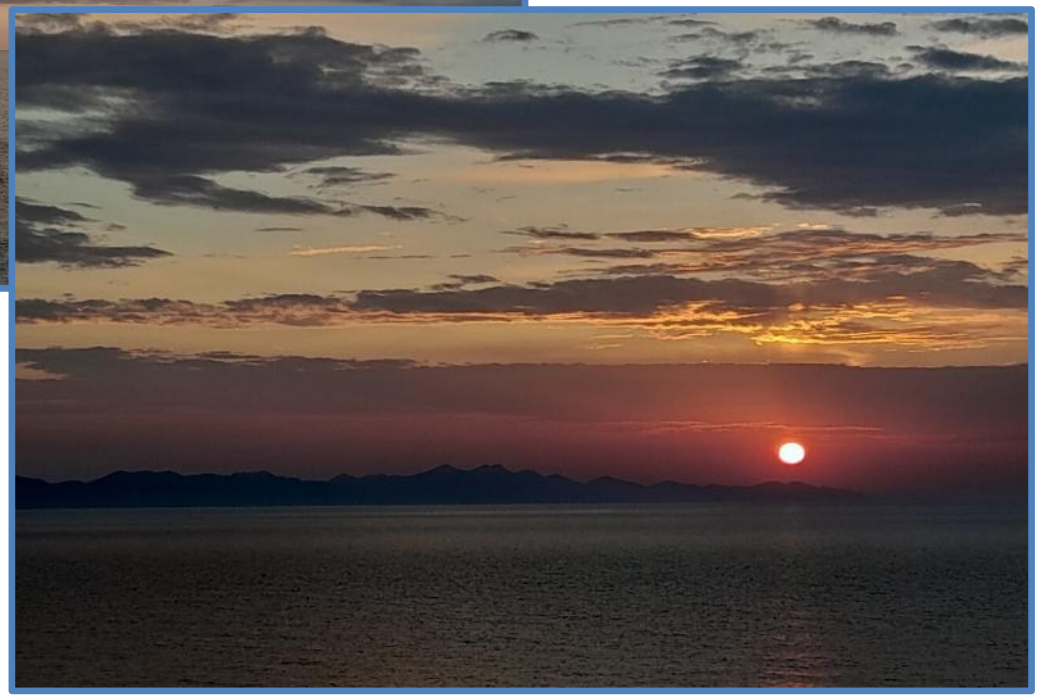
Back to Basics
Solar Observing and Imaging

Dr Stuart Green

British Astronomical Association

Supporting amateur astronomers since 1890

The Sun is a dangerous object to observe. Do not look at the Sun directly either through a telescope or with the unprotected naked eye. Any mistake can result in serious damage to your eyesight, so do not take any chances and always think about what you are doing.

