2006 NC Astronomers' Meeting

Saturday, 30 September, Elon University

Presented by Guilford Technical Community College and Elon University
In conjunction with the Fall 2006 NCS-AAPT/SPS Meeting

8:00-9:00 **Registration, Coffee (McKinnon D)**

9:05 -10:00 **NCA Oral Session I (Koury Business Center 101)**

- **Welcoming Remarks**
- ***Revealing the Structure of Dusty Environments of Hot Pre-Main-Sequence Stars***
  Anatoly Miroshnichenko, UNC-Greensboro
- ***Accretion Rate Measurements of Young Stars: An Observational Test of "Disk-locking" Theory***
  Claude Mack, UNC-Chapel Hill
- **1-minute Poster Summaries**

10:05-10:45 **NCS-AAPT & SPS & NCA Display Session (Moseley Center – McKinnon D)**

10:45-11:45 **SPS & NCA Plenary Session (Koury Business Center 101)**

- ***A Milisecond Pulsar (and Basic Physics) Bonanza with the GBT***
  Scott Ransom, NRAO

11:45-1:00 **Lunch**

1:00-2:00 **NCA Oral Session II (Koury Business Center 101)**

- ***Theoretical Beam Patterns of a 26m Radio Telescope With Various Feed Systems***
  Anna Castelaz, UNC-Asheville
- ***The Pisgah Astronomical Research and Science Education Center (PARSEC)***
  Chuck Bennett, UNC-Asheville
- ***Central Stars of Propylds***
  Mike Castelaz, Pisgah Astronomical Research Institute
- ***Gamma-Ray Blazars: Past and Future***
  Steve Bloom, Hampden Sydney College

2:00-2:15 **Break**

2:15-3:15 **NCS-AAPT Contributed Papers Session C: Astronomy/Relativity Pedagogy (Moseley Center – McKinnon E)**

- ***Critical Thinking in Introductory Astronomy***
  Joe Heafner Catawba, Valley Community College
- ***Mining the Sloan Digital Sky Survey at Cape Fear High School***
  Harlan Devore, Cape Fear High School
- ***Open Source Physics Curriculum Material for Relativity***
  Wolfgang Christian, Mario Belloni, Davidson College
- ***Physics 'N' Eggs***
  John Hubisz, North Carolina State University

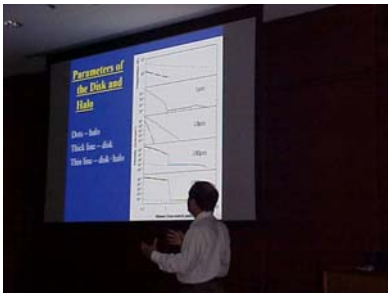
3:20-4:00 **Oral Session III (Koury Business Center 101)**

- ***GRBFast: Modeling Afterglows with Bayesian Inference and Genetic Algorithms***
  Drew Foster, UNC-Chapel Hill
- ***Remote Observing with Skynet: Introduction and Updates***
  Kevin Ivarsen, Dan Reichart, UNC-Chapel Hill

NCA Oral Session I — 9:05-10:00, Koury Business Center 101

Welcoming Remarks

Revealing the Structure of Dusty Environments of Hot Pre-Main-Sequence Stars
Anatoly Miroshnichenko, UNC-Greensboro



The questions of whether hot stars can form planets and how their dusty environments differ from those of solar-like stars at early stages of evolution are still unknown issues in modern astrophysics. Two different geometries have been proposed to explain the dust emission from hot pre-main-sequence stars: flared disks and ``classical'' geometrically-thin optically-thick disks embedded in optically-thin halos. I will discuss the main observational features that give us information about the circumstellar dust geometry and highlight what each of the models is capable of explaining. I show that only imaging observations can differentiate these two morphologies, while flux measurements can never distinguish between them. A model constructed with one geometry implies an equivalent model with the other that produces the identical flux at every wavelength.

