

# Physics News

MICHIGAN TECH PHYSICS DEPARTMENT NEWSLETTER

Fall 1999

Volume 2, No. 1

## A note from the Chair

*By Dr. J. Bruce Rafert  
Professor and Chair*



Faculty, Students, and Alumni:

The past year has seen an explosion of outstanding developments for the physics department. We now lead the college in research expenditures, have started the last year that MTU will be on quarters with an exceptionally strong first year class of students, and have continued to hire faculty who have national and international leadership roles in research, and scholarship.

Perhaps most importantly, physics has emerged as one of the premier departments at MTU, and will be prominently featured in the new proposed Center for Integrated Learning and Information Technology (CILIT for short) -- more than doubling our current size if this project is successful. This is a critical moment when we stand poised to develop Michigan's best instructional program, and I hope you will all be willing to assist us in this effort (see tear-card for CILIT Project).

*-jbrafert@mtu.edu*

***View the Physics Department course offerings  
located at  
<http://www.admin.mtu.edu/em/student>***

## Current Research: Dr. Christ Ftaclas

*By Christ Ftaclas  
Associate Professor*



In astronomy whenever we develop any new observational capability we strive always to open some new window in observational parameter space. That is, we try to explore a new wavelength region or some new domain of spectral or spatial resolution. Experience has shown that this not only yields the science initially sought but generally new and unanticipated results as well. My research has been mainly focused on this kind of instrumental advance but not in a new resolution or wavelength regime but rather in imaging in a part of the sky that until recently was virtually un-probed by direct means at any wavelength. The target is the halo region immediately surrounding any bright source.

The few square arc seconds of the circumstellar halo take up so little of the sky, yet this region is disproportionately rich with astronomical importance and potential. It is here that we need to look in order to understand how planetary systems are formed and to search for extrasolar planets and brown dwarfs. Also, it is here that the nature of the central regions of quasar host galaxies remains hidden. Every faint or unseen companion problem as well as evolution of binaries and the nature of the low end of the mass stellar spectrum can be addressed by direct imaging in the circumstellar region. These problems are fundamental to our understanding of the universe.

The problem of imaging in the stellar halo is twofold. First, it is like looking into a bright light so we are essentially "blinded" to fainter objects near a bright central

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# Current Research

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source. Second, the objects of greatest interest, sub-stellar companions are intrinsically faint. We could somehow cover up, or occult the bright star but the background would remain unchanged at the location of the source we are looking for. It is essential to lower the stellar background without compromising the source you are looking for. We are developing an instrument that can do this called the Stellar Coronagraph. It was invented by Bernard Lyot in the early 1930's for examining the corona of the Sun but was later adapted for stellar applications. Some time ago I led a team that found that the performance of the instrument could be greatly enhanced which enabled direct imaging of extrasolar planetary systems (<http://www.phy.mtu.edu/~cftaclas/>).

The stellar halo consists of light that is scattered and diffracted from the central star. For space systems scatter introduced by fabrication and alignment errors in the telescopes optical system. For ground-based systems, scatter is dominated by the large phase errors introduced by the turbulent atmosphere. The coronagraph has very different actions and advantages in these two regimes. Unlike most optical instruments it is a fully diffractive system. It is a Fourier filter that allows suppression of the stellar halo while leaving off-axis sources intact. Figure 1 below illustrates the extreme performance that is capable in the diffraction-limited regime using a laboratory built instrument.

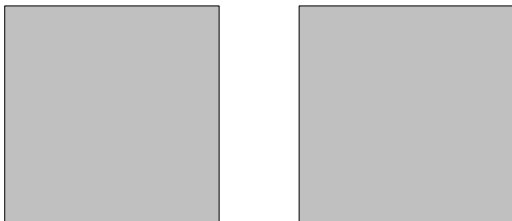


Figure 1. The negative images above were taken with a laboratory coronagraph. The image on the left has been occulted by a tapered transmission occulting mask but the rest of the instrument is not in place. In the figure on the right the full instrument is in place. The difference in the exposure parameters of the two images is such that if the exposure on the left is 1 second, the one on the right would be 25 minutes.

The search for extrasolar planets: <http://wwwusr.obspm.fr/departement/darc/planets/encycl.html> is, in many ways, the defining problem for coronagraphs. To date several planetary systems have been found: (<http://cannon.sfsu.edu/~gmarcy/planetsearch/planetsearch.html>), but they have all been detected by indirect means that measure the recoil velocity of the star as the planet orbits

it. Imaging is an essential adjunct to this method because radial velocity techniques are biased towards fast moving systems, that is, planets in close orbits. The planets found to date are all giant planets very close to their parent stars unlike our own Solar System. Imaging, on the other hand, is biased towards planets in larger orbits, more like our own system.

