Undergraduate Astronomy Research and Education through Observation of Jupiter Impact Flashes to Characterize Small-Body Populations in the Outer Solar System

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We report observation of Jupiter to detect impact flashes at a student-operated observatory at Hampton University. Our project is motivated by impacts recorded by amateur astronomers; if enough flashes are observed, the measurements will reveal the size distribution of those impactors, which may help us understand how the outer solar system has evolved since its formation. National Science Foundation provided funding to construct a roof-top observatory to be operated by undergraduate students to develop a telescope system for such observations, and to conduct long-term monitoring of Jupiter to detect impact flashes. The project will also provide locally-generated science content for education and public outreach, which will make STEM more relevant on a historically black university campus, and help increase representation of African Americans in scientific research and broader STEM disciplines. The project's objective is to measure the size distribution of Jovian impactors, which are thought to be members of the Jupiter Family Comets (JFC) that originate beyond Neptune's orbit. Most JFCs are too dim for direct telescopic observation from Earth, so the project will observe Jupiter impacts to measure the sizes of objects that are otherwise impossible to observe. If the JFC size distribution shows signs of numerous collisions in the past, it would be consistent with the hypothesis that Uranus and Neptune violently migrated outward early in the solar system history and scattered primordial planetesimal objects. If the JFC population contains more small fragments than expected from collisions, it would reveal that most comets eventually break up during their repeated close encounters with the sun. If the JFC population contains few small objects, it would indicate that at least some JFCs have been left undisturbed since the formation of the solar system. The main technical challenge here is to detect a sufficient number of impacts to build a statistically significant size distribution. The goal of the current student-led exploratory project is to reduce uncertainties regarding the number of impacts per year to enable a larger impact survey in the future. Our project is supported by NSF EAGER Award 1649878.

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