Accretion Rate Measurements of Young Stars: An Observational Test of "Disk-locking" Theory
Claude Mack, UNC-Chapel Hill

Classical T Tauri Stars (CTTS) shed a considerable amount of their angular momentum as they evolve into zero-age main sequence (ZAMS) stars. One of the dominant theories for explaining this phenomenon is the disk-locking theory, which describes the interaction between a star's magnetic field and the circumstellar disk as a braking mechanism that transfers angular momentum from the star to material in the disk. The field lines dig into the disk and accrete material onto the star, simultaneously expelling other material and thereby removing angular momentum from the star. For this model of young stars and disk interaction, there exists a simple theoretical relationship between five key parameters: the stellar radius, the stellar mass, the rotation period, and two parameters related to accretion, namely the accretion rate and the filling factor. In order to take advantage of this relationship, we observed approximately 100 young stars in the Orion Nebula for which the first three parameters are already known. The accretion parameters can then be determined by analyzing and modeling the star's spectrum in the region of the Balmer jump (3646 A). Therefore, all that remains is to input the observed values in the theoretical equation and thereby perform a critical observational test of disk-locking theory.

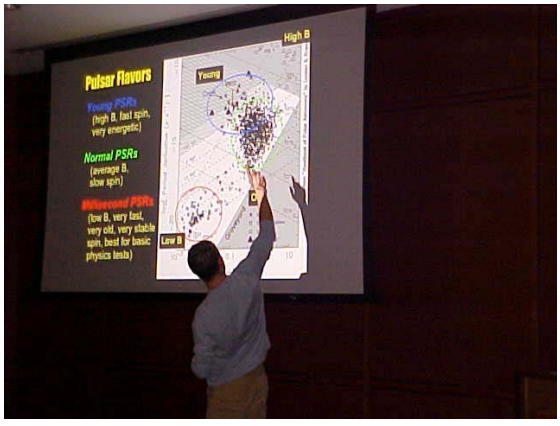
1-minute poster summaries

Display Session
10:05-10:45

Abstracts are listed at the end of this document.

Invited Presentation — 10:45-11:45, Koury Business Center 101

A Millisecond Pulsar (and Basic Physics) Bonanza with the GBT
Scott Ransom, NRAO



In the past 5 years, the Green Bank Telescope (GBT) has discovered at least 60 new radio pulsars in globular clusters, effectively doubling the number known. The vast majority of these new systems are millisecond pulsars and about half of them are members of binaries. The rich cluster Terzan 5 alone now contains 33 known millisecond pulsars -- by far the most of any globular cluster. Many of the pulsars are truly unique and/or exotic objects that could only have been produced in dense cluster cores after stellar interactions. Some of the stranger systems include the fastest known spinning neutron star (PSR J1748-2446ad at 716 Hz), 9 highly eccentric binary systems, at least 5 eclipsing systems, and 2 millisecond pulsars which seemingly have main-sequence-like stellar companions. Several of these pulsars constrain the equation of state of matter at supra-nuclear densities, while others will eventually provide masses of spun-up neutron stars and interesting tests of gravitational theories. In addition, the pulsars will allow us to probe a wide variety of other astrophysics such as eclipse mechanisms, cluster dynamics, and the structure of the interstellar medium.

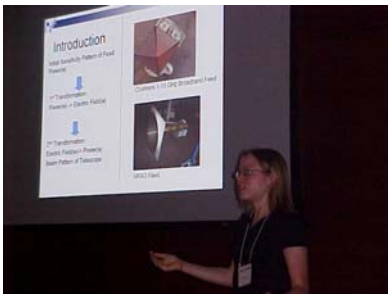
Dr. Scott Ransom is an associate astronomer at the Charlottesville, VA center of the National Radio Astronomy Observatory. He studies pulsars, which are exotic remnants of exploded stars. His research has turned up dozens of pulsars in dense clusters of stars, and his group recently announced the detection of the fastest spinning pulsar yet observed.

Originally from Ohio, Scott Ransom received his BS in physics from the U. S. Military Academy at West Point, and served five years as a field artillery officer. He received Master's and Doctoral degrees from Harvard University, and worked three years as a Post-doctoral Research Fellow at McGill University in Montreal, before coming to the NRAO in 2004. Scott lives in Charlottesville, VA, with his wife and two children, and when he's not discovering pulsars, he enjoys hiking and rock climbing.

For more information about Dr. Ransom and his research, visit his web site, read his Curriculum Vitae, or see a list of his publications.

