The C-19 Stellar Stream
as seen by DESI

Nasser G. A. Mohammed, Joseph Tang, Ting S. Li, DESI Milky Way Survey Working Group

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References

We provide an analysis of the extremely metal-poor C-19 stellar stream. Data from the first three years of observations from the Dark Energy Spectroscopic Survey (DESI) identifies ~3 times more spectroscopic member stars than the most recent measurements, allowing us to better constrain the properties of this unique stream.

Stellar Streams

Milky Way (MW)-like galaxies evolve hierarchically through mergers of dwarf galaxies (DGs) and globular clusters (GCs) [1,2]. The tidal disruption of these satellites during the mergers creates **stellar streams** that we can observe today.

Streams are tidally disrupted satellites merging with the MW

Dark Matter

Stellar streams are **long**, spanning ~10–100 kpc. Due to this, they have likely interacted gravitationally with dark matter (DM) substructures predicted by DM models. Stellar streams hold memories of these interactions in morphological features and kinematic heating [5].

The C-19 Stellar Stream

C-19 is the **most metal-poor stellar population** discovered to date [6]. Its variations of light element abundances) are **characteristic of a GC**, however, measurements of its velocity dispersion align with a **DG progenitor** [7].

C-19 is extremely **metal-poor.** Its chemical makeup suggests **GC origins**, but its kinematics suggest **DG origins.**

DESI Data Release 1: Stellar Catalogue, Fig. 16

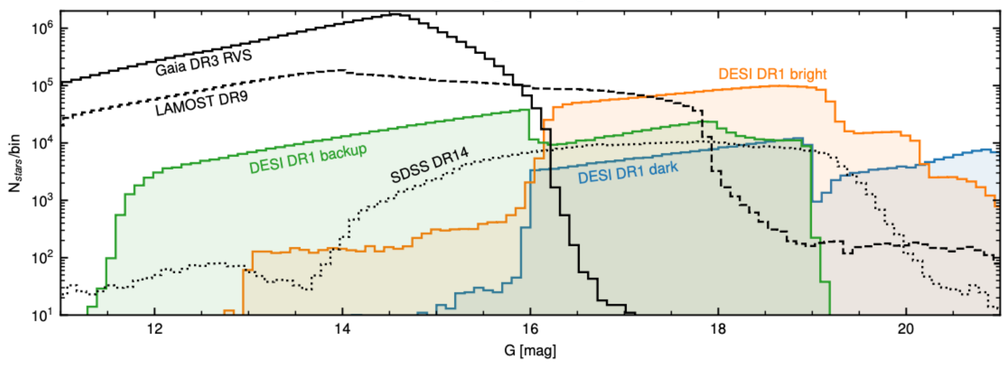

Fig 1. DESI Magnitude range: G = 12-21 mag with a median radial velocity accuracy ~1 km/s. Koposov & Li et al. 2025, arXiv: 2505.14787

The Dark Energy Spectroscopic Instrument (DESI)

DESI is a **multi-object spectrograph** equipped with a 4m aperture and 5,000 fibers [3]. There have been 4 million stars observed from the first 13 months of DESI operations (DR1) [4] . This work uses ***~15 million stars*** with radial velocity measurements from the first three years. ~20 million stellar spectra are to be observed by end of survey (2021-2026).

