Spectroscopic and Photometric observations at Molėtai AO for the ESA PLATO space mission

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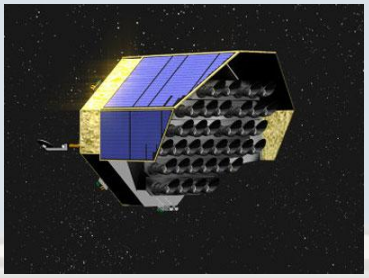
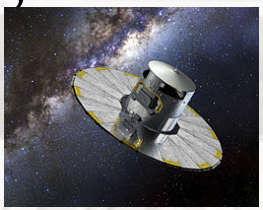
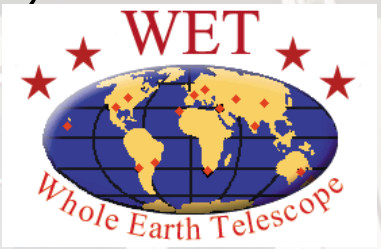
Gaia Alerts - UTRECHT, 2016 12 07

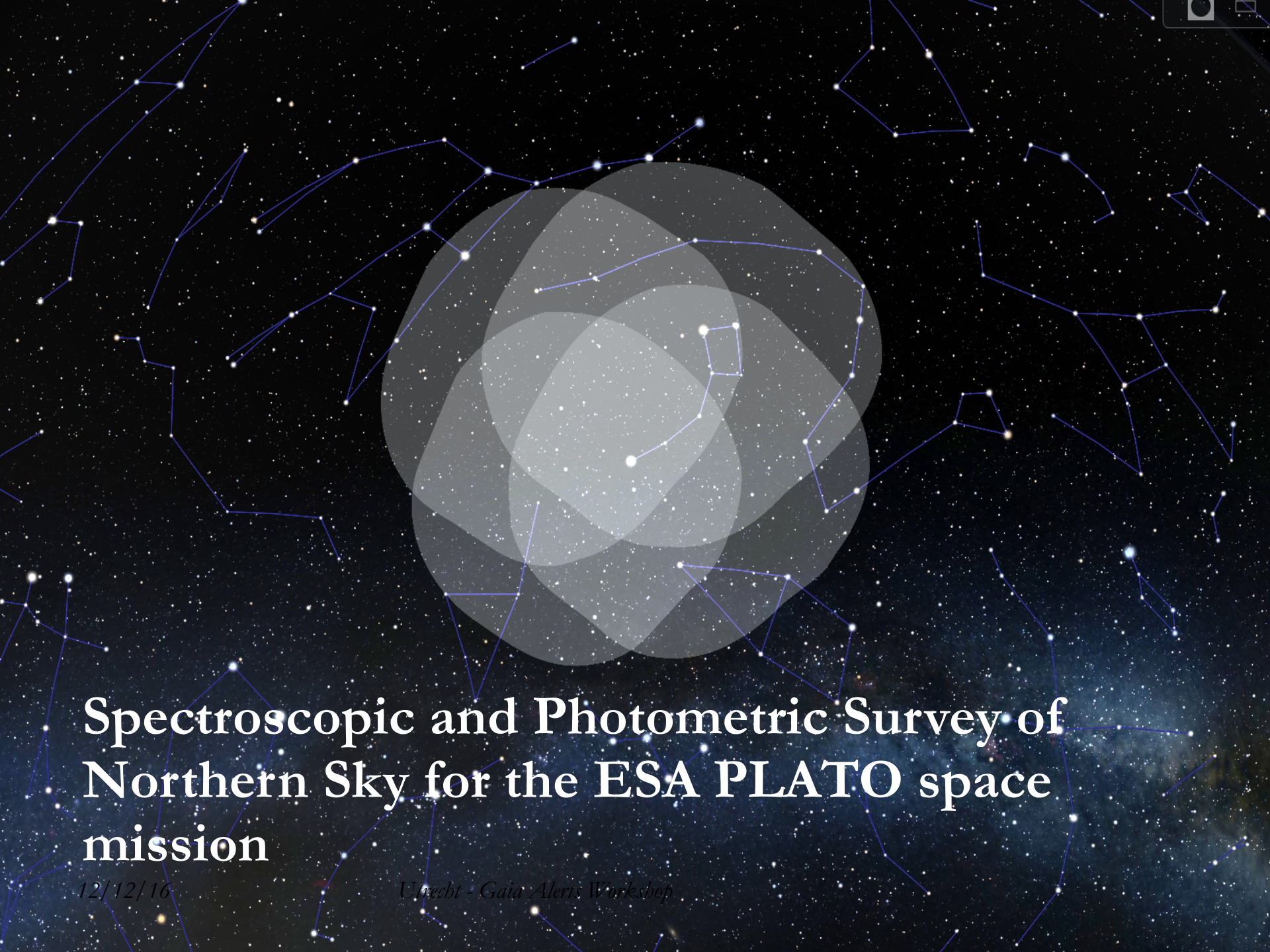
Collaboration in projects



- PLATO (2024, ESA)
- TESS (Transiting Exoplanet Survey Satellite, Dec. 2017, NASA)
- Gaia Alerts
- Kepler Objects of Interest (KOI)
- BRITE (Poland, Austria, Canada)
- Whole Earth Telescope (WET)
- Other individual collaborations







Spectroscopic and Photometric Survey of Northern Sky for the ESA PLATO space mission

Survey for PLATO

- Need of stellar variability and spectroscopic information that is necessary for a development of the PLATO input catalog
- Current photometric catalogs and spectroscopic surveys are not enough

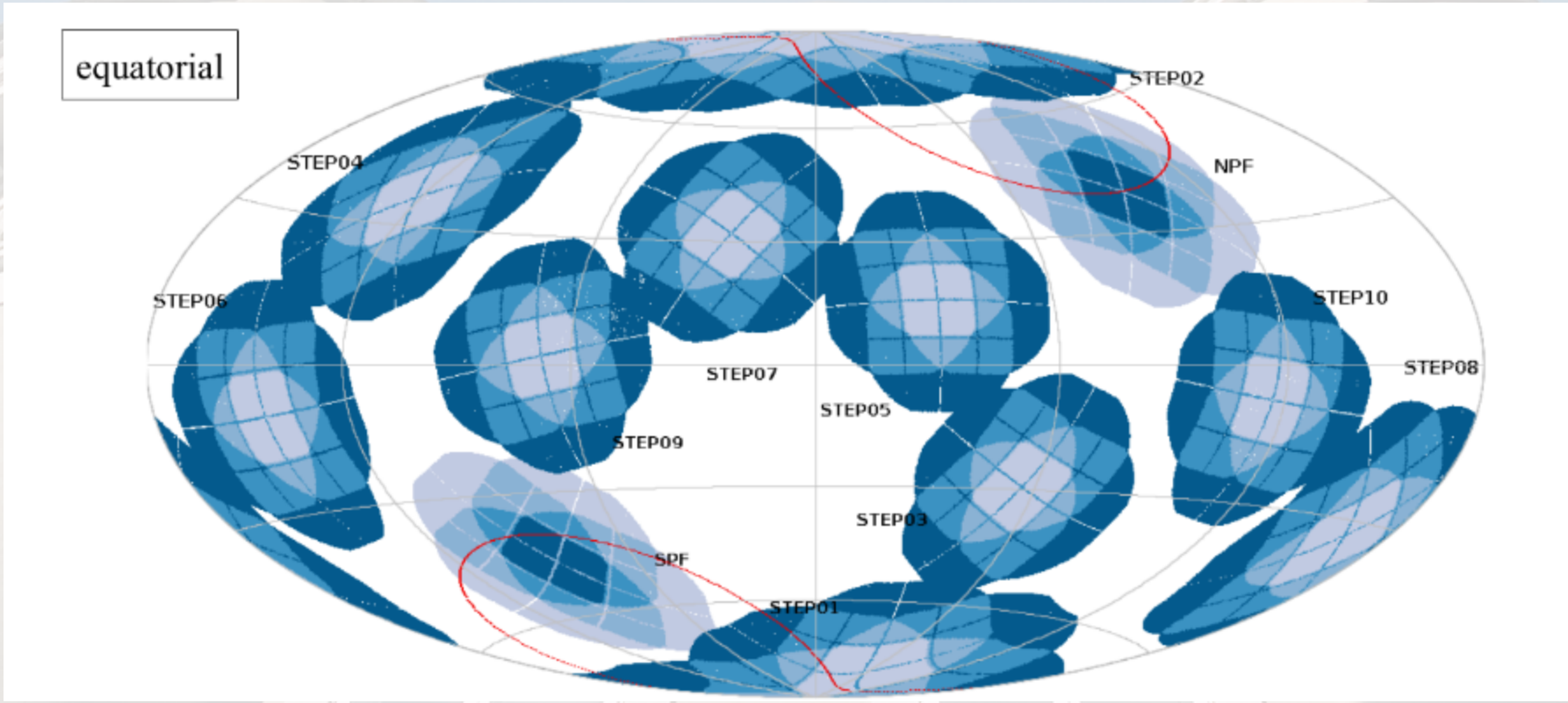
Survey for PLATO

- Molėtai astronomical observatory:

  The advantage is its location and instrumentation: the largest telescope in the northern Europe (1.65 m) with high resolution spectrograph @ latitude N 55.3^{o}

  (most spectroscopic surveys were done from southern hemisphere)
- Polaris region accessible
- Important for PLATO and TESS missions

