MAR16-2015-002993

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

How does the cortex get its folds? The role of tension-based morphogenesis

DAVID VAN ESSEN, Washington University in St Louis

The cerebral cortex is a sheet-like structure that is convoluted to varying degrees in different species and, for human cortex, shows remarkable variability across individuals – even in identical twins. This talk will discuss key biological events and physical forces involved in how the cortex gets its folds. The early stages of cortical morphogenesis are established by exquisitely regulated patterns of cellular proliferation and migration that place the right numbers of cells in an appropriate starting configuration. A major focus will be on the proposed role of mechanical tension in the next stages of morphogenesis. Does tension along apical dendrites of cortical pyramidal cells help make the cortex a sheet? Does tension along long-distance axons cause the cortex to fold? These are attractive but controversial ideas. I will suggest ways in which physicists can contribute critical models and analyses that may help distinguish the relative contributions of several mechanisms (differential proliferation, buckling of the cortical sheet, and tension-based cortical folding). Physicists can also help in evaluating the degree to which cortical circuits reflect principles of compact wiring and the putative role of tension-based morphogenesis in wiring length minimization.