Abstract Submitted
for the FWS17 Meeting of
The American Physical Society

Resonance Threshold and Bistability in a Parametrically-Driven Pendulum ALISON HUFF, JOHNATHON THOMPSON, JACOB PATE, HANNAH KIM, RAYMOND CHIAO, JAY SHARPING, Univ of California - Merced
— We examine the steady-state energy of a weakly-damped pendulum driven into parametric resonance. Motion control and data acquisition of the pendulum are accomplished using a micro-controller, which we use to record the passage time of the pendulum through its equilibrium position and obtain the maximum speed per oscillation as a function of time. As examples of the interesting physics which the experiment reveals, we present contour plots depicting the energy of the system as functions of driven frequency and modulation depth, as well as the bistability of the system for various modulation depths. We observe the transition to steady state oscillation and compare the experimental oscillation threshold with theoretical expectations. The equations of motion can be derived from first principles, and the cost-friendly and easily constructed apparatus makes this robust experiment a method for undergraduate students to thoroughly understand damped harmonic motion and parametric amplification in an upper-division mechanics class environment.

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Date submitted: 29 Sep 2017 Electronic form version 1.4