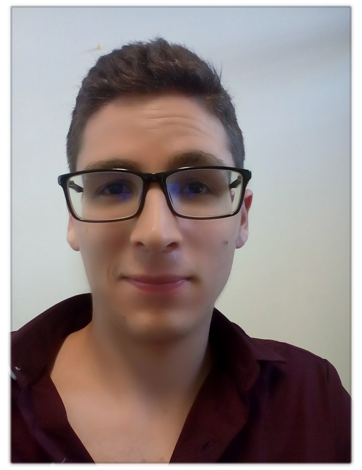

Characterising the nature of the faintest Milky Way satellites with the Pristine Survey

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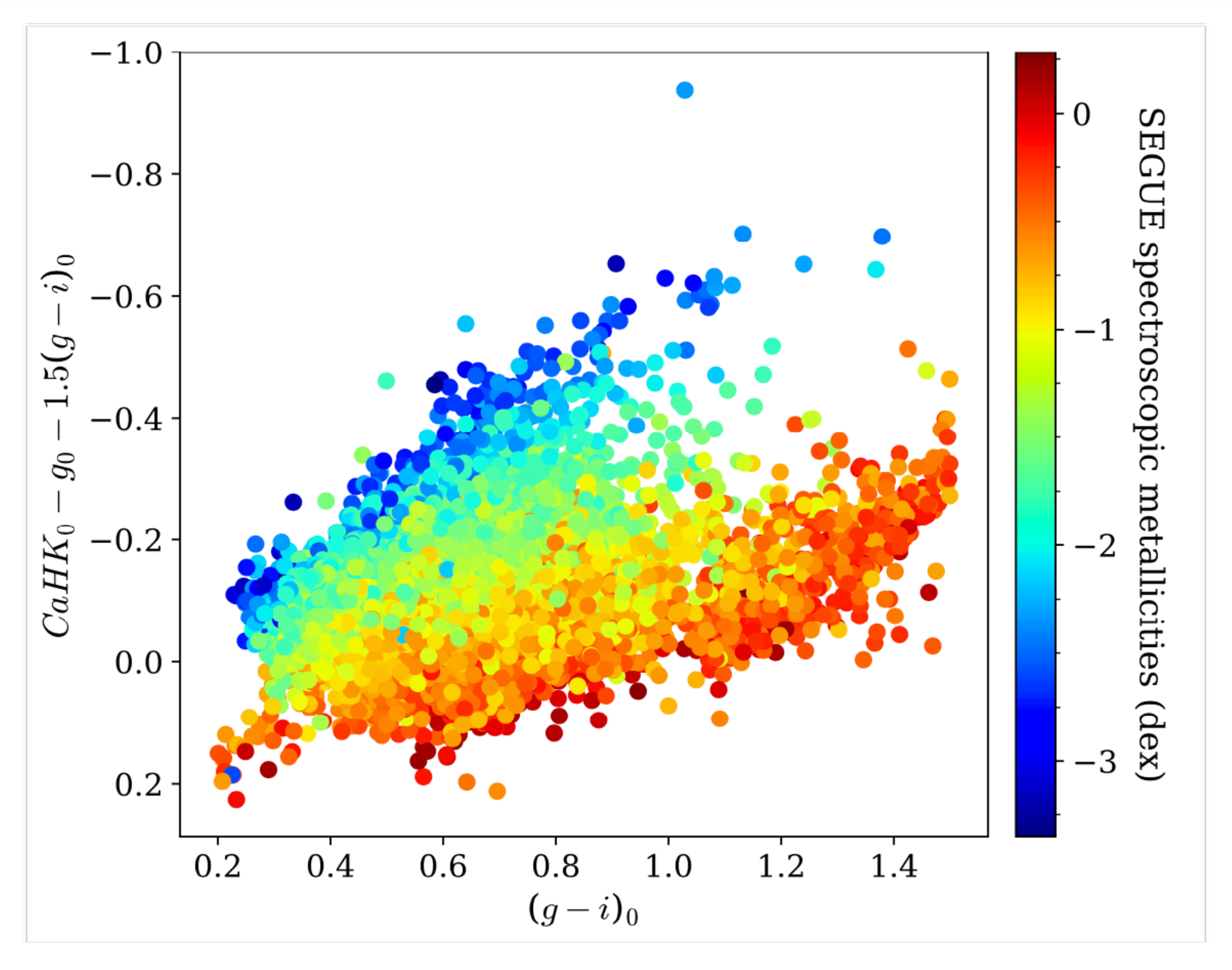
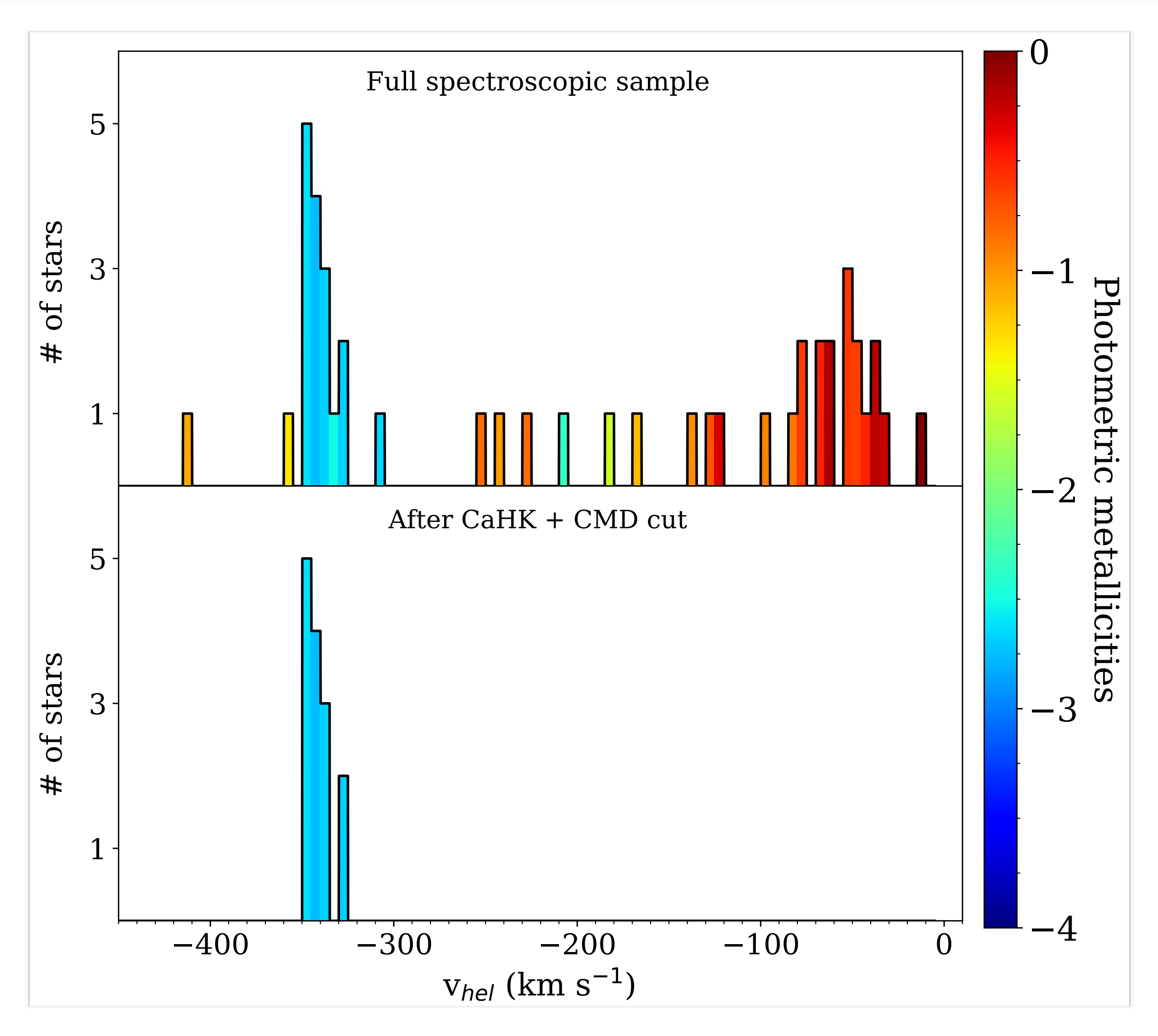
Abstract: Pristine is a photometric survey that can infer the metallicity of stars with photometry, thanks to its narrow-band filter centred on the Ca H & K doublet lines. We present how the survey can be used to efficiently study the faintest satellites of the Milky Way. In a spectroscopic dataset, Pristine allows to identify member stars by weeding out the more metal-rich contamination of the Milky Way. The photometric metallicities can even be used to directly infer the systemic metallicity and the metallicity dispersion, and therefore to characterise the nature of these faint systems.

