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Functional Data Analysis for Extracting the Intrinsic Dimensionality of Spectra: Prospects for Chemical Tagging

Thursday 21 October 2021 12:45 (15 minutes)

High-resolution spectroscopic surveys of the Milky Way have entered the *Big Data* regime, and have opened avenues for solving outstanding questions in Galactic Archaeology. However, exploiting their full potential is limited by complex systematics, whose characterization has not received much attention in modern spectroscopic analyses. We present a novel method to disentangle the component of spectral data space intrinsic to the stars from that due to systematics. Using Functional Principal Component Analysis (FPCA) on a large sample of giant spectra from the Apache Point Observatory Galactic Evolution Experiment (APOGEE), we find that the intrinsic structure above the level of observational uncertainties requires ≈10 Functional Principal Components (FPCs). Our FPCs can reduce the dimensionality of spectra, remove systematics, and impute masked wavelengths, thereby enabling accurate studies of stellar populations. To demonstrate the applicability of our FPCs, we use them to infer stellar parameters and abundances of giants in the open cluster M67. We employ Sequential Neural Likelihood, a simulation-based Bayesian inference method that learns likelihood functions using neural density estimators, to incorporate non-Gaussian effects in spectral likelihoods. By hierarchically combining the inferred abundances, we put stringent constraints on the chemical homogeneity in M67. In this talk, I will discuss spectral dimensionality reduction using FPCA and its application to M67. I will also discuss the promising implications of our results for the future of *chemical tagging* in the Milky Way.

Type

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