

Professional / Amateur collaborations in exoplanetary science

Alexandre Santerne

Instituto de Astrofísica e Ciências do Espaço, Universidade do Porto

alexandre.santerne@astro.up.pt



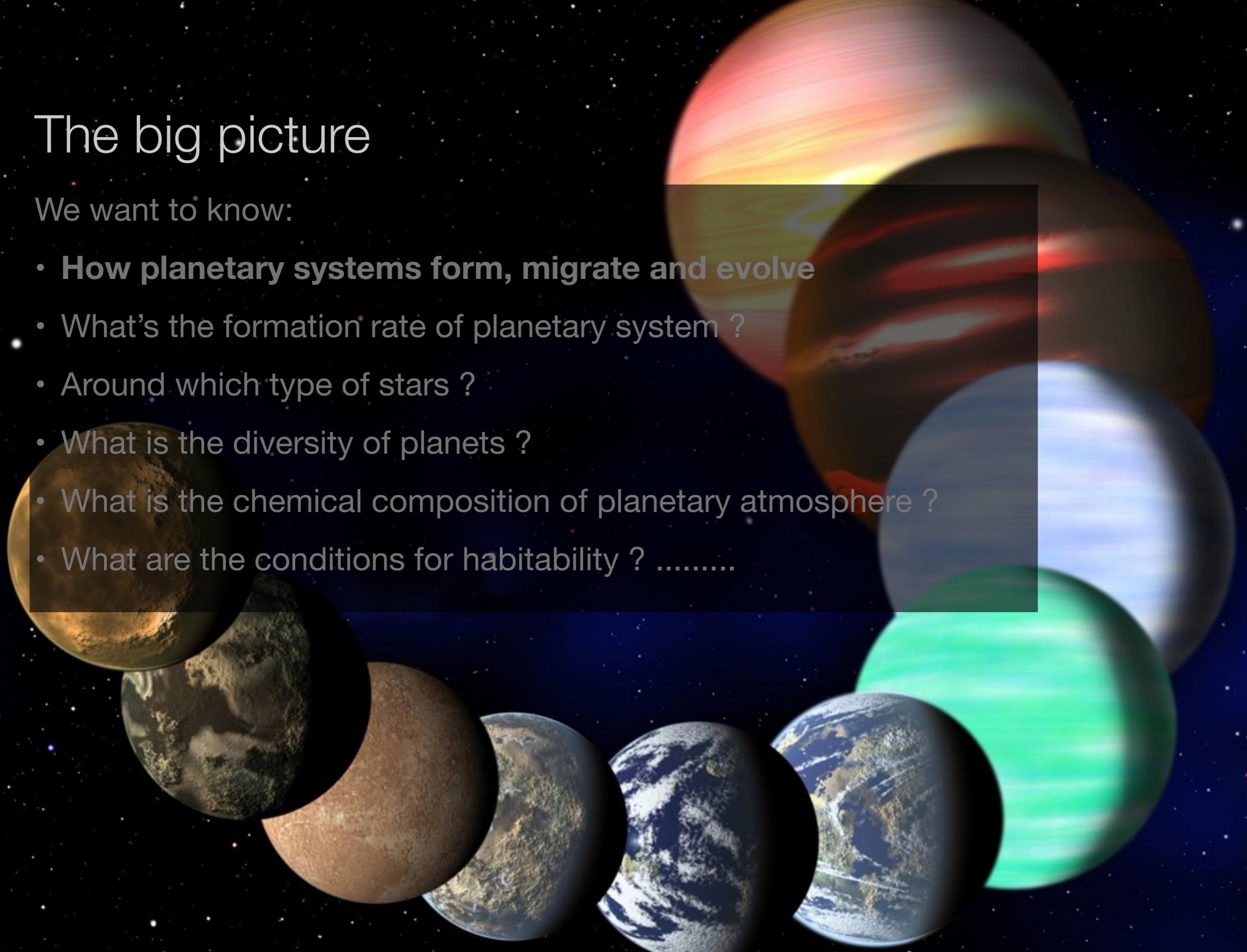
Outline

- Exoplanets: the big picture
- collaborations in photometry
- collaborations in spectroscopy
- conclusion & perspectives

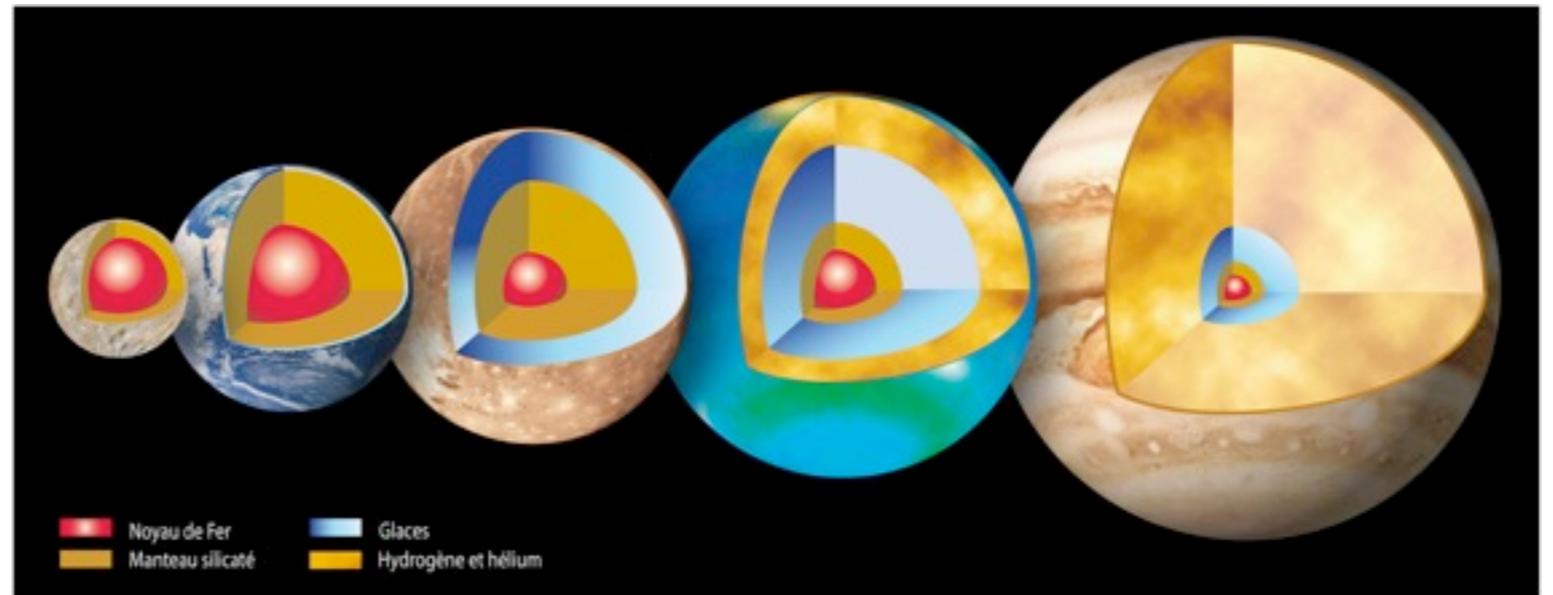
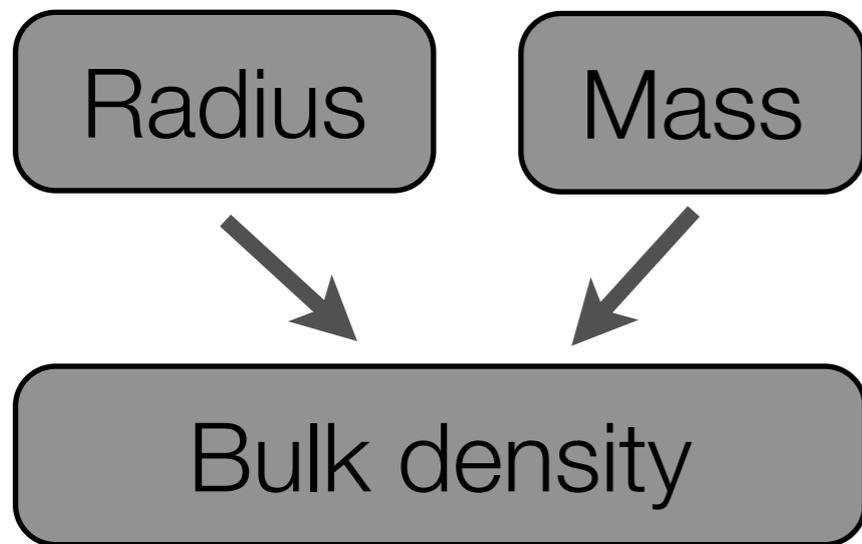
The big picture

We want to know:

- **How planetary systems form, migrate and evolve**
- What's the formation rate of planetary system ?
- Around which type of stars ?
- What is the diversity of planets ?
- What is the chemical composition of planetary atmosphere ?
- What are the conditions for habitability ?