NCA Oral Session II 1:00-2:00, Koury Business Center 101

Theoretical Beam Patterns of a 26m Radio Telescope With Various Feed Systems
Anna Castelaz, UNC-Asheville



My objective was to calculate theoretical beam patterns of the two 26m radio telescopes located at Pisgah Astronomical Research Institute (PARI) using various feed systems available in the near and long term. These include both NRAO feeds currently at PARI on loan from Green Bank and feeds newly developed at Chalmers University of Technology in Sweden. Using known sensitivity patterns collected from laboratory testing of the feeds, I calculated the theoretical beam pattern of a 26m telescope using the feed under consideration. We plan to use these feeds in the instrumentation under development through Pisgah Astronomical Research and Education Center (PARSEC) for the 26m meter telescopes at PARI. This work was carried out through the 2006 PARSEC Internship Program, and was supported by NASA Award NNG05GQ66, the North Carolina Space Grant, and the Glaxo-Wellcome Endowment at UNCA.

The Pisgah Astronomical Research and Science Education Center (PARSEC)
Chuck Bennett, UNC-Asheville

PARSEC is an inter-institutional center of the UNC System with a mission to facilitate collaborations with the Pisgah Astronomical Research Institute (PARI). Potential participants include UNC constituent institutions, K-12, and through a proposed affiliates program, community colleges, privates, and public institutions from other states. PARSEC can provide collaboration opportunities that enhance competitive funding applications, access to PARI instrument facilities for feasibility studies, and assistance with negotiating discounts to the posted PARI facility rates. For more information, see http://parsec.unca.edu/.

Central Stars of Propylds
Mike Castelaz, Pisgah Astronomical Research Institute

The Orion proplyds are of astrophysical interest because they offer a unique opportunity to study important aspects of protostellar and protoplanetary evolution. Proplyds offer the only opportunity known in which to study the effects of external ionization on this phase of young stellar object disk evolution in an external environment like that of the early Solar System. Most proplyds have central stars or starlike objects visible in HST WFPC V continuum or narrow-band filters. No optical spectra of these stars have yet been published. The physical properties of the central stars are of interest in fully understanding these systems. Some of the observable IR SED of the disk comes from reprocessed emission from the central star and thus depends on central star properties. Also, accretion rates and disk lifetimes are affected by the mass of the central star. We obtained one spectrum each of three central stars (218-354, 164-510, and 171-340) using the HST STIS instrument. With a spatial resolution of 0.05 arcsecond per pixel STIS easily resolved the central star in all three objects. A preliminary report was made at the NC Astronomers Meeting in 2004. We have since completed our analysis and will report on the spectral types, masses, and luminosities for the three central stars.

Gamma-Ray Blazars: Past and Future
Steve Bloom, Hampden Sydney College

I will begin by reviewing the blazer phenomenon and the results of Compton Gamma-Ray Observatory, including recent models. I will follow with my own recent analysis regarding the statistics of these sources, and then finally discuss prospects with the next mission, GLAST, due for launch next year.

NCS-AAPT Session C: Astronomy/Relativity Pedagogy
2:15-3:15, Moseley Center - McKinnon E

Critical Thinking in Introductory Astronomy
Joe Heafner Catawba, Valley Community College
Most introductory science courses advertise critical thinking, but my observations indicate that very few courses actually spend any time developing the skills necessary to approach science. In this talk, I will outline the approach I have taken to build critical thinking skills in CVCC's introductory astronomy courses. Sample materials will be available.

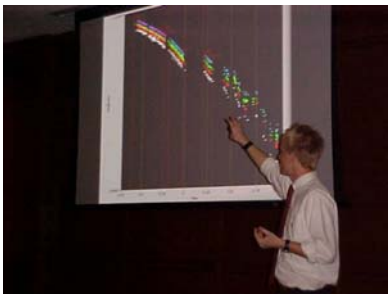
Mining the Sloan Digital Sky Survey at Cape Fear High School
Harlan Devore, Cape Fear High School
Some Cape Fear High School students don't just learn about science -- they learn science by becoming research scientists. Using astronomical images, our research students have found new supernovae, recovered and measured Near Earth Objects, and found new asteroids. We mine astronomical data bases such as Sloan Digital Sky Survey to do authentic research projects. Last year, we found a new way to measure Hubble's constant, measured galaxy metallicity, and searched for hidden blazars. We learn science by doing science!

