

Student Programs and Research at PARI



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INTRODUCTION

- ∞ PARI is a not-for-profit public foundation for research and education in radio and optical astronomy for a broad cross-section of users.
- ∞ Pre-college through post-graduate students have the opportunity to work and learn with full time and visiting astronomers.
- ∞ Additional access is provided on a remote basis through this Internet site and StarLab to grades K-12 and the public.
- ∞ PARI is not restricted to these projects and invites innovative research and education opportunities.

Pisgah Astronomical Research Institute

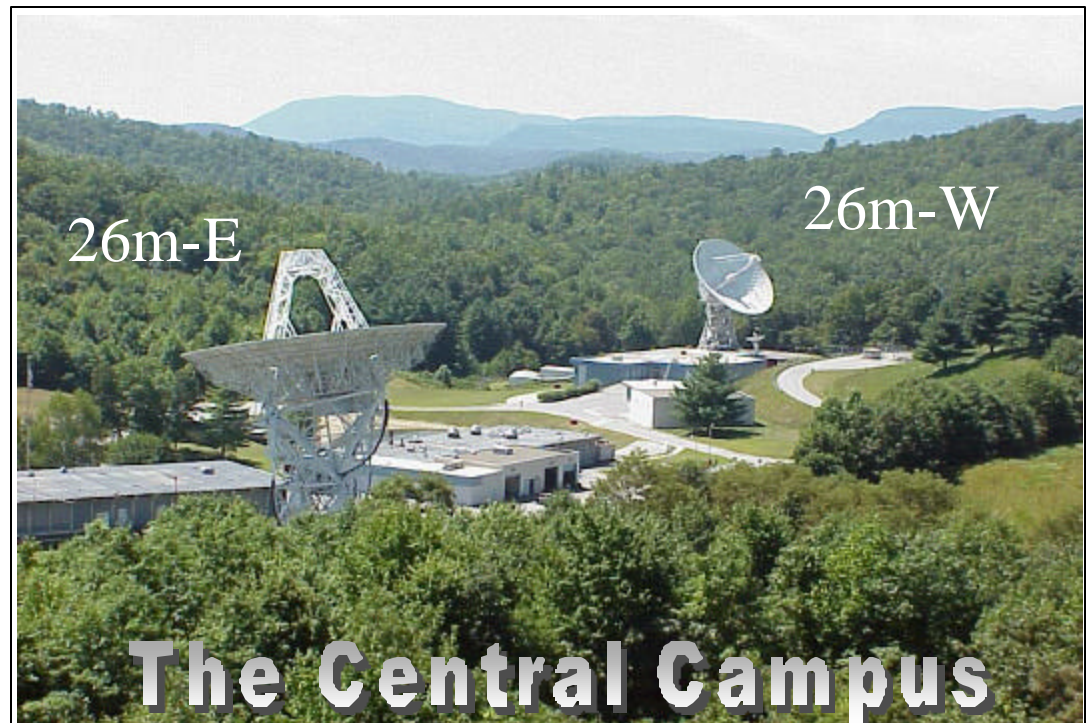


The Pisgah Astronomical Research Institute, located in western North Carolina, is shown above. Two 26-m, one 12-m, and the 4.6-m make up the PARI Radio Observatories. In addition, nine optical telescopes, from 0.12-m to 1.8-m are in operation or being planned as part of the PARI Optical Observatories.

Telescopes and Instrumentation Available for Student Research Projects

PARI Flagship Radio Telescopes

- **Two 26-m Radio Telescopes**
- **Both have Spectrum and continuum mapping capabilities**



1420 MHz and 4.8 GHz receivers on the 26-m and 4.6-m radio telescopes

4.6-m Radio Telescope



Students and their teachers from Reynolds H.S.

The 4.6-m “Smiley” radio telescope has receivers at 1.4, 4.8, 6.7, and 12.2 GHz. The telescope can be controlled over the Internet.

