Spectral and photometric observations of some transient Gaia alert objects in Shamakhy Observatory

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Goal, tasks and methods

- Our observatory has been connected to the Gaia Opticon group since December 2019. Since then, our subgroup has been involved in ground-based observations of the Gaia transient alert objects. We cooperate, in particular, with colleagues from the Warsaw University under the guidance of Dr. Lukasz Wyrzykowski.

- The main goal is, first of all, to carry out a classification of unknown objects, and in particular to find among them potential black holes and potential gravitational lenses objects.

- Spectral observations with the ShAO 2-m telescope were used. In addition, photometric CCD observation was carried out in standard broadband filters.
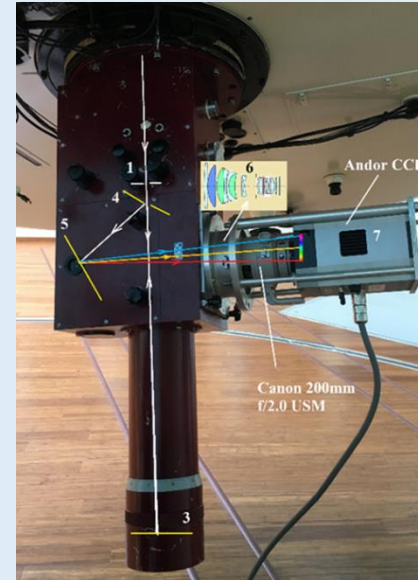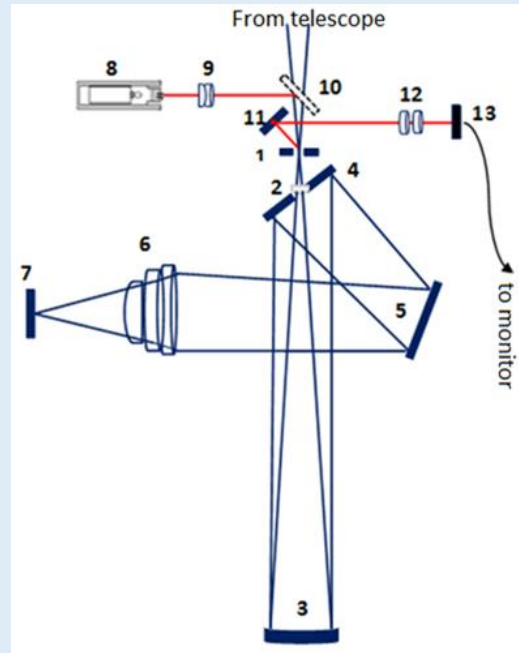
Telescopes and instruments

1. 2 m telescope (Karl Zeyss), focus Cassegrain, F=29.5 mm, A=1/14.7
2. Field size 6.99"/mm, useful field 6x6'
3. Spectrograph MUAGS working in one band classic spectrum with spectral resolution R=1500-2000

2 m telescope
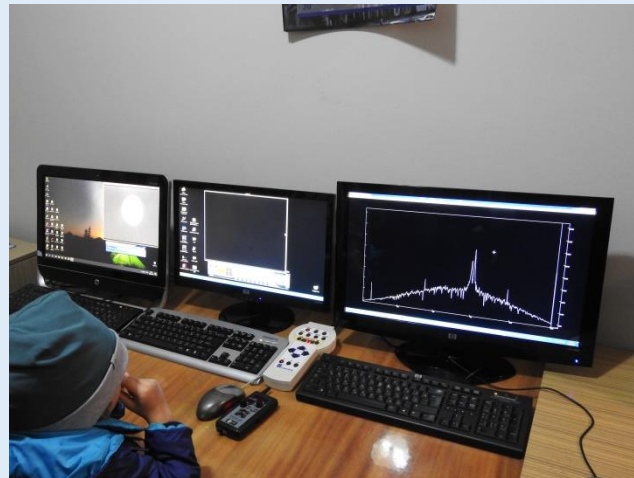
Classic UAGS+ANDOR

λ 3800-8000 Å   144 Å/mm, 75 Å/mm
λ 3800-5300 Å   25 Å/mm
λ 5000-8000 Å   30 Å/mm

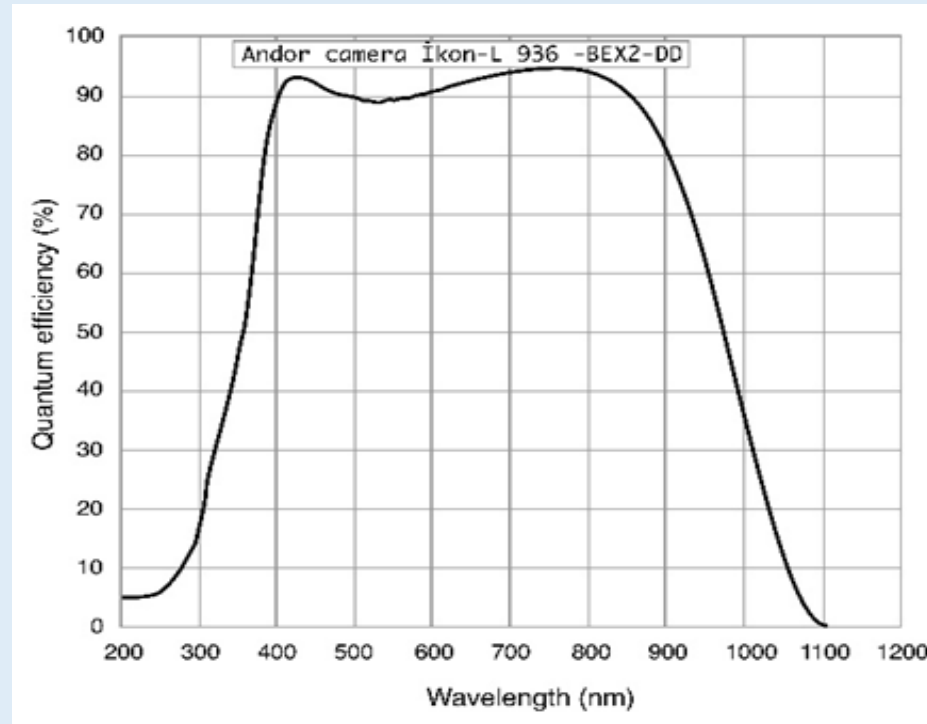F=200 mm, aperture f/2   Objective
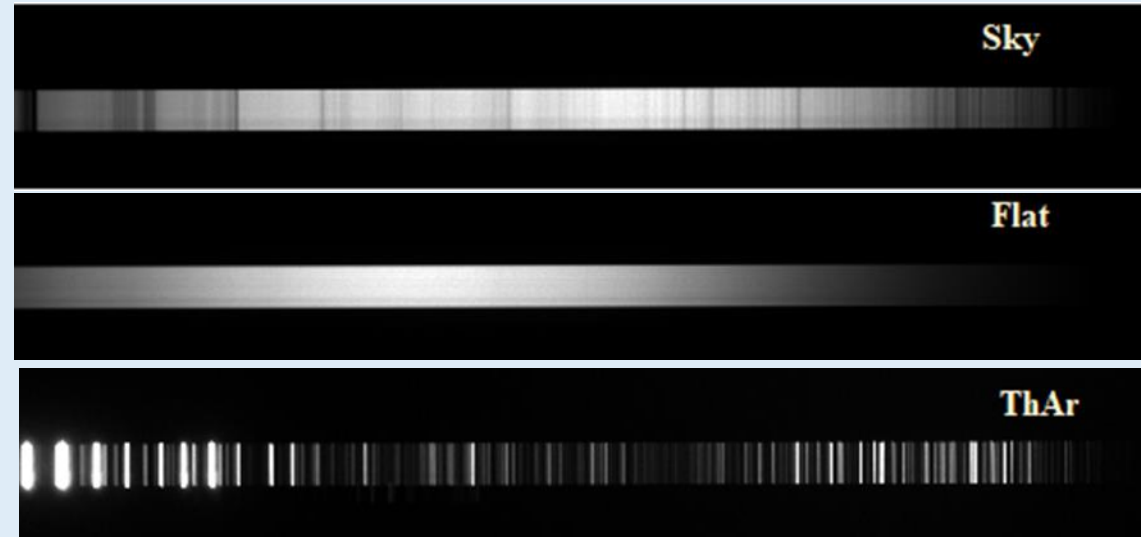Canon EF

