How to use the Cosmological Schwinger principle to predict energy flux, entropy, and an effective electric field at the start of Inflation in terms of Inflaton potentials.

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The idea is to cut down on the number of independent variables to get as simple an emergent space time structure of entropy and its generation as possible. Initial assumptions as to $T_{Planck} \sim 10^{19}\, GeV$ .An effective electric field, based upon the Cosmological Schwinger principle is derived, via dimensional analysis, then a heat flux, with subsequent entropy production in a manner tied in with candidates as to inflaton potentials in a way the author has not seen in the literature. The effective electric field is important because it enables a direct analogy with the Schwinger result , 1951 , of an E field leading to a numerical count of pairs of $e^+ e^-$ charges nucleated in a space time volume $V \cdot t$. Note that in most inflationary models, the usual assumption is for a magnetic field, not electric field. Having an electric field permits a kink anti kink construction in lieu of what Beckwith did in CDW (PhD dissertation) plus allows for explicit emergent relic particle frequency range between one to 100 GigaHertz. The novel contribution is the importance of a relic E field, instead of a B field, in inflationary relic particle formation and vacuum nucleation for reasons explained in this manuscript.

PACS: 89.70.Cf, 95.35. +d, 95.36. +x

A. INTRODUCTION

This paper intends to find ways to configure scaling procedures to answer the question as to what would be optimal conditions for initial entropy production initially. To begin this inquiry we can start with examining candidates for the initial configuration of the normalized energy density. .The normalized energy density of gravitational waves, as given by Maggiore **[1]** is

$$\Omega_{gw} \equiv \frac{\rho_{gw}}{\rho_c} \equiv \int_{\nu=0}^{\nu=\infty} d(\log \nu) \cdot \Omega_{gw}(\nu) \Rightarrow h_0^2 \Omega_{gw}(\nu) \cong 3.6 \cdot \left[\frac{n_\nu}{10^{37}}\right] \cdot \left(\frac{\nu}{1kHz}\right)^4 \qquad (1.1)$$

Where n_ν is a frequency-based count of gravitons per unit cell of phase space. Eq. (1.1) leads to , as given to Fig. 1. candidates as to early universe models which should be investigated experimentally.The author, Beckwith, wishes to determine inputs into n_ν above, in terms of frequency, and also initial temperature.

Further more after creating an effective E field , Beckwith will find numerical inputs into Eq. (1.1) based upon the 1951 Schwinger transition amplitude result [2] . I.e. making use of , for a ' charge' q, and a defined electric field E

$$\left|\left\langle 0^- \middle| 0^+ \right\rangle\right|^2 = \exp\left[-\frac{VT_{time}}{(2\pi)^3} \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2} (qE)^2 \cdot \exp\left(-n\pi \cdot m^2 / qE\right)\right] \qquad (1.2)$$

What is in the brackets of the exponential is a way of counting the number of space tim $e^+ e^-$ charges nucleated in a space time volume $V \cdot t$. Beckwith used a very similar constructions with Density wave physics [3] and also has extended this idea to use in graviton physics, in a kink- anti kink construction [4]

The idea, after one knows how to obtain a counting algorithm, with additional refiments will be to use what can be understood by the above analogy, assuming a minimal mass $m \cong m_{eff}$ for m_{eff} , as Beckwith brought up [5] as will be discussed in the text below , as inputs into the models represented by Fig 1 below.