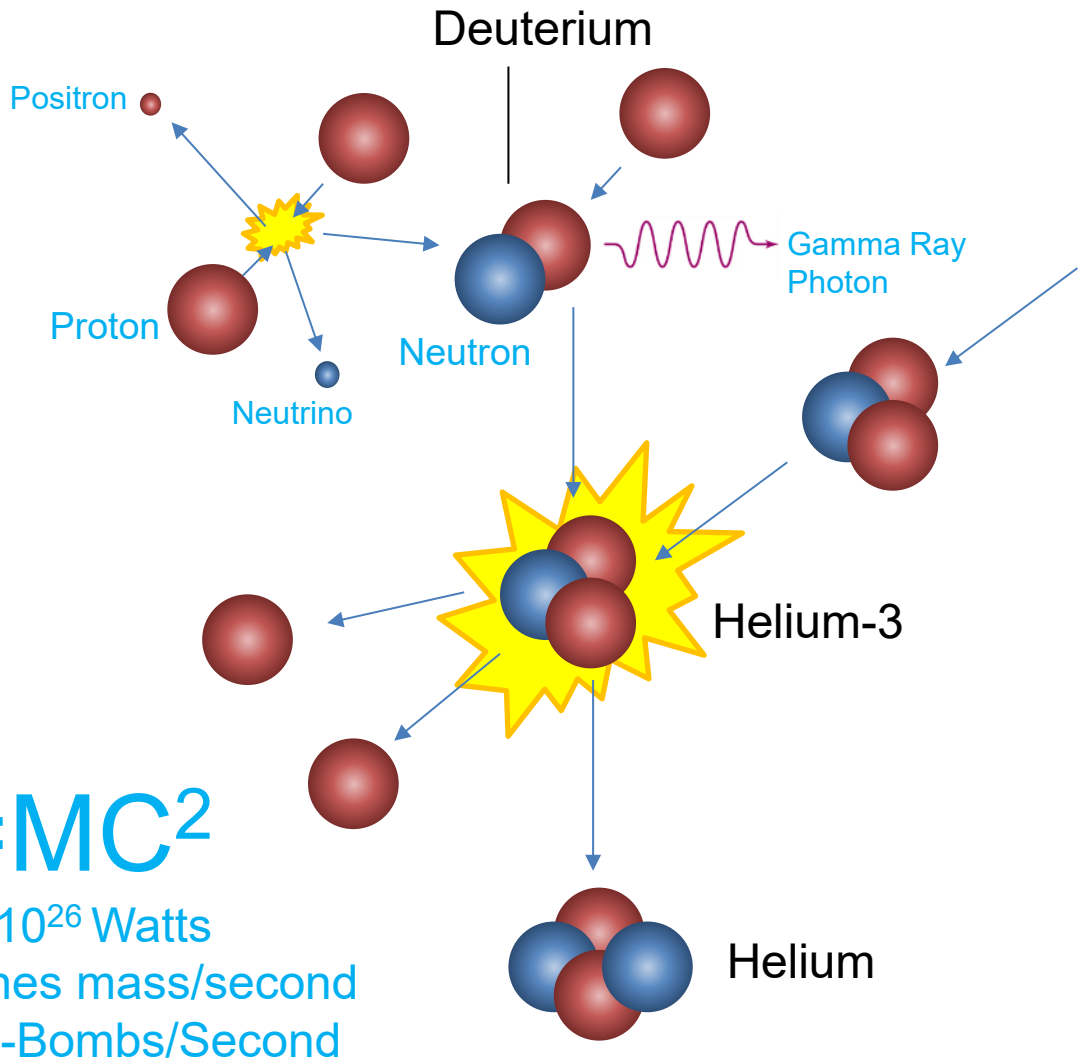


Sun Facts

- Yellow Dwarf Star (‘G’ type)
- 73% hydrogen, 25% helium, balance- ‘metals’
- Age - 4.5 Billion years
- Distance from Earth- average 150 million km (93 million miles)
- Volume 1.3 million Earths
- Diameter 1.39 million km (864,938 Miles) (Earth 12,756 km, 7,926 Miles)
- Angular size in our sky ~ 0.5 degrees
- Produces energy from nuclear fusion in core (not burning like coal)
- Core Temperature ~15 million °C
- ‘Surface’ temperature (photosphere) ~ 5,500 °C
- Corona 1-3 million °C
- Produces white light (all visible spectral colours)

Energy From Nuclear Fusion

Image credit: YouTube | realestaterockstar)



