

# THE CO 2-1/1-0 RATIO IN THE DISK AND CENTER OF THE MILKY WAY GALAXY

TETSUO HASEGAWA, JUN-ICHI MORINO, TSUYOSHI SAWADA,  
TOSHIHIRO HANDA AND KUMIKO SATO

*Institute of Astronomy, The University of Tokyo  
Osawa, Mitaka, Tokyo 181, Japan*

TOMO HARU OKA

*The Institute of Physical and Chemical Research (RIKEN)  
Hirosawa, Wako, Saitama 351-01, Japan*

SEIICHI SAKAMOTO AND KAZUO SORAI

*Nobeyama Radio Observatory, National Astronomical Observatory  
Minamimaki, Minamisaku, Nagano 384-13, Japan*

MASUMICHI SETA

*Communications Research Laboratories  
Nukui-kita machi, Koganei, Tokyo 184, Japan*

MASAHIKO HAYASHI

*National Astronomical Observatory  
Osawa, Mitaka, Tokyo 181, Japan*

LEONARDO BRONFMAN AND JORGE MAY

*Departamento de Astronomía, Universidad de Chile  
Casilla 36-D, Santiago, Chile*

ROY BOOTH AND LARS-ÅKE NYMAN

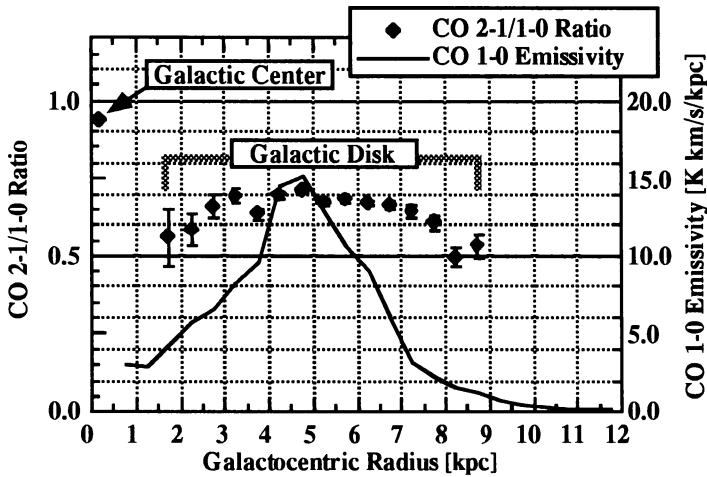
*Onsala Space Observatory  
S-439 92 Onsala, Sweden*

AND

PETER SHAVER

*European Southern Observatory  
D-85748 Garching, Germany*

We are conducting a survey of the CO  $J=2-1$  line emission in the southern Milky Way (the Tokyo-Onsala-ESO-Calán Galactic CO survey), using the 60-cm radio telescope (*VST2*) in La Silla, Chile. It is combined with



*Figure 1.* The CO  $J=2-1/J=1-0$  intensity ratio as a function of the Galactocentric radius. The Galactic center value is an average over all emission within  $|l| \leq 2.5^\circ$  and  $|b| \leq 1^\circ$ . The disk value is from the data at  $|l| = 5^\circ \rightarrow 85^\circ$  sampled and analyzed symmetrically for the 1st and 4th quadrants. A flat rotation at  $\Theta_0 = 220 \text{ km s}^{-1}$  was assumed.

the northern survey made with the identical telescope (*VST1*) at Nobeyama (*e.g.*, Sakamoto *et al.* 1995), and is directly comparable with the Columbia survey of the CO  $J=1-0$  emission (*e.g.*, Dame *et al.* 1987).

Figure 1 shows the CO  $J=2-1/J=1-0$  ratio plotted against the Galactocentric radii. The data are from i) the galactic plane pilot survey that covers  $|l| \leq 90^\circ$  sampled at every degree (Hasegawa *et al.*, in preparation), and ii) the new survey of the Galactic center region covering  $|l| \leq 6^\circ$  and  $|b| \leq 2^\circ$  (Sawada *et al.*, in preparation). The molecular gas in the central 750 pc of the Galaxy exhibit markedly higher  $J=2-1/J=1-0$  ratio of  $0.93 \pm 0.02$ , in contrast to the disk gas with the ratio of 0.5-0.7 (total intensity ratio being  $0.66 \pm 0.01$ ). The Galactic center value in our previous paper (Oka *et al.* 1997) was underestimated.

## References

- Dame, T. M., Ungrechts, H., Cohen, R. S., de Geus, E. J., Grenier, I.A., May, J., Murphy, D. C., Nyman, L. Å., & Thaddeus, P. (1987) A composite CO survey of the entire Milky Way, *ApJ*, **322**, pp. 706-720
- Oka, T., Hasegawa, T., Hayashi, M., Handa, T., & Sakamoto, S. (1997) CO ( $J=2-1$ ) line observations of the Galactic center molecular cloud complex. II. Dynamical structure and physical conditions, *ApJ* in press.
- Sakamoto, S., Hasegawa, T., Hayashi, M., Handa, T., & Oka, T. (1995) An out-of-plane CO ( $J=2-1$ ) survey of the Milky Way. I. The data, *ApJS*, **100**, pp. 125-131