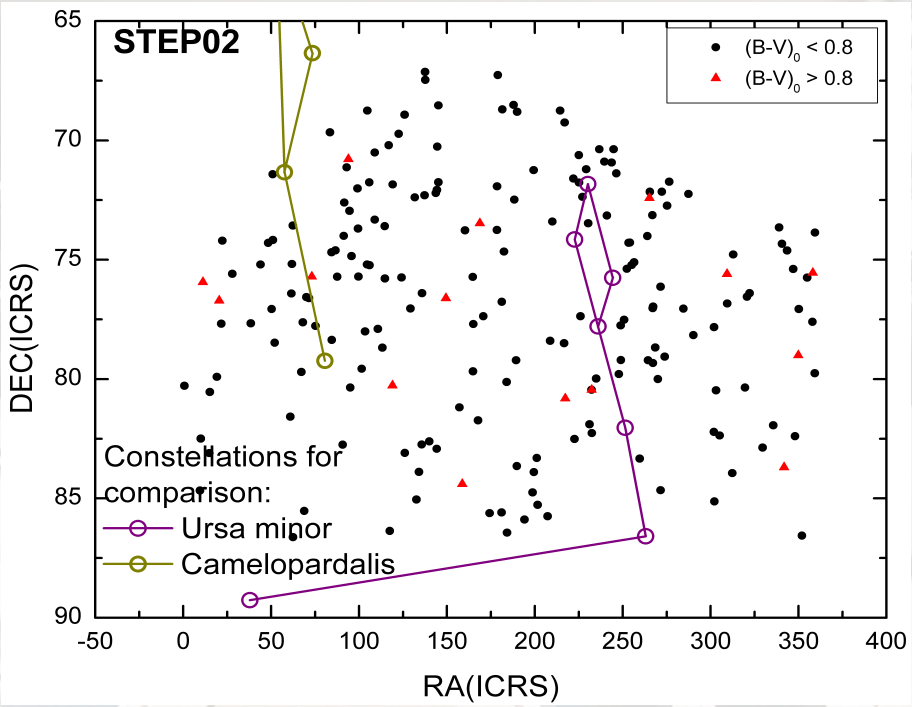
Survey for PLATO



Survey for PLATO

Only 10% of STEP2 FGK targets have some spectroscopic information.

More stars have photometric magnitudes V&B, but plenty of bright stars are not classified (no sp.type).



Survey for PLATO

- **Spectroscopy**: dwarfs and sub-giants (V<8 mag) of F5 and cooler spectral types (~180 in a field)

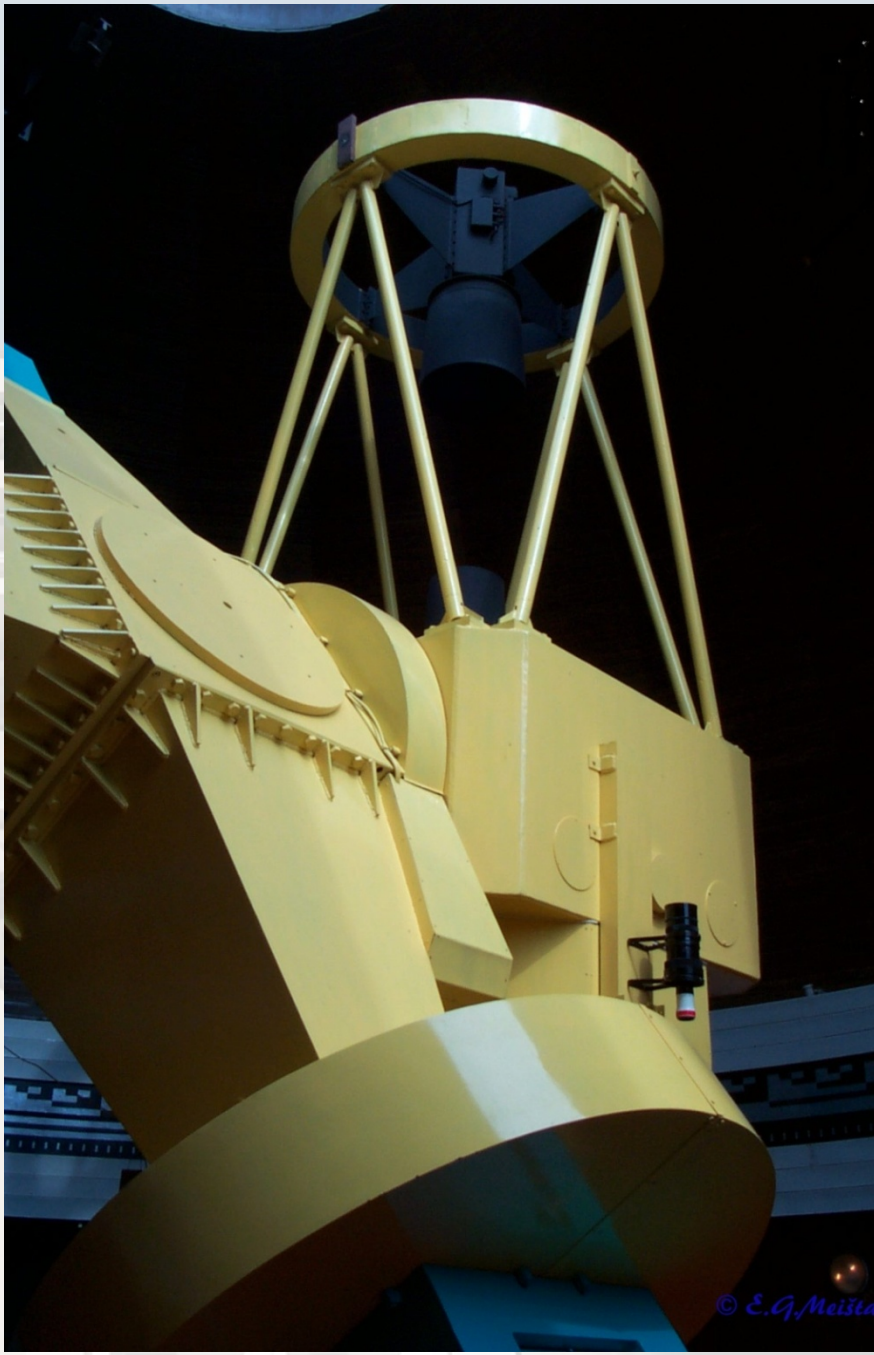
Results will consist of (1) main atmospheric parameters (T_{eff}, log(g), metallicity, microturbulence) and chemical composition (up to 32 elements) of brightest stars for the PLATO 2 and 3 samples.

1.65 m. telescope

- 1.65 m. Ritchey-Chretien

  CCD photometer (~8x8 arcmin)

  High resolution spectrograph



VUES

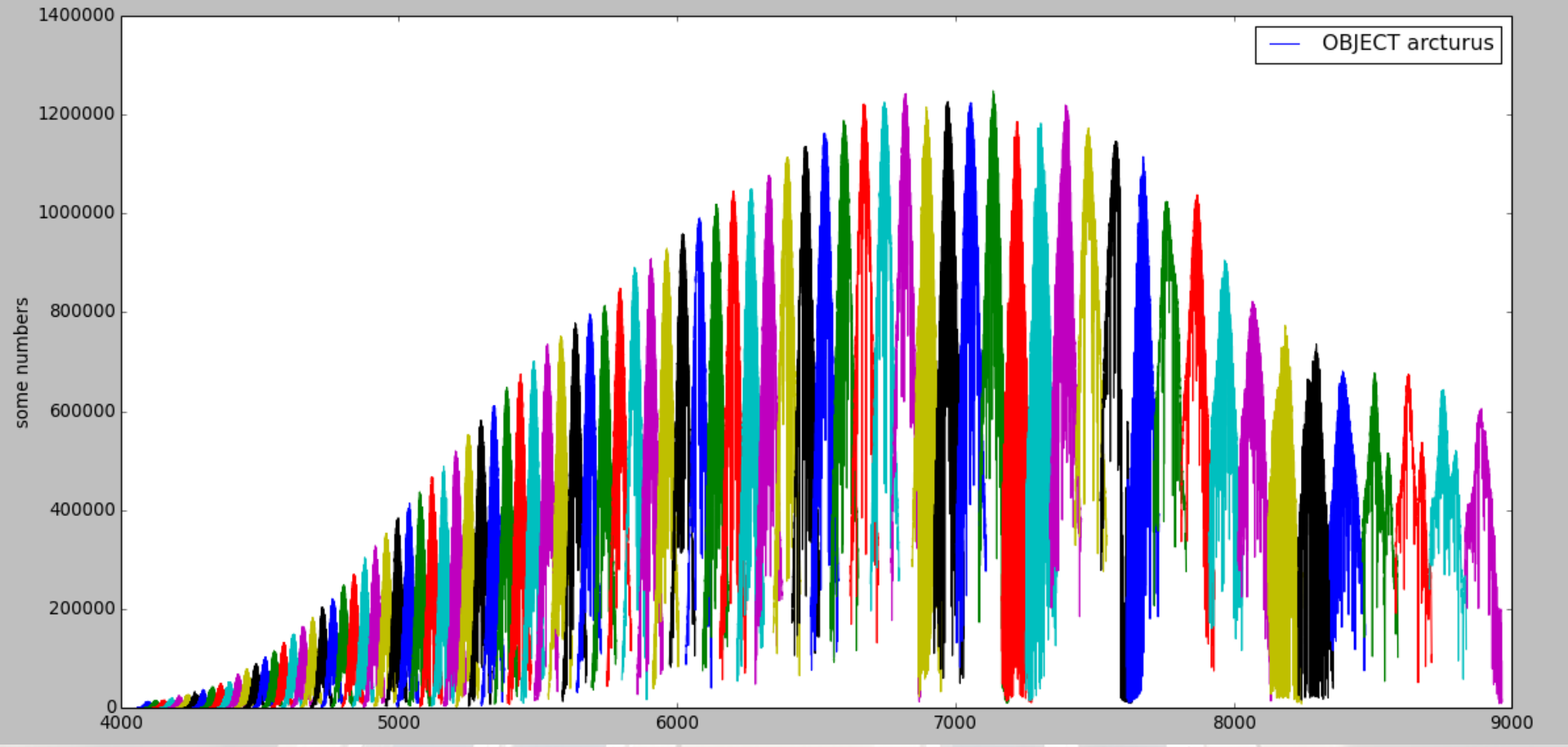
Designed, built, and delivered by the Yale Exoplanet Laboratory

