# SEMINAR
## ALL ARE WELCOME

TEMASEK LIFESCIENCES LABORATORY

**17 October 2019 (Thursday), 3.30pm**
**The Auditorium (Level 1)**
**Hosted by: Dr Fumio Motegi**

## Space-time-frequency Shape Mapping Reveals Harmonics in Contractile Oscillations During Cytokinesis

**Professor Amy Shaub MADDOX**
**University of North Carolina at Chapel Hill, USA**



Amy is from the Chicago area and was trained at UNC and in San Diego, California. Amy started her faculty career in Montreal, Canada and has been back at UNC for six years. Amy's lab is funded by the NIH and NSF and studies the molecular and physical mechanisms of cell shape change during cell division and oogenesis. Amy has two children and enjoys hiking in nature, swimming, mindfulness, cooking and music.

Cell and tissue shape changes in animals are driven by poorly understood rearrangements of the actomyosin cortical contractile cytoskeleton. In cytokinesis, a cortical actomyosin ring physically partitions one cell into two. To gain novel insights into the mechanisms of cell-autonomous cytokinetic contractility, we used the C. elegans zygote as a model cell type and imaged cytokinesis with unprecedented temporal resolution. We found that ring closure speed was not constant but instead underwent repeated cycles of acceleration and deceleration. Closure speed was also non-uniform around the ring and the focus of highest contraction speed traveled circumferentially. To quantify speed oscillations, we combined computational spatial oversampling, continuous wavelet transform, and mode decomposition. We found that the inward displacement dynamics of ring segments were the composite of several co-existing amplitude- and frequency-modulated wave modes with approximately 18, 36 and 72-second periodicity. Fitting to a wave-shape model revealed that the entire range of speed oscillations can be described by a single time-varying amplitude, a single time-varying frequency, and a shape factor, suggesting that speed oscillation are driven by a single oscillator. Last, to retain the spatial relationships among contracting segments of the cytokinetic ring, we performed mode decomposition in three dimensions on a spacetime-frequency kymocube of our wavelet transform output. We found three major classes of frequency surfaces varying little over space and time. Principal component analysis of these two-dimensional modes confirmed that the frequencies of contractile oscillations are related as a harmonic and sub-harmonic around a fundamental frequency, which resembles the pacemaker kinetics of the cytokinetic master regulator RhoA.

**Recent Publications:**

1. Kathryn Rehain Bell, Michael E. Werner, Anusha Doshi, Daniel B. Cortes, Adam Sattler, Thanh Vuong-Brender, Michel Labouesse, **Amy Shaub Maddox** (2019) "Novel cytokinetic ring components limit RhoA activity and contractility." bioRxiv DOI 10.1101/633743

2.D.B Cortes, M. Gordon, F. Nédélec, **A.S. Maddox** (2019) "Bond type and discretization of non-muscle myosin II are critical for simulated contractile dynamics." bioRxiv DOI 10.1101/669382

3.Rehain-Bell K, Love A, Werner ME, MacLeod I, Yates JR 3rd, **Maddox AS** (2017) "A Sterile 20 Family Kinase and Its Co-factor CCM-3 Regulate Contractile Ring Proteins on Germline Intercellular Bridges." PubMed.gov DOI: 10.1016/j.cub.2017.01.058.