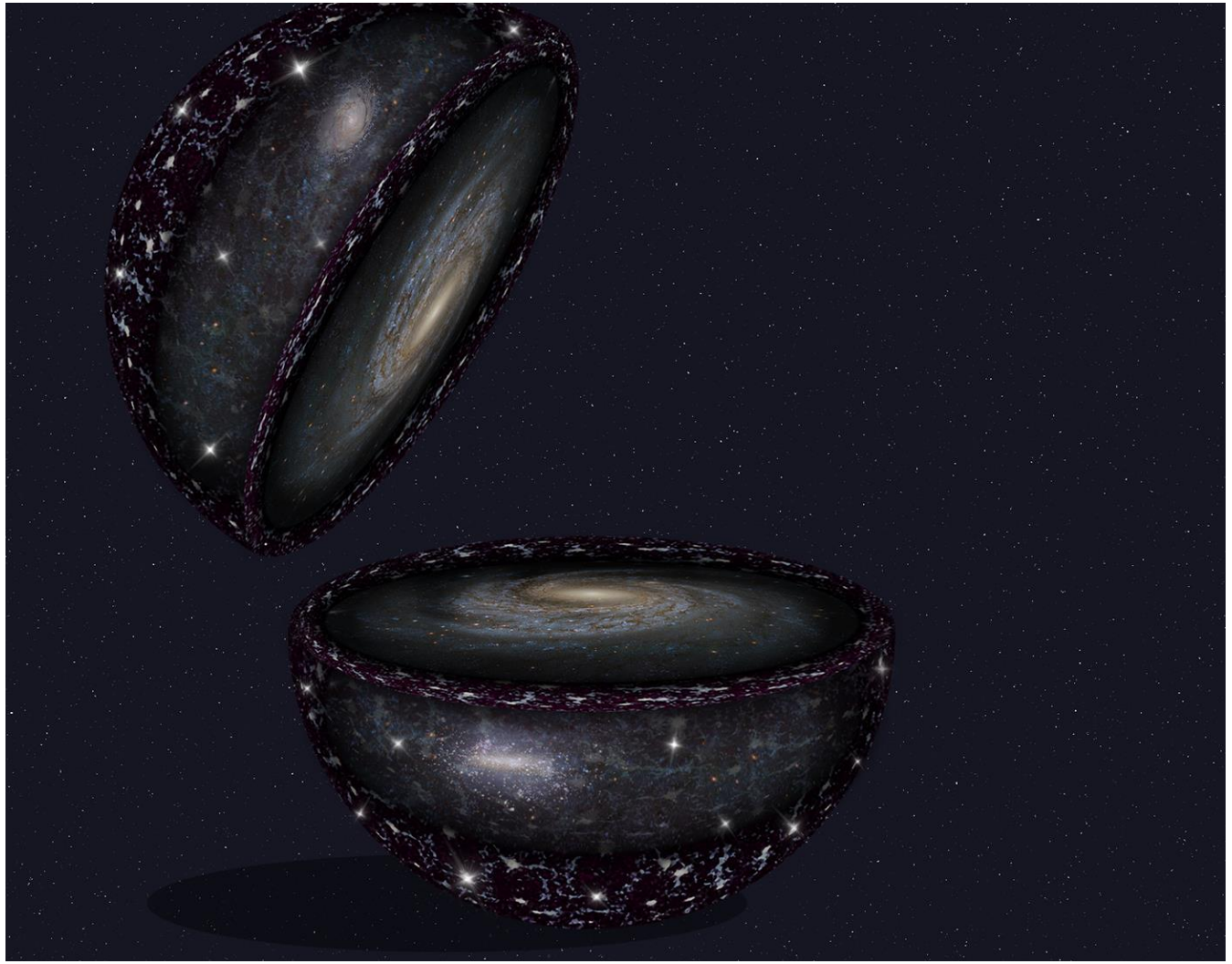
Stellar Populations in SDSS-V/Milky Way Mapper

Jennifer Johnson

Ohio State University

SDSS-V collaboration



SDSS-V collaboration

Instrumentation

BOSS:

R~2000

$\lambda \sim 3900–10{,}000$ A

σ_{RV}~ 5-10km/s

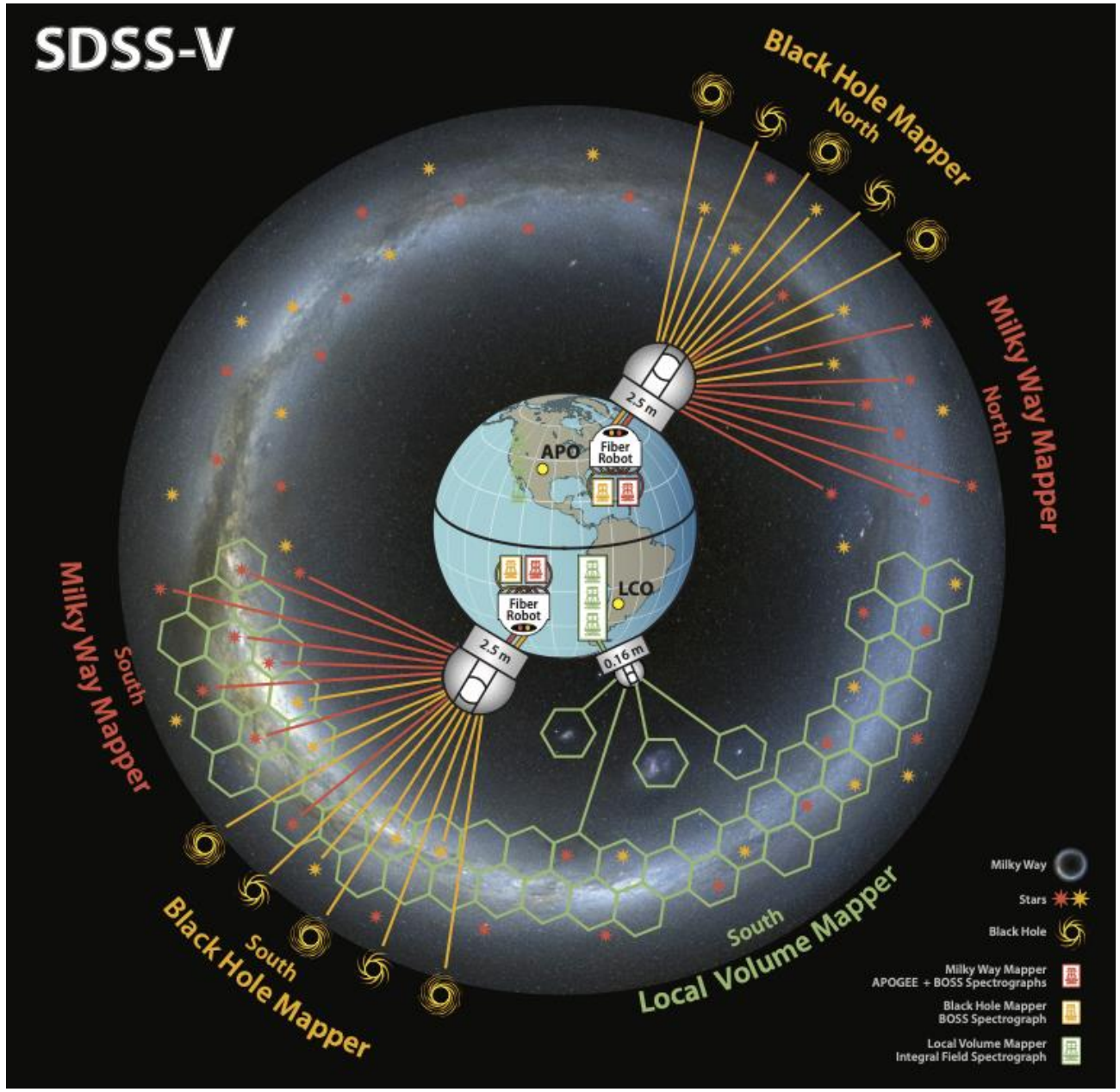
APOGEE:

R~22,500

$\lambda \sim 1.51–1.7$ μm

σ_{RV}~ 30-100 m/s

500 fibers in each hemisphere



Instrument

BOSS:

R~2000

$\lambda \sim 3900–$

σ_{RV}~ 5-10

APOGEE:

R~22,500

$\lambda \sim 1.51–$

σ_{RV}~ 30-1

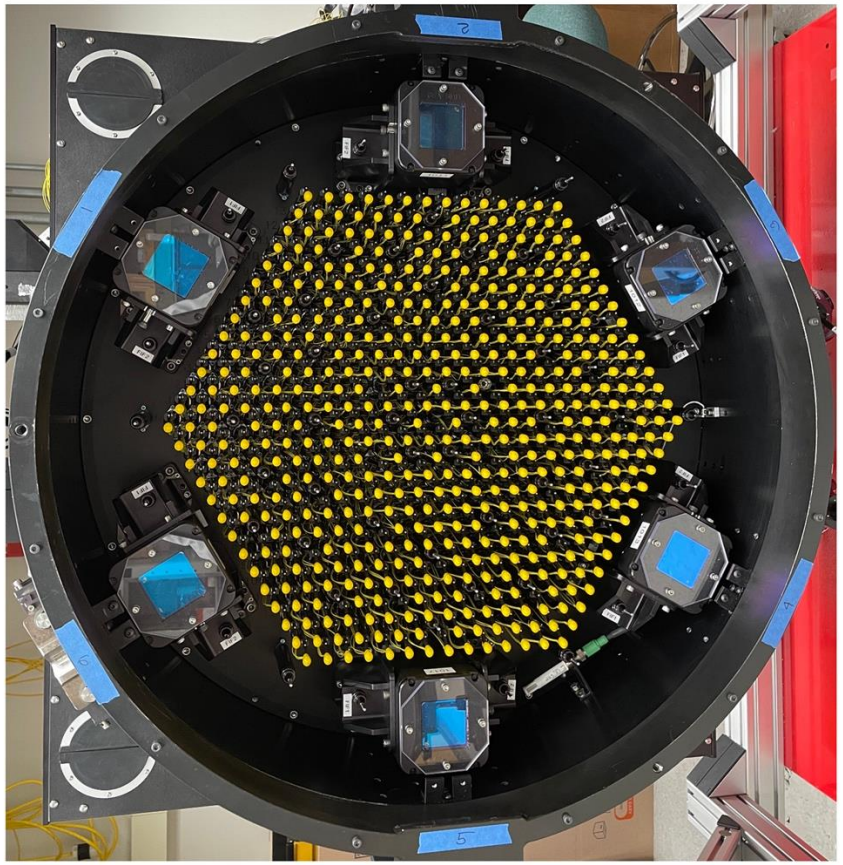
SDSS-V is the latest version of the Sloan Digital Sky Survey

