Full wwPDB X-ray Structure Validation Report (i)

Aug 15, 2023 – 06:07 PM EDT

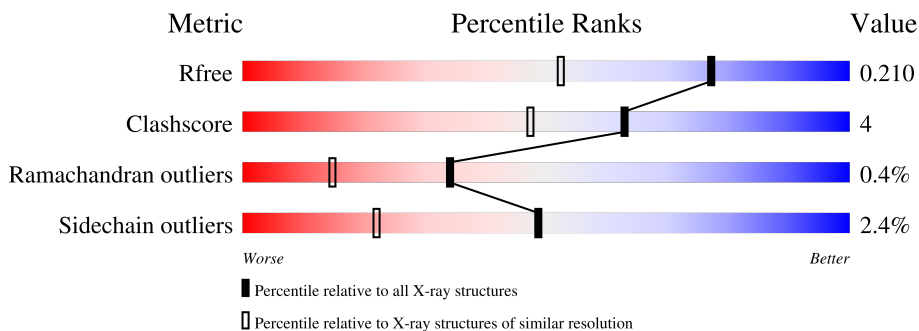|		
PDB ID	:	1X7Y
Title	:	Crystal structure of the human mitochondrial branched-chain alpha-ketoacid dehydrogenase
Authors	:	Wynn, R.M.; Kato, M.; Machius, M.; Chuang, J.L.; Li, J.; Tomchick, D.R.; Chuang, D.T.
Deposited on	:	2004-08-16
Resolution	:	1.57 Å(reported)

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 1.57 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	Percentile Ranks	Value
Rfree		0.210
Clashscore		4
Ramachandran outliers		0.4%
Sidechain outliers		2.4%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	5534 (1.60-1.56)
Clashscore	141614	5861 (1.60-1.56)
Ramachandran outliers	138981	5708 (1.60-1.56)
Sidechain outliers	138945	5703 (1.60-1.56)

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 <=5%

Mol	Chain	Length	Quality of chain
1	A	400	82% 9% · 8%
2	B	342	89% 6% · ·

2 Entry composition ⓘ

There are 8 unique types of molecules in this entry. The entry contains 6425 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 2-oxoisovalerate dehydrogenase alpha subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	369	Total 3053	C 1927	N 541	O 565	S 20	0	12	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	292	ASN	SER	engineered mutation	UNP P12694

- Molecule 2 is a protein called 2-oxoisovalerate dehydrogenase beta subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	329	Total 2613	C 1679	N 433	O 486	S 15	0	6	0

- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

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

- Molecule 4 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total 1	Mn 1	0	0

- Molecule 5 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

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

- Molecule 6 is THIAMINE DIPHOSPHATE (three-letter code: TPP) (formula: $C_{12}H_{19}N_4O_7P_2S$).
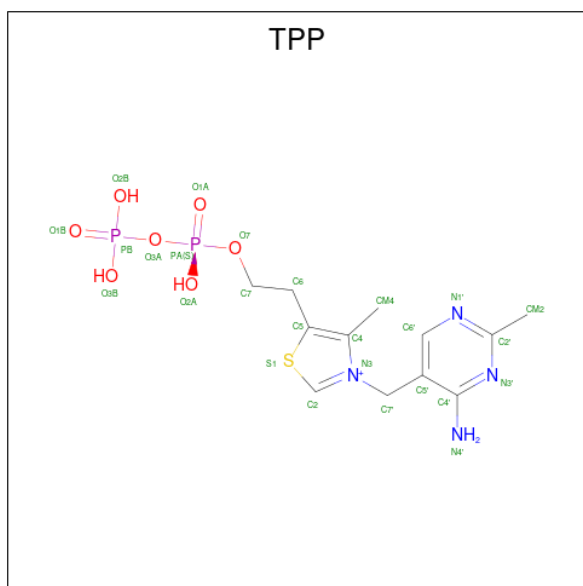
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	N	O	P	S		
6	A	1	26	12	4	7	2	1	0	0

