

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.

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1. Introduction

In extended UV disks (XUV disks), the gas-depletion timescale due to star formation (SF) with HI alone is ~ 10 times the Hubble time (~ 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 $16''$, ~ 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 H α 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 $6.2 \times 10^4 M_{\odot}$ assuming the Milky-Way X_{CO} and a Gaussian profile of CO emission with a peak of $2 \times \text{rms}$ 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 ($= \frac{M_{\star}}{M_{\star} + M_{\text{mol}}}$) 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.