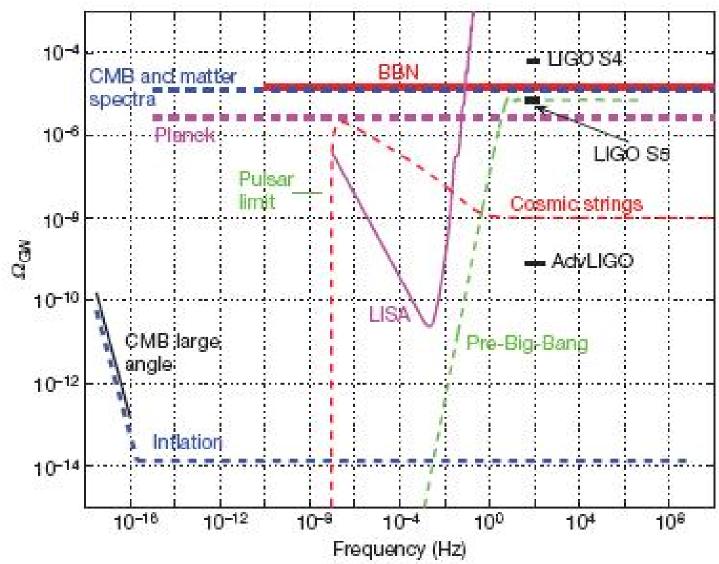

Figure 1. From. Abbott et al. **[6]** (2009) shows the relation between Ω_g and frequency.

Beckwith has derived a way to use two different Friedman equations to come up with a way for estimating Entropy [5] Also, by applying a Gaussian bifurcation mapping Beckwith defined the initial degrees of space time freedom up to over 1000 per unit of phase space during inflation [5] . What Beckwith would like to do now, is to define entropy, initially, in terms of slow roll parameters, and also an effective electric field.[4] The effective E field so created is a way to join vacuum nucleation with a deeper understanding of inflaton physics, and also nucleation of counted 'pairs' of vacuum nucleated structures[7] allowing for implementation of Y. Jack Ng's "infinite quantum statistics"[8] to inflaton/ inflationary physics. Finally, the applied electric field is a way to present an evolving creation of relic particles up to the point of chaotic dynamics becoming dominant, in the permitted frequency range. The route to chaos, in an eventually stochastic background has a well defined sequence of evolution, and the formulation of the emergent structure electric field permits identification of key 'bandwidth frequency ranges for relic particles, before the creation of a stochastic background of signal to noise chaos , permitting identification of key frequency patches to identify as high frequency signals of relic particles in the relic particles created at the start of inflation.

What Beckwith intends to do is to use the emergent structure implied by the cosmological Schwinger method, as outlined by J. Martin[7] as a way to come up with the number of emergent particles in initial phase space counting, and from there to from first principles, tie in the phase space numerical counting , and entropy with different candidates as to the inflaton potential. Beckwith , via dimensional analysis[5] made the following identifications. I.e. Force = qE = $[T\Delta S / dist] = \hbar \cdot [[\omega_{Final} - \omega_{initial}]/ dist]$ which in terms of inflaton physics leads to , if $V' = dV/d\phi$, etc. , where V is an inflaton potential, and dist refers to the distance , usually of some power of Planck length, or more, so then that one would be looking at

$$[T\Delta S / dist] = [\hbar/dist] \cdot \left[2k^2 - \frac{1}{\eta^2}\left[M_{Planck}^2 \cdot \left[\frac{6}{16\pi} - \frac{3}{4\pi}\right] \cdot \left[\frac{V'}{V}\right]^2 - \frac{3}{4\pi} \cdot M_{Planck}^2 \cdot \left[\frac{V''}{V}\right]\right]\right]^{1/2} \qquad (1.3)$$

Eq. (1.3) divided by a charge, q, gives a candidate relic electric field. While the existence of a charge, q, as an independent entity, at the onset of inflation is open to question, i.e. highly unlikely electrons would have a chance of forming at or before the quark-gluon plasma state of matter, what the author, Beckwith [5] is paying attention to is using inputs into the Free energy, as can be specified by the following: If one identified the evolution of temperature, with energy, and made the following identification, $\breve{T}$ for time, and Ω_0 for a special frequency range, as inputs into [5]

$$E_{thermal} \approx \frac{1}{2} k_B T_{temperature} \propto \left[\Omega_0 \breve{T}\right] \sim \tilde{\beta} \qquad (1.4)$$

