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Title: "Debris Disk Structure and Morphology as Revealed by Aggressive STIS Multi-Roll Coronagraphy: A New Look at Some Old Friends"

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ABSTRACT:

We present new imaging results from a well-selected sample of 11 circumstellar debris disks, all with HST pedigree, using STIS visible-light 6-roll PSF-template subtracted coronagraphy (PSFTSC). These new observations, pushing HST to its highest levels of coronagraphic performance, simultaneously probe both the interior regions of these debris systems, with inner working distances < app 8 AU for half the stars in this sample (corresponding to the giant planet and Kuiper belt regions within our own solar system), and the exterior regions far beyond. These new images enable direct inter-comparison of the architectures of these exoplanetary debris systems in the context of our own Solar System. These observations also permit us, for the first time, to characterize material in these regions at high spatial resolution and identify disk sub-structures that are signposts of planet formation and evolution; in particular, asymmetries and non-uniform debris structures that signal the presence of co-orbiting perturbing planets, and dynamical interactions (e.g., resulting in posited small grain stripping and disk "pollution") with the ISM. We focus here on recently acquired and reduced images of he circumstellar debris systems about: AU Mic (edge-on, and @ 10 pc the closest star in our sample), HD 61005, HD 32297 and HD 15115 (all with morphologies strongly suggestive of ISM wind interactions), HD 181327 & HD107146 (close to face-on with respectively narrow and broad debris rings), and MP Mus (a "mature" proto-planetary disk hosted by a cTTS). All of our objects were previously observed in the near-IR with inferior spatial resolution and imaging efficacy, but with NICMOS r = 0.3" inner working angle (IWA) comparable to STIS multi-roll coronagraphy. The combination of new optical and existing near-IR imaging can strongly constrain the dust properties, thus enabling an assessment of grain processing and planetesimal populations. These results will directly inform upon the posited planet formation mechanisms that occur after the ~ 10 My epoch of gas depletion, a time in our solar system when giant planets were migrating and terrestrial planets were forming, and directly test theoretical models of these processes. These observations uniquely probe both into the interior regions of these systems and are sensitive to and spatially resolve low surface-brightness (SB) material at large stellocentric distances with spatial resolution comparable to ACS and with augmenting NICMOS near-IR disk photometry in hand.