

Mercedes Richards, Professor

Exoplanets and Brown Dwarfs

1. Questions and Objectives

The primary focus of the research performed by Dr. Mercedes Richards is to develop a better understanding of the process of mass transfer in interacting binaries and the influence of magnetic activity on the accretion process. She has employed a multifaceted approach to model and create images of the accretion flows in interacting binaries. Such accretion flows occur in a wide variety of systems, including compact binaries (novae, dwarf novae, polars, X-ray binaries), non-compact systems (e.g., Algols), and accreting brown dwarfs. Her work has focused on binaries which contain a hot blue main sequence star with a cool magnetically-active companion that fills its Roche lobe (Algols), and also the detached magnetically-active RS CVn binaries in which no Roche lobe overflow is expected. The non-compact Algol binaries are in the slow phase of mass transfer and are not usually associated with violent phenomena, hence they provide a unique environment in which we can observe mass transfer by Roche lobe overflow. Moreover, since the mass-losing star is magnetically-active, the influence of magnetic fields on the mass transfer process can also be examined. Dr. Richards has studied cycles of magnetic activity on cool stars in binaries and also long term magnetic cycles on the Sun.

Dr. Richards has used tomography, hydrodynamic simulations, as well as observed and synthetic spectra to study the accretion structures in non-compact binaries, to understand the physical processes that influence the flow of gas between the stars, and to produce 3D velocity images of these gas flows. Her research encompasses the disciplines of Stellar Astrophysics, Computational Astrophysics, Exoplanets and Brown Dwarfs, and Astrostatistics

2. Discoveries and Milestones

In the specific area of Exoplanets and Brown Dwarfs, Dr. Richards has organized a conference entitled “From Interacting Binaries to Exoplanets: Essential Modeling Tools,” to be held at the Astronomical Institute of the Slovak Academy of Sciences in Tatranska Lomnica, Slovakia, from July 18-22, 2011. The goals of the conference are to unite the exoplanet and binary star communities to discuss the many imaging techniques, modeling codes, and computational tools that are in common use for the study of interacting binaries, brown dwarfs, and exoplanets. This historic meeting will spark a significant advance in the tools that are used to study stellar astrophysics. The International Astronomical Union (IAU) has recognized the importance of this conference and has selected it as one of the nine IAU Symposia to be held in 2011; it is listed as *IAU Symposium 282*.

Richards and her collaborators

(1) organized IAU Symposium 282 on Essential Modeling Tools used to study of exoplanets, brown dwarfs, and interacting binaries. The conference website is <http://www.astro.sk/IB2E/> . Dr. Richards is the Chair of the Scientific Organizing Committee for this conference.

(2) studied the spectra of brown dwarfs in eclipsing binary systems.

3. Current Exoplanet and Brown Dwarf Projects

Active research projects of interest to graduate students:

(1) Analysis of optical and near IR spectra of brown dwarfs and low mass objects to explain the large amplitude, partly irregular, photometric variations that have been detected in these systems.

4. Participants/Personnel (last 5 years)

Senior Researchers: Jan Budaj, Alon Retter, Elena Slobounov (Research Computing & Cyber-infrastructure)

Graduate Students: Megan Comins, Brendan Miller, Manodeep Sinha

Undergraduate Students: Michael Rogers, Tae, Kang, Derek Einsig, Michael Peth, John Fisher

5. Student Highlights:

6. Links:

Home page: <http://www.astro.psu.edu/users/mrichards/>

Research page: <http://www.astro.psu.edu/users/mrichards/webpage/research.html>

Publications: <http://www.astro.psu.edu/users/mrichards/webpage/papers.html>

Shellspec code: <http://www.ta3.sk/~budaj/shellspec.html>

International Conference: 2011 July 18 – 22, IAU Symposium 282, “From Interacting Binaries to Exoplanets: Essential Modeling Tools,” Tatranská Lomnica, Slovakia (www.ta3.sk/IB2E/)

Press Release: 2003 Aug. 22 on “Major Flares are Predictable on Far-Away Stars, Analysis of Radio Observations Reveals,” Office of Public Relations, Eberly College of Science, Penn State University. (<http://www.science.psu.edu/alert/Richards8-2003.htm>)

2009 July 30: “Stellar Detective: A Profile of Professor Mercedes Richards,” Penn State Live, Penn State University. (<http://live.psu.edu/story/40752/nw63>)

Other links:

<http://www.rps.psu.edu/unplugged/spring09/March25.html>

<http://www.rps.psu.edu/unplugged/spring09/richards.html>

<http://www.rps.psu.edu/0405/flares.html>

<http://www.rps.psu.edu/probing/pluto.html>