CCD Andor

Five step cooling system
Air -80°C
Water+air   -100°C
"Andor" (ikonL-936-BEX2-DD) : Size- 2048x2048 px (1 px= 13.5 µ)
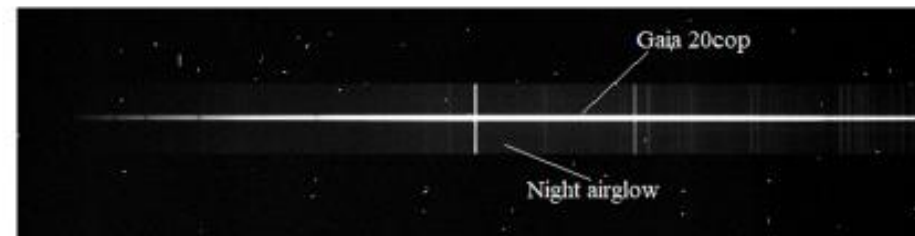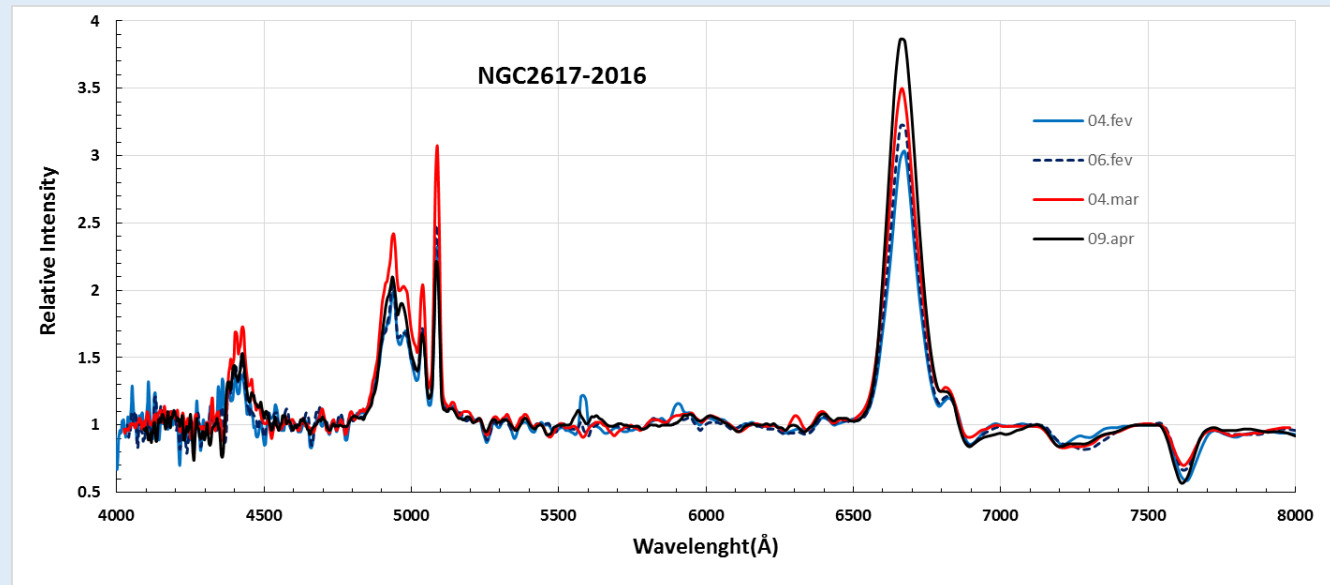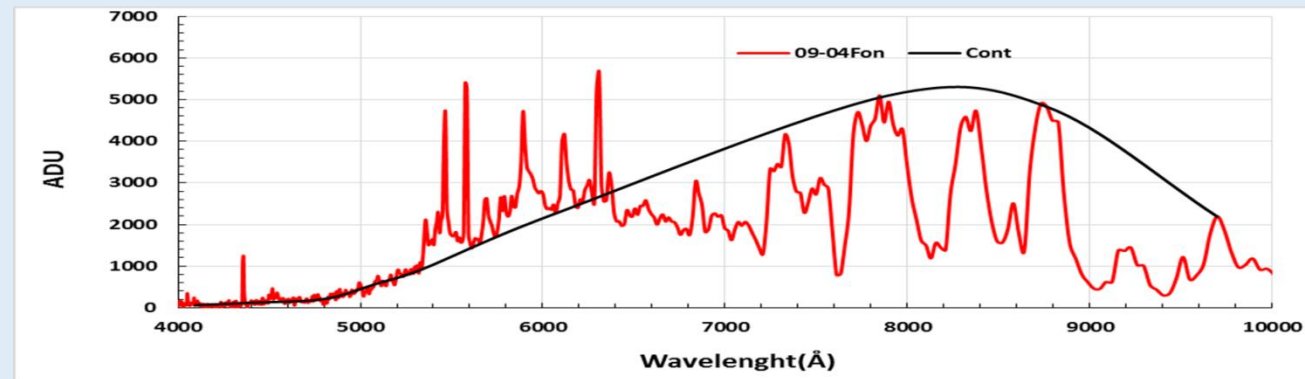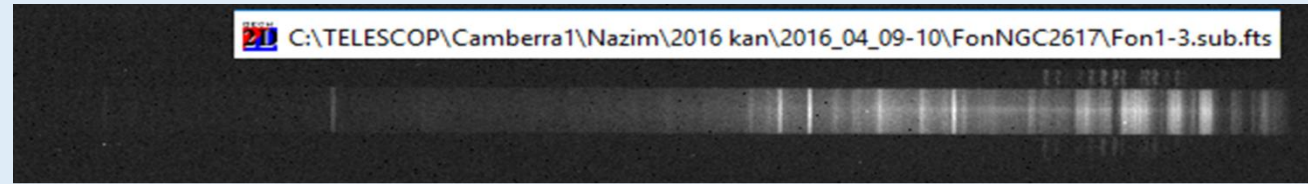
Example

