N16a Line-depth ratios as indicators of stellar parameters: the metallicity and gravity effects based on WINERED near-IR high-resolution spectra

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Determination of effective temperature ($T_{\rm eff}$) is often the first and essential step in stellar spectral analysis. When high-resolution spectra are available, the line-depth ratio (LDR) method can achieve a precision of 5–10 K. Ratios of depths of two carefully selected lines are very sensitive to $T_{\rm eff}$. However, their dependencies on other stellar parameters like metallicity and gravity need to be controlled, if not negligible. They may alter the LDR–$T_{\rm eff}$ relations and increase the error in derived $T_{\rm eff}$.

To quantify these effects, we observed a moderate sample (around 200) of stars spreading a wide range of stellar parameters using $z'JY$-band high-resolution spectrograph WINERED. Similarly to the result with APOGEE H-band spectra which we presented in the last meeting, the metallicity effect for the WINERED dataset is confirmed, and we can describe the effect as "rotation" of the relation caused by line saturation. We also detected the gravity effect as a clear separation between LDR–$T_{\rm eff}$ relations for dwarf and giant/supergiant. The separation is larger in lower $T_{\rm eff}$, while it diminishes in high temperature; such a trend is also found in a simulation using synthetic spectra. These effects of metallicity and gravity may allow one to determine multiple stellar parameters simultaneously and empirically based on LDRs, very simple observables.