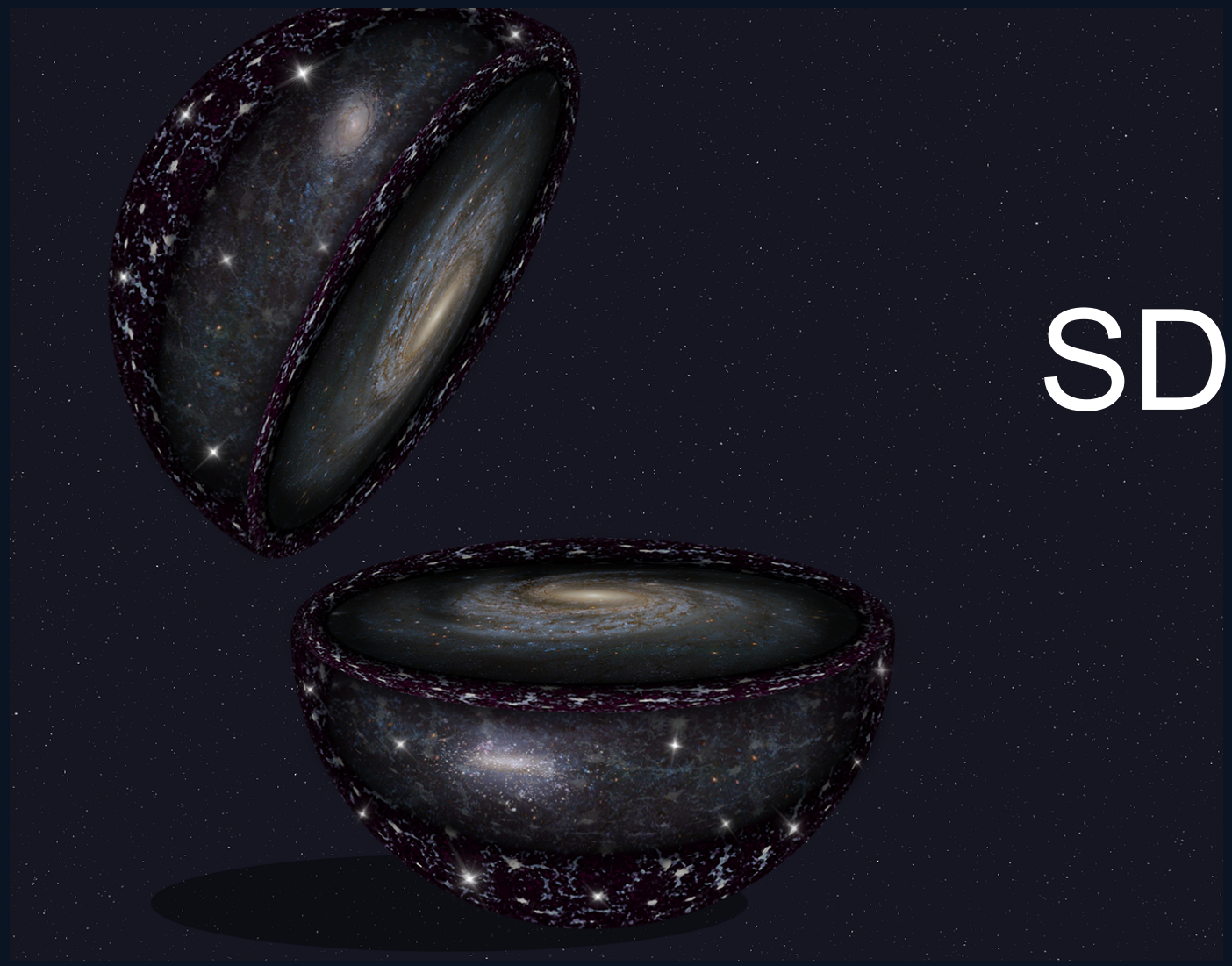
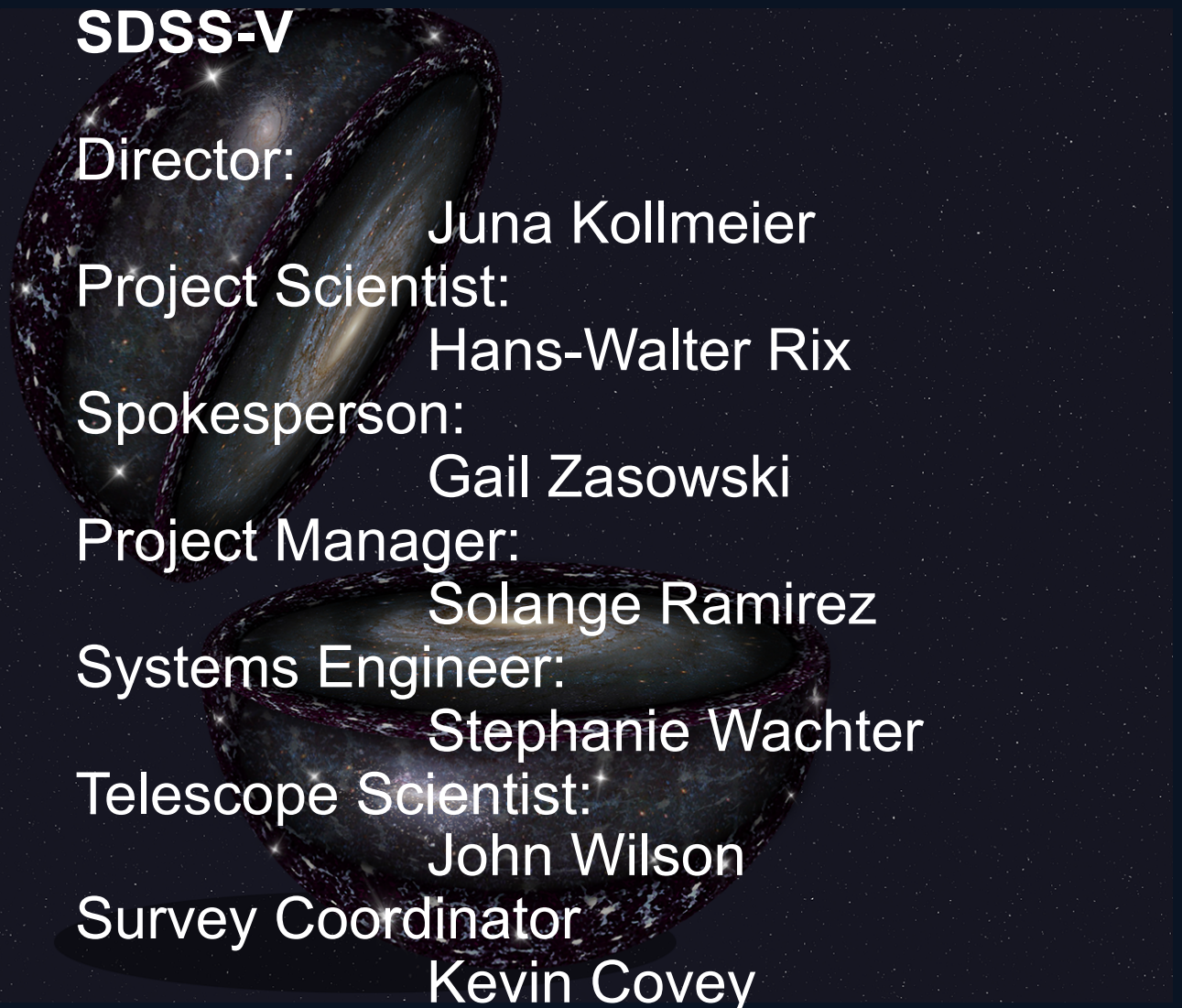


SDSS-V

Jennifer Johnson
for MWM team



SDSS-V

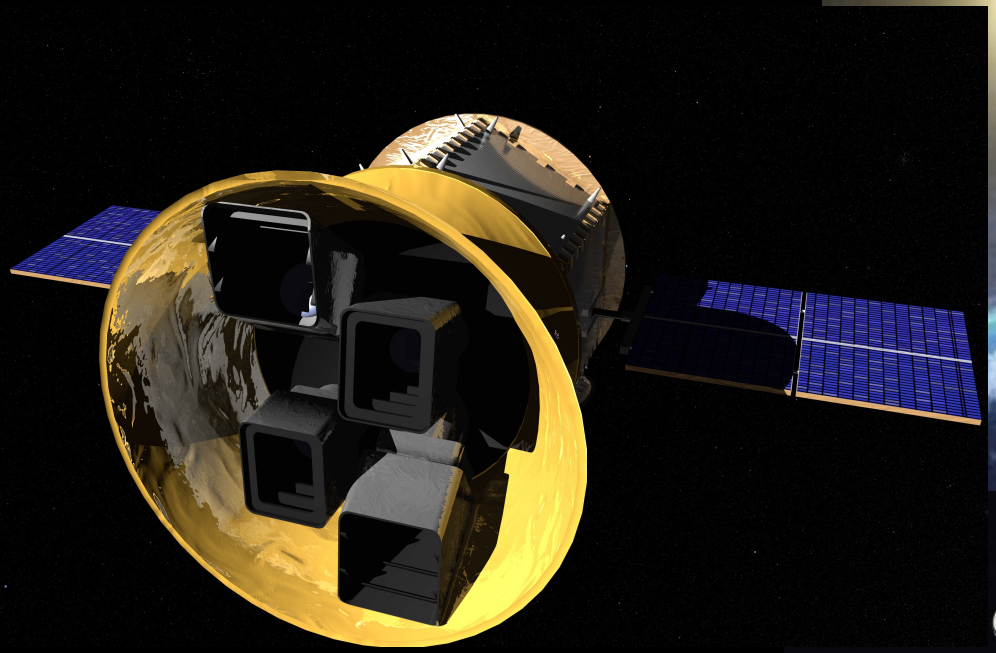
Director:
Juna Kollmeier
Project Scientist:
Hans-Walter Rix
Spokesperson:
Gail Zasowski
Project Manager:
Solange Ramirez
Systems Engineer:
Stephanie Wachter
Telescope Scientist:
John Wilson
Survey Coordinator
Kevin Covey

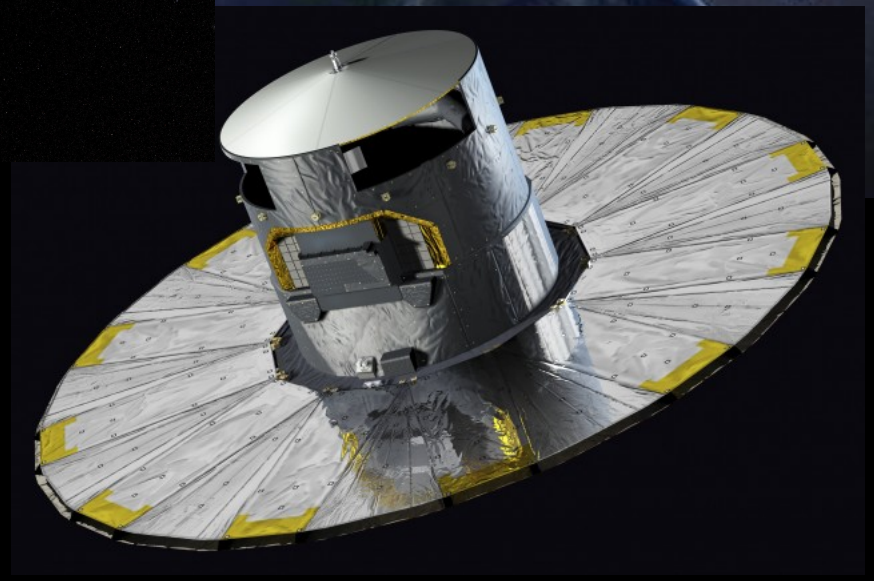
MWM

Jon Bird
Andy Casey
Nathan De Lee
Boris Gaensicke
Saskia Hekker
Jens Kauffmann
Marina Kounkel
Chao Liu
Gal Matjevic
Melissa Ness
David Nidever
Eddie Schafly
Axel Schwope
Keivan Stassun
Johanna Teske
Andrew Tkachenko
Nick Troup
and Many More!