Open Source Physics Curriculum Material for Relativity
Wolfgang Christian, Mario Belloni, Davidson College
There are many reasons to create computer-based material for relativity. Special and general relativity are full of (apparent) paradoxes, and, like quantum mechanics, captivate students' interest in physics. We report on the development of new Open Source Physics (OSP) simulations and curricular material created for the exploration of relativity. Examples, including the gravitational red shift and the trajectories of particles and light rays in the vicinity of non-spinning and spinning black holes, will be shown. Additional examples are available at: http://www.opensourcephysics.org/. Partial funding for this work was obtained through NSF grant DUE-0442581.

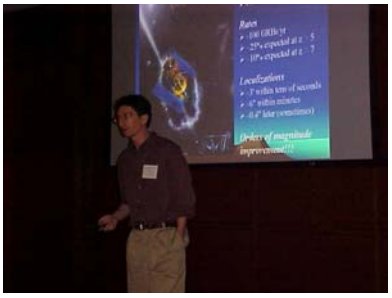
Physics 'N' Eggs
John Hubisz, North Carolina State University
Do you have a demonstration for a neutron star? Would you like a couple of experiments that can be eaten afterwards? How about introducing some humor into the classroom?

NCA Oral Session III — 3:20-4:00, Koury Business Center 101

GRBFast: Modeling Afterglows with Bayesian Inference and Genetic Algorithms
Drew Foster, UNC-Chapel Hill
We present GRBFast, a data modeling software package, which combines elements of Bayesian inference and a genetic algorithm to fit complicated models to large Gamma Ray Burst (GRB) data sets We will use this application to study the physical mechanisms at work in GRB afterglows by examining their chromatic and temporal characteristics. We also present preliminary results for our modeling efforts of GRB 060206.



Remote Observing with Skynet: Introduction and Updates
Kevin Ivarsen, Dan Reichart, UNC-Chapel Hill
Skynet is a network of robotic telescopes operated by several groups and coordinated by the University of North Carolina. The driving motivation of Skynet is to perform rapid follow up of GRBs in many filters simultaneously. However, the system is also heavily used by observers who submit jobs and retrieve data through our web site. We will give an introduction to Skynet operation, and report on new and upcoming hardware and software features.



A brief workshop was set up after this presentation – for further demonstration of Skynet and for establishing accounts.

The 2006 NC Astronomers' Meeting is being held jointly with the Fall NCS-AAPT/SPS Meeting at Elon University. The program for the NCS-AAPT/SPS Meeting can be found at the event web site: http://org.elon.edu/ncsaapt/index.html. Maps and directions to the meeting are also available there.

NCA Display Abstracts

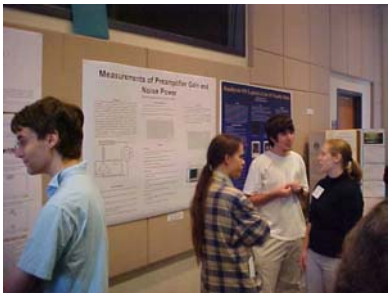
Daytime Utilization of a University Observatory for Laboratory Instruction
John Mattox, Fayetteville State University
Scheduling convenience provides a strong incentive to fully explore effective utilization of educational observatories during daylight hours. I present two compelling educational activities: daylight observation of Venus, and the use of a CCD camera to determine the surface temperature of a sunspot. With a clear sky, and when its elongation exceeds ap. 10 degrees, Venus is apparent in the daytime sky once a telescope is pointed at it. This can be accomplished either with a digital pointing system, or with setting circles on an equatorially mounted telescope using the Sun to initialize right ascension. Using the telescope pointing direction as a reference, it is then also possible under good circumstances for students to see Venus in the daytime sky with their naked eyes. Students may use a CCD image to estimate the sunspot temperature using the nominal surface temperature of the Sun, the Stefan-Boltzmann law, and the ratio of the intensity of the sunspot surface to that of the adjacent normal surface.

