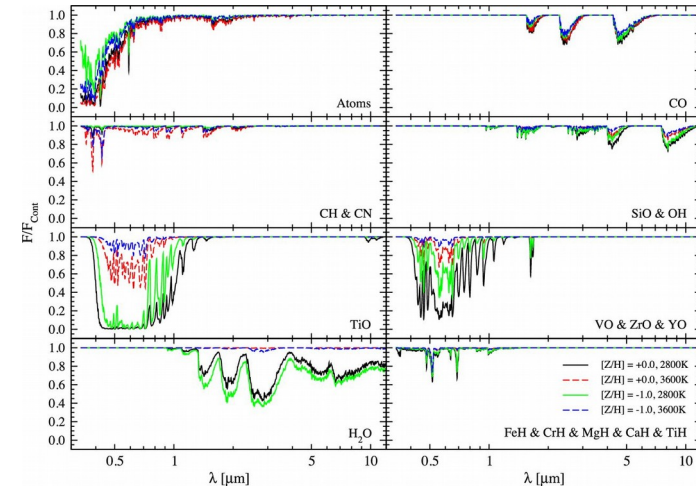
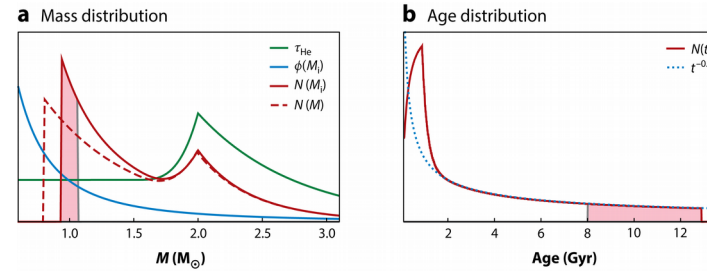
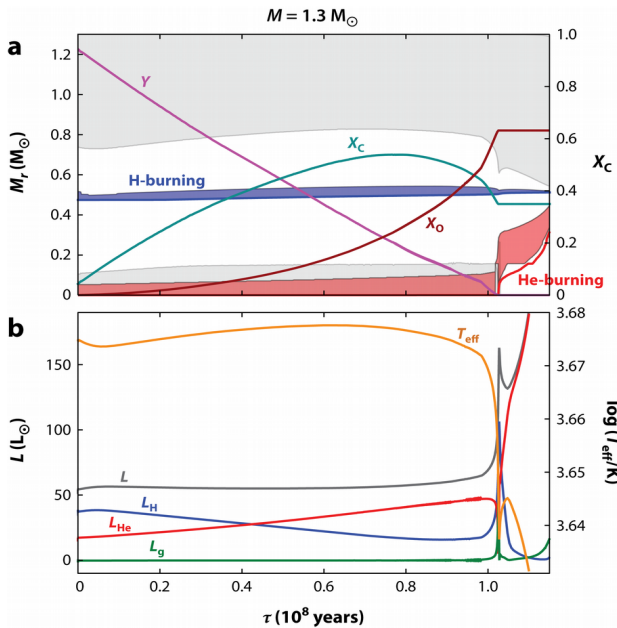
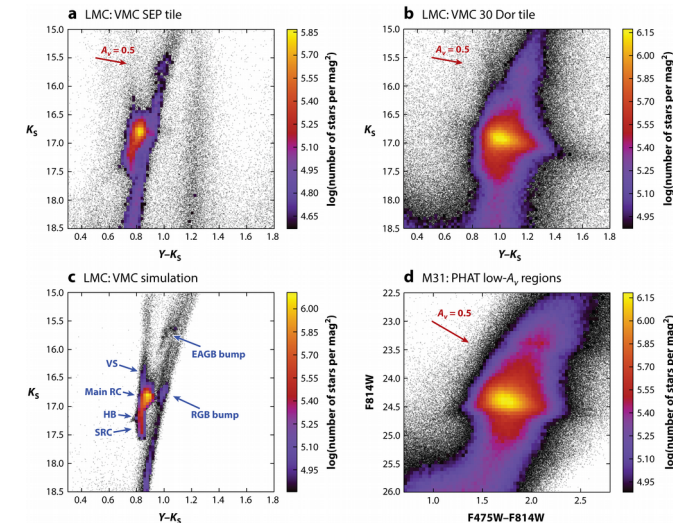
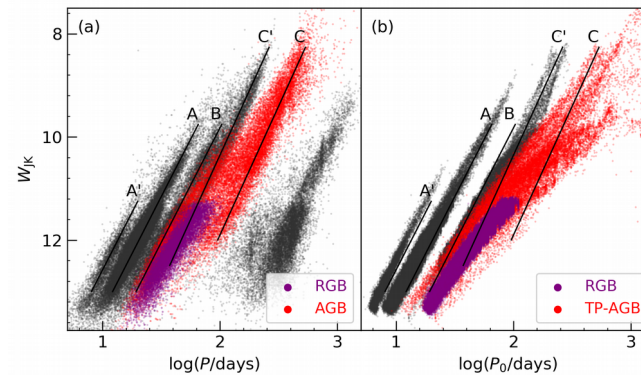
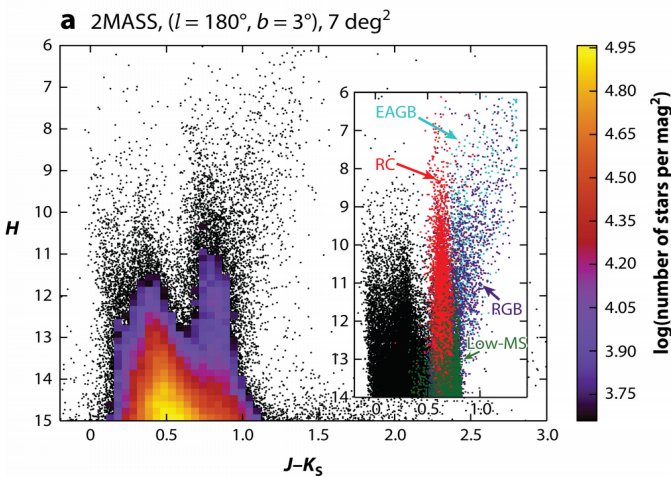
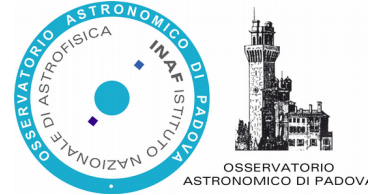