Why SDSS-V?

Why SDSS-V?



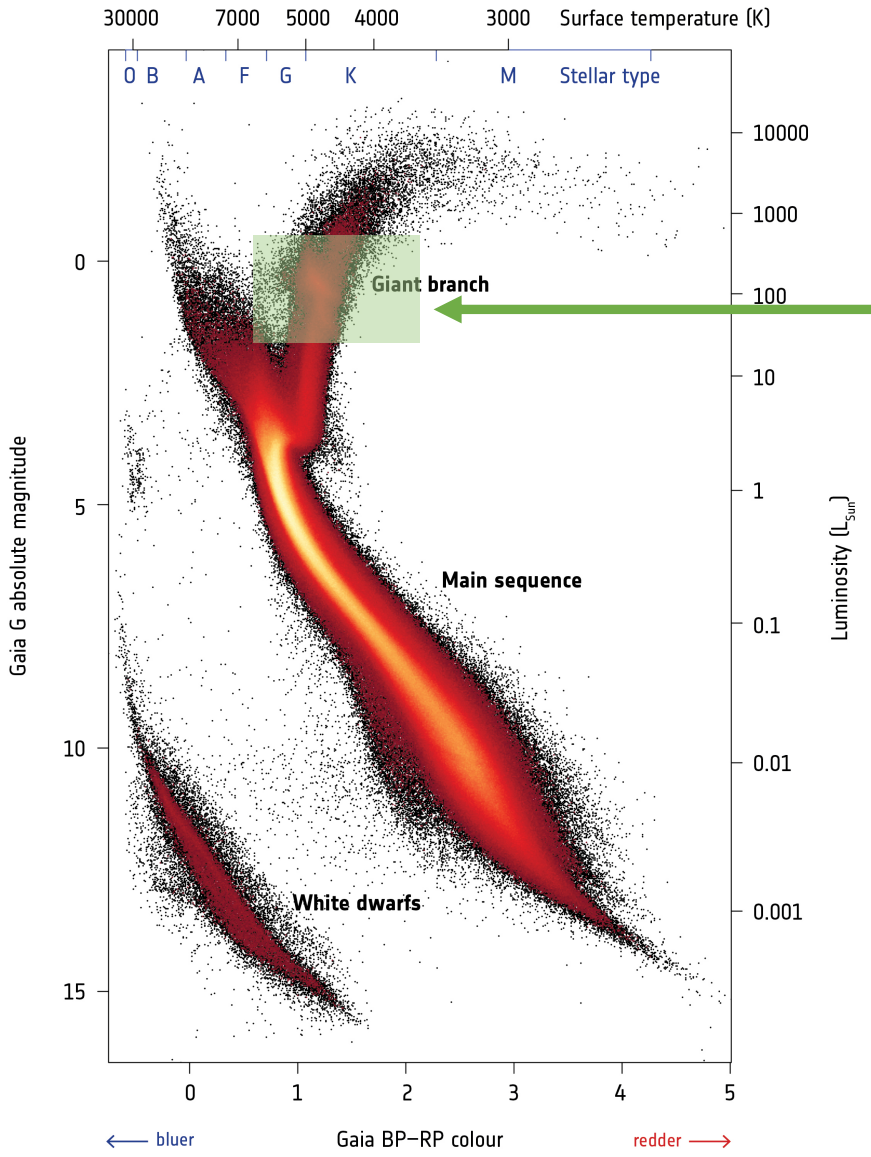


Parameters of SDSS-V survey

- APO in the North, LCO in the South – both 2.5 meter telescopes
- 1 APOGEE spectrograph
  - H-band, R~22,500
- 1 BOSS spectrograph
  - Optical, R~2000
- 5 year survey, starting in mid-2020
- Fiber robot system to replace aluminum plates – need to be commissioned before massive multiplexing starts
- 500 robots – up to 300 fibers to the APOGEE spectrographs, 500 fibers to BOSS spectrographs

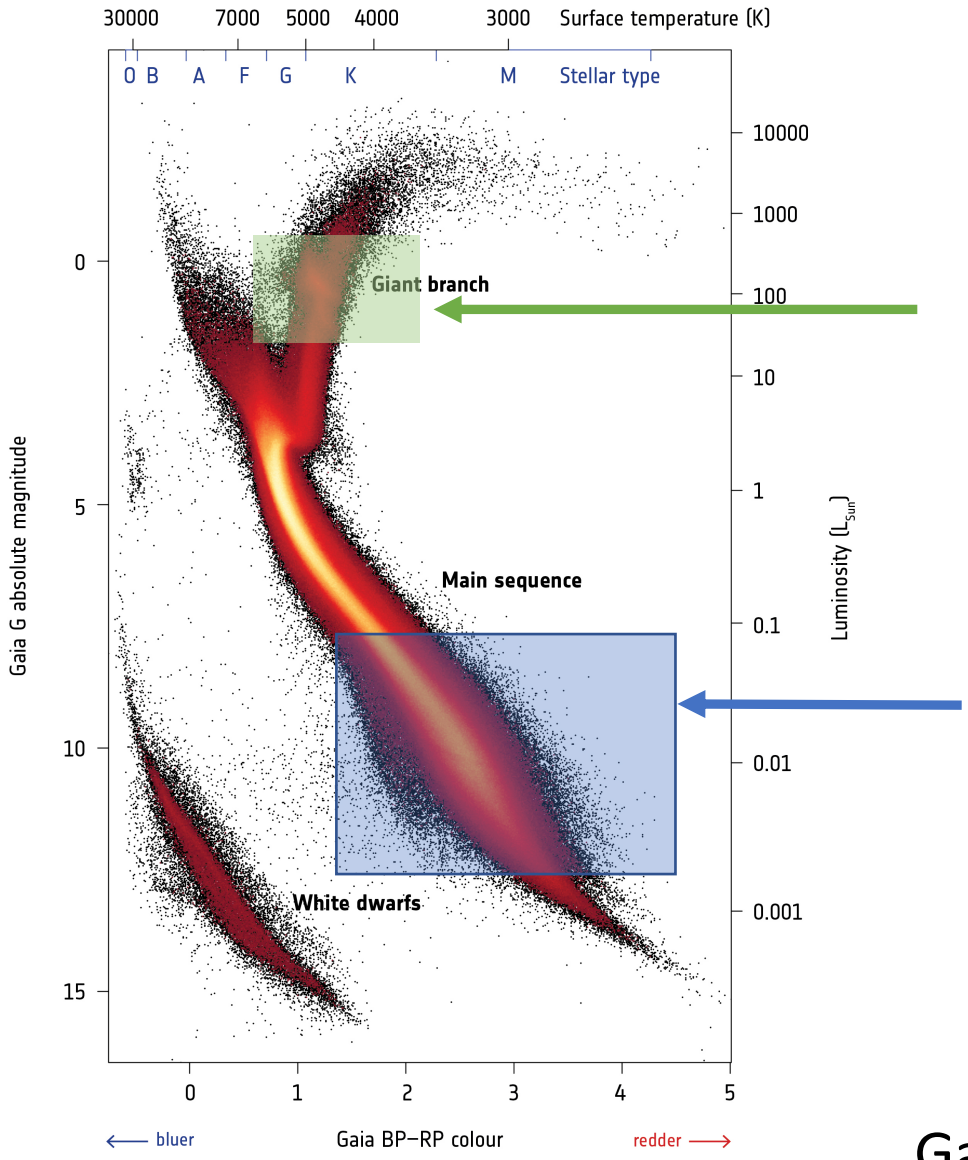
SDSS-V -- Milky Way Mapper

Animation courtesy of C Sayres



TESS RGB Stars

Gaia DR2 HR Diagram



TESS RGB Stars

TESS Planet Hosts and Unbiased Sample

Gaia DR2 HR Diagram

TESS planet hosts

Require high SNR to measure all the relevant elements: Si, Mg, Fe, Na, Al, Ca
Note that [Fe/H] and [α/Fe] at least are needed to get correct M dwarf radii