Space and Atmospheric Facility at North Carolina A&T State University
Jyoti R. Nair, N. C. A&T State University
The Study of Space and Atmospheric Physics is planned at Department of Physics, NC A&T State University, NC, to meet the needs of the minority community to build a general capability in atmospheric/space science as a necessary support for academic infrastructure development. This course is intended for graduate and undergraduate students who wish to pursue research in space/atmospheric physics. In order to fortify this effort, we have initiated a collaborative work with US Air Force and GSFC, NASA. The main rationale of this proposed project work is to investigate the current scientific issues associated with Magnetosphere-Ionsophere-Thermosphere System (MITS) like the Total Electron Content (TEC) variations, scintillations and disturbances, and the morphology/manifestations of Ionospheric Spread F phenomena that vary with locations (longitude and latitude), especially over low and mid-latitudes, which is also an important diagnostic for understanding space weather. In addition to this, we plan to install two ground based instruments, a magnetometer and a coherent beacon receiver, at North Carolina A&T State University (a mid- latitude station: Geog. Latitude ~36 degree N), to provide local measurements for geomagnetic activity and TEC/scintillations effects respectively. Scientists, teachers/ professors and students who are interested in studying the space/atmospheric physics and located at different institutions can also make use of these facilities. This work will be the first of its kind in the sense that it will be first ground-based instruments to be installed in North Carolina in a minority community university (HBCU) as a part of Research and Education outreach in space/atmospheric physics. Some of these aspects are discussed here.

Analysis of Lepine's List of Nearby Stars
Jessica McNutt, UNC-Asheville
An analysis of Lepine's list (2005, AJ 130, 1680) of newly discovered stars was conducted at the Pisgah Astronomical Research Institute in Rosman, NC in hopes of supporting future research involving the search for potential hosts for nearby, extraterrestrial planets. The celestial coordinates were extracted from Lepine's list and cross-referenced with the Northern Sky Variability Survey to determine which stars among them were variable. The stars deemed variable were then cross referenced with the ROSAT all sky survey to determine if any were x-ray sources and to obtain their flux. It was determined that roughly half of the list of newly discovered nearby stars published by Lepine was variable. The search done with the ROSAT all sky survey is, at this point, being verified. Future work will include statistical studies of the sample and follow-up observations of candidate variable stars. This work was carried out through the 2006 PARSEC Internship Program, and was supported by NASA Award NNG05GQ66, the North Carolina Space Grant, and the Glaxo-Wellcome Endowment at UNCA.

The Light Curve and Parameters of Eclipsing Binary System FL Orionis
Dan Caton, Adam Smith, Appalachian State University
We have obtained BVRI light curves for the neglected eclipsing binary FL Orionis, as well as times of minimum light to provide a revised period (the first accurate period) and ephemeris. Further, we present a solution of the light curve, solved with the BinaryMaker3 eclipsing binary synthesis program. This work is also to be submitted for publication in the near future.

Measurements of Preamplifier Gain and Noise Power
Root Kirbach and Kris Vorren
Four microwave amplifiers were tested for use on the interferometer being developed with two 26-meter radio telescopes at the Pisgah Astronomical Research Institute in Rosman, NC. Using a spectrum analyzer and a network analyzer, we measured the gain and noise power as a function of temperature. Specific tests were also carried out to characterize the gain and noise fluctuations over time. Our tests showed that these amplifiers were very suitable for interferometer use with gain fluctuations of less than 0.8%. A radio frequency interference survey was also conducted with results indicating the existence of interference free bands for interferometry. This work was carried out through the 2006 PARSEC Internship Program, and was supported by NASA Award NNG05GQ66, the North Carolina Space Grant, and the Glaxo-Wellcome Endowment at UNCA.



Temperature Control of Electronics in a Radio Telescope Feed
Matthew Brown and Christian Kaltreider, UNC-Asheville
Our project is part of the creation of a radio interferometer utilizing 26m radio telescopes at the Pisgah Astronomical Research Institute (PARI). Toward this goal, this project's focus is the reduction of thermal noise and achieving gain stability in signal amplification electronics via temperature control. Devices and their control schemes were investigated in a laboratory simulation of a telescope's feed box. Stability was achieved within 1 degree Celsius in an outer enclosure and within 0.1 degree Celsius in an inner enclosure. This work was carried out through the 2006 PARSEC Internship Program, and was supported by NASA Award NNG05GQ66, the North Carolina Space Grant, and the Glaxo-Wellcome Endowment at UNCA.

