wwPDB X-ray Structure Validation Summary Report (i)

Feb 9, 2026 – 12:49 am GMT

PDB ID	:	9GAL / pdb_00009gal
Title	:	3-methylbenzoyl-CoA reductase from Thauera chlorobenzoica (subunits MbdON) + ADP
Authors	:	Ermler, U.; Boll, M.; Demmer, U.; Fuchs, J.
Deposited on	:	2024-07-29
Resolution	:	2.15 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (i)) were used in the production of this report:

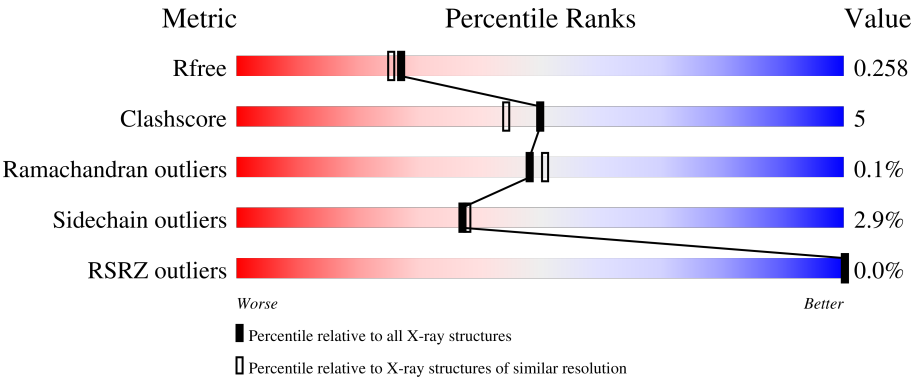
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48

1 Overall quality at a glance (i)

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}	164625	1881 (2.16-2.16)
Clashscore	180529	2047 (2.16-2.16)
Ramachandran outliers	177936	2027 (2.16-2.16)
Sidechain outliers	177891	2026 (2.16-2.16)
RSRZ outliers	164620	1882 (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 <=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	445	83% 15%
1	E	445	84% 12%
1	I	445	86% 10%
1	M	445	84% 14%
2	B	388	89% 10%

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Mol	Chain	Length	Quality of chain
2	F	388	89% 11%
2	J	388	89% 11%
2	N	388	89% 10%
3	C	273	84% 11%
3	G	273	78% 18%
3	K	273	84% 12%
3	O	273	81% 15%
4	D	269	81% 14%
4	H	269	84% 12%
4	L	269	80% 15%
4	P	269	79% 17%

2 Entry composition (i)

There are 10 unique types of molecules in this entry. The entry contains 42682 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 3-methylbenzoyl-CoA reductase beta subunit MbdO.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	437	Total	C	N	O	S	0	2	0
			3471	2200	602	651	18			
1	E	436	Total	C	N	O	S	0	2	0
			3464	2196	597	653	18			
1	I	436	Total	C	N	O	S	0	3	0
			3473	2202	599	654	18			
1	M	437	Total	C	N	O	S	0	2	0
			3468	2198	599	653	18			

- Molecule 2 is a protein called 3-methylbenzoyl-CoA reductase gamma subunit MbdN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	387	Total	C	N	O	S	0	0	0
			3093	1965	525	588	15			
2	F	387	Total	C	N	O	S	0	0	0
			3093	1965	525	588	15			
2	J	387	Total	C	N	O	S	0	0	0
			3093	1965	525	588	15			
2	N	387	Total	C	N	O	S	0	0	0
			3093	1965	525	588	15			

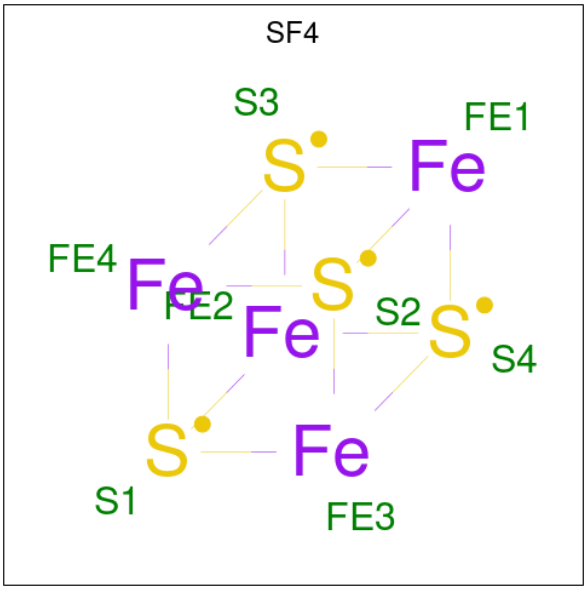
- Molecule 3 is a protein called 3-methylbenzoyl-CoA reductase delta subunit MbdP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	264	Total	C	N	O	S	0	3	0
			2023	1264	360	385	14			
3	G	264	Total	C	N	O	S	0	3	0
			2026	1266	363	383	14			
3	K	264	Total	C	N	O	S	0	1	0
			2004	1254	355	381	14			
3	O	264	Total	C	N	O	S	0	2	0
			2015	1260	359	382	14			

- Molecule 4 is a protein called 3-methylbenzoyl-CoA reductase alpha subunit MbdQ.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	261	Total	C	N	O	S	0	1	0
			1934	1215	345	363	11			
4	H	261	Total	C	N	O	S	0	0	0
			1928	1212	344	361	11			
4	L	261	Total	C	N	O	S	0	1	0
			1939	1218	348	362	11			
4	P	261	Total	C	N	O	S	0	1	0
			1939	1218	348	362	11			

- Molecule 5 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	Fe	S		0	0
			8	4	4			
5	B	1	Total	Fe	S		0	0
			8	4	4			
5	D	1	Total	Fe	S		0	0
			8	4	4			
5	E	1	Total	Fe	S		0	0
			8	4	4			
5	F	1	Total	Fe	S		0	0
			8	4	4			
5	G	1	Total	Fe	S		0	0
			8	4	4			

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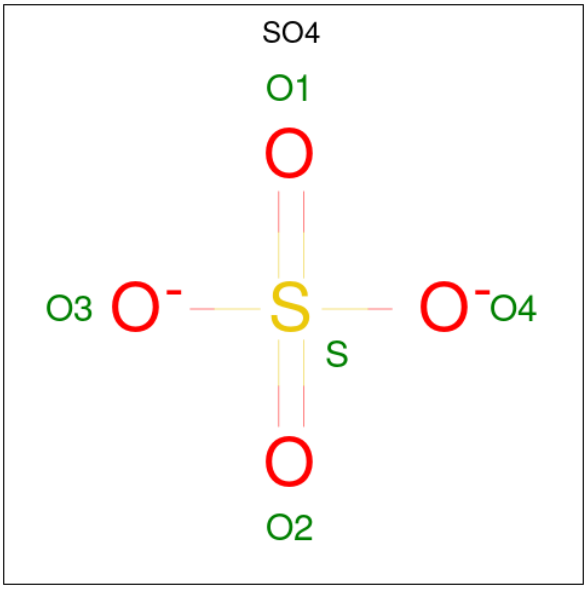
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	I	1	Total Fe S 8 4 4	0	0
5	J	1	Total Fe S 8 4 4	0	0
5	L	1	Total Fe S 8 4 4	0	0
5	M	1	Total Fe S 8 4 4	0	0
5	N	1	Total Fe S 8 4 4	0	0
5	O	1	Total Fe S 8 4 4	0	0

- Molecule 6 is SULFATE ION (CCD ID: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	B	1	Total O S 5 4 1	0	0
6	C	1	Total O S 5 4 1	0	0
6	E	1	Total O S 5 4 1	0	0
6	F	1	Total O S 5 4 1	0	0
6	G	1	Total O S 5 4 1	0	0

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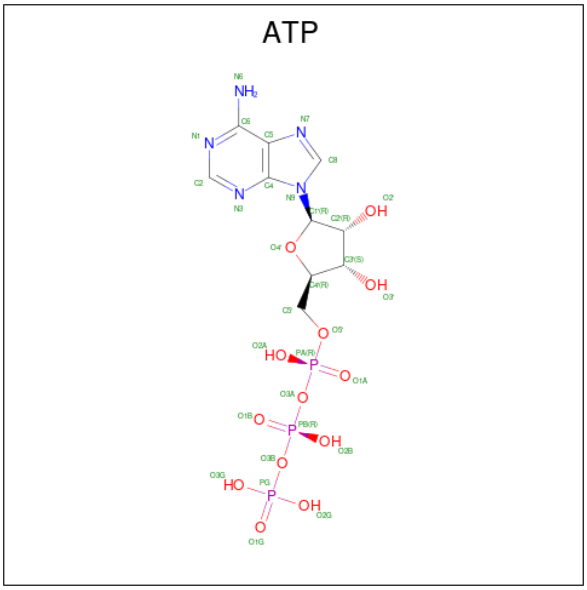
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	J	1	Total O S 5 4 1	0	0
6	K	1	Total O S 5 4 1	0	0
6	L	1	Total O S 5 4 1	0	0
6	M	1	Total O S 5 4 1	0	0
6	N	1	Total O S 5 4 1	0	0
6	O	1	Total O S 5 4 1	0	0
6	P	1	Total O S 5 4 1	0	0

- Molecule 7 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: $C_{10}H_{16}N_5O_{13}P_3$) (labeled as "Ligand of Interest" by depositor).

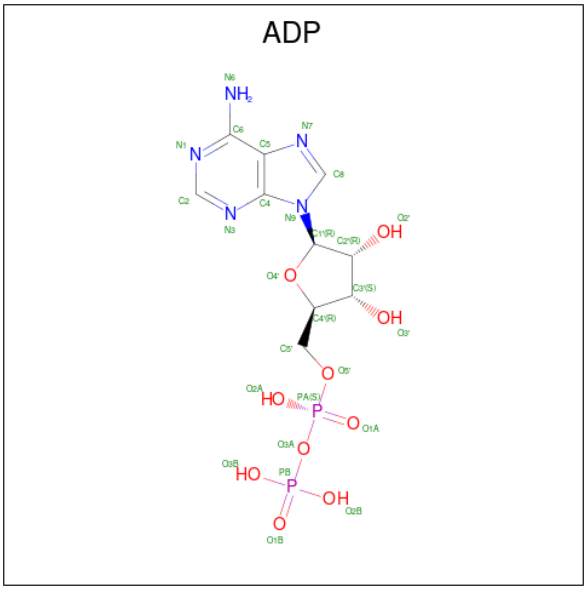


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	C	1	Total C N O P 31 10 5 13 3	0	0
7	G	1	Total C N O P 31 10 5 13 3	0	0
7	K	1	Total C N O P 31 10 5 13 3	0	0
7	O	1	Total C N O P 31 10 5 13 3	0	0

- Molecule 8 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	C	1	Total Mg 1 1	0	0
8	D	1	Total Mg 1 1	0	0
8	G	1	Total Mg 1 1	0	0
8	H	1	Total Mg 1 1	0	0
8	K	1	Total Mg 1 1	0	0
8	L	1	Total Mg 1 1	0	0
8	O	1	Total Mg 1 1	0	0
8	P	1	Total Mg 1 1	0	0

- Molecule 9 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: $C_{10}H_{15}N_5O_{10}P_2$) (labeled as "Ligand of Interest" by depositor).



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

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

- Molecule 10 is water.

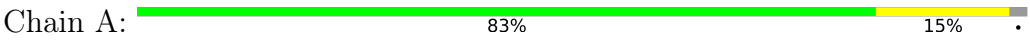
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	13	Total	O	0	0
			13	13		
10	B	17	Total	O	0	0
			17	17		
10	C	8	Total	O	0	0
			8	8		
10	D	7	Total	O	0	0
			7	7		
10	E	18	Total	O	0	0
			18	18		
10	F	25	Total	O	0	1
			26	26		
10	G	14	Total	O	0	0
			14	14		
10	H	9	Total	O	0	0
			9	9		
10	I	15	Total	O	0	0
			15	15		
10	J	36	Total	O	0	0
			36	36		
10	K	12	Total	O	0	0
			12	12		
10	L	12	Total	O	0	0
			12	12		
10	M	9	Total	O	0	0
			9	9		
10	N	10	Total	O	0	0
			10	10		
10	O	14	Total	O	0	0
			14	14		
10	P	10	Total	O	0	0
			10	10		

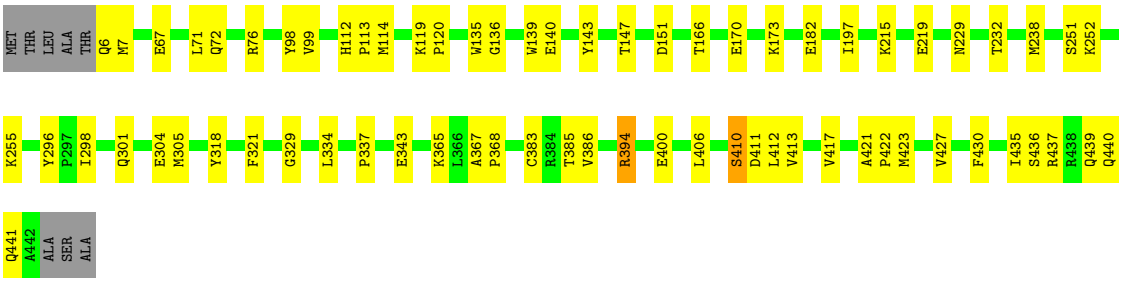
3 Residue-property plots (i)

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: 3-methylbenzoyl-CoA reductase beta subunit MbdO

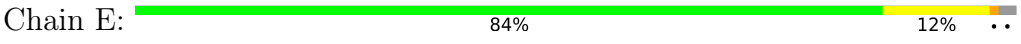
Chain A:





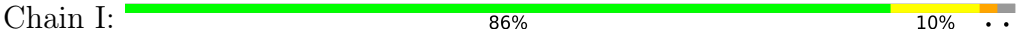
• Molecule 1: 3-methylbenzoyl-CoA reductase beta subunit MbdO

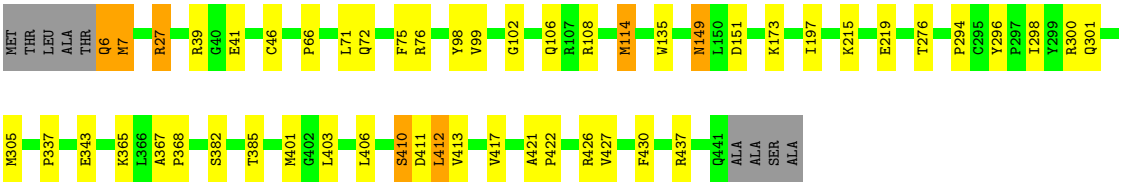
Chain E:



• Molecule 1: 3-methylbenzoyl-CoA reductase beta subunit MbdO

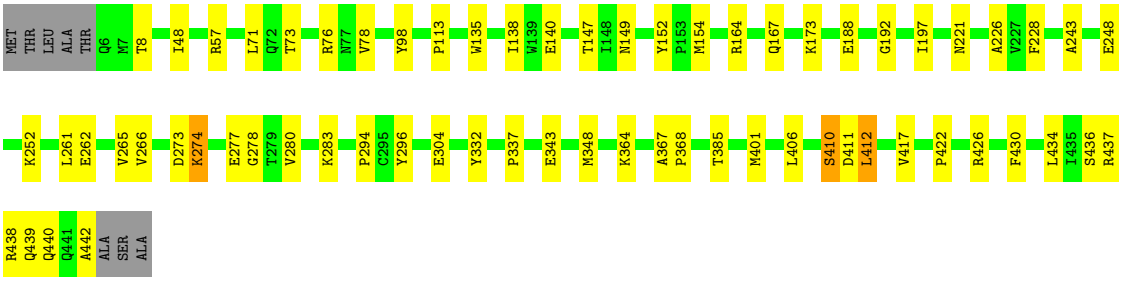
Chain I:





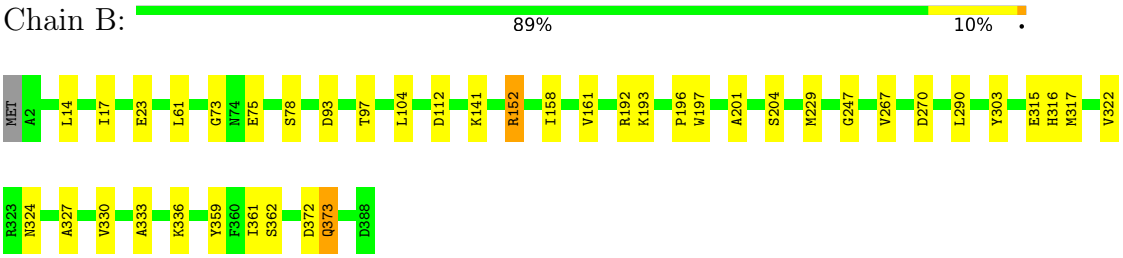
• Molecule 1: 3-methylbenzoyl-CoA reductase beta subunit MbdO

Chain M:



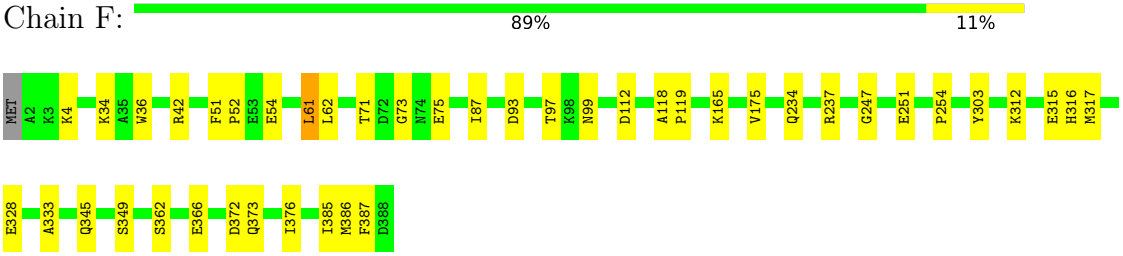
• Molecule 2: 3-methylbenzoyl-CoA reductase gamma subunit MbdN

Chain B:



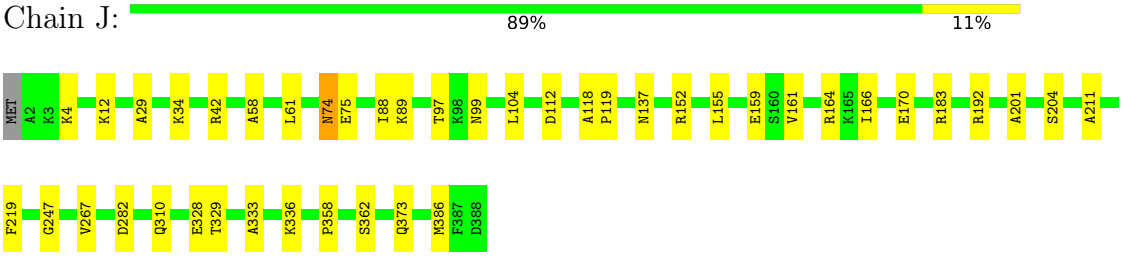
• Molecule 2: 3-methylbenzoyl-CoA reductase gamma subunit MbdN

Chain F:



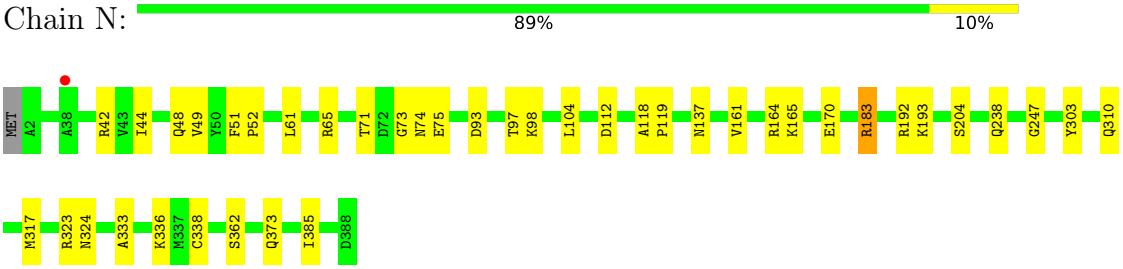
• Molecule 2: 3-methylbenzoyl-CoA reductase gamma subunit MbdN

Chain J:



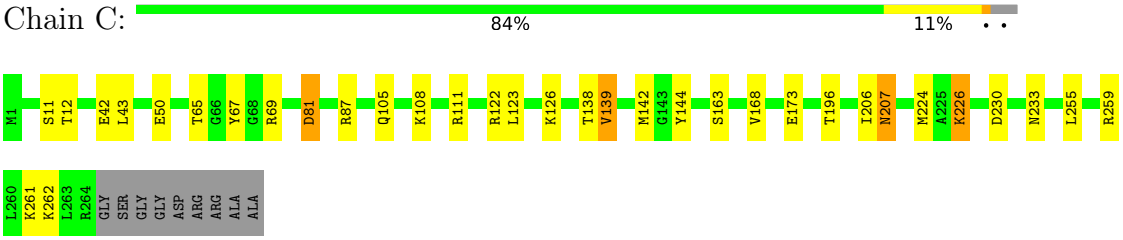
• Molecule 2: 3-methylbenzoyl-CoA reductase gamma subunit MbdN

Chain N:



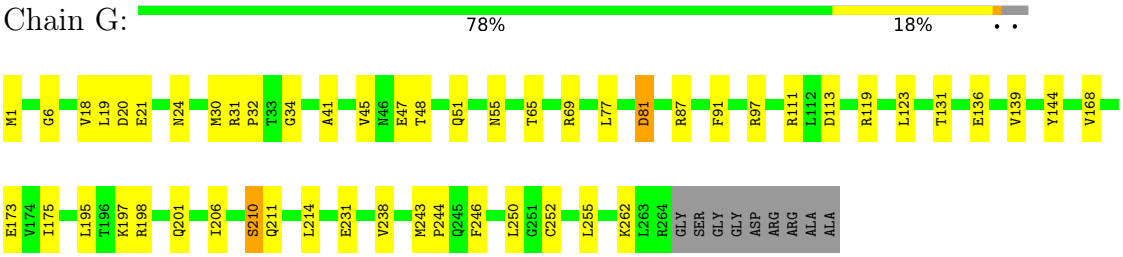
• Molecule 3: 3-methylbenzoyl-CoA reductase delta subunit MbdP

Chain C:



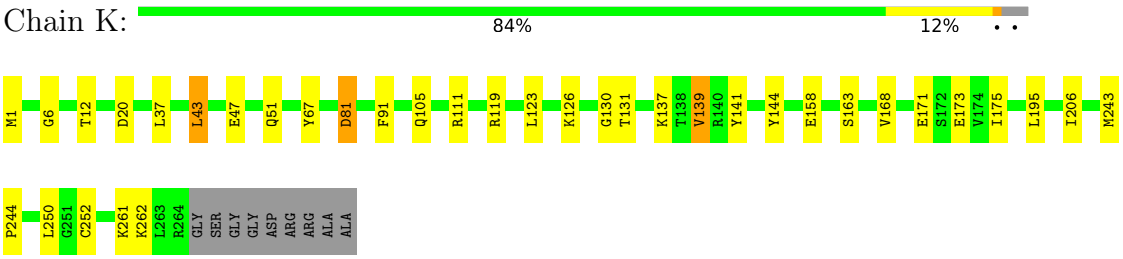
• Molecule 3: 3-methylbenzoyl-CoA reductase delta subunit MbdP

Chain G:



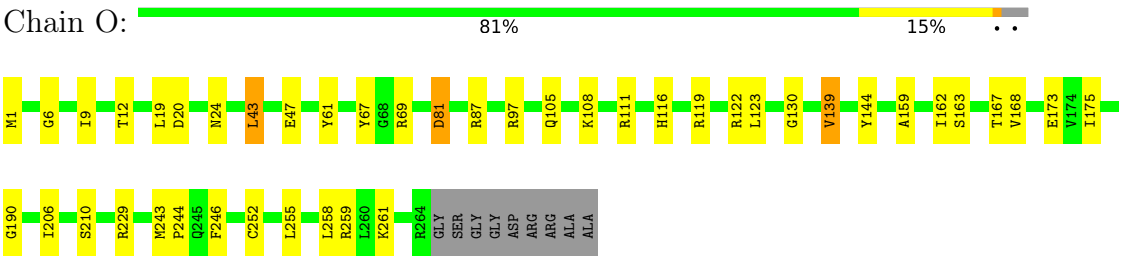
• Molecule 3: 3-methylbenzoyl-CoA reductase delta subunit MbdP

Chain K:



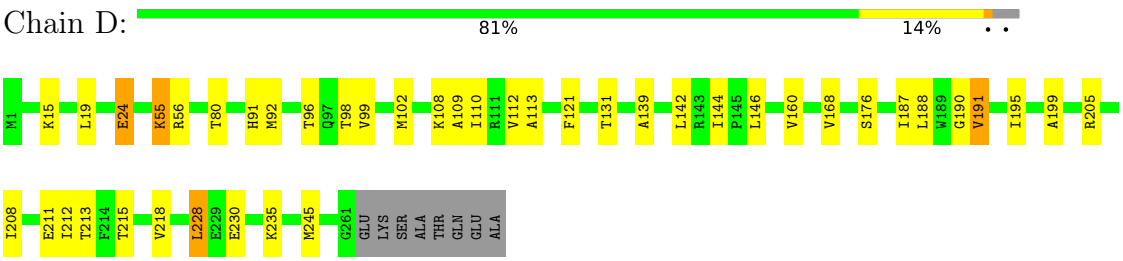
• Molecule 3: 3-methylbenzoyl-CoA reductase delta subunit MbdP

Chain O:



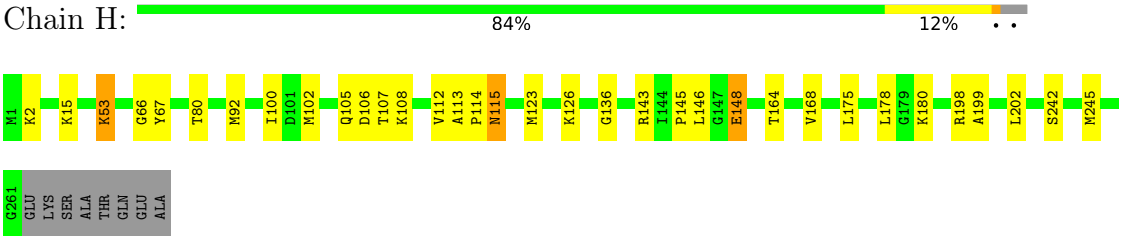
• Molecule 4: 3-methylbenzoyl-CoA reductase alpha subunit MbdQ

Chain D:



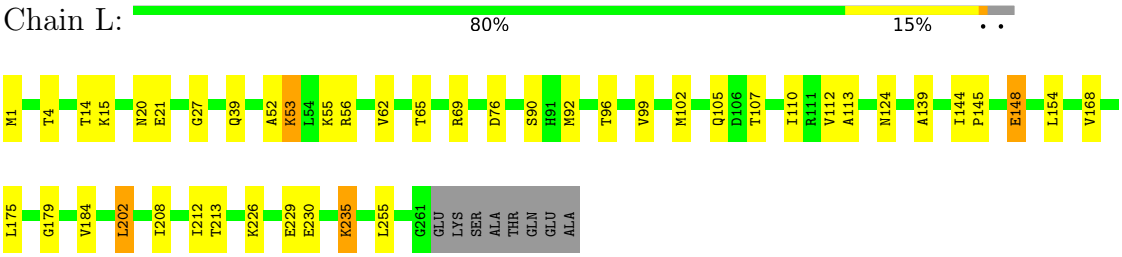
• Molecule 4: 3-methylbenzoyl-CoA reductase alpha subunit MbdQ

Chain H:



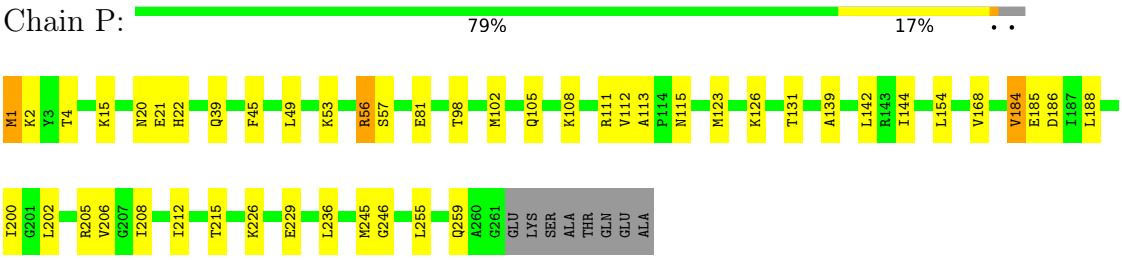
• Molecule 4: 3-methylbenzoyl-CoA reductase alpha subunit MbdQ

Chain L:



• Molecule 4: 3-methylbenzoyl-CoA reductase alpha subunit MbdQ

Chain P:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	235.92Å 157.90Å 165.15Å 90.00° 90.47° 90.00°	Depositor
Resolution (Å)	47.81 – 2.15 47.81 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.7 (47.81-2.15) 97.4 (47.81-2.15)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.23 (at 2.16Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.238 , 0.260 0.239 , 0.258	Depositor DCC
R_{free} test set	16470 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	45.9	Xtriage
Anisotropy	0.226	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 25.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.097 for -h,-k,l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	42682	wwPDB-VP
Average B, all atoms (Å^2)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.65% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: ATP, ADP, SF4, MG, SO4

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	0.20	0/3546	0.36	0/4792
1	E	0.17	0/3539	0.35	0/4783
1	I	0.20	0/3548	0.36	0/4794
1	M	0.19	0/3543	0.37	0/4789
2	B	0.16	0/3159	0.36	0/4281
2	F	0.18	0/3159	0.35	0/4281
2	J	0.17	0/3159	0.36	0/4281
2	N	0.19	0/3159	0.37	2/4281 (0.0%)
3	C	0.16	0/2050	0.32	0/2765
3	G	0.18	0/2053	0.33	0/2768
3	K	0.16	0/2031	0.32	0/2740
3	O	0.19	0/2042	0.35	0/2754
4	D	0.16	0/1962	0.33	0/2642
4	H	0.18	0/1956	0.36	0/2634
4	L	0.16	0/1967	0.35	0/2648
4	P	0.16	0/1967	0.36	0/2648
All	All	0.18	0/42840	0.35	2/57881 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	N	48	GLN	CA-C-N	5.03	130.76	121.70
2	N	48	GLN	C-N-CA	5.03	130.76	121.70

