Using NASA Archives in the High School Classroom and Beyond Through the NASA/IPAC Teacher Archival Research Program (NITARP)

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Abstract

Numerous high school students would benefit from ways to extend their work in science and technology beyond the traditional high school science classroom. The NITARP (NASA IPAC Teacher Archive Research Program) program provides a link between NASA researchers and high school teachers to create methods of working with archival data from NASA space telescopes in ways that are appropriate for a high school student. Our example of such a study was to investigate whether the UV light emitted from the accretion disk of an Active Galactic Nucleus (AGN) is correlated with the IR emission from its surrounding dust. Contemporaneous data was obtained from the GALEX and Spitzer data archives for a set of galaxies. Students learned about the physics of the science in question, the structure of the archived data stored in NASA databases, extraction methods for obtaining relevant data, use of photometry tools to make brightness measurements, and relevant correlations that could be determined. If a set of instructions and a set of relevant research questions were available for general use at the high school level, numerous students would have an independent way to construct a science research project and extend their knowledge of the scientific process and data handling techniques. Our results suggest that students are eager to have these research opportunities and will make use of web-based information to carry out research projects to answer relevant questions. Our goal is to create a web-based collection of instructions and research questions for independent research opportunities for high school students.

Developing the research question?

Teachers attended the January 2010 AAS meeting for a crash course in astronomy research with data archives. At this time they met with their mentor scientist to discuss possible research topics. A focus question was developed and preliminary research started.

Developing the research Plan?

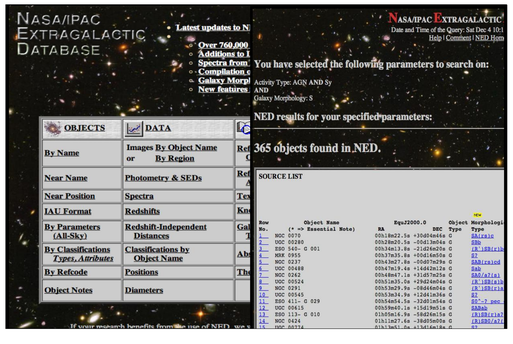
Teachers returned home and jointly develop the research plan. Some teachers involved students in this phase. Communication took place with the group via conference call, skype, and email. The plan was finalized and submitted for review in February 2010.

Archival data from the Spitzer and GALEX Space Telescopes will be used in an attempt to determine the inherent luminosity of nearby Active Galactic Nuclei (AGN) by plotting a UV-IR color-magnitude diagram. The previous difficulty in determining the luminosity of AGN using this technique has been that AGN are variable and observations were often taken at widely different times. As a result color-magnitude diagrams were constructed using UV and IR data points acquired decades apart. Also there is usually an unknown amount of obscuration towards the AGN emission region. This study attempts to mitigate both of those issues: i) by using data that were collected much closer in time to each other, since both GALEX and Spitzer were launched and carried out most of their observations within the same 5 year period; and ii) by choosing Type I AGN, which show the least amount of obscuration.

Choosing AGN Targets for the Study → Teachers/Students Visit the Spitzer Science Center – Begin Data Analysis → Back Home - Data Analysis by Students and Teachers

The NASA/IPAC Extragalactic Database (NED) was used by teachers and students to search for appropriate AGN targets. Using the "Search for Objects by Classifications" in NED, we initially limited our selection to Seyfert Type 1 AGN in Elliptical or S0 type Galaxies ensuring the least amount of obscuration. In addition targets with z < 0.01 were selected to ensure the image of the galaxy was large enough to make accurate measurements.

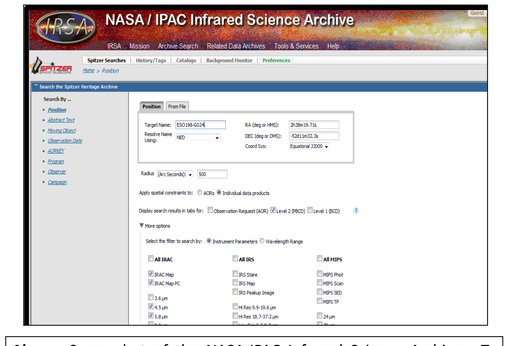
http://nedwww.ipac.caltech.edu/



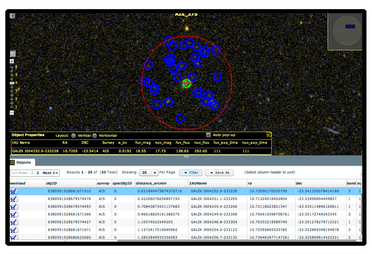
Above: Darci Sampsell and Domenic Murtari determine if targets found in NED have GALEX and Spitzer data available.

