High-Resolution IR Spectroscopy of Sagittarius Stream Stars

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The Data:

The 8 stars you are seeing in this poster are M giant members of the North leading arm of the Sagittarius (Sgr) tidal system. The observations were made back in 2010 using the (currently decommissioned) PHOENIX High-Resolution Infrared Spectrograph (Hinkle et al. 1998), providing high-quality data with resolution power of R~50,000 and signal-to-noise ratios over 300 per resolution element at 15,550 Å.

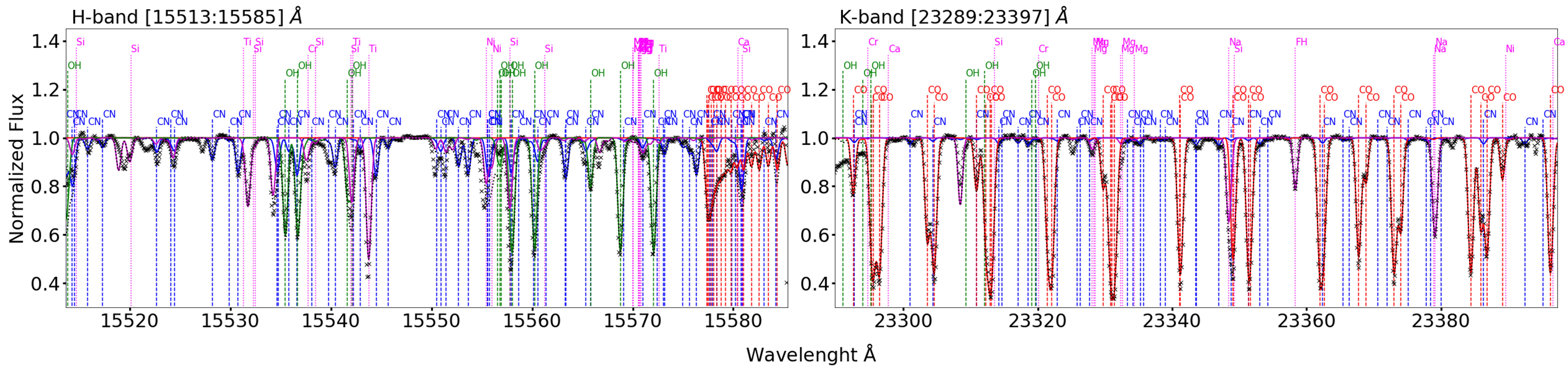

Figure 1: Obtained PHOENIX spectra in the H-band (15513:15585 Å) and K-band (23289:23397 Å) from one of the observed stars as shown in X marks. Molecular and atomic species are indicated and labelled. Synthetic spectra of different colours indicate the contribution of the species throughout the spectra. Very busy plot, scan the QR code for a better look!

IR – Complementary wavelength coverage:

While some abundances are available for chemical analysis from various surveys (e.g., O, Mg, Ca, Ni, Mn), others are not due to the wavelength coverage and SNR/resolution (e.g., C and O isotope ratios, F, P, Y, La, Eu, etc). A more complete chemical characterization of the Milky Way and its accreted systems will provide a stronger observational framework to compare with chemical evolution models.

Fluorine:

F is a rare and fragile element with complex nucleosynthesis for which abundances are accessible from the HF molecular transition at 2.3 µm. We can use the sensitivity of F as a novel tool to explore the chemical evolution in accreted systems (see e.g., Lugaro et al. 2004, Cunha et al. 2008, Ryde et al. 2020, and Mura-Guzmán et al. 2020). Figure 2 shows our preliminary results from PHOENIX in 8 Sgr stream stars.

