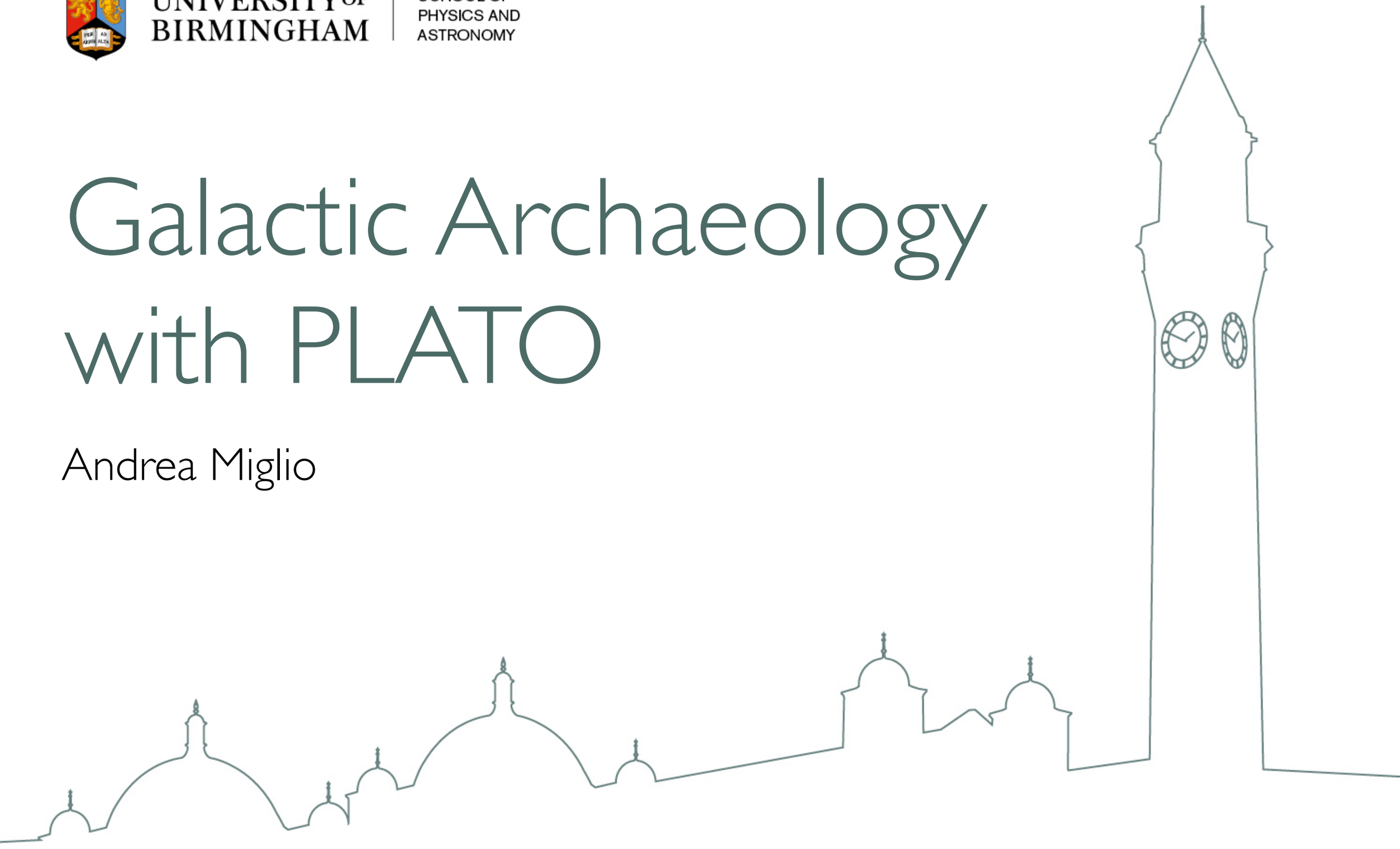
UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