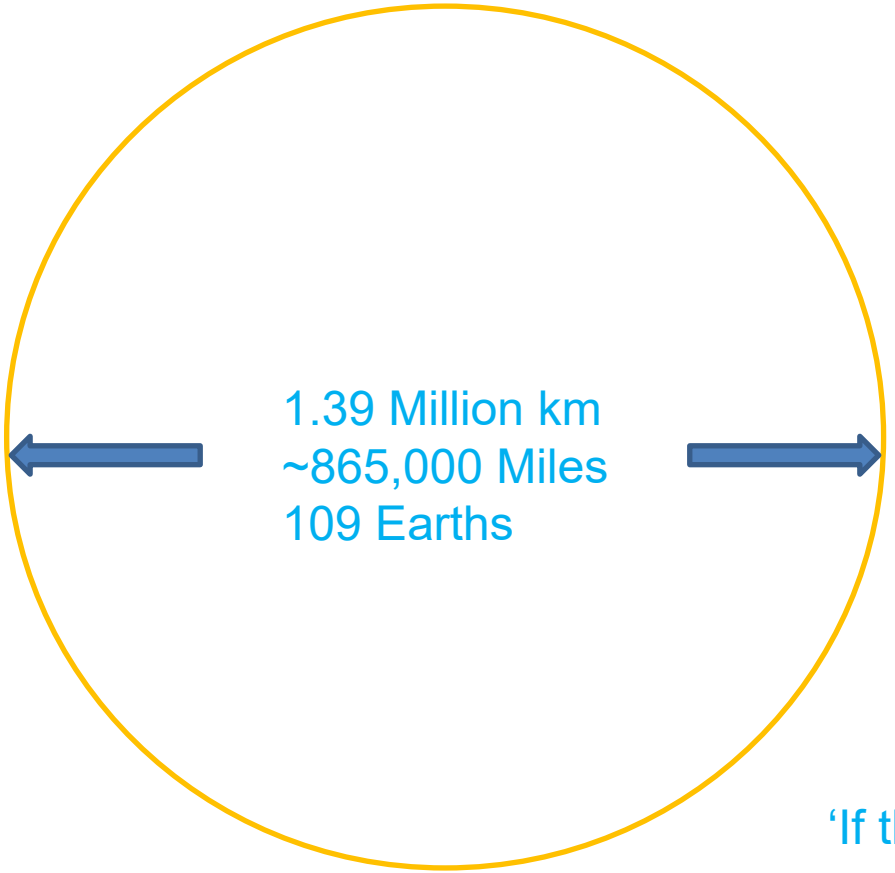
$E=MC^2$

3.8×10^{26} Watts

4 million tonnes mass/second

Billions of H-Bombs/Second

Awesome Scale of the Sun

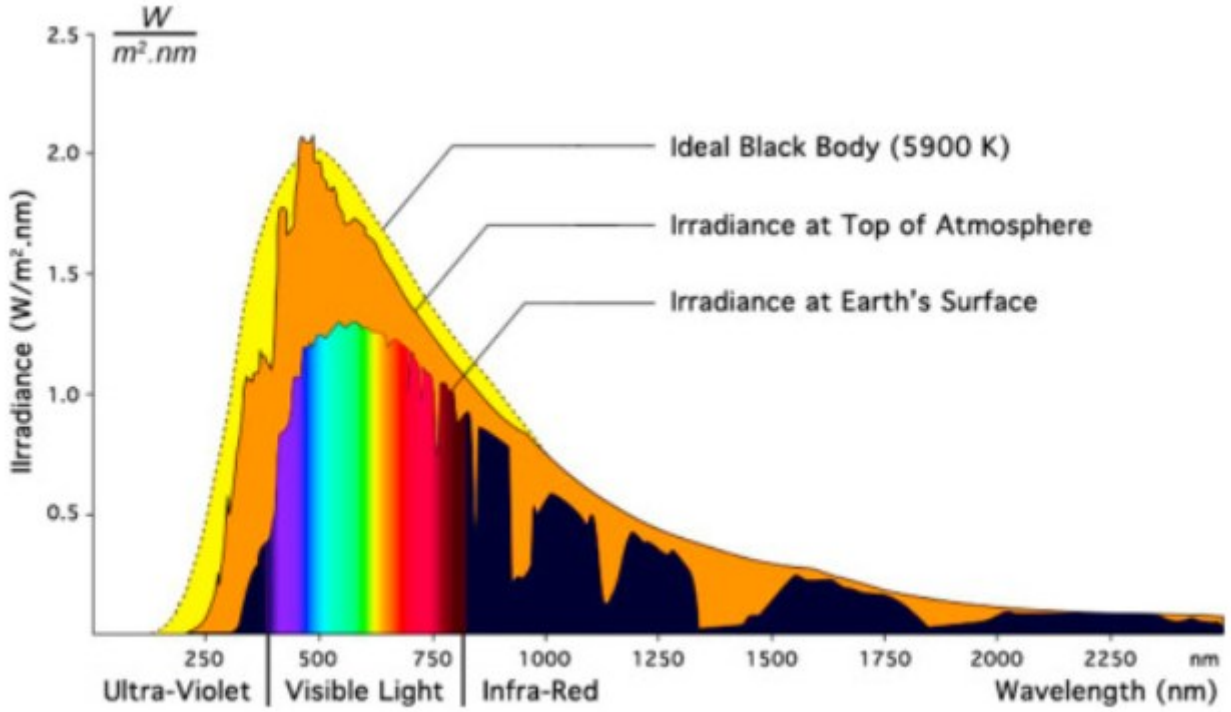


Earth

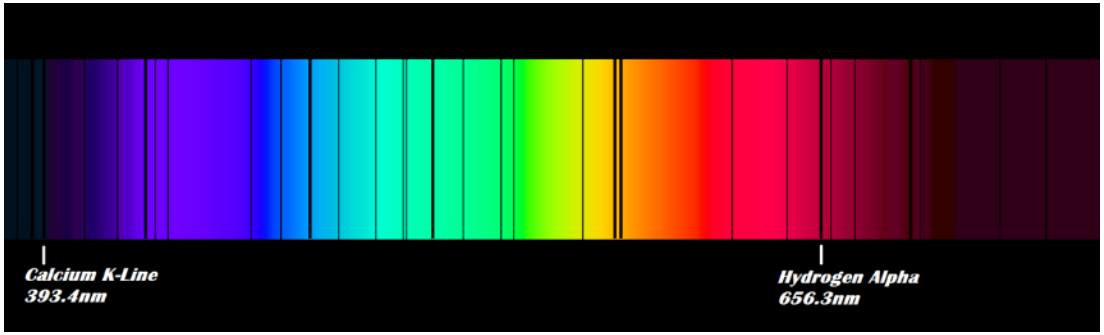
12,756 km
7,926 Miles

‘If the Sun were 1m wide, the Earth would have a diameter of approximately 9 mm’

