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Spectacular *Spitzer* images of the Trifid Nebula: Protostars in a young, massive-star-forming region

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Abstract.

Spitzer IRAC and MIPS images of the Trifid Nebula (M20; see Figure 1) reveal its spectacular appearance in infrared light, demonstrating its special evolutionary stage: recently-formed massive protostars and numerous young stars, including a single O star that illuminates the surrounding molecular cloud from which it formed and unveiling large-scale, filamentary dark clouds. The hot dust grains show contrasting infrared colors in shells, arcs, bow-shocks and dark cores. Multiple protostars, previously defined as Class 0 from dust continuum and molecular outflow observations, are revealed in the infrared within the cold dust continuum peaks TC3 and TC4. The cold dust continuum cores of TC1 and TC2 contain only one protostar each; the newly-discovered infrared protostar in TC2 is the driving source of the HH399 jet. The *Spitzer* color-color diagram allowed us to identify ∼150 young stellar objects (YSO) and classify them into different evolutionary stages, and also revealed a new class of YSO which are bright at 24μm but with spectral energy distribution peaking at 5-8μm; we name these sources "Hot excess" YSO. Despite of expectation that Class 0 sources would be "starless" cores, the *Spitzer* images, with unprecedented sensitivity, uncover mid-infrared emission from these Class 0 protostars. The mid-infrared detections of Class 0 protostars show that the emission escapes the dense, cold envelope of young protostars; the mid-infrared emission cannot arise from the same location as the mm-wave emission, and instead must arise from a much smaller region with less intervening extinction to the central accretion. The presence of multiple protostars within the cold cores of Class 0 objects implies that clustering occurs at this early stage of star formation. The most massive stars are located at the center of the cluster and are formed simultaneously with low-mass stars. The angular and mass distributions of protostars within the dust cores imply that these early protostars are competing for materials and the clustering is consistent with competitive accretion.

Figure 1. Mosaicked three-color *Spitzer* image of the Trifid Nebula. Blue, green and red represent IRAC 4.5 and 8μm, and MIPS 24μm images, respectively. PAH-dominated emission appears in green, hot dust grains appear in red and young stars appear in red or yellow point sources. Also note filamentary dark clouds on western side of M20. The diffuse emission at 8 and 24μm ranges between 80 and 450 MJy sr^{-1}, and between 90 and 280 MJy sr^{-1}, respectively. The image is centered at R.A. $18^{\rm h}02^{\rm m}26^{\rm s}$ and Dec. $-23^\circ00'39''$ (J2000) and covers $18'\times26'$ arcmin field of view.