Dyson's probability expression for Gerstsenshtein coupling between Photons and Graviton interaction with a B field in a GW detector of given pre determined frequency for GW entering the GW detector

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Abstract

As of 2012, and put in a journal in 2013, Dyson came up with criteria as to the Gertsenshtein process in photon-graviton coupling, with criteria as to the likelihood as to if the Gertsenshtein process actually can occur. This methodology is applied to a small spatial geometry as to Tokamak's generating external to the GW detector GW which are measured in a GW detector with a 100% probability of Gertsenshtein coupling of gravitons and photons, if there is a magnetic field of magnitude 10 to the 9th power, Gauss inside the GW detector. For a Tokamak generating GW measured by a new prototype GW detector, which has a strong magnetic field contained within the GW detector. We propose this form of arrangement due to a misunderstanding by Dyson as to the analysis of GW , which can be measured. If a GW detector has a very strong magnetic field, with weak magnetic field outside the GW detector, then the long distance approximations by Dyson do not hold and the problem, by default is far simpler than what Dyson proposed. Furthermore, we will in the conclusion allude to the Gertsenshtein GW – magnetic field interaction within the detector, which generates photons as less efficient in photonic signal production to another process which is listed in this manuscript. Finally the analysis of using the Earth surface area as a GW detector for solar produced Gravitons is unnecessary and scarcely believable as to there allegedly being 1 detected graviton out of 10 to the 43rd power number of Gravitons, in a 'scattering experiment' arrangement most similar to Mott Scattering which has no connections as to the Gertenshtein process. Finally the Gertenshtein process is not the last word in how GW and Gravitons interacting with a static magnetic field produce photon signals. These considerations have been muddled by Dyson due to his mistaken emphasis upon magnetic fields outside the GW detector. Hence, his unphysical assumption that a static magnetic field must be analyzed for kilometer long trajectories of Gravitons to a GW detector.

Key words: *"heavy" gravity, Tokamaks, Gertsenshtein effect.*

1. Introduction:

Dyson in [1] derived a minimum probability for the occurrence of the Gertsenshtein effect [2]. While the Gertsenshtein effect is not the only way to explain a coupling between photons and gravitons[3] the criteria so derived by Dyson, [1] is effective in terms of small device geometry as represented by [4] and [5] as to generation of GW. As Dr. Li and others relate in their research work [6], gravitons coupled to photons are a mainstay as to GW detection, use of Dyson's criteria in [1] is an excellent way to initiate a minimum strength of a magnetic field coupled GW frequency [4]. The problem is that Dyson incorrectly assumed that the main conversion of gravitons to photons, occurred in a magnetic field external to a gravitational wave detector. A review of what was accomplished by Dr. Li and others as far as planning show that the main magnetic field as to the Gertsenshtein exchange between gravitons (entering the GW detector), and a huge magnetic field, is within the GW detector which would put a very different set of priorities upon the utilization of Dyson derived probabilities as to the Gertshenshtein process of photons being created by graviton intersection with a strong magnetic field within a GW detector. To do so, we first review an example of how a thought experiment could provide a better analysis as to where to expect effective utilization of the Gertshenshtein effect in GW physics. From then, on, we will analyze the problem more generally and also touch on the limitations of the example given by Dyson as to the Earth as a detector of Gravitons.

II. Probability for the Gertsentshtein effect, as described by Dyson for the Tokamak experiment.

We will briefly report upon Dyson's well written summary results, passing by necessity to the parton the likelihood of the Gertsenshtein effect occurring in a laboratory environment [1]. In doing so we put in specific limits as to frequency and the magnetic field, since in our work the objective will be to have at least theoretically a 100% chance of photon-graviton interaction [2] which is the heart of what Dyson reported in his research findings. What we find, is that with a frequency of about 10 to the 9th Hertz and a magnetic field of 10 to the 9th Gauss that there is nearly 100% chance of the Gertsentshtein effect being observed, within the confines of the Tokamak experiment as outlined in [4].

In general relativity the metric $g_{ab}(\boldsymbol{x}, t)$ is a set of numbers associated with each point which gives the distance to neighboring points. I.e. general relativity is a classical theory. By necessity, perturbations from flat Euclidian space, are usually configured as ripples in 'flat space', which are the imprint of gravitational waves in space-time. Our paper is to first of all give the probability of a pairing of photons to gravitons linkage, the Gertentshtein effect, as to how the signatures of a perturbation to the metric $g_{ab}(\boldsymbol{x}, t)$ is linkable to photons and vice versa. The Gertentshtein effect is linked to how there is a linkage, signal wise, between gravitons and photons, and we are concerned as to what is a threshold as to insure that GW may be matched to the photons used by Dr. Li and others to signify GW , either in free pace, or due to a Tokamak [4,5], with GW going into a detector [6,7,8]. To do so let us look at the Dyson criteria as a minimum threshold for the Gertentshtein effect happening [1], namely

