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Detecting tidal tail of the globular cluster Whiting 1

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Abstract. Whiting 1 is a faint and young globular cluster embedded in the Sag dSph. It has similar distance, metalicity and radial velocity with the trailing stream of the Sag. Due to these special properties, Whiting 1 was suggested to be associated with the trailing stream of Sag. However, its origin is still unclear and further investigation of its relation with Sgr dSph is needed. In this work, we use DECaLS data to search the tidal tail of Whiting 1, with the aim of looking for spatial connection between Whiting 1 and Sgr dSph. With Matched Filter method, we detected a tidal tail around the main body of Whiting 1. This tail extends to at least 0.5 degree and aligns with the mean orbit direction of Sgr dSph. This tail is newly detected and it provides additional evidence of the association between Whiting 1 and Sgr trailing stream.

Keywords. galaxies: clusters: individual: Whiting 1 – Galaxy: structure – surveys

1. Introduction

Whiting 1 ($\alpha = 02:02:57$, $\delta = -03:15:10$) is a faint and young globular cluster in the halo of the Milky Way. Its distance is ∼29.4 kpc and its age is ∼6.5 Gyr (Carraro *et al.* 2007). Along with its low metalicity (z = 0.004), Whiting 1 was proposed to be an unusually young halo globular cluster.

The formation and evolution of Whiting 1 draws much attention since it was discovered. Since this cluster is embedded in the Sagittarius dwarf spheroidal galaxy (Sgr dSph), previous research has focused on its association with Sgr. Carraro *et al.* 2007 observed the radial velocity of Whiting 1, and found its radial velocity (-130.6 km s^{-1}) is comparable to that of the Sgr trailing stream. Besides, the age and metalicity of Whiting 1 also are consistent with those of the main body of the Sgr dSph. All this information implies that Whiting 1 might be formed by the progressive disruption of the Sgr dSph and is associated with Sgr trailing stream.

If Whiting 1 originated from the Sgr trailing stream, its morphology should show some clues with its progenitor, e.g., a tidal tail aligns along the orbit of Sgr trailing stream. However, due to lack of deep data, few studies on this have been found in previous literature.

2. Data and Method

In this paper, we aim to search for the tidal tail of Whiting 1. We utilize a deep imaging Sky survey, DECam Legacy Survey (DECaLS, Dey *et al.* 2019) to perform the Matched Filter (MF) methodology. DECaLS covers Whiting 1 and is deep to $g = 24.0$, $r = 23.4$ mag (S/N = 5). The basic procedures of MF are as described in Rockosi *et al.* (2002) and the CMD template is constructed by $(g - r)$ vs r. Since Whiting 1 is embedded in

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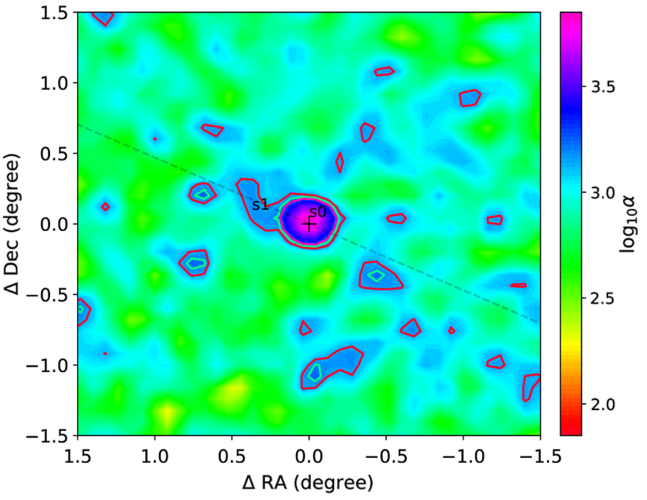

Figure 1. The Logarithm of the density ($\log_{10}\alpha$) of stars that passed the matched filter $(g-r, r)$. The black plus marker indicates the center of Whiting 1, and s_1 is the detected tidal tail. The black dashed line indicates the mean orbital direction of Sgr dSph according to Law & Majewski (2010).

the Sgr trailing stream, and it has similar CMD to Sgr trailing stream (especially under the main sequence turn off), we perform the MF work under several limiting magnitudes. The r data are limited at 21,21.5,...24 mag, with a 0.5 mag interval. We compared the density maps of the MF selection, and consider the features which appear under every testing limiting magnitude as possible features belongs to Whiting 1.

3. Results

Figure 1 is the density map of the MF selection under limiting magnitude of $r = 22.5$ mag. The structure s_0 is the main body of Whiting 1, and s_1 is its tidal tail. For s_1, it is newly detected. From its spatial appearance, this feature extends from South-East to North-West, and aligns well with the mean orbit direction of Sgr dSph. The significance of this tail is $>3.0\sigma$, and its shape is at least 0.5° of projected length. This tail of Whiting 1 was not detected before, even though Carballo-Bello *et al.* (2017) shows some hints of tail-like features around Whiting 1.

An updated and improved version of the results presented here is currently being prepared for publication (Nie *et al.* 2020, in preparation).

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