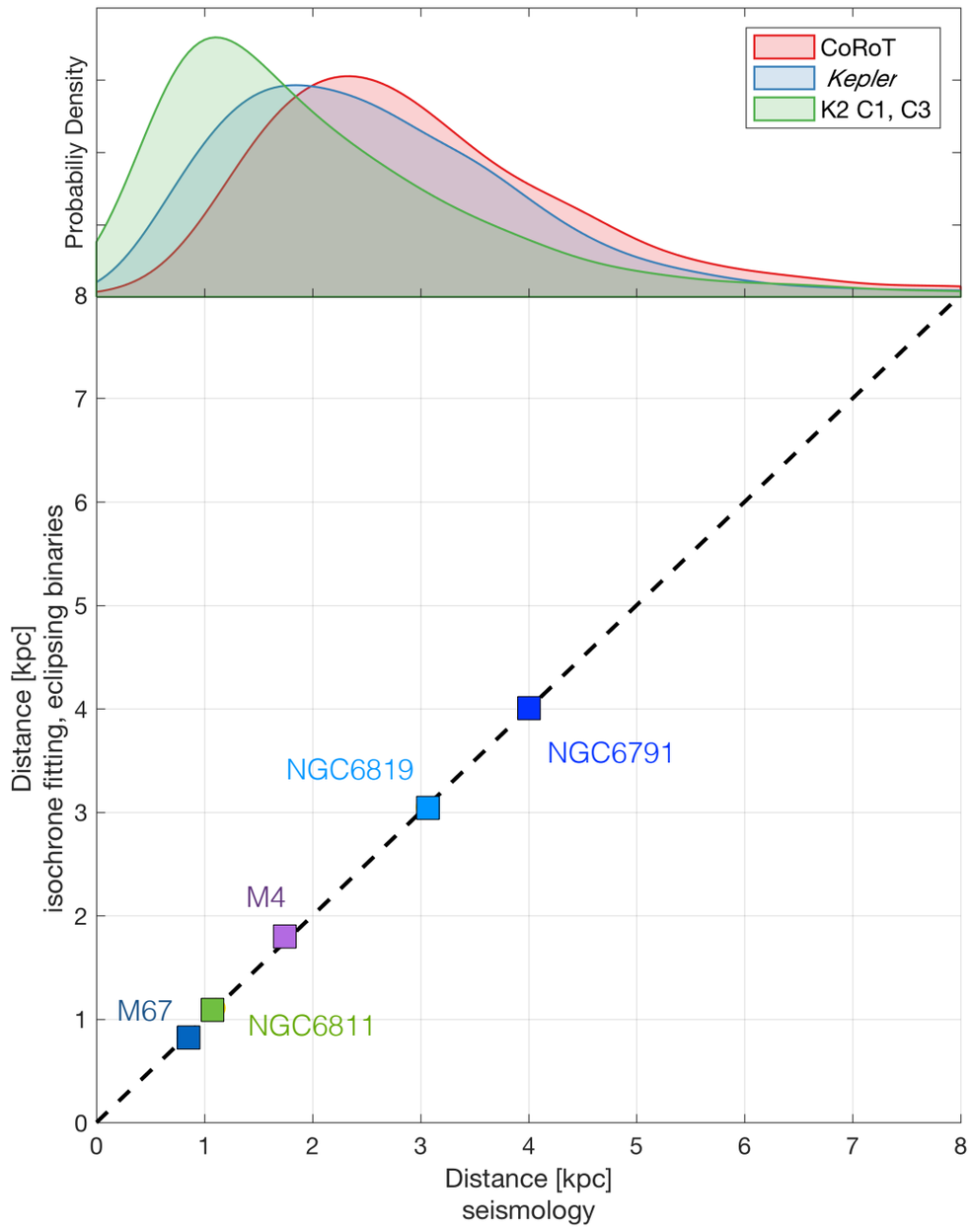
Galactic Archaeology with PLATO

Andrea Miglio

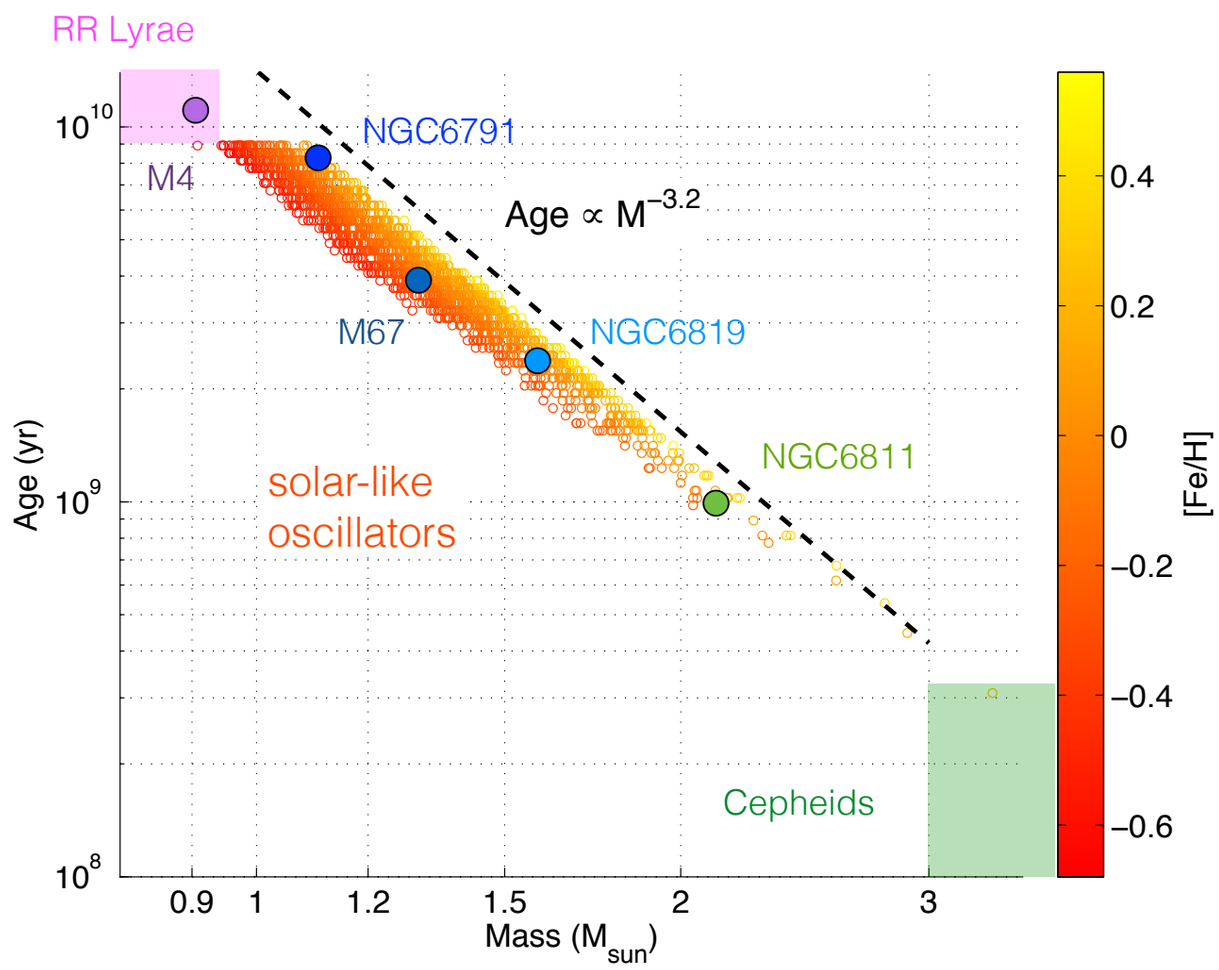


solar-like oscillating red giants: clocks and rulers for Galactic studies

distance



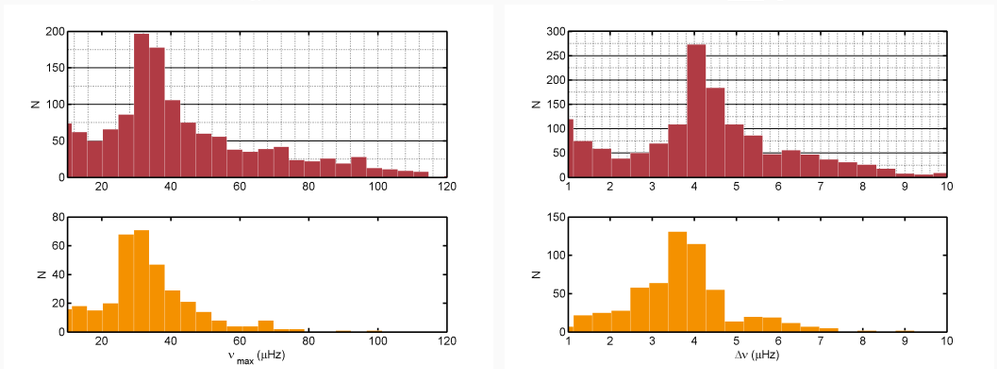
age



stellar populations studies

Probing populations of red giants in the galactic disk with CoRoT⋆

A. Miglio[1,⋆⋆], J. Montalbán[1], F. Baudin[2], P. Eggenberger[1,3], A. Noels[1], S. Hekker[4,5,6], J. De Ridder[5], W. Weiss[7], and A. Baglin[8]



2009

+ test of seismically determined masses &radii

Galactic archaeology: mapping and dating stellar populations with asteroseismology of red-giant stars

A. Miglio,[1,2⋆] C. Chiappini,[3] T. Morel,[4] M. Barbieri,[5] W. J. Chaplin,[1] L. Girardi,[6] J. Montalbán,[4] M. Valentini,[4] B. Mosser,[7] F. Baudin,[8] L. Casagrande,[9] L. Fossati,[10] V. Silva Aguirre[11] and A. Baglin[7]

