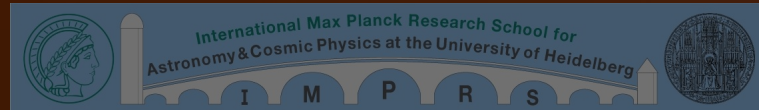
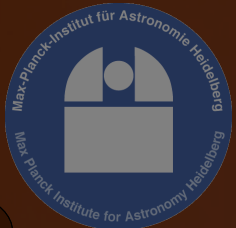


# Disentangling planetary RV signals and stellar activity

Planet formation and evolution, Munich  
September 6, 2012

Maren Mohler-Fischer

Max-Planck-Institute for Astronomy  
Heidelberg, Germany



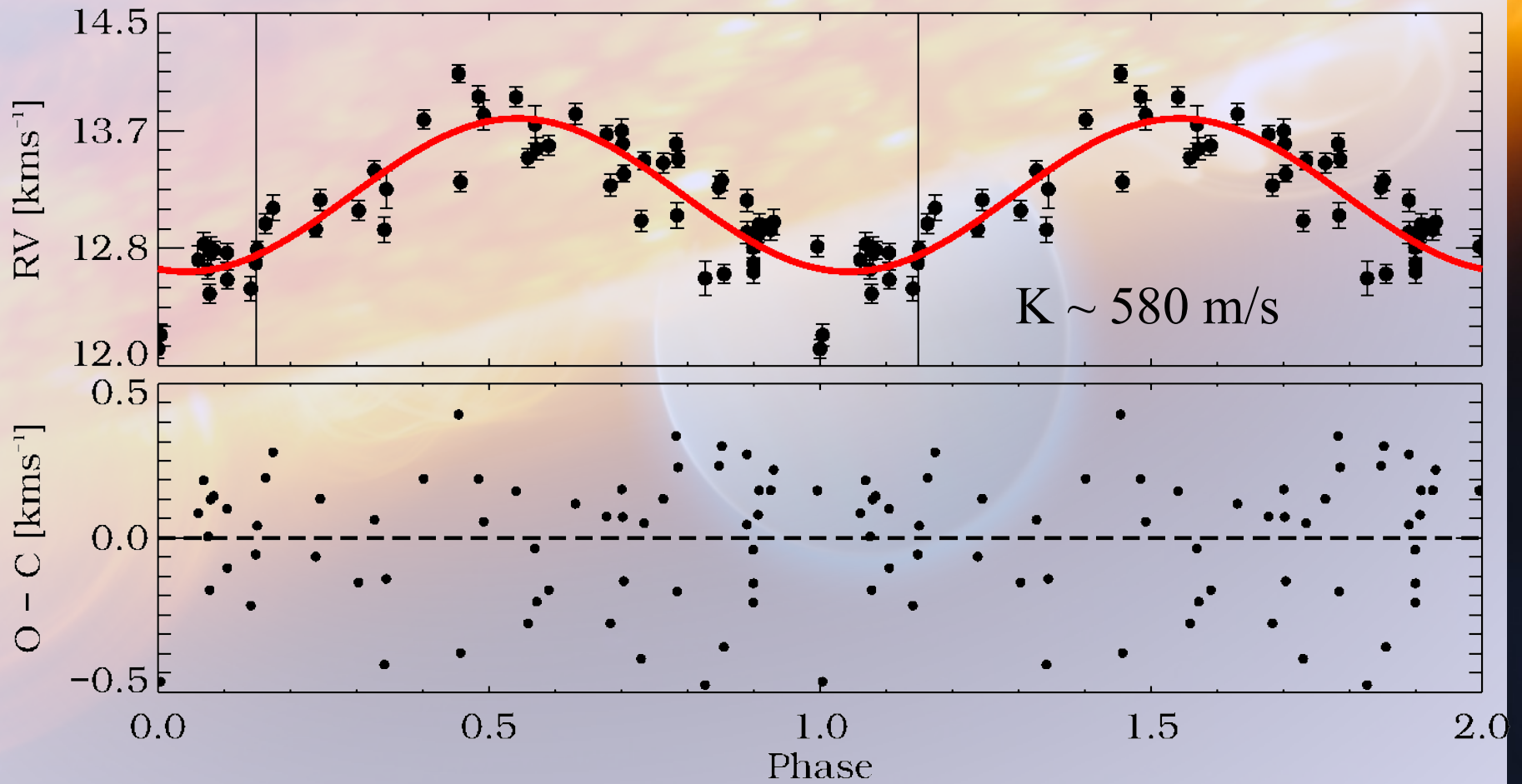
- PhD student at MPIA, Heidelberg
- Looking for planets around young stars ( $< 600$  Myr) with the radial velocity (RV) method
- Working together with
  - Thomas Henning (MPIA)
  - Ralf Launhardt (MPIA)
  - André Müller (ESO Chile)
  - Eike Guenther (LSW Tautenburg)

