MITE

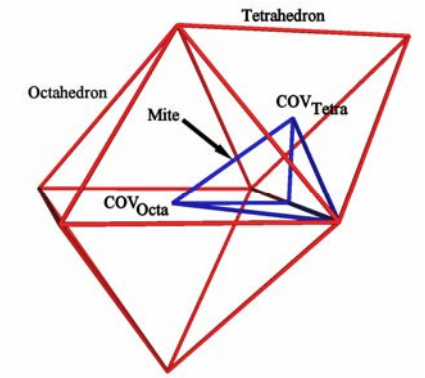

Figure 1 Mite defined within Octahedron-Tetrahedron pair.

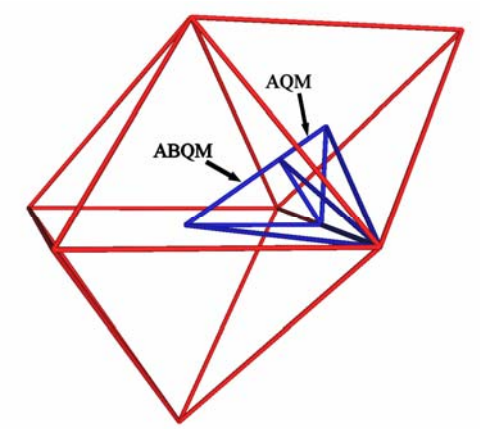

Figure 2 Mite composed of 1 AQM and 1 ABQM.

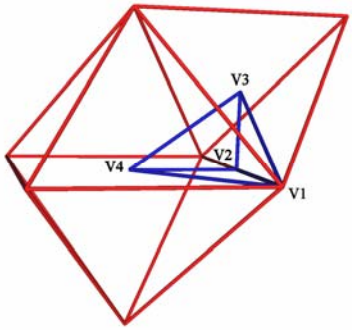

Figure 3 Vertex labels for Mite.

Topology:

Vertices = 4

Edges = 6

Faces = 4 triangles

Lengths:

EL ≡ Regular Tetrahedron edge length = Regular Octahedron edge length.

Edge Lengths:

$$V1.V2 = \frac{1}{2}\ EL$$

$$V1.V3 = \frac{3}{2\sqrt{6}}\ EL \cong 0.612\ 372\ 436\ EL$$

$$V1.V4 = \frac{1}{\sqrt{2}}\ EL \cong 0.707\ 106\ 781\ EL$$

$$V2.V3 = \frac{1}{2\sqrt{2}}\ EL \cong 0.353\ 553\ 391\ EL$$

$$V2.V4 = \frac{1}{2}\ EL = 0.5\ EL$$

$$V3.V4 = \frac{3}{2\sqrt{6}}\ EL \cong 0.612\ 372\ 436\ EL$$

Center of Face to Vertex:

$$DF(V1.V2.V3)V(V1) = \frac{1}{2\sqrt{2}}\ EL \cong 0.353\ 553\ 391\ EL$$

$$DF(V1.V2.V3)V(V2) = \frac{1}{2\sqrt{6}}\ EL \cong 0.204\ 124\ 145\ EL$$

$$DF(V1.V2.V3)V(V3) = \frac{1}{2\sqrt{3}}\ EL \cong 0.288\ 675\ 135\ EL$$

$$DF(V1.V2.V4)V(V1) = \frac{\sqrt{5}}{6}\ EL \cong 0.372\ 677\ 996\ EL$$

$$DF(V1.V2.V4)V(V2) = \frac{1}{3\sqrt{2}}\ EL \cong 0.235\ 702\ 260\ EL$$

$$DF(V1.V2.V4)V(V4) = \frac{\sqrt{5}}{6}\ EL \cong 0.372\ 677\ 996\ EL$$

$$DF(V1.V3.V4)V(V1) = \frac{\sqrt{11}}{6\sqrt{2}}\ EL \cong 0.390\ 867\ 980\ EL$$

$$DF(V1.V3.V4)V(V3) = \frac{1}{3}\ EL \cong 0.333\ 333\ 333\ EL$$

$$DF(V1.V3.V4)V(V4) = \frac{\sqrt{11}}{6\sqrt{2}}\ EL \cong 0.390\ 867\ 980\ EL$$