2013

stellar populations studies

2016

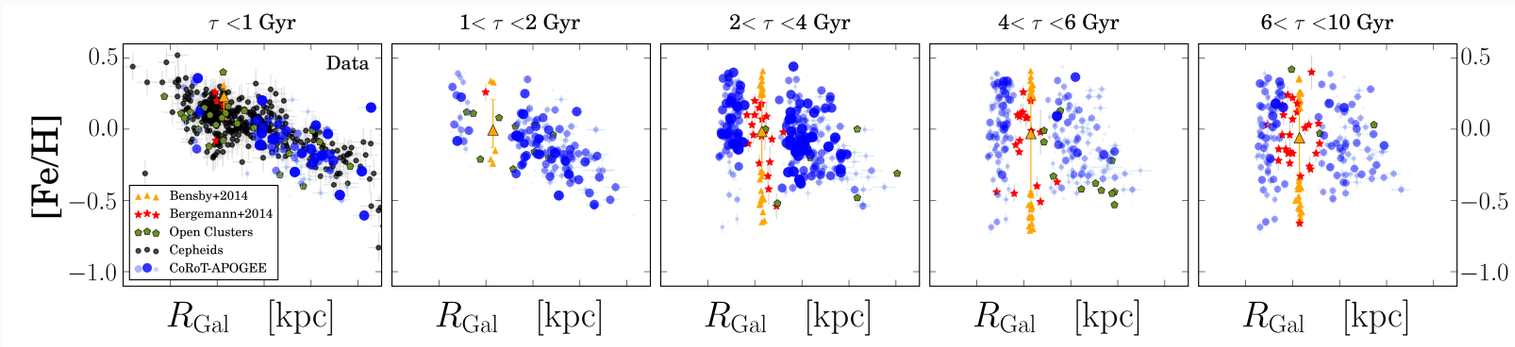
Galactic Archaeology with asteroseismology and spectroscopy: Red giants observed by CoRoT and APOGEE

F. Anders[1,2], C. Chiappini[1,2], T. S. Rodrigues[2,3,4], A. Miglio[5], J. Montalbán[4], B. Mosser[6], L. Girardi[2,3], M. Valentini[1], A. Noels[7], T. Morel[7], J. A. Johnson[8], M. Schultheis[9], F. Baudin[10], R. de Assis Peralta[6], S. Hekker[11,12], N. Themeßl[11,12], T. Kallinger[13], R. A. García[14], S. Mathur[15], A. Baglin[6], B. X. Santiago[2,16], M. Martig[17], I. Minchev[1], M. Steinmetz[1], L. N. da Costa[2,18], M. A. G. Maia[2,18], C. Allende Prieto[19,20], K. Cunha[18], T. C. Beers[21], C. Epstein[8], A. E. García Pérez[19,20], D. A. García-Hernández[19,20], P. Harding[22], J. Holtzman[23], S. R. Majewski[24], Sz. Mészáros[25,26], D. Nidever[27], K. Pan[22,28], M. Pinsonneault[8], R. P. Schiavon[29], D. P. Schneider[30,31], M. D. Shetrone[32], K. Stassun[33], O. Zamora[19,20], G. Zasowski[34]

2016

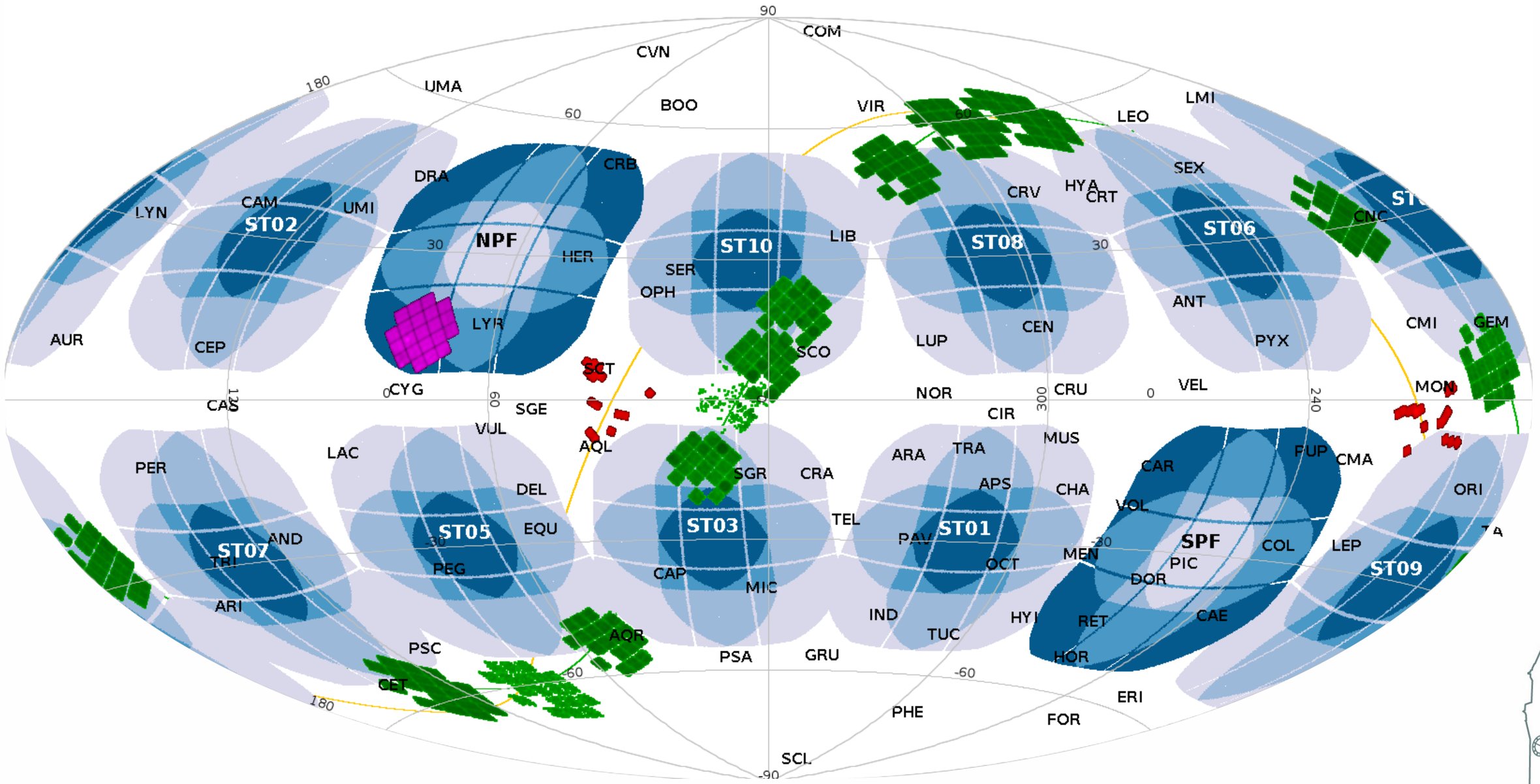
Red giants observed by CoRoT and APOGEE: The evolution of the Milky Way's radial metallicity gradient

F. Anders[1,2], C. Chiappini[1,2], I. Minchev[1], A. Miglio[3], J. Montalbán[4], B. Mosser[5], T. S. Rodrigues[2,4,6], B. X. Santiago[2,7], L. N. da Costa[2,8], D. A. García-Hernández[9,10], M. A. G. Maia[2,8], D. P. Schneider[11,12], M. Schultheis[13], M. Steinmetz[1], M. Valentini[1], O. Zamora[9,10]



see also Casagrande et al. 2016 (seismology+stroemgren photometry)

PLATO: field of view



PLATO-UPD-SCI-TN-001 - "PLATO preliminary field selection", Nascimbeni, Piotto, Granata, University of Padova

INTERNATIONAL SPACE SCIENCE INSTITUTE

Members of the team

Name	*Affiliation*	*Country*
Luca Casagrande	Australian National University	Australia
Cristina Chiappini	AIP Potsdam	Germany
Guy Davies	University of Birmingham	UK
Ken Freeman	Australian National University	Australia
Gerry Gilmore	IoA Cambridge	UK
Leo Girardi	INAF Padova	Italy
Paula Jofre	IoA Cambridge	UK
Daisuke Kawata	MSSL	UK
Paula Jofre	IoA Cambridge	UK
Andrea Miglio	University of Birmingham	UK
Benoit Mosser	Observatoire de Paris	France

