Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Simulating Cell Deformation with Optical Forces using the Immersed Boundary Method IHAB SRAJ, University of Maryland Baltimore County, DAVID MARR, Colorado School of Mines, CHARLES EGGLETON, University of Maryland Baltimore County — The mechanical deformation of biological cells is an efficient experimental method to study the cellular properties and identify diseased cells. Optical forces have been successfully used to induce small and even large scale deformations that do not alter the cellular properties, mainly due to minimal direct contact, compared to other experimental techniques (micro-pipette aspiration, atomic force microscopy). A review on the recent advances in the area of optical cell deformation shows that a variety of deforming conditions can be imposed using different methods (optical tweezers and optical stretcher) to simulate the different biological conditions. Computational simulations, on the other hand, can be used to guide and explain the experimental observations. In this work, we will present a new numerical simulation of cell optical deformability using the immersed boundary method. Cells are considered as 3D elastic capsules immersed in a fluid. Optical forces are calculated using the ray optics technique and applied on the capsule membrane that inducing transient Stokes flow. The current study is primarily focused on the deformation of spherical cells as well as biconcave discoid representing red blood cells. The deformation pattern and relaxation time will be reported over a range of forces.

Charles Eggleton
University of Maryland Baltimore County

Date submitted: 29 Jul 2008 Electronic form version 1.4