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A Kiloparsec Scale Molecualr Gas Disk in Late-stage Mergers

We present the CO imaging study of 37 optically-selected late-stage mergers (merger remnants) in the local Universe using new and archival interferometric CO maps. The new maps with spatial resolution of $\lesssim$ 1 kpc were obtained toward 27 merger remnants using ALMA, CARMA, and SMA. At a kiloparsec scale, we reveal a high occurrence of molecular gas disks in the merger remnants. We find that 80 % (24/30) of the sources, which were detected in the CO line, show kinematical signatures of rotating molecular gas disks in their velocity fields, and the sizes of these disks vary significantly from 1.1 kpc to 9.3 kpc. We also find that the emission peaks are clearly shifted from the galactic centers in 75 % (18/24) sources with molecular gas disks, suggesting the presence of a ring and/or a bar. The size of the molecular gas disks in 54 % of the 24 sources is more compact than the effective radius of the stellar spheroidal component. These small gas disks may have formed by past gas inflow that was triggered by dynamical instability following the merging. On the other hand, the rest of the sample have gas disks which are extended relative to the stellar component. We also find a positive correlation between the size ratio and total far-infrared luminosity. This suggests that the physical activities that are responsible for increasing luminosity, namely starburst/AGN, are related to the formation of the extended molecular gas disks. The molecular gas mass range between 10^7 $M_\odot$and 10^{11} $M_\odot$. Assuming a constant star formation rate and no gas reservoir, the molecular gas in the merger remnants is expected to run out before the phase mixing is completed. Unless gas reservoir are supplied, the merger remnants with compact disks will results in gas-poor early-type galaxies rather than gas-rich late-type galaxies. Our analysis also show detailed structures of the molecular gas disks. The molecular gas disks in the merger remnants show various properties, and we conclude that our sample includes merger remnants at different stages of their evolution, progenitors of galaxies with different characteristics, or different initial conditions.