



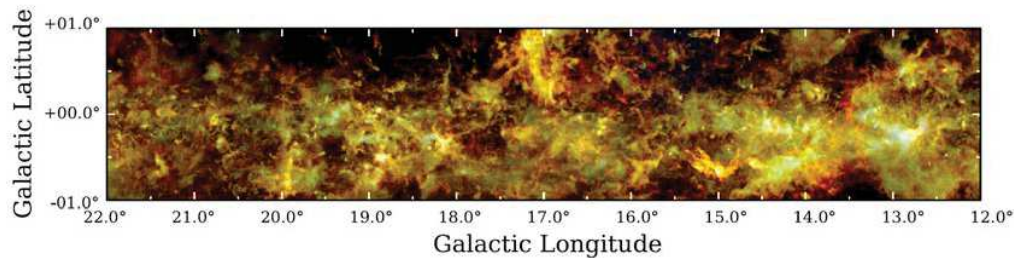
## Status of Nobeyama Radio Observatory

Ken'ichi Tatematsu<sup>(1)</sup>

(1) Nobeyama Radio Observatory, NAOJ, Nobeyama, Minamisaku, Nagano, Japan, e-mail: k.tatematsu@nao.ac.jp

The status of Nobeyama 45-m radio telescope and Nobeyama Radio Polarimeters is reported.

Three legacy programs with the 45-m telescope, FUGIN (Galactic Plane survey, PI = T. Umemoto), Star Formation Project (PI = F.; Nakamura), and COMING (nearby galaxies, PI = K. Sorai) were completed in 2017 May, and the three-dimensional FITS data were released on Japanese Virtual Observatory (<http://jvo.nao.ac.jp/index-e.html>) in 2018 June. FUGIN surveyed the areas of  $l = 10$ -50 and 198-236 degrees,  $b = -1$  to 1 degree in  $^{12}\text{CO}$ ,  $^{13}\text{CO}$ , and  $\text{C}^{18}\text{O}$  at  $\sim 20$  arcsec resolution (e.g., Umemoto+2017). Evidence of cloud-cloud collisions was reported (e.g., Torii+2018). Star Formation Project observed Orion A, Aquila Rift, and M17 SWex in  $^{12}\text{CO}$ ,  $^{13}\text{CO}$ ,  $\text{C}^{18}\text{O}$ ,  $\text{N}_2\text{H}^+$ , and 94 GHz CCS. The data of the Star Formation Project for Orion were combined with the CARMA data (e.g., Kong+2018). COMING observed 147 nearby galaxies in  $^{12}\text{CO}$ ,  $^{13}\text{CO}$ , and  $\text{C}^{18}\text{O}$  (e.g., Hatakeyama+2017). Part of the research results will be reported in the PASJ special issue "Nobeyama 45m Telescope: Legacy Projects and Receiver FOREST" (2019).



**Figure 1.** A composite map of  $^{12}\text{CO}$  (red),  $^{13}\text{CO}$  (green), and  $\text{C}^{18}\text{O}$  (blue) from the FUGIN survey (Umemoto+2017).

A new two-year large program (PI = K. Tatematsu) with the 45-m telescope started in 2017 December, and  $\sim 200$  SCUBA-2 cores cataloged from the Planck Galactic Cold Clumps are being observed in eight lines including deuterated molecular lines  $\text{N}_2\text{D}^+$  and DNC. The initial conditions for star formation will be investigated in terms of chemical evolution from deuterium fraction.

Regarding the solar radio emission, the total solar fluxes at 1, 2, 3.75, and 9.4 GHz were observed continuously from 1957 to 1994 at Toyokawa, Japan, and from 1994 until now at Nobeyama, Japan, with the current Nobeyama Radio Polarimeters (Shimojo+2017). It was found that the microwave spectra at the solar minima of Cycles 20-24 agree with each other.

1. T. Umemoto et al., "FOREST unbiased Galactic plane imaging survey with the Nobeyama 45 m telescope (FUGIN). I. Project overview and initial results," *PASJ*, **69**, 78, August 2017, doi: 10.1093/pasj/psx061.
2. K. Torii et al., "Large-scale CO  $J=1-0$  observations of the giant molecular cloud associated with the infrared ring N35 with the Nobeyama 45-m telescope," *PASJ*, **70**, 51, May 2018, doi: 10.1093/pasj/psy019.
3. T. Hatakeyama et al., "CO Multi-line Imaging of Nearby Galaxies (COMING). II. Transitions between atomic and molecular gas, diffuse and dense gas, gas and stars in the dwarf galaxy NGC 2976," *PASJ*, **69**, 67, August 2017, doi: 10.1093/pasj/psx044.
4. S. Kong et al., "The CARMA-NRO Orion Survey," *ApJS*, **236**, 25, June 2018, doi: 10.3847/1538-4365/aabafc.

5. M. Shimojo et al., “The CARMA-NRO Orion Survey,” *ApJ*, **848**, 62, October 2017, doi: 10.3847/1538-4357/aa8c75.