2020-2027

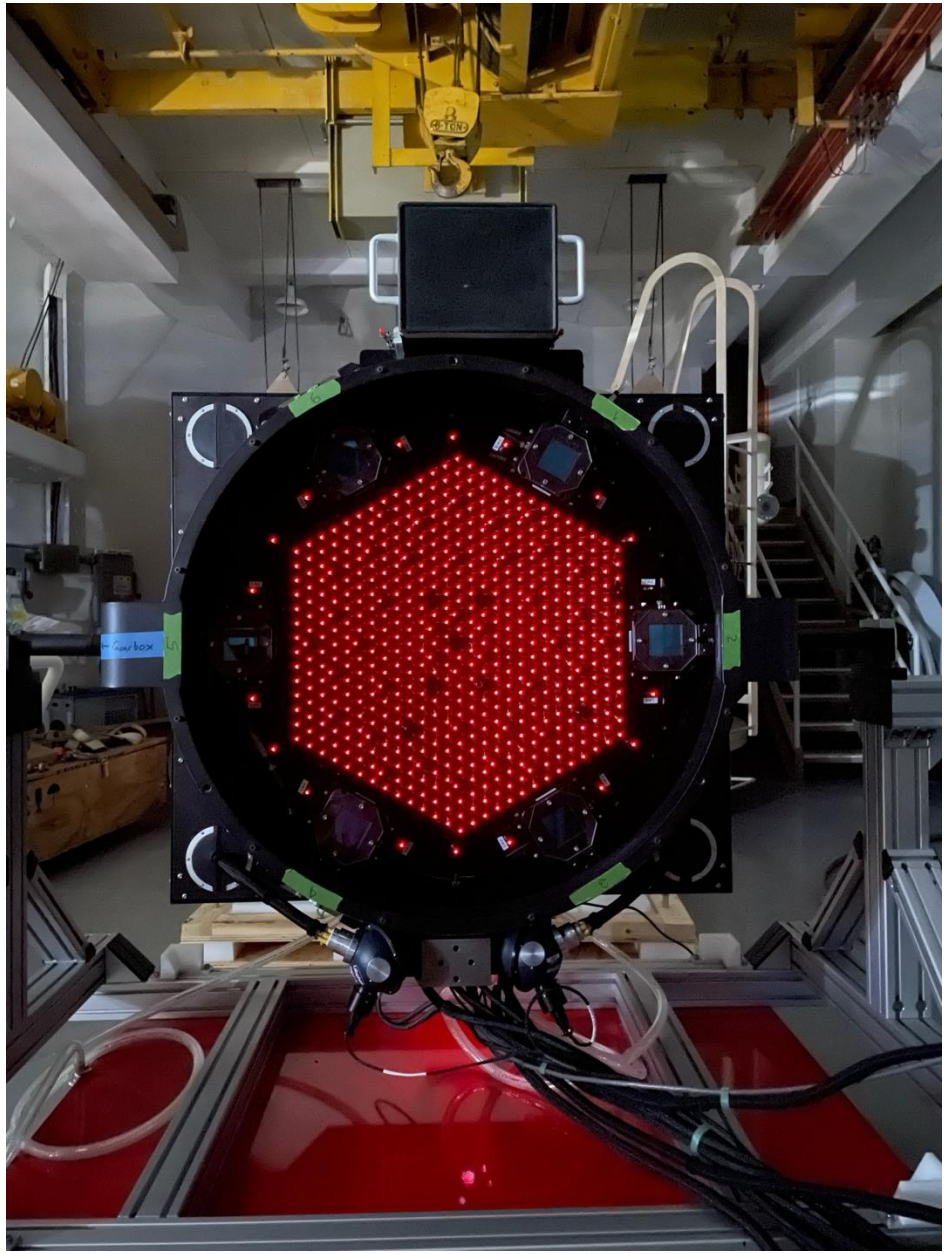
- Complete Galactic coverage
- Time-domain
- X-ray follow-up
- BOSS and APOGEE spectrographs in both hemispheres
- Dedicated IFU telescope in the South

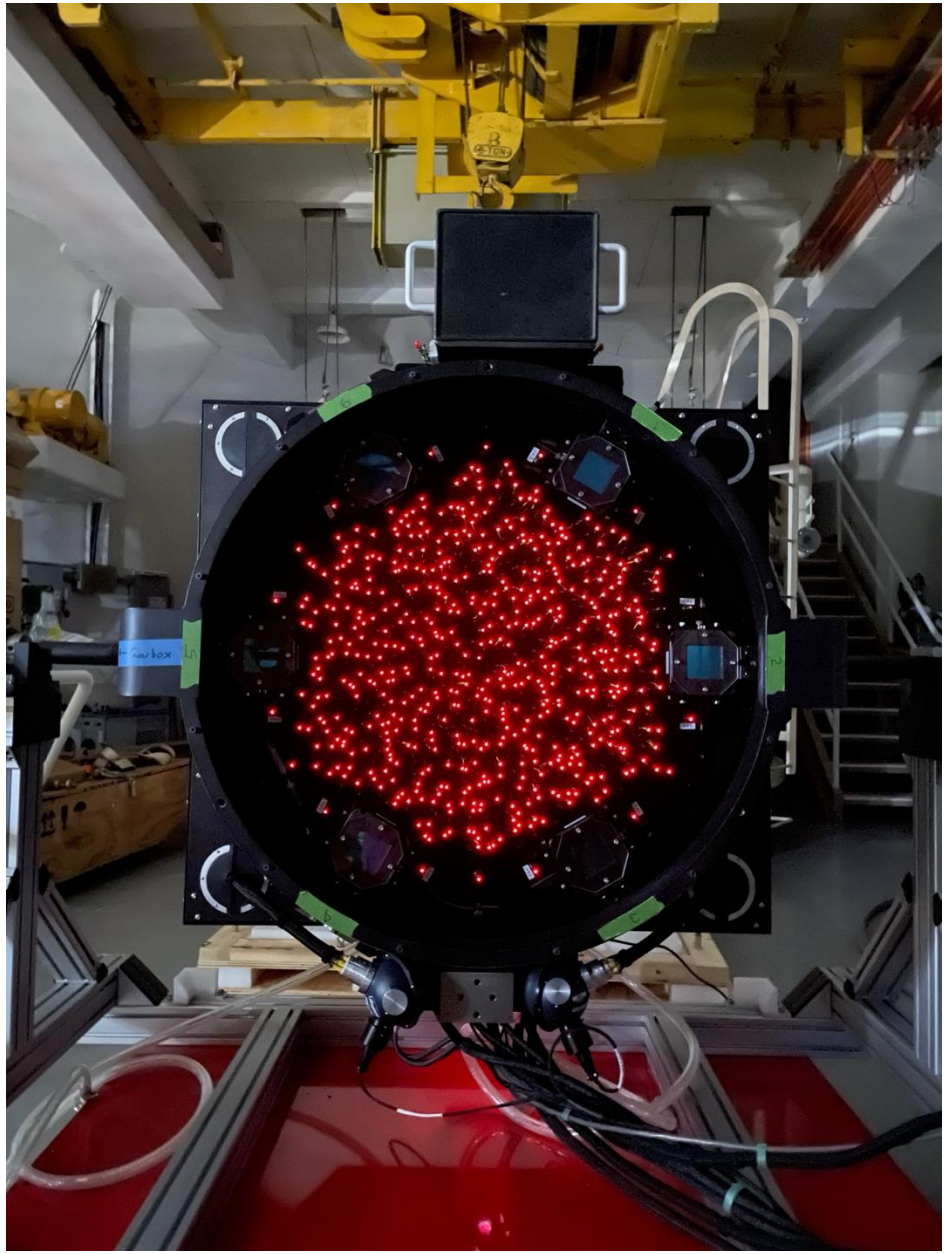
Plates →

Focal Plane System with Robots



Y Position [mm]





Retired SDSS plates

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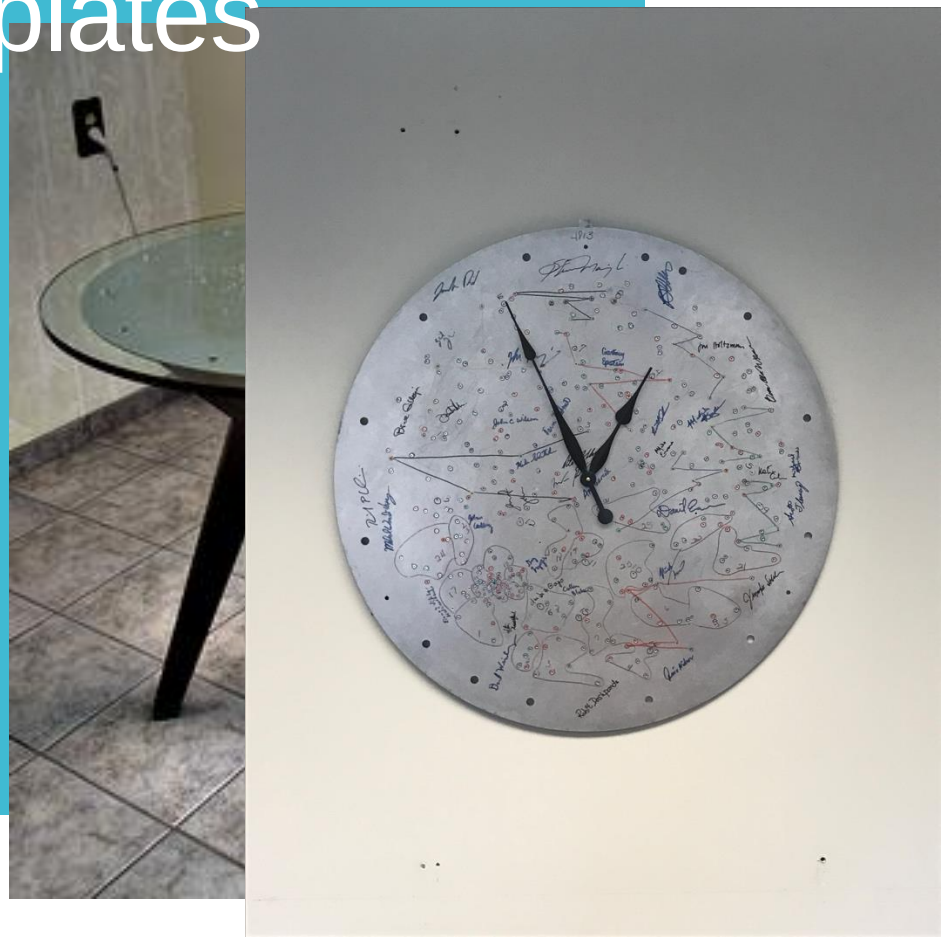

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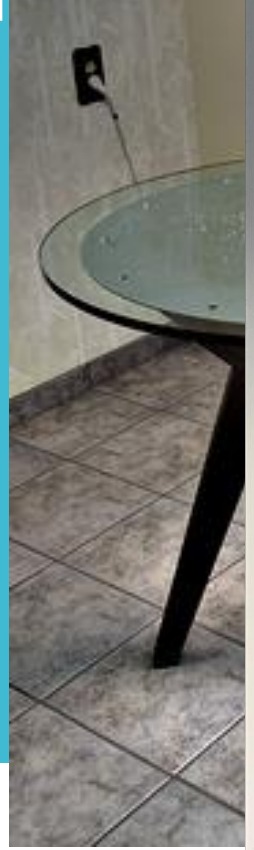