Here, the thermal energy, , if we have a change in the temperature, as given by temperature ranging as $T_{temperature} \varepsilon \left(0^+, 10^{19} GeV\right)$, in a time range up to the Planck interval of time $t_P \sim 10^{-44} \sec$, so that one is looking at $\tilde{\beta} \approx |F| \equiv \frac{5}{2} k_B T \cdot \overline{N}$, as a free energy. And this parameter, if $\dddot{N}$, as an initial entropy, arrow of time configuration, were fixed, then the change in temperature would lead to change in 'free energy' , so that work, is here, change in energy, and dE = TdS – p dV, with work is force times distance. In basic physics, this would lead to force being work (here, change in energy) divided by distance. In this case, $\Delta\tilde{\beta} \cong \left(5 k_B \Delta T_{temp} / 2\right) \cdot \overline{N} \sim$ Force times $dist$ =distance . The assumption wouild be that there would be an initial fixed entropy arising, with $\overline{N}$ a nucleated structure arising in a short time interval as a temperature $T_{temperature} \varepsilon \left(0^+, 10^{19} GeV\right)$ arrives. So then, one will have, dimensionally speaking [5],

$$\frac{\Delta\tilde{\beta}}{dist} \cong \left(5 k_B \Delta T_{temp} / 2\right) \cdot \frac{\overline{N}}{dist} \sim qE_{net-electric-field} \sim \left[T \Delta S / dist\right] \qquad (1.5)$$

The parameter, as given by $\Delta\tilde{\beta}$ will be one of the parameters used to define chaotic Gaussian mappings, whereas the right hand side of Eq. (1.5) is Eq. (1.3) which is force, which is in Eq. (1.3) linked to inflaton physics. Next, will be the identification of inflation physics, as dimensionally argued in both Eq. (1.3) and Eq. (1.5) to choices in the inflaton potential. To see that, consider the following, as given by Eq. (1.6) below[5]

Candidates as to the inflaton potential would be in powers of the inflaton, i.e. in terms of ϕ^N, with N=4 effectively ruled out, and perhaps N=2 an admissible candidate (chaotic inflation). For N = 2, one gets [5]

$$[\Delta S] = [\hbar/T] \cdot \left[2k^2 - \frac{1}{\eta^2}\left[M_{Planck}^2 \cdot \left[\left[\frac{6}{4\pi} - \frac{12}{4\pi}\right] \cdot \left[\frac{1}{\phi}\right]^2 - \frac{6}{4\pi} \cdot \left[\frac{1}{\phi^2}\right]\right]\right]\right]^{1/2} \sim n_{Particle-Count} \qquad (1.6)$$

Making a comparison as to coming up with a weighted average of $\Delta S \sim 10^5$, with varying values of a scalar field of the form $0 < \phi < 2\pi$,for when one has $\eta \varepsilon (-10^{-44} \sec, 0)$, and $0 < T \leq T_{Planck} \sim 10^{19} GeV$ would lead to a rich phenomenology , where one could see, as an example, variations as of a time parameter, and the forms of how the wave length, k , evolved, especially if the $\Delta S \sim 10^5$ remained relatively constant . I.e. why did the value of the wavelength, k, vary so much, in a short period of time, i.e. less than Planck time? As mentioned before in [5] this would entail, a way to determine how the initial wave vector, k, was formed and to what degree the variation in the inflaton $0 < \phi < 2\pi$ occurs. I.e. it gives a way to vary the inflaton, and to look at , even with a constant temperature T what is happening to entropy, initially.