## Example star

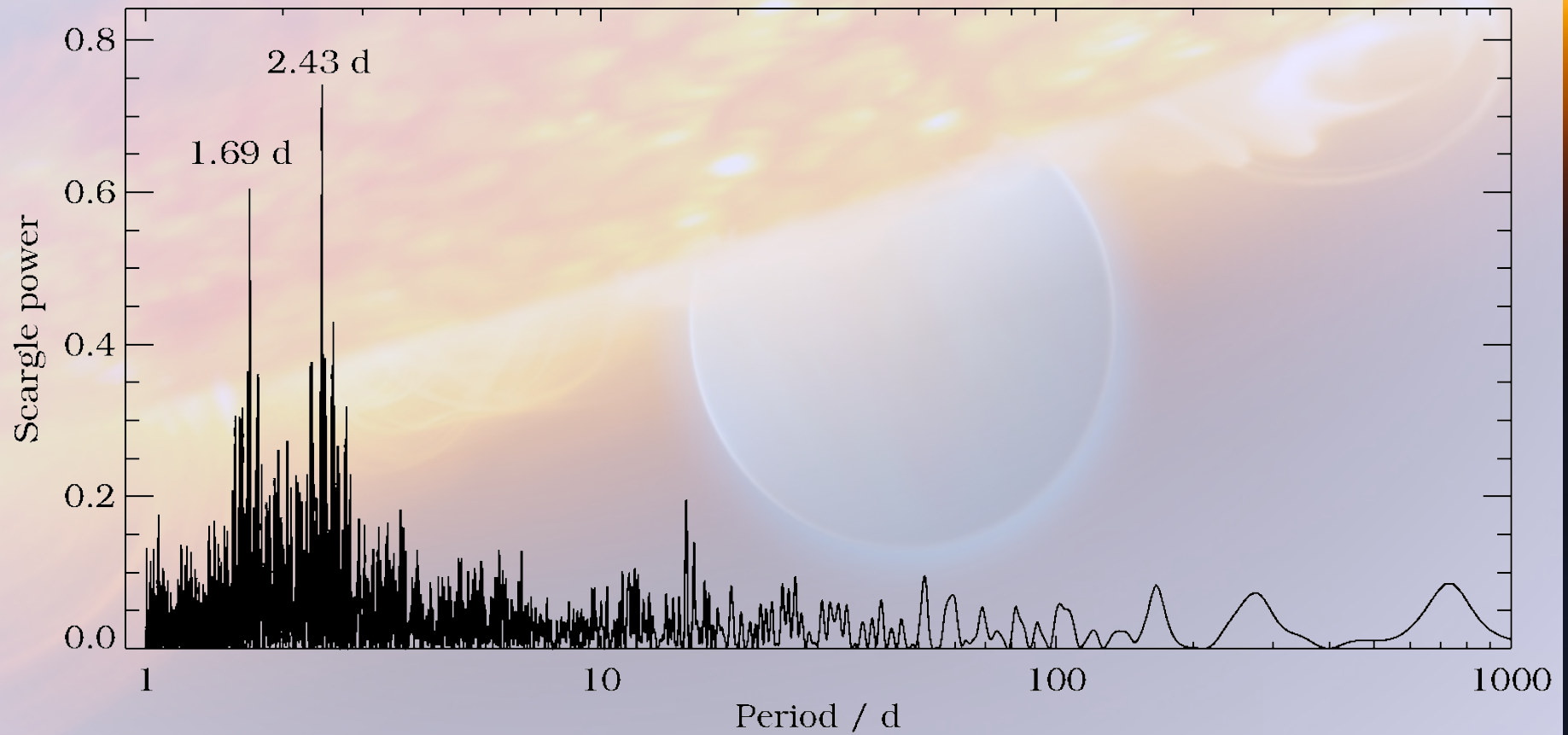
- G9V star
- $T_{\text{eff}} = (5235 \pm 125) \text{ K}$
- $\log g = 3.9 \pm 0.3$
- $v \sin i = (20.8 \pm 0.4) \text{ km/s}$
- Age:
  - $(9 \pm 3) \text{ Myr}$  - Lithium equivalent width
  - $(16 \pm 3) \text{ Myr}$  - activity index, Ca II K emission line
- Observations: 57 spectra with FEROS at the MPG/ESO 2.2m telescope @ La Silla, Chile  
(between Jan 2010 and Jun 2012)



