Benchmark Stars for seismic parameters

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WP124 Objectives

➢ Define forward, inverse, and glitch-related procedures for determining stellar radii, masses, and ages for stars of the core program, from a combination of seismic and non-seismic data.

Limitation

➢ Retrieved parameters are model-dependent.

Aim of studying benchmark stars

➢ Obtain independent accurate determinations of the stellar parameters to identify biases that may result from inadequacies in our stellar models.

Possible benchmark stars

- Stars in reach of interferometry (for radii).

- Stars in particular binary systems

  Eclipsing +SB2 binaries (for radii and masses)

  SB2 + Astrometric or visual/interferometric (for masses)

+ Asteroseismic data

Possible benchmark stars

- Stochastic pulsators in reach of interferometry

Current limits: V<~ 7 mag; Accuracy in radii ~1% for G-type solar-like star V~5

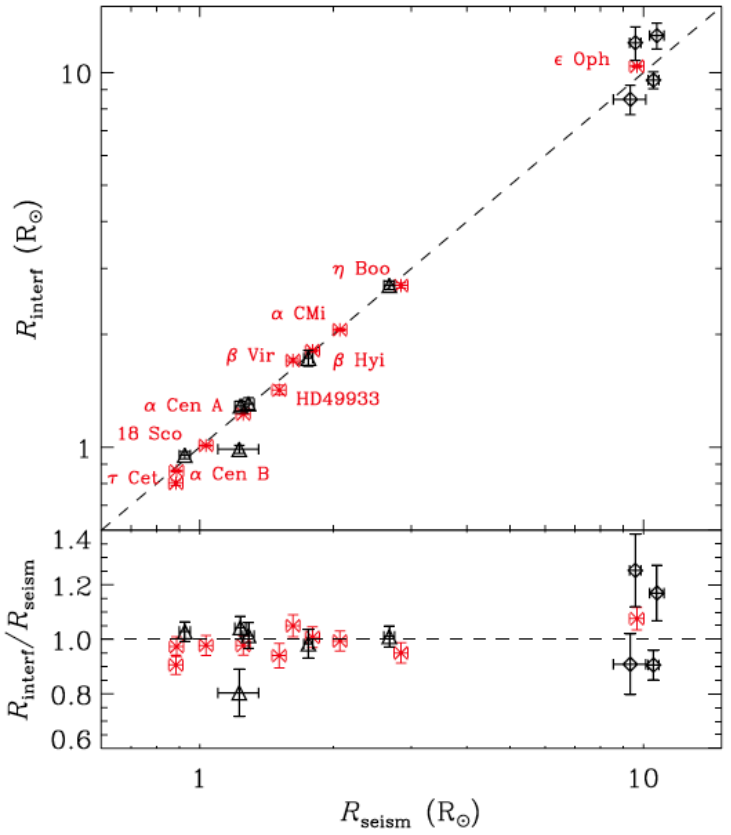
Facilities: CHARA, VLTI, NPOI

Possible benchmark stars

- Stochastic pulsators in reach of interferometry

So far <~ 20 main-sequence or subgiant stars

No systematic differences found between seismic and interferometric radii.