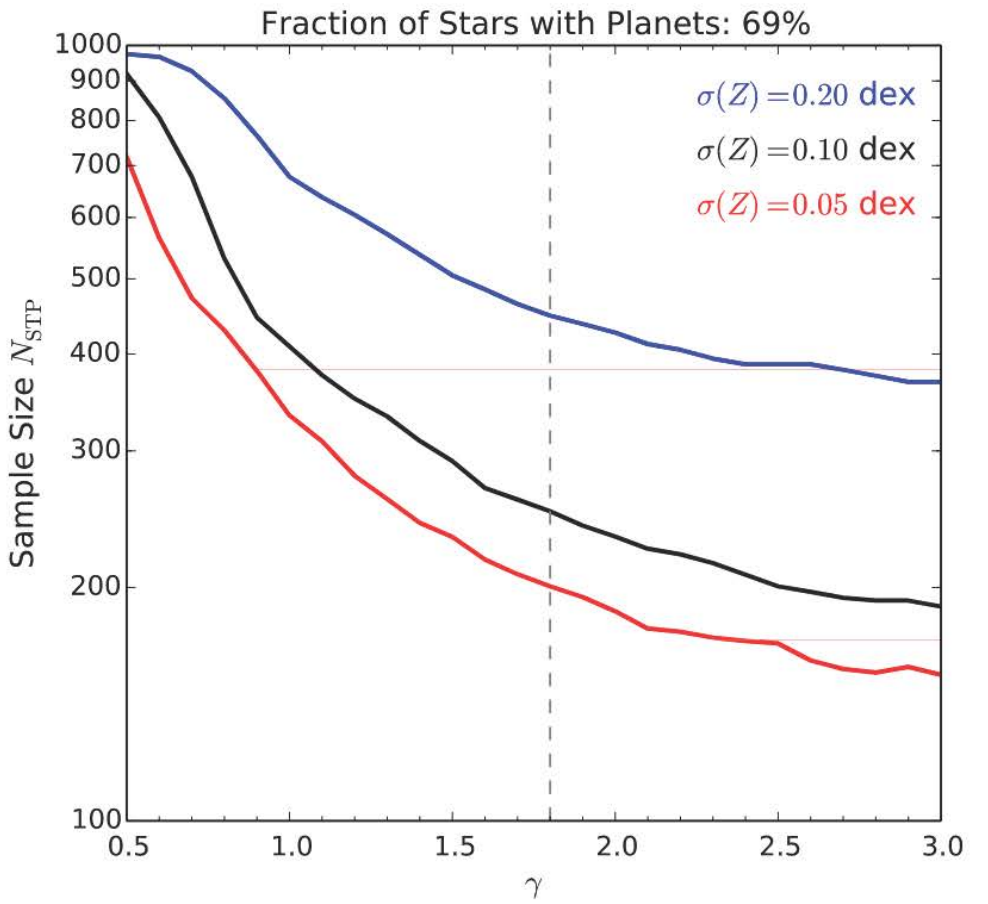
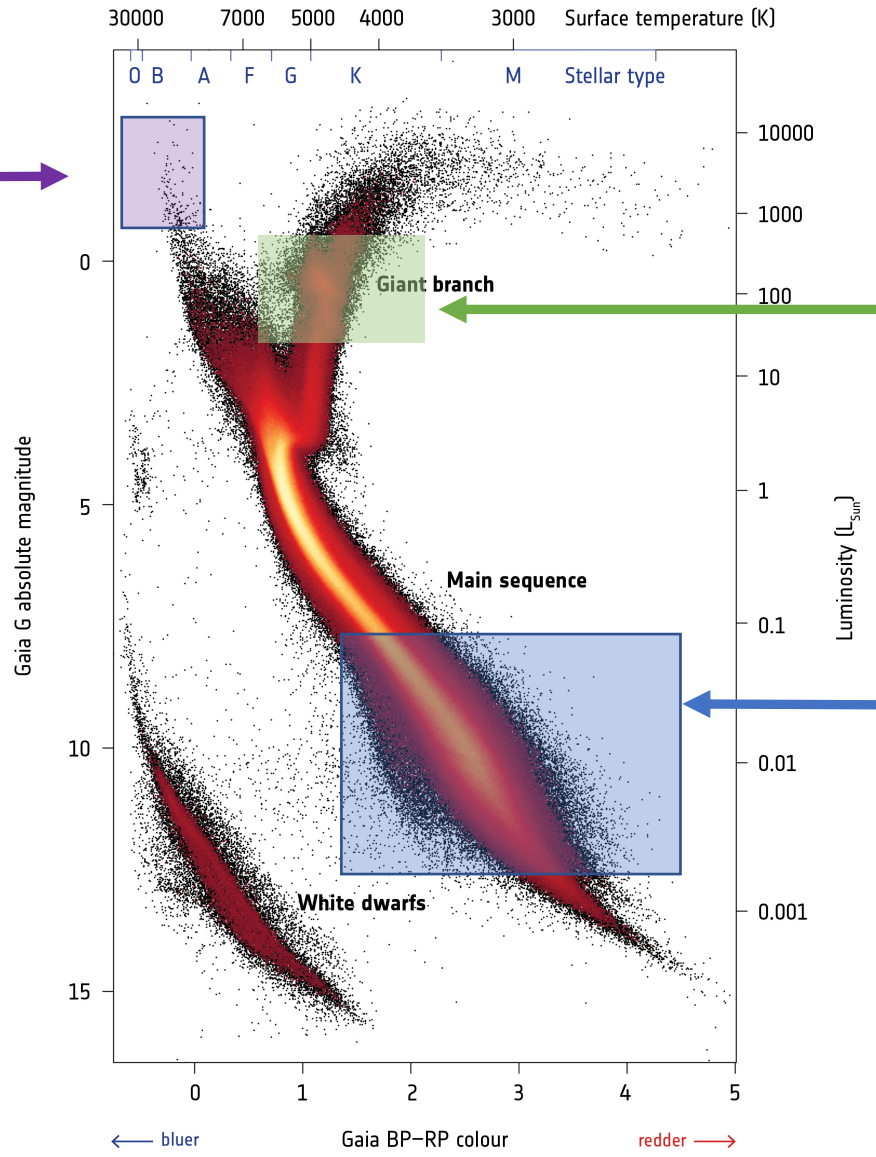


Figure 3. For the nominal small planet occurrence rate $\eta = 69\%$ and three choices of the metallicity measurement precision, the critical sample size N_{STP} ($=N_{SNTP}$) required to confidently detect the planet–metallicity correlation with a power-law index γ. Here the term "confidently" means that a random set of STP and SNTP samples has greater than 95% probability to detect the input correlation at greater than the 2σ confidence level.

Zhu et al. 2016

Convective Cores



TESS RGB Stars

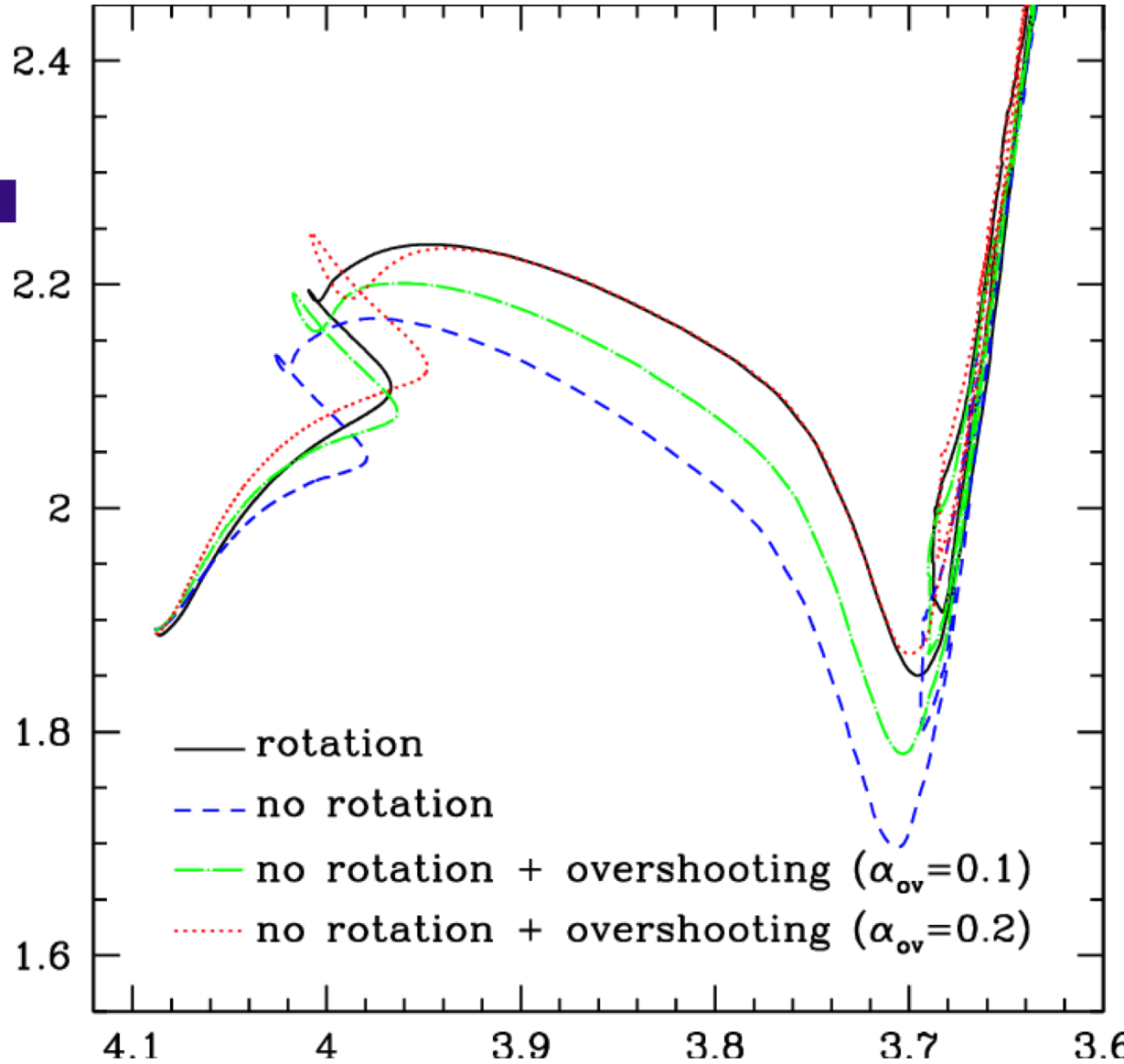
TESS Planet Hosts and Unbiased Sample

Gaia DR2 HR Diagram

Convective Cores

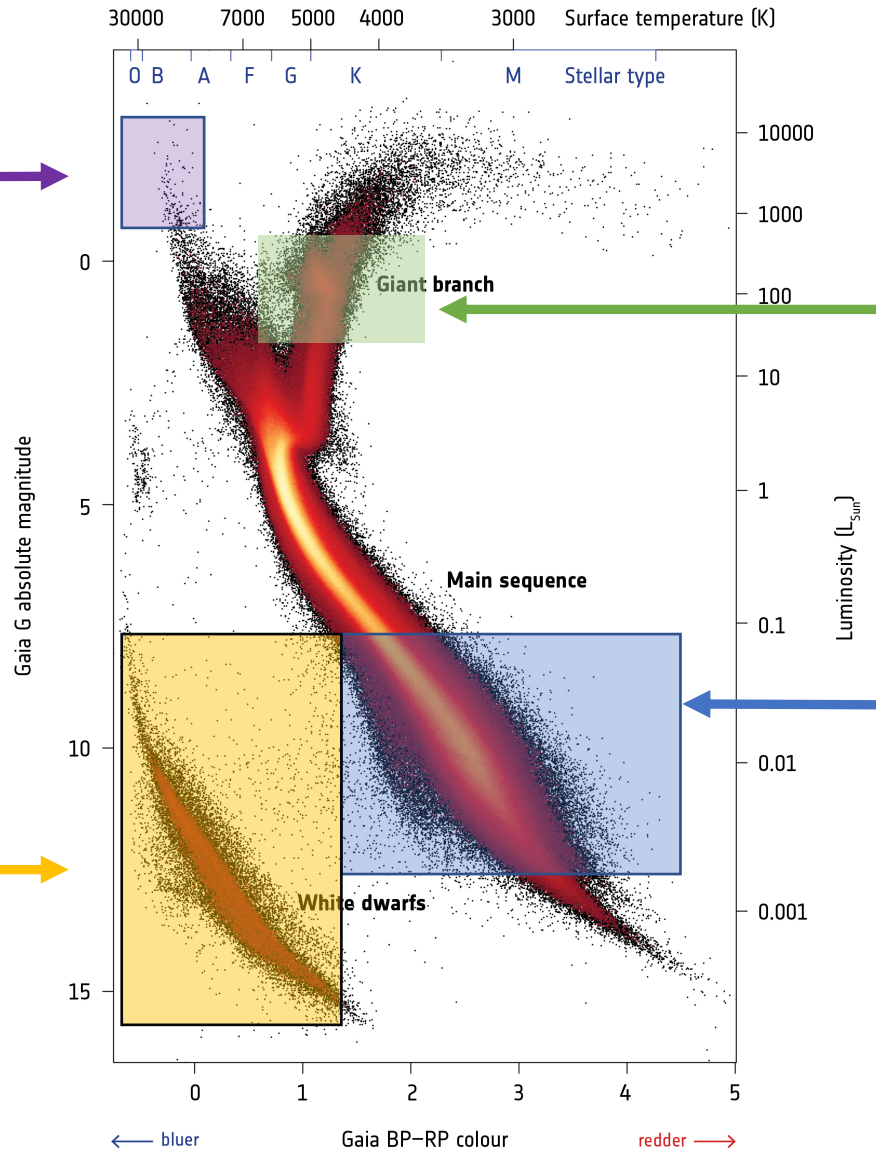
Using O and B eclipsing binaries in the CVZ, determine M and R

