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A physical model for microtubule polymerization VAHID REZANIA, JACK A. TUSZYNSKI, University of Alberta — In this work we propose a microscopic model to study the polymerization of microtubules (MTs). Starting from fundamental reactions during MT's assembly and disassembly processes, we systematically derive a nonlinear system of equations that determines the dynamics of microtubules in 3D. We found that the dynamics of a MT is mathematically expressed via a cubic-quintic nonlinear Schrodinger (NLS) equation. Interestingly, the generic 3D solution of the NLS equation exhibits linear growing and shortening in time as well as temporal fluctuations about a mean value which are qualitatively similar to the dynamic instability of MTs observed experimentally. By solving equations numerically, we have found spatio-temporal patterns consistent with experimental observations.

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