# Modelling stellar populations (in 10 slides)



Léo Girardi

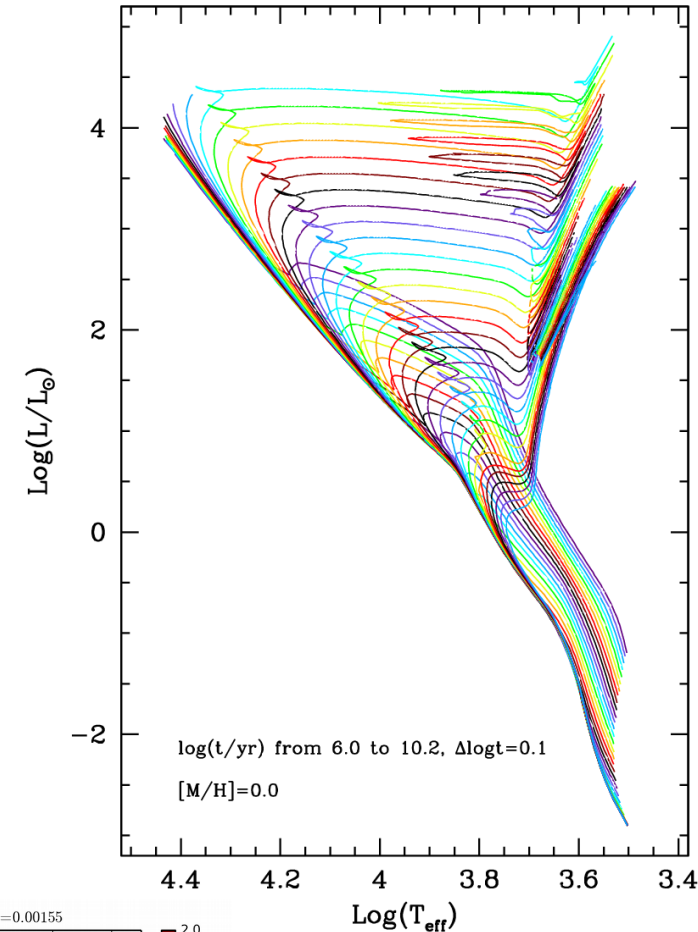
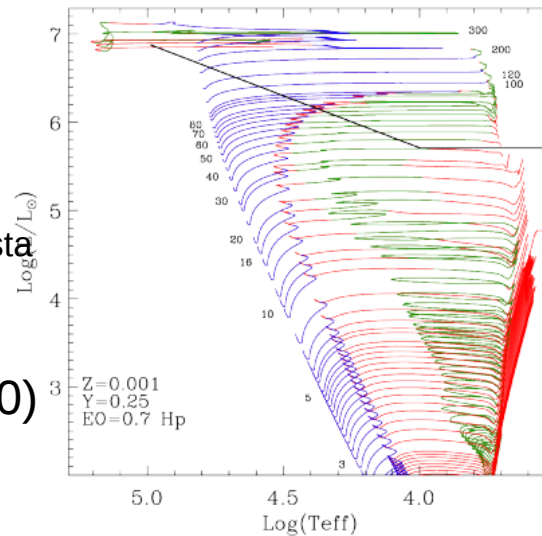


# PARSEC – the Padova And tRieste Stellar Evolution Code

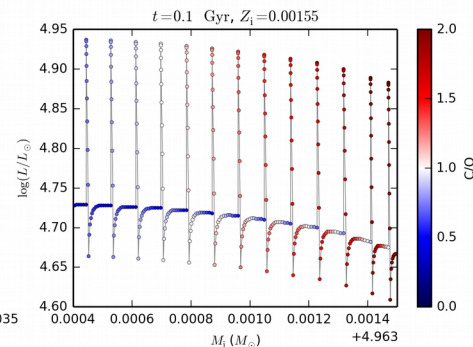
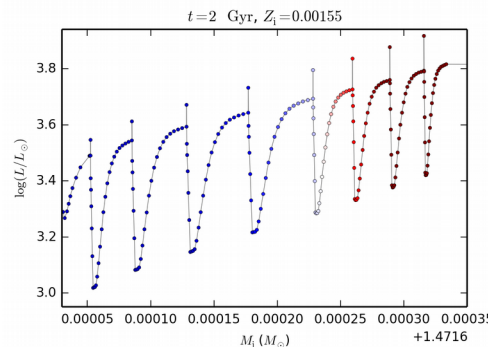
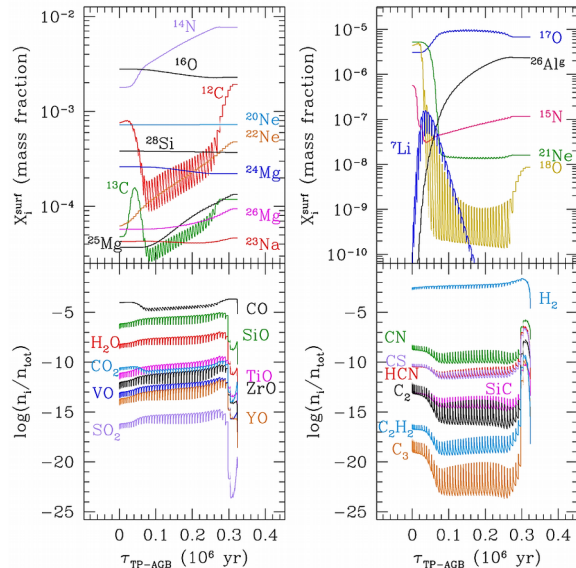


Alessandro Bressan, Paola Marigo, LG, Guglielmo Costa

PARSEC = Evolution from pre-MS to TP-AGB or Fe-group core (Bressan+20)  
Now with rotation! (Costa+19)