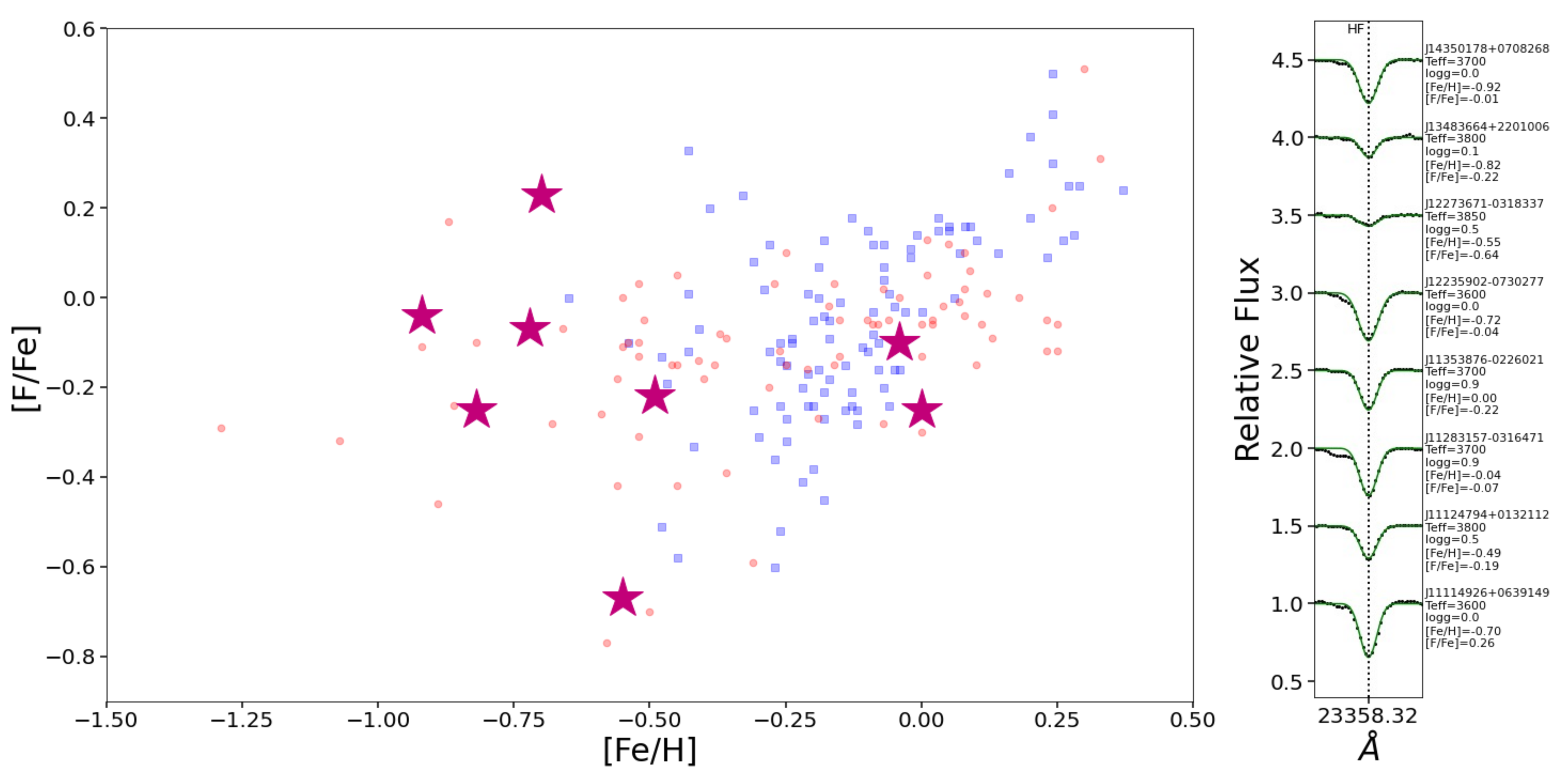

Figure 2: Left panel – [F/Fe] vs [Fe/H] Literature compilation of F abundances from Jönsson et al. (2017b), Guerço et al. (2019b), Ryde et al. (2020), and Nandakumar et al. (2023) in red dots and blue squares for the Milky Way thick and thin disks, respectively. Fluorine abundances from Sagittarius Stream stars are shown in magenta star symbols. Right panel – Synthetic spectra fitting for F abundances from HF molecular transition in the observed sample.

