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THE STAR FORMATION HISTORY OF M33'S OUTER REGIONS

M. K. Barker,[1] A. Sarajedini,[1] D. Geisler,[2] P. Harding,[3] and P. Schommer[4]

The stellar populations of a galaxy are a fossil record of its formation and evolution and the various physical processes involved.

Therefore, studying the resolved stellar populations of nearby galaxies can provide important constraints on their structure, formation, and evolution. To that end, we have obtained VI photometry with the Advanced Camera for Surveys on the *Hubble Space Telescope* for three fields at deprojected radii $\sim 9-13$ kpc along M33's southeast minor axis. These fields lie at $\sim 4-6$ visual scale lengths from M33's nucleus.

We have modeled the observed color-magnitude diagrams as linear combinations of individual synthetic populations with different ages and metallicities using the IAC-star and StarFISH codes (Aparicio & Gallart 2004; Harris & Zaritsky 2001). To gain a better understanding of the systematic errors we have conducted the analysis with two different sets of stellar evolutionary tracks which we designate as Padova (Girardi et al. 2000) and Teramo (Pietrinferni et al. 2004). The precise details of the results depend on which tracks are used but we can make several conclusions that are fairly robust despite the differences. Both sets of tracks predict the mean age to increase and the mean metallicity to decrease with radius. Allowing age and metallicity to be free parameters and assuming star formation began $\sim$ 14 Gyr ago, we find that the mean age of all stars and stellar remnants increases from $\sim$ 6 Gyr to $\sim$ 8 Gyr and the mean global metallicity decreases from ~ -0.7 to ~ -0.9. The random errors on these estimates are 1.0 Gyr and 0.1 dex. By comparing the results of the two sets of stellar tracks for the real data and for test populations with known SFH we have estimated the systematic errors to be 1.0 Gyr and 0.2 dex. These do not include uncertainties in the bolometric corrections or variations in α-element abundance which deserve future study.

[1]Department of Astronomy, University of Florida, Gainesville, FL 32611, USA (mbarker@astro.ufl.edu).

[2]Gpo. de Astronomía, Depto. de Física, Universidad de Concepción, Chile.

[3]Astronomy Dept., Case Western Reserve University, Cleveland, OH, USA.

[4]Cerro Tololo Inter-American Observatory, NOAO, La Serena, Chile.

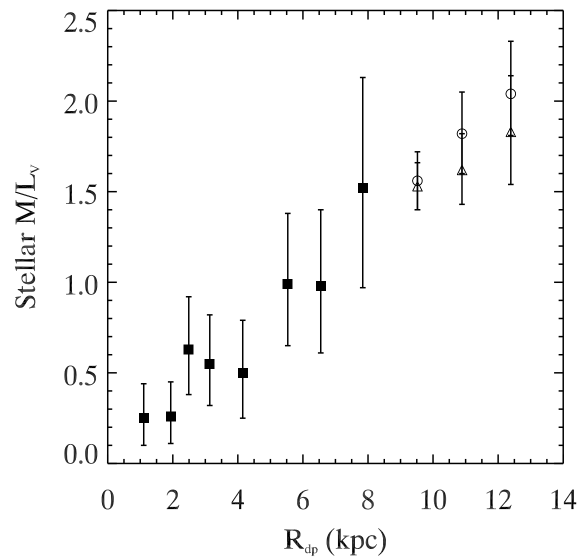

Fig. 1. V-band stellar mass-to-light ratio in M33.

We show the stellar V-band mass-to-light ratio implied by our results in Figure 1 assuming a distance of 867 kpc to M33 (Galleti et al. 2004). The Padova results are shown as circles while the Teramo results are shown as triangles. The filled squares represent the results of Ciardullo et al. (2004) based on the kinematics of planetary nebulae in M33. Taken at face value, Figure 1 suggests that the mean age of M33's entire stellar disk increases with radius. However, heavy current star formation could be driving down the mass-to-light ratio in M33's inner disk because the youngest stars (age $\lesssim$ 1 Gyr) contribute the majority of the integrated light. The GTC will be invaluable in elucidating this matter by complementing future star formation history studies of M33's inner disk with spectroscopic kinematics and abundances of stars in various evolutionary stages.

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