



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:37 PM UTC

PDB ID : 6I2Q / pdb_00006i2q
Title : Crystal structure of the wild-type SucA domain of Mycobacterium smegmatis
KGD (alpha-ketoglutarate decarboxylase), in complex with GarA
Authors : Wagner, T.; Bellinzoni, M.; Alzari, P.M.
Deposited on : 2018-11-01
Resolution : 2.15 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) : 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

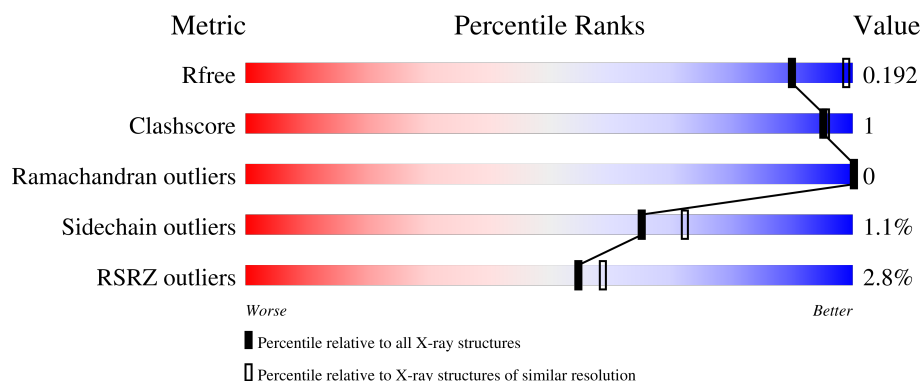
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

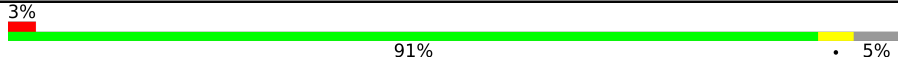
The reported resolution of this entry is 2.15 Å.

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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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 $\leq 5\%$. 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	868	
2	B	115	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 7567 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 Multifunctional 2-oxoglutarate metabolism enzyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	824	Total	C	N	O	S	0	3	0
			6443	4054	1143	1222	24			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	360	GLY	-	expression tag	UNP A0R2B1

- Molecule 2 is a protein called Glycogen accumulation regulator GarA.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	97	Total	C	N	O	0	0	0
			740	462	134	144			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	44	GLY	-	expression tag	UNP A0QYG2

- Molecule 3 is THIAMINE DIPHOSPHATE (CCD ID: TPP) (formula: C₁₂H₁₉N₄O₇P₂S).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	S	0	0
			26	12	4	7	2	1		

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

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

- Molecule 5 is CALCIUM ION (CCD ID: CA) (formula: Ca).

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

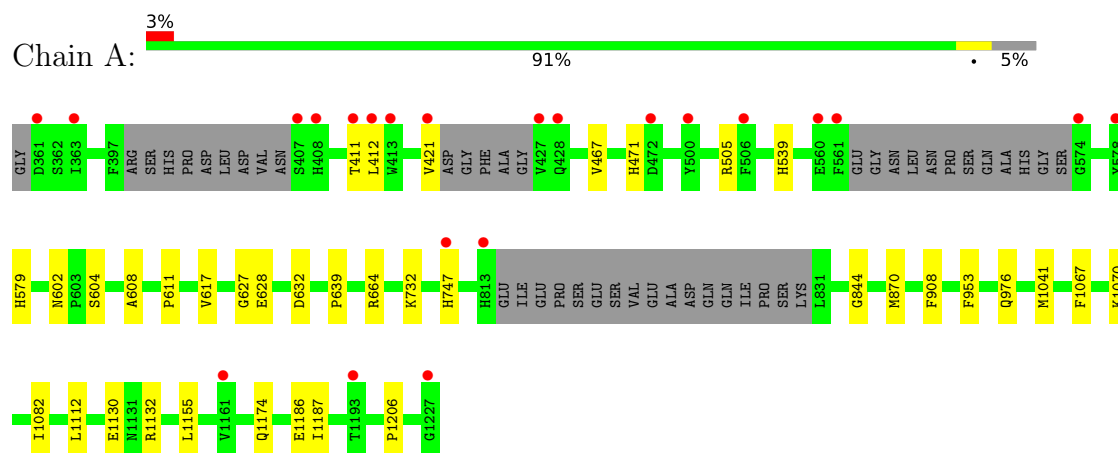
- Molecule 6 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	336	Total O 336 336	0	0
6	B	20	Total O 20 20	0	0