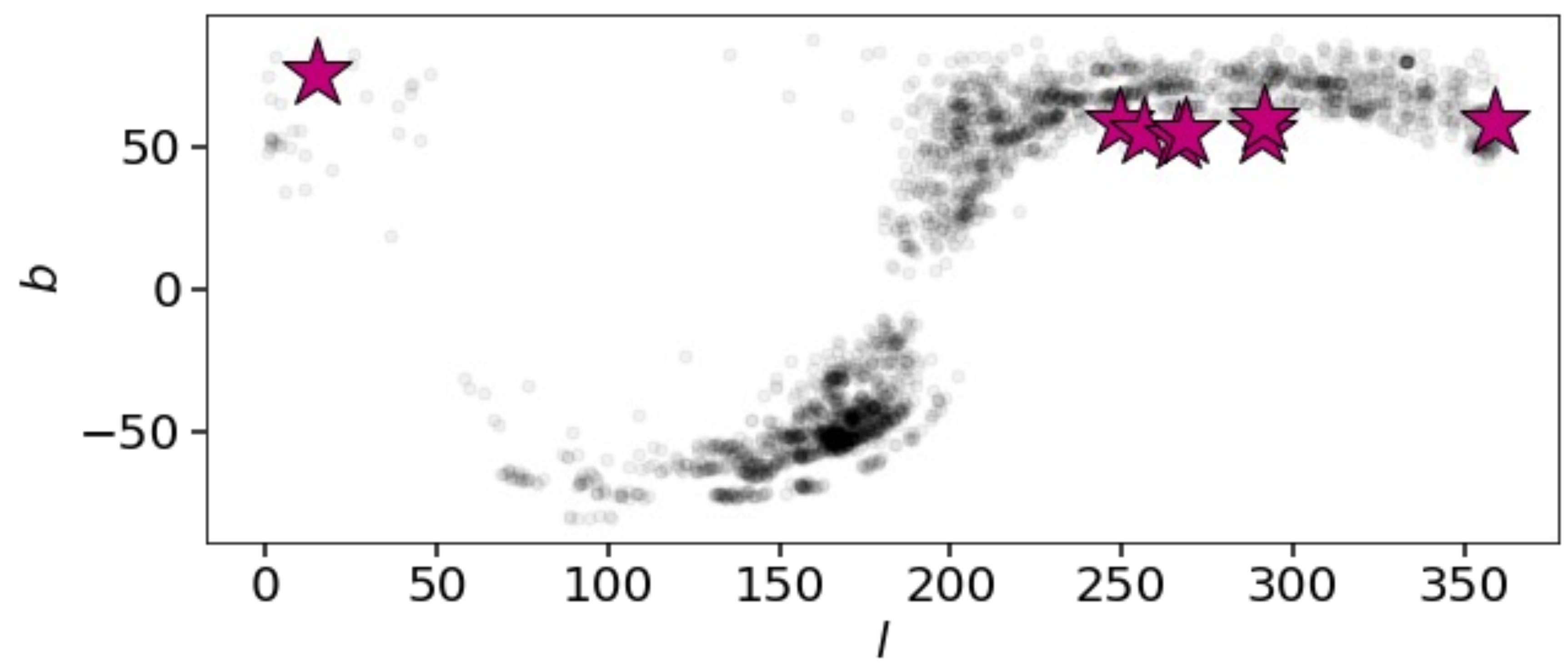

Figure 3: Location of the observed Sgr stream stars shown as magenta stars. Sgr stream K- & M-giants and BHB stars from Yang et al. 2019 are shown in grey circles.

New IR spectrographs:

PHOENIX was NOT cross-dispersed and could do only a single order over a reduced wavelength range. The new generation of high-resolution IR spectrographs, such as CRIRES+ and IGRINS 1 and 2, offer a wider wavelength coverage, more efficient observations and dedicated data reduction pipelines.

High-resolution in the era of Big Surveys:

In the upcoming years we will navigate a true sea of data. Thanks to ongoing and upcoming surveys, we can do science that would have been unfeasible 20 years ago. In this context, high-resolution spectroscopy has become complementary as follow-up observations. Can we keep up the pace?

What do you think?! Let me know scanning this QR code

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