Students and teachers traveled to the SSC in July 2010 where they met with Mentor Scientists Varoujan Gorjian and Luisa Rebull. Gained the following skills:

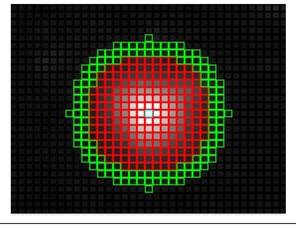
- **Accessing the Spitzer and GALEX Archives**
- **Using Aperture Photometry Tool (APT)**
- **Data interpretation**
- **Accessing and editing the NITARP Wiki**
- **Effective teamwork and communication**



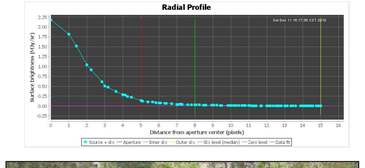
Above: Screenshot of the NASA-IPAC Infrared Science Archive. To eliminate contamination from the host galaxy's bulge due to the emission by the AGN, we used Spitzer 4.5 and 5.8 micron data. The Spitzer Heritage Archive is hosted by IRSA.



Above: Screenshot of the GALEX Data Archive. The archive was used to acquire pipeline NUV and FUV photometry data for our targets.



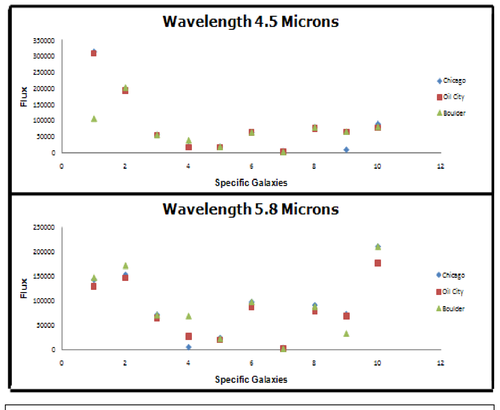
Above: Typical measurement of AGN using APT (Red = selected photometry aperture, Green = sky value. **Below:** Radial profile used to verify aperture settings in APT.



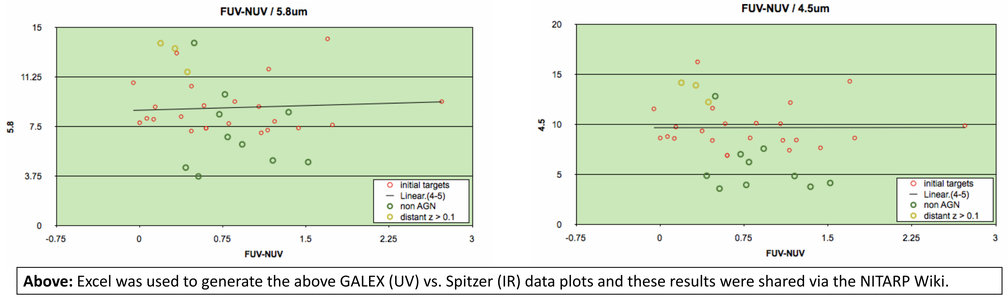
Above: Group takes a break to visit NASA-JPL.

Following our visit to the SSC, teachers and students returned home where they continued data analysis and identification of additional AGN targets. Collaboration between the teachers and students took place via the NITARP Wiki, Skype, teleconference, and email.

Above: Students from West Niles High School work on the project. Student teacher groups from all four schools met after school and/or weekends to conduct data analysis.



Above: Students from all schools used APT to measure flux values for targets in the Spitzer images. These values were then compared with other schools using various methods including Excel.



Above: Excel was used to generate the above GALEX (UV) vs. Spitzer (IR) data plots and these results were shared via the NITARP Wiki.

RESULTS: No correlation found between UV and IR emissions of AGN.

BUT … lots of learning along the way as summed up by one of the NITARP students … "Space is one of the most wondrous frontiers available to modern science, yet is the most difficult to explore in a high school setting. It has the potential to ignite student interest in science more perhaps than any other subject, but is almost never available in the classroom. NITARP gives teachers that opportunity." - Kevin Hale