The General Assembly of Galaxy Halos: Structure, Origin and Evolution
Proceedings IAU Symposium No. 317, 2015
A. Bragaglia, M. Arnaboldi, M. Rejkuba & D. Romano, eds.

doi:10.1017/S1743921315007097

Photometric Metallicity of the Sagittarius Stream in the south Galactic cap

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Abstract. Based on SDSS and South Galactic Cap U-band Sky Survey (SCUSS) photometry, we try to study the photometric metallicity of the Sagittarius (Sgr) stream in the south Galactic cap. We find that the Sgr stream has a wider metallicity distribution, and that its median metallicity is richer than that of the field halo stars. The neighboring field halo stars in our studied fields can be modeled by a two-Gaussian model, with peaks at [Fe/H]= −1.9 and [Fe/H]= −1.5. The metallicity distribution function (MDF) of the mixed population (Sgr stream and halo stars) has peaks at [Fe/H]= −1.9, [Fe/H]= −1.5 and [Fe/H]= −0.5, respectively.

Keywords. Galaxy: metallicity - Galaxy: stellar content - Galaxy: halo

1. Introduction

It is now generally believed that the Galaxy was formed through repeated aggregation with dwarf galaxies and this merging process left behind many streams, satellites and substructures in the Galactic halo. The chemistry and kinematics of the substructures in the halo preserve a detailed record of its formation or the Galaxy's formation. Some large surveys provided astronomers a great opportunity to study the substructures of the Galaxy photometrically and spectroscopically (Ivezić *et al.* 2000, Newberg *et al.* 2002, 2007, Belokurov 2006, 2007, Grillmair 2006, 2009). Over the past decades, many works have appeared on the metallicity of substructures such as the Sgr stream that are based either on high-resolution spectra of a small amount of stars or on low-resolution spectra of some giant stars. But the limited number of spectra is far from enough to study the metallicity of a vast region of the Galaxy. In this regard, we attempt to estimate the photometric metallicity distribution function (MDF) of the Sgr stream in south Galactic cap. This is an application of the SCUSS u-band photometric metallicity calibration (Gu *et al.* 2015).

2. Photometric metallicity estimation of the Sgr stream in the south Galactic cap

In this study, we use mainly the SCUSS u-band and SDSS Dr8 data. The SCUSS is an international cooperative project, which is undertaken by National Astronomical Observatories, Chinese Academy of Sciences and Steward Observatory, University of Arizona, USA. It is an u band (3538 Å) imaging survey program with the 90 inch (2.3 m) Bok telescope located on Kitt Peak. This survey has imaged ~ 4000 deg^2 in the south Galactic cap ($30° < l < 210°$, $-80° < b < -20°$). The limiting magnitude of SCUSS u band

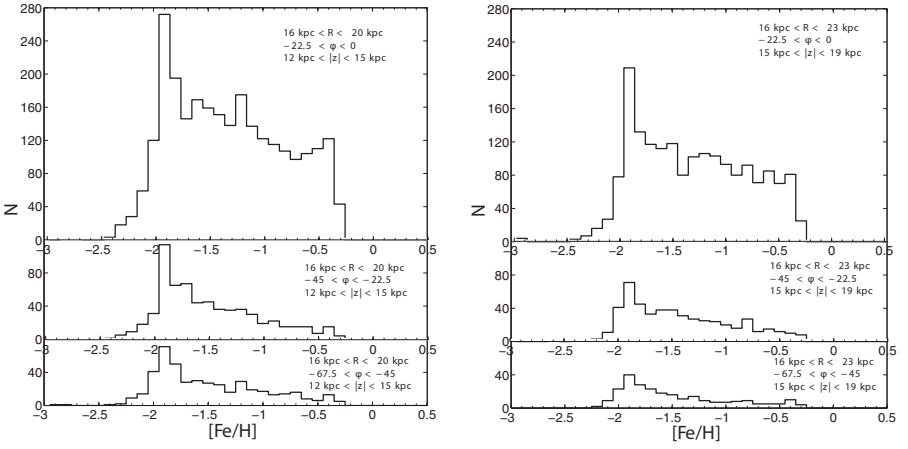

Figure 1. The metallicity distribution of the F/G ($0.2 < g - r < 0.4$) main sequence stars with $g < 21$ in different space volume. The top two histograms correspond to the Sgr stream region. The middle and the bottom histograms correspond to the vicinities of the Sgr stream region.

may be 1.5 mag deeper than that of SDSS u (Jia *et al.* 2014). Due to its relative deep magnitude and high accuracy from SCUSS data, we expect a wide application range of the photometric estimate. Gu *et al.* (2015) give the SCUSS photometric metallicity calibration. Since the photometric metallicity calibration can be used up to a faint magnitude of g=21, we can apply it to the Sgr stream stars with $20.5 < g < 21$ to analyze its MDF.

We find that a three-Gaussian model is appropriate for the MDF of the mixed population (Sgr stream and halo stars), and a two-Gaussian model for the MDF of neighboring stars (mainly halo stars). The three Gaussians of the mixed population have peaks at [Fe/H]=−1.9, [Fe/H]=−1.5 and [Fe/H]=−0.5 respectively. The two-Gaussian model representing the MDF of halo stars in the studied field has peaks at [Fe/H]=−1.5 and [Fe/H]=−1.9. This shows that the Sgr stream has a wider metallicity distribution, and that its median metallicity is richer than that of the field halo stars.

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https://doi.org/10.1017/S1743921315007097 Published online by Cambridge University Press