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POLARIZATION OF THE DAYTIME SKY

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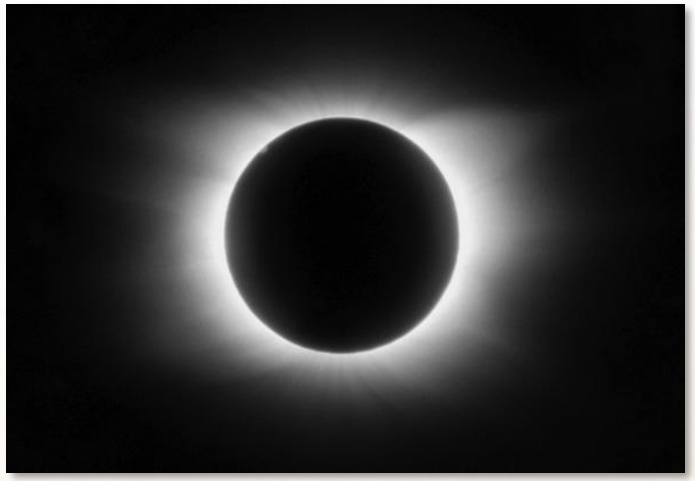
Motivation

- Observations of total solar eclipses in polarized light
- Evolution of observational instruments
  - Analog camera and linear polarization filter – up to 2006 incl.
  - Digital camera and linear polarization filter – from 2009 – 2022 incl.
  - Polarization camera – for future observations
- The need to check the new method



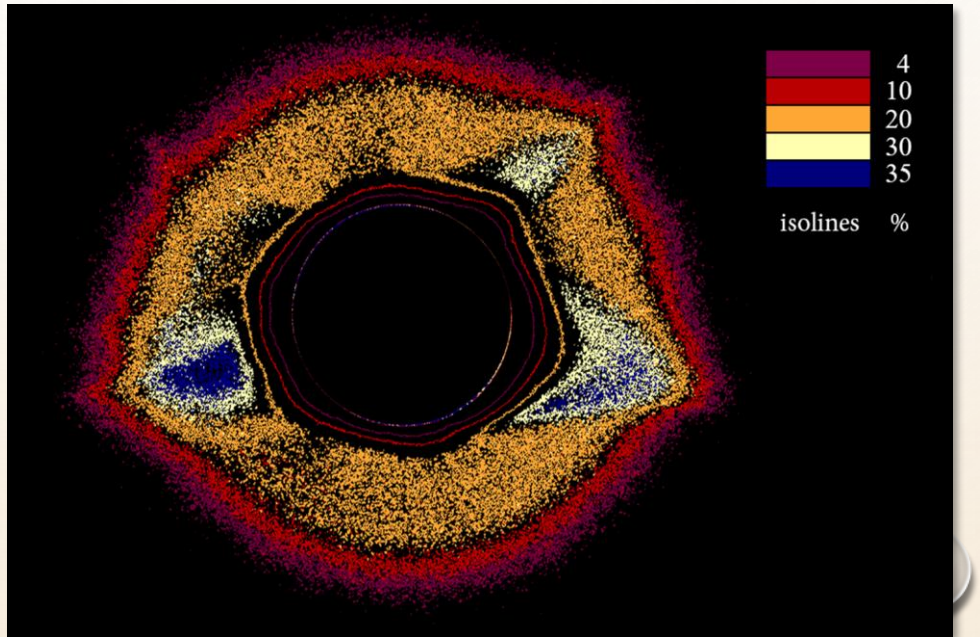
White-light corona photographed during total solar eclipse in Turkey, 2006

History of observations

11.08.1999 Bulgaria → 29.03.2006 Turkey → 22.07.2009 China → 21.08.2017 USA → 02.07.2019 Chile → 14.12.2020 Argentina → 23.04.2023 Australia

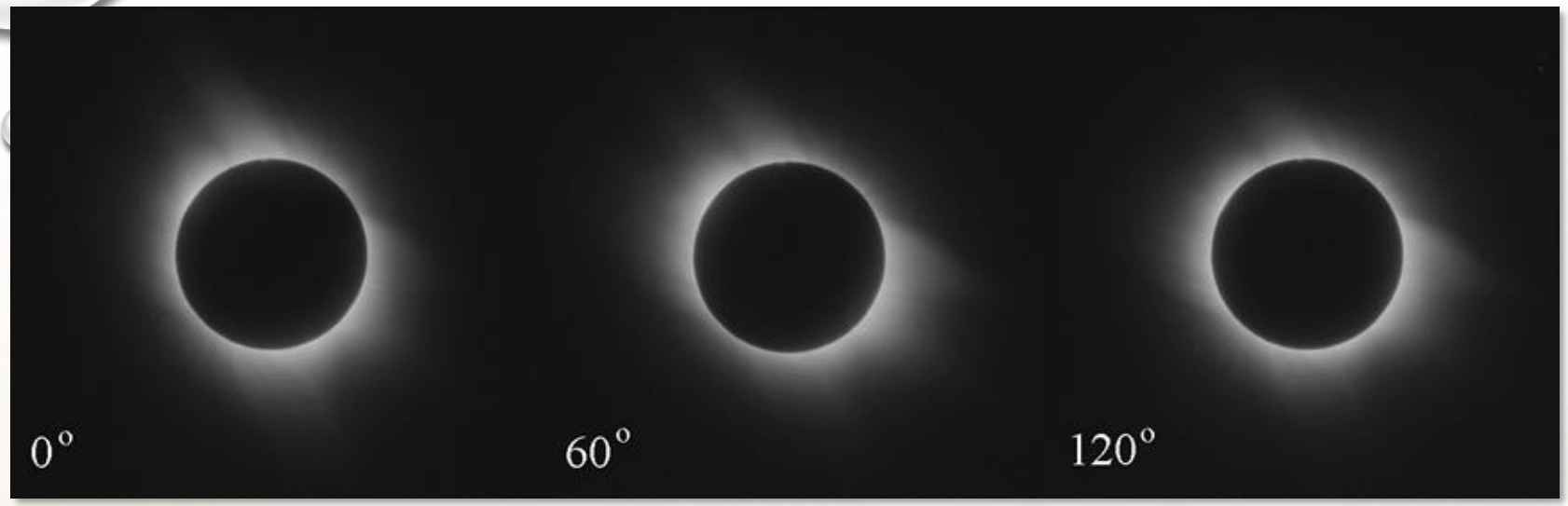
Essential tasks during the observations of total solar eclipses:

