Modeling Maser Activity of Organic Molecules toward Sgr B2

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Single-dish observations have revealed that the Sagittarius B2 molecular cloud at the Galactic Center hosts maser emission from several organic molecules, including CH_2NH [1], HNCNH [2], and $HCOOCH_3$ [3]. However, the lack of spatial information for these new maser species has prevented us from assessing their excitation conditions and pumping mechanisms. In this presentation, we introduce a cutting-edge tool for modeling and fitting the maser signals, leveraging non-LTE radiative transfer models and Bayesian statistics. This MCMC approach enables us to quantitatively assess the physical conditions of maser clumps under varying continuum background radiation levels. Our analyses suggest reference conditions for a gas clump to achieve the necessary population inversion for maser action, specifically a kinetic temperature of ~30 K, a gas density of $\sim 10^4$ cm^{-3}, and a molecular column density of 10^{16}-10^{17} cm^{-2} in the context of collisional pumped CH_3OH maser. In addition, the recent interferometric observations conducted with both ALMA and VLA enable us to compare the spatial origins and compact extents of maser emissions from several molecular species. We find a close spatial relationship between the 5.29 GHz CH_2NH maser and the 4.36 GHz CH_3NH_2 maser with the 84 GHz CH_3OH maser, supporting a shared collisional pumping mechanism.

References

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