Using Machine Learning to Catalog Accreted Stars in Gaia DR3 Survey.

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Background

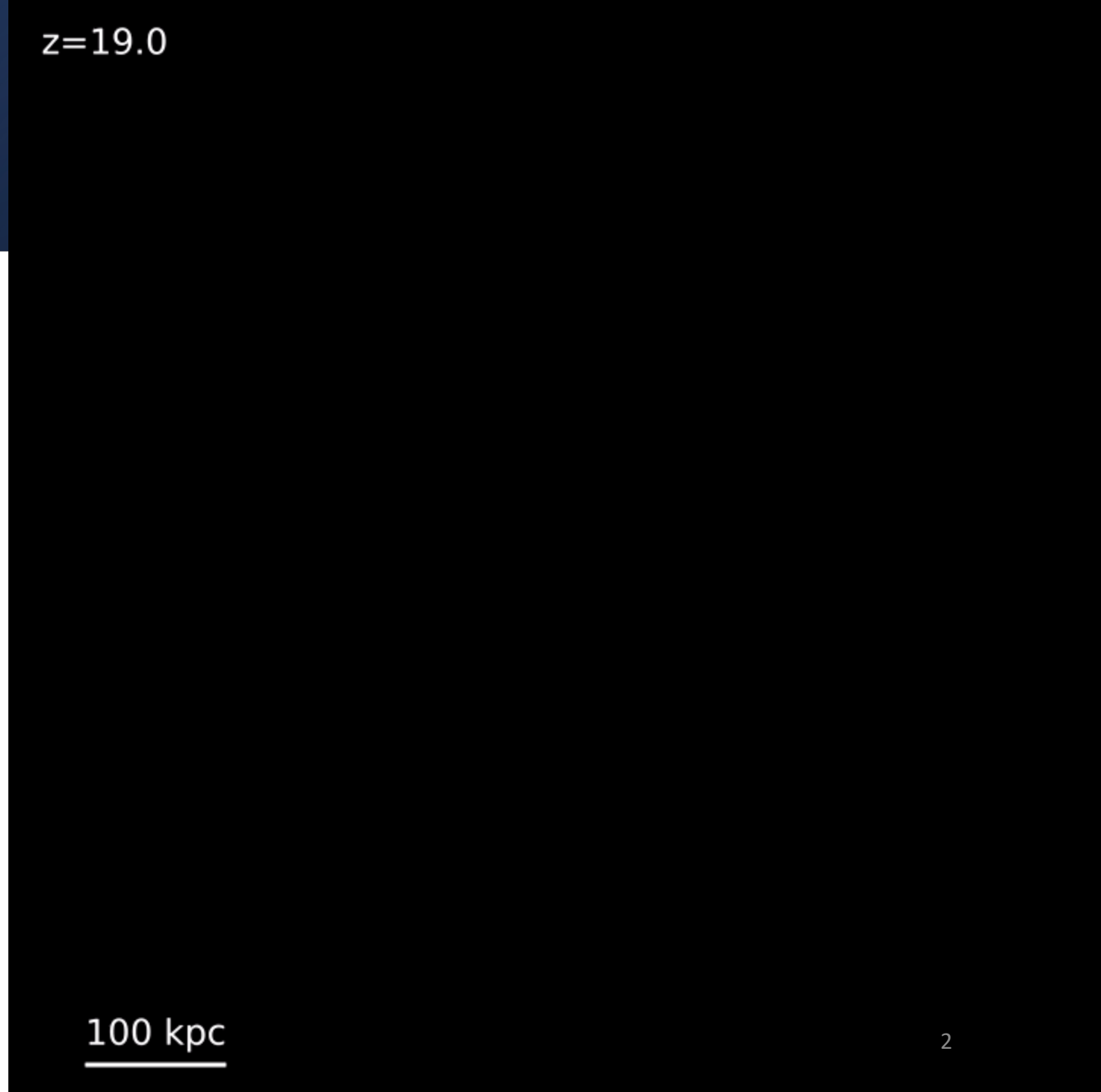
In situ stars

Born within the galaxy.

