



# Crowdsourcing as a Means of Evaluating Astronomical Data



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## Abstract

The discovery of previously unknown, extreme sources of infrared excess served as a highly engaging, year-long project for five teachers, a NASA research astronomer, and 20 high school students in the NITARP program (NASA/IPAC Teacher Archive Research Program). Beginning with over one million sources culled from the Spitzer Enhanced Imaging Products (SEIP) archive, the project team used color-color plots to identify just over one hundred candidate sources with SNR > 10. A crowdsourcing process was then implemented, which allowed project members to independently evaluate and rate the validity of each source based on actual SEIP archive images. The crowdsourcing technique employed proved to be both effective and efficient for evaluating sources and ultimately deciding which objects merited further study. This research was made possible through the NASA/IPAC Teacher Archive Research Program (NITARP) and was funded by the NASA Astrophysics Data Program.



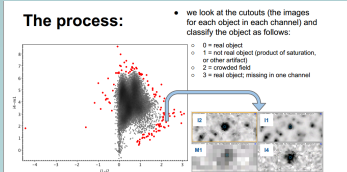
## The NITARP Process

In January 2014, the SEIP Infrared Excess (SIRXS) team met at the AAS Conference in Washington, DC to kick off its research project with mentor scientist, Varoujan Gorjian, Ph.D. Weekly teleconferences were held to identify the critical science concepts to be learned for the project, which prepared all the teachers and their students for the intense week of research at Caltech in July. Through the guidance of their mentor scientist, the team learned about blackbody radiation, IR excess, color-color diagrams, and the NASA/IPAC Archives. Towards the end of the week a method was devised which allowed all team members to independently evaluate the candidate sources after returning to their home cities. This crowdsourcing technique moved the project forward effectively without each member having to remain co-located.

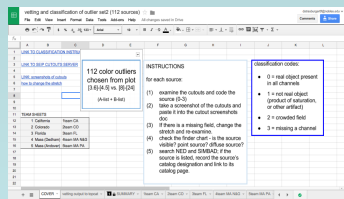
"For all of my familiarity with iPads, SmartBoards, and Google docs, this is the first time 21<sup>st</sup> century tools truly revolutionized the way I worked with students. We were a functioning, interdependent team ... that happened to be spread throughout the entire country from coast to coast. Thank you for blowing my mind!" Todd, Educator, Estes Park, CO

**Crowdsourcing** is the process of obtaining content or services by soliciting contributions from an online community rather than a centralized group of people. The primary benefits are: 1) taking advantage of the diversity of the skills and experiences of the online contributors, and 2) co-location is not necessary. The number of contributors for this project was extended by including many other students who did not attend the Caltech week.

The process:



"Crowdsourcing can be a powerful research tool. It allowed us to check our decisions upwards of 20 times for each source, in a time effective manner, resulting in more accurate evaluations." Kevin, Educator, Torrance, CA



"You won't regret participating in the NITARP program! It will require a lot of effort and diligence, but it reaps so many rewards. For those who have never taken an astronomy class, this experience will open your eyes, quite literally, to a whole new world. And for those who have taken astronomy, this will be a great opportunity to apply your knowledge to the real world and contribute to authentic scientific research." Jessica, Student, Torrance, CA

"The project reminded me that while science may not always be flashy, or make the New York Times headlines, every aspect is nevertheless important. We all got first hand experience doing the actual research work itself. We were part of the process, not just spectators, and because of that, we walked away from NITARP with a strengthened understanding of how science works." Ishaan, Student, Dedham, MA

"Unlike a typical school lab, in which students are expected to follow a recipe to reach a desired answer, we went into this project without knowing the outcomes. Dr. Gorjian worked with us, rather than ahead of us, so the participants truly felt that they were contributing to the results. During this project we learned by example that authentic research involves mistakes, revisions, and persistence." Phillips Andover Academy students, Andover, MA



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"I formed connections with students and teachers with diverse skill sets, personalities, and backgrounds. When one team member struggled, another was there to help them with a new tool or revisit an existing idea." Antoinette, Student, Dedham, MA