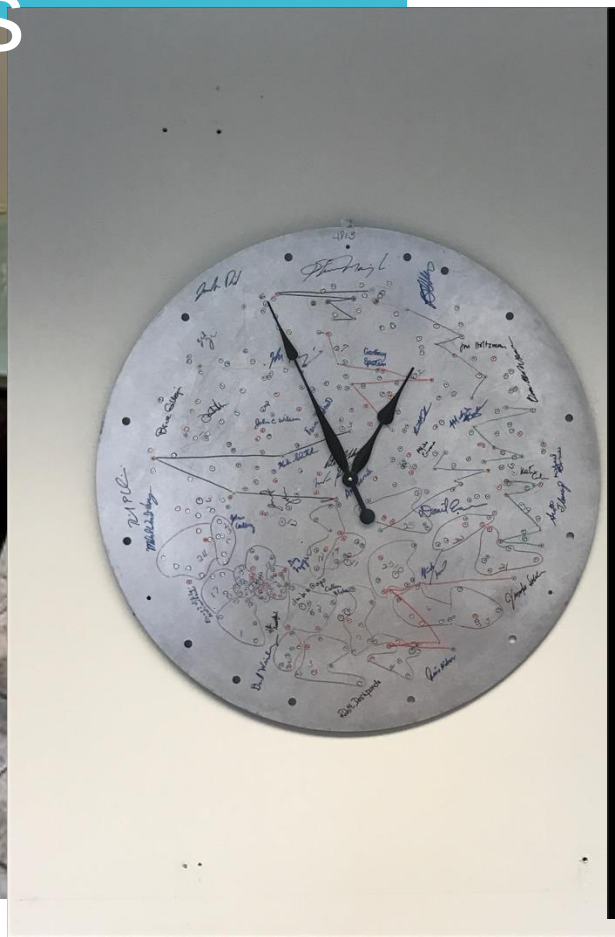

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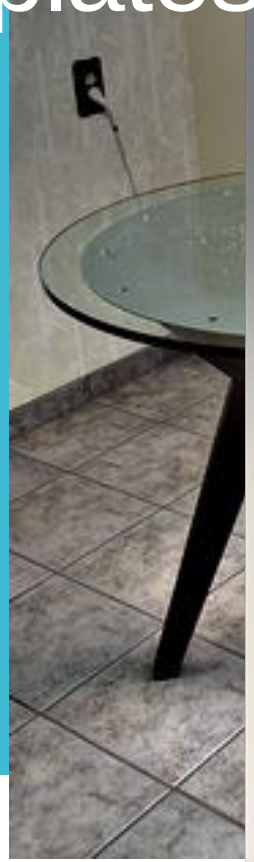

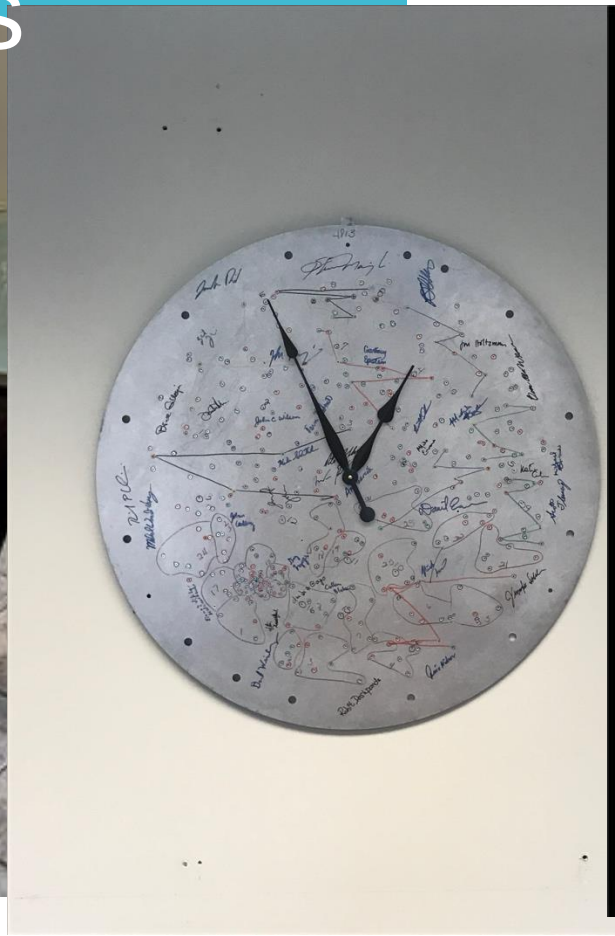

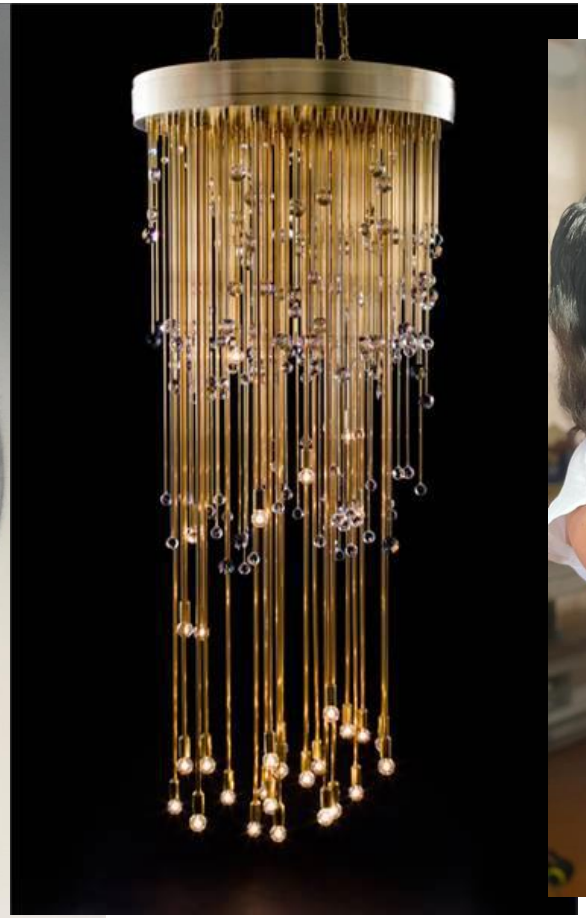

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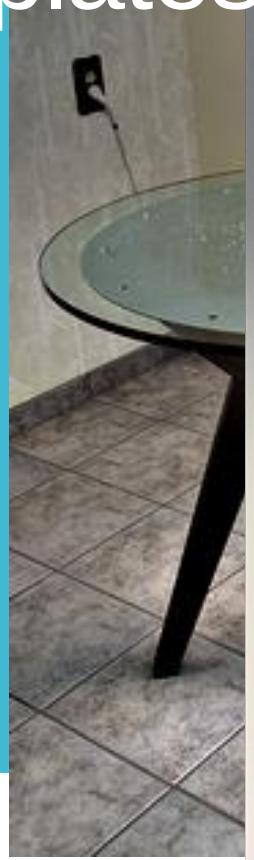
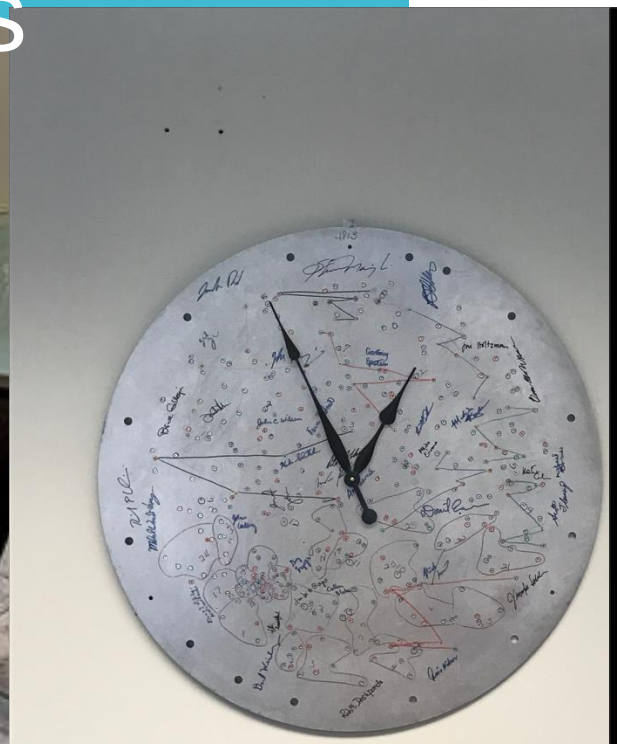
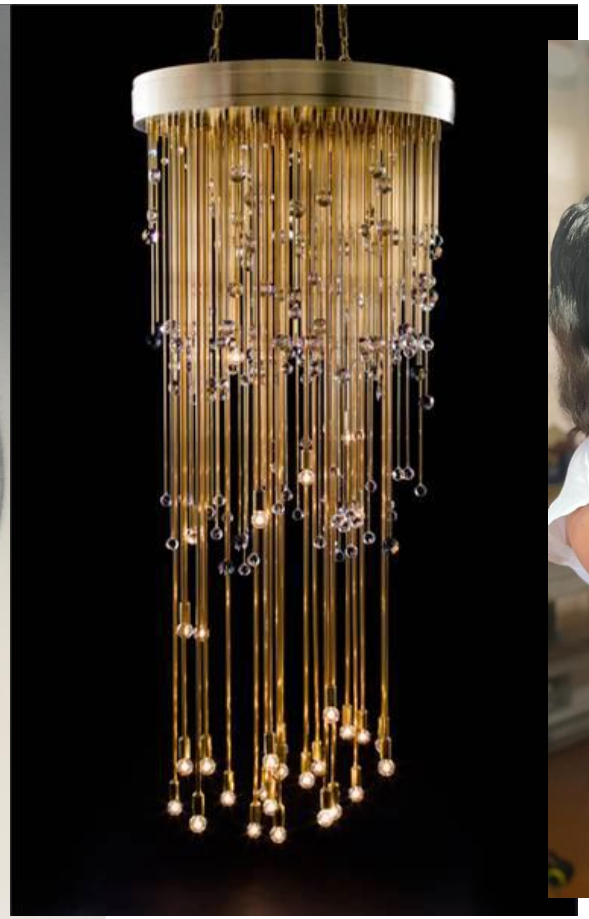
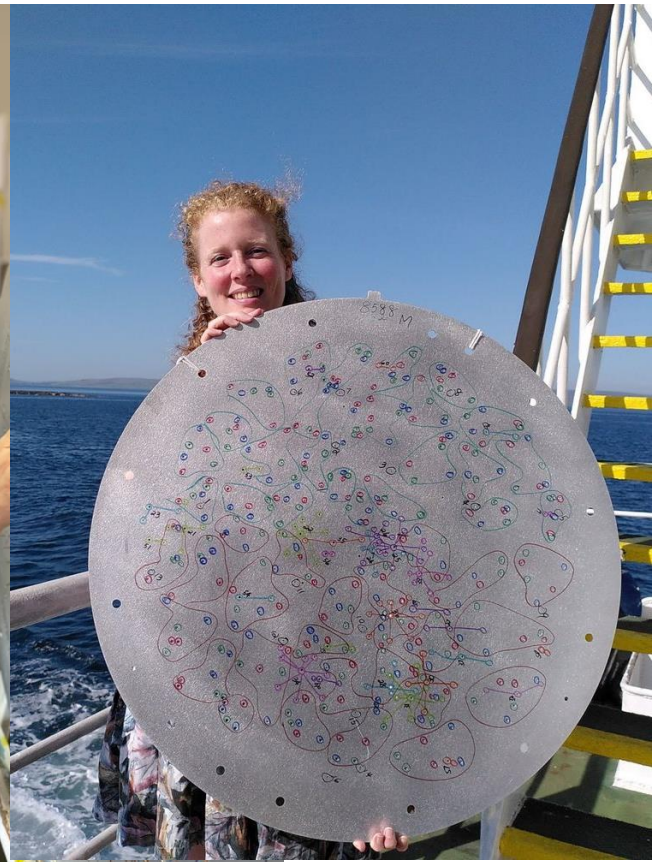
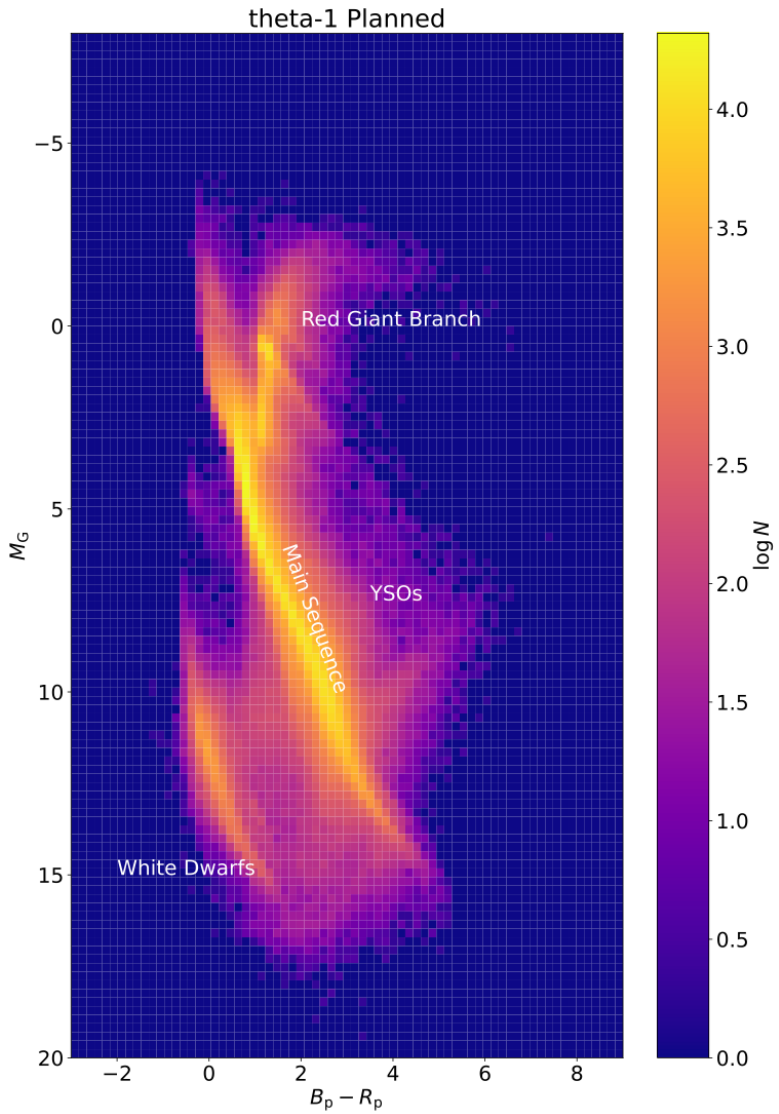










