

# The Pan-STARRS $3\pi$ Survey and the Brown Dwarf Factory

E. A. Magnier<sup>1</sup>, M. Liu<sup>1</sup>, B. Goldman<sup>2</sup>, D. G. Monet<sup>3</sup>,  
K. C. Chambers<sup>1</sup> and N. Kaiser<sup>1</sup>

<sup>1</sup>IfA, U. Hawaii, 2680 Woodlawn Dr., Honolulu, HI 96822, USA email: [eugene@ifa.hawaii.edu](mailto:eugene@ifa.hawaii.edu)

<sup>2</sup>M.P.I.A., Königstuhl 17, D-69117 Heidelberg, Germany email: [goldman@mpia-hd.mpg.de](mailto:goldman@mpia-hd.mpg.de)

<sup>3</sup>USNO, P.O. Box 1149, Flagstaff, AZ 86002, U.S.A email: [dgm@noifs.navy.mil](mailto:dgm@noifs.navy.mil)

**Abstract.** The Pan-STARRS 1 Telescope (PS1) is currently (2009 Aug) undergoing final commissioning efforts and starting to perform initial science observations for the PS1 survey mission. PS1 will greatly expand the known population of Brown Dwarfs, with discovery via photometry, proper-motion, and parallax.

---

PS1 uses a 1.8m primary mirror to image a 7 deg<sup>2</sup> field of view onto a 1.4 Gigapixel camera. PS1, located on the summit of Haleakala, Maui, was built by the Pan-STARRS Project and will be operated for the science survey mission by the PS1 Science Consortium (<http://ps1sc.ifa.hawaii.edu>). The Pan-STARRS Project, operating at the University of Hawaii, is working towards Pan-STARRS 4, a survey instrument to be deployed on Mauna Kea in Hawaii consisting of 4 identical 1.8m telescopes which observe the same portion of the sky at the same time. PS1 is a demonstration of the technology, and a major survey instrument on its own.

PS1 will perform a multi-level survey mission lasting at least 3 years, with wide ranging science goals. Roughly 56% of the time will be spent on the  $3\pi$  Survey in which the full sky region observable from Hawaii will be repeatedly observed over the 3 years; most of the remainder of the time will go to repeated observations of various specific fields, and an additional portion will be used to search for potentially hazardous asteroids by observing along the Earth's orbit (the 'sweet-spot survey'). By the end of the mission, each patch in the  $3\pi$  Survey region ( $\delta > -30^\circ$ ) will be observed 12 times in each of 5 filters, with expected detection limits of (*grizy* = 23.2, 22.7, 22.6, 21.6, 20.1).

Since 2009 April, PS1 has been operating with somewhat less than 50% of time for initial science observations. On-going engineering work is being performed to improve the image quality and operational efficiency. Even the modest science observations to date have resulted in a substantial survey data set. In a 30 day period in 2009 June & July, operating at this reduced rate,  $3\pi$  observations have already covered over 25,000 deg<sup>2</sup> (single filter), equivalently to roughly 60% of the SDSS survey. The measured detection limit in *y* band depends on the image quality, but can reach the predicted 20.1 limit in appropriate conditions. Typical values in the survey data to date are in the range *y* = 19.5 – 20.1; the *z*-band detection limit is about 0.5 lower than expected.

We are learning how to search through the data set for brown dwarfs, starting with simple two-colour plots including 2MASS *JHK* photometry. At this stage, it is crucial to limit possible brown dwarf candidates to the most reliable objects by requiring two detections in each of the *y* and *z* filters. As multiple epochs become available, precision proper-motion and parallaxes will greatly improve the search efficiency.