Solar Output vs Wavelength

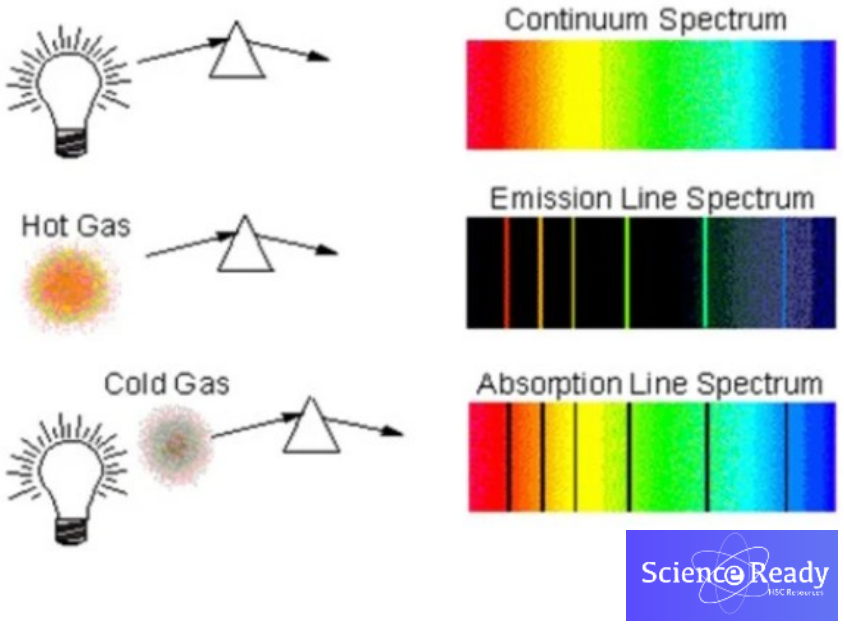


Joseph von Fraunhofer

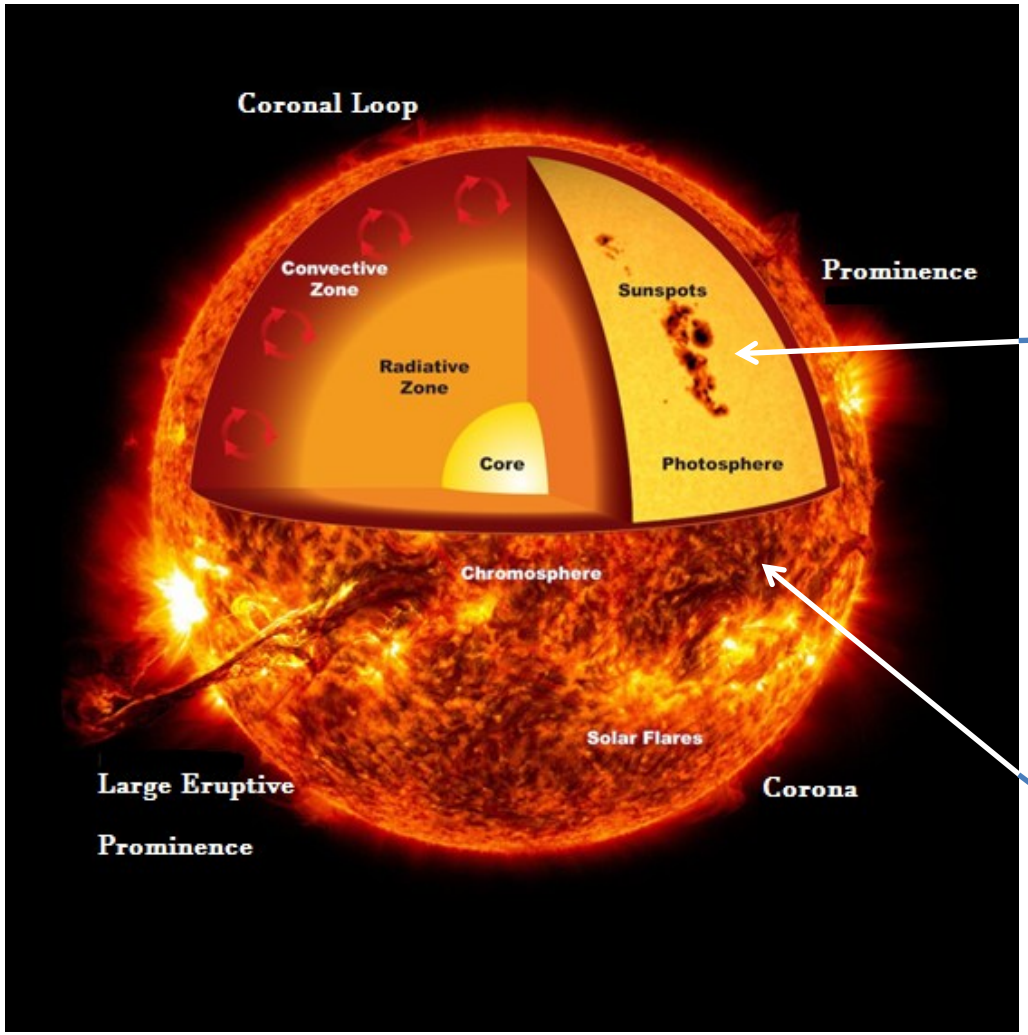


Fraunhofer lines of the sun

Light Emission/Absorption



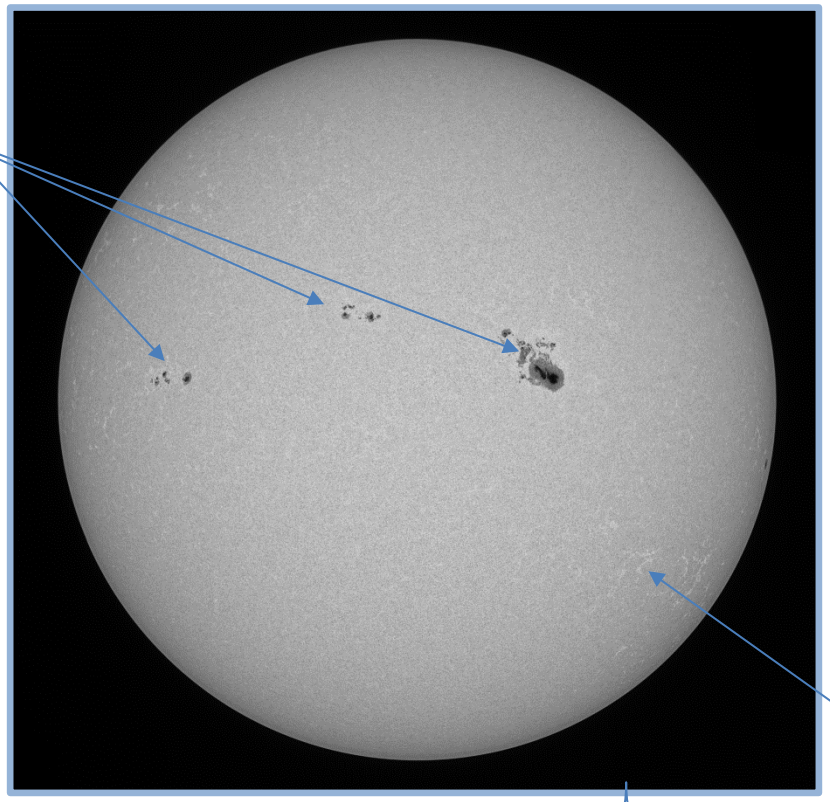
Anatomy of the Sun



'White light' photosphere

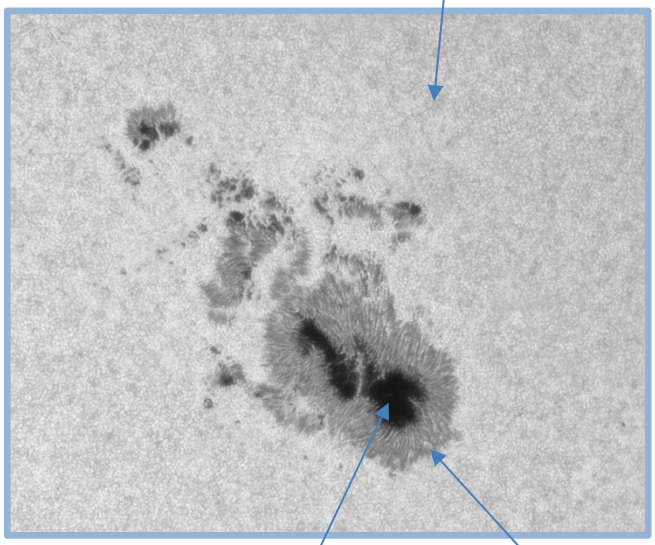
Chromosphere- 2,100km thick region above Photosphere

Anatomy of the Sun
Photosphere ‘White Light’