- Observations of polarized light from the white-light corona
- Determination of the degree of linear polarization of active regions
- Dependencies between the degree of linear polarization and electron density of the K-corona
- Dependencies between the latitude of the Sun and the degree of linear polarization

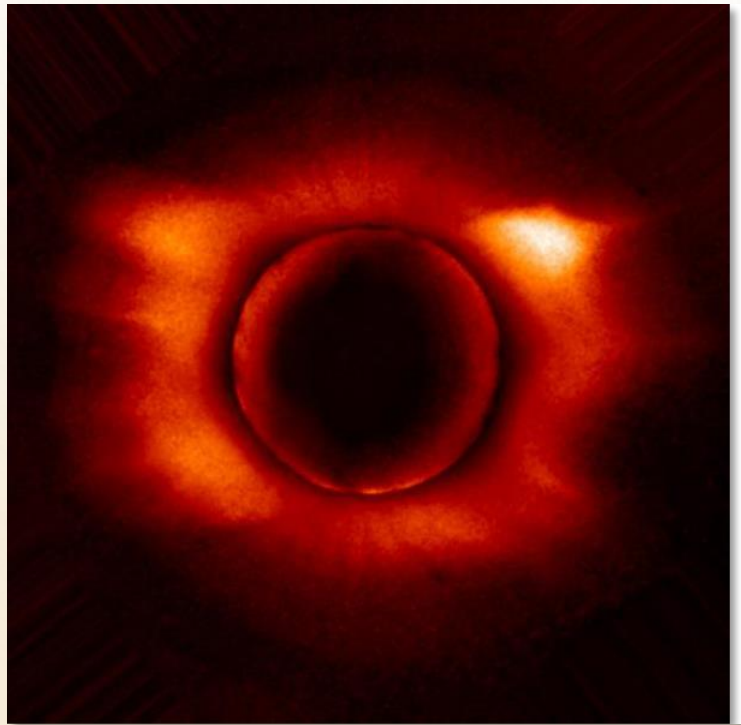


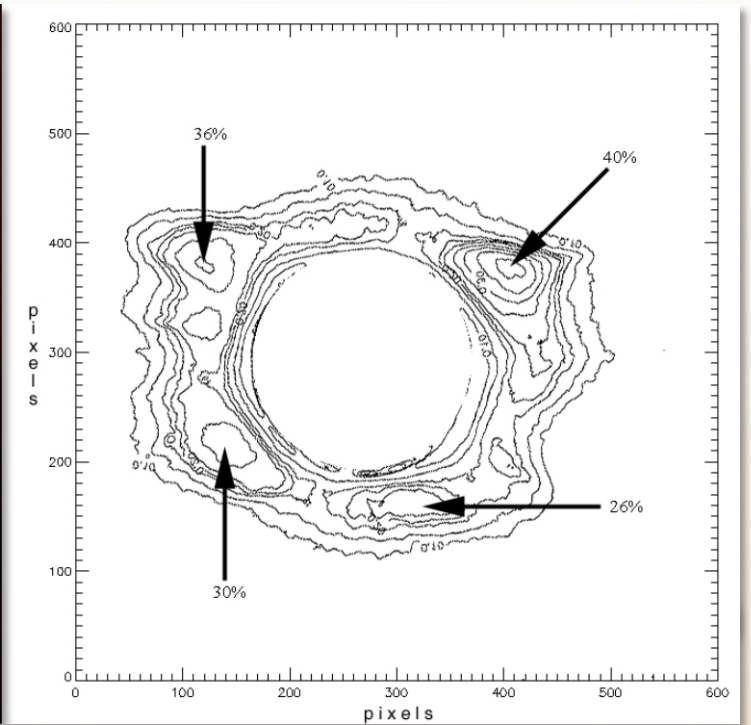
Results for degree of polarization
Total solar eclipse in USA, 2017

Degree of linear polarization of solar corona



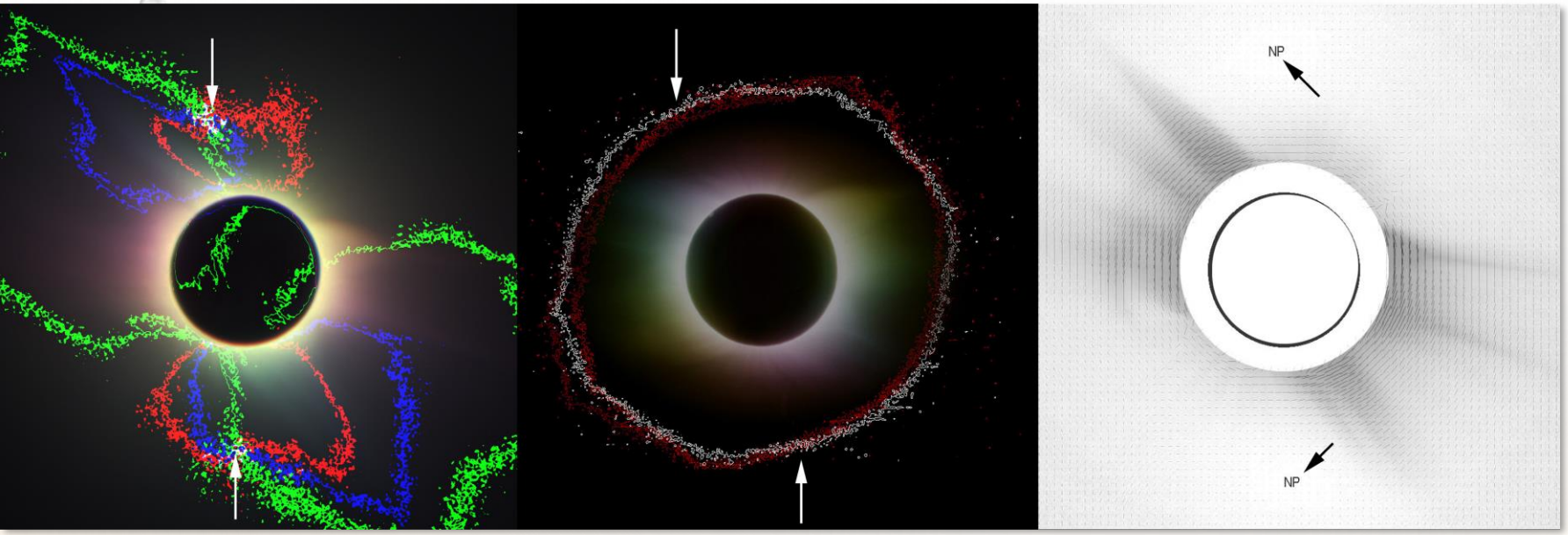
Polarized corona photographed during total solar eclipse in Turkey, 2006



