Galactic Archeology with Gaia and APOGEE

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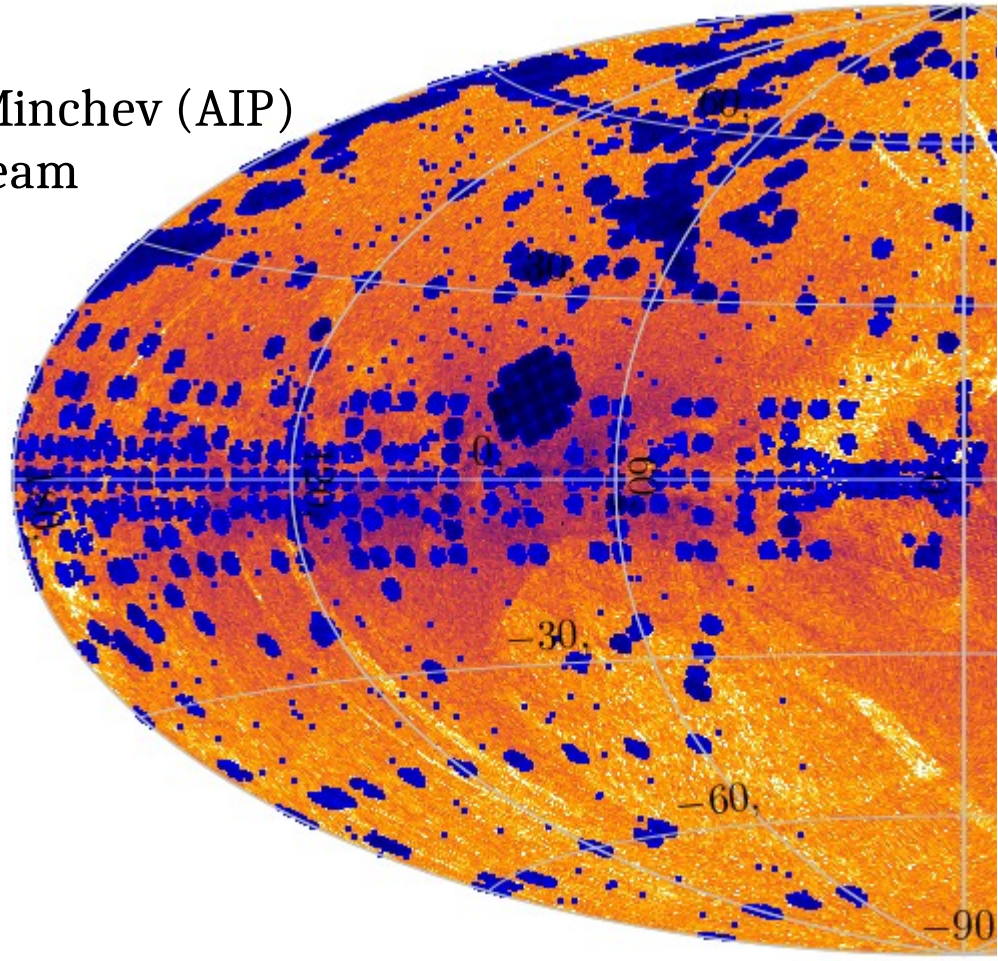


gaia

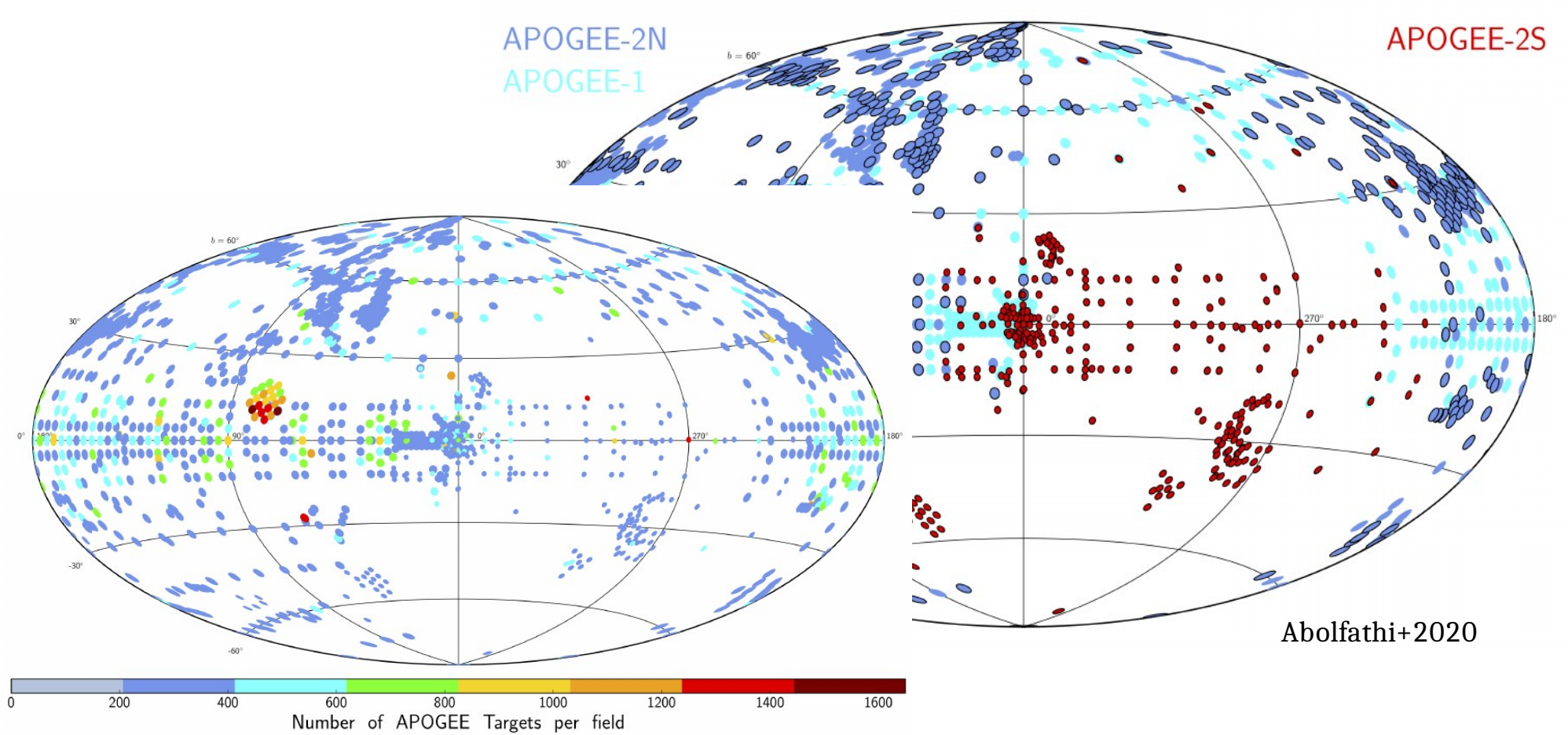
APOGEE

SDSSIII

LIneA
Laboratório Interinstitucional de e-Astronomia

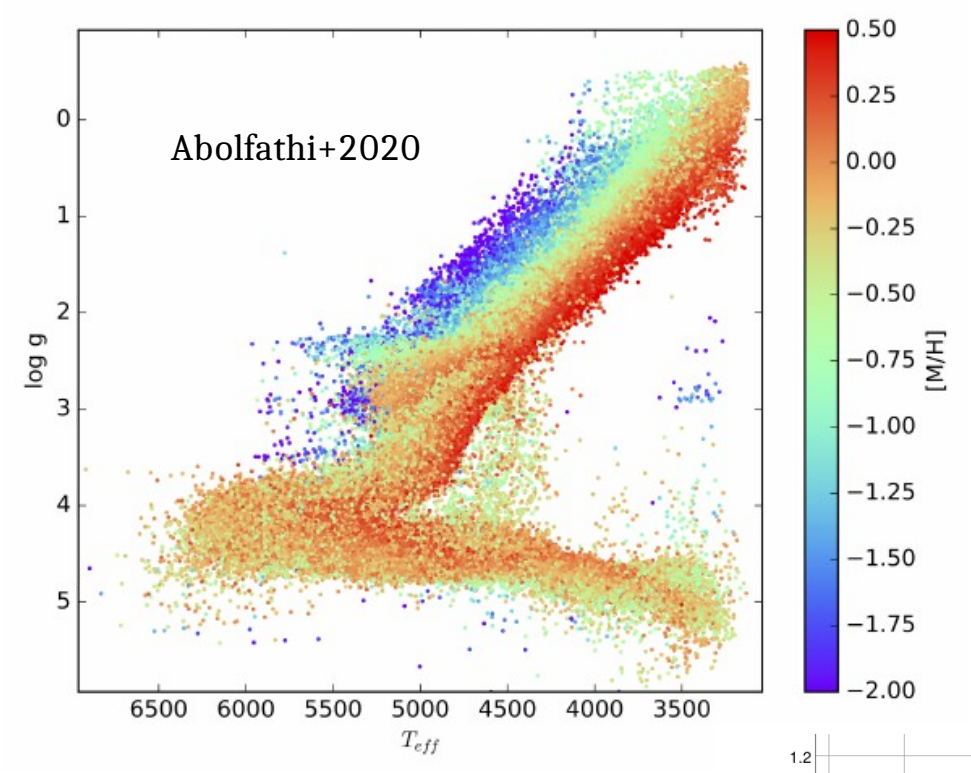
AIP
Leibniz-Institut für Astrophysik Potsdam

APOGEE DR16 data



- 437,485 unique stars as of SDSS DR16
- 1.8 million individual spectra (typically >3 epochs per star)
- ~350,000 stars (dwarfs+giants) with 6D kinematics + metallicities
- ~100,000 giants with HQ stellar parameters, 6D kinematics, and >15 chemical abundances in the Gaia parallax sphere

APOGEE data: dr16.sdss.org



https://dr16.sdss.org/sas/dr16/apogee/spectro/redux/r12/stars/

Index of /sas/dr16/apogee/spectro/redux/r12/stars/

File Name ↓
Parent directory/
apo1m/
apo25m/
clusters/
lco25m/
plan/
plots/
allField-r12.fits
spectro_redux_r12_stars.sha1sum

