The Randall Harper Award

for Outstanding Research in Physics and Astronomy

Award Application Form
Deadline March 29

Name of Applicant: _____
Applicant's Class: ⊙ Junior ○ Senior
Applicant's Major: _____

Applicant's Local Address: _____
Applicant's Local Phone: _____
Name and Addresses of Applicant's Parents or Guardians:

Recipient's Hometown Newspaper: _____

Listing of Research Publications and Presentations:

Sadler, S. M., Strolger, L., & Wolff, S. 2011, Bulletin of the American Astronomical Society, 43, #337.14
Sadler, S. M., Strolger, L., Wolff, S., & Gott, A 2011, National Conference on Undergraduate Research, Ithaca College, Ithaca, NY
Sadler, S. M., Strolger, L., Wolff, S. 2010, Southeastern Section of the American Physical Society, Louisiana State University, Baton Rouge, LA
Strolger, L.-G., van Dyk, S., Wolff, S., Campbell, L., Sadler, S., & Pease, A. 2011, NOAO Proposal ID #2011A-0416, 416
Wolff, S., Strolger, L., Sadler, S. 2011, National Conference on Undergraduate Research, Ithaca College, Ithaca, NY

Attach one (and only one) page providing a description of the research for which you wish to be judged. The quality of the described research will be based on originality, creativity, difficulty, and significance.

I serve as a co-investigator on a project led by Dr. Strolger in which we seek to better understand the physical constraints under which progenitor systems ultimately yield Type Ia supernovae, which prove to be an important test of the robustness of these tools in precisely measuring Dark Energy. To test the physical environmental effects on SNe Ia production, we will determine the ages and metallicities of ~60 galaxies that have hosted type Ia SNe from the Nearby Galaxy Supernova Search. The complete sample will provide a validity test of the mostly indirect trends being established for SNe Ia from the LOSS, SDSS, SNfactory, and other surveys, and will resolve the most influential factors for SN Ia production: dominant parent population age, rate of star-formation, or metallicity.

Currently, there are investigations on SN Ia rate and luminosity trends based on environmental parameters (luminosity and morphology). These investigations are proving to be largely ambiguous partially due to the use of indirect proxies used for galaxy metallicities, as there are large variations in these relations. We propose that a smaller sample of hosts would yield more precise measures, as it would allow for direct measures of the age and metallicities as well as star formation rates.

This is a project for which I have worn many hats. I began as an Academy student in 2009 by re-analyzing NGSS data, searching for missed supernovae and other interesting objects. From there, I was charged to determine the statistical significance of the number supernovae hosted by a number of galaxies in 100 years. Using the KS test, we determined that it is not unusual for a galaxy to host 9 supernovae in 100 years, though this is a rare event. Progressing with the project, we continued to acquire follow-up data of the ~60 SNe and strong SN candidate hosts using the Mayall 4-meter + RCSpectrograph and Hale 200" + Double Spec.

To measure the metallicites and ages of these host galaxies, I explored a method using an IDL code called EZ_Ages. EZ_Ages measures intensities of absorption features, called Lick indices, and compares them to an internal dataset. I tested the legitimacy of the EZ_Ages measurements by cross checking them with synthetic MILES SSP spectra models of specified ages and metallicites. After checking for correctness, I found that EZ_Ages was not sufficient in extrapolating outside of its "comfort-zone." I found that EZ_Ages fails to produce measurements for galaxies that are still star-forming, an issue for our sample set.

Since the prewritten program failed, we have begun to write code that uses least squares. Every MILES spectrum of each combination of age and metallicity is subtracted from the host galaxy spectrum. Each difference is then squared and the least square is reported. Thus far, preliminary results express that we are headed in the correct direction.

Early results, in Figure 1, show a preliminary trend toward higher metallicity or older populations. Though these coincide, we have only produced measurements for seven of ~60 hosts, and it is too early to say that these trends go hand in hand.

The next step in this investigation is to continue complete the collection of the rest of the data sample, and I am listed as co-investigator on proposals for additional time for 2011B. Once complete, we will reduce and analyze the spectra. I anticipate having a majority of these spectra reduced and analyzed by next May and I plan to use these data as my undergraduate honors thesis. Though these results are preliminary, we are one step closer to understanding the most interesting and poorly understood tools in modern cosmology.

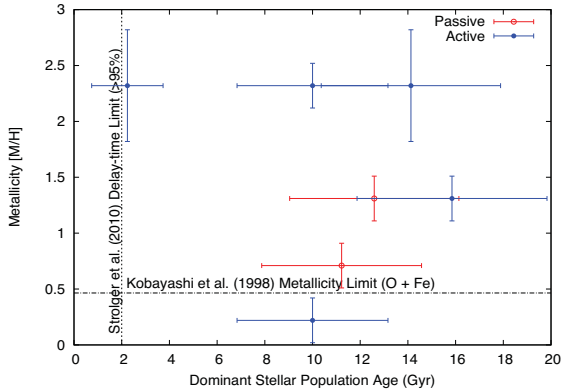

Figure 1: Preliminary results using the Least Square method. Included are age and metallicity limits for Type Ia SNe.