Targets for MWM

Previous generations of SDSS

Optical

- Standards, Mistakes
- SEGUE, SEGUE-2

Near-IR

- APOGEE 1-2

Gaia HRD for targets within 1 kpc

Figure from J. Carlberg

Galactic Genesis

~ 2million red giants across the Galaxy

- moving more slowly than hoped

Contiguous coverage of the disk

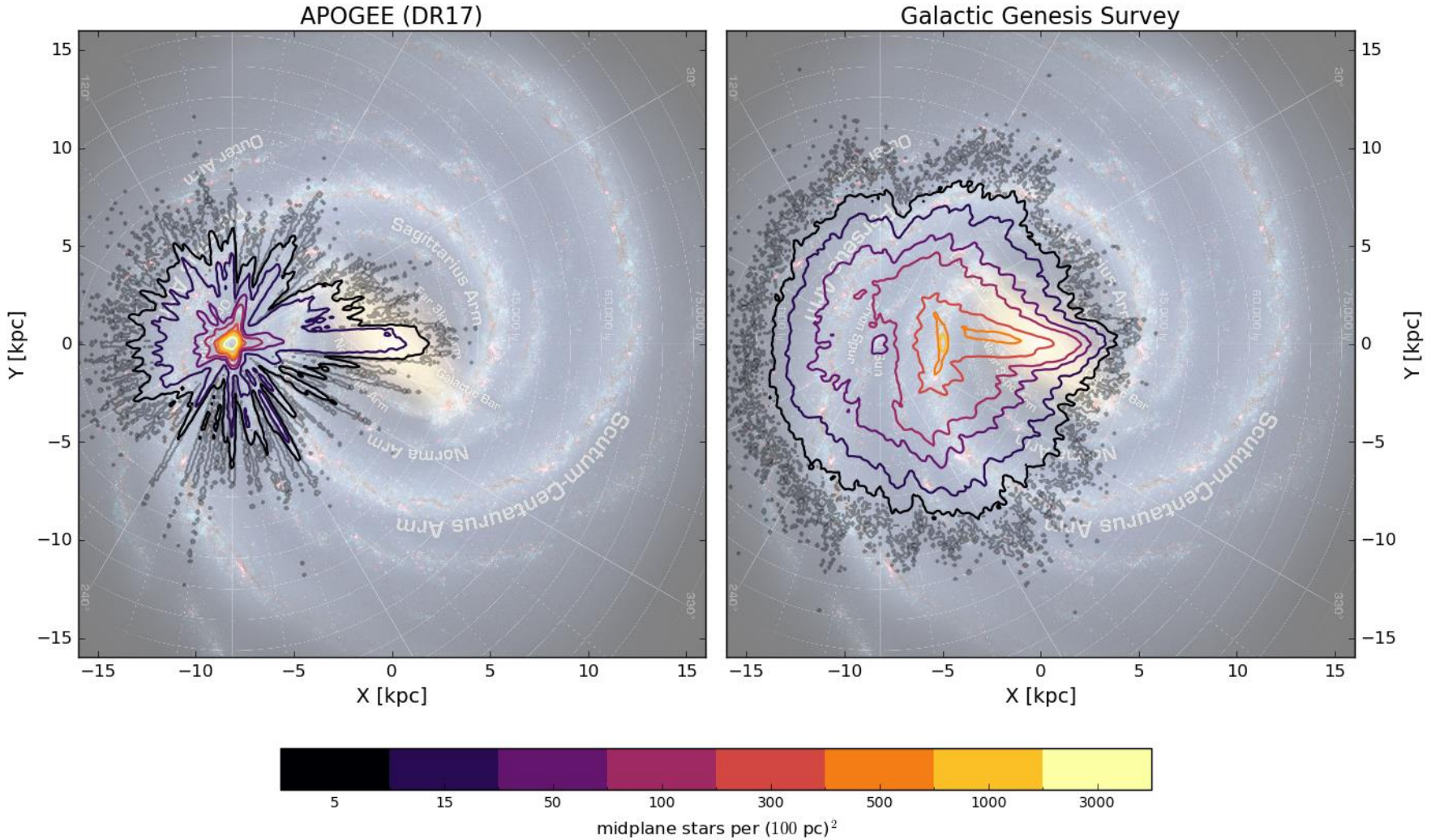
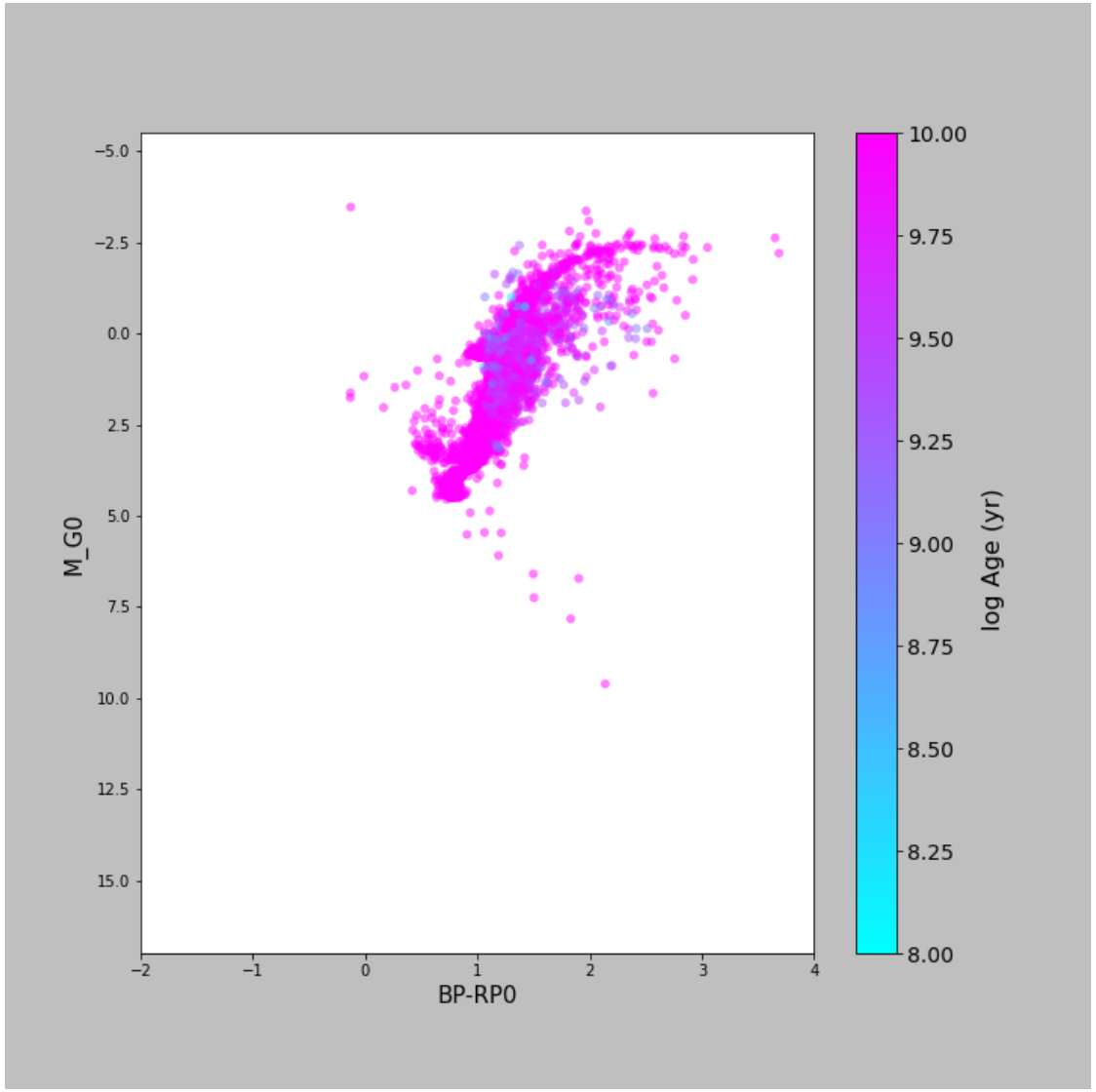