SDSS-IV Science Archive Server (SAS)

https://dr16.sdss.org/infrared/spectrum/search

SDSS Science Archive Server (SAS)

Home | Imaging | Optical Spectra | Infrared Spectra | MaStar Spectra

Basic Search | Bulk Search | Bitmasks

Spectrum Search

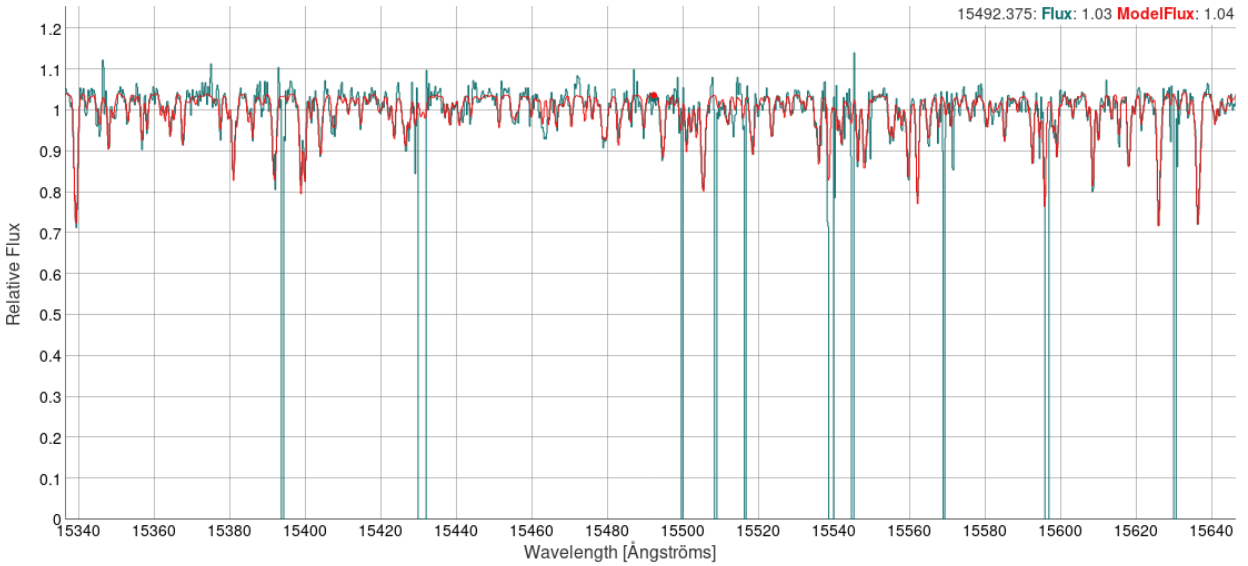
APRED_VERS: r12 | Commiss: No | Telescope: Any | ASPCAP: Not Required

Plate: e.g., 4946 | MJD: e.g., 55732 | FiberID(s): e.g., 1-20, 24 (or leave empty for all fiberIDs) | Minimum Combined S/N: e.g., 18.0

Location ID: e.g., 4412 | APOGEE ID: e.g., 2M05580827+1345138 | Field: e.g., N4147 | Reduction ID: e.g., RR_Lyr

RA: e.g., 07:00:00 | Dec: e.g., +04:25:00

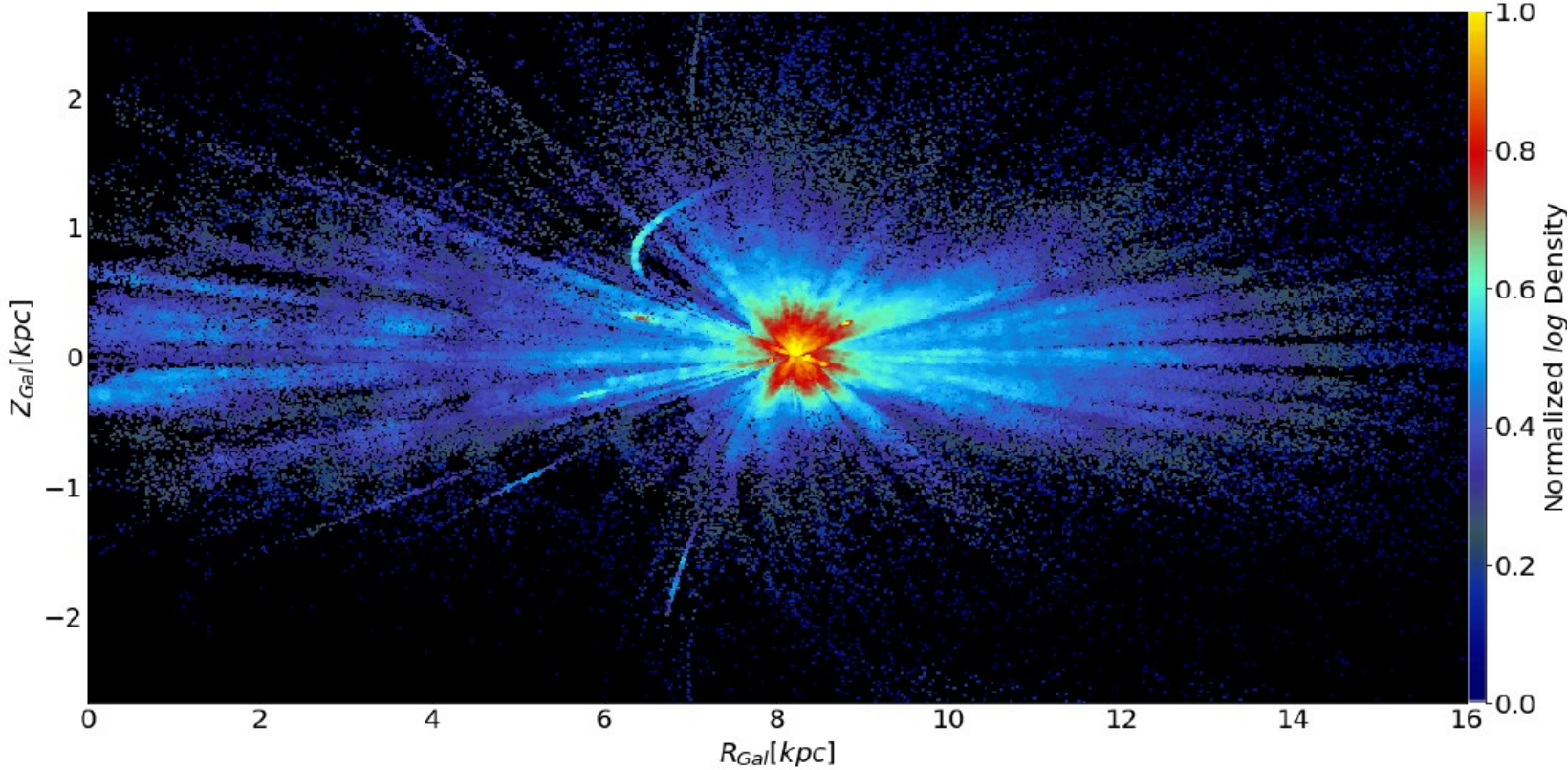
Search | Clear



APOGEE DR16 value-added catalogues

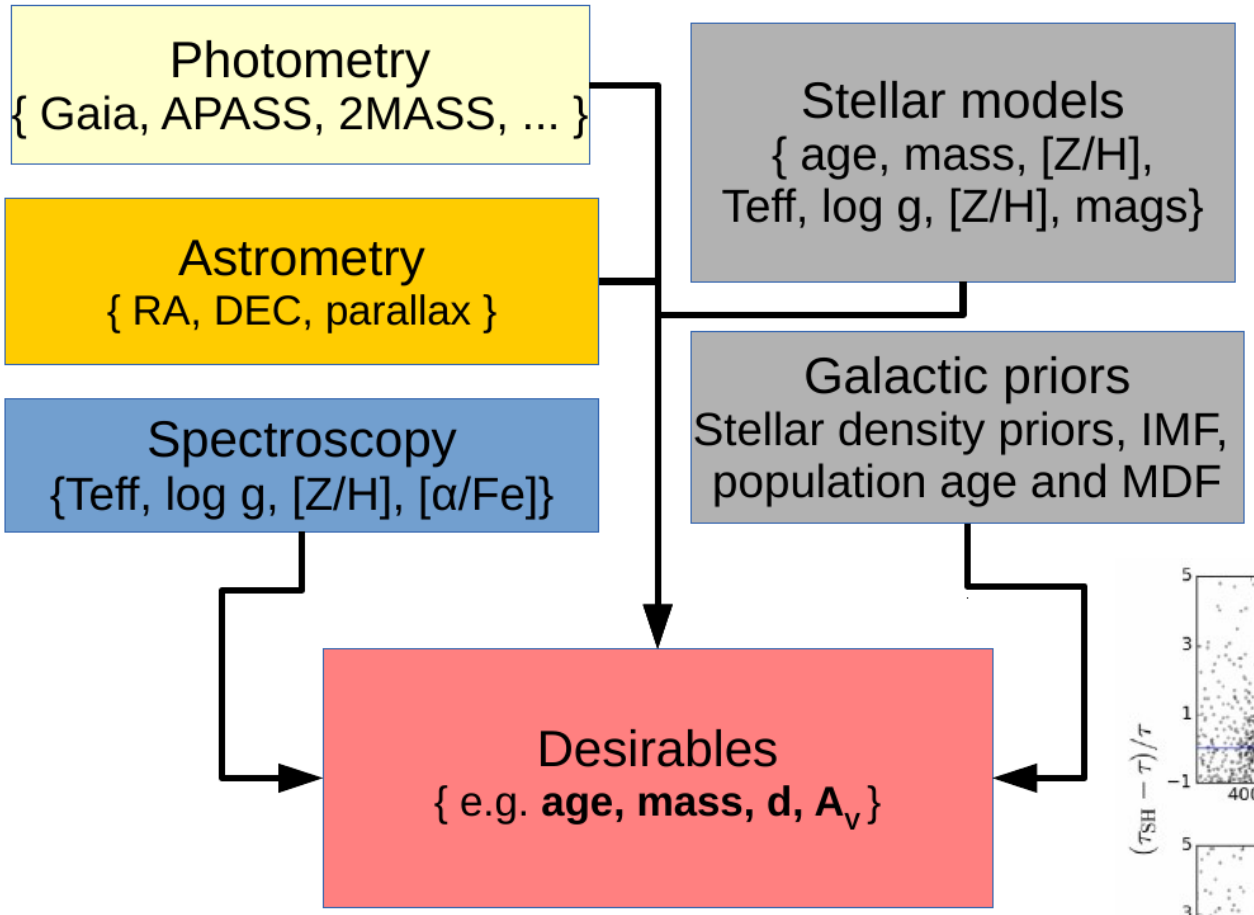
New or Updated Value Added Catalogs (VACs)

