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Unlocking Cosmic Distances with AGB Stars: The Potential of Mira Variables as Precision Distance Indicators

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Recently, Mira variables have gained renewed attention as a viable alternative to Cepheids for the initial step in the cosmological distance scale. Their advantages include being inherently brighter in the infrared spectrum, more prevalent, and found in diverse environments. Moreover, their evolutionary endpoint as white dwarfs links them to the progenitors of Type Ia supernovae, and as such they belong to the same population as the subsequent rung of the distance ladder. Replacing Cepheids with Miras has thus been proposed as an effective way to scrutinize Cepheids'distances and address the significance of the so-called "Hubble tension"—a discrepancy exceeding 5σ between the Hubble constant values derived from cosmic microwave background radiation analyses and those obtained via the cosmological distance scale, potentially hinting at undiscovered early universe physics.

In my presentation, I will delve into Mira variables' potential and limitations as precise distance indicators through their period-luminosity relationship. The intricate dynamics of Miras, especially as thermally pulsating AGB stars, introduce complexity to their period-luminosity relationship. Factors such as their alternating shell nuclear burning, surface composition alterations from dredge-up events, and reduction of their convective envelope due to mass loss —also responsible for shifting their emission from optical to infrared wavelengths —influence this relationship's accuracy. I will evaluate the inherent scatter in the period-luminosity relation stemming from these evolutionary processes, and introduce our latest work on empirically characterizing this relation with our data from NASA's Spitzer, Hubble and Webb telescopes.

Primary author: MARENGO, Massimo (Florida State University)

Presenter: MARENGO, Massimo (Florida State University)

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