Rossiter McLaughlin measurements with Harps-North

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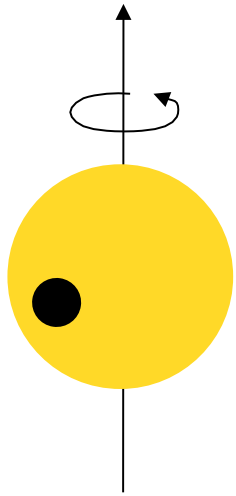
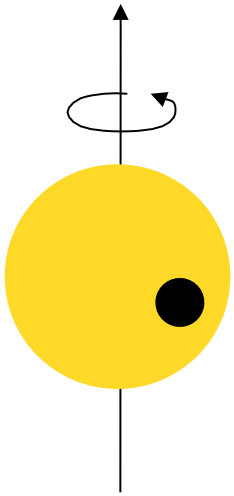
Radial velocity anomaly during transit

When a transiting planet hides stellar rotation



Planet hide approaching side

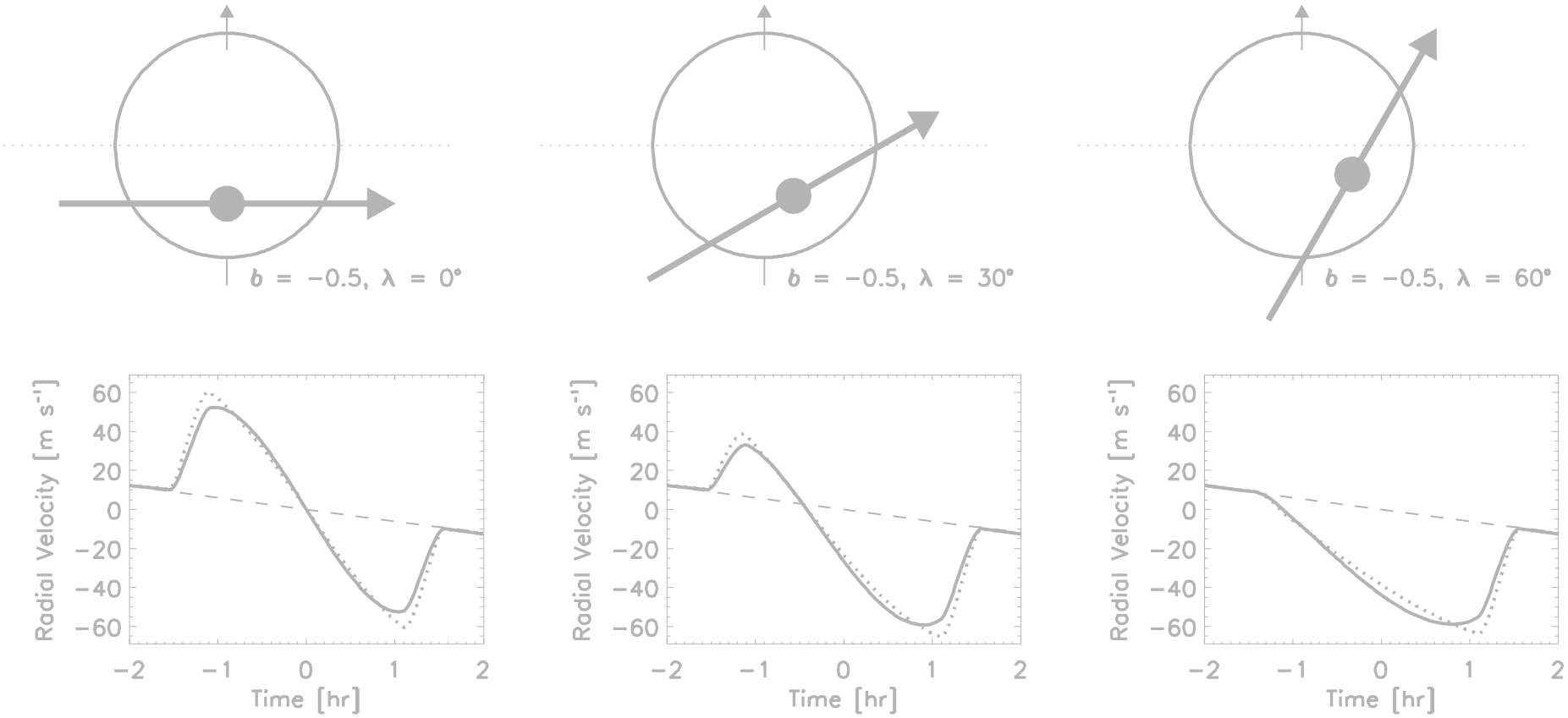


Planet hide receding side

Radial velocity would have anomalous excursion during transit

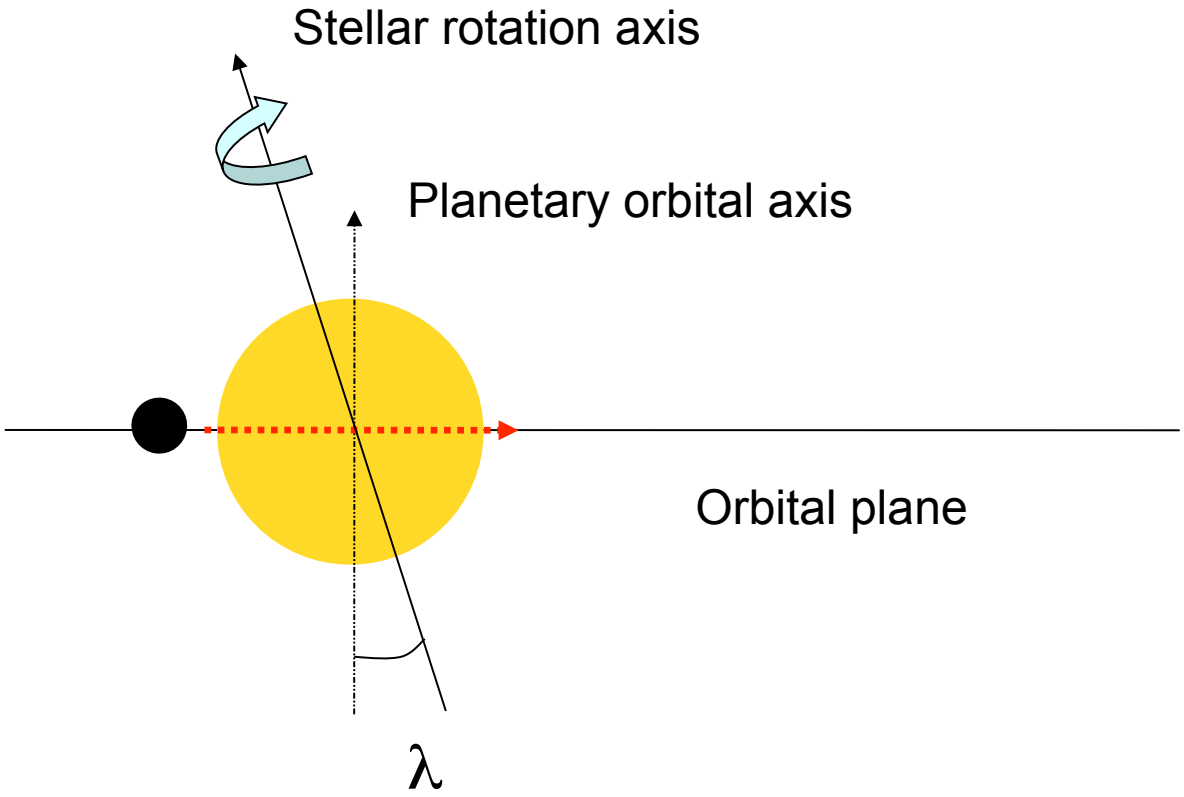
What can we learn from RM observations?

