



OAPD days - INAF Padova

27-28 June 2024

Surveying and modelling resolved stellar populations of nearby galaxies

Giada Pastorelli on behalf of the stellar astrophysics group

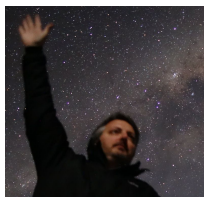
Leo Girardi, Paola Marigo, Sandro Bressan, Guglielmo Costa, Simone Zaggia, Michele Trabucchi, Diego Bossini, Francesco Addari, Kendall Shepherd, Guglielmo Volpato, Alessandro Mazzi, Chi Thanh Nguyen, Greta Ettore, Francesco Guerriero

People

INAF-OAPd



Leo Girardi



Simone Zaggia



Giada Pastorelli



Paola Marigo



Michele Trabucchi



Diego Bossini



Guglielmo Volpato

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Federico di Giacomo
INAF-OAS BO



Sandro Bressan
SISSA



Chi Thanh Nguyen
INAF-OATs



Guglielmo Costa
Uni Lyon

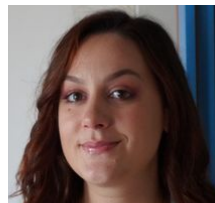


Francesco Addari
SISSA

Other institutions/associati



Francesco Guerriero
Uni Leiden



Greta Ettore
Uni Bologna



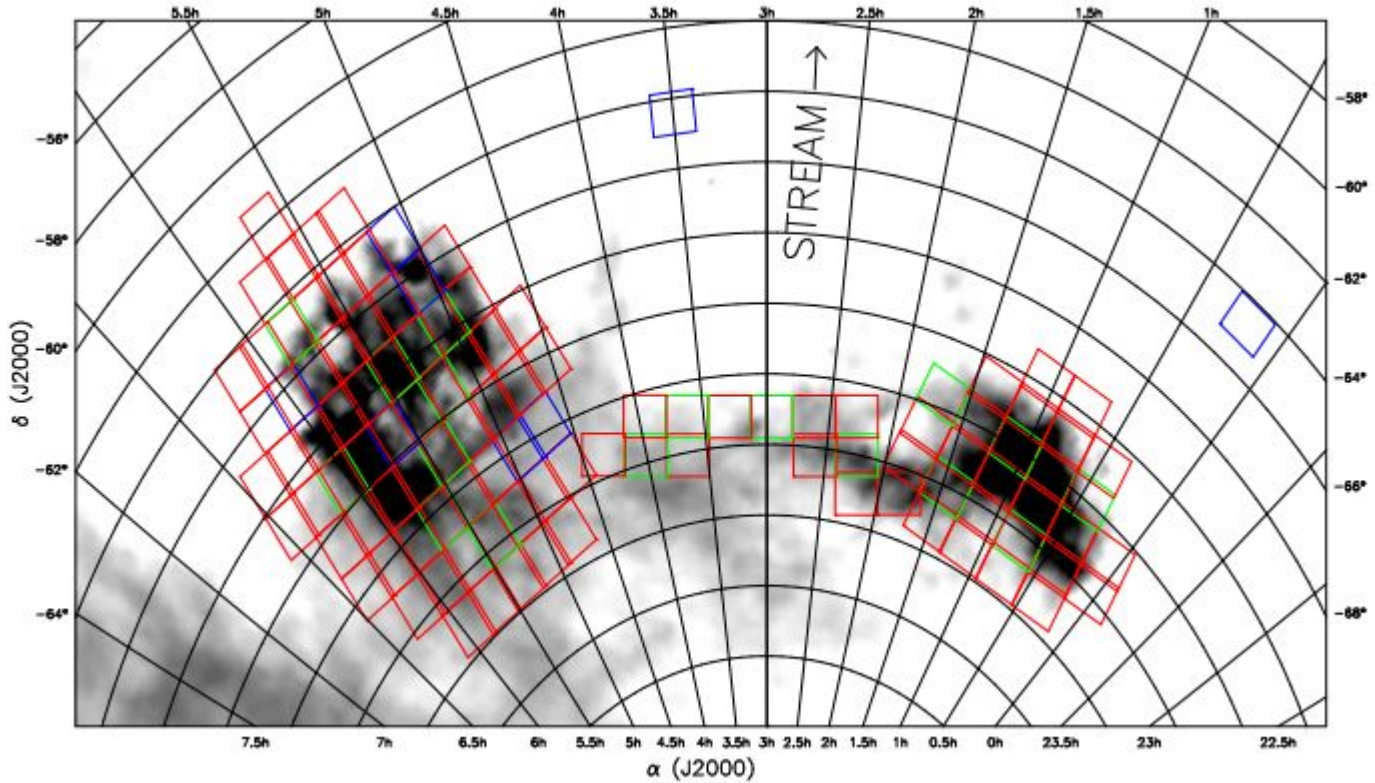
Alessandro Mazzi
Uni Bologna



Kendall Shepherd
SISSA

Star Formation Histories from VISTA IR photometry

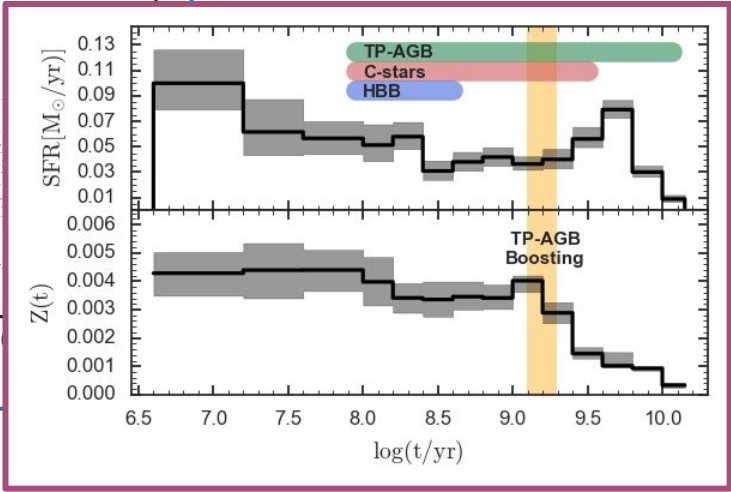
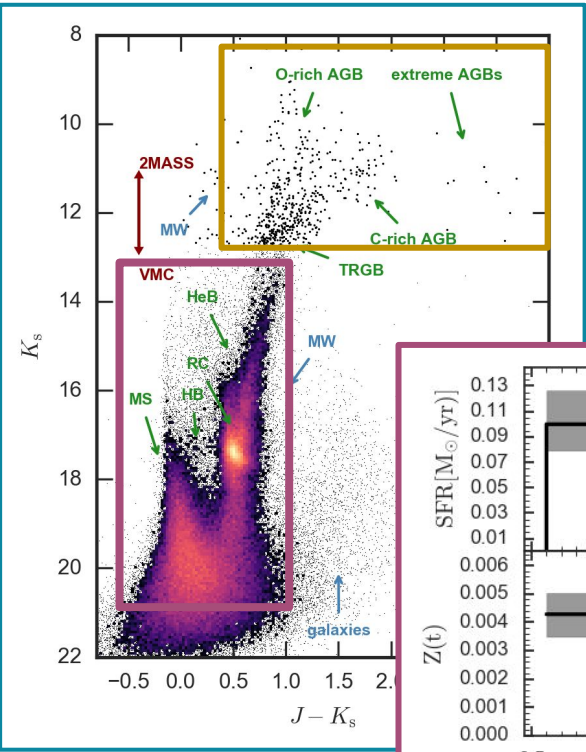
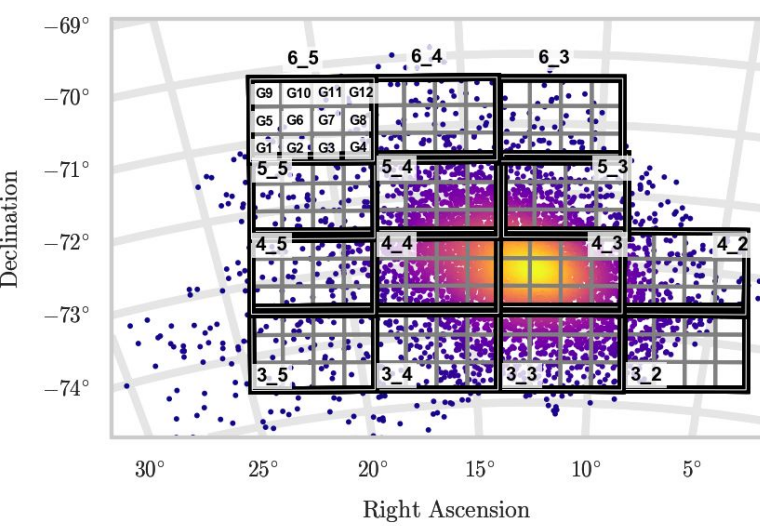
Vista Survey of the Magellanic Clouds (VMC, Cioni+11)