Vilnius University Echelle Spectrograph (VUES)

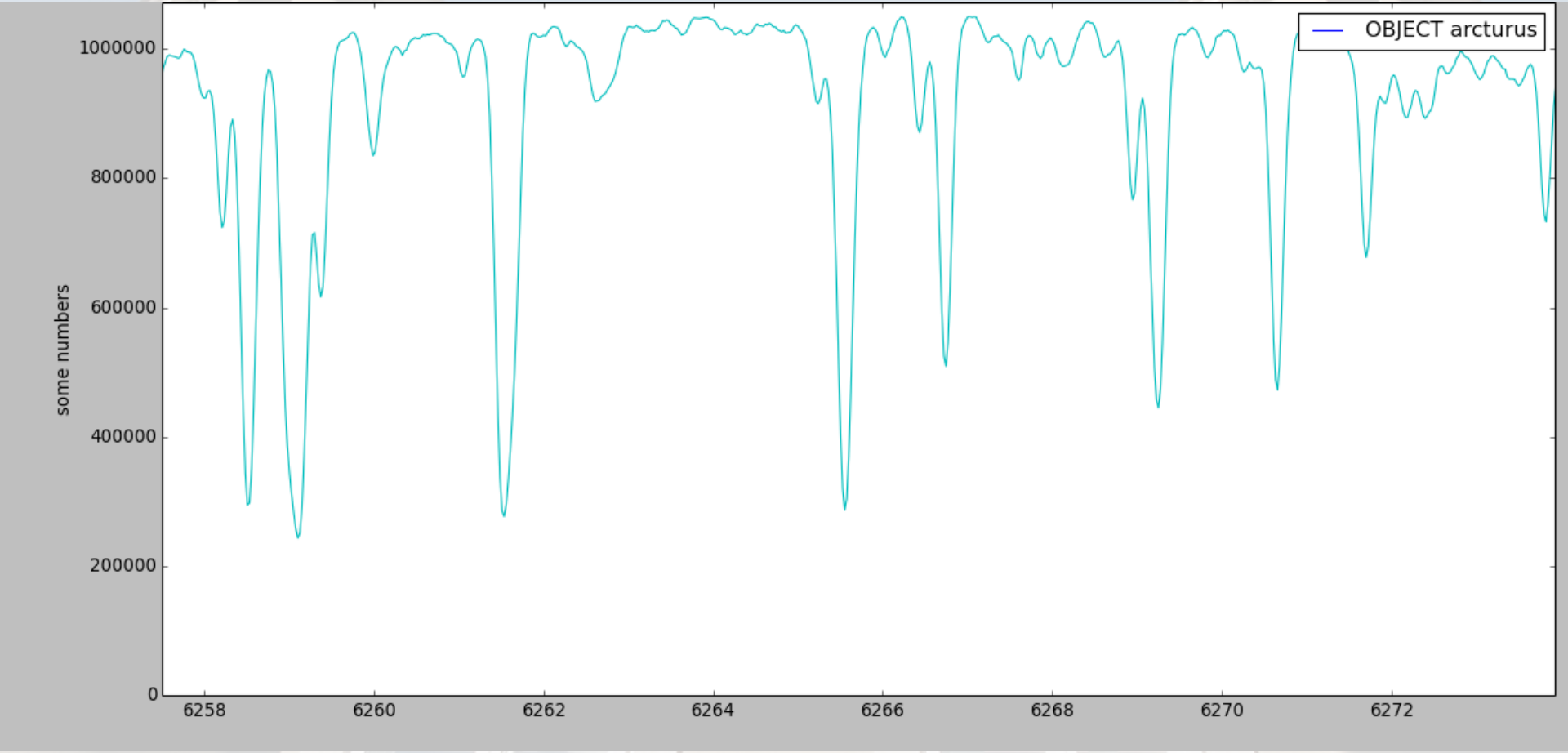
Key parameters of the spectrograph:

Wavelength Range	λ = 400–880 nm
Spectral Resolution Modes, λ / $\delta\lambda$	30000; 45000; 60000
Echelle spectrum	70 – 153 raws
Ešele difrakcinė gardelė	31.6 grooves/mm
Instrumental Throughput	25%, λ = 543 nm
Broad-spectrum optical fiber (FBPI)	fiber, Φ = 100 µm, l = 16 m
On-sky Fiber Aperture	2.5 arcseconds
Spectrograph Detector	4k x 4k x 15 µm pixel pitch
Temperature	-94°C

Spectrum


OBJECT arcturus
some numbers
1400000
1200000
1000000
800000
600000
400000
200000
0
4000
5000
6000
7000
8000
9000

Spectrum


OBJECT arcturus
some numbers
1000000
800000
600000
400000
200000
0
6258
6260
6262
6264
6266
6268
6270
6272

Survey for PLATO

- **Time-series photometry**: bright objects V<11mag for PLATO 1, 2, 3, and 4 samples (mostly in Step2 and some in other PLATO fields).

The aim of time-series photometry : search for any variability of stars in PLATO field Step2 (and other PLATO fields)

We selected fields with suspected variable stars (<11 mag (V), most of them are cooler than F0) with thought to avoid blind search for variability (because of the size of FOV and time limitation)

Photometric observations

35/51 cm Maksutov telescope at Molėtai AO

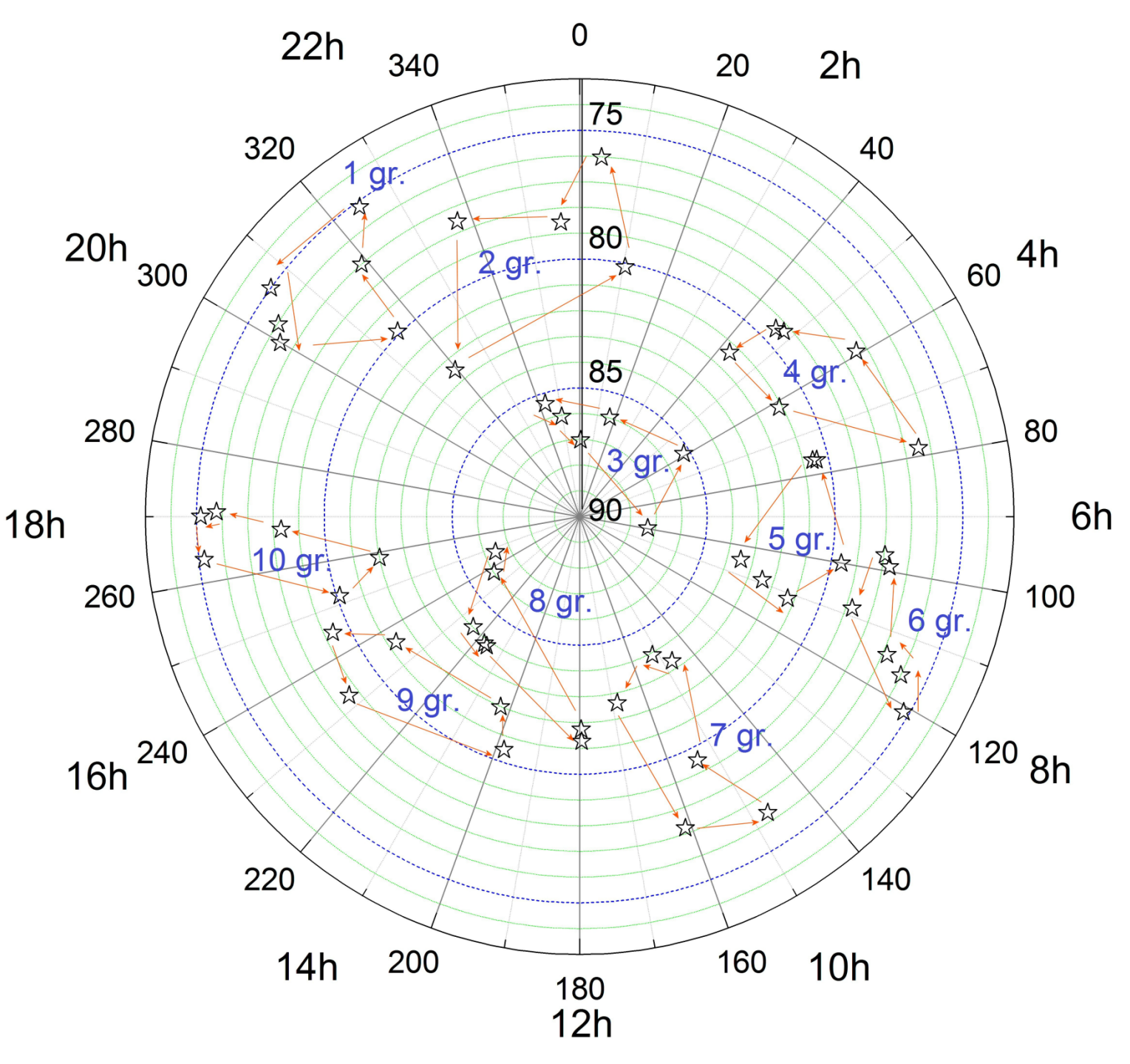
CCD camera E2V CCD47-10

Thermoelectric cooling (-30^{o}C)

