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The Lifecycle of Dust and Metals in Low-Abundance Galaxies

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Abstract. The earliest generations of stars were produced in galaxies at high redshift. The physical conditions in which these stars formed, produced heavy elements and dust, and subsequently ended their life cycles, however, are vastly different from those in the Milky Way. Nearby low metal-abundance galaxies provide critical laboratories within which it is possible to observe conditions similar to those at high redshift, shedding light on the lifecycle of dust and metals in the early Universe. Does the process of star formation change at low metallicity? How did galaxies in the early Universe produce significant amounts of dust without the elapsed time necessary for stars to evolve to the asymptotic giant branch (AGB) phase and contribute via mass loss? Here we present work cataloging dust-producing sources in the nearby metal-poor galaxy NGC 6822 and outline forthcoming GTO observations of this system and the blue compact dwarf I Zw 18 with JWST.

Keywords. galaxies: dwarf – galaxies: irregular – galaxies: individual (NGC 6822) – infrared: galaxies – infrared: stars – stars: AGB and post-AGB

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1. Introduction

The nearby (∼500 kpc) metal-poor ([Fe/H] ≈ −1.2; $Z \approx 30\%\ Z_{\odot}$) star-forming galaxy NGC 6822 is thought to be analogous to systems at the epoch of peak star formation. In order to understand the lifecycle of dust in early-Universe systems, we must identify dusty and dust-producing stars in these low-abundance environments.

The *James Webb Space Telescope* (JWST) will provide unparalleled photometric sensitivity to such evolved stars. Utilizing Mid-Infrared Instrument (MIRI) and Near-Infrared Camera (NIRCam), our GTO program observing NGC 6822 will return data equivalent to the SAGE (Meixner *et al.* 2006) studies of the Large and Small Magellanic Clouds. Filter combinations were specifically selected to optimize detection of dusty sources (Jones *et al.* 2017). The planned imaging footprints for MIRI and NIRCam are illustrated as Fig. 1. In preparation, we have examined this galaxy with archival infrared photometric data in order to identify candidate AGB stars.

2. AGB Star Identification

We have adopted *Spitzer* mid-IR photometry of NGC 6822 from Khan *et al.* (2015), which possesses IRAC 3.6, 4.5, 5.8, and 8.0 μm and MIPS 24 μm data. These data have

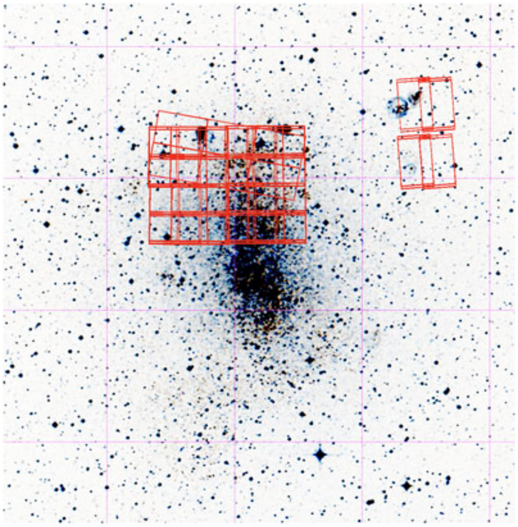

Figure 1. Observational footprints of MIRI and NIRCam for our JWST GTO program for NGC 6822. Coverage includes many prominent star-forming regions in this galaxy.

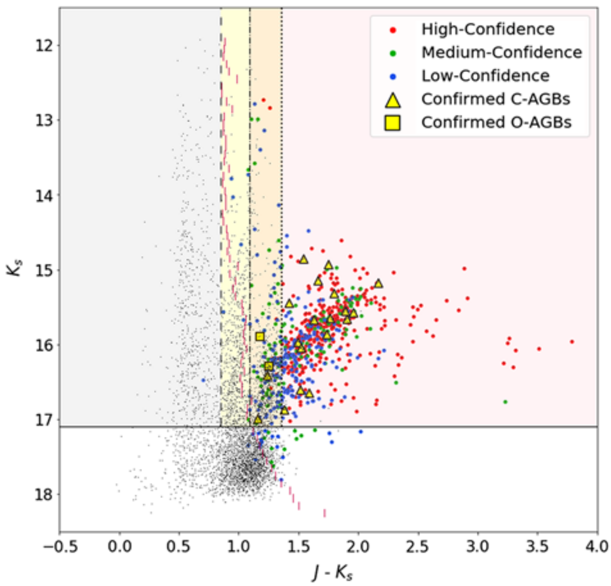

Figure 2. CMD with 3-σ red-excess threshold, color cuts, AGB candidates of varying confidence levels, and spectroscopically confirmed AGB stars from Kacharov *et al.* (2012).

been matched to J, H, and K_S near-IR photometry from the IRSF (Whitelock *et al.* 2013). Contaminant objects such as PNe, H II regions, and SNRs were removed. Our catalog contains 30,761 unique objects, 5,565 of which are common to both surveys.

In each of eight color-magnitude diagrams (CMDs), red-excess objects are isolated and subsequently selected as AGB star candidates based on frequency of appearance. Color cuts are then applied based on Cioni & Habing (2005) in order to distinguish between oxygen- and carbon-rich AGBs. In total, 691 AGB star candidates were identified (Fig. 2).

The current number of AGB star candidates identified is preliminary. Work is ongoing to include other wide-field surveys and optical data. We are currently implementing a

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deeper catalog of near-IR photometry covering a wider spatial area, which aligns better with our JWST field of view. Additionally, improved color-cut criteria will more robustly identify the population of candidate AGB stars in NGC 6822.

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