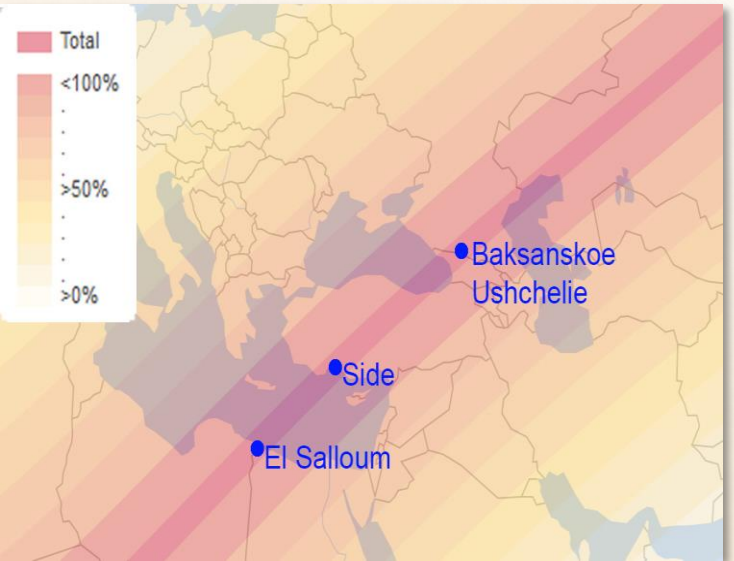


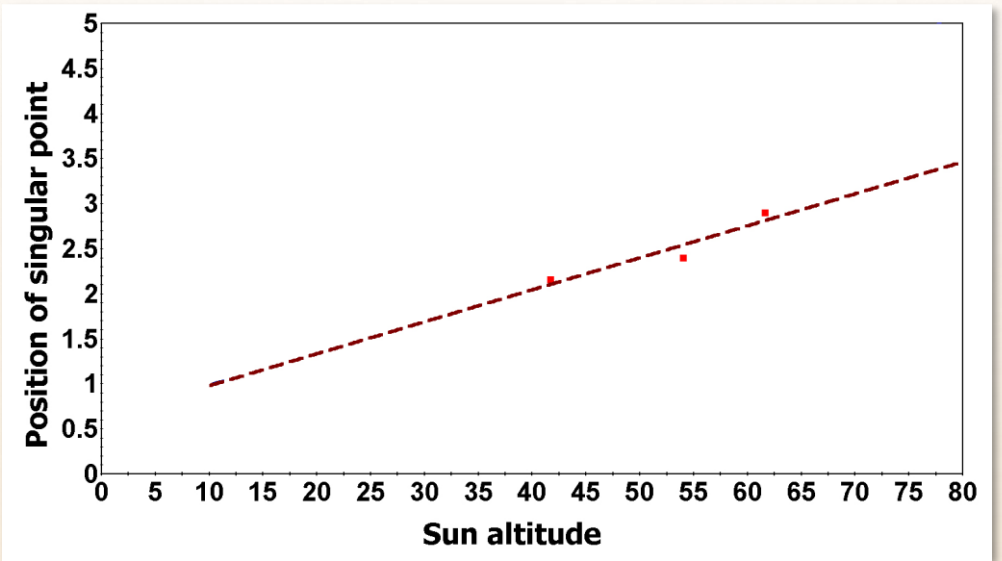
Results for degree of polarization
Total solar eclipse in Turkey, 2006

Sky polarization effect



Positions of singular polarization points in the solar corona during the total solar eclipse, 2006.