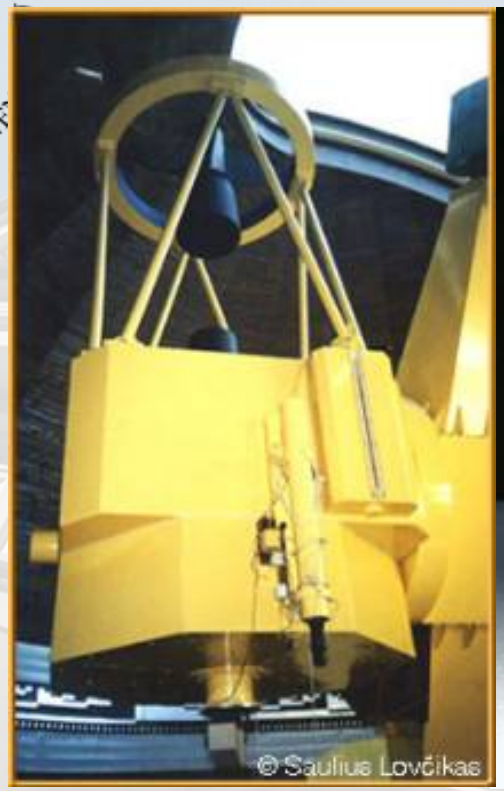
Array Size (pixels)1024 x 1024

Pixel Size 13 x 13 microns

FOV 39x39 (arcmin^{2})


0
20
2h
40
4h
60
80
6h
100
120
8h
140
10h
160
180
12h
200
14h
220
240
16h
260
18h
280
300
20h
320
22h
340
75
80
85
90
1 gr.
2 gr.
3 gr.
4 gr.
5 gr.
6 gr.
7 gr.
8 gr.
9 gr.
10 gr.

Photometric observations



165 cm telescope at Moletai AO

CCD camera E2V CCD47-10

Thermoelectric cooling (-30^{o}C)

Array Size (pixels)1024 x 1024

Pixel Size 13 x 13 microns

FOV 8.2x8.2 (arcmin^{2})

Observed: ~20 fields around suspected variable stars:

10 in *Step 2*

7 in *Step 5*

3 in *Step 7*

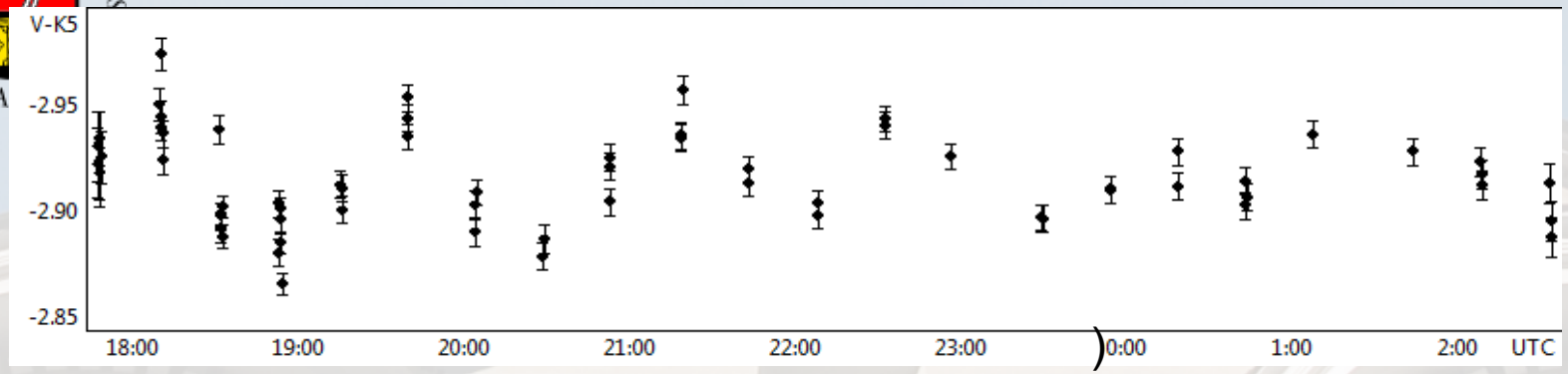
and 1 in *NPF* (long cadence field)

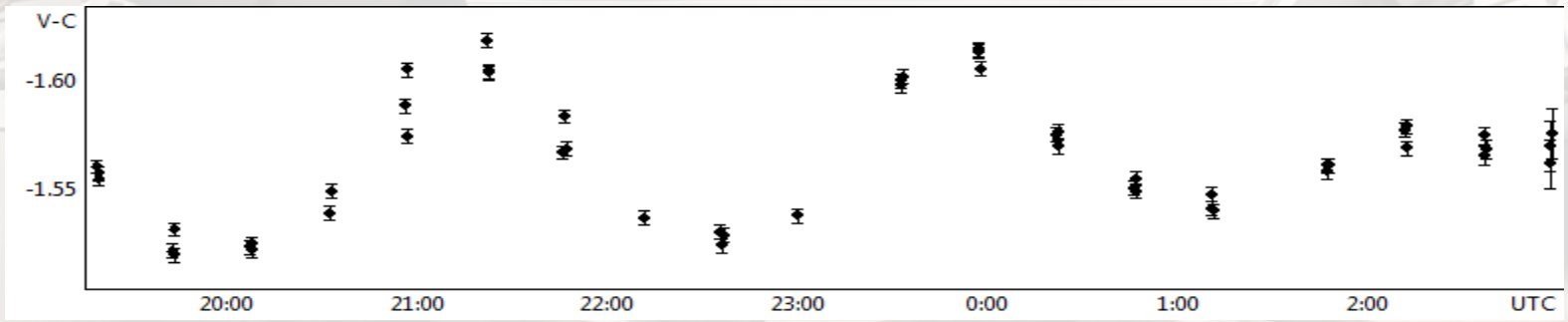
Found: 9 variables (possibly delta Scuti, one of them long periodic (days?))

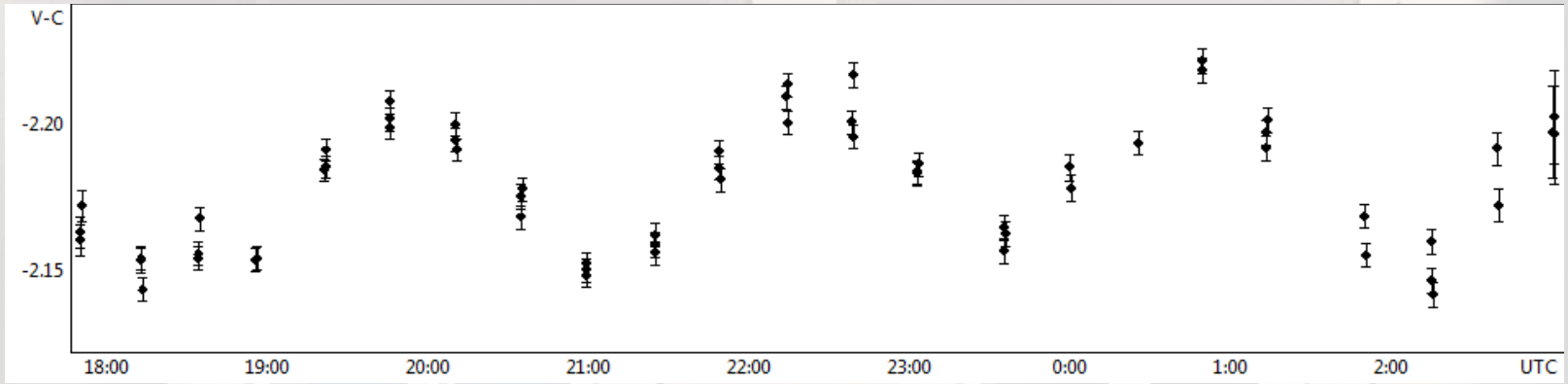
+4 variables in the field (eclipsing binaries)