Figure from J. Bird

Galactic Archaeology

Schematic illustration of the stellar populations observed by MWM, focusing on age

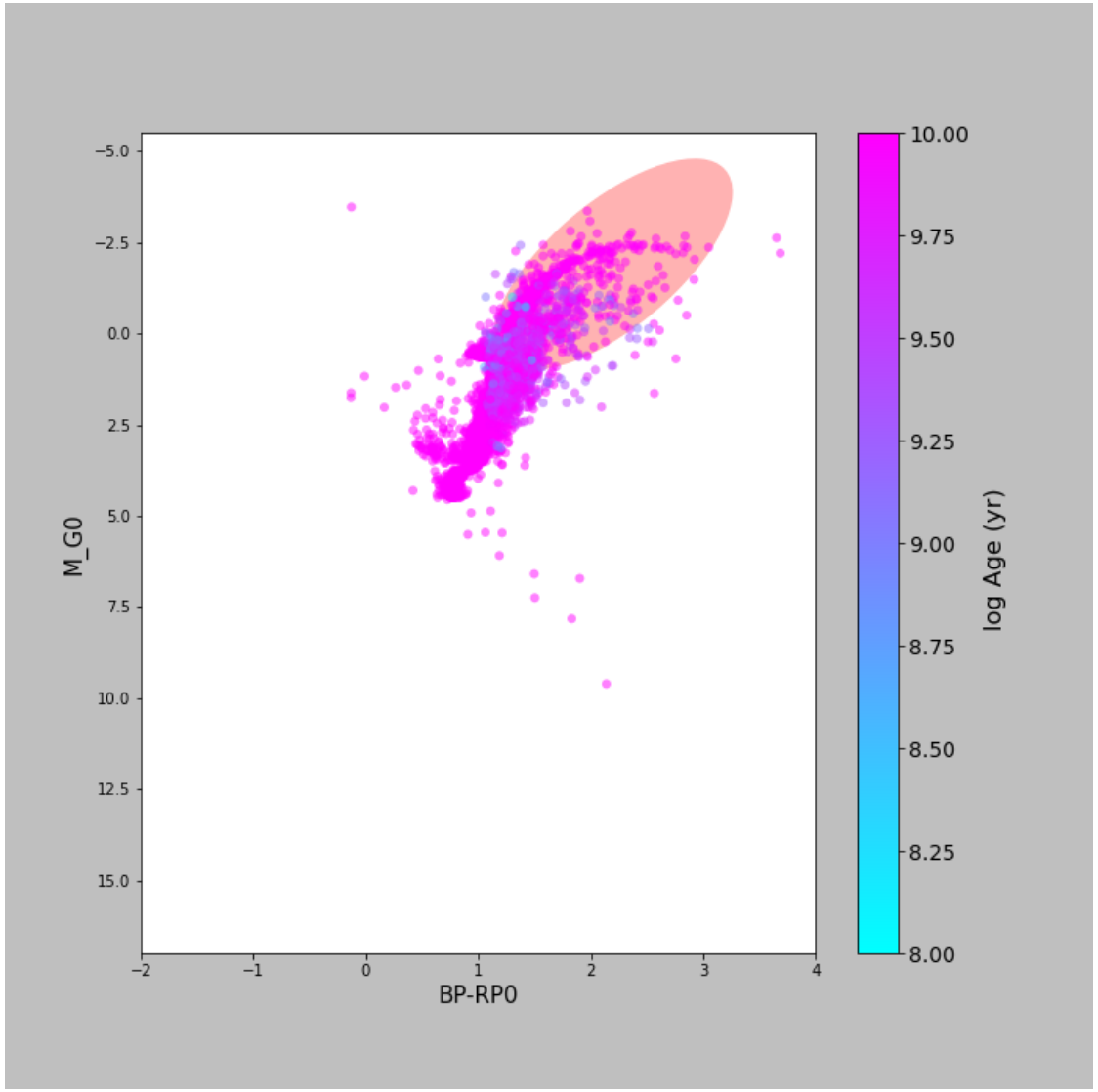


47Tuc –Gaia Collab, 2018
APOKASC3- Pinsonneault et al. 2024

Galactic Archaeology

Galactic Genesis

- Red luminous giants
- APOGEE
- Abundance ratios

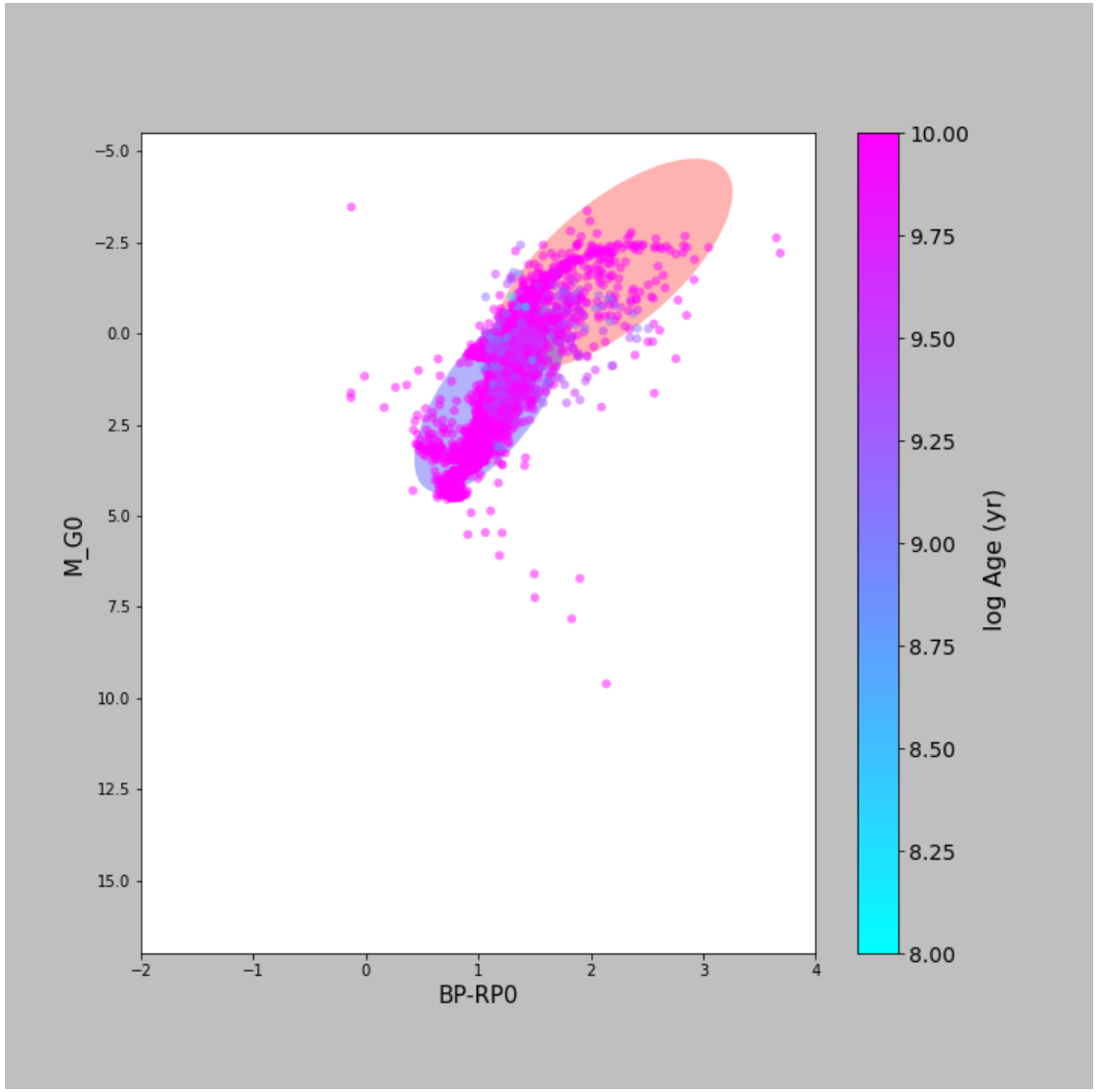


47Tuc –Gaia Collab, 2018
APOKASC3- Pinsonneault et al 2024

Galactic Archaeology

TESS RGBs

- Asteroseismic targets
- Red clump/giant
- APOGEE
- > 100,000 possible pulsators