Young Scientists

Ben Rendle	University of Birmingham	UK
Keith Hawkins	Columbia University	USA

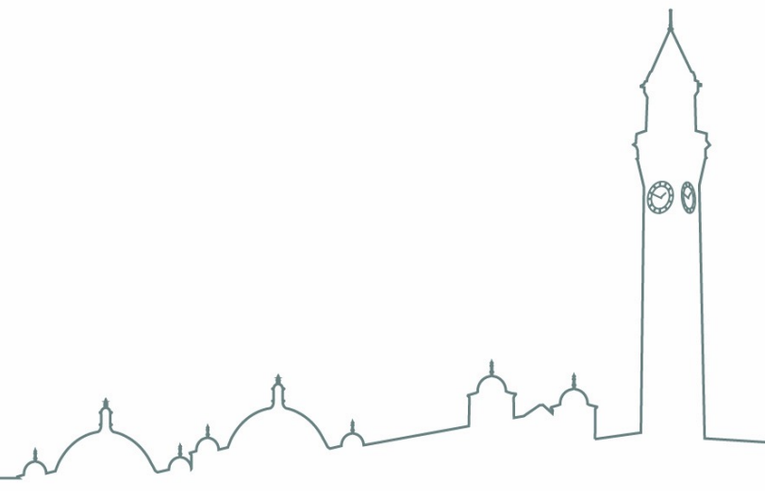
key questions in Galactic astrophysics in 10-15 yrs time

Cristina Chiappini, Ken Freeman, Daisuke Kawata, Gerry Gilmore

5 key questions identified ⇒ what is needed to address them?

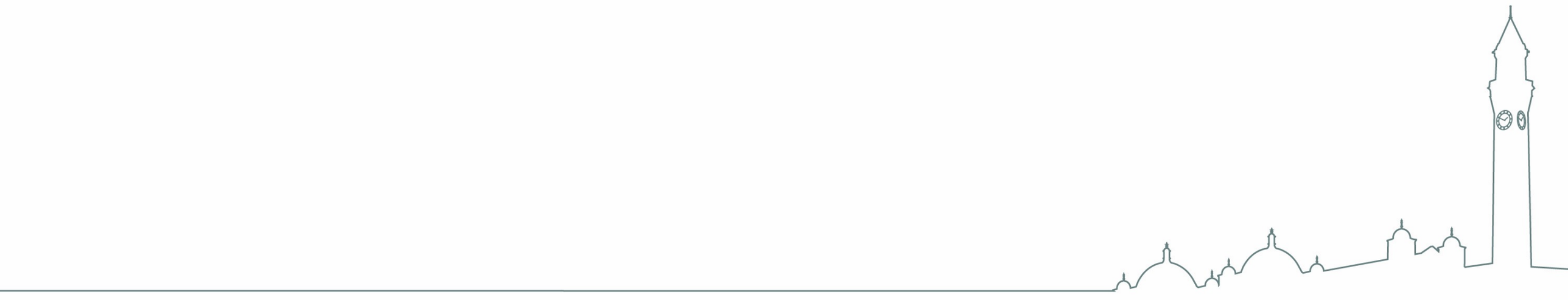
see Miglio et al. 2017

- how many stars, and where
- precision on stellar properties



Can PLATO answer these questions?

- number and location of observing fields
- magnitude selection
- duration of the observational campaigns

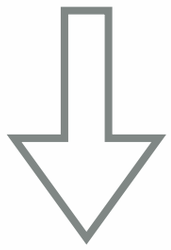


method

- generate a synthetic population with TRILEGAL *Leo Girardi*

- vary the duration of the campaigns, which affects:

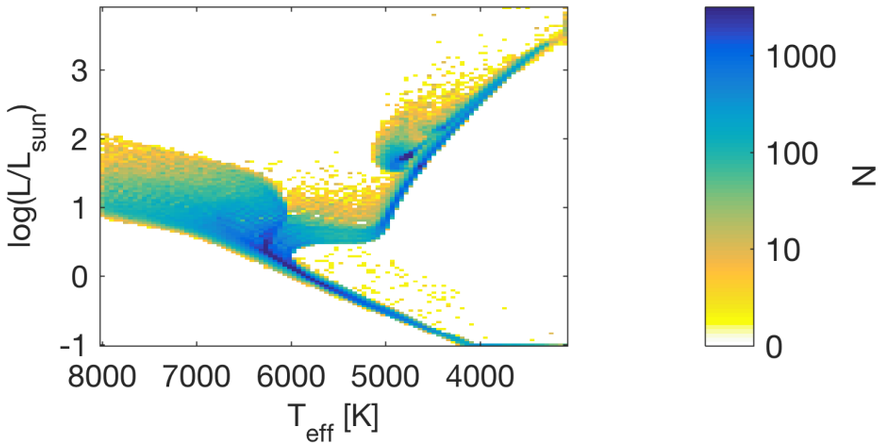
  - detectability of oscillations (GK giants, aka "ageing stars")
  - which properties of the spectrum can be measured, and their precision + accuracy.