- Molecule 7 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	B	1	Total 6	C 3	O 3	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	414	Total 414	O 414	0	0
8	B	309	Total 309	O 309	0	0

3 Residue-property plots ⓘ

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: gre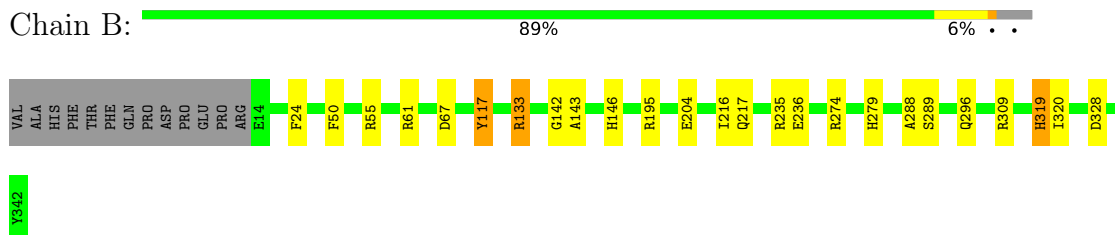en = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: 2-oxoisovalerate dehydrogenase alpha subunit

Chain A:
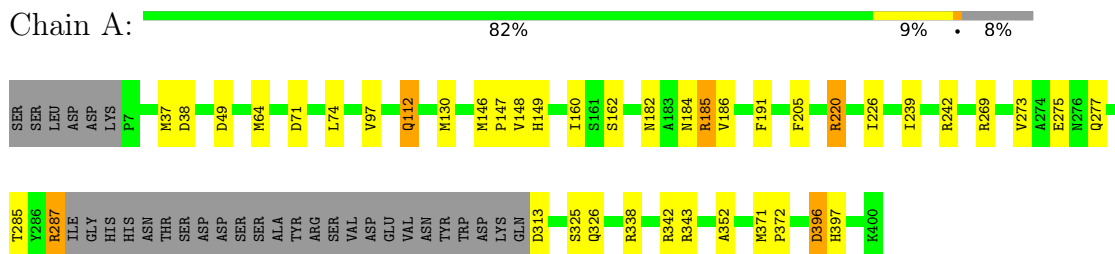
• Molecule 2: 2-oxoisovalerate dehydrogenase beta subunit

Chain B:

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α, β, γ	145.67Å 145.67Å 69.24Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 1.57 32.23 – 1.57	Depositor EDS
% Data completeness (in resolution range)	99.7 (50.00-1.57) 99.7 (32.23-1.57)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.18 (at 1.57Å)	Xtriage
Refinement program	REFMAC 5.2.0003	Depositor
R, R_{free}	0.150 , 0.167 0.203 , 0.210	Depositor DCC
R_{free} test set	1515 reflections (1.29%)	wwPDB-VP
Wilson B-factor (Å^2)	15.2	Xtriage
Anisotropy	0.391	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 69.3	EDS
L-test for twinning[2]	$< |L| > = 0.51, < L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.018 for -h,-k,l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	6425	wwPDB-VP
Average B, all atoms (Å^2)	13.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.23% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: K, CL, MN, TPP, GOL

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	0.90	1/3127 (0.0%)	0.95	9/4225 (0.2%)
2	B	0.90	0/2679	0.94	8/3639 (0.2%)
All	All	0.90	1/5806 (0.0%)	0.94	17/7864 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	191	PHE	CE2-CZ	5.46	1.47	1.37