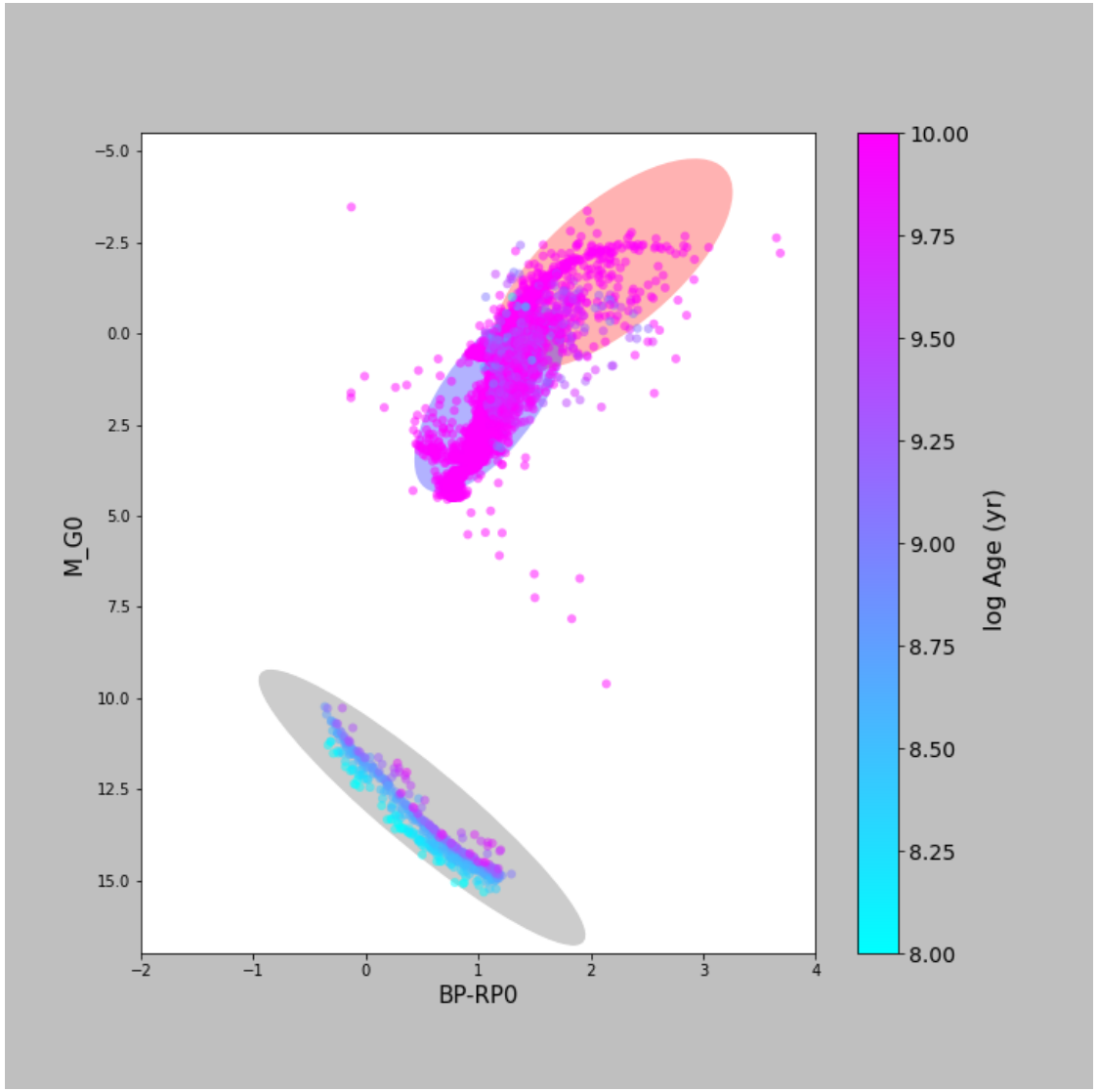


47Tuc –Gaia Collab, 2018
APOKASC3- Pinsonneault et al 2024

Galactic Archaeology

White Dwarfs

- BOSS
- Aim for at least 2 epochs
- Parameters for the DA WD



O'Brien et al. 2024

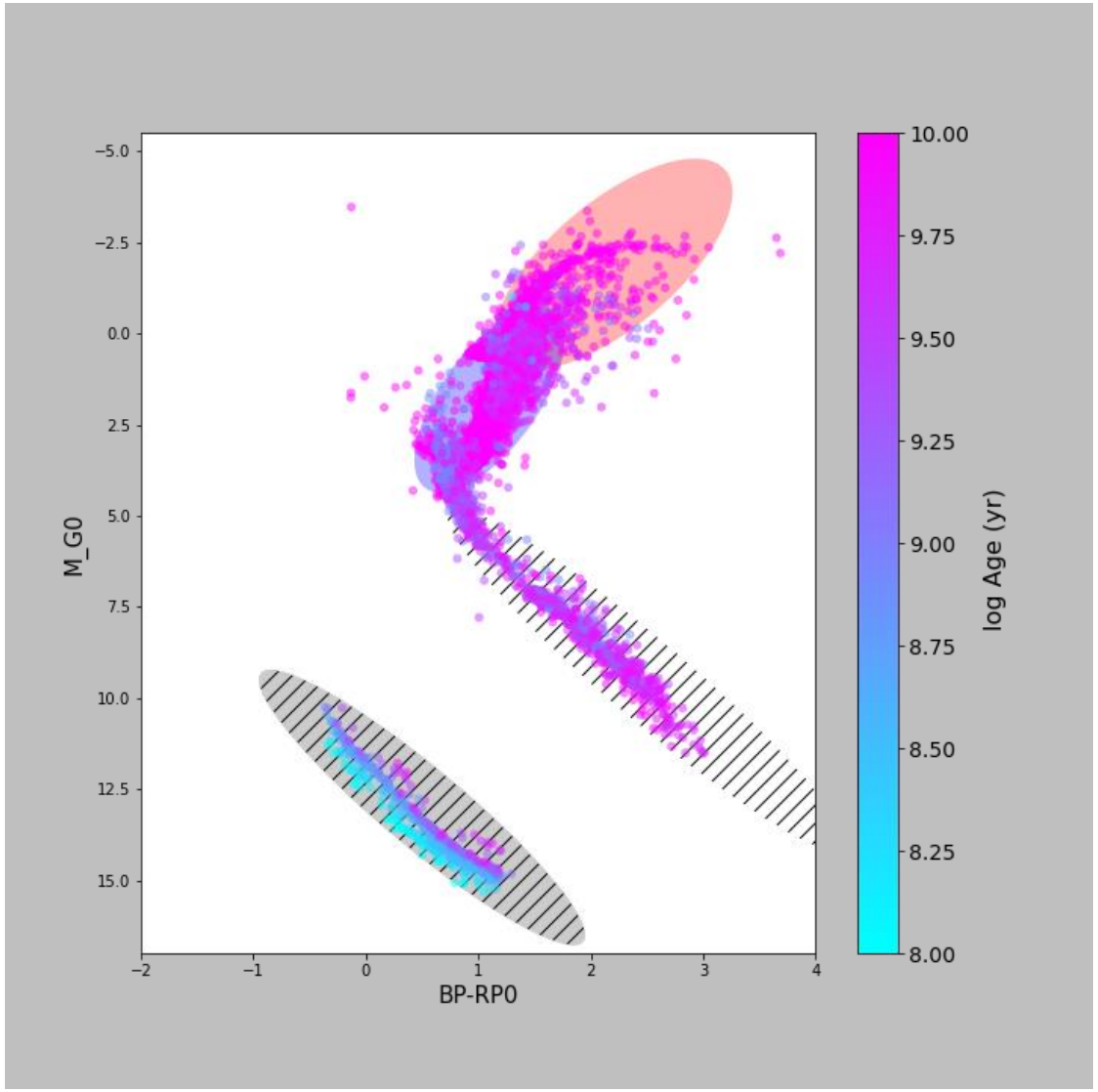
Galactic Archaeology

Solar Neighborhood

- Stars within ~ 100 kpc
- APOGEE & BOSS
- Ages for MS stars from gyrochronology

Halo

- Distant giants
- High proper motion
- BOSS

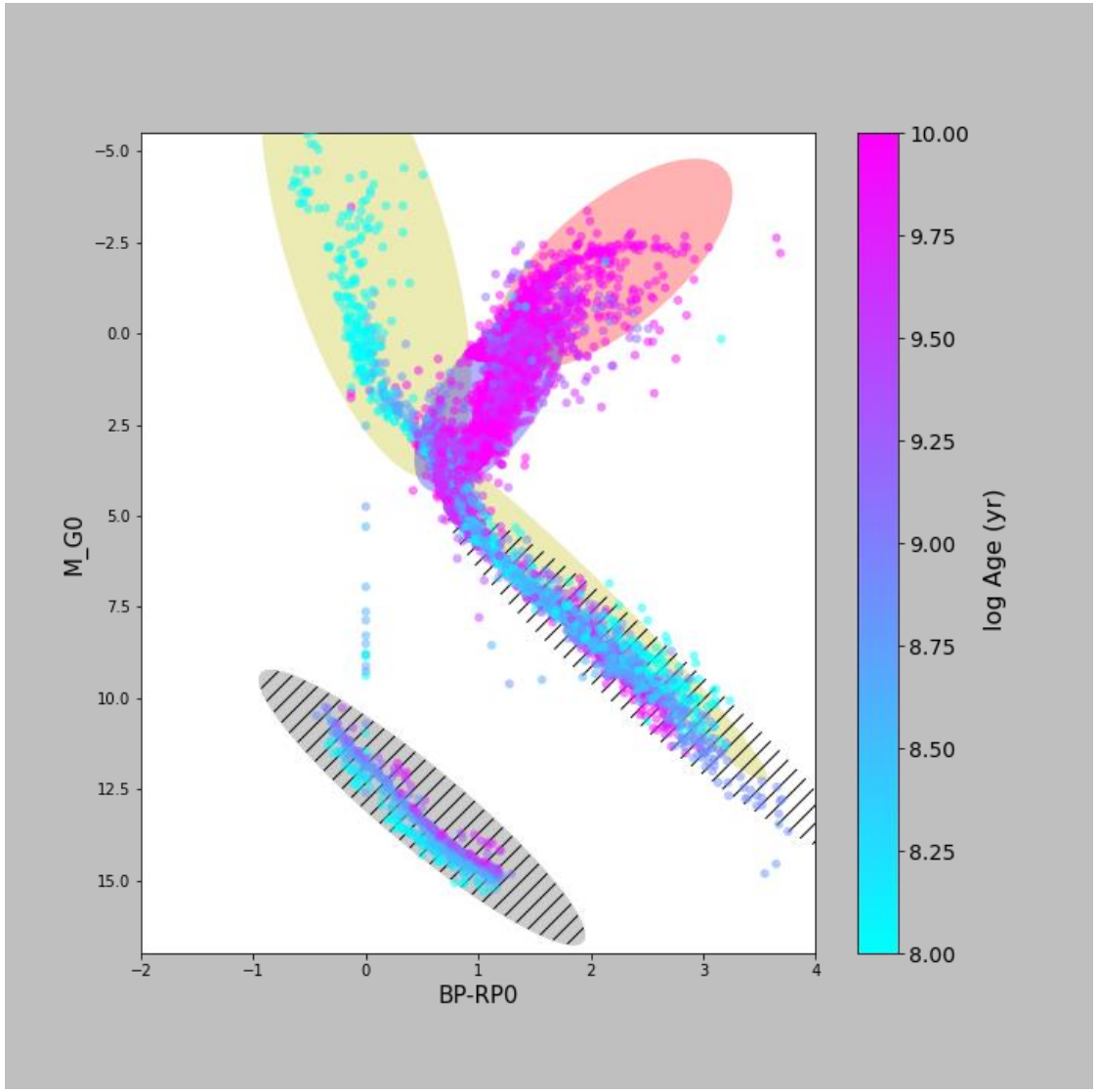


Lu et al. 2024

Galactic Archaeology

Young Stars

- OBA stars with 2 epochs of BOSS
- Low-mass YSOs with APOGEE & BOSS
- Abundances & Li and Hα measurements