Description	Section	Reference(s)
APOGEE-2 Red Clumps	§4.5.1	Bovy et al. (2014)
APOGEE-2 `astroNN`	§4.5.2	Leung & Bovy (2019a)
APOGEE-2 *Joker*	§4.5.3	Price-Whelan et al. (2017, 2018)
APOGEE-2 OCCAM	§4.5.4	Donor et al. (2018, 2020)
APOGEE-2 StarHorse	§4.5.5	Queiroz et al. (2018); Anders et al. (2019)
eBOSS ELG classification	§5.1.3	Zhang et al. (2019)
SDSS Galaxy Single Fiber FIREFLY	§5.1.3	Comparat et al. (2017)
SPIDERS X-ray clusters	§5.3.4	Clerc et al. (2016), C. Kirkpatrick et al. in prep.
SPIDERS Rosat and XMM-Slew Sources	§5.3.5	Comparat et al. (2020)
SPIDERS Multiwavelength Properties of RASS and XMMSL AGN	§5.3.6	Comparat et al. (2020)
SPIDERS Black Hole M		
MaNGA Stellar Masses		
MaNGA `PawlikMorph`		

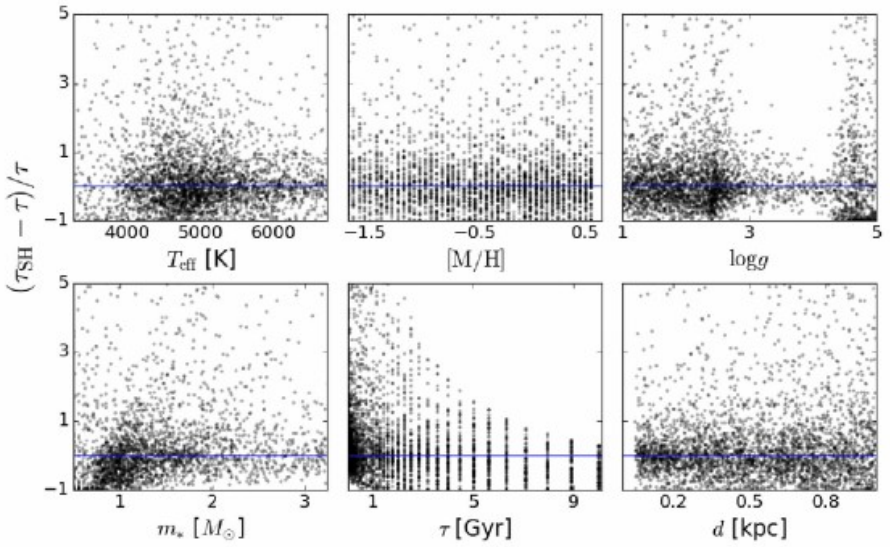


Queiroz+2020

Synergies from APOGEE + Gaia

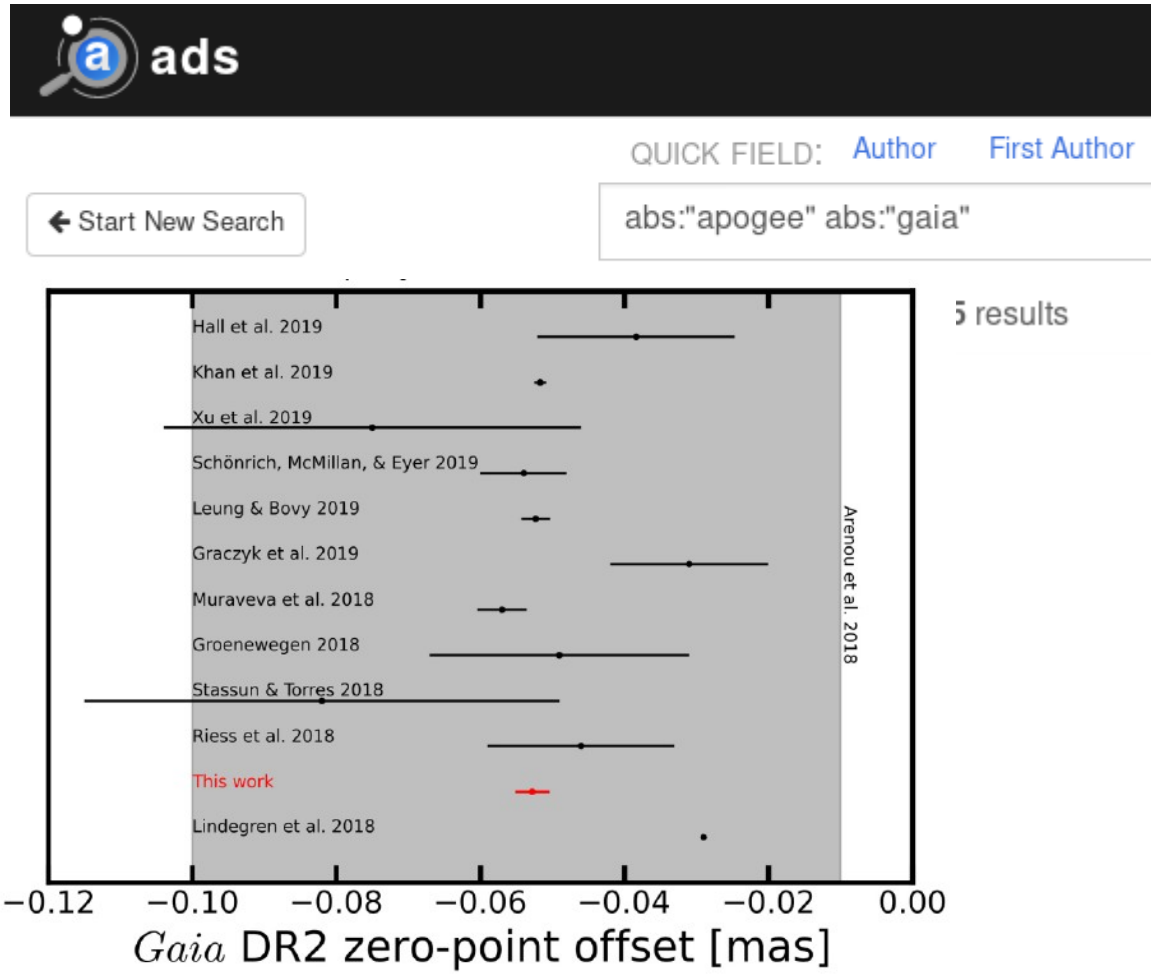


Getting masses, distances
Ages for $O(10^5)$ stars



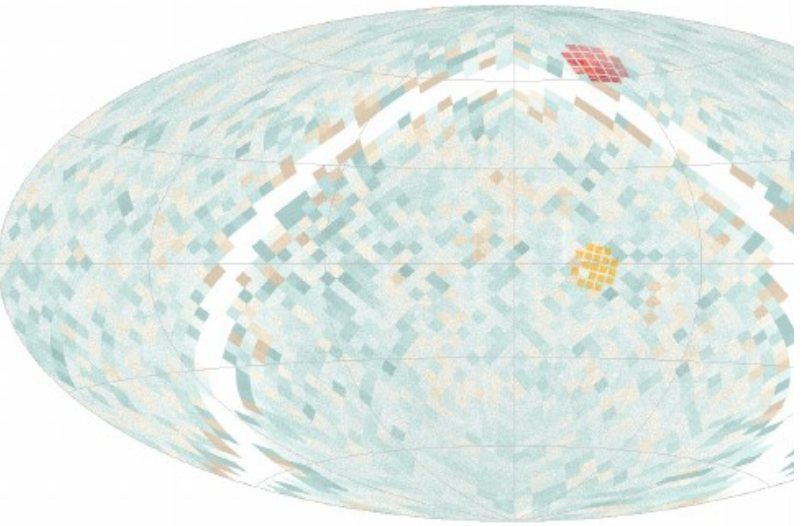
Queiroz+2018

Synergies from APOGEE + Gaia

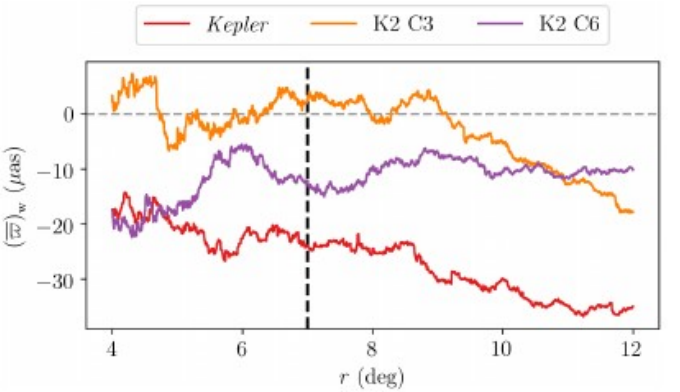


Zinn+2019

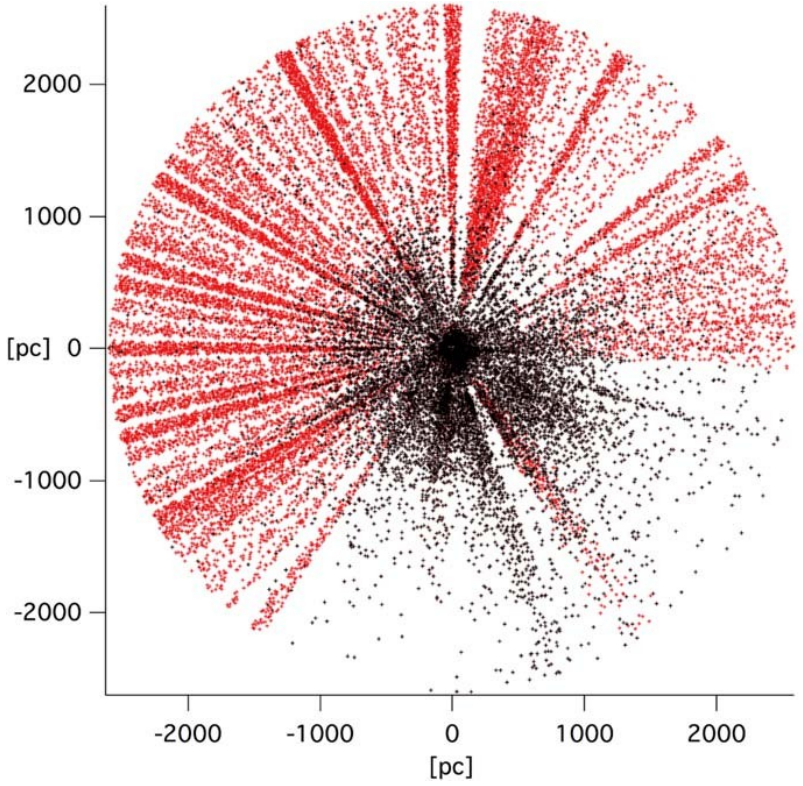
Gaia parallax zeropoint calibration



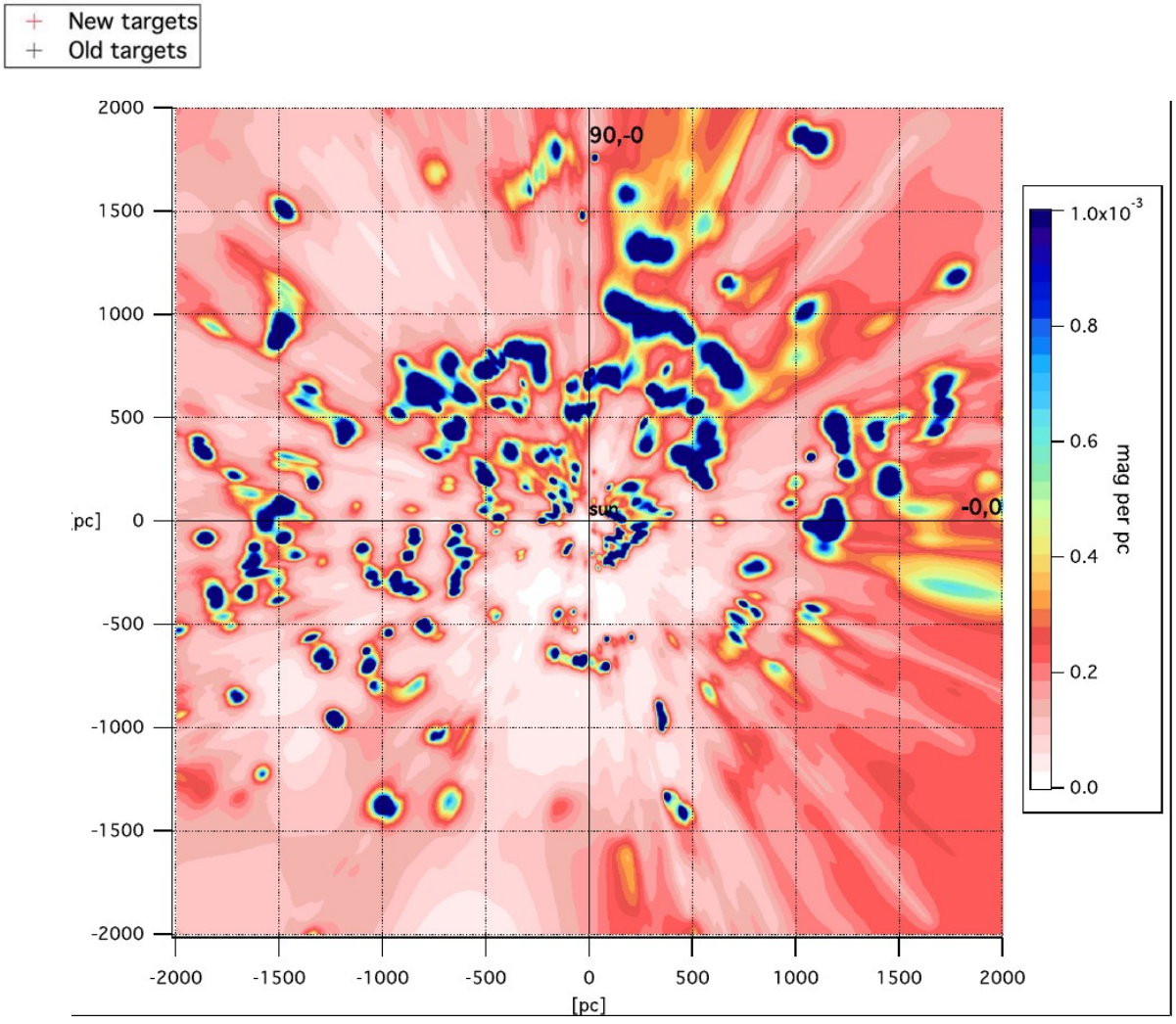
Khan+2019



Science enabled by APOGEE + Gaia

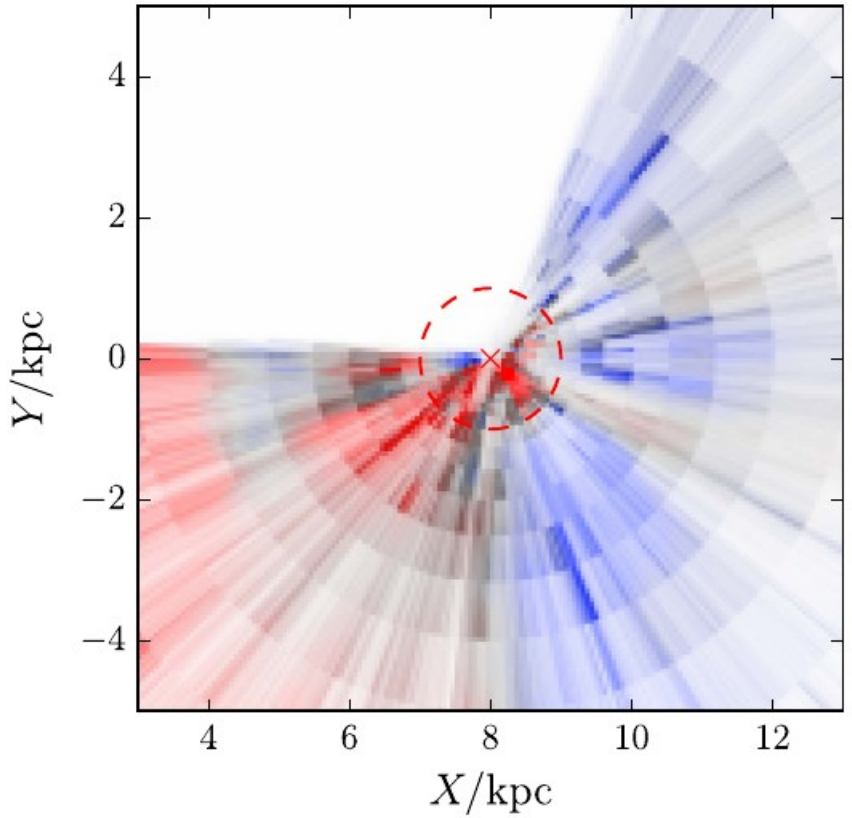


