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2σ SIGNALS FOR THE ELECTRO-GRAVITATIONAL INDUCTION BASED ON BEAM INSTABILITY IN CHARGED PARTICLE STORAGE RINGS *

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Abstract

Changes in beam position within charged particle accelerator storage rings have been observed due to changes in gravity caused by the moon and sun. The terrestrial tidal model has been used to explain this type of beam instability. Further analysis reveals that these instabilities arise from changes in the electron beam energy, that may not only come from movements of the accelerator components due to terrestrial tidal forces, and may caused by the unsighted process. We try to induce an electromotive force along the ring, referred to as electro-gravitational induction (EGI). The circular motion of the charged particles causes the accumulation of the EGI in the storage ring, turn by turn. We used existing data from storage ring beam signals to estimate the maximum value of the gravity coefficient of the induced electromotive force.

INTRODUCTION

LEP and Spring8 have observed COD changes, the period of 12 hours, comes from the gravity changes, the change of acceleration of gravity g, delta g caused by the moon and sun moving relative to the earth[1-2]. See the Figure 1 and 2.

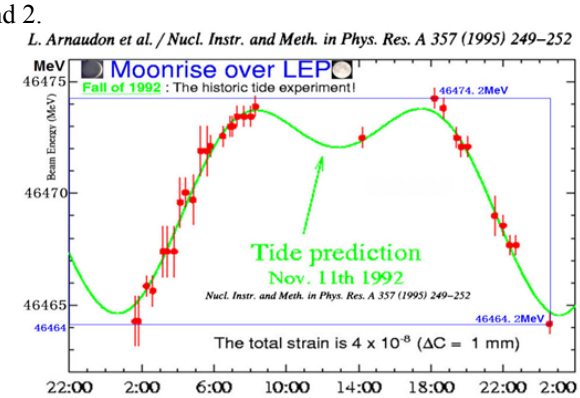

Figure 1: LEP Observation, see reference [1].

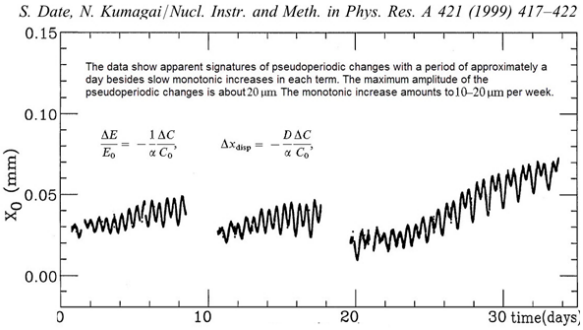

Figure 2: SPrng8 observation, see reference [2].

Phenomenology, we would assume that the gravity changes caused by the moon and sun moving at the storage ring have caused the beam energy changes in the storage ring [3].

$$\Delta E = \xi \cdot \Delta g \quad (1)$$

Which ΔE is the beam energy changes, caused by gravity changes Δg. If it is true, then it may be the electro-gravitational induction (EGI). We have discussed the possibility of EGI, and estimate the maximum value of the gravity coefficient of the induced electromotive force by using the existing beam data from the storage rings.

The EGI coefficient ξ is found to be less than $3.78\ \mathrm{statcoul}^{-1} \cdot \mathrm{m}^{-1} \cdot \mathrm{kg} \cdot \mathrm{sec}$. There is still a question of whether the value ξ actually exists or zero; we may be able to obtain a more accurate measurement from a setup with no feedback systems in place, that is, no beam energy compensation systems, beam orbit correction systems, and so on.

Furthermore, the EGI coefficient $\xi \leq 3.78\ \mathrm{stat}coul^{-1} \cdot m^{-1} \cdot \mathrm{kg} \cdot \mathrm{sec}$ can also be formulated using the existing constants, G and κ_e:

$$\xi \leq 9.7 \times 10^{-4} \left(\frac{1}{c} \sqrt{\frac{\kappa_e}{G}} \right) \quad (2)$$

where G is the gravitational constant, κ_e is the dielectric constant, and c is the speed of light in a vacuum. From equation (6), we see that the resulting value of ξ would be less than that obtained above, if the EGI does in fact exist.

DISCUSSION

The changes of COD predicts by the EGI is in a same-phase transformation with the changes caused by the Newton tidal force. However, EGI, if exist, will affects the positive charged particle and negative charged particle in opposite way, one is accelerated and another is decelerated at same time, in same place. For example, if we have two same size rings, located in the same site of ground, one is electron ring another is positron ring, moving in same direction; we can measure the COD of these two similar storage rings respectively at same time, and noted as $\mathrm{COD}_+(t)$ for the closed obit distortion of the positive particles beam, $\mathrm{COD}_-(t)$ for the negative particles beam, respectively. So we can obtain the $\Delta\mathrm{COD}(t)$, $\Delta\mathrm{COD}(t) = \mathrm{COD}_+(t) - \mathrm{COD}_-(t)$, see the Figure3. Therefore, $\Delta\mathrm{COD}(t)$ signals will be independent on the terrestrial tidal force. So the effect of the EGI model will be $\Delta\mathrm{COD}(t)/2$. Here, we must consider all the influence

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Table 1: Parameters for Different Storage Rings

	NL Northern latitude	L_0(m) Ring circumference	E_0(GeV) Beam energy	ΔL_{max} measured COD changes	ξ (maximum) $\left(10^{-2}\ \mathrm{stat}coul^{-1} \cdot m^{-1} \cdot \mathrm{kg} \cdot \mathrm{s}\right)$ EGI coefficient
LEP[1]	46	26658.9	91	0.1mm	3.76
SPring8[2]	34.9	1435.9	8	56μm	2.09
APS[3]	41.7	1105	7	40μm	3.78

NL: Northern latitude; L_0: Expected path perimeter; E_0: Beam energy in GeV; ΔL: measured COD changes; ΔL_{max}: maximum COD change per day; ξ: calculation of the EGI coefficient in $\mathrm{stat}coul^{-1} \cdot m^{-1} \cdot \mathrm{kg} \cdot \mathrm{s}$.

of other factors, such as the synchronization, RF system and feedback systems and others when we check EGI, in practice.

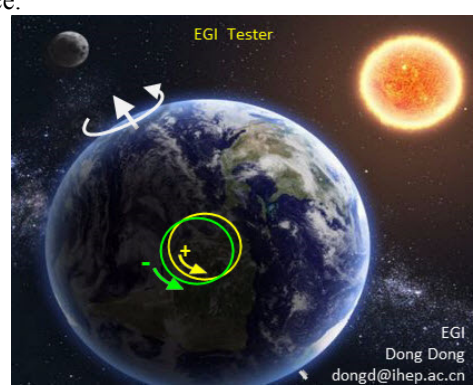

Figure 3: Two ring for checking EGI effect.

For example, based the Beijing Electron and Positron Collider (BEPC), which has two rings, one is electron ring and the other is positron, if we modify the machine so that the electron and positron beam moves at the same direction in the two ring at same time, then we can check the EGI model true or false by measuring $\Delta\mathrm{COD}(t)$, in future.

REFERENCES

[1] L. Arnaudon et al., "Effects of terrestrial tides on the LEP beam energy". *Nucl. Instr. Meth*. **A357**,249-252 (1995).
[2] S. Date, N. Kumagai, "A long term observation of the DC component of the horizontal COD in the storage ring of Spring-8". *Nucl. Instr. Meth.***A421**, 417-422 (1999).
[3] Junyi Dong, etc, "On the Electro-Gravitational Induction Predicted by Beam Instability in Charged Particle Storage Rings". *e-Print Archive chinaXiv:201609.00255.*