Results (and a few surprises) from JWST imaging of Edge-On Protoplanetary Disks

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By occulting direct starlight and presenting their vertical structures to direct view, edge-on protoplanetary disks are uniquely valuable systems for imaging in scattered starlight. From the optical to the mid-infrared, the wavelength dependence of the dust lane thickness provides clues about dust grain sizes and dust settling. In JWST Cycle 1 we imaged four prototype systems, finding that three of them still appeared as bipolar scattered light nebulae even at 21 microns, and that grains as large as 10 microns must still be present at the disk scattering surfaces. In JWST cycle 2, a dozen more edge-on protoplanetary disks were imaged with NIRCam and MIRI. In this contribution we will present a few highlights. Briefly, we find an unexpected diversity of source properties including 1) more systems that still appear as bipolar nebulae at 21 microns; 2) PAH emission extending well beyond the disk in two Ae star sources; 3) a newly recognized disk silhouette in Ophiuchus; 4) a system with unique mid-IR outflow features unseen at other wavelengths; 5) targets that transition from bipolar nebulae in the optical to PSF-dominated systems in the mid-IR; and 6) one system that is now revealed as an edge-on torus. Through these studies, we have also devised new approaches for measuring ice abundances of the main species (H_2O, CO, CO_2) in highly inclined protoplanetary disks.

In strong synergy with HST, ALMA, and VLT/SPHERE , these JWST images shed new lights on several key aspects of the structure and evolution of disks and their dusty content: dust settling and radial drift, level of turbulence, disk wind and dust entrainment... Better, in combination with the on-going DISKSTRAT ALMA large Program (PI R. LeGal; Co-PI F Menard) that will study molecular gas emission in the same sample of edge-on disks, all these results will yield an unprecedented view of the 3-dimensional distribution of gas and dust in disks.

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