Intensity-calibrated molecular spectroscopy and determination of intrinsic line intensity $S\mu^2$ for CH_2DOH

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Isotopic fractionation in molecules is known as one of the powerful tools to trace the molecular evolution during the Solar system. Among various interstellar species, methanol is the most abundant saturated-organic molecule and is known as an important species to form more complex organic molecules in interstellar clouds. Observing isotope fractionation ratios of methanol is especially useful to reveal reaction pathways of such organic molecules [e.g., 1, 2]. Despite its importance, current spectroscopic information is not enough to determine their abundances accurately even for the methanol isotopologues. For example, CH_2DOH significantly suffers from the uncertainty of intrinsic line intensities ($S\mu^2$) due to their floppy nature. Although $S\mu^2$ of each transition line is a critical parameter to derive accurate column density and temperature of the molecular gas, they are not easy to be evaluated theoretically for the asymmetric-top asymmetric-frame isotopologue. With our emission-type spectrometer, SUMIRE [3], using technique developed for radio astronomical observations, we can now derive $S\mu^2$ and transition frequency for various isotopologues of methanol by laboratory spectroscopy in the millimeter-wave region from 216 GHz to 264 GHz [4,5]. In the *b*-type transitions of CH_2DOH, significant systematic errors were found between theoretical and experimental $S\mu^2$ for three torsional sub-state, e_0, e_1 and o_1 as shown in Figure 1. This study will enable us to trace deuterium fractionation of COMs along the star formation.

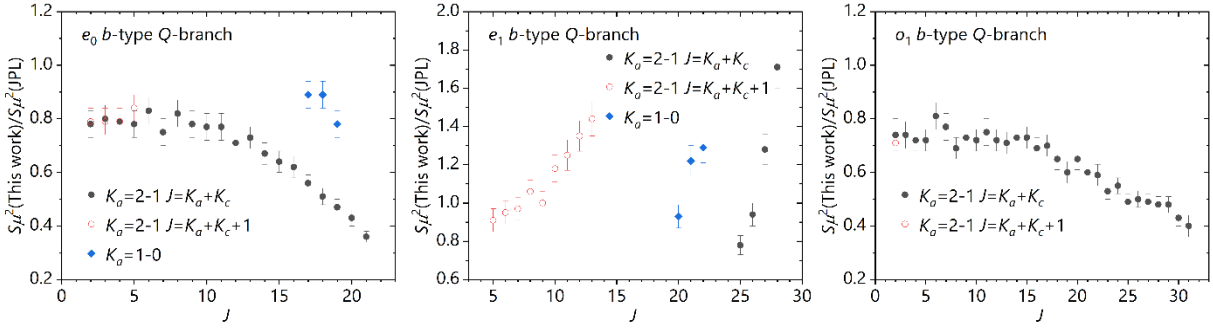

Figure 1: Ratios between the $S\mu^2$ values derived in this study and those listed in the JPL database for the *b*-type *Q*-branches in CH_2DOH.

References

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