3D extinction maps of the solar vicinity



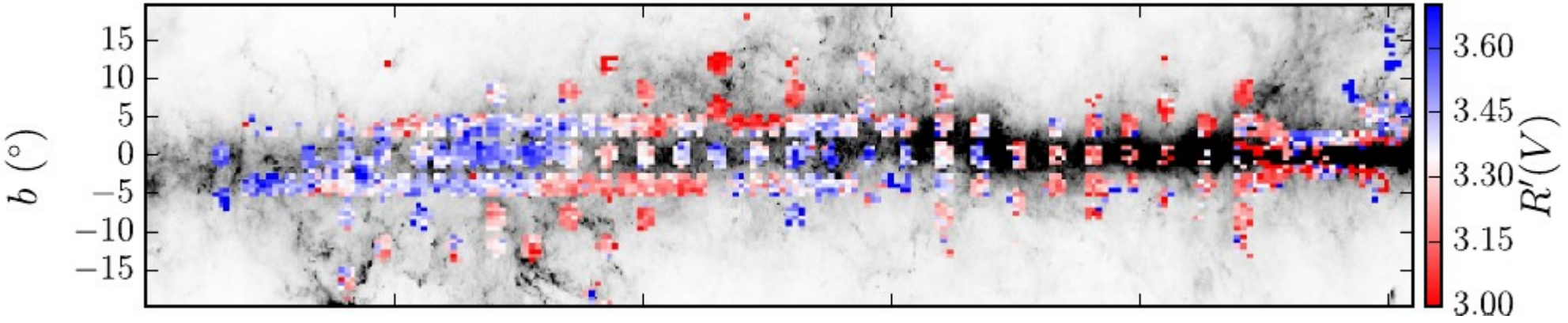
Lallement+2018

Science enabled by APOGEE + Gaia



Variations in the Galactic Extinction Law

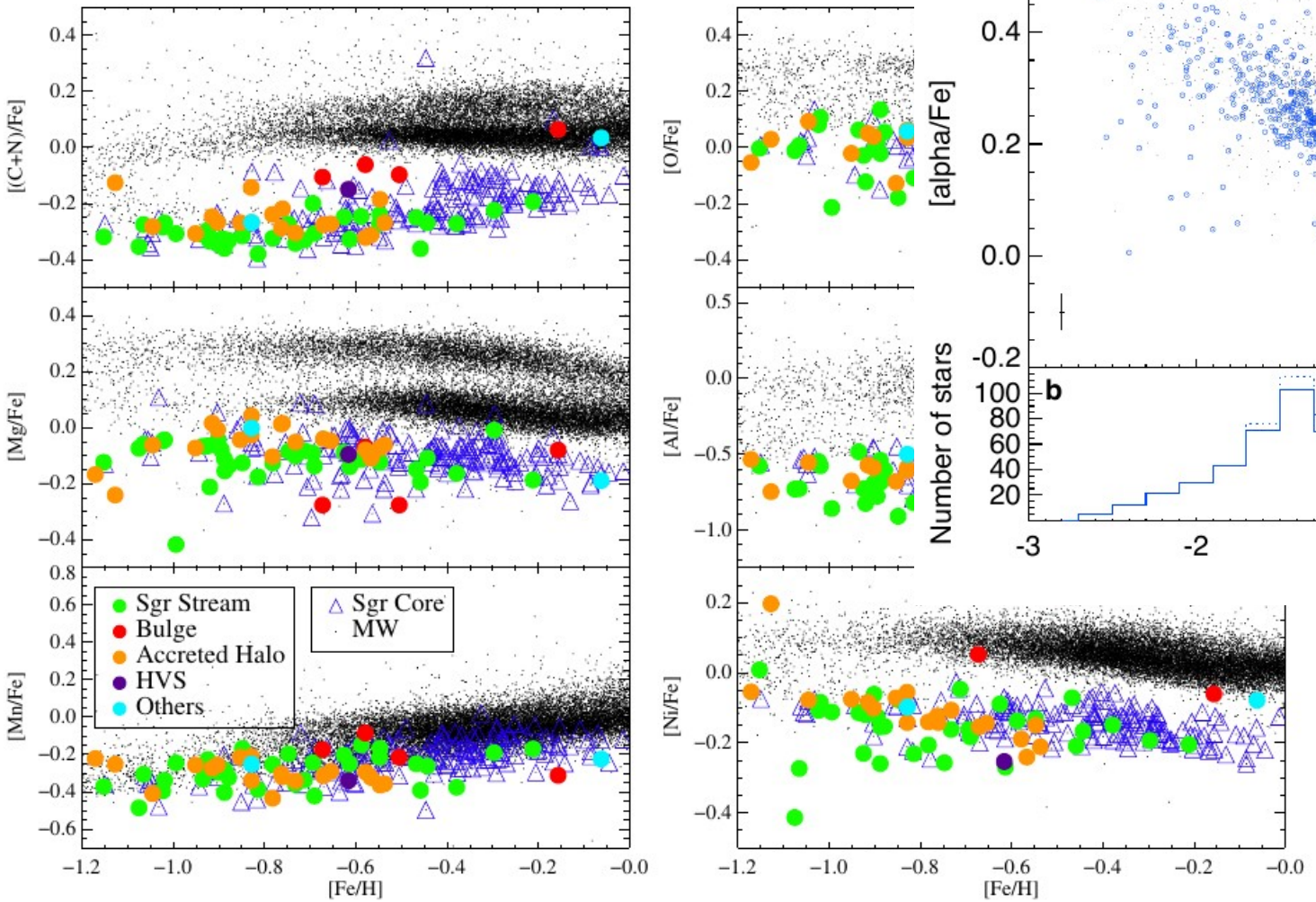
Schlafly+2017

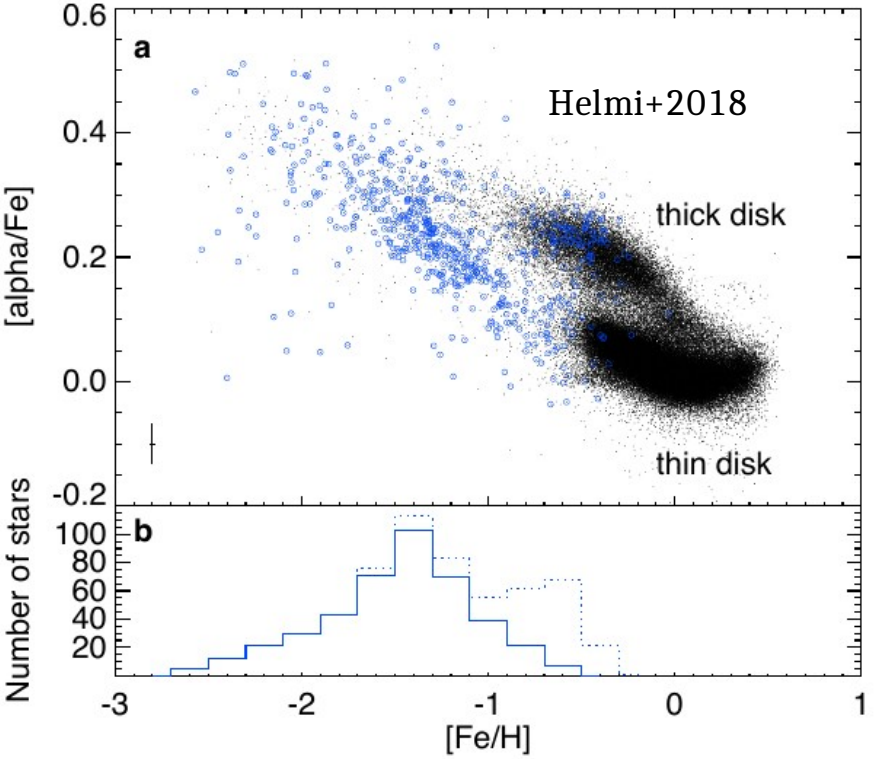


Science enabled by APOGEE + Gaia

Chemically identifying stellar populations

Hasselquist+2019





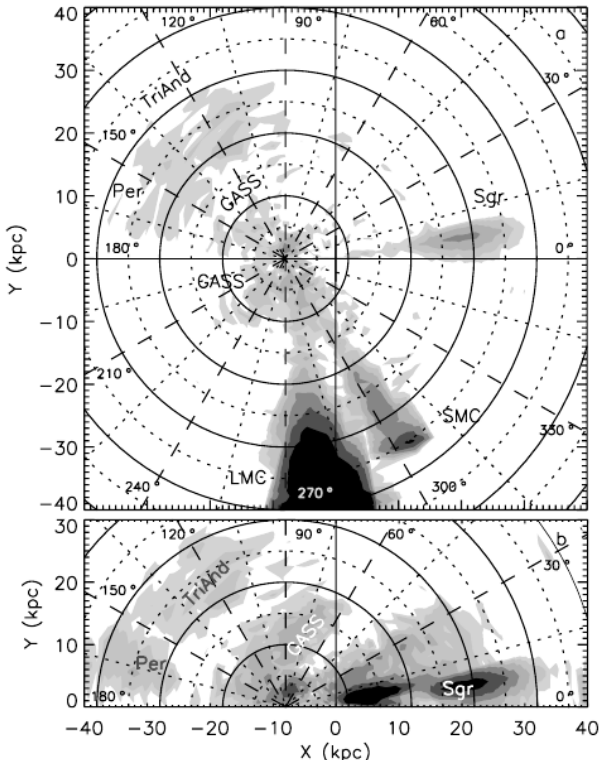
Numerous other studies using similar weak chemical tagging techniques:

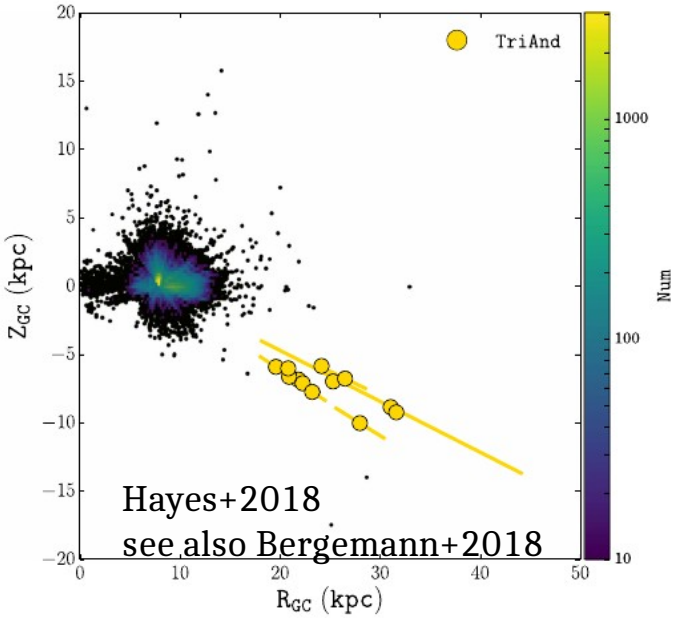
Schiavon+2017, Fernandez-Trincado+2015-2019, Hayes+2019, Horta+2020...