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	133	ARG	NE-CZ-NH2	-8.07	116.27	120.30
2	B	61	ARG	NE-CZ-NH2	-7.32	116.64	120.30
2	B	61	ARG	NE-CZ-NH1	7.09	123.85	120.30
1	A	71	ASP	CB-CG-OD1	7.05	124.65	118.30
1	A	220	ARG	NE-CZ-NH2	-6.15	117.22	120.30
2	B	67	ASP	CB-CG-OD2	6.03	123.73	118.30
1	A	38	ASP	CB-CG-OD2	5.61	123.34	118.30
2	B	117	TYR	CB-CG-CD1	-5.53	117.68	121.00
1	A	112	GLN	CA-CB-CG	-5.52	101.25	113.40
1	A	49	ASP	CB-CG-OD1	5.52	123.27	118.30
1	A	220	ARG	NE-CZ-NH1	5.51	123.06	120.30
1	A	205	PHE	CB-CG-CD2	-5.34	117.06	120.80
2	B	133	ARG	NE-CZ-NH1	5.16	122.88	120.30
1	A	242	ARG	NE-CZ-NH1	5.16	122.88	120.30
2	B	274	ARG	NE-CZ-NH2	-5.08	117.76	120.30
2	B	328	ASP	CB-CG-OD1	5.03	122.83	118.30
1	A	37	MET	CG-SD-CE	-5.01	92.18	100.20

There are no chirality outliers.

There are no planarity outliers.

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	3053	0	2949	32	0
2	B	2613	0	2572	16	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	1	0	0	0	0
5	A	1	0	0	1	0
6	A	26	0	16	1	0
7	B	6	0	8	0	0
8	A	414	0	0	10	1
8	B	309	0	0	3	0
All	All	6425	0	5545	49	1

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 (49) 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:186[A]:VAL:CG2	1:A:273[A]:VAL:CG2	1.95	1.42
1:A:186[A]:VAL:CG2	1:A:273[A]:VAL:HG23	1.50	1.37
1:A:186[A]:VAL:HG23	1:A:273[A]:VAL:CG2	1.70	1.11
1:A:186[A]:VAL:HG22	1:A:273[A]:VAL:CG2	1.73	1.09
1:A:338:ARG:HD2	8:A:1279:HOH:O	1.55	1.05
1:A:186[A]:VAL:HG21	1:A:273[A]:VAL:HG23	1.43	1.00
1:A:186[A]:VAL:HG22	1:A:273[A]:VAL:HG23	1.33	0.98
1:A:186[A]:VAL:HG23	1:A:273[A]:VAL:HG21	1.44	0.96
1:A:185:ARG:HG2	8:A:1138:HOH:O	1.69	0.93
1:A:186[A]:VAL:HG22	1:A:273[A]:VAL:HG22	1.52	0.89
2:B:289[C]:SER:OG	2:B:309:ARG:NH1	2.07	0.87
1:A:186[A]:VAL:CG2	1:A:273[A]:VAL:HG22	2.01	0.87
2:B:236:GLU:HG2	8:B:1236:HOH:O	1.79	0.81

