



Archival Search for Active Asteroids in Subaru Hyper Suprime-Cam Public Data Release 3

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We are searching for new active asteroids using data from the Subaru Hyper Suprime-Cam (HSC) Public Data Release 3 (PDR3). The active asteroids are a poorly understood class of asteroids, which have orbits similar to other asteroids but exhibit tails or comae like comets. Of the over 1.4 million catalogued minor planets, most of which are main belt asteroids, fewer than 100 of the asteroids have exhibited activity, and roughly half of those are thought to be driven by water ice. The true fraction and solar system distribution of active asteroids is poorly known as most have been discovered serendipitously by a variety of methods. In this work, we search for activity among the known asteroids using one of the deepest wide-area public datasets available, the HSC PDR3. The goal of this work is to discover new active asteroid candidates and recurring activity in known active asteroids in archival data, collect contemporary images of those asteroids using ground based telescopes, and assess the true rate of active asteroid activity in a consistent manner using a large dataset. This will lead to insights into the present day distribution of water ice in our solar system.

The HSC PDR3 has been collected using one of the largest ground-based optical telescopes, the 8.2 m Subaru telescope atop Maunakea in Hawaii which regularly achieves image quality better than 0.7 arcseconds yielding single-image depths of 25 to 25.5 magnitudes in the typical exposure times used for the PDR3. In addition, HSC itself has an extremely wide field of view, about 1.8 square degrees, for such a large telescope. Over 13,000 fields were imaged in good conditions with HSC as part of the PDR3, representing over 23,000 square degrees. The PDR3 dataset was collected for scientific purposes unrelated to the asteroids but many fields contain serendipitous images of asteroids. We have cross-correlated the PDR3 fields and the Minor Planet Database using the SkyBoT project and find that over 230,000 minor planets (over 15% of all minor planets and the vast majority asteroids) were serendipitously imaged in the dataset for a total of over 1.6 million minor planet images. We have begun the process of constructing thumbnail images of these minor planets from the full HSC PDR3 data release and expect to finish this year.

Initially, we are examining images by eye ourselves to determine activity candidates. However, we will launch a Citizen Science campaign akin to activeasteroids.net, which has to date only used data from the DECam public archive. This will allow us to mobilize volunteers to examine more images than we can reliably categorize ourselves. We present first results from this work including an assessment of activity levels for thousands of asteroids most likely to exhibit activity including: previously known active asteroids, distant C-type main belt asteroids, and Centaurs on unstable orbits that could have recently moved inward from the trans-Neptunian region.

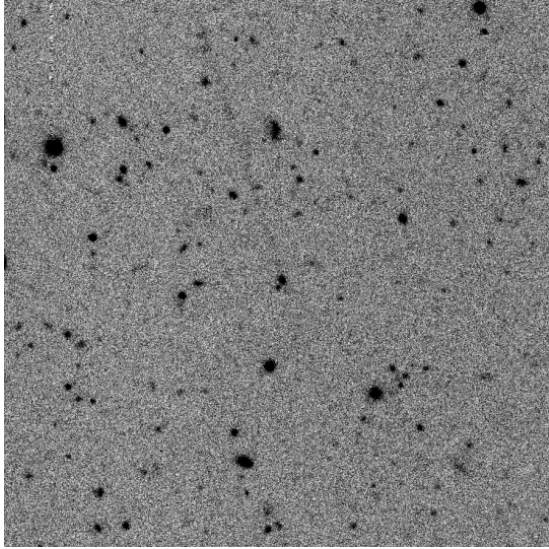


Figure 1: One of 4 images from the HSC PDR3 archive of known active outer main belt asteroid 331P/Gibbs, exhibiting a faint linear tail.

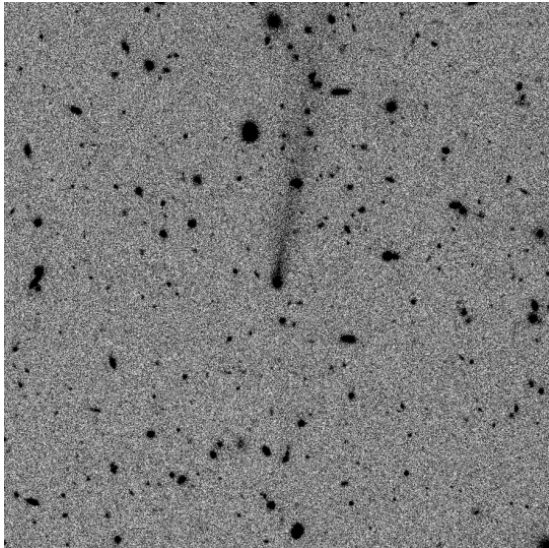


Figure 2: One of 17 images from the HSC PDR3 archive of known Jupiter family comet 242P/Spahr, exhibiting a tail. While not a primary target of this work, many comets are present in the HSC PDR3.