B. First principle evaluation of initial bits of information, as opposed to numerical counting, and entropy

A consequence of Verlinde's [9] generalization of entropy as also discussed by Beckwith[5] , and the number of 'bits' yields the following consideration, which will be put here for startling effect. Namely, if a net acceleration is such that $a_{accel} = 2\pi k_B cT/\hbar$ as mentioned by Verlinde [5], [9] as an Unruh result, and that the number of 'bits' is

$$n_{Bit} = \frac{\Delta S}{\Delta x} \cdot \frac{c^2}{\pi \cdot k_B^2 T} \approx \frac{3 \cdot (1.66)^2 g^*}{\left[\Delta x \cong l_p\right]} \cdot \frac{c^2 \cdot T^2}{\pi \cdot k_B^2} \tag{1.7}$$

This Eq. (1.7) has a T^2 temperature dependence for information bits , as opposed to [5]

$$S \sim 3 \cdot \left[1.66 \cdot \sqrt{\tilde{g}_*}\right]^2 T^3 \sim n_f \tag{1.8}$$

Should the $\Delta x \cong l_p$ order of magnitude minimum grid size hold, then conceivably when T ~ 10^{19} GeV[5]

$$n_{Bit} \approx \frac{3 \cdot (1.66)^2 g^*}{\left[\Delta x \cong l_p\right]} \cdot \frac{c^2 \cdot T^2}{\pi \cdot k_B^2} \sim 3 \cdot \left[1.66 \cdot \sqrt{\tilde{g}_*}\right]^2 T^3 \tag{1.9}$$

The situation for which one has [5], [9] $\Delta x \cong l^{1/3} l_{Planck}^{2/3}$ with $l \sim l_{Planck}$ corresponds to $n_{Bit} \propto T^3$ whereas $n_{Bit} \propto T^2$ if $\Delta x \cong l^{1/3} l_{Planck}^{2/3} >> l_{Planck}$. This issue will be analyzed in future publications. If the bits of information can be related to a numerical count, the next step will be to make a linkage between thermal heat flux, due to the initial start of inflation, with degrees of freedom rising from a point, almost zero to over 1000 in a Planck time interval.

D. How to set up a bifurcation diagram for creation of N(T)~ 10^3 degrees of freedom at the start of inflation.

In a word, the way to introduce the expansion of the degrees of freedom from nearly zero, at the maximum point of contraction to having **N(T)~ 10^3** is to first of all define the classical and quantum regimes of gravity in such a way as to minimize the point of the bifurcation diagram affected by quantum processes.[5]

I.e. classical physics, with smoothness of space time structure down to a gird size of $l_{Planck} \sim 10^{33}$ centimeters at the start of inflationary expansion. Have, when doing this construction what would be needed would be to look at the maximum point of contraction, set at $l_{Planck} \sim 10^{33}$ centimeters as the quantum 'dot' , as a de facto measure zero set, as the bounce point, with classical physics behavior before and after the bounce 'through' the quantum dot.

Dynamical systems modeling could be directly employed right 'after' evolution through the 'quantum dot' regime, with a transfer of crunched in energy to Hemoltz free energy, as the driver 'force' for a Gauss map type chaotic diagram right after the transition to the quantum 'dot' point of maximum contraction. The diagram, in a bifurcation sense would look like an application of the Gauss mapping of [5], [10]

$$x_{i+1} = \exp\left[-\tilde{\alpha} \cdot x_i^2\right] + \tilde{\beta} \tag{1.10}$$

In dynamical systems type parlance, one would achieve a diagram, with tree structure looking like what was given by Binous [11], using material written up by Lynch [5], [10] , i.e. by looking at his bifurcation diagram for the Gauss map .Binous's demonstration plots the bifurcation diagram for user-set values of the parameter . Different values of the parameter lead to bifurcation, period doubling, and other types of chaotic dynamical behavior. For the authors purposes, the parameter x_{i+1} and x_i^2 as put in Eq. (1.10) would represent the evolution of number of number of degrees of freedom, with ironically, the near zero behavior, plus a Hemoltz degree of freedom parameter set in as feed into $\tilde{\beta}$. In a word, the quantum 'dot' contribution would be a measure set zero glitch in the mapping given by Eq. (1.10), with the understanding that where the parameter $\tilde{\beta}$ 'turns on' would be right AFTER the 'bounce' through the infinitesimally small quantum 'dot' regime. Far from being trivial, there would be a specific interative chaotic behavior initiated by the turning on of parameter $\tilde{\beta}$,corresponding as brought up by Dickau [12] as a connection between octo-octonionic space and the degrees of freedom available at the beginning of inflation. I.e. turning on the parameter $\tilde{\beta}$ would be a way to have Lisi's E8 structure [13] be nucleated at the beginning of space time.

