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Hα emitters in the Magellanic Clouds: searching for Be stars using high-resolution multi-band photometry

F. Navarete[1], P. Ticiani[2], A. Figueiredo[2] and A. C. Carciofi[2]

[1]*SOAR Telescope/NSF's NOIRLab, Avda Juan Cisternas 1500, 1700000, La Serena, Chile.*
[2]*Universidade de São Paulo, Instituto de Astronomia, Geofisica e Ciências Atmosféricas, Rua do Matão 1226, Cidade Universitária São Paulo-SP, 05508-090, Brazil.*

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Classical Be stars are a subset of main-sequence (MS) B-type stars associated with viscous Keplerian decretion disks responsible for their emission lines. In addition, fast rotation is a fundamental ingredient for the existence of Be stars, as they are by far the fastest among non-degenerate stars. To date, at least three proposed scenarios try to explain the spin-up mechanism and the existence of Be stars: Be stars are born as fast rotators; the spin-up would occur during the evolution of a binary system; or they would start as slow rotators, increasing their rotation throughout their evolution. Even though all mentioned scenarios may play a role in the origin of Be stars, discriminating the relative prevalence of each scenario is a key step towards a better understanding of these objects.

Hα emission is a clear indicator of circumstellar activity in Be stars, historically employed to assess the classical Be star (CBe) population in young open clusters (YOCs). The YOC NGC330 in the Small Magellanic Cloud exhibits a large known fraction of Be stars and was selected for a pilot study to establish a comprehensive methodology for identifying Hα emitters in the Magellanic Clouds, encompassing the entire B-type spectral range. Using the SOAR Adaptative Module Imager (SAMI), we investigated the stellar population of NGC330 using multi-band $BVRI$+Hα imaging (Fig. 1). We identified Hα emitters within the entire V-band range covered by SAMI/SOAR observations ($V \lesssim 22$), comprising the complete B-type stellar population and offering a unique opportunity to explore the Be phenomenon across all spectral sub-classes. The stellar radial distribution shows a clear bimodal pattern between the most massive (B5 or earlier) and the lower-mass main-sequence objects (later than B6) within the cluster. The former is concentrated towards the cluster center (showing a dispersion of $\sigma = 4.26 \pm 0.20$ pc), whereas the latter extends across larger radii ($\sigma = 10.83 \pm 0.65$ pc), indicating mass stratification within NGC330. The total fraction of emitters is $4.4 \pm 0.5\%$, notably smaller than previous estimates from flux- or seeing-limited observations. However, a higher fraction of Hα emitters is observed among higher-mass stars ($32.8 \pm 3.4\%$) than within lower-mass ($4.4 \pm 0.9\%$). Consequently, the putative

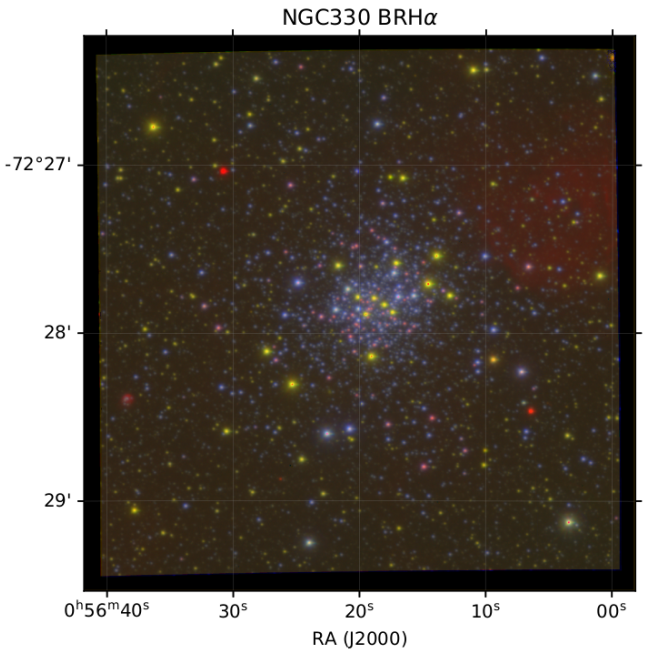

Figure 1. False-color BRHα image of NGC330 (blue: B, green: R, red: Hα) from SOAR/SAMI observations. The image has a 3.1'×3.1' field-of-view, centered at R.A.=00:56:20.0, Decl.=-72:27:51.67 (J2000). North is up, and East is to the left.

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CBe population exhibits distinct dynamical characteristics compared to the bulk of the stellar population in NGC330. These findings highlight the significance of the current observations in providing a complete picture of the CBe population in NGC330.

Combined with the analysis of further YOCs in the Magellanic Clouds, this survey will provide crucial evidence for understanding the Be phenomenon as a function of metallicity and age, putting critical observational constraints on the origin of these massive stellar objects. The complete work will be presented in Navarete et al. (2024).

References

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