A Sound Solution to an Ancient Problem

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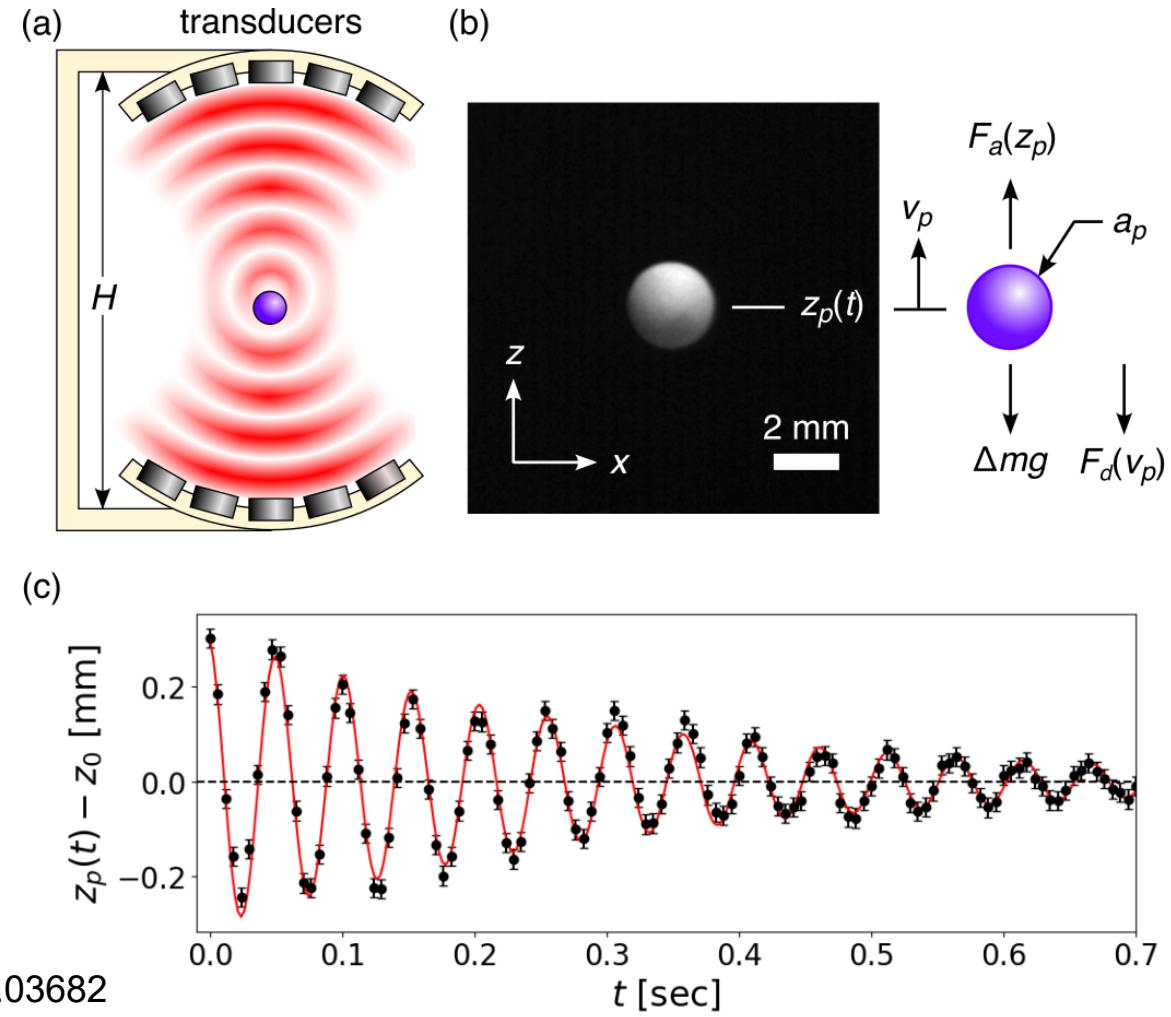
Acoustodynamic Mass Determination

Weighing small objects has been a critical challenge for commerce and science throughout history. Conventional balances and scales compare the weight of a test object to a standard mass or force, respectively. Both approaches run into difficulties when they are applied to millimeter-scale objects with milligram-scale masses.

An exceptionally effective solution involves (a) levitating the test object in the sound waves projected by a pair of ultrasonic transducers and (b) precisely tracking its motions with a video camera as (c) the object is set into oscillation by a hologram made of sound. The key to interpreting the resulting trajectory is to account properly for the inertia and drag of the displaced air.

Precise self-calibrated mass determination: A small series of one-second measurements can determine the mass of a milligram object to within a microgram, and its mass density to within a hundred parts per million. The same measurements also characterize the acoustic trap, making this a self-calibrating precision measurement technique that also casts new light on fundamental wave-matter interactions



Morrell and Grier, *Physical Review E,* in press (2023), arXiv:cond-mat/2308.03682

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Rebooting the *Scientific Frontiers Program*

David G. Grier, New York University

High-Impact K-12+ STEM Outreach

Since 2005, Grier has organized the award-winning *Scientific Frontiers Program,* which brings hands-on science immersion to students from New York City schools. The SEP hosts lab tours for public school field trips, research internships for high-school students, and in-classroom science enrichment for participating partner schools. In running these programs, the SEP has formed partnerships with more than a dozen New York City public schools, half a dozen private schools and two charter schools.

The SEPs programs leverage partnerships with major STEM outreach organizations including the BioBus, the Billion Oyster Project and the Johns Hopkins Center for Talented Youth.

Most hands-on SEP activities were curtailed by the pandemic. This has been the first academic year since 2020 in which all pre-pandemic activities have resumed, including renewed relationships with partner institutions.

These images show a few vignettes of the Grier's activities within the SEP, including class trips, high-school internships, recruitment and professional development.