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3D Studies of Recycling Signatures within Irregular Galaxies

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Abstract. We present a 3D analysis based on Fabry–Perot data of some astronomical objects directly related to recycling processes within the irregular galaxies NGC4449 and IC1613.

1. Introduction

Recycling processes of interstellar matter within galaxies are a fundamental element of galactic evolution and they are mainly carried out by massive stars. The ideal framework to analyse such processes could be that one where the objects of interest are immersed and preserved in an environment relatively free of perturbations such as density waves or galactic interactions. This is why isolated Irregular galaxies (Irrs) arise as the best laboratories to follow the evolution of recycling signatures in their ISM, namely star forming regions, supernova remnants, Wolf–Rayet stars, superbubbles, and diffuse ionized gas (DIG) to mention a few (see also Hensler 2003). Here we present results of the kinematics in some specific populations of the Irr galaxies NGC4449 and IC1613. The observations were performed by means of the Fabry–Perot interferometer PUMA, at the Observatorio Astronómico Nacional at San Pedro Mártir, México. The mapping was carried out centered on the lines of Hα and [SII]. For more details of equipment and observational setup, see Valdez–Gutiérrez et al. (2001). Due to the nature of our data we were able to perform the kinematical analysis of the ionized gas from a global as well as local perspective.

2. The DIG in NGC4449

As our spectroscopic study reveals in this galaxy (Valdez–Gutiérrez et al. 2002), the DIG displays a very complex behavior. For the very widespread DIG over the disk, kinematical evidence favors shocks as the energy supplying mechanism. For the inner DIG (close to the HII regions) its fueling is provided by energetic photons escaping from HII complexes. For this galaxy, the (indirect) origin of the DIG's ionization is supported by its evolutionary history: an interacting scenario generating a bar–like potential well in the host galaxy, turbulence and falling

in of material that triggers star formation over the whole body of the galaxy, giving rise to an impressive network of loops, tunnels, chimneys and bubbles, altogether developing the DIG that embraces NGC4449. DIG profile decomposition required multicomponent fits, particularly at locations where infall of gas has been invoked and where filaments or shells can be seen in projection. On global scales in NGC4449, DIG velocity dispersions increase their values from the outskirts toward the interior of the disk (from 10 to 75 km s^{-1}). However, values at infall locations reach up to 4 times the velocity dispersion of the nearest HII region. In general, the resulting DIG velocities and velocity dispersions were larger than the values we secured for the HII regions. Altogether, these facts suggest that shocks are taking place all over the DIG in NGC4449.

3. The superbubble population in IC1613

In the relatively isolated Irr IC1613, we studied a well preserved superbubble population (17 objects; Valdez–Gutiérrez et al. 2001) which is a patent signature of its ISM recycling. From our kinematical analysis we concluded that almost all superbubbles are explained in terms of the combined action of stellar winds and SN explosions (the standard model; Weaver et al. 1977). Profile decomposition yields expansion velocities in the range 24–50 km s^{-1}. The derived dynamical ages are of the order of 1–2 Myr and shorter than ages of the stellar associations interior to the superbubbles. From optical and NIR photometry of the IC 1613 stellar component we found that superbubble expansion velocities lower than 30 km s^{-1} are easily explained by the blue stars ($M_V < -2$) inside them, assuming that they are all supergiants and earlier than B0. In general, the mechanical energies of all the superbubbles represent ~80% of the energy of one supernova explosion. Due to this, one or two SN explosions could account for the superbubble formation or acceleration. But no traces of such SN explosions, say extended X–rays sources or non-thermal radio emission, have been found (but see Rosado, Valdez–Gutiérrez, et al. 2001).

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