Y, J, Ks
Deep
Multi-epoch

SFH and 3D
structure

Star Formation Histories from VISTA IR photometry



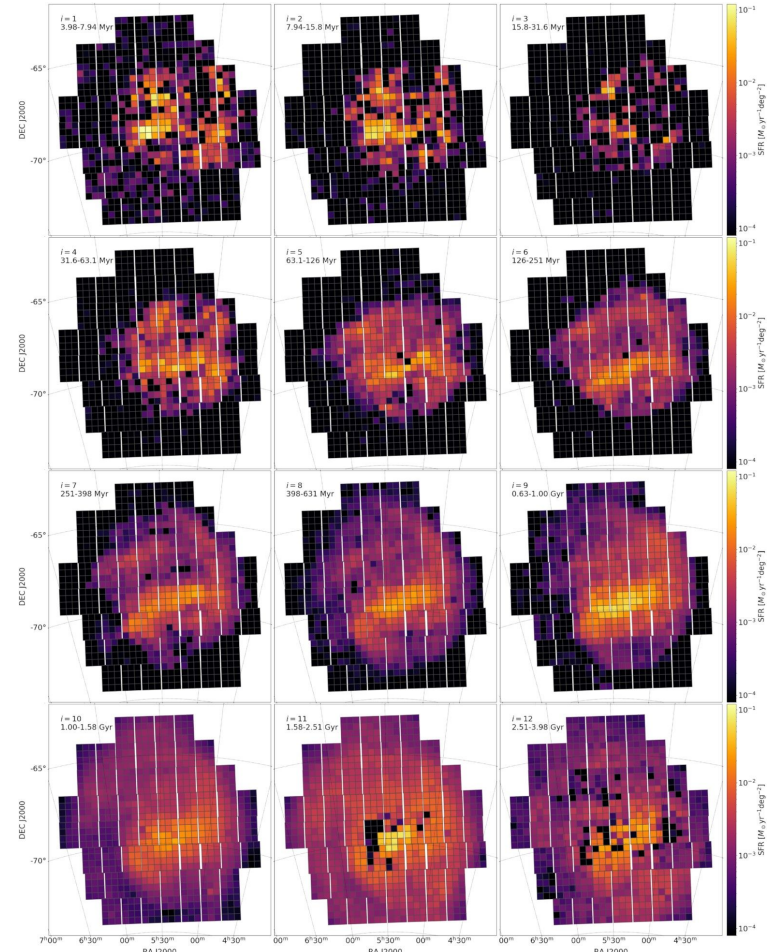
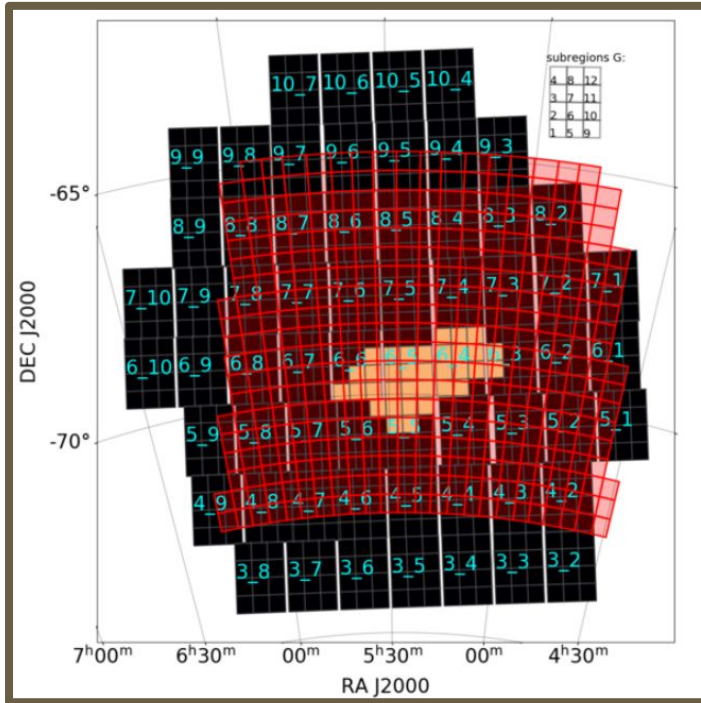
Small Magellanic Cloud (Rubele+18)

Robust SFR(t), AMR, distance & Av

CMD fitting based on TRILEGAL and PARSEC 1.2S

Star Formation Histories from VISTA IR photometry

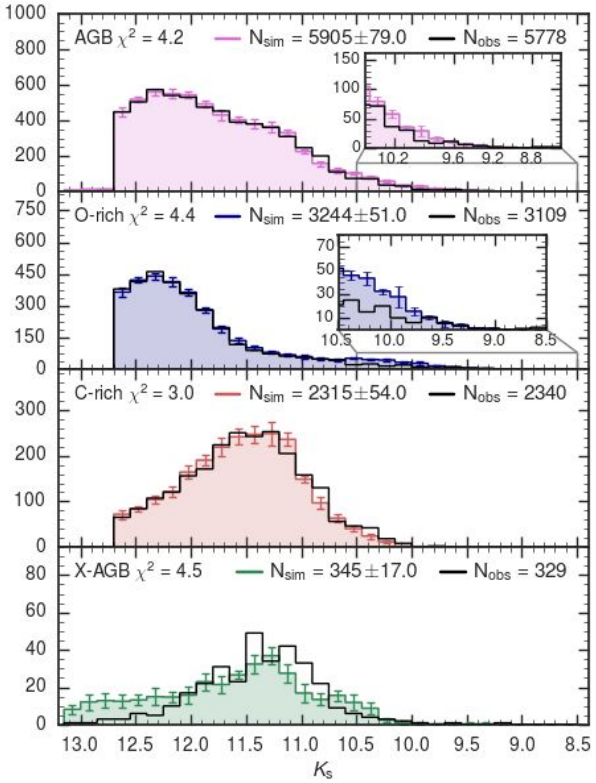
Large Magellanic Cloud
(Mazzi+21)



Spitzer SAGE surveys to calibrate AGB models



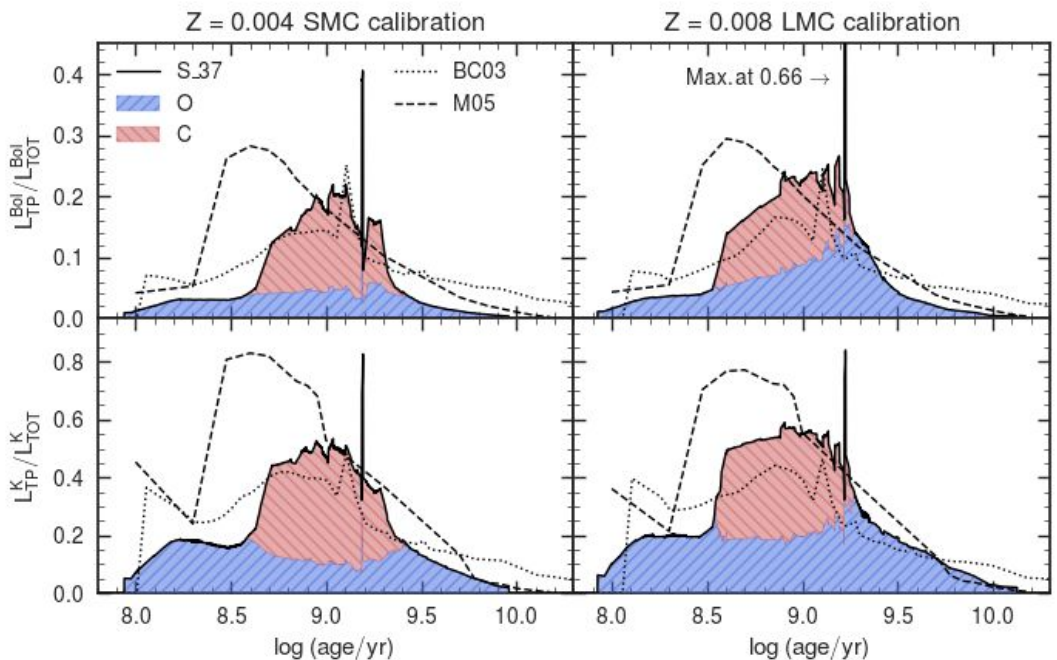
SMC best-fitting model
(out of 35 sets of COLIBRI models)



From Pastorelli+19,+20

SMC and LMC catalogs w/ optical to IR photometry and C- and M-stars identification (Boyer+11, Srinivasan+16)

