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POLICAN: A NEAR-INFRARED IMAGING POLARIMETER AT OAGH

R. Devaraj[1], A. Luna[1], L. Carrasco[1], Y. D. Mayya[1], and O. Serrano-Bernal[1]

We present a near-infrared linear imaging polarimeter POLICAN, developed for the Cananea near-infrared camera (CANICA) at the 2.1m telescope of the Guillermo Haro Astrophysical Observatory (OAGH) located at Cananea, Sonora, México. POLICAN reaches a limiting magnitude to about 16^{th} *mag* with a polarimetric accuracy of about 1% for bright sources.

POLICAN is designed for linear polarimetric observations and is fixed externally to CANICA (see Figure 1). The main elements of POLICAN are a rotating super achromatic (1−2.7 μm) half waveplate (HWP) as the modulator and a fixed wire-grid polarizer as the analyser. The HWP rotation is controlled using a stepper motor drive. CANICA has a HgCdTe detector with 1024 × 1024 pixels. The primary broad-band near-infrared (NIR) filters are J, H and $K^{'}$. The camera re-images the incoming f/12 beam into f/6 yielding a plate scale of 0.32 arcsec/pixel, providing a field-of-view (FOV) of 5.5 × 5.5 arcmin^2. CANICA readout is structured to obtain correlated double sampled (CDS) images. Readout noise and dark current are kept minimum at operating temperature of 77 K cooled by liquid nitrogen.

The polarimetric observations are carried out by modulating the light through different steps of HWP angles $(0°, 22.5°, 45°, 67.5°)$. Each observation set for a particular HWP angle consists of number of dithered images distributed in a random pattern or having alternating source and off-field sky. Image reduction and analyses of POLICAN data is a two stage process carried out with a pipeline developed using IRAF and IDL software. The first stage involves grouping of the images and linearity correction. The linearity corrected images are dark current subtracted and flat-fielded using polarimetric flats. Next the median sky from the images is subtracted to remove sky contribution. The images are then combined and astrometry corrected to 2MASS

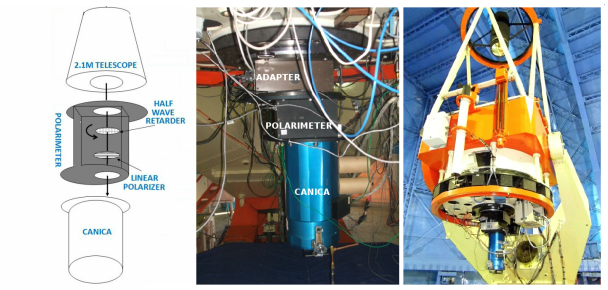

Fig. 1. The left image shows the block diagram of POLICAN. The center and right images are photos taken after integrating POLICAN with CANICA and telescope.

(Skrutskie et al. 2006) leading to science quality image for each HWP. The second stage involves multiple analyses by calculating the Stokes parameters (I, Q and U) and applying corrections to yield polarization percentages, position angles and their corresponding uncertainties (Devaraj et al. 2015).

Polarimetric calibration was derived from the MIMIR instrument (Clemens et al. 2012b). The first step involved measuring the instrumental polarization across the full FOV by analysing multiple observations of globular cluster $M5$. The second step involved determining the zero-phase-offset angle of the HWP for changing the polarization position angles into equatorial system. The zero-phase-offset angle for POLICAN was determined to be 139° from observations of polarimetric standards.

Observations on molecular clouds were carried out and compared to results of GPIPS (Clemens et al. 2012a) data. POLICAN achieved polarimetric accuracies of 1% having uncertainities in polarization of 0.1% to 30 % for bright to faint sources. POLICAN will serve as a reliable and sensitive NIR polarimeter for studying magnetic fields and polarization properties in the galactic medium.

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[1]Instituto Nacional de Astrofísica, Óptica y Electrónica, Luis Enrique Erro # 1, Tonantzintla, Puebla - 72840, México (dev@inaoep.mx).

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