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NIR STUDIES OF H II GALAXIES WITH CANICA

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RESUMEN

Se presenta un trabajo basado en los primeros datos obtenidos con la nueva Cámara en el cercano infrarrojo de Cananea o CANICA, desarrollada en el Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE). La cámara ha sido construída por el equipo liderado por Luis Carrasco en los laboratorios del INAOE y con financiación del CONACyT. Los datos se obtuvieron durante las primeras fases de ingeniería y comisionado de la cámara. Se presenta una discusión para el caso de algunas galaxias H II con diferentes tipos morfológicos y a distancias intermedias que se observaron con CANICA. El objetivo es obtener la función de luminosidad a partir de fotometría en el cercano Infrarrojo y determinar la formación estelar y la historia evolutiva de estas galaxias.

ABSTRACT

We present a report on the first data obtained with the new Cananea Near Infrared Camera or CANICA, developed at the National Institute for Astrophysics, Optics and Electronics (INAOE). The camera was constructed by a team led by Luis Carrasco at our laboratories and with a grant from CONACYT. The data was obtained during the early phases of engineering and commissioning of the camera. We present a discussion for several H II galaxies of various morphological types at intermediate distances observed with the CANICA instrument. The aim is to generate a luminosity function from the NIR photometry and determine the star-formation and evolutionary history of these galaxies.

Key Words: **GALAXIES — GALAXIES: INFRARED — GALAXIES: STARBURSTS — INSTRUMENTATION: MISCELLANEOUS**

1. INTRODUCTION

H II galaxies constitute a class of small gas–rich metal–poor, starburst galaxies whose optical appearance is dominated by one or more high surface brightness star–forming regions. Their optical spectra are characterized by a blue continuum and strong nebular Balmer and forbidden emission lines, similar to the spectra of H II regions. These galaxies are excellent examples of the "starburst" phenomenon, in which a vigorous but short lived burst of massive star formation has recently occurred, and are the simplest galaxies of this class. Since their discovery (Searle & Sargent 1972) the large reservoirs of H I and the low metal abundances in these galaxies have led to the suggestion that these objects are truly young systems in which a burst of star formation is occurring for the very first time. Previous episodes of star formation would presumably have depleted the H II gas and enriched the emission line gas in metals.

Despite these indications of youth, optical CCD imaging of a large sample of H II galaxies have revealed that in the majority of objects a faint extended elliptical envelope of late–type stars surrounds the compact central starburst regions (e.g. Thuan 1983; Kunth, Maurogordato & Vigroux 1988; Doublier, Compte, Petrosian, et al. 1997; Telles, Melnick & Terlevich 1997) and Guimaraes & Telles (2003).

Near Infrared observations combined with evolutionary synthesis models have shown that these faint components are probably composed of stars older than several Gyrs for a sample of bright H II galaxies (Telles & Sampson 2001; Telles 2002). Nevertheless, a small fraction (less than 10%) of the stellar component is substantially older than the current starburst population. These are unresolved, stellar looking faint objects found by objective prism surveys (in particular the University of Michigan Survey) due to their strong emission line properties. It is amongst these lowest luminosity galaxies where we expect to find the most metal poor, least evolved galaxies. If this is truly the case, these objects would constitute the nearest examples of "primeval galaxies". A study of their properties would have a profound impact on the understanding of both the "star-

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burst" phenomenon and galaxy formation mechanisms (Guimaraes & Telles, 2003). In any case they are the least evolved galaxies that can be studied in the nearby Universe.

Using the new Cananea Near Infrared Camera (CANICA) constructed by a team lead by Luis Carrasco at INAOE, we have obtained data for a large number of H II galaxies for which spectroscopic data is already being secured (Telles 2003). NIR photometry will be obtained for more than 250 galaxies in order to understand their star–formation history. In section § 2 we shall give details of the instrument construction and performance. In section § 3 we will describe the data obtained during the first phases of testing and commissioning of the CANICA instrument, as well as future work.

2. A NEW INSTRUMENT: CANICA AT THE OAGH

The design and construction of CANICA was posible by means of a grant obtained through CONACYT by Luis Carrasco as PI of the project for a new NIR imaging camera to be installed at the 2.12m reflector telescope of the "Guillermo Haro" National Astrophysical Observatory (OAGH) at Cananea, Sonora. The optical design was developed by Sergio Vázquez from the Optical Department at INAOE under the supervision of Luis Carrasco. Work started at the laboratory once all parts were assembled with the collaboration mainly of Gustavo A. Escobedo, Oscar Hernández and Edgar Castillo at the construction phase, testing and control for the final testing both at the lab and at the telescope. The instrument was installed at the telescope on April 2002 and soon after fairly good data was obtained. The camera is fitted with a focal reducer and provided with a Rockwell Scientific Hawaii 2.5 Detector. This is an array of 1024 x 1024 pixels, with an image scale of 0.32 arcsec/pixel. Its field of view (FOV) is therefore 5.5 arcmin. Two filter wheels allow the housing of several filters, both for galactic and extragalactic work. The software was mostly developed by Oscar Hernández while the user's interface is being continuously upgraded by Edgar Castillo and Teresa Orozco, the INAOE's NIR group at Cananea's Observatory. Upgrading for a NIR spectrograph is under way.

3. OBSERVATIONS OF H II GALAXIES

Our present status with the new camera will allow us to detect the presence of the low surface brightness underlying the stellar population in star–forming dwarfs using high S/N CANICA deep near–infrared images. The surface brightness distributions in the near–infrared (J, H & K) should reflect the spatial distributions of the stellar component. Therefore, their NIR colors with the optical colors in conjunction with evolutionary synthesis models (Chávez, Bressan, Rodríguez & Vega, in preparation) will tell us something about the history of star formation of the underlying stellar population. The luminosity, the general morphologies and spatial extents, can also be compared with images obtained through Brγ, the $[FeII]$ and H_2 filters already implemented at CANICA. These images contain information about the ionized gas and the origin of its ionization and hence trace the exact location of sites of recent star–formation, possibly revealing sub–structures. When the broad band peaks coincide with the Brγ emission then the near–IR is likely to be dominated by young red supergiant stars while if they do not coincide, then we may identify old populations. We would like to count with $[FeII]$ and H_2 emission maps of these galaxies in order to evaluate the amount of shocked gas and its energy input in the ISM.

The selected sample has included objects with z that will fall on adequate filters to obtain the given emission lines. So both, Hα and K images, have been obtained in order to detect the old star population (if present). We plan to have blue images (V) that will predict metallicity contents (Bressan, 2004). From the SLOAN Survey we are completing Telles' sample with low surface brightness galaxies (V magnitudes). We are also observing those galaxies that have not being included in the 2MASS Survey. Using our preliminary data the reduction of a few of the images from some H II galaxies in common with the 2MASS survey have shown quite nicely, that our images with CANICA go *deeper* by 1.5 mag at K, so it will detect extended galaxy features as well as any possible companions that may be triggering the "starburst" phenomenon in these H II compact galaxies.

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