Contribution to integrated light of SSPs



HST surveys of M31 and M33

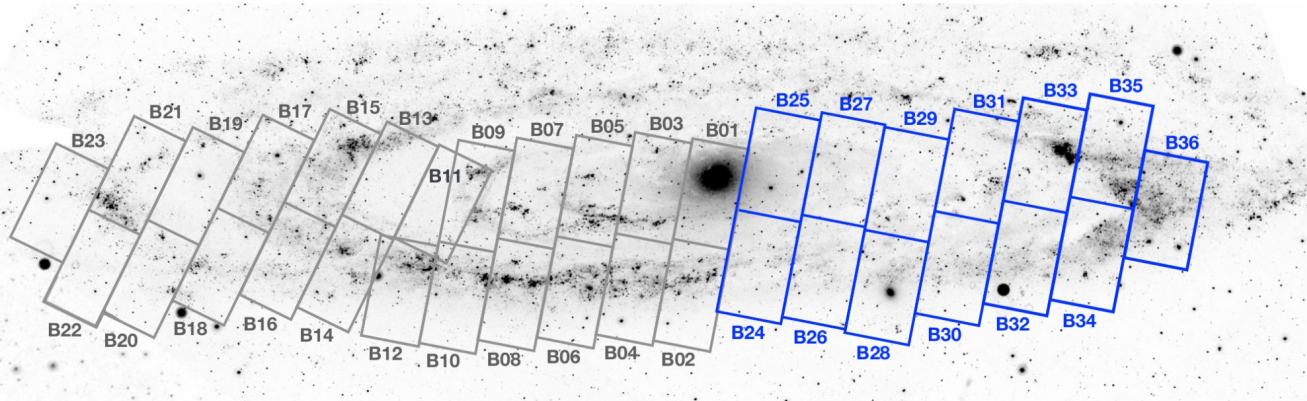
Dalcanton+12, Williams+14: >1200 HST orbits to image M31 and M33 inner disks – detailed stellar populations, dust, star clusters & stellar evolution

F275W, F336W (WFC3/UVIS) F475W, F814W (ACS/WFC) F110W, F160W (WFC3/IR)

PHAT (6 filters)

PHAST (4 filters)

PHATTER (6 filters)

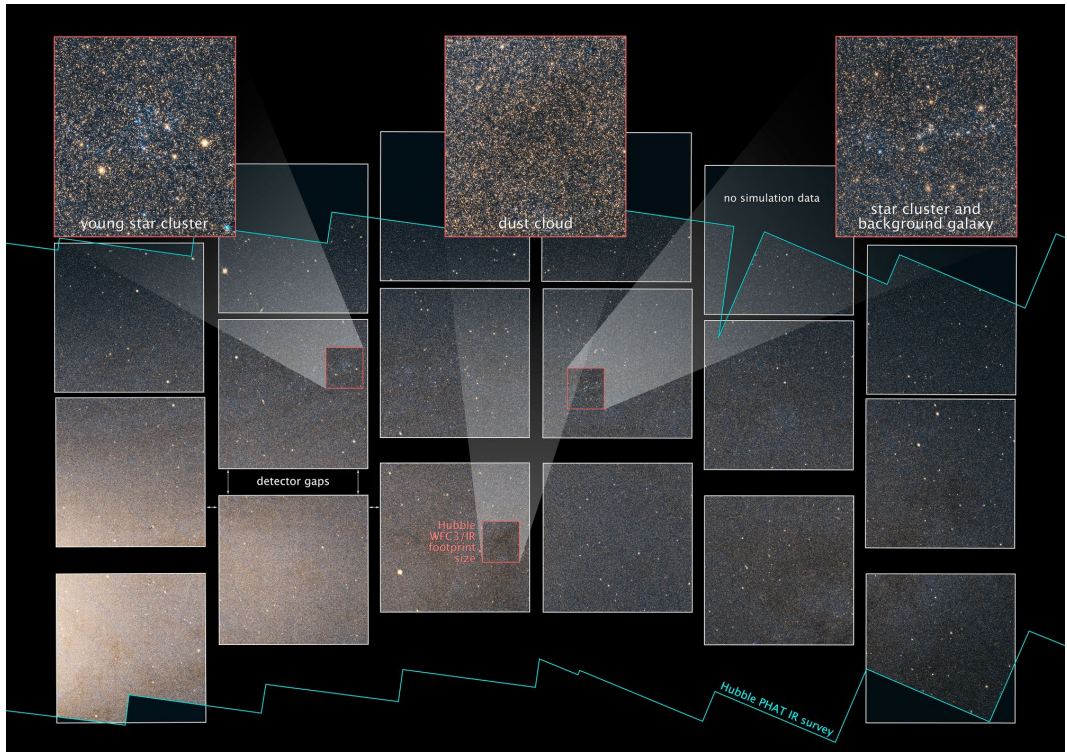
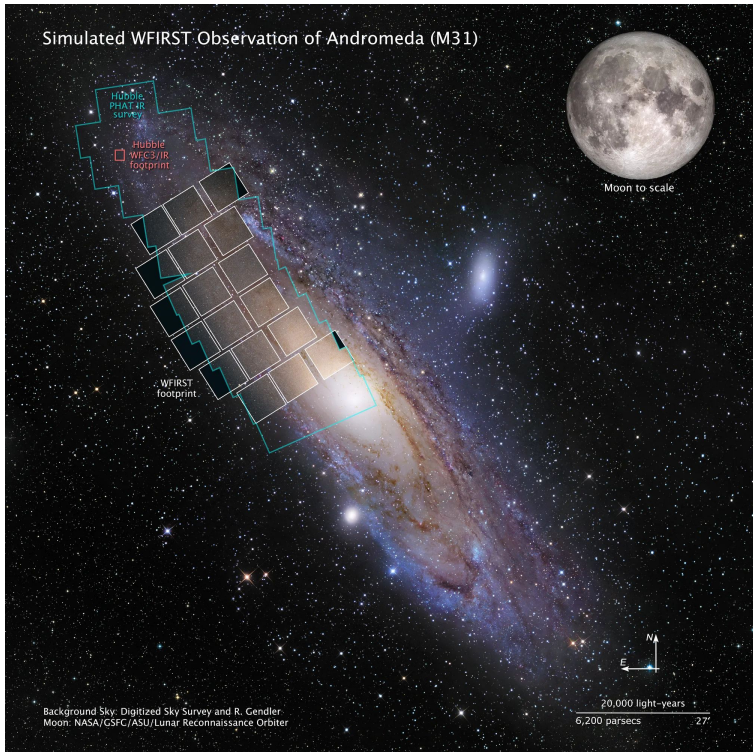


From Chen+, under revision ApJ

NASA, ESA, Digitized Sky Survey 2; acknowledgment: Davide De Martin

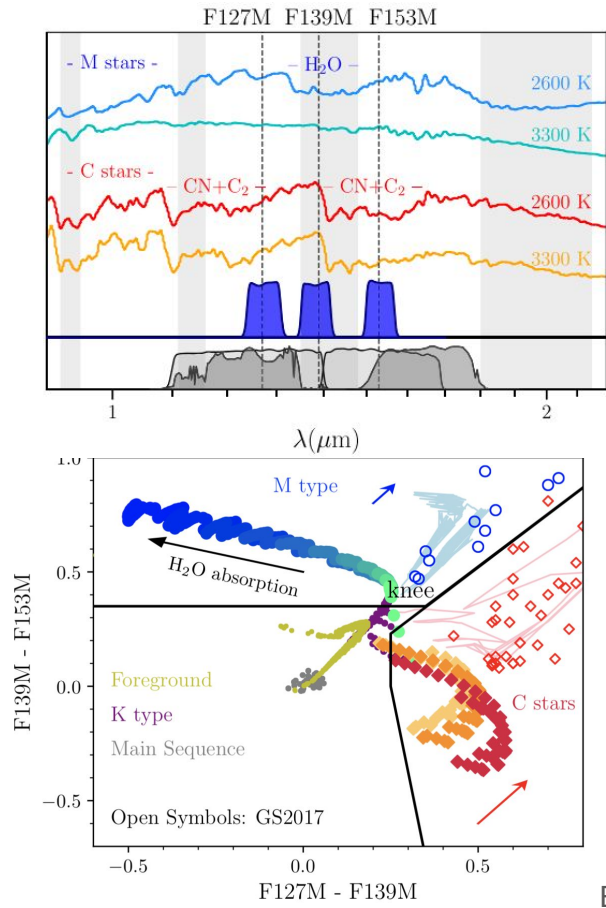
Roman Infrared Nearby Galaxies Survey (RINGS)

- Girardi, Kalirai, Dalcanton+: participation in the WFIRST Filters WG
- Williams+: software to simulate, and later reduce, Roman data of nearby galaxies

