Characterization of blue straggler stars in the galactic field

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Abstract

The main goal of this work is to build a large sample of blue straggler stars (BS stars) in the galactic field region using Sloan Digital Sky Survey (SDSS) data. In order to accomplish this task, classical methods of separation of BS from BHB stars were compared with new proposed restrictions based on their atmospheric parameters, which are estimated by the SEGUE Stellar Parameter Pipeline (SSPP). The selection methods yielded a sample of 8001 BS stars, which were kinematically analyzed through their radial velocities. The results suggest that many of them might have extragalactic origin and about 1000 objetcs may be associated with Sagittarius stream.

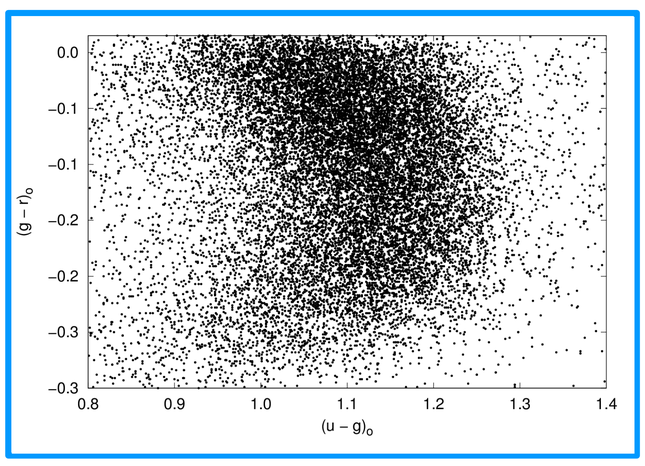
Introduction

Proposed origins for field BS stars:
(see Carney 2005)
– Mass transfer
– Extragalactic
(interactions with dwarf galaxies)

Search for BS candidates in the field:
– A-type stars
– Metal poor: [Fe/H] < -0.4
(metalicities from SEGUE Stellar Parameter Pipeline - SSPP)
– Main sequence stars

Data

Sloan Digital Sky Survey (SDSS)
Data Release 8 (DR8)



The color selection in $(u - g)_0$ and $(g - r)_0$ used to select A-type stars. BS and BHB stars are commonly found in this region.

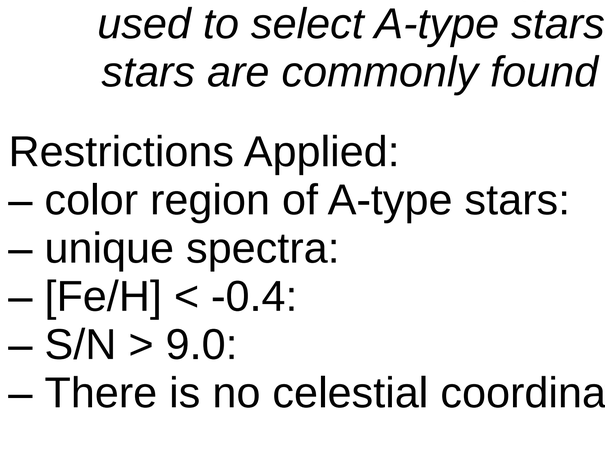
Restrictions Applied:
– color region of A-type stars: 21692
– unique spectra: 19771
– [Fe/H] < -0.4: 18560
– S/N > 9.0: 15757
– There is no celestial coordinate cut!

Analysis

Balmer line profiles:

[1] **f_m** vs **$D_{0.2}$** method:

flux at center of the line
vs
width 20% below the continuun level
(see Kinman 1994)



Comparison between a BS star (red) and a BHB star (blue).

[2] Scale-shape-width method:
(see Clewley 2002)
c* vs *b
(parameters of Sérsic profile)

