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The Star Formation of a Giant H II Region in M 101

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Abstract. We present a study of the star formation process in the giant H II region NGC 5471 in the outskirts of M 101 from both integrated and resolved photometry. Stellar population analysis with the code CHORIZOS is compatible with the hypothesis that this regions has, at least, two different populations. The color-magnitude diagram of the region as derived from HST/WPFC2 photometry shows that star formation has been going on for the last 70 Myr.

1. Introduction

M 101 (NGC 5457) is a giant spiral galaxy containing a large number of very luminous giant H II regions, of which NGC 5471 is one of the outermost at a galactocentric radius of about 25 kpc. Its characteristics place it among the category of giant star forming regions and therefore it is an excellent candidate for the study of complex star formation. In this study we combine HST-WFPC2 data, JHK_s CCD images obtained with the 3.6-m Telescopio Nazionale Galileo (TNG) at La Palma Observatory and the ARNICA camera and Galaxy Evolution Explorer (GALEX) far-ultraviolet (FUV) and near-ultraviolet (NUV) images to try and characterize the star formation process trough the use of stellar population techniques.

2. Integrated Study

In order to perform an analysis of the stellar population content of the main components in NGC 5471 we derived the integrated magnitudes (JHK+ F547M + F675W) in eleven different apertures by means of the POLYPHOT task in IRAF, which each of one includes a cluster. GALEX images does not have enough resolution to define the eleven polygons, so we performed circular aperture photometry over the whole region in all the images (ultraviolet, optical and infrared). To find the correspondence between the observed photometric properties and the models, we have used CHORIZOS code (Maíz-Apellániz 2004). The code uses χ^2 minimization to find all models (Starburst99) compatible with the observed data. We have fixed two of these parameters: the known metallicity of NGC 5471 and the type of dust $R_V = 3.1$, leaving unconstrained the amount of extinction and the age. The code gives a wide range of possibilities in age and reddening for each polygon, implying that the optical and infrared data is

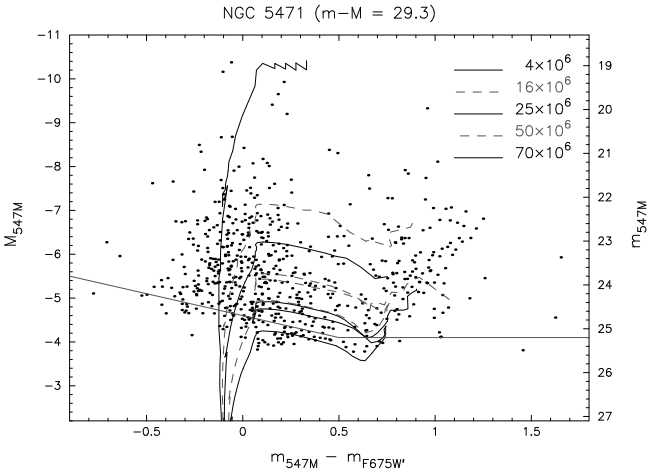

Figure 1. Color-magnitude diagram of NGC 5471 with isochrones from 4 to 70 Myr.

degenerated. In the case of the circular aperture including ultraviolet data, the code gives only two possible solutions: one of 7 Myr and another of 70 Myr. This results is compatible with the hypothesis that this regions has, at least, two different populations.

3. Stellar Study

The stellar photometric analysis was performed with the HSTPHOT package Dolphin (2000). We obtained the completeness limit by adding artificial stars to the images and subject them to the same analysis as the real ones. The 50% completeness of the F547M filter derived on the basis of the color-magnitude diagram (CMD) data is 25.2 mag, while that for the F657W filter is 50% at 24.7 mag. Our CMD consist of the sum of the intrinsic population (IP) and the contaminating field population (FS) and therefore the CMD shows both populations (IP+FS). The field star contribution has been estimated using the CMD of adjacent fields FS containing only foreground and background stars. FS contribution may be removed statistically (Bellazzini et al. 1999) by comparing the local density of stars in the two diagrams. We assume a distance modulus of $(m - M) = 29.3$ for M 101 (Stetson et al. 1998). In Fig. 1 the final CMD is plotted. Overimposed are isochrones of different ages with a mixture of different age populations ranged from 4 to 70 Myr showing that the star formation in NGC 5471 has been going on for at least that period.

References

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