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A Parametric Oscillator Experiment for Undergraduates ALISON HUFF, JOHNATHON THOMPSON, JACOB PATE, HANNAH KIM, RAYMOND CHIAO, JAY SHARPING, Univ of California - Merced — We describe an upper-division undergraduate-level analytic mechanics experiment or classroom demonstration of a weakly-damped pendulum driven into parametric resonance. Students can derive the equations of motion from first principles and extract key oscillator features, such as quality factor and parametric gain, from experimental data. The apparatus is compact, portable and easily constructed from inexpensive components. Motion control and data acquisition are accomplished using an Arduino micro-controller incorporating a servo motor, laser sensor, and data logger. We 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. We observe the transition to steady state oscillation and compare the experimental oscillation threshold with theoretical expectations. A thorough understanding of this hands-on laboratory exercise provides a foundation for current research in quantum information and opto-mechanics, where damped harmonic motion, quality factor, and parametric amplification are central.

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