Sunspots

Faculae

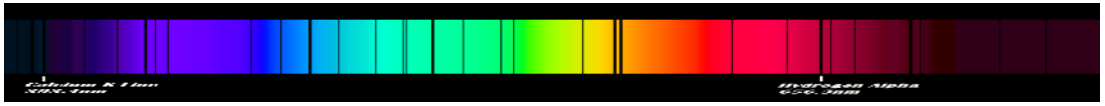


Granules

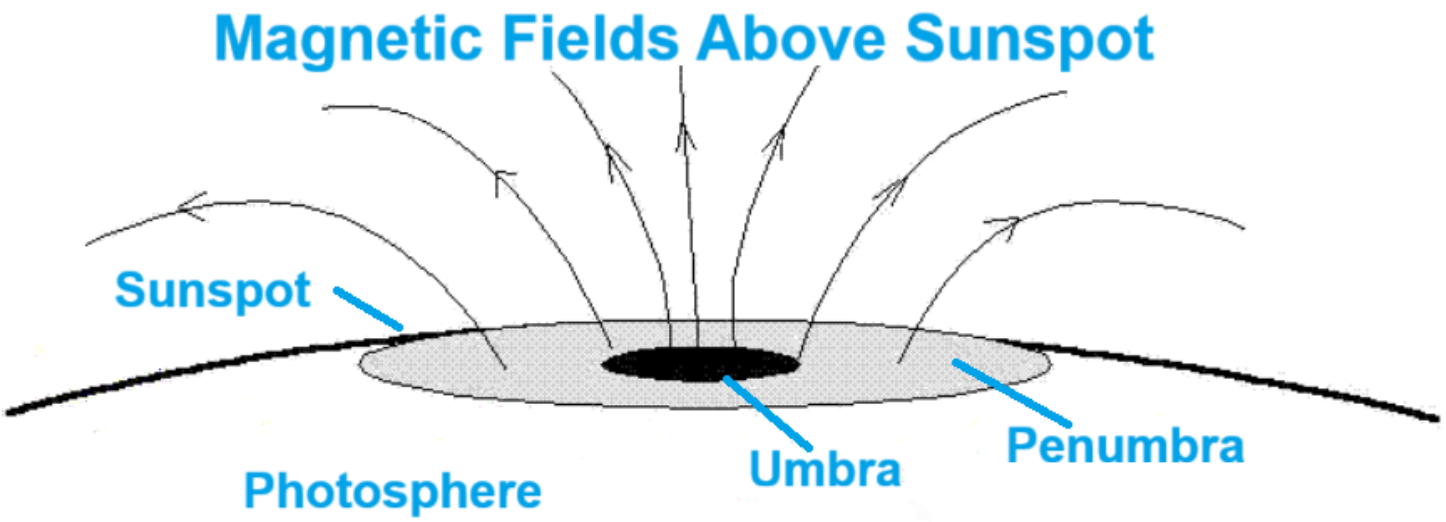
Umbra

Penumbra

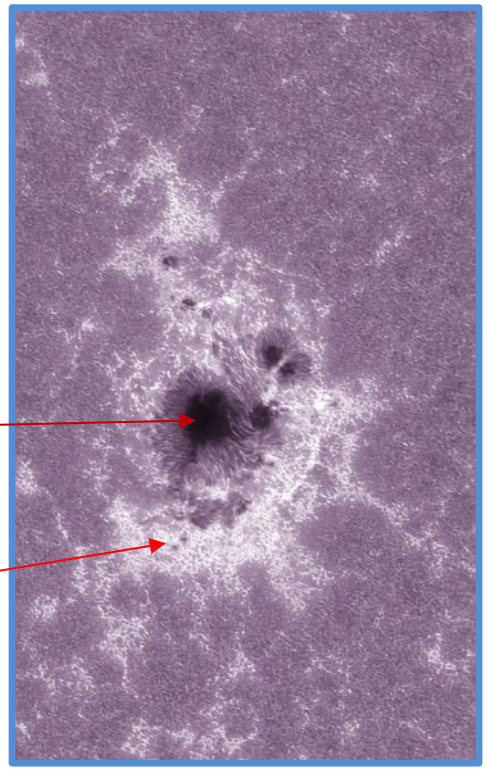
Photosphere in ‘white light’

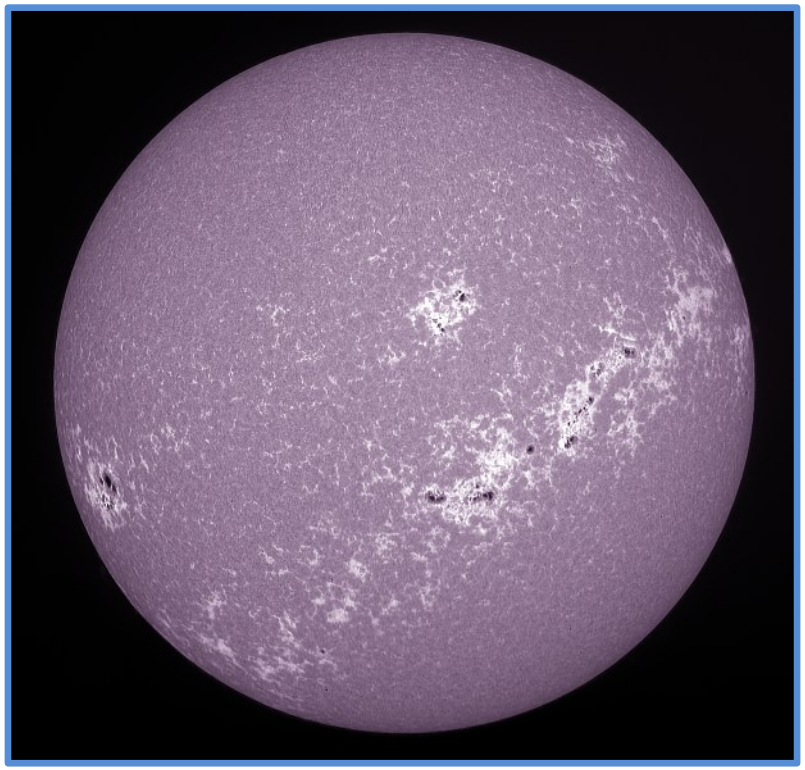


Anatomy of the Sun
Photosphere ‘White Light’