Accreted stars

Merged with the galaxy.

Latte simulation (m12i): formation over 13.8 billion years showing stars

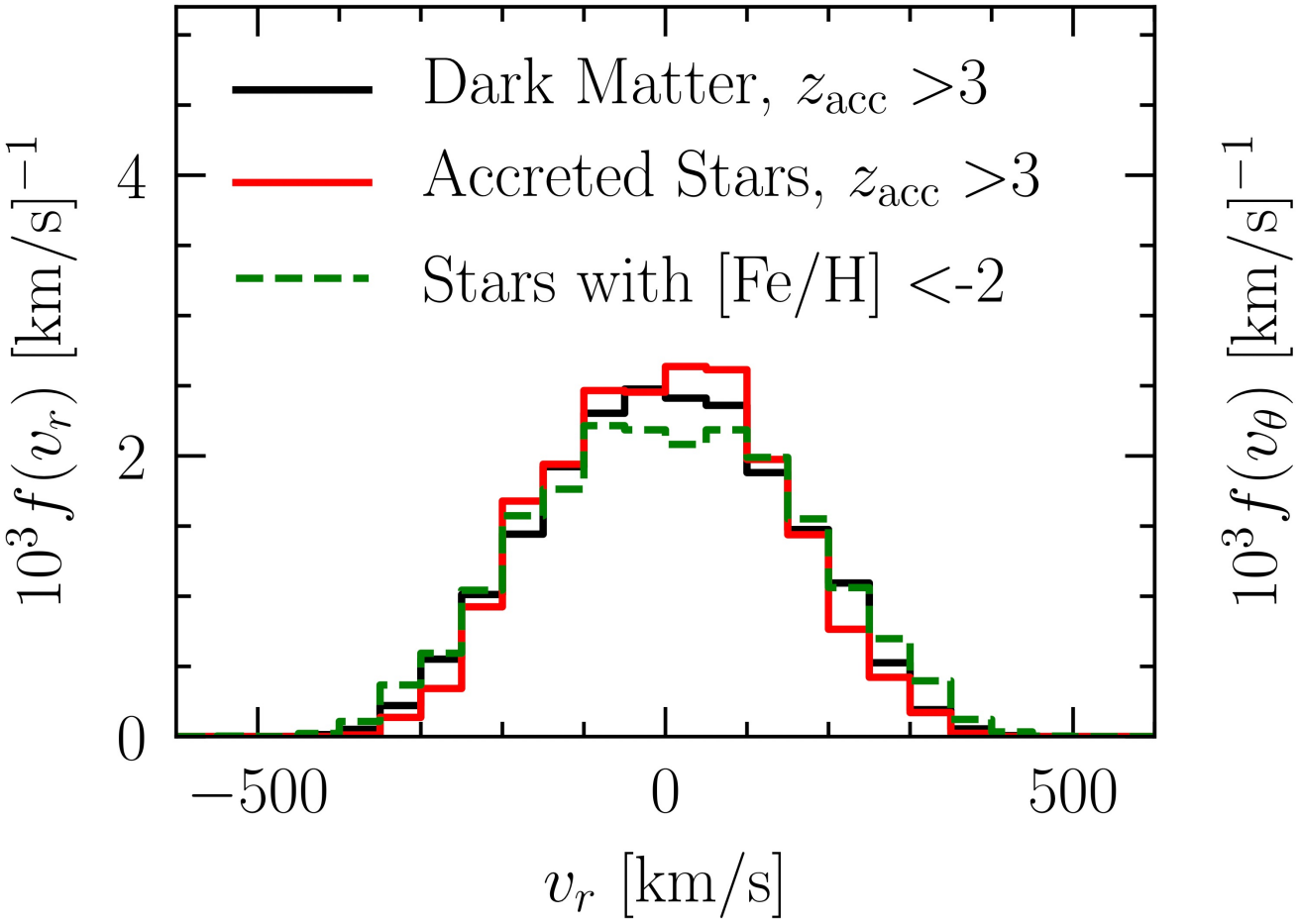


Objective

- To build an Accretion Catalog of the Milky Way using Gaia DR3.