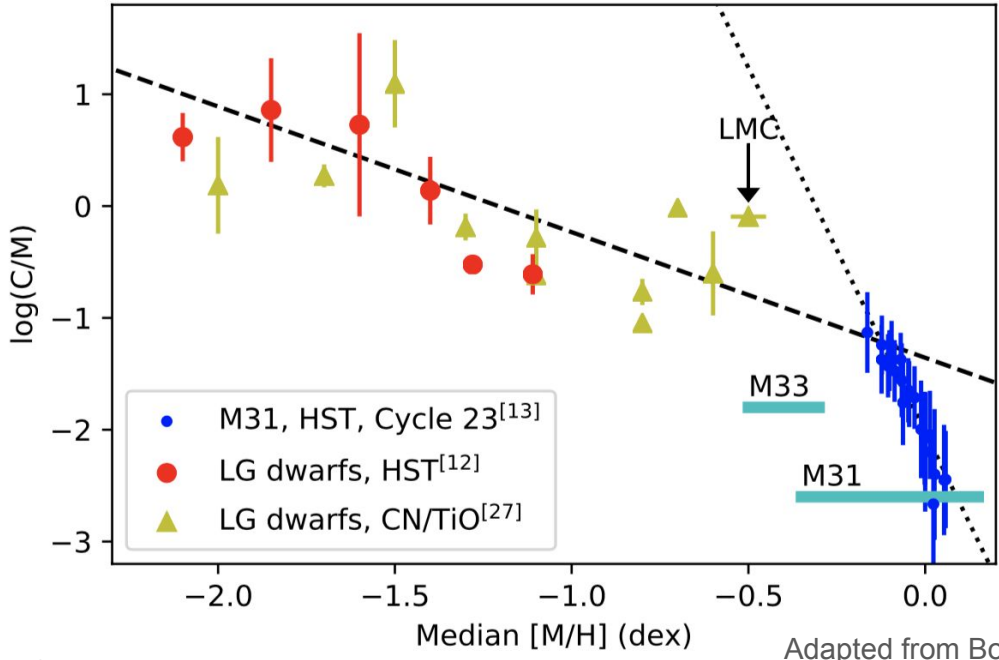


WFIRST simulation: NASA, STScI, and B. F. Williams (University of Washington)

HST/WFC3 medium-band IR programs



Adding HST/WFC3 medium filters to measure C/M ratio of AGB stars

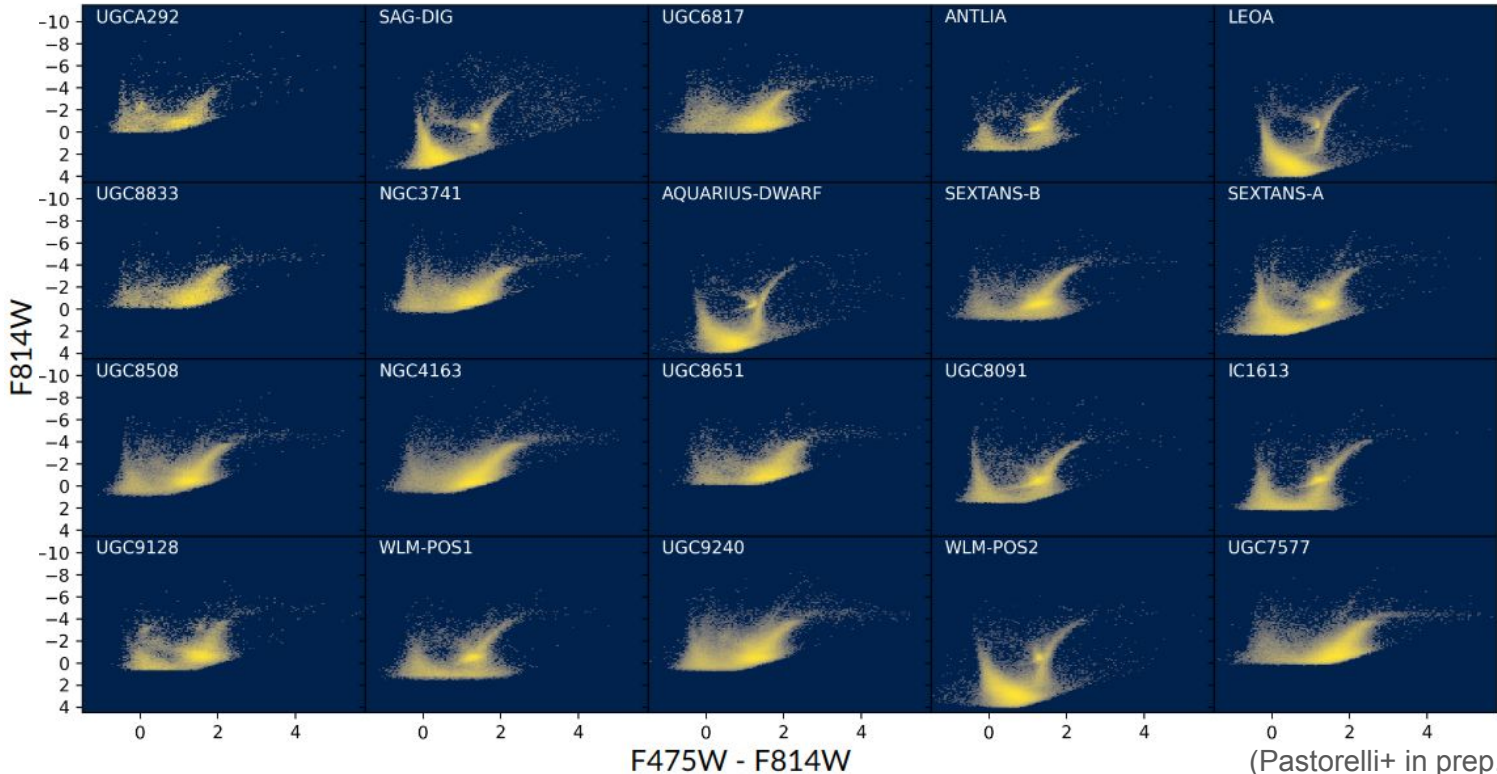


Boyer+13,+17

Adapted from Boyer+19

Local Ultraviolet to Infrared Treasury (LUVIT) HST Survey

19 metal poor dwarf galaxies w/ HST F127M, F139, F153M, F110W, F160W plus F275W, F336W & archival F475W, F814W IR: GO-16162 (PI Boyer) & GO-15275 (PI: Gilbert)



Star formation history

Identification of:
> C- and M-stars
> R/B HeB stars

Synthetic catalogs with TRILEGAL

Constraints for AGB and CHeB models at low metallicity

(Pastorelli+ in prep.)

Fitting HST data of Magellanic Clouds' clusters with rotating models

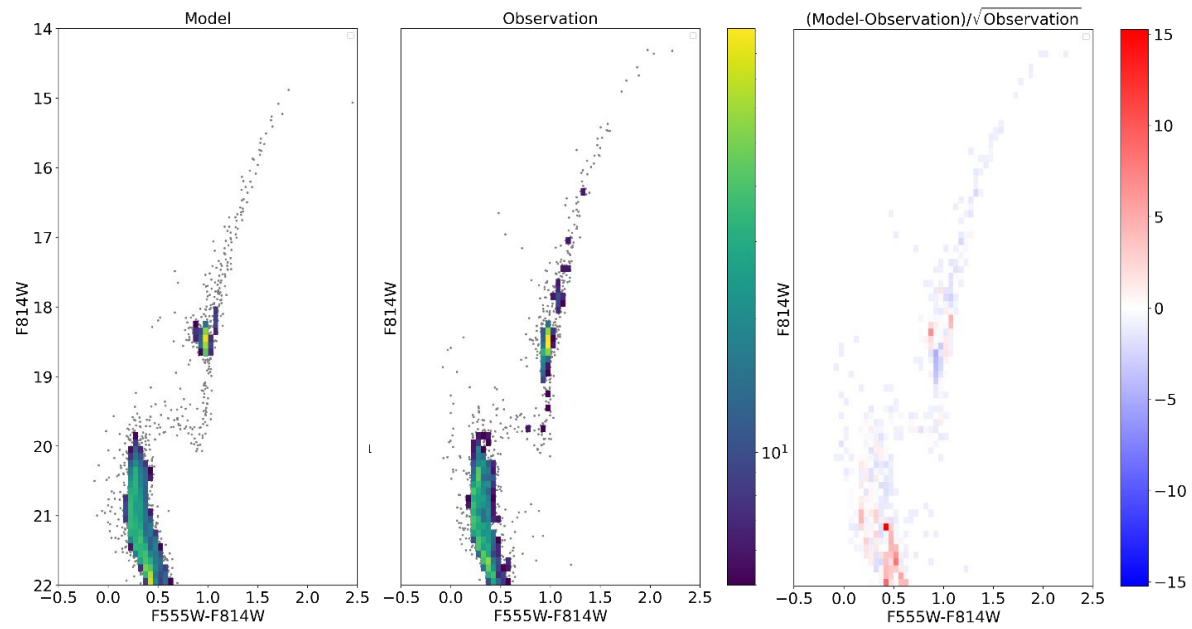
Several GO & Archival projects in collaboration with Paul Goudfrooij (STScI) and Ben Williams (UW)

NGC 1651 (LMC)



Credits: ESA/Hubble & NASA, L. Girardi, F. Niederhofer

NGC 419 (SMC)



Adapted from Ettore+ (submitted)