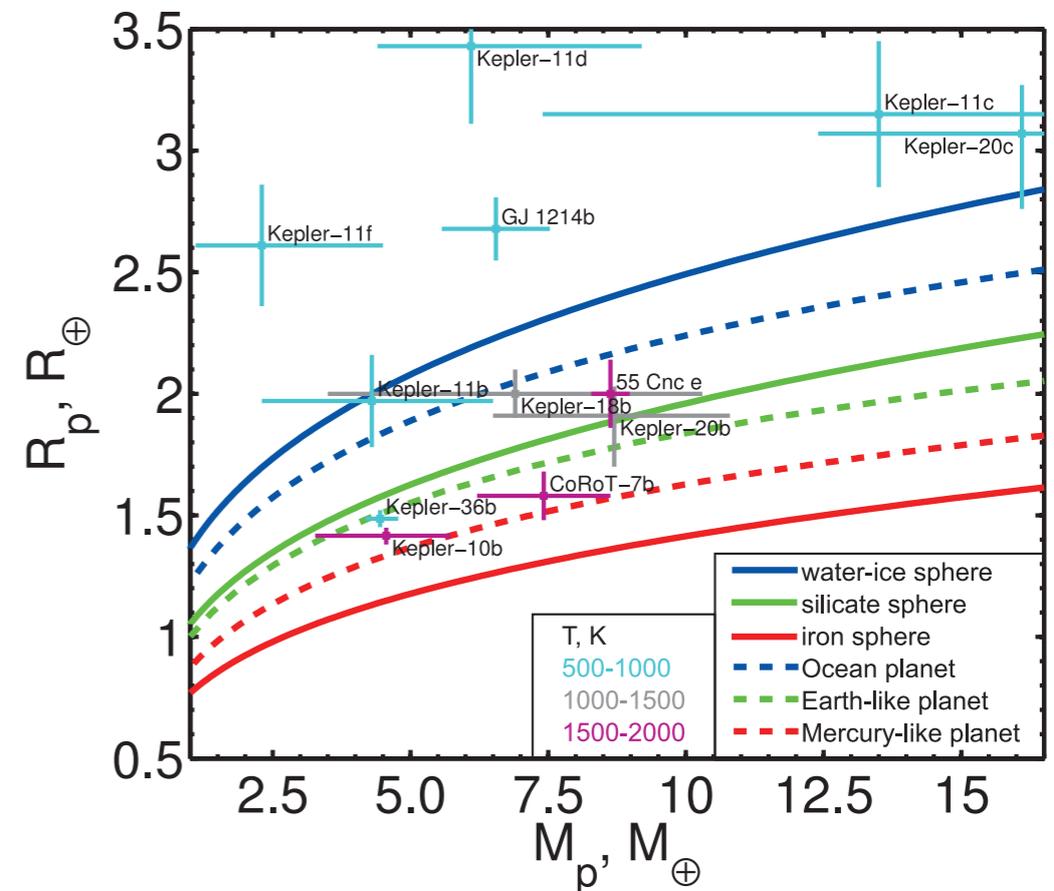


Transiting exoplanets = comparative planetology



**Know the mass & density:
know the nature**

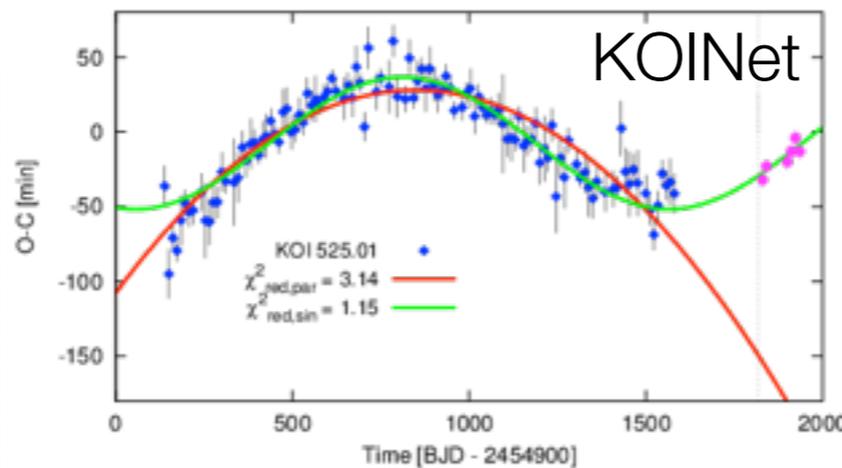
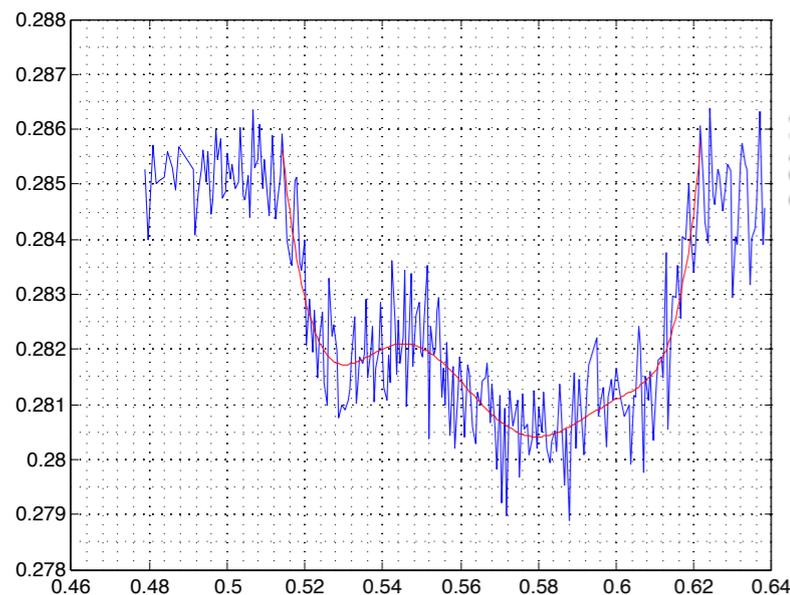
(rocky, Neptune-like, giant, brown dwarf, ...)



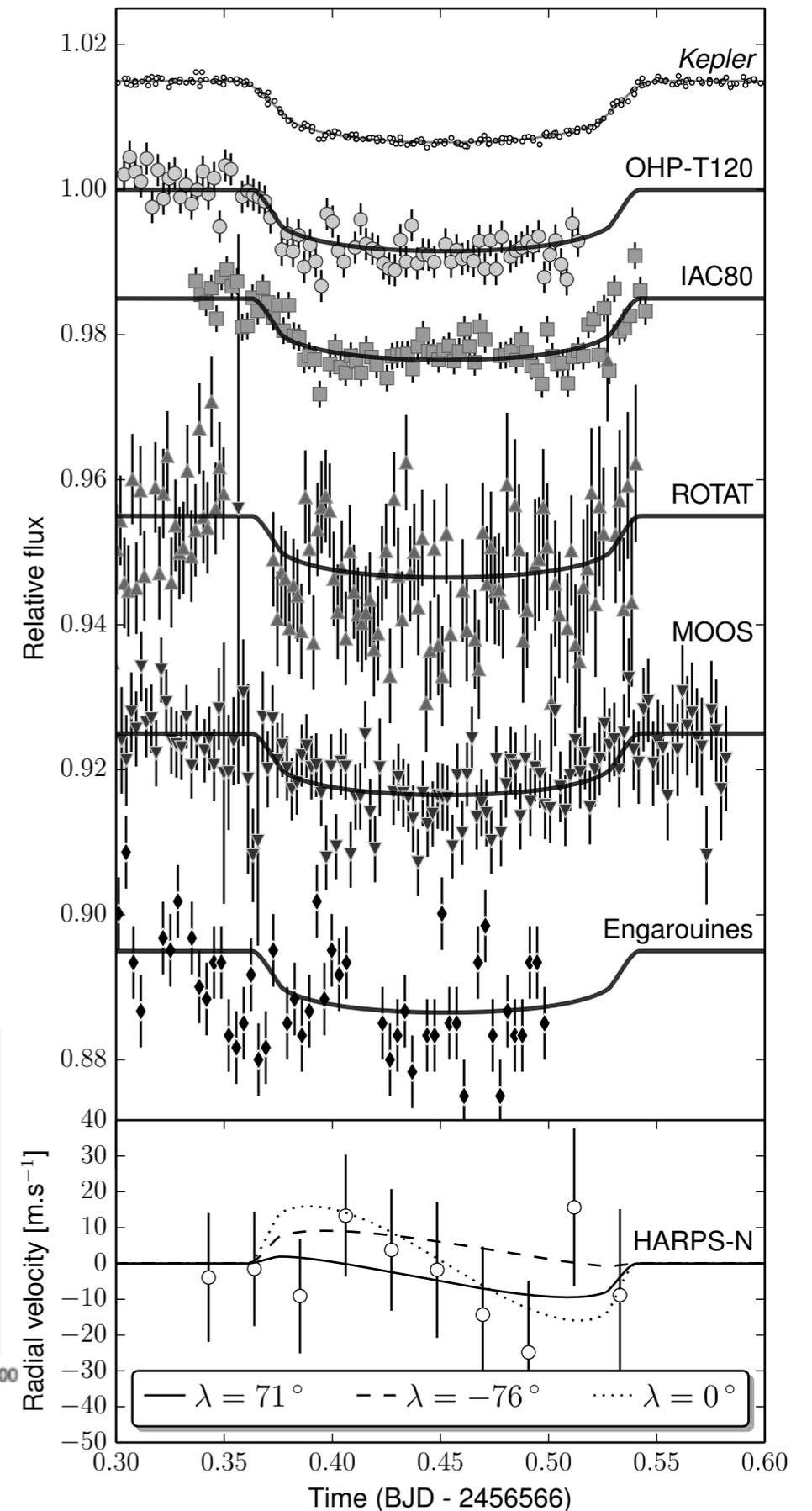
Photometry

Niches

- Keep transit ephemeris up-to-date.
- Search for other companions in the system by transit timing variations.
- Study stellar activity using planet-spot crossing events.
- Detect transit on planets detected by radial velocity.



