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NAME: Magda Arnaboldi

AFFILIATION: ESO

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TITLE: Kinematically cold and warm planetary nebulae samples, HII regions and Supernovae remnants in the disc of the face-on spiral galaxy NGC 628 (M74)

AUTHORS: Magda Arnaboldi & the PN.S consortium

AFFILIATIONS: ESO, IUCAA, MPE, et al.

ABSTRACT:

As a step towards measuring the disc mass-to-light ratios and the age-velocity dispersion relation for normal spiral galaxies, we present the results from the observations of the galaxy NGC 628 with the Planetary Nebulae Spectrograph (PN.S) equipped with the H α arm. We identify planetary nebulae (PNe) in the face-on spiral galaxy NGC 628 (M74) such that we can measure the velocity dispersion of the stars perpendicular to the main plane of the disc. As PNe are the late nebular phases of intermediate to low mass stars, they are naturally associated with the evolved stars whose scale height is measured for edge-on discs in the near-infrared wavelengths. By solving the Jeans equation for the older component, we derive the mass-to-light ratio for the stellar disc as function of radial distance. We compare the surface density profile of PNe and HII regions vs. the surface brightness profile in the V band of the stars as function of radius in NGC 628. The PN surface density profile follows the exponential light in the disc, while the resolved surface HII density profile displays a cut-off at $R \sim 300''$, consistent with a sharp decrease of the H α emission at $R_{25 \sim 312''} = 13.4$ kpc. We further characterize the line-of-sight velocity distribution (LOSVD) of PNe in the disc of NGC 628 out to $R = 18$ kpc; the PN LOSVD of the entire sample is wider than that of the HII tracers, over the same range of radii. We find that the selected HII regions, Supernovae remnants (SNRs) and PNe have different..