The Resolved Stellar Populations in 50 Regions in M83

Hwihyun Kim[1](Hwihyun.kim@asu.edu), B. C. Whitmore[2], R. Chandar[3],
C. C. Kaleida[4], R. A. Windhorst[1], & WFC3 SOC team
[1]Arizona State University, [2]STScI, [3]Univ. of Toledo, [4]CTIO

Abstract

We present a multi-wavelength photometric study of ~15,000 resolved stars in the nearby spiral galaxy M83 (NGC 5236, D=4.61Mpc) based on Hubble Space Telescope Wide Field Camera 3 observations using four filters: F336W, F438W, F555W, and F814W. We select 50 regions (average size of 260 pc by 280 pc) in the spiral arm and inter-arm areas of M83, and determine the age distribution of the luminous stellar populations in each region. This is accomplished by correcting for extinction towards each individual star by comparing its colors with prediction from stellar isochrones. The F336W filter is particularly useful for age-dating populations of young stars and breaking the degeneracy between age and dust extinction. We compare the resulting luminosity-weighted mean ages of the luminous stars in the 50 regions with those determined from several independent methods, and find reasonably good agreement between these methods. We also find that young stars are much more likely to exist in concentrated aggregates along spiral arms, while older stars are more dispersed. The locations of Wolf-Rayet stars are found to correlate with the positions of many of the youngest regions, providing additional support for our ability to accurately estimate ages.

