

PHYSICAL MATHEMATICS SEMINAR

BALANCING WITH THE INNER EAR: WHY IT WORKS SO WELL, AND HOW IT GOES WRONG

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ABSTRACT:

In order to sense rotation, all vertebrates use a set of inner-ear organs called semicircular canals. These exquisite little structures are almost entirely mechanical in origin, and rely on physical displacements of fluids and an elastic membrane to translate a rotation into a neural signal. I briefly review the basic operation of the semicircular canals, and will then discuss research into two areas:

1. "Top shelf vertigo", or BPPV, is a mechanical disorder of the semicircular canals. Persons with BPPV experience severe dizziness after their head is tilted back (as if to look at the top shelf). The medical community has proposed that rogue crystals in the canal are to blame. We quantitatively examine such proposals from a fluid mechanical standpoint (with H. Stone, T. Hain and M. Weidman).
2. Shocking fact: the semicircular canals of all vertebrates -- from mice to whales -- are essentially the same size. Why would this be? If one thinks of evolution as an ongoing search to improve, then perhaps the semicircular canals are "optimized". After all, the eye operates at the single-photon level and the cochlea is thermal-noise limited. In fact, the "optimal design" for the semicircular canals has dimensions that are consistent with those shared by all vertebrates, and parameter space is quite constrained.

TUESDAY, FEBRUARY 22, 2005

2:30 PM

Building 2, Room 338

Refreshments at 3:30 PM in Building 2, Room 349.



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