How to Interpret Gravitational Events in the Newton’s Rotating Bucket? (Gravitational Phonons)

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Abstract — The Newton’s rotating bucket with gravitational events occurring in that bucket is a starting point for any new model describing gravitational situations and serves as a “filter” for any proposed gravitational model. The topic of this contribution is to describe the self-organization of H$_2$O molecules in the rotating bucket based on the Einstein-Shannon (ES) log-normal distribution of gravitationally redshifted velocities of H$_2$O molecules. The joint cooperation of the Earth’s gravitational field with the centrifugal force acts as that “hidden” organizing agent. H$_2$O molecules transfer the gravitational phonons and reflect them on the surfaces of the wall, bottom, and the water surface of Newton’s bucket and form the 3D paraboloid. Five new experimental predictions are proposed and compared with the experiments. The external observer is unaware that the H$_2$O molecules in Newton’s bucket are phonon velocity-organized due to the Earth’s gravitational redshift and the rotation of Newton’s bucket. The microscopic interplay of gravitational phonons inside of Newton’s bucket is hidden from the macroscopic analysis of the external observers. The external observer claims that these centrifugal forces are fictitious. In order to discover the real actions of those self-organized forces, the observer has to be a part of the rotating system in the presence of the Earth’s gravitational field or to study the rotating system in proposed experiments.

Keywords — Newton’s rotating bucket, ES log-normal distribution, phonon velocity-organization of molecules, gravitational phonons, properties of the paraboloid.

I. INTRODUCTION

Newton’s rotating bucket [1] with its gravitational events serves as a “filter” for any gravitational theory. Any realistic gravitational theory has to pass through this entrance gate and offer an interpretation of the formed paraboloid surrounded by H$_2$O molecules. Ernst Mach [2] inspired scholars to develop models describing the events in this “simple” rotating system, e.g., [3]-[16]. On the other side, chemical engineers collected numerous experimental observations of that formed paraboloid in Newton’s rotating bucket, e.g., [17]-[28]. Can we discover a hidden-organizing agent in that Newton’s bucket leading to the formation of the observed paraboloid surrounded by H$_2$O molecules? We were encouraged by the Novalis’ quote: “Hypotheses are nets; only he that casts will catch”.

II. THE ES LOG-NORMAL DISTRIBUTION OF GRAVITATIONAL PHONON VELOCITIES

In the previous contribution [29] we have introduced the model of the Einstein-Shannon log-normal distribution of the Solar gravitationally redshifted velocities with the Einstein scale parameter and the Shannon shape parameter. The Solar gravitational field is acting on all Maxwell-Boltzmann particles and causing the observed spread of redshifted velocities of individual particles towards the center of the Sun. Microscopically, there should be observed a universal distribution function of those redshifted velocities of the Maxwell-Boltzmann particles that moves with their molecular velocities given by the Maxwell-Boltzmann distribution.

Similarly, we can use this model for the Earth’s gravitational field where the redshifted velocity on the surface of the Earth $v_{\text{GRS MEDIAN}}$ can be written as the GRAVITATIONAL PHONON VELOCITY:

$$v^\mu = v_{\text{GRS MEDIAN}} = \frac{GM_\oplus}{R_\oplus c} \approx 208.5 \text{ mm s}^{-1}$$

(1)

where median $\mu = \ln (v_{\text{GRS MEDIAN}})$, G is the Newtonian gravitational constant, $M_\oplus$ is the mass of the Earth, $R_\oplus$ is the radius of the Earth, and c is the constant of the light speed.

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Claude Shannon derived for the log-normal distribution the Shannon shape parameter $\sigma = 1/\sqrt{6} \approx 0.4082$ based on the extremal principle of entropy. There are a lot of situations where this Shannon shape parameter determines very well the observed experimental data, e.g. [30] with a very good introduction to this Shannon model.

