



Exoplanetary research in Ondřejov

Marek Skarka



Astronomical Institute
of the Czech Academy of Sciences



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Astronomical Institute SAV, Stará Lesná

July 19, 2018



Smejalka

113

AVYDON sro -
pila Ondřejov

Astronomický ústav
AV ČR - Ondřejov

Strimelická

Strimelická

113

Turkovická

113

Školní

Ondřejov

Pizzeria Pietro

Ondřejov - Obec

3D TECH spol. s r.o.

113

335

335

Astronomical Institute of CAS

- 1898 – Ground purchased in Ondřejov
- 1928 – Observatory donated to Czech state
- 1954 – Observatory became a part of the Czech Academy of Sciences

Scientific cooperation:

IAU, ESO (2007), ESA (2008)

~160 employs

Departments:

- **Solar physics** (spots, oscillations, eruptions, ALMA, Solar orbiter, GREGOR, EST)
- **Stellar physics** (hot stars, stellar atmospheres and winds, astroinformatics, **exoplanets**)
- **Interplanetary matter** (European and desert firebal network, asteroids)
- **Galaxies and planetary systems** (dynamics and kinematics of galaxies, interstellar matter, formation and fade of stars)



1906 Zakládání centrální kopule - Josef Jan Friš

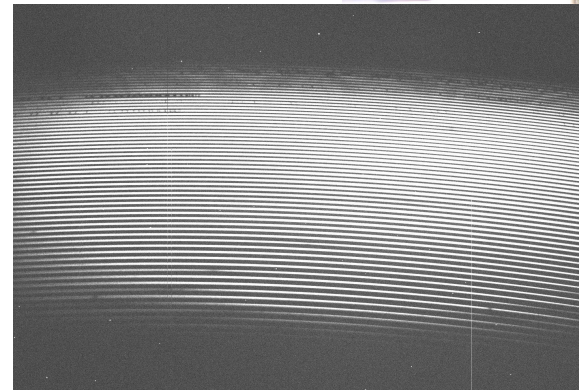
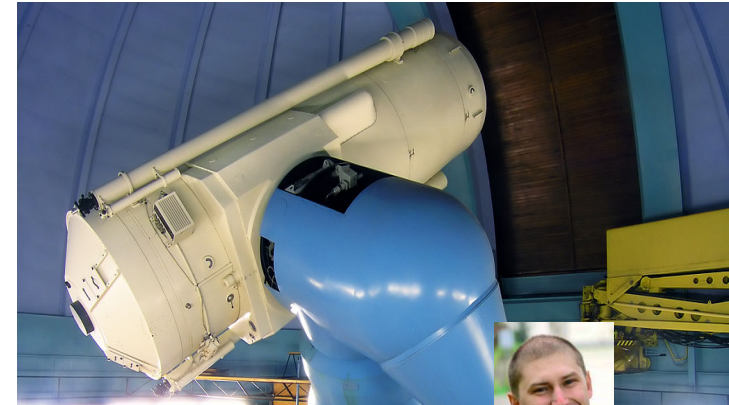
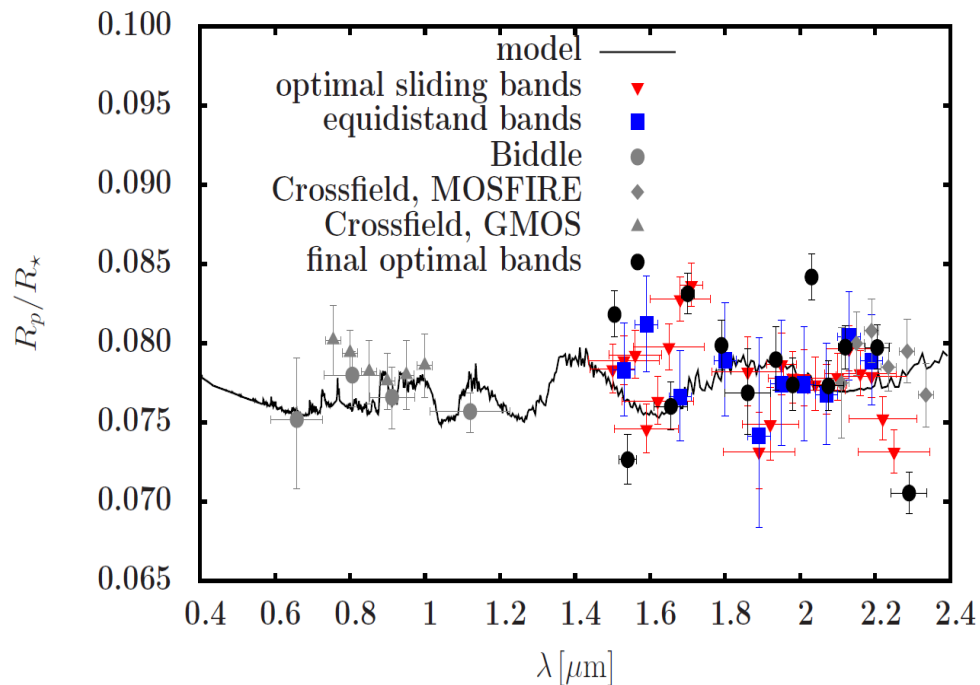
**Science, public outreach,
teaching activities**

www.asu.cas.cz

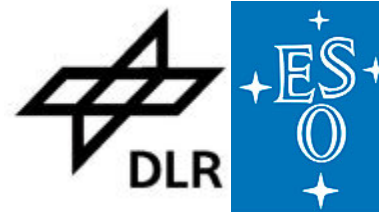
Exoplanet group

P. Kabáth (head, petr.kabath@asu.cas.cz), **T. Kloková** (postdoc), **M. Skarka** (postdoc), **E. Plávalová** (postdoc), **M. Blažek** (PhD student), **D. Dupkala**, **J. Dvořáková** (BSc students)

- **RV spectroscopic follow-up of K2/TESS/PLATO candidates**
- Exoplanetary atmospheres – photometry, transmission spectroscopy
- Stellar activity and exoplanets
- PLATO space mission ground based support



