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The Brazil nut effect under reduced gravity

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Abstract

We present laboratory experiments of a vertically vibrated granular medium consisting of 1mm diameter glass beads with embedded 8mm diameter intruder glass beads. We carried out laboratory experiments for an effective gravity range between 0.25g and 2.0g. We use these to refine the empirical relation between the shaking and the gravity dependence of the effect as suggested by [6].

1. Introduction

The Brazil nut effect has been suggested to play a role in explaining the size seggregation on solar system bodies like Itokawa [5]. Initial experiments by [2] show a dependency of the Brazil Nut effect with the ambient gravity but do not allow to constrain well the functional dependence. These new experiments are performed in the laboratory using a linear motor, allowing covering a broader effective gravity range for the experiments, ranging from 0.25g to 2.0g . These measurements also allow a detailed assessment of the influence of different excitation accelerations. We use the data of the derived rise velocities to compare with and to look into the validity of models (e.g. Knight et al, or Grossman [1, 4])

2. Experiment

We use a linear stage which allows us to impose arbitrary movement onto the experiment container. The experiment container is 10cm in diameter and 10cm in height. We use lime glass beads with 1mm and intruders of 8mm diameter. The top of the container is observed by a camera to assess when the intruders moved from the bottom of the container to the top

3. Analysis

Yamada and Katsuragi [3,6] defined a dimension-less shaking parameter S and showed that it suited the description of vibration systems well:

$$S = \Gamma \cdot \frac{A_0}{d} = \frac{\left(2\pi \cdot A_0 f\right)^2}{gd} \qquad (1)$$

With the amplitude A_0, frequency of shaking f, ambient gravity g and the particle diameter d. We will use this dimension-less view on the brazil nut to derive its more dependence on experiment dimensions and gravity.

4. Summary and Conclusions

Fitting relation for the g dependence in this dimensionless form which suggests a dependence less than linear in g but more than square-root.

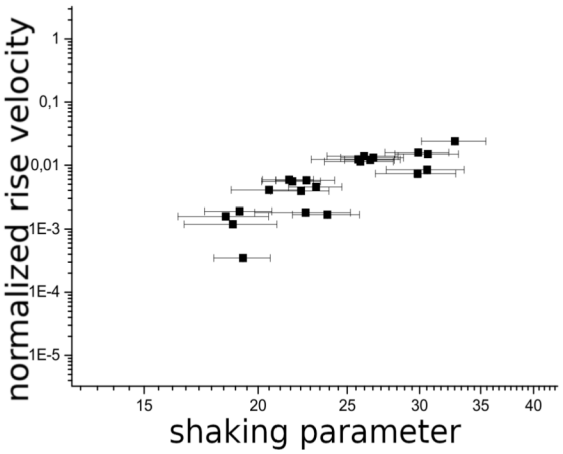

Figure 1: Relation between the shaking parameter and the observed rise velocity

We will disucss our findings with respect to the surface of small bodies like Itokawa , where the measured rise time will allow to estimate the exposure of the asteroid to impact-induced vibrations.

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References

[1] E.L. Grossman, Phys. Rev. E 56, 3290 (1997)

[2] C. Güttler, I. Von Borstel, R. Schräpler and J. Blum, Phys. Rev. E 87 (2013)

[3] H. Katsuragi, Sci. Rep. 5, 17279 (2015)

[4] J.B. Knight, E.E. Ehrichs, V. Y. Kuperman, J.K. Flint, H.M. Jaeger and S.R. Nagel, Phys. Rev. E 54, 5726 (1996)

[5] S. Matsumura, D.C. Richardson, P. Michel, S.R. Schwartz, R.-L. Ballouz, MNRAS, Volume 443, Issue 4, pp 3368–3380 (2014),

[6] T.M. Yamada and H. Katsuragi, Planet. Space Sci., 100, 79 (2014)