International Journal of Modern Physics: Advances in Theory and Application
Vol. 2, Issue 1, 2017, Pages 35-42
Published Online on September 14, 2017

http://jyotiacademicpress.org

THE INABILITY OF THE WHITE-JUDAY WARP FIELD INTERFEROMETER TO SPECTRALLY RESOLVE SPACETIME DISTORTIONS

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Keywords and phrases: interferometer, White-Juday, microlensing, air refraction, spacetime distortion.
Received June 29, 2017

Abstract

The authors of this paper contend that the experiments being conducted with the White-Juday Warp Field Interferometer [1, 2, 3] by the Eagleworks research group at NASA's Johnson Space Center will be unable to detect spacetime distortions resulting from the experimentally obtainable electric field of a parallel plate capacitor configuration. The authors, who are not involved with this research group, argue that any post-processing results indicating a vanishing, non-zero difference between the charged and uncharged states of the capacitor are due to local effects rather than spacetime perturbations.

1. Introduction

Located in the Eagleworks Laboratory at the Johnson Space Center in Houston, Texas, the White-Juday Warp Field Interferometer (WJWFI), which is a modified, seismically-isolated Fabry-Pérot interferometer, has been developed to detect space time distortions created by a $\sim 10^6 \mathrm{V} \cdot \mathrm{m}^{-1}$ static electric field. The interferometer employs a 6328Å HeNe laser, in which one of the two beams passes between two electrically charged parallel plates. The beams are recombined on a CCD array.

However, we show that the spacetime distortions produced by such an electric field are exceptionally below the theoretical detection threshold of all present-day interferometry techniques. Additionally, an analysis of refractive index variations, due to plausible air temperature differences in the laboratory, was conducted, and the resulting beam refraction is shown to be potentially above the lower limit of detectability of the WJWFI.

The purpose of this note is to provide physics students with an actual lab example of the critical importance of making an accurate order of magnitude estimate of the capability of a measuring device before constructing that device. Otherwise the effort that is put into building the device will be of little value.

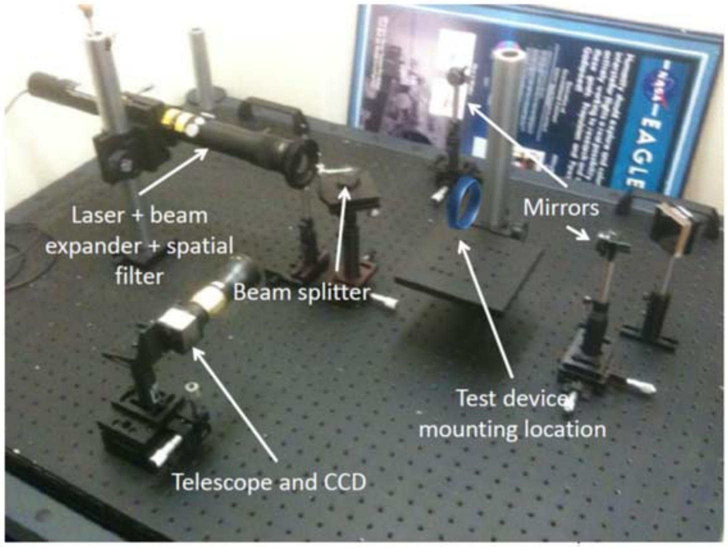

Figure 1. The White-Juday Warp Field Interferometer[1].

2. The Spacetime Distortions due to the Electric Field

The exact electric field strength between the plates being used in this experiment has not been specified in the literature. However, in this paper, we assume a generous $10^6\,\mathrm{V}\cdot\mathrm{m}^{-1}$ static electric field created by a 100kV potential difference across a 0.1m air gap. Therefore, the energy density (u_E) produced is:

$$u_E = \frac{\varepsilon_o V^2}{2d^2} = 4.4\mathrm{J}\cdot\mathrm{m}^{-3}. \tag{1}$$

Evaluation of the full normalized stress energy tensor is not necessary to affirm that the time-independent spacetime distortion, which is determined from (2) and is $9.2\times10^{-43}\,\mathrm{m}^{-2}$, cannot be resolved by any known experimental technique

[1]From: http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130011213.pdf

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}. \tag{2}$$

Additionally, an Alcubierre warp bubble can be formed only by negative energy density and/or negative pressure [4], and it is improbable that this experimental technique could be seamlessly extrapolated for the case of $-\rho$ terms in $T_{\mu\nu}$.

For the White-Juday Warp Field Interferometer to attempt to detect the microlensing caused by the above $4.4\text{J} \cdot \text{m}^{-3}$ electric field with a 0.1m radius and a $L = 10\text{m}$ path length, the following results. From (3), (4), and (5), respectively, the Schwarzschild radius (R_S) is $1.92 \times 10^{-23}\text{m}$, the Einstein radius (R_E) is $8.76 \times 10^{-12}\text{m}$, and the angular diameter (θ) is 1.81×10^{-6} arcseconds, which is 3 orders of magnitude below the maximum discernable resolution of approximately 10^{-3} arcseconds [5].

$$R_S = \frac{2GM}{c^2}, \tag{3}$$

$$R_E = \sqrt{\frac{2L}{R_S}}, \tag{4}$$

$$\theta = \frac{2R_E}{L}. \tag{5}$$

The WJWFI is totally incapable of detecting the minute distortions of spacetime produced by a $4.4\text{J} \cdot \text{m}^{-3}$ electric field. The static electric field of equivalent radius required to achieve the microlensing detection threshold would be $\sim 10^{12}\text{V} \cdot \text{m}^{-1}$. Therefore, any vanishing non-zero difference between the charged and uncharged states of the plates is clearly due other factors.