Spektrin alınması:
Cihaz- 2-m telescope with UAGS + objective Canon EF (f=200 mm, f/2) + CCD Andor (ikonL-936-BEX2-DD 2048x2048, pixel size 13.5x13.5 μm) spectrograph.
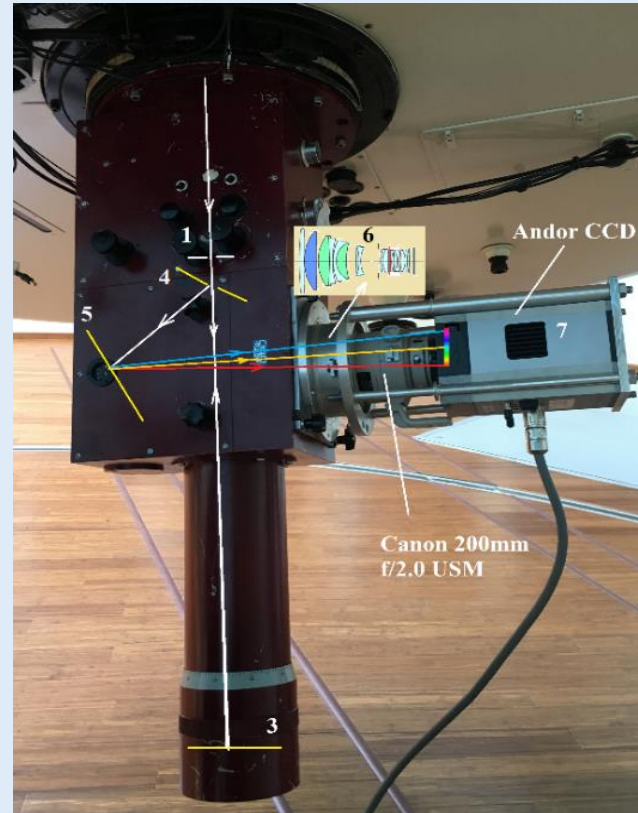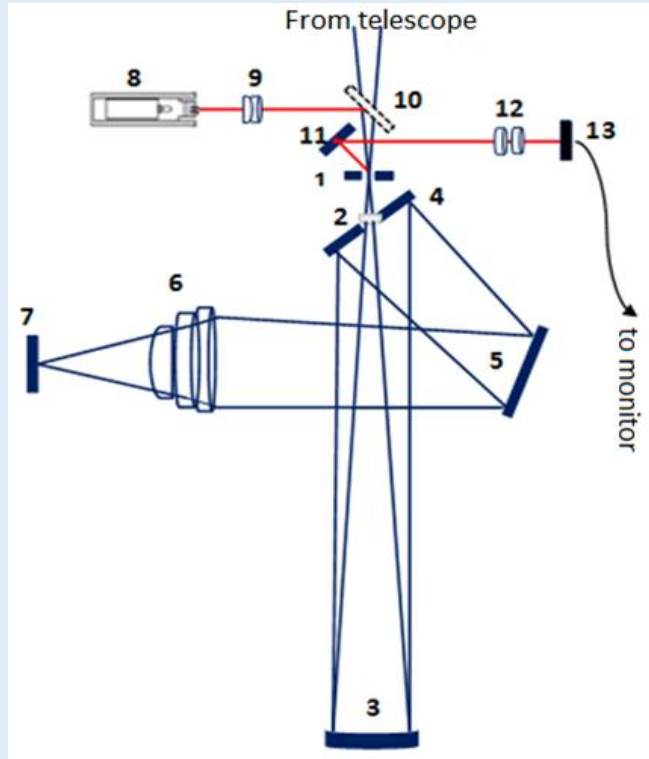F_{col}=1100 mm, grating 325.5 grovers/mm, blaze angle=4°.

Obyektin və gecə göyünün (fon) spektri eyni kadrda alınır (yarığın hündürlüyü-80")
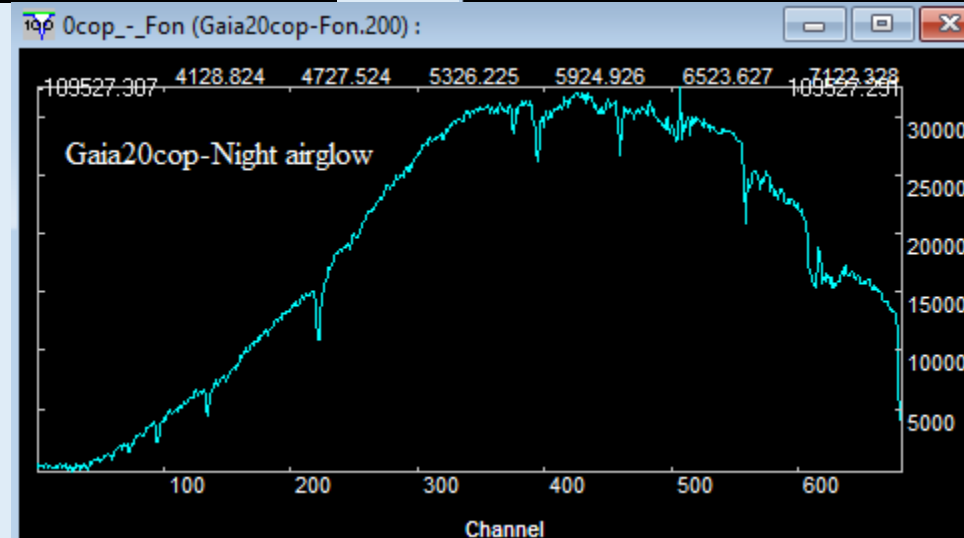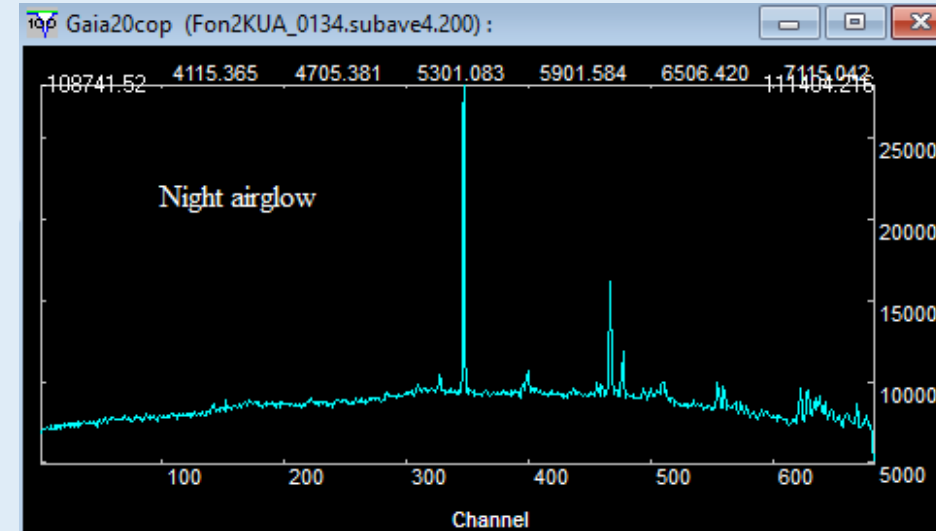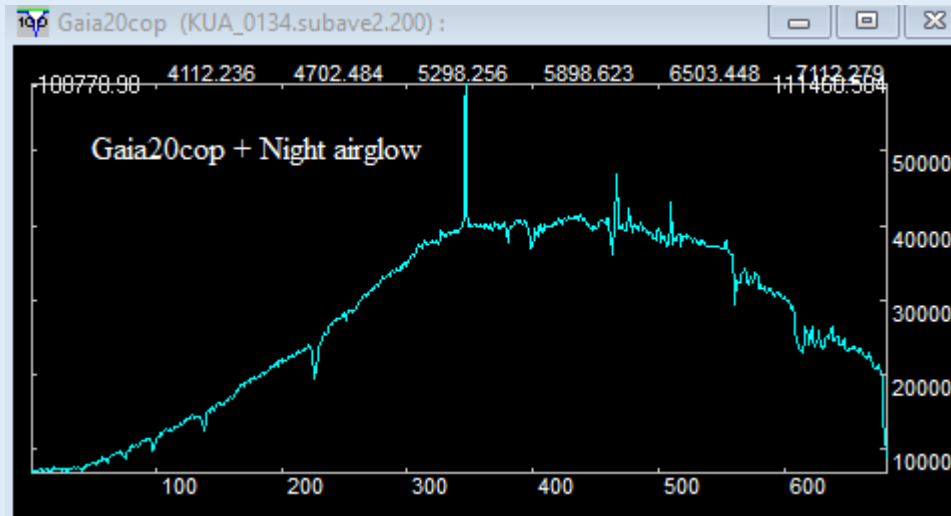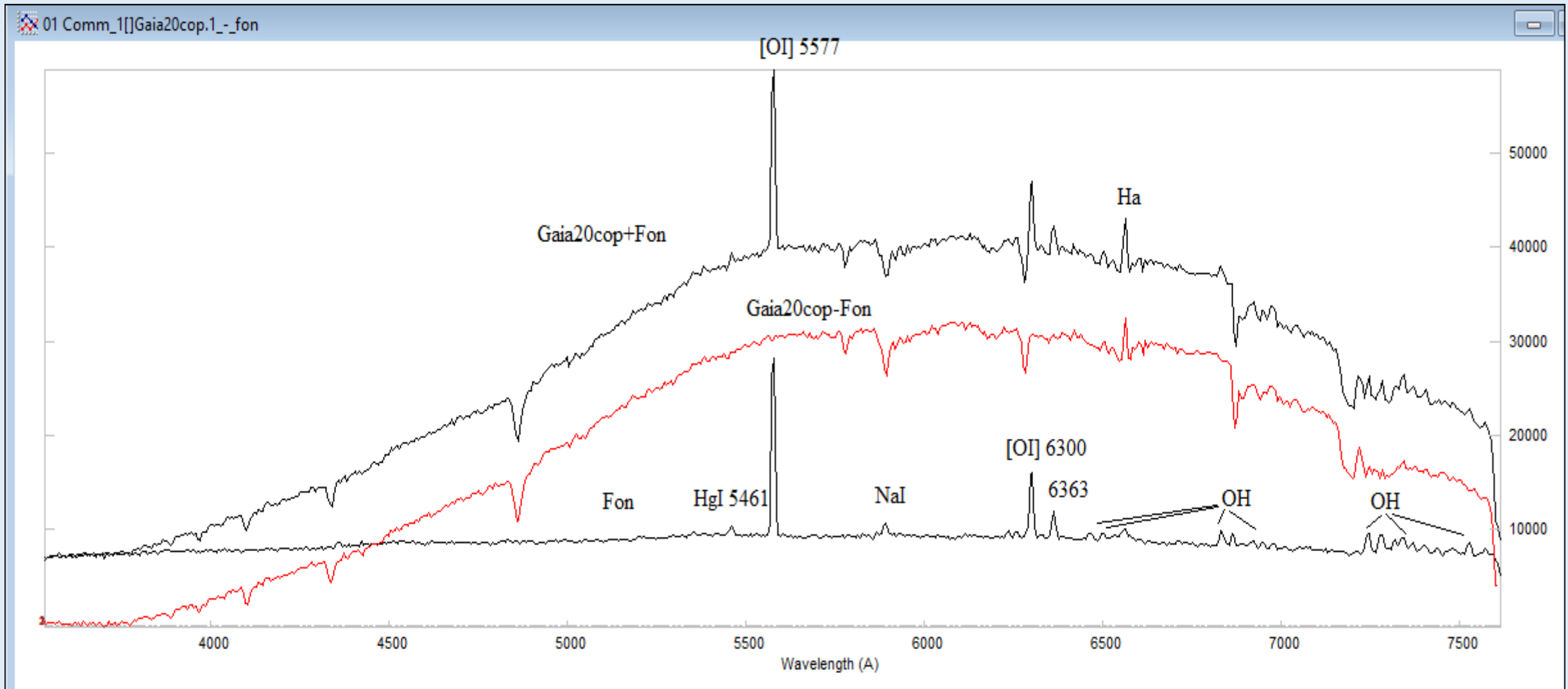
Spectrum NGC 2617

