

B - Biology
132 Noyes
2:00 - 2:20 PM

Daniel Nedelcu
Massachusetts Institute of
Technology

A Computationally-Biased
Directed Evolution Approach
Applied to GFP

Stephen L. Mayo
*Professor of Biology and
Chemistry; Associate
Investigator, Howard Hughes
Medical Institute*
Thomas Treynor
*Postdoctoral Scholar in
Chemistry*

DARPA Grand Challenge
Poster Session
Glanville Courtyard,
Beckman Institute
12:00 - 2:00 pm

Lisa K. Nyström
Lund Institute of
Technology

System Level Analysis for
DARPA Grand Challenge

Richard M. Murray
*Professor of Control and
Dynamical Systems*
Lars B. Cremean
*Graduate Student in
Mechanical Engineering*

C - Chemistry
147 Noyes
1:00 - 1:20 PM

Angela C. Olson
Northern State University
*Howard Hughes Medical
Institute MURF Fellow*

Progress Towards the Total
Synthesis of
Cylindrocyclophane A:
Synthesis of Suzuki Cross-
Coupling Fragment
Potassium Trifluoroborate

David W.C. MacMillan
Professor of Chemistry
Nicole Goodwin
Graduate Student in Chemistry

E - Geological and
Planetary Sciences
Beckman Institute
Auditorium
3:10 - 3:30 PM

Darren Pais
Saint Louis University

Unusual Configurations of
Layers Within the North
Polar Cap of Mars

Bruce C. Murray
*Professor of Planetary Science
and Geology, Emeritus*
Asmin Pathare
*Postdoctoral Scholar in
Planetary Science*

G - Physics, Mathematics,
and Astronomy
125 Baxter
1:40 - 2:00 PM

Robert F. Penna
University of Rochester

Optical Variability in Massive
Black Hole Mergers

E. Sterl Phinney
*Professor of Theoretical
Astrophysics*
Milos Milosavljevic
*Sherman Fairchild Postdoctoral
Scholar in Theoretical
Astrophysics*

E - Geological and
Planetary Sciences
Beckman Institute
Auditorium
3:50 - 4:10 PM

James R. Perkins
Coastal Carolina University

Missing ECMWF Ozone Data
and Its Reintegration Into the
Datasets

Yuk L. Yung
Professor of Planetary Science
Dong L. Wu
Research Scientist, JPL

M - Control and Dynamical
Systems/Mechanical
Engineering
33 Baxter
3:30 - 3:50 PM

**Pedro Miguel D. Pinto de
Almeida**
University of Portugal

Strategy Interfaces for Multi-
Robot Games (RoboFlag):
Game Data Abstraction and
Representation

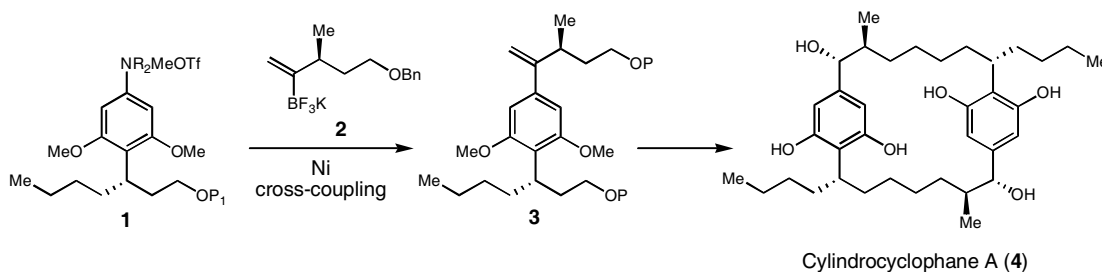
Richard M. Murray
*Professor of Control and
Dynamical Systems*

Progress Towards the Total Synthesis of Cylindrocyclophane A: Synthesis of Suzuki Cross-Coupling Fragment Potassium Trifluoroborate

Angela Olson

Mentor: David MacMillan

Cylindrocyclophane A **4** belongs to a family of natural products bearing 22-membered [7,7]-paracyclophane rings. These cylindrocyclophanes display a toxic effect against the KB and LoVo tumor cell lines. This project focuses on the development of a suitable synthetic route for the Suzuki cross-coupling fragment potassium trifluoroborate **2**. The synthesis features asymmetric enantioselective organocatalytic methods developed within the MacMillan group.



Unusual Configurations of Layers Within the North Polar Cap of Mars

Darren Pais

Mentors: Bruce Murray, Asmin Pathare, and Shane Byrne

Understanding erosion and deformation of the Martian North Polar Layered Deposits (NPLD) may provide critical insight into the Martian global climatic processes. Troughs in the NPLD, on which detailed layering is exposed, can appear straight, curved, offset or divided. Here we examine small-scale variations in layer properties within these troughs, over distances of 20 to 40 kilometers, using digital elevation models from Mars Orbiter Laser Altimeter data and high resolution images from the Mars Orbiter Camera and from the Thermal Emission Imaging System. Three-dimensional reconstructions, layer traces and planar approximations constructed to study variations in layer stratigraphy reveal an interesting 'wrinkle'-shaped feature at the junctions of multiple offset troughs. This phenomenon seems restricted to offset troughs in the quadrant of the NPLD bounded by the 270E and 0E longitudes. Planar approximations for layers in these troughs show distinct deviations from the plane at the offset, in contrast to layers in straight-lying troughs that can be well-approximated with planar fits. This indicates either intense deformation or erosion that appears to be localized in the vicinity of the offsets. Future investigations using data from orbital subsurface radar sounders may help discriminate which of these processes is primarily responsible for the observed layer stratigraphy.

Optical Variability in Massive Black Hole Mergers

Bob Penna

Mentors: E. Sterl Phinney and Milos Milosavljevic

Binary supermassive black holes are expected to form in galactic mergers. The black holes in the binary may ultimately coalesce, emitting gravitational waves. Any cold gas attempting to accrete onto the black holes forms a circumbinary accretion disk. Coalescence of black holes in general relativity is accompanied by radiation recoil and the loss of a few percent of the total black hole mass to gravitational waves. We study the response of the accretion disk to these processes. The reduction in total black hole mass due to gravitational wave losses excites an axisymmetric wave in the disk. Radiation recoil drives asymmetric waves and warps in the outer disk. These distortions to the disk cause the spectrum of thermal continuum radiation observed from the disk to vary. Detection of the optical counterpart to coalescence will help pinpoint the sources and redshifts of these massive black hole binary coalescence events. This information can be used to map the distance-redshift relation over a large span of redshift and observationally probe the dark energy equation of state.

Missing ECMWF Ozone Data and Its Reintegration Into the Datasets

James Perkins

Mentor: Yuk L. Yung