+ close cooperation with
Tautenburg observatory



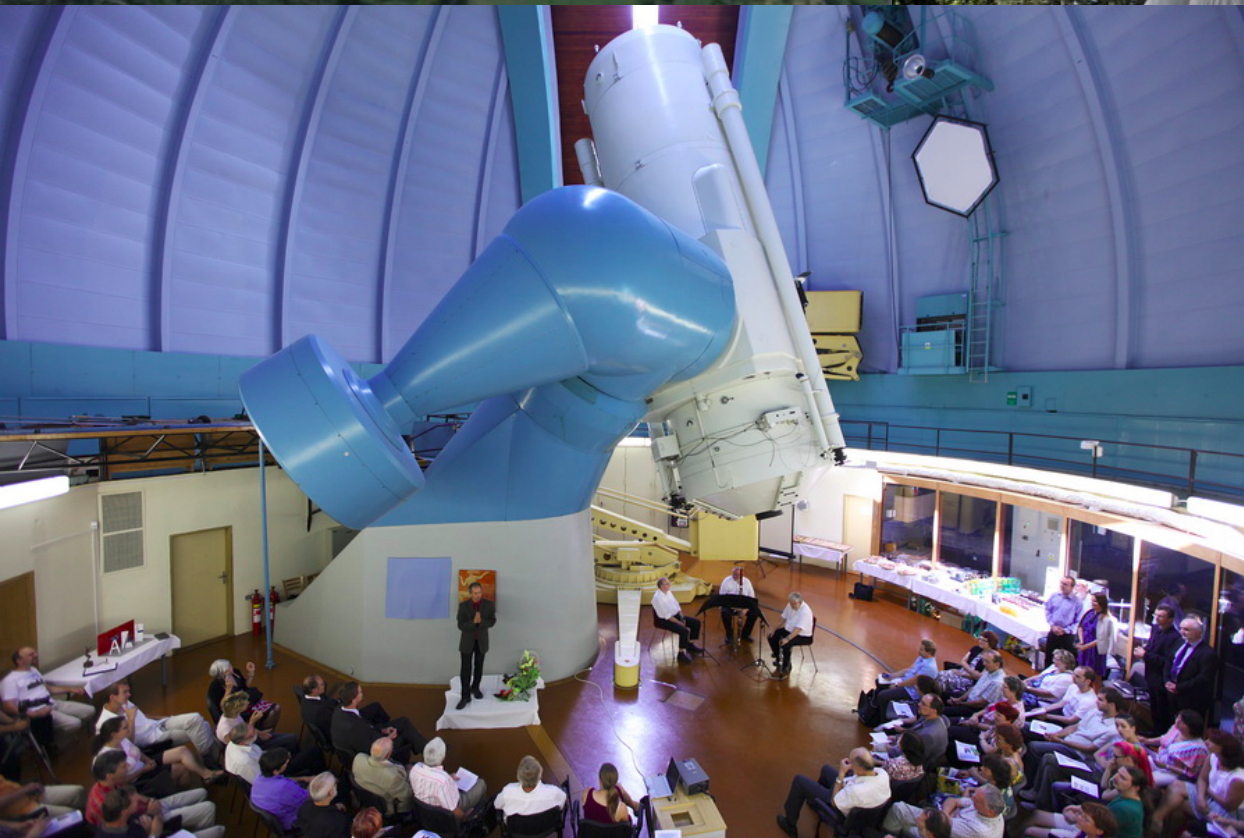
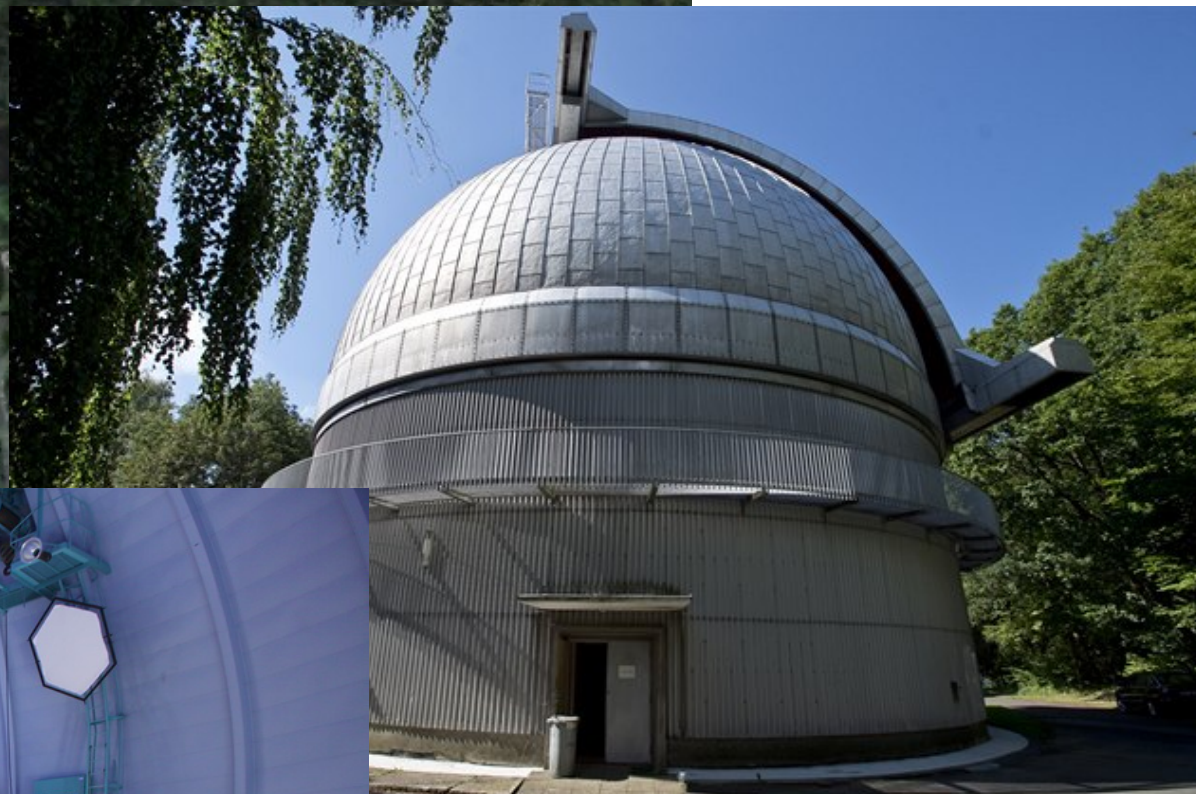
European
Southern
Observatory