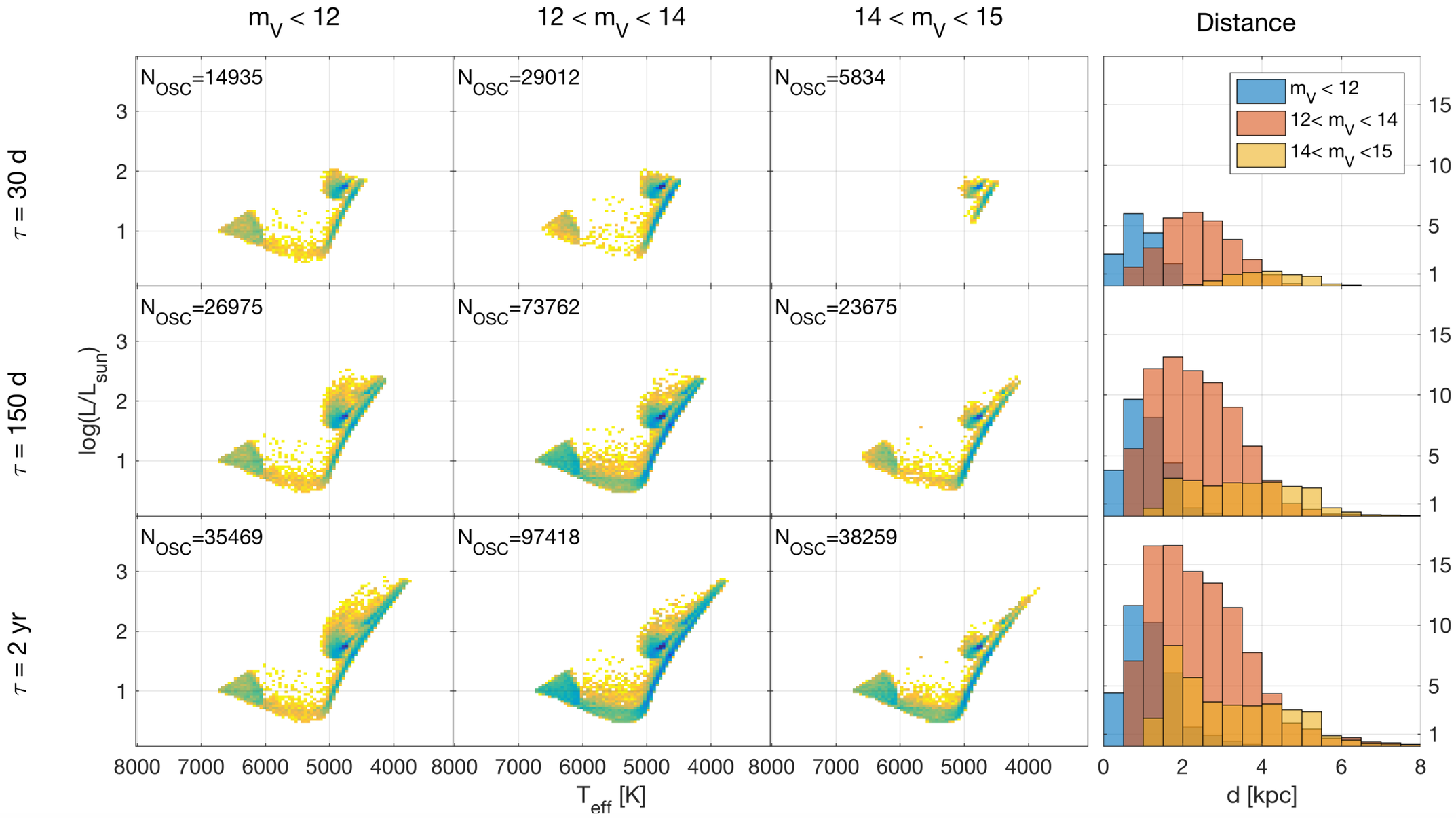


precision on inferred stellar properties

seismic yields
600s cadence

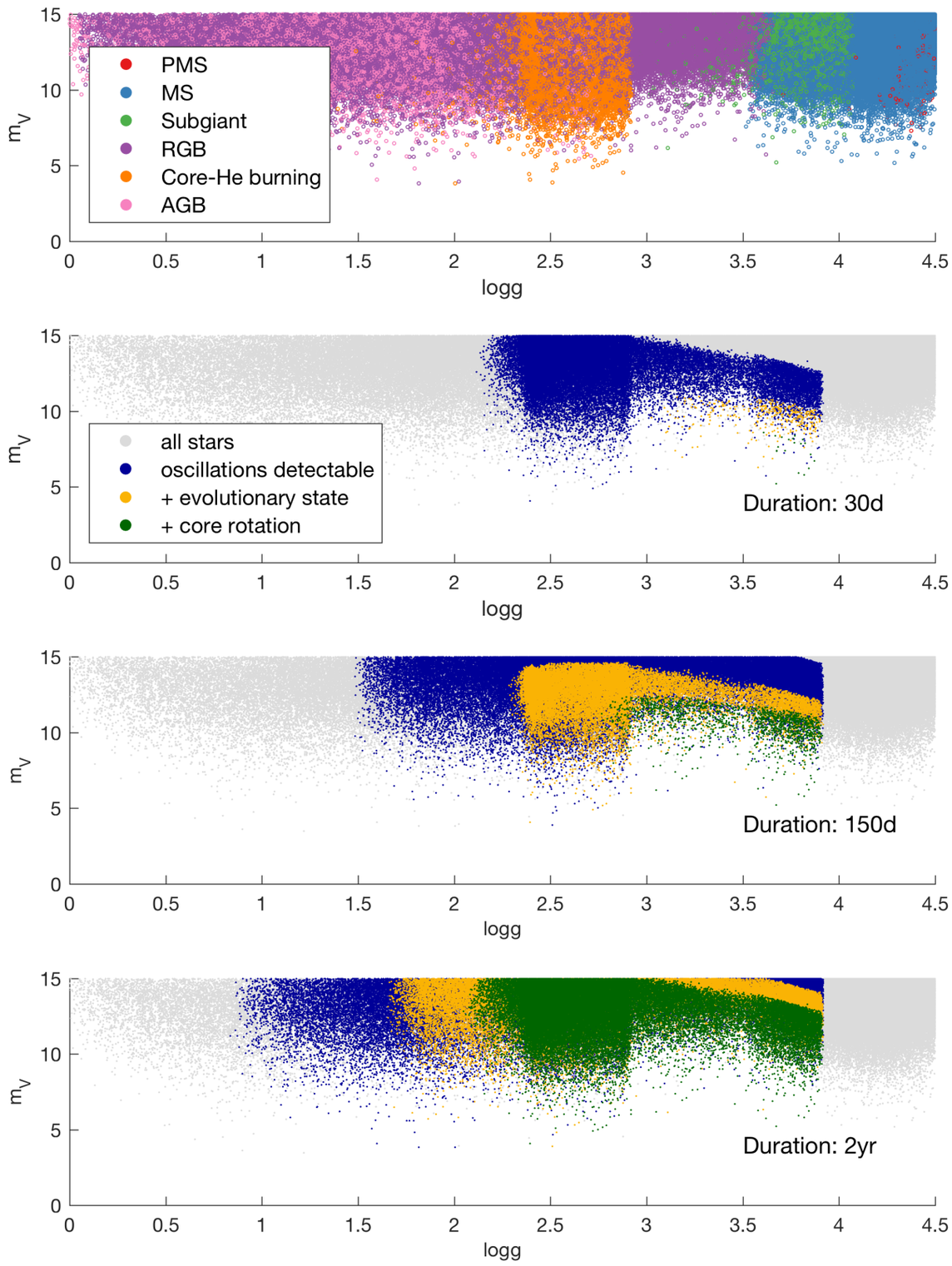
Benoit Mosser, Guy Davies





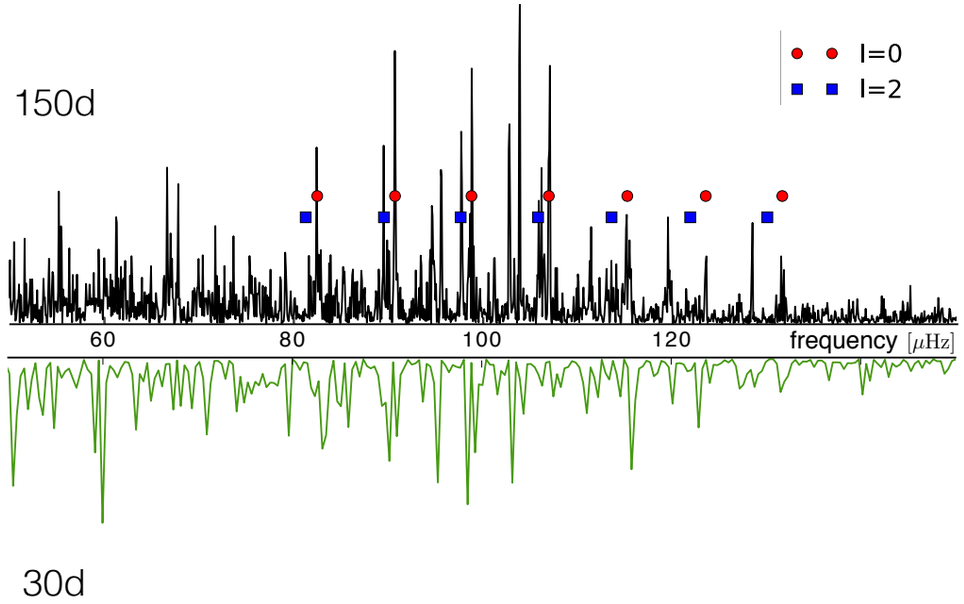
seismic yields

Benoit Mosser, Guy Davies