As the author sees it, $\tilde{\beta}$ would be proportional to the Hemoltz free energy, F, where as Mandl [14] relates, page 272, the usual definition of F=E - TS , becomes, instead, here, using partition function, Z, with $\overline{N}$ a 'numerical count factor', so that [5], [14]

$$F = -k_B T \cdot \ln Z(T,V,\overline{N}) \qquad (1.11)$$

Note that Y. Jack Ng.[8] sets a modification of $Z_N \sim \left(\frac{1}{N!}\right)\cdot\left(\frac{V}{\lambda^3}\right)^N$ as in the use of his infinite quantum statistics, with the outcome that [5] $F = -k_B T \cdot \ln Z(T,V,\overline{N}) \equiv -k_B TN\left[\ln(V/\lambda^3) + 5/2\right]$ with V ~ (Planck length)^3, and the Entropy obeying [5], [8]

$$S \approx N \cdot \left(\log\left[V/N\lambda^3\right] + 5/2\right) \xrightarrow[Ng-\inf inite-Quantum-Statistics]{} N \cdot \left(\log\left[V/\lambda^3\right] + 5/2\right) \approx N \qquad (1.12)$$

Such that the free energy, using Ng. infinite quantum statistics reasoning would be [5], [8] a feed into a nucleated structure, A structure which will be examined in the next section via looking at the absolute value of $F = -k_B T \cdot \ln Z(T,V,\overline{N}) \equiv -\frac{5}{2}\cdot k_B T\overline{N}$. Note, here, that the absolute value of F given is a driver to chaotic dynamics, while $x_{i+1} = \exp\left[-\tilde{\alpha}\cdot x_i^2\right] + \tilde{\beta}$, has $\tilde{\beta} \cong |F|$, with coefficient $\tilde{\beta} \cong |F|$ turning on at the start of the inflationary era due to a temperature flux starting as a driving force, and $\tilde{\alpha}$ being a coefficient of damping of degrees of freedom to near zero, as the contraction phase of the 'universe' , while x_i ~ degree of degrees of freedom, which would grow dramatically, once $\tilde{\beta} \cong |F|$ turns on . We will then next show how , not only would there be a contribution to increase in degrees of freedom, but that would also be an increase in structure, in a vacuum nucleation sense, due to the contribution of Eq. (1.4) above to a driving frequency and its application to the rise of general nucleated structure in the beginning of space time evolution.[5]

E. Linking driving "frequency" as a result of change in temperature to relic particles .

After presenting this initial argument, we will bring up similar, more refined attempts by Jacobson [15], and also Rosenblum, Pikovsky, Kurths [16] via their phased synchronization of chaotic oscillators to suggest necessary refinements ss to the linkage of the chaotic Gaussian mapping with structure formation. The first part of the following discussion is meant to be motivational, with references from the other papers as being refinements which will be worked on in additional publications.

The main idea is,that $\tilde{\beta}$ increasing up to a maximum temperature T would enable the evolution and spontaneous construction of the Lisi E8 structure as given by [13]. As Beckwith wrote up [5], including in additional energy due to an increase of $\tilde{\beta}$ due to increasing temperature T would have striking similarities to the following

Observe the following argument as given by V. F. Mukhanov, and Swinitzki [5], [17] , as to additional particles being 'created' due to what is an infusion of energy in an oscillator , obeying the following equations of motion [5], [17]

$$\begin{aligned} &\ddot{q}(t) + \omega_0^2 q(t) = 0, \text{ for } t < 0 \text{ and } t > \breve{T}; \\ &\ddot{q}(t) - \Omega_0^2 q(t) = 0, \text{ for } 0 < t < \breve{T} \end{aligned} \tag{1.13}$$