www.eso.org





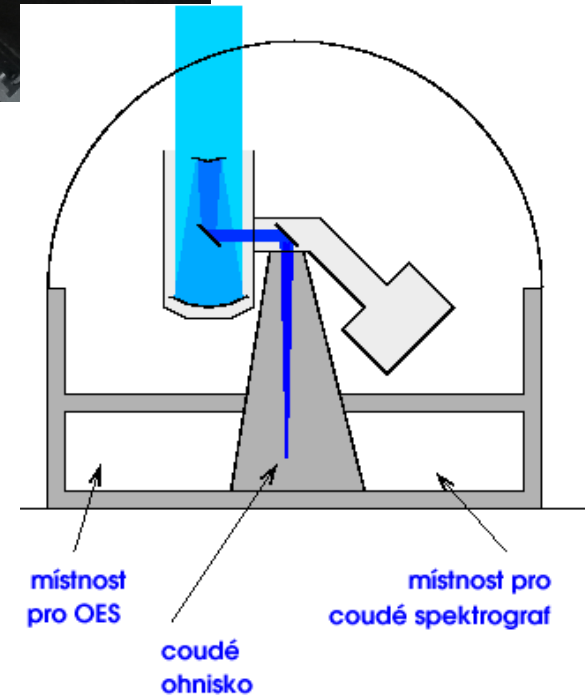
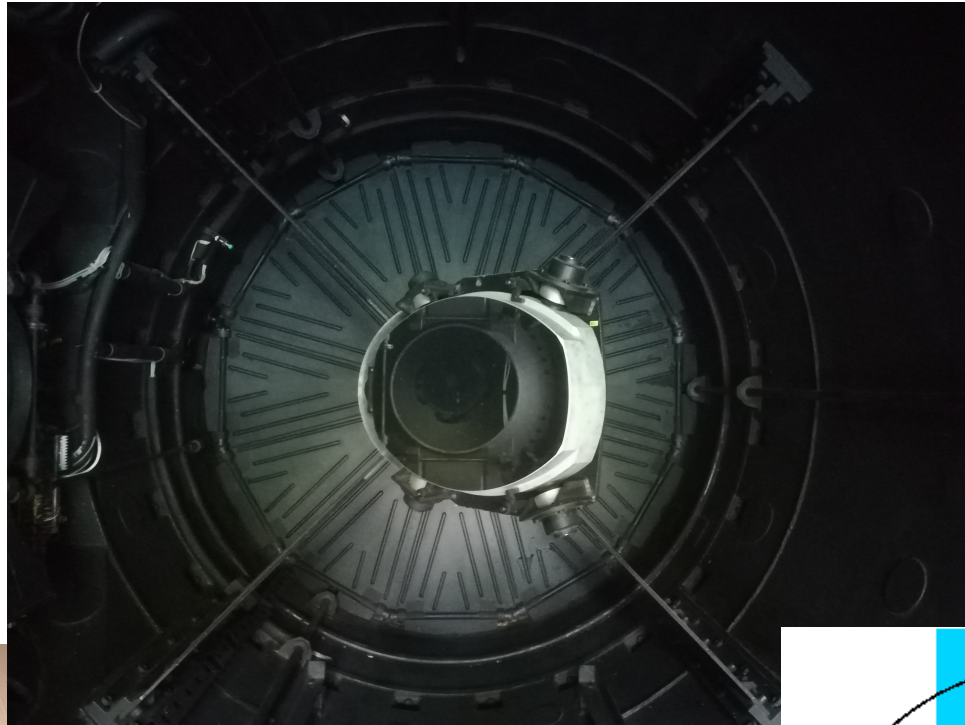
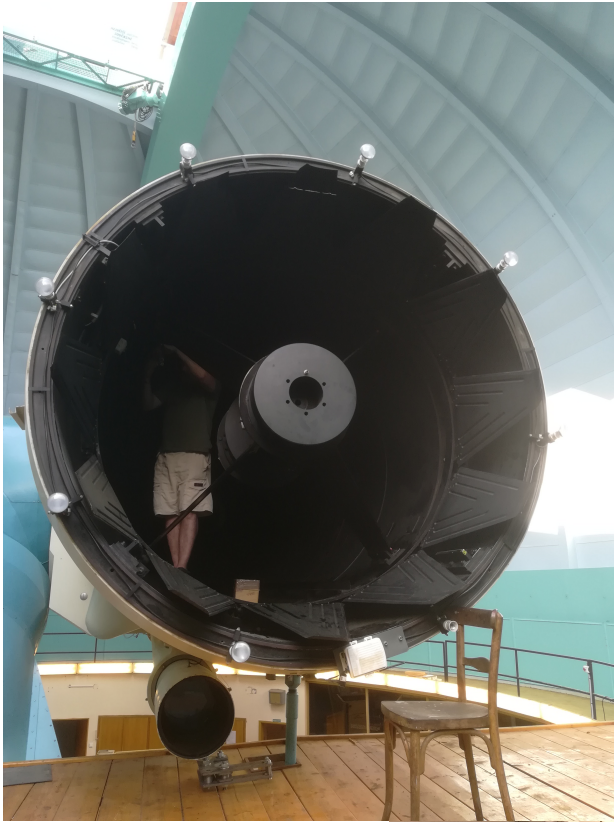
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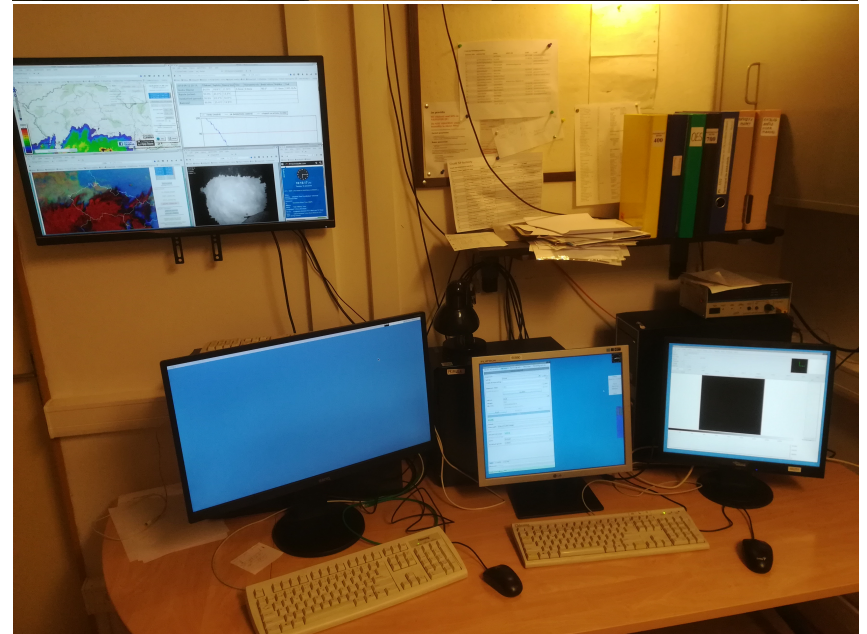
2-m Perek telescope

- Built in 1967
- Modernized, remotely operable
- Coude focus 63.5 m

Perek telescope – Coude focus



Perek telescope – command center



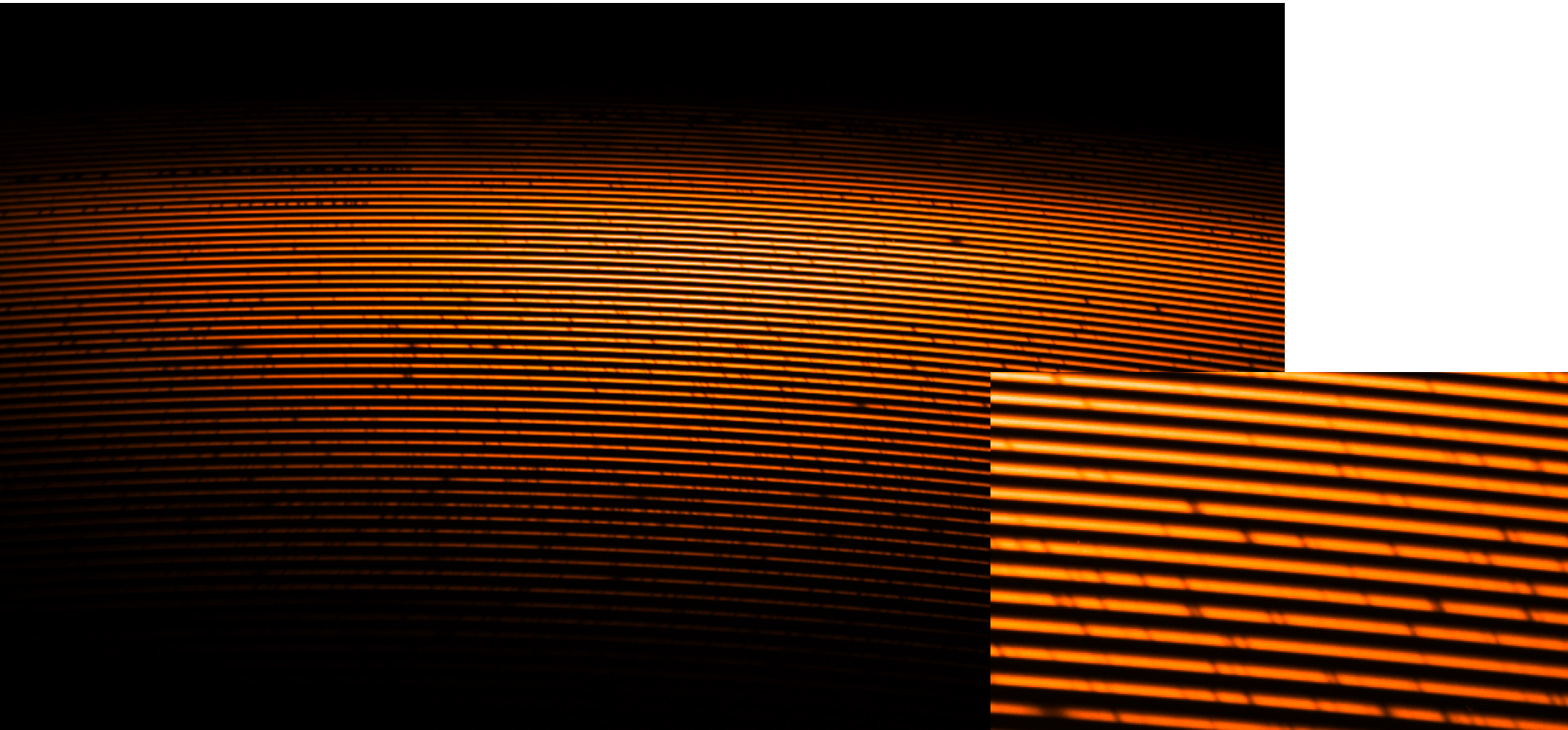
Ondřejov echelle spectrograph (OES)