Fitting HST data of Magellanic Clouds' clusters with rotating models

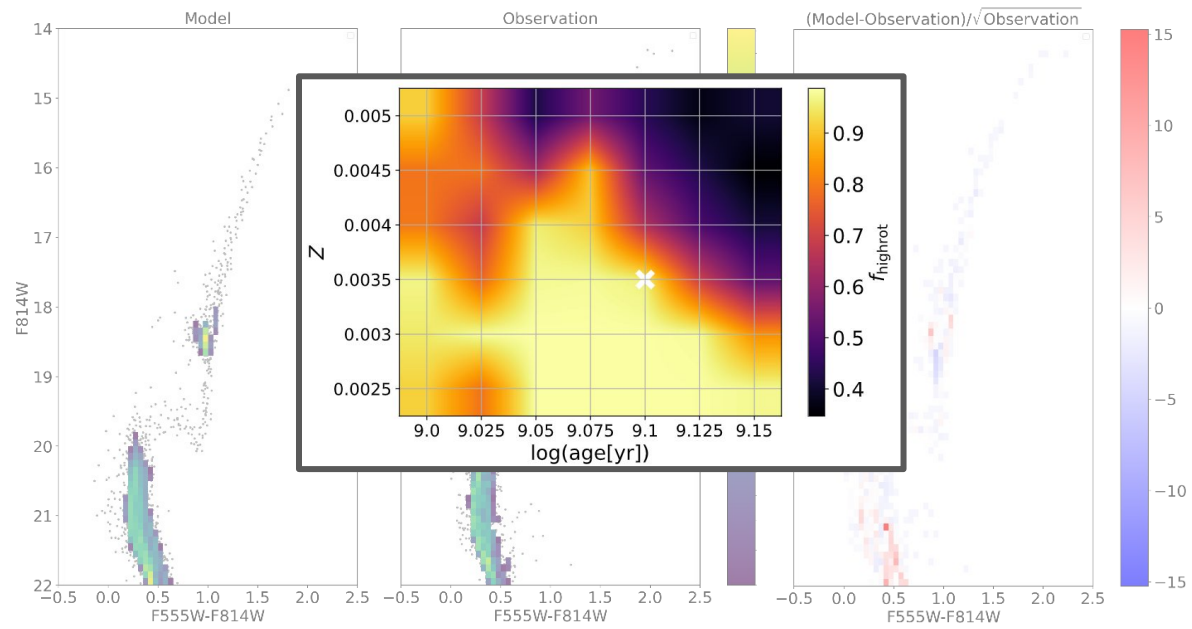
Several GO & Archival projects in collaboration with Paul Goudfrooij (STScI) and Ben Williams (UW)

NGC 1651 (LMC)



Credits: ESA/Hubble & NASA, L. Girardi, F. Niederhofer

Very high fraction of fast rotators



Adapted from Ettore+ (submitted)

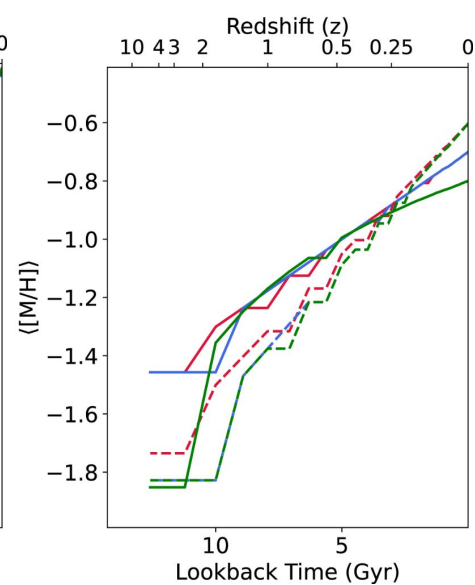
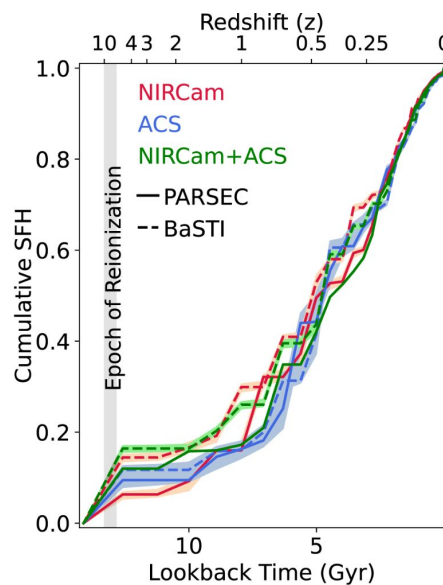
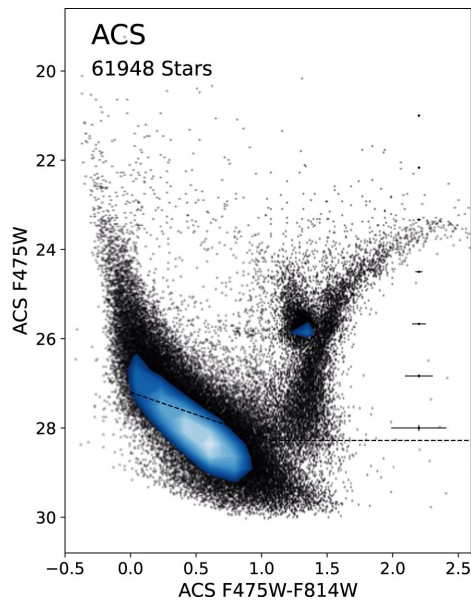
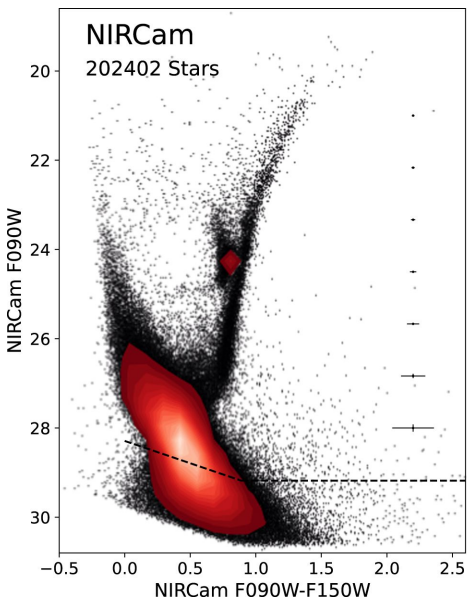
The JWST Resolved Stellar Populations

Early Release Science Program

JWST-ERS 1334
PI Dan Weisz
[ers-stars.github.io](https://github.com/ers-stars)

NIRCam & NIRISS imaging of globular cluster **M92**, ultra-faint dwarf galaxy **Draco II**, and star-forming dwarf galaxy **WLM**

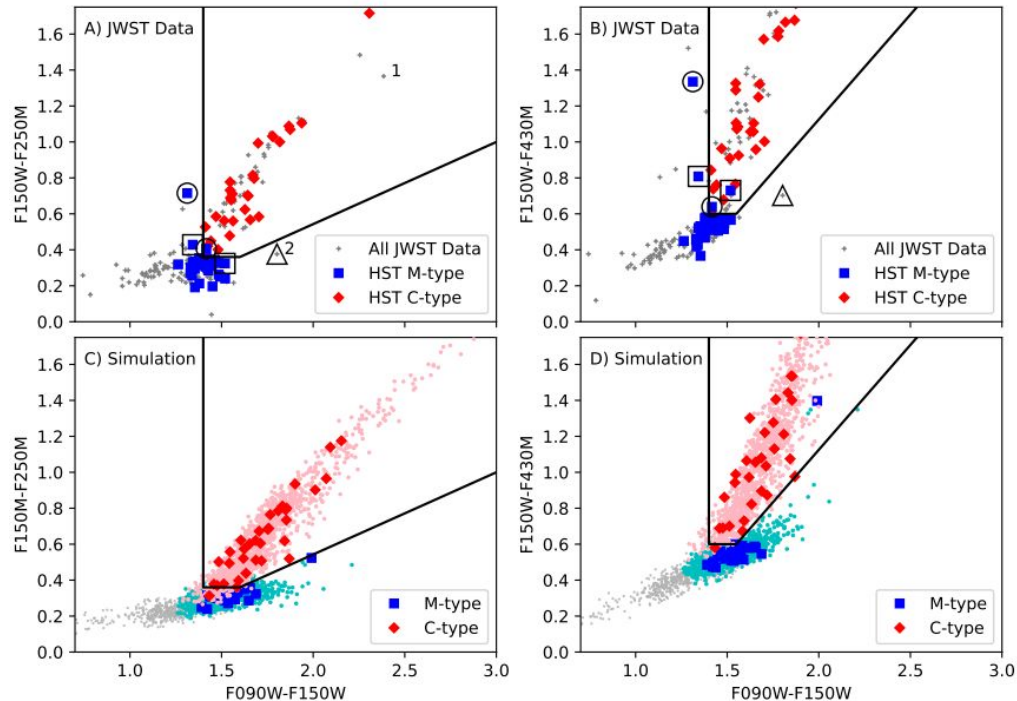
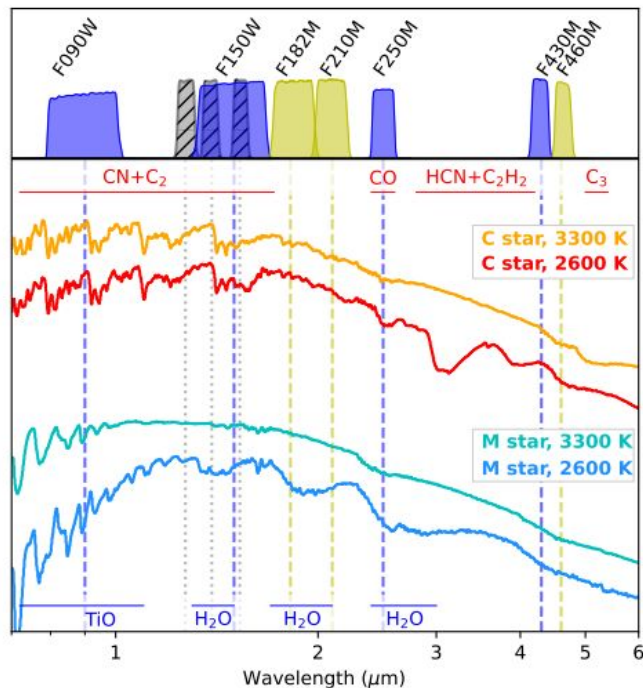
SFH of WLM from McQuinn+2024