,Given $\Omega_0 \breve{T} >> 1$, with a starting solution of $q(t) \equiv q_1 \sin(\omega_0 t)$ if t <0, Mukhanov state that for [5], [17] $t > \breve{T}$;

$$q_2 \approx \frac{1}{2}\sqrt{1 + \frac{\omega_0^2}{\Omega_0^2}} \cdot \exp\left[\Omega_0 \breve{T}\right] \tag{1.14}$$

The Mukhanov et al argument [5],[17]leads to an exercise which Mukhanov claims is solutions to the exercise yields an increase in number count, as can be given by setting the oscillator in the ground state with $q_1 = \omega_0^{-1/2}$, with the number of particles linked to amplitude by $\breve{n} = [1/2] \cdot (q_0^2 \omega_0 - 1)$, leading to [5],[17]

$$\breve{n} = [1/2] \cdot \left(1 + \left[\omega_0^2 / \Omega_0^2\right]\right) \cdot \sinh^2\left[\Omega_0 \breve{T}\right] \tag{1.15}$$

I.e. for non zero $\left[\Omega_0 \breve{T}\right]$, Eq (1.15) leads to exponential expansion of the numerical state. For sufficiently large $\left[\Omega_0 \breve{T}\right]$, Eq. (1.13) and Eq. (1.14) are equivalent to placing of energy into a system, leading to vacuum nucleation. A further step in this direction is given by Mukhanov on page 82 of his book leading to a Bogoluybov particle number density of becoming exponentially large [5],[17]

$$\breve{\breve{n}} \sim \cdot \sinh^2\left[m_0 \eta_1\right] \tag{1.16}$$

Eq. (1.14) to Eq. (1.15) are , for sufficiently large $\left[\Omega_0 \breve{T}\right]$ a way to quantify what happens if initial thermal energy are placed in a harmonic system, leading to vacuum particle ' creation' Eq. (1.16) is the formal Bogolyubov coefficient limit of particle creation . Note that $\ddot{q}(t) - \Omega_0^2 q(t) = 0$, for $0 < t < \breve{T}$ corresponds to a thermal flux of energy into a time interval $0 < t < \breve{T}$. If $\breve{T} \approx \left[t_{Planck} \propto 10^{-44} \sec\right]$or some multiple of t_{Planck} and if $\Omega_0 \propto 10^{10}\, Hz$, then Eq (1.13), and Eq. (1.15) plus its generalization as given in Eq. (1.16) may be a way to imply either vacuum nucleation , or transport of gravitons from a prior to the present universe.

To generalize what is done from Eq. (1.13) to Eq. (1.16) as brought up by Rosenblum, Pikovsky, Kurths[16] would be to seek an explicit coupling of the coupled oscillations which would be used to set up

Eq. (1.10) with Eq. (1.13) to Eq. (1.16) explicitly. In order to take such a coupling,of chaotic oscillators, one would need to move beyond the idea given in this document's section E to look at Force = qE = $[T\Delta S / dist] = \hbar \cdot [[\omega_{Final} - \omega_{initial}]/dist]$, with possibly setting $\omega_{initial} = 0$, i.e. to look at candidates for ω_{Final} from the perspective of frequencies about and around $\Omega_0 \propto 10^{10} Hz$.

The author's initial results seem to indicate that in doing so, there is a range of values of permitted Ω_0 values from 1 Giga Herz up to 100 Giga Hertz, and this due to the choices in grid size from a minimum value $l_{Planck} \propto 10^{-33}$ centimeters, to those several thousand times larger, for reasons brought up earlier.