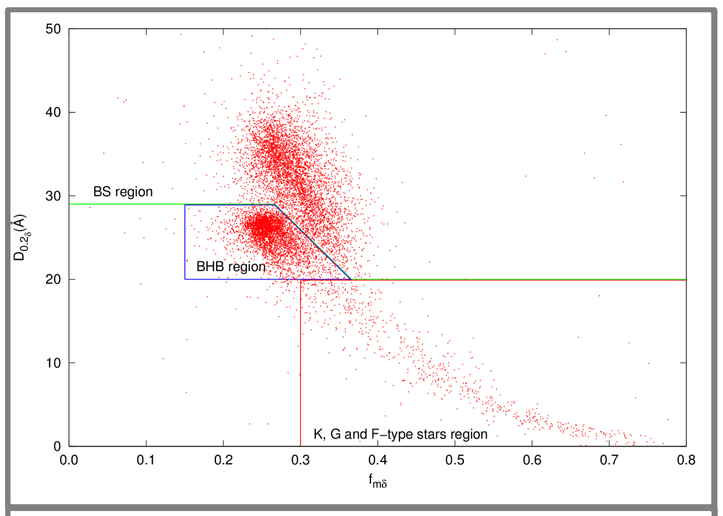
$$S(x) = n - ae^{-\left(\frac{|x-x_0|}{b}\right)^c}$$

(Sérsic profile)

[3] Atmospheric parameters:
- log(g) and T_{eff} from SSPP

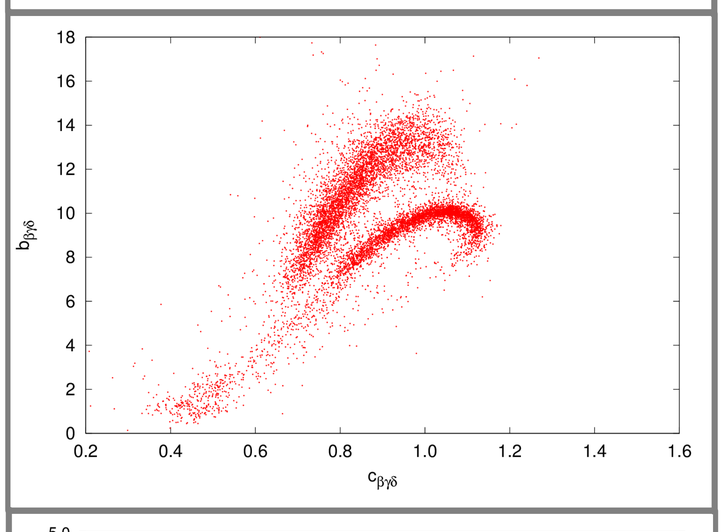
Results

Selection Methods:

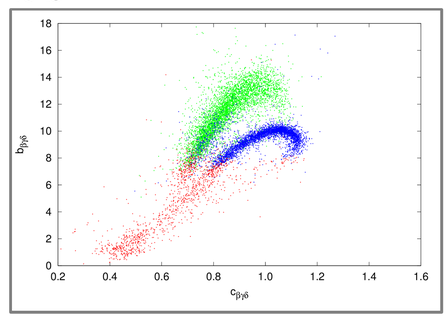


[1] f_m *vs* $D_{0.2}$

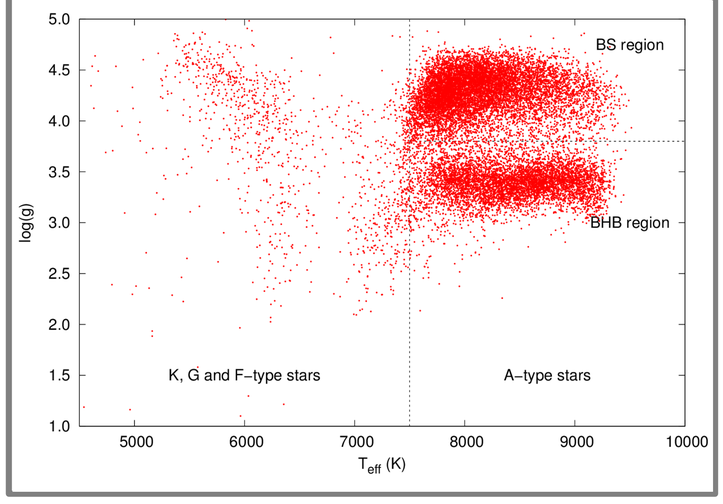
Giant stars have line wings systematically narrower than main sequence stars



