Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

A Mathematical Model of Intracranial Saccular Aneurysms: Evidence of Hemodynamic Instability MICHAEL CALVISI, University of Colorado at Colorado Springs, STEPHEN DAVIS, MICHAEL MIKSIS, Northwestern University — Intracranial saccular aneurysms tend to form at the apex of arterial bifurcations and often assume a nominally spherical shape. In certain cases, the aneurysm growth can become unstable and lead to rupture. While the mechanisms of instability are not well understood, hemodynamics almost certainly play an important role. In this talk, a mathematical model of a saccular aneurysm is presented that describes the shape deformations of an initially spherical membrane interacting with a viscous fluid in the interior. The governing equations are derived from the equations of a thin shell supplemented with a constitutive model that is representative of aneurysmal tissue. Among the key findings are that two families of free vibration modes exist and, for certain values of the membrane properties, one family of nonspherical, axisymmetric modes is unstable to small perturbations. In addition, the presence of a vortical interior flow of sufficient strength can excite resonance of the membrane – an unstable phenomenon that might cause eventual rupture.

Michael Calvisi
University of Colorado at Colorado Springs

Date submitted: 06 Aug 2010 Electronic form version 1.4