Spectrograph

Processing of spectrum:
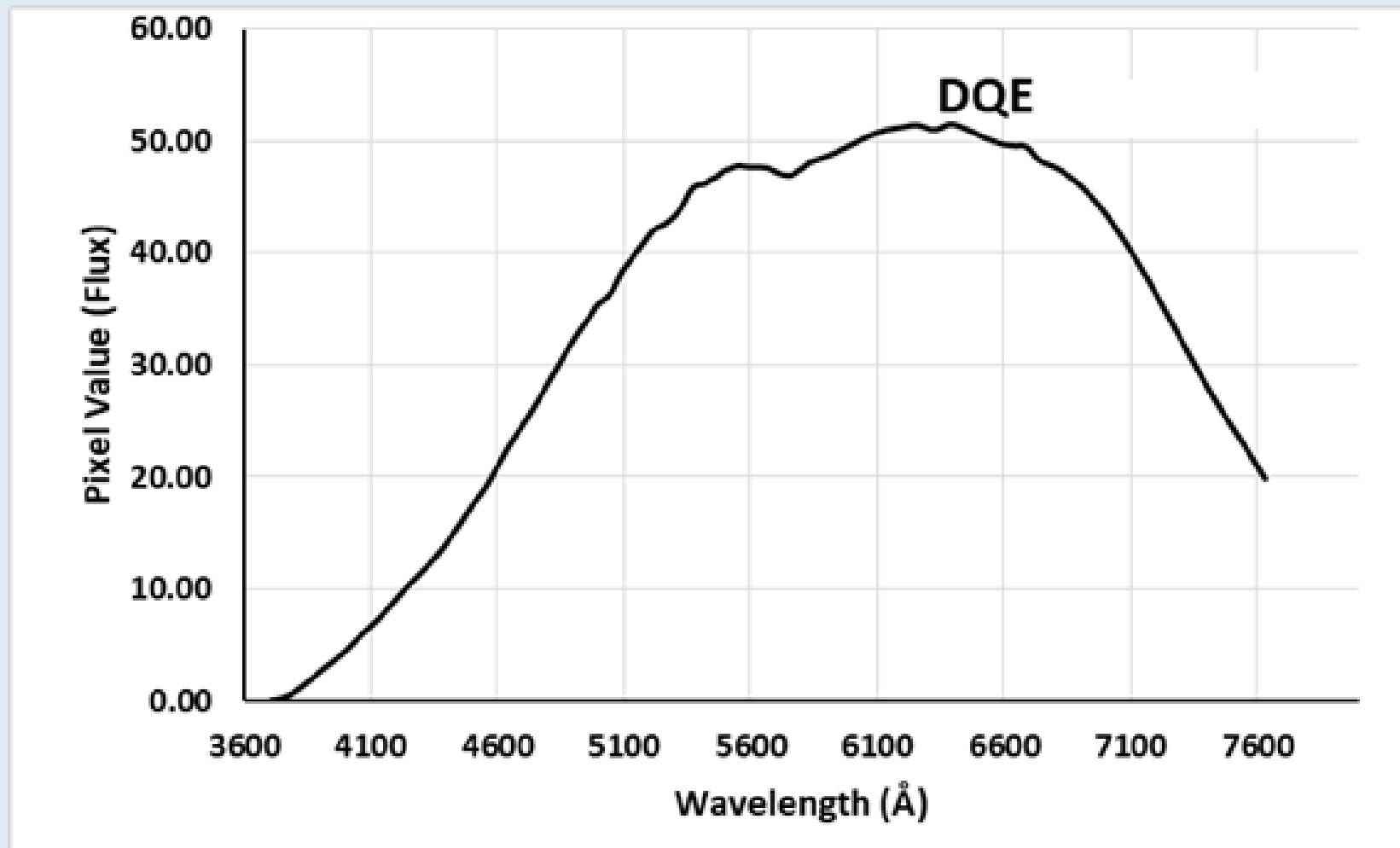1. Subtraction of night background for objects and standard star spectrum