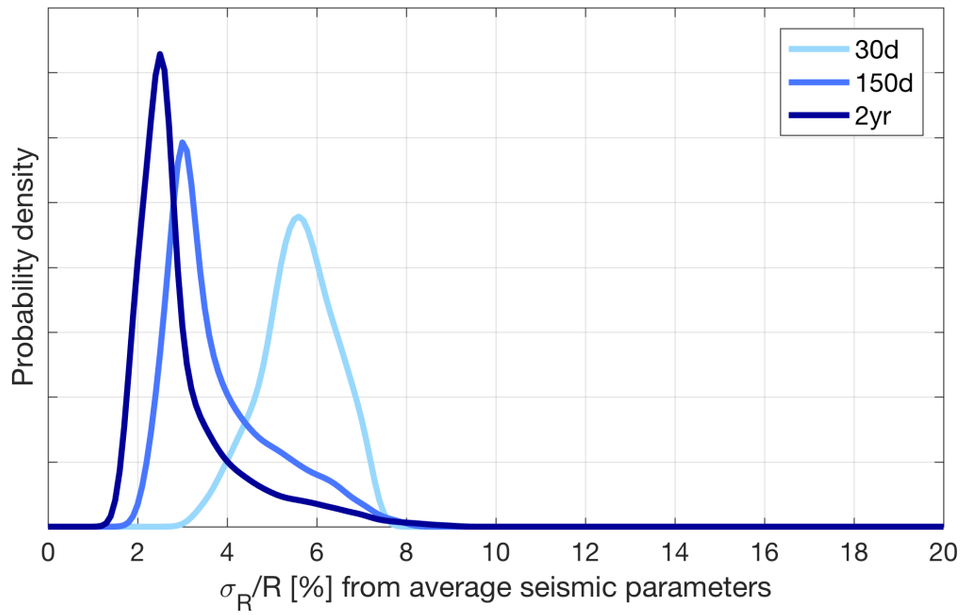


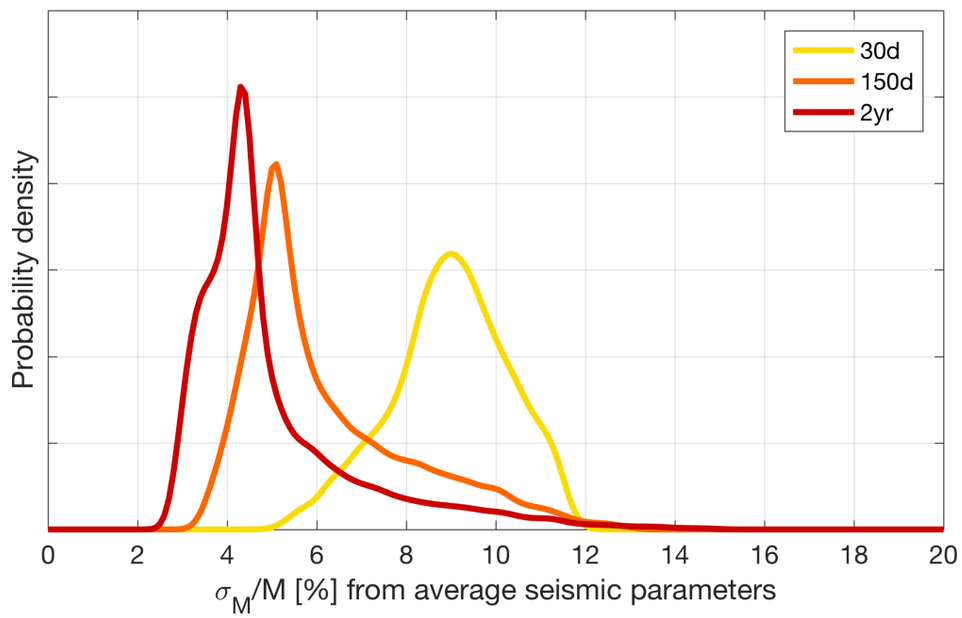
~ 150d :

- evolutionary state
- accurate individual radial mode frequencies

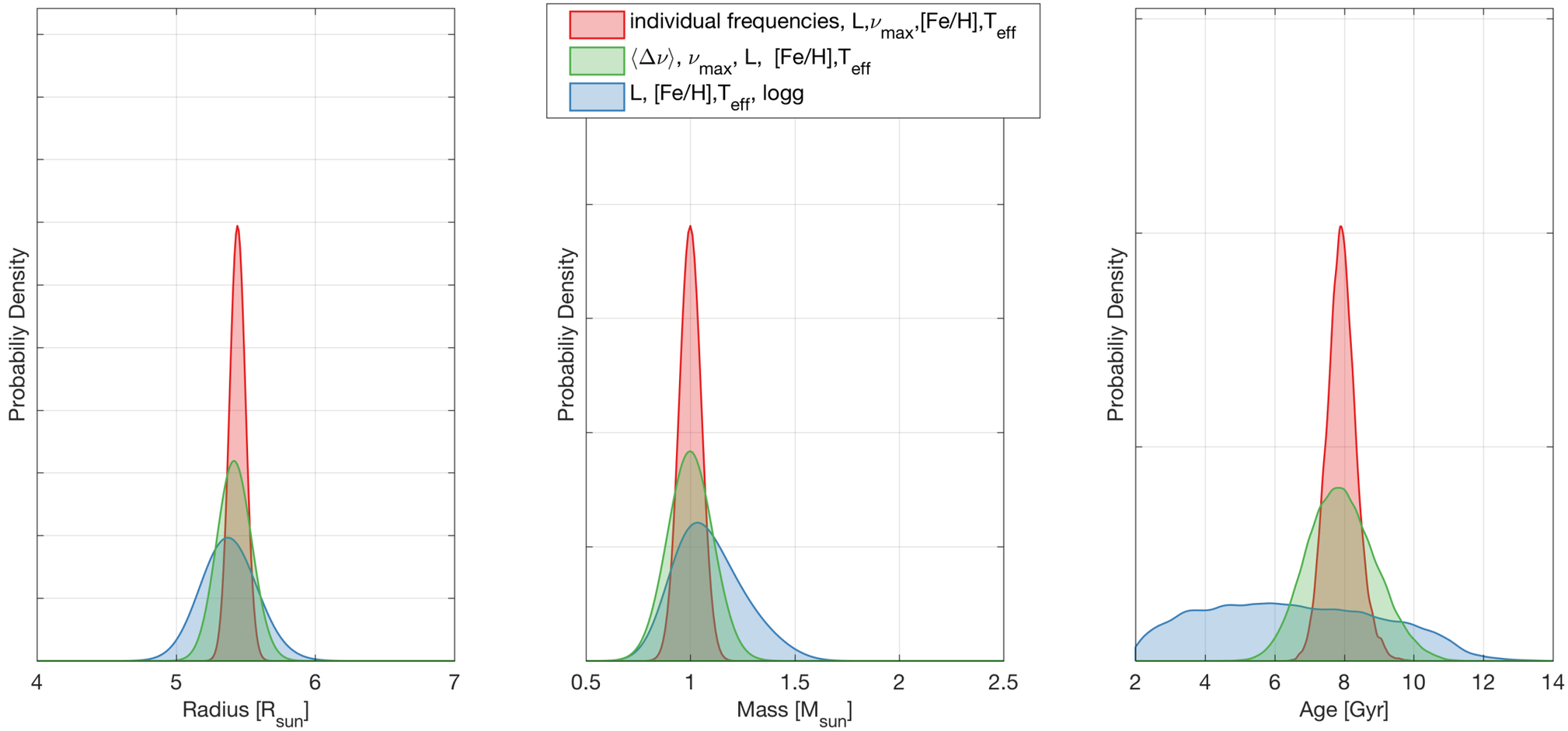


expected precision (average seismic parameters)