- Installed in 2007 (Koubský et al. 2007)
- $R \sim 44000$, 360-950 nm
- Commercial photo lens
- Nitrogen-cooled
- Environment at ~ 21 Celsius degree
- Aluminium assembly
- ThAr lamp for calibration



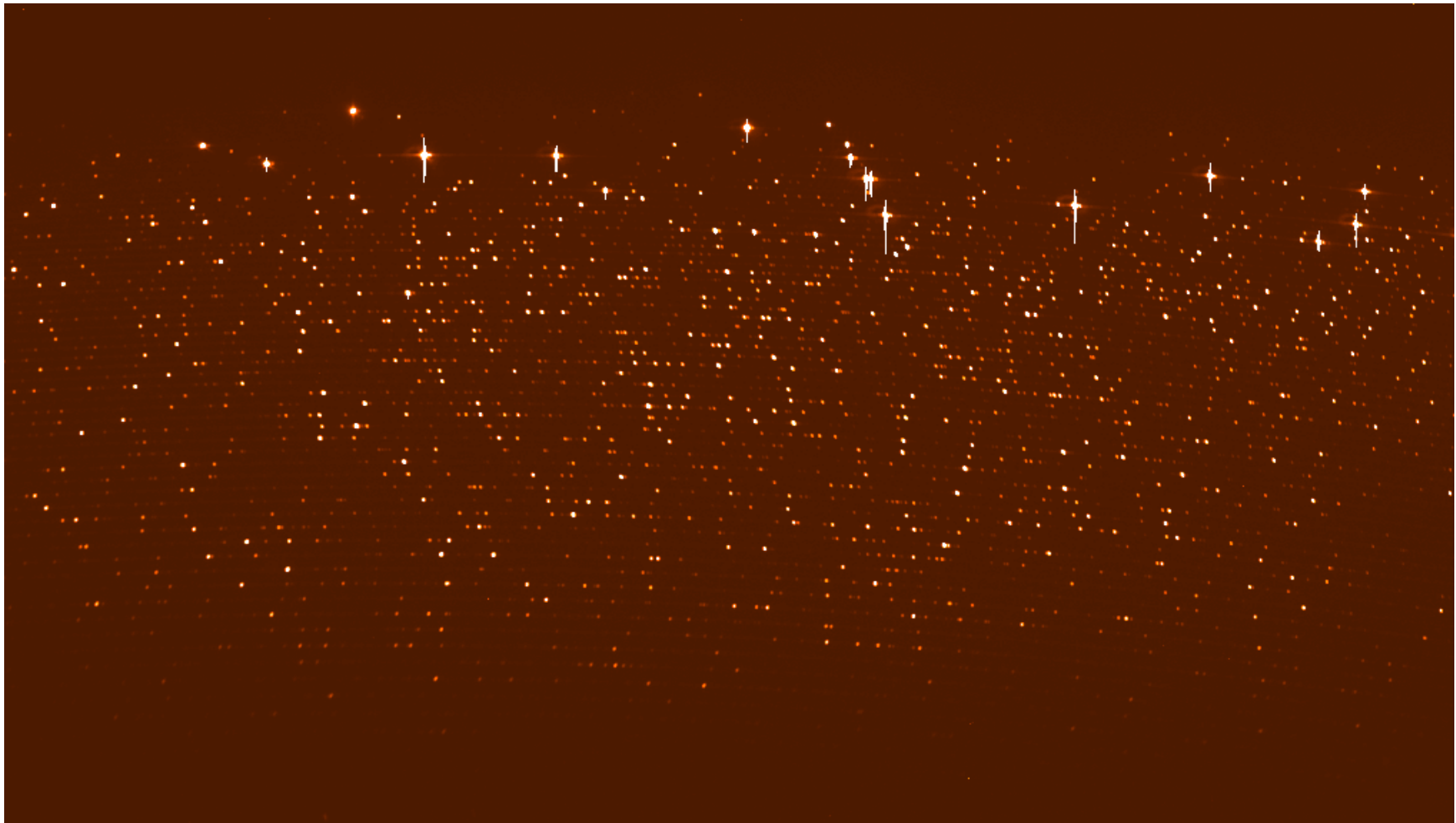
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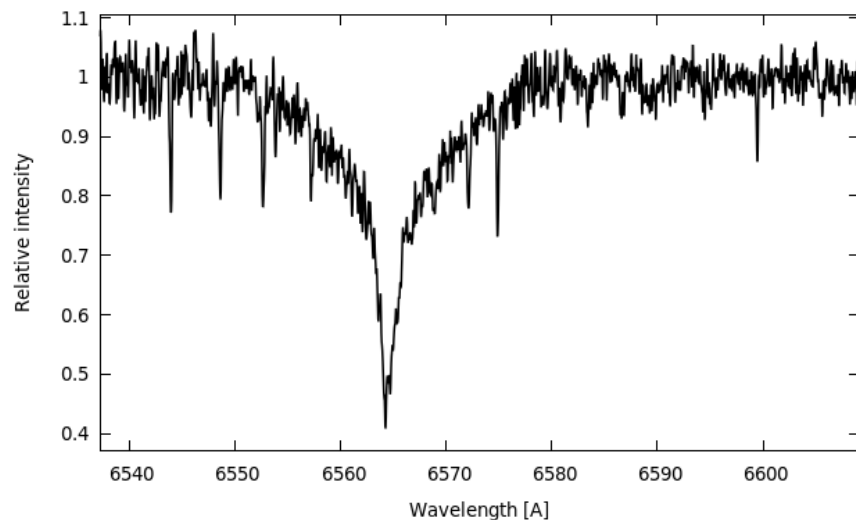