Anatomy of the Sun
Chromosphere 393.4 nm

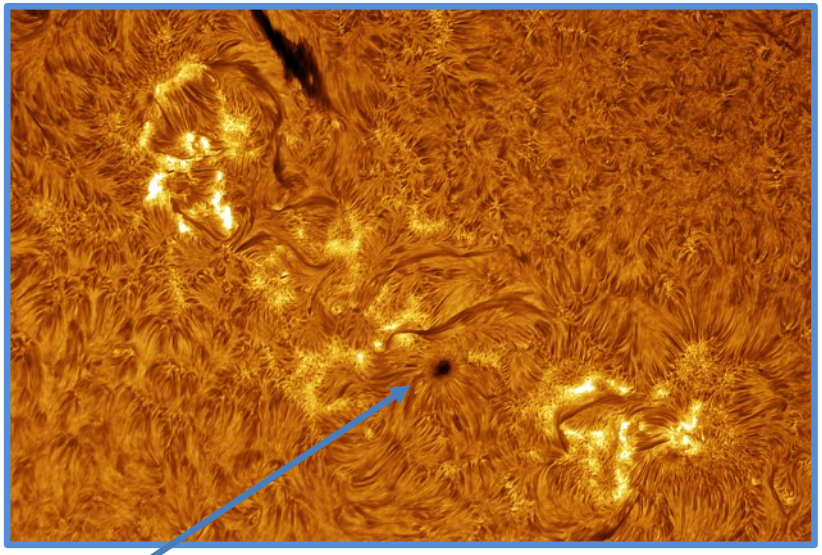




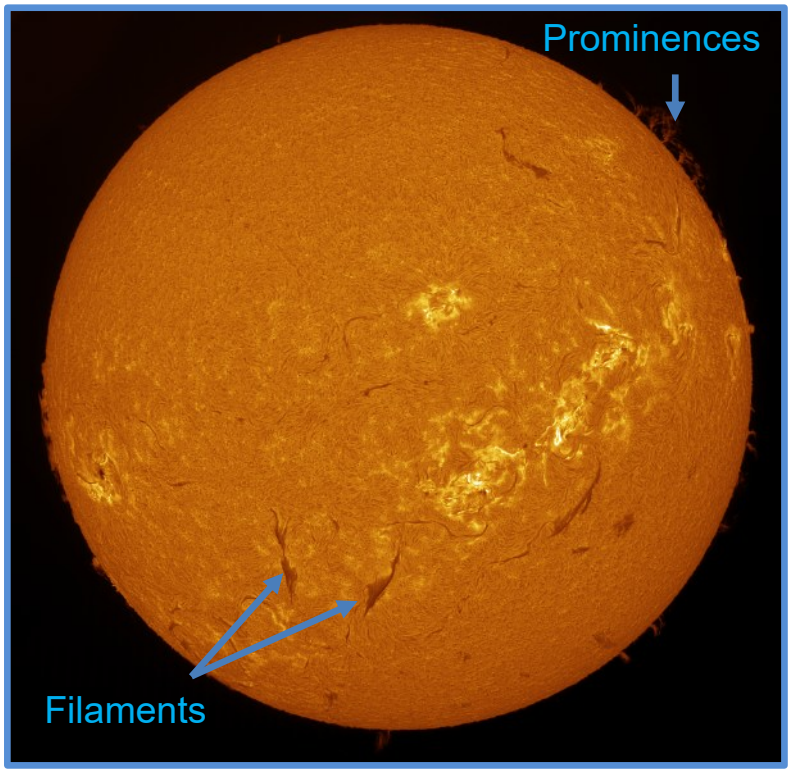
Chromosphere in Calcium II K at 393.4 nm

