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Investigating the evolution of merger remnants from the formation of gas disks

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Abstract. Our new compilation of interferometric CO data suggests that nuclear and extended molecular gas disks are common in the final stages of mergers. Comparing the sizes of the molecular gas disk and gas mass fractions to early-type and late-type galaxies, about half of the sample show similar properties to early-type galaxies, which have compact gas disks and low gas mass fractions. We also find that sources with extended gas disks and large gas mass fractions may become disk-dominated galaxies.

Keywords. galaxies: evolution - galaxies: formation - galaxies: interactions - galaxies: ISM - galaxies: kinematics and dynamics - radio lines: galaxies

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Major mergers of two disk galaxies are widely believed to provide a way to form a spheroid-dominated early-type galaxy (ETG; e.g., Barnes & Hernquist 1992). Contrary to the classical scenario, recent simulations with more realistic gas physics have shown that some mergers will reform extended gas disks and evolve into disk-dominated late-type galaxies (LTGs; e.g., Springel & Hernquist 2005). In order to check this scenario, we investigate interferometric CO maps of 37 optically-selected merger remnants, which are taken from the merger remnant sample (Rothberg & Joseph 2004). New maps were obtained toward 27/37 sources with ALMA, CARMA, and SMA, and the CO detection rate is 74% (20/27). We find that 80% (24/30) of the sources with robust CO detections show kinematical signatures of the molecular gas disk in their velocity fields (Figure 1).

We compare the properties of molecular gas and stellar components in the merger remnants with ETGs and LTGs to investigate the evolution of merger remnants. The majority of the merger remnants shows a compact molecular gas disk relative to the stellar component. Unless the disks grow significantly, for example from the return of ejected molecular gas or tidal HI gas, the sources will likely evolve into ETGs. We tentatively

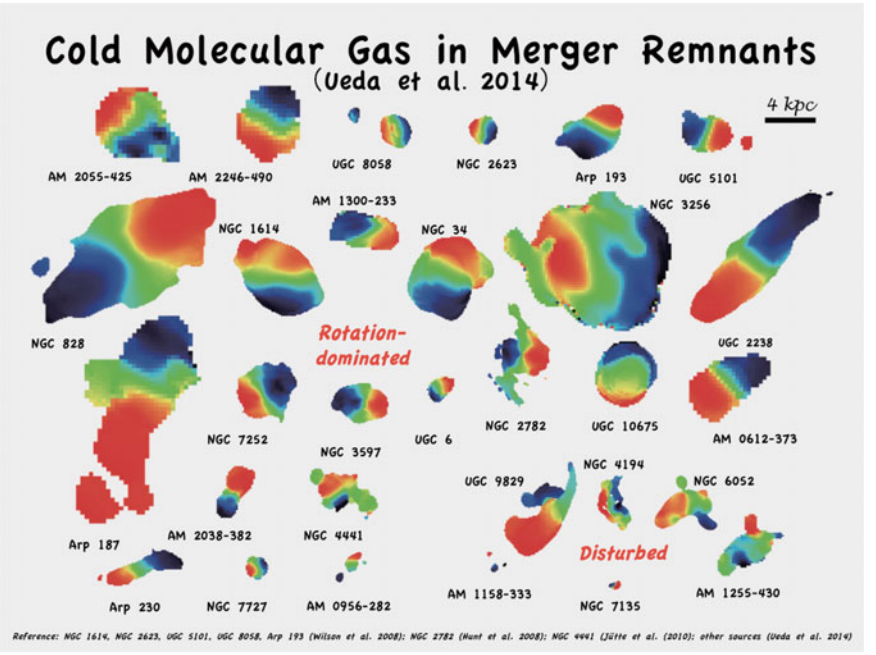

Figure 1. The CO velocity fields of 30 merger remnants (References of the CO data: Hunt *et al.* 2008; Wilson *et al.* 2008; Jütte *et al.* 2010; Ueda *et al.* 2014). The CO data products are publicly released on the website (http://alma-intweb.mtk.nao.ac.jp/~jueda/data/mr/data.html).

suggest that sources with extended gas disks and large gas mass fractions may become disk-dominated LTGs, if there are no further mechanisms to transport the molecular gas toward the central region thereby decreasing the disk size.

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