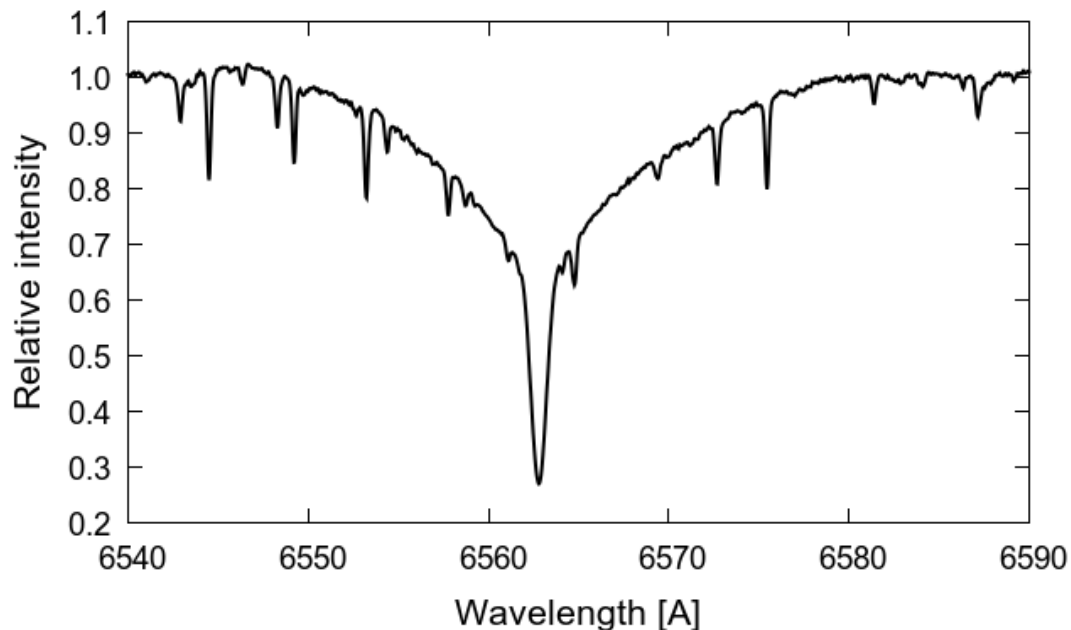
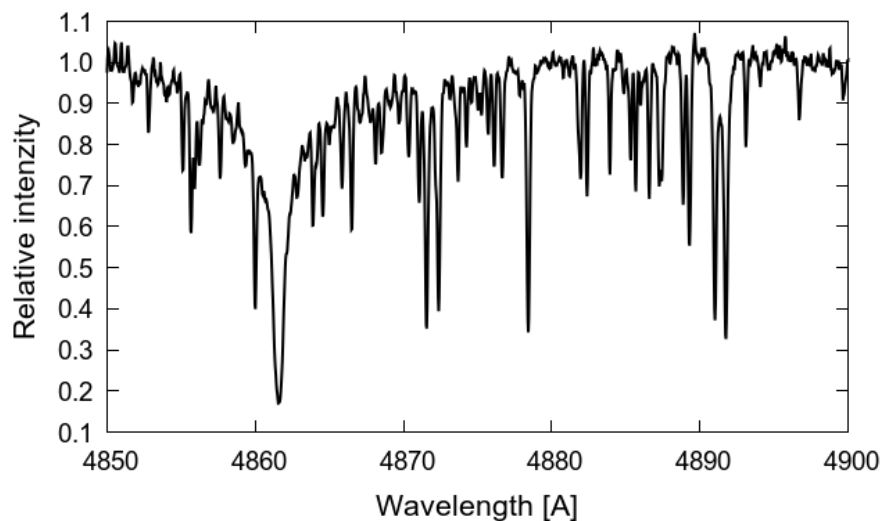
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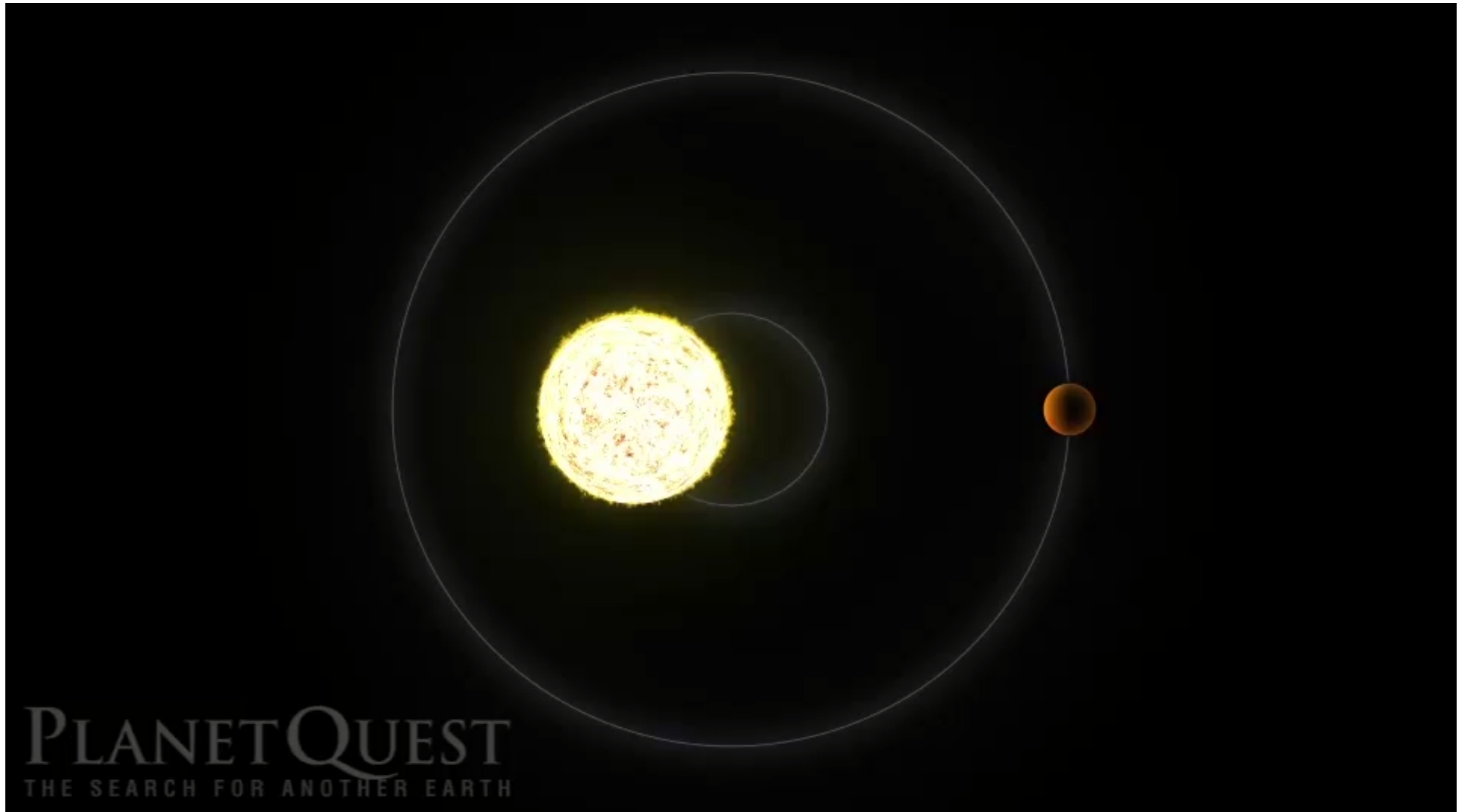


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- **Magnitude limit at 13 mag**

