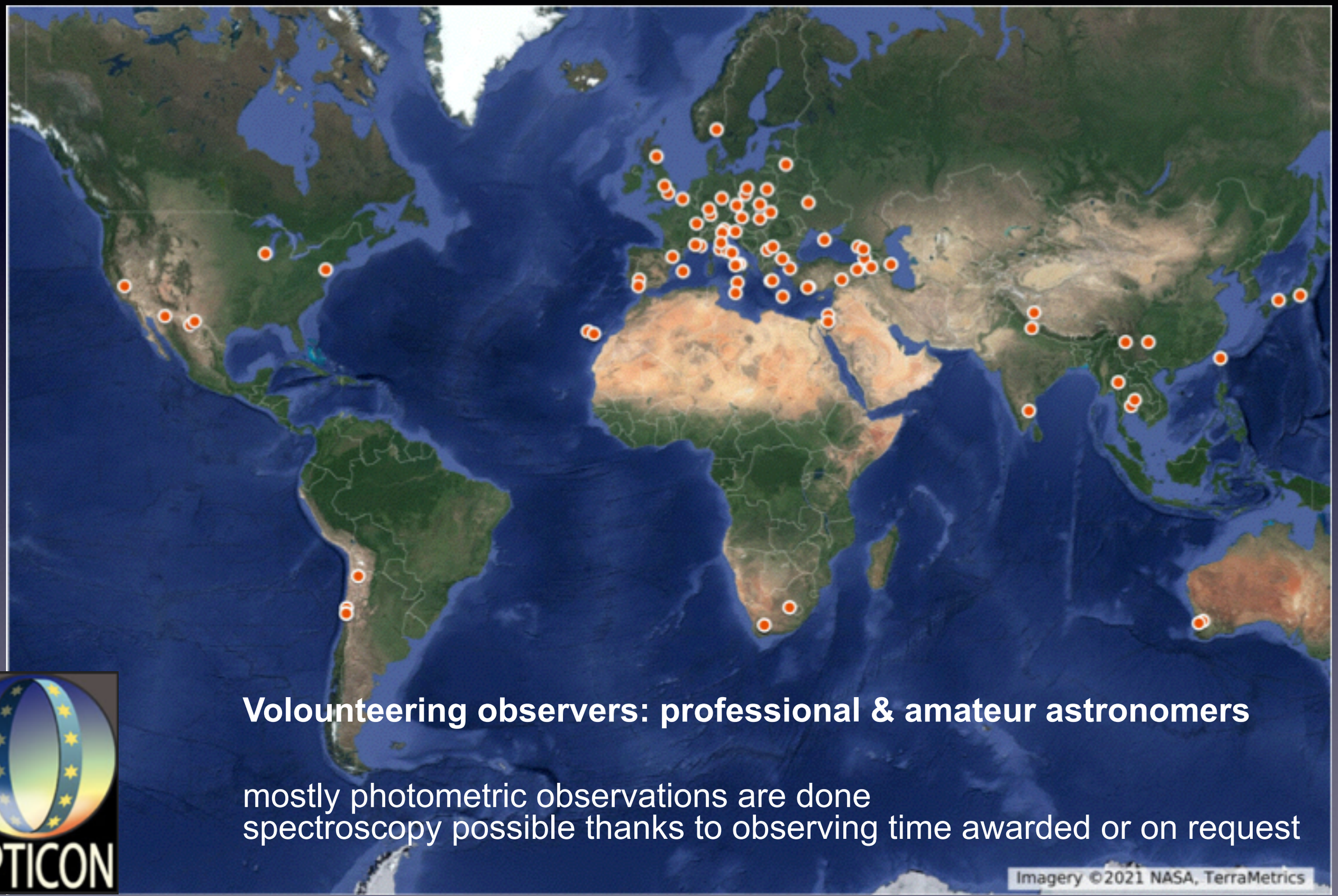
Spectroscopic classification of Gaia microlensing event candidates

Paweł Zieliński
Astronomical Observatory, University of Warsaw

OPTICON follow-up network



OPTICON

In collaboration with

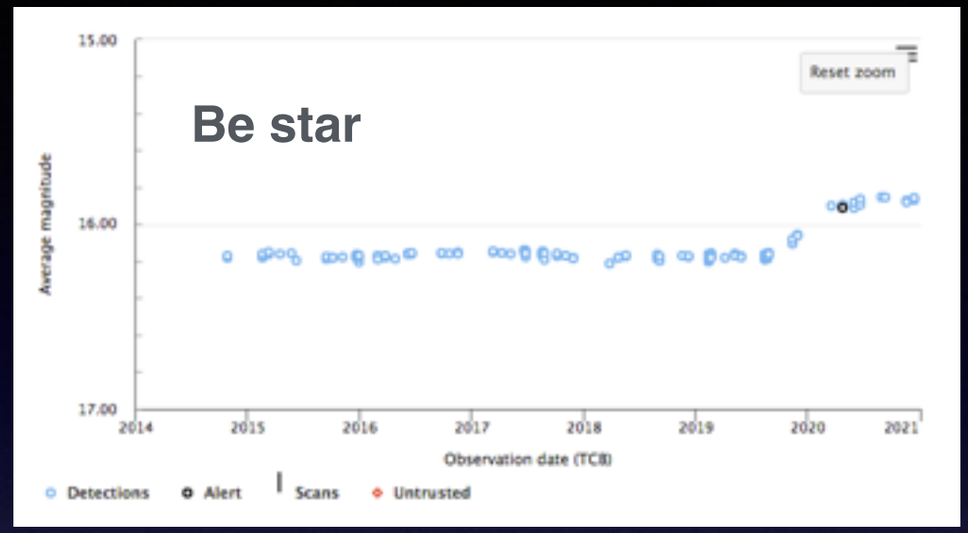
- Robert Smith, Jon Marchant and the Liverpool Telescope Support Astronomers
- Marco C. Lam, Tel Aviv University
- Nariman Ismailov and Shamakhi Astrophysical Observatory
- Andre N. Chene and Gemini Support Astronomers
- David Buckley and SALT Support Astronomers
- Felice Cusano, Alessia Garofalo and Loiano Observatory
- Rachel Street, Etienne Bachelet and Las Cumbres Observatory
- Markus Hundertmark and Yannis Tsapras, Heidelberg University
- Teams from Asiago Observatory & Palomar Observatory
- INT Support Astronomers
- VLT Support Astronomers
- Klaus G. Strassmeier, Ilya Ilyin and Large Binocular Telescope Team

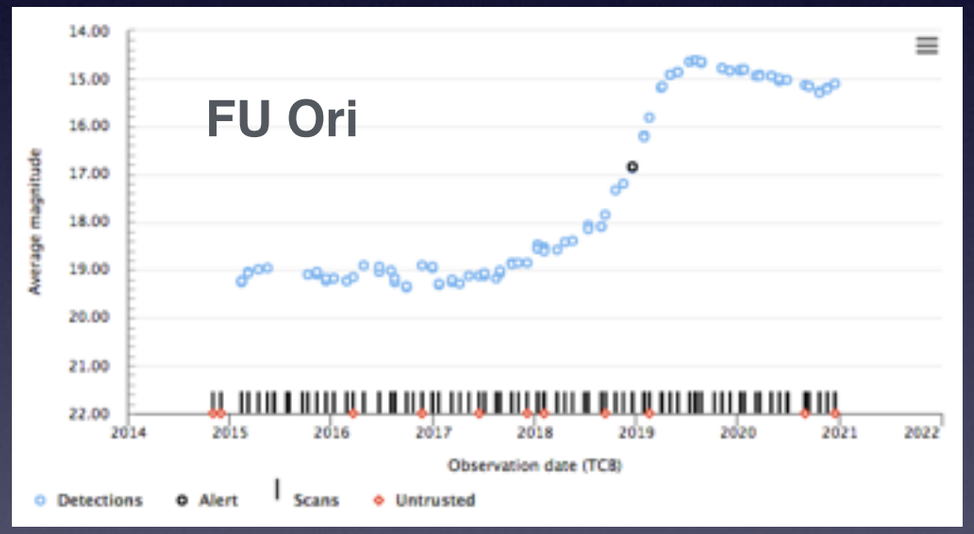
Motivation

Why to perform spectroscopic observations?

