Using IRSA's Milky Way Surveys in Education and Public Outreach

http://nitarp.ipac.caltech.edu/

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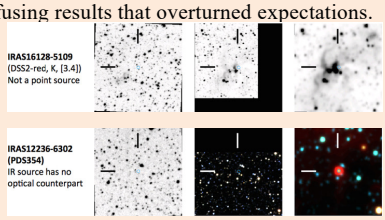
Abstract: There is a tremendous wealth of data housed at NASA's Infrared Science Archive (IRSA). IRSA provides access to more than 700 billion astronomical measurements, including numerous surveys of the Milky Way. IRSA also provides tools that enable interactive exploration of the data. Approximately 15% of refereed journal articles in astrophysics annually use data that ultimately come from IRSA. NITARP, the NASA/IPAC Teacher Archive Research Program, has been running (in one form or another) since 2005. NITARP partners small groups of largely high school educators with a research astronomer for a year-long authentic research project. NITARP projects use data and tools from IRSA, and more than half of the projects include data from Milky Way surveys. I will summarize some of the science done by these teams, and some of the impacts of this experience on teachers and students.

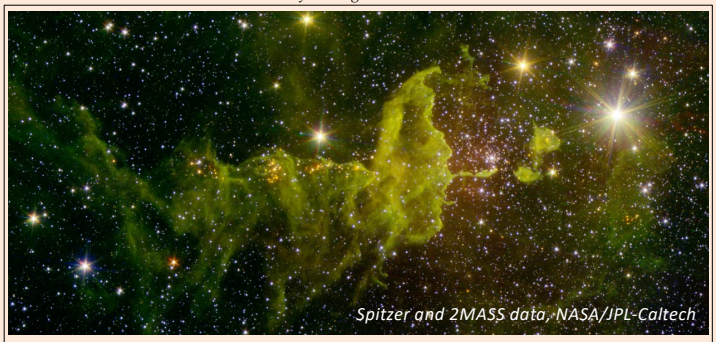
What is NITARP? NITARP, the NASA/IPAC Teacher Archive Research Program, gets teachers involved in authentic astronomical research. We partner small groups of educators with a professional astronomer mentor for a year-long original research project using archival data from IPAC. The teams experience the entire research process, from writing a proposal, to doing the research, to presenting the results at an American Astronomical Society (AAS) meeting. The program runs from January through January. Applications are available annually in May and are due in September. The educators' experiences color their teaching for years to come, influencing thousands of students per teacher.

Rebull et al. (2015, AJ, 150, 123) is based on work from a 2014 NITARP team, using archival data from 2MASS, Spitzer, WISE, IRAS, AKARI, MSX, and DENIS. When stars move from the main sequence to the giant branch, any close-in planets will get 'eaten' by the expanding star. But will this leave any observational signatures? Some models say an IR excess can result. This team explored K giants that the literature asserted had IR excesses. The work resolved a good deal of source confusion (some seen here), and moreover found complicated and confusing results that overturned expectations.



We gratefully acknowledge funding via NASA Astrophysics Data Program funds.

Photo from 2023 AAS: 2022 class (2 teams) finishing up; 2023 class (2 teams) starting up; alumni who raised their own money to come; and students from past classes now participating as astronomy undergraduate students!



Rebull et al. (2023, AJ, 266, 87) combined work from two NITARP teams (2015 and 2020/21), and archival data from 2MASS, Spitzer, WISE, UKIDSS, Gaia, IPHAS, PanSTARRS, MSX, AKARI, and Herschel. Largely using tools hosted at IRSA, this team explored candidate young stellar objects (YSOs) from the literature and identified new YSO candidates in this region, IC417. There are 710 YSOs and candidate YSOs in the final catalog, 503 of which are in the higher quality bins. There is no evidence for an age spread in the "braided" region in the center/left of this image, consistent with literature assertions that the trigger for star formation came from 'above' in this image.

[educator:] Astronomy is imagination powered by math and inspired by the sky. I am surprised and delighted at the sheer volume of data available and all the opportunity hidden inside it.

[student:] It was epic learning how to actually go through the data and interpret what we were seeing.

[educator:] I know so much more about the wealth of information available to me, so we are going to be using a lot more actual, real astronomy data in my classroom.

[educator: NITARP] was one of the strongest experiences I have had in my 20+ years teaching. Your program is amazing and you are wonderful. It is priceless. I know you invest so much into it; I wanted to share a bit of the impact you are having. Thanks for doing what you do so well.

[educator:] This experience made me think about the massive amount of astronomical data generated and archived. There must be all kinds of new discoveries waiting to be found in those data!

[educator:] [The most surprising thing was] the sheer amount of data that astronomers have to work with. At times it seems as if it could be overwhelming.

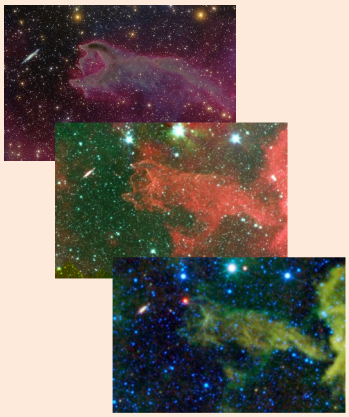
[student:] Previously, I did not entirely understand how versatile the data collected by telescopes are.

*[educator:] **NITARP is the single best professional development opportunity I have ever been a part of and has fundamentally changed the way I teach in the classroom.***

*[educator:] Not only did [NITARP] change how I understand astronomers, but how others understand astronomers. The look on people's faces when I talk about the Caltech astronomer and how **she** is guiding us through the research process is extremely telling. I think it is easy to point the finger at others when they profile astronomers as "old white guys in lab coats" but I am afraid I may have also held that misinformed preconceived notion.*

Using IRSA's MW surveys in non-NITARP ways: IRSA has a YouTube feed in which we have posted videos. Most of the videos are short, but some are longer, with suggestions of concepts or lessons that can be built around IRSA's data and tools. The QR code links to a playlist that collects all such videos. The first video takes an image from social media; attaches coordinates to it to demonstrate how much sky it covers; shows how big it is compared to a JWST field of view; shows how JWST wavelengths compare to Spitzer, WISE, and Herschel; and shows that two IR-bright sources (likely YSOs) are embedded within a dark cloud that was noted in the original post. *Got an idea for more such videos? Email me!*

We're presenting results. Including the 2024 Jan AAS, NITARP has presented 77 science posters, 81 education posters, 9 astronomy research journal articles, and 8 education journal articles.



Rebull et al. (2011, AJ, 142, 25) is based on work from a 2010 team, using data from 2MASS & new data from Spitzer, plus some new optical data. They studied CG 4 (seen here) and Sa 101, found IR excesses in all 6 literature young stellar objects (YSOs), and identified 16 new YSO candidates.