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The Fabra-ROA Baker-Nunn Camera at Observatori Astronòmic del Montsec: A Wide-field Imaging Facility for Exoplanet Transit Detection

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Abstract. A number of Baker-Nunn Camera (BNC) were manufactured by Smithsonian Institution during the 60's as optical tracking systems for artificial satellites with optimal optical and mechanical specifications. One of them was installed at the Real Instituto y Observatorio de la Armada (ROA). We have conducted a profound refurbishment project of the telescope to be installed at Observatori Astronòmic del Montsec (OAdM) (Fors 2009). As a result, the BNC offers the largest combination of a huge FOV (4.4°x4.4°) and aperture (leading to a limiting magnitude of V∼20). These specifications, together with their remote and robotic natures, allows this instrument to face an observational program of exoplanets detection by means of transit technique with high signal-to-noise ratio in the appropiate magnitude range.

Refurbishment Project

The BNC was designed as a f/1 0.5m photographic wide field (5°x30°) telescope with a spot size smaller than 20μm throughout the FOV.

Among some others, the BNC has been refurbished following these phases: mechanical modification of the mount into equatorial and motorization of the two axes, optical refiguring of the originally photographic curved FOV to enable the use of a 4kx4k 9-μm custom-designed FLI ProLine CCD camera (see Figure 1) and to comply the Baker's original design spot size diagram, manufacture of a tip-tilt adjustable spider vanes assembly and athermal CCD focus system (see Figure 2), mirror realuminization and outermost 50cm lens repolishing to increase the throughput of the system, construction of a reinforced glass-fiber enclosure with sliding roof which will host the BNC at OAdM (see Figure 3), development of an XML-based messaging protocol and Java GUIs software, named Instrument-Neutral Distributed Interface (INDI), to control every device of the observatory and schedule its operation both in remote and robotic modes (Downey 2009).

On 23 Sep 2008, the BNC successfully saw first technical light at ROA testing site (see Figure 4). Note this image was still taken with the unpolished 50cm lens and non-realuminizated mirror. The definitive commissioning at OAdM is expected by early Spring 2010.

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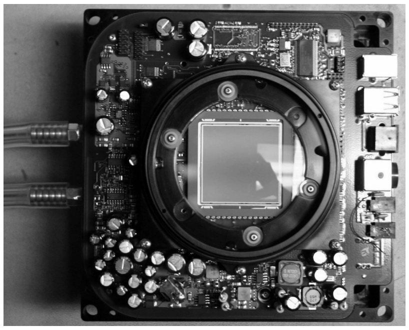

Figure 1. Custom-designed FLI CCD with field flattener.

Figure 2. Spider vanes assembly and focus system for the CCD.

Figure 3. Reinforced glass-fiber enclosure at OAdM.

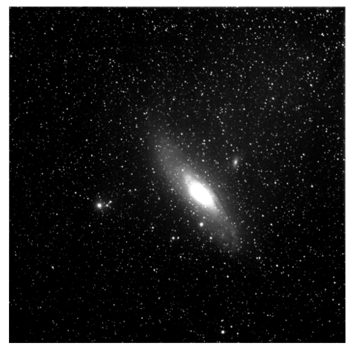

Figure 4. First technical light of M31 at ROA on 23 Sep 2008.

Transit Exoplanet Detection

The robotic nature of the BNC, its huge FOV and its considerable aperture, enables the telescope to succesfully detect transits of exoplanets. This expectation is supported by the fact that the Automatic Patrol Telescope (APT), originally a BNC twin of ours and, which after a similar refurfishment (although with an smaller FOV and less sensitive CCD), has succesfully compiled the UNSW Extrasolar Planet Search 2004-2007 catalogue of exoplanets candidates (Christiansen et al. 2008). This catalogue shows that BNC-based cameras can accomplish millimagnitude photometry at least up to V$\sim$14 magnitude.

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