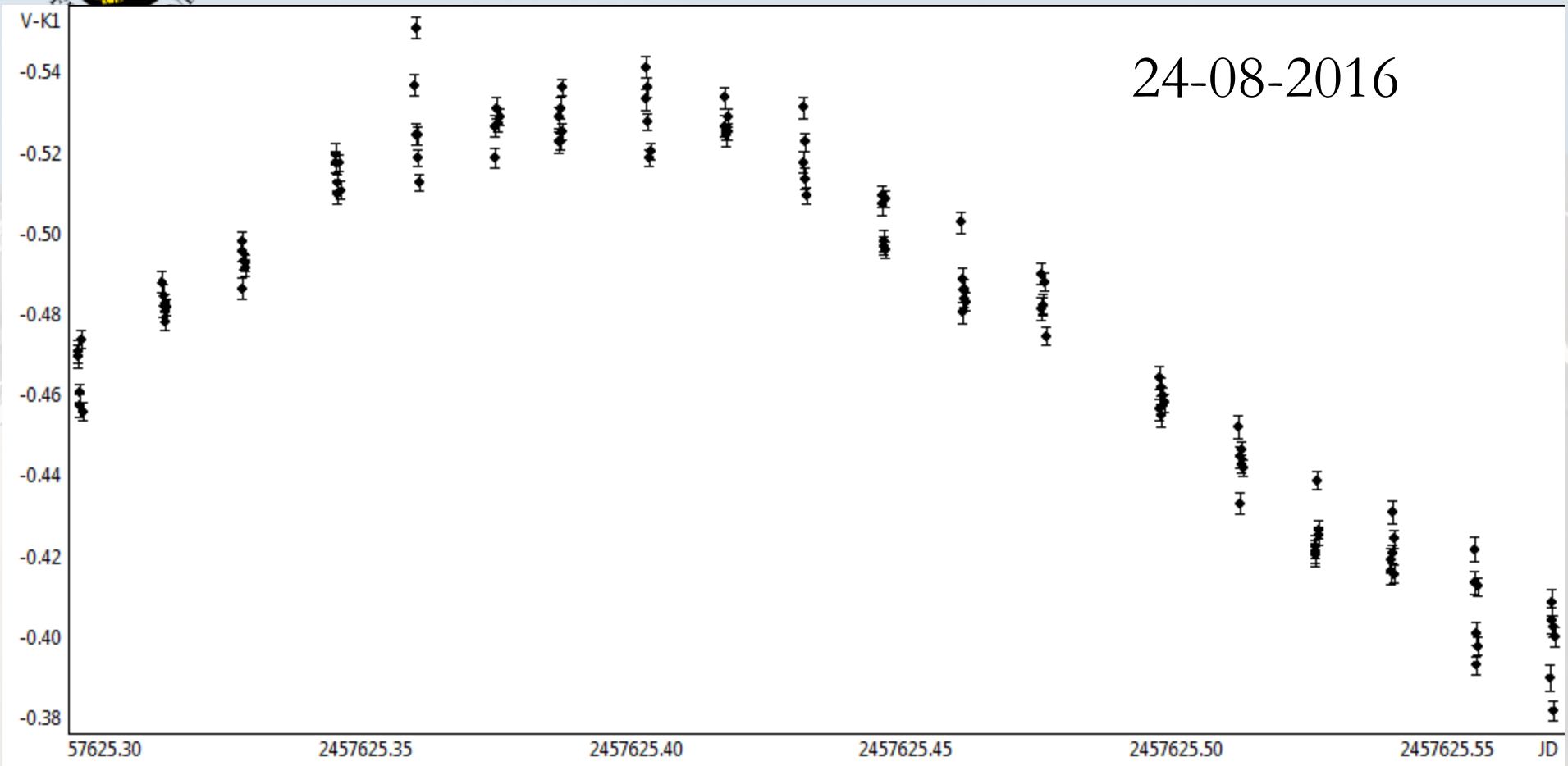
+5 suspicious, maybe variables (need more careful analysis)

