Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

The fern sporangium: an ultrafast natural catapult XAVIER NOBLIN, LPMC, UMR 6622 CNRS-UNS, Parc Valrose, 06108 Nice cedex 2, , France, MEDERIC ARGENTINA, LJAD, UMR 6621 CNRS-UNS, Parc Valrose, 06108 Nice cedex 2, France, JARED WESTBROOK, Department of Botany, University of Florida, Gainesville, FL, 32611 USA, CORALINE LLORENS, NICOLAS ROJAS, LJAD, UMR 6621 CNRS-UNS, Parc Valrose, 06108 Nice cedex 2, France, JACQUES DUMAIS, OEB, Harvard University, 16 Divinity Avenue, 02138 Cambridge, MA, USA — Plants have developed fascinating mechanisms to create ultra fast movements that often reach the upper limit allowed by physical laws. Inspiration for new technologies is one of the reasons for the strong interest for these mechanisms, along with the deep interest of understanding complex, natural systems. The fern sporangium is a capsule that contains the spores, it is surrounded by a row of cells called the annulus which acts as a beam. Due to the water evaporation from its cells, the annulus bends strongly and induces elastic energy storage during an opening phase. The tension in the cells breaks when cavitation bubbles appear in the cells, leading to a fast release of the elastic energy. The fern sporangium then acts as a catapult which ejects rapidly its spores by closing back to the initial closed shape. We have analyzed the slow opening motion and the fast catapulting mechanism. We found that the catapult motion involves two time scales, showing a very original behavior. In man-made catapults, the recoil motion needs to be arrested by a cross bar so that the projectile is released from the arm. We show here that the fern sporangium replaces the essential cross bar by an elegant poroelastic damping, leading to a completely autonomous, efficient device.

Xavier Noblin
LPMC, UMR 6622 CNRS-UNS, Parc Valrose,
06108 Nice cedex 2, France

Date submitted: 12 Dec 2011 Electronic form version 1.4