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PROTOPLANETARY DISKS IN THE HOSTILE ENVIRONMENT OF CARINA

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We report the first direct imaging of protoplanetary disks in the star-forming region of Carina, the most distant, massive cluster in which disks have been imaged.

Using the Atacama Large Millimeter/submillimeter Array (ALMA), the disks are observed at the location of the young stellar objects (YSOs) PCYC 429 for 104-593 and PCYC 1173 for 105-600 (Povich et al. 2011). As it is shown in Fig. 1, they are embedded inside evaporating gaseous globules (EGGs) and exhibit outflow activity in the form of Herbig-Haro objects, evidencing the ongoing accretion process onto the protostars.

The disks are detected with peak signals about 50σ and 100σ, and both are resolved with an average de-convolved size of $0.05'' \times 0.03'' \approx 120$ AU $\times$ 70 AU at the Carina distance of 2300 pc (Smith & Brooks 2008). From the millimeter fluxes, we derive masses M_{disk} of about 50 M_{Jup} and 30 M_{Jup} for 104-593 and 105-600, respectively. These values are on the upper end of the typical M_{disk} distribution found in Class I sources in less hostile environments as Taurus and Orion (see Williams & Cieza 2011, and references therein). The disks are considered protoplanetary since the measured masses are well above the minimum M_{disk} of about 10 M_{Jup} required for a pre-solar nebula to develop a planetary system (Weidenschilling 1977). Additionally, since the minimum timescale to form planets is $\sim 1-2$ Myr (Lissauer et al. 2009; Najita & Kenyon 2014), the Carina population is old enough to be plausible that young planets are forming within these EGGs ($\sim 1-4$ Myr; Smith & Brooks 2008).

No millimeter emission was detected above the 4σ threshold in a section of the Tr 14 cluster. These threshold yields an upper limit of ~ 7 M_{Jup} to the mass of any disk that might be present, which is roughly similar to the median mass of $\sim 5-8$ M_{Jup} for Class II disks (see Williams & Cieza 2011). The ALMA field contained a total of 12 YSOs and, when considering the M_{disk} distribution in low-mass star-forming regions, we expected to detect about half of them above the threshold. The absence of massive disks could be related to the singular action of the external photoevaporation by the massive members of Tr 14 (see Mesa-Delgado et al. 2016), gravitational encounters during the embedded phase of the cluster (see Vincke & Pfalzner 2016), or the combined effect of both mechanisms.

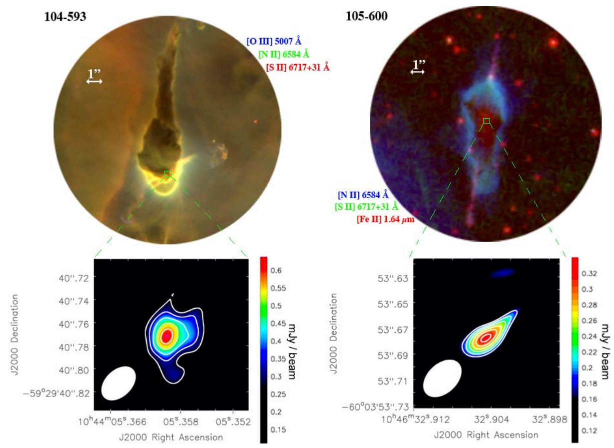

Fig. 1. Top: RGB images of the EGGs 104-593 (left-hand side) and 105-600 (right-hand side) constructed from narrow-band *Hubble Space Telescope* images. Bottom: ALMA detections at 1.3 mm continuum emission resolved with a beam size of $0.03'' \times 0.02''$ (white ellipses). See more details in Mesa-Delgado et al. (2016).

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