Subtraction of the background radiation (bottom) from the spectrum Gaia20cop (top), as a result we have clean spectrum (red) of the object.
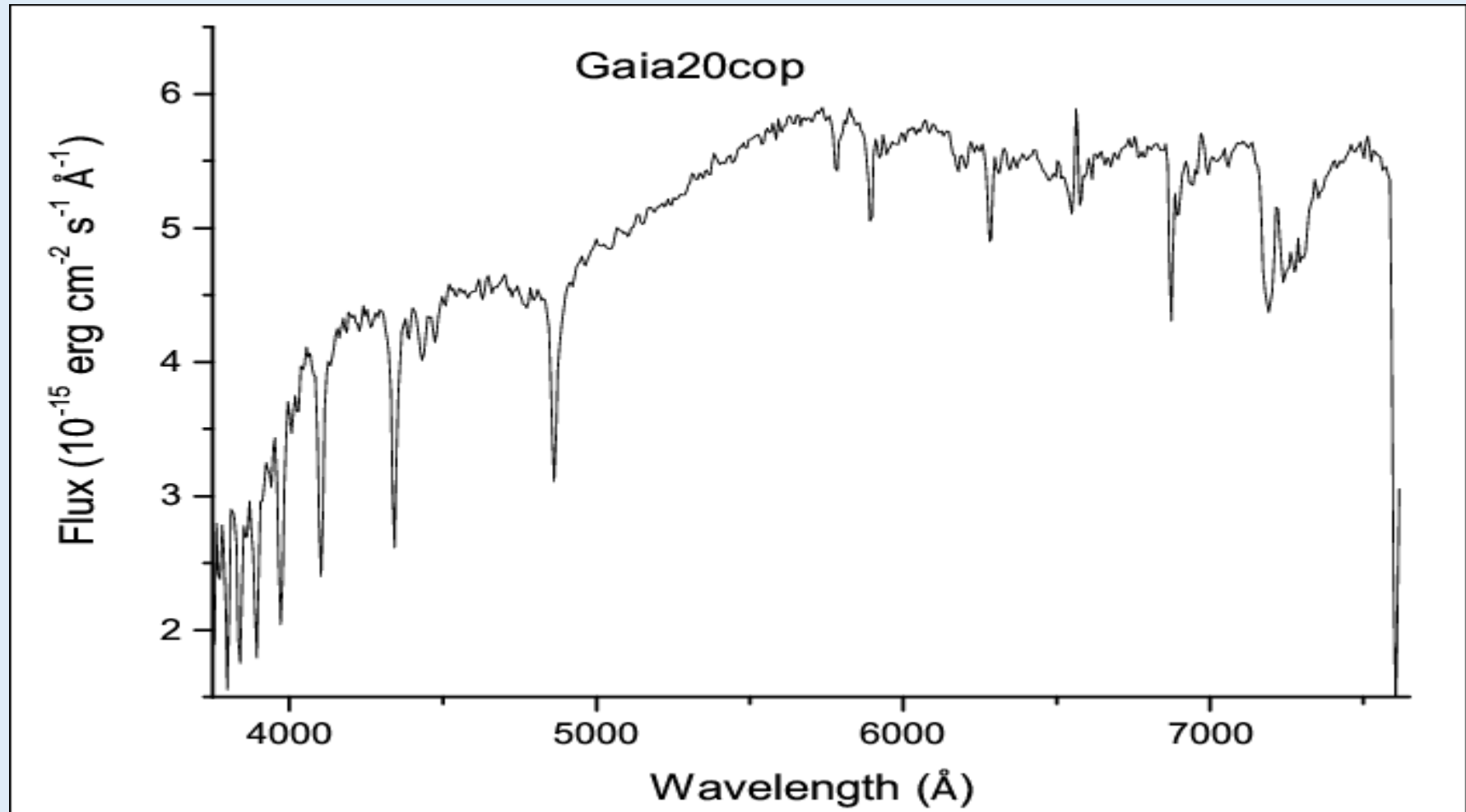
Detection procedure:
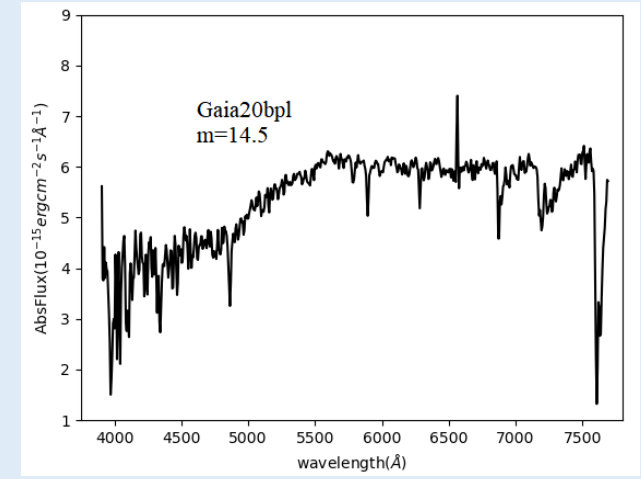2. DQE (detective quantum efficiency) .

Detection procedure:
2. For the DQE curves of standard stars absolute flux distribution of the star was detected.

Examples of some objects spectrum:

Zeiss 600

Seyss-600 teleskopu
D=600 mm, F=7500 mm

Fotometr-Polarimetr + CCD
Faydalı sahə-17 arcmin
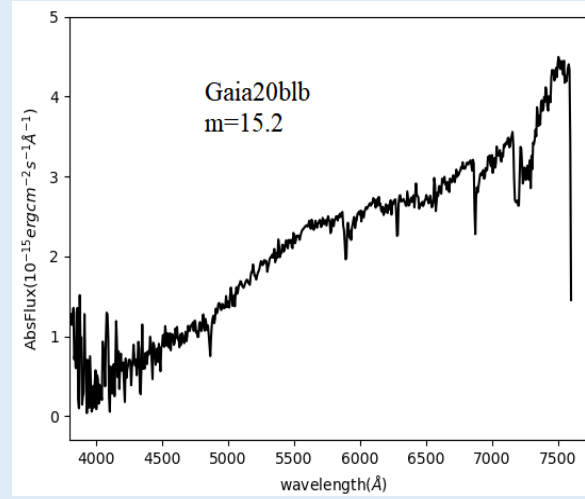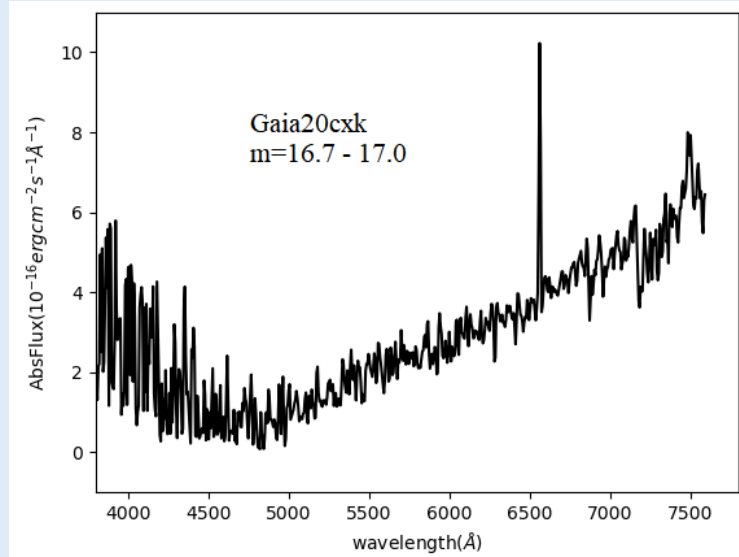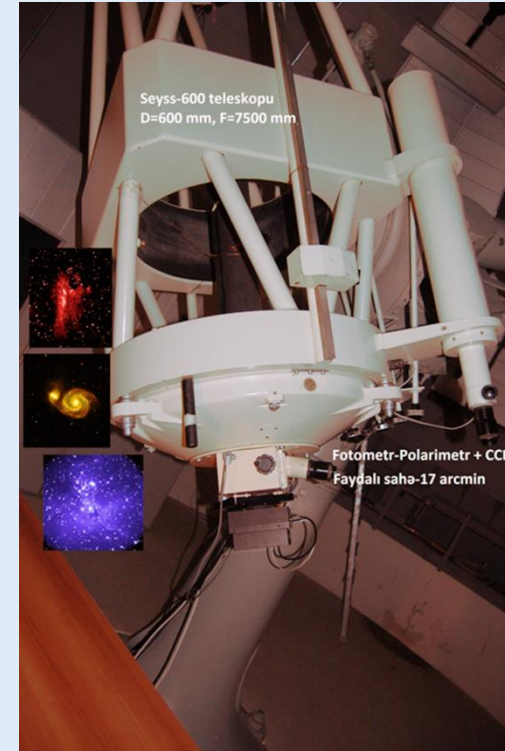
60 cm Cassegrain, λ=48° 35' 50" E, φ=40° 46' 51" N