The shape of RM anomaly
depends on the trajectory of the transiting planet.



Gaudi & Winn (2007)

Observable parameter



λ: sky-projected angle between

the stellar spin axis and the planetary orbital axis

(e.g., Ohta et al. 2005, Gimenez 2006, Gaudi & Winn 2007)

Why is the RM effect interesting?

λ is connected with planet migration models.

e.g.,

- Type II migration
  - planetary disk and planet interaction
- Jumping Jupiter model
  - multiple-planet interaction and scattering
- Kozai migration
  - perturbation by a binary companion

Comparison of resultant planets

Type II migration

- small eccentricity and inclination
- roughly explain semi-major axis distribution (Ida & Lin 2004)
- cannot explain eccentric planets

Jumping Jupiter / Kozai migration

- possible large eccentricity and inclination
- explain eccentricity distribution when combined with Type II migration models

Motivation of RM observations

- λ is an important and basic parameter to characterize planetary systems architecture
- We can test those planet migration models via the RM effect.

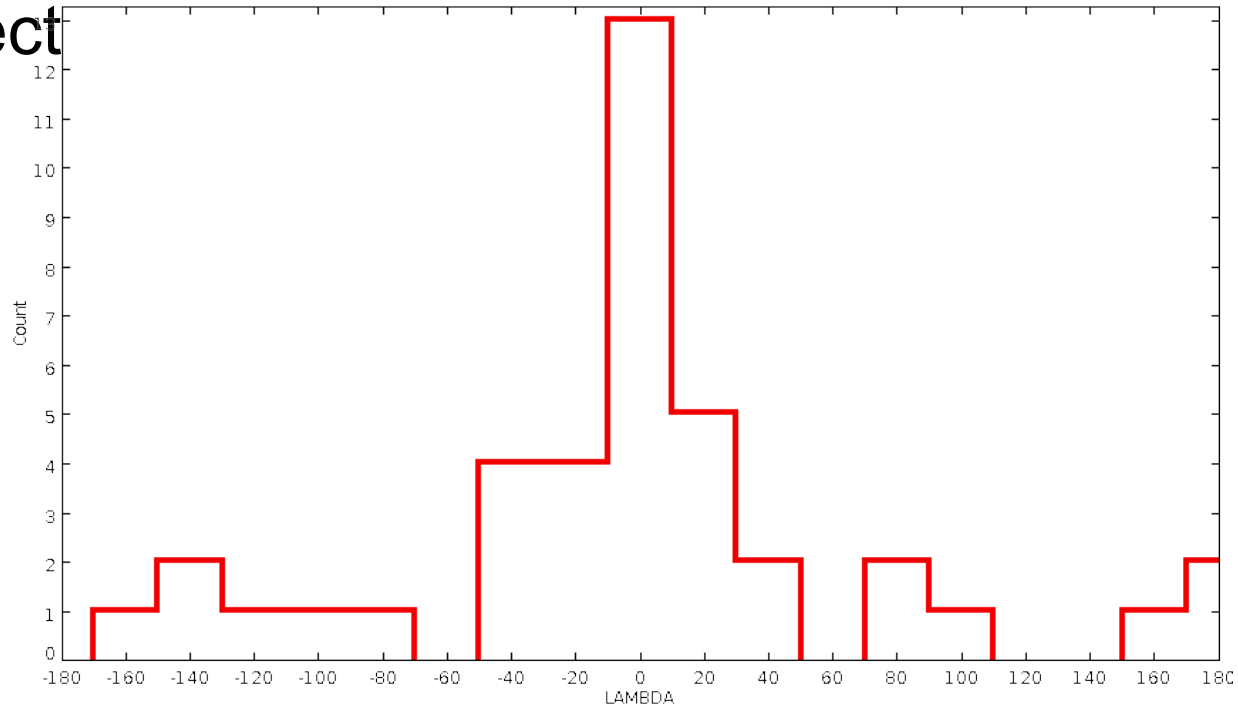
The RM study is unique for transiting systems!