Low Frequency Radio Telescope

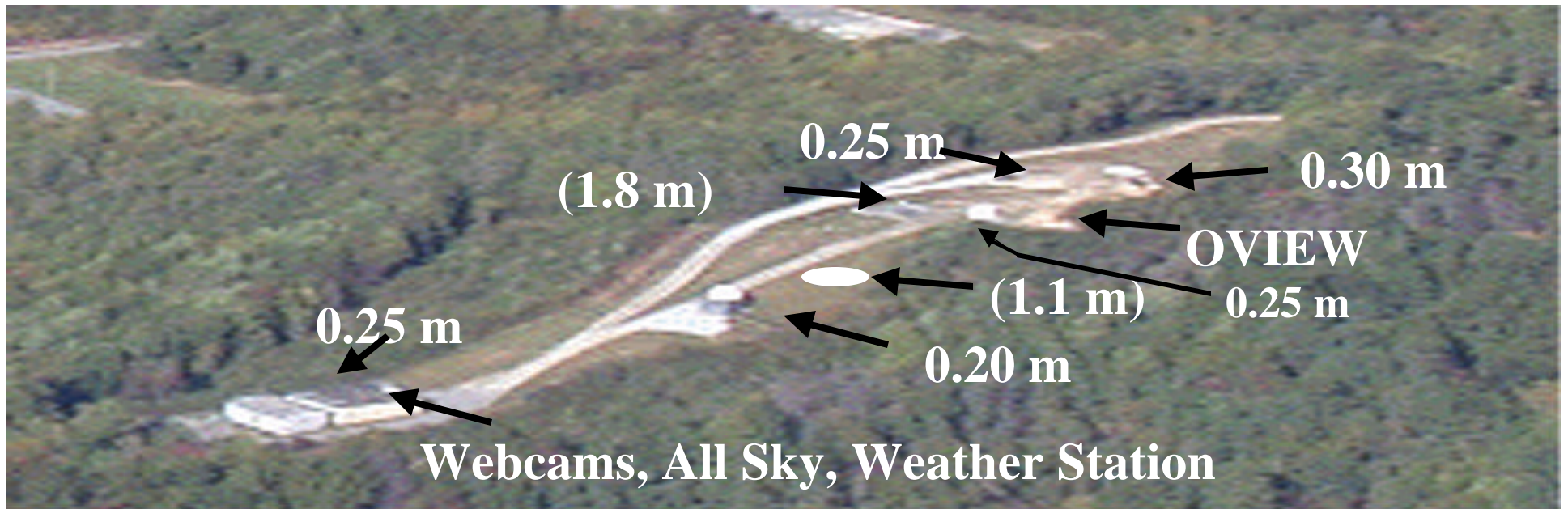
Jupiter/Io 17-30 MHz antenna



**PARI's pair of M-Squared 17-30LP7 log periodic yagis
for Jupiter/Io and Solar Observations**

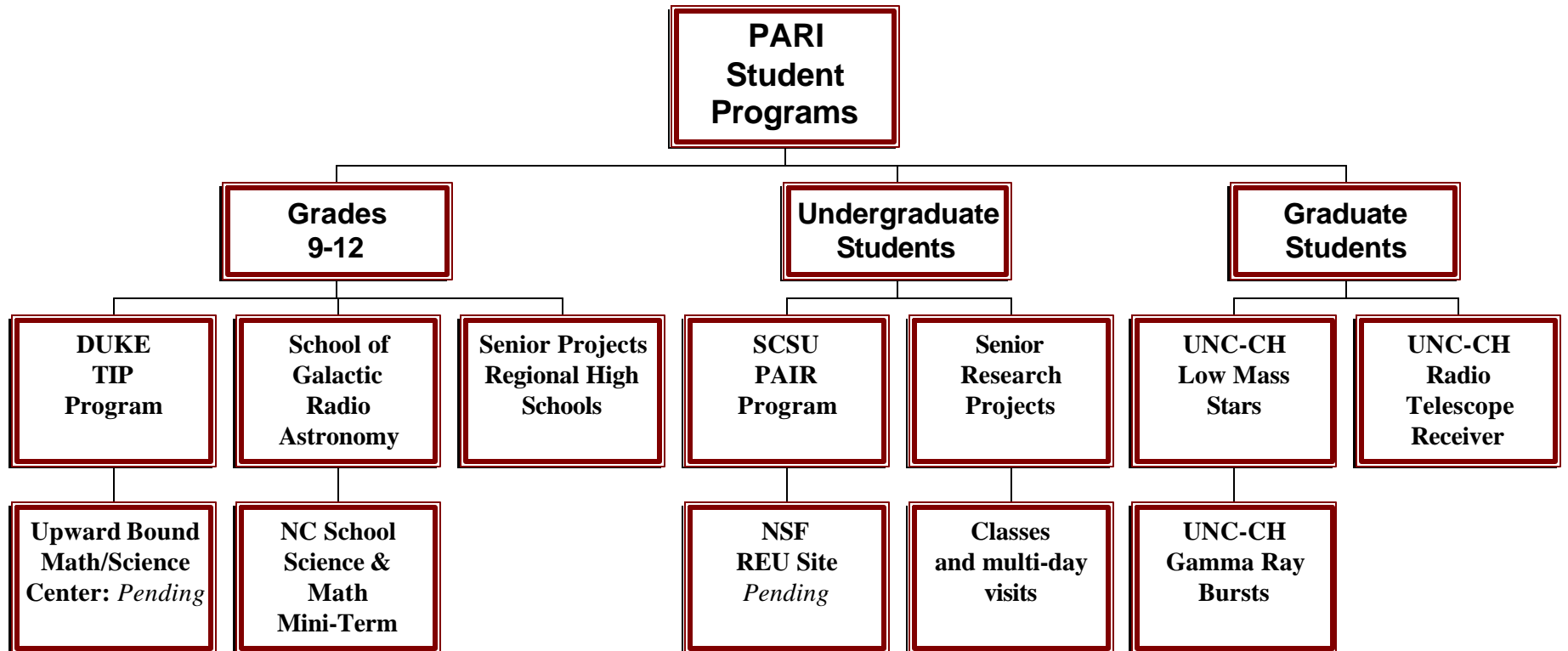
Data from a daily decameter wavelength (17 – 30 MHz) study of Jupiter-Io and Solar radio emissions are being measured

PARI Optical Telescopes



- ※ One 30 cm Telescope and CCD (SBIG ST10XME)
- ※ Three 25 cm Telescopes and CCDs (SBIG STV, and SBIG ST-7)
- ※ Two 20 cm Telescope CCD (Apogee AP4)
- ※ Two 12.7 cm Telescopes and CCDs (SBIG STVs)
- ※ All Sky camera (SBIG AllSky)
- ※ Webcams