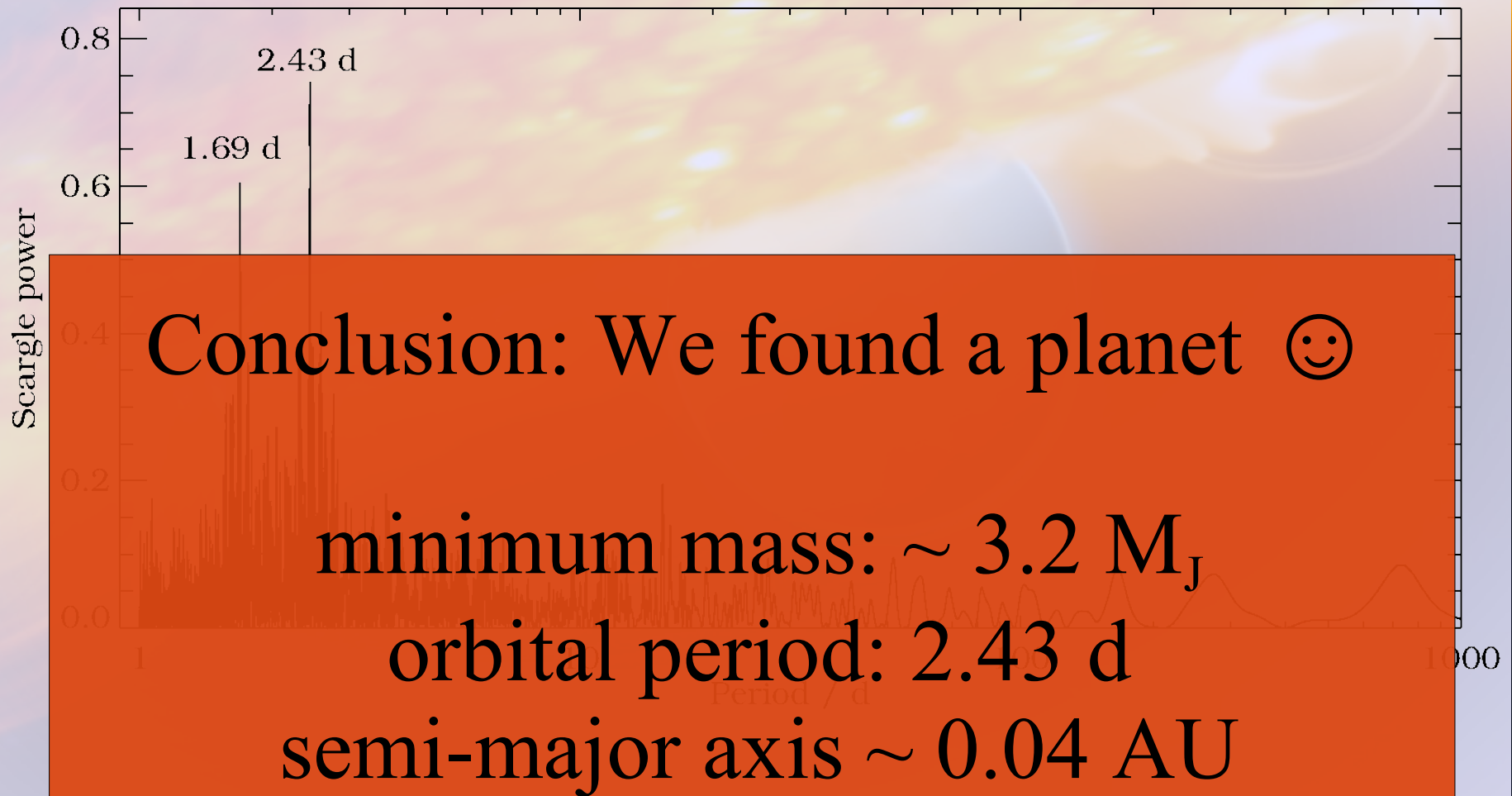
# The radial velocity signal



# The radial velocity signal

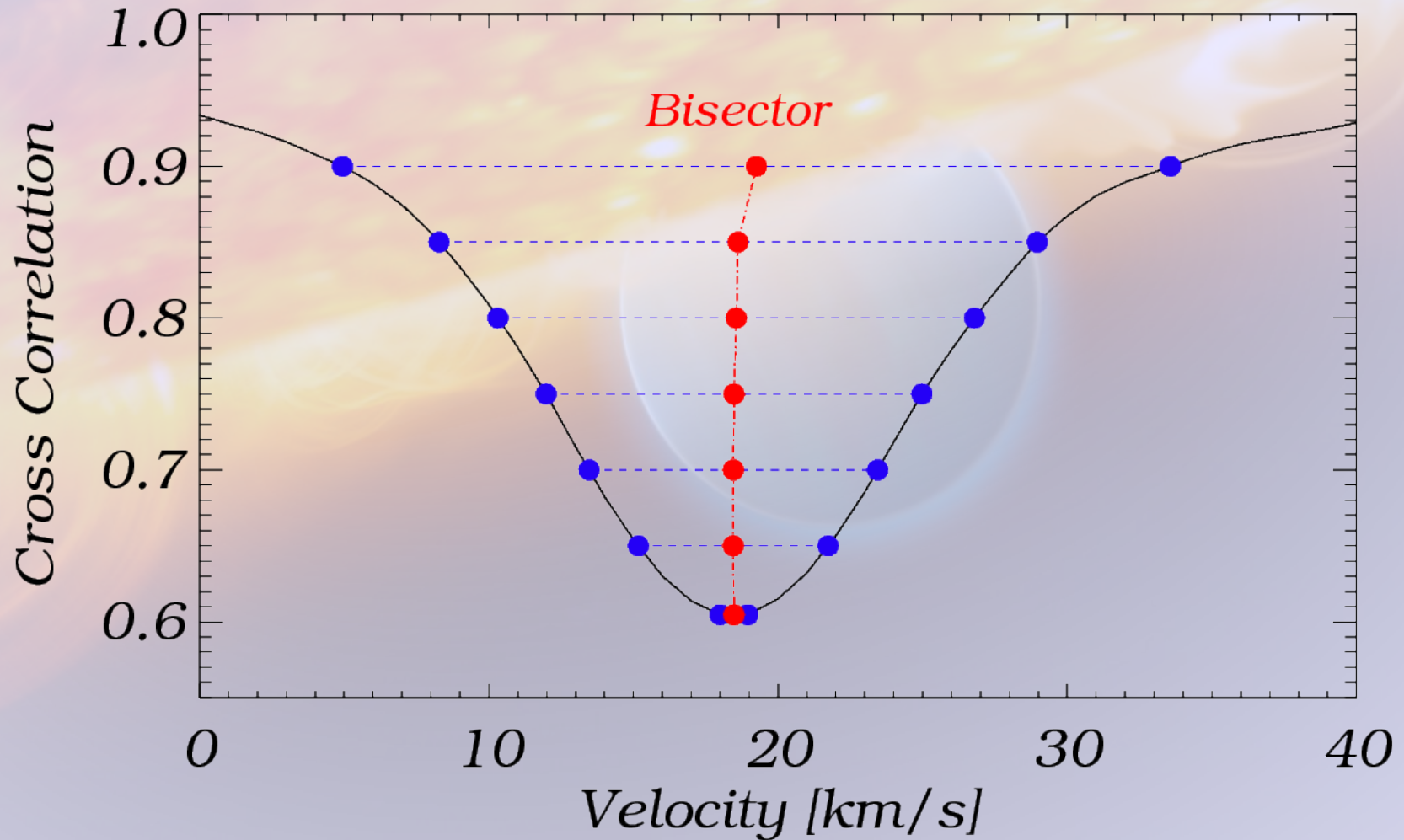


## The radial velocity signal

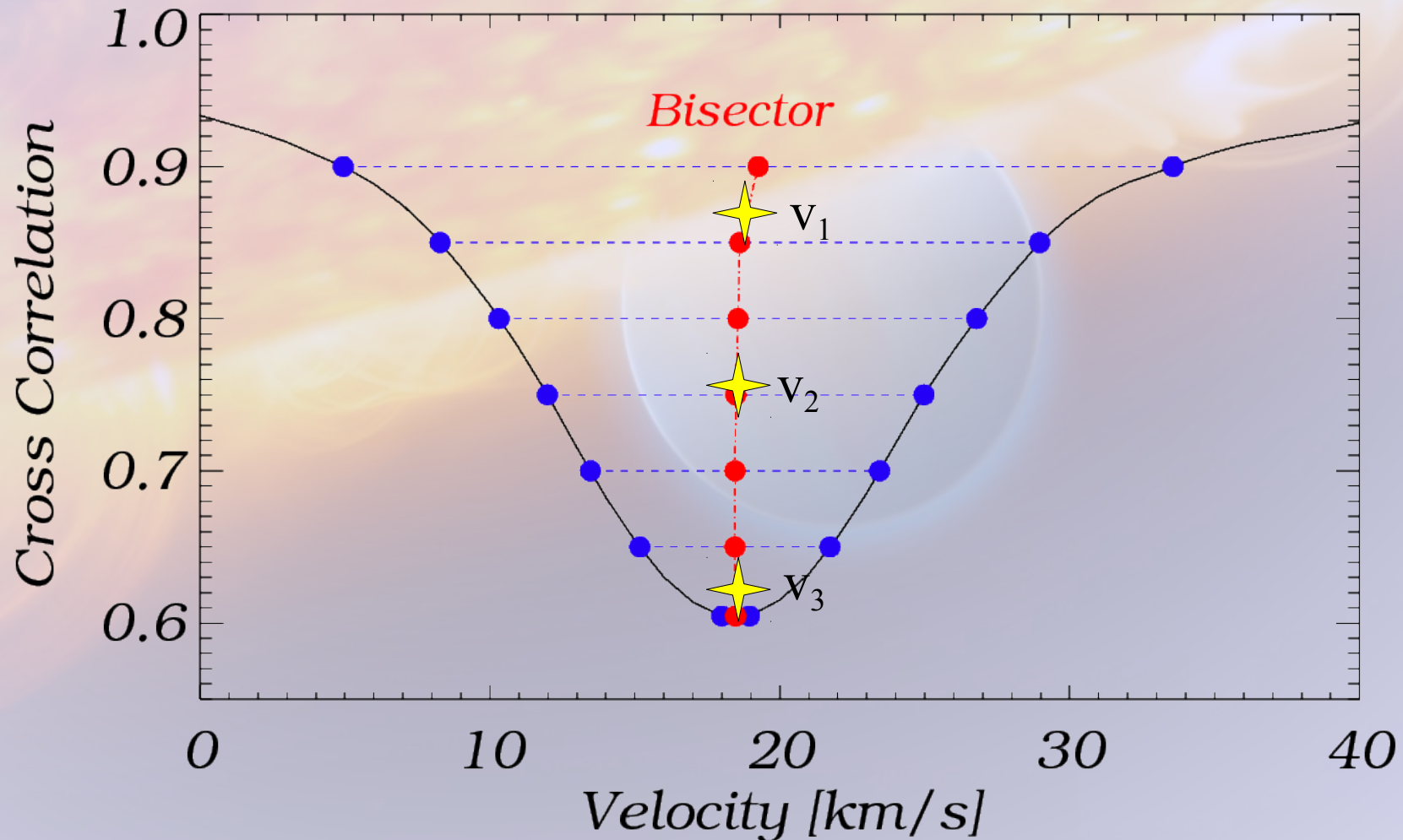




