An overview of “Entropy and 'The Arrow of Time' “:

$$E(t) = E_0 e^{\nu t} \text{ if and only if } E(s) = \frac{\eta\,\nu}{e^{\eta\,\nu/E_{av}} - 1} \tag{1}$$

$$\text{For any integrable function } E(t),\ \lim_{t \to s} \frac{\eta\,\nu}{e^{\eta\,\nu/E_{av}} - 1} = E(s) \tag{2}$$

$$E(t) = E_0 e^{\nu t} \text{ if and only if } \Delta E = \eta\,\nu \tag{3}$$

$$E(t) = E_0 e^{rt} \textit{ if and only if } \frac{\Delta E}{E_{av}} = r\Delta t \tag{4}$$

These are all mathematical results proven in “A 'Planck-like' Characterization of Exponential Functions”. The mathematics to these has been checked by a number of mathematicians. These are true and valid statements.

$$E_0 = \frac{\Delta E}{e^{\Delta E/E_{av}} - 1} = \frac{\eta\,\nu}{e^{\eta\,\nu/\kappa T} - 1} \qquad \text{(if } E(t) \text{ is any exponential function)} \tag{5}$$

or,

$$E_0 \approx \frac{\Delta E}{e^{\Delta E/E_{av}} - 1} \approx \frac{\eta\,\nu}{e^{\eta\,\nu/\kappa T} - 1} \qquad \text{(if } E(t) \text{ is any integrable function)} \tag{6}$$

These are basically restatements of the above results better adapted for the arguments to follow in the paper. Also purely mathematical results with no reference to Physics.

$$e^{\Delta E/E_{av}} = 1 + \frac{\Delta E}{E_0} = \frac{E}{E_0} \text{ and so, } \frac{\Delta E}{E_{av}} = \ln\left(\frac{E}{E_0}\right) \tag{7}$$

This is just an equivalent manipulation of (5). It can be viewed as a purely mathematical result.

Planck's Law in Physics, $E_0 = \frac{h\nu}{e^{h\nu/kT} - 1}$ *, can also be written as* $E_0 = \frac{\Delta E}{e^{\Delta E/E_{av}} - 1}$ *where* $E_{av} = kT$*.*

Thermodynamic Entropy ΔS_θ *by definition is* $\Delta S_\theta = \frac{\Delta E}{T}$.

From equation (7) above we have that

$$\Delta S_\theta = k \cdot \ln\left(\frac{E}{E_0}\right) \tag{8}$$

From Statistical Thermodynamics, Boltzmann's Entropy Equation is

$$\Delta S_\theta = k \cdot \ln(\Omega) \tag{9}$$

where Ω is the *number of mircostates of the system*

Comparing (8) and (9), we have that $\Omega = \frac{E}{E_0}.$ *(10)*

From characterization (1), we have that $E(t) = E_0 e^{\nu(t - t_0)}$ *and so*

$$\Delta S_\theta = k\nu \Delta t \qquad (11)$$

This shows the relationship between entropy and time.

If for any function E(t) we instead define entropy as

$$\Delta S = \eta / E_{av} \qquad (12)$$

then we would have,

$$\Delta S = \Delta t \qquad (13)$$

In any case, The Second Law of Thermodynamics would state that

"Any physical process takes time to occur" *(14)*

The Second Law as stated confirms my claim that we have 'accumulation of energy before manifestation of energy' as it asserts that there must be a lapse of time Δt *for any energy interaction. The 'accumulation of energy' is the time-integral of energy. It is the quantity 'eta'. Planck's constant is such a quantity.*