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Physical Description of Mitotic Spindle Orientation During Cell Division ANDREA JIMÉNEZ-DALMARONI, University College London, UK, MANUEL THÉRY, Laboratoire Biopuces CEA, Grenoble, France, VICTOR RACINE, MICHEL BORNENS, Institut Curie, Paris, France, FRANK JÜLICHER, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — During cell division, the duplicated chromosomes are physically separated by the action of the mitotic spindle. The spindle is a dynamic structure of the cytoskeleton, which consists of two microtubule asters. Its orientation defines the axis along which the cell divides. Recent experiments show that the spindle orientation depends on the spatial distribution of cell adhesion sites. Here we show that the experimentally observed spindle orientation can be understood as the result of the action of cortical force generators acting on the spindle. We assume that the local activity of force generators is controlled by the spatial distribution of cell adhesion sites determined by the particular geometry of the adhesive substrate. We develop a simple physical description of the spindle mechanics, which allows us to calculate the torque acting on the spindle, as well as the energy profile and the angular distribution of spindle orientation. Our model accounts for the preferred spindle orientation, as well as the full shape of the angular distributions of spindle orientation observed in a large variety of pattern geometries. M. Théry, A. Jiménez-Dalmaroni, et al., Nature 447, 493 (2007).

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