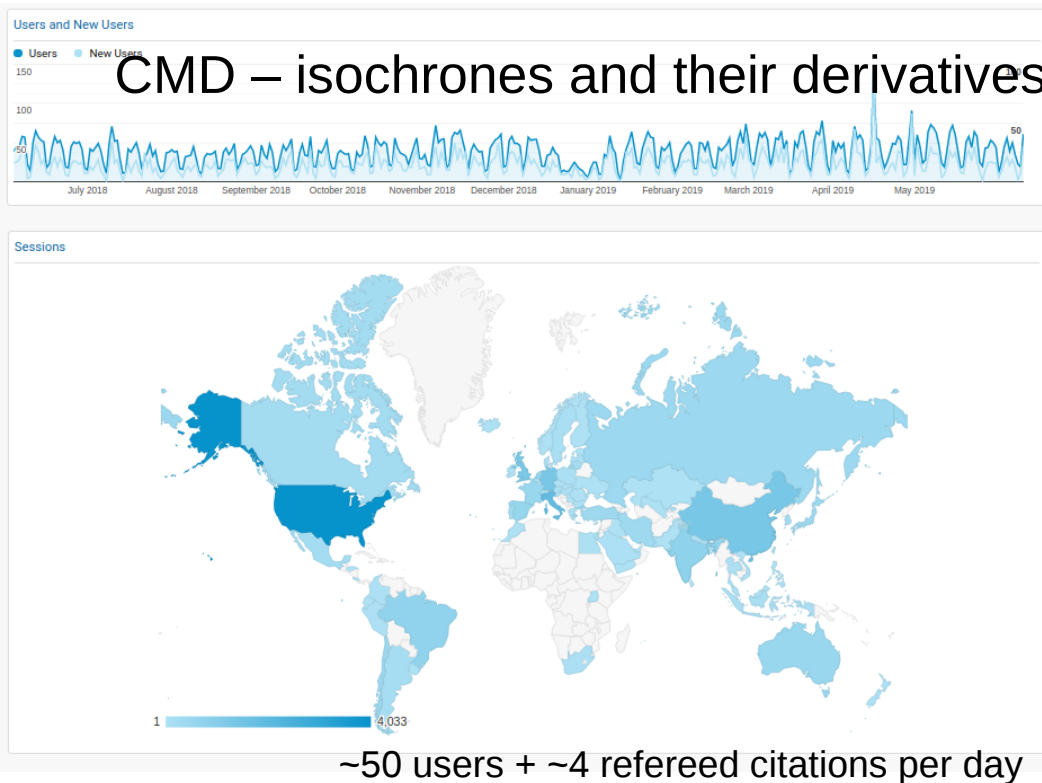
+ COLIBRI =  
detailed TP-AGB



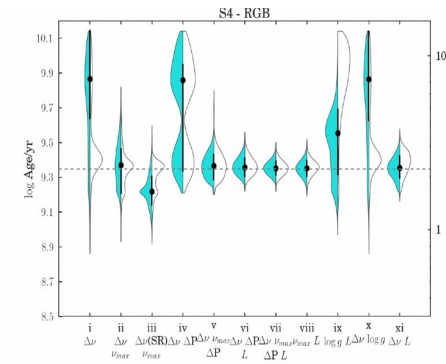
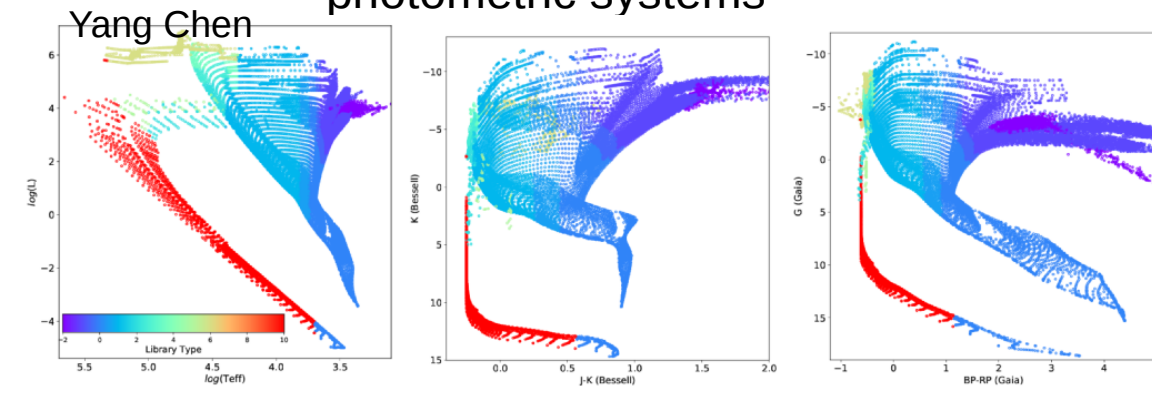
Marigo+17



# Web services – <http://stev.oapd.inaf.it>



## YBC – transformations to >50 photometric systems

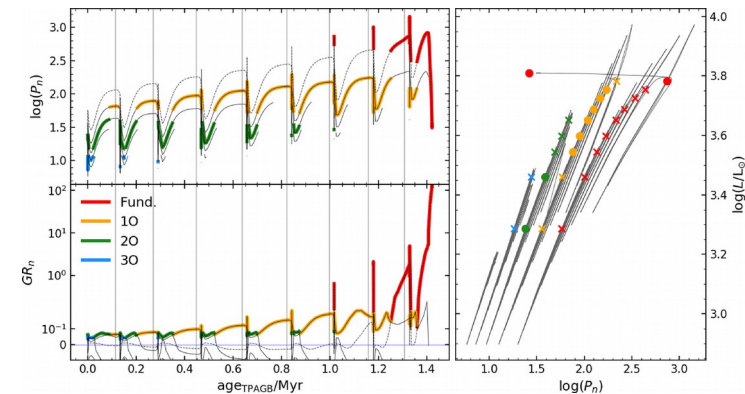


## PARAM – Bayesian stellar properties



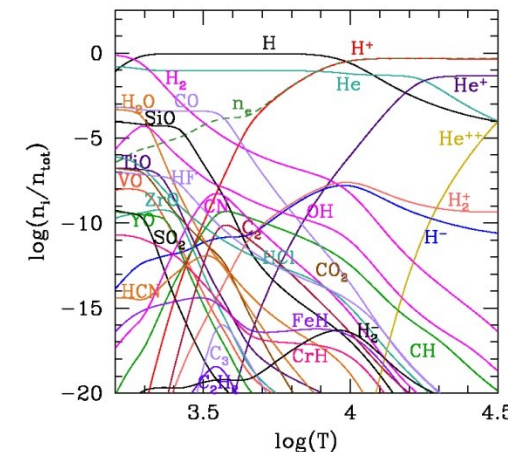
Thaise  
Rodrigues

## Pulsation – periods and growth rates of long period variables



Michele  
Trabucchi

## AESOPUS – Rosseland mean opacities on demand

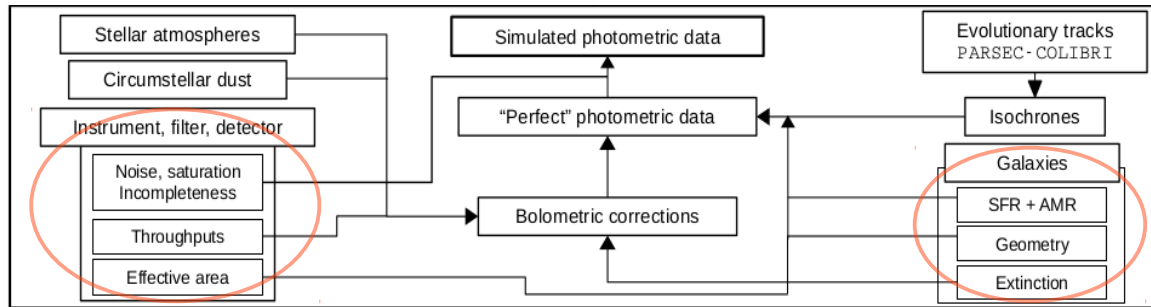


P. Marigo  
+  
Bernhard  
Aringer



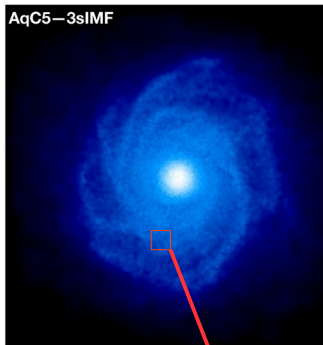
# TRILEGAL – TRIdimensional model of the GALaxy