$$D \cdot B^2 \cdot \omega \leq 10^{43} \tag{1}$$

The propagation distance is given by ***D,*** the magnetic field by ***B,*** and the frequency of gravitational radiation is given by ω . We assume that the gravitational frequency is commensurate with the gravitational frequency of gravitons, i.e. that they are, averaged out one and the same thing. In doing so, making use of [4] we suppose on the basis of analysis that*D* is of the order of 10 to the 2nd power, since ***D*** is usually measured in centimeter, and by [2] we are thinking of about a 1 meter **If *B* is of the order of 10 to the 9thGauss Hertz**, as deemed likely by [3], then we have that if the **GW frequency , ω is likewise about 10 to the 9th Hertz** , that Eq.(1) is easy to satisfy. Note that if one has a vastly extended value for ***D,* say 10 to the 13th centimeters** that the inequality of Eq.(1) does not hold, so that by definition, as explained by Dyson that in a lot of cases, not relevant to [4] , that Eq.(1) is not valid, hence there would be no interexchange between gravitons and photons, and hence, if applied to the Dr. Li detector [6,7,8] no way to measure gravitons by their photonic signature. Fortunately, as given by [3] this extended version of ***D,* say 10 to the 13th centimeters**does not hold. And that then Eq. (1) holds. If so then, the probability of the Gertentshtein effect is presentable as, approximately,

$$P \leq \left(10^{36} / B^2 \cdot \omega^2\right) \propto 10^{36}/10^{18} \cdot 10^{18} \square 1 \equiv 100\% \tag{2}$$

Summing up Eq. (2) is that the chosen values, namely if ***D***is of the order of 10 to the 2nd power, *B* is of the order of 10 to the 9th power Gauss, and ω is likewise about 10 to the 9th Hertz leads to approximately 100% chance of seeing Gertsenshtein effects in the planned Tokamak experiment in [4].In making this prediction as to Eq. (2), we can say that the left hand side, leading up to the evaluation of P with a numerator equal to 10 to the 36th power will be about unity for the values of *B* detector fields in Gauss (magnetic field) or the generated gravitational field frequency ω from the Tokamak, making an enormous magnetic field in the GW detector itself mandatory, which would necessitate a huge cryogenics effort, with commensurate machinery. Keep in mind that the GW detector is, as given in [3] about five meters above the Tokamak [4], i.e. presumably the one in Hefei, PRC [5]

Note, that , ironically, Dyson gets much smaller values of Eq.(2) than the above, by postulating GW frequency inputs as to the value of ω about 10 to the 20th Hertz, i.e. our value of ω is likewise about 10 to the 9th Hertz, much lower. If one has such a high frequency, as given by Dyson, the of course, Eq.(2) would then be close to zero for the probability of the Gertentshtein effect happening. I.e. our analysis indicates that a medium high GW frequency, presumably close to 10 to the 9th Hertz, and ***D*** 10 to the 2nd power, presenting satisfaction of both Eq.(1) and Eq.(2). Note the main point though, for large values of ***D,*** Eq. (1) will not hold, making Eq.(2) not relevant, and that means in terms of the Dyson analysis, that far away objects generating gravitons will not be detectable. Via the Gertentshtein effect.There is no such limitation due to a failure of Eq.(1) in the Tokamak GW generation setup [3] since then, for Tokamaks, *D* is very small. But if D is large in the case of a lot of astrophysical applications, then almost certainly one never gets to Eq.(2) since the Gertsenshtein effect is ruled out. We assume, next that refinements as to the Gertsenshtein effect are in the works, as given by [1] and [2] and next work out a protocol as to the next topic, i.e. early universe shift in space-time geometry leading to GW signals. We will briefly mention what the GW signals are, which are probably accessible if the Gertsenshtein effect is improved upon. Note that the following discussion in terms of alteration of early universe space-time being identified via a small phase shift, which is discussed below. If that is not feasible, and we cannot even verify a sensitivity to GW via photonic linkage, via the Gertsenshtein effect, then the following discussion is not even worth considering.

III. Why the work by Dyson is not pertinent to long distance approximations as done in his manuscript if the main magnetic field for the Gertsenshtein effect occurs within a detector?

On the face of it, the way the question as to if the Gertsenshtein effect[2] occurs outside a gravitational wave detector appears to be contrived. We assert this is not a contrived question, since the planned detector has a magnetic field many times stronger than what would be expected by conditions on the Earth surface, with Gertsenshtein effects occurring due to the Earth's comparatively very minor magnetic field not playing a role. As given by [2] there is a well defined physical process for graviton-magnetic field interactions which would lead to a photon cascade, enough so, so that large D values, as given above to the tune of many kilometers in length are not advisable or necessary. Needless to say, if one does not believe that the Gertsenshtein effect is not mainly restricted within a GW detector, there are still serious problems with the Dyson formulation.