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	3471	0	3404	36	0
1	E	3464	0	3390	40	0
1	I	3473	0	3402	30	0
1	M	3468	0	3395	41	0
2	B	3093	0	3036	30	0
2	F	3093	0	3036	28	0
2	J	3093	0	3036	24	0
2	N	3093	0	3036	26	0
3	C	2023	0	2047	19	0
3	G	2026	0	2056	31	0
3	K	2004	0	2032	23	0
3	O	2015	0	2044	25	0
4	D	1934	0	1966	32	0
4	H	1928	0	1962	27	0
4	L	1939	0	1974	29	0
4	P	1939	0	1974	34	0
5	A	8	0	0	0	0
5	B	8	0	0	0	0
5	D	8	0	0	0	0
5	E	8	0	0	0	0
5	F	8	0	0	0	0
5	G	8	0	0	0	0
5	I	8	0	0	0	0
5	J	8	0	0	0	0
5	L	8	0	0	0	0
5	M	8	0	0	0	0
5	N	8	0	0	1	0
5	O	8	0	0	0	0
6	B	5	0	0	0	0
6	C	5	0	0	0	0
6	E	5	0	0	0	0
6	F	5	0	0	0	0
6	G	5	0	0	0	0
6	J	5	0	0	0	0
6	K	5	0	0	0	0
6	L	5	0	0	0	0
6	M	5	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	N	5	0	0	0	0
6	O	5	0	0	0	0
6	P	5	0	0	0	0
7	C	31	0	12	0	0
7	G	31	0	12	1	0
7	K	31	0	12	0	0
7	O	31	0	12	0	0
8	C	1	0	0	0	0
8	D	1	0	0	0	0
8	G	1	0	0	0	0
8	H	1	0	0	0	0
8	K	1	0	0	0	0
8	L	1	0	0	0	0
8	O	1	0	0	0	0
8	P	1	0	0	0	0
9	D	27	0	12	1	0
9	H	27	0	12	0	0
9	L	27	0	12	0	0
9	P	27	0	12	1	0
10	A	13	0	0	0	0
10	B	17	0	0	0	0
10	C	8	0	0	1	0
10	D	7	0	0	0	0
10	E	18	0	0	1	0
10	F	26	0	0	0	0
10	G	14	0	0	0	0
10	H	9	0	0	0	0
10	I	15	0	0	0	0
10	J	36	0	0	0	0
10	K	12	0	0	0	0
10	L	12	0	0	0	0
10	M	9	0	0	0	0
10	N	10	0	0	0	0
10	O	14	0	0	2	0
10	P	10	0	0	1	0
All	All	42682	0	41886	438	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.

The worst 5 of 438 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:F:71:THR:HG22	2:F:73:GLY:H	1.30	0.94
2:N:71:THR:HG22	2:N:73:GLY:H	1.34	0.90
4:D:102:MET:HE3	4:D:131:THR:HG21	1.56	0.87
4:D:208:ILE:HG23	4:D:212:ILE:HD11	1.59	0.85
1:A:197:ILE:HD11	1:A:337:PRO:HG2	1.61	0.81

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	A	437/445 (98%)	427 (98%)	9 (2%)	1 (0%)	44	44
1	E	436/445 (98%)	425 (98%)	10 (2%)	1 (0%)	44	44
1	I	437/445 (98%)	425 (97%)	11 (2%)	1 (0%)	44	44
1	M	437/445 (98%)	424 (97%)	13 (3%)	0	100	100
2	B	385/388 (99%)	375 (97%)	10 (3%)	0	100	100
2	F	385/388 (99%)	377 (98%)	8 (2%)	0	100	100
2	J	385/388 (99%)	376 (98%)	9 (2%)	0	100	100
2	N	385/388 (99%)	379 (98%)	6 (2%)	0	100	100
3	C	265/273 (97%)	263 (99%)	1 (0%)	1 (0%)	30	27
3	G	265/273 (97%)	257 (97%)	8 (3%)	0	100	100
3	K	263/273 (96%)	258 (98%)	5 (2%)	0	100	100
3	O	264/273 (97%)	259 (98%)	5 (2%)	0	100	100
4	D	260/269 (97%)	258 (99%)	1 (0%)	1 (0%)	30	27
4	H	259/269 (96%)	257 (99%)	2 (1%)	0	100	100
4	L	260/269 (97%)	259 (100%)	1 (0%)	0	100	100
4	P	260/269 (97%)	259 (100%)	1 (0%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	5383/5500 (98%)	5278 (98%)	100 (2%)	5 (0%)	48 51

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	410	SER
1	I	410	SER
1	A	410	SER
3	C	207	ASN
4	D	191	VAL

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	368/371 (99%)	356 (97%)	12 (3%)	33 33
1	E	368/371 (99%)	356 (97%)	12 (3%)	33 33
1	I	369/371 (100%)	357 (97%)	12 (3%)	33 33
1	M	368/371 (99%)	356 (97%)	12 (3%)	33 33
2	B	335/336 (100%)	332 (99%)	3 (1%)	75 81
2	F	335/336 (100%)	331 (99%)	4 (1%)	67 73
2	J	335/336 (100%)	328 (98%)	7 (2%)	48 53
2	N	335/336 (100%)	331 (99%)	4 (1%)	67 73
3	C	214/215 (100%)	204 (95%)	10 (5%)	22 19
3	G	214/215 (100%)	209 (98%)	5 (2%)	45 49
3	K	212/215 (99%)	204 (96%)	8 (4%)	28 27
3	O	213/215 (99%)	204 (96%)	9 (4%)	25 24
4	D	198/203 (98%)	189 (96%)	9 (4%)	23 21
4	H	197/203 (97%)	192 (98%)	5 (2%)	42 45
4	L	198/203 (98%)	190 (96%)	8 (4%)	27 25

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
4	P	198/203 (98%)	189 (96%)	9 (4%)	23 21
All	All	4457/4500 (99%)	4328 (97%)	129 (3%)	37 38

5 of 129 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	O	116	HIS
3	O	261	LYS
2	F	165	LYS
2	F	61	LEU
4	P	21	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 34 such sidechains are listed below:

Mol	Chain	Res	Type
4	L	193	GLN
1	M	202	GLN
1	M	267	HIS
1	E	223	ASN
1	E	202	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 40 ligands modelled in this entry, 8 are monoatomic - leaving 32 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	$\#\|Z\| > 2$
5	SF4	M	501	1	0,12,12	-	-	-		
5	SF4	O	303	3,4	0,12,12	-	-	-		
5	SF4	B	401	2	0,12,12	-	-	-		
7	ATP	K	301	8	26,33,33	0.94	2 (7%)	31,52,52	1.16	2 (6%)
7	ATP	O	301	8	26,33,33	0.94	2 (7%)	31,52,52	1.17	4 (12%)
5	SF4	A	501	1	0,12,12	-	-	-		
6	SO4	M	502	-	4,4,4	0.41	0	6,6,6	0.07	0
5	SF4	N	401	2	0,12,12	-	-	-		
6	SO4	K	303	-	4,4,4	0.14	0	6,6,6	0.07	0
6	SO4	O	304	-	4,4,4	0.41	0	6,6,6	0.07	0
5	SF4	I	501	1	0,12,12	-	-	-		
7	ATP	G	301	8	26,33,33	0.94	2 (7%)	31,52,52	1.17	2 (6%)
6	SO4	E	502	-	4,4,4	0.40	0	6,6,6	0.13	0
5	SF4	L	301	3,4	0,12,12	-	-	-		
5	SF4	J	401	2	0,12,12	-	-	-		
6	SO4	L	304	-	4,4,4	0.48	0	6,6,6	0.28	0
9	ADP	H	301	8	24,29,29	1.16	3 (12%)	29,45,45	1.63	7 (24%)
9	ADP	L	302	8	24,29,29	0.99	2 (8%)	29,45,45	1.57	4 (13%)
6	SO4	C	303	-	4,4,4	0.43	0	6,6,6	0.05	0
6	SO4	N	402	-	4,4,4	0.15	0	6,6,6	0.05	0
6	SO4	P	303	-	4,4,4	0.42	0	6,6,6	0.18	0
5	SF4	E	501	1	0,12,12	-	-	-		
9	ADP	P	301	8	24,29,29	0.97	3 (12%)	29,45,45	1.51	4 (13%)
5	SF4	F	401	2	0,12,12	-	-	-		
5	SF4	D	300	3,4	0,12,12	-	-	-		
6	SO4	B	402	-	4,4,4	0.14	0	6,6,6	0.06	0
9	ADP	D	301	8	24,29,29	1.18	3 (12%)	29,45,45	1.67	6 (20%)
6	SO4	G	304	-	4,4,4	0.15	0	6,6,6	0.08	0
6	SO4	J	402	-	4,4,4	0.45	0	6,6,6	0.06	0
7	ATP	C	301	8	26,33,33	0.93	3 (11%)	31,52,52	1.18	2 (6%)
6	SO4	F	402	-	4,4,4	0.16	0	6,6,6	0.05	0
5	SF4	G	303	3,4	0,12,12	-	-	-		

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
5	SF4	M	501	1	-	-	0/6/5/5
5	SF4	O	303	3,4	-	-	0/6/5/5
5	SF4	B	401	2	-	-	0/6/5/5
7	ATP	K	301	8	-	0/18/38/38	0/3/3/3
7	ATP	O	301	8	-	0/18/38/38	0/3/3/3
5	SF4	A	501	1	-	-	0/6/5/5
5	SF4	N	401	2	-	-	0/6/5/5
5	SF4	I	501	1	-	-	0/6/5/5
7	ATP	G	301	8	-	1/18/38/38	0/3/3/3
5	SF4	L	301	3,4	-	-	0/6/5/5
5	SF4	J	401	2	-	-	0/6/5/5
9	ADP	H	301	8	-	0/12/32/32	0/3/3/3
9	ADP	L	302	8	-	0/12/32/32	0/3/3/3
5	SF4	E	501	1	-	-	0/6/5/5
9	ADP	P	301	8	-	0/12/32/32	0/3/3/3
5	SF4	F	401	2	-	-	0/6/5/5
5	SF4	D	300	3,4	-	-	0/6/5/5
9	ADP	D	301	8	-	0/12/32/32	0/3/3/3
7	ATP	C	301	8	-	2/18/38/38	0/3/3/3
5	SF4	G	303	3,4	-	-	0/6/5/5

The worst 5 of 20 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	D	301	ADP	O4'-C1'	2.85	1.45	1.41
9	H	301	ADP	O4'-C1'	2.71	1.44	1.41
9	L	302	ADP	O4'-C1'	2.50	1.44	1.41
9	H	301	ADP	C5-C4	2.45	1.47	1.40
9	P	301	ADP	C5-C4	2.43	1.47	1.40

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
9	D	301	ADP	C3'-C2'-C1'	4.87	108.31	100.98
9	L	302	ADP	C3'-C2'-C1'	4.27	107.41	100.98
9	P	301	ADP	C3'-C2'-C1'	4.12	107.18	100.98
9	H	301	ADP	C3'-C2'-C1'	3.86	106.79	100.98
9	L	302	ADP	N3-C2-N1	-3.71	122.87	128.68

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
7	C	301	ATP	PB-O3B-PG-O1G
7	C	301	ATP	PG-O3B-PB-O1B
7	G	301	ATP	C3'-C4'-C5'-O5'

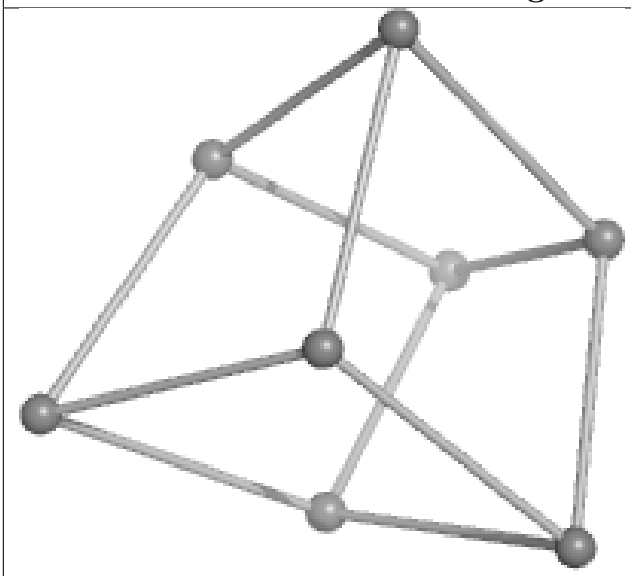
There are no ring outliers.

4 monomers are involved in 4 short contacts:

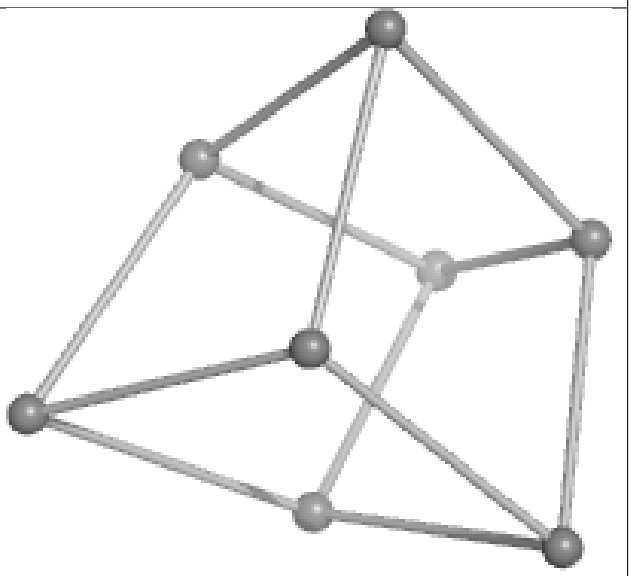
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	N	401	SF4	1	0
7	G	301	ATP	1	0
9	P	301	ADP	1	0
9	D	301	ADP	1	0

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.

