CubeSat Interferometry for THz Astrophysics, Planetary Science and Earth Observing

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Abstract—While great strides have been made in far-infrared astrophysics with the NASA Spitzer and ESA Herschel missions, sub-arcsecond spatial resolution from space is still beyond the reach of current technologies. The Atacama Large Millimeter Array has produced stunning images from the ground of planetary systems in the process of formation, but cannot observe two key molecules, water (H_2O) and oxygen (O_2), due to the presence of Earth's atmosphere. The concept proposed here will enable interferometric imaging with sub-arcsecond resolution of water and other key far-infrared molecular species from space at a cost far lower than the flagship class interferometric missions previously proposed (e.g. ESA's ESPRIT). We propose to study the concept of a far-infrared interferometer based on a constellation of CubeSat antenna elements with a central ESPA-class correlator satellite optimized for the imaging of water in protoplanetary systems. Such a mission would produce groundbreaking images of newly forming planetary systems in a key astrophysical and astrobiological tracer, the 557 GHz ground state line of water. By leveraging recent developments in CubeSat technology, inflatable reflectors, miniaturized receiver systems and low power CMOS digital electronics, such a mission could be implemented at an Explorer level budget. In addition to the proposed astrophysics application, the developments proposed here could also find application in planetary science (FIR spectroscopy of comets and small bodies) and Earth observing (high resolution imaging of Earth from geostationary orbit).