Huber et al. 2012

Possible benchmark stars

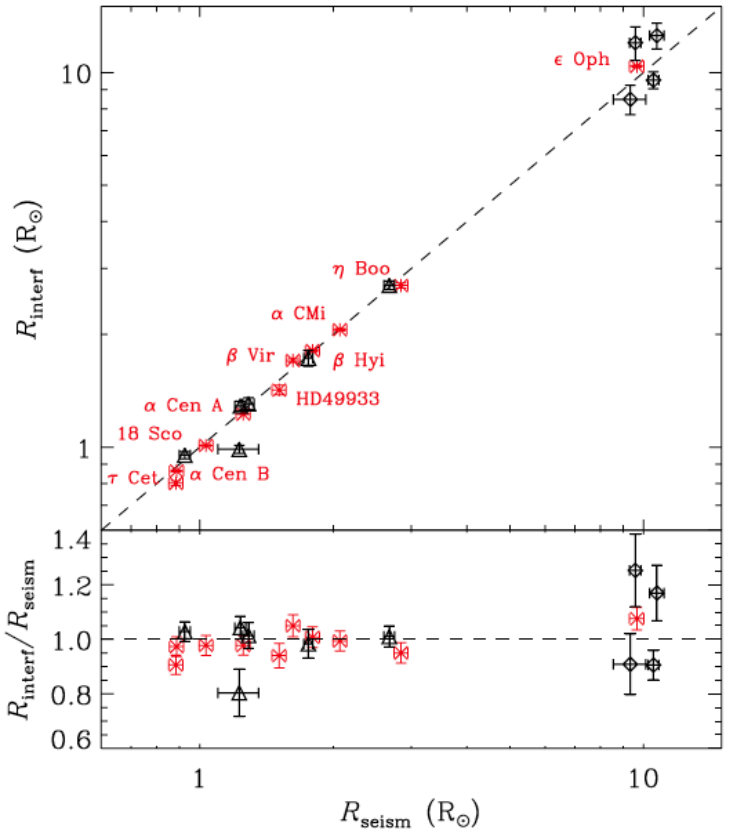
- Stochastic pulsators in reach of interferometry

So far <~ 20 main-sequence or subgiant stars

After Tess: potential targets will increase to ~500.

=> Even before PLATO we will be telescope limited, rather than target limited

=> need to select most promising targets:
e.g., well resolved
accurate parallaxes
most promising (PLATO) asteroseismic targets



Huber et al. 2012

Possible benchmark stars

- Stochastic pulsators in reach of interferometry

Relevant ongoing / planned campaigns

GAIA: benchmark stars (see Creevey's and Heiter's talk)

TESS: asteroseismology-interferometry sample

Possible benchmark stars

- Stars in particular binary systems

  Eclipsing, double-line spectroscopic binaries (for radii and masses)

  Double-line spectroscopic binaries + Astrometric or visual/interferometric (for masses)

Possible benchmark stars

- Stars in particular binary systems

  Eclipsing, double-line spectroscopic binaries (for radii and masses)

  DEBcat: DEBs with radii and masses with precision better than 2%
  (Southworth 2014)

  Unfortunately, most stochastic pulsators so far found in such systems are red giants.

  Ultimately, validation with this type of binaries for main-sequence/subgiant stars will be done post-PLATO launch.

Possible benchmark stars

- Stars in particular binary systems

  Double-line spectroscopic binaries + Astrometric or visual/interferometric (for masses)

  Very few known systems contain a main-sequence or subgiant stochastic pulsator (e.g, alpha Cen A and B, Procyon, 70 Oph) .

  There is general agreement between seismic and dynamical masses for these few cases

Possible benchmark stars

- Stars in particular binary systems

  Double-line spectroscopic binaries + Astrometric or visual/interferometric (for masses)

  After GAIA many more astrometric orbits will be available. Also the number of interferometrically resolved binaries is increasing.

  For PLATO => find SB2 which are promising asteroseismic targets (or with confirmed pulsations post-TESS) and get RVs orbits?

Possible benchmark stars

- Stars in particular binary systems

  Double-line spectroscopic binaries + Astrometric or visual/interferometric (for masses)

  Relevant sources/ongoing projects

  - SB9 Catalogue for spectroscopic binaries (Pourbaix et al. 2004, regularly updated)
  - Masses of of the components of SB2s observed with Gaia (Halbwachs et al, 2014, 2016; Kiefer et al, 2016).

  Aim: obtain RVs orbital elements such that in combination with GAIA astrometry will provide masses with relative errors ~1%.

Possible benchmark stars

A note on efficiency

Kepler Interferometric program → about 30 targets in ~5 years

SB2 GAIA project project → minimum masses for 10 binaries in ~5 years

Thank You!