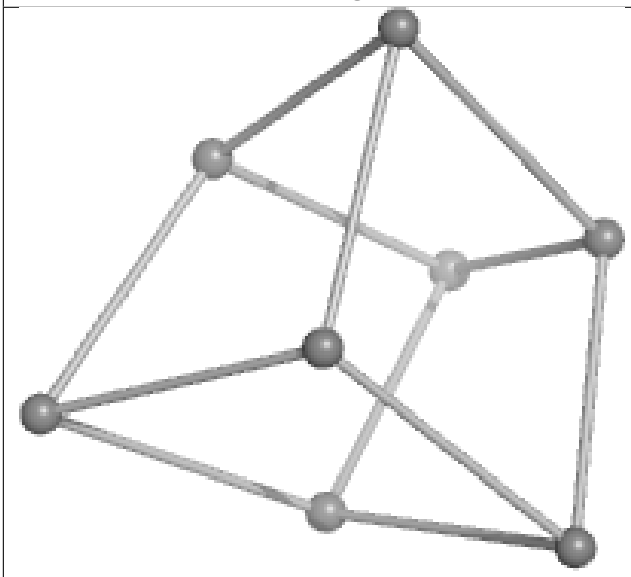
Ligand SF4 M 501



Bond lengths



Bond angles



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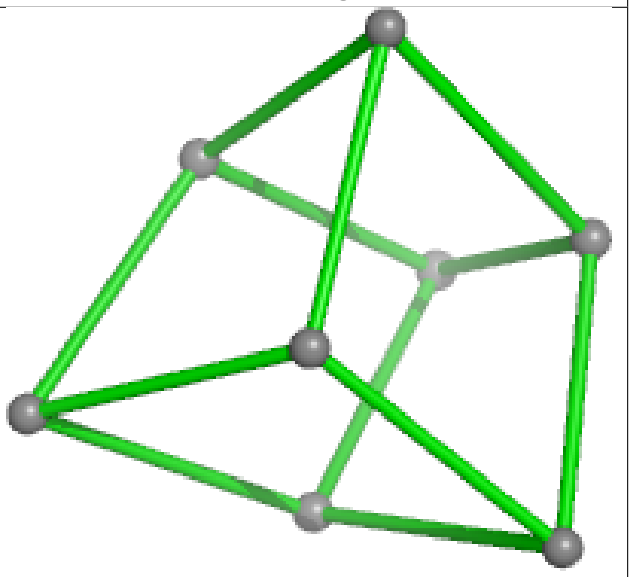
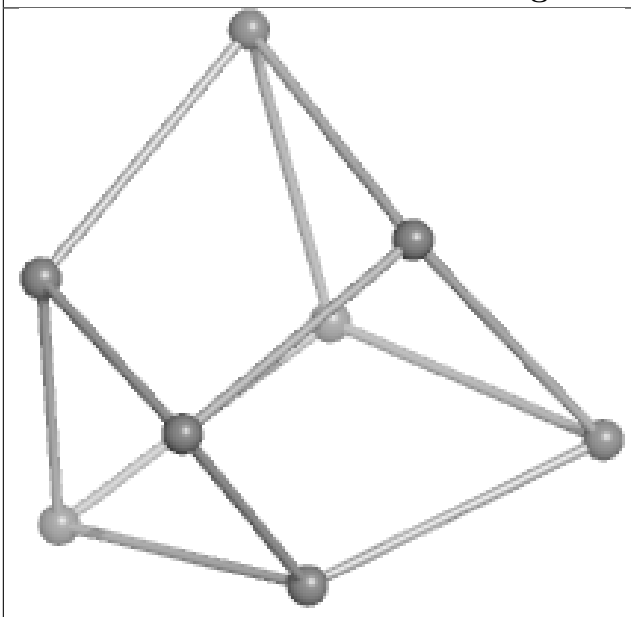


Rings

Ligand SF4 O 303



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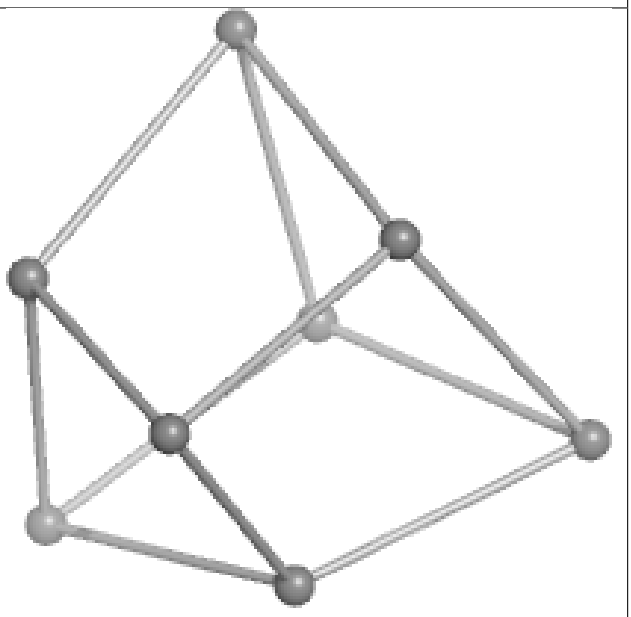
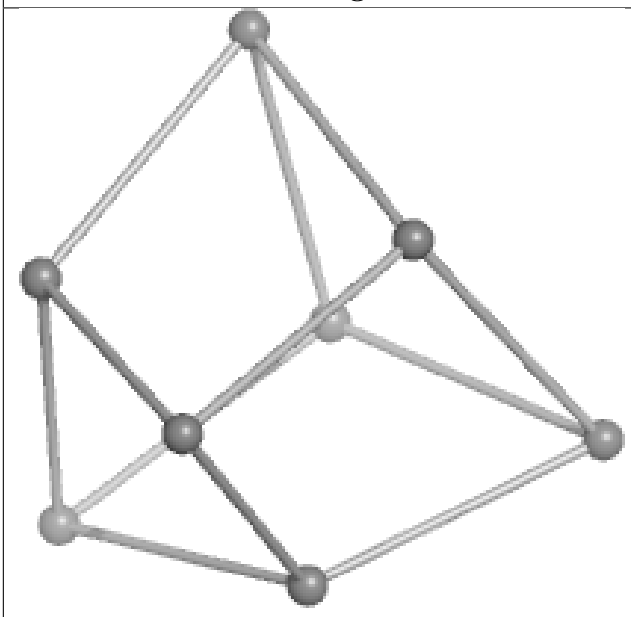


Bond angles



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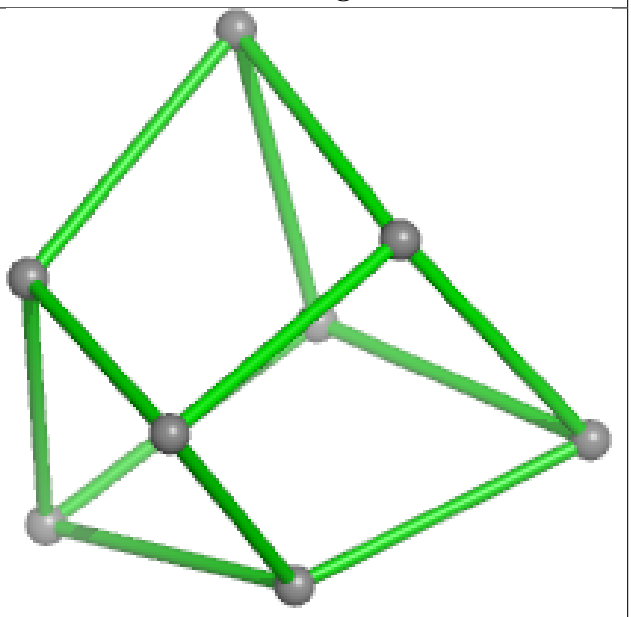
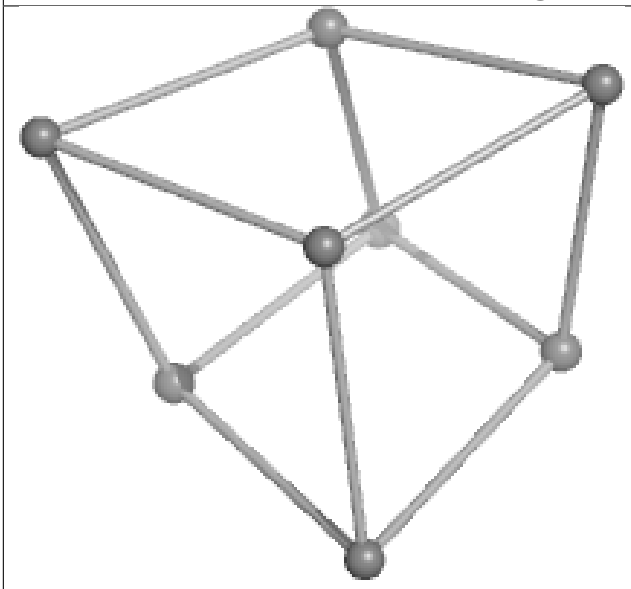
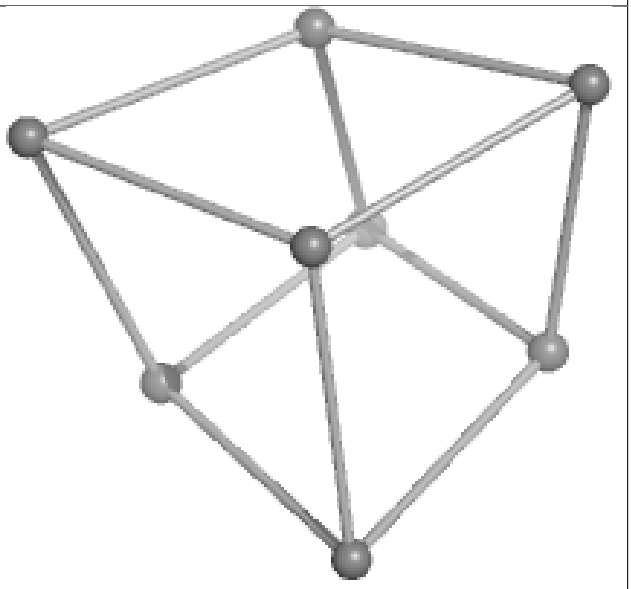