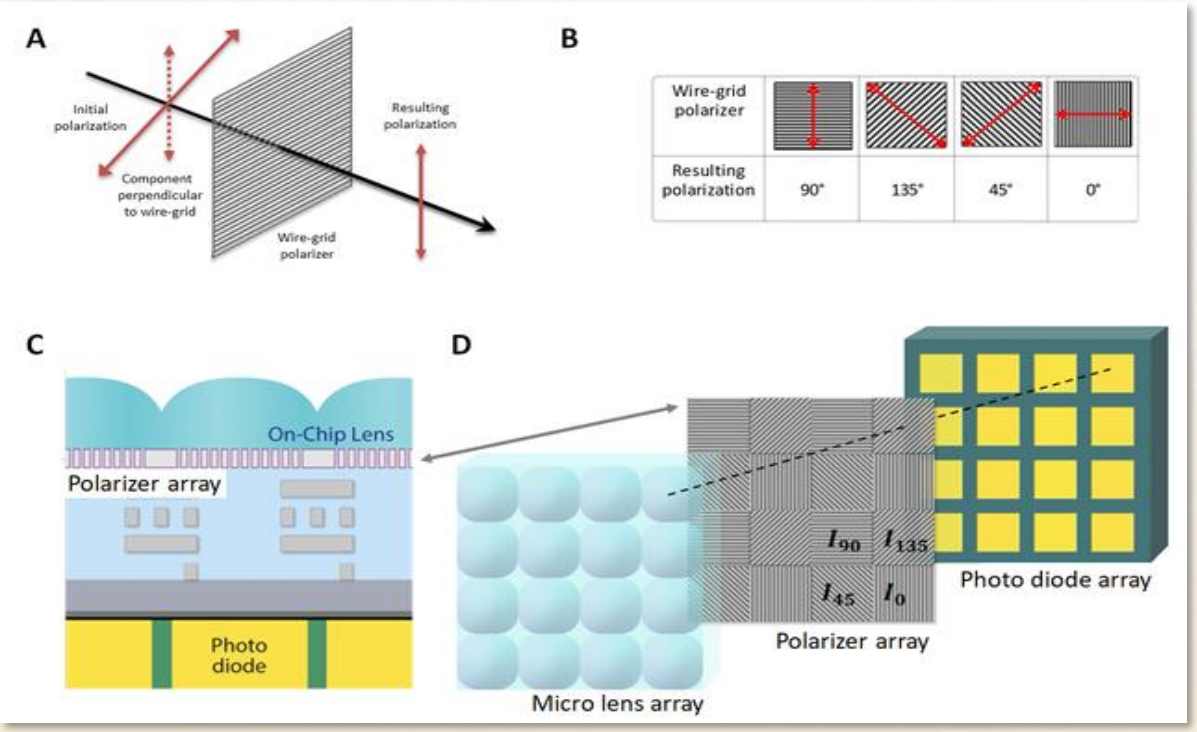




Dependence of the position of singular polarization points on altitude of the Sun during observations from three locations shown on previous picture.

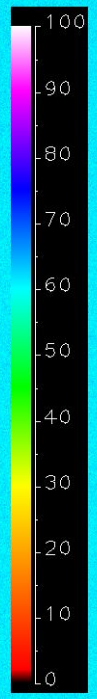
New polarization camera

SVS-Vistek exo253ZGE Polarized



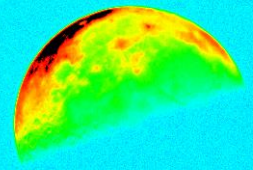
Technical characteristics:

Resolution [MP]	12.3 MP
Resolution (h x v)	4096 x 3000 px
Frame rate (max.)	10 fps
Chroma	mono polarized
Manufacturer	Sony
Sensor type	Area CMOS
Sensor size (h x v)	14.13 x 10.35 mm
Pixel size (h x v)	3.45 x 3.45 µm
Exposure time (min)	28 µs
Exposure time (max)	1 sec (external ∞)
Dimensions (w x h x d)	50 x 50 x 43 mm
Weight	140 g
Operating temperature (housing)	-10 to 60 °C
Ambient humidity	10 to 90 % (non-condensing)

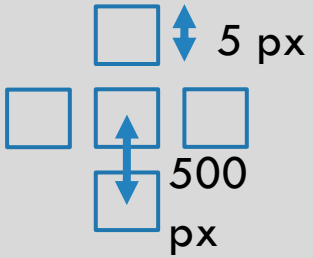


Experimental setup

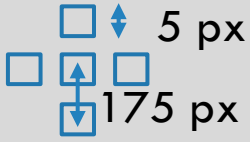
- Polarization camera exo253ZGE + 70 mm lens
- Polarization camera exo253ZGE + 200 mm lens