Three different delta Scuti stars observed on 09-09-2016

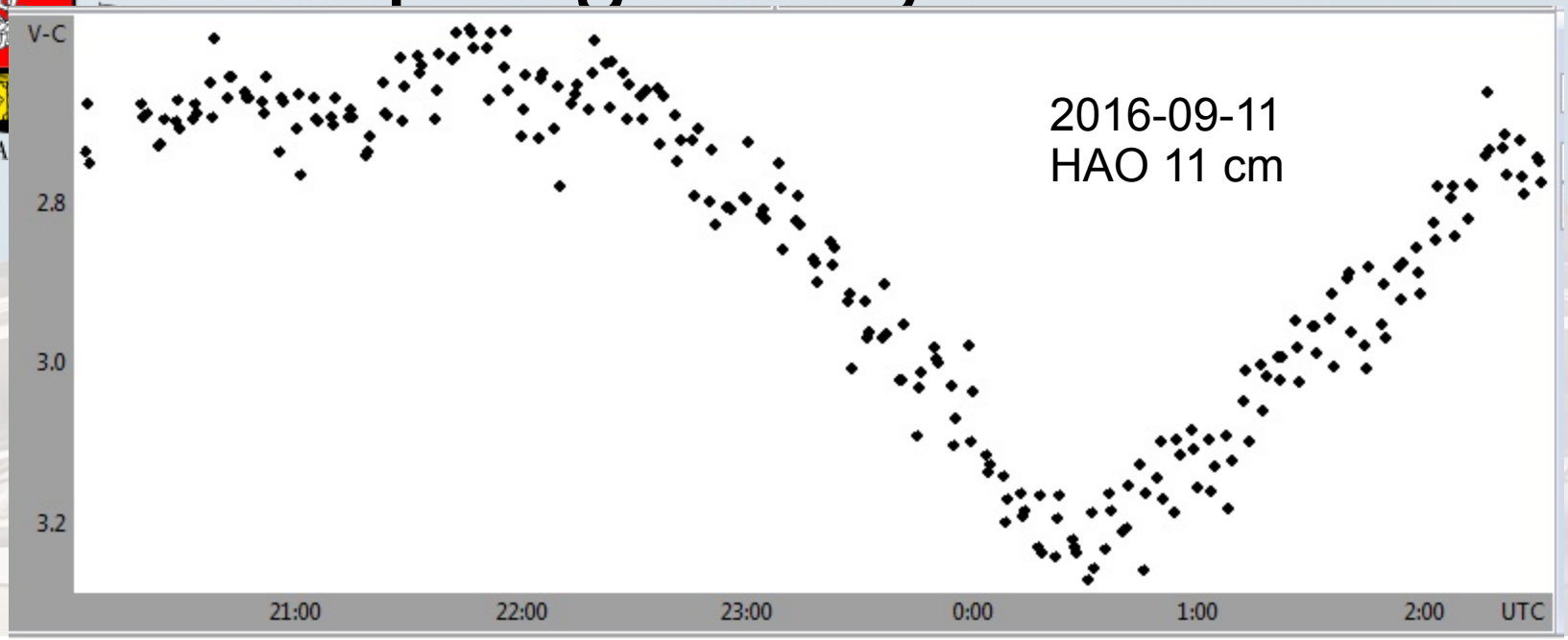


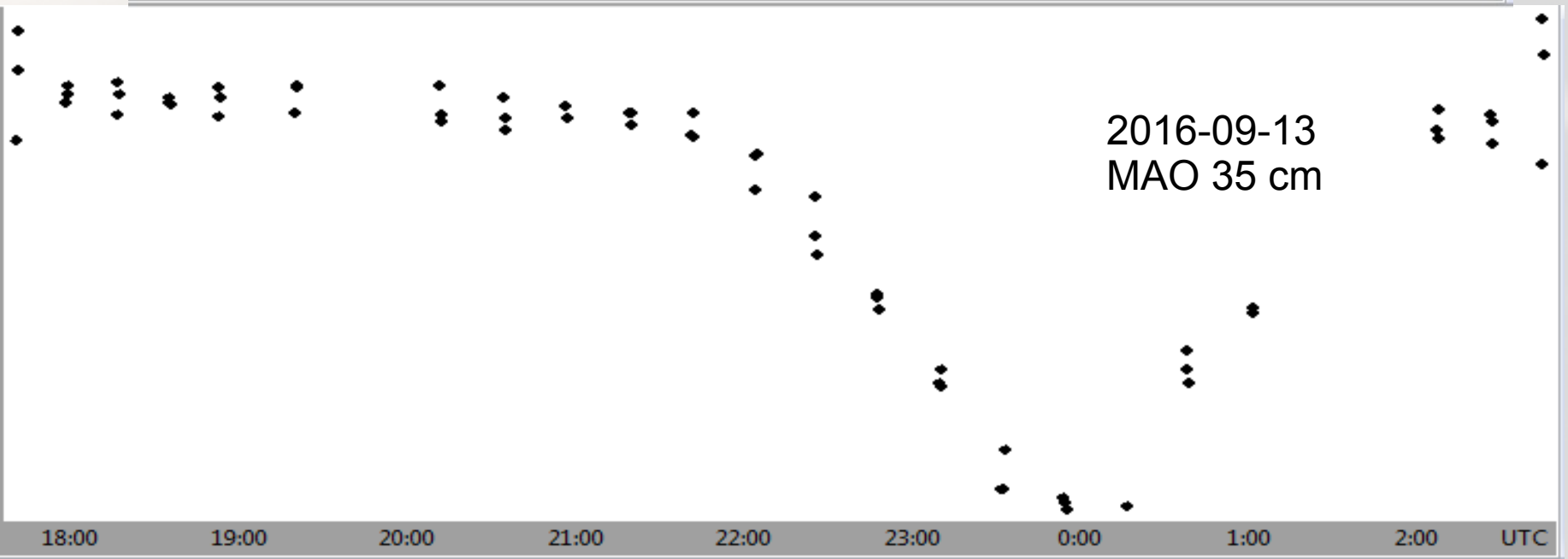


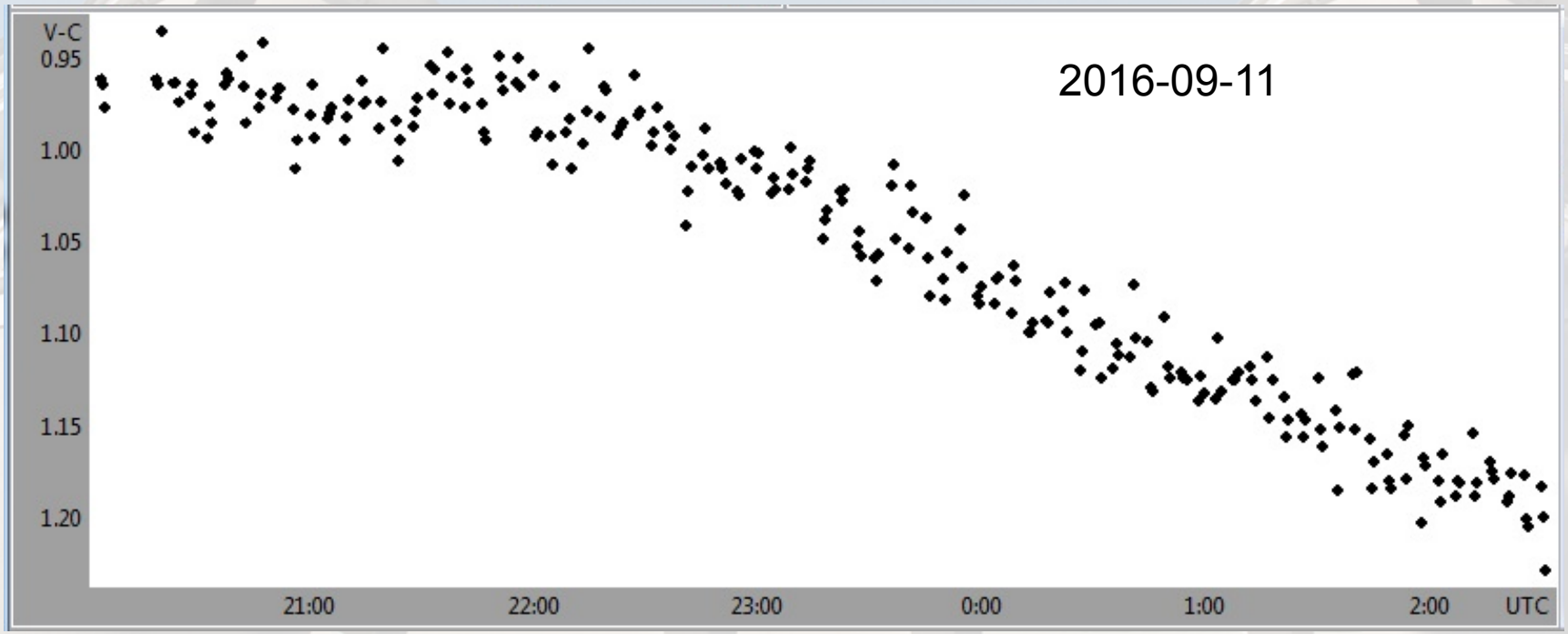



V-K1
-0.54
-0.52
-0.50
-0.48
-0.46
-0.44
-0.42
-0.40
-0.38
57625.30
2457625.35
2457625.40
2457625.45
2457625.50
2457625.55
JD
24-08-2016

Eclipsing binary






V-C
0.95
1.00
1.05
1.10
1.15
1.20
2016-09-11
21:00
22:00
23:00
0:00
1:00
2:00
UTC

Survey for PLATO

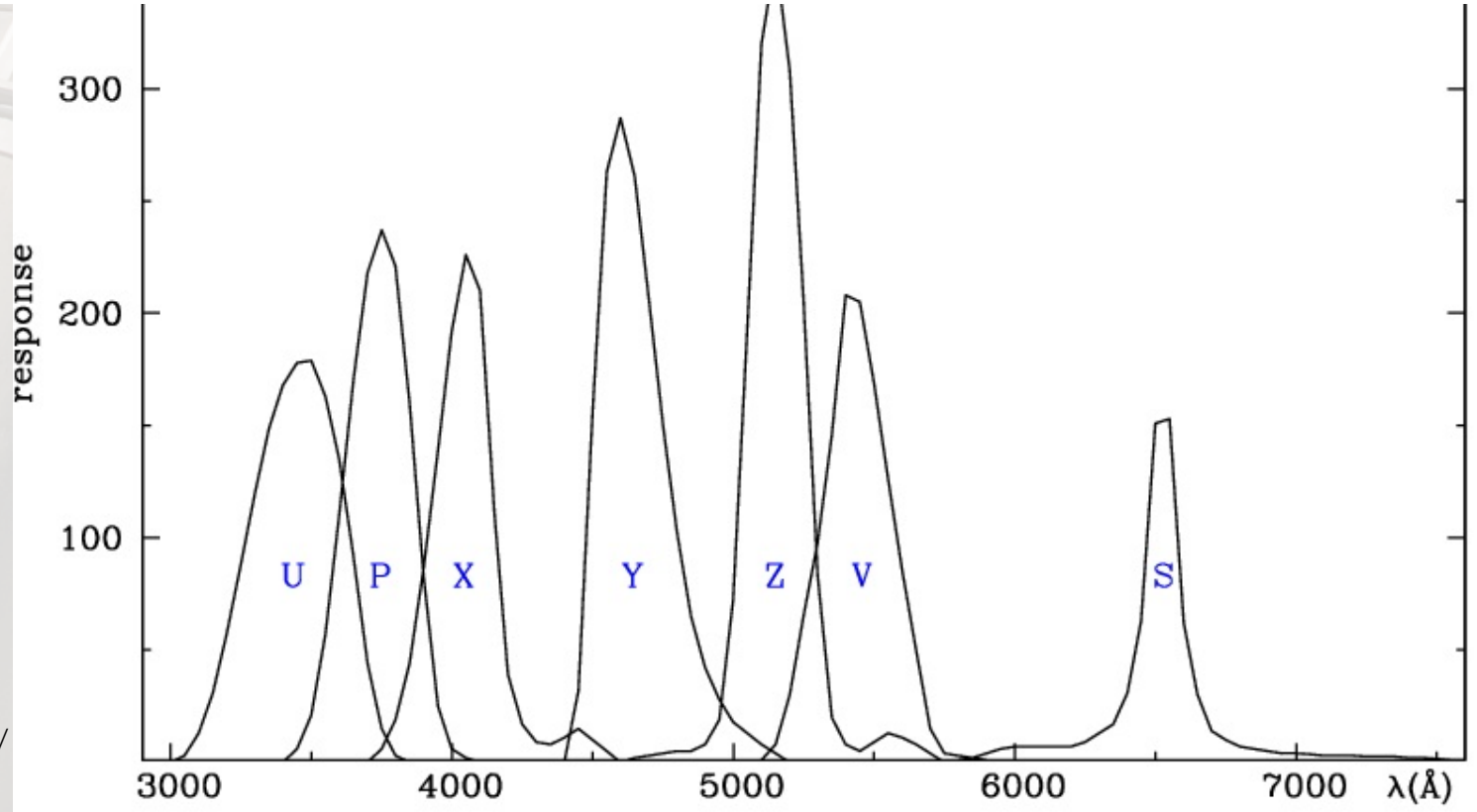
Future plans:

- Photometric classification in medium bands Vilnius photometric system of new found variable stars, if needed.
- Simultaneous spectroscopic+photometric observations of the most interesting variable targets.

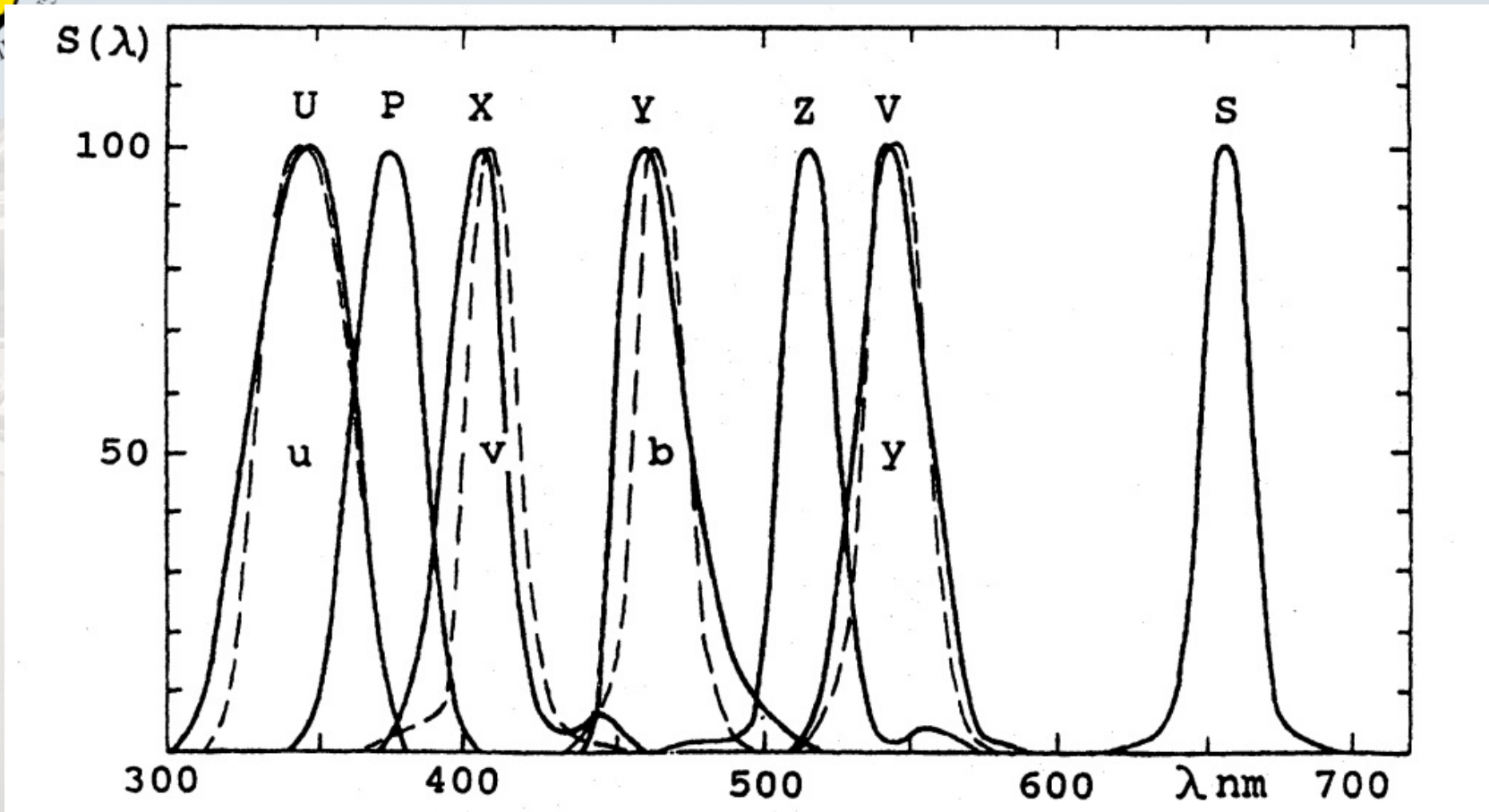
Vilnius photometric system

medium-band seven-colour	U	P	X	Y	Z	V	S
Mean wavelength (nm)	345	374	405	466	516	544	656
Half-width (nm)	40	26	22	26	21	26	20