Table I summarizes some properties of the ES log-normal distribution of gravitational phonon velocities on the surface of the Earth.

| NOTATION                     | LOG-NORMAL PROPERTIES                      |
|------------------------------|---------------------------------------------|
| Einstein scale parameter     | $\mu = \ln \left( \frac{GM_\oplus}{R_\oplus c} \right)$ |
| Shannon shape parameter      | $\sigma = \frac{1}{\sqrt{6}} \approx 0.4082$ |
| PDF                          | $\frac{1}{\sigma \sqrt{2\pi}} \exp \left( -\frac{(\ln(x) - \mu)^2}{2\sigma^2} \right)$ |

| PROPERTIES OF GRAVITATIONAL PHONONS |
|-------------------------------------|
| PHONON MODE                         | $\exp(\mu - \sigma^2) \approx 176.5 \text{ mm s}^{-1}$ |
| PHONON MEDIAN                       | $\exp(\mu) = 208.5 \text{ mm s}^{-1}$ |
| PHONON MEAN                         | $\exp\left(\mu + \frac{\sigma^2}{2}\right) \approx 226.6 \text{ mm s}^{-1}$ |
| PHONON TOWARDS THE EARTH            | $\exp(\mu + \sigma^2) \approx 246.3 \text{ mm s}^{-1}$ |

The ES log-normal distribution determined by the Einstein median redshifted velocity $v_{GRS \text{ MEDIAN}} = 208.5 \text{ mm s}^{-1}$ (the scale parameter) and the Shannon shape parameter $\sigma = 1/\sqrt{6}$ is shown in Fig. 1.

![Fig. 1. The ES log-normal distribution of gravitational phonon velocities on the surface of the Earth.](image-url)

We can compare the median gravitational redshifted velocity $v_{GRS \text{ MEDIAN}}$ with the speed of sound $c_S$ in water at 20°C as:

$$ M = \frac{GM_\oplus}{R_\oplus c} \approx \frac{0.20845}{1481} = 1.407 \cdot 10^{-3} $$

where the Mach number $M$ has very low value - the median of PHONON gravitationally redshifted velocity of H$_2$O molecule is very small in compare with the speed of sound of water at 20 °C. In our model the H$_2$O molecules transfer these GRAVITATIONAL PHONONS towards to the wall, bottom and the surface of the water level of the Newton’s rotating bucket. These gravitational phonons are reflected on these surfaces and create a 3D structure leading to the formation of the paraboloid in the Newton’s rotating bucket.

The further more detailed investigation of this gravitational phonon behavior in water should be done by specialists on the underwater acoustic and phonon properties in liquids, e.g., [31]-[33].
III. SEVERAL NEW PROPERTIES OF THE PARABOLOID IN THE NEWTON’S BUCKET

The properties of the paraboloid and its shape dependence on the spinning of Newton’s bucket are very well-known. Fig. 1 shows some volume values around the paraboloid with the volume $V_{\text{paraboloid}} = \frac{1}{2} \times \pi \times R^2 \times h$.

![Diagram showing volume values around the paraboloid](image)

Fig. 2. Some volume values around the paraboloid in the spinning Newton’s bucket

In our model we assume that gravitational phonon velocities under the joint co-operation of the Earth’s gravitational field and the centrifugal force are reflected on the surfaces of the wall, bottom, and the water level and create the resulting parabolic shape in the Newton’s rotating bucket. Figure 2 depicts an ideal picture of the structure of gravitational phonon velocities carried among the water molecules.

![Diagram showing phase classification](image)

Fig. 3. The self-organization of gravitational phonon velocities in the rotating Newton’s bucket – phase A with lower phonon velocities than median, phase B with higher phonon velocities than median, phase C is the mixture of all phonon velocities.

The “simple” Newton’s rotating bucket is a very well-organized system of gravitational phonon velocities carried through the network of water molecules. The centrifugal force serves as the active organizer of those gravitational phonon velocities with their messengers – the water molecules. In Fig. 4 we can see a possible structure of those gravitational phonon velocities.

![Diagram showing estimated scenario](image)

Fig. 4. The estimated scenario of the self-organization of gravitational phonon velocities in the rotating Newton’s bucket – the centrifugal force organizes gravitational phonons.
The self-organized gravitational phonons slightly modify the gravitational acceleration towards the center of the Earth as $g^* e^{1/6}$ and the centrifugal acceleration as $\omega^2 \times r \times e^{1/6}$. This situation is shown on the Fig. 5.

Fig. 5. The modification of gravitational acceleration and the centrifugal acceleration in the Newton’s rotating bucket.