<http://koinet.astro.physik.uni-goettingen.de>



Santerne et al. (2014)

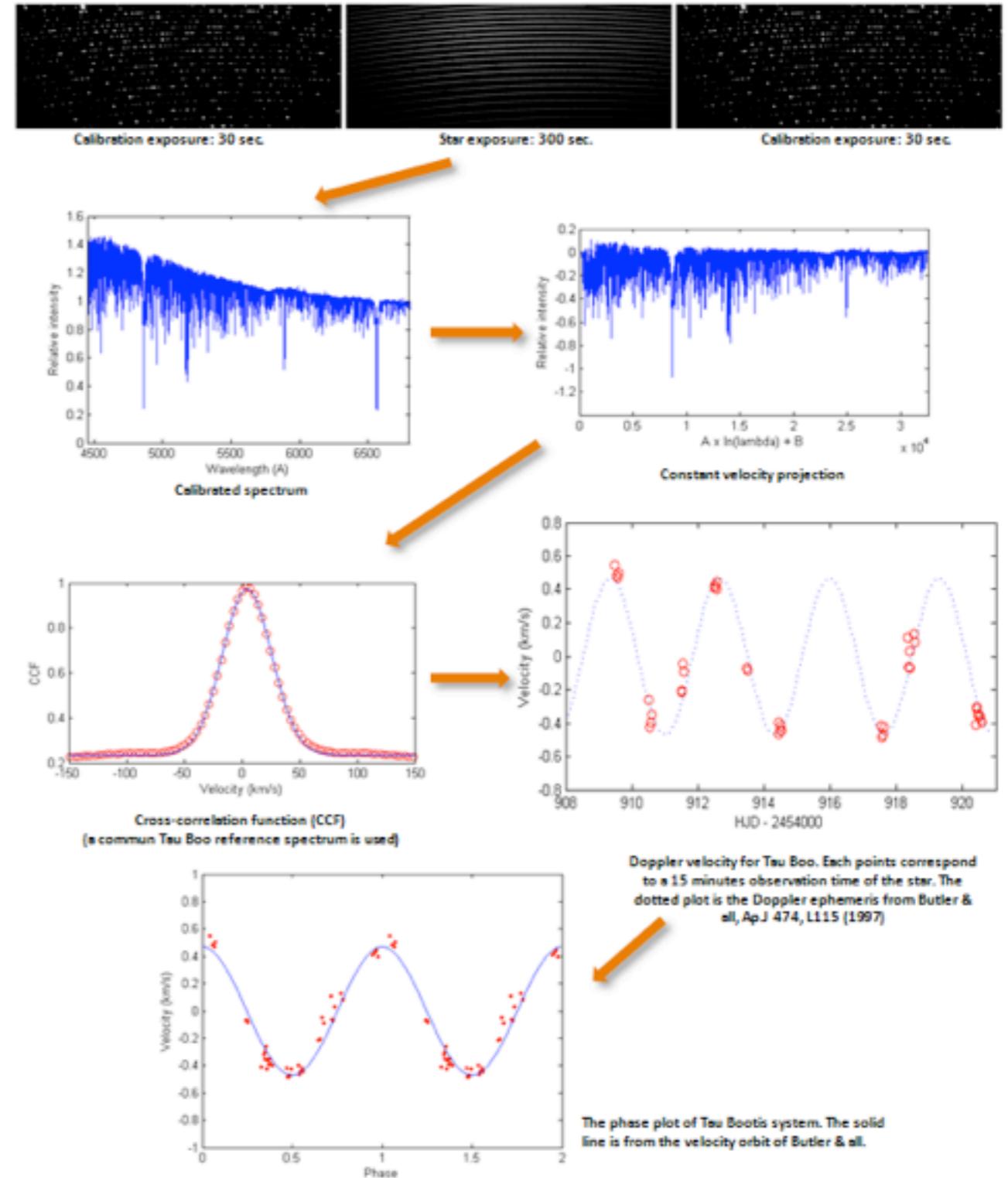
Spectroscopy

Amateur radial velocities



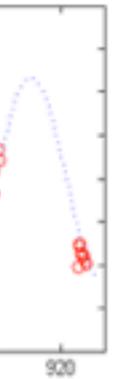
