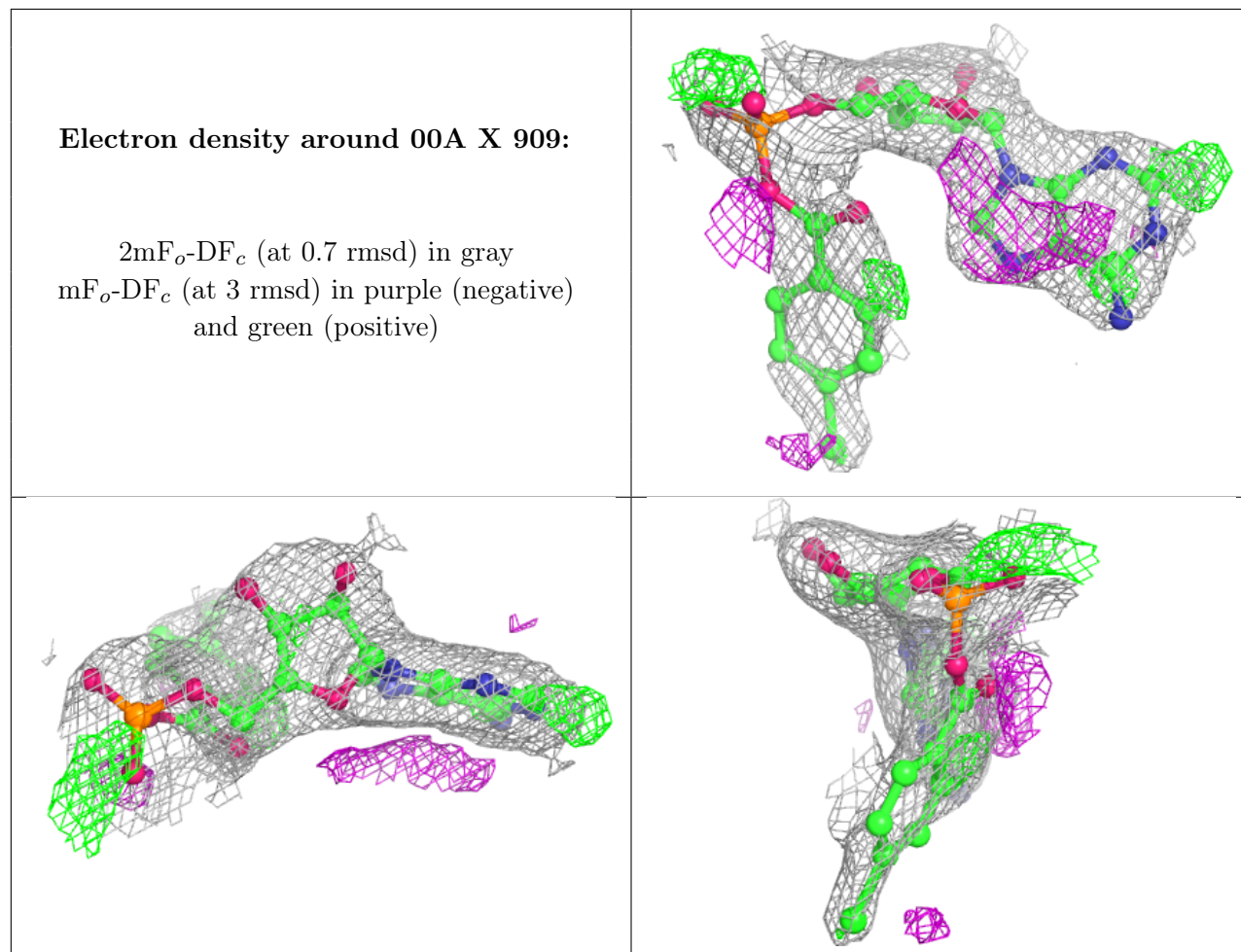
## 6.4 Ligands [i](#)

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
3	EDO	X	802	4/4	0.73	0.23	68,69,71,72	0
3	EDO	X	803	4/4	0.78	0.23	59,68,68,70	0
2	00A	X	909	32/32	0.79	0.23	66,69,76,77	0
3	EDO	X	801	4/4	0.88	0.15	80,82,83,83	0
3	EDO	X	804	4/4	0.94	0.46	55,59,59,63	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.