- to distinguish genuine microlensing events from other types of outbursts and variables
- Gaia Alerts are usually not classified by AlertPipe
- to select a sample of microlensing events for which an intensive OPTICON follow-up monitoring is continued
- the most interesting targets are studied in detail - determination of parameters of the source star, line-of-sight extinction and distance estimation that is essential in solving the microlensing puzzle

To monitor, or not to monitor, that is the question…





Telescopes in use

- for low-resolution spectra

10-m SALT/RSS
R ~ 1000

2-m LT/SPRAT
R ~ 350

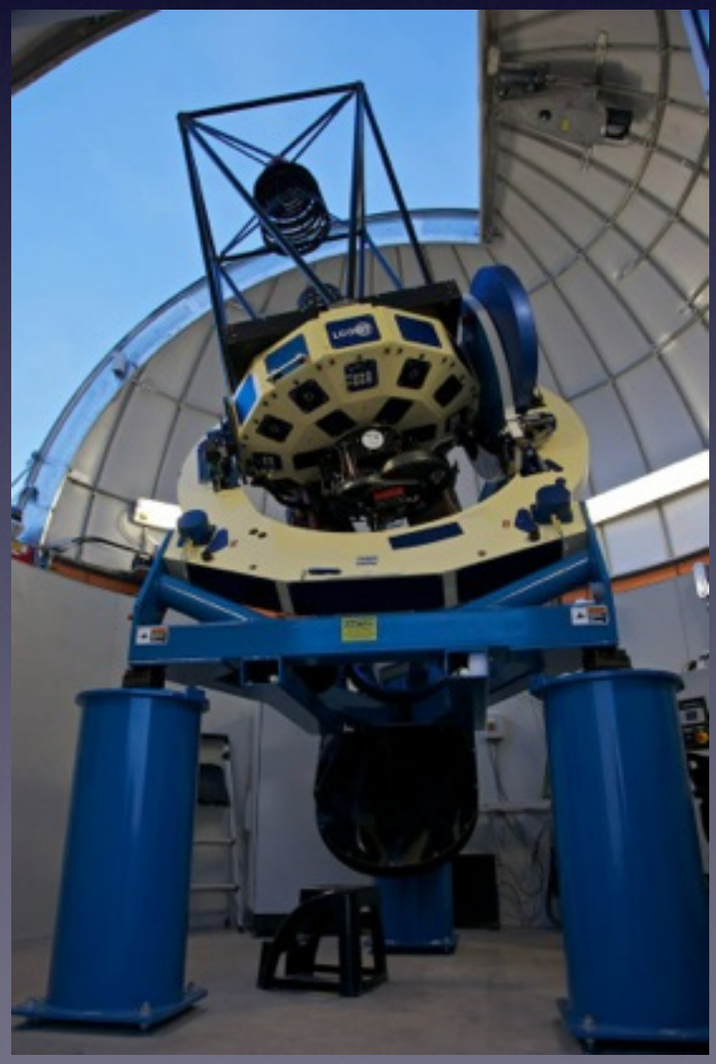
2-m ShAO/UAGS
R ~ 2000

8-m Gemini/GMOS N&S
R ~ 2000

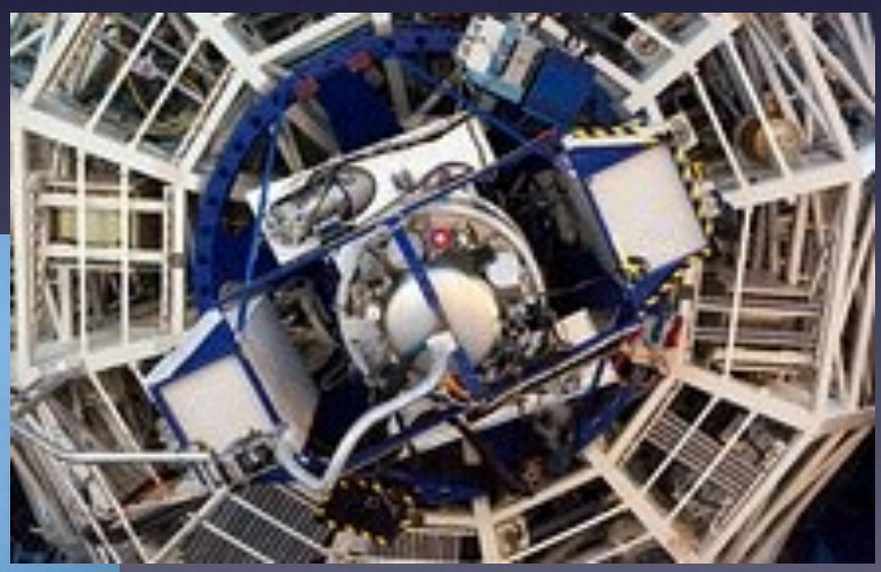
Telescopes in use

- for high-resolution spectra

1-m LCO/NRES
R ~ 50000



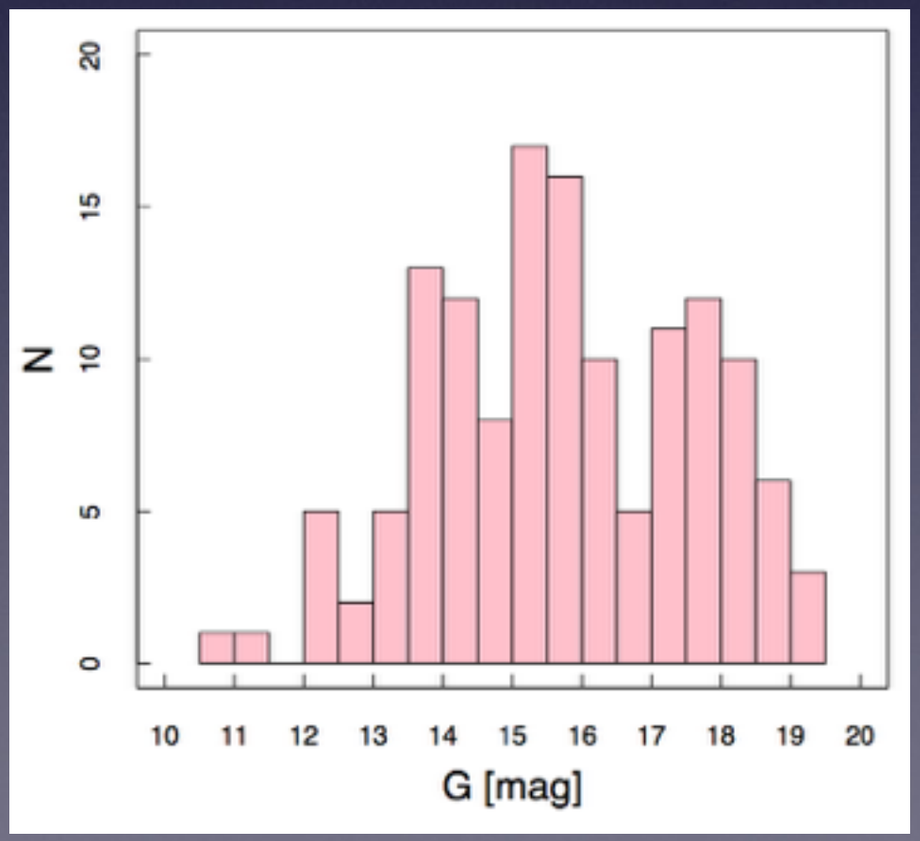
8-m VLT/X-Shooter
R ~ 17000

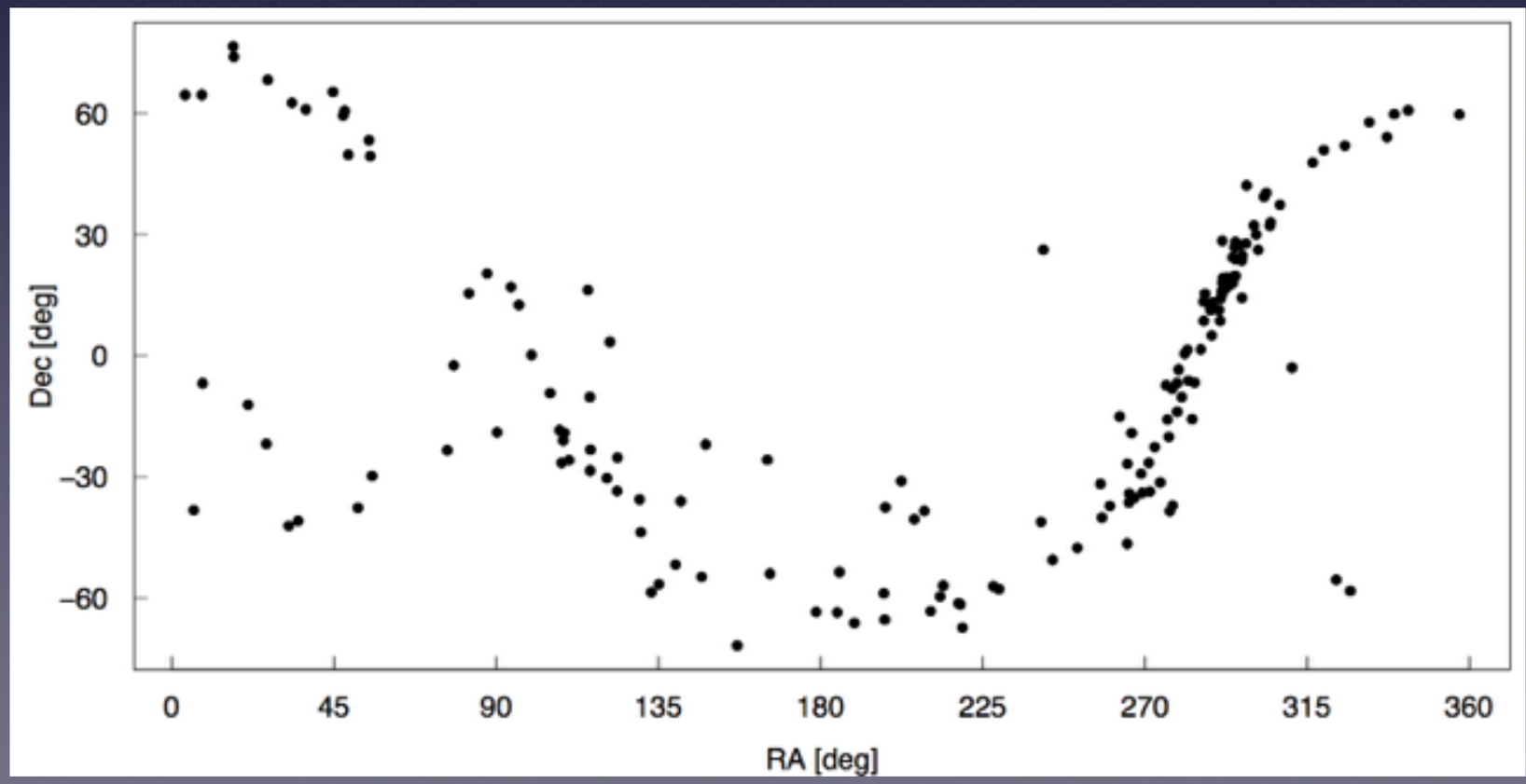


2x8.4-m LBT/PEPSI
R < 250000

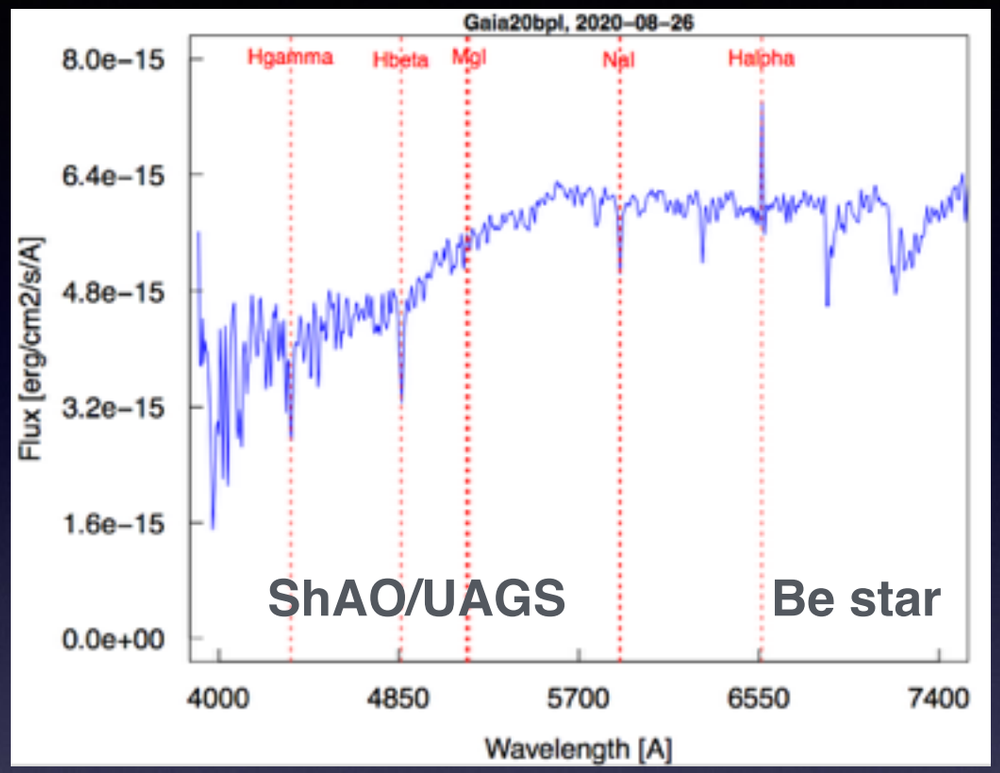
List of targets

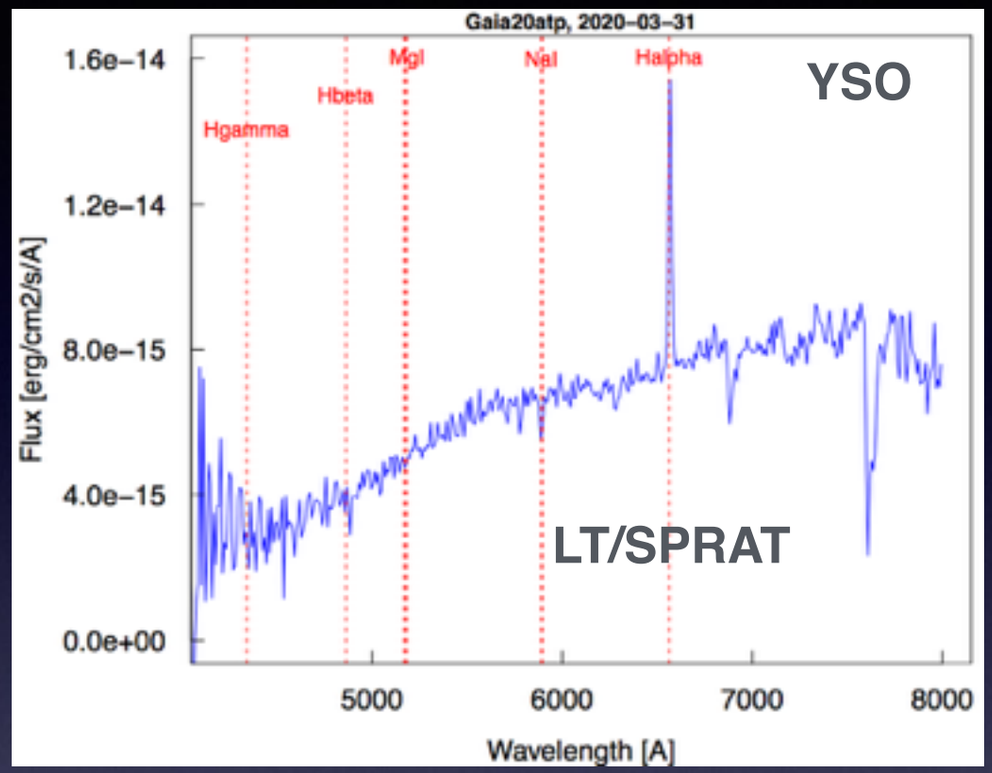
- 344 microlensing event candidates detected by Gaia
- spectra collected for 161 objects (ulens and non-ulens)
- mostly low-resolution spectra obtained but sometimes high-resolution data also