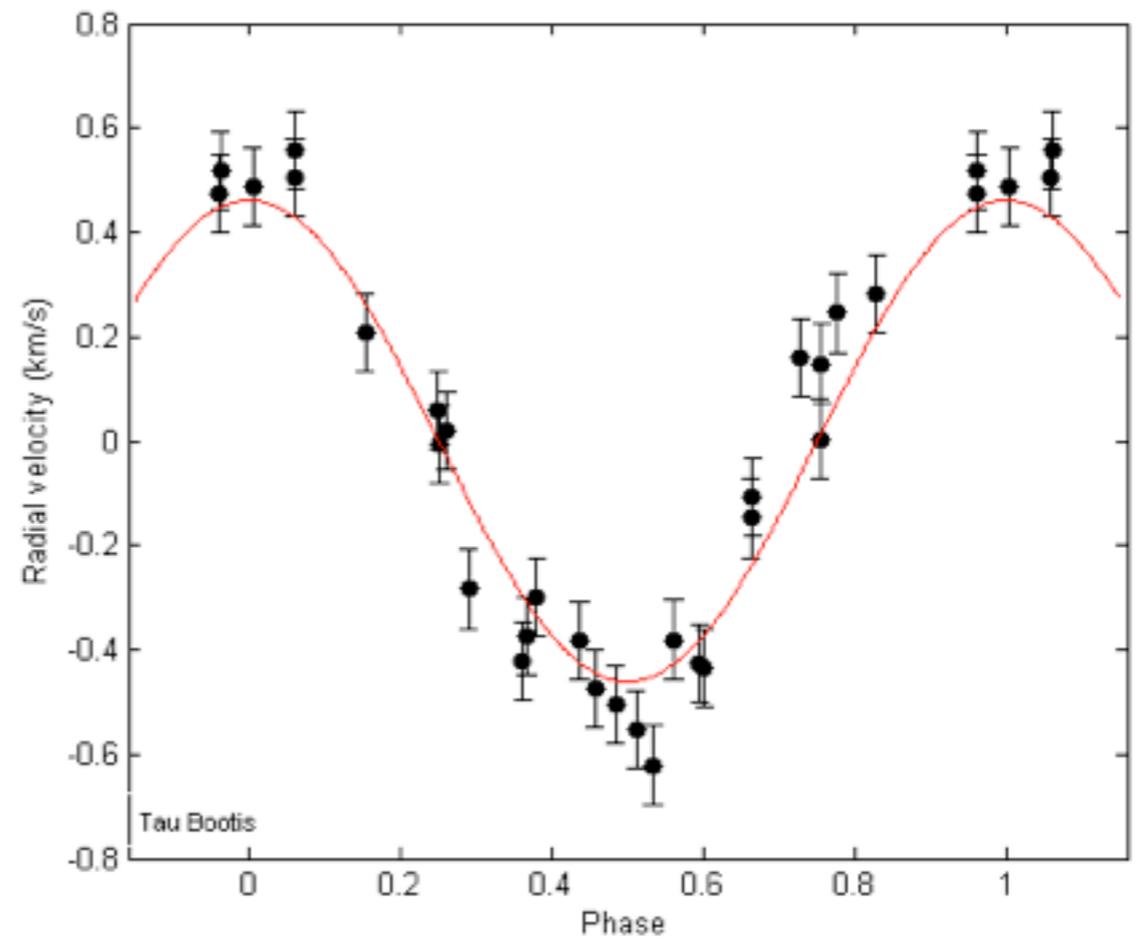
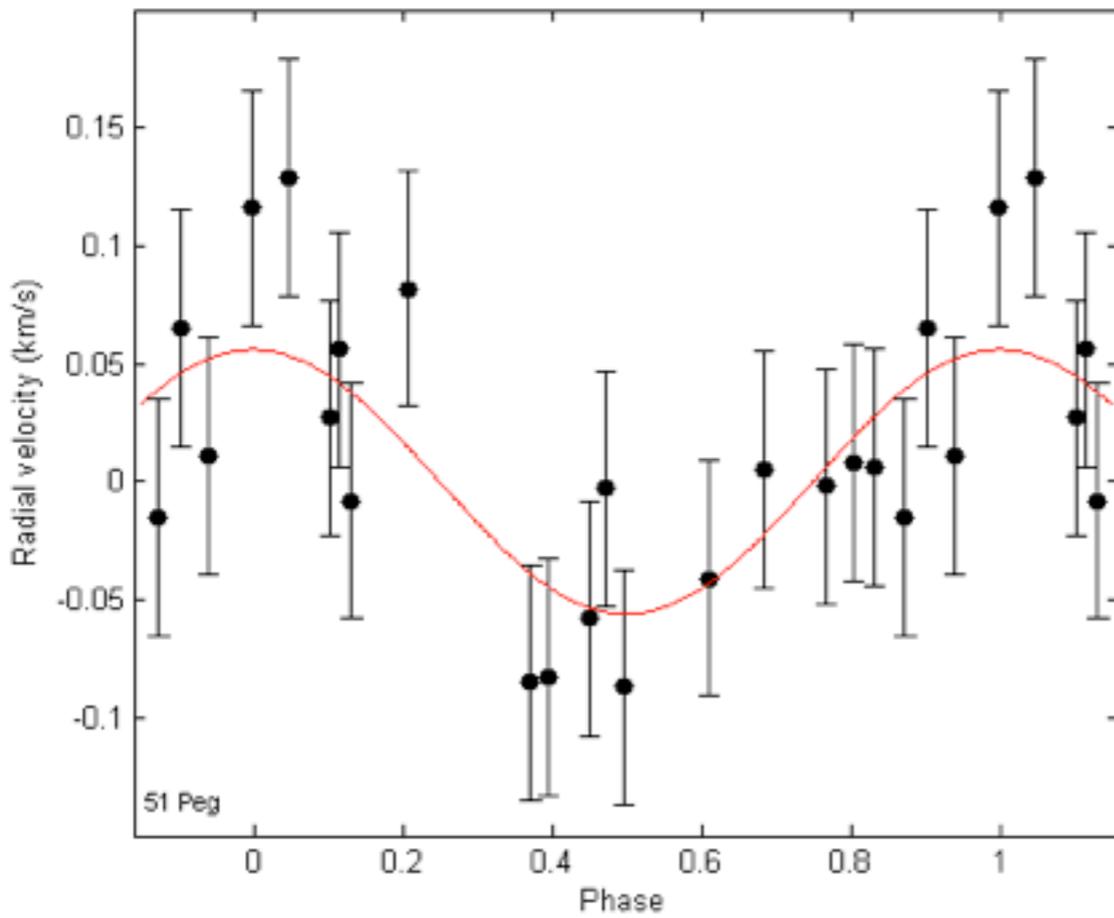
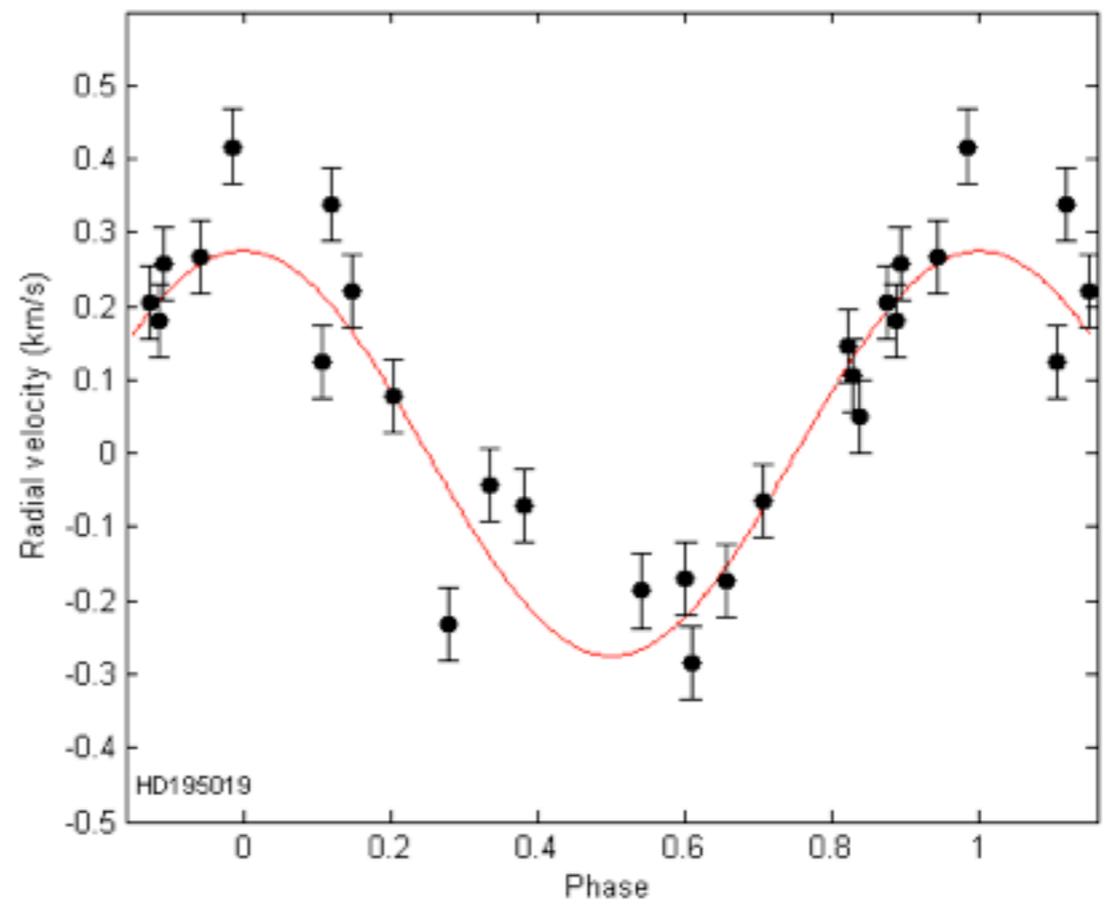
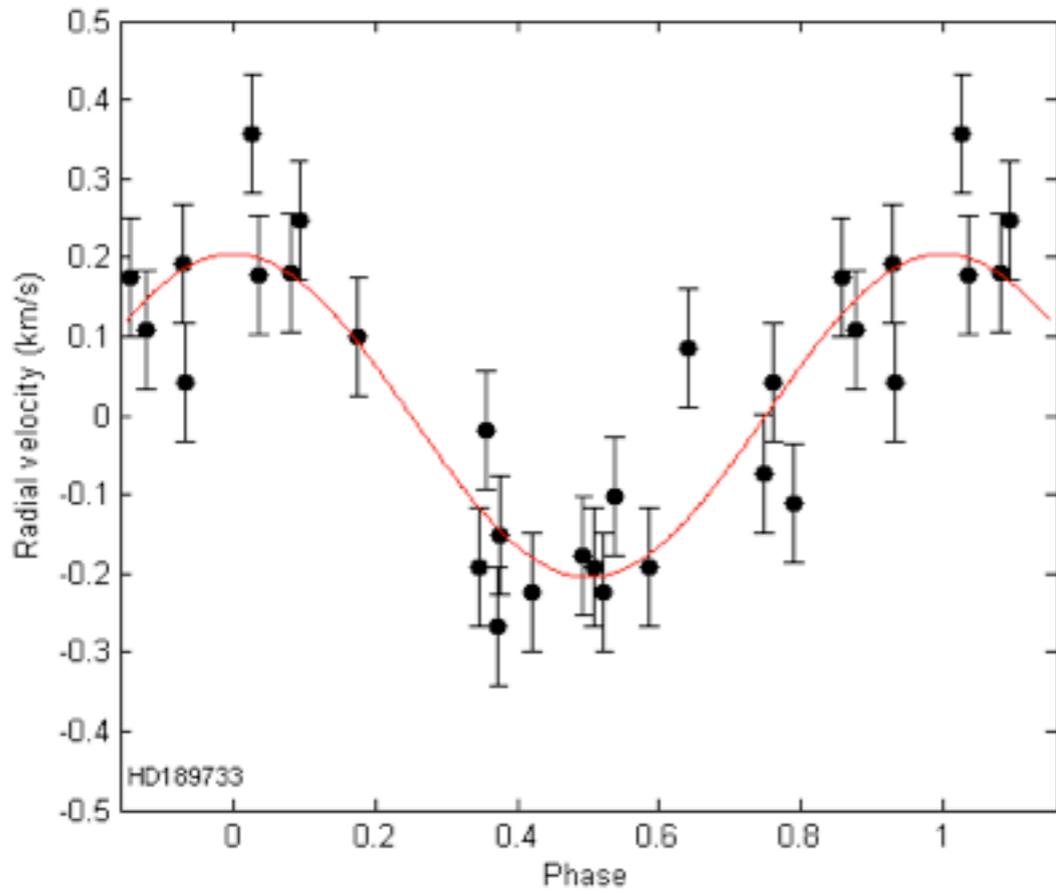


