

Galactic Stellar Halo Luminosity Function

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Abstract

- We measure the stellar halo luminosity function using a magnitude complete, tangential velocity-selected sample from Gaia DR3.
- The dimmest subdwarfs found reach an absolute M_G magnitude near 14 mag, and the dimmest halo white dwarfs reach 15 mag.
- We find a turnover in the subdwarf luminosity function at M_G around 10 mag after which the function falls to the extent of the subdwarf branch at 14 mag.
- We convert the Gaia G band to Johnson's V and find the stellar halo luminosity compares well with previous results.
- The stellar halo sample contains more stars and probes a wider range of absolute magnitudes than previous studies.
- In further efforts we will use this result to measure the stellar halo mass function and mass-to-light ratio.

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Data and Analysis

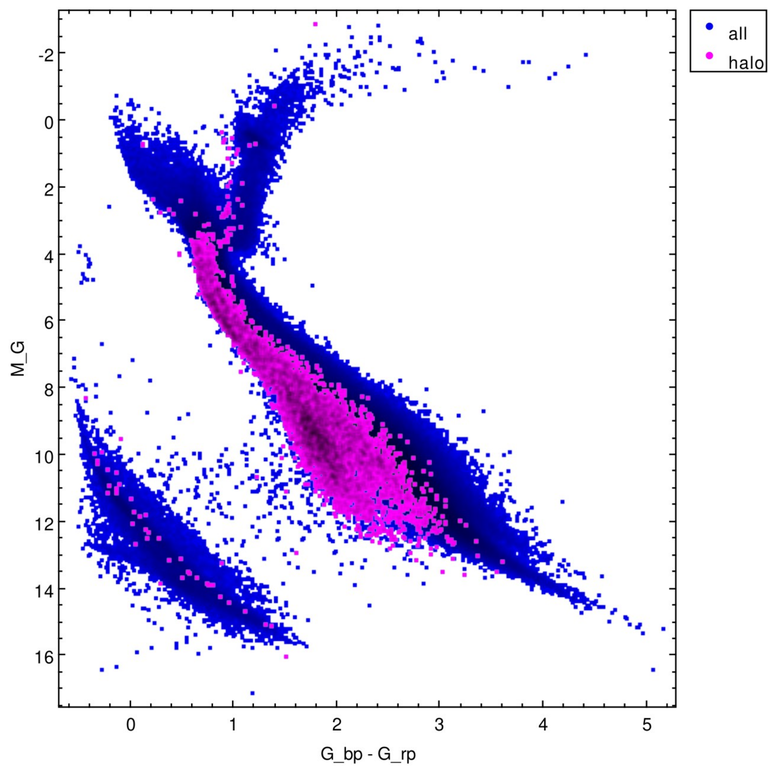


Fig 1. Color-magnitude diagram for stars within a column around the Sun (blue, column selection displayed in Fig 2, left panel). Halo stars (magenta) are selected by tangential velocity > 200 km/s. After an additional culling of |b|>30 deg, the halo sample totals to 5358 stars including subdwarfs, giants, white dwarfs, and blue stragglers.