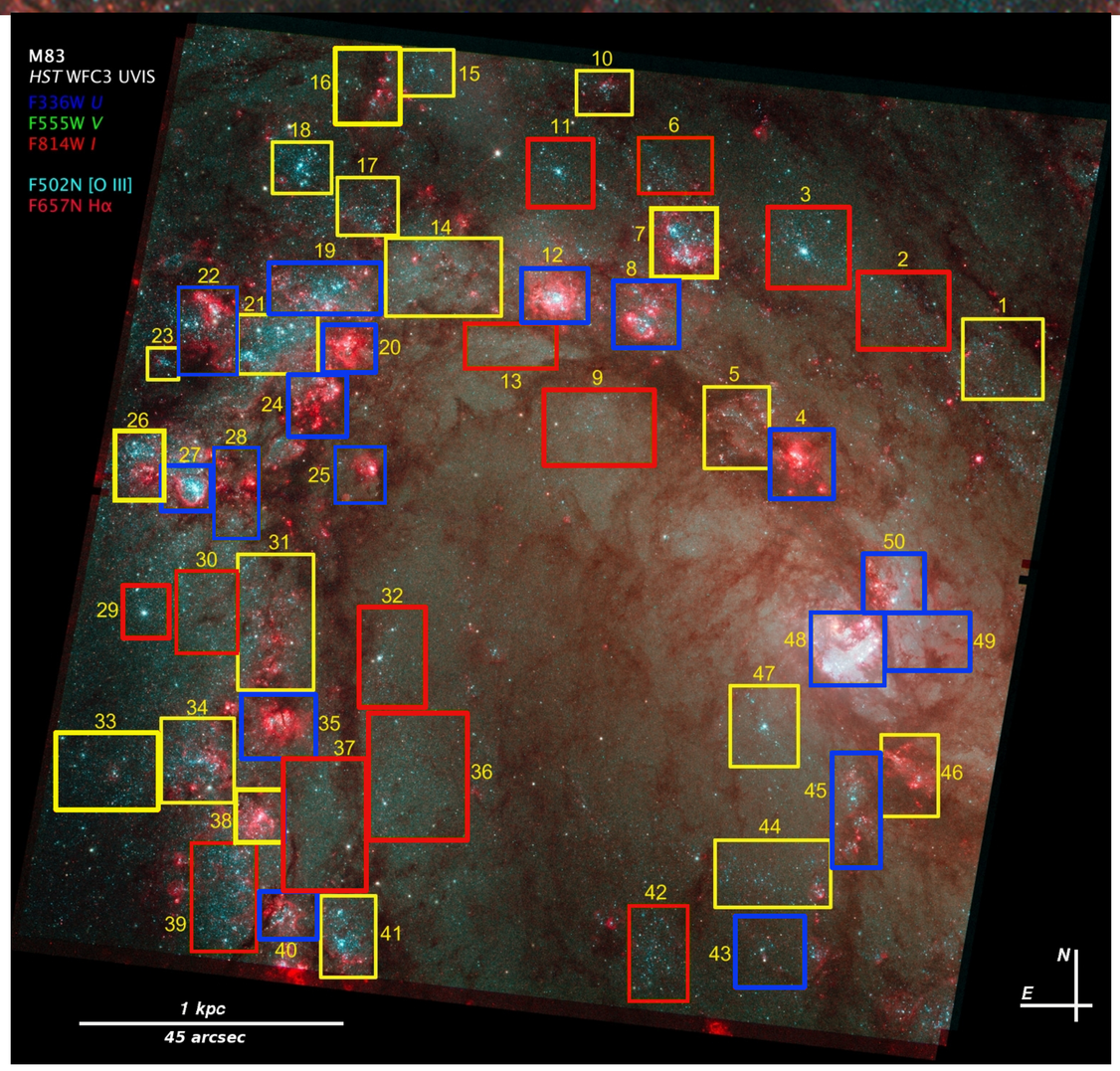


Figure 3. Color composite of the M83 WFC3 images. 50 regions are selected and outlined in boxes of three different colors based on stellar ages (1-10 Myr in blue, 10-20 Myr in yellow, and greater than 20 Myr in red) determined from their CMDs.

Spatial Distribution

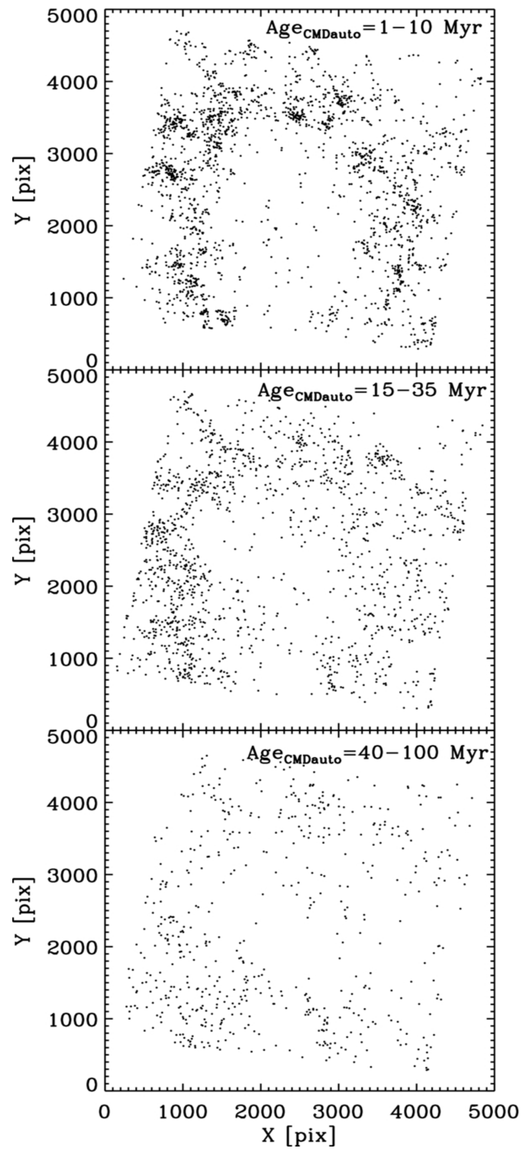


Figure 6. The spatial distribution of stars shows that younger stars are more clustered, and associated with active star-forming regions and spiral arms.

