

# PHYSICAL MATHEMATICS SEMINAR

## Extinguishing Light with Nanoparticles: Optimal Shapes and New Fundamental Limits

**OWEN MILLER**

Massachusetts Institute of Technology

### ABSTRACT:

The scattering of light by small particles has been studied since Rayleigh's explanation for the blue sky. Metallic nanoparticles are particularly strong scatterers and absorbers, with applications ranging from obscurant smoke grenades to new cancer treatments. Recent improvements in chemical synthesis have enabled a variety of nanoparticle shapes and sizes, but there has been little theoretical treatment beyond spherical systems. We show that an unconventional eigenproblem formulation - with resonant materials instead of resonant frequencies - yields new, shape-independent upper limits on the extinction (scattering + absorption) per volume of dilute, randomly arranged nanoparticles. For many materials, we show that optimally-designed spheroids closely approach our bounds. When spheroids are not sufficient, we use large-scale computational optimization techniques to discover new, superior structures that approach the fundamental limits.

**TUESDAY, APRIL 22, 2014**

**2:30 PM**

**Building E17, Room 136**

*Reception following in Building E17, Room 401A  
(Math Dept. Common Room)*

<http://math.mit.edu/pms/>



Massachusetts Institute of Technology