- Bisector of the CCF



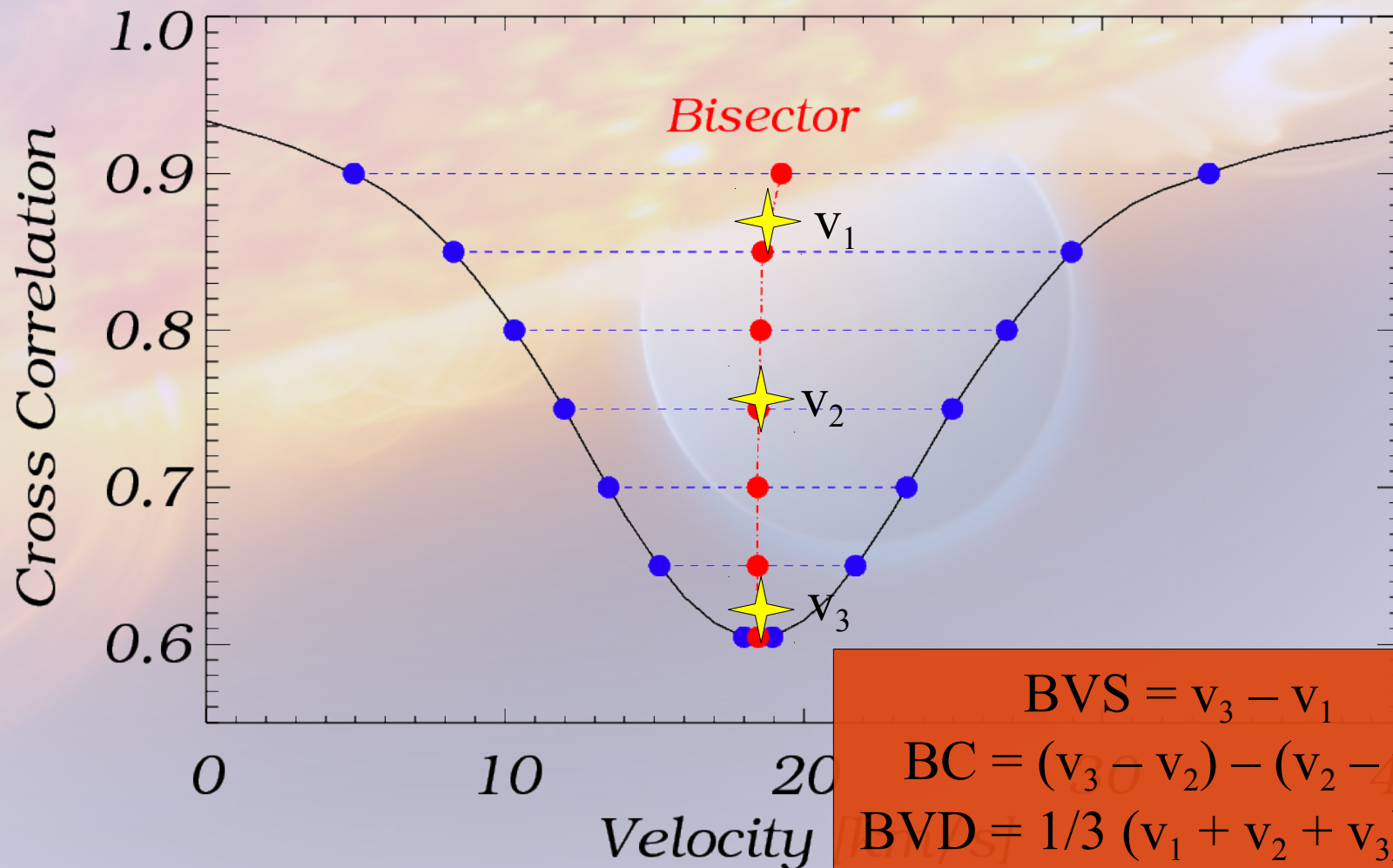
- Bisector of the CCF



Location of  $v_1$ ,  $v_2$ ,  $v_3$  Povich et al., 2001



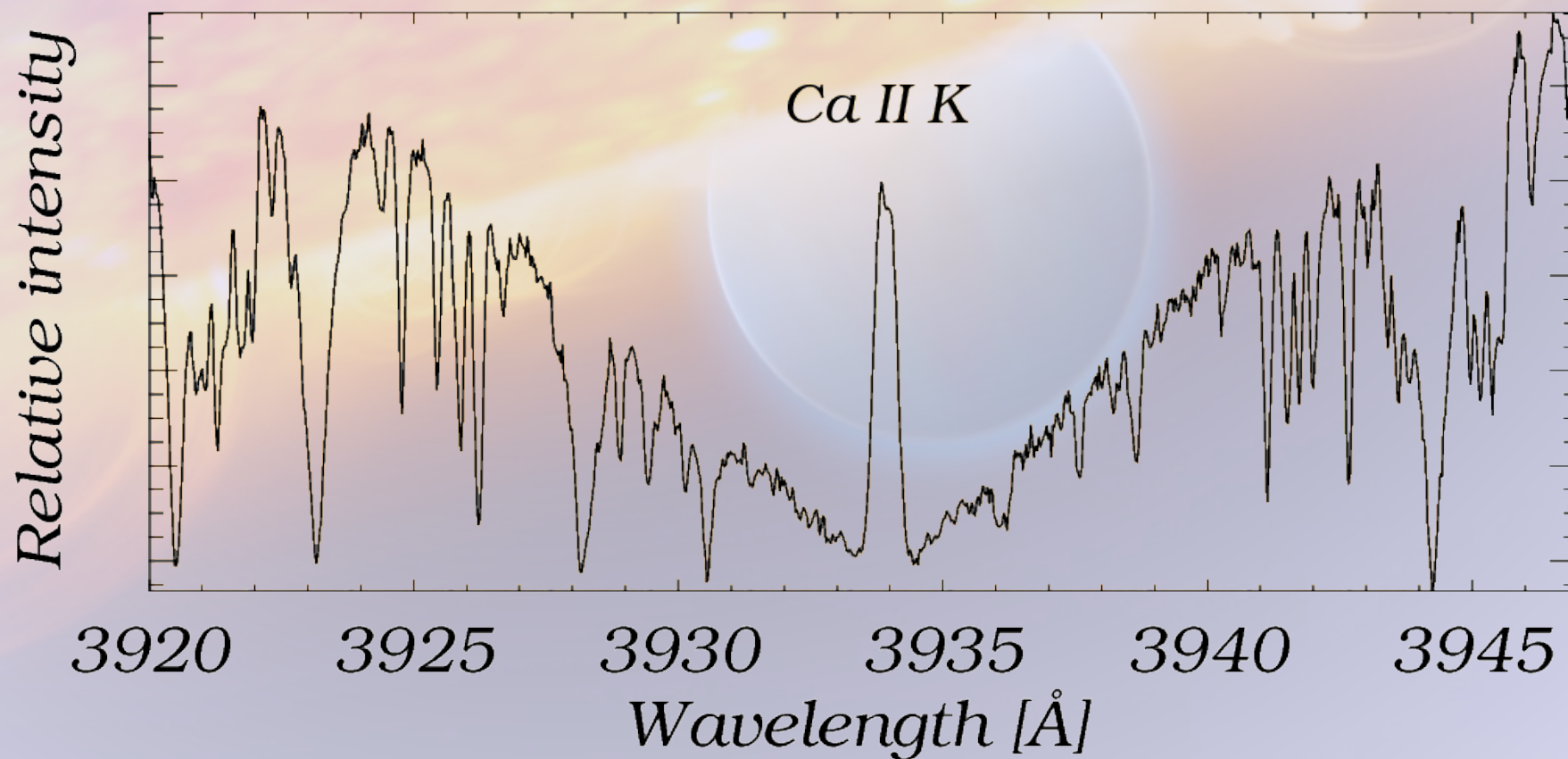
- Bisector of the CCF



Location of  $v_1, v_2, v_3$  Povich et al., 2001