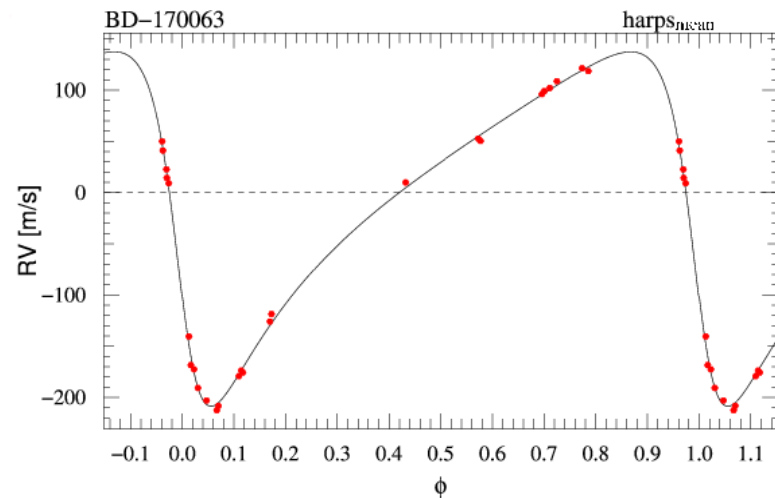
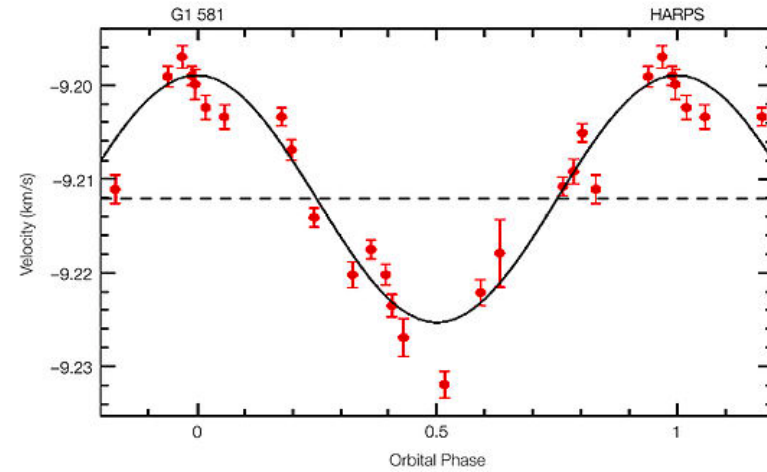
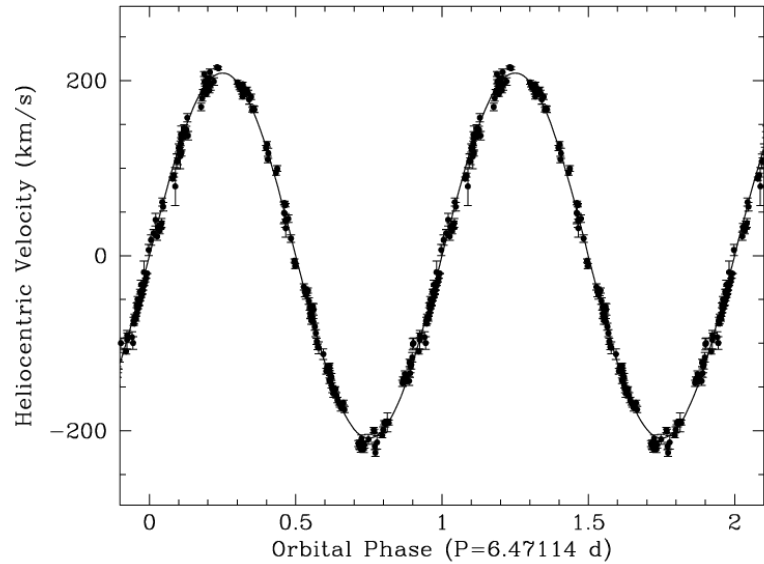


Radial velocity measurements with OES



Radial velocity measurements with OES

Radial velocity determination (Doppler shift of the lines)

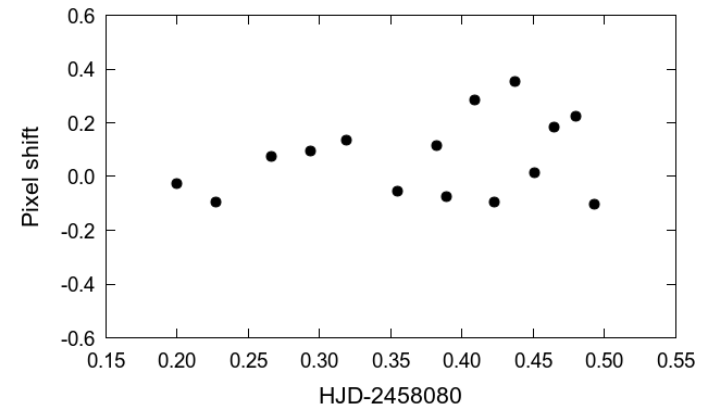


$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

Radial velocity measurements with OES

To reach sub-km/s accuracy of RVs we adopted these steps:

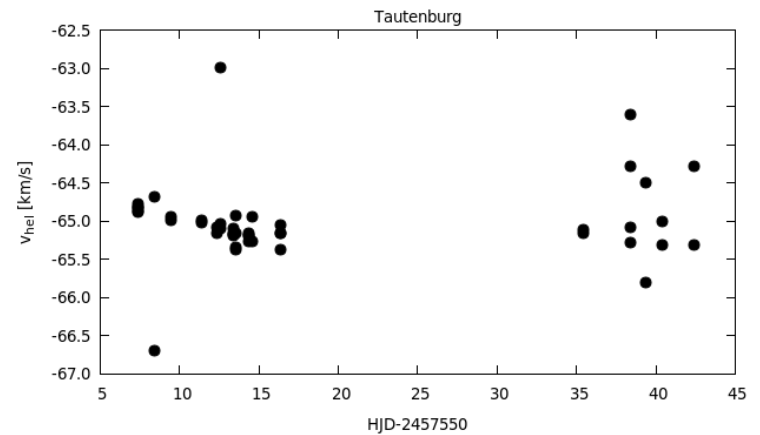
- Scientific spectrum is extract using narrow aperture
- Use only one ThAr calibration spectrum taken at the end of night is used
- For each scientific frame a calibration spectrum is extracted from ThAr frame
- Spectra are shifted using telluric lines in a narrow region
- All spectra are corrected of the motion of the Earth (29.7 km/s) and Earth rotation (460 m/s)
- With such approach we are able to get
 - RMS~80 m/s over one night
 - RMS~110 m/s over one month
 - RMS~350 m/s over one year