Carl-Zeiss

1. **Fekv=7500 mm, f/12.5, 17'x17', 27.5 "/mm**

2. **Fekv=4680 mm, f/7.8, 27'x27', 44"/mm (with Celeron adapter 0.6)**

Photometer BVRIcRc + Halpha

CCD FLI 4kx4k, 9μm
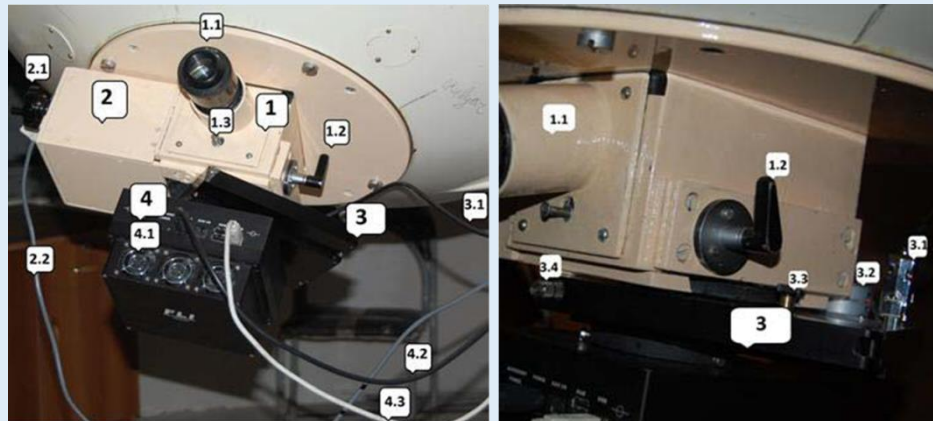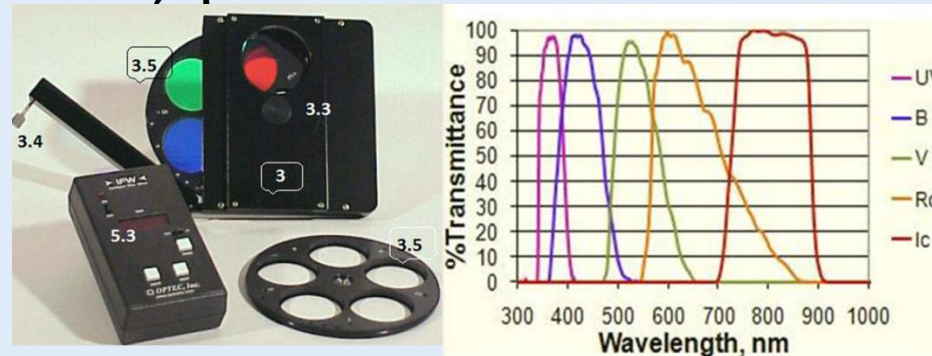
MaxDel 6

M67, M51, NGC 6946
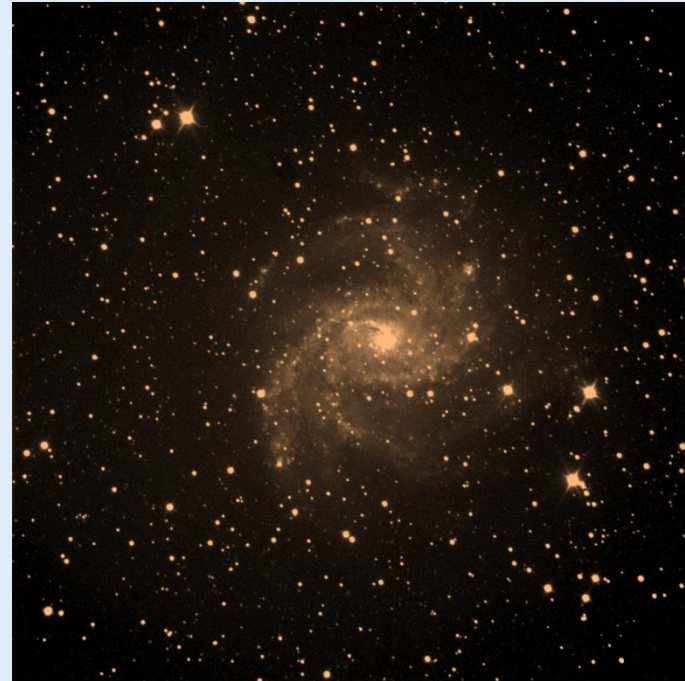
Gaia20cgo

Table 1. Journal of observations SN2020jee.