A code to simulate any photometry of any piece of any galaxy

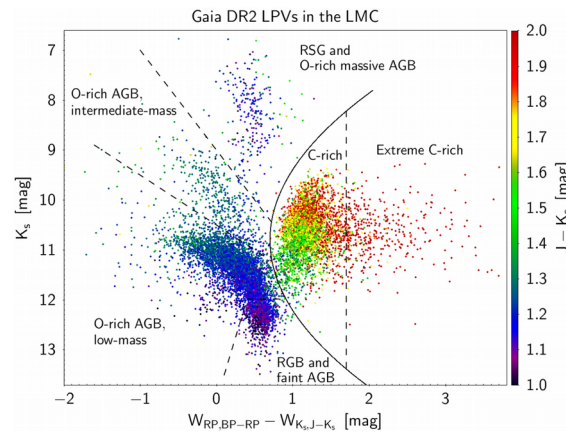
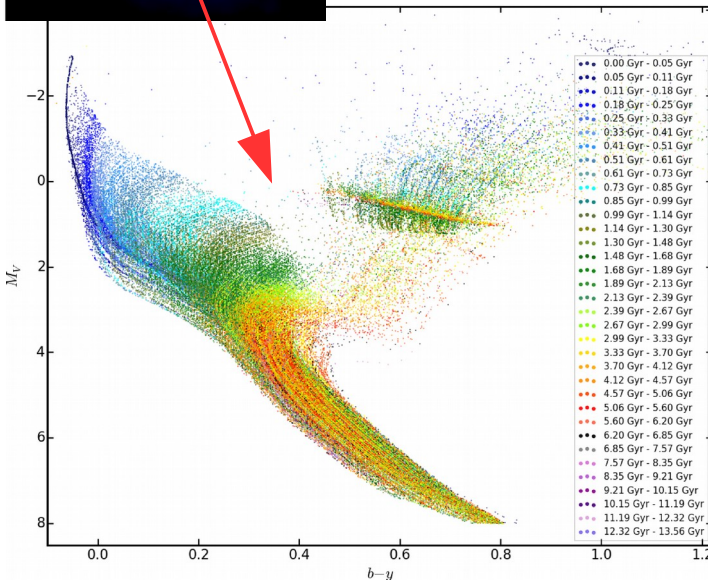


Latest additions:

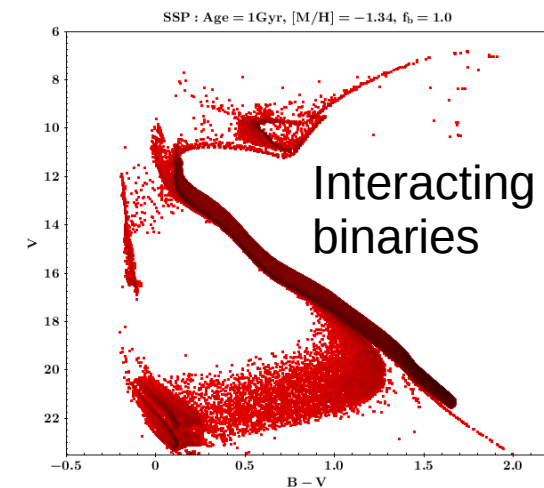
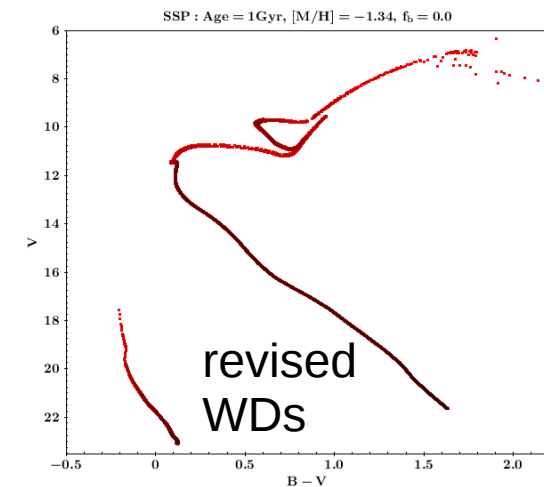
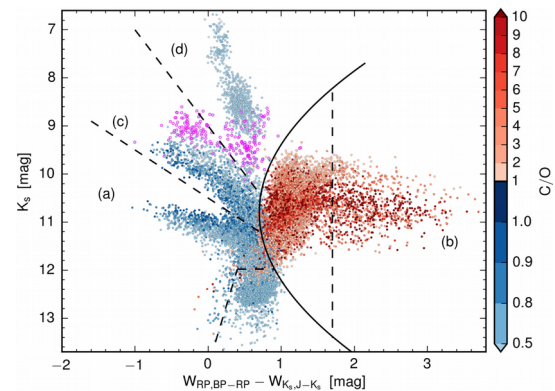
Piero Dal Tio



e.g. a cosmological simulation observed with TRILEGAL (Valentini+18)



e.g. Gaia DR2 x TRILEGAL LPVs (Lebzelter+18)



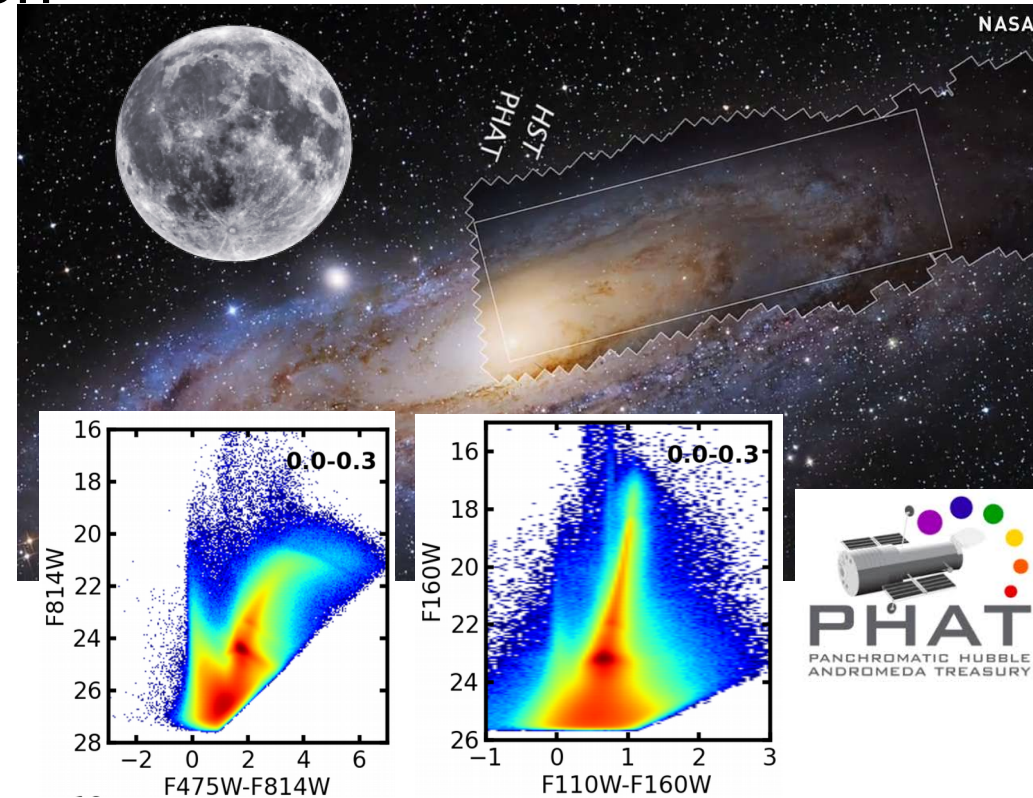
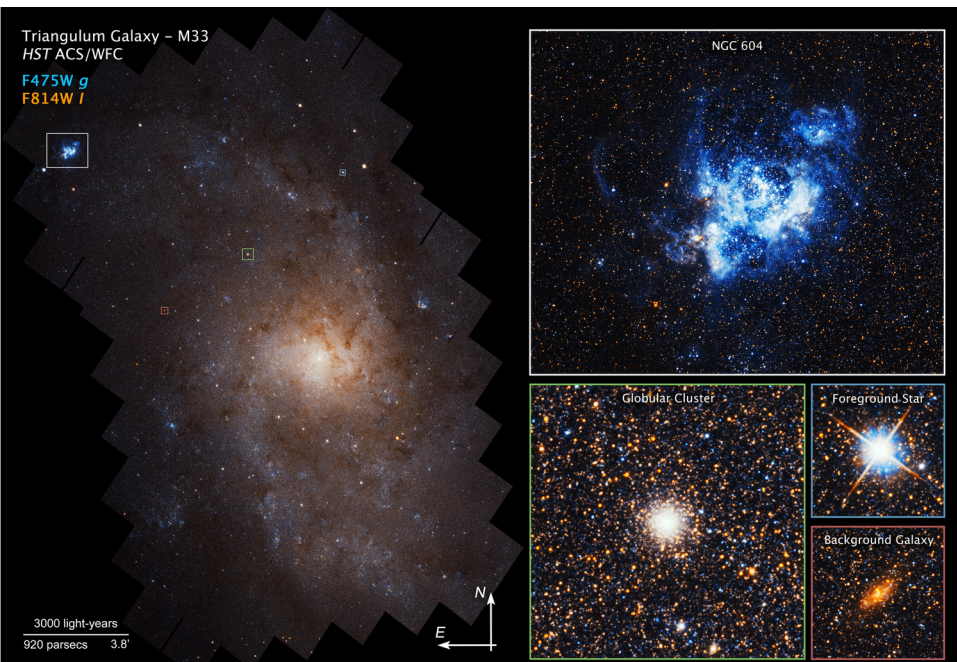


