Cell cycle, cell division, cell death

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At the "Cell size, Cell division and Contractility" Minisymposium, 10 exciting talks described insights into cell cycle dynamics and mechanisms of spatial organization from the subcellular to organismal scales.

A fundamental question is how cells coordinate growth and division to maintain constant size. The group of **Jan Skotheim** (Stanford University) found that most proteins in budding yeast remain at constant concentrations during the cell cycle, but that cell growth dilutes the cell cycle inhibitor Whi5 to trigger division (Schmoller *et al.*, 2015). He reported that they have now identified a group of ~100 proteins that become diluted during cell growth. This special group is enriched for chromatin-binding proteins, suggesting that cells control the abundance of these genome-associated proteins through size-independent mechanisms. **Cliff Sandlin** (University of Pennsylvania) described novel fluorescent cell size sensors whose nuclear:cytoplasmic fluorescence ratio shifts in response to cell size, enabling this property to be monitored quantitatively in diverse contexts.

Several presentations offered insights into how space and time are harnessed by regulatory networks to control cellular activities. Work from the lab of **Abby Dernburg** (University of California, Berkeley) revealed that the synaptonemal complex (SC), a polymer that assembles between paired chromosomes during meiosis, is a liquid crystal (Rog *et al.*, 2017). They have now identified signaling molecules that undergo a reaction-diffusion process within the SC to pattern meiotic recombination. Spatial organization is also important during embryogenesis, as shown by **Victoria Deneke** (Duke University), who discussed how the even spacing of nuclei in syncytial *Drosophila* embryos is maintained, and how it promotes their near-synchronous division (Deneke *et al.*, 2016). Multiple waves of localized cortical contraction drive cytoplasmic flows and expulsion of nuclei from the center toward the embryo poles. Actin waves were also important to the work of **Andrew Moore** (University of Pennsylvania), who described the cyclic assembly of F-actin driven by CDC42, N-WASP, and Arp2/3 (Moore *et al.*, 2016). These cyclic waves of actin assembly/disassembly drive mitochondrial motility, leading to the effective dispersion of these organelles throughout dividing cells. **Fumio Motegi** (National University of Singapore) investigated how early *Caenorhabditis elegans* embryos organize division. He showed that an Aurora-A kinase variant localizes to and promotes maturation of centrosomes, but fails to elicit cortical polarity, demonstrating that these two roles are separable.

The physical properties and spatial organization of intracellular structures was another important theme of the session. **Gautam Dey** (MRC University College London) showed how nuclear pores are specifically excluded from regions of the nuclear envelope that adopt high curvature as the nucleus divides in *Schizosaccharomyces pombe*. The mechanism of nuclear envelope resolution following "closed" mitosis in fission yeast depends on ESCRTIII complexes and lamina sealing, much like the open mitoses of animal cells. **Michael Werner** (University of North Carolina–Chapel Hill) presented observations and measurements of cyclic waves of contractility in the cytokinetic ring of the *C. elegans* zygote (Dorn *et al.*, 2016). These speed oscillations are modulated by both well-known and novel cytokinetic ring proteins, including the heterodimeric kinase complex GCK-1/CCM-3, which was found to limit both the abundance of ring structural proteins and ring speed. **Sathish Thiyagarajan** (Columbia University) built a molecularly explicit model of the *S. pombe* cytokinetic ring implementing experimentally measured data on components and their organization (Laplante *et al.*, 2016). Model results and novel experimental measurements of ring tension showed that the two myosin-II isoforms in the ring generate tension by pulling on membrane-anchored actin filaments. **Younan Li** (University of Chicago) argued for the importance of templated actin polymerization to sustain circumferential cytoskeletal alignment even as components rapidly turn over in the *C. elegans* zygote cytokinetic ring.

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