Rings

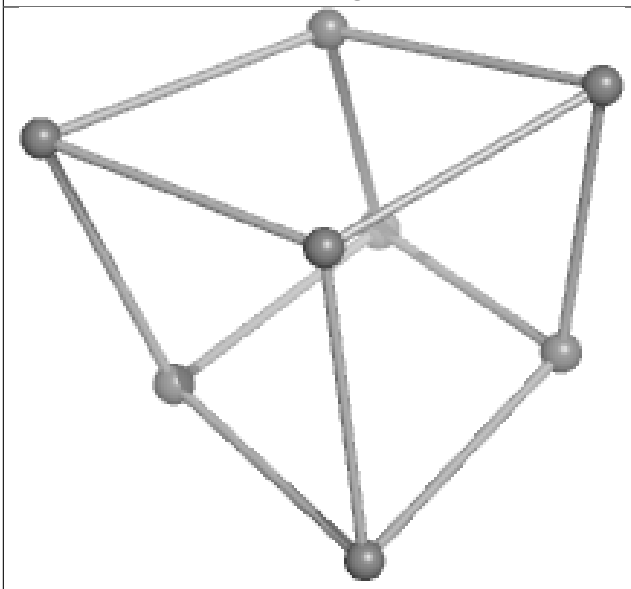
Ligand SF4 B 401



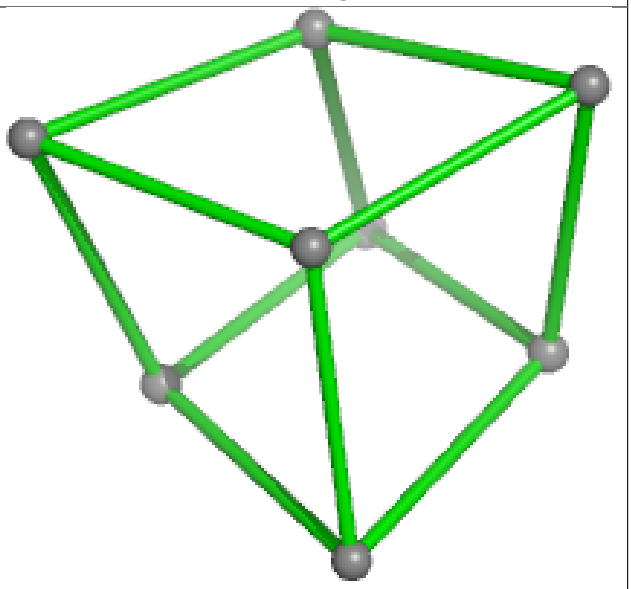
Bond lengths



Bond angles

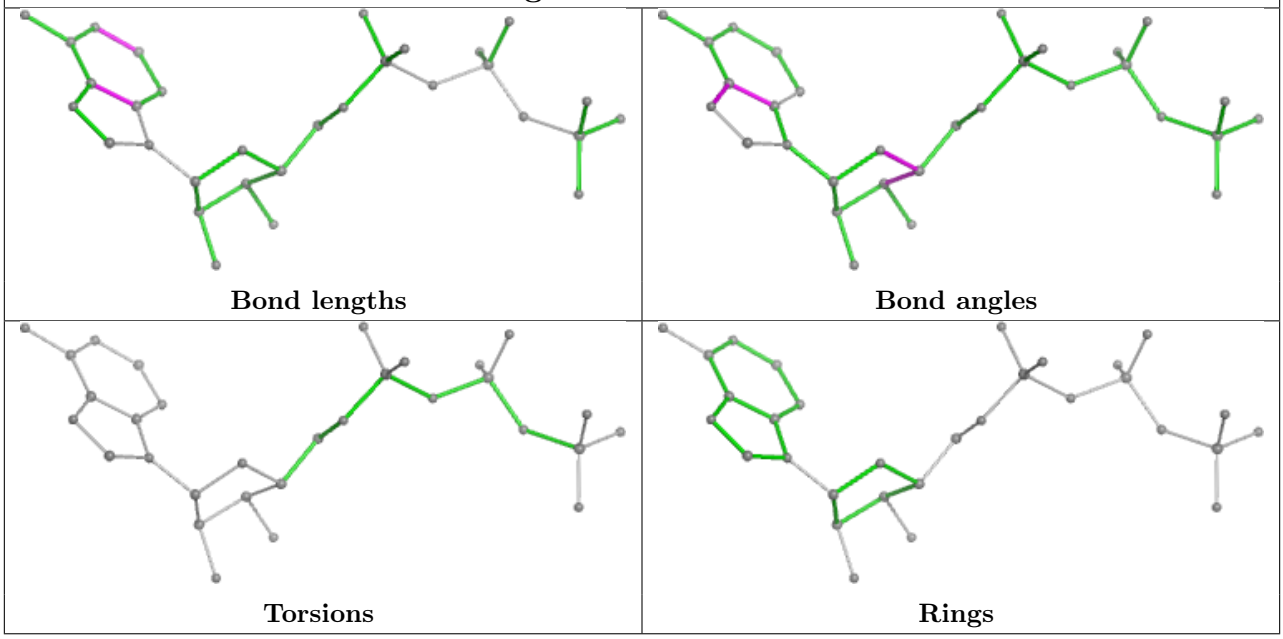


Torsions



Rings

Ligand ATP K 301



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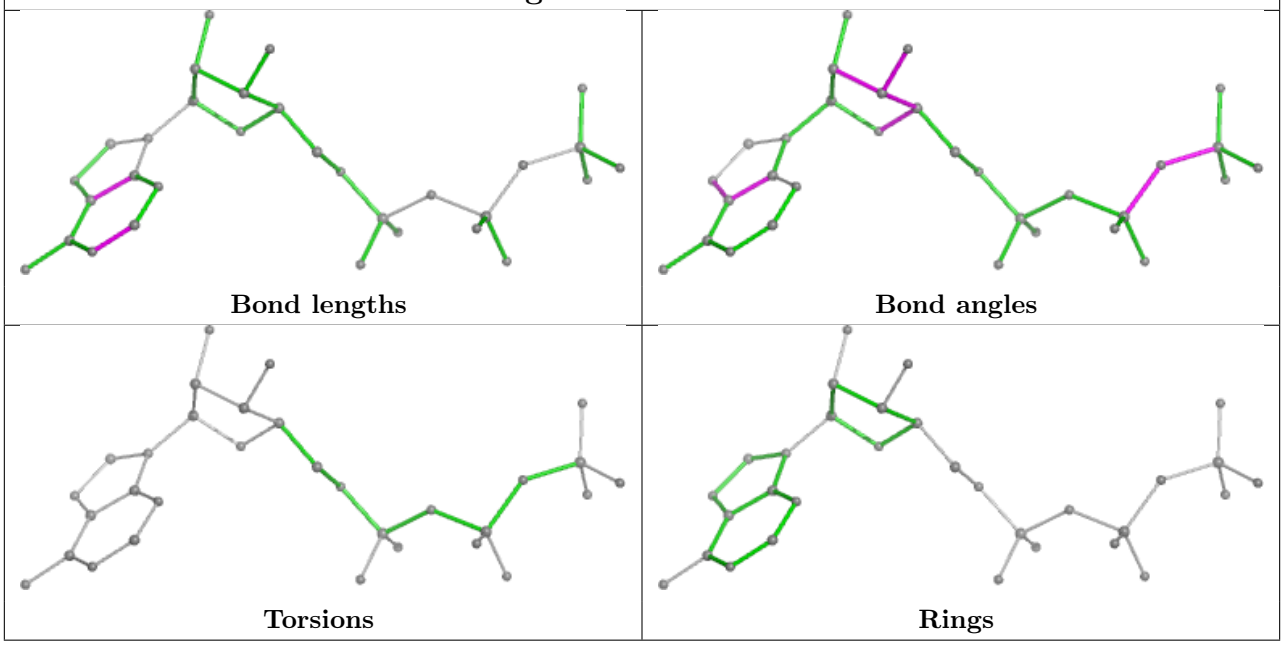
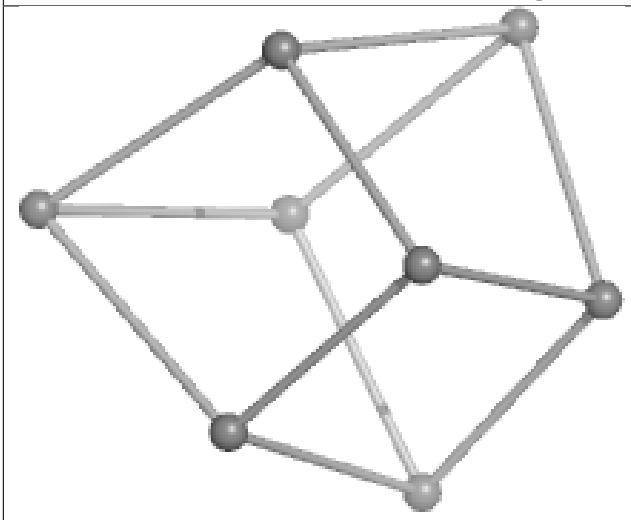
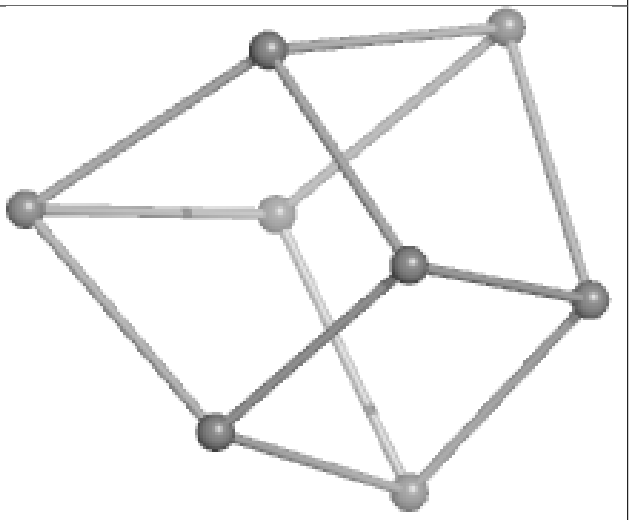


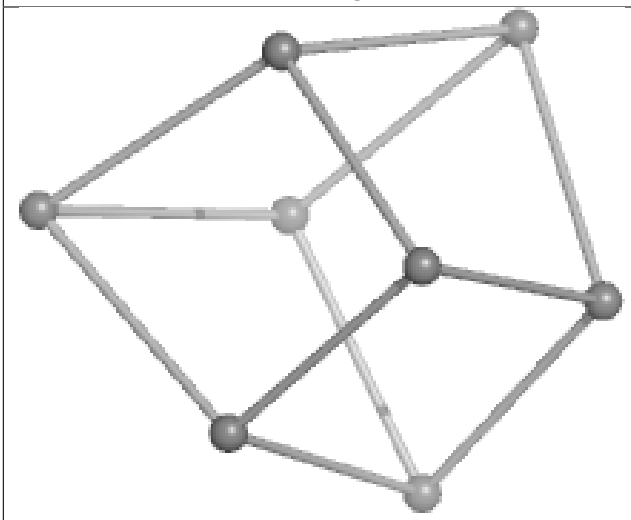
Ligand SF4 A 501



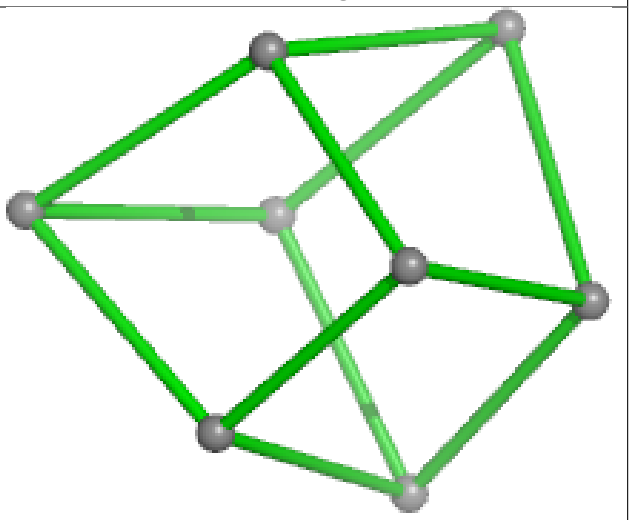
Bond lengths



Bond angles

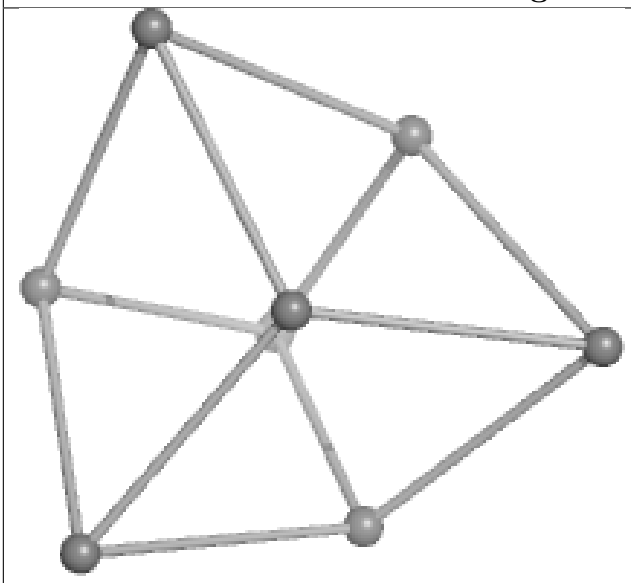


Torsions

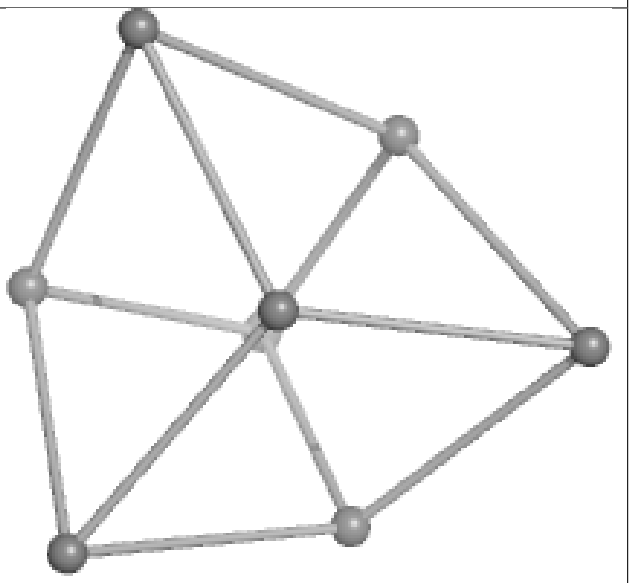


Rings

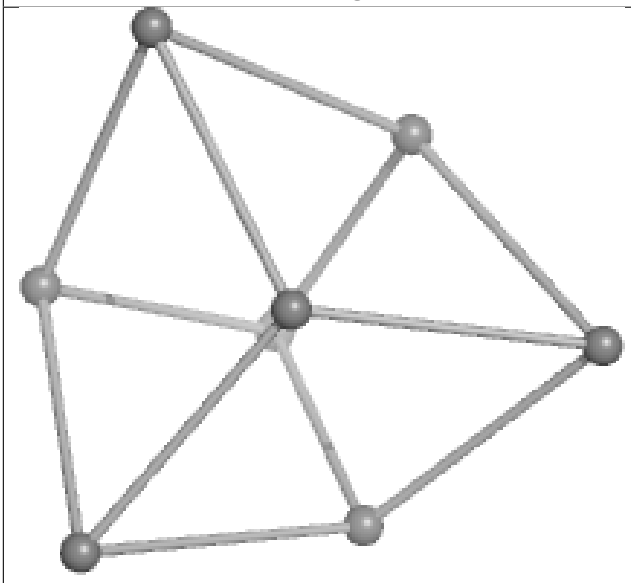
Ligand SF4 N 401



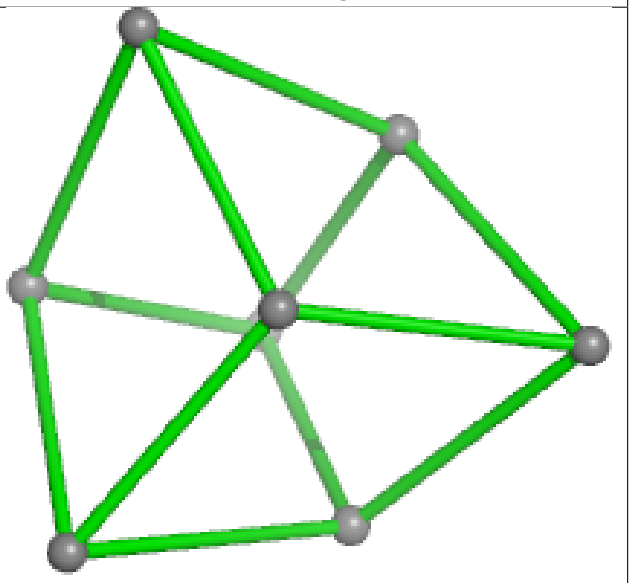
Bond lengths



Bond angles

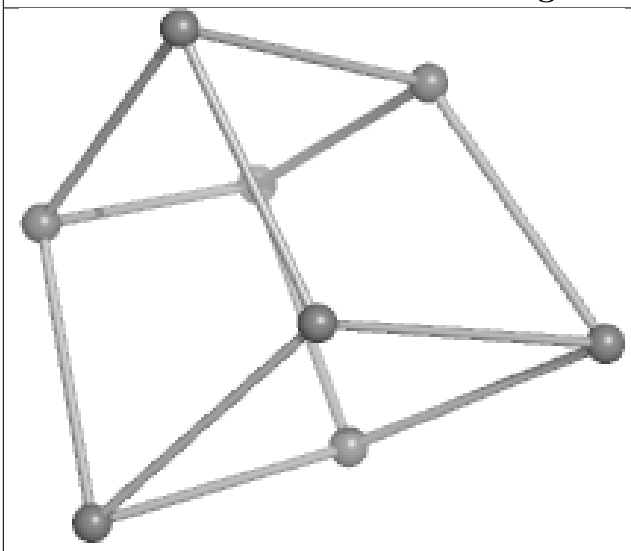


Torsions



Rings

Ligand SF4 I 501



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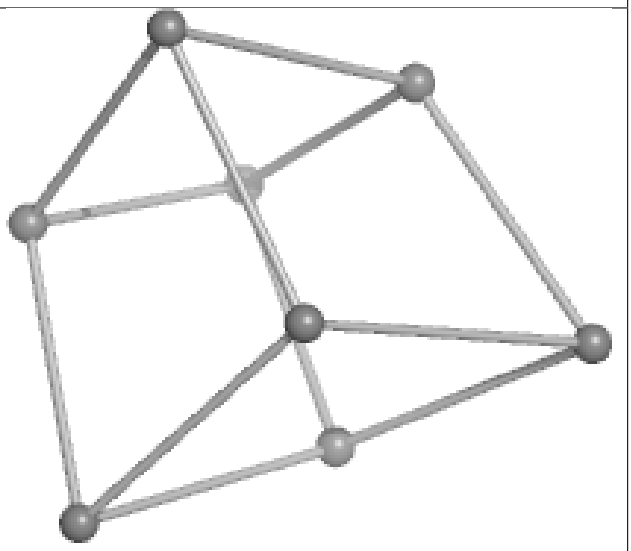
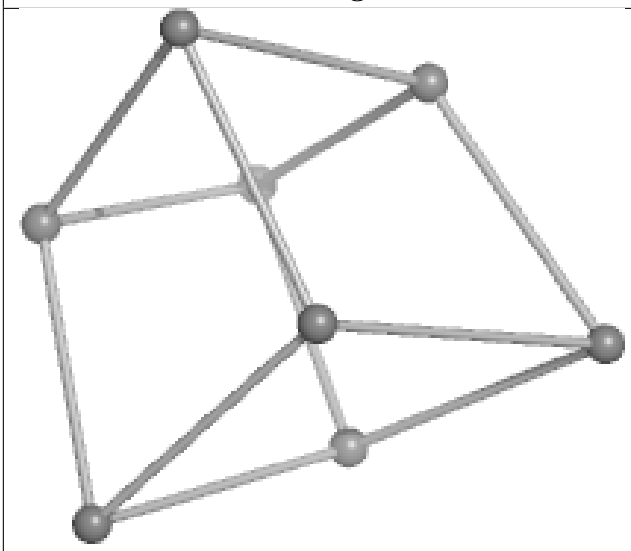
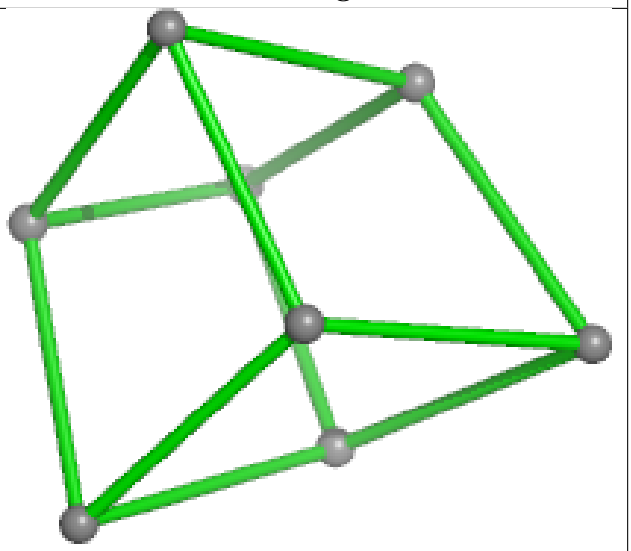