www.SHELYAK.com



<http://www.astrosurf.com/buil/extrasolar/obs.htm>

Ar



respond
tor. The
Butler &

High-resolution amateur spectroscopy

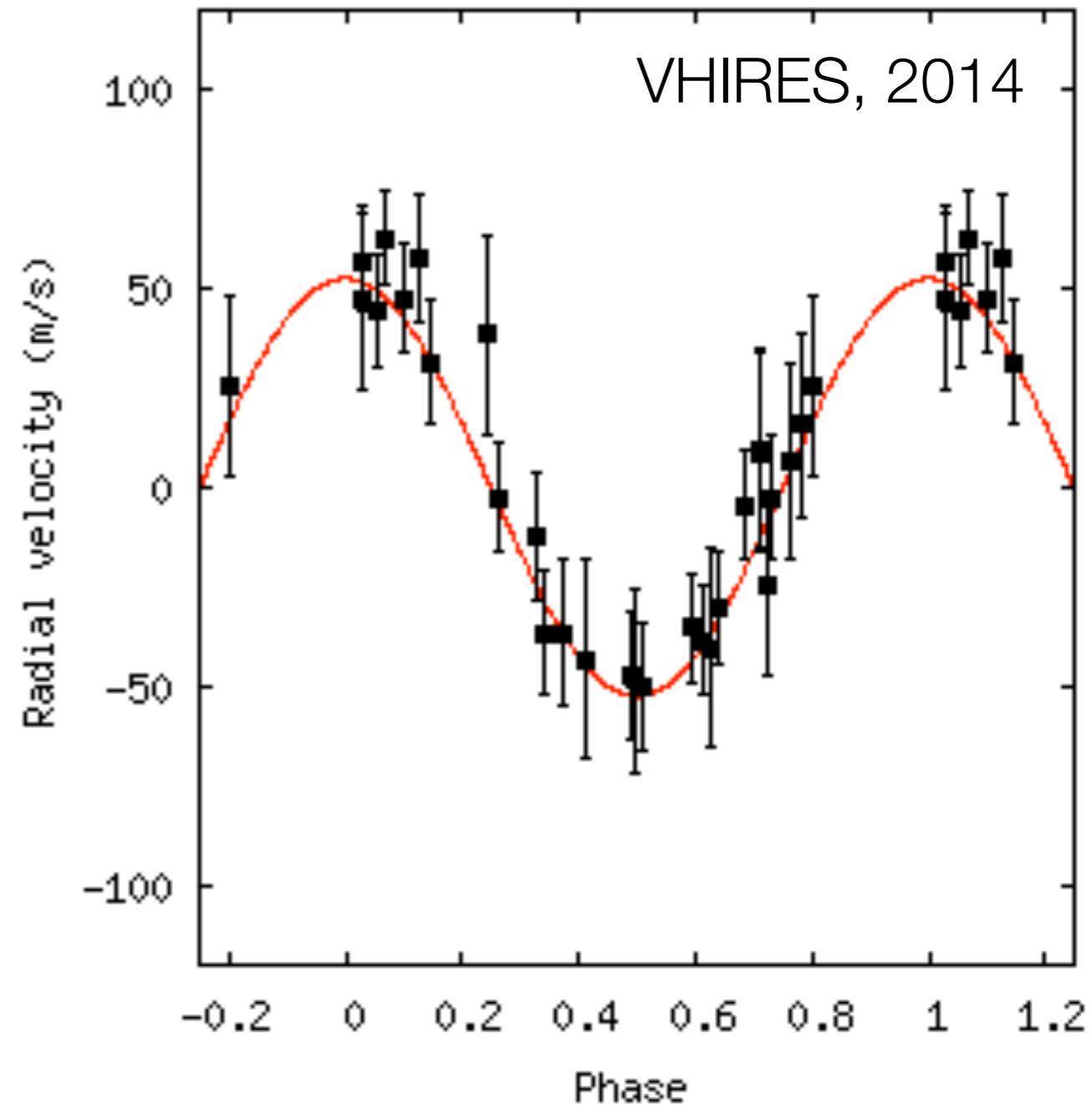
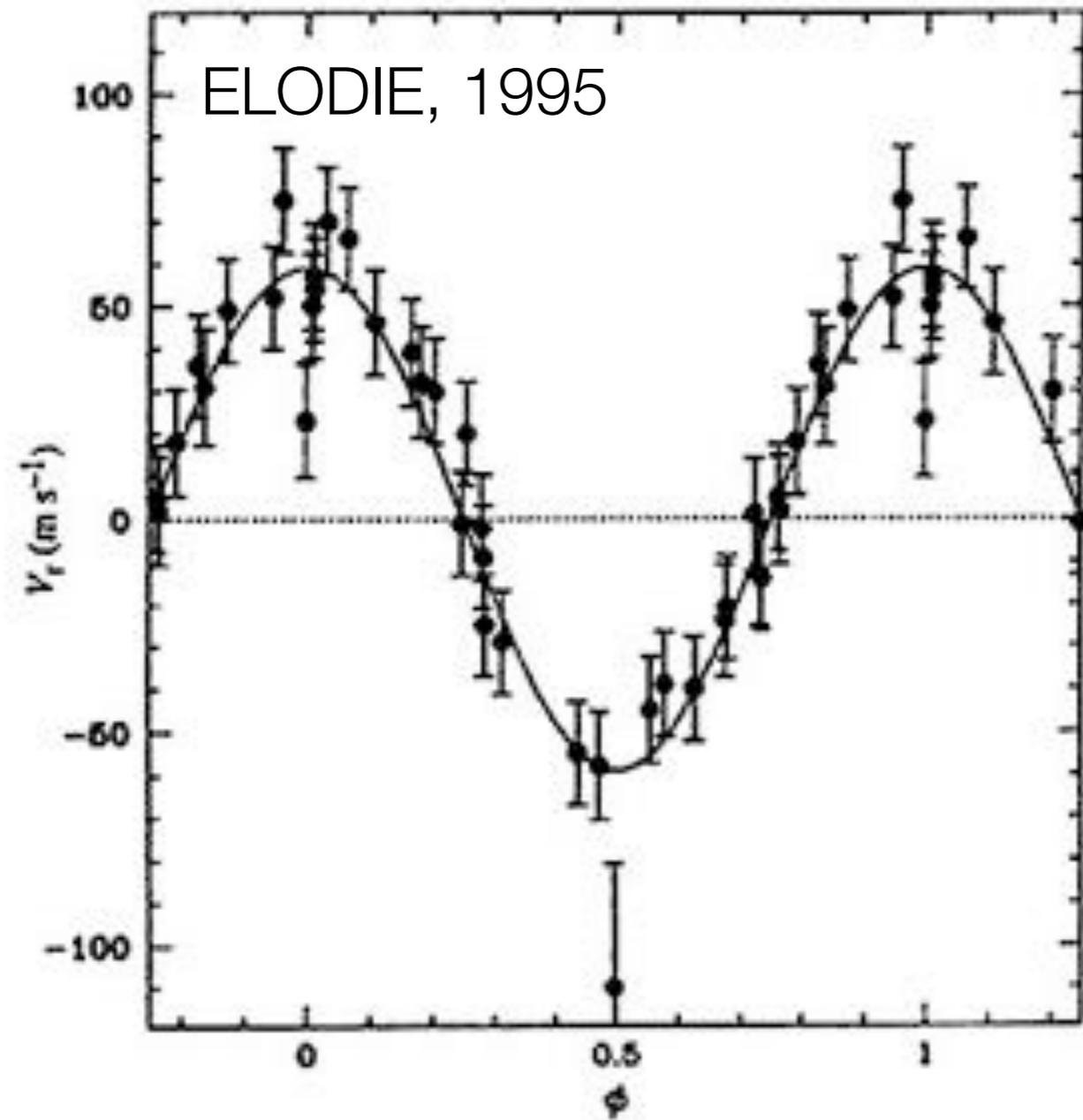
Echelle
spectrograph
 $R \sim 50\,000$