Star by Star Extinction Correction

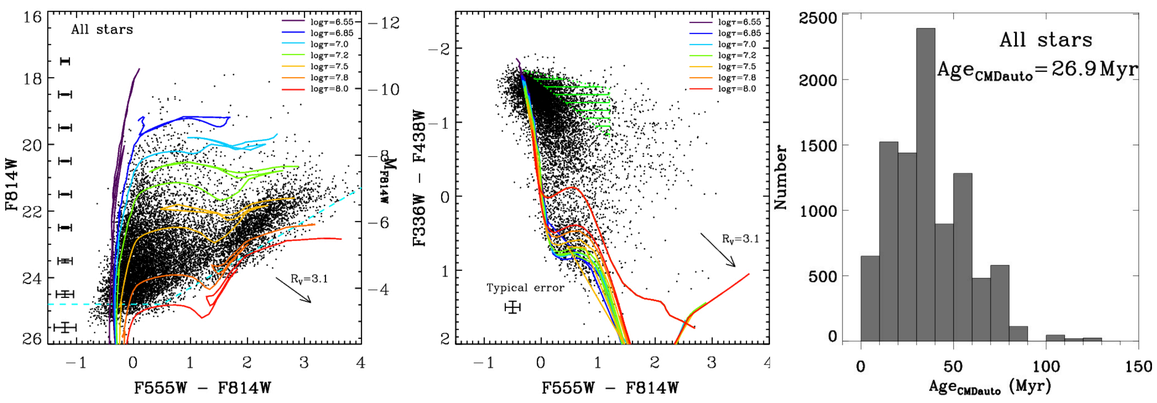


Figure 1. Color-magnitude diagram (*left*), color-color diagram (*middle*), and histogram of age distribution (*right*) of resolved stars in M83. Padova isochrones for Z=0.019 are overlaid. F336W, F438W, F555W, and F814W magnitudes are in Vega magnitude. The arrow in each panel indicates the direction of the reddening vector with R_V=3.1.

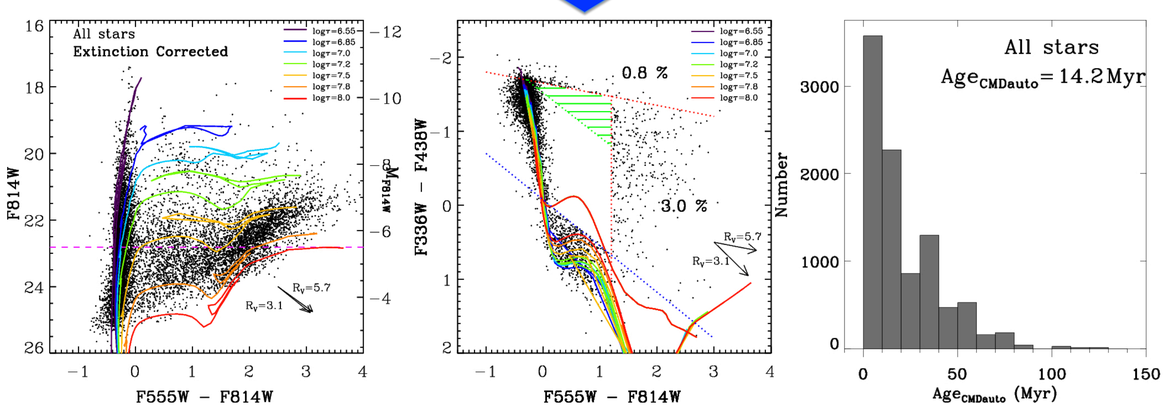


Figure 2. CMD (*left*), color-color diagram (*middle*), and histogram of age distribution (*right*) of all stars corrected for the internal extinction determined for each individual star. Two arrows in each panel show reddening vectors with R_V= 3.1 (standard) and R_V= 5.7 (flatter). The luminosity-weighted age determined from CMD is changed from ~27 Myr to 14 Myr.

