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The metallicity gradient of sagittarius dwarf spheroidal galaxy prior to infall constrained by S-PLUS observations of its tidal stream

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Several major substructures, like the Sagittarius stream, have been observed in the Milky Way halo over the past few years. These substructures are likely remnants of past accretion events, therefore, investigating their origin and nature is crucial to understanding the formation and evolution of our Galaxy in the context of hierarchical galactic formation. In this study, we used photometric metallicities to study the current metallicity gradient in the arms of the Sagittarius stream, and compared these results to predictions of N-body simulations to reconstruct the original metallicity gradient in the Sagittarius dwarf galaxy prior to its accretion by the Milky Way. To build our sample, we did a cross-match between S-PLUS (Mendes de Oliveira et al., 2019) DR4 photometry and a list of Sagittarius stream members from Ramos et al. (2022), which were selected using astrometric data from Gaia DR3. We applied two different techniques to estimate photometric metallicities: an artificial neural network and a random-forest algorithm, resulting in two samples of, respectively, 7398 and 4683 stars with reliable metallicity measurements. We measured a gradient of ≈ -0.0030 dex/degree for the leading arm of the stream. For the trailing arm, we found no significant gradient when considering the whole area covered by S-PLUS ($20 \leq \Lambda \leq 130$ degrees). However, the region near the core ($20 \leq \Lambda \leq 70$ degrees) also presents a

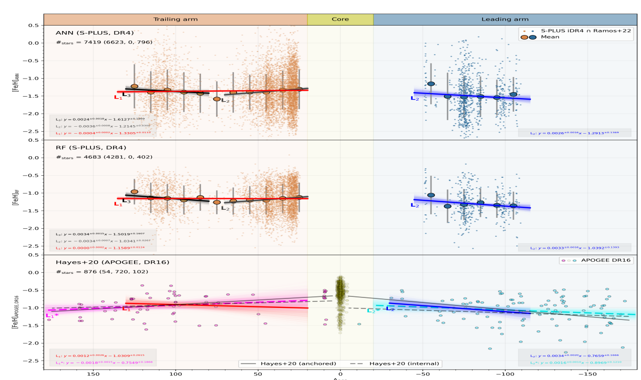

Figure 1. Metallicity of stars members of the Sagittarius stream as a function of their longitudinal position across the stream. The top and middle panels correspond to the photometric metallicity derived from S-PLUS DR4 using artificial neural networks (top) and random forest (middle). The trailing arm is represented in red, while the leading arm is represented in blue. The gradients were measured using least squares linear regression and uncertainties were obtained by using a bootstrap technique. For comparison, the bottom panel shows the spectroscopic metallicities of APOGEE DR16 and gradients measured by Hayes et al. (2020).

gradient of ≈ −0.0035 dex/degree. We show that our photometric metallicities reproduce the result of , when the same longitudinal intervals are considered. We imprinted artificial metallicities to particles in a N-body simulation (Vasiliev et al., 2021) considering different scenarios of original metallicity gradients. Comparing simulated and observed results, we were able to show that the current metallicity gradient in the stream is consistent with an original metallicity gradient between −0.22 and −0.37 dex/kpc in the Sagittarius progenitor galaxy.

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