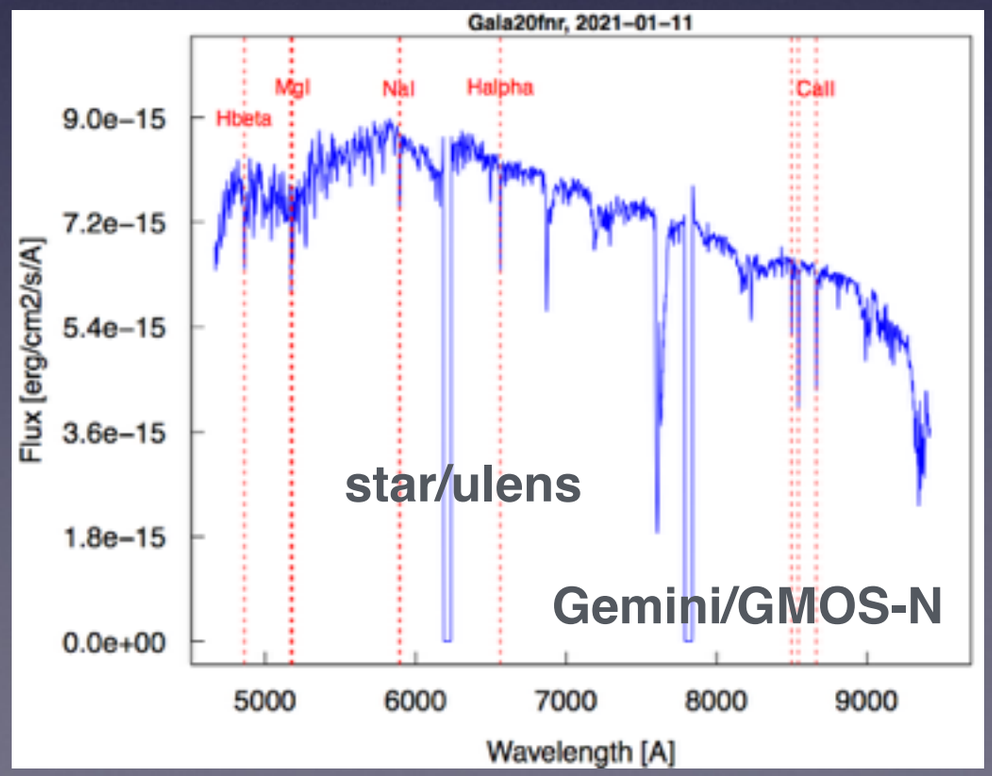


Low-res data



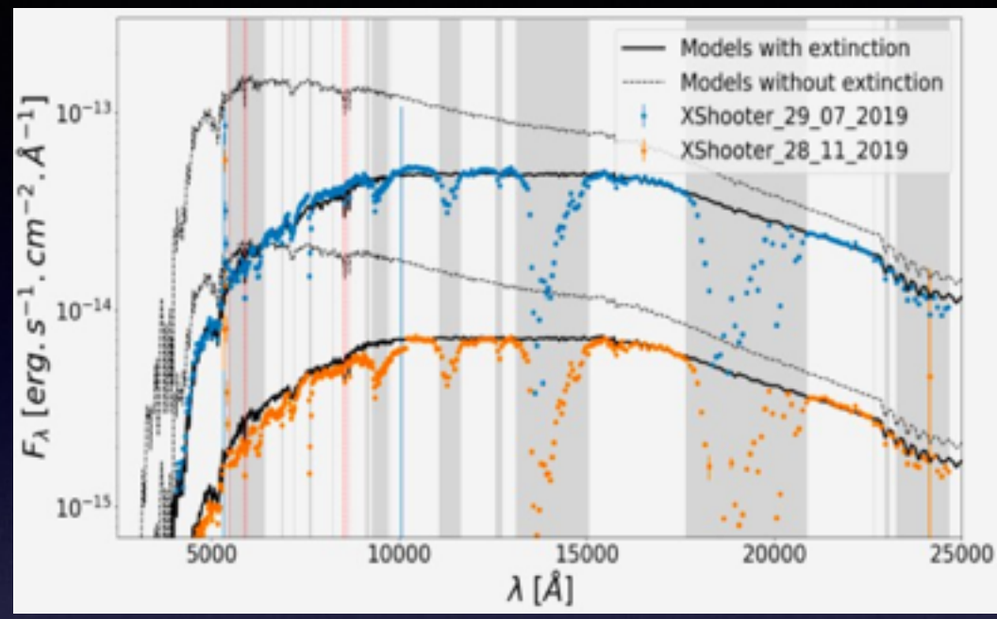


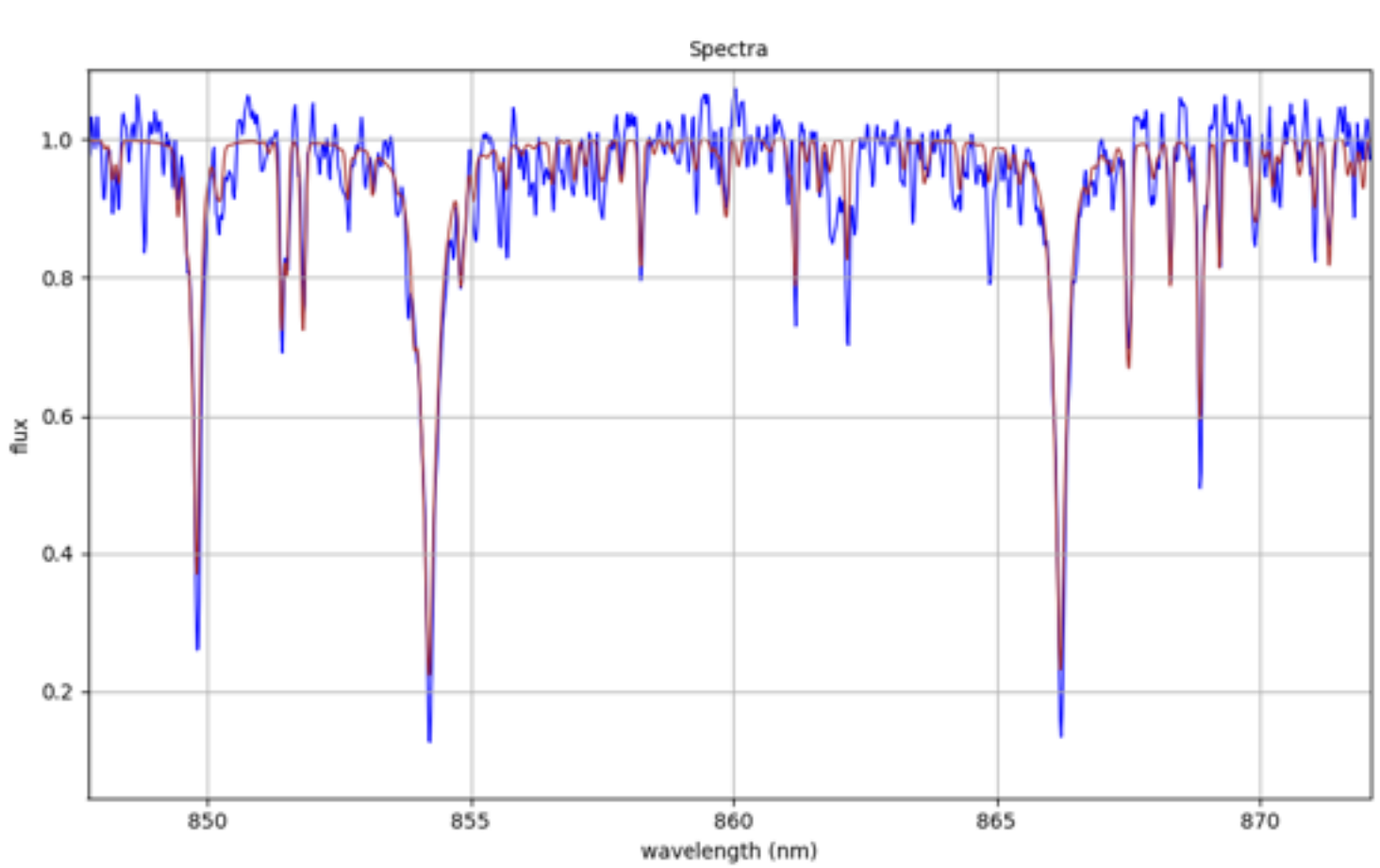
- classification of Gaia Alerts based on prominent spectral features and shape of continuum
- division on two groups: ulens („normal" star) and non-ulens (Be stars, YSOs, CVs, Miras, etc.)
- 18 Astronomer's Telegrams published so far



High-res data

- absorption line analysis —> parameters determination (Teff, logg, [M/H])
- synthetic spectra modelling based on ATLAS9 and/or MARCS models, different radiative transfer codes implemented in iSpec framework (Blanco-Cuaresma 2019)
- matching of obtained spectra with templates (low-res and high-res) —> Etienne Bachelet analysis





Teff, logg, [M/H]

