Looking for New Light

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In many ways, astronomers are in the dark about asteroids. In the dark depths of the Kuiper Asteroid Belt beyond Neptune's orbit, and even in the nearby Main Belt between Jupiter and Mars, most asteroids are too small to reflect back enough sunlight to be seen by our telescopes. But as cosmic rays travel through our solar system, they may strike a glancing blow off the surface of an asteroid, producing gamma rays (short wavelength light waves). Researchers now report that they can use this gamma ray radiation to infer the number of small asteroids in different groups of small solar system bodies. However, they will have to wait to test their ideas until the new Gamma-ray Large Area Space Telescope (GLAST), launched last week by NASA, returns data.

The paper detailing this new technique will be published by researchers from the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) and the Santa Cruz Institute for Particle Physics (SCIPP) at U.C. Santa Cruz in the July 10 issue of The Astrophysical Journal.

Although GLAST's sensitivity won't be high enough for the researchers to see the outline of any individual asteroids, it will be able to detect an overall glow of gamma-ray light from large ensembles of these small bodies. The more light detected by GLAST, the more asteroids must exist in that area. To determine the relationship between the brightness of the observed gamma rays and the number of asteroids in a given area, the researchers used the gamma-ray emissions from the moon as a "standard candle" to create a scale. Researchers compared the gamma ray emissions from the moon with its size to create a scale for determining the sizes of unseen asteroids based on the gamma rays they emit.

Knowing the densities of groups of asteroids in our solar system could yield a great deal of information for astronomers. Being able to compare the difference in the asteroid population densities of the Main Asteroid Belt and the Kuiper Asteroid Belt could support or oppose the theory that the Main Belt has had a more violent, collision-filled past than the icy Kuiper Belt. The size distribution of the smallest bodies in our solar system can tell us how the largest bodies (which later became planets) grew in their early stages; and if we can better understand the history of the formation of the solar system, we can apply it to other planetary systems.

This new information will assist astronomers looking at gamma-ray sources toward the Galactic Center as well as outside of the Milky Way. The Galactic Center contains a web of overlapping gamma-ray sources which are difficult to discern from each other and one of the favored places to search for elusive dark matter. The orbital plane of our solar system (the ecliptic) is projected across the Galactic Center, so we cannot look to the Galactic Center without looking through a collection of asteroids. Understanding each source of gamma rays is important in untangling the web.

The paper's authors, Igor Moskalenko (Stanford/KIPAC), Troy Porter (SCIPP), Seth Digel (SLAC/KIPAC), Peter Michelson (Stanford/KIPAC) and Jonathan Ormes (U. Denver and KIPAC), theorize that this measurement will be particularly useful for planetary scientists, the cosmic-ray community and those who search for clues of new physics, including signatures of dark matter, in the Galactic Center and in the unresolved emissions from outside the Galaxy.

Source: Stanford Linear Accelerator Center