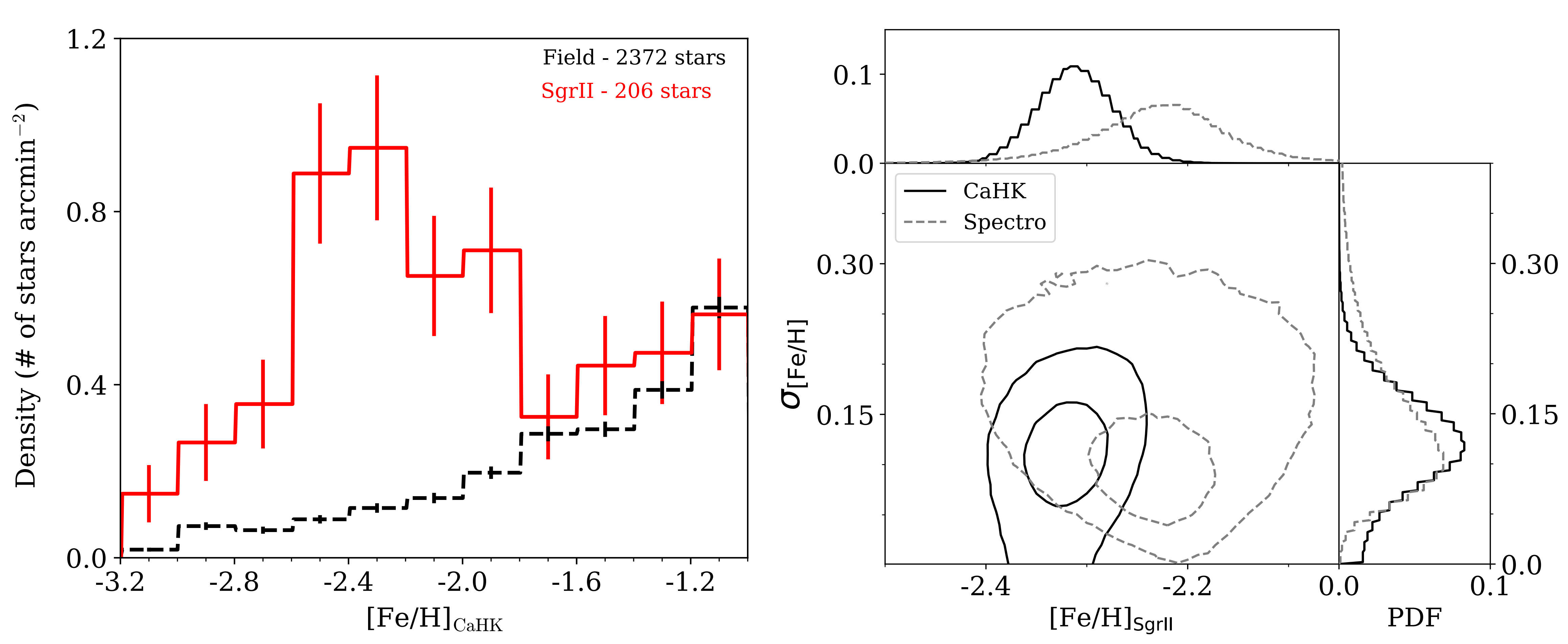
Pristine is a photometric survey based on a narrow-band, metallicity-sensitive filter centred on the Ca H & K doublet lines. This figure shows ~7000 stars observed in Pristine in a colour-colour diagram, with the $(g-i)^{SDSS}_0$ temperature proxy on the x-axis, and the CaHK magnitude on the y-axis. Since the CaHK is metallicity-sensitive, stars in this diagram are distributed according to their metallicities. This is shown by the colour scheme representing their spectroscopic metallicities from SDSS/SEGUE. Stars with a known spectroscopic [Fe/H] shown here are used to calibrate the Pristine model. Once the model is calibrated, Pristine can infer the metallicity of any star observed with the CaHK filter and broadband photometry.