Secondly, Jacobson's linearlized perturbations [15] and dispersions relations sections , in terms of an aether background have in its Eq. (28) and Eq. (30) potentially useful limits as to additional constraints for the
frequency $[T\Delta S / dist] = \hbar \cdot [[\omega_{Final} - \omega_{initial}]/dist]$ to obey, in the limits that k → 0 as is in Eq. (1.3) above. If , as an example, Jacobson's dispersion relationship[15] as of his Eq (30) can be reconciled with the limits of k → 0 as is in our Eq. (1.3) , and $[T\Delta S / dist] = \hbar \cdot [[\omega_{Final} - \omega_{initial}]/dist]$, this may entail a re do of thinking concerning if Donnelly and Jacobson's damped harmonic oscillator for the inflaton, with a driving term, i.e. his Eq. (85) is applicable, i.e. his[15]

$$\ddot{\phi} + \theta \cdot \dot{\phi} + m^2 \phi + \mu M \phi = 0 \qquad (1.17).$$

This Eq. (1.17) is a driven damped Harmonic Oscillator , with a 'source' term. I.e. the idea is that with an Aether , or some similar background, possibly with the Aether having the same function as DE, up to a point, with damping put in, as seen above, as a further modification as to inflaton potentials which inputs as to our Eq. (1.3) to Eq. (1.6) should be considered. All this will be tried in future extensions of this projects future research directions.

The author's own work, at least in low red shift regimes up to a billion years ago [4] , emphasizes the role of massive gravitons with having, in higher than four dimensions qualitative over lap in dynamical behavior as to the speed of cosmological expansion a billion years ago as attributed to DE . Beckwith's own work 4], as also Alves [18], involves what is known as the de celeration parameter to show a resumption of a speed up of cosmological acceleration one billion years ago.. Making use of Eq. (1.17) would be a way, to perhaps make linkage between massive gravitons, as given by Beckwith [4] as well as an Alves [18] with the implications of Donnelly_ and Jacobson's damped driven harmonic oscillator [15] as represented by Eq. (1.17) above, which would make our investigation more comprehensive.

F. Conclusion. Effective "electric field" as proportional to temperature, to the first power. Its interpretation.

What the author would like to formally investigate would be a direct application of Eq. (1.4)., and Eq. (1.5)

$$\text{Force} = qE = [T\Delta S / dist] = \hbar[\omega_{Final} - \omega_{initial}]/dist] \sim m_{net}\ a_{accel} = m_{net}\ 2\pi k_B cT/\hbar \qquad (1.18)$$

As mentioned by Beckwith,[5], the **<u>lowest possible value</u>** for m_{net} would be $m_{net} \sim m_{graviton} \approx 10^{-65} grams$, with varying inputs into the temperature, T. Note that Y. Jack Ng [8], has $S \approx n_{Particle-count}$ for counting WIMP Dark Matter, with a much higher mass than what is observed with any accounting for 4 dimensional Gravitons. The current model WIMP model has individual particles as of up to 100 GeV . I.e. a conclusion that one may have up to [5]

$$m_{net} \sim 10^{38} \cdot \left[m_{graviton} \approx 10^{-65}\, grams \right] \tag{1.19}$$

If one is relating this to gravitons, which have ~ 10^{-38} mass of a WIMP particle, then , $\Delta S \sim 10^{5} \propto n_{f}$ could be part of the force, and net 'electrical field' a numerical count could be taken with a value of 10^{1} up to 10^{5} in value. This would be in line with what Beckwith [5] has already estimated for $\Delta S \sim 10^{5} \propto n_{f}$ Finally, once this task is done, the author thinks that L. Glinka's formula [19], [20] of

$$n_{f} = [1/4] \cdot \left[\sqrt{\frac{v(a_{initial})}{v(a)}} - \sqrt{\frac{v(a)}{v(a_{final})}} \right] \tag{1.20}$$

could be investigated as being part of the bridge between phenomenology of what inflaton potentials should be used, i.e. the inputs into the Eq (1.4) lead to a number of permissible inputs into the inflaton potential which should be looked at . I.e. the values of the inflaton field which are acceptable , i.e. for $\phi \varepsilon (0, 2\pi)$ What remains to be seen would be if the Schwinger numerical counting formula [2] as given in the argument of the exponential of Eq. (1.2) leads to a way to represent a numerical counting procedure giving reality to Y. Jack Ng.s infinite quantum statistics [8] , via $S \sim N$ with N representing a numerical counting of some assembly of effective mass of gravitons [4], [8] . The goal would be to make a linkage between the instanton – anti instanton construction as Beckwith used in [5] below, for electric fields , and an emergent graviton , along the lines of the false vacuum nucleation procedure seen below.