## Activity indicators

- Activity index  $S_{\text{FEROS}}$
- Ca II K asymmetry

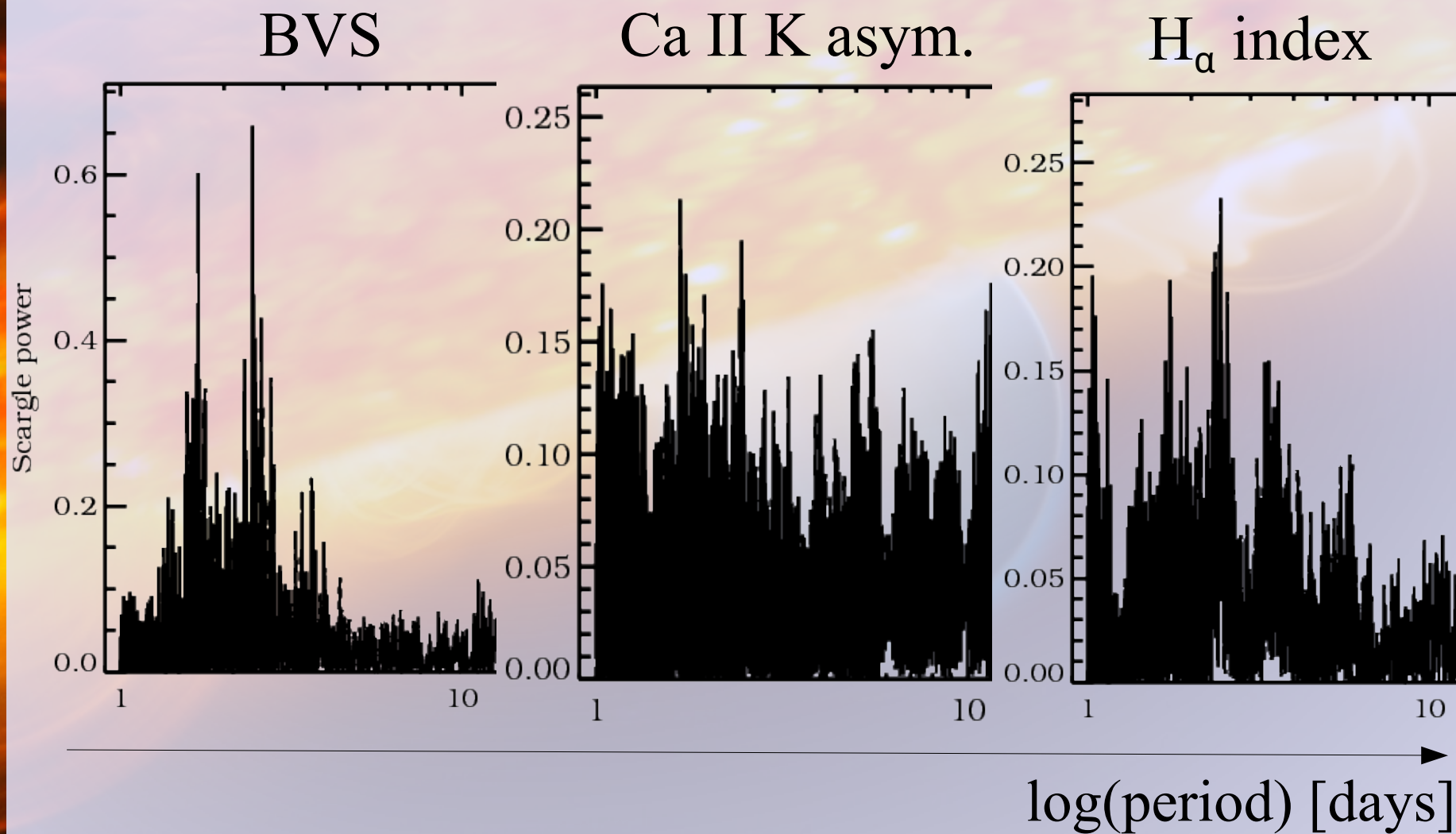


## Activity indicators

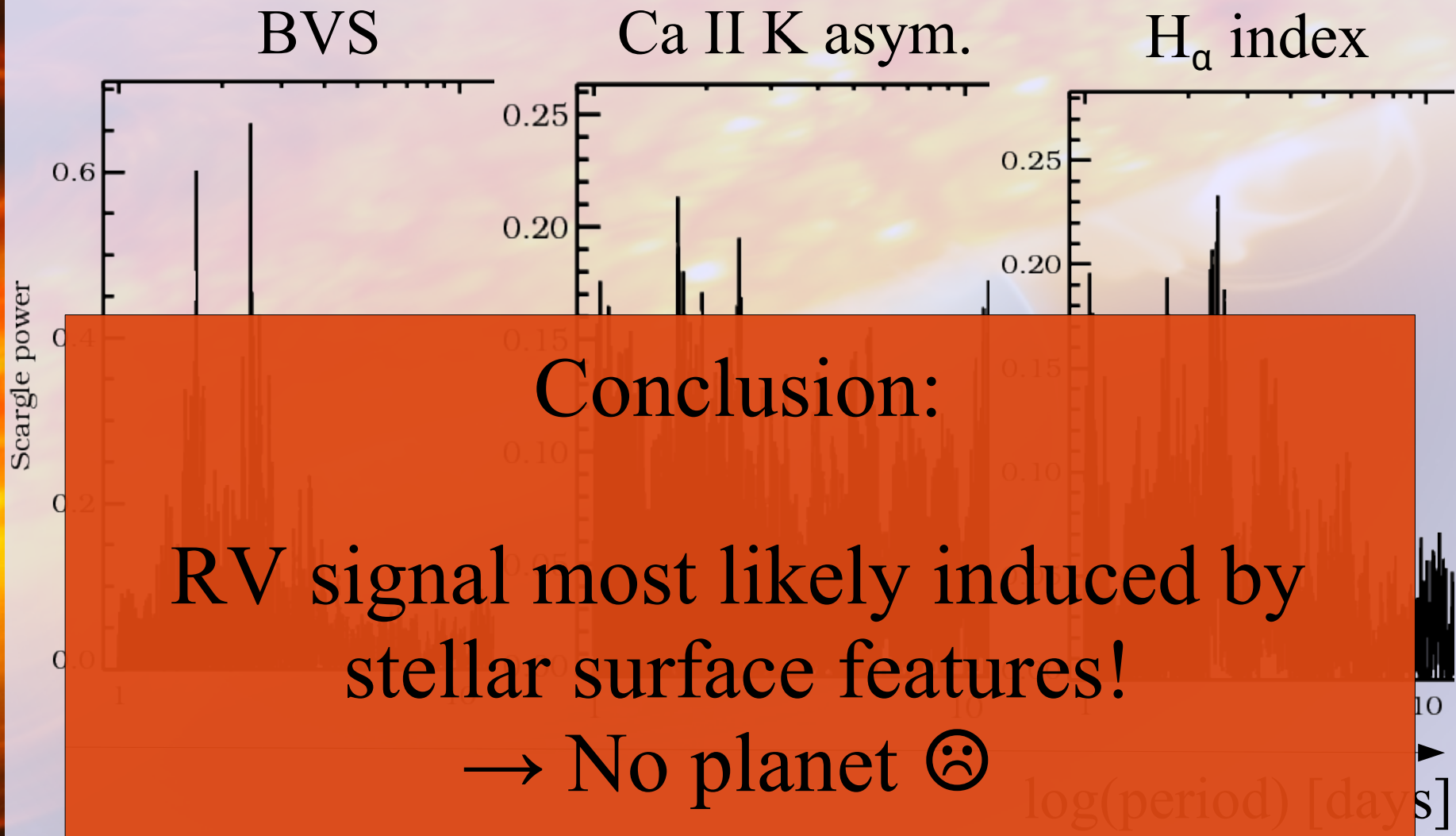
- Activity index  $S_{\text{FEROS}}$
- Ca II K asymmetry
- Line depth ratios (e.g. V I / Fe I @ 6252 & 6253 Å)  
→ temperature changes, Catalano et al., 2002
- TiO bandstrength, Reid et al., 1995
- $H_{\alpha}$  index → tracer for accretion, flares etc.