Motivation

Velocity Distribution for m12i

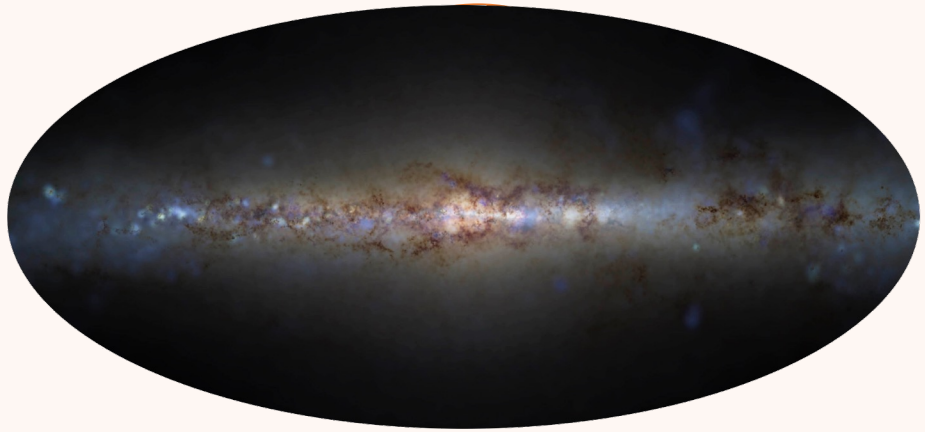


L. Necib et al., The Astrophysical Journal 883, 27 (2019).

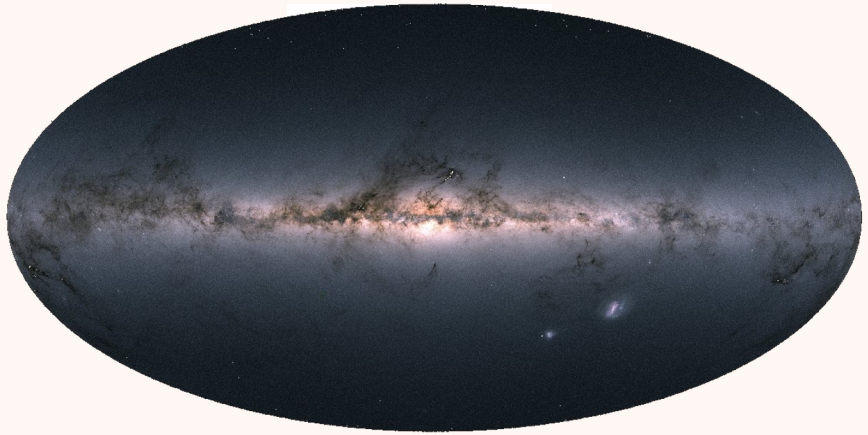
Gaia ESA Data Release 3 (DR3)

- Release on June 13, 2022.
- Abundant radial velocity measurements.
- Well measured parallax.