The JWST Resolved Stellar Populations Early Release Science Program

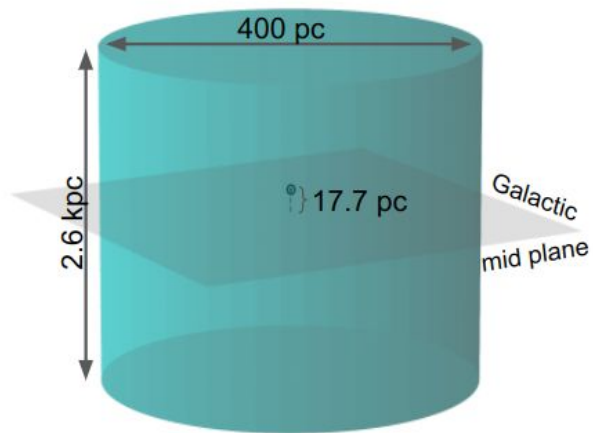
JWST-ERS 1334
PI Dan Weisz
[ers-stars.github.io](https://github.com/ers-stars)

Identifying evolved stars with JWST from Boyer+2024

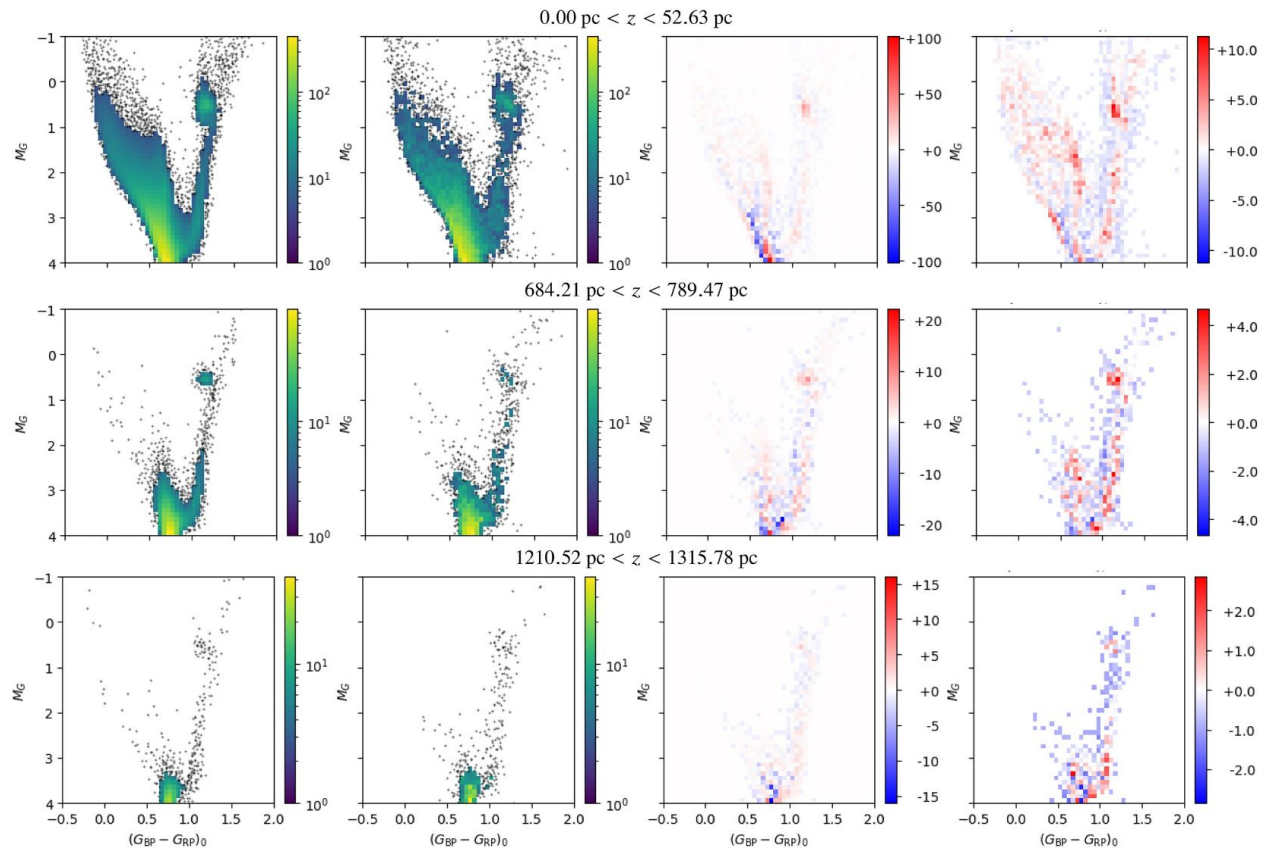


The SFH of the Milky Way disk with Gaia DR3 data

Vertical structure of the star formation history across the solar cylinder (Mazzi+23)

