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A 3-D Biophysical Model of Mitotic Spindle Formation STUART SCHAFFNER, JORGE JOSE, Northeastern University — The mitotic spindle is the scaffolding on which plant and animal cell division occurs. It is known that under certain circumstances the spindle self-assembles, using only a few functional elements. We have been developing increasingly realistic biophysical models of spindle self-assembly. Our earlier 2-D model produced spindle patterns under certain conditions. Our more realistic 3-D model is defined by coupled Langevin equations that mimic the mechanical and thermal interactions between microtubules and molecular motors. Microtubules pivot on fixed kinesin motors and are drawn into poles by dynein motors. The distribution of pivot points form boundary conditions whose spherical asymmetry guides spindle formation. Unlike the 2-D model, the 3-D model correctly handles microtubule entanglement. Initial runs of the 3-D model show that spindle self-assembly is indeed possible under certain conditions. We are currently performing calculations to determine how parameter changes affect spindle formation and pattern morphology. In particular, we are varying dynein motor processivity, the degree of spherical asymmetry, and dynein motor concentrations.

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