The gravitational acceleration $g$ in the spinning Newton’s bucket is slightly modified:

$$e^{1/6} g = e^{1/6} V_{GRS\ MEDIAN} \frac{c}{R_0} = e^{1/6} \frac{GM}{R_0^2} \approx e^{1/6} 9.8 \text{ ms}^{-2}$$ (3)

Now, we have to propose some experiments where these modified gravitational and centrifugal effects can be seen in data.

IV. THE PROPOSED EXPERIMENTS WITH THE NEWTON’S ROTATING BUCKET

There are five possible experiments how to test the gravitational effects in the spinning Newton’s bucket given in Table II: 1) the moment of inertia of the water in the spinning bucket, 2) the gravitational potential energy of the water relative to the bottom of the spinning Newton’s bucket, 3) work of the external force to achieve angular velocity $\omega$, 4) the height of paraboloid in the spinning Newton’s bucket, 5) the height of the centrum of mass above the bottom.

| The moment of inertia of the water in the spinning Newton’s bucket | Reference | The height of the paraboloid in the spinning Newton’s bucket | Reference |
|---|---|---|---|
| $I = \frac{mR^2}{2} \left(1 + \frac{1}{3} \frac{\omega^2 R^4}{4 gH}\right)$ | Formula in [20] | $h = \frac{\omega^2 R^4}{2 g}$ | General knowledge |
| $I = \frac{mR^2}{2} \left(1 + e^{1/3} \frac{1}{3} \frac{\omega^2 R^4}{4 gH}\right)$ | Prediction | $h = \frac{1}{1.18136...} \frac{\omega^2 R^4}{2 g}$ | Experiment in [35] |

| The gravitational potential energy of the water relative to the bottom of the spinning Newton’s bucket | The height of the centrum of mass $h_{cm}$ from the bottom |
|---|---|
| $U_g = \frac{mgH}{2} \left(1 + \frac{1}{3} \frac{\omega^2 R^4}{16 g^2 H^2}\right)$ | Formula in [20] | $h_{cm} = \frac{H}{2} \left(1 + \frac{1}{3} \frac{\omega^2 R^4}{16 g^2 H^2}\right)$ | Formual in [34] |
| $U_g = \frac{mgH}{2} \left(1 + e^{1/3} \frac{1}{3} \frac{\omega^2 R^4}{16 g^2 H^2}\right)$ | Prediction | $h_{cm} = \frac{H}{2} \left(1 + e^{1/3} \frac{1}{3} \frac{\omega^2 R^4}{16 g^2 H^2}\right)$ | Prediction |

Work of the external force (input work) needed to accelerate a body from 0 to angular velocity $\omega$:

$$W = \frac{mR^2}{2} \left(1 + \frac{1}{3} \frac{\omega^2 R^4}{24 g H^2}\right) \omega^2 = \frac{1}{2} \omega^2$$ (3)

$$W = \frac{mR^2}{2} \left(1 + e^{1/3} \frac{1}{3} \frac{\omega^2 R^4}{24 g H^2}\right) \omega^2 e^{1/3}$$ Prediction
The experiment with the height of the paraboloid in the spinning beaker was done by Aman Mehta and Deepak Choudhary and published on September 04, 2021 [34] with the easy setup. This experiment can be done in any basic laboratory.

V. THE MEASUREMENT IN THE ROTATING SYSTEM USING THE MÖSSBAUER EFFECT

Walter Kündig in 1963 [36] published his excellent experimental data with the basic idea of the experiment: a Mössbauer source is placed in the center of a system rotating with the angular velocity \( \omega \), an absorber is mounted at the radius \( R_A \), and a counter is at rest beyond the absorber. Using an ultracentrifuge rotor, the SHIFT of the 14.4-keV Mössbauer absorption line of Fe\(^{57} \) was measured as the function of \( \omega \times R_A \).

In 2008 Khomletsksii, Yarman, and Missevitsch [37] corrected the calculation of Walter Kündig. In 2009 Khomletsksii, Yarman, Missevitsch, and Rogozev [38] presented new experimental data of this Mössbauer experiment based on the COUNT RATE of detected \( \gamma \)-quanta \( N \) as a function of \( \omega \times R_A \) and published a different quantity. In 2015 Yarman et al. [39] published a new more precise experimental result based again on the COUNT RATE of detected \( \gamma \)-quanta \( N \) as a function of \( \omega \times R_A \).

