Recovering low-amplitude planetary signals from near-infrared RV data using Wapiti, a PCA-based telluric correction method

We present Wapiti (Weighted principAl comPonent analysIs reconsTructIon), a data-driven method based on weighted Principal Component Analysis, developed to suppress telluric contamination in near-infrared radial velocity (RV) datasets. Applied to SPIRou (SPectropolarimètre InfraROUge) observations of the M dwarf Gl 725 B, Wapiti enhances the detectability of very low-amplitude signals ($\sim$1.5 m/s) that would otherwise remain buried in telluric noise.

By correcting line-by-line RV time series, Wapiti allows the recovery of two planetary signals, including a 3.4 $M_\oplus$ planet located within the habitable zone of the host star. Injection-recovery simulations confirm that Wapiti significantly boosts sensitivity in the low semi-amplitude regime, even under limited BERV (barycentric Earth radial velocity) coverage.

This study highlights the critical role of machine learning techniques in modern exoplanet detection pipelines and emphasizes their necessity for exploiting the full potential of near-infrared spectroscopic surveys.