Ananke based on FIRE



m12i

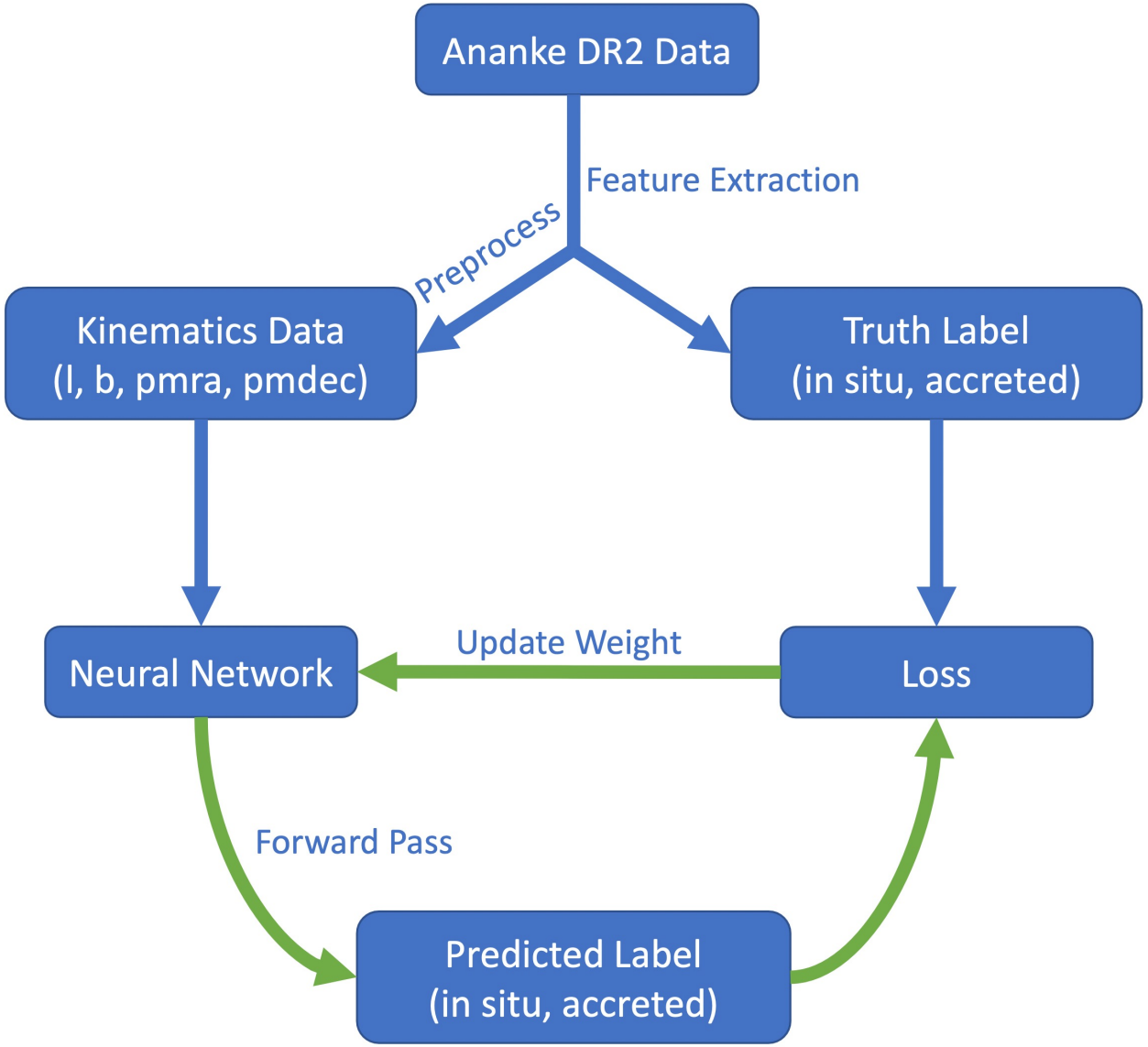


Gaia DR2

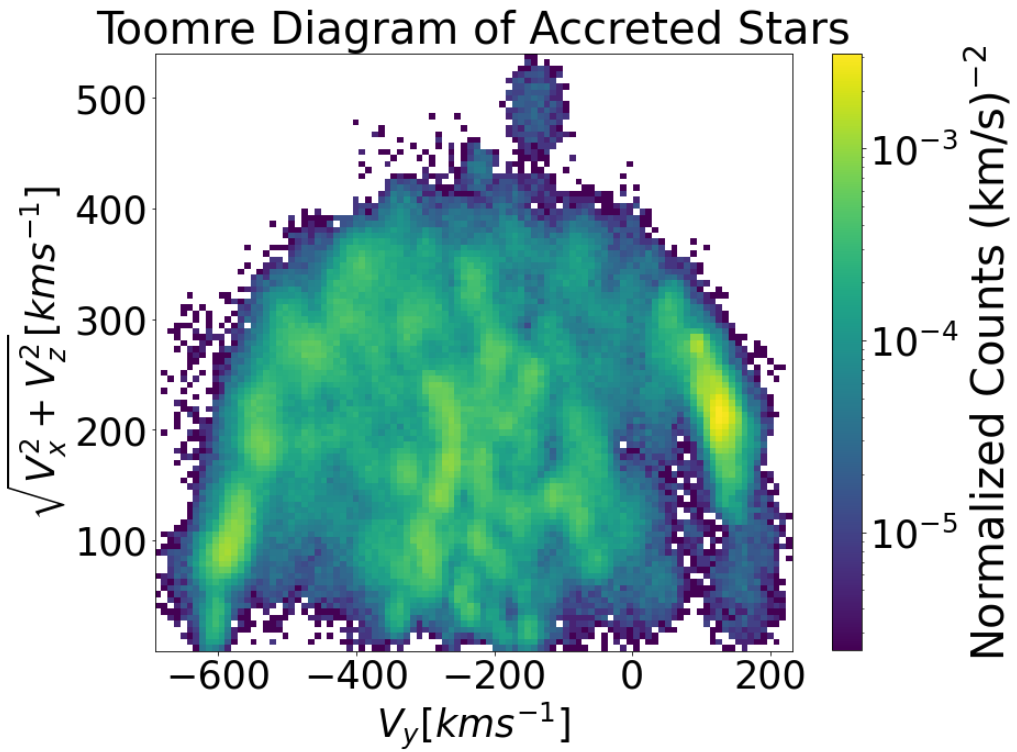