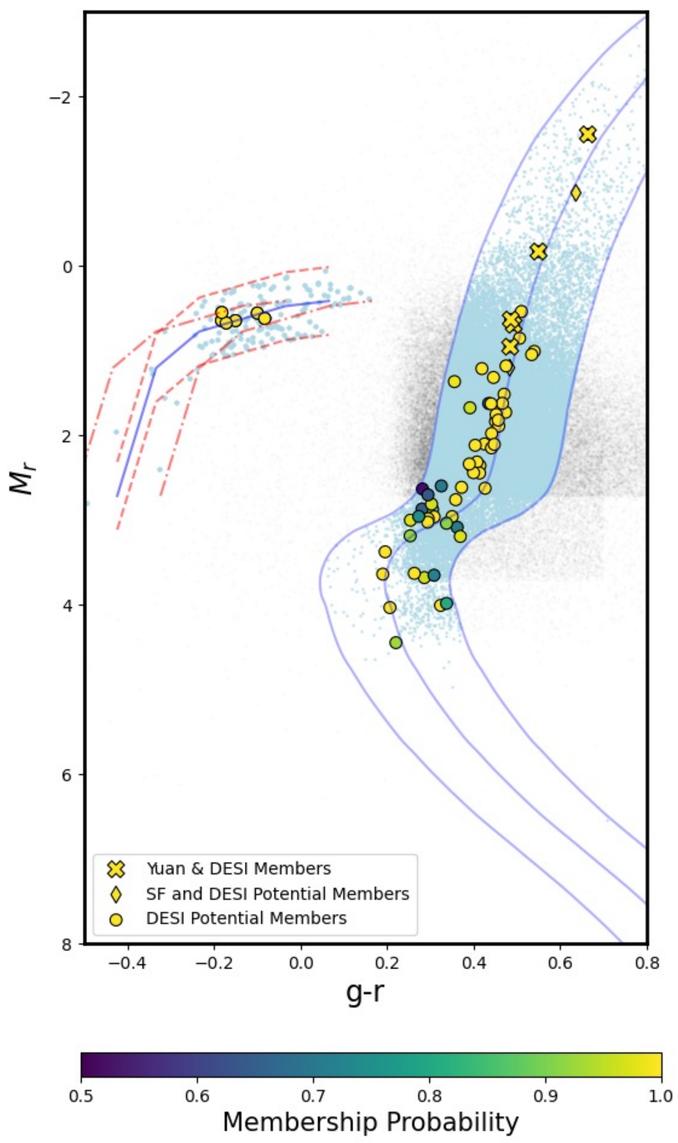

Fig 2. 13.5 Gyr Isochrone for [Fe/H] = -2.49 stellar population.

Results

We find **71 high probable members**, recovering all members identified in [8] that are in the DESI footprint. We do this using a 2-component Gaussian mixture model to separate member stars from non-members.

