

ASTERIOD SEARCH CAMPAIGN: A Pilot Program for High School & College Students.

J. Patrick Miller¹, Jeffrey W. Davis¹, Carlton R. Pennypacker², Graeme L. White³ ¹Hardin-Simmons University, Abilene, TX ; ²Lawrence Berkeley National Laboratory (Hands-On Universe), Berkeley, CA; ³Centre for Astronomy, James Cook University, Townsville, Australia.

Using astronomical images provided the next day (i.e., essentially real-time), students from five high schools searched these images for original discoveries of unknown asteroids. Four of the schools were in the United States (NC, UT, PA,VA) and the fifth was in Poland. This was a pilot project conducted at Hardin-Simmons University (HSU; Abilene, TX) in association with Hands-On Universe at the University of California, Berkeley.

The images were from the Blanco 4-m telescope located at the Cerro Tololo Inter-American Observatory (CTIO; Chile). Utilizing this instrument was ESSENCE, "Equation of State: SupErNovae trace Cosmic Expansion", which on each night provided eight 1k x 4k images of the same "wbb9" deep sky field. The images were in pairs taken approximately 40 minutes apart, the first in the red bandwidth and the second in the infrared.

Prior to providing the images to the high schools for the asteroid search, the images were processed at Hardin-Simmons University. Using the space-varying kernel subtraction method proposed by Christophe Alard (Alard, C., A&AS, 2000, 144, 363), the images were subtracted. Given the difference in colors, this subtraction was a particular challenge. The residual light on the subtraction was heavily masked by comparing the original images for bright objects appearing at the same pixel locations (i.e., not moving).

The original images with the Alard subtraction were uploaded onto HSU Blackboard into folders that were accessed by the participating high schools. Over the next two days and utilizing the Aladin Sky Atlas (Centre de Données astronomiques de Strasbourg; A&AS, 2000,143, 33), the students searched the subtraction for asteroid signatures and compared (blinked) the original two images to verify discoveries.

These discoveries were reported back to Hardin-Simmons, which followed them up with the Minor Planet Checker (MPChecker) at the Minor Planet Center (Smithsonian Astrophysical Observatory; International Astronomical Union). Any unknown asteroids were recorded with a follow-up image request sent to the Astronomical Research Institute (ARI; Charleston, IL).

Using a 32" telescope, the ARI took follow-up images of the discoveries within seven days in order to comply with the discovery requirements of the Minor Planet Center. These follow-up images were subtracted and returned to the schools for a second analysis in order to confirm the discovery.

Also, real-time images were provided to the schools by the Astronomical Research Institute. The purposes of these images were to confirm near-Earth objects (NEO) reported by the Minor Planet Center and to make original asteroid discoveries. These images were analyzed following the above procedure.

At the time of the writing of this abstract, the Asteroid Search Campaign is still in progress. Students have found a number of candidates from the ESSENCE images that are in the follow-up imaging process. From the ARI images, several NEO confirmations credited to the students have been made, and one comet was identified.

The long-term goal is to build the pilot project into an ongoing program with participating high schools, colleges, and universities from all over the world. Not only is it possible for students to make original asteroid discoveries, they can make original discoveries of supernovae, active galactic nuclei, Kuiper Belt objects, and comets. Future search campaigns for these objects are under development for March 2007, October 2007, and March 2008.

The authors wish to thank Dr. R. Christopher Smith, National Optical Astronomical Observatory, for arranging the use of ESSENCE images for this pilot project. Also, they thank Robert E. Holmes, Jr. of the Astronomical Research Institute for providing the necessary follow-up images of asteroid discoveries and real-time images for NEO confirmations. ARI is a non-profit 501(c)(3) corporation.

They thank Dr. Christopher L. McNair, Dean of the Holland School of Science & Mathematics, at Hardin-Simmons University for use of the necessary facilities to coordinate the project.

Finally, special gratitude is expressed to Harlan Devore, Cape Fear High School (Fayetteville, NC). Mr. Devore was instrumental in testing the software and procedures used in the Asteroid Search Campaign. He also provided mentoring and technical advice to the participating high schools.