$$DF(V2.V3.V4)V(V2) = \frac{1}{2\sqrt{6}}\ EL \cong 0.204\ 124\ 145\ EL$$

$$DF(V2.V3.V4)V(V3) = \frac{1}{2\sqrt{3}}\ EL \cong 0.288\ 675\ 135\ EL$$

$$DF(V2.V3.V4)V(V4) = \frac{1}{2\sqrt{2}}\ EL \cong 0.353\ 553\ 391\ EL$$

Center of Face to Mid-edge:

$$DF(V1.V2.V3)E(V1.V2) = \frac{1}{4\sqrt{3}}\ EL \cong 0.144\ 337\ 567\ EL$$

$$DF(V1.V2.V3)E(V1.V3) = \frac{1}{4\sqrt{6}}\ EL \cong 0.102\ 062\ 073\ EL$$

$$DF(V1.V2.V3)E(V2.V3) = \frac{1}{4\sqrt{2}}\ EL \cong 0.176\ 776\ 695\ EL$$

$$DF(V1.V2.V4)E(V1.V2) = \frac{\sqrt{5}}{12}\ EL \cong 0.186\ 338\ 998\ EL$$

$$DF(V1.V2.V4)E(V1.V4) = \frac{1}{6\sqrt{2}}\ EL \cong 0.117\ 851\ 130\ EL$$

$$DF(V1.V2.V4)E(V2.V4) = \frac{\sqrt{5}}{12}\ EL \cong 0.186\ 338\ 998\ EL$$

$$DF(V1.V3.V4)E(V1.V3) = \frac{\sqrt{11}}{12\sqrt{2}}\ EL \cong 0.195\ 433\ 990\ EL$$

$$DF(V1.V3.V4)E(V1.V4) = \frac{1}{6}\ EL \cong 0.166\ 666\ 667\ EL$$

$$DF(V1.V3.V4)E(V3.V4) = \frac{\sqrt{11}}{12\sqrt{2}}\ EL \cong 0.195\ 433\ 990\ EL$$

$$DF(V2.V3.V4)E(V2.V3) = \frac{1}{4\sqrt{2}}\ EL \cong 0.176\ 776\ 695\ EL$$

$$DF(V2.V3.V4)E(V2.V4) = \frac{1}{4\sqrt{3}}\ EL \cong 0.144\ 337\ 567\ EL$$

$$DF(V2.V3.V4)E(V3.V4) = \frac{1}{4\sqrt{6}}\ EL \cong 0.102\ 062\ 073\ EL$$

Center of Volume to Vertex:

$$DVV(V1) = \frac{\sqrt{21}}{8\sqrt{2}}\ EL \cong 0.405\ 046\ 294\ EL$$

$$DVV(V2) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVV(V3) = \frac{\sqrt{13}}{8\sqrt{2}}\ EL \cong 0.318\ 688\ 720\ EL$$

$$DVV(V4) = \frac{\sqrt{21}}{8\sqrt{2}}\ EL \cong 0.405\ 046\ 294\ EL$$

Center of Volume to Mid-edge:

$$DVE(V1.V2) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVE(V1.V3) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVE(V1.V4) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVE(V2.V3) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVE(V2.V4) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

$$DVE(V3.V4) = \frac{\sqrt{5}}{8\sqrt{2}}\ EL \cong 0.197\ 642\ 354\ EL$$

Center of Volume to Face Center:

$$\text{DVF(V1.V2.V3)} = \frac{\sqrt{21}}{24\sqrt{2}}\ \text{EL} \cong 0.135\ 015\ 431\ \text{EL}$$

$$\text{DVF(V1.V2.V4)} = \frac{\sqrt{13}}{24\sqrt{2}}\ \text{EL} \cong 0.106\ 229\ 573\ \text{EL}$$

$$\text{DVF(V1.V3.V4)} = \frac{\sqrt{5}}{24\sqrt{2}}\ \text{EL} \cong 0.065\ 880\ 785\ \text{EL}$$

$$\text{DVF(V2.V3.V4)} = \frac{\sqrt{7}}{8\sqrt{6}}\ \text{EL} \cong 0.135\ 015\ 431\ \text{EL}$$

