# Millimeter emission in the methanol maser flare source G24.33+0.14

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In September 2019, a sudden brightening of the 6.7 GHz methanol maser line (methanol maser flare) was reported for the high-mass young stellar object (HMYSO) G24.33+0.14. It is suggested that this event would be caused by a transient mass accretion burst event in HMYSOs as reported for other HMYSOs, S255IR NIRS3, NGC6334I-MM1, and G358.93-0.03-MM1. Among them, G24.33+0.14 seems to be a unique case because it has been identified a past maser flare event with an interval of 8-year. In the case of another recent methanol maser flare event in G358.93-0.03-MM1, several methanol transitions from centimeter to submillimeter wavelengths also showed flare activities. To study time-variability of methanol maser lines at millimeter wavelengths in G24.33+0.14, we conducted target-of-opportunity (ToO) observations using the Atacama Large Millimeter/submillimeter Array (ALMA) as a director's discretionary time (DDT) [1]. We observed the millimeter continuum and molecular lines at Band 6 (217-230 GHz) toward G24.33+0.14 in the pre-flare phase in August 2016 (Cycle 3) and the mid-flare phase in September 2019 (Cycle 6 DDT) at resolutions of about 300 milliarcseconds.

We identified 3 continuum sources in G24.33+0.14, where the brightest source, C1, is associated with the 6.7 GHz maser emission. The continuum sources show only marginal increases in flux density with a mean flux ratio (Cycle 6/Cycle 3) of 1.16. In addition, we also compared the total 26 millimeter transitions from 13 molecular species between the Cycle 3 and Cycle 6 data and found similar levels of flux differences of ~12%. Considering the flux calibration accuracy of ALMA, 10%, these differences would not be significant. On the other hands, we investigated 8 methanol lines identified in our observing band including a $^{13}C$ isotopologue and a torsionally excited transition and found an average flux ratio (Cycle 6/Cycle 3) of 1.23+/-0.13. There is a possible tendency that the higher excitation lines show a larger flux increase in Cycle 6. If this systematic trend is real, it would suggest radiative heating close to the central HMYSO caused by the accretion event which could expand the size of the emission region and/or change the excitation conditions.

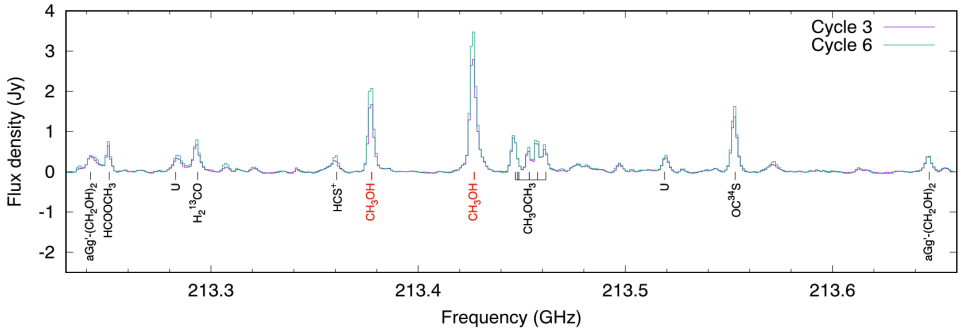


Figure 1: A sample spectrum of G24.33+0.14 [1].

## References

[1] T. Hirota, Wolak, P, Hunter, T. R., et al. 2022, PASJ, 74, 1234.