3. Air Refraction

The dependence of the index of refraction of air on the vacuum wavelength of incident EM radiation is given by:

$$(n-1)\times 10^{8} = 8340.78 + \left[\frac{2.405640\times 10^{6}}{130-\lambda^{-2}}\right] + \left[\frac{1.5994\times 10^{4}}{38.9-\lambda^{-2}}\right]. \quad (6)$$

(7) accounts for arbitrary pressures and the presence of water vapour, and is plotted in Figure 2.

$$(n-1)\times 10^{8} = \left\{8340.78 + \left[\frac{2.405640\times 10^{6}}{130-\lambda^{-2}}\right] + \left[\frac{1.5994\times 10^{4}}{38.9-\lambda^{-2}}\right]\right\} \times \left(\frac{p}{720.775}\right)\left[\frac{1+p(0.817-0.0133T)\times 10^{-6}}{1+0.0036610T}\right] - f\left[5.722-\frac{0.0457}{\lambda^{2}}\right], \quad (7)$$

where n is the index of refraction, λ is the vacuum wavelength (m), T is the temperature (Celsius), p is the total pressure (torricelli), and f is the partial pressure of water vapour (torricelli) [6]. For this analysis, the atmosphere in the Eagleworks laboratory is assumed to be dry, CO_2-free air with the molar composition, pressure and approximate temperature as shown in Table 1.

Table 1. Composition and molar percentage of the components of dry air (T = 288.16K, P = 1013.25mb) [6]

Composition	Molar Percentage
N_2	78.09
O_2	20.95
Ar	0.93
CO_2	0.03

By dividing the Edlén equation [7] by 1.000162, the effect of carbon dioxide on refraction is removed [6].

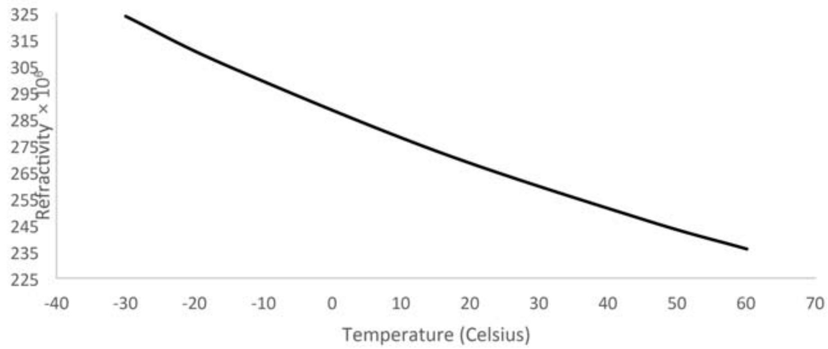

Figure 2. Refractivity versus temperature (p = 1013.25mb, λ = 6328Å, RH%[2] = 0).

For a first order model, a 6328Å laser beam is incident at 0.1° upon the interface between parcels of still air at 20°C and 21°C; the resulting difference in the refraction angles at the interface is $10^{-7\circ}$. When permitted to travel along a 2.0m post-interface path, the lateral beam deviation, as a result of refraction, is 31.7Å, and is thus significantly below the threshold of detectability of the WJWFI. Only for angles of incidence greater than approximately 17° would the lateral deviation of the beam be comparable to, or greater than, the laser wavelength.

Unless the WJWFI experiment is performed in vacuua, refraction-induced beam divergences along the arms of the interferometer cannot be eliminated and could be sporadically evident.

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[2] Relative humidity.

4. Conclusion

The White-Juday Warp Field Interferometer (WJWFI) has been demonstrated to be incapable of resolving the minute distortions of spacetime created by a $10^6 \mathrm{V} \cdot \mathrm{m}^{-1}$ electric field. The WJWFI at Eagleworks Lab at NASA-Johnson Space Center provides an example of a measuring device incapable of making measurements at the scale needed.

Additionally, variations in temperature were shown to produce potentially detectable changes in the refractive index of air, which could result in occasional spurious interference fringes. Although a more rigorous model, which considers a time- and spatially-changing index of refraction gradient along the interferometer arm, would result in a smaller lateral beam deviation, the purpose for which the WJWFI is intended has been shown to be unachievable.

Thus, were any signals to appear in the White-Juday Warp Field Interferometer, they would most often be attributable to either electronic noise or the classical electrodynamics interaction between the ionized air between the plates and the electromagnetic radiation of the laser. An in-depth collaboration with precision interferometry experts, in which highly sophisticated measurements at a quiet location and in ultra-high vacuum were made, would be necessary in order to add appreciably to the state of the art.

This note provides a simple lesson for physics students: attention must be given to the capability of a measuring device before it is put to use. If the device cannot make measurements to the required precision, then it should not have been built and construction efforts were a waste of time. Unfortunately, such was the fate of the Eagleworks Lab WJWFI.

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