Physics Colloquium
Graduate Posters
Michigan Technological University
Thursday, April 18. 2013
1:00 – 3:00 pm
Aftermath Atrium in Fisher Hall

Paleomagnetism of the Baraga-Marquette Dyke Swarms
Renee Batzloff
Advisors: Drs. Aleksey Smirnov and Will Cantrell

Abstract: It is well accepted that the geomagnetic field strength has been sufficient to provide magnetic shielding of the atmosphere and biosphere from solar radiation for at least 500 million years. The link between the strength and direction of the geomagnetic field and inner Earth processes could be the key to gaining insight on our planet's early evolution. Well-preserved extrusive Precambrian rocks are rare, but can be found in the Lake Superior region, making the Keweenaw an ideal location for ancient magnetic field studies. For this study, a total of 28 mafic dykes in the Baraga region were sampled. The collected specimens are presently undergoing thermal demagnetization treatments to determine the geomagnetic field direction at 1.1 Ga. Here we will present an outline of our research methodology and results of prior work in this region.

Observations of Cloud Droplet Size Distributions on Microphysically Relevant Scales
Matthew J. Beals
Advisor: Dr. Raymond Shaw

Abstract: Cloud droplet size distributions are obtained from reconstructed digital holograms taken by the HOLODEC II (Holographic Detector for Clouds, version 2) during the IDEAS-4 campaign. Each digital hologram encodes the image and three dimensional position of all cloud particles contained within the 15 cm^3 sample volume at the time of exposure. Through digital reconstruction techniques, particle size and position data are extracted from the hologram, and size distributions are calculated. The retrieved size distributions therefore represent particles sampled from discrete, spatially localized volumes of cloud air. The droplets are therefore microphysically connected in terms of vapor diffusion, heat transfer, and collisions. These size distributions are compared with data recorded by other optical cloud probes that flew aboard the NCAR C-130 during IDEAS-4. Size distributions were obtained under a variety of conditions, including developing cumulus, stratocumulus, and mixed phase clouds in a storm system. Size distributions and related parameters derived from HOLODEC II data are compared with those obtained by other instrumentation to gauge performance in regions of uniform cloud and to investigate variability across cloud edges and the role of spatial averaging.

Morphology of Aerosol Particles at Freeway On-Ramps
Swarup China
Advisor: Claudio Mazzoleni

Abstract: Atmospheric aerosols impact the environment and climate by affecting Earth's radiation balance, cloud formation and atmospheric chemistry. Vehicles are the dominant source of pollution in urban environments. Diesel and gasoline particulate matter emissions are primarily composed of agglomerated soot particles and volatile organic and sulfur compounds. The morphology of atmospheric particles influences their optical properties and therefore their radiative forcing; the morphology also affects the particles' transport and lifecycle. In this study we investigated morphological and structural properties of road-side aerosol particles at cloverleaf freeway on-ramps in the Detroit–Ann Arbor geographical area.

A Multi-Band, Unidirectional Invisibility Cloak Based on Optical Design
Ran Duan
Advisors: Drs. Ravindra Pandey and Elena Semouchkina

Abstract: The work on the transformation optics and the conformal mapping inspires the research on the invisibility cloak for years. However, the parameters of the materials' properties are required to be spatially dispersed and even singular sometimes mathematically, which is difficult to implement. A microwave transmission cloak composed of lenses is proposed and designed based on the method of the optical design. For the wave propagating in the principle axis direction, the cloaking effect is achieved and demonstrated by full wave simulation. Compared with the scattering cross width (SCW) caused by a conductive circular object which can be concealed by this cloak, the SCW of the cloaked object achieves significant reduction at multiple bands.

Fast Imaging of Freezing Drops: Studies of Contact Nucleation
Colin Gurganus
Advisor: Dr. Raymond Shaw

Abstract: Contact nucleation remains enigmatic and our approach utilizes simple experiments to disentangle several competing hypothesizes. To that end, the focus of our initial study was droplets in a spherical cap geometry resting on homogeneous and atomically smooth silicon substrates [Gurganus, Kostinski and Shaw, 2011]. Observations of the nucleation sites in these slowly cooled systems revealed no preference for nucleation at the triple line, a surprising null result. It remains unclear to what extent morphology, texture and heat flux influence the nucleation rate in other non-idealized systems. Here we report on the modification of our experiment to examine these parameters in more detail.

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