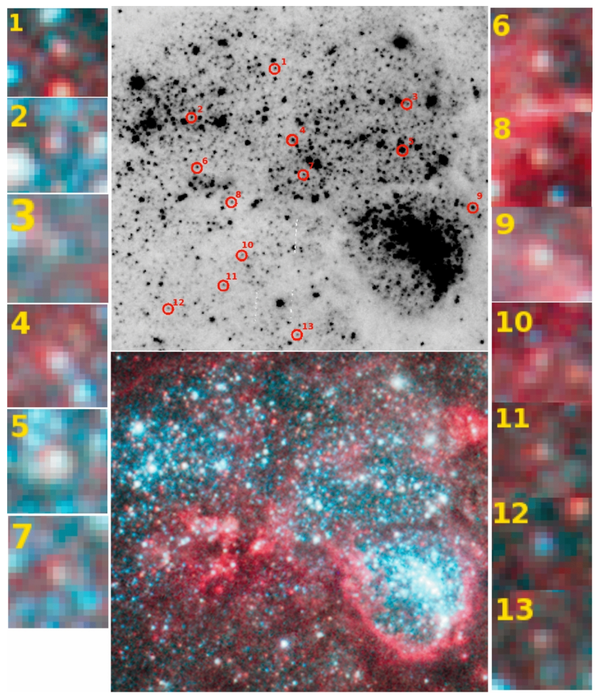
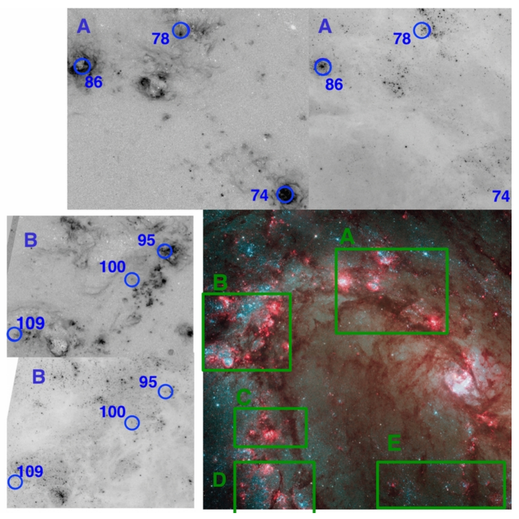


Figure 4. Examples of "pseudo-matches". The photometry for ~3% of stars is compromised. Half of them are very close super-positions of blue and red stars.

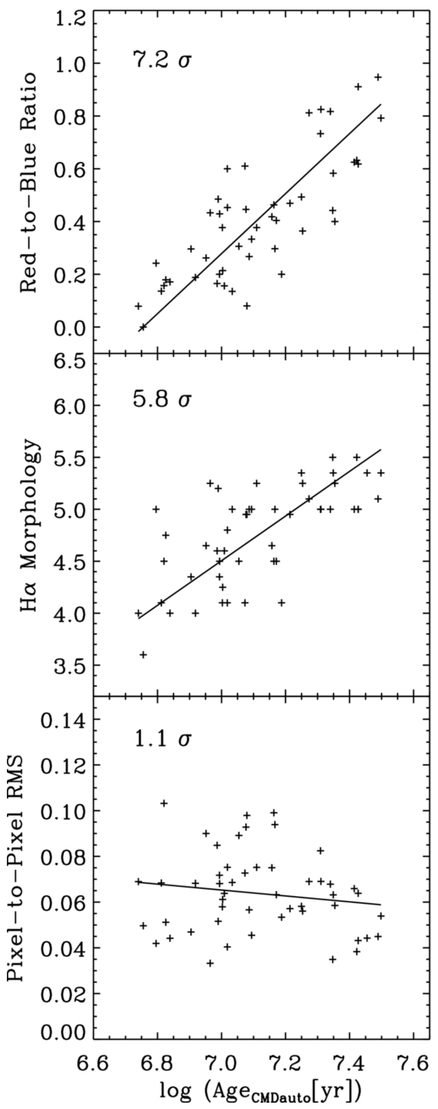
Distribution of Wolf-Rayet Sources

Figure 5. Locations of Wolf-Rayet sources (blue circles) observed with ground-based telescopes are associated with the youngest regions.



Correlations

Figure 7. Correlations between the number ratios of red-to-blue stars, Hα morphologies, pixel-to-pixel surface brightness fluctuations, and the stellar ages from CMD fitting for 50 selected regions. Solid lines are the best linear fits to the data. The stellar ages correlate fairly well with the other estimates.



Summary

- The CMD and color-color diagrams of resolved stars in M83 are used to determine the ages of individual stars after the star-by-star extinction correction.
- The younger stars (< 10 Myr) are more clustered and associated with the active star-forming areas on the spiral arm, while the older stars are more diffuse.
- Stellar ages correlate fairly well with the other age estimates.
- This work is published in Kim et al. 2012, ApJ, 753, 26.

Support for this program #11360 was provided by NASA through a grant from the STScI, which is operated by the AURA, Inc., under NASA contract NAS 5-26555. This poster is based on Early Release Science observations made by the WFC3 Science Oversight Committee. We are grateful to the Director of the Space Telescope Science Institute for awarding Director's Discretionary time for this program.