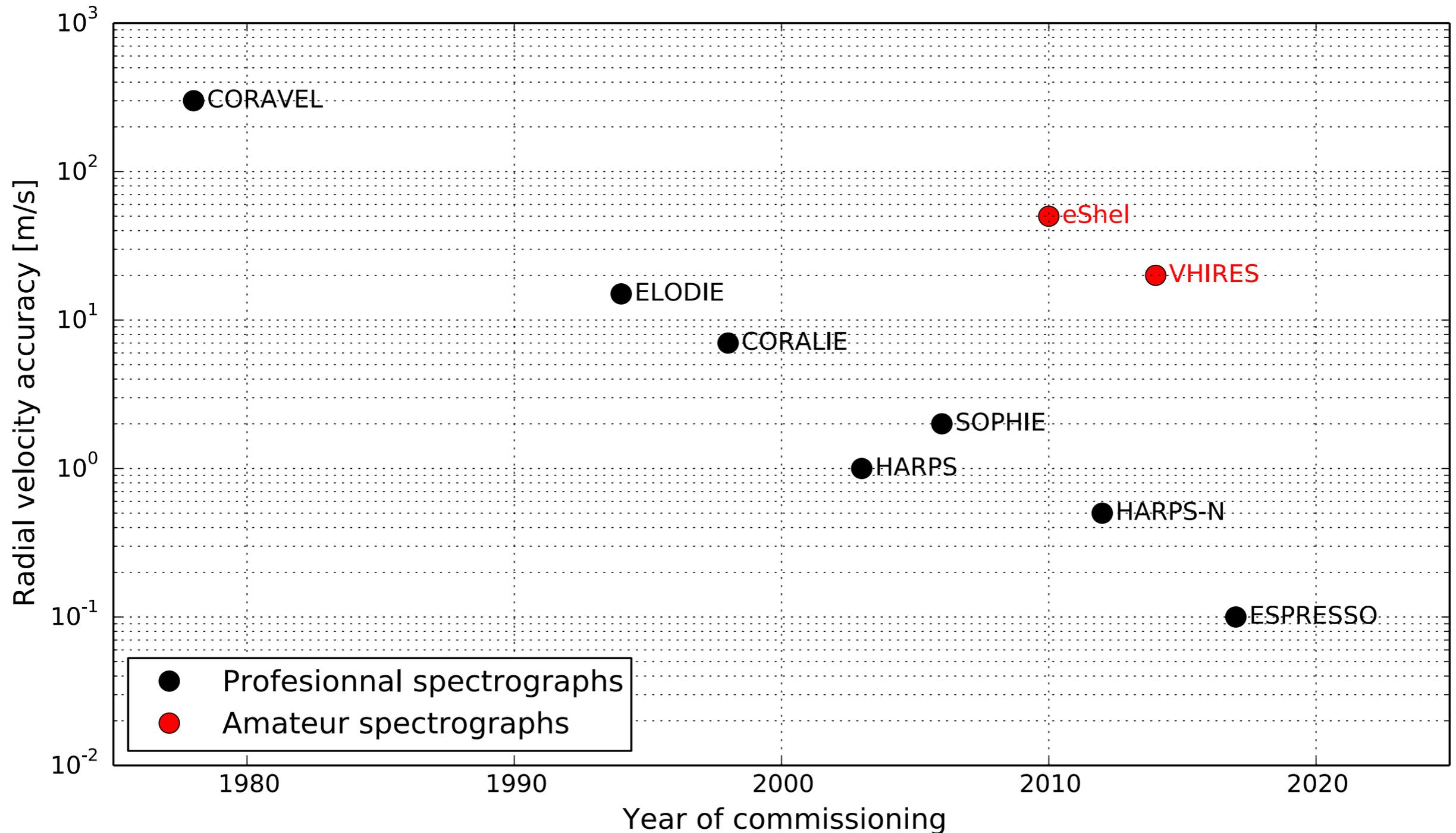
High-resolution amateur spectroscopy



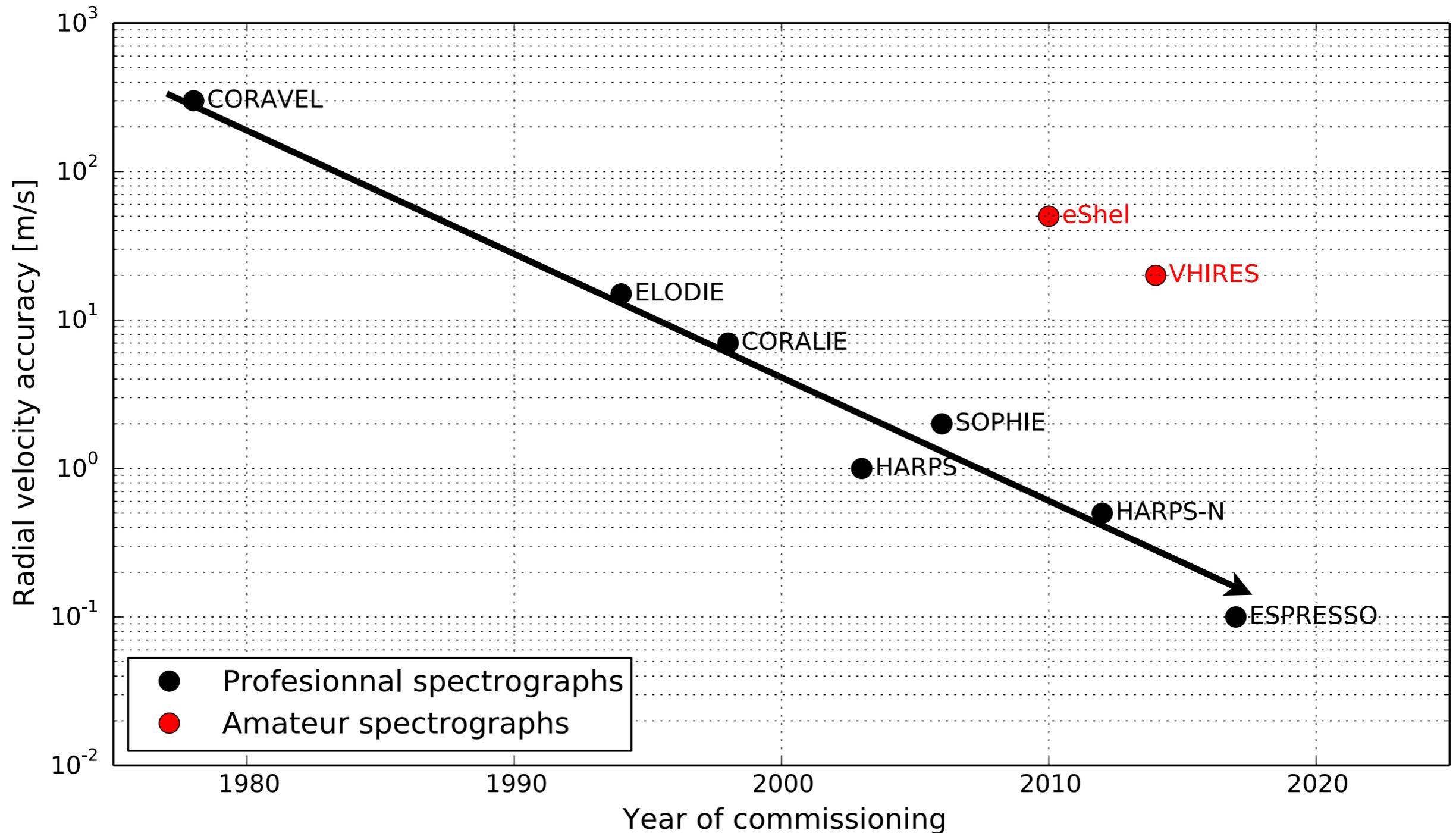
High-resolution amateur spectroscopy



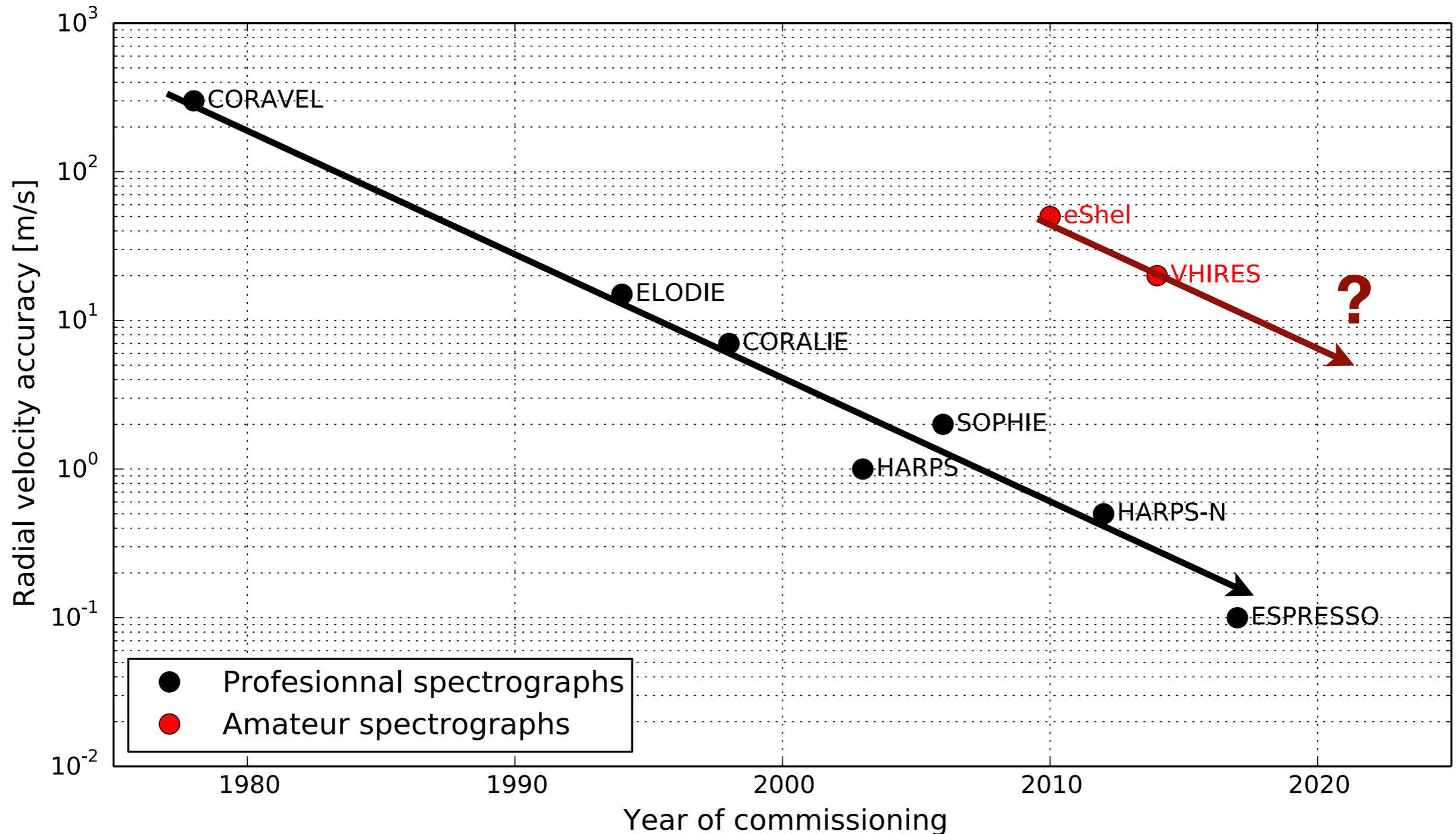
The “Moore law” for spectrographs’ accuracy



The “Moore law” for spectrographs’ accuracy



The “Moore law” for spectrographs’ accuracy



Niches for amateurs

- Radial velocity survey
- Follow-up of transit survey

Niches for amateurs

- Radial velocity survey

Objective: search for massive planets / brown dwarfs
around bright fast-rotating (F) stars

- Follow-up of transit survey

Niches for amateurs

- Radial velocity survey

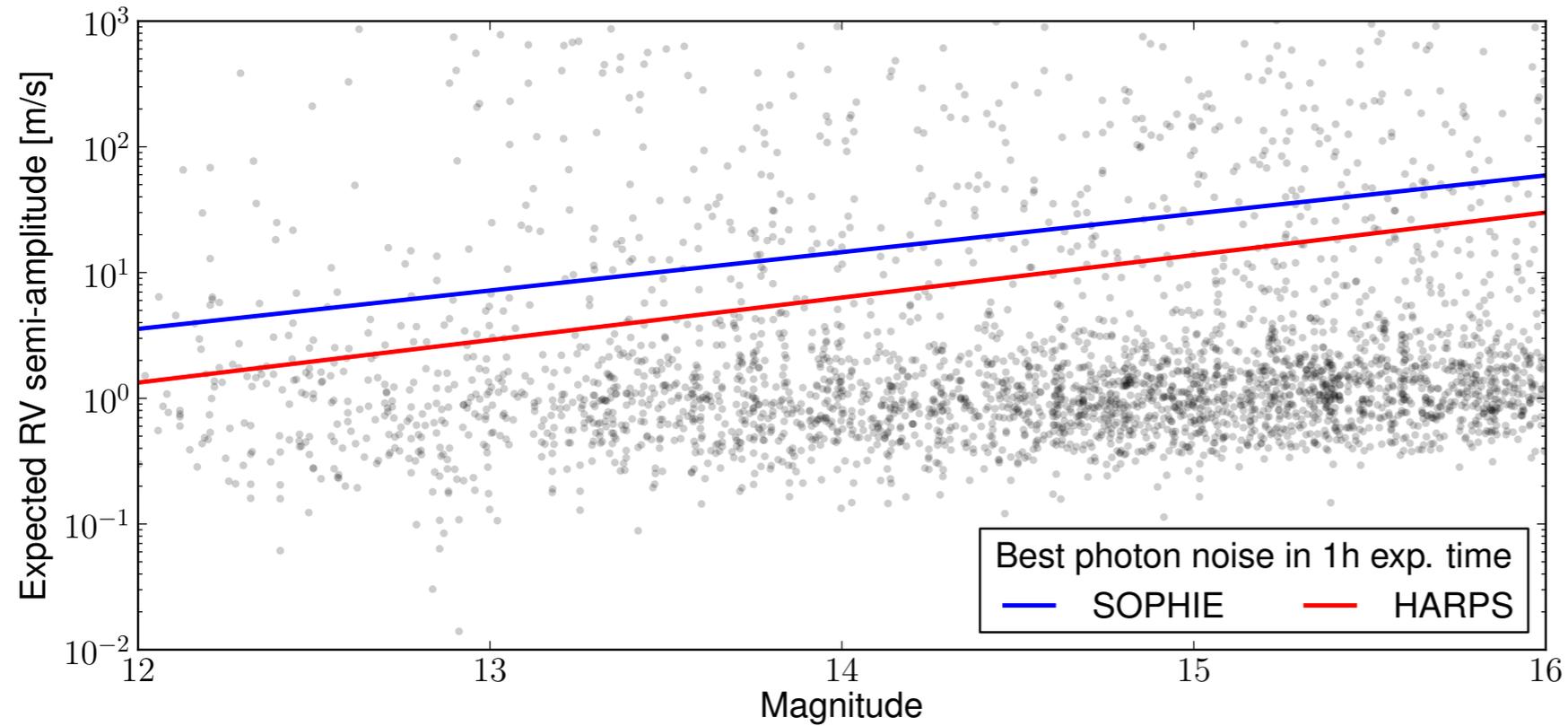
Objective: search for massive planets / brown dwarfs
around bright fast-rotating (F) stars