# HST surveys of nearby galaxies –

led by J. Dalcanton  
+former students

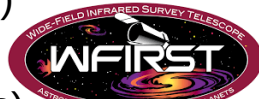


- ANGST + ANGRRR + ANGST-NIR – ~100 resolved galaxies up to 4 Mpc



- PHAT – 117 million M31 stars in 6 broad filters (Williams+11) + NIR medium bands (Boyer+19)
- PHAT-M33 – just ~30 million in M33 (ongoing)
- WINGS – WFIRST Nearby Galaxy Survey (Williams+17; will happen if WFIRST happens)
- The only JWST Early Release Science proposal dealing with stellar populations (Weisz+21)

All these surveys were also motivated by improving Padova stellar models





# Magellanic Cloud surveys – HST archival proposals + VMC @ ESO

100 clusters all ages –  
Fousneau+, Goudfroy+, ...

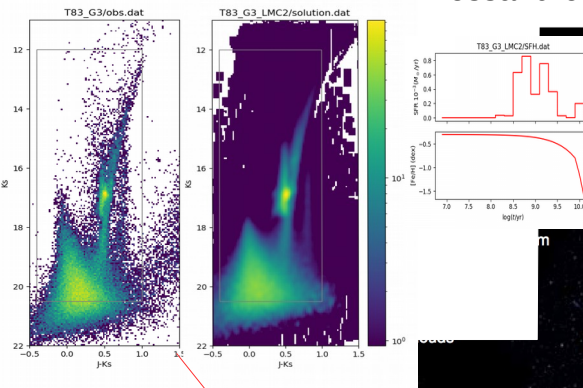


Guglielmo Costa

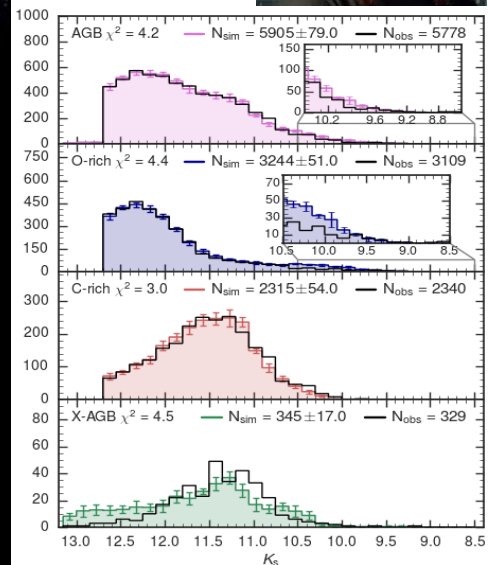
- PSF photometry (Rubele+)
- Maps of star formation history (Rubele+18, Mazzi+20)



Alessandro Mazzi



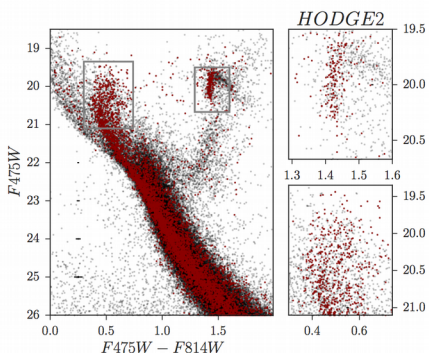
Giada Pastorelli



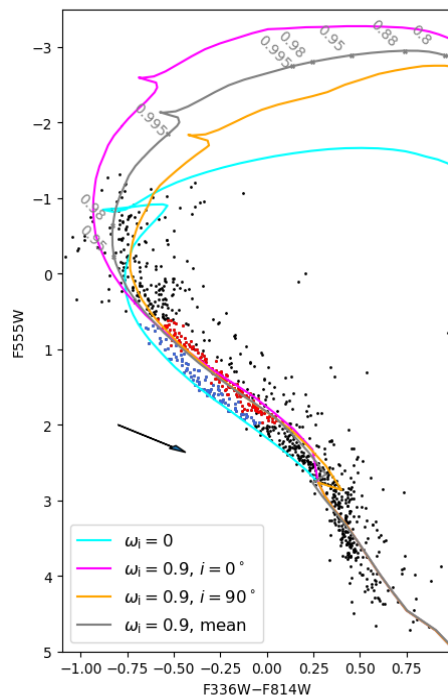
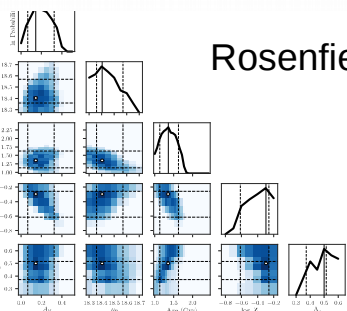
Calibrating TP-AGB  
evolution (Pastorelli+19)