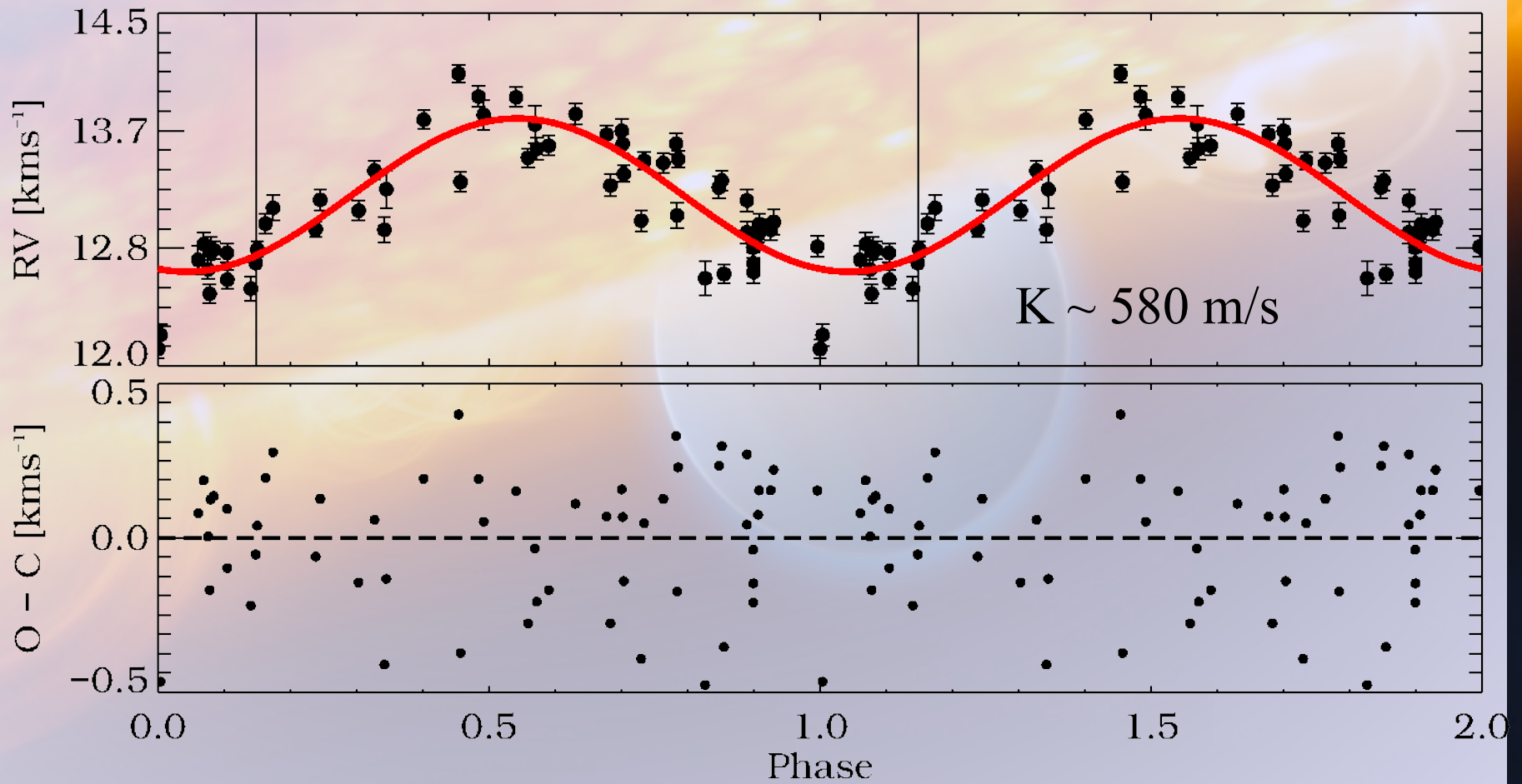
# Activity indicators - Results



## Activity indicators - Results



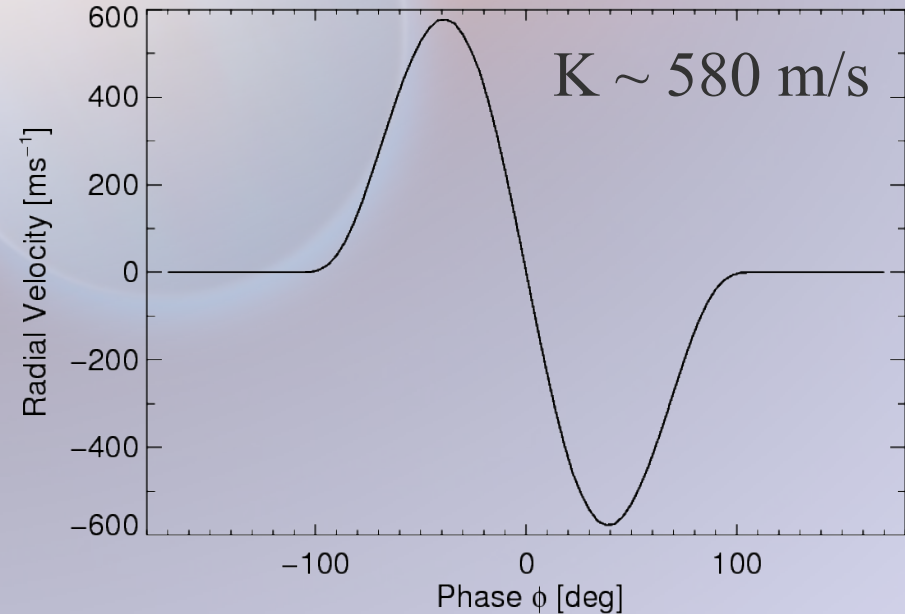
# Star spots – the explanation?