Comeron et al. 2012, Gaia Collab 2018, Pederson et al. 2019

MWM

Binaries

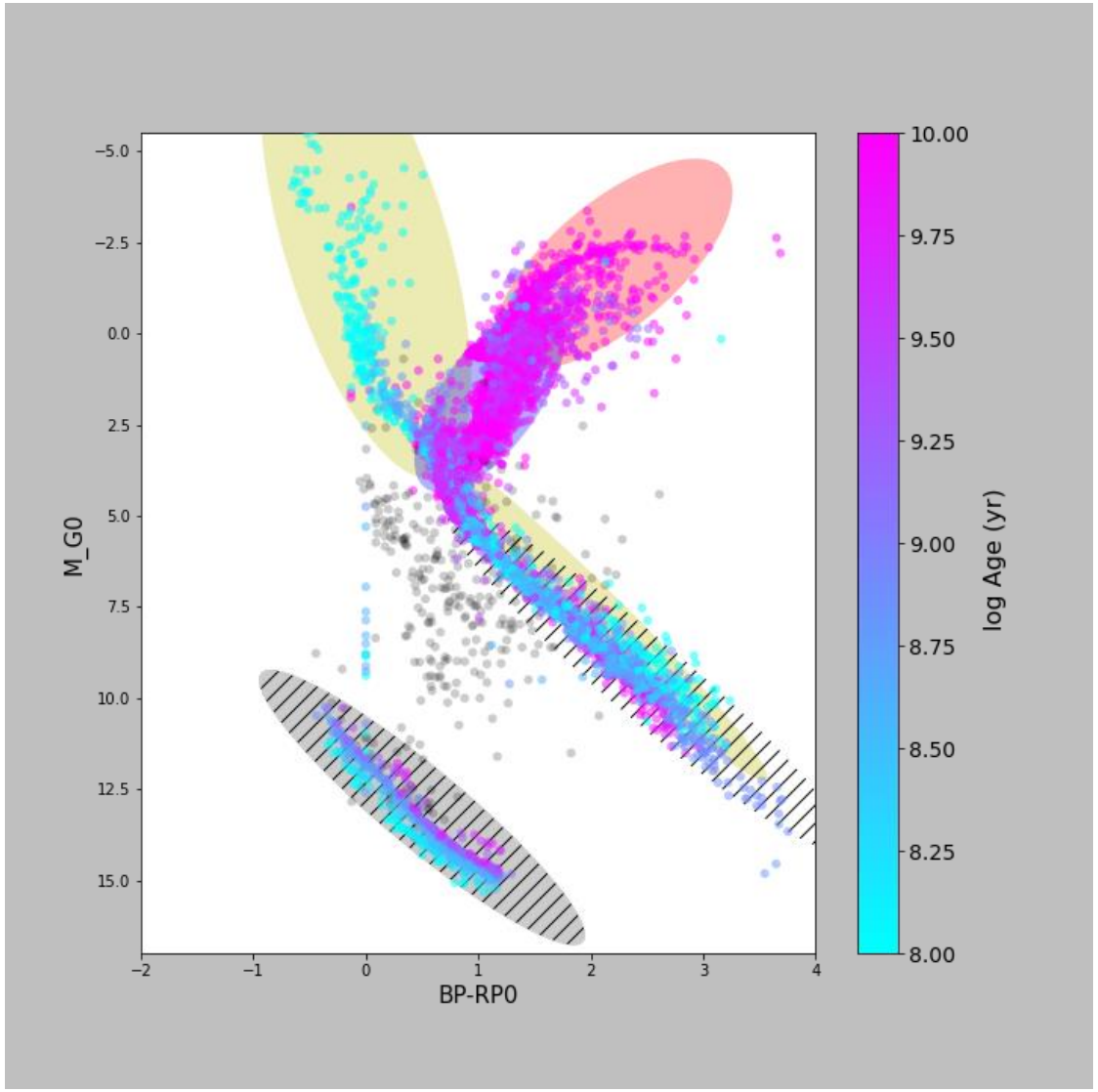
- Wide Binaries
- RV variables
- Compact Objects