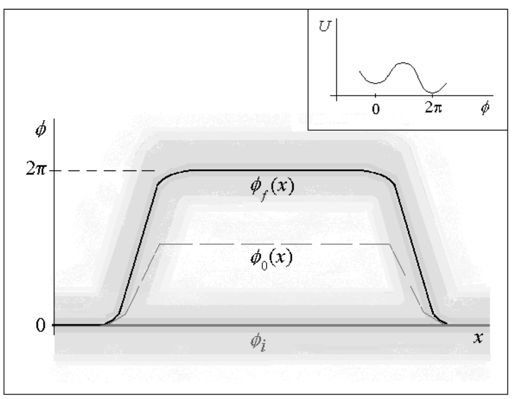

Fig. 2. The pop up effects of an intanton-anti-instanton in Euclidian space from references [4] , [21]

In order to connect with GR, one needs to have a higher dimensional analog of this pop up, as discussed in [4] We hope to, with comparisons between Eq. (1.4) and Fig 1, to find appropriate inflaton potentials and their scaling behavior so Eq. (1.4) and the space time nucleation, with an effective electric field is clearly understood by an extension of the Schwinger result given in Eq. (1.2) and its Ng. counter part $S \sim N$

.Also one of the most exciting part of this inquiry would be to find if there is a way to make a linkage with Eq. (1.1.7) , and DE with the work done by the author with massive gravitons, to mimic DE one billion years ago. The author's motivation was in his work as reported in Dark Side of the Universe, 2010 [22], to obtain a working DM / DE joint model, in a way better than current work done with Chapygin Gas models.[23], [24] . Having a linkage given between Eq. (1.17) of a damped driven inflaton field, with an 'aether' in space time, possibly linked to DE would be a way to show to what degree inflaton physics can be linked to de facto synthesis of DM / DE models[4]. If such a linkage can be made, it would among with the author's view of space time inflation being driven by an E field inflaton field, as a source of entropy, give insight as to what role the formation of relic particles play in entropy production. Last, but not least. A model using a Gaussian bifurcation map for generation of chaotic dynamics as to creation of many degrees of freedom, i.e. up to 1000, in place of the usual top number between 100 to 120 , with a turn on of Hemoltz Free energy right after the start of inflation[5]. The author is convinced that the generation of Hemoltz Free energy , as portrayed is a classical phenomenon, but that the quantum Gravity congruent grid size, possibly as small as a Planck length is very important. A great deal of analytical work has been done as to isolate the regime of where Classical and Quantum Gravity intersect. It is the author's firm conviction that this debate can be settled by ascribing the regime of space time as of the order of, or slightly larger than the length of a Planck size grid size, $l_{Planck} \sim 10^{-33}$ centimeters (at best it would be about two to three orders of degree larger) as where gravity is a purely quantum phenomenon, where as when the Hemoltz free energy term[5] is turned on, right AFTER the growth of space time past $l_{Planck} \sim 10^{-33}$ centimeters as where chaotic, classical dynamics plays a dominant role.Proving this latter conjecture would allow for , among other things helping to isolate the frequency ranges for production of relic particles, whose faint traces show up in an other wise almost perfect "white noise" of relic GW / relic graviton frequencies from the big bang. Numerous authors, including Buoanno [25] have stated that this white noise is not analyzable. If one takes into account that the approach to chaos has well defined steps up to its initiation, physically, the author asserts that this last assumption may be falsifiable experimentally.

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