70 mm lens



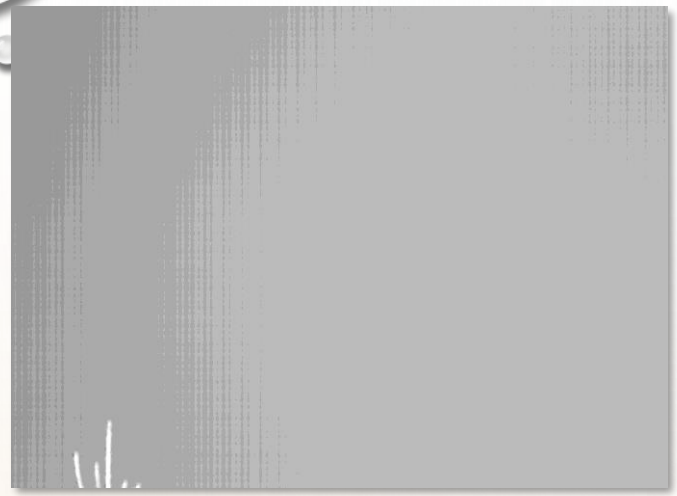
200 mm lens



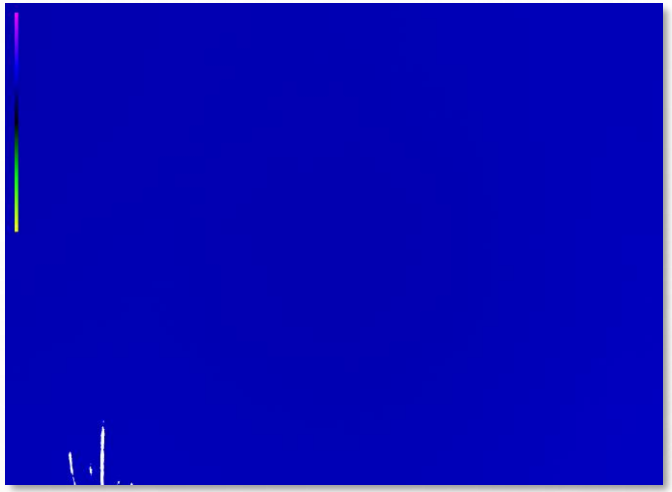
Raw picture of polarized moonlight

Daytime sky polarization

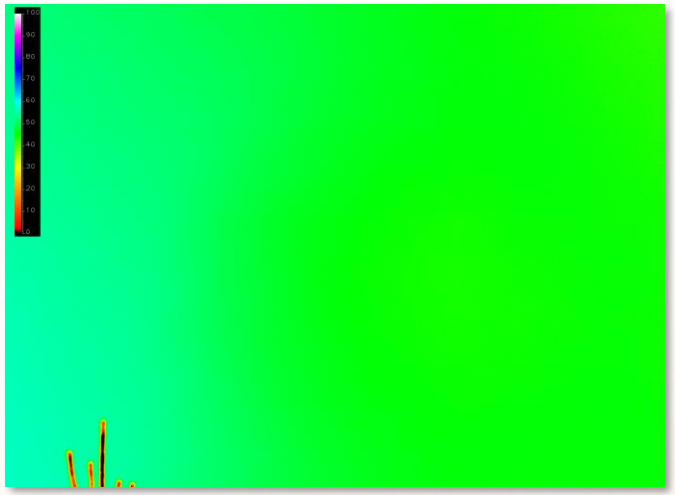
On 70 mm:



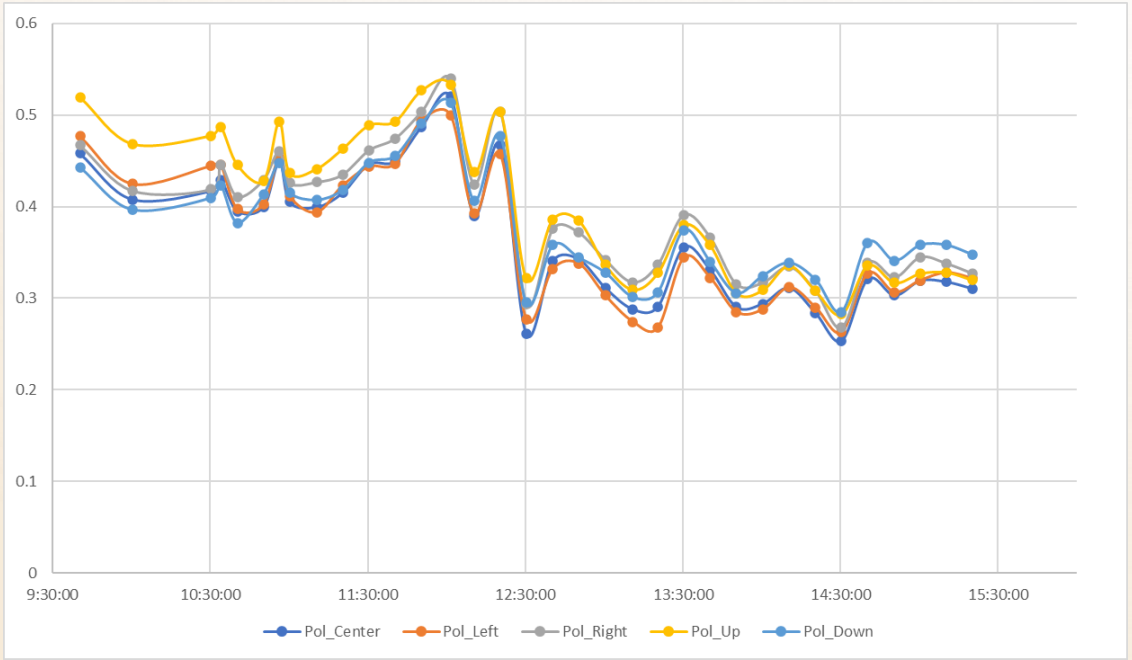
Raw picture of daytime sky polarization



Representation of the polarization angle using the data from the camera

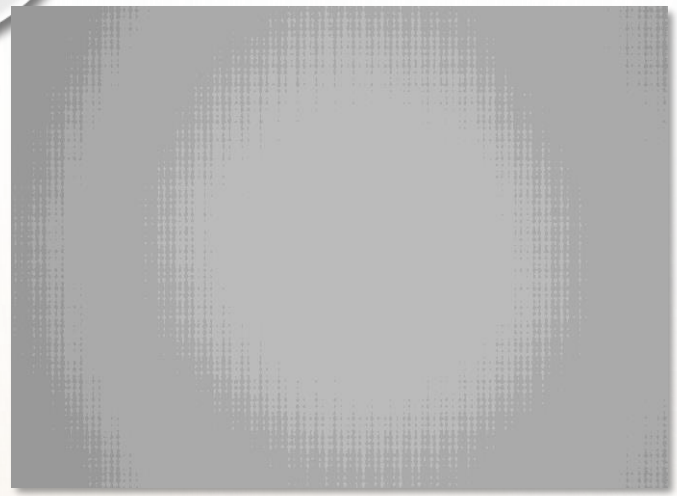


Representation of the degree of polarization using the data from the camera



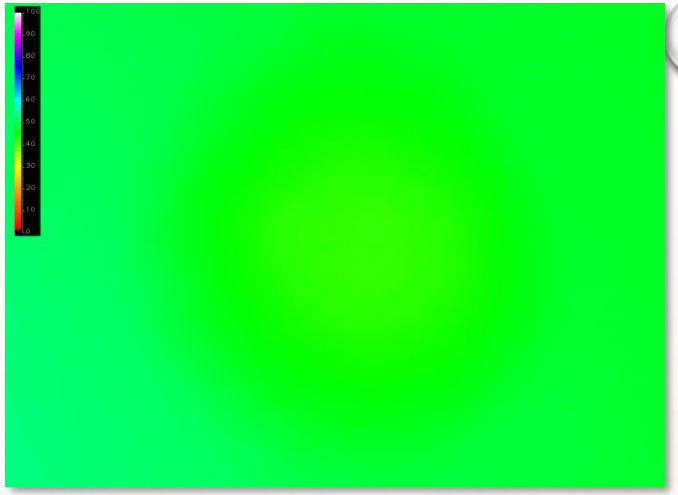
Total results for degree of polarization for all 35 images taken in period of 6 hours on 19.08.2022 from NAO Rozhen

On 200 mm:

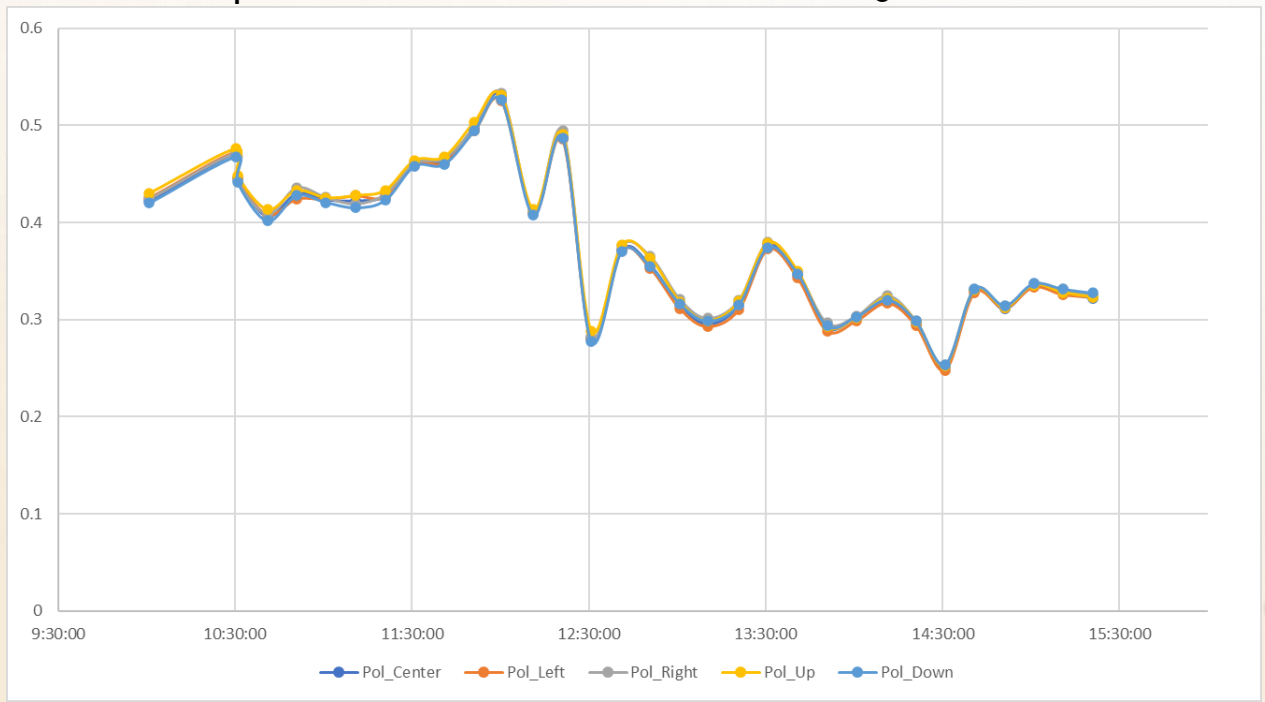


Raw picture of daytime sky polarization

Representation of the polarization angle using the data from the camera



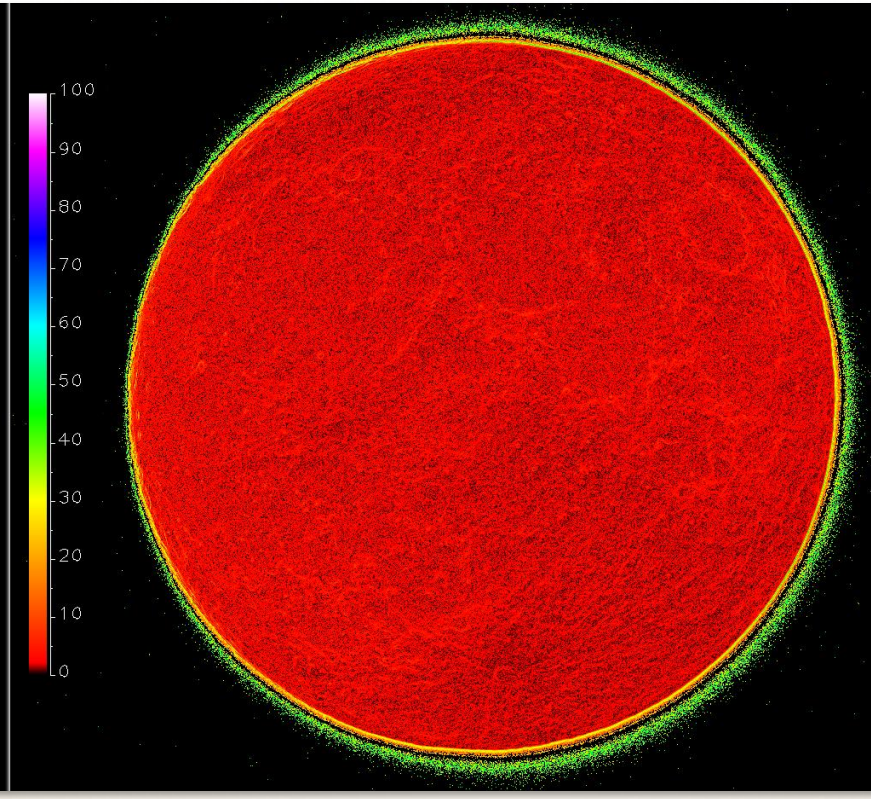
Representation of the degree of polarization using the data from the camera