1900 May 28: the Day Wadesboro North Carolina was the Center of American Astrophysical Research
Tom English, Guilford Technical Community College
The Solar Eclipse of 1900 May 28 provided a unique opportunity to mobilize American astronomers around a specific research effort. A charter committee of the newly formed Astronomical and Astro-physical Society of America (later to be called the AAS), chaired by Simon Newcomb, but run by George Ellery Hale, attempted to coordinate and standardize observing efforts for the eclipse. The eclipse track crossed the southeastern U.S. from New Orleans to Norfolk, and observers were stationed all along the shadow path. Astronomers were thickest on the ground, however, in Wadesboro, NC, with major expeditions fielded there from Princeton, Yerkes, the Smithsonian Institution, and the British Astronomical Association. The Wadesboro expeditions represented a changing of the guard in American astrophysics. Pioneers of the first generation of astrophysics in America, S. P. Langley and C. A. Young, brought large groups, and individuals who would influence American astronomy in the coming decades, such as Hale and Henry Norris Russell, were also there. The presentation will give a who's-who of astronomers at Wadesboro, explain why that NC town was the station of choice, and outline the eclipse research efforts undertaken there.

Interactive Color Photometry of Star Clusters using an Inexpensive CCD
Donald F. Collins and Hannah L. Barks, Warren Wilson College
A highly engaging activity has been developed for students to examine color-enhanced telescope images of open stellar clusters. The images have been acquired using an inexpensive non-cooled Meade DSI Pro CCD camera. The camera comes with blue, green, and red filters as well as an IR block filter in order to obtain reasonably high quality blue, green, and red images. After alignment of the three-color images, users can "point and click" on each star in a cluster image on a computer screen. This program, written in Matlab, immediately plots each star's measured luminosity as a function of measured color index, thus providing an interactive plotting of a Hertzsprung Russell diagram. The algorithm will be briefly described and demonstrated. Students have responded well to this application in general astronomy. Some student reports have shown surprising misconceptions about the nature of H-R diagrams, which will be addressed in future applications.
Note: This poster was presented at the Summer 2006 Meeting of AAPT.

Monitoring the North Celestial Pole with a Robotic Camera
Mel Blake, Pisgah Astronomical Research Institute
We have constructed a dedicated robotic instrument to monitor the region within 4 degrees of the north celestial pole continuously every clear night. The camera consists of a 0.23m telephoto lens with a STV CCD camera attached, providing a field of view of 4 X 5 degrees. Since October 2004 we have collected more than 12000 images of the region surrounding Polaris using this instrument. The camera obtains a sequence of short and long exposures for conducting searches for transient and variable objects and for monitoring the Cepheid variable Polaris. Polaris has exhibited unique behavior for a Cepheid variable, with previous authors (Kamper et al. 1984; Evans et al. 1998) observing Polaris to nearly cease its pulsation. Monitoring Polaris with high secular coverage should help explain this behavior. We describe here the design of the observatory, its operation and control systems and give preliminary examples of the data products from this project. We discuss future improvements to the instrument that will provide unique data on Polaris and objects near it on the sky. We acknowledge support from the Fund for Astrophysical Research through funds donated by the Institute for Space Observations.

Pisgah Astronomical Research Institute
J.D. Cline, M.W. Castelaz, & D. Clavier, Pisgah Astronomical Research Institute
Pisgah Astronomical Research Institute (PARI) is a not-for-profit public foundation located at a former NASA Tracking Station in Western North Carolina. PARI is a radio and optical observatory engaged in edcuation, research, and public outreach. We will present the status of the facilties which include two 26m radio telescopes, a 4.6m radio telescope, a 12m radio telescope, several optical telescopes, a distance learning center, and lab space available to researchers and science educators. We will also present 2006-2007 infrastructure improvement plans.

Summer 2006 at PARI
M.W. Castelaz, J.D. Cline, Pisgah Astronomical Research Institute
Pisgah Astronomical Research Institute (PARI) was the home to 47 high schools students, 8 undergraduate students, 4 professional scientists and their staffs, and teacher workshops during the Summer 2006. Students from the Duke Talent Identification Program Summer Field Study in Astronomy conducted research for two weeks at PARI. Twenty-seven high school students from Transylvania, Henderson, and Jackson Counties in NC began a year-long program with a week resident at PARI. These students are participating in Space Science Lab, a lab for monitoring radio and optical solar activity. Radio interferometry, pulsars, 37 MHz radio mitigation, and upper atmospheric winds filled the scientific roster. And more than 50 teachers participated in OSBERVE, Pisgah Forest Institute, and PARI School of Galactic Radio Astronomy workshops. We will present a summary of these programs.