Proposed Laboratory Measurement of the Gravitational Repulsion Predicted by Quantum Celestial Mechanics (QCM)

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Quantum Celestial Mechanics (QCM) predicts the quantization of the orbital angular momentum per unit mass for bodies orbiting a central mass in response to attractive and repulsive gravitational accelerations. Applications to the Solar System, multi-planet exosystems, and to the Pluto system of 5 moons suggest its validity. A laboratory experiment to check this constraint is proposed.

1 Introduction

The gravitational constant G has now been measured by several new techniques, including a dynamic measurement by resonating beams [1] and a simple pendulum laser interferometer [2]. Both methods as well as Advanced LIGO and other gravitational sensors could also measure the repulsive gravitational acceleration predicted by the quantization of angular momentum per unit mass constraint [3] of Quantum Celestial Mechanics (QCM).

Although the Pluto system with its 5 satellites has already been a definitive test of this constraint [4], and its successful applications to the Solar System and numerous multi-planet exosystems have been achieved [5], an Earth-bound laboratory measurement confirmation is preferred.

According to QCM, which is derived from the general relativistic Hamilton-Jacobi equation, the quantization of orbital angular momentum L per unit mass μ constraint of the orbiting body, with quantization integer m, depends upon the total angular momentum L_T for the system of total mass M_T as

$$L/\mu = m\, L_T/M_T\,. \tag{1}$$

Recall that all orbits are equilibrium orbits for Newtonian gravitation for a central mass M and orbit distance r because the radial acceleration

$$\ddot{r} = -\frac{GM}{r^2} + \frac{L^2}{\mu^2\, r^3}\,. \tag{2}$$

But for QCM, the subset of allowed equilibrium orbits are the ones that obey

$$\ddot{r} = -\frac{GM}{r^2} + \frac{m\,(m+1)\, L_T^2}{M_T^2\, r^3} \tag{3}$$

for circular orbits. Therefore, a very small radial displacement from the equilibrium radius r_{eq} of orbit results in an acceleration in the opposite direction.

2 Lab experiment parameters

In order to mimic a Keplerian circular orbit, one would place an ideal rotating metal cylinder of mass M and radius R at a distance r from the gravitational detector. A simple estimation of the parameters for a laboratory scale measurement is made by assuming that the detector is essentially a point mass M_d responding instead of an extended geometrical object. Therefore,

$$r_{eq} = \frac{m\,(m+1)\, L_T^2}{GM\, M_T^2} \approx \frac{m\,(m+1)\, R^4\omega^2 M}{4G\,(M+M_d)^2}\,. \tag{4}$$

Inserting some reasonable values: $M = 5\,\mathrm{kg}$, $R = 5\,\mathrm{cm}$, $M_d = 2\,\mathrm{kg}$, and $m = 1$, the first equilibrium radius will be at $r_{eq} \approx 4781\omega^2$ metre. For $r_{eq} = 1$ metre, i.e. fit in a lab room,

$$\omega \approxeq 0.0145\,\mathrm{rad/s} \approx 8.3\,\mathrm{rot/hr}\,. \tag{5}$$

By varying the rotation rate ω of the cylinder one can sweep back and forth through several equilibrium radii for $m = 1, 2, 3, ...$ to observe attractive and repulsive accelerations at $r_{eq} = 2r_0, 6r_0, 12r_0, ...$ sensed by the detector, with rapidly decreasing interaction accelerations with increasing r_{eq}.

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References

1. Brack T., Balabdaoui F., *et al*. Dynamic measurement of gravitational coupling between resonating beams in the hertz regime. *Nature Physics*, 2022. //doi.org/10.1038/s41567-022-01642-8.
2. Parks H. V. and Faller J. E. A simple pendulum laser interferometer for determining the gravitational constant. *Phil. Trans. A Math. Phys. Eng. Sci.*, 2014, v. 372 (2026).
3. Preston H. G. and Potter F. Exploring large-scale gravitational quantization without $\hbar$ in planetary systems, galaxies, and the Universe. arXiv: gr-qc/0303112.
4. Potter F. Update on Pluto and Its 5 Moons Obeying the Quantization of Angular Momentum per Unit Mass. *Prog. in Phys.*, 2016, v. 12 (1), 56–58.
5. Potter F. Multi-planet exosystems all obey orbital angular momentum quantization per unit mass predicted by Quantum Celestial Mechanics(QCM). *Prog. in Phys.*, 2013, v. 9 (3), 29–30.