LOW-TEMPERATURE HIGH PRECISION MEASUREMENTS OF LINE MIXING and COLLISIONAL INDUCED ABSORPTION IN THE OXYGEN A-BAND

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Because of the constant mixing ratio of molecular oxygen ($O_2$) within the Earth’s atmosphere, the $O_2$ A-band is commonly used in satellite and remote sensing measurements as a measure of the airmass. A recent collaborative effort has produced a self-consistent integrated spectroscopic model for the $O_2$ A-Band that simultaneously accounts for high-order line-shapes, line mixing (LM), and collisional induced absorption (CIA). This model has improved OCO-2 mission retrievals of dry air CO$_2$, however, limitations in existing spectroscopic models still lead to airmass dependent biases. Currently, model development is limited by a lack of high resolution experimental data at low temperatures and in the R-branch. To address this, measurements of the entire $O_2$ A-band were recently made with a variable-temperature cavity ring-down spectrometer (CRDS) over a range of temperatures, pressures, and molar fractions. Because of the limited dynamic range of the CRDS system, at high molar fractions of $O_2$ saturation can occur at the line cores of strong transitions. Therefore, a range of molar fraction $O_2$ samples were employed. Low mole fraction data, which was unaffected by saturation provided information on the temperature dependence of high-order line-shape parameters. Conversely, high molar fraction data provided information on LM and CIA effects that dominate absorption in the troughs between saturated transitions. By combining this high-resolution experimental data, that covers both the entire $O_2$ A-Band as well as a range of temperatures, with existing datasets, these results aim to improve on LM and CIA models for the next iteration of the global $O_2$ A-Band model.