IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Gravity and Fundamental Physics (1)

Author: Mr. Hosei O
Department of Engineering, The University of Tokyo, Japan

Prof. Soichi Tatsumi
Japan

SELF-ASSEMBLY OF GRANULAR GAS AND THREE DIMENSIONAL PATTERN FORMATION IN A MICROGRAVITY ENVIRONMENT

Abstract

In this study, we present findings from a granular gas experiment conducted under microgravity conditions on the International Space Station in February 2023. Granular gases, comprised of dilute systems of granular particles in microgravity, exhibit unique dynamic behaviors that diverge from those of molecular gases, primarily due to their inelastic nature. In such gases, particles move briskly and dissipate energy upon collisions, a phenomenon that has garnered interest in the field of non-equilibrium physics, notably illustrated by Haff's law. Although simulations have extensively explored this process, empirical studies are rare, attributed to the necessity of a sustained, high-quality microgravity environment. Nonetheless, experimental investigation is crucial, given the significance of granular physics in both space science, such as in the formation of celestial bodies, and aerospace engineering, including extraterrestrial mining operations. Our experimental setup consisted of approximately 4,000 copper spheres, each with a diameter of 1.5mm, contained within a plastic sphere with a diameter of 100mm. To initiate particle movement, the sphere was agitated for 10 seconds, followed by a 1-minute observation period to monitor the cooling process. This cooling phase was meticulously recorded from both front and side perspectives for subsequent analysis. The outcomes of our experiment reveal that the velocity distribution of the granular gas conforms closely to the velocity decay predicted by Haff's law simulations. However, contrary to expectations, we did not observe particle clustering attributable to electrostatic forces. This paper delves into a comprehensive analysis of the results and discusses the broader implications of these findings for understanding non-equilibrium physical processes in microgravity conditions.