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:55[A]:ARG:HD2	2:B:195:ARG:HH22	1.47	0.80
2:B:216:ILE:HD12	2:B:235:ARG:HH11	1.45	0.79
1:A:326:GLN:HA	8:A:1053:HOH:O	1.81	0.78
2:B:55[A]:ARG:HD2	2:B:195:ARG:NH2	1.99	0.76
2:B:216:ILE:HD12	2:B:235:ARG:NH1	2.03	0.72
2:B:217:GLN:NE2	8:B:1210:HOH:O	2.23	0.72
5:A:804:CL:CL	6:A:901:TPP:H2	2.28	0.71
1:A:313:ASP:HA	8:A:1169:HOH:O	1.96	0.66
1:A:287:ARG:HD3	8:A:1004:HOH:O	1.99	0.62
1:A:64[B]:MET:SD	1:A:97[B]:VAL:HG21	2.39	0.61
1:A:64[B]:MET:CG	1:A:97[B]:VAL:HG21	2.29	0.61
1:A:74:LEU:HD21	1:A:130[A]:MET:SD	2.40	0.61
1:A:149:HIS:HE1	1:A:162:SER:OG	1.84	0.60
2:B:279:HIS:CE1	2:B:288:ALA:H	2.20	0.59
2:B:279:HIS:HE1	2:B:288:ALA:H	1.49	0.58
1:A:326:GLN:CA	8:A:1053:HOH:O	2.46	0.57
1:A:287:ARG:HG2	8:A:1088:HOH:O	2.04	0.56
1:A:146[B]:MET:HG2	1:A:147:PRO:HD2	1.88	0.55
1:A:64[B]:MET:HG3	1:A:97[B]:VAL:HG21	1.89	0.54
1:A:325:SER:HB3	8:A:1312:HOH:O	2.10	0.51
2:B:55[B]:ARG:HG3	2:B:195:ARG:NH2	2.28	0.49
1:A:186[A]:VAL:HG21	1:A:269:ARG:HG2	1.95	0.48
1:A:396:ASP:OD2	1:A:397[A]:HIS:CE1	2.68	0.46
2:B:142:GLY:O	2:B:146[A]:HIS:HB2	2.15	0.46
1:A:285:THR:HG23	8:A:1173:HOH:O	2.16	0.45
2:B:204:GLU:CD	8:B:1194:HOH:O	2.55	0.45
1:A:275:GLU:OE1	1:A:277:GLN:NE2	2.45	0.44
2:B:55[B]:ARG:HG3	2:B:195:ARG:HH21	1.82	0.43
1:A:371[B]:MET:HA	1:A:372:PRO:HD3	1.82	0.43
1:A:147:PRO:O	1:A:149:HIS:HD2	2.02	0.43
1:A:112:GLN:HA	1:A:160:ILE:HD12	2.01	0.42
1:A:130[A]:MET:HB3	1:A:352:ALA:CB	2.50	0.42
2:B:143:ALA:HB2	2:B:319:HIS:HB2	2.01	0.42
2:B:320:ILE:HD12	2:B:320:ILE:HA	1.97	0.41
1:A:285:THR:CG2	8:A:1173:HOH:O	2.68	0.40
2:B:289[C]:SER:HG	2:B:309:ARG:NH1	2.17	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
8:A:1072:HOH:O	8:A:1072:HOH:O[5_555]	2.06	0.14

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	377/400 (94%)	371 (98%)	4 (1%)	2 (0%)	29	10
2	B	334/342 (98%)	323 (97%)	10 (3%)	1 (0%)	41	21
All	All	711/742 (96%)	694 (98%)	14 (2%)	3 (0%)	34	15

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	226	ILE
1	A	148	VAL
2	B	319	HIS

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	319/336 (95%)	310 (97%)	9 (3%)	43	17
2	B	284/289 (98%)	279 (98%)	5 (2%)	59	34
All	All	603/625 (96%)	589 (98%)	14 (2%)	49	23

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

Mol	Chain	Res	Type
1	A	182	ASN
1	A	184	ASN
1	A	185	ARG
1	A	220	ARG
1	A	239	ILE
1	A	287	ARG
1	A	342	ARG
1	A	343	ARG
1	A	396	ASP
2	B	24	PHE
2	B	50	PHE
2	B	117	TYR
2	B	133	ARG
2	B	296	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	149	HIS
1	A	276	ASN
1	A	333	GLN
1	A	340	GLN
1	A	351	GLN
2	B	217	GLN
2	B	279	HIS
2	B	296	GLN

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 ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 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	TPP	A	901	4	22,27,27	1.84	5 (22%)	29,40,40	1.93	8 (27%)
7	GOL	B	1001	-	5,5,5	0.45	0	5,5,5	0.90	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
6	TPP	A	901	4	-	0/16/17/17	0/2/2/2
7	GOL	B	1001	-	-	0/4/4/4	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	901	TPP	C2-N3	6.22	1.49	1.36
6	A	901	TPP	C4'-N3'	2.66	1.38	1.35
6	A	901	TPP	C6-C5	2.56	1.52	1.50
6	A	901	TPP	C2'-N3'	2.30	1.38	1.34
6	A	901	TPP	CM4-C4	2.14	1.54	1.49

