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The role of cytoplasmic proteins on cell polarity formation of asymmetric cell division

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Asymmetric cell division is one of the widespread mechanisms for generating cell diversity, for which a mother cell creates a polarity in both membrane and cytosol. In both experiment and theoretical approaches, PAR polarity of *C. elegans* embryo has been extensively well-studied and it was found that Anterior-Posterior (AP) polarity of cell membrane proteins plays a crucial role in determining cell asymmetry. However, most of previous studies have not considered the role of cytoplasmic proteins on AP polarity formation, although AP polarity is occurred with a tight regulation of both membrane and cytoplasmic proteins such as MEX-5/6 and PAR-5. Here, we develop a multi-dimensional polarity model including cell's geometrical property and show how the cytoplasmic protein plays an important role in creating a robust AP polarity. We also show that the cell geometry can give a critical effect on AP polarity, and the temporal and spatial regulation for the robust AP polarity is based on the harmony of biochemical, mechanical, and cell geometric properties.

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