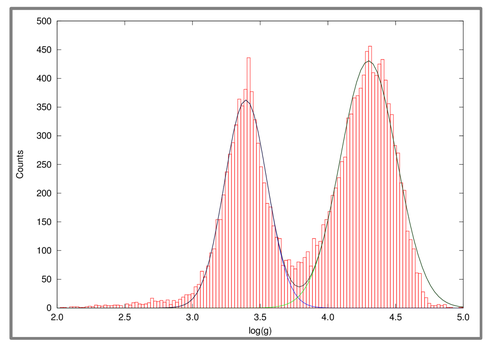
[2] c *vs* b



[1] and [2] methods are combined to separate BS from BHB stars with S/N > 15



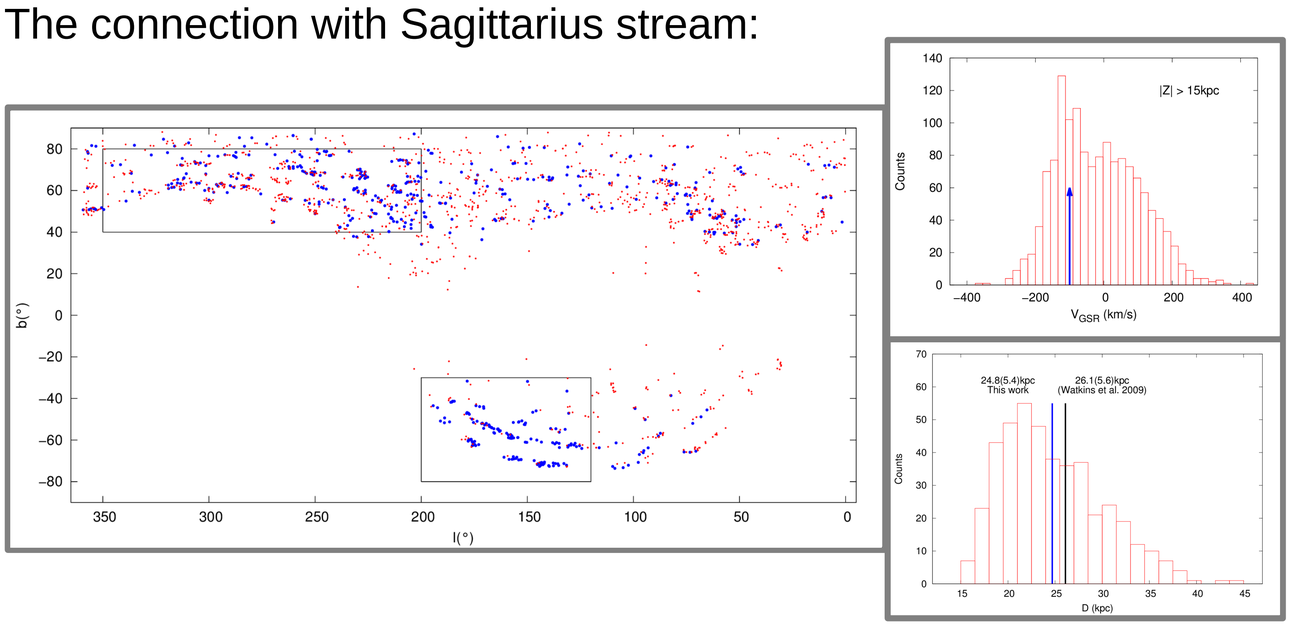
[3] T_{eff} *vs* *log(g)*



log(g) *can separate stars with S/N > 9*

[1] + [2] + [3] = 8001 accepted BS candidates
(~95% of confidence)

The connection with Sagittarius stream:



Top right panel: V_{GSR} distribution of stars with |Z| > 15 kpc
(the blue arrow shows the typical VGSR of Saggitarius stream - Koposov 2012)
Left panel: blue dots are objects with -180 km/s < V_{GSR} < -50 km/s
(the black rectangles show the main location of the Saggitarius stream)
Bottom right panel: distance of stars in blue (within the rectangles) on left panel
(blue line: average distance estimated by this work using BS stars: Kinman et al. 1994)
(black line: average distance estimated by Watkins et al. (2009) using RR-Lyrae stars)

References:

Carney B. W., Latham D. W., Laird J. B., AJ, 2005, vol. 129, p. 466;
Clewley L. Warren S. J., Hewett P., Wilkinson M., Evans N. W., vol 220 of IAU Symposium, 2004, p. 209;
Kinman T. D., Suntzeff N. B., Kraft R. P., AJ, 1994, vol. 108, p. 1722;
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