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Landau-Zener Transitions in Coupled Thermoacoustic Oscillators

Stacks AARON HORIKAMI, CICELY POTTER, CHIT KWOK, BONNIE ANDERSEN, Utah Valley University — Landau-Zener transitions are characteristic in two level quantum systems and occur in many areas of physics and chemistry from ammonia masers to rapid adiabatic passage. Coupled pendulums, mass-spring systems, and RLC circuits are a few macroscopic analogs of coupled oscillators. A closed bottle-shaped acoustic resonator can result in coupled oscillations between the resonance of the neck and the cavity. Landau-Zener transitions occur between overtone modes as the cavity is lengthened such that its resonance passes through the resonance of the neck. The thermoacoustic stack is located in the neck and the length of the cavity can be varied with a piston. Previously, transitions were observed as the cavity was lengthened by hand. In this study the piston was controlled with a high level of accuracy with a translation stage. Four different neck-cavity combinations were tested using two neck lengths (3.8 cm and 5.8 cm, both with inner-diameters of 1.9 cm) and two cavity inner-diameters (4.8 cm and 9.5 cm). Mode transitions have been observed to occur repeatedly for a given input power at the same position within a standard deviation of 1.3 mm. The transition positions were also tested as a function of input power. For some input powers/positions, the temperature gradient fell below the critical temperature gradient, resulting in a loss of sound at those positions.

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