A Latte cosmological simulation of a Milky Way-like galaxy.

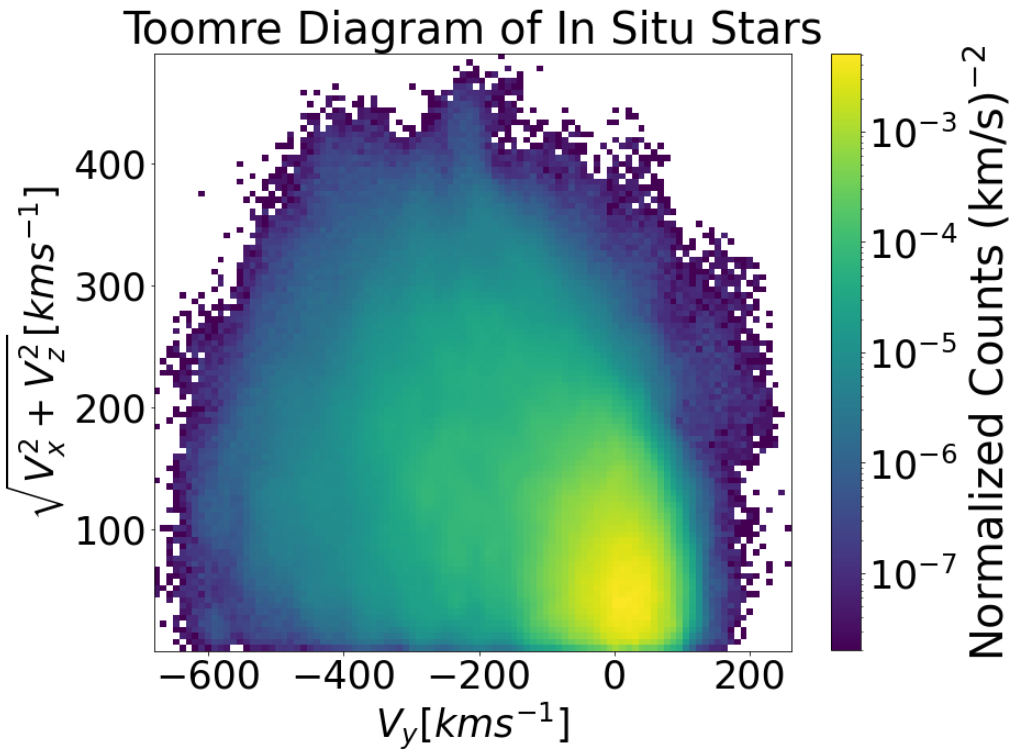
FIRE Gaia Collaboration et al. (2016).

