Department of Electrical, Electronic and Computer Engineering	Key words	Radio Astronomy, Galaxies, Molecular cloud, Star formation, Development of receiver for radio telescope

Ph.D. in Science / Professor

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Education

College of Natural Sciences, First Cluster of Colleges, University of Tsukuba
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Professional Background

Postdoctoral Researcher (Univ. of Tsukuba), Postdoctoral Researcher (Center for Astronomy, Ibaraki University), Specially Appointed Researcher Staff (Nobeyama Radio Observatory, NAOJ), Specially Appointed Assistant Professor (ALMA Project, NAOJ)

Consultations, Lectures, and Collaborative Research Themes

Radio Astronomy, Astrophysics, Development of radio telescope systems, Machine learning with astronomical archival data

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Main research themes and their characteristics

「Observational study of the Universe using radio telescopes」

The basic building blocks of galaxies are stars and the interstellar medium (gas and dust). Since stars are born from the interstellar medium, the study of the interstellar medium is essential to elucidate star formation and galaxy evolution. In particular, low-temperature and high-density regions of the interstellar medium, known as molecular clouds, are closely related to star formation. On the other hand, hydrogen molecules, which are the main component of the molecular clouds, cannot be observed directly, so it is necessary to study the distribution, dynamics, and physical state of the molecular clouds using other molecular emission lines, such as carbon monoxide (CO). We have performed observations of the molecular clouds in galaxies by using various telescopes, including the Nobeyama 45-m radio telescope, ALMA, and VLA.

Despite the importance of determining the dynamics of molecular clouds, we can only observe the velocity components projected in the line-of-sight direction. By applying a simple model to the distribution of molecular gas and line-of-sight velocity obtained from CO observations of the nearby spiral galaxy M51 (see Figure 1), we have derived the velocity vectors of the molecular gas in the galactic disk. Furthermore, utilizing the obtained velocity vectors, we obtained the velocity change of the gas as it passes through the spiral arms, the orbit of the gas, and the distribution of shear intensity in the galaxy, and for the first time, we have observationally shown that shear has a significant effect on the evolution of molecular clouds and star formation.

Fig.1 Distribution of stars (left: optical wavelength, Hubble Space Telescope) and molecular gas (right: radio waves, (CO(1-0)) Nobeyama 45m radio telescope) in the nearby spiral galaxy M51

We also obtained the distribution, dynamics, and physical state of the gas in the circumnuclear disk (CND) associated with the supermassive black hole at the center of the nearby galaxy NGC 613(see Figure 2), and found that the molecular gas is ejected by the jet from the active galactic nucleus. We also found that the gas in the central region is heated by the jets, which suppresses star formation.

In metal-poor environments such as distant galaxies, recent theoretical studies have suggested that neutral atomic carbon (CI) is useful as a global tracer for low-temperature molecular gas, in contrast to CO, which has been conventionally used. However, its usefulness has not been observationally proven. We performed a comparison using CO, CI, and molecular gas estimated from the cold dust through far-infrared observations in the nearby galaxy M83. The results show that the CI distribution agrees well with that predicted by the photodissociation model, and that CI is less reliable than CO in tracing cold molecular gas in the galactic disk.

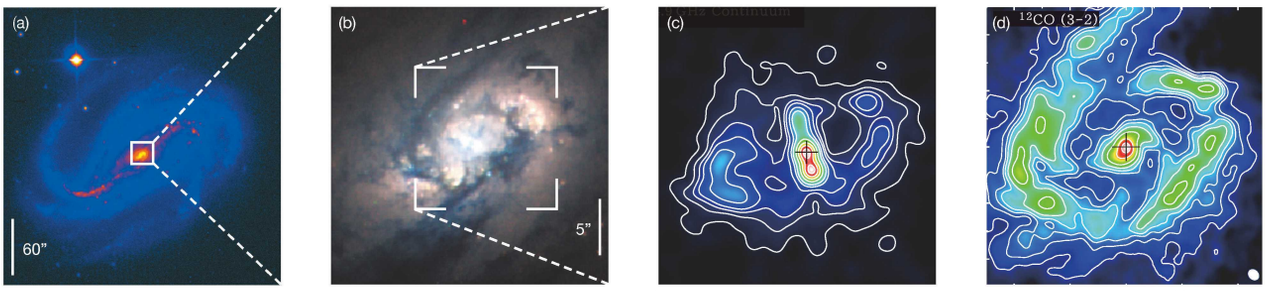

Fig.2 (a) The entire image of the nearby barred spiral galaxy NGC 613 in optical wavelength (Cerro Tololo Pan-American Observatory) and images of the central region (b) optical wavelength (Hubble Space Radio Telescope), (c) radio (4.9 GHz continuum: VLA), (d) radio (CO(J=3-2): ALMA)

Major academic publications

- Miyamoto Y., et al. , “Atomic Carbon [CI] (3P1–3P0) Mapping of the Nearby Galaxy M83”, PASJ, Volume 73, Issue 3, pp 552-567
- Miyamoto Y., et al., “ALMA [C I] observations toward the central region of Seyfert galaxy NGC 613”, PASJ, Volume 70, Issue 3, id.L1, pp 1-6
- Miyamoto Y., et al., “ALMA multiline observations toward the central region of NGC 613”, PASJ, Volume 69, Issue 5, id.83, pp 1-24
- Miyamoto Y., et al., “Hot Ammonia in the Center of the Seyfert 2 galaxy NGC 3079”, PASJ, Volume 67, Issue 1, id.5, pp 1-15
- Miyamoto Y., et al., “Influence of Shear Motion on Evolution of Molecular Clouds in the Spiral Galaxy M51”, PASJ, Volume 66, Issue 2, id.36, pp1-8