Anatomy of the Sun
Chromosphere 656.3 nm

Active Region

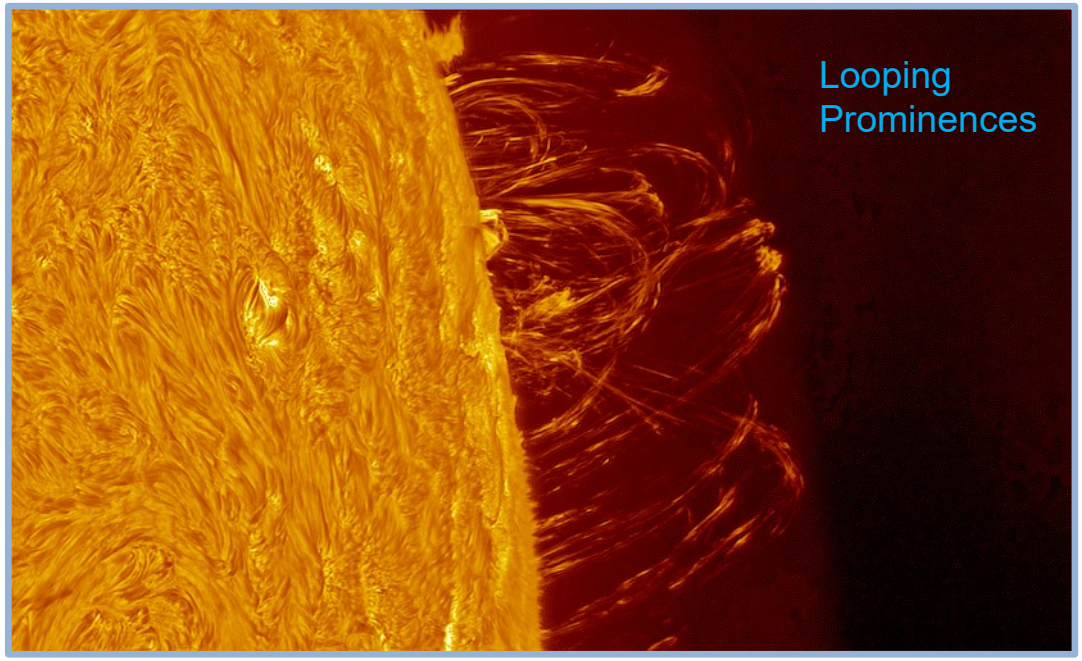


Sunspot

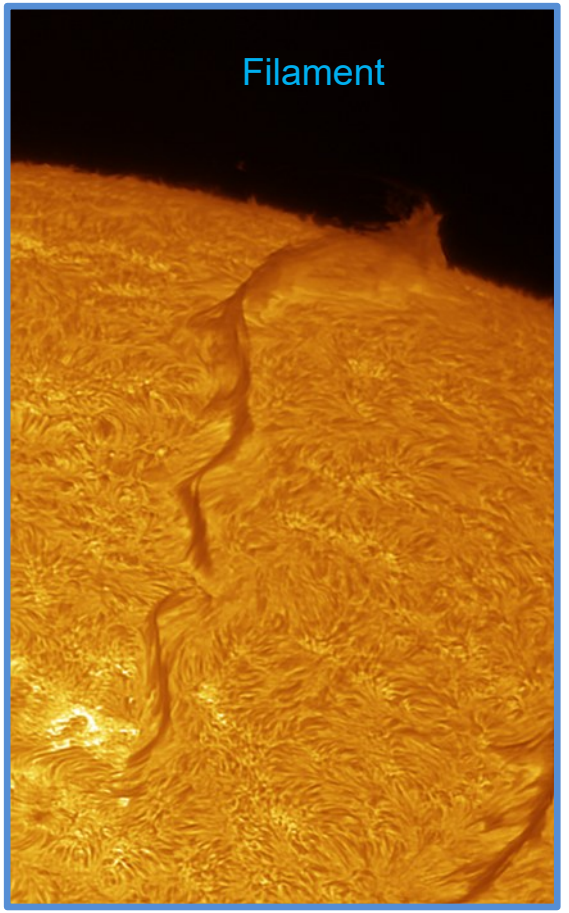


Chromosphere in Hydrogen Alpha

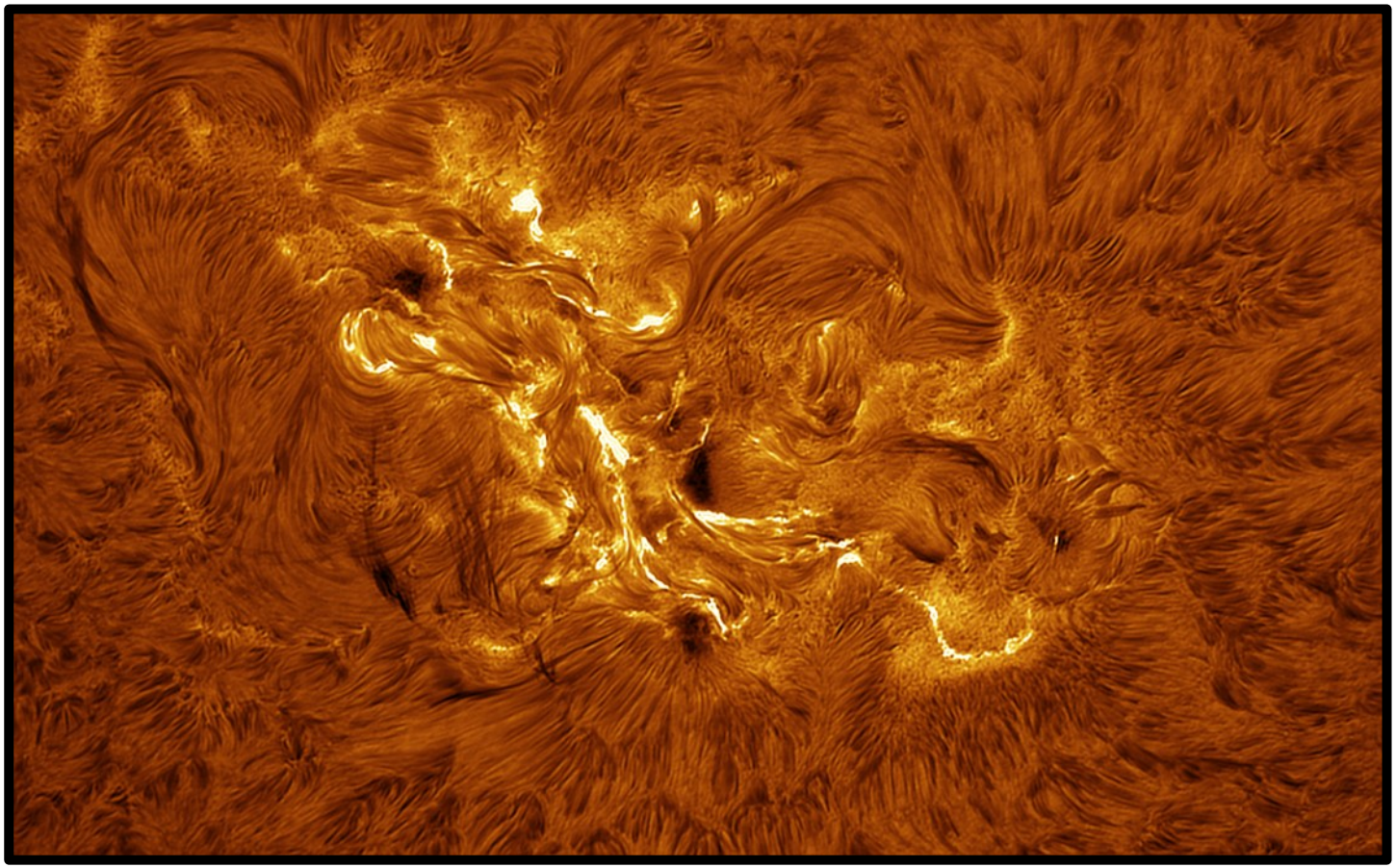
Anatomy of the Sun
Chromosphere 656.3 nm



