REVIEWING GRISHCHUK GW GENERATOR VIA TOKAMAK PHYSICS

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We generalize Grishchuk and Sazhin's[1] amplitude for GW generation due to plasma in a toroid for Tokamak physics, obtaining central strain values up to $h_{\text{2nd-term}} \sim 10^{-25}$–$10^{-26}$. This value may allow detection of GW. The critical breakthrough is in utilizing a burning plasma drift current, which relies upon a thermal contribution to an electric field. The gravitational wave amplitude would be detectable in part also due to the Tokamak reaching the threshold for plasma fusion burning, when $T_{\text{Temp}} \geq 100$ keV, which is how one could detect GW of amplitude so low five meters above the Tokamak center.

1 Introduction

We update Grishchuk and Sazhin[1] with plasma fusion burning. Consult the author's vixra.org article[2] and Mazzucato[3] for a good heuristic overview of the E–M wave problem and nuclear fusion, which gives a good grounding as to E and M waves, plasmas and fusion processes. Finally, the work if completed experimentally involves connections to a Tokamak in Hefei, PRC.[4] Russian physicists Grishchuk and Sashin[1] obtained the amplitude of a gravitational wave (GW) in a plasma as

$$A(\text{amplitude} - \text{GW}) = h \sim \frac{G}{c^4} \cdot E^2 \cdot \lambda_{\text{GW}}^2. \tag{1}$$

Compare with Beckwith,[2] and we can diagram the situation.[4] Here, E is the electric field and λ_{GW} is the wavelength for the GW generated by the Tokamak in our model. The original Grishchuk model has very small strain values, defining the relationship between GW wavelength and frequency: If $\omega_{\text{GW}} \sim 10^6$ Hz, $\lambda_{\text{GW}} \sim 300$ m. We assume setting $\omega_{\text{GW}} \sim 10^9$ Hz ($\lambda_{\text{GW}} \sim 0.3$ m) as a baseline measurement for GW detection above the Tokamak. Dr. Li has recently suggested considering an even higher frequency: $\omega_{\text{GW}} \sim 10^{10}$ Hz ($\lambda_{\text{GW}} \sim 0.03$ m). Furthermore, we will write the strain introduced by (massive) gravitons[4] from an Ohm's law treatment of current and electric field, by first-principles comparison of the terms' magnitude:[2,5]

$$A(\text{amplitude} - \text{GW})) \sim h \sim \frac{G \cdot W_E \cdot V_{\text{volume}}}{c^4 \cdot a} \tag{2}$$

where W_E is average energy density, V_{volume} is toroid volume, and a is the inner toroid radius.

2 Phenomenology to Confirm

Eq. (2) is due to the first term of a two-part composition of the strain, with the second term of the strain value significantly larger than the first term and due to ignition of the plasma in the Tokamak. The first term of strain is largely due to what was calculated by Grishchuk.[1] The second term is due to plasma fusion burning. This plasma fusion burning contribution is due to nonequilibrium contributions to plasma ignition, which will be elaborated on in this document. The first term is given by Eq. (3) below and the all important second term is given by Eq. (4).

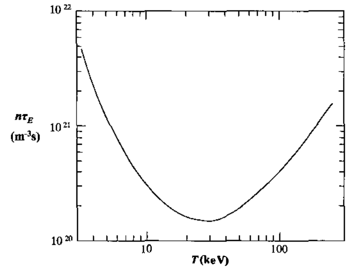
$$h_{1st-term} \sim \frac{G}{c^4} \cdot E^2 \cdot \lambda_{GW}^2 \sim \frac{G}{c^4} \cdot \left[\frac{J}{\sigma}\right]^2 \cdot \lambda_{GW}^2 \tag{3}$$

$$h_{2nd-term} \sim \frac{G}{c^4} \cdot B_\theta^2 \cdot \left(\frac{j_b}{n_j \cdot e_j}\right)^2 \cdot \lambda_{GW}^2 \sim \frac{G}{c^4} \cdot \frac{\xi^{\frac{1}{4}} a^2 T_{\mathrm{Temp}}^2}{e_j^2} \cdot \lambda_{GW}^2 \sim 10^{-25} \tag{4}$$

Eq. (4) is about five orders of magnitude larger than Eq. (3), with the temperature given by Wesson in Figure 1. Note that $h_{1st-term}$ is due to the electric field within the toroid, not plasma fusion burning. In use of the facility,[4] Chongqing University researchers will need an experimental protocol to read Eq. (4) for plasma fusion burning situations, which will be aided by the fact that the Hefei Tokamak has an unusually long stable-fusion period, corresponding to about the low point of Figure 1 and lasting for up to 100 s. We state that this will aid in obtaining a suitable value of Eq. (4), above which in turn will be affected that the one rule we have is that the strain drops in detectability an order of two above the Tokamak center.

$$h_{2nd-term}\,|_{5m-above-Tokamak} \sim \mathrm{O}(T_{\mathrm{Temp}}^2 \cdot \lambda_{GW}^2 10^{-25} \bigotimes 10^{-2} \propto 10^{-27} \tag{5}$$

Researchers in Chongqing University will have to measure this to confirm GW and gravitons.



(Figure reproduced from Wesson.[6])

Figure 1 – The value of $n\tau_E$ required to obtain ignition, as a function of temperature.

3 Conclusion: GW Generation Due to the Thermal Output of Plasma Burning

$h \sim 10^{-27}$ for a GW five meters above a Tokamak represents the extreme limits of what could be detected, but it is within the design specifications.[7] The challenge, as frankly brought up in discussions in Chongqing University is to push development of GW detection hardware to its limits, and use the Hefei Tokamak configuration as a test bed for the new technology embodied in the plasma fusion burning generation of gravitation waves.

References

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