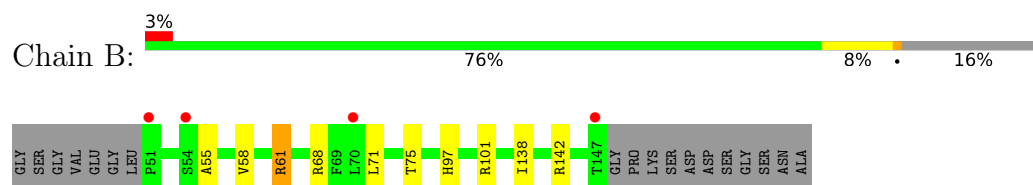
3 Residue-property plots [i](#)

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: Multifunctional 2-oxoglutarate metabolism enzyme



- Molecule 2: Glycogen accumulation regulator GarA



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	141.25Å 167.85Å 102.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	31.48 – 2.15 31.48 – 2.15	Depositor EDS
% Data completeness (in resolution range)	98.7 (31.48-2.15) 98.7 (31.48-2.15)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.29 (at 2.16Å)	Xtriage
Refinement program	BUSTER 2.10.3	Depositor
R, R_{free}	0.163 , 0.191 0.165 , 0.192	Depositor DCC
R_{free} test set	3374 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	40.2	Xtriage
Anisotropy	0.266	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 54.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	7567	wwPDB-VP
Average B, all atoms (Å ²)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.80% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: CA, MG, TPP

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	0.86	2/6577 (0.0%)	1.18	13/8908 (0.1%)
2	B	0.75	0/753	1.00	0/1020
All	All	0.85	2/7330 (0.0%)	1.17	13/9928 (0.1%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	870	MET	SD-CE	-7.56	1.60	1.79
1	A	1041	MET	SD-CE	-7.01	1.62	1.79

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	953	PHE	CA-CB-CG	5.72	119.52	113.80
1	A	844	GLY	CA-C-N	5.49	127.63	120.28
1	A	844	GLY	C-N-CA	5.49	127.63	120.28
1	A	411	THR	CA-C-N	5.47	128.37	120.38
1	A	411	THR	C-N-CA	5.47	128.37	120.38
1	A	632	ASP	CA-CB-CG	5.47	118.07	112.60
1	A	1082	ILE	CA-C-N	5.37	127.74	120.38
1	A	1082	ILE	C-N-CA	5.37	127.74	120.38
1	A	1067	PHE	CA-CB-CG	-5.34	108.46	113.80
1	A	627	GLY	CA-C-N	5.15	127.49	120.54
1	A	627	GLY	C-N-CA	5.15	127.49	120.54
1	A	1186	GLU	CA-C-N	5.15	127.15	120.56
1	A	1186	GLU	C-N-CA	5.15	127.15	120.56

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	6443	0	6286	12	0
2	B	740	0	727	5	0
3	A	26	0	16	0	0
4	A	1	0	0	0	0
5	A	1	0	0	0	0
6	A	336	0	0	3	0
6	B	20	0	0	0	0
All	All	7567	0	7029	17	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 1.

All (17) 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)
2:B:58:VAL:HG22	2:B:68:ARG:HG2	1.81	0.61
2:B:75:THR:HG22	2:B:101:ARG:HG2	1.87	0.57
1:A:471:HIS:HE1	6:A:2293:HOH:O	1.88	0.56
1:A:505:ARG:HA	1:A:747:HIS:O	2.06	0.55
1:A:732:LYS:HD3	6:A:2377:HOH:O	2.09	0.53
1:A:539[B]:HIS:CE1	1:A:604:SER:HA	2.45	0.52
2:B:97:HIS:CD2	2:B:138:ILE:HG23	2.49	0.47
1:A:617:VAL:HG11	1:A:639:PRO:HG3	1.97	0.45
1:A:1130:GLU:HB3	1:A:1132:ARG:HG3	1.98	0.44
2:B:55:ALA:HB3	2:B:71:LEU:HB2	1.98	0.44
1:A:1174:GLN:OE1	1:A:1206:PRO:HA	2.17	0.44
1:A:579:HIS:HD2	1:A:602:ASN:O	2.02	0.43
1:A:908:PHE:CZ	1:A:1070:LYS:HG2	2.53	0.42
1:A:608:ALA:O	1:A:611:PRO:HD2	2.20	0.41
1:A:732:LYS:CD	6:A:2377:HOH:O	2.67	0.41
1:A:628:GLU:HG2	1:A:664:ARG:O	2.20	0.41
2:B:61:ARG:HB2	2:B:142:ARG:HB2	2.02	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	817/868 (94%)	797 (98%)	20 (2%)	0	100	100
2	B	95/115 (83%)	92 (97%)	3 (3%)	0	100	100
All	All	912/983 (93%)	889 (98%)	23 (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	674/726 (93%)	667 (99%)	7 (1%)	68	75
2	B	81/93 (87%)	80 (99%)	1 (1%)	63	70
All	All	755/819 (92%)	747 (99%)	8 (1%)	65	72

