Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Tearing of thin spherical shells adhered to equally curved rigid substrates CONNOR MCMAHAN, ANNA LEE, JOEL MARTHELOT, PEDRO REIS, Massachusetts Institute of Technology — Lasik (Laser-Assisted in Situ Keratomileusis) eye surgery involves the tearing of the corneal epithelium to remodel the corneal stroma for corrections such as myopia, hyperopia and astigmatism. One issue with this procedure is that during the tearing of the corneal epithelium, if the two propagating cracks coalesce, a flap detaches which could cause significant complications in the recovery of the patient. We seek to gain a predictive physical understanding of this process by performing precision desktop experiments on an analogue model system. First, thin spherical shells of nearly uniform thickness are fabricated by the coating of hemispherical molds with a polymer solution, which upon curing yields an elastic and brittle structure. We then create two notches near the equator of the shell and tear a flap by pulling tangentially to the spherical substrate, towards its pole. The resulting fracture paths are characterized by high-resolution 3D digital scanning. Our primary focus is on establishing how the positive Gaussian curvature of the system affects the path of the crack tip. Our results are directly contrasted against previous studies on systems with zero Gaussian curvature, where films were torn from planar and cylindrical substrates.

Anna Lee
Massachusetts Institute of Technology

Date submitted: 06 Nov 2015 Electronic form version 1.4