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Laser Hole-Drilling as a Probe of Morphogenetic Stresses in Embryonic Epithelia: Experimental Observations[1] XIAOYAN MA, M. SHANE HUTSON, Vanderbilt University — During the development of an organism, sheets of epithelial cells expand, contract and bend due to forces generated within the cell sheets. These forces can be probed by laser hole-drilling – a method borrowed from the analysis of residual stress in manufactured widgets – in which a laser microbeam ablates a single cell surface or the edge shared by adjacent cells. We have applied this method to the embryonic epithelia of GFP-labeled fruit fly *(Drosophila)* embryos. After ablation of one shared edge, we follow the recoil dynamics (strain relaxation) of adjacent cell edges (with time resolution down to 2 ms). The recoils show two distinct phases; and the initial recoil velocity can be consistently retrieved through a double-exponential fit. We observe a strong correlation between the initial recoil velocity and the orientation of the ablated cell edge. This correlation is particularly pronounced in embryos during late dorsal closure. Measuring orientation with respect to the long (anterior-posterior) axis of the embryo, both the recoil velocities and the distribution of cell edge orientations have sharp peaks near 30° and 150°. In early dorsal closure, the distribution of cell edge orientation has three much weaker peaks and the recoil velocities only show a weak maximum near 90°.

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