- Follow-up of transit survey

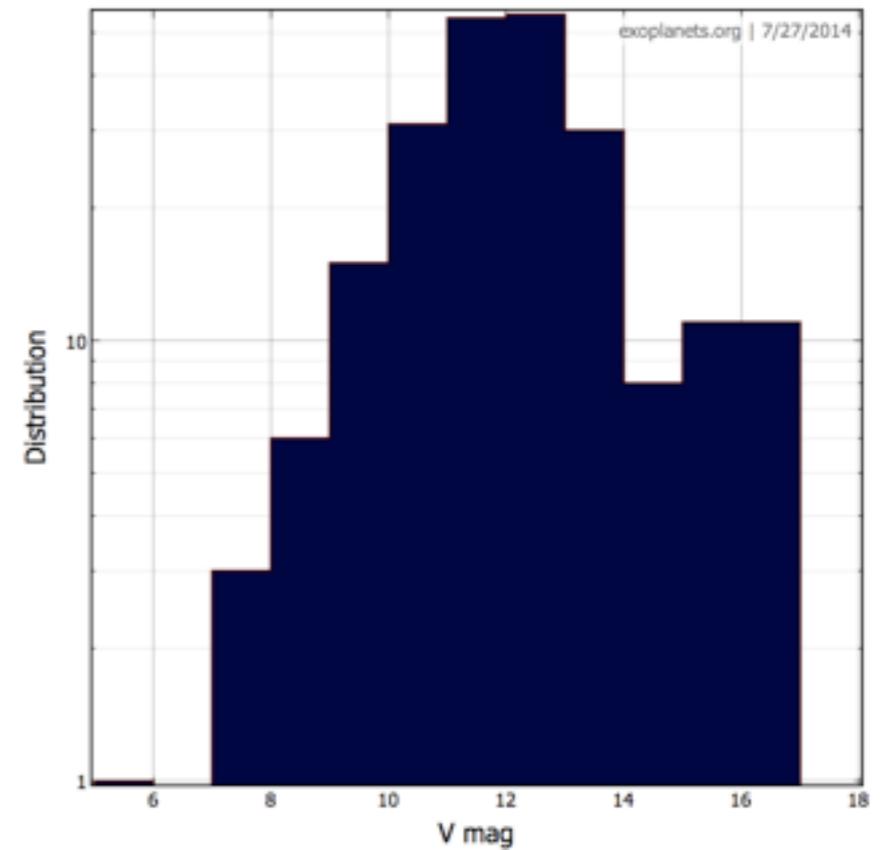
Objective: characterise giant planets transiting bright stars

Today

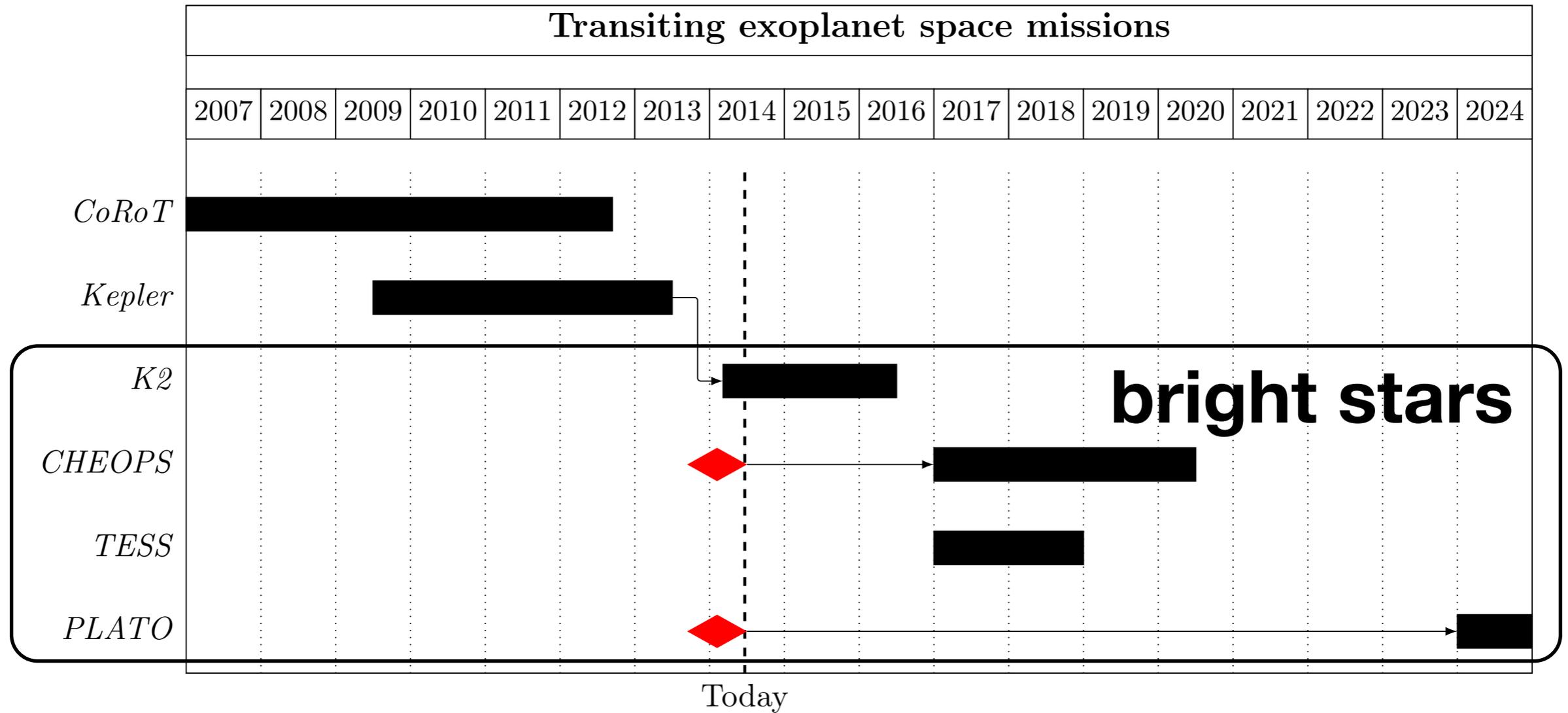
Kepler candidates



All planets

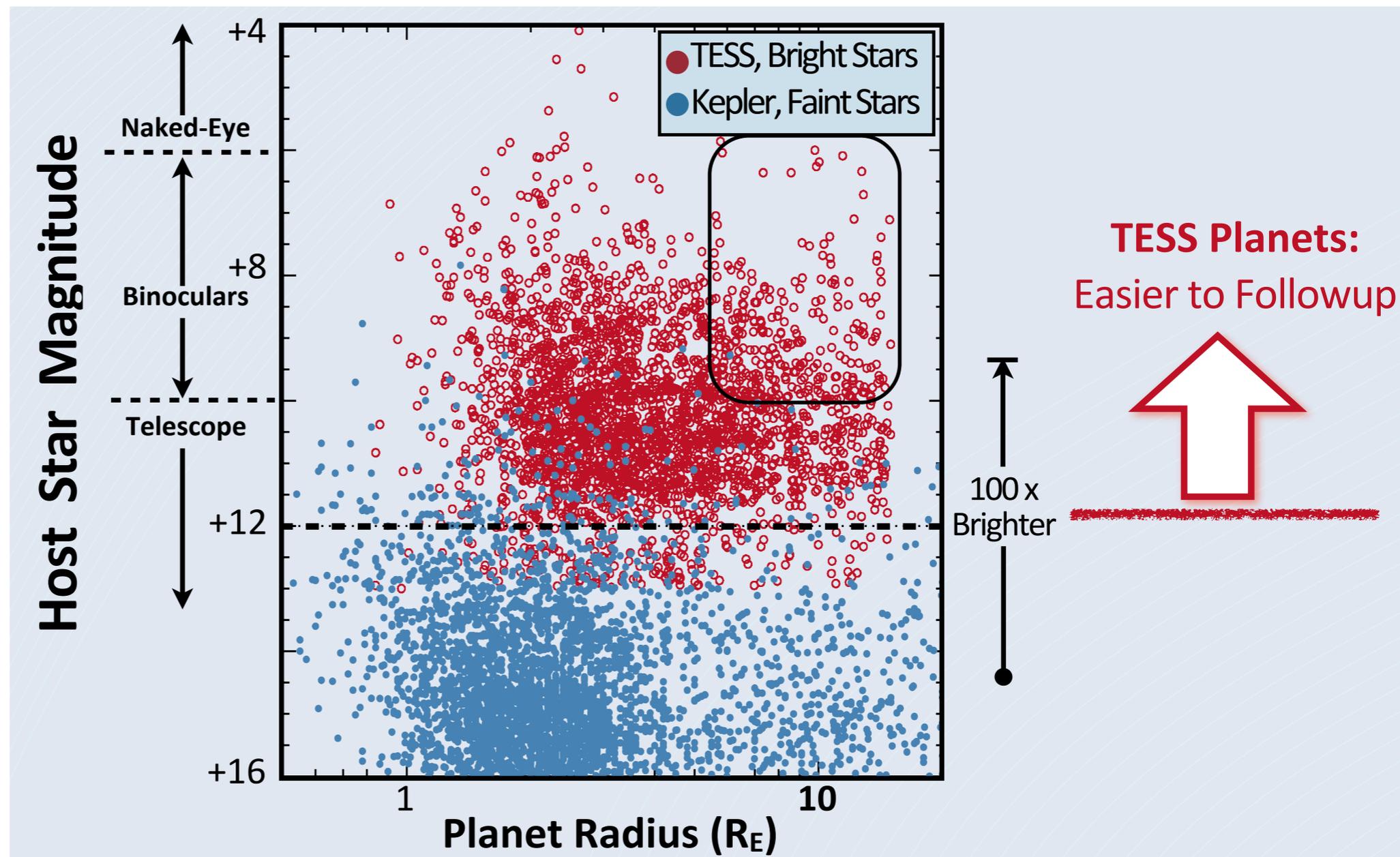


Tomorrow



TESS (Transit Exoplanet Survey Satellite)