Right now we are working on an interesting array of instruments that either are dedicated coronagraphs or will contain a coronagraphic channel. At NASA's Infrared Telescope Facility (<http://irtf.ifa.hawaii.edu/>) on Mauna Kea I have collaborated with Bob Brown of the University of Arizona to add a cryogenic coronagraphic relay to the facility camera. We have been doing exciting work with this instrument and one of our images was recently selected for the cover of a report to the National Research Council (<http://www.nas.edu/ssb/wsmomenu.htm>). At Mount Wilson (<http://www.mtwilson.edu>) we are adding a visible light coronagraphic channel to the 100 inch telescope. This historic telescope was first used by Hubble to show that the universe was, indeed, made up of many individual galaxies. It has found new life with the addition of one of the world's few visible light adaptive optics systems. Working with Doug Toomey at Mauna Kea Infrared we are currently in the study phase of a Near Infrared Coronagraphic Imager (NICI) for Gemini South nearing completion in Chile. Gemini (<http://www.us-gemini.noao.edu/>) is an international project to build twin eight meter telescopes on Mauna Kea and in Chile. Working with Charles Telesco (U. of Florida) we are currently studying Canarycam, a mid infrared camera that will contain a coronagraphic channel and will be the first instrument built for the Gran Telescopio Canarias (<http://www.iac.es/gabinete/grante/gtc1.html>) being built in the Canary Islands by the Spanish government. This will be a ten-meter class telescope closely based on the Keck Telescopes in Hawaii. We expect to begin work on these last two instruments during 2000.

-cftaclas@mtu.edu

## New Ph.D. Candidates

Chen Chen  
Alexei Dorofeev  
Chunming Gao  
Da Gao  
Martin Patton  
Zhouxuan Teng  
Michael Tews  
Aaron Wilson  
Changgong Zhou



# Society of Physics Students-MTU Chapter

The SPS had its first meeting for the school year Sept. 21 and there were quite a few new faces interested in SPS activities. We are planning on doing the usual activities such as scoop sales, softball games, and student/faculty luncheons and mixers. This year however, we are going to focus on doing projects that are physics related. Members of SPS will come up with project ideas and we will discuss which ones we want to work on. Some ideas that have come up already are building a rail gun, and a large Tesla coil. I'm sure we will have more ideas at our next meeting. Through the building of projects SPS will become more active than it has been in the past and will pull more physics majors together in the interest of physics.

## Recent Degree Recipients

### Fall 1998 - Spring 1999

Suresh K. Sampath, Ph.D.

Charles Fachting, BS

Annikka M. Kendall, BS

Stacy A. Lybert, BS, Cum Laude

Ryan J. Ringle, BS, Magna Cum Laude

Jeremy D. Rogers, BS Cum Laude

Kimberely J. Wegner, BS, Cum Laude

## Department Update

Pamm Besmer who worked as a secretary in the Physics Department for several years, has accepted a 9-month position in the Social Sciences Department at MTU. Congratulations and best wishes Pamm!

Mary (Marg) Rohrer has joined the Physics Department as a secretary. Marg previously worked as a secretary in the Seaman Mineral Museum at MTU. Welcome to the department Marg!

## The Physics Learning Center

The Physics Learning Center (PLC) provides a safe and studious atmosphere for students and coaches. The PLC also provides an alternative work environment for students that desire this form of tutelage. Successful students who are able to communicate their knowledge of physics and related topics staff the PLC. The main purpose of the coaches is to help students learn problem solving skills and test taking skills, as well as help students establish stronger study habits. These services are provided through a variety of services that consist of appointments, teams, and walk-in sessions.

The PLC concentrates its attention on PH204 and PH205, although when available coaching for PH201, PH203, PH206 and PH310 is available.

The demand for the PLC has risen this year from 50 weekly appointments last year to over one hundred this year. Unfortunately team usage has seen a decrease this year, three teams were cancelled due to insufficient interest from students. The walk-in hours have also seen a marked increase in usage and the PLC has had to respond by staffing more coaches at these times. The walk-in hours are Monday-Thursday 3:00 - 5:00 p.m. and 7:00 - 9:00 p.m.

Due to increased support from the University and the department, along with exceptional dedication from the coaches and our wonderful advisor, Dr. John Jaszczak, everything seems to be coming together for a great year!

For more information, see our web site at [www.phy.mtu.edu](http://www.phy.mtu.edu) or contact Head Coach David Oros by email at [dporos@mtu.edu](mailto:dporos@mtu.edu).



## Thanks!

We offer our deepest thanks to friends and alumni who have made a recent contribution to the department. We appreciate your continued interest in the Department of Physics at Michigan Technological University

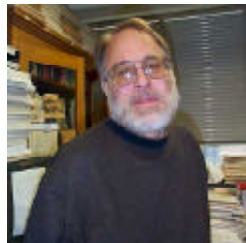
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## Faculty Spotlight

*Donald R. Beck*  
*Professor, Ph.D.*  
*Lehigh University, 1968*  
*Atomic and Molecular Physics*



Professor Beck is one of the nation's leading theoretical physicists in the area of computational atomic and molecular physics, and is an expert in the construction and application of large computational code for studies of complicated atoms.

Research Award, 1991

*-donald@mtu.edu*

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gmgoudge@mtu.edu

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