↓

R, M, Mv, Av

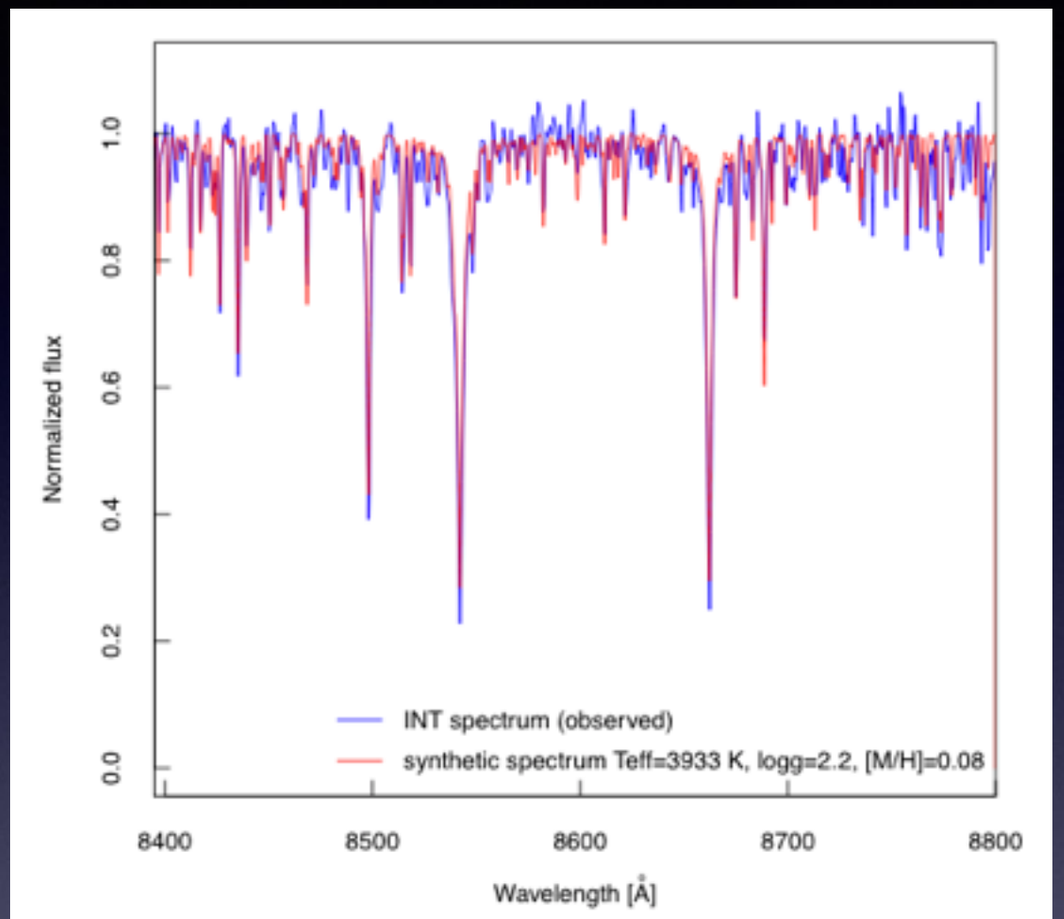
↓

Ds

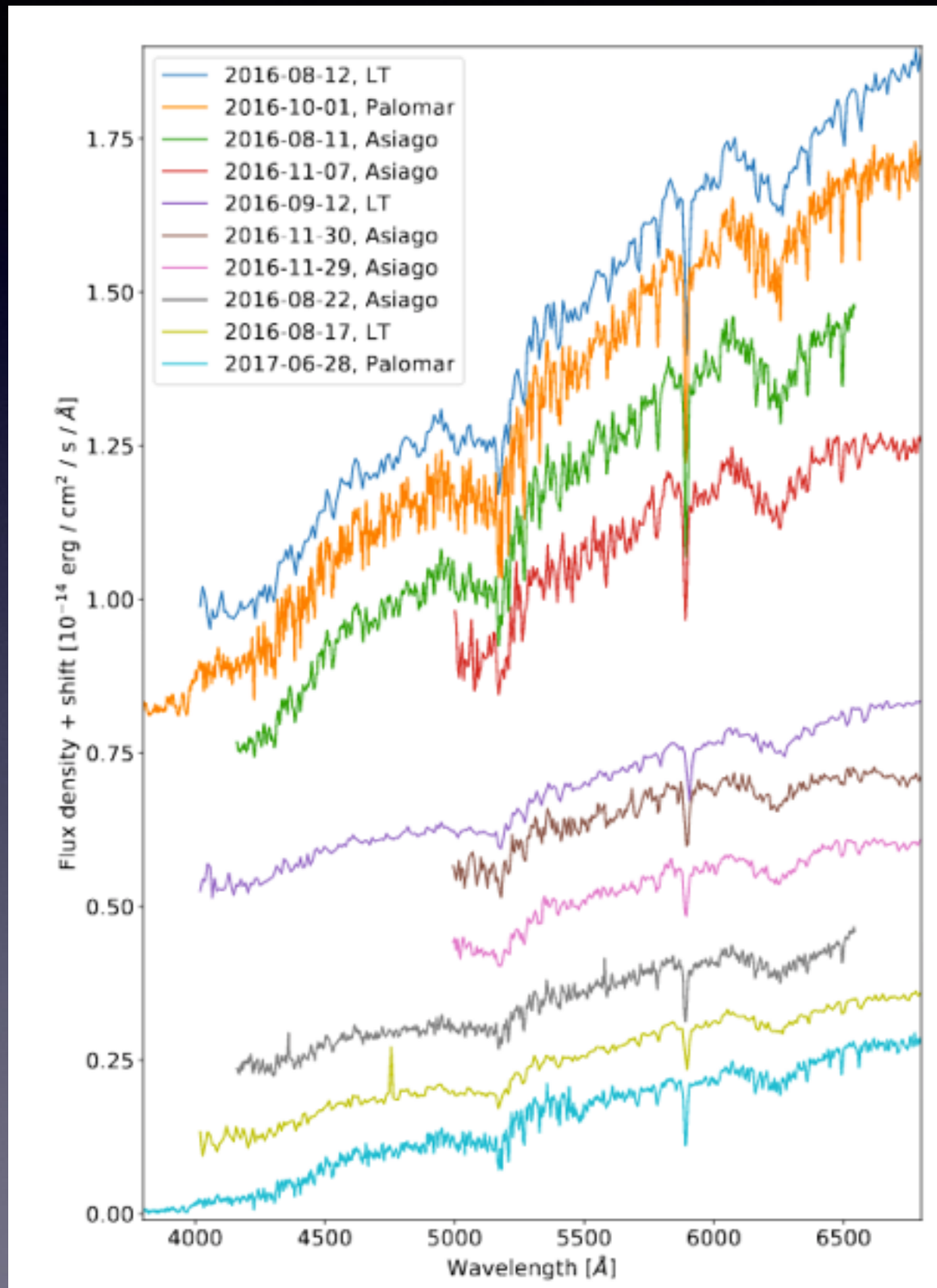
stellar isochrones, empirical relations

from Mv and Av

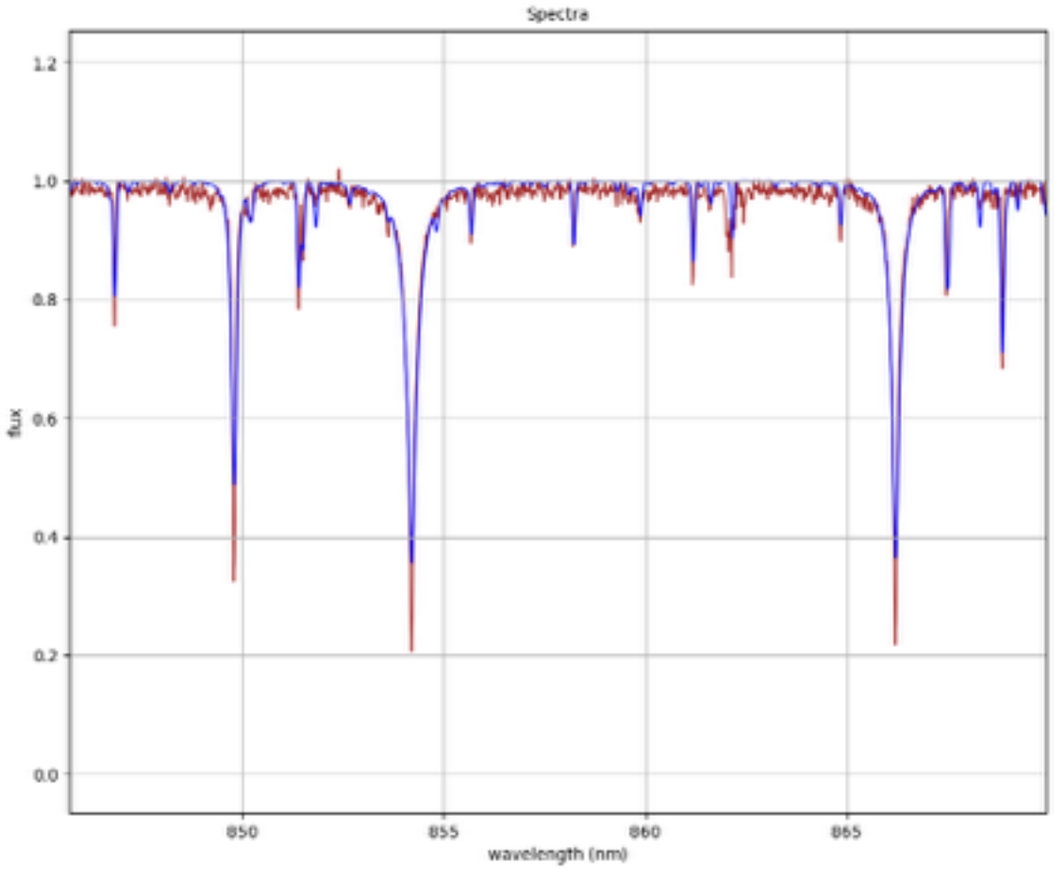
Interesting case: Gaia16aye



