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Stochastic phase of ventral furrow formation in the *Drosophila* embryo: cellular constriction chains, mechanical feedback, and robustness JERZY BLAWZDZIEWICZ, Texas Tech University, GUO-JIE J. GAO, Shizuoka University, MICHAEL C. HOLCOMB, Texas Tech University, JEFFREY H. THOMAS, TTUHSC — The key process giving rise to ventral furrow formation (VFF) in *Drosophila* embryo is apical constriction of cells in the ventral region. The constriction produces negative spontaneous curvature of the cell layer. During the initial slower phase of VFF approximately 40% of cells constrict in a seemingly random order. We show that this initial phase of VFF does not depend on random uncorrelated events. Instead, constricted cell apices form well-defined correlated structures, i.e., cellular constriction chains (CCCs), indicative of strong spatial and directional correlations between the constriction events. We argue that this chain formation is a signature of mechanical signaling that coordinates apical constrictions through tensile stress. To gain insights into the mechanisms involved in this correlated constriction process, we propose an active granular fluid (AGF) model which considers a tissue as a collection of mechanically active, stress-responsive objects. Our AGF molecular dynamics simulations show that cell constriction sensitivity to tensile stress results in formation of CCCs whereas compressive-stress sensitivity leads to compact constricted cell clusters; the CCCs, which can penetrate less-active regions, increase the robustness of the VFF process.

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