Constrain asteroseismic models and derive internal structure, for example, the amount of core overshoot



Eggengerger et al 2009

Convective Cores



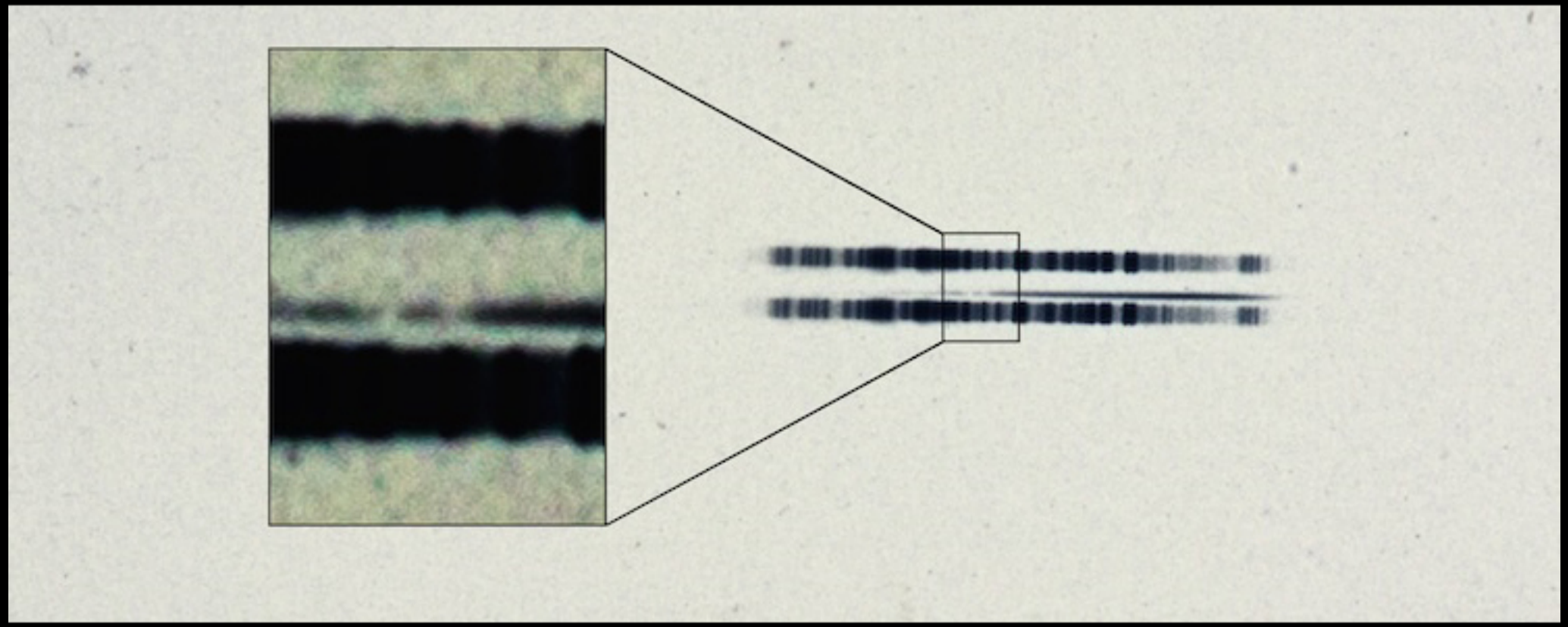
TESS RGB Stars

TESS Planet Hosts and Unbiased Sample

White Dwarfs

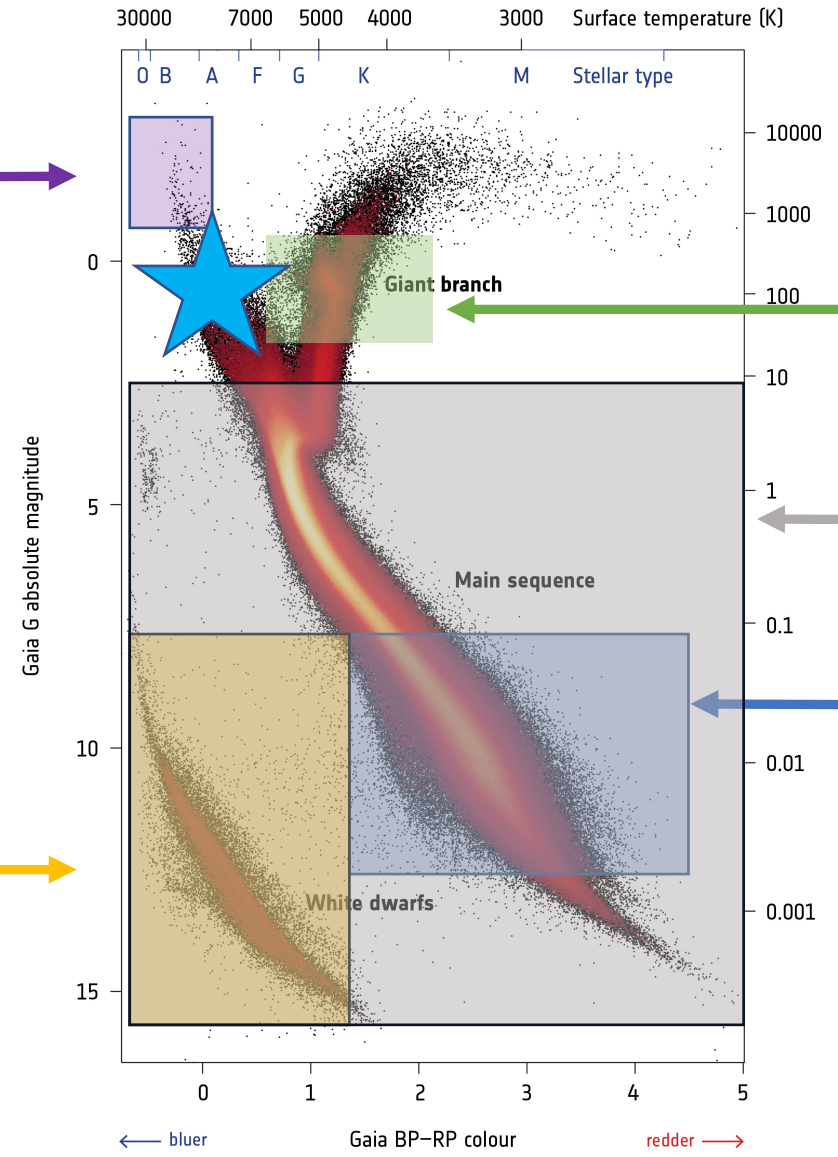
Gaia DR2 HR Diagram

White Dwarfs to G < 20, ~200,000 stars



Credit: Carnegie Observatories, Jay Farhi

Convective Cores



TESS RGB Stars

Solar Neighborhood Census

TESS Planet Hosts and Unbiased Sample

White Dwarfs

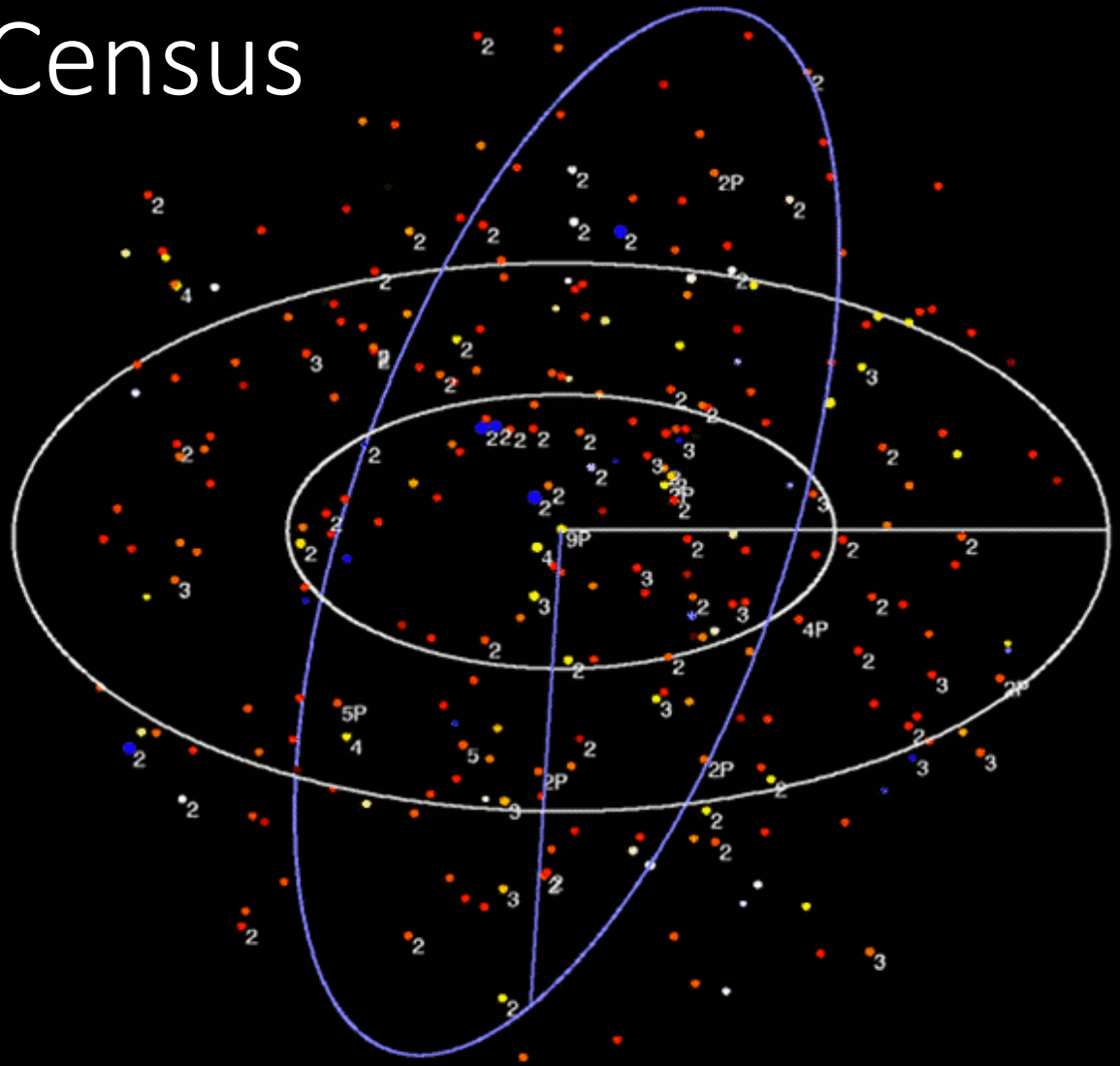
Gaia DR2 HR Diagram

Solar Neighborhood Census

~300,000 stars within 100 pc
-- volume-limited to H-burning limit
~5000 with SDSS spectra already

Compare with 400 stars in the RECON 10 pc sample

Exploit wide binaries, best studied cool stars, etc.