BV photometry

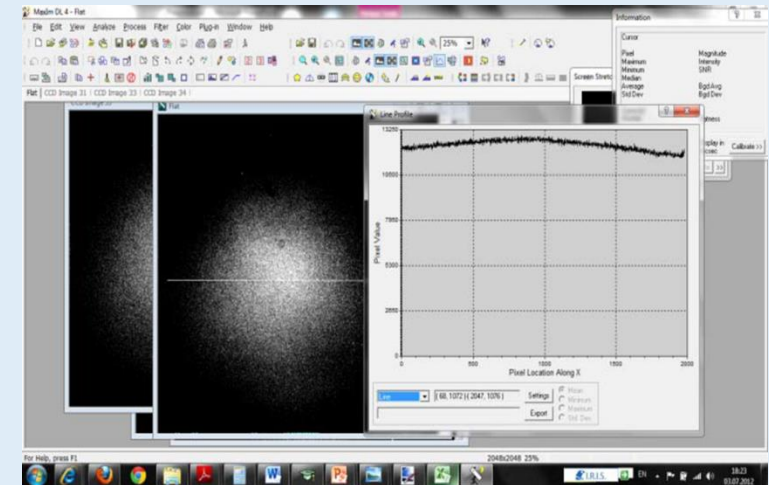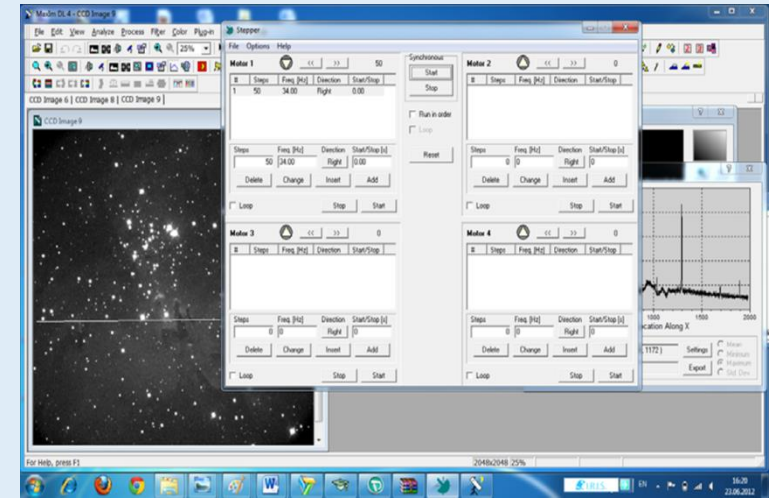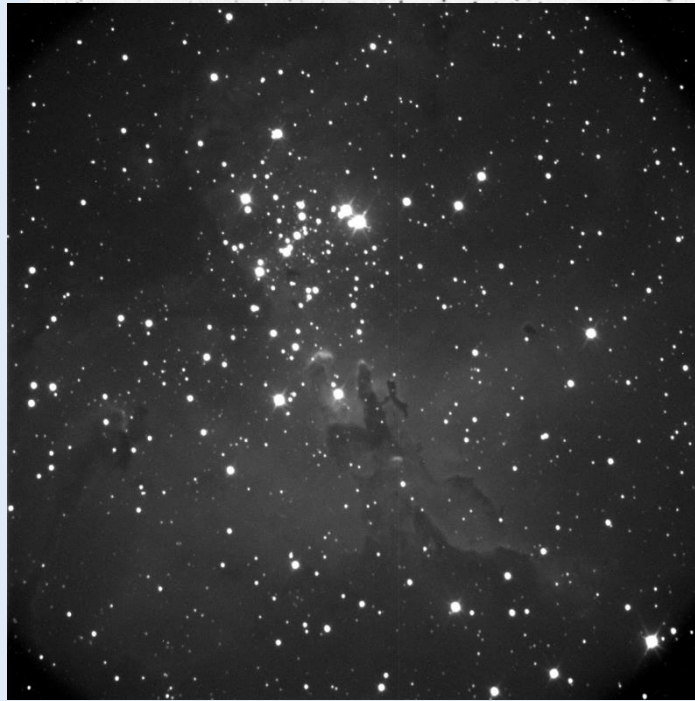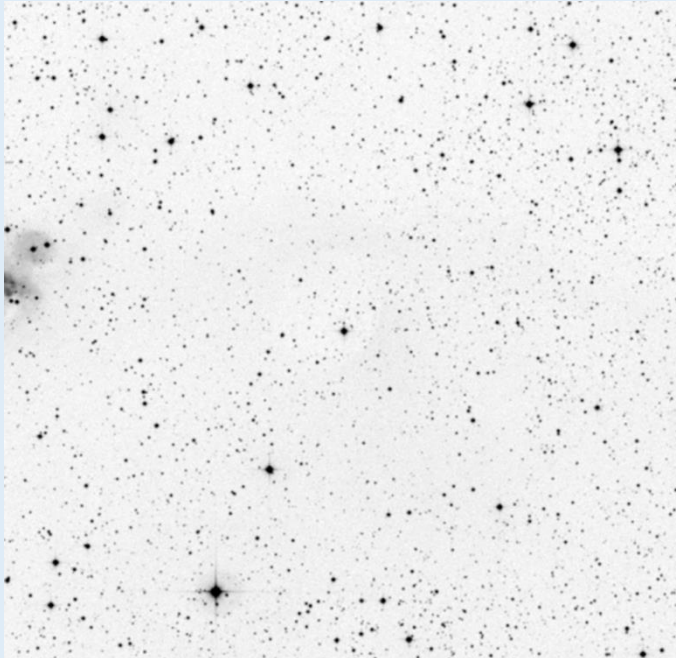| Date	UT	JD	Bands	mag	± σ	B-V
21.05.2020	18:14:24	2458991.26	V	15.45	0.01	0.719
21.05.2020	18:43:12	2458991.28	B	16.169	0.02	
27.05.2020	18:57:36	2458997.29	V	15.15	0.005	0.71
27.05.2020	19:26:24	2458997.31	B	15.86	0.006	
16.06.2020	19:12:00	2459017.30	V	16.259	0.010	1.039
23.06.2020	18:43:12	2459024.28	V	16.342	0.02	
23.06.2020	19:12:00	2459024.30	B	17.381	0.03	

Spectral observations

Date	UT	JD	Spectral range, Å	Exposition, sec	S/N
21.05.2020	18:24	2458991.26	3700-8000	3600	345
27.05.2020	19:06	2458997.29	3700-8000	2000	220
16.06.2020	19:32	2459017.31	3700-8000	3000	95
23.06.2020	18:17	2459024.26	3700-8000	2000	115