Now, there is an intensive discussion how to interpret those data – one side of the discussion interprets these data with the mathematical rules of the general theory of relativity, the other side arguments with concept beyond the general theory of relativity, e.g., [40]-[48].

We summarize those experimental data in Table III where \( E_A \) and \( E_S \) are the characteristic energies of the absorber and the source.

| TABLE III: THE DATA OF MÖSSBAUER EXPERIMENT IN A ROTATING SYSTEM |
|---------------------------------------------------------------|
| Mössbauer experiment in a rotating system         | Theory of relativity     |
| \( \frac{E_A - E_S}{E_S} = \frac{\alpha \omega R_A^2}{2c^2} \) | Kündig [36] based on the SHIFT of the line |
| \( \frac{E_A - E_S}{E_S} = -(1.0065 \pm 0.011) \frac{\alpha \omega R_A^2}{2c^2} \) | Correction by Khomletsksii et al. [37] based on the SHIFT of the line |
| \( \frac{E_A - E_S}{E_S} = -(1.192 \pm 0.011) \frac{\alpha \omega R_A^2}{2c^2} \) | Prediction for the moment of inertia of that system |
| \( \frac{E_A - E_S}{E_S} = -e^{\omega \omega R_A^2/2c^2} = -1.18136... \frac{\alpha \omega R_A^2}{2c^2} \) | New data of Khomletsksii et al. [38] based on the COUNT RATE |
| \( \frac{E_A - E_S}{E_S} = -(0.68 \pm 0.03) \frac{\alpha \omega R_A^2}{c^2} \) | New data of Khomletsksii et al. [39] based on the COUNT RATE |
| \( \frac{E_A - E_S}{E_S} = -(0.69 \pm 0.02) \frac{\alpha \omega R_A^2}{c^2} \) | Prediction for the potential energy of that system |

Table III gives two different experimental quantities for the same rotating system: the first one based on the SHIFT of the line can be interpreted as the measure of the moment of inertia of that system, the second one based on the COUNT RATE can be interpreted as the measure of the potential energy of that system. We know from the literature that there are different interpretations of these experimental data, e.g., [40]-[48].

VI. SIX STEPS IN THE EXPERIMENT WITH THE NEWTON’S BUCKET

During the run of the experiment with Newton’s bucket we can distinguish six steps (partly based on the analysis of Enrico Gasco [49]):

1. The rope has not started its development and the bucket and the water are both at rest.
2. The rope starts unrolling, the bucket is put into rotational motion, gravitational phonons from the bucket walls and bottom are transferred into the water molecules in a state of rest relative to the observer.
3. The gravitational phonons from bucket walls and bottom start to self-organize water molecules according their gravitational phonon velocities. The water molecules start to create a modified surface.
4. The bucket and the water rotate with the same angular velocity. The joint co-operation of the Earth’s gravitational field and the centrifugal force create the observed 3D structure of gravitational phonons communicated through water molecules – the paraboloid is formed.
5. The rotation of bucket is stopped and the gravitational phonons from water molecules are absorbed.
by the walls and bottom of the bucket.

6. The bucket and the water are both at rest.

There is one interesting question formulated by Hartman and Nissim-Sabat [50]: “Consider two coaxial buckets A and B rotating with equal and opposite angular velocities.” One would observe paraboloids in these two buckets. Will be the height of both paraboloids the same or different?

VII. CONCLUSION

We might open a new road leading towards the interpretation of gravitational events occurring in Newton’s rotating bucket based on the model of gravitational phonons organized by the joint cooperation of the Earth’s gravitational field and the centrifugal force. Several new experiments were proposed to compare these predictions with the experimental data. One proposed experiment with the measurement of the paraboloid height in a rotating beaker can be realized in any basic laboratory. The other experiments have to be done in sophisticated laboratories using the rotating system based on the Mössbauer effect. This contribution could stimulate some new activities of the international community to reanalyze all existing data on the gravitational effects in rotating systems and to collect more precise and better-defined data with our existing technology. There is space enough for all participants in this Project.

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CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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