Bond angles

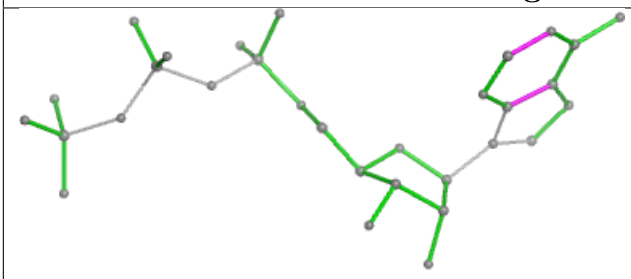


Torsions



Rings

Ligand ATP G 301



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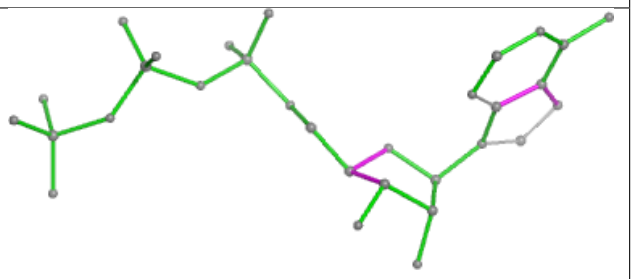
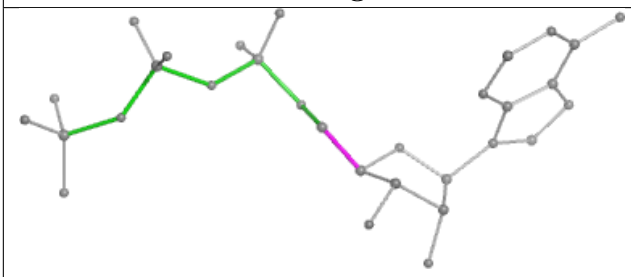
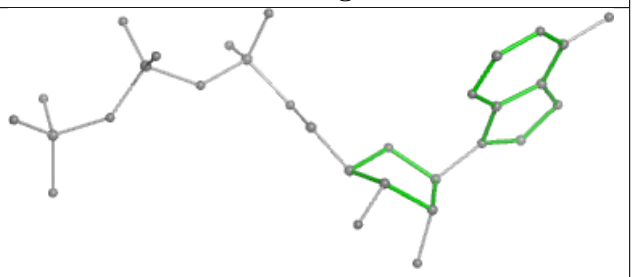