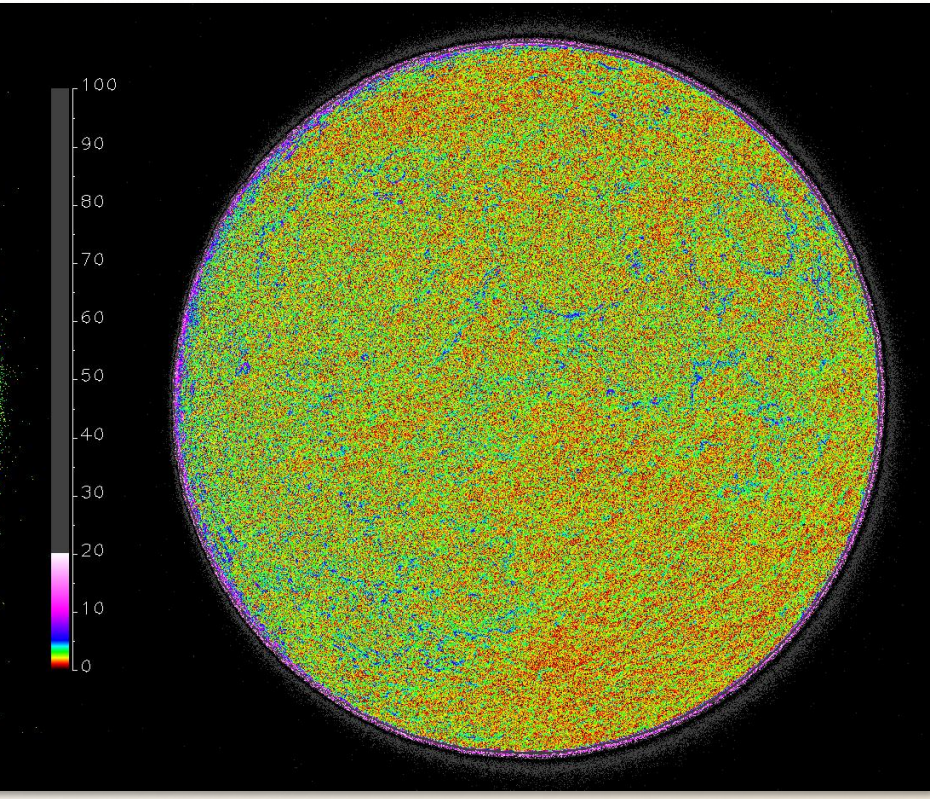
Total results for degree of polarization for all 33 images taken in period of 6 hours on 19.08.2022 from NAO Rozhen

Full moon polarization

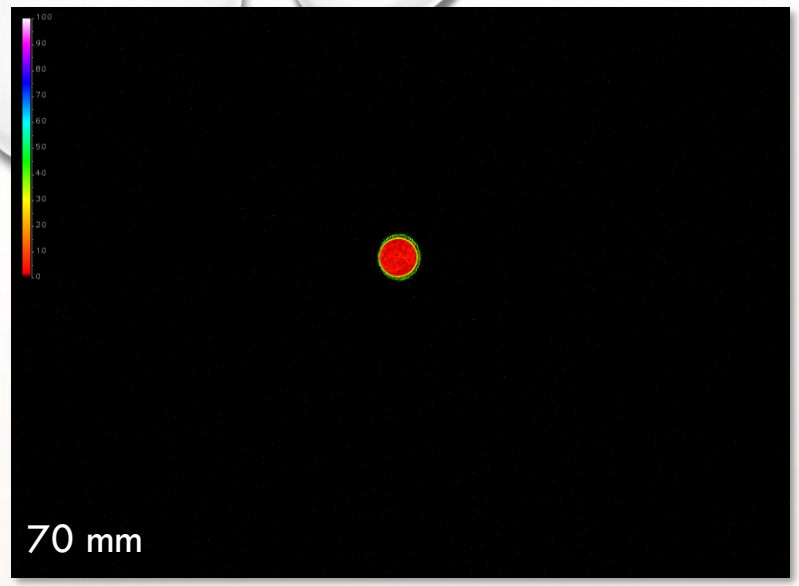
Raw picture of the full moon

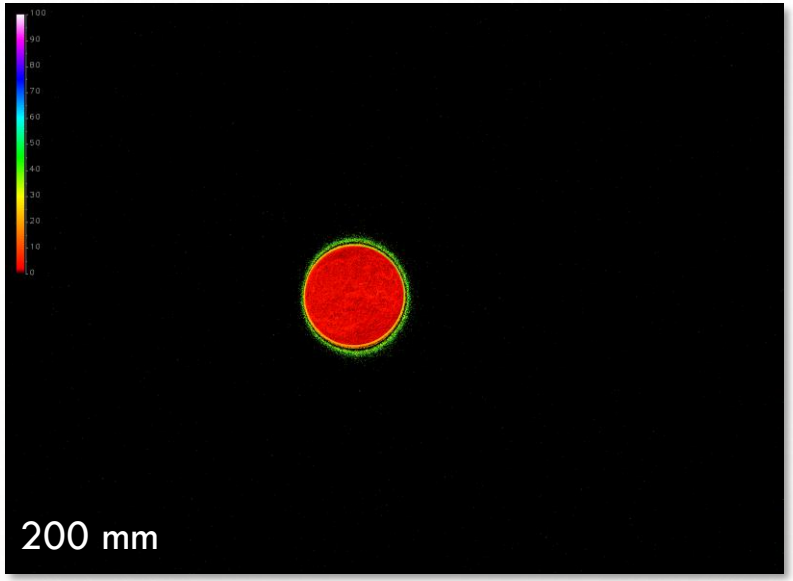


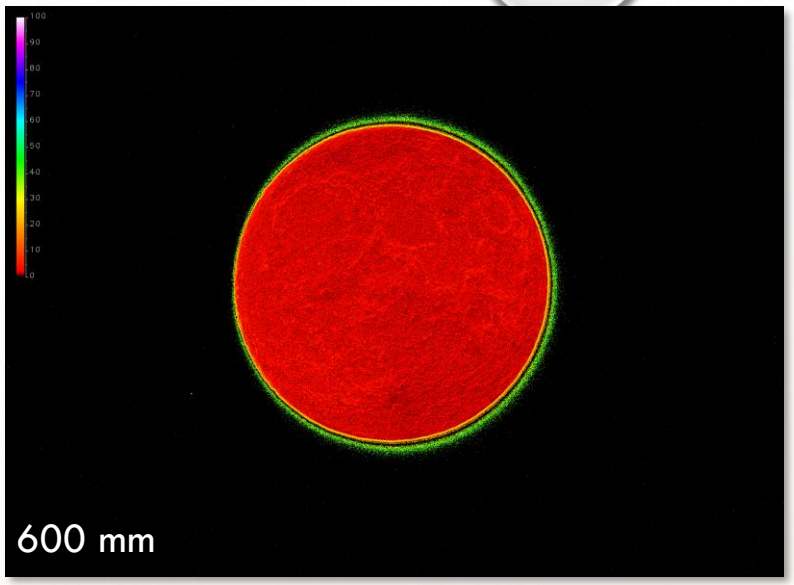
Representation of the degree of polarization using the data from the camera (first experimental scale)



