Teacher-Student Education and Public Outreach Using Spitzer Data

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Abstract

As part of the NASA-IPAC Teacher Archival Research Program (NITARP), astronomers, teachers, and students collaborated in using archival data from the Spitzer Space Telescope to identify galaxy clusters around Active Galactic Nuclei (AGN) at a high redshift of z~1. The team analyzed 168 fields around AGN to determine if an over density of sources existed. The team, including members from across the US, initially explored the idea at the 2011 Winter AAS Meeting. The initial meeting followed up with regular conference calls, and a 4-day face to face meeting at the Spitzer Science Center in Pasadena, CA. Throughout the process, teachers and students gained a great deal of knowledge and experiences conducting authentic science research, and scientists gained a deeper understanding of education issues. The poster will present the processes used to engage students in this real-world experience, and the many benefits to all. In addition, our team will present inquiry based activities using archival data from the Spitzer Space Telescope, APT photometry software, and an Excel spreadsheet template, to enrich their understanding of the structure of the universe. NITARP is a NASA funded program.

Developing the Research Question & Plan

Winter & Spring of 2011

- Attended and became familiar with the AAS meeting
- Met with the research team and discussed possible topics with lead scientists
- Spring of 2011, held weekly teleconferences writing the proposal, developing the project goals and working through the background science behind the research topic

Data Collection & Analysis

Summer & Fall of 2011

While visiting Caltech/JPL the research group began the data collection and analysis process. In order to obtain useful scientific data from Spitzer the group completed the following:

- Used APT (http://www.aperturephotometry.org/aptool/) to measure the photometry of all point sources in the mosaic created around targeted AGN.
- APT was used to measure photometry and background noise was subtracted through this process.
- Due to APT measuring in microjanskys the group converted this into a magnitude value.
- Magnitude values were then subtracted to calculate a color ratio, this ratio was then used to help find sources that might be at the same redshift as the AGN.
- Candidates with a color ratio between -0.1 and -0.4 are believed to have redshifts similar to that of the AGN in question and as a result distances of all of these objects would be similar to that of the AGN.

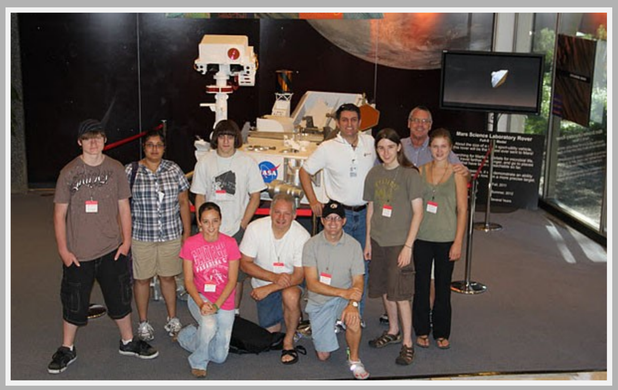
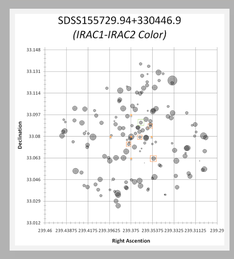


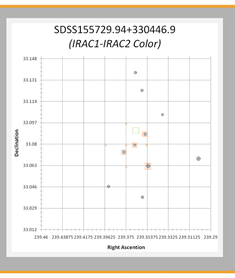
Image Above: Team Red Shift during a tour of the JPL

Image Above: Team Red Shift group photo during our tour of the JPL

Travel to Caltech & JPL: Data Analysis

- In August, the team spent 5 days in Pasadena working through the research question and learning the science of galaxy clusters.
- Days were spent using Aperture Photometry Tool (APT) as well as creating a dynamic Excel spreadsheet which allowed our team to convert data from APT into a graphical representation of sources/candidates that surrounded our targeted AGN.
- We were also fortunate to have a guided tour of JPL and Caltech by our very own lead research scientist Dr. Gorjian.





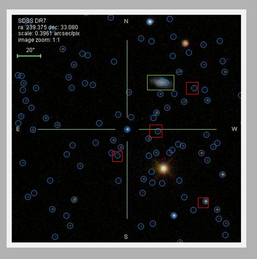
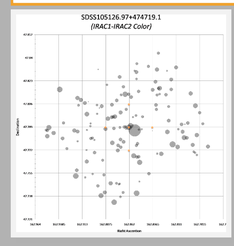


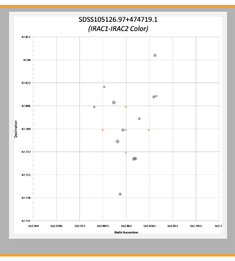
Figure 1(above)

Left image: plot showing an AGN with all photometric sources prior to color selection 1' radius is displayed as four orange points surrounding the AGN (at center).

Center image: Same AGN after using color selection technique.

Right image: Sloan Digital Sky Survey image of AGN. Red boxes indicate a possible correlation with sources in the center image. Sources appear red to indicate a possible redshift.





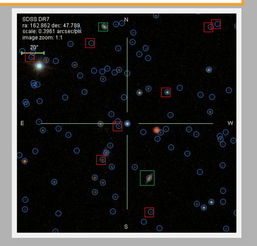


Figure 2 (above)

Left image: plot showing an AGN with all photometric sources prior to color selection 1' radius is displayed as four orange points surrounding the AGN (at center).

Center image: Same AGN after using color selection technique.

Right image: Sloan Digital Sky Survey image of AGN. Red boxes indicate a possible correlation with sources in the center image. Sources appear red to indicate a possible redshift.

Results From the NITARP Experience

1.What activities did we engage in as part of this research project?

- The team first met at the 2011 Winter AAS meeting in Seattle to discuss possible research topics and learn about current astronomy research being conducted.
- Developed a question based on guidance from our mentor research astronomers (V.Gorijan & A. Galametz)
- Shortly after the AAS meeting, we drafted our research proposal with final approval coming in the spring
- Conducted weekly teleconferences with our team to share and discuss insights and ask questions about our work
- Traveled to the Spitzer Science Center on the Caltech campus in August– spent several days intensively training in the use of image analysis software needed for our work identifying distant galactic clusters, as well as developing an Excel spreadsheet that allowed our group to visualize and filter our data

2.What did teachers, astronomers, and students gain from taking part in this project?

- Experienced true scientific research and inquiry
- Learned how data archives can be used to conduct real and meaningful research
- Traveled to JPL & Caltech to witness how scientific research is conducted, given a crash course in the science around galaxy clusters and given a tour of a world class research facility
- Scientists interacted with educators and became more aware of the issues and needs facing K-12 teachers and students

3.**How have we shared this experience with others?**

- Adam Keeton, Shefali Mehta, and Tim Spuck, high school science teachers, have spoken with fellow science teachers across the nation through various outlets, discussing the value of the NITARP Program. News articles have also been published about the experience.
- On December 13, 2011 Tim served as a panelist on the "Partnering Scientists and Teachers: Priming the STEM Pipeline" presentation at the Woodrow Wilson Center in Washington DC. In his comments he discussed the effectiveness of the NITARP program.

Future Plans for Team Red Shift

We plan to develop a lab activity that can be shared with other teachers. Teachers and students who complete the lab will be able to simulate the processes our team worked through and use the archives to conduct additional searches for distant galaxy clusters.

Team Red Shift hopes to be involved with the collection of spectra for our potential new cluster finds, continue with the research and remain involved until we are able to publish our results.

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