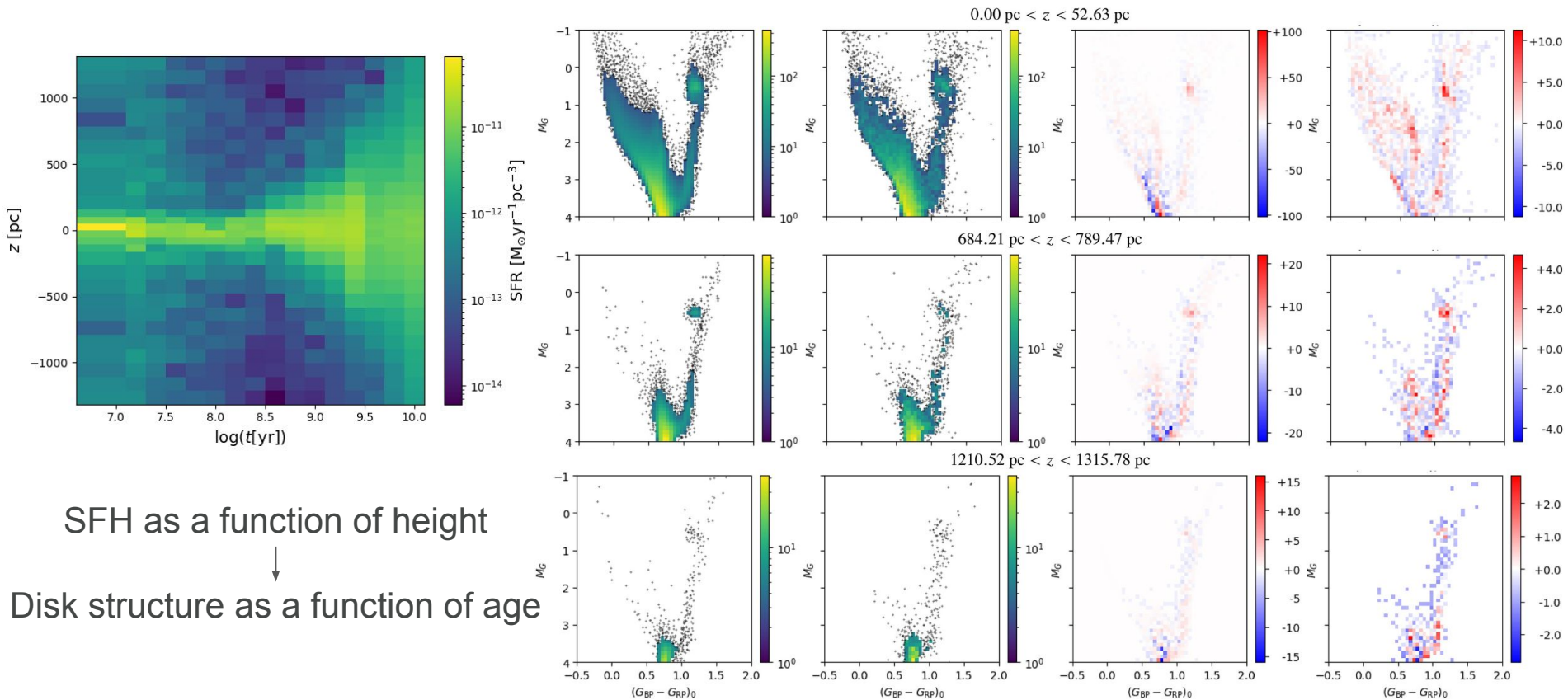


SFH as a function of height



The SFH of the Milky Way disk with Gaia DR3 data

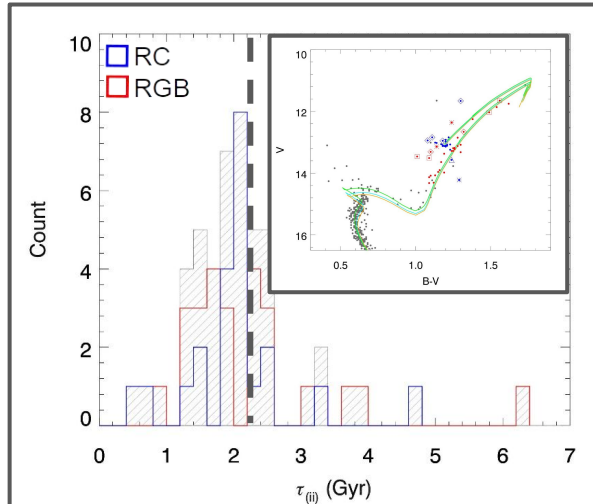
Vertical structure of the star formation history across the solar cylinder (Mazzi+23)



Asteroseismology

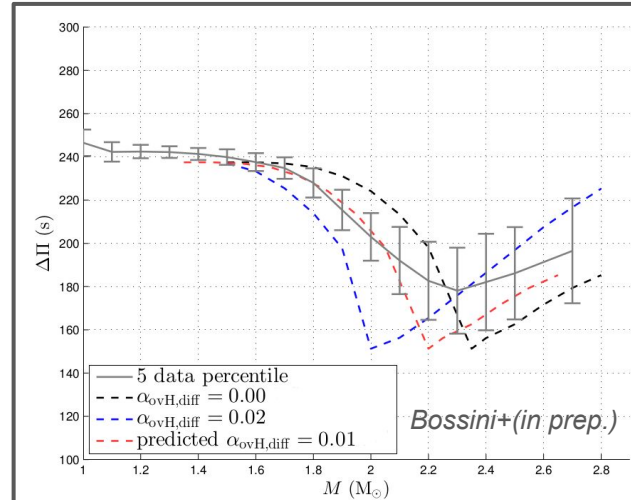
Collaborations with stellar evolution and “galactic archeology” teams in *Kepler*, PLATO, HAYDN (Miglio, Mosser, Campante, Cunha)

Kepler



Stellar characterization with asteroseismology using [PARAM](#) and determination of cluster ages through Red Giants members (Rodrigues+17)

PLATO



Target selection for a calibration sample within WP127 to map the red clump - secondary clump transition mass and calibrating the MS core mixing in intermediate-mass stars



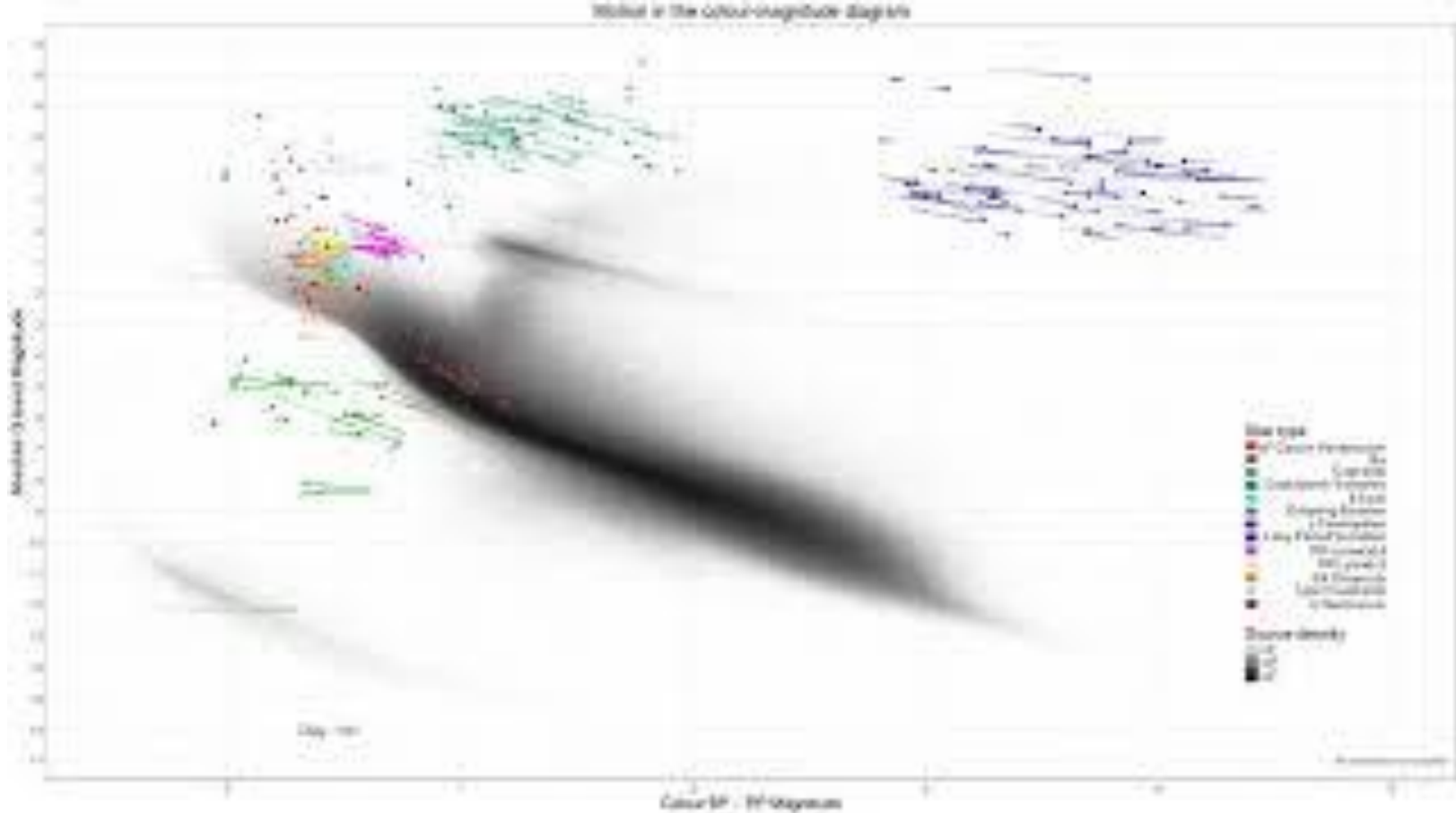
High-precision Asteroseismology in DeNse stellar fields

Core team of [HAYDN](#) PI A. Miglio

Proposed ESA/M7 mission for asteroseismology in dense stellar fields. Postponed to M8

Stellar variability surveys

More info about the video in the next slide



Stellar variability surveys

Variable stars in the Hertzsprung-Russell diagram

Description of the video

This video shows the way variable stars change their brightness and colour over time, as viewed by ESA's Gaia satellite using information from the mission's second data release. The stars are plotted on a Hertzsprung-Russell diagram, named after the astronomers who devised it in the early 20th century, which locates stars according to their colour and brightness.

