Molecular Gas Distributions of Interacting Galaxies in Early and Mid Stage Using $^{12}$CO($J=1–0$) Mapping Observations

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Galaxies frequently interact with other galaxies and give an influence of strong gravity on each other. Those celestial objects whose distributions and kinematics of stars and gas are changed by the gravity are called as interacting galaxies. Interacting galaxies have an important features of active star formation which have known from about 30 years ago. Although many studies have been done, a precise mechanism of active star formation in interacting galaxies is an open question. Since stars are made from molecular gas, it is necessary to understand the properties of molecular gas in interacting galaxies for clarifying the mechanism of bursts of star formation. Most of previous observations aimed only at the centre of galaxies where emission from molecular gas tends to be strong, distributions of molecular gas is unknown. Even more, the most targets of observational studies are interacting galaxies in late stage whose star formation activity is already enhanced. Thus, the properties of molecular gas in interacting galaxies in early stage are scarcely investigated. Although interacting galaxies in late stage can be used to investigate the “results” of an enhancement of star formation, its “cause” can not be understood without observing interacting galaxies in early stage.

In order to understand how star formation activity is enhanced through galaxy interactions, we performed $^{12}$CO($J=1–0$), which is a good tracer of diffuse molecular gas, mapping observations using NRO 45-m radio telescope and revealed the distributions of molecular gas of four interacting galaxies in early and mid stage: Arp 84, VV 219, VV 254, Arp 244 (Fig. 1). The distributions of molecular gas greatly differ from both atomic gas and old stars whose data are already obtained with other telescopes. These discrepancies imply that the effects by the interaction on each medium are different and physical properties should be also changed from isolated galaxies. We derived the degree of central concentration of molecular gas and found that molecular gas in interacting galaxies in early and mid stage are less concentrated than that in isolated galaxies. This result is opposite to the fact that molecular gas in interacting galaxies in late stage is highly concentrated toward the centre of the galaxy and numerical simulations which suggest gas inflow occurs when two galaxies collide. We obtained a picture that the interaction does not proceed through a direct infall of molecular gas to a galactic centre but through complicated processes such as an off-centre and/or wide distributions of molecular gas in the beginning of the interaction.

![Integrated intensity maps of $^{12}$CO($J=1–0$). Arp 84 (top-left), VV 219 (top-right), VV 254 (bottom-left), Arp 244 (bottom-right).](image)

Figure 1: Integrated intensity maps of $^{12}$CO($J=1–0$). Arp 84 (top-left), VV 219 (top-right), VV 254 (bottom-left), Arp 244 (bottom-right).

Reference