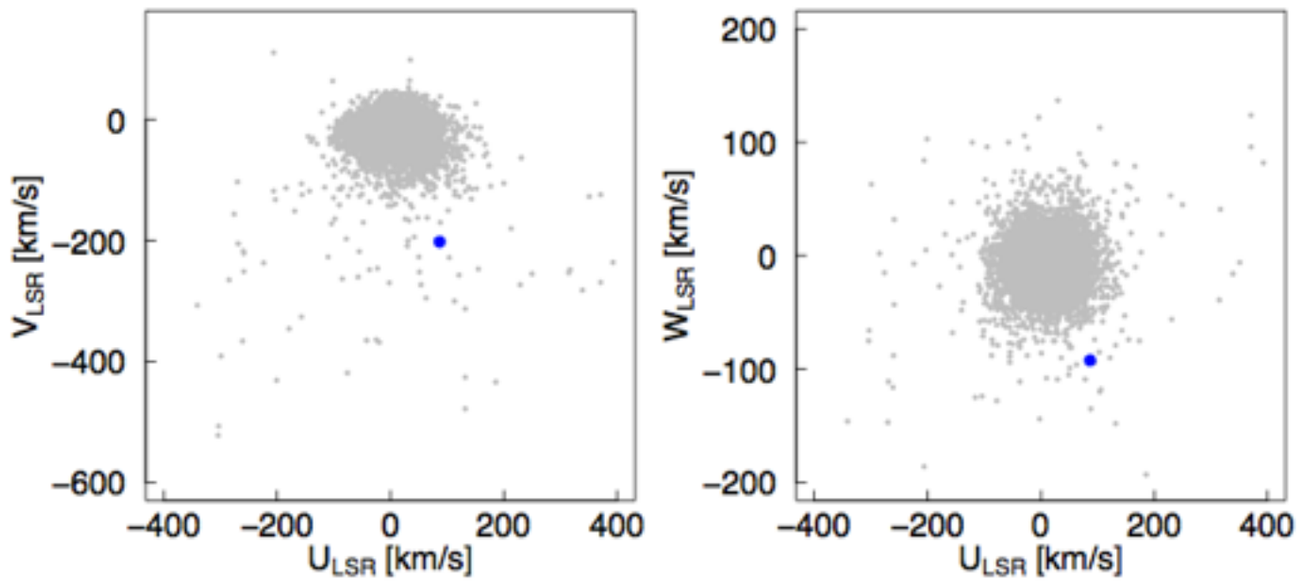
- 2.5 m INT/IDS spectrum (2016-11-19)
- set of low-res spectra LT/SPRAT, Asiago/AFOSC and Palomar/DBSP
- source is K5III star at distance 9.6 kpc
- binary microlensing event published in Wyrzykowski et al. 2020