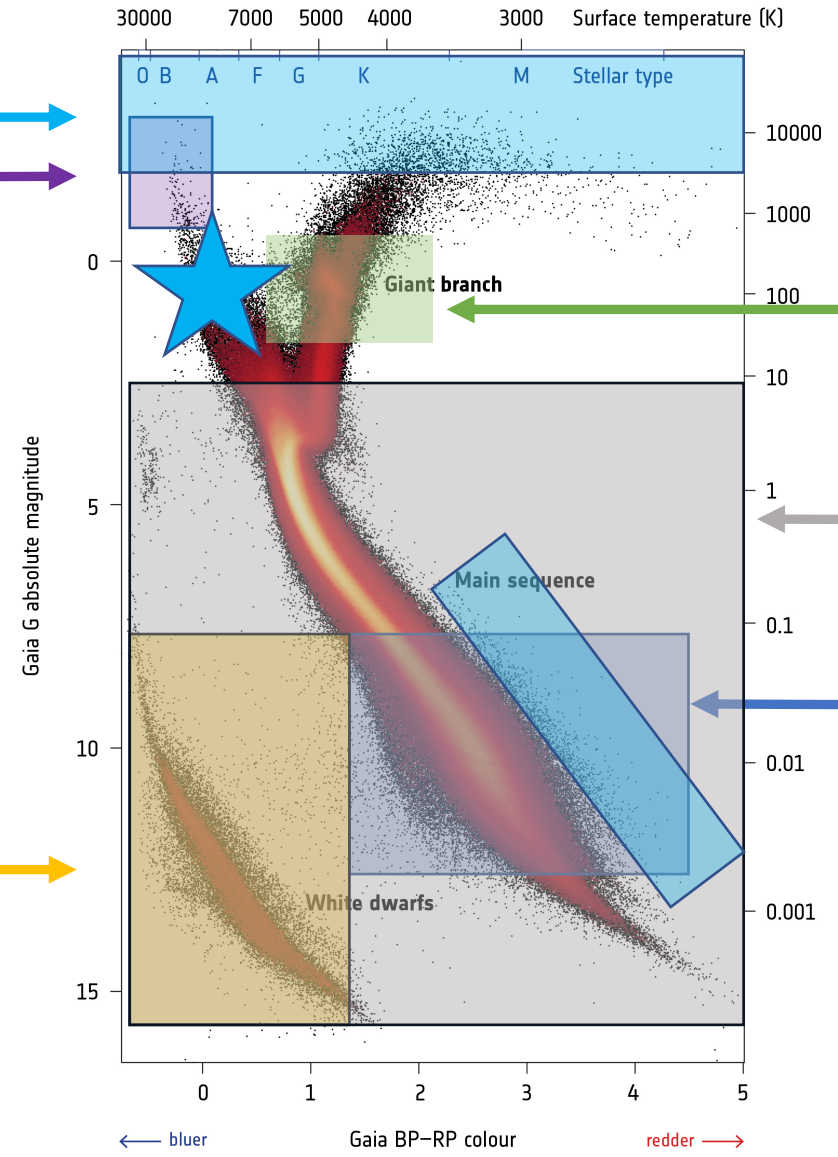


RECONSand reference www.recons.org

The Young Galaxy

Convective Cores

White Dwarfs



TESS RGB Stars

Solar Neighborhood Census

TESS Planet Hosts and Unbiased Sample

Gaia DR2 HR Diagram

Targeting for the Young Galaxy

~100,000 protostars – pre-main-sequence stars -- all-sky to H < 13 with APOGEE

~100,000 massive stars (to 6 solar masses) with BOSS spectrographs

Targeting for YSG/RSG still being worked out

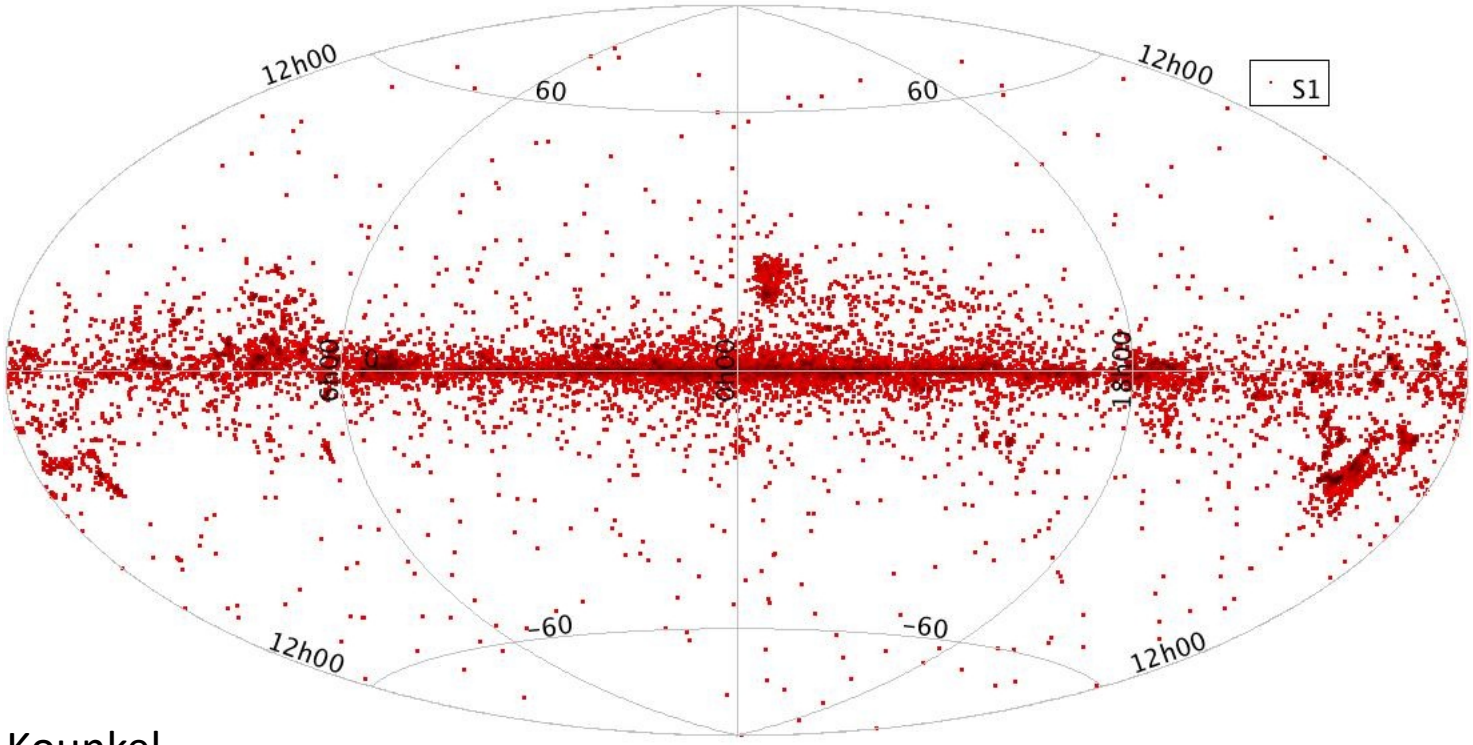
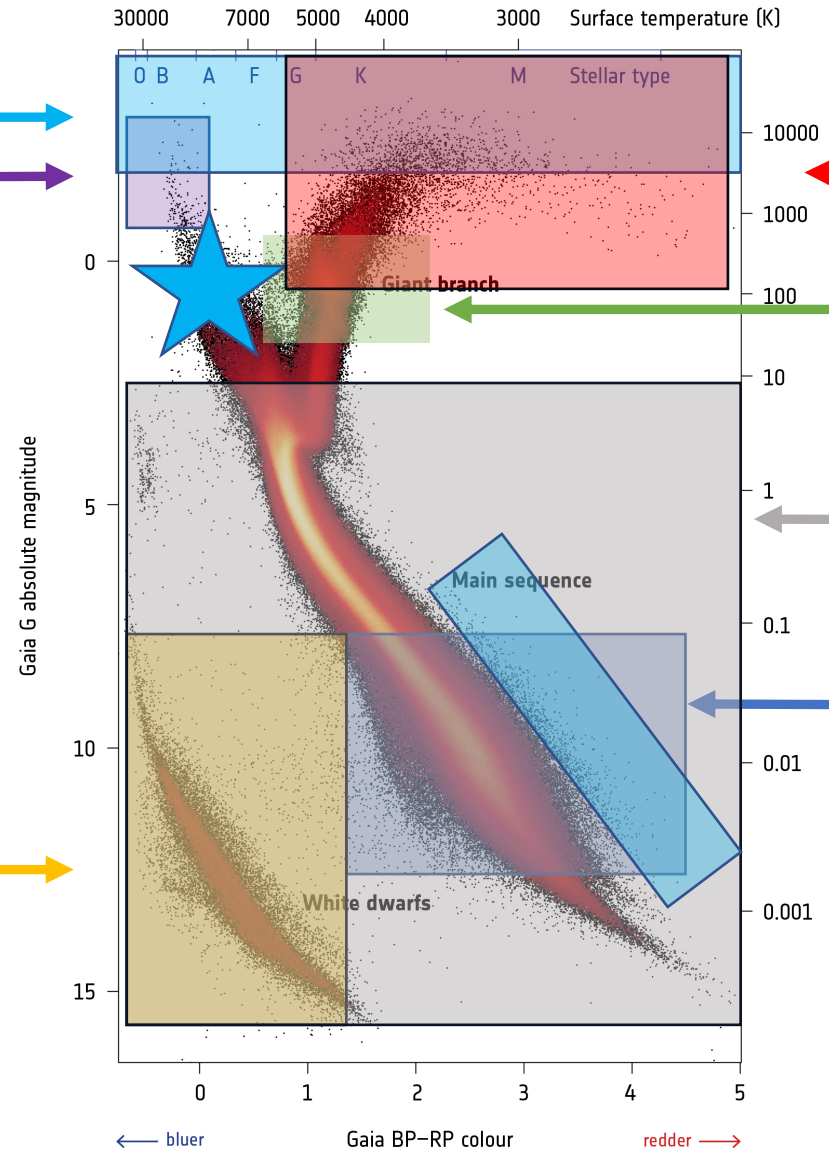


Figure: Marina Kounkel

The Young Galaxy

Convective Cores

White Dwarfs



Galactic Genesis

TESS RGB Stars

Solar Neighborhood Census

TESS Planet Hosts and Unbiased Sample

Gaia DR2 HR Diagram

Galactic Genesis

Main Selection Criteria -- > 5 million stars

- H < 11
- G-H > 3.5
- MWM + Gaia – abundances and stellar parameters for all the stars