Methods

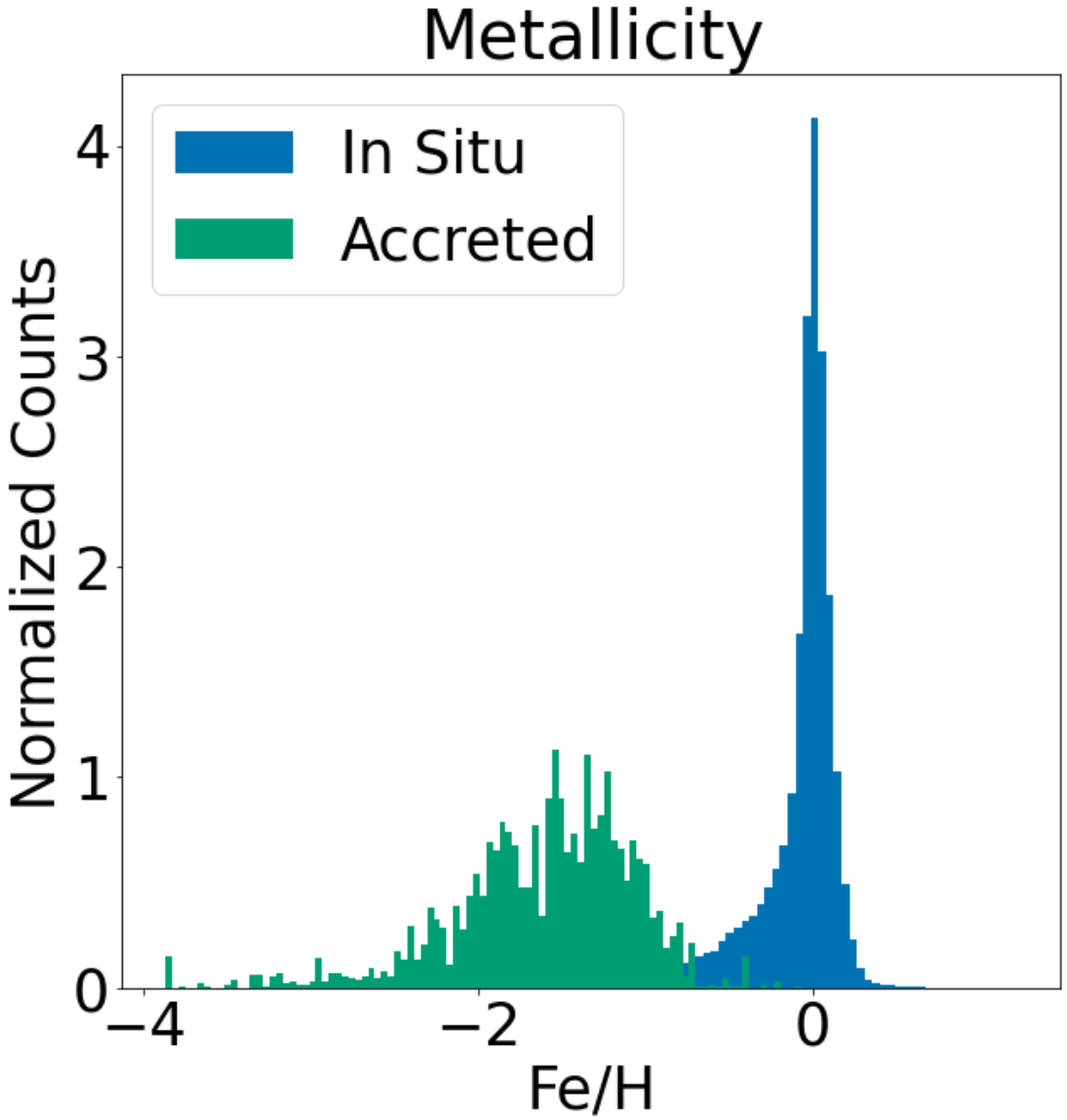

Ananke DR2 Data
Feature Extraction
Preprocess
Kinematics Data
(l, b, pmra, pmdec)
Truth Label
(in situ, accreted)
Neural Network
Update Weight
Loss
Forward Pass
Predicted Label
(in situ, accreted)

In Situ and Accreted Stars in m12i.

