MASSIVE STARS IN NGC 604: AN HST/NICMOS+ACS PERSPECTIVE

R. H. Barbá,¹ J. Maíz Apellaniz,² E. Pérez,² M. Rubio,³ A. D. Bolatto,⁴ C. Fariña,⁵ G. Bosch,⁵ and N. R. Walborn⁶

RESUMEN

Se presenta el informe en avance de un análisis profundo de la región HII extragaláctica de NGC 604 en M33. Este objeto es considerado el prototipo de una asociación OB a gran escala, y sus propiedades generales (contenido de estrellas masivas, juventud y baja extinción hacia ella) hacen a este objeto ideal para un análisis detallado. En este informe presentamos los resultados preliminares de las nuevas observaciones obtenidas con la Cámara 2 de NICMOS y la Cámara Avanzada para Sondeos (ACS) del Telescopio Espacial Hubble, entre los cuales destacamos los descubrimientos de: (a) cuatro candidatas a estrellas supergigantes rojas y que se hallan asociadas espacialmente a estrellas de tipo Wolf-Rayet ya conocidas en el área; (b) una gran población de objetos estelares jóvenes que se hallan asociados a los núcleos de gas molecular previamente conocidos y a regiones de muy alta extinción, siendo algunos de estos objetos jóvenes muy luminosos.

ABSTRACT

This is a report in advance of an in-depth analysis of the extragalactic giant HII region NGC 604 in M33. This object is the prototypical scale OB association and its properties (massive stellar content, young, and low foreground extinction) make it an ideal object to a detailed analysis. Here, we present the very early results of new Hubble Space Telescope observations obtained with the NICMOS Camera 2 and the Advanced Camera for Surveys (ACS), namely: (a) the discovery of four new red supergiant star candidates which are closely (parsec-scale) associated to known Wolf-Rayet stars; (b) the discovery of a large population of young stellar objects associated to the previously known molecular cores and regions with high extinction, some of them being high luminosity objects.

Key Words: H II regions: individual (NGC 604) — open clusters and associations — stars: early-type — stars: supergiants

1. OVERVIEW OF THE PROJECT

Giant HII regions (GHRs) are among the most luminous objects that can be observed in distant galaxies. They are closely related to the starburst phenomenon, where the star formation occurs at extremely high rates. Their natural extension to larger scales are the starburst galaxies, which can be traced to cosmological distances and used as astrophysical signposts of the star formation history of the Universe.

¹Departamento de Física, Universidad de La Serena, Benavente 980, La Serena, Chile (rbarba@dfuls.cl).
²Instituto de Astrofísica de Andalucía-CSIC, Camino bajo de Huétor 50, Granada, Spain (jmaiz@iaa.es).
³Departamento de Astronomía, Universidad de Chile, Santiago, Chile.
⁴Dept. Astronomy and Radio Astronomy Laboratory, University of California, Berkeley, CA 94720, USA; Dept. Astronomy and Laboratory for Millimeter-Wave Astronomy, University of Maryland, College Park, MD 20742, USA.
⁵Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, and Instituto de Astrofísica La Plata, Argentina.
⁶Space Telescope Science Institute, 3700 San Martin Dr., Baltimore, Maryland 21218, USA.
terprise, we plan to classify spectroscopically about 200 massive stars, to measure their spectral energy distribution from 1300 Å to 2.2 µm, to identify the younger stellar population (mostly hidden inside dust clouds), to determine the extinction law and the possible variations as a function of environmental conditions, and to analyze the relationship between the hot stars and the surrounding gas and molecular clouds. The project is based mostly on observations gathered using Hubble Space Telescope instruments (WFPC2, STIS, NICMOS and ACS), near-infrared narrow-band imaging with NIRI at Gemini North, and the CO 1-0 transition observed with the Combined Array for Research in Millimeter-wave Astronomy (CARMA). The NICMOS, STIS and ACS data were obtained under proposals 10419 (PI R. Barbá), 9096 and 10722 (PI J. Maz Apellaniz), respectively.

In this first report, we present the NICMOS camera 2 (NIC2) observations of NGC 604 and a neighbour control field obtained through broadband filters F110W, F160W and F205W. These observations cover the 35″ × 35″ central part of NGC 604, with an additional subfield to the South, where a bright infrared source and a CO cloud are located. A “control” field with the same exposure times and dither pattern was obtained about 1′ to the north of the core of NGC 604 in order to be used for comparison in the photometric analysis.

The NIC2 images were processed using the PyDrizzle package (Hack 2002) and registered to the ACS HRC mosaics of the same field. Figure 1 shows the complete F205W mosaic of NGC 604, indicating the main and secondary SOBA, as described by Maíz Apellaniz et al. (2004), and a new OB association to the South. Point spread function (PSF) photometry was performed on the complete set of NIC2 images, using both observed and synthetic PSF stars, allowing us to reach 5σ source detections at about 22 mags in the F205W filter, corresponding to a main-sequence early-B type star at the distance of M33 (840 kpc).

From the very early analysis of NIC2 imaging and the comparison with ACS and NIRI data we can highlight the following discoveries: (a) four new red supergiant star candidates and their spatial association (at 1″ scale, i.e. 4 pc) with known WR stars or WR candidates; and (b) a large population of young stellar objects associated to the previously known molecular cores and filled H II regions, some of them being high luminous objects (about 10^5 L_☉).

RHB acknowledges support from FONDECYT No. 1050052 (Chile). M.R. is supported by the Chilean Center for Astrophysics FONDAP No. 15010003. Support for this work was provided by NASA through grant GO-10419.01-A from Space Telescope Science Institute, which is operated by AURA, Inc., under NASA contract NAS 5-26555.

REFERENCES

