Formation and Evolution of Galaxy Outskirts
Proceedings IAU Symposium No. 321, 2016
A. Gil de Paz, J.H. Knapen & J.C. Lee, eds.

doi:10.1017/S174392131601156X

Search for molecular gas in XUV disk of M83

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Abstract. We report a non-detection of CO(J=1-0) emission from one of the brightest H II regions in the extended UV (XUV) disks of M 83 with on-source integration time of 11 hours.

Keywords. ISM: molecules, ISM: clouds, galaxies: individual (M 83), radio lines: ISM

1. Introduction

In extended UV disks (XUV disks), the gas-depletion timescale due to star formation (SF) with HI alone is $\sim$ 10 times the Hubble time ($\sim$ 100 Gyr), compared to only 2-3 Gyr in normal galactic disks (Bigiel *et al.* 2010). However, studies of gas content in XUV disks have been limited to atomic gas, and a lack of information on molecular gas prevents us from understanding SF and gas-phase structure in such an extreme environment.

2. Observation and Result

We observed one H II region in the XUV disk of M 83 in CO(J=1-0) using the NRO 45-m telescope† (beam size of 16″, $\sim$ 350 pc at the distance of M 83). The H II region is located at $\sim$ 3x the optical disk radius ($\frac{D_{25}}{2}$), and its metallicity is 0.3 $Z_\odot$ (Bresolin *et al.* 2009). The stellar mass of an associated young star cluster is expected to be $\sim 5 \times 10^3$ $M_\odot$ based on our deep optical Hα and broadband images taken with Suprime-Cam on the Subaru telescope (Koda *et al.* 2012). No apparent CO emission was detected after an 10.8-hrs integration. The achieved rms is 21.0 mK in T_{mb} scale over 0.32 km s^{-1} resolution. The upper limit for M_{mol} (molecular gas mass) is 6.2×10^4 $M_\odot$ assuming the Milky-Way X_{CO} and a Gaussian profile of CO emission with a peak of 2×rms and FWHM of 2.3 km s^{-1}. Our result suggests an 8x larger X_{CO} in the XUV disk versus the Milky-Way value if we assume typical galactic disk SFE ($= \frac{M_\star}{M_\star + M_{mol}}$) of 1%. Otherwise we would be forced to conclude that SFE is elevated in XUV-disks compared to ordinary galactic environments, an unphysical result given the low gas densities.

References

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† The 45-m radio telescope is operated by Nobeyama Radio Observatory, a branch of NAOJ.