- ※ Weather Station

Current Student Programs at PARI



Examples of High School Research Projects

- **North Carolina School of Science Math, Durham NC**
 - Mini-term, 7 students spent 10 days at PARI, Spring 2002.
 - Used both 26-m and Smiley.
 - Projects:

Mapping the Galactic Center at 1420 MHz using the West 26 m radio telescope

Mapping the entire Galactic Plane at 1420 MHz using the Smiley 4.6 m radio telescope

Measuring the frequency dependence of quasar emission using the West 26-m radio telescope

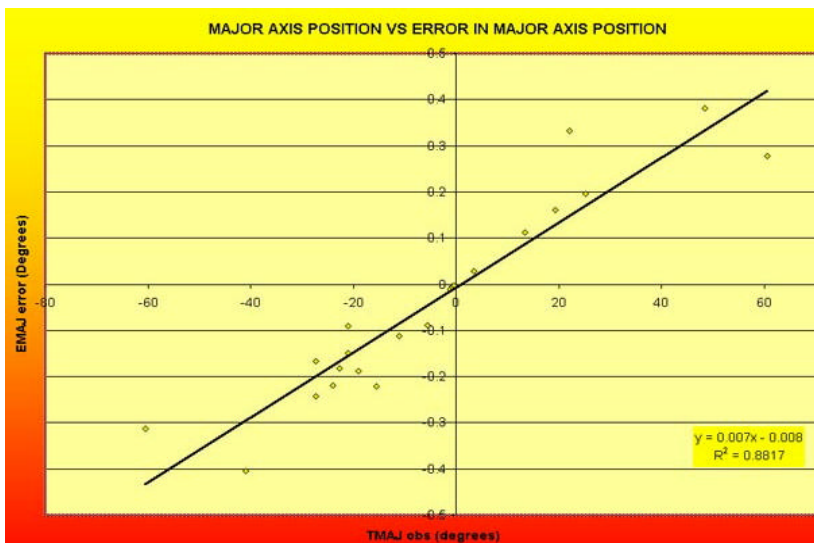
Measuring the pointing model for the East 26-m radio telescope