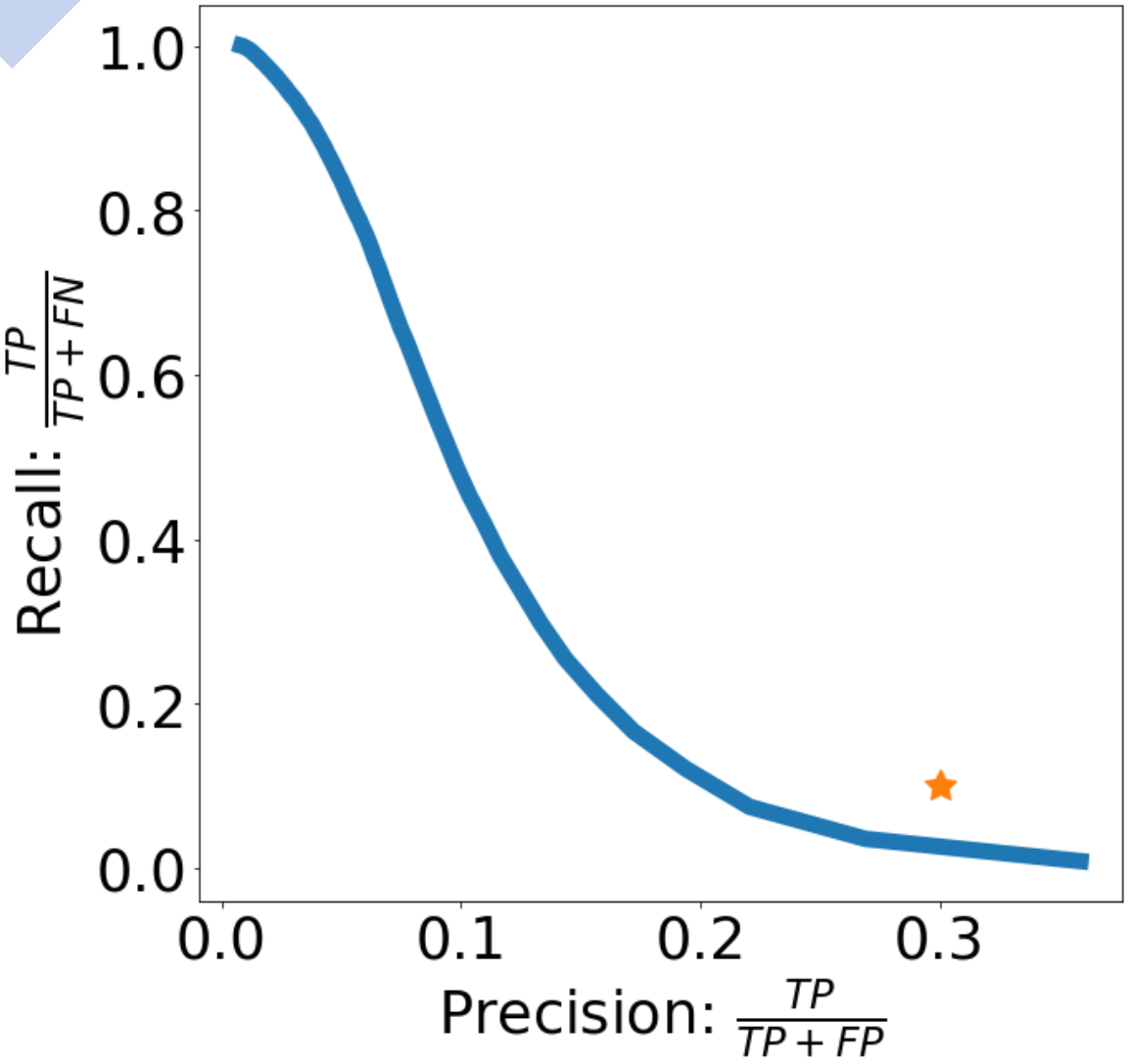




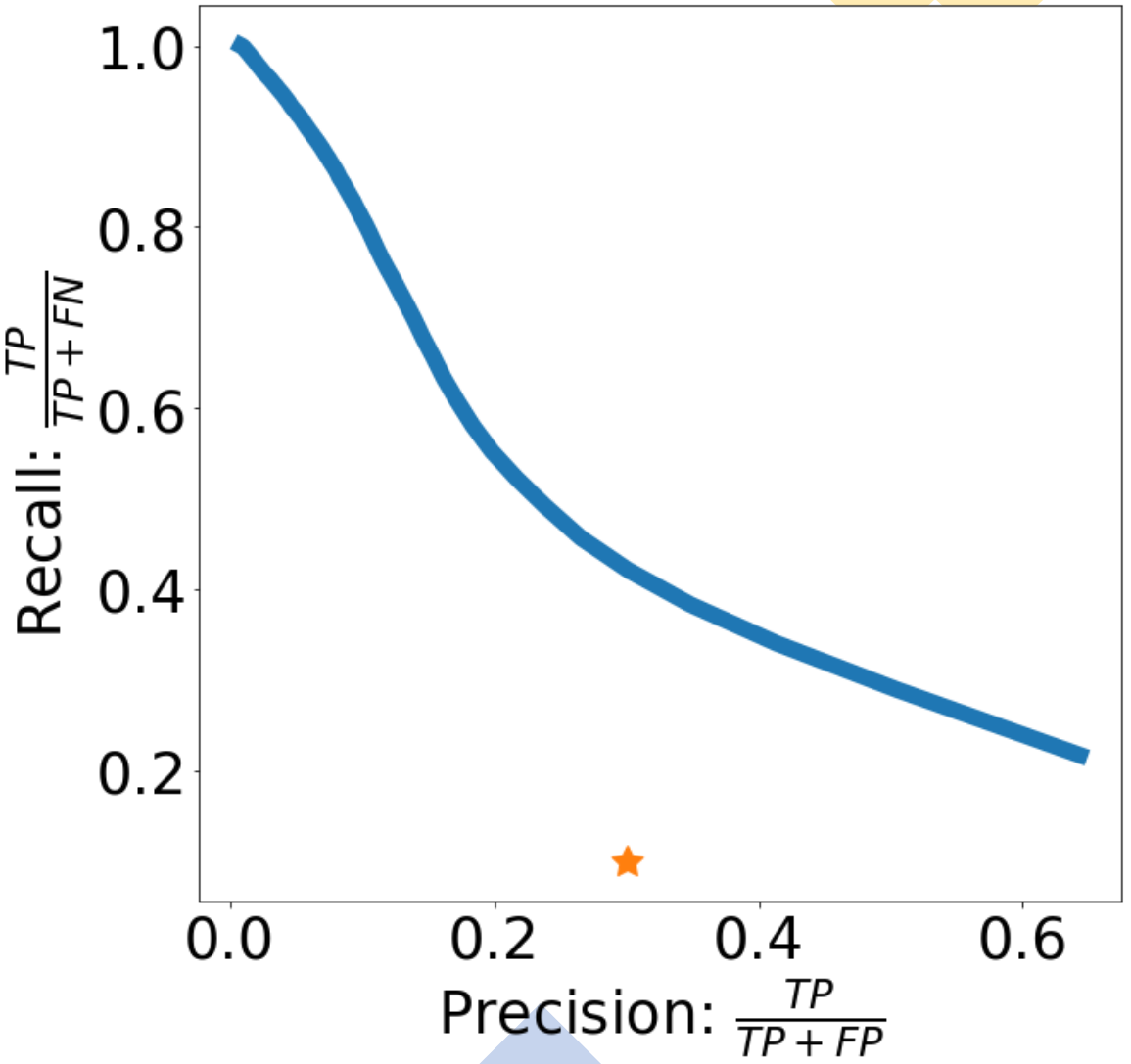
In Situ and Accreted Stars in m12i.



4D Kinematics



5D Kinematics



Next Steps

- Gaia DR2
- Ananke DR3
- Gaia DR3

Main Takeaways + Q & A

The Milky Way experienced a hierarchical structure formation.

We use the simulated galaxy data to train our neural networks.

The accretion catalog can help map out dark matter.