RESEARCH OF THE ELECTRO-GRAVITATIONAL INDUCTION BY USING COD SIGNALS IN CHARGED PARTICLE STORAGE RINGS*

Dong Dong†, Institute of High Energy Physics, China Academic Science, Beijing, China
Junyi Dong, Binghamton University, NYSU, Binghamton, USA

Abstract

Form the beam instability in the charged particle storage ring; researchers have known that one kinds of long term beam instability, 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, so called the terrestrial tidal forces. Phenomenology, we would say 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. If it is true, then it may be the electro-gravitational induction (EGI). In this paper, we will discuss 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.

INTRODUCTION

One kind of changes of the beam instability, a long-term oscillation of the horizontal COD which period is 12hrs was found in the charged particles storage ring [1-3]. For this phenomenon, a conventional explanation has been done by using the tidal force model of Newton. The COD' changing means that the charged particle' energy changing. When it comes with phenomenology, the energy change of charged particles is due to the variation of the gravitational potential of the moon and the sun relative to the site of storage ring at the earth face. This may be a show of the wanted, mysterious interaction between the gravitation field and the electromagnetic field. Although chance of this idea is true is rare, it is still important for us to take a serious look at this hypothesis.

We take a circle motion of charged particles as a metal ring and assume this metal ring rolling with Earth's rotation in the gravitational field of the Moon and the Sun, and get induction electromotive force in this charged particle metal ring. In this hypothesis, a similar 12hrs period COD change can be obtained, and may be needed more checking in detail in future.

MODEL OF THE ELECTRO-GRAVITATIONAL INDUCTION (EGI)

Let the line perpendicular to the intensity of the gravitational field $\vec{g}$ be denoted by $d\vec{l}$. When $d\vec{l}$ moves perpendicular to $\vec{g}$ with a velocity $\vec{v}$, it will produce an electromotive force $\vec{\mathcal{E}}_g$ along the line $d\vec{l}$,

$$\vec{\mathcal{E}}_g = -\xi\,(\vec{v} \times \vec{g})\,dl \qquad (1)$$

where ξ is the EGI coefficient [4]. The line integral of (1) is the electromotive force $\mathcal{E}_g$.From (1), we got (2) for a ring,

$$\mathcal{E}_g = (-\xi)\frac{d\vec{g}}{dr} \cdot \vec{S}_{ring} \cdot V_{ring\times\frac{d\vec{g}}{dr}} \qquad (2)$$

where the charged particle ring C is bounded by an open surface $\vec{S}_{ring}$ with unit normal $\vec{n}$ and $V_{ring\times\frac{d\vec{g}}{dr}}$ is the velocity of the surface $\vec{S}_{ring}$ in the direction perpendicular to the gradient $\vec{g}$. This means that the EGI would be proportional to the gradient $\vec{g}$, surface $\vec{S}_{ring}$ and velocity of the surface $\vec{S}_{ring}$ in the direction perpendicular to the gradient $\vec{g}$.

DISCUSSION

As a preliminary estimation to EGI, we disregarded the influence of any factors other than gravity on the beam position and used the maximum change per day in the amplitude of the COD in the calculation of the ξ maximum value, as we did not know what kind of feedback systems were working in the storage ring when the BPM data were measured or what the primary influence on the beam orbit was. Table 1 shows the relative expected path perimeter and the corresponding change in energy for several major storage rings [1-3].

The EGI coefficient ξ is found to be less than $3.78\ \mathrm{stat}coul^{-1}\cdot m^{-1}\cdot \mathrm{kg}\cdot \mathrm{sec}$. 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 ξ can also be formulated using the existing constants, G and κ_e:

$$\xi \le 3.78\ \mathrm{stat}coul^{-1}\cdot m^{-1}\cdot \mathrm{kg}\cdot \mathrm{sec} = 9.77\times 10^{-4}\left(\frac{1}{c}\sqrt{\frac{\kappa_e}{G}}\right) \qquad (3)$$

where G is the gravitational constant, κ_e is the dielectric constant, and c is the speed of light in a vacuum. From equation (3), we see that the resulting value of ξ would be less than that obtained above, if the EGI does exist in fact.

CONCLUTIONS

Because 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 different way, one is accelerated and another is decelerated at same time, in same place. For example, if

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† dongd@ihep.ac.cn

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Table 1: Parameters for different storage rings.

Storage Ring	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

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 $\mathrm{COD}_{+}(\mathrm{t})$ for the closed obit distortion of the positive particles beam, $\mathrm{COD}_{-}(\mathrm{t})$ for the negative particles beam, respectively. So we can obtain the $\Delta\mathrm{COD}(\mathrm{t})$, $\Delta\mathrm{COD}(\mathrm{t}) = \mathrm{COD}_{+}(\mathrm{t}) - \mathrm{COD}_{-}(\mathrm{t})$, therefore, $\Delta\mathrm{COD}(\mathrm{t})$ signals will be independent on the terrestrial tidal force. So the effect of the EGI model will be $\Delta\mathrm{COD}(\mathrm{t})/2$. Here, we must consider all the influence of other factors, such as the synchronization, RF system and feedback systems and others when we check EGI, in practice.

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 ing $\Delta\mathrm{COD}(\mathrm{t})$, in future.

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