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A SINFONI view of the nuclear star formation ring in NGC 613

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Abstract. We present preliminary results from a near-infrared, integral-field study of the central 500 pc in the nearby Sbc spiral NGC 613. More specifically, we present maps of various gaseous emission lines in which the ring structure can be identified. The ring consists of at least seven "hot spots" that are actively forming stars and thus can be identified in recombination lines of hydrogen (H) and Helium (He). The molecular gas (traced by emission from the H_2 molecule) is more evenly distributed over the entire ring. We also present H- and K-band spectra of one of the ring hot spots and the nucleus of NGC 613 (i.e. the central $1''$). The nucleus emits little or no flux in H or He recombination lines. Instead, its spectrum is dominated by H_2 and [FeII] emission, suggesting that NGC 613 is currently in a phase in which gas is accumulating within the central 50 pc. Moreover, we find clear evidence that the ring structure is disturbed by an energetic outflow from the nucleus, supporting evidence that NGC 613 harbors an AGN.

Keywords. galaxies: spiral, galaxies: nuclei, galaxies: individual (NGC 613)

1. Introduction

In many spiral galaxies of early- and intermediate Hubble type (Sc-Sa), active star formation is organized in circumnuclear rings which are believed to form where the stellar orbits experience dynamical resonances with a rotating bar-shaped potential. Star formation rings not only offer a unique opportunity to study massive star formation in external galaxies, they are also important for the secular evolution of disk galaxies (Kormendy & Kennicutt 2004). This is particularly true for the innermost of the dynamical resonances which is called either the "inner Lindblad resonance" (ILR) or - in cases where a compact massive object leads to an additional dynamical resonance - the "nuclear Lindblad resonance" (NLR, Fukuda 1998). Either of these resonances can produce gas rings with radii of a few hundred pc or less, depending on the enclosed mass, and the rotation speed of the galaxy disk.

The large, relatively nearby ($d = 17.5$ Mpc), and strongly barred Sbc spiral NGC 613 provides a good example. We have observed the center of NGC 613 with the Very Large Telescope (VLT), using the near-infrared integral-field spectrograph SINFONI. In Fig. 1, we show the morphology of the ring as seen in various NIR emission lines, and show example H- and K-band spectra ($R \approx 1500$) of the nucleus and one of the ring "hot spots". Note the "gap" in the ring structure towards the north-east that is obvious in all NIR emission line maps. This feature is aligned with the radio continuum jet first reported by Hummel *et al.* (1987), and thus is probably produced by an outflow from the nucleus. A full analysis of this data set (as well as similar data for four other spirals) will be presented in a forthcoming paper (Böker *et al.* 2007, in prep.).

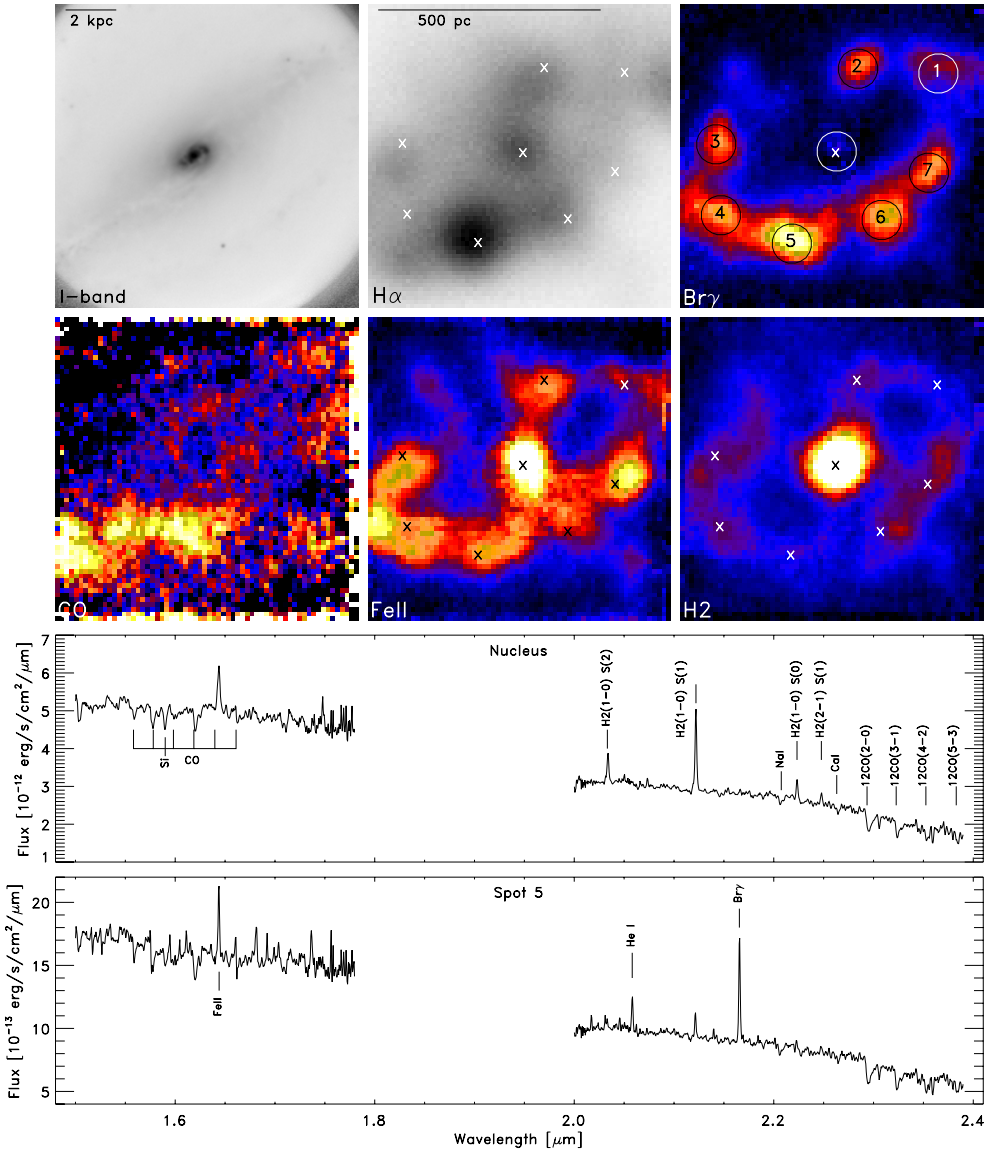

Figure 1. The nuclear star formation ring in NGC 613: a) I-band image with a circular field of view of $\approx 1'.8$ diameter, b) Hα, c) Brγ, d) CO index, e) H_2 (2.122 μm), f) FeII (1.644 μm). Panels b) - f) cover the central $8'' \times 8''$. Data in panels a) and b) are taken from Knapen *et al.* (2006), all others are extracted from the SINFONI observations. The bottom two panels show example SINFONI spectra, extracted over $1''$ diameter circular apertures centered on the nucleus and the hot spot labeled "5" in the Brγ map.

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