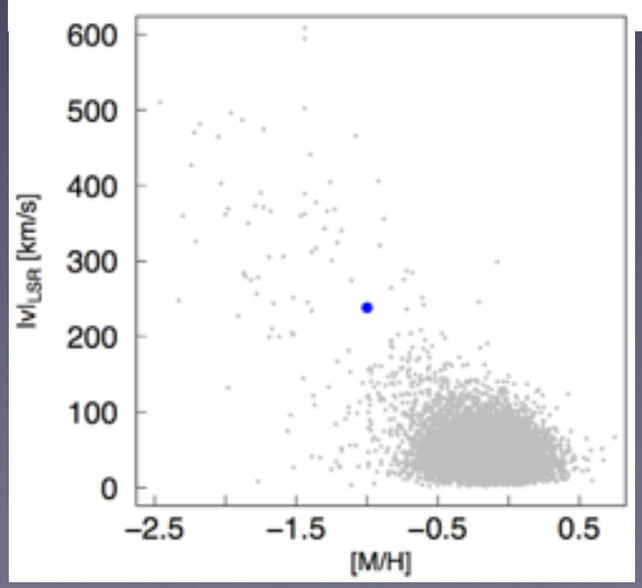


Interesting case: Gaia19bcm

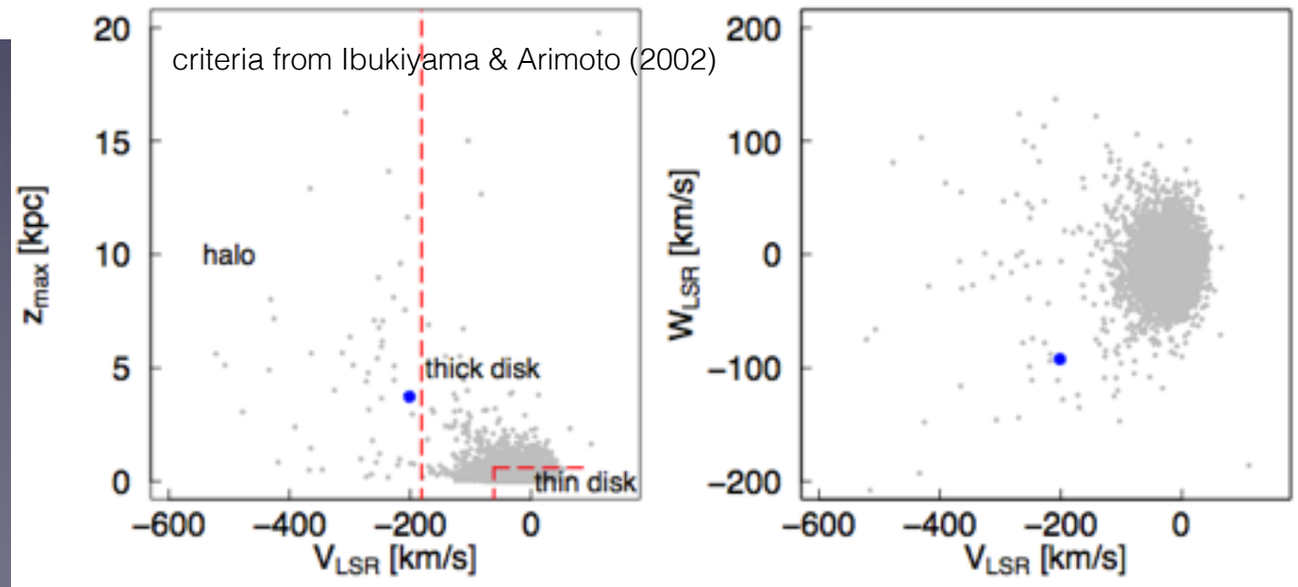


- source is K2III star at distance 4.7 kpc

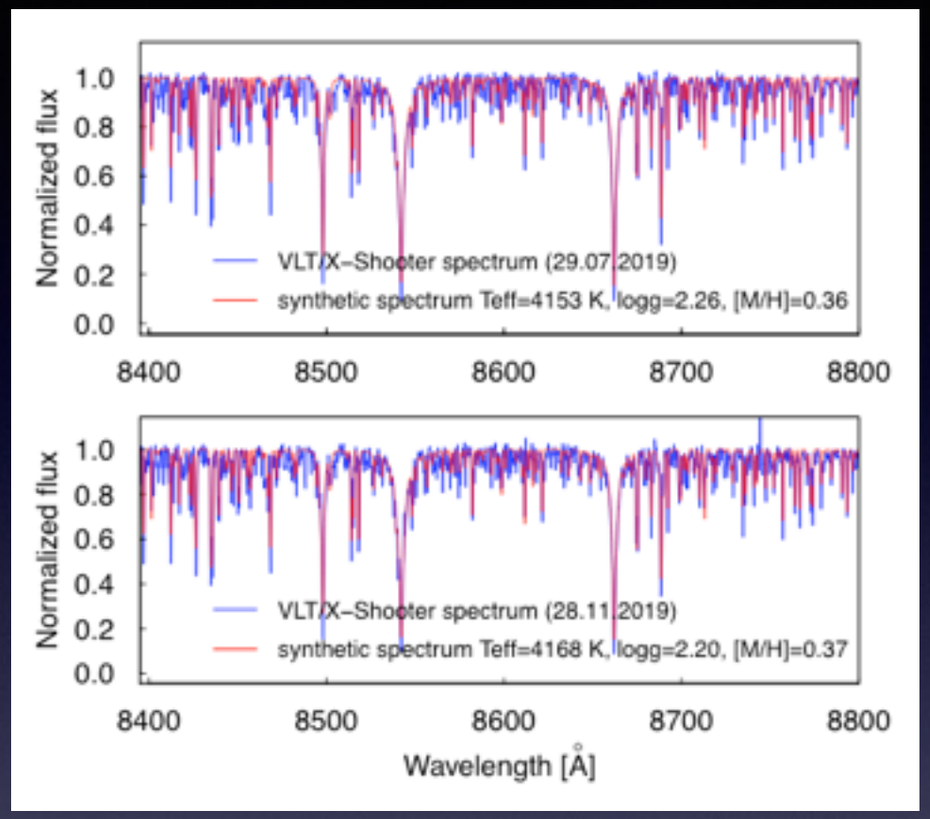


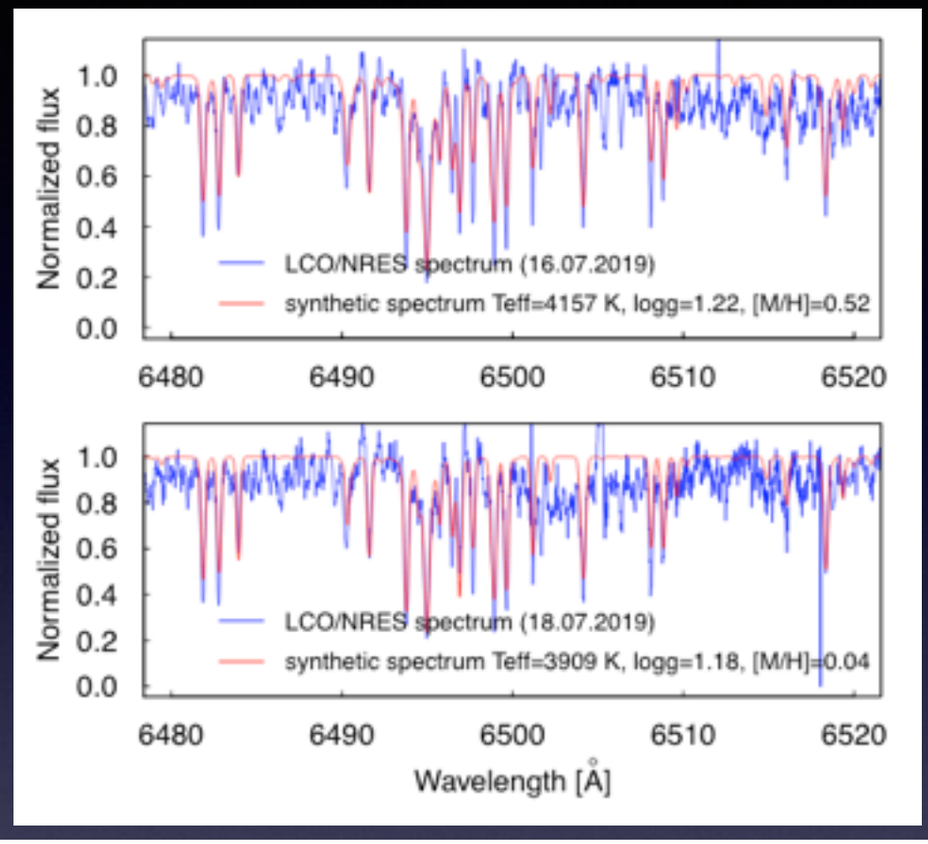


- metal-poor giant located in Galactic halo