Building a radio telescope from scratch



- **Brevard High School, Brevard, NC.**
 - Used Smiley in the classroom over the Internet for Physics lesson on Doppler Shift.
 - Class of students.
 - Used periodically throughout Spring 2002 semester.
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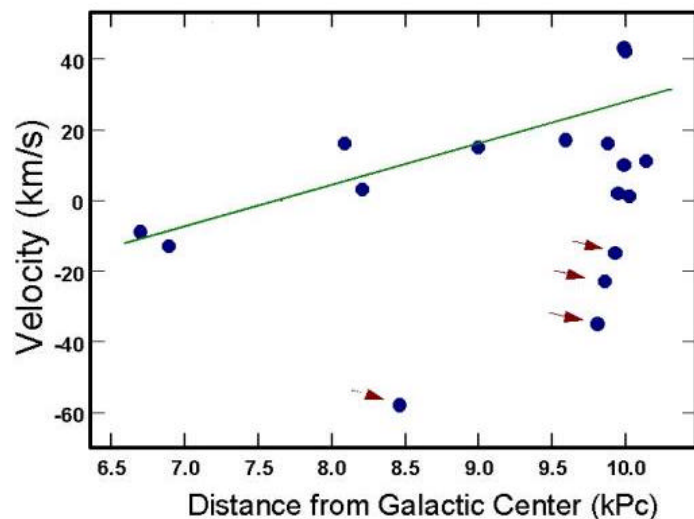
- **Science Hill High School, Johnson City, TN**
 - Individual Student Summer 2002 Research: Measuring and Applying a Pointing Model at 1420 MHz to 26-W Radio Telescope.



The plot shows one of results from the pointing measurements. The X-axis is the 26 W radio telescope Major axis position of a radio source and the Y-axis is the difference between the observed and catalog position. The slope, in this particular graph, represents the Major axis scale factor.

➤ **Reynolds High School
Asheville, NC**

- Individual Semester Senior Research, Fall 2002: Both 26-m radio telescopes used together to monitor brightness variations in RS CVn stars.



Plot w/o LSR Correction

➤ **Freedom High School,
Morganton, NC**

- Individual Semester Senior Research, Spring 2002: Mapping the Galactic plane at 1420 MHz.

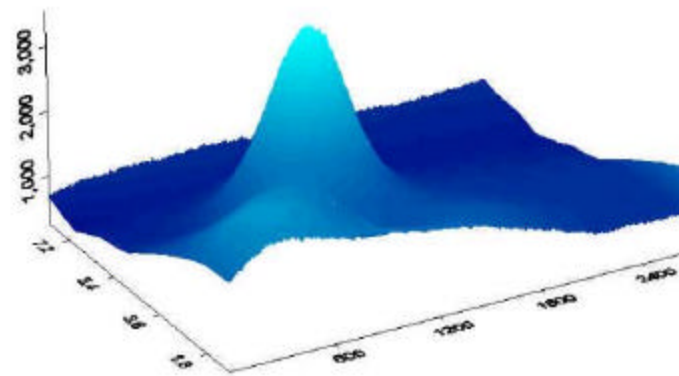
Examples of Undergraduate Research Projects

➤ **UNC-Asheville**

- Daytime optical photometry techniques; Individual Research Summer 2001
- Mapping regions of star formation at 4.8 GHz; Individual Research Fall 2001
- Optical telescope remote control development; Individual Research Spring 2003



Daytime image of Altair



4.8 GHz, 1 sq.deg. Vir A

➤ **South Carolina State University; Academic years 2001-2003**

- Four teams of 3 students work on the upgrade to the PARI 4.6-m Smiley radio telescope.