Bond angles

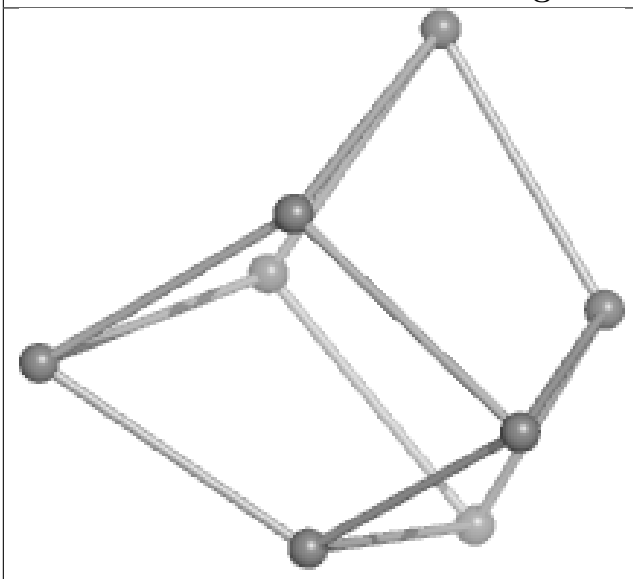


Torsions

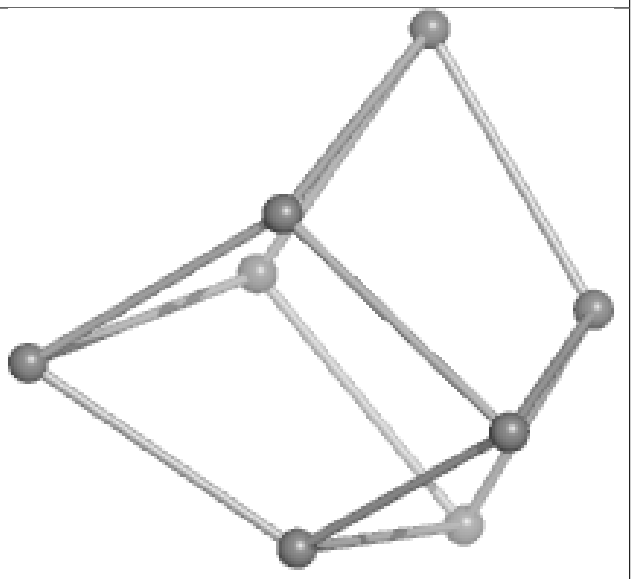


Rings

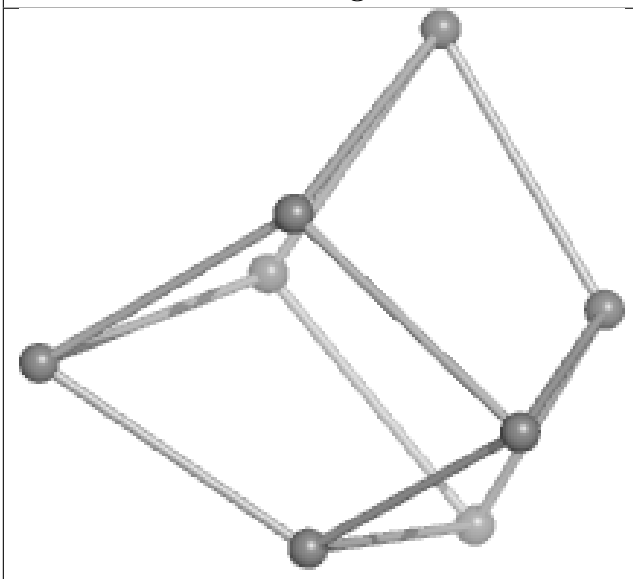
Ligand SF4 L 301



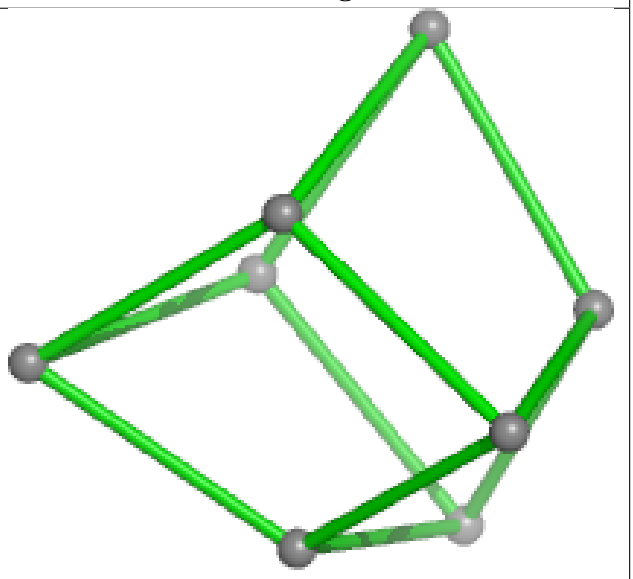
Bond lengths



Bond angles

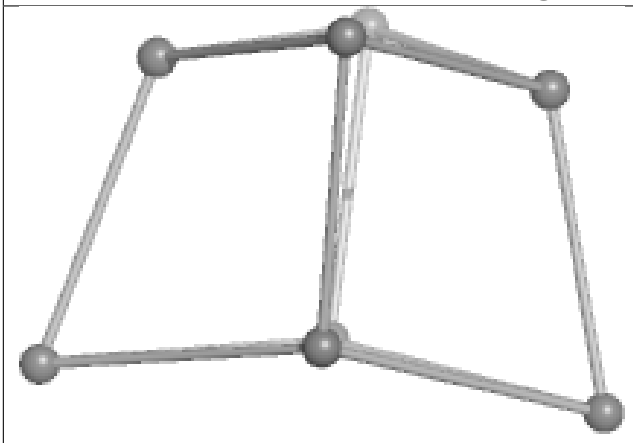


Torsions

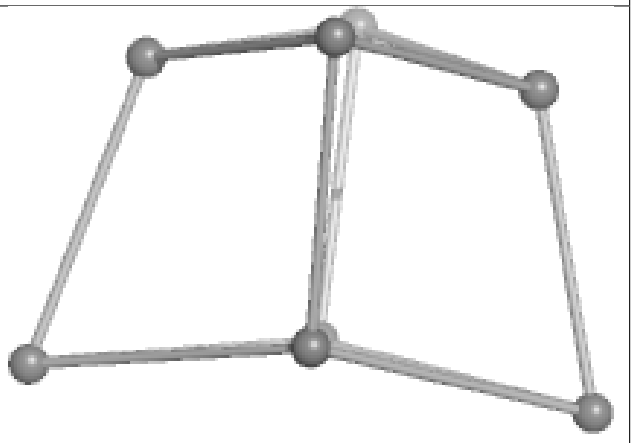


Rings

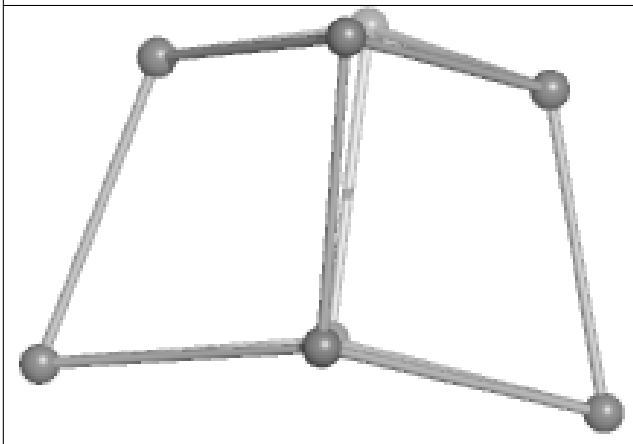
Ligand SF4 J 401



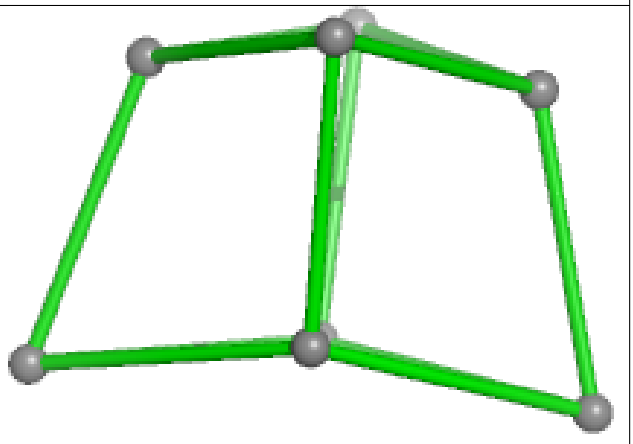
Bond lengths



Bond angles

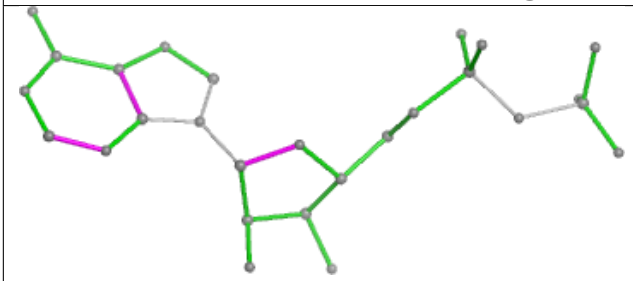


Torsions

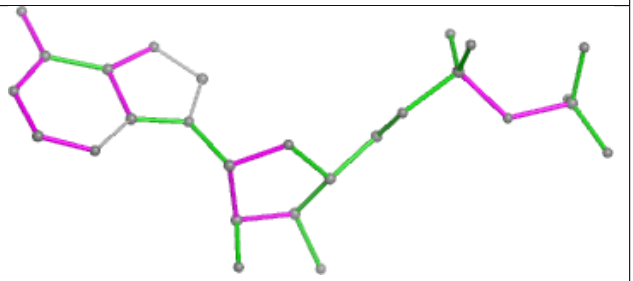


Rings

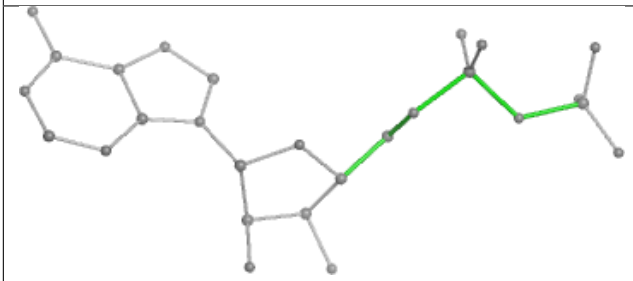
Ligand ADP H 301



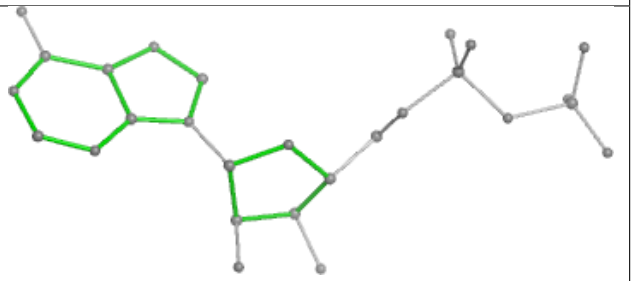
Bond lengths



Bond angles

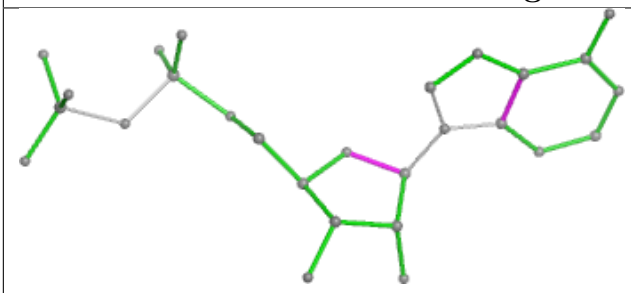


Torsions

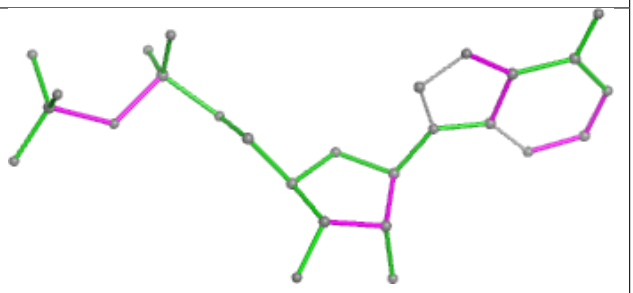


Rings

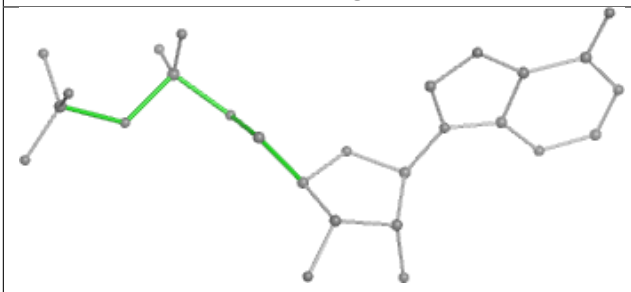
Ligand ADP L 302



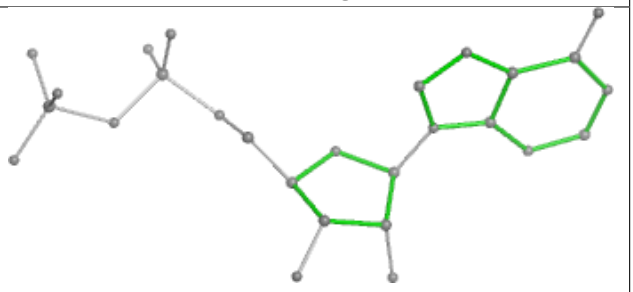
Bond lengths



Bond angles

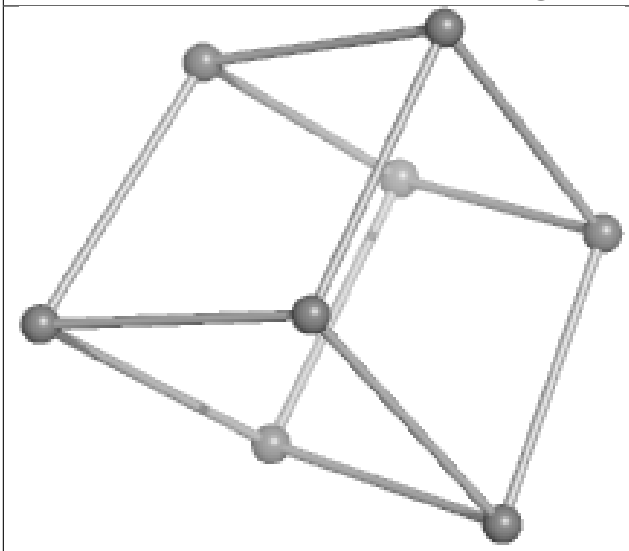


Torsions

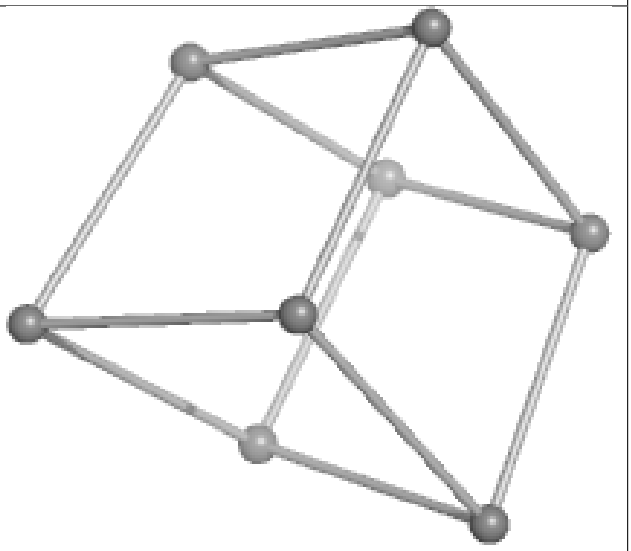


Rings

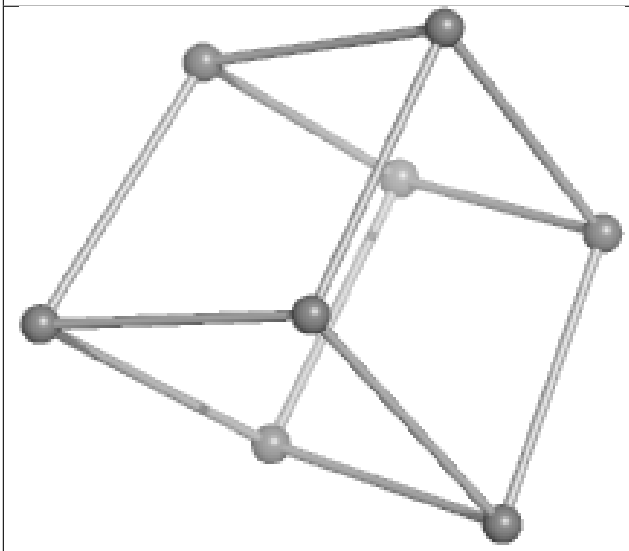
Ligand SF4 E 501



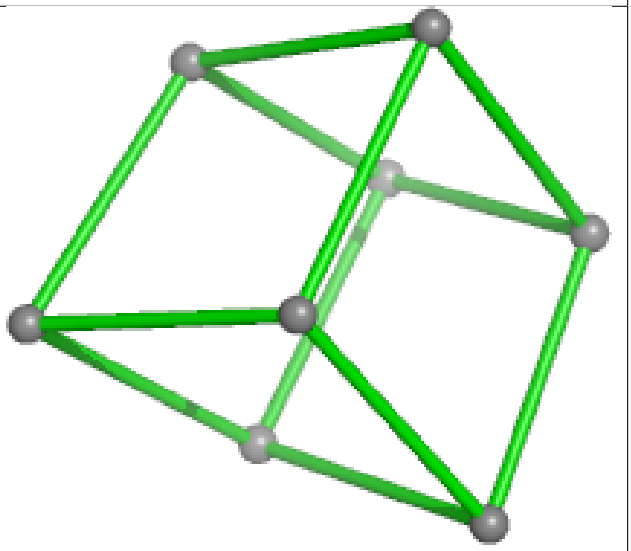
Bond lengths



Bond angles

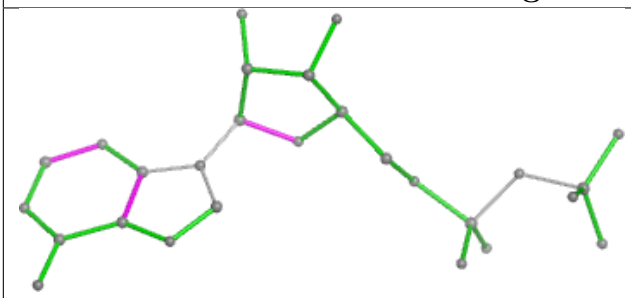


Torsions

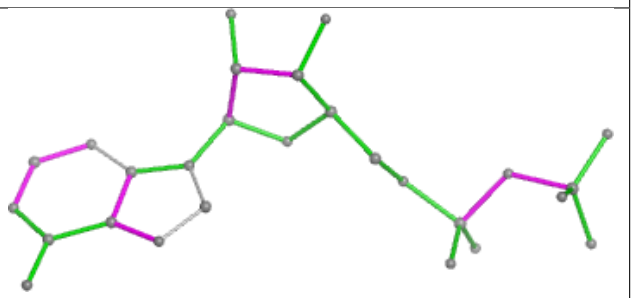


Rings

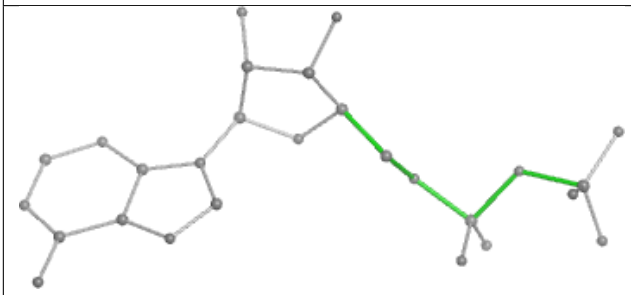
Ligand ADP P 301



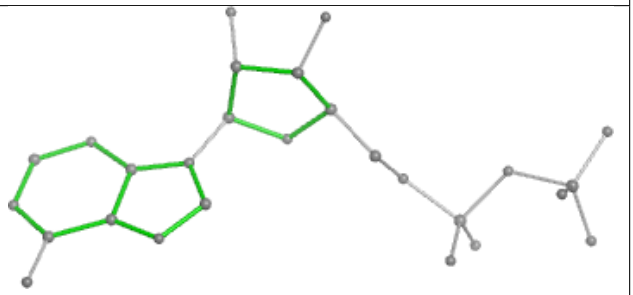
Bond lengths



Bond angles

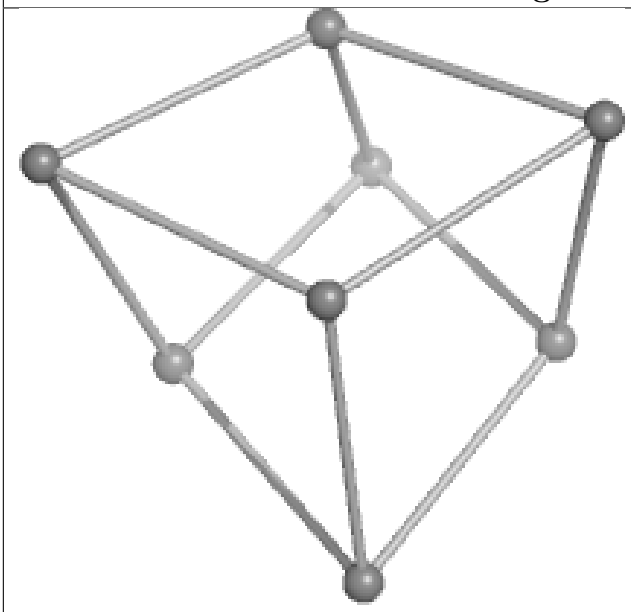


Torsions

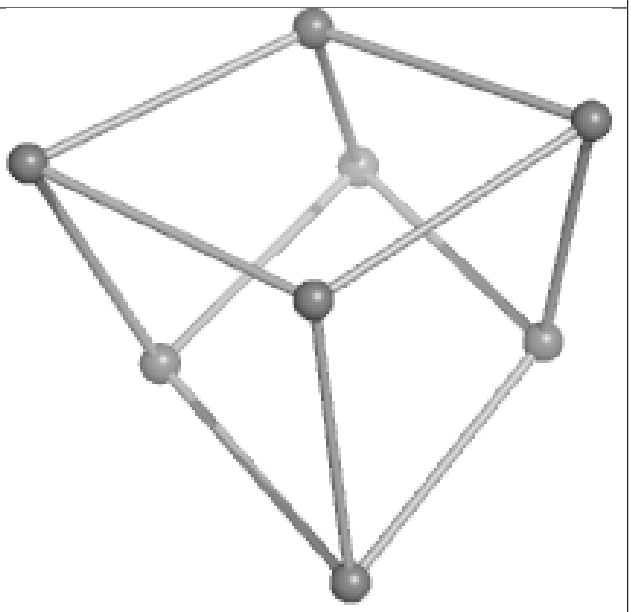


Rings

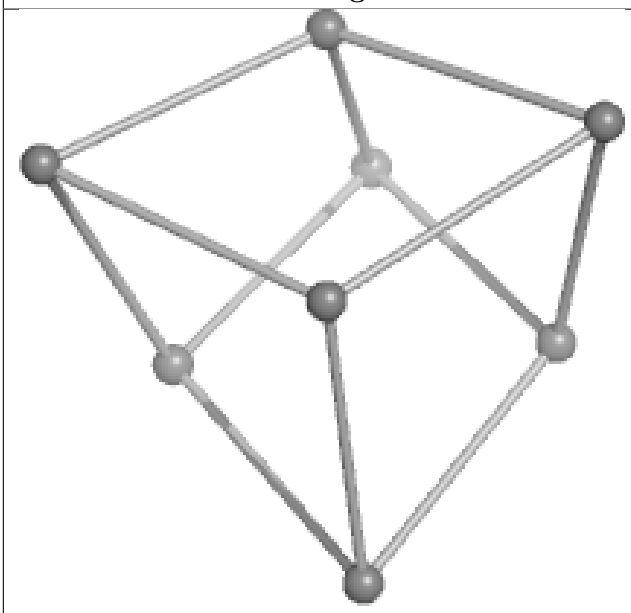
Ligand SF4 F 401



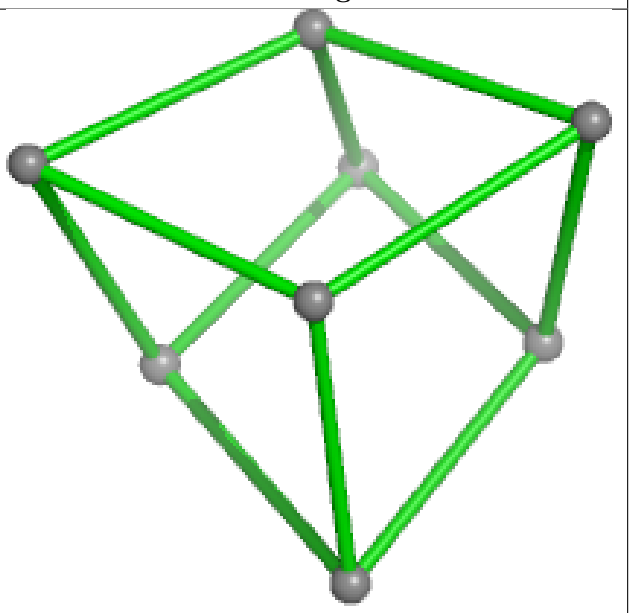
Bond lengths



Bond angles

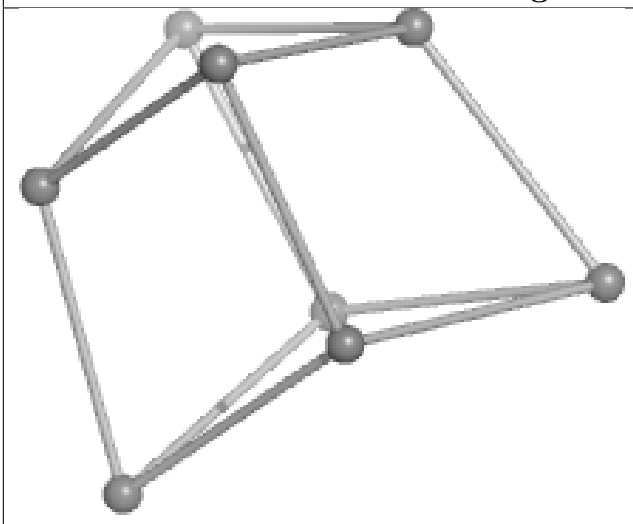


Torsions

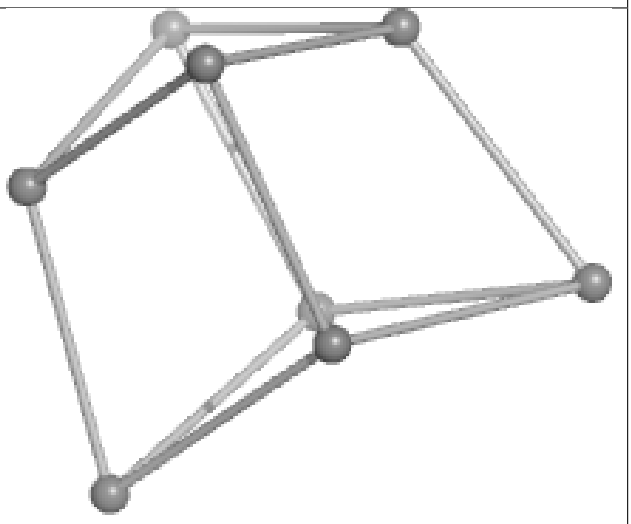


Rings

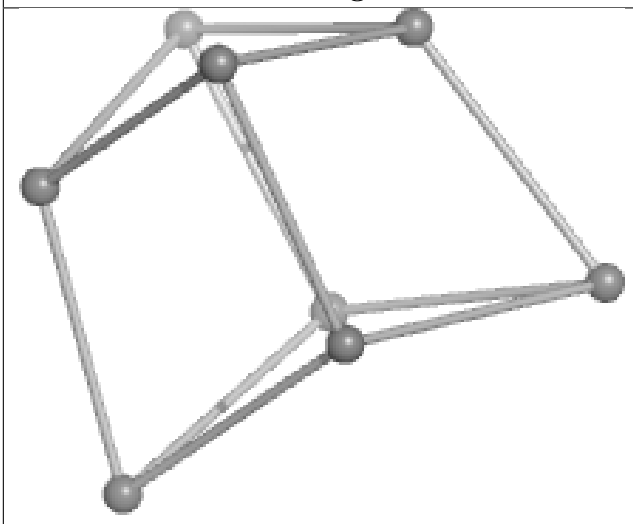
Ligand SF4 D 300



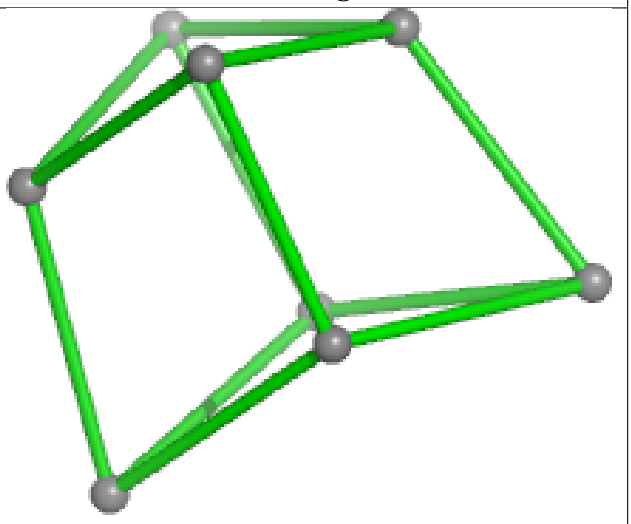
Bond lengths



Bond angles

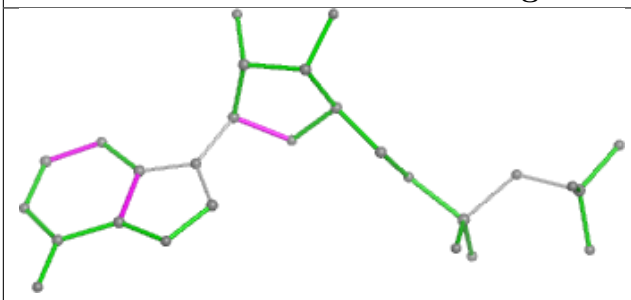


Torsions

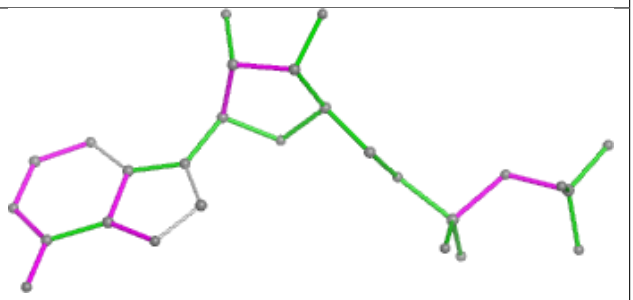


Rings

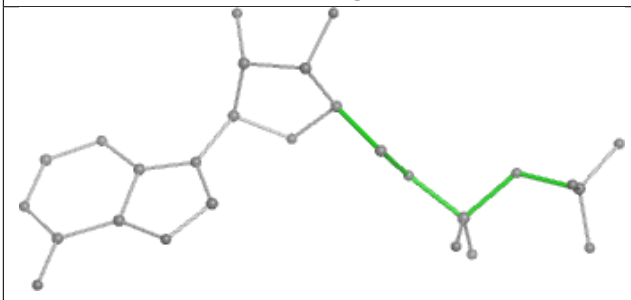
Ligand ADP D 301



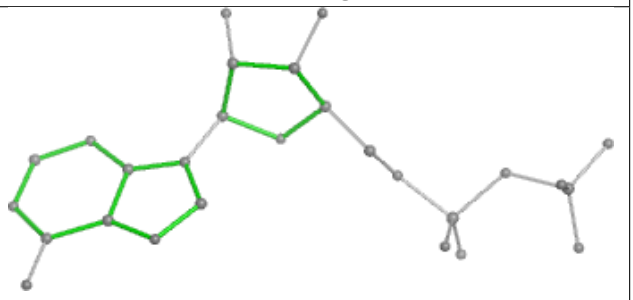
Bond lengths



Bond angles

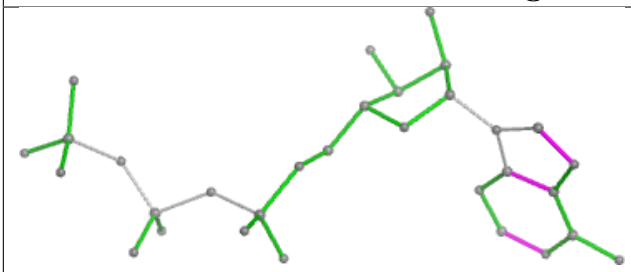


Torsions

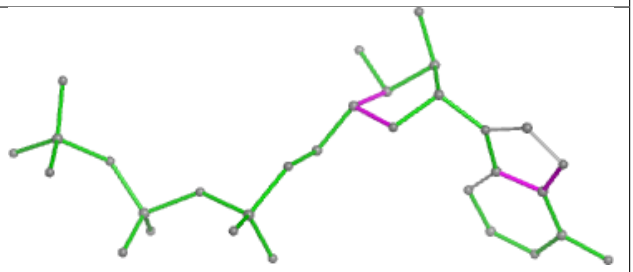


Rings

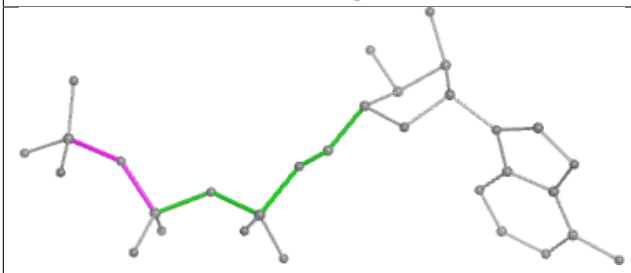
Ligand ATP C 301



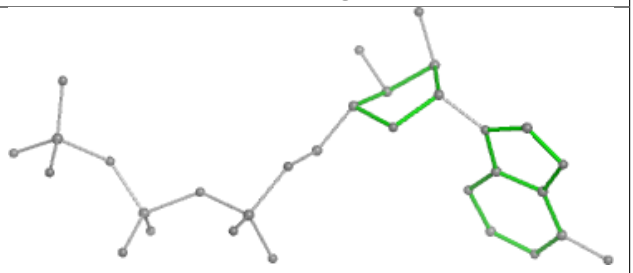
Bond lengths



Bond angles

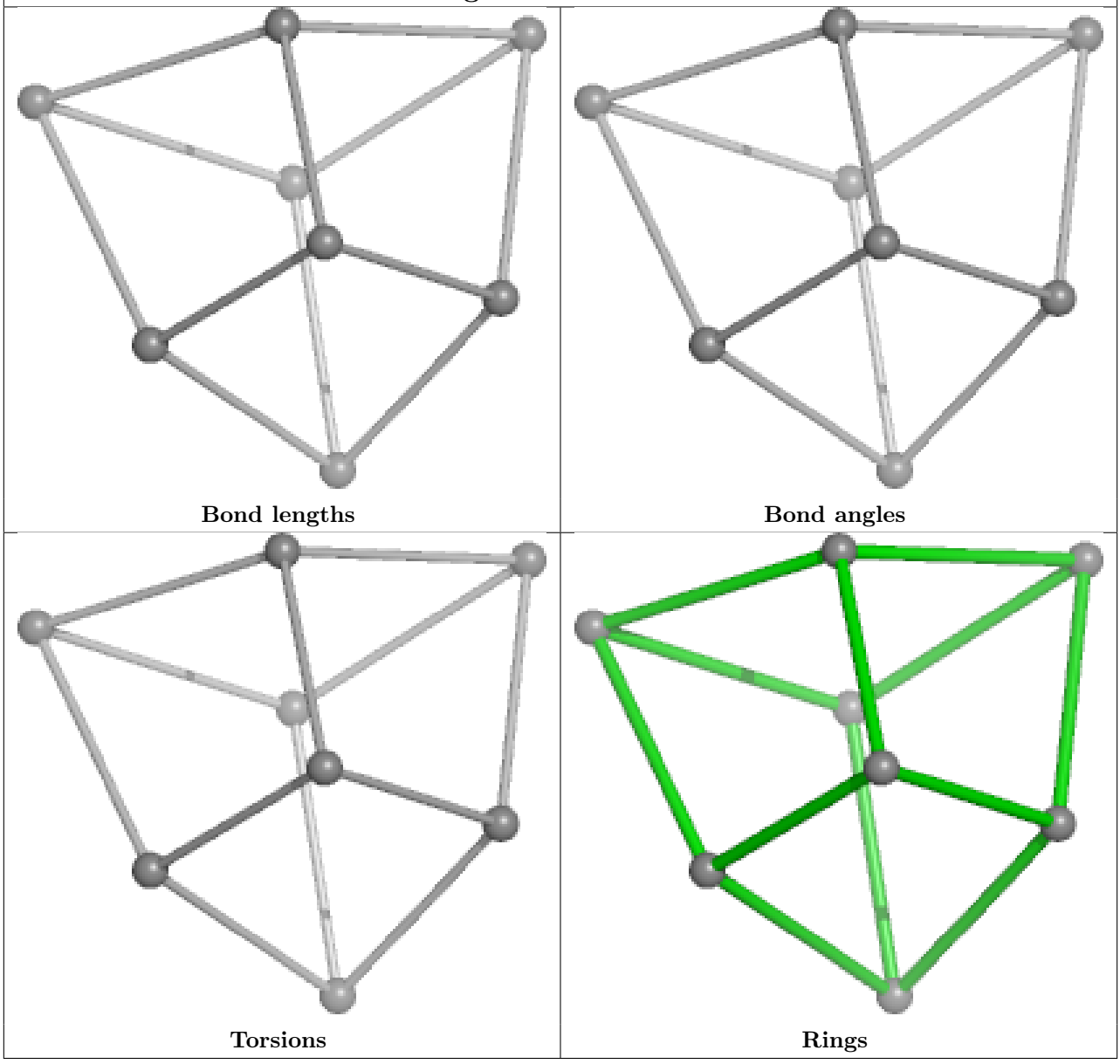


Torsions



Rings

Ligand SF4 G 303



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^{th} 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	437/445 (98%)	-1.10	0 100 100	21, 47, 62, 103	2 (0%)
1	E	436/445 (97%)	-1.15	0 100 100	19, 46, 59, 84	2 (0%)
1	I	436/445 (97%)	-1.12	0 100 100	20, 48, 64, 91	3 (0%)