Areas:

$$\text{V1.V2.V3} = \frac{1}{8\sqrt{2}}\ \text{EL}^2 \cong 0.088\ 388\ 348\ \text{EL}^2$$

$$\text{V1.V2.V4} = \frac{1}{8}\ \text{EL}^2 = 0.125\ \text{EL}^2$$

$$\text{V1.V3.V4} = \frac{1}{4\sqrt{2}}\ \text{EL}^2 \cong 0.176\ 776\ 695\ \text{EL}^2$$

$$\text{V2.V3.V4} = \frac{1}{8\sqrt{2}}\ \text{EL}^2 \cong 0.088\ 388\ 348\ \text{EL}^2$$

$$\text{Total face area} = \frac{4+\sqrt{2}}{8\sqrt{2}}\ \text{EL}^2 \cong 0.478\ 553\ 391\ \text{EL}^2$$

Volume:

Cubic measure volume equation = $\frac{1}{48\sqrt{2}}\ \mathrm{EL}^3 \cong 0.014\ 731\ 391\ \mathrm{EL}^3$.

Synergetics' Tetra-volume equation = $\frac{1}{8}\ \mathrm{EL}^3 \cong 0.125\ \mathrm{EL}^3$

Angles:

Face Angles:

Sum of face angles = 720°

V2.V1.V3 = $\arccos\left(\frac{\sqrt{2}}{\sqrt{3}}\right) \cong 35.264\ 389\ 683°$

V2.V1.V4 = 45°

V3.V1.V4 = $\arcsin\left(\frac{1}{\sqrt{3}}\right) + \arccos\left(\frac{2\sqrt{2}}{3}\right) \cong 54.735\ 610\ 317°$

V1.V2.V3 = 90°

V1.V2.V4 = 90°

V3.V2.V4 = 90°

V1.V3.V2 = $\arccos\left(\frac{1}{\sqrt{3}}\right) \cong 54.735\ 610\ 317°$

V1.V3.V4 = $\arcsin\left(\frac{2\sqrt{2}}{3}\right) \cong 70.528\ 779\ 366°$

V2.V3.V4 = $\arccos\left(\frac{1}{\sqrt{3}}\right) \cong 54.735\ 610\ 317°$

V1.V4.V2 = 45°

$$V1.V4.V3 = \arccos\left(\frac{1}{\sqrt{3}}\right) \cong 54.735\,610\,317°$$

$$V2.V4.V3 = \arccos\left(\frac{\sqrt{2}}{\sqrt{3}}\right) \cong 35.264\,389\,683°$$

Central Angles (identified by edge labels):

$$V1.V2 = \arccos\left(\frac{-3}{\sqrt{105}}\right) \cong 107.023\,866\,185°$$

$$V1.V3 = \arccos\left(\frac{-7}{\sqrt{273}}\right) \cong 115.065\,829\,225°$$

$$V1.V4 = \arccos\left(\frac{-11}{21}\right) \cong 121.588\,135\,505°$$

$$V2.V3 = \arccos\left(\frac{1}{\sqrt{65}}\right) \cong 82.874\,983\,651°$$

$$V2.V4 = \arccos\left(\frac{-3}{\sqrt{105}}\right) \cong 107.023\,866\,185°$$

$$V3.V4 = \arccos\left(\frac{-7}{\sqrt{273}}\right) \cong 115.065\,829\,225°$$

Dihedral Angles (identified by edge labels):

V1.V2 = 90°

V1.V3 = 60°

V1.V4 = 45°

V2.V3 = 90°

V2.V4 = 90°

V3.V4 = 60°

Vertex Coordinates (X, Y, Z):

$$V1 = \left(\frac{-3}{8}, \frac{-1}{4\sqrt{3}}, \frac{-1}{8\sqrt{6}} \right) EL$$
$$\cong (-0.375,\ -0.144\ 337\ 567,\ -0.051\ 031\ 036)\ EL$$

$$V2 = \left(\frac{1}{8}, \frac{-1}{4\sqrt{3}}, \frac{-1}{8\sqrt{6}} \right) EL$$
$$\cong (0.125,\ -0.144\ 337\ 567,\ -0.051\ 031\ 036)\ EL$$

$$V3 = \left(\frac{1}{8}, \frac{1}{4\sqrt{3}}, \frac{-5}{8\sqrt{6}} \right) EL$$
$$\cong (0.125,\ 0.144\ 337\ 567,\ -0.255\ 155\ 182)\ EL$$

$$V4 = \left(\frac{1}{8}, \frac{1}{4\sqrt{3}}, \frac{7}{8\sqrt{6}} \right) EL$$
$$\cong (0.125,\ 0.144\ 337\ 567,\ 0.357\ 217\ 254)\ EL$$