Projects include:

Feedbox temperature

control development

Computer control of the
telescope

Internet Control

Database Management



Wofford College. One Day Visit. Fall 2002. Students grouped and assigned to a radio telescope: 26-East, 26-West, and Smiley. The groups were given bright radio sources and were expected to observe the strength of the radio signal, and the Doppler shift of the 21-cm line.

➤ **North Carolina State University, Summer 2002**

- Individual Summer Research: JAVA Applets development for Smiley control and data

➤ **Harvey Mudd College, Summer 2002**

- Individual Summer Research: Software development – Examples of code written includes *mapping routine that includes interface to 20 MHz A/D card used specifically for holography of the radio telescope dishes, control of a 5-inch Celestron NextStar and SBIG STV, weather station.*

➤ **Harvard University, Summer 2002**

- Individual Summer Research: Development of C++ code to convert PARI radio data into FITS format.
- See Poster at this Meeting: Session 55.08U “A Program to Convert Raw Single Dish Data into a Format Suitable for AIPS++”

Graduate Research Projects Underway at PARI

Three Ph.D. candidate graduate students from UNC-Chapel Hill

- *Mercedes Lopez-Morales* (2001-2003):
 - Three-year optical survey to find detached low mass eclipsing binaries and use them to make direct measurements of masses and radii.
 - Using a 2048 x 2048 pixel CCD camera and 0.2-m, f/6.3 telescope to cover 1.6 sq. deg. per image.

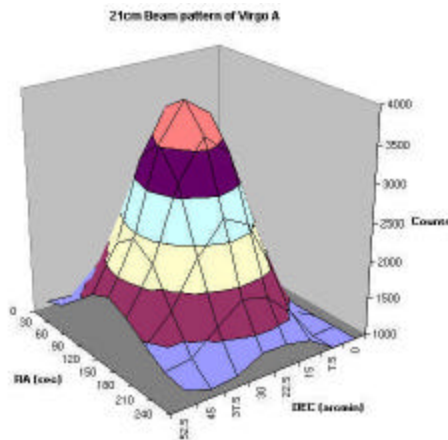


Mercedes at her 20 cm Robotic Telescope

➤ *Melissa Nysewander (2002-2004):*

- Studying near-IR emission from Gamma Ray Bursts.
 - Currently is assembling an instrument used to detect near-infrared (NIR) emission from gamma-ray bursts (GRBs).
 - Instrument is located on the PARI Optical Ridge
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-

➤ *Miles Blanton (2002):*



- Interested in using the PARI 26-m radio telescopes to measure Intraday Variables
- He was at PARI during the Summer 2002 measuring the characteristics of the 26-m radio telescopes antennae and feeds as a first step.

1420 MHz Beam, Vir A

List of Possible Student Research Projects

The research projects are mentored either by the PARI staff or by individual, or groups, of professors and teachers.

PARI is not restricted to these projects and invites innovative research.

In Radio Astronomy

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|---|---|
| <ul style="list-style-type: none">• Galactic Plane velocity mapping• Galactic center velocity mapping• SNR velocity structure | <ul style="list-style-type: none">• Multifrequency observations of QSOs• Solar activity at 20 MHz• Jupiter/Io interaction at 20 MHz |
|---|---|

In Optical Astronomy

- Eclipsing binary light curve: e.g. Low Mass Stars
- Pulsating variables (e.g Cepheids, Miras) light curves
- Targets of opportunity, such as recurrent novae, gamma ray bursts

In Computer Science

- | | |
|---|---|
| <ul style="list-style-type: none">• CCD camera control• Radio and optical telescope control• Control of A/D cards, Parallel I/O cards, relays | <ul style="list-style-type: none">• JAVA code for remote operation of telescopes• Web site development |
|---|---|

In RF and Electrical Engineering

- Development of coolers for the amplifiers at the feeds of the radio telescopes
- Signal processing
- Detector development – e.g. 327 MHz system for pulsar research.



Undergraduates from South Carolina State University are shown here working on the feedbox of the Smiley 4.6-m radio telescope.

CONTACT US IF YOU ARE INTERESTED IN SENDING
STUDENTS OR HOLDING CLASSES AT PARI

Long-term planning:

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