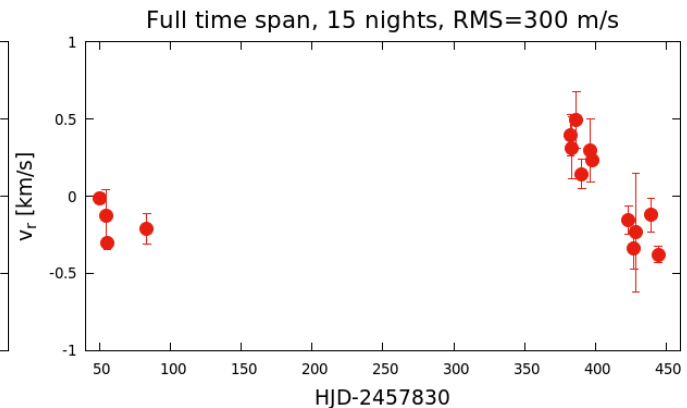
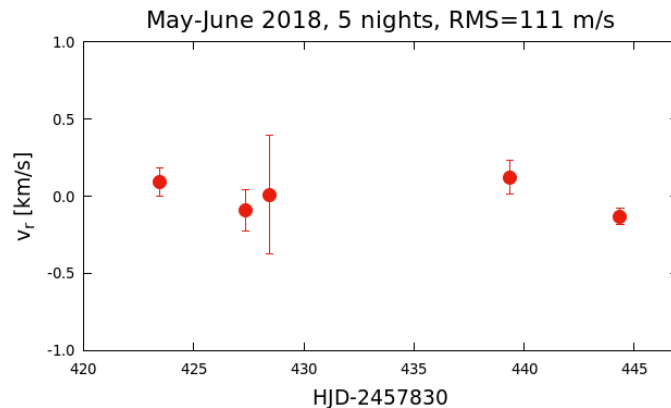
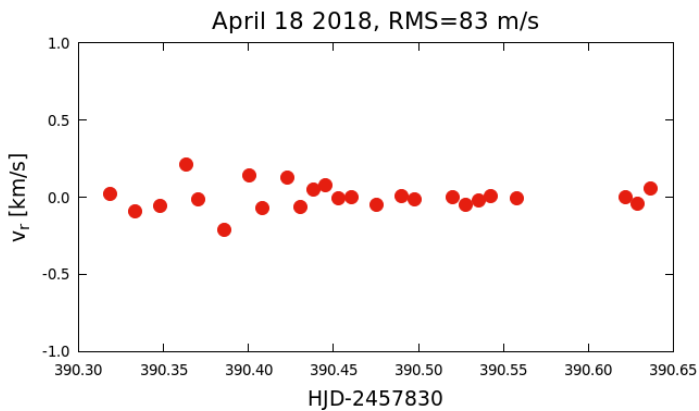
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Radial velocity standard HD 109358, G0V, V=4.3 mag



Preliminary tests of the iodine cell suggest stability of 10 m/s!

Radial velocity measurements with OES

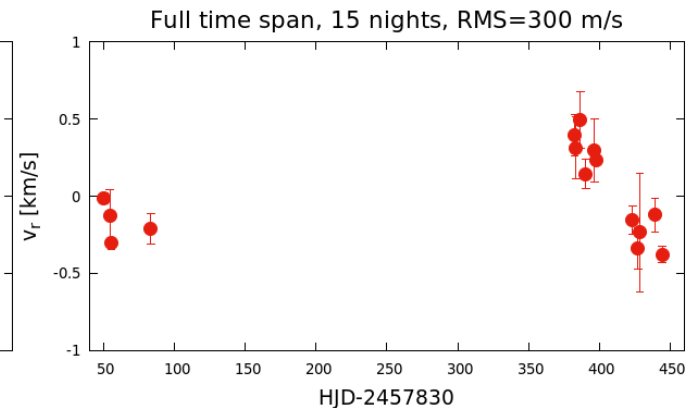
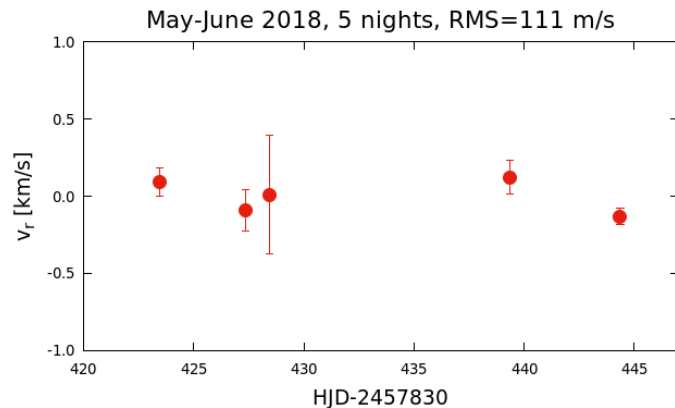
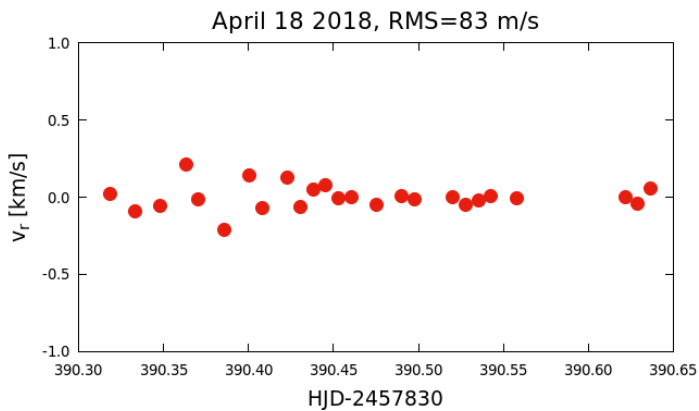
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Kabáth et al. 2018, submitted to PASP