More info

More about Gaia's second data release: <http://sci.esa.int/gaia/60192-gaia-creates-richest-star-map-of-our-galaxy-and-beyond/>

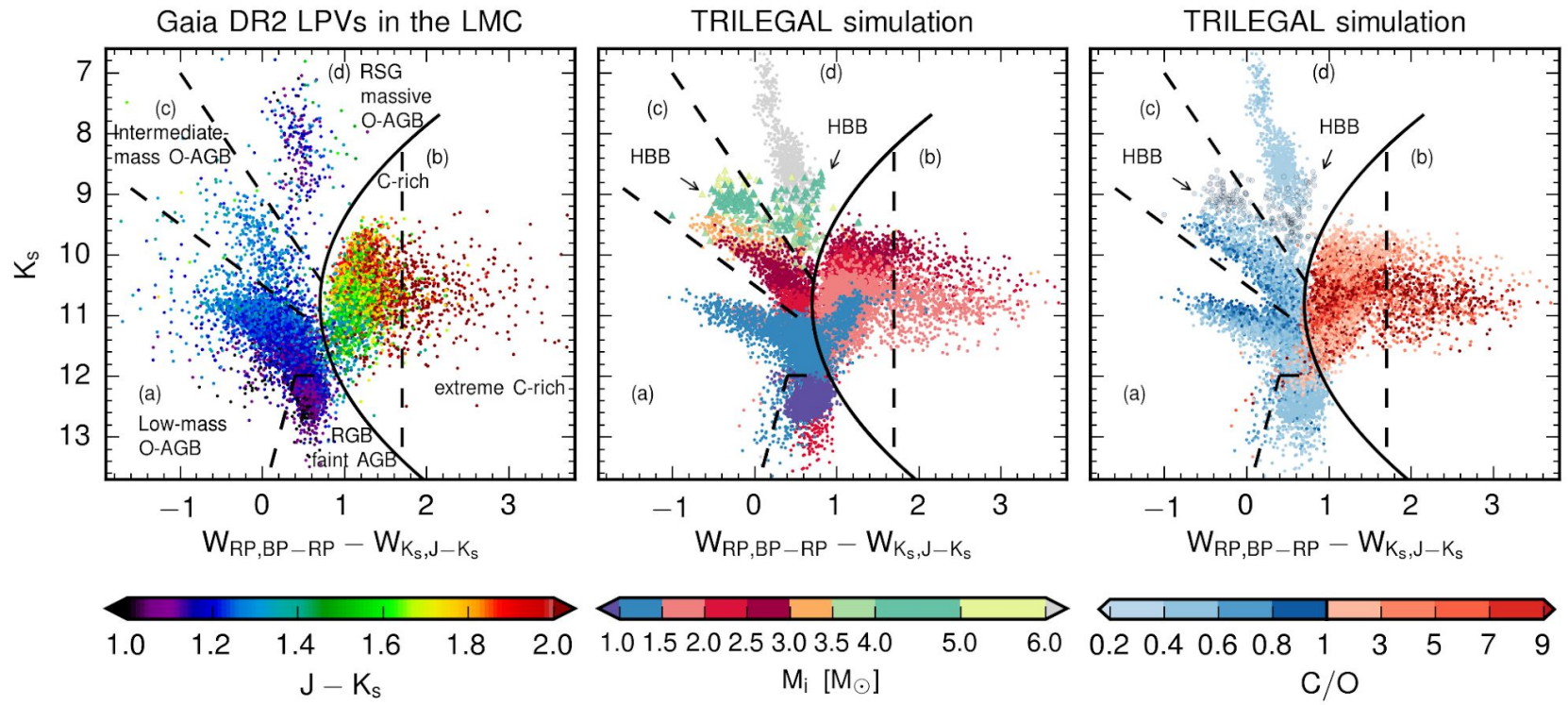
More information about this video and a download option can be found at <http://sci.esa.int/gaia/60239-variable-stars-in-the-hertzsprung-russell-diagram/>

Credit: ESA/Gaia/DPAC, CC BY-SA 3.0 IGO
<http://creativecommons.org/licenses/by-sa/3.0/igo/>

Acknowledgement: Gaia Data Processing and Analysis Consortium (DPAC); Gaia Coordination Unit 7; K. Nienartowicz / L. Eyer / L. Rimoldini / O. Marchal / F. Glass

Stellar variability surveys

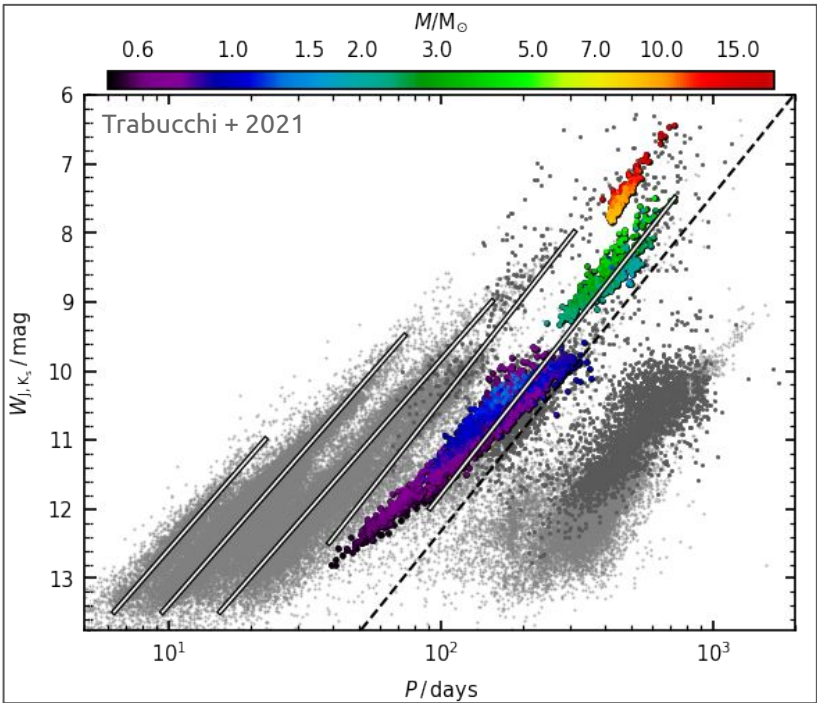
Long Period Variable stars in the Gaia-2MASS diagram



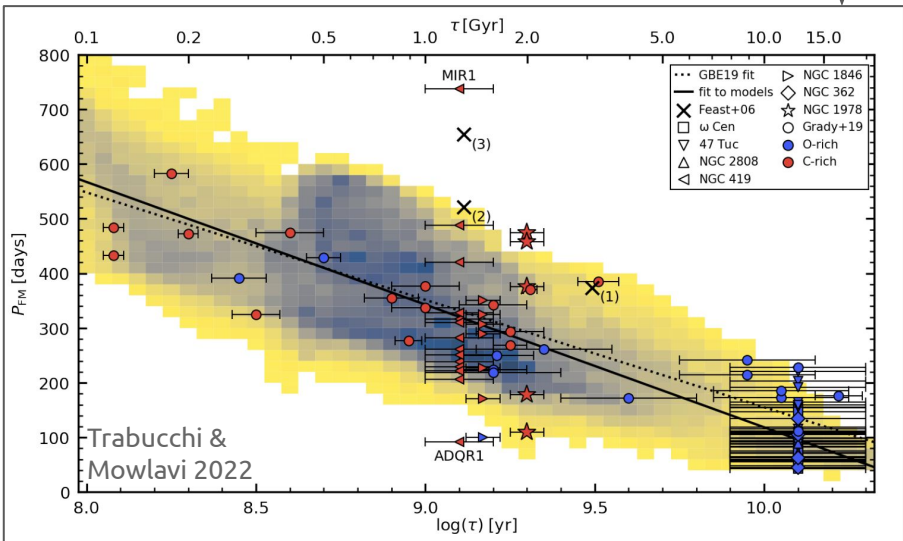
Adapted from Lebzelter+18

Stellar variability surveys

Interpreting data from OGLE, Gaia, ZTF and preparing for Rubin/LSST



Period-Luminosity & Period-Age relations of Long-Period Variables



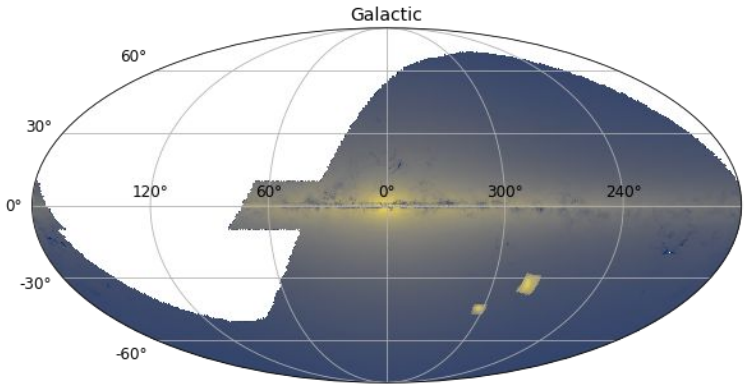
Ready
Periods & dominant mode for LPVs and Classical Cepheids

On-going
Photometric amplitudes, Light-curve templates, RR-Lyrae

Next
Other variable stars: Solar-like oscillators ...
→ Community input

Rubin-LSST & our in-kind contribution

Population models of the LSST stellar content – *Popstar-LSST* PI L. Girardi



- > Optimization of survey strategy
- > Interpretation of LSST data
- > Further constraints to stellar models

ApJS paper [Dal Tio+22](#)
TRILEGAL [Single](#) & [Binary](#) star catalogs
Jupyter Notebook Tutorials [here](#)
In-kind contributions [Rubin-LSST@Italy](#)