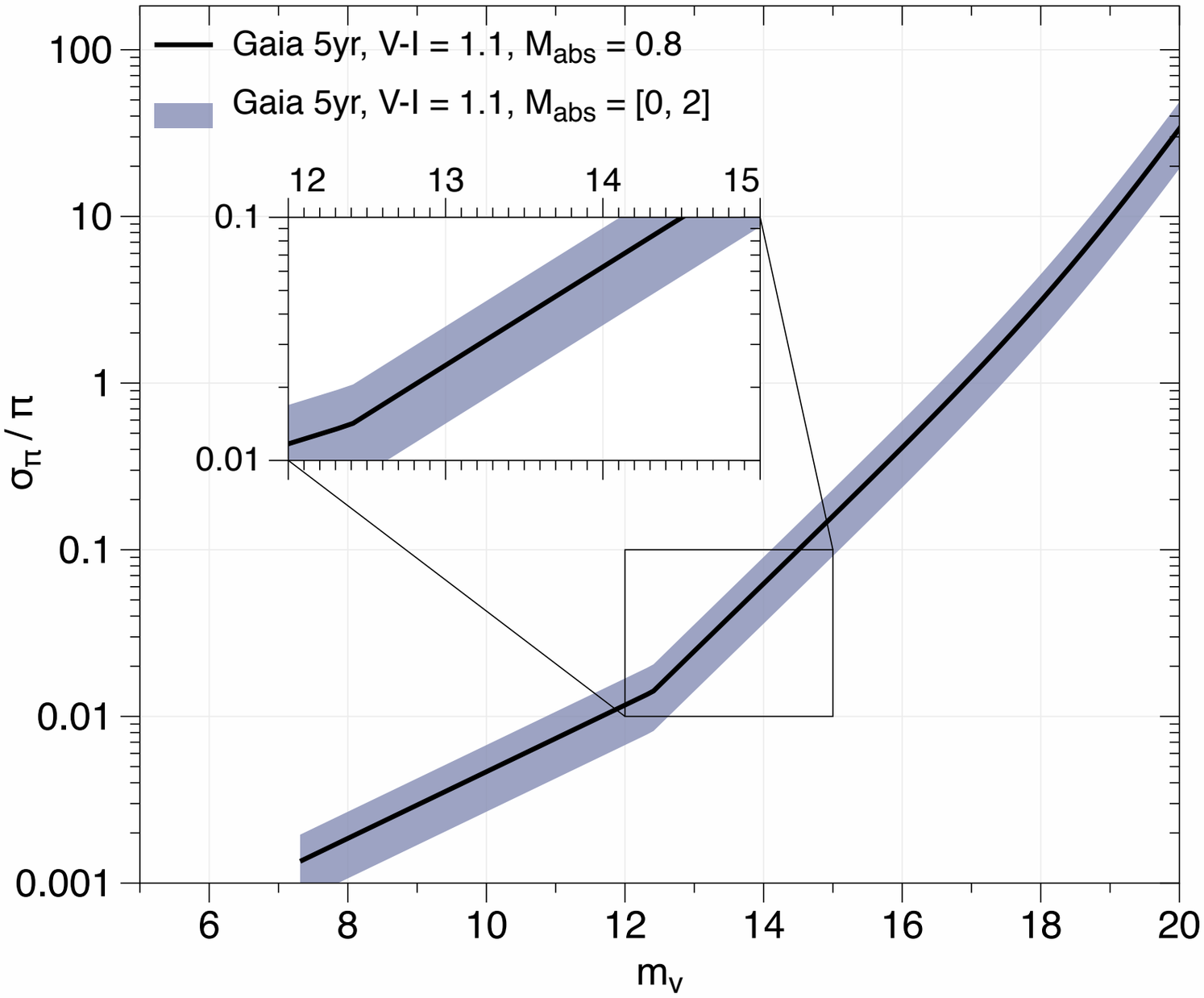




expected precision
(+ individual radial-mode frequencies)



distances


Gaia 5yr, V-I = 1.1, M_{abs} = 0.8
Gaia 5yr, V-I = 1.1, M_{abs} = [0, 2]
σ_π / π
m_V
100
10
1
0.1
0.01
0.001
6
8
10
12
14
16
18
20
12
13
14
15
0.1
0.01

Astronomische Nachrichten

ORIGINAL ARTICLE

PLATO *as it is*: A legacy mission for Galactic archaeology

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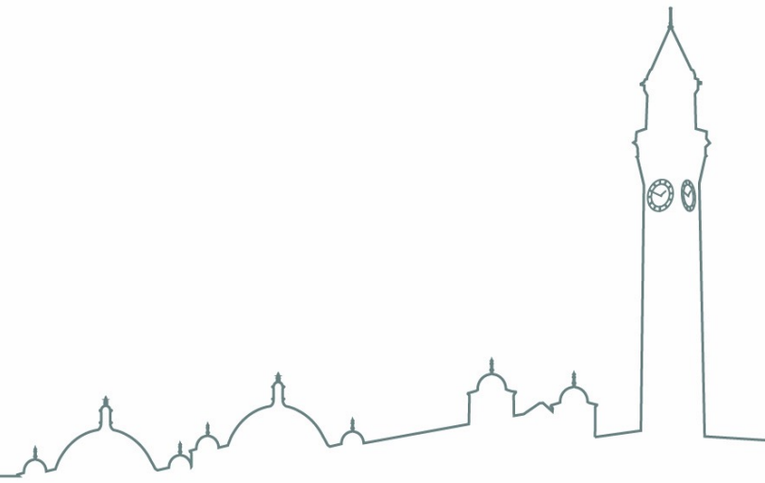
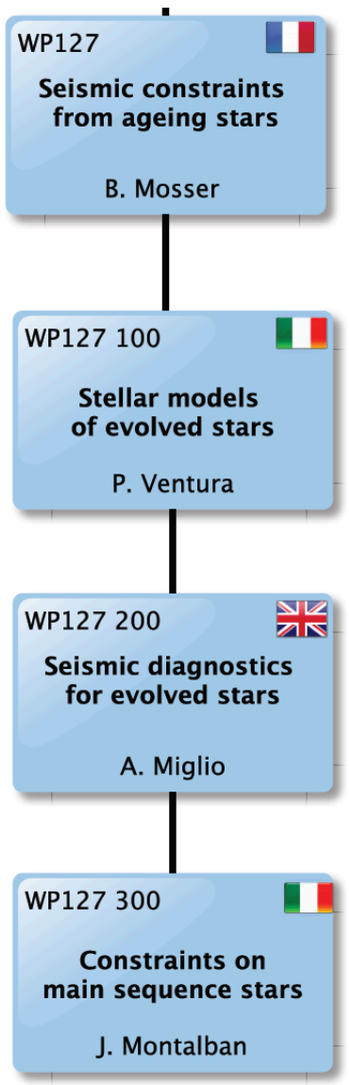
- strong support from the Galactic formation and evolution community
- make sure we get (10-15 yrs down the line) the data that will enable the required precision
- 10 yrs to figure out accuracy (develop, test, and improve stellar models and analysis methods)