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	A	901	TPP	C6-C5-C4	4.97	131.42	127.43
6	A	901	TPP	C6'-N1'-C2'	3.68	122.23	115.96
6	A	901	TPP	C7'-N3-C2	-3.57	118.91	125.35
6	A	901	TPP	C5-C4-N3	3.23	114.03	107.57
6	A	901	TPP	C5'-C6'-N1'	-2.75	119.24	123.82
6	A	901	TPP	CM2-C2'-N1'	2.68	120.08	117.14
6	A	901	TPP	C6'-C5'-C4'	2.16	118.66	115.72

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| Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	A	901	TPP	C5'-C4'-N4'	2.10	125.16	122.19

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	901	TPP	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 then 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.

Ligand TPP A 901
Bond lengths | Bond angles
Torsions | Rings
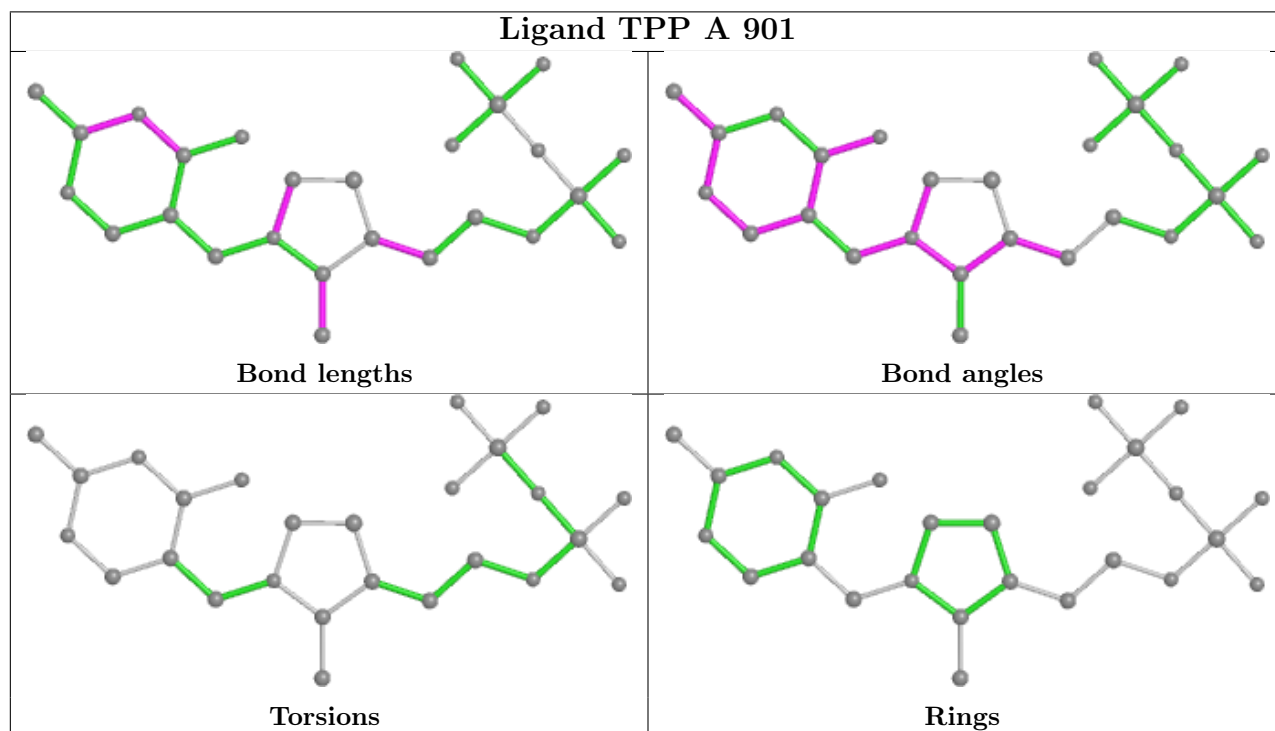
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