Science enabled by APOGEE + Gaia

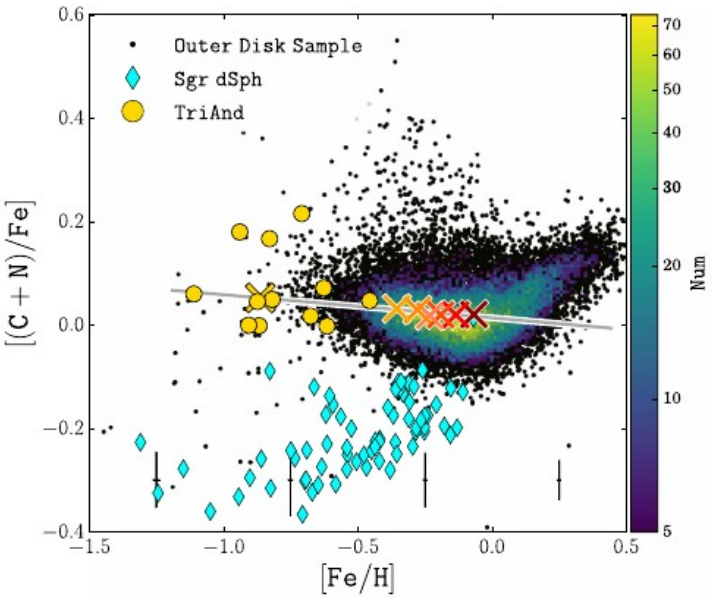
Disc orgin of stellar overdensities

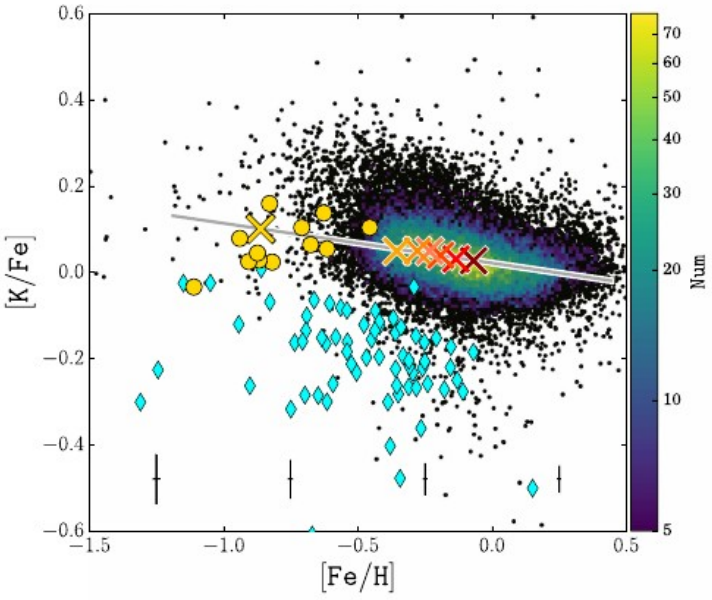
Rocha-Pinto+2004

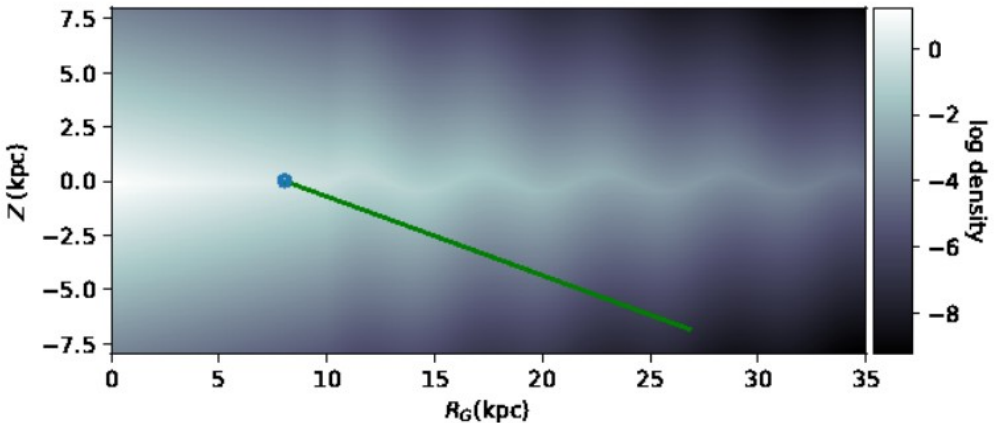




Hayes+2018
see also Bergemann+2018



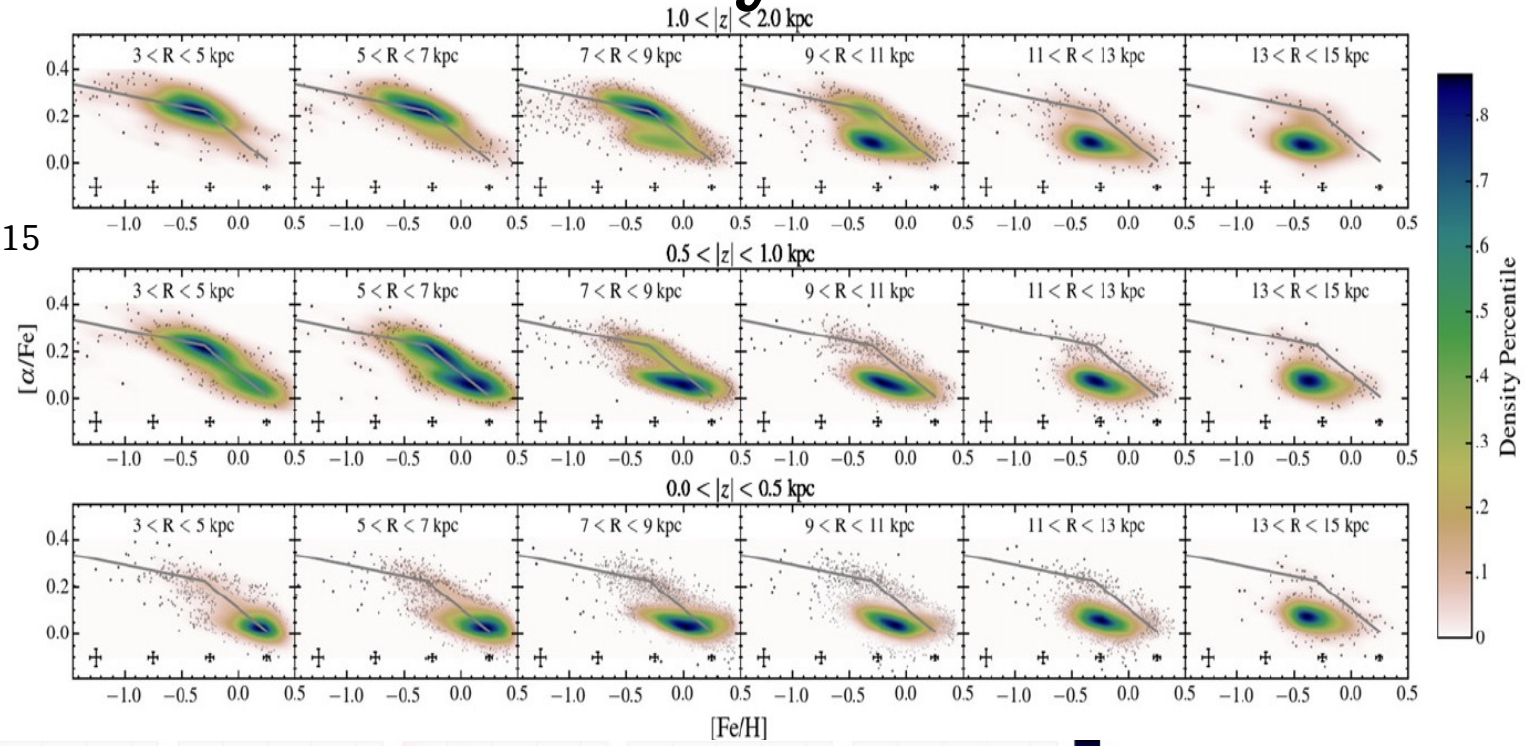




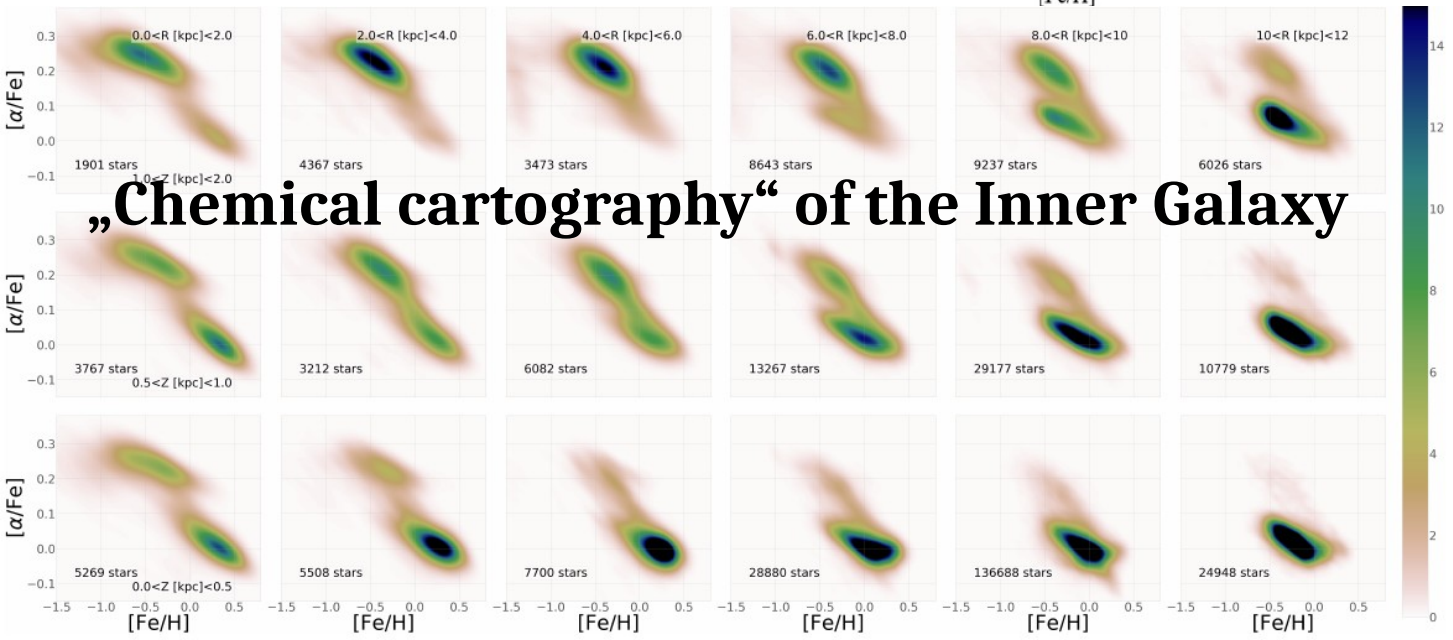
Perottoni+2018

Science enabled by APOGEE + Gaia

Hayden+2015



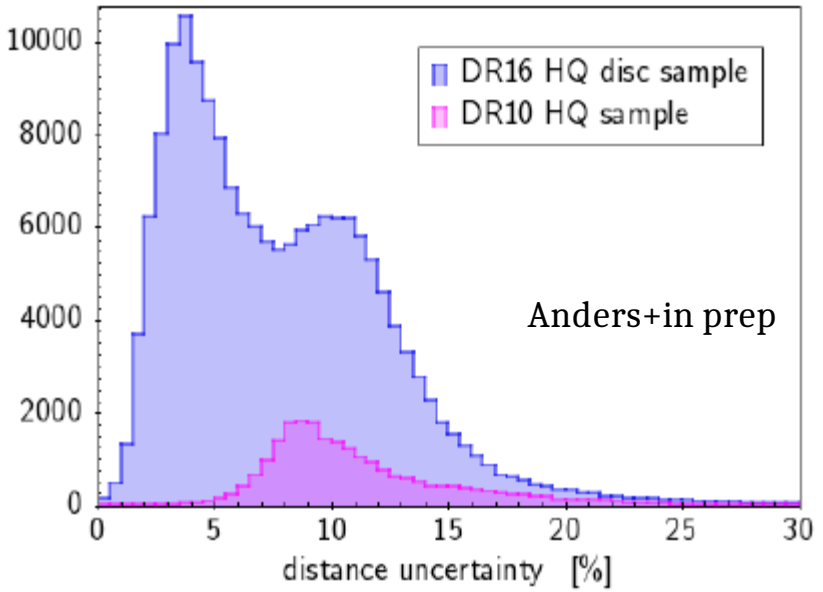
„Chemical cartography“ of the Inner Galaxy