supernovae SN2020jee
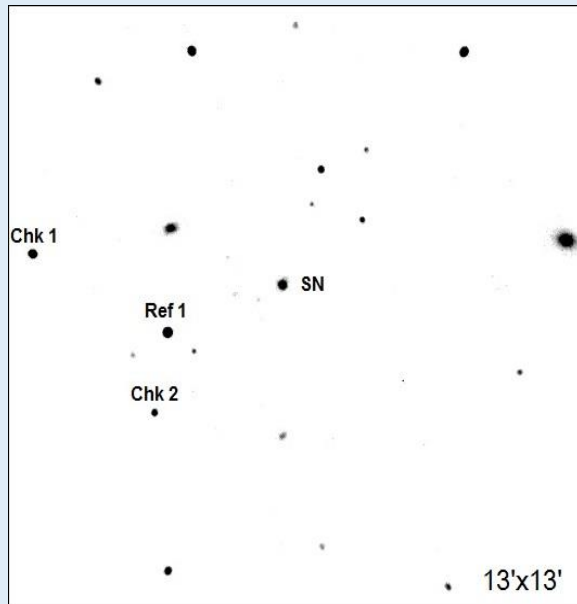
Fig.1. The searching field of the SN2020jee. Feference stars magnitudes are V=13.042±0.02, B=14.031±0.01
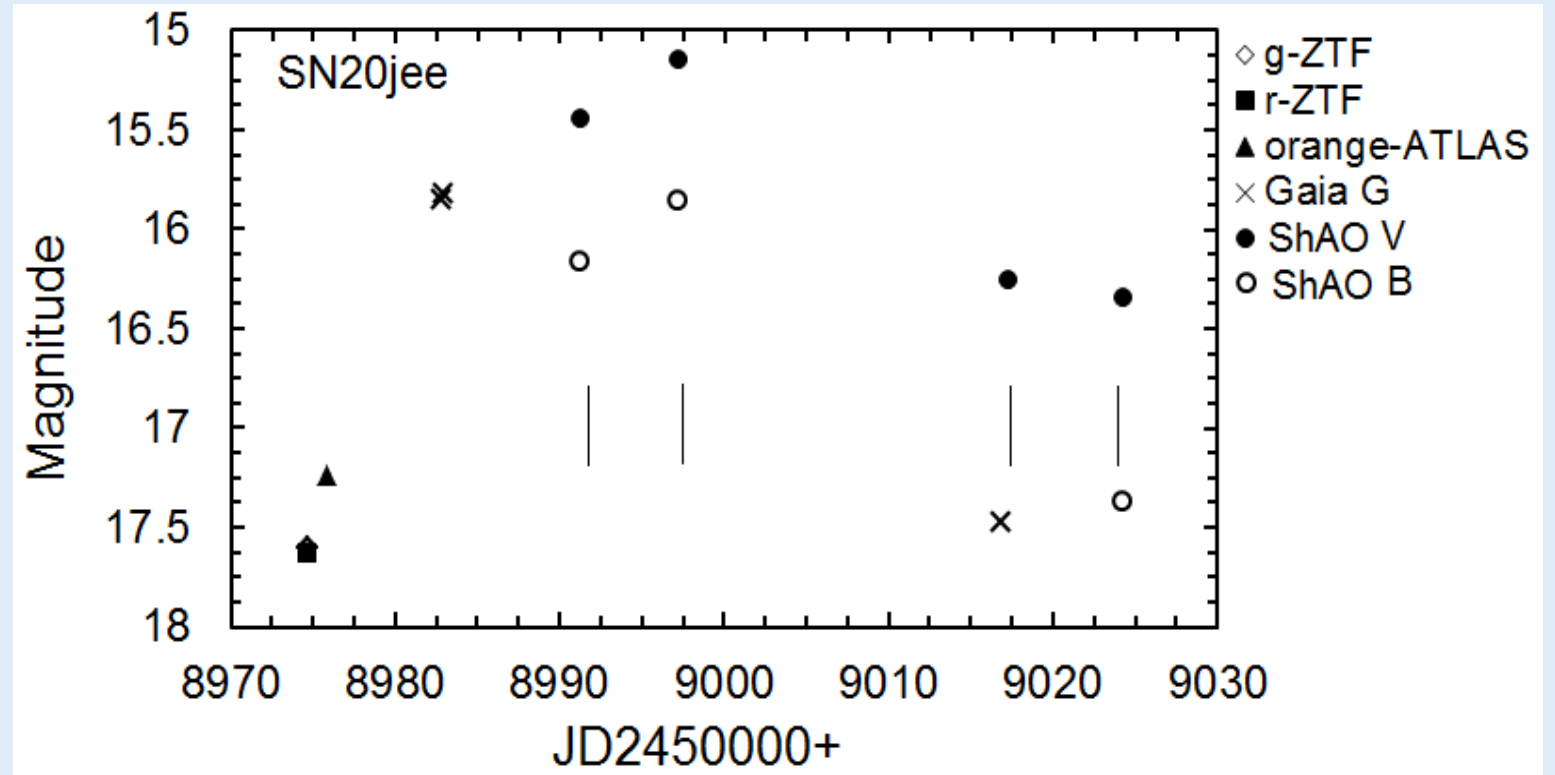

Fig.2. SN20jee supernova light variations in time. Different characters in the figure indicate data from different authors. Vertical segments indicate the dates of receipt of the spectra in the ShAO. oreng-ATLAS - J. Tonry, L. Denneau, A. Heinze et al. (ESO), Gaia G -S.T. Hodgkin, E. Breedt, A. Delgado et al., on

Supernovae SN20jee

Other spectrums which are shown in Fig. 3 were obtained in the ShAO. Judging by the photometric data, a spectrum was obtained at 05.21.2020 to the maximum brightness in bands B and V (Fig. 3). We can see here the bands of the Si II, Fe II, FeIII, Ca II line groups which are clearly distinguished. We measured the shift of the Si II line, where two lines λ6347 + 6371 Å are dominated. On May 21, 2020, the enhancement velocity of the photosphere shell was obtained at about -10116 ± 15 km/s. Based on the material, an article is being prepared for publication.
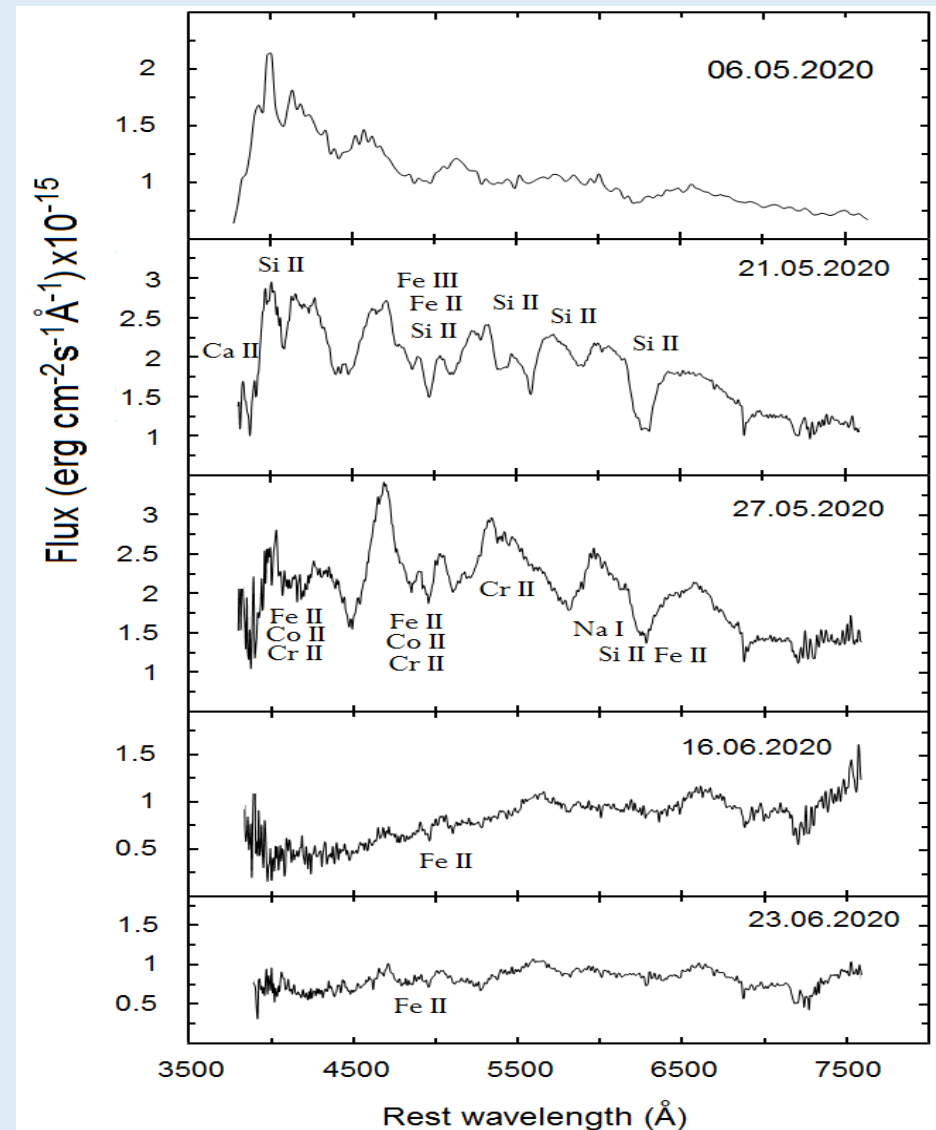
Conclusions

- We describe a detailed methodology for performing of the spectral and photometric observations of transient objects within the framework of the Gaia Opticon program. We have using two telescopes for BVR photometric observations: a 60 cm reflector for long-term observations, and a 30 cm refraktor, which operates synchronously with spectral observations, which is performing at the 2 m telescope.

- The results of observations of the supernova SN Ia Gaia20cgo at the different phases of activity are presented, obtained parameters and the distance to the host galaxy in which the explosion is occurred.

Thank you