- paper in prep

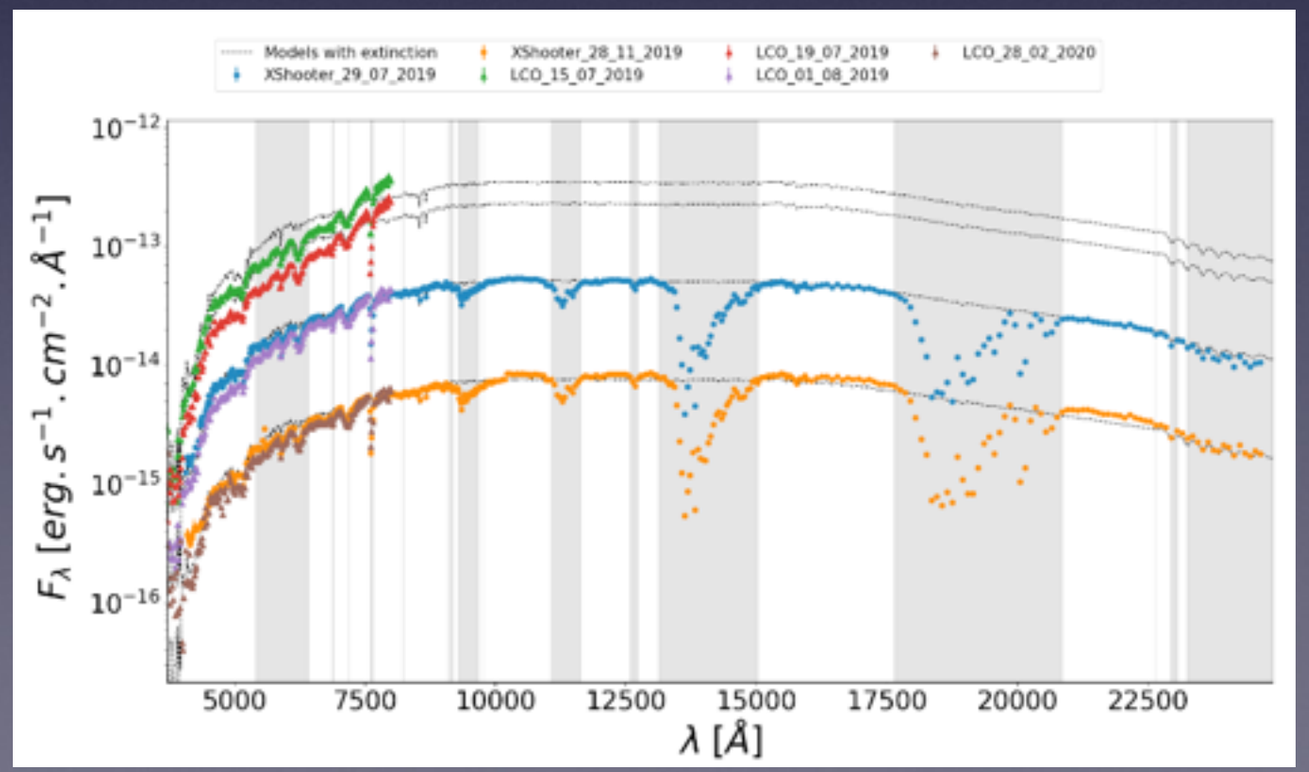


Interesting case: Gaia19bld





- source is K3 giant at distance 7.8 kpc
- template matching based on VLT/X-Shooter and LCO/FLOYDS data delivers Av value
- Bachelet et al. 2021, in review



Thank you!

Paweł Zieliński
pzielinski@astrouw.edu.pl