Constraining  
overshooting

+ fast rotators – Costa+19



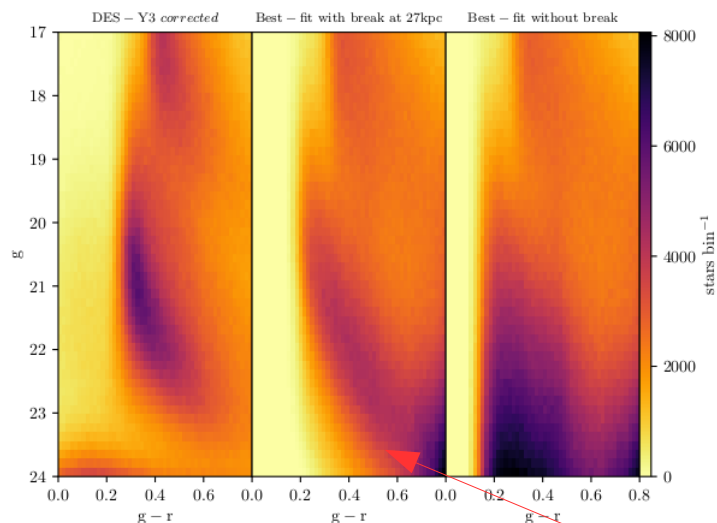
Rosenfield+17



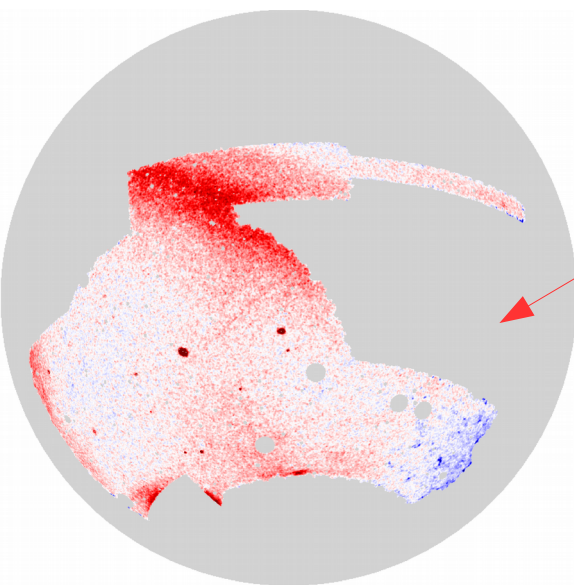


# CMD fitting of huge sky areas

Halo from 5000 deg<sup>2</sup> of Dark Energy Survey

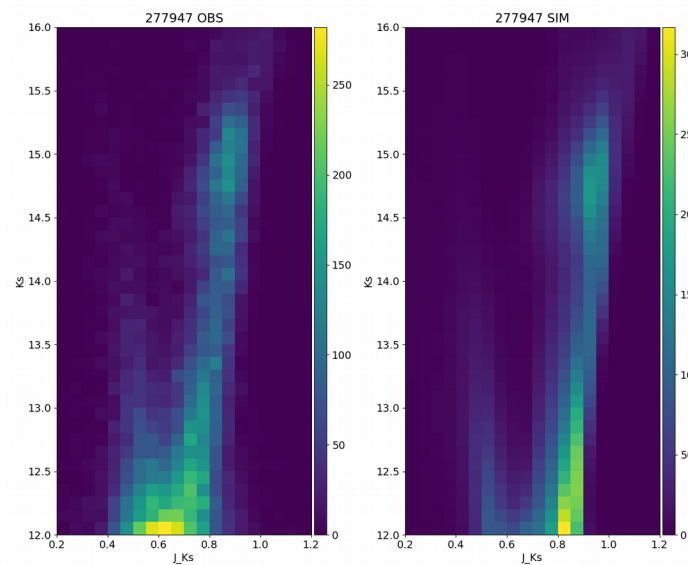
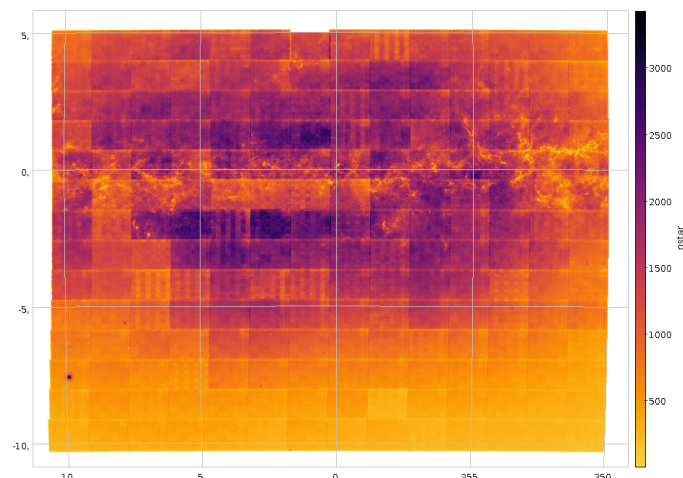


Break in slope of  
outer halo  
+ structures from  
map of residuals



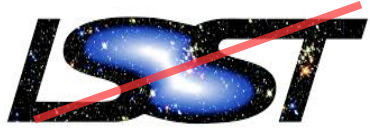
Adriano Pieres

Bulge structure from VVV



Alessandro Mazzi

# The stellar content of



# Vera Rubin ST

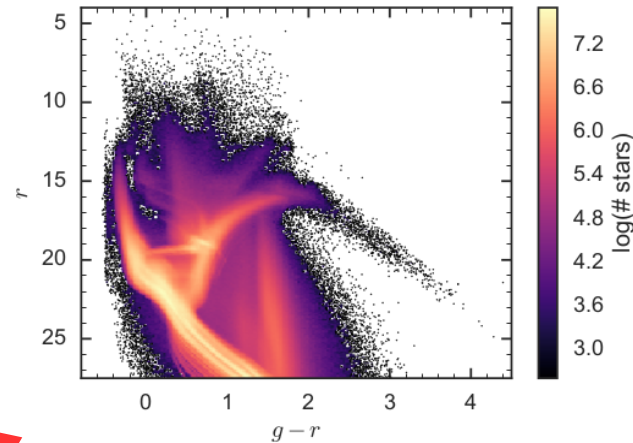
First LSST simulation, 19 Gstars in NOAO Data Lab