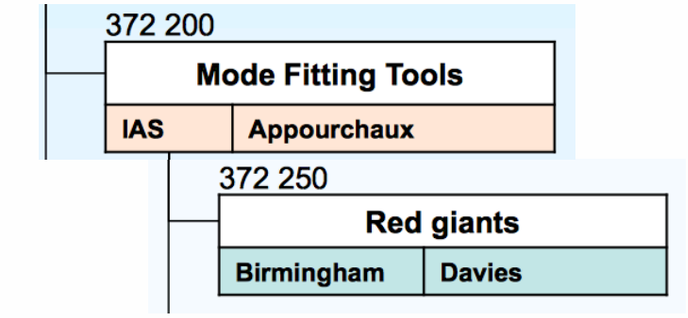


GK giants stars in PLATO

PSPM



PDC



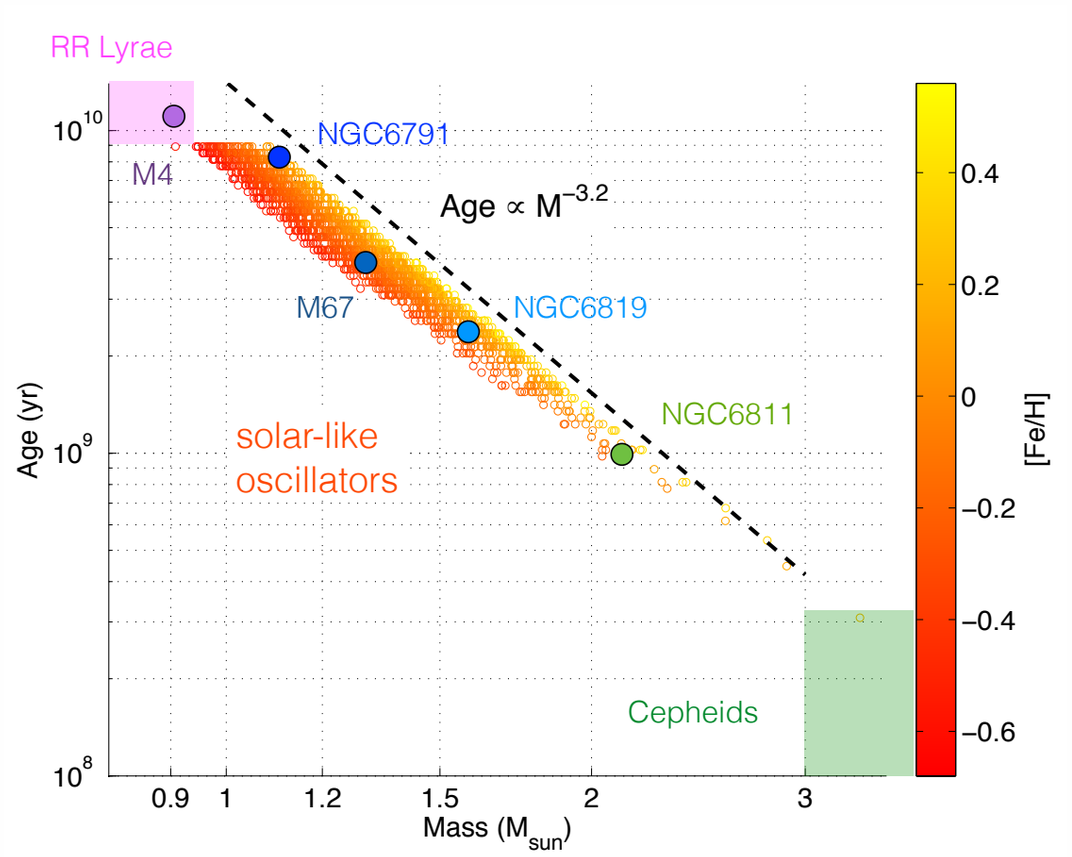
direct links to core science

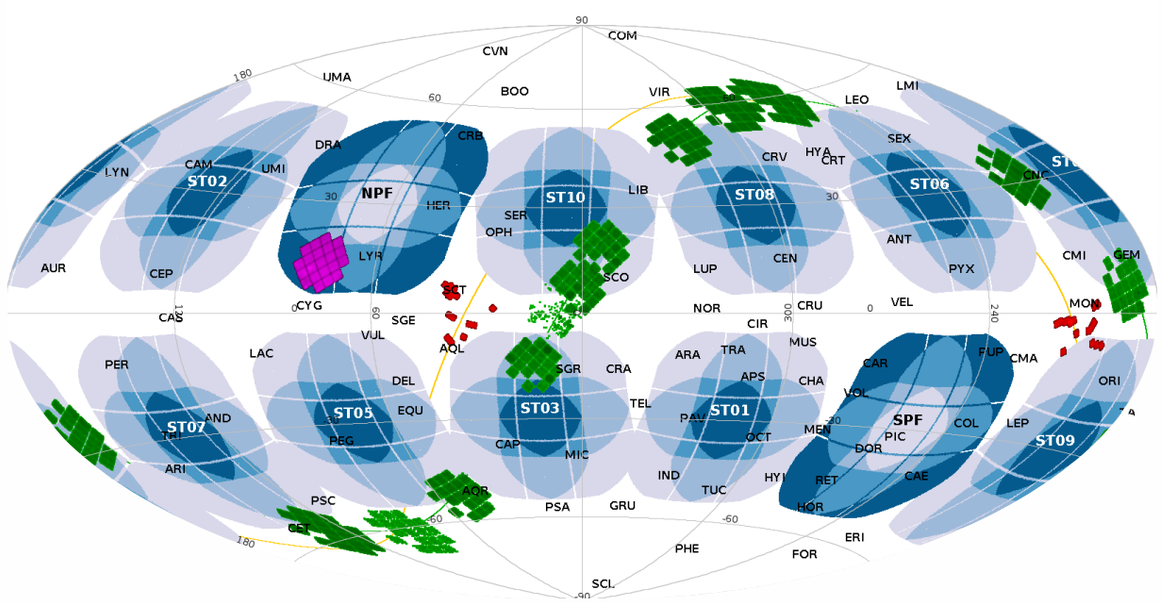
- improving stellar physics and accuracy of age determination of MS stars
- planets around evolved stars

e.g. see Veras 2016, RSOS

Galactic archeology with PLATO

complementing Gaia's view of the Milky Way with precise and accurate ages





PLATO-UPD-SCI-TN-001 - "PLATO preliminary field selection", Nascimbeni, Piotto, Granata, University of Padova