

PHYSICAL MATH SEMINAR

Shaping instabilities: tuning and playability of the clarinet and buckling in periodic prestressed beams



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ABSTRACT:

Self-sustained sound production and elastic buckling both arise through a loss of stability. How can geometry and spatially distributed prestress shape the responses that emerge? In this presentation, we will explore this question through the tuning and playability of the clarinet and the buckling of beams with alternating regions of tension and compression.

We first explore how player controls and uncertain air temperature affect clarinet tuning, using an explicit formulation combining harmonic balance and polynomial chaos. Experiments and simulations then reveal how nonlinear dissipation in a single tonehole enables transitions to higher notes, and how its geometry governs fundamental musical compromises.

Turning to elasticity, we investigate theoretically and experimentally how prestress shapes the buckling modes of a beam. For sufficiently strong tensile barriers and appropriate compatibility conditions, the buckling problem approaches the stationary Schrödinger equation for a finite potential well. Extending the prestress pattern to finite periodic arrays reveals how local and global symmetries constrain the admissible buckling modes.

Tuesday, October 20th, 2026

2:30 PM – 3:30 PM

Building 2, Room 449