The official team +

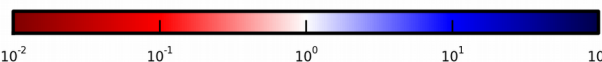
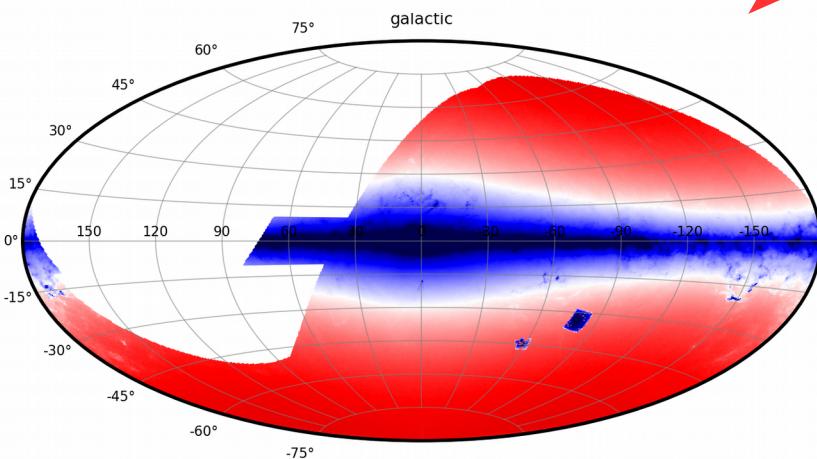
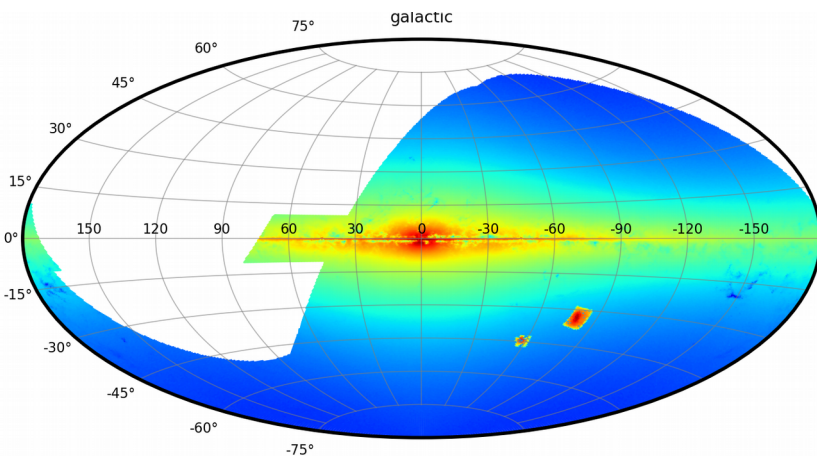
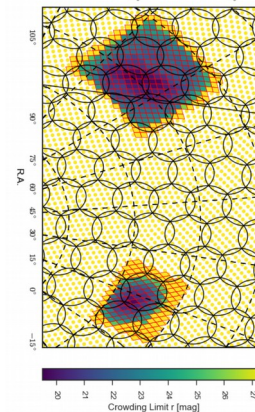
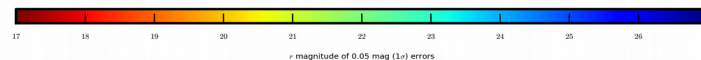
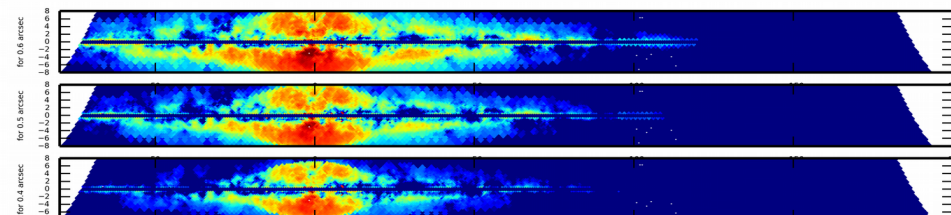
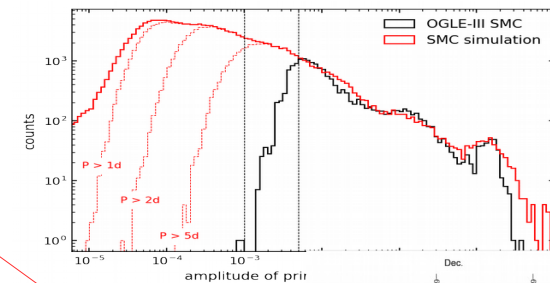


