Towards a fully Bayesian RV extraction model

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The level of precision needed to detect Earth-like planets orbiting other suns requires new development in both instrumentation (e.g. ESPRESSO) and the data analysis paradigm. In recent years we have seen the advent of new RV extraction methodologies that can, under certain conditions, surpass the widely used Cross-Correlation Function (CCF) method.

As an example, using a template matching approach, the s-BART (Semi-Bayesian Approach for RVs with Template-matching) pipeline (Silva et al. 2022) has been recently featured in the detection of a candidate short-period planet, with approximately half of Earth's mass, orbiting Proxima Centauri (Faria et al. 2022). However, in this methodology, the usage of a stellar model built from observations of the star leads to a mixture of information between the model (the stellar template) and the data with which the model is compared to (the observations). This is not fully compatible with a Bayesian framework but, as a first-order approximation, s-BART ignores this problem, as the information of a single observation is much smaller than the one from the template. To overcome such limitation, the next step is to move towards a fully probabilistic stellar model ideally built simultaneously with the RV extraction and telluric correction. In this talk, we present preliminary results of a new methodology that leverages Gaussian Processes to generate a model of the stellar spectra of each order, whilst enforcing the assumption of an achromatic RV-shift, compatible with what we expect to find from planetary companions. The first promising results will be presented.