Review of Eq. (1) and Eq.(2) above come up with the datum that satisfying Eq (1) is necessary for implementation of Eq. (2), i.e. Eq. (2) in full generality would likely read as

$$P \sim \sin^2 \sqrt{\left(10^{36} / B^2 \cdot \omega^2\right)} \tag{3}$$

The main absurdity of this formulation is that usually, in interstellar space that one has low B field magnitudes, and low GW frequency values, i.e. ω as low as 100 Hz. Or as high as $\omega \sim 10^9 - 10^{10}\, Hz$ i.e. in that sense, the Dyson examples chosen as of implementation of Eq.(1) and Eq.(2) go off the rails, with it being extraordinarily easy for enormous values of $\left(10^{36} / B^2 \cdot \omega^2\right)$ in many situations. I.e. Dyson picked the values of B and also the picked value of $\omega \sim 10^{20}\, Hz$ is chosen for the purpose of making $P \sim \sin^2 \sqrt{\left(10^{36} / B^2 \cdot \omega^2\right)} \propto 10^{36} / B^2 \cdot \omega^2 << 1$, i.e. Dyson cherry picked the numbers to make the probability for the Gertsenshtein effect as almost non existent, even if Eq.(1) were satisfied. But show me an example where one would have $\omega \sim 10^{20}\, Hz$ in interstellar space ? This is important since $\omega \sim 10^{20}\, Hz$ is not feasible to entertain in most examples, and if one is looking at GW detectors, as has been done in [ ] one is visualizing $\omega \sim 10^9 - 10^{10}\, Hz$ in the high end of the GW frequency values, as is given in the Tokamakak example in Section II. I.e. Dyson's analysis of $P \sim \sin^2 \sqrt{\left(10^{36} / B^2 \cdot \omega^2\right)} \propto 10^{36} / B^2 \cdot \omega^2 << 1$ was arbitrarily picked to kill the possibility of a reading of the Gertsenshtein effect[1]. We close this section by asserting that Dyson is confused as to where the Gertsenshtein effect should occur in terms of space-time interactions for proper utilization of a Device physics analysis of where gravitons and B fields interact, and that the large D values he postulates, are not relevant to the case where the Gertsenshtein effect occurs, mainly inside a GW detector. This concludes our analysis of Dyson's failure to properly set up the benchmarks as to analysis of where the Gertsenshtein effect really occurs. So then, we conclude with this statement, and then move to the deficiencies as to Dyson's assertion as to the Earth as a graviton detector, which is section IV below.

IV. Dyson's analysis of the Earth as a GW detector. Incomplete physics, and why

We now review the particulars of Dyson's analysis of the Earth as a GW detector[1]. In doing so we are using the same numbers ,and our break down of the results show that Dyson is making some assumptions here, which need to be seriously reviewed. In debt with the methodology of finding out what is germane in his analysis to research.

To begin with, Dysons, formulae (23) has a next flux of Gravitons hitting the surface of the Earth from the Sun

F(flux)-gravitons hitting Earth = 4×10^{-4} **Gravitons per cm, squared, per second** (4)

In this , using Dysons numbers, he claims that only **1 graviton out of 10 to the 32^{nd} power of gravitons can be detected by the Earth's surface**, assuming a graviton has about a kilovolt of energy i.e. this is, in its heart a situation where Dyson [1]is assuming an absorbtion cross section 10 to the minus 41^{st} power per square centimeter per gram for the Earth, and an absurdly low collision rate. If this were true we are neglecting the Gertsenshtein interaction, since we are assuming no magnetic interface with incoming gravitons. This is only justifiable if there is a hard sphere collision between incoming 'gravitons' and ordinary matter. The analysis is incomplete and unnecessary since Dyson has set up a reseach meme where the Gertsenshtein [1], [2] interaction regime stretching kilometers in duration with no fidelity as to the fact that the interaction space between gravitons and a magnetic field is within a GW detector, and does not stretch kilometers in duration away from the GW detector.

V. Conclusion. Using the good part of the Dyson analysis, and keeping in mind improvments as to the Gertsenshtein graviton-magnetic field regime are in the offing.

What we have done is to ascertain that the Gertsheshtein interaction is valuable in small space geometry. We have in Section II, where the Dyson analysis can FIX appropriate GW and graviton frequency values, and magnetic field values, so the Gertenshtein interaction is certain to occur. In this, Dyson is warmly thanked for the insight. What we will bring up in closing is that the Gertshenshtein interaction is not necessarily the last word in effective graviton-magnetic field interactions and that improvments are in the offing which could enhance the role of GW detection. To do so, we can make an estimate that from a very simplistic viewpoint, that the view point of what is called the Li effect , [6], [7], [8] involves a magnetic field of the same frequency, direction and appropriate phase of the gravtional wave field. The Gertsenshtein effect does not involve that E and M field and is proportional to h squared, not h, and in sensitivity the Gertsenshtein effect is about 30 orders of magnitude smaller than the Li effect. For GW of interest. This involves h, which is the strain value of incoming GW entering in a detector. What we will do next is to provide details of this from a semi classical and quantum field theoretic stand point while thanking Dyson for a short hand as to fixing a relationship between magnetic field strength, and incoming GW frequency as to maximize the chance of experimental GW detection.

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