Abstract Submitted
for the 4CF12 Meeting of
The American Physical Society

Dissonant Modes of Bottle-shaped Thermoacoustic Prime Movers Part 1: Mode Transitions with Varying Cavity Length JACOB WRIGHT, BONNIE ANDERSEN, Utah Valley University — Dissonant overtones of closed bottle-shaped thermoacoustic prime movers are discussed. The resonator consists of two concentric cylinders with differing cross-sectional areas, closed at the outer ends. The condition for resonance results in a transcendental equation, which is solved numerically. The neck and cavity behave as coupled resonators, where the neck is a quarter-wave resonator and the cavity is a half-wave resonator. A variable cylindrical cavity with a sliding piston was constructed to study the nature of the device as the cavity length is varied. The stack is located in the neck region and the length and inner diameter of the neck are 5.39 and 1.91 cm, respectively. The inner diameter of the cavity is 4.76 cm and has a maximum length of 38 cm. The dominant mode of operation depends on the length of the cavity, favoring successively higher modes as the cavity length increases. The volume filling factor of the stack material was varied from 2 to 5% to determine whether the amount of stack material affects the transitions. These filling factors were selected to yield hydraulic radii comparable to the thermal penetration depth for the highest and lowest possible fundamental frequencies of the system. The transition to higher modes occurs roughly where the higher mode overlaps with the fundamental frequency of the neck region, and is independent of the stack filling factor. With the given dimensions, three transitions to higher modes were observed, with frequencies consistent with the model.

Bonnie Andersen
Utah Valley University

Date submitted: 24 Sep 2012 Electronic form version 1.4