1	M	437/445 (98%)	-1.00	0 100 100	23, 53, 70, 97	2 (0%)
2	B	387/388 (99%)	-1.17	0 100 100	38, 47, 58, 83	0
2	F	387/388 (99%)	-1.15	0 100 100	35, 45, 59, 76	0
2	J	387/388 (99%)	-1.17	0 100 100	36, 46, 60, 73	0
2	N	387/388 (99%)	-0.94	1 (0%) 90 92	39, 55, 73, 88	0
3	C	264/273 (96%)	-1.05	0 100 100	22, 52, 71, 82	3 (1%)
3	G	264/273 (96%)	-1.12	0 100 100	21, 46, 65, 74	3 (1%)
3	K	264/273 (96%)	-1.13	0 100 100	21, 46, 60, 72	1 (0%)
3	O	264/273 (96%)	-1.10	0 100 100	21, 48, 66, 81	2 (0%)
4	D	261/269 (97%)	-0.95	0 100 100	25, 60, 75, 85	1 (0%)
4	H	261/269 (97%)	-1.02	0 100 100	40, 53, 69, 92	0
4	L	261/269 (97%)	-1.06	0 100 100	26, 52, 66, 75	1 (0%)
4	P	261/269 (97%)	-1.01	0 100 100	26, 54, 66, 80	1 (0%)
All	All	5394/5500 (98%)	-1.08	1 (0%) 100 100	19, 49, 68, 103	21 (0%)

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	N	38	ALA	2.4

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

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^{th} 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^2)	Q<0.9
6	SO4	E	502	5/5	0.95	0.09	50,52,55,75	0
6	SO4	P	303	5/5	0.96	0.04	55,56,60,85	0
6	SO4	K	303	5/5	0.97	0.09	53,56,58,59	0
6	SO4	L	304	5/5	0.97	0.13	53,54,56,77	0
6	SO4	M	502	5/5	0.97	0.10	50,51,58,76	0
6	SO4	O	304	5/5	0.97	0.03	55,56,58,81	0
6	SO4	C	303	5/5	0.97	0.09	50,54,59,74	0
6	SO4	J	402	5/5	0.98	0.05	48,49,51,56	0
6	SO4	G	304	5/5	0.98	0.04	50,52,60,62	1
6	SO4	N	402	5/5	0.99	0.04	54,55,62,62	0
6	SO4	F	402	5/5	0.99	0.06	46,49,52,54	0
6	SO4	B	402	5/5	0.99	0.04	45,49,50,51	0
7	ATP	C	301	31/31	0.99	0.03	46,51,56,58	0
7	ATP	G	301	31/31	0.99	0.03	37,42,46,48	0
7	ATP	K	301	31/31	0.99	0.03	35,42,48,49	0
7	ATP	O	301	31/31	0.99	0.03	39,44,47,49	0
9	ADP	D	301	27/27	0.99	0.04	46,52,58,60	0
9	ADP	H	301	27/27	0.99	0.03	40,46,48,49	0
9	ADP	P	301	27/27	0.99	0.03	42,47,50,52	0
5	SF4	J	401	8/8	1.00	0.02	31,34,39,42	0
5	SF4	L	301	8/8	1.00	0.02	35,37,38,41	0
5	SF4	M	501	8/8	1.00	0.01	39,42,44,45	0
5	SF4	N	401	8/8	1.00	0.01	38,42,43,47	0
5	SF4	O	303	8/8	1.00	0.02	36,40,43,46	0
5	SF4	A	501	8/8	1.00	0.02	36,40,43,47	0
5	SF4	B	401	8/8	1.00	0.02	34,39,40,44	0
5	SF4	D	300	8/8	1.00	0.02	37,39,42,43	0
5	SF4	E	501	8/8	1.00	0.02	37,38,41,42	0
8	MG	C	302	1/1	1.00	0.02	48,48,48,48	0
8	MG	D	302	1/1	1.00	0.02	51,51,51,51	0
8	MG	G	302	1/1	1.00	0.01	39,39,39,39	0
8	MG	H	302	1/1	1.00	0.01	47,47,47,47	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
8	MG	K	302	1/1	1.00	0.01	39,39,39,39	0
8	MG	L	303	1/1	1.00	0.02	42,42,42,42	0
8	MG	O	302	1/1	1.00	0.01	51,51,51,51	0
8	MG	P	302	1/1	1.00	0.01	46,46,46,46	0
5	SF4	F	401	8/8	1.00	0.02	31,34,39,40	0
5	SF4	G	303	8/8	1.00	0.02	32,36,40,41	0
9	ADP	L	302	27/27	1.00	0.03	39,43,48,49	0
5	SF4	I	501	8/8	1.00	0.02	35,43,46,47	0

6.5 Other polymers (i)

There are no such residues in this entry.