Pristine can be useful to study the faintest satellites of the Milky Way. We show here the radial velocities of 51 stars in the vicinity of the Milky Way satellite Dra II (Mv ~ -0.8 mag) obtained with Keck/DEIMOS. Each velocity bin is colour-coded according to the mean photometric metallicity of all stars in the bin. This allows to identify the very metal-poor population typical of dwarf galaxies and infer the dynamical properties of the system without being polluted by potential Milky Way contaminants.

This figure shows the Metallicity Distribution Functions (MDF) of a two half-light radii region centred on another satellite of the Milky Way, Sgr II (Mv ~ -5.2 mag, r_h ~ 35.5 pc), and for a field region of the same area, a few arc minutes away from Sgr II. The metallicity represented on the x-axis are derived from Pristine. The metal-poor population of Sgr II appears very clearly here.



Since we have the MDFs of the field and Sgr II using only the photometric metallicities provided by Pristine, the next step is to infer the systemic metallicity ($[Fe/H_{SgrII}]$) and the metallicity dispersion ($\sigma_{[Fe/H]}$) of the satellite. To do so, we assume that the MDF shown in red is the sum of the field MDF in black, and a normal distribution corresponding to the population of Sgr II, with a mean and a standard deviation corresponding respectively to $[Fe/H_{SgrII}]$ and $\sigma_{[Fe/H]}$. The result is the PDF shown in black in Figure 4. To compare the performance of the method, the metallicity properties of Sgr II inferred with spectroscopy are shown in grey. The two methods yield compatible results, showing that it is possible to infer the metallicity properties of the system with the Pristine metallicities only.

References: Starkenburg et al., 2017 ; Longeard et al., 2018 ; Longeard et al., 2019