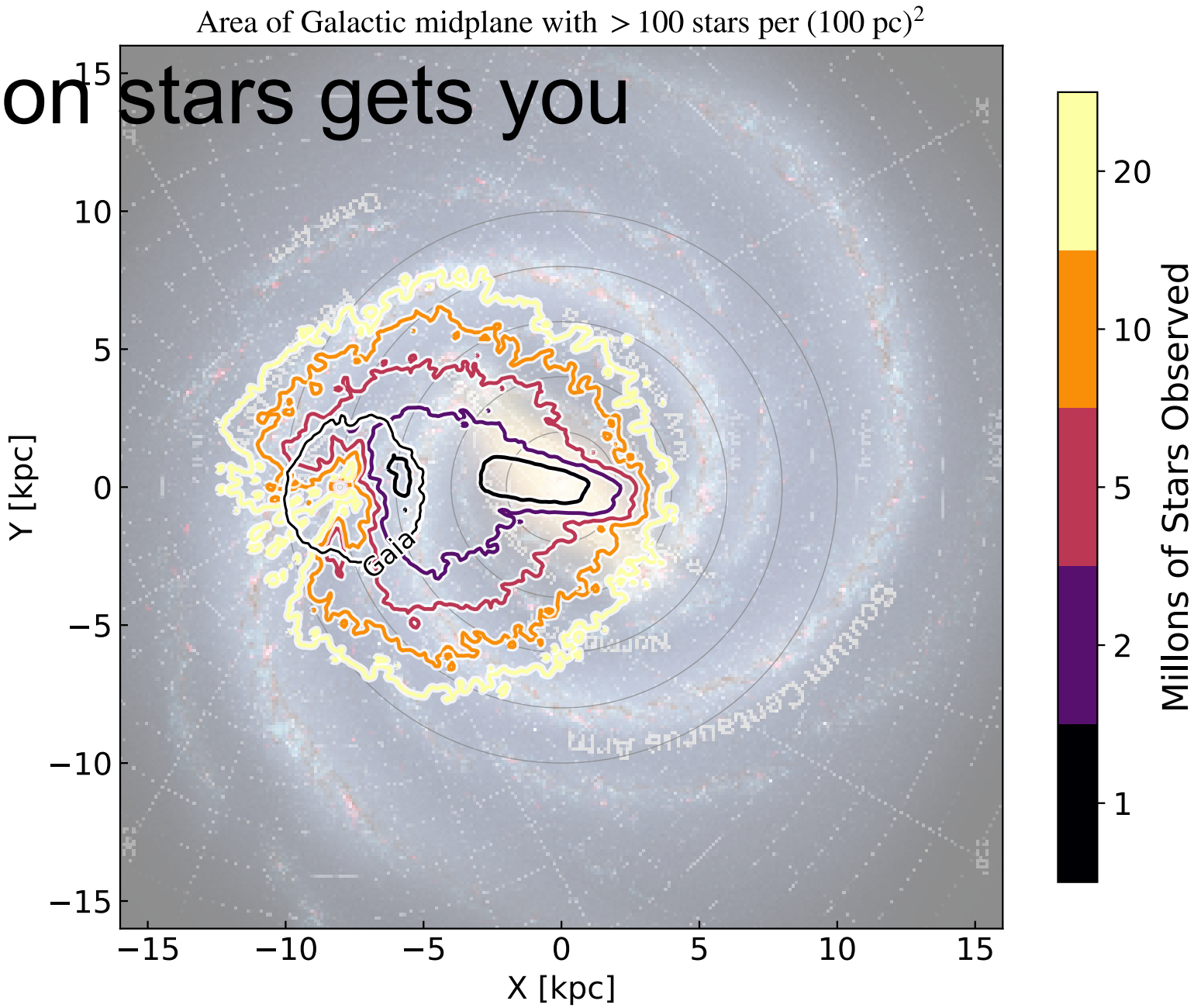
Gaia magnitudes are used; Gaia parallaxes are not

- With DR2 accuracy and assuming 15% accuracy for spectroscopic parallaxes (Hogg+ 2019), spectra outdo Gaia at around 3.75 kpc
- So goal of complementing Gaia in the red, luminous regime leads to getting enough stars to probe the Galaxy contiguously to appreciable distances

What 5 million stars gets you

Contours show the distance reached at 100 stars/(100 pc)^3 density in a Galaxia model
H < 11, G-H > 3.5