Chromosphere in Hydrogen Alpha



Active Region in Hydrogen Alpha

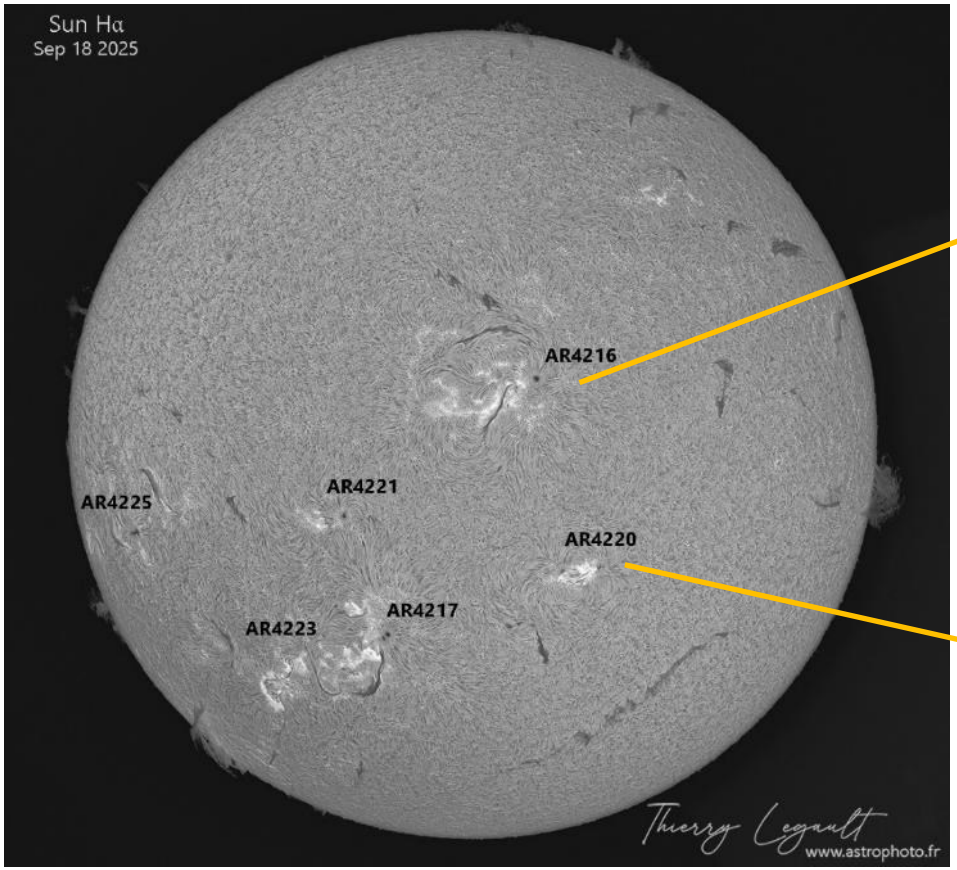


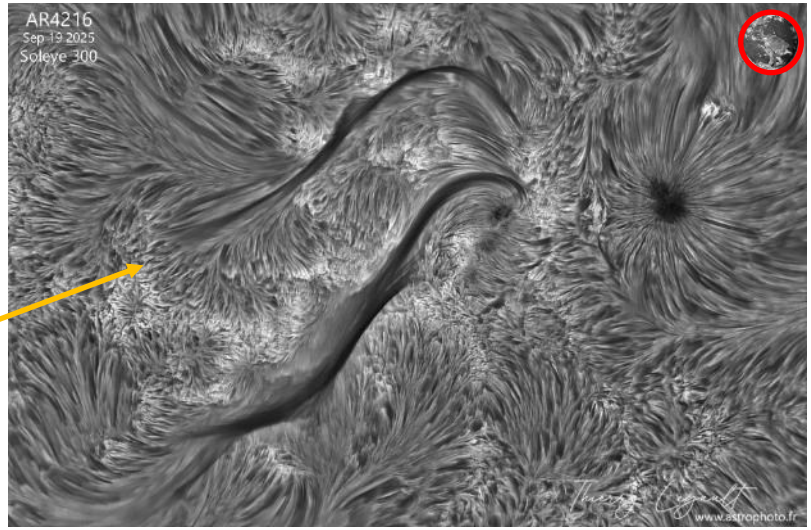
Hydrogen Alpha Image of an Active Region on the Sun
150mm double stacked refractor at ~f34

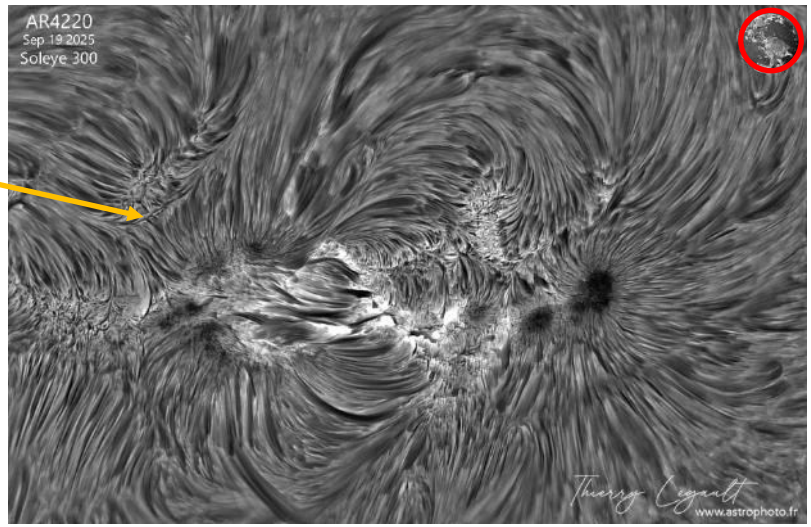
Anatomy of the Sun
Corona

Credit: Alexandra Hart
2017 Total Solar Eclipse Oregon, USA