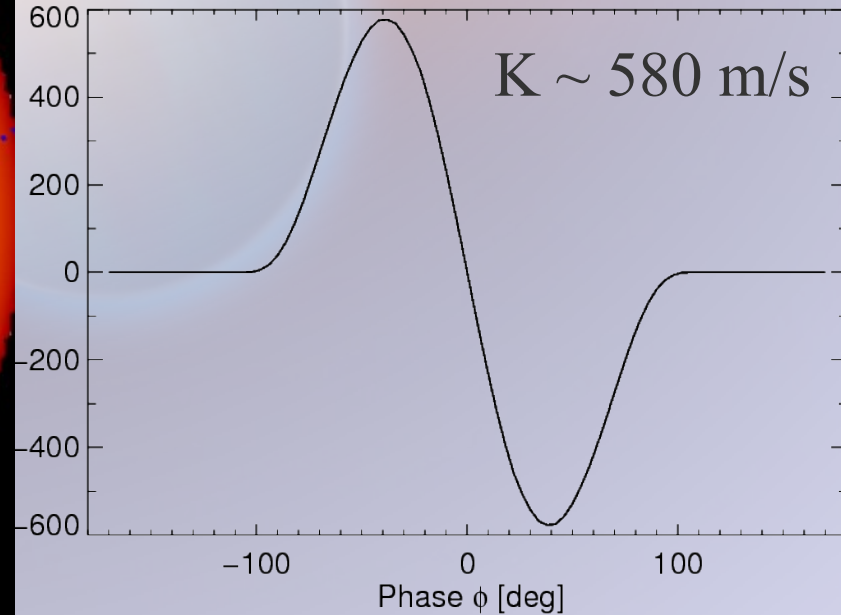
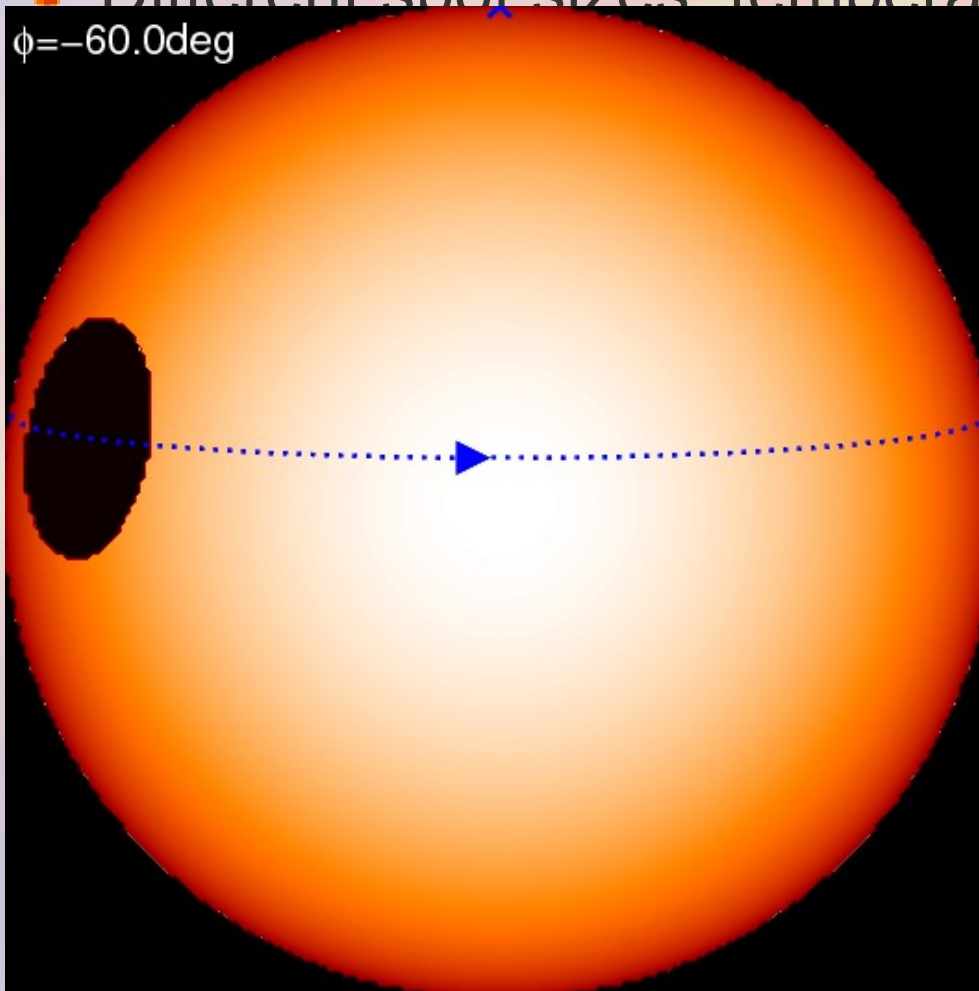
## Star spots – the explanation?

- Simulated grid of dark, cool stellar surface spots
- Different spot sizes, temperatures, latitude and system inclinations
- **RESULT:** Dark, cool spot of
  - 3200 K ( $\Delta T \sim 2000$  K)
  - Covering 6 % of stellar surface
  - Latitude  $\sim 10^\circ$
  - System inclination  $\sim 5^\circ$



## Star spots – the explanation?

- Simulated grid of dark, cool stellar surface spots
- Different spot sizes, temperatures, latitude and



- **Stellar surface features** of young stellar objects can **mimic** radial velocity signals of potential **planetary companions**.
- A detailed analysis of **stellar activity indicators** is essential to disentangle planet signals and activity.
- Ongoing: **Fit spot model to the RV curve**
  - Detailed information about involved stellar surface features