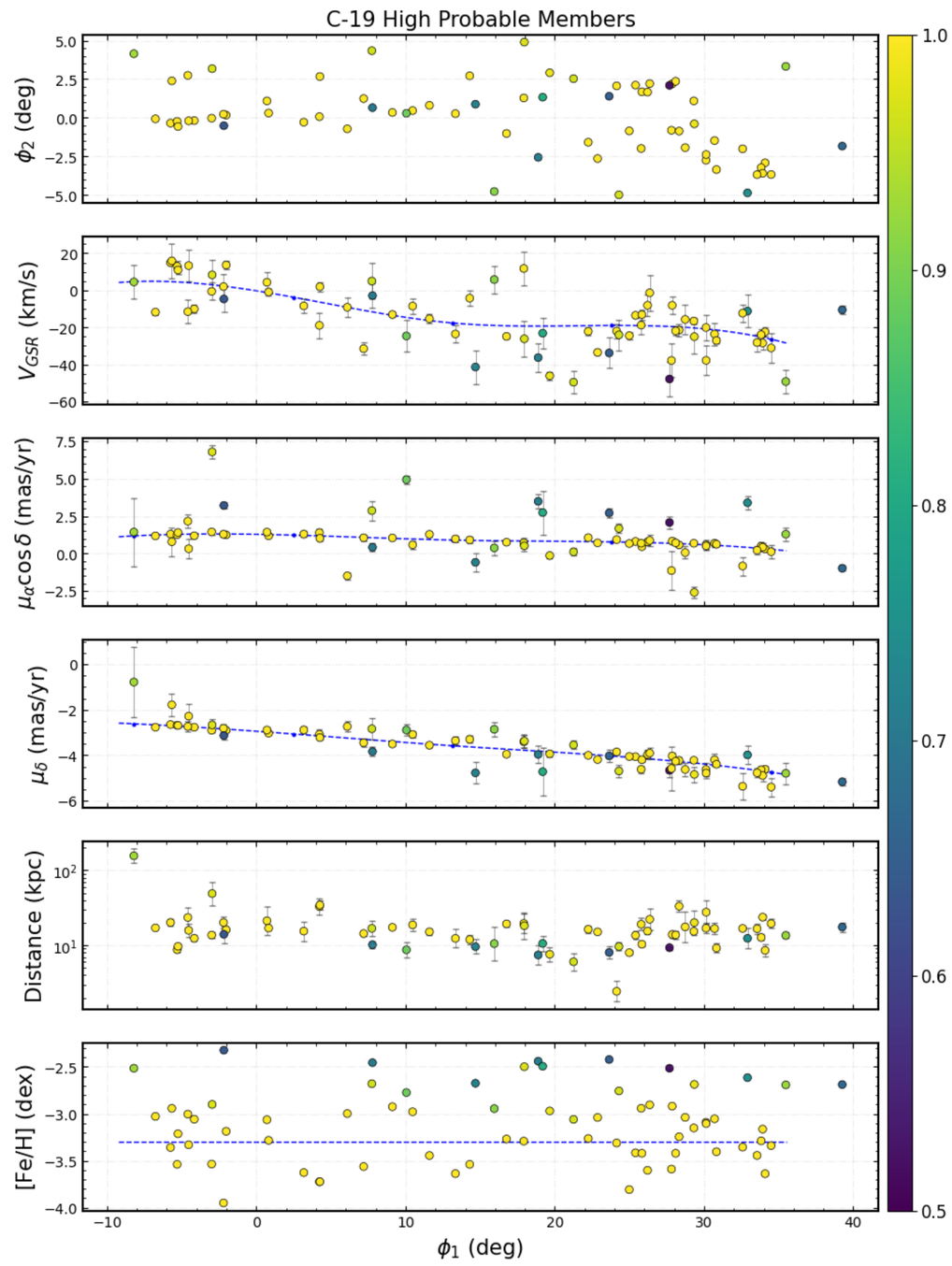

Fig 3. 71 stars with membership probability > 50%. Derived stream tracks from mixture model shown in blue.

Discussion: The Spur in C-19

We spot a **'spur'** in C-19 around a $\phi_1 \sim 25^o$, similar to features previously identified in the GD-1, Atlas Altiqa-Uma, and Ophiuchus streams [9, 10, 11]. We look in *Gaia* Data Release 3 (DR3) [12] for similar structure to ensure the spur isn't a side-effect of our mixture model. We find the **same morphology** when we reduce the Gaia DR3 data with respect to our fitted stream tracks.

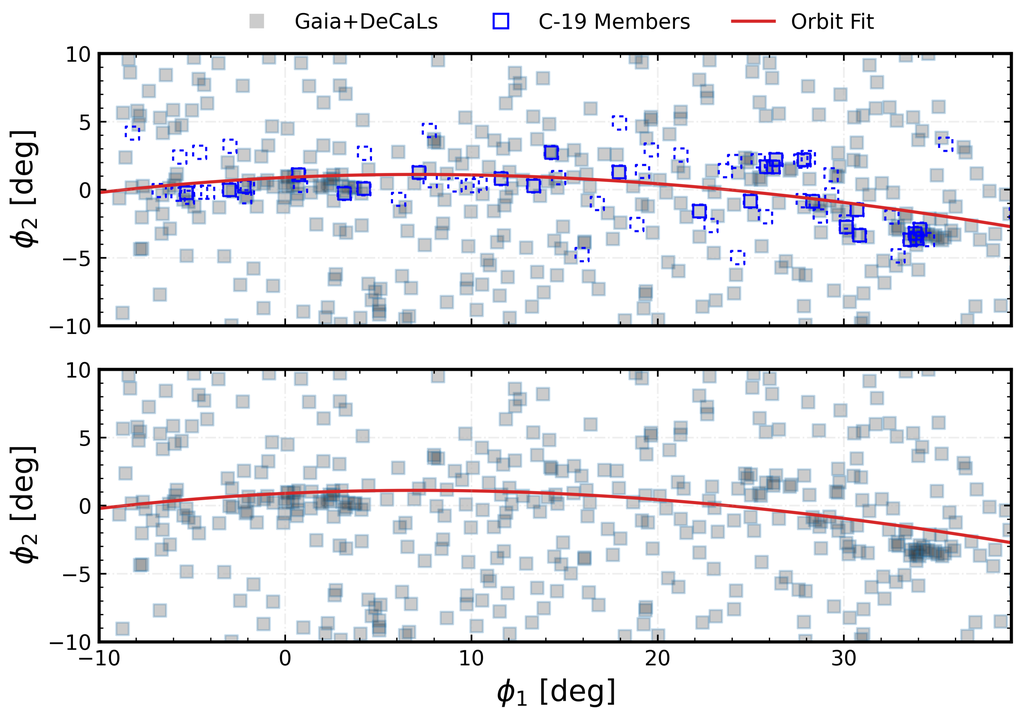

Fig 4. C-19 field as seen in Gaia Data Release 3 with high-probability members shown in blue (top). Orbit track is overlayed to highlight the spur structure.

Takeaways

- C-19 is **an extremely metal-poor stellar population**
- We obtain **71 member stars** with spectra and probabilities > 50%, **3x as many as previously found**
- We measure a velocity dispersion of $8.9^{+1.5}_{-1.1}$ km/s and a metallicity of $-3.3^{+0.05}_{-0.04}$ dex.
- There is a **spur** in **C-19 indicative of a past collision**
- By **the end of the DESI Milky Way Survey**, we expect to observe **3x** as many C-19 member stars down to a magnitude of G ~ 19.