Figure: Jon Bird

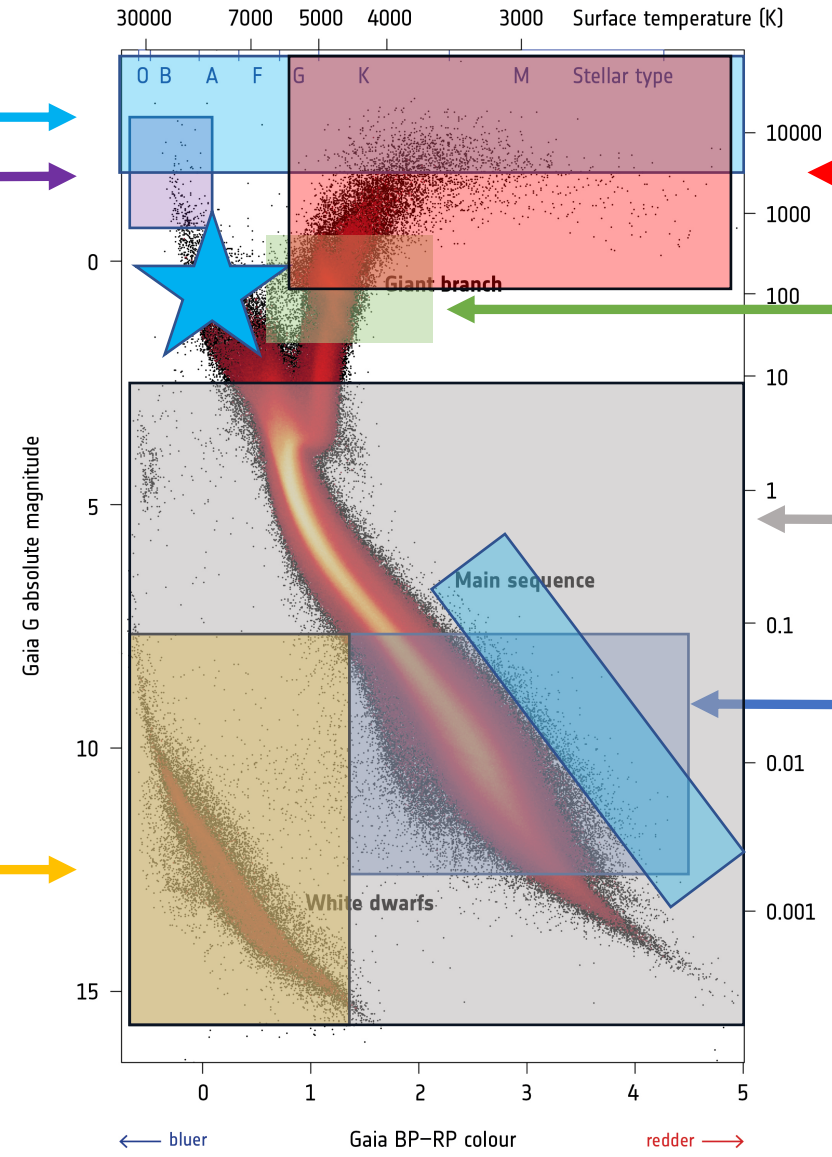


The Young Galaxy

Convective Cores

Dust
eROSITA
Binaries

White Dwarfs



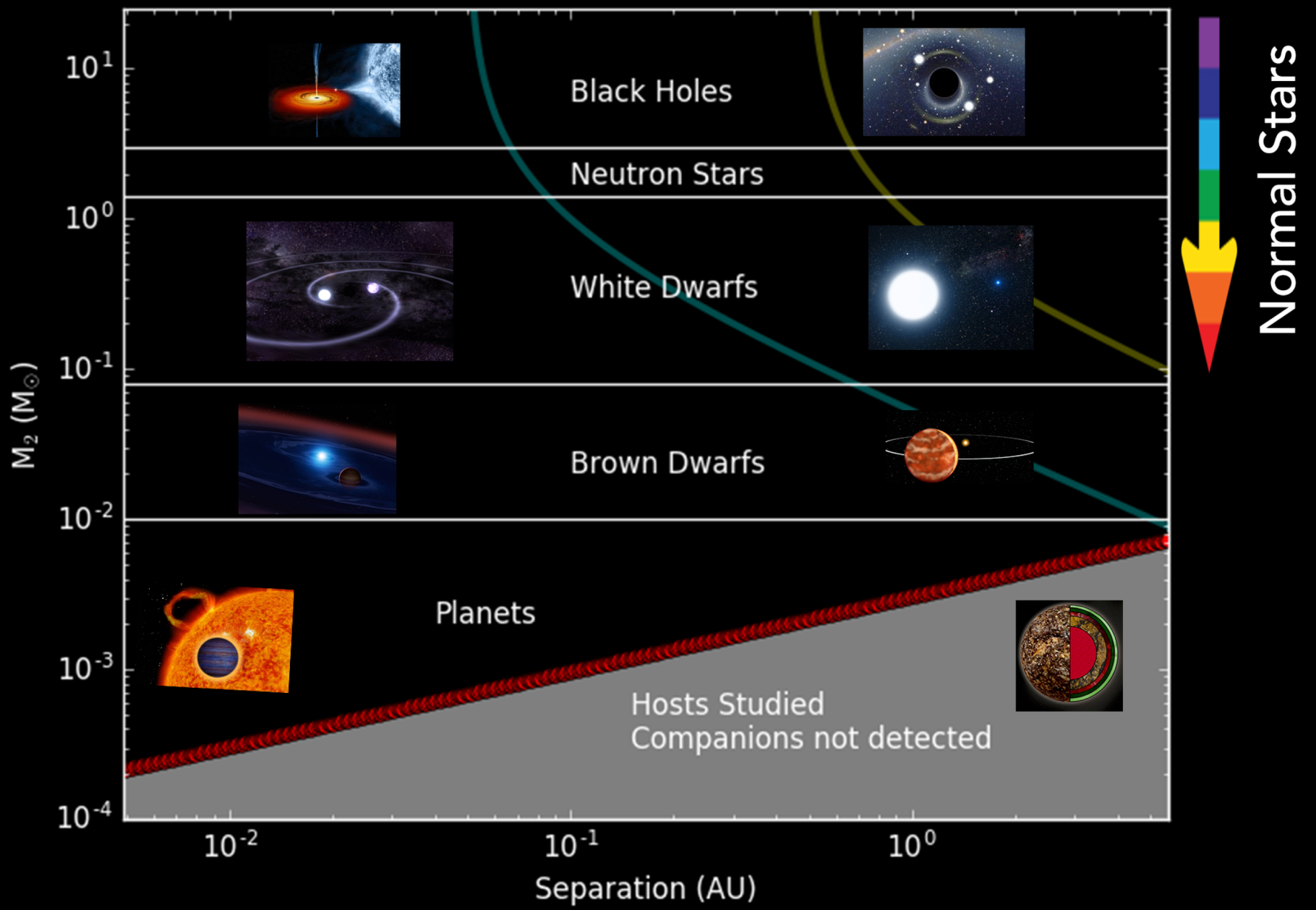
Galactic Genesis

TESS RGB Stars

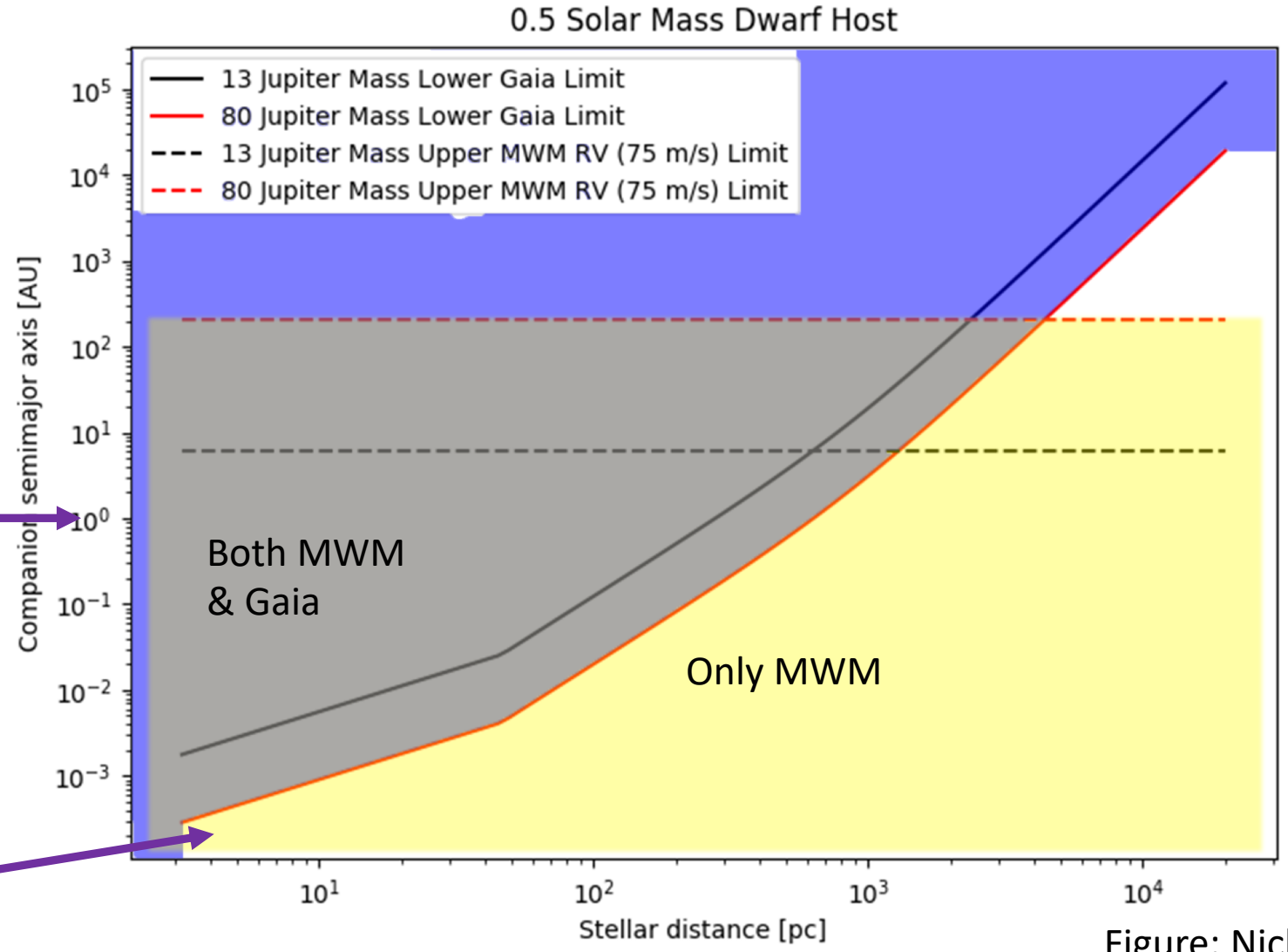
Solar Neighborhood
Census

TESS Planet Hosts
and Unbiased
Sample

Gaia DR2 HR Diagram


Black Holes
Neutron Stars
White Dwarfs
Brown Dwarfs
Planets
Hosts Studied
Companions not detected
Normal Stars
M_2 ($M_\odot$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-2}
10^{-1}
10^0
Separation (AU)

Binary Science in the Gaia Era



"Desert" Area

Close WD binaries

Figure: Nick Troup

MWM and Binary Science

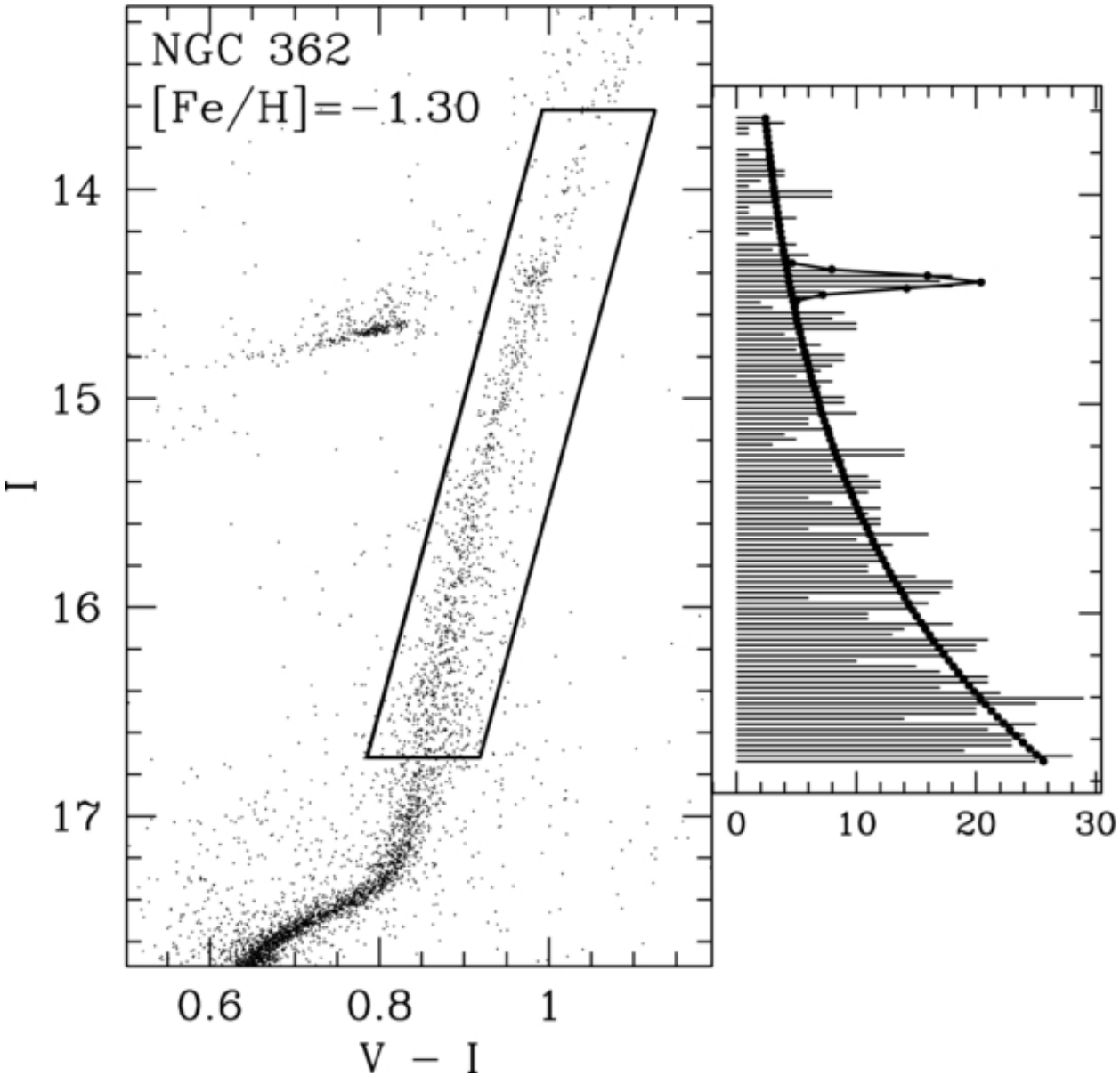
Observations with MWM

- Improve accuracy to 75 m/s on the APOGEE spectrograph
- Massive Stars
- Single-epoch observations of astrometric binaries, particularly those with dark companions
  - Mass, metallicity, age-indicator
- Search for compact binaries
- Long-baseline observations of stars observed in APOGEE-1 and -2