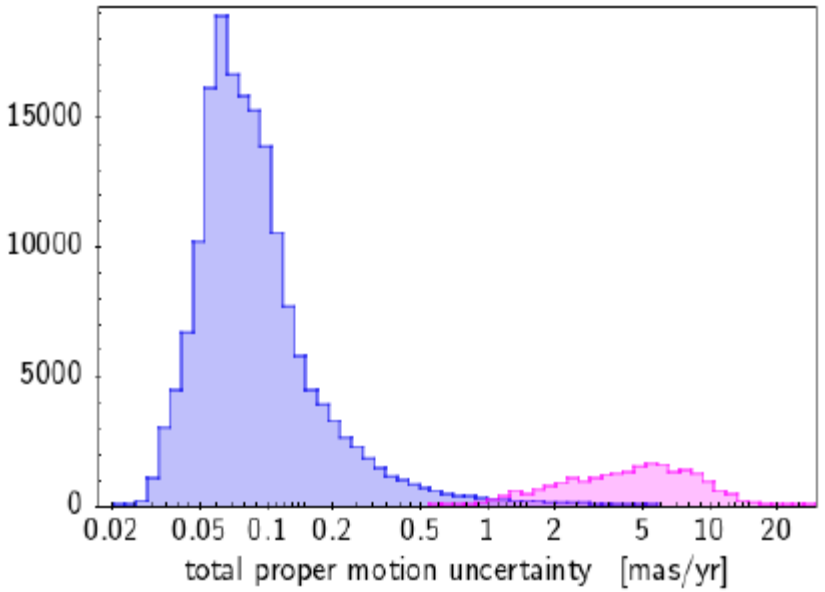


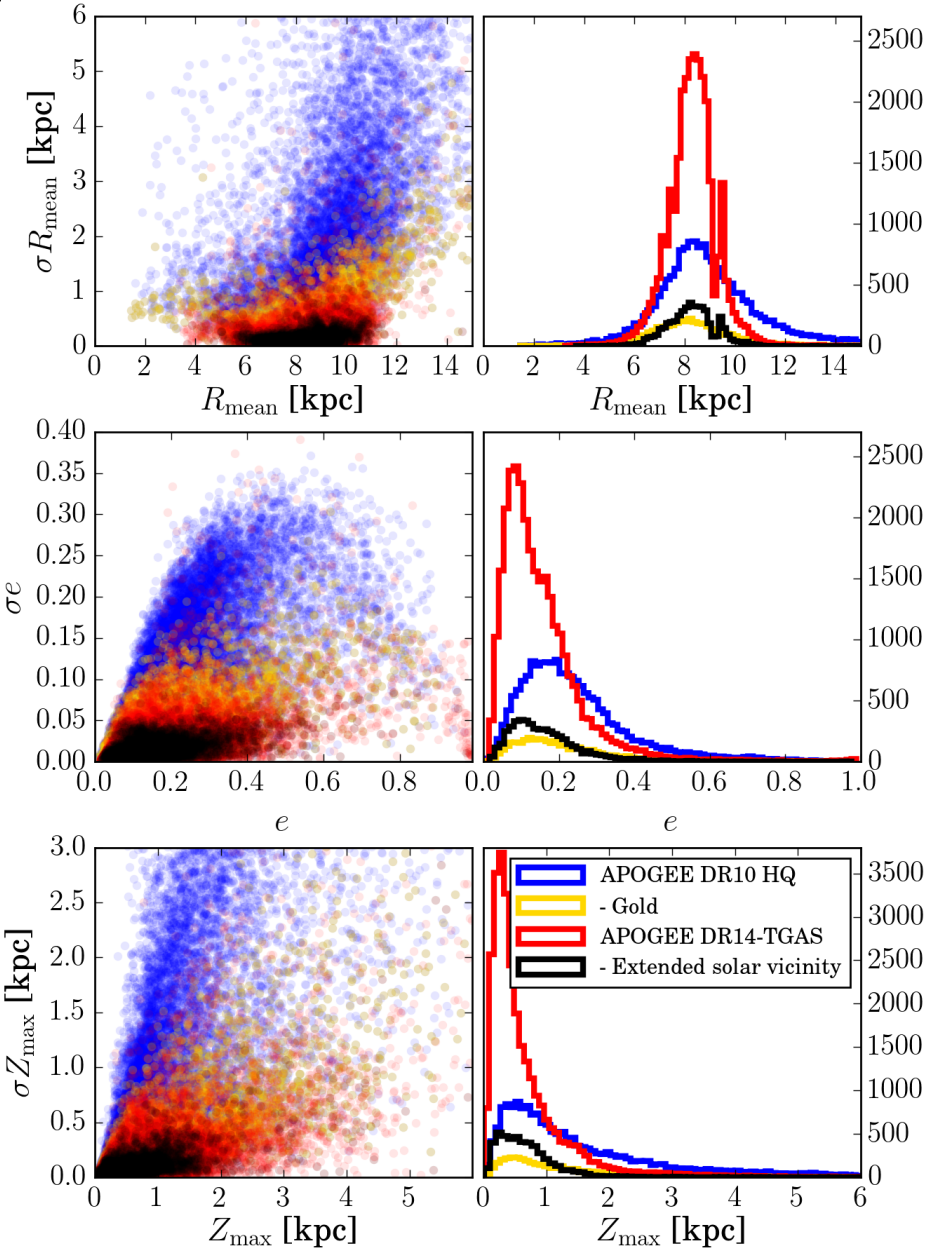
Queiroz+2020

Science enabled by APOGEE + Gaia

Disc chemo-kinematics

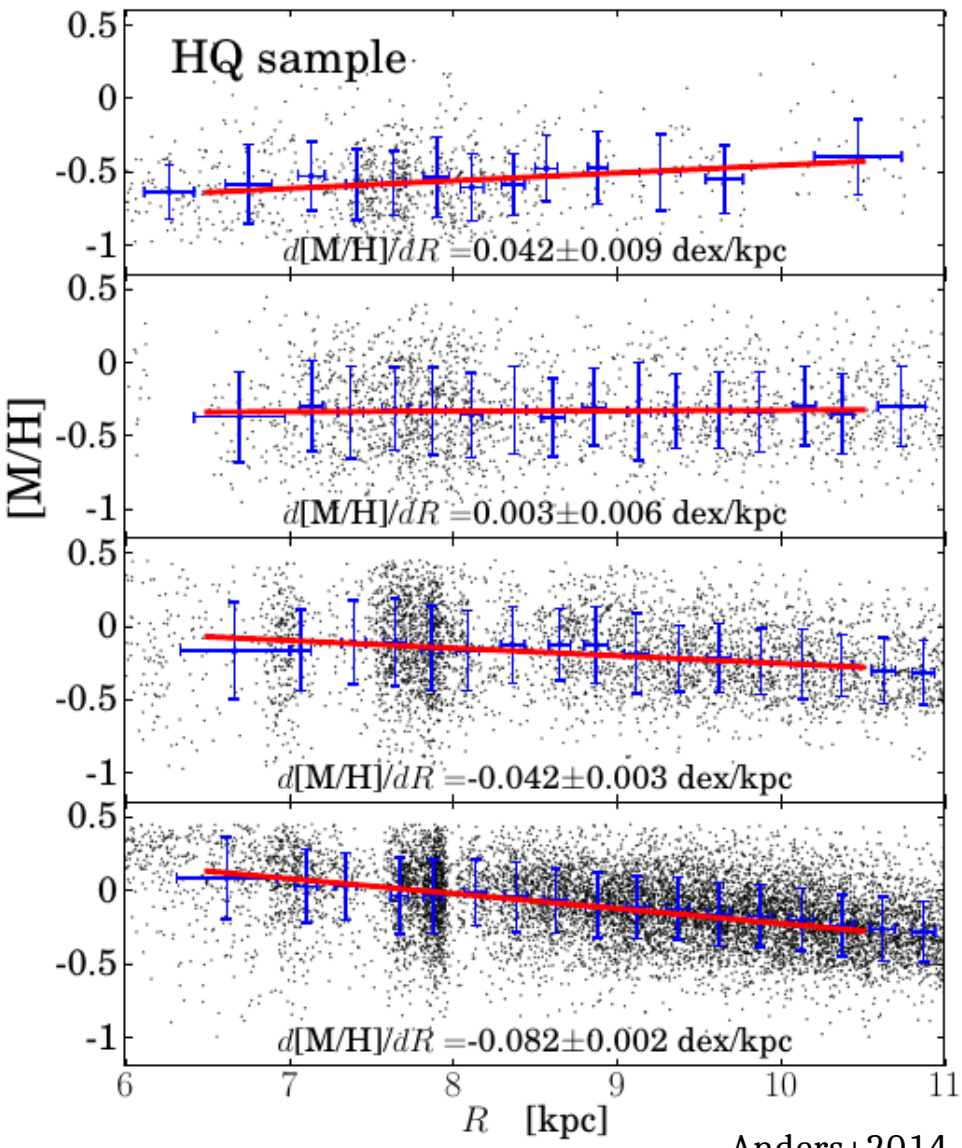






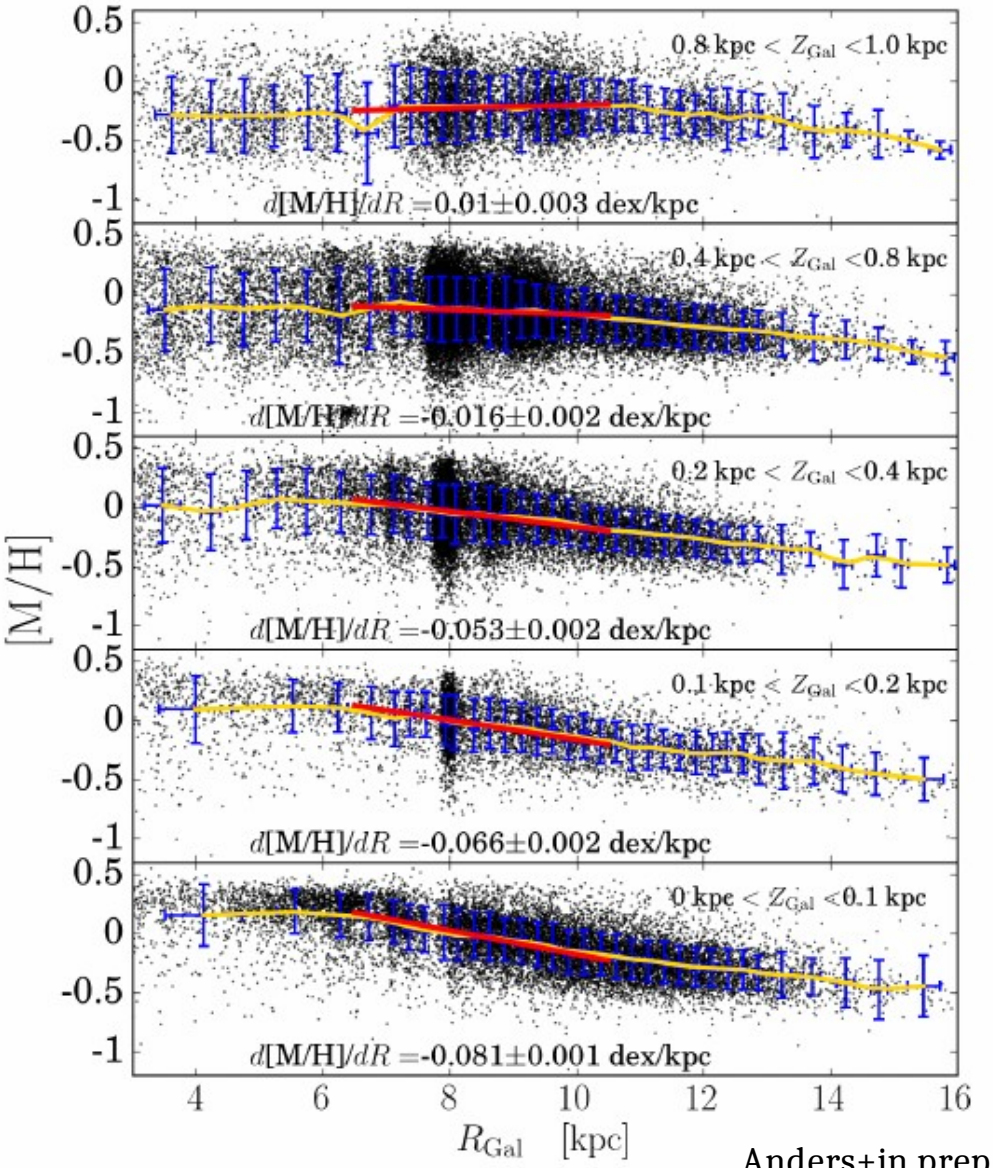
Science enabled by APOGEE + Gaia

Disc chemo-kinematics



Anders+2014

APOGEE DR16 HQ disc sample



Anders+in prep

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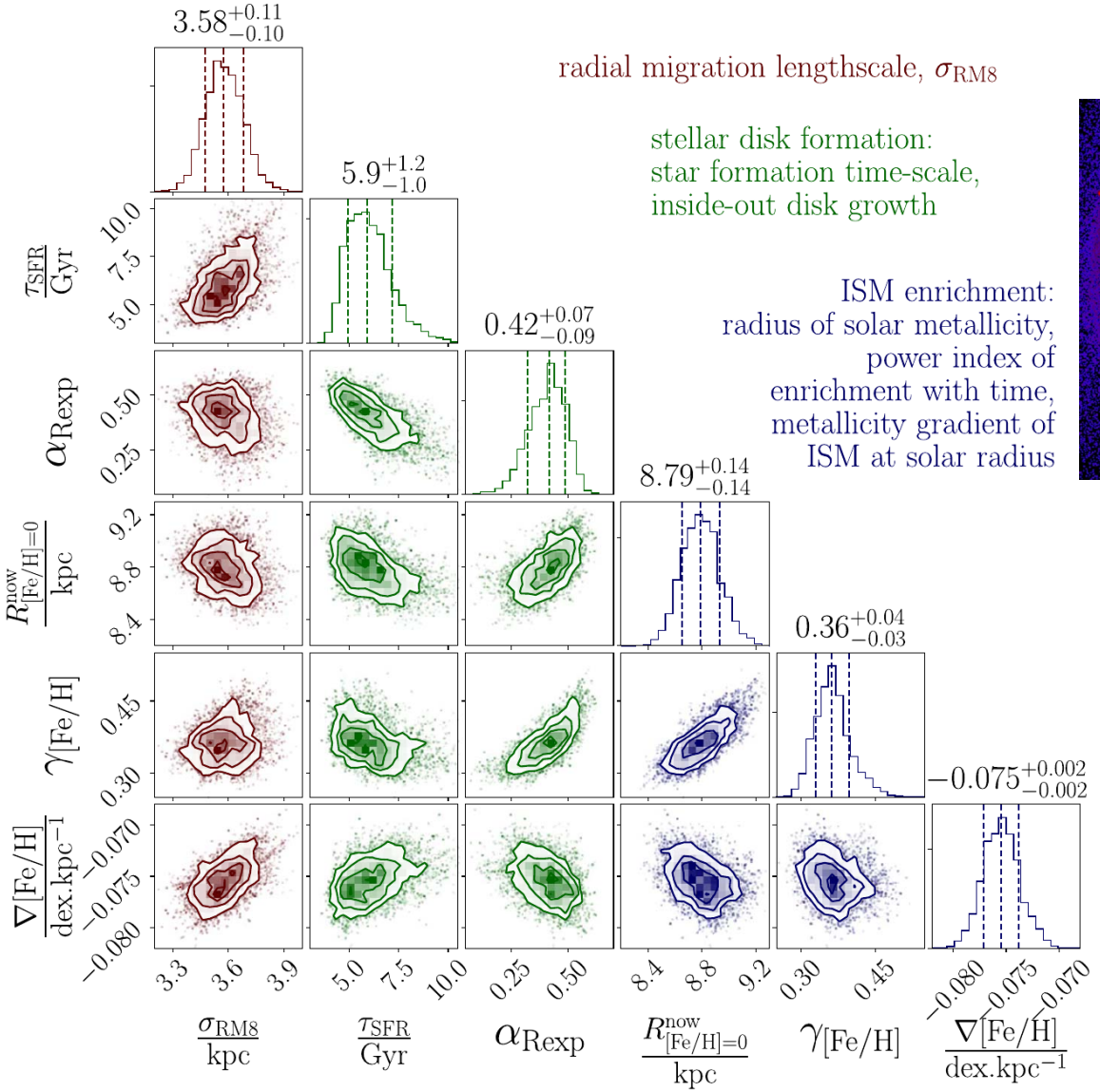

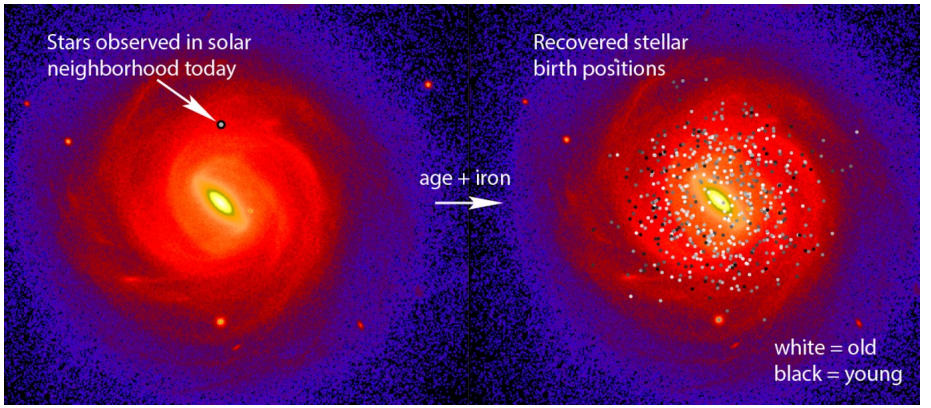

Minchev+2018

Frankel+2018, 2019, 2020,
See also Feltzing,Bouwers+2019

Towards solving the migration problem of GCE:
Infer the migration and chemical history at the same time!

Summary

- APOGEE DR16 + VACs are out: use them! They are underexplored!
- The APOGEE-Gaia sample is a rich testbed & playground – not only for Galactic Astrophysics
- NIR MO spectroscopy is the most useful tool to study distant regions of the Galaxy (bar, bulge, far side of the disc)
- APOGEE will stop taking data this year, SDSS-V (optical+NIR on 2 telescopes) is materialising
- But a NIR MOS survey facility on an 8m would be even cooler:)