Observing panorama

40 systems with RM effect measured

Most of the planets are aligned (|λ|<30º).

Not aligned tends to be found around slightly evolved stars or high temperature stars (Winn 2010).

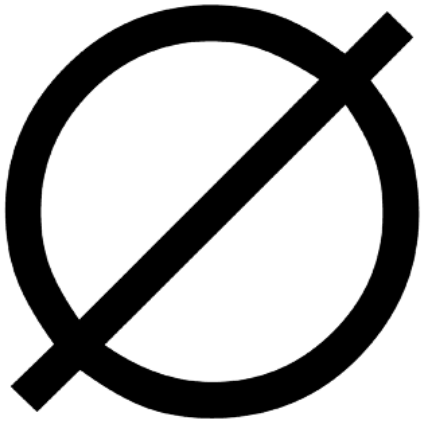


Targets

11/2011 : >100 transiting planets

Excluding the systems with

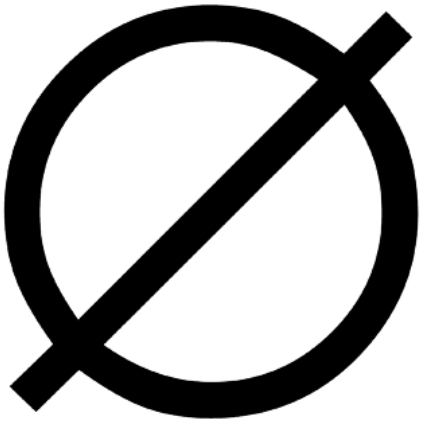
- oooo
- oooo
- oooo
- oooo
- Kepler planets

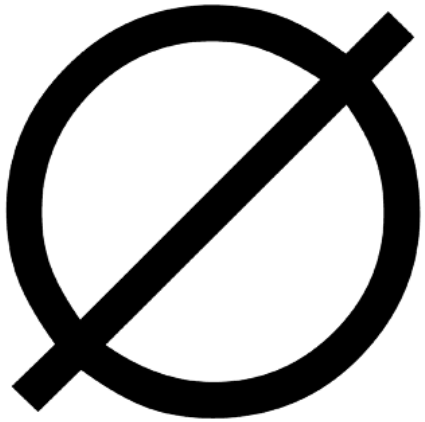


There are oooo planets oooo.

The adopted selection criteria guarantee an efficient observation mode with Harps-

Targets characteristics





Program

We plan to perform observations of oooo planets with oooo.

These observation can increase oooo the total number of systems with RM measurements.

In our sample we expect to detect about oooo misaligned planets.

oooo

In order to maximize the results, the target list will be continuously updated and complemented with the newly discovered transiting planets.

Particular attention will be devoted to select transiting planets oooo

A parallel theoretical work on the interpretation of the results will be performed.

Program summary

One target per night

oooo nights per year (oooo per semester)

Total length oooo years (+ extension)

Total time requested oooo nights (+ extension)

Observations are time critical

Collaboration already ongoing with oooo

Ready to go (all the tools for the analysis of RM effect are already developed)

Theoretical interpretation

The information on the alignments obtained from the observations, will be compared with the already performed N-Body simulations in order to:

- Predict the evolution of inclinations taking in to account stellar evolution
- Assess the extent to which the observed alignments is a by-product of the formation process of the system
- Assess if the observed orbital state is transitory or stable and, in presence of a perturbing body predict the evolution of the system
- Explore, for high-inclination multi-planet systems, the possible orbital configurations that could have originated the observed configuration
- Assess the likeliness of Earth-sized planets in the habitable zone of the observed systems