Created in 1963 by Vytautas Straižys and his coworkers



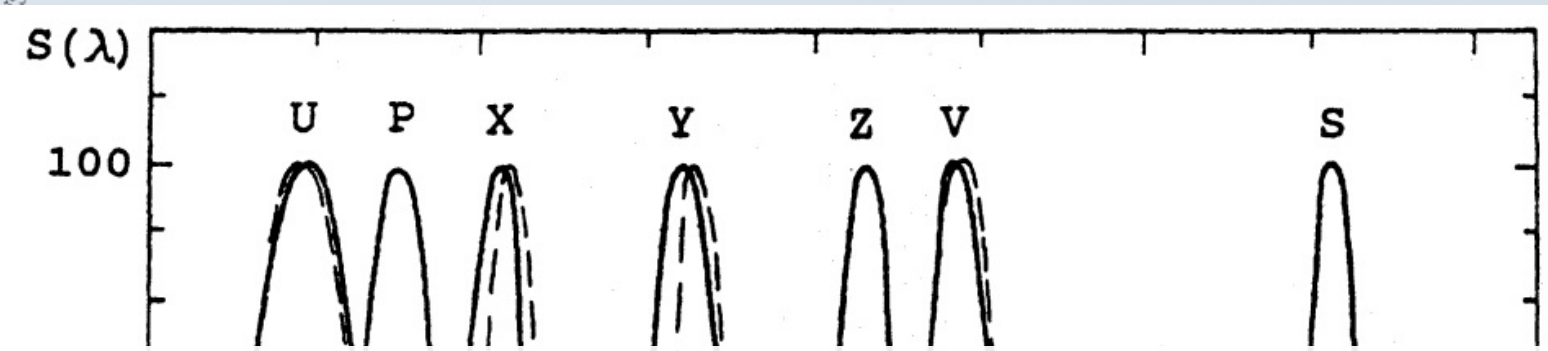
StromVil photometric system



U and **X** magnitudes – for the temperature classification of early-type stars is based on Balmer jump (one beyond the Balmer jump (U) and another after the jump (X)).

The **Y** bandpass is near the breakpoint of the interstellar extinction law.

StromVil photometric system



- The **P** magnitude - placed exactly **on the Balmer jump**; it is an indicator of **luminosity classes of B-A-F stars**.
- The **Z** magnitude is placed on the **Mg I triplet** and the MgH molecular band. It is sensitive to the **luminosity classes of G-K-M stars**.
- The **V** magnitude - to coincide with a similar bandpass in the UBV system. It provides the possibility to relate these two photometric systems.
- **S** bandpass coincides with **H alpha line** position and provides information about **emission or absorption** phenomena in that line.

passbands.

0.63 m. Cassegrain + CORAVEL

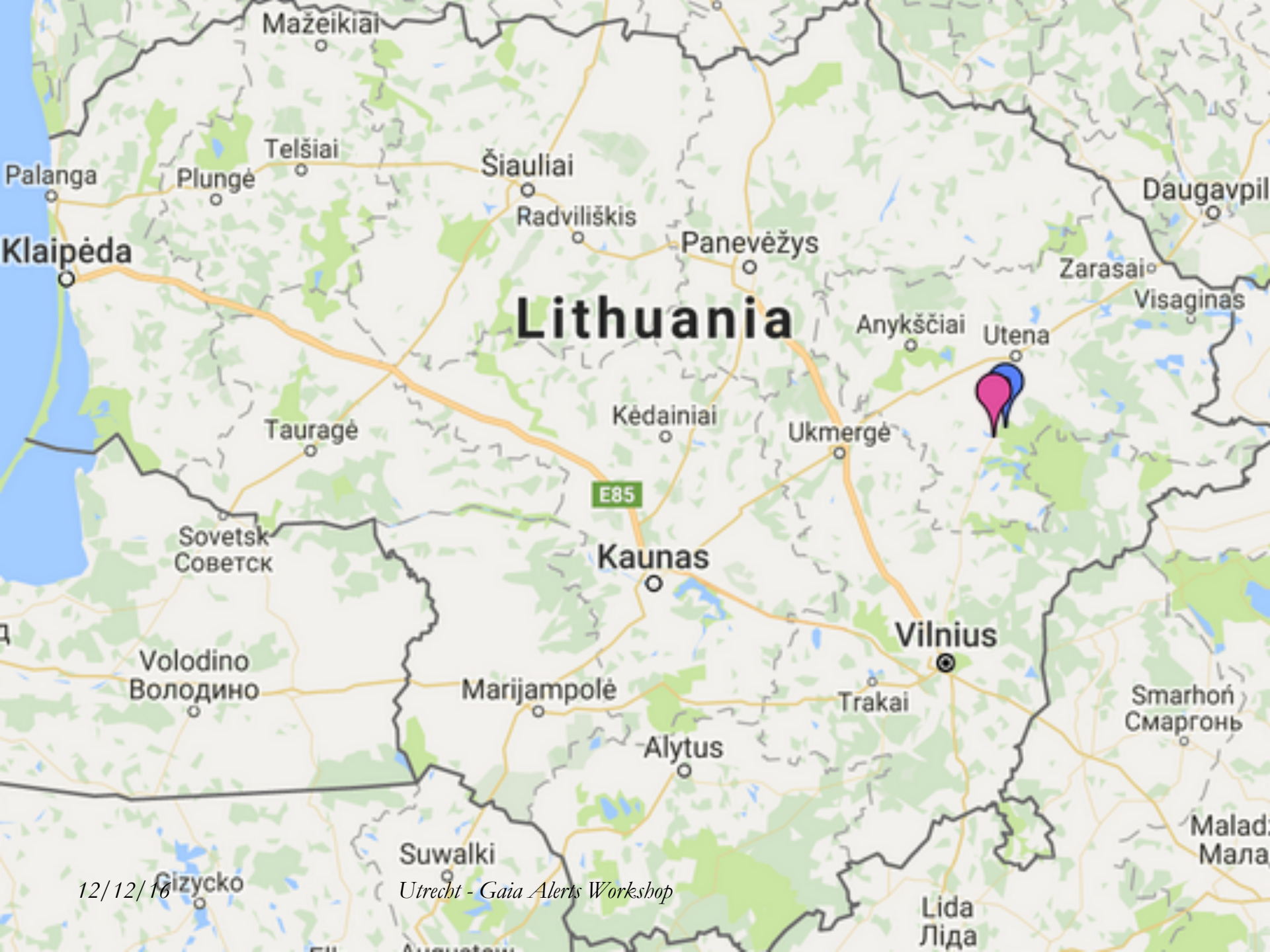
Radial velocities of binary systems

Accuracy: ~1km/s

Instrumentation

- 1.65 m Ritchey-Chretien
  - CCD photometer (8x8 arcmin)
  - High resolution spectrograph
- 0.63 m Cassegrain
  - Coravel type Radial Velocity instrument
- 0.35/0.51 m wide field Maksutov
  - CCD photometer (39x39 arcmin^2)

More info about instruments on Moletai Astronomical observatory webpage (http://mao.tfai.vu.lt)


Mažeikiai
Telšiai
Palanga
Plungė
Šiauliai
Radviliškis
Klaipėda
Panevėžys
Daugavpil
Zarasai
Visaginas
Lithuania
Anykščiai
Utena
Kėdainiai
Ukmergė
Tauragė
E85
Sovetsk
Советск
Kaunas
Vilnius
Volodino
Володино
Marijampolė
Trakai
Smarhoń
Смаргонь
Alytus
Suwalki
Lida
Ліда

Winter

Summer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FOR PHYSICAL SCIENCES
AND TECHNOLOGY

Apply for observing time

- 60% of the time can be used by foreign applicants
- Short-time proposals are very welcome
- Service observations can be a good option
- Simple application procedure

Apply for observing time

- 60% of a time can be used by foreign applicants
- Simple application procedure

Deadlines

For the normal proposal cycle*	Submission Deadline
December to February	31of October
March to May	31 of January
June to August	30 of April
September to November	31 of June

*Proposals are reviewed in 15 days after the submission deadline

More details on our webpage: http://mao.tfai.vu.lt/

Other observatories (HAO)

Coordinates: 10.3886 E 59.4344 N

Other observatories (HAO)