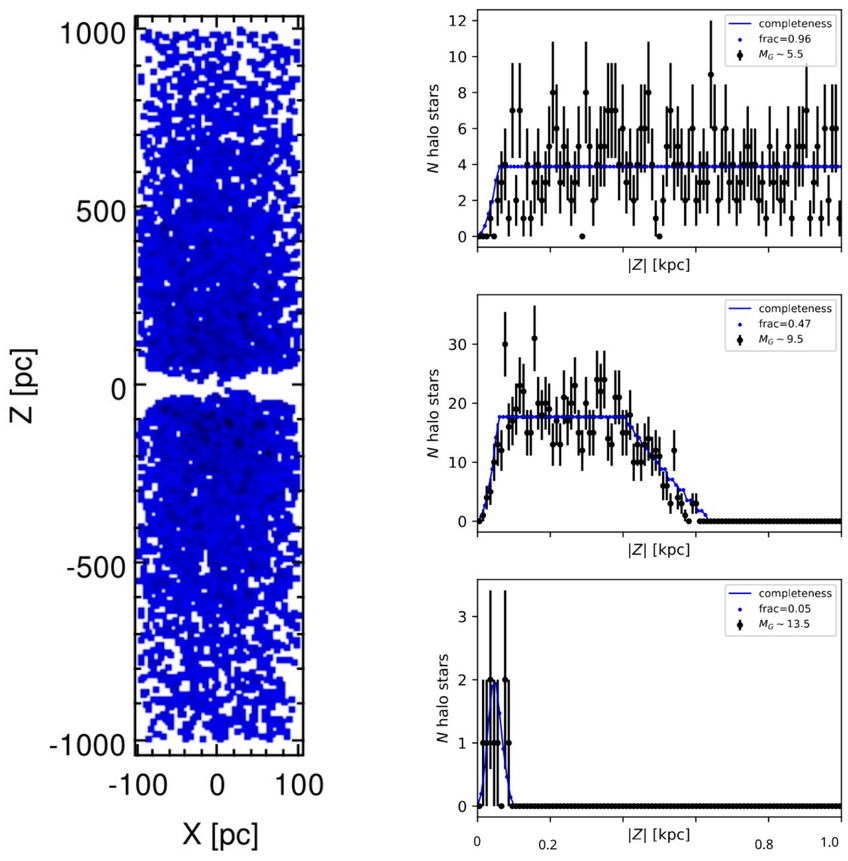


Fig 2. Left: Halo stars in the solar neighborhood are selected in a column with radius of 100 pc and height 2 kpc. The decreasing number of stars with increasing Z is due to decreasing completeness. Right: Completeness curve (blue line) is calculated to correct the luminosity function. Black markers show the number of halo stars at |Z| kpc above/below the disk midplane before completeness correction. At M_G ~-5.5, top panel, the stars share absolute magnitude similar to the Sun and are complete within our sample. At dimmer absolute magnitudes (M_G ~-9.5 and ~-13.5, middle and lower panels) the more distant stars are too dim to be included in Gaia DR3.

Results

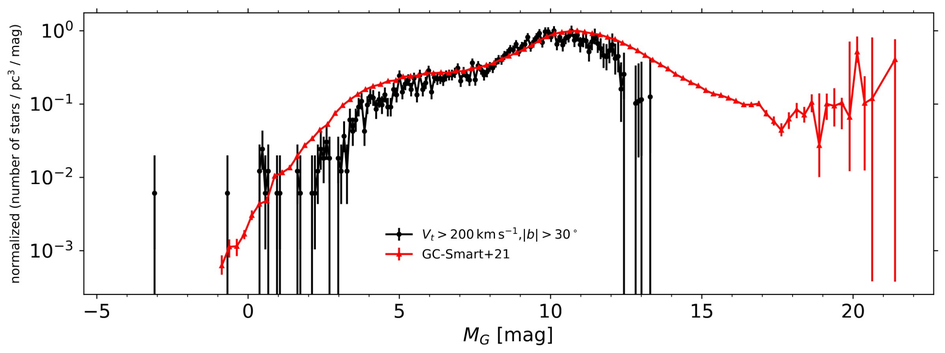


Fig 3. Luminosity function for halo subdwarfs and giants within the solar neighborhood (black) compared with the disk luminosity function (red, stars<100 pc) from Gaia Collaboration, et al. (2021, GC-Smart+21). Functions are normalized by their peak values. The bin widths are 0.1 (black) and 0.25 (red) magnitudes in absolute Gaia M_G magnitude.

Discussion

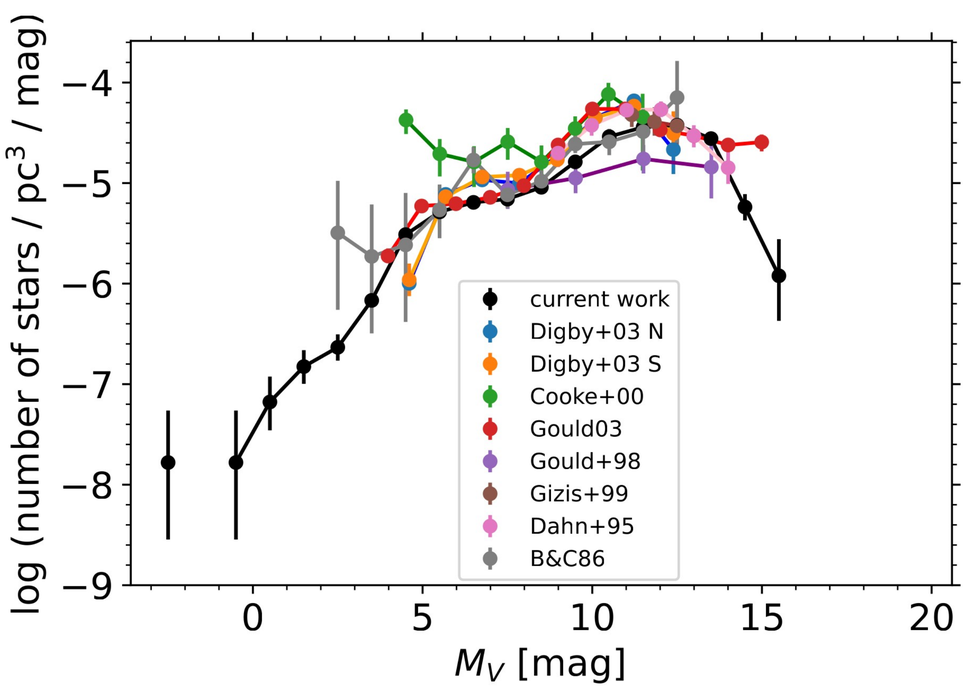


Fig 4. Luminosity function for halo stars within the solar neighborhood (black) compared with stellar halo luminosity functions from Bahcall & Casertano (1986, B&C86), Dahn et al. (1995), Gould et al. (1998), Gizis & Reid (1999), Cooke & Reid (2000), Gould (2003), and Digby et al. (2003). The functions compare well with the current sample, which contains more stars and probes a wider range of absolute magnitudes.

References

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Dahn, et al. 1995, in The Bottom of the Main Sequence - and Beyond, 239
Digby, et al. 2003, MNRAS, 344, 583
Gaia Collaboration, et al. 2021, A&A, 649, A6
Gizis, et al. 1999, AJ, 117, 508
Gould, et al. 1998, ApJ, 503, 798
Gould 2003, ApJ, 583, 765