eROSITA X-ray emitters

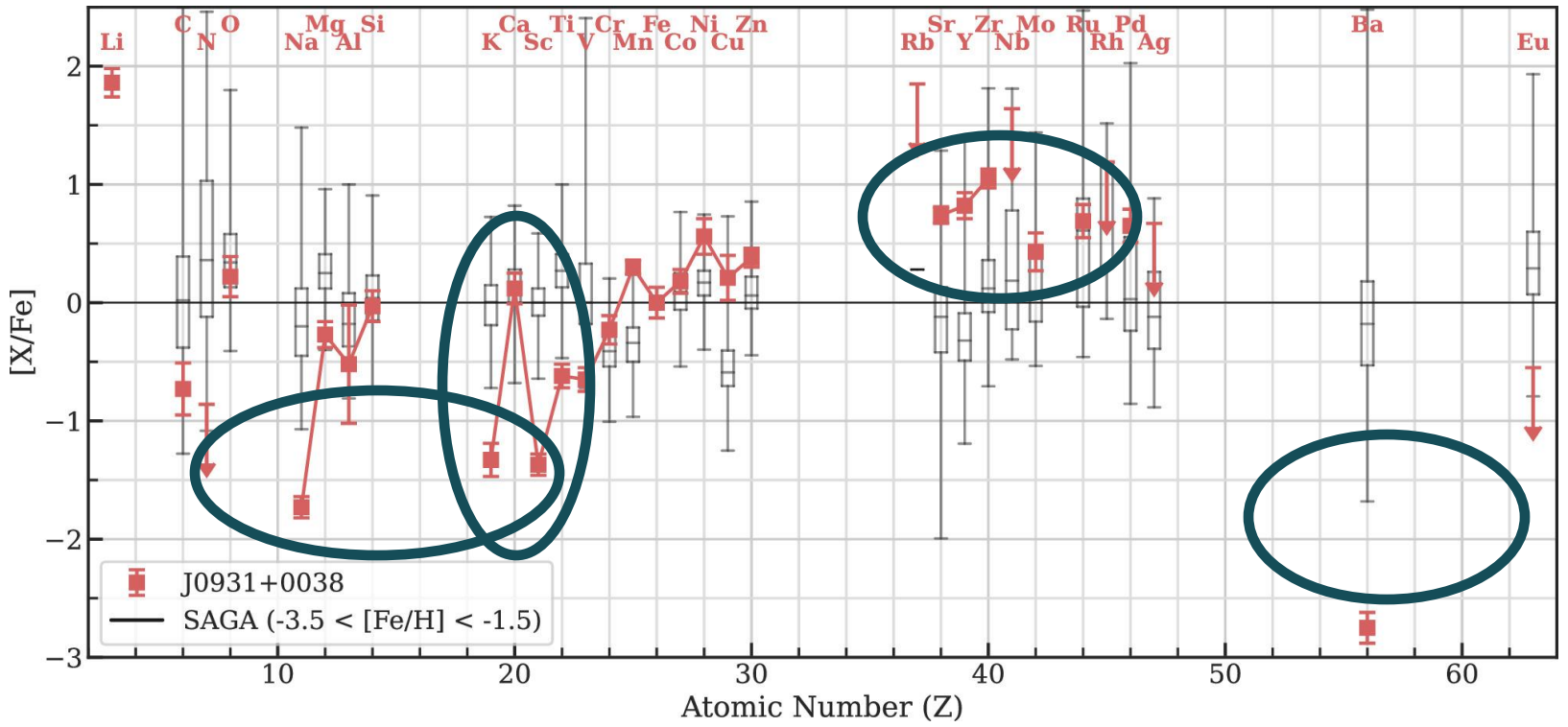
Dust

Magellanic Genesis

Exoplanet Hosts



AAVSO

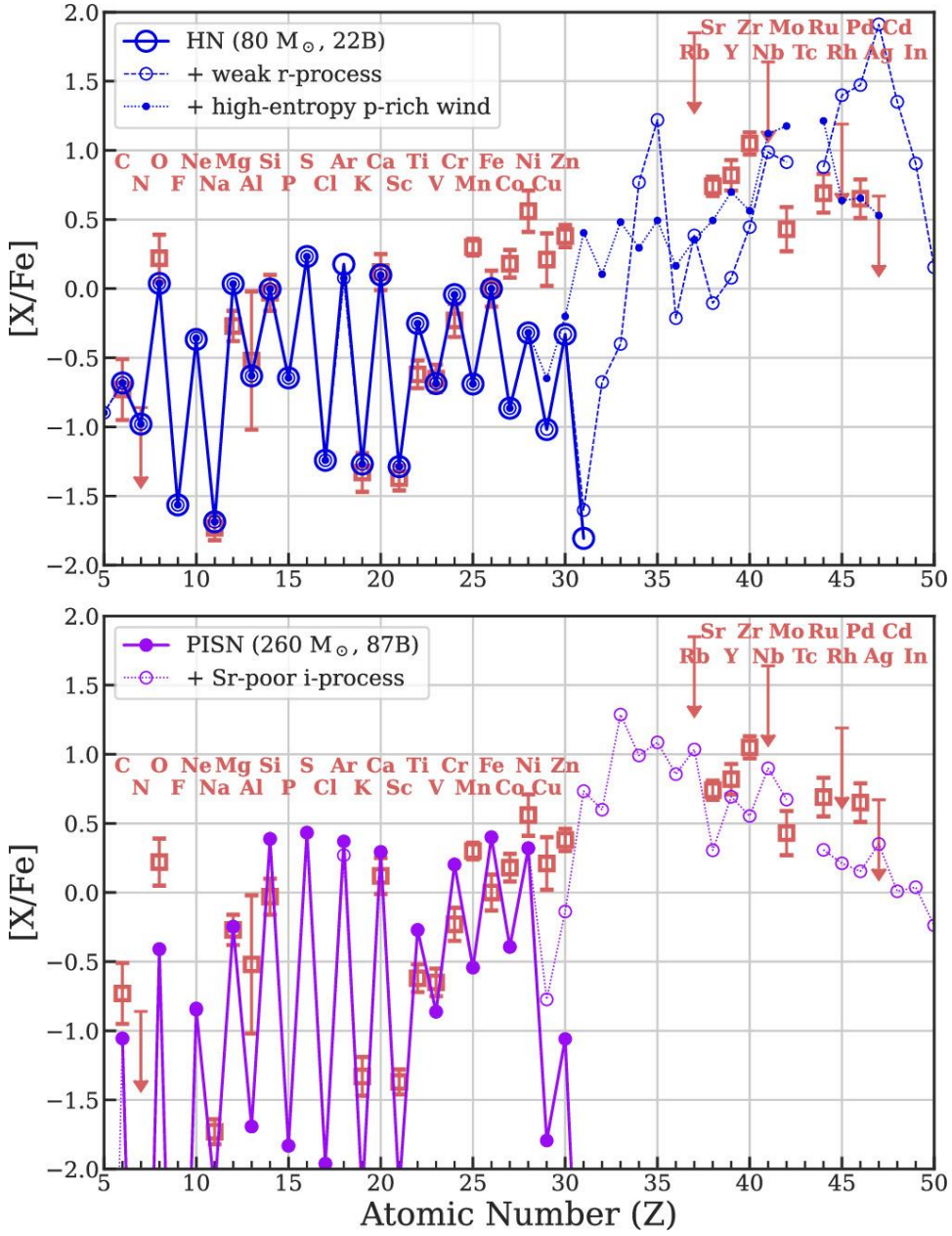


Nucleosynthesis in the Early Universe

Ji et al. 2024

Nucleosynthesis in the Early Universe

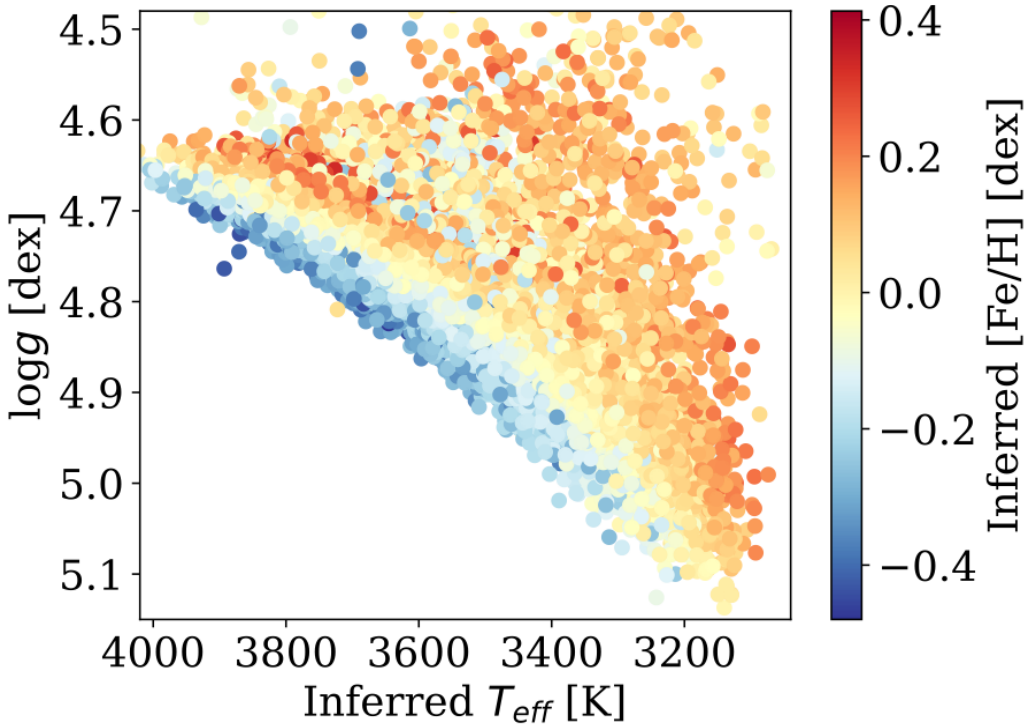
- Best fit models
- Low amounts of N, Na, etc suggest a single source
- High [Fe/H] ~-1.75 means much Fe production
- Need to add processes together ad hoc



M dwarfs in Milky Way Mapper

APOGEE DR17 ASPCAP metallicities too low for cool M dwarfs

Behmard et al. used the Cannon with labels from Souto et al. 2022 and members of wide binaries to derive parameters for M dwarfs observed with APOGEE in DR19

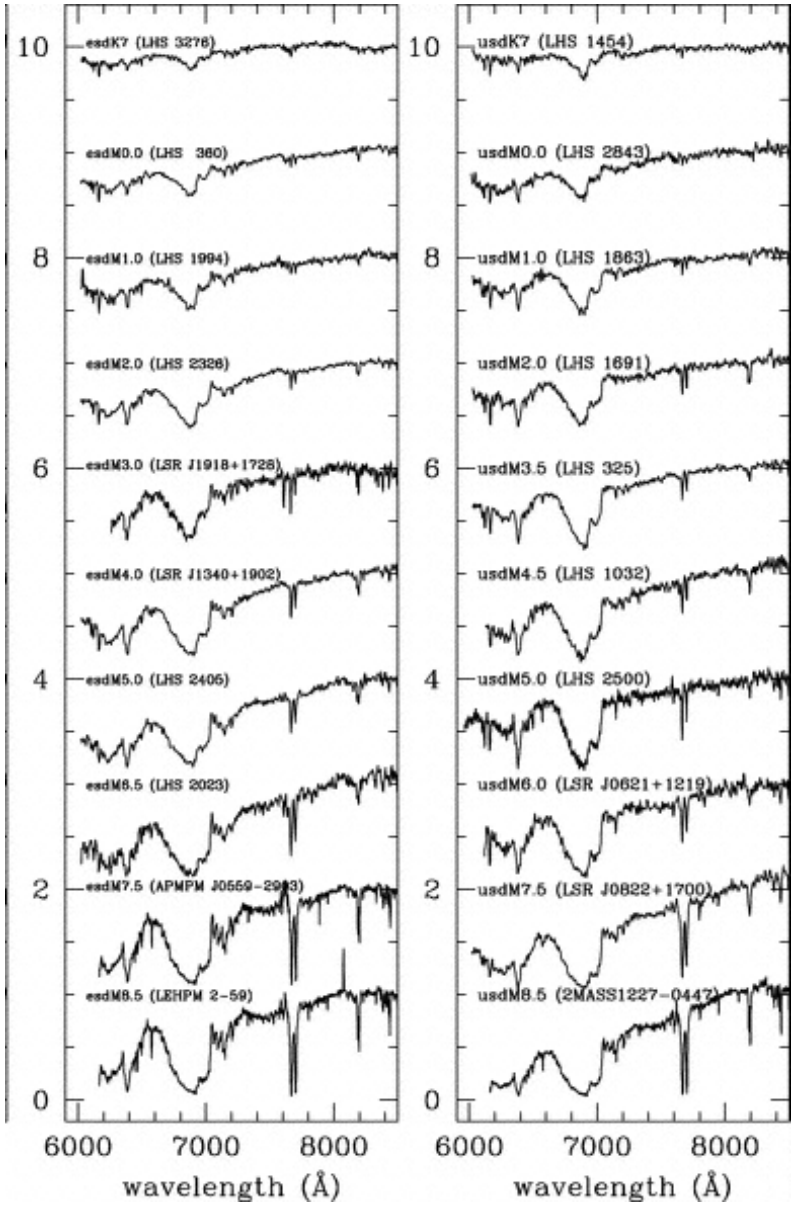


Metal-poor M dwarfs

M dwarfs below [Fe/H] < -0.5 rarely have accurate metallicities

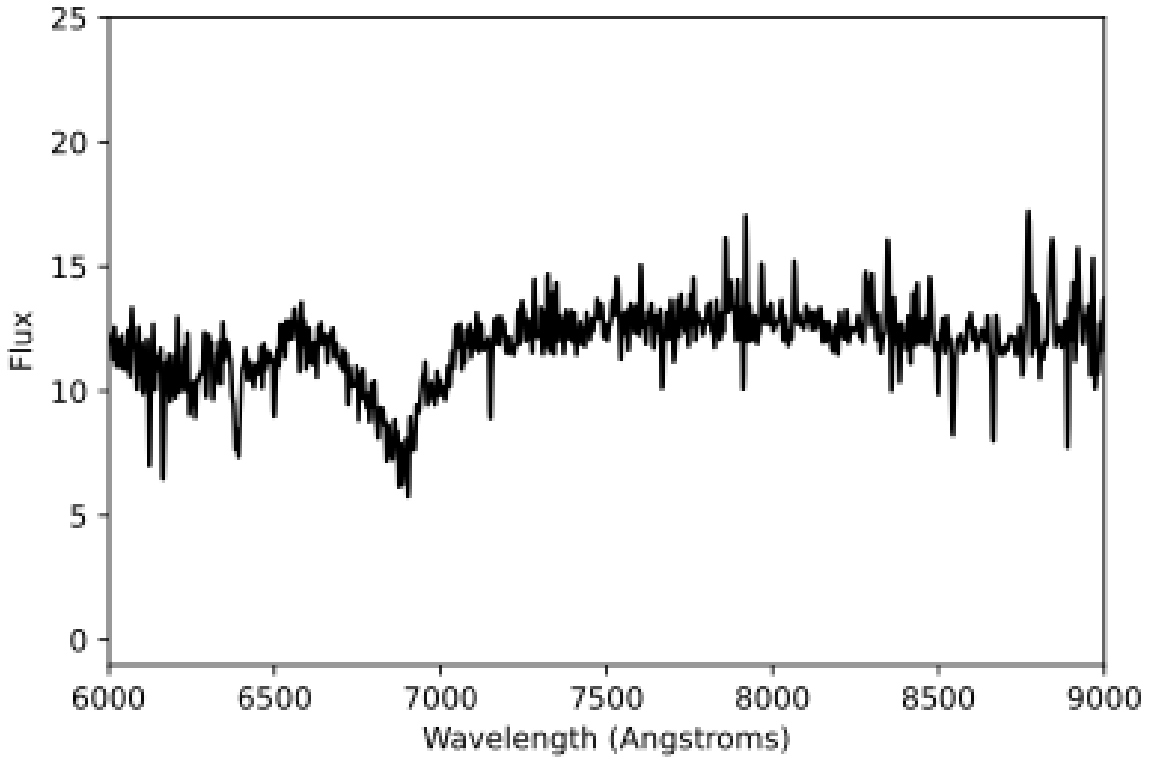
But they are out there

Lepine et al. (2007)



Metal-poor M dwarfs

Please D. Souto's poster: *Are the metal-poor M dwarfs in the solar neighborhood actually from our neighborhood?* for low-metallicity M dwarf examples



Metal-poor M dwarf candidate observed by BOSS & id'ed by E. Galligan & Z. Way

MWM is getting high-resolution spectra of metal-poor M dwarfs with BOSS spectra to get a training set

Data Release 19

To the collaboration – now

To the world – July 2025

- Northern data through July 2023
- Astra stellar parameters
  - ASPCAP
  - SnowWhite
  - APOGEENet, BOSSNet
  - SLAM
  - Cannon, Payne, AstroNN
  - "Best params" file – one line for each star with our opinion
- Upcoming: Release tagged versions of stellar parameters & abundances on a daily basis to collaboration

Documentation

- DocuFeest – New York University
- DocuCeilidh – St. Andrews
- DocuBrew – Ohio State
- DocuZoom – Zoom
- DocuLlama – Still Zoom (but with llamas)
- DocuChili – New Mexico State

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Documentation

DocuOrca

- DocuChili – New Mexico State

Looking ahead to DR20

Improved high-resolution stellar parameters

- NLTE effects
- M dwarf linelist and magnetic effects
- Rotation for red giants
- Updated linelists
- Grok – led by Adam Wheeler

Improved low-resolution stellar parameters

- Improved training sets
- Adding models for DB stars
- Adding models for OB star metal-lines
- Better classifiers
- CLAM – led by Andy Casey