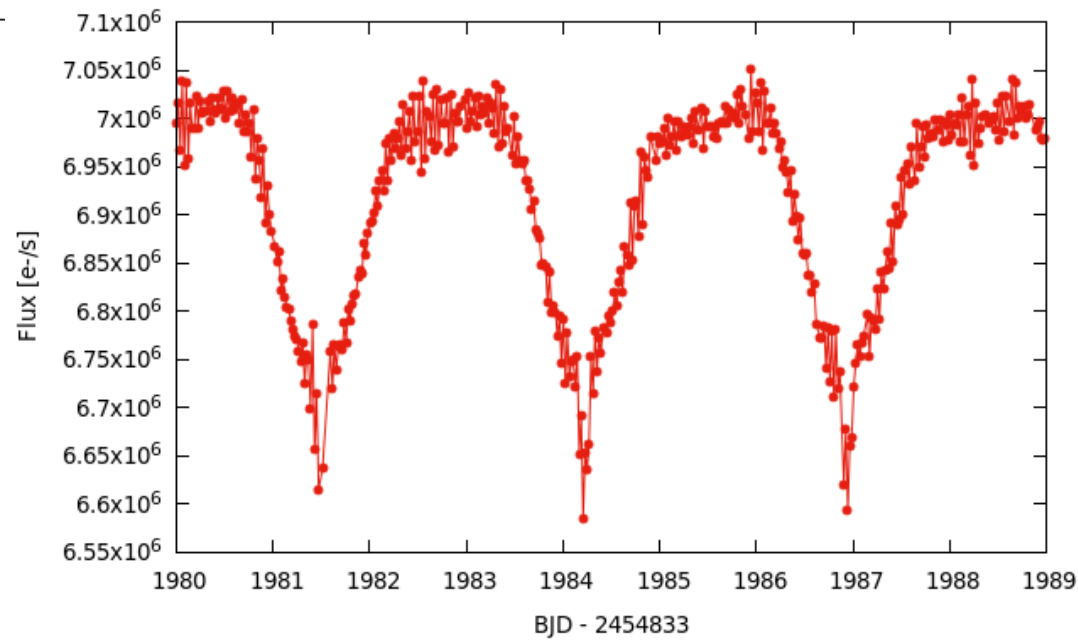
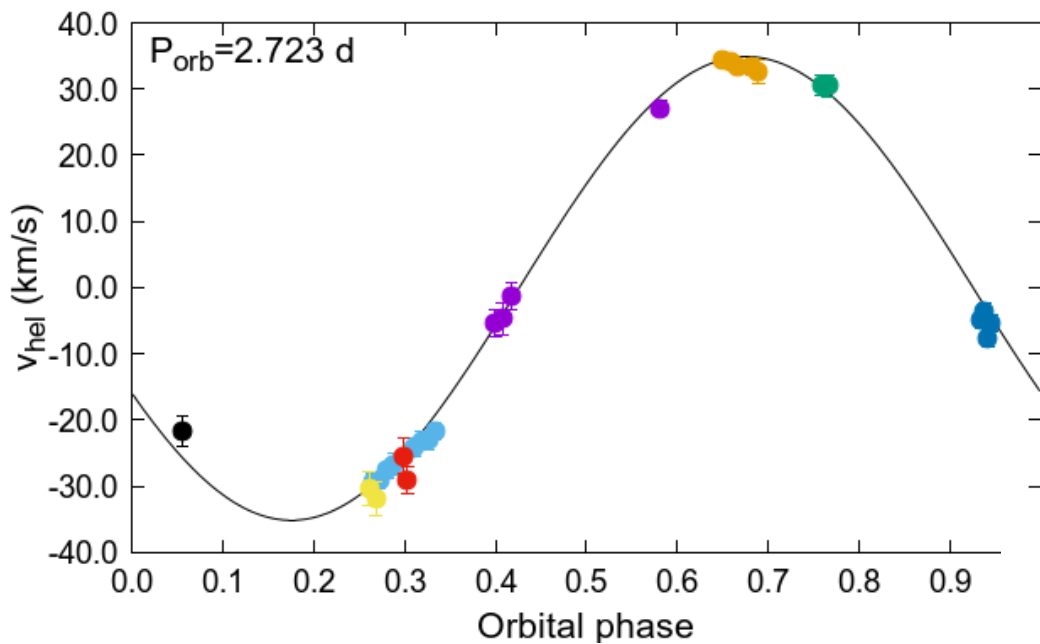
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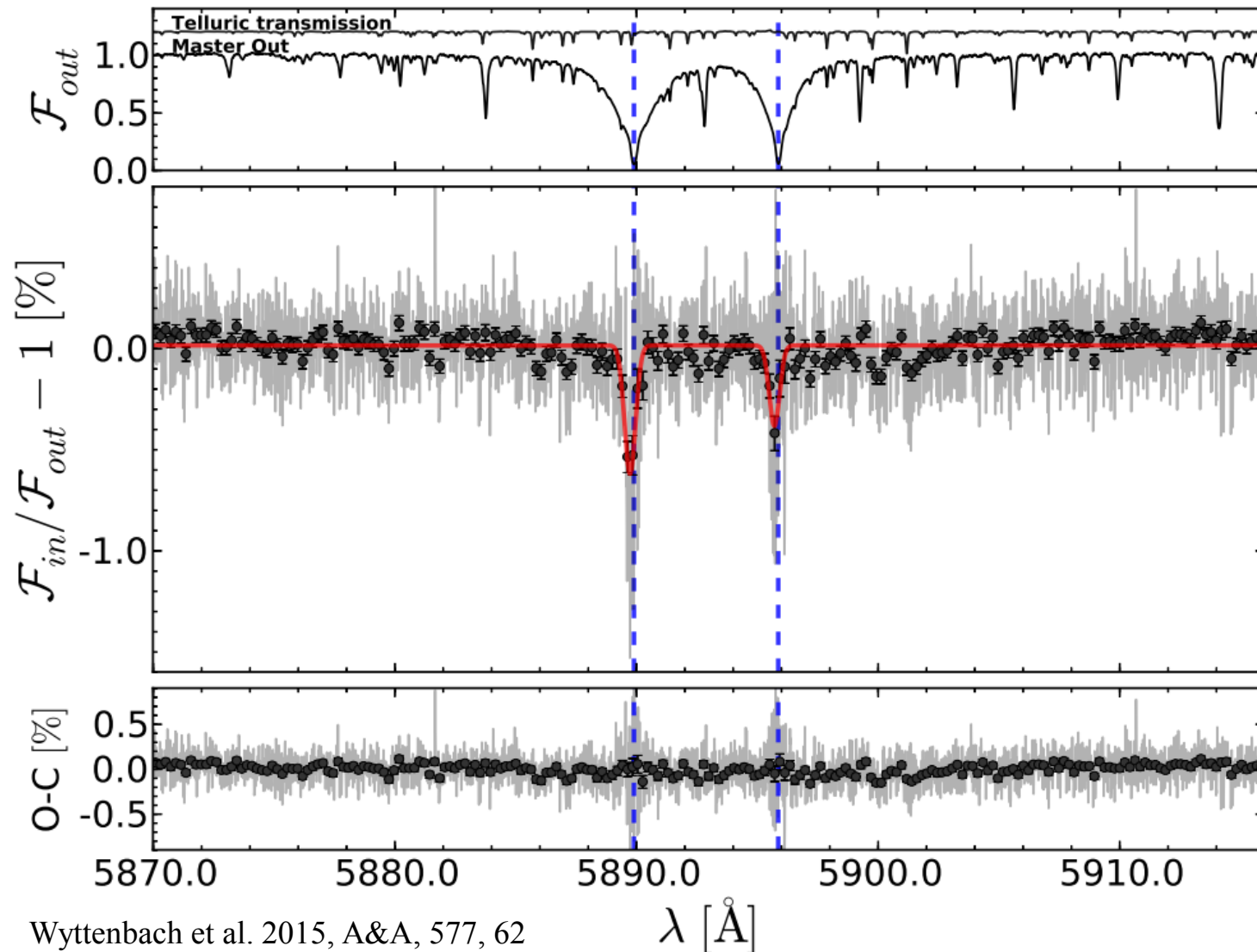
Observing program

- Exoplanets
 - Exo-candidates (RVs; EPIC 201534540, EPIC 210925707 ...; Skarka et al., in prep.)



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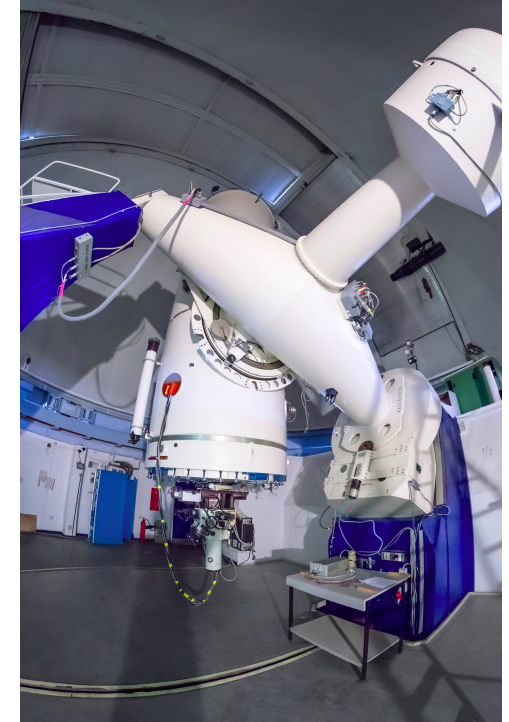
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- Brown-dwarf binaries (GJ 504, 51 Eri ...)
- 'Balona stars'
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Future plans

- Employ iodine cell
- Employ OPERA
- Get involved in an international obs program(s), PLATO consortium
- Build a spectrograph at La Silla (PLATOSpec)
- Establish an exoplanet community in Czech Republic



Thank you for your attention