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Physical determinants of bipolar mitotic spindle assembly and stability in fission yeast[1] MEREDITH BETTERTON, ROBERT BLACKWELL, CHRISTOPHER EDELMAIER, OLIVER SWEEZY-SCHINDLER, ADAM LAMSON, ZACHARY GERGELY, EILEEN O'TOOLE, AMMON CRAPO, LOREN HOUGH, J. RICHARD MCINTOSH, MATTHEW GLASER, Univ of Colorado - Boulder — Mitotic spindles use an elegant bipolar architecture to segregate duplicated chromosomes with high fidelity. Bipolar spindles form from a monopolar initial condition; this is the most fundamental construction problem that the spindle must solve. Microtubules, motors, and crosslinkers are important for bipolarity, but the mechanisms necessary and sufficient for spindle assembly remain unknown. Here we describe a physical model that exhibits de novo bipolar spindle formation. We began with previously published data on fission-yeast spindle-pole-body size and microtubule number, kinesin-5 motors, kinesin-14 motors, and passive crosslinkers. Our model results agree quantitatively with our experiments in fission yeast, thereby establishing a minimal system with which to interrogate collective self assembly. By varying features of our model, we identify a set of functions essential for the generation and stability of spindle bipolarity. When kinesin-5 motors are present, their bidirectionality is essential, but spindles can form in the presence of passive crosslinkers alone. We also identify characteristic failed states of spindle assembly, which are avoided by creation and maintenance of antiparallel microtubule overlaps.

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