Unfolded Vertex Coordinates (X, Y):

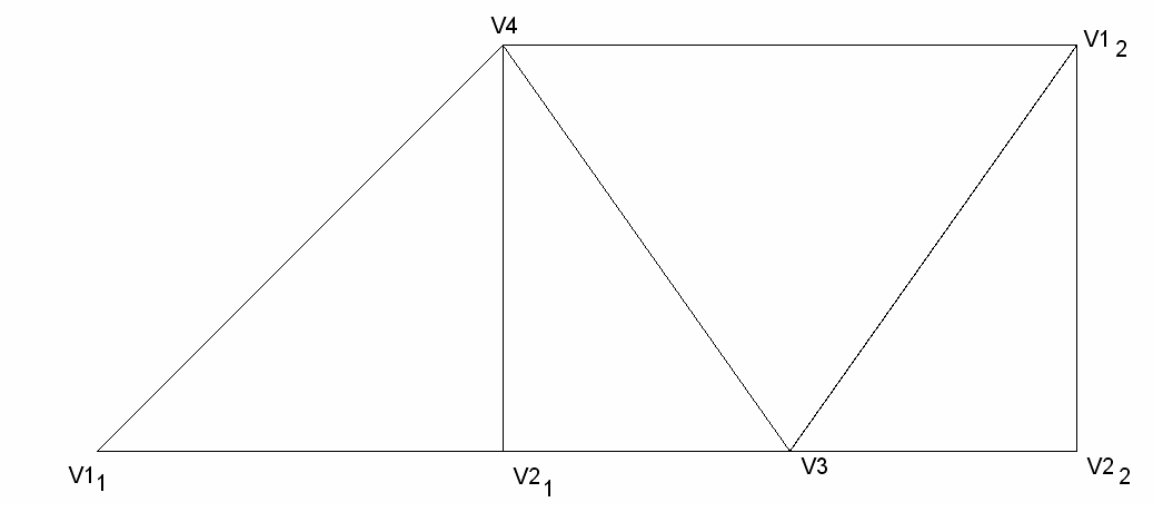

Figure 7 Layout for the Mite.

$$\alpha = \arccos\left(\frac{1}{\sqrt{3}}\right) \cong 54.735\ 610\ 317°$$

$V1_1 = (0.0, 0.0)$ EL

$$V1_2 = \left(\frac{1+\sqrt{2}}{2\sqrt{2}} + \frac{3}{2\sqrt{6}}\cos(\alpha), \frac{1}{2}\right) \text{ EL}$$
$$\cong (1.207\ 106\ 8, 0.5) \text{ EL}$$

$$V2_1 = \left(\frac{1}{2}, 0.0\right) \text{ EL} \cong (0.5, 0.0) \text{ EL}$$

$$V2_2 = \left(\frac{1+\sqrt{2}}{2\sqrt{2}} + \frac{3}{2\sqrt{6}}\cos(\alpha), 0\right) \text{ EL}$$
$$\cong (1.207\ 106\ 8, 0.0) \text{ EL}$$

$$V3 = \left(\frac{1+\sqrt{2}}{2\sqrt{2}}, 0.0\right) \text{ EL} \cong (0.853\ 553, 0.0) \text{ EL}$$

$$V4 = \left(\frac{1}{2}, \frac{1}{2}\right) \text{ EL} = (0.5, 0.5) \text{ EL}$$

Comments:

The Mites are composed of one A Quantum Module and one AB Quantum Module (which is itself composed of one AQM and one BQM).

The positive Mite contains one positive B Quantum Module while the negative Mite contains one negative B Quantum Module.

Despite the compositional differences, the positive and negative Mites are the same polyhedron. That is, without knowing the compositional makeup of the Mite, it is not possible to distinguish between a positive and a negative Mite.