ABSTRACT

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Herschel/PACS spectroscopy of envelopes and disks around low-mass young stars

Nascent protostars are born deeply enshrouded in envelopes. As the young star grows in mass, accretion onto the star drives powerful outflows into the envelope, opening a cavity and shocking any material near the interaction region. Perhaps a result of the energy deposited into the envelope by the powerful outflows, the envelope eventually dissipates, revealing a disk where any planet-formation occurs. The WISH and DIGIT Herschel Key Programs use far-IR line emission observed with PACS and HIFI to diagnose how the importance and strength of these physical processes change as YSOs evolve. We present Herschel/PACS spectroscopy, obtained in the WISH and DIGIT surveys, of warm H2O, CO, OH, and [O I] line emission of low-mass young stellar objects, spanning the evolution from the optically-thick envelope of Class 0 objects to envelope-free disks of Class 2 objects. While the envelope remains, bright far-IR line emission traces heating along the cavity walls by outflow shocks and UV photons. The physical extent, excitation, and flux ratios of the bright emission lines are used to identify how the star and its outflow deposits energy into the surrounding envelope, including UV-photons and shocks heating a thin layer along the cavity walls. Once the envelope has dissapeared, faint CO and O I emission reveals a warm disk surface.