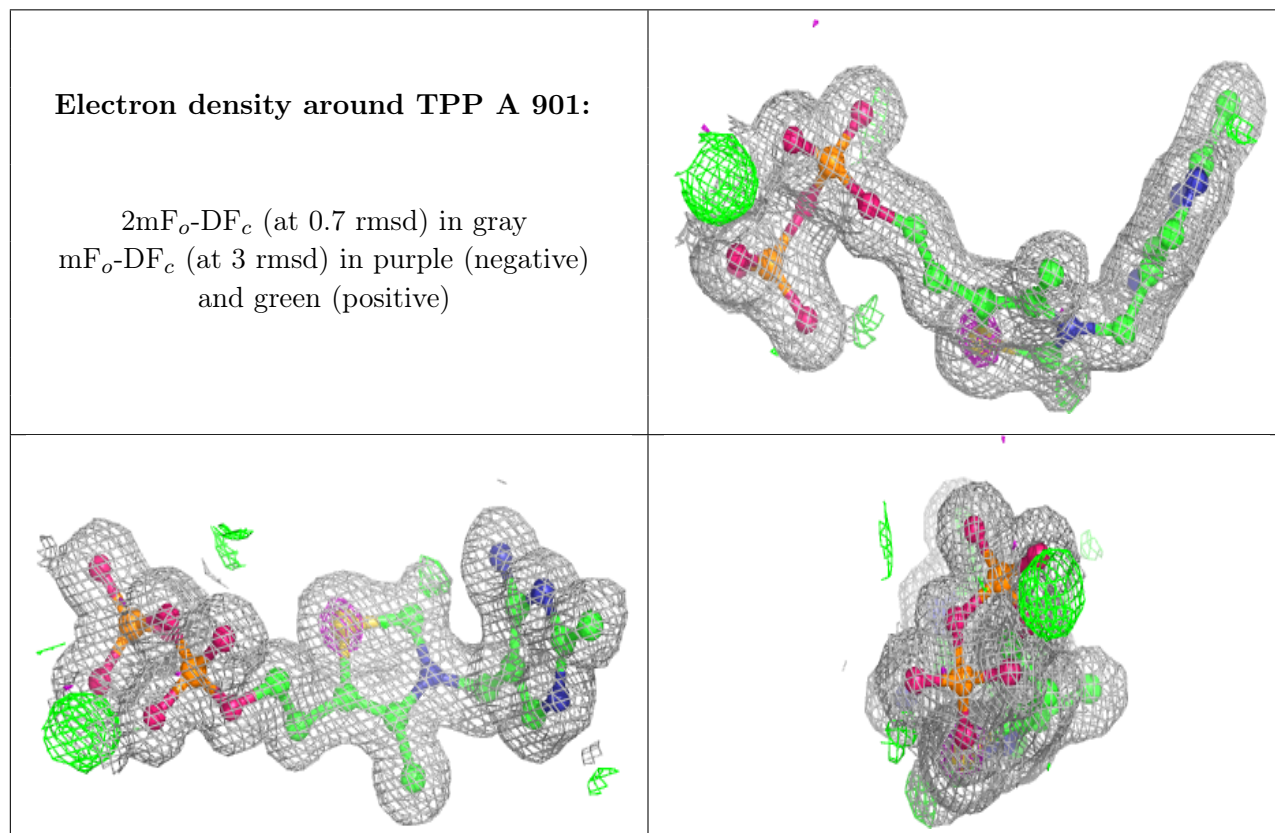## 6.3 Carbohydrates ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4 Ligands ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

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 TPP A 901:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative) and green (positive)

6.5 Other polymers ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.