+ many others



- Star counts
- star/galaxy ratios
- CMDs
- crowding limits
- pulsating giants

To help definition of LSST main- and mini-surveys



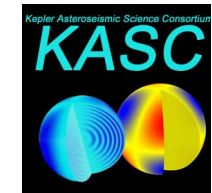
star-to-galaxy ratio, single visit



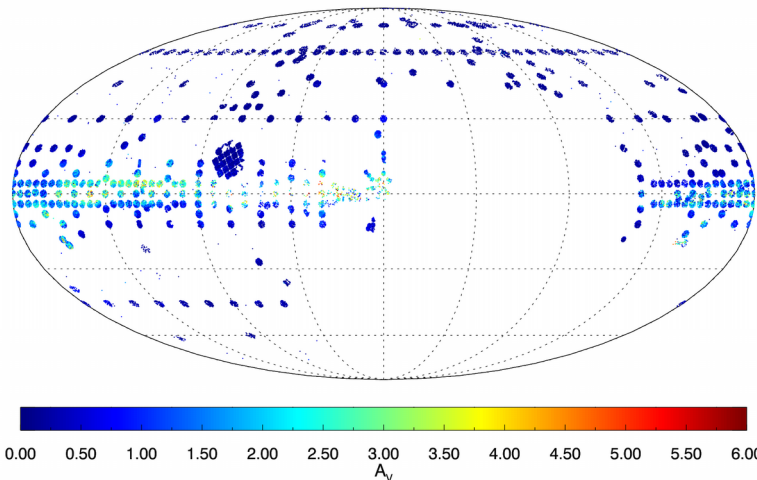


# Ensemble asteroseismology

APOGEE+KASC + Andrea Miglio's ERC Consolidator

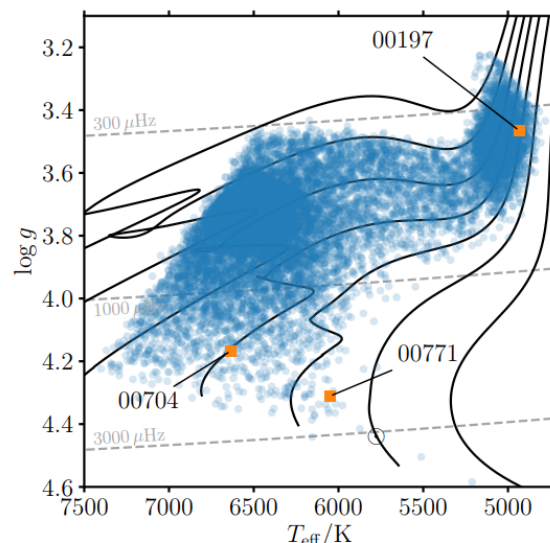


PARAM

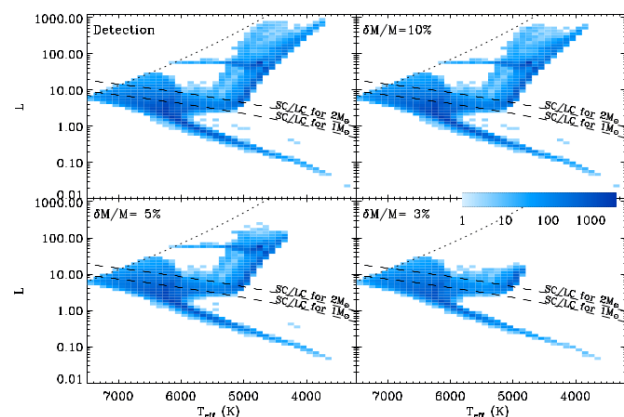
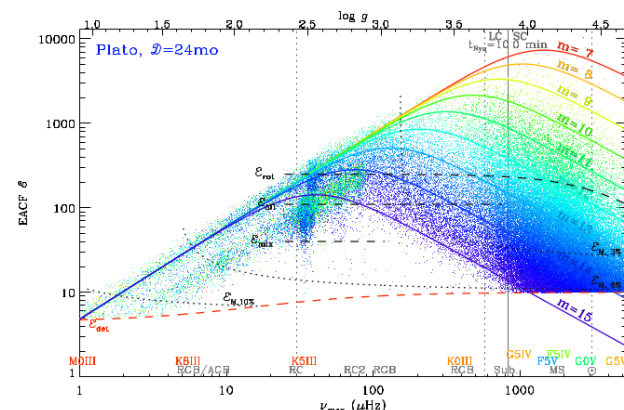


e.g. distances+extinction for APOGEE+KASC

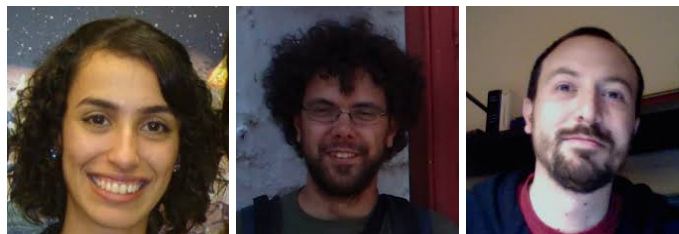
The final goal: ages accurate to  $\sim 10\%$  for  $>>100,000$  field stars up to 15 kpc away



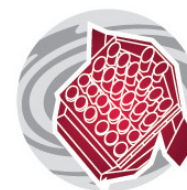
e.g. preparation for TESS (Ball+19)



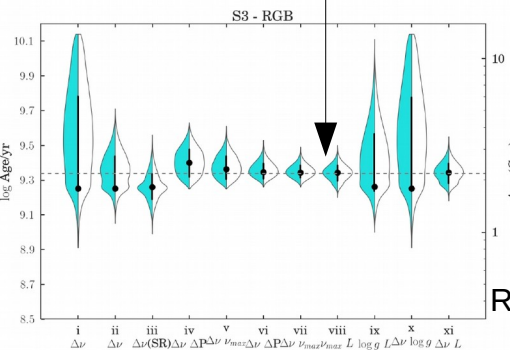
e.g. expected asteroseismic performance of PLATO (Miglio+18, Mosser+19)



Thaise Rodrigues, Diego Bossini, Andrea Miglio



plato



Rodrigues+17

+ planning post-PLATO era! = ESA Voyager2050

## calibrating the TP-AGB phase ERC Consolidator, PI Marigo

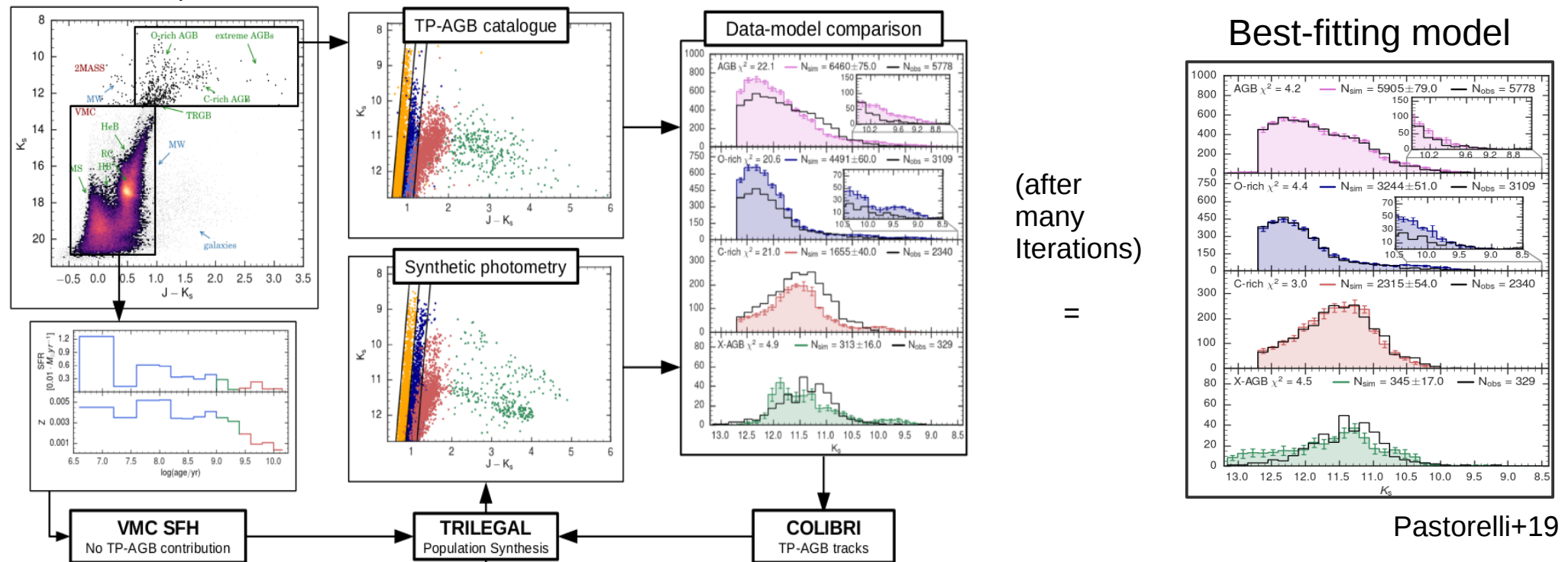
Models being provided by STARKEY:

- Evolutionary tracks
- Spectra with photosphere + RT by circumstellar dust
- Synthetic photometry in >50 systems
- Periods+growth rates of long period variables
- Mass loss from dynamical models
- Chemical yields

As far as possible calibrated (against resolved galaxies)



At OAPd, main involvement is on WP5 – the Calibration Set:





# Prospects for the future

- We have competitive codes + work enough for the next 10 years – including early involvement in JWST, LSST, WFIRST and PLATO.
- But without new funding and positions, we will be simply transferring know how and money to other institutes. Consider that:
- In the past 5 years, these works were worth
  - >6 million euro of public funding (mainly ERC and NASA) to small groups at U.Padova, U.Washington, STScI, U.Birmingham, Linea-Rio,
  - but just <0.1 million arrived directly to OAPd (1 PRIN-INAF + 1 mini-fraction of sub-Premiale).
- No position for stellar modeling at OAPd since 2005.