Pre-main-sequence Stars in the SMC and LMC

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Abstract.
We present first results of a survey for pre-main-sequence stars in the Magellanic Clouds. Our search concentrated on NGC 346, the most prominent OB association in the Small Magellanic Cloud, and on the 30 Dor starburst cluster in the Large Magellanic Cloud. The identification of the young low- to intermediate-mass stellar population in the SMC and LMC allows us to study whether or not these populations formed simultaneously with high-mass stars, and to what an extent lower metallicity affects the low-mass IMF. We can also evaluate the duration of star formation in a starburst region.

1. Introduction and Observations

We followed two strategies to search for pre-main-sequence stars in the Magellanic Clouds. In NGC 346, we selected a $2' \times 2'$ field slightly off the brightest stars of the association and in a region with a relatively small amount of diffuse nebulosity. This field was observed with the ESO/NTT in the optical under subarcsec seeing conditions. The total exposure time of our NGC 346 Deep Field amounts to 300 minutes in Hα, and 16 minutes in the V and R band. Pre-main-sequence star candidates were identified based on their Hα emission, and their position in a V vs. V-R color-magnitude diagram.

The crowded environment in the starburst cluster in 30 Dor requires higher spatial resolution, and thus a different observing strategy. We used HST/NICMOS (see contribution by Zinnecker et al.) to obtain deep H band images of the central $1' \times 1'$ of the cluster and of two $20'' \times 1'$ wings extending outwards (effective exposure time 60 min at each position). In addition, 4 comparison fields outside the starburst cluster, but still within the 30 Dor region were observed.
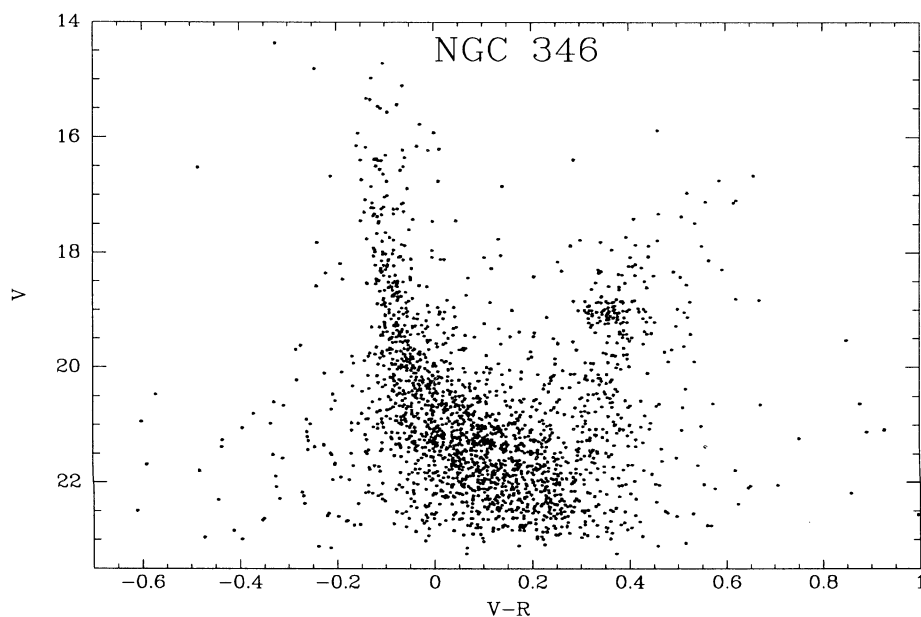
Figure 1.   The V vs. V–R color-magnitude diagram shows the young population of NGC 346 (blue main-sequence) and the underlying intermediate age field population (red clump).

2.   Results and Discussion

In NGC 346, we reached a limiting magnitude of $22\overset{m}{.}5$ in broad and narrow-band filters (see Figure 1), which enables us to detect main-sequence stars down to a spectral type of F5 (1.4 $M_\odot$) and – for an age of 2 Myr – also slightly more massive pre-main-sequence stars (at this particular age, pre-main-sequence stars with a mass between 1 $M_\odot$ and 2 $M_\odot$ are actually less luminous than their main-sequence counterparts with the same mass). Objects with Hα emission were identified by comparing the observations in the R-band and the Hα filter. Even on spatial scales of $0\overset{''}{.}5$ (best seeing value in any single 30min exposure in Hα), variations in the diffuse background proved to be the limiting factor for identifying pre-main-sequence stars based on their Hα emission. Nevertheless, we detected about 150 objects with excess emission in Hα among 2500 stars. The Hα emitting stars are good candidates for pre-main-sequence Herbig AeBe stars. We intend follow-up observations using the Focal Reducer/low dispersion Spectrograph (FORS) at the VLT.

   In 30 Dor, observed luminosity functions on and off the cluster were compared with theoretical luminosity functions. We were able to get an independent age estimate, to identify low-mass pre-main-sequence stars, and to compute the slope of the IMF. A detailed description of the 30 Dor results can be found in the contribution by Zinnecker et al. (this volume).