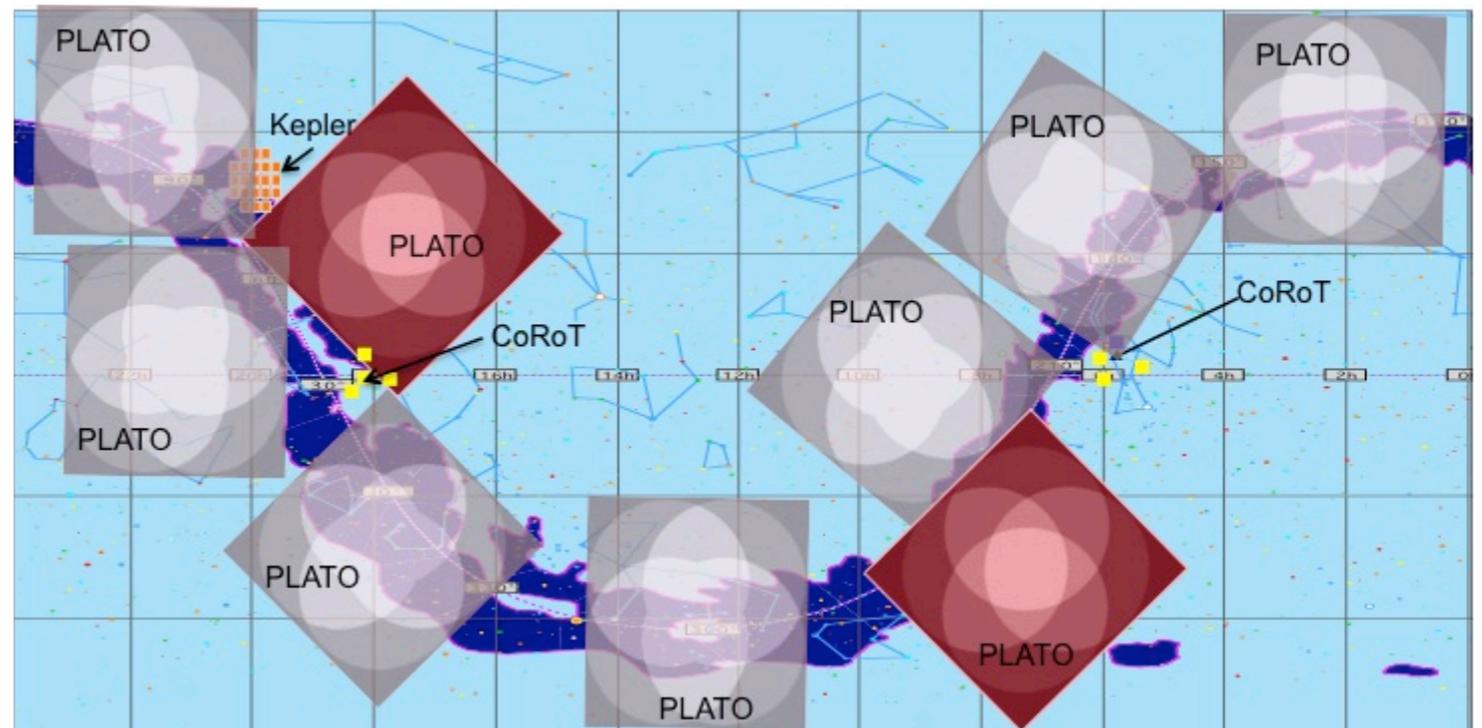
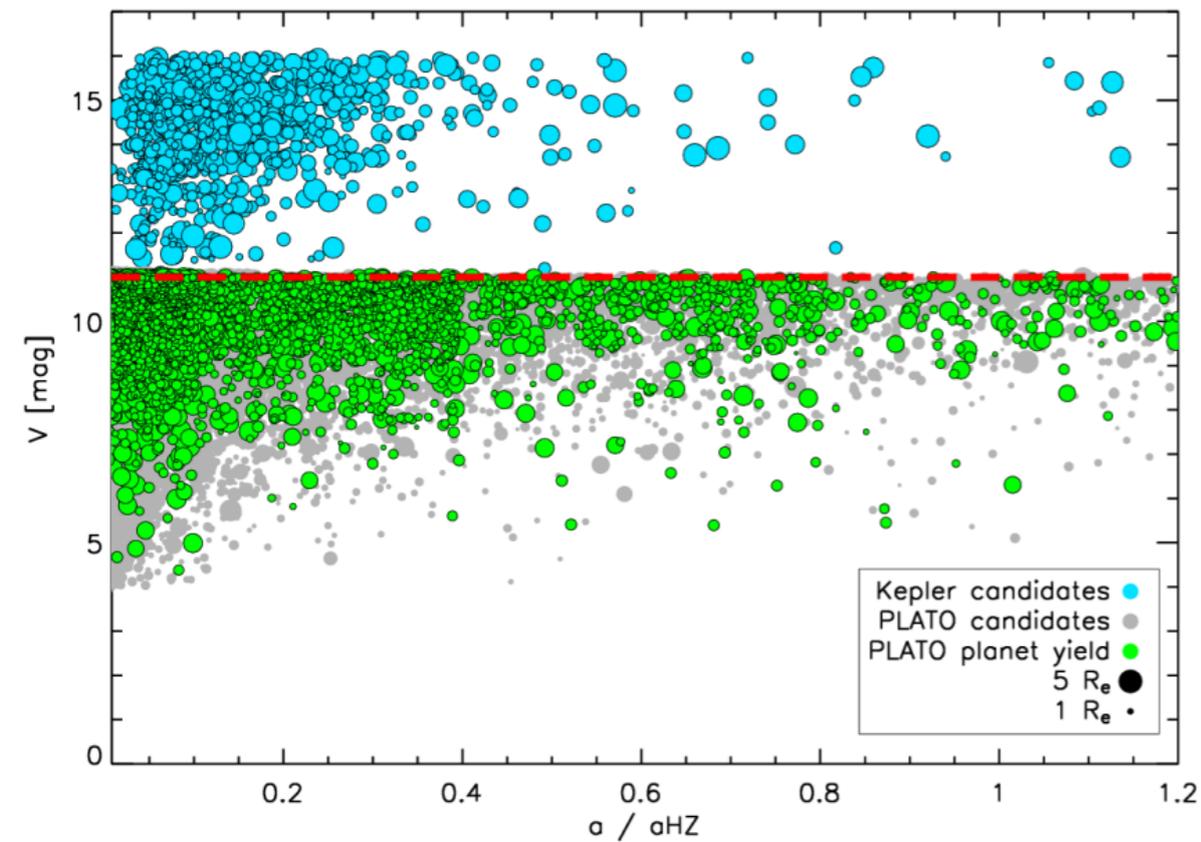
- Full-sky survey of stars brighter than $m_v \sim 12$
- Observing run of 27 days



PLATO (PLAnetary Transits and Oscillations)

- 42% of the sky

- stars as bright as $m_v \sim 4$



	PLATO 2.0	Kepler	CoRoT	Ref.
No. of bright targets ≤ 11 mag	$\sim 85,000$ stars total*	$\sim 6,000$ stars	~ 370	2, 4, 5

Perspectives & Conclusion

- Exoplanet studies are accessible to amateur astronomers - in photometry and spectroscopy.
- The study of giant exoplanets transiting bright star could performed by amateurs
- In photometry: check for background eclipsing binaries.
- In spectroscopy: by participating to the radial velocity follow-up (screen out false positives and characterise giant planets).
- Room for large pro/am collaborations in the context of future space missions (esp. TESS & PLATO) -> bright stars.

Photometry: see Mousis et al. (2014)
Spectroscopy: Santerne et al. (in prep.)

The “french” Pro/Am school

- Oleron 2003, La Rochelle 2006, 2009, 2012, TBD 2015.



The “french” Pro/Am school

- Oleron 2003, La Rochelle 2006, 2009, 2012, TBD 2015.
- Cocktail recipes:
 - ~50% of pro's
 - ~50% of am'sshake during 1 week -> new collaborations !



The “french” Pro/Am school

- Oleron 2003, La Rochelle 2006, 2009, 2012, TBD 2015.

Some key dates:

- Cocktail recipes:
 - ~50% of pro's
 - ~50% of am'sshake during 1 week -> new collaborations !
- 2006 - start of pro/am collaborations in spectroscopy
2009 - start of pro/am collaborations in exoplanets
(improved in 2012)



What about an European pro/am meeting ??

- Thanks for your attention -