Exploiting Continuity

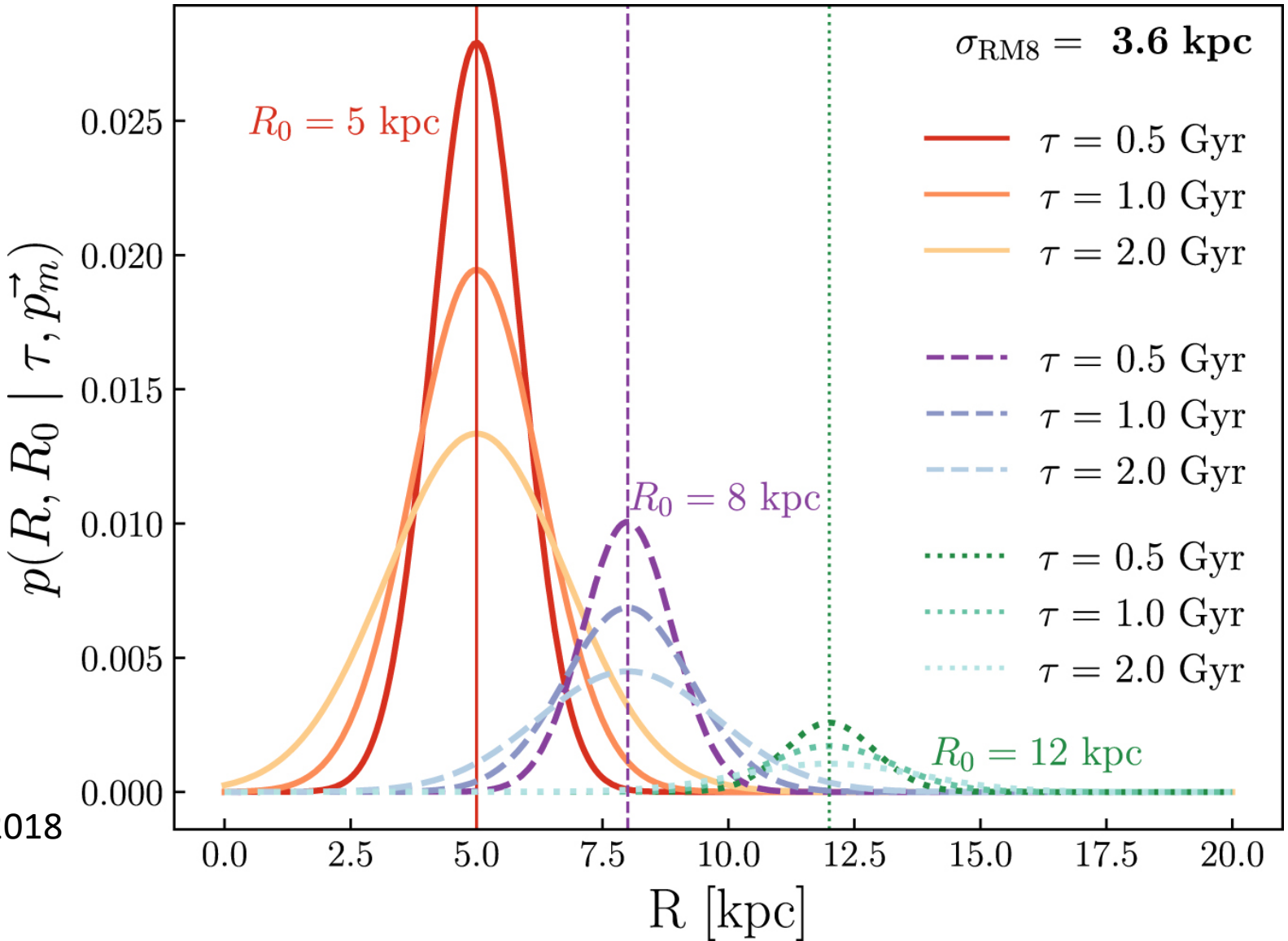
Nature doesn’t do this →

Red Giant bump: Classic Example



Nataf 2013

Radial Migration and Continuity



Frankel et al. 2018

Star formation in WDs & low-mass stars

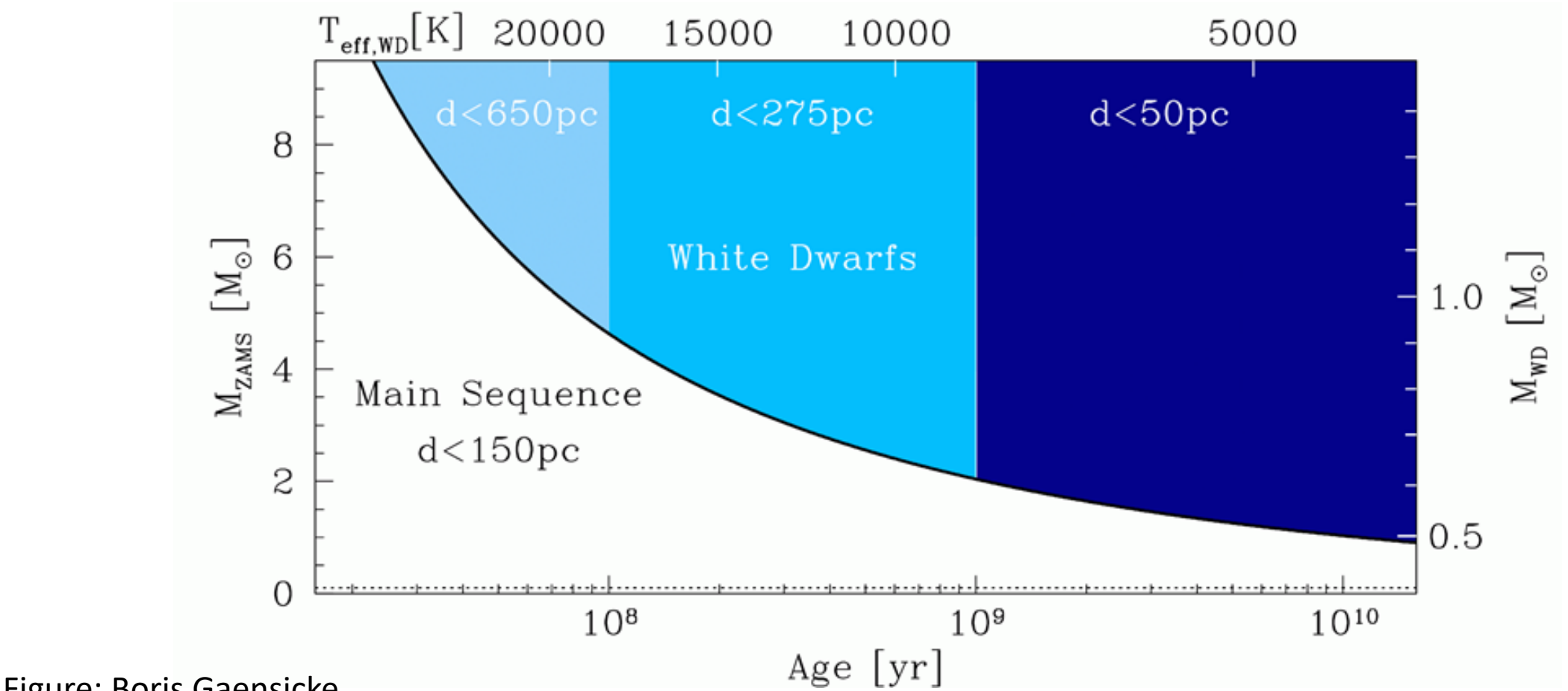
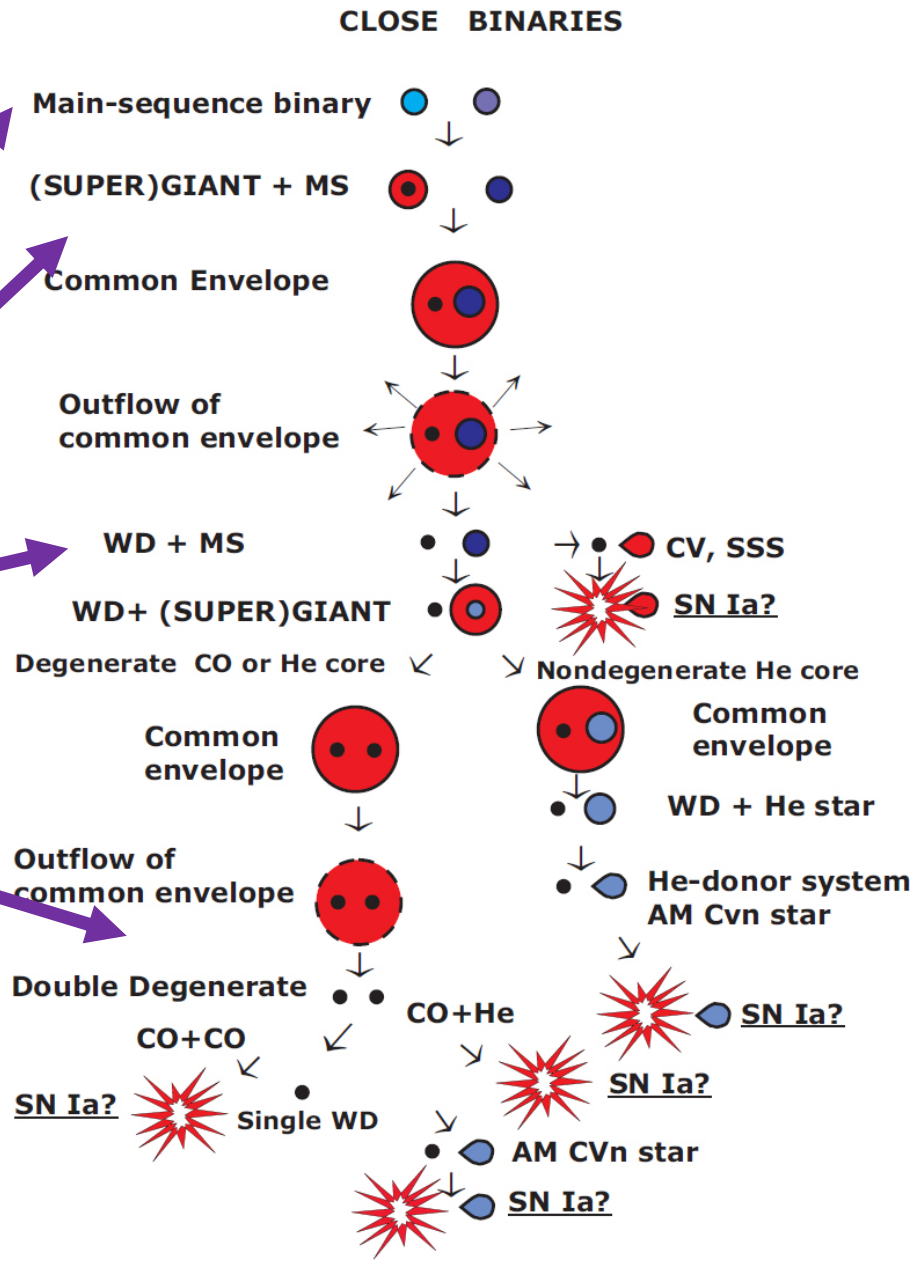
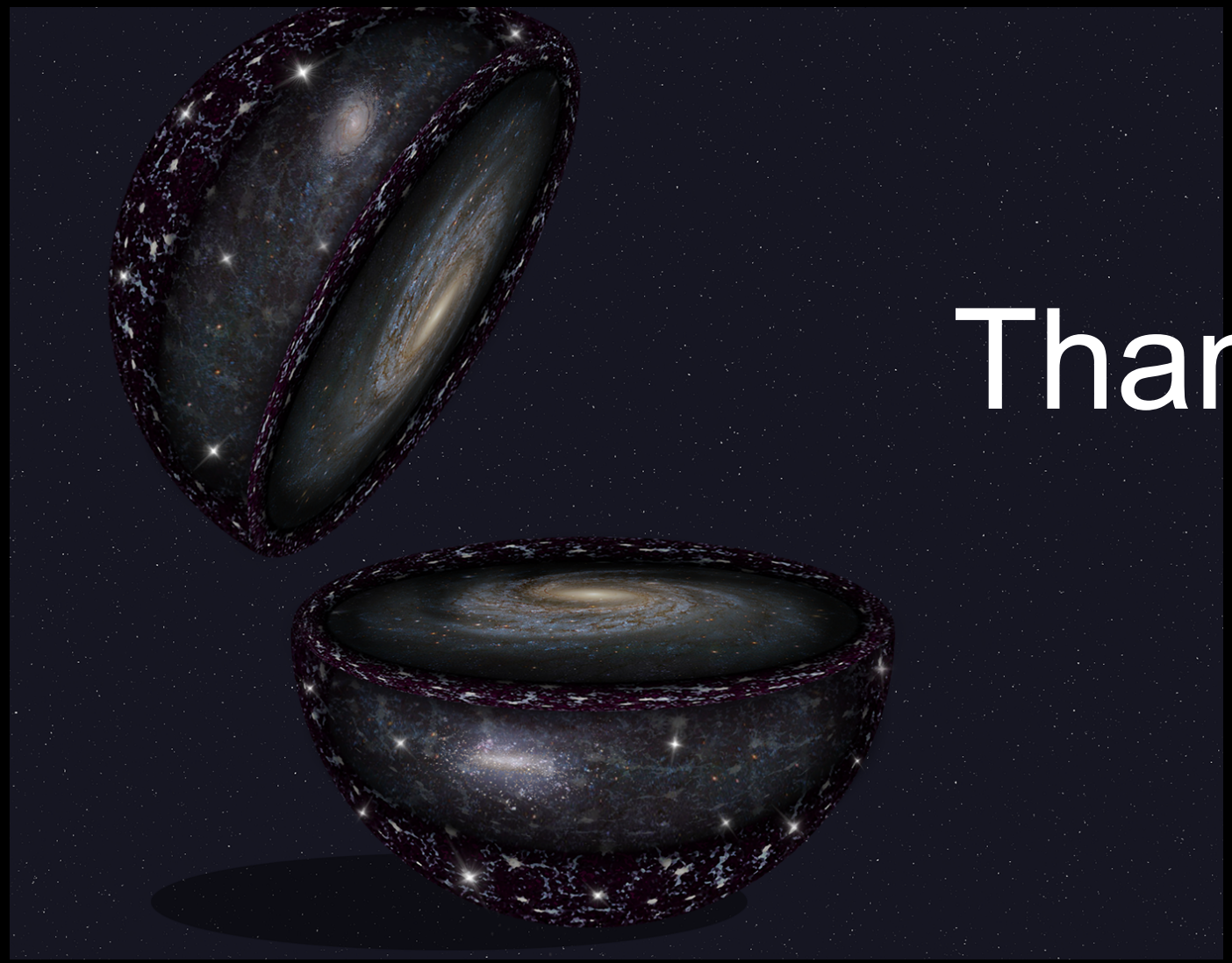


Figure: Boris Gaensicke

Should be able to see these phases!!!!





Thank you!