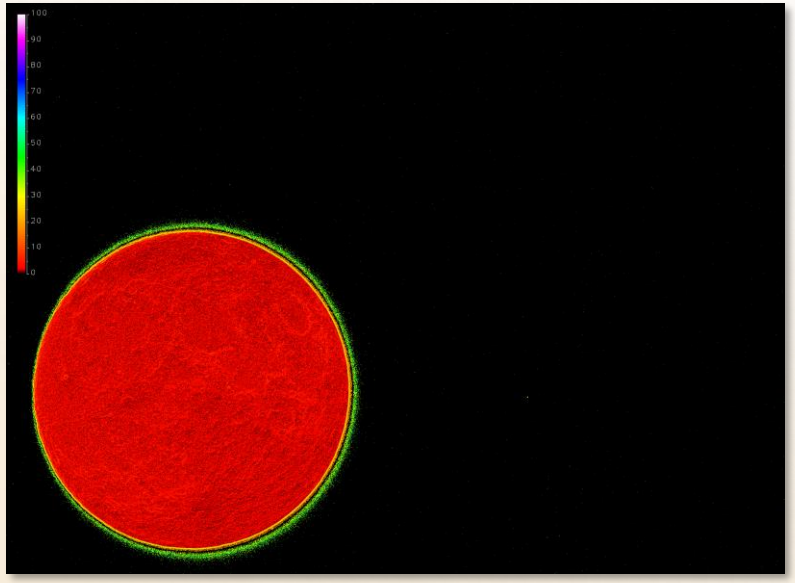
Representation of the degree of polarization using the data from the camera (second experimental scale)

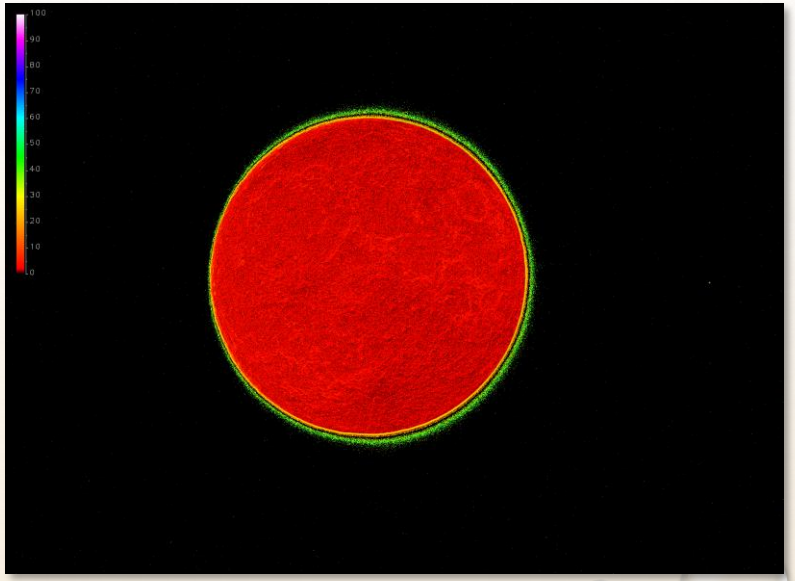


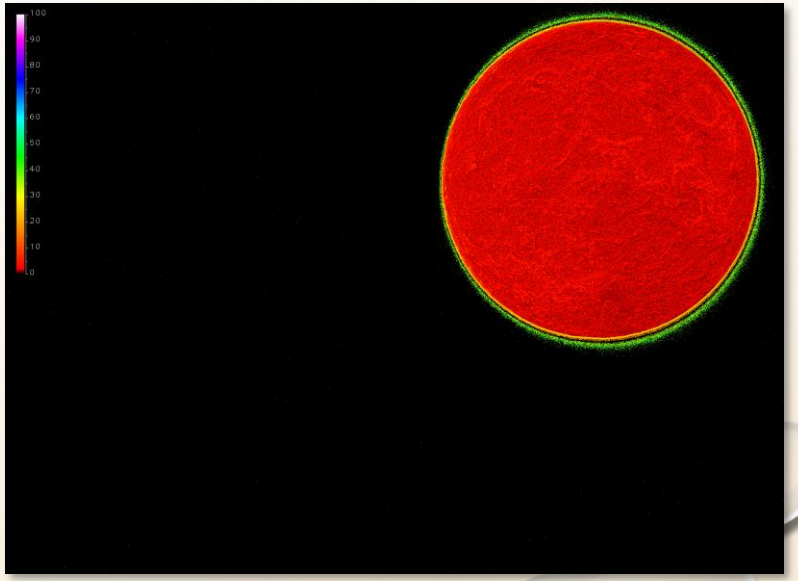




Representation of the degree of polarization using the data from the camera with three different lenses







Representation of the degree of polarization with different positions of the moon on the camera matrix

Conclusions and open questions

- First results show that the new polarization camera can be used for photographing solar eclipses.
- Benefits of this method are: simultaneous observations at four different angles of polarization, time saving and error reducing.
- For polarized observations of solar eclipses, it is important to use lenses with longer focal length to reduce the influence of the position of the corona on the image.

- May the exposure influence the results for the degree of polarization?
- May the altitude influence the results for the degree of polarization?
- What will be the results if we use different narrowband filters? – next experiment with full moon observations

THANK YOU!

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