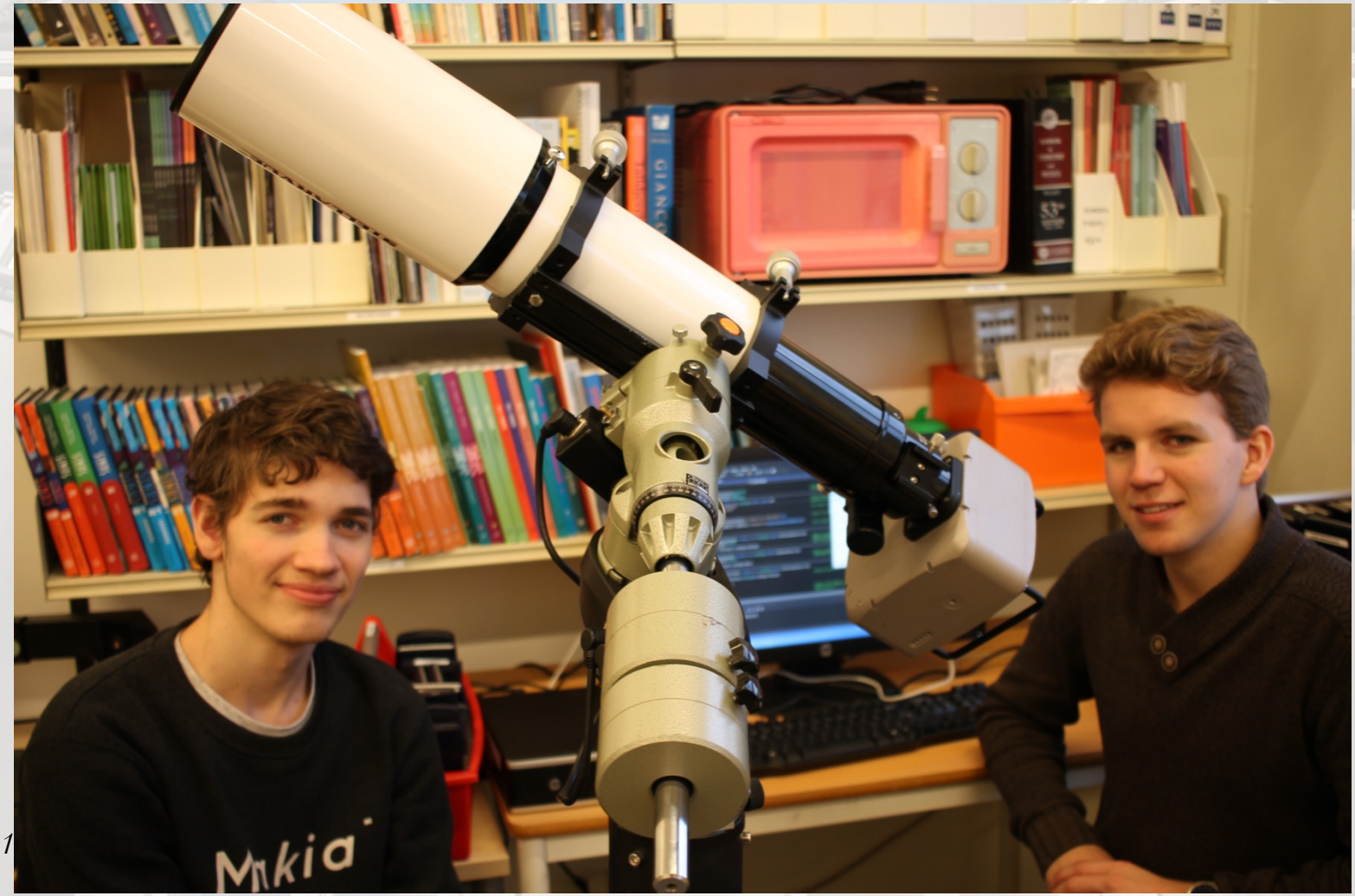
Jan Kare Trandem Quam (amateur-astronomer and teacher in the Horten Secondary School)

Horten AO
Newton reflector
50 cm parabolic primary mirror
F: 1993 mm

CCD camera: Sony ICX-285AL .
Aircooling, down to 27°C below ambient T.
Field of view: 15.5x11.6 arcmin.

Other observatories (HAO)

11 cm telescope for stars brighter than 6 mag



Other observatories (HAO)

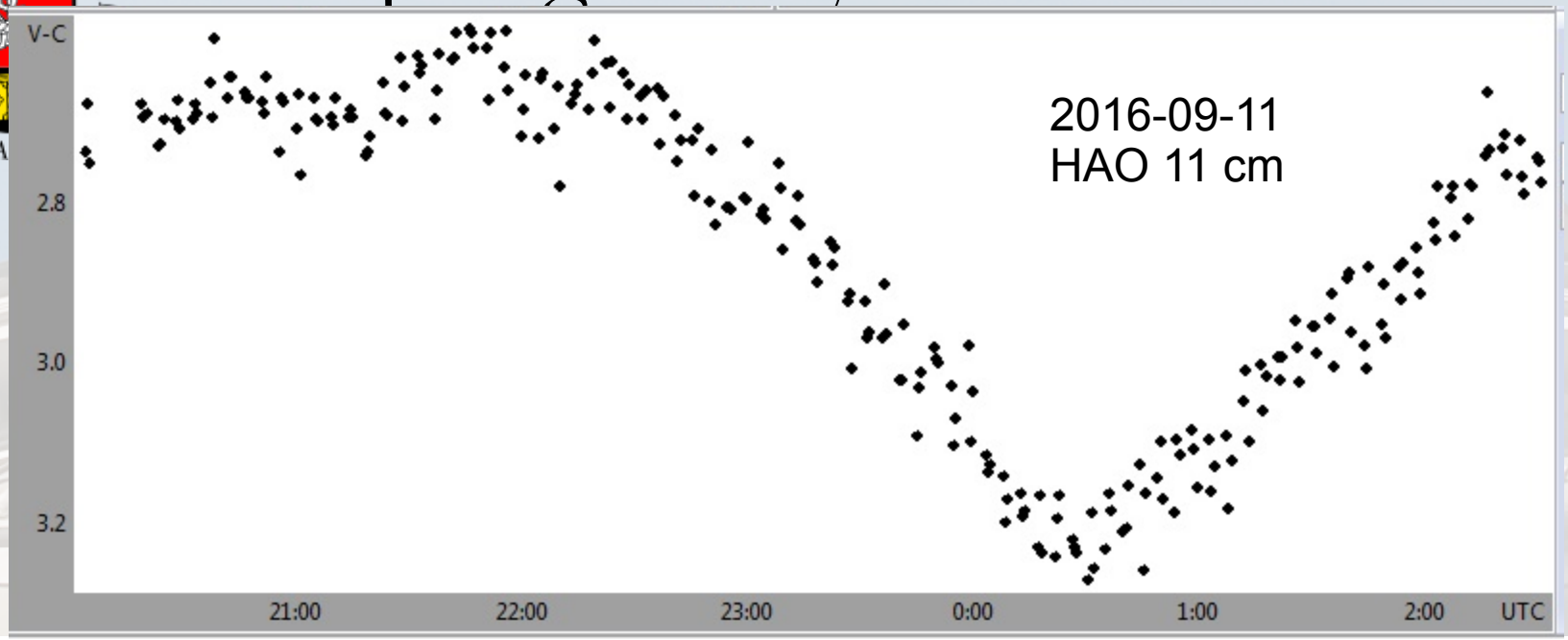
11 cm telescope for stars brighter than 6 mag

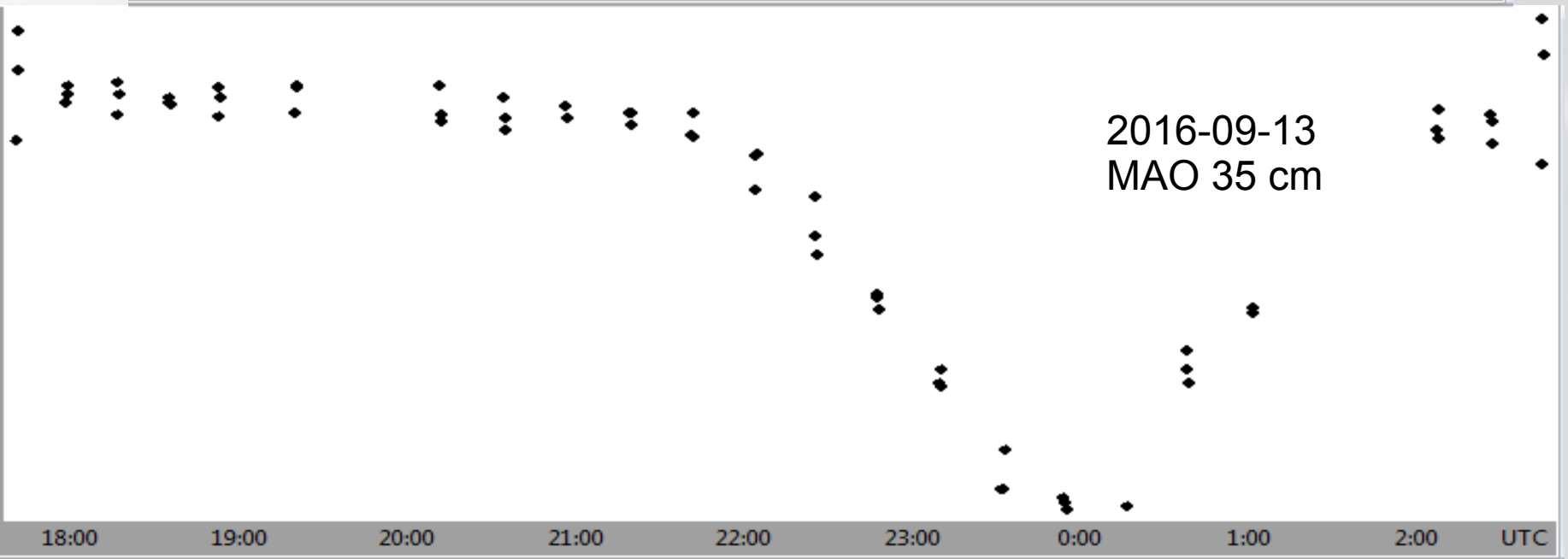
11 cm refractor with low-dispersion glass
F: 770mm
Equipped with a field corrector
StellarVue, USA.

CCD camera: SBIG STL 1301E
The field of view: 1.2°x1.5°
The resolution: ~4"/pixel.

The interface is developed by Horten secondary school students in Visual Basic by supervision of Jan Quam. It allows an automatic scanning of the sky.

Eclipsing binary





Thank you!