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	412	LEU
1	A	421	VAL
1	A	467	VAL
1	A	976	GLN
1	A	1112	LEU
1	A	1155	LEU
1	A	1187	ILE
2	B	61	ARG

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

Mol	Chain	Res	Type
1	A	379	ASN
1	A	679	GLN
1	A	1001	GLN
1	A	1219	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 [i](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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	$\# Z > 2$
3	TPP	A	2001	4	26,27,27	0.67	0	38,40,40	0.65	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
3	TPP	A	2001	4	-	1/17/17/17	0/2/2/2

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

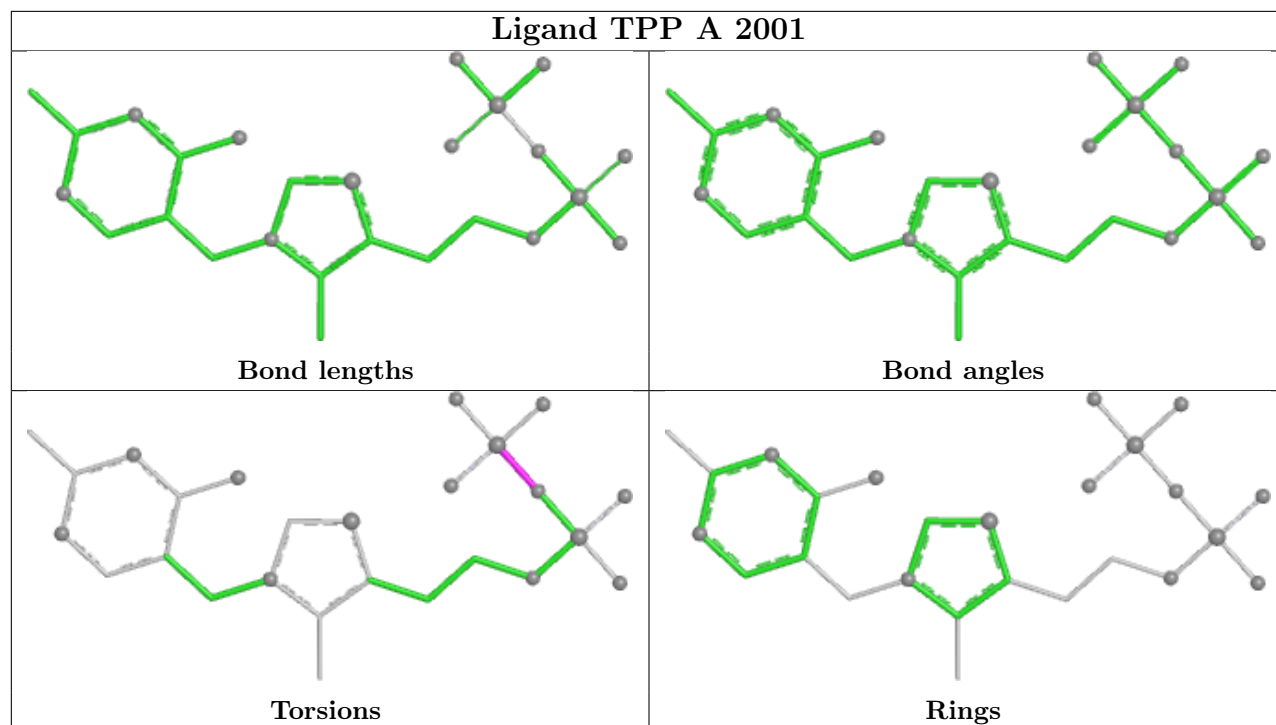
All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	2001	TPP	PA-O3A-PB-O3B

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, 95th 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 ²)	Q<0.9
1	A	824/868 (94%)	-0.10	22 (2%) 56 60	21, 49, 91, 124	3 (0%)
2	B	97/115 (84%)	0.42	4 (4%) 41 46	45, 70, 120, 148	0
All	All	921/983 (93%)	-0.04	26 (2%) 55 59	21, 52, 95, 148	3 (0%)

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	421	VAL	5.0
2	B	147	THR	4.2
1	A	407	SER	4.1
1	A	361	ASP	4.0
1	A	412	LEU	3.9
2	B	51	PRO	3.9
1	A	561	PHE	3.8
1	A	1227	GLY	3.7
1	A	813	HIS	3.7
1	A	413	TRP	3.6
1	A	427	VAL	3.6
1	A	574	GLY	3.1
1	A	408	HIS	3.1
1	A	578	TYR	2.7
1	A	428	GLN	2.5
1	A	500	TYR	2.4
2	B	70	LEU	2.4
1	A	363	ILE	2.4
1	A	1161	VAL	2.4
1	A	560	GLU	2.3
1	A	472	ASP	2.2
1	A	747	HIS	2.2
2	B	54	SER	2.2
1	A	1193	THR	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	411	THR	2.0
1	A	506	PHE	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](#)

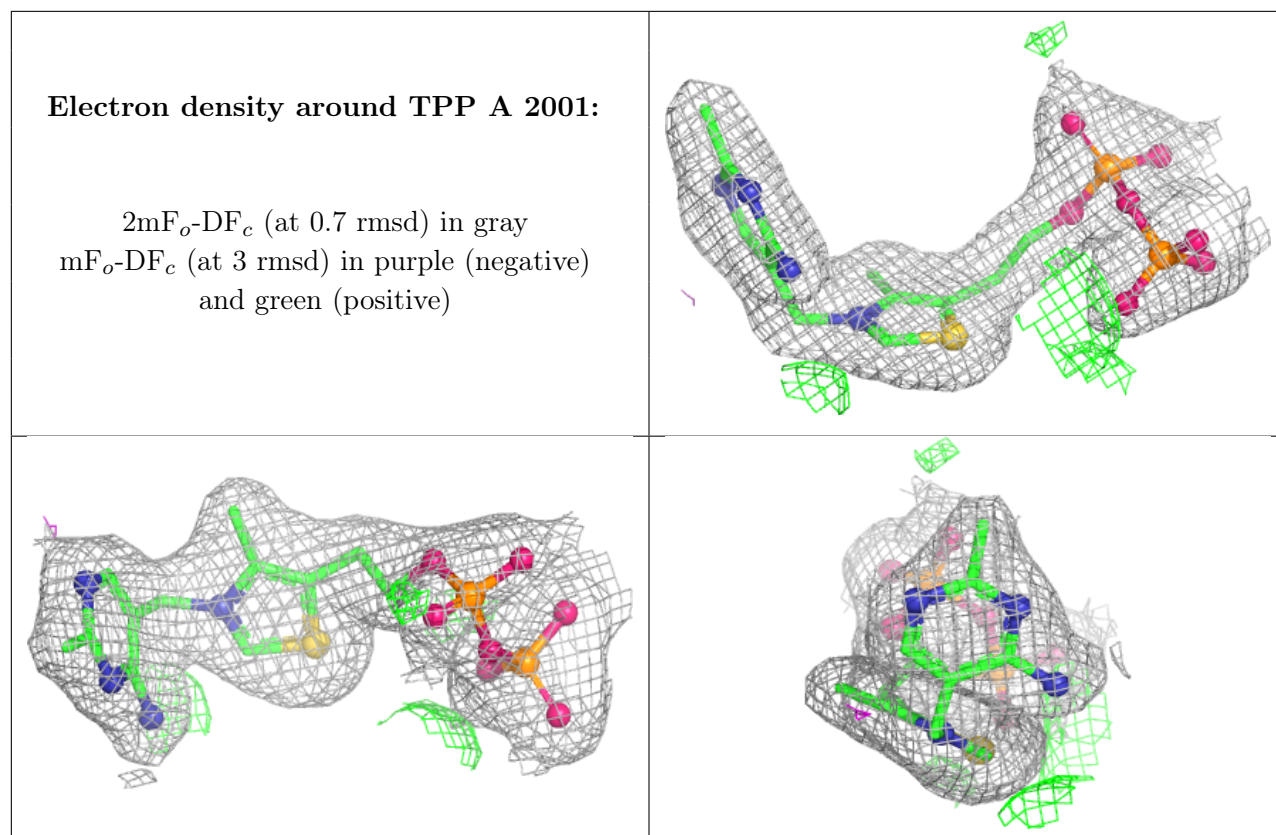
There are no oligosaccharides in this entry.

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, 95th 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($\text{\AA}^2$)	Q<0.9
3	TPP	A	2001	26/26	0.99	0.04	26,33,35,39	0
5	CA	A	2003	1/1	0.99	0.03	48,48,48,48	0
4	MG	A	2002	1/1	1.00	0.05	29,29,29,29	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.