Probing the earliest stage of protostellar evolution using mm and submm dust continuum emission

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Barnard 1-b core in the Perseus molecular cloud complex harbors two mm/submm sources, B1-bN and B1-bS, which are not visible in the Spitzer 24 and 70 μm images. The interferometric observations with the Submillimeter Array, Nobeyama Millimeter Array, and the Very Large Array clearly detected the dust continuum emission from these two sources at 1.1 mm, 1.3 mm, 3 mm, and 7 mm, suggesting that these sources already contain compact objects. The Spectral energy distributions of these sources imply that they are extremely cold (T_{dust} = 16–19 K) and low luminosity (L_{bol} = 0.14–0.31 L_{SUN}) objects. They are likely to be in the earlier evolutionary stage as compared to the known class 0 protostars, and are good candidates for the first hydrostatic cores. The 0.5"resolution image at 7 mm partially resolved the compact sources in B1-bN and B1-bS. The beam deconvolved size of these compact sources is ~100 AU, which is comparable to that of the circumstellar disks in the class 0 protostars L1448 C(N) and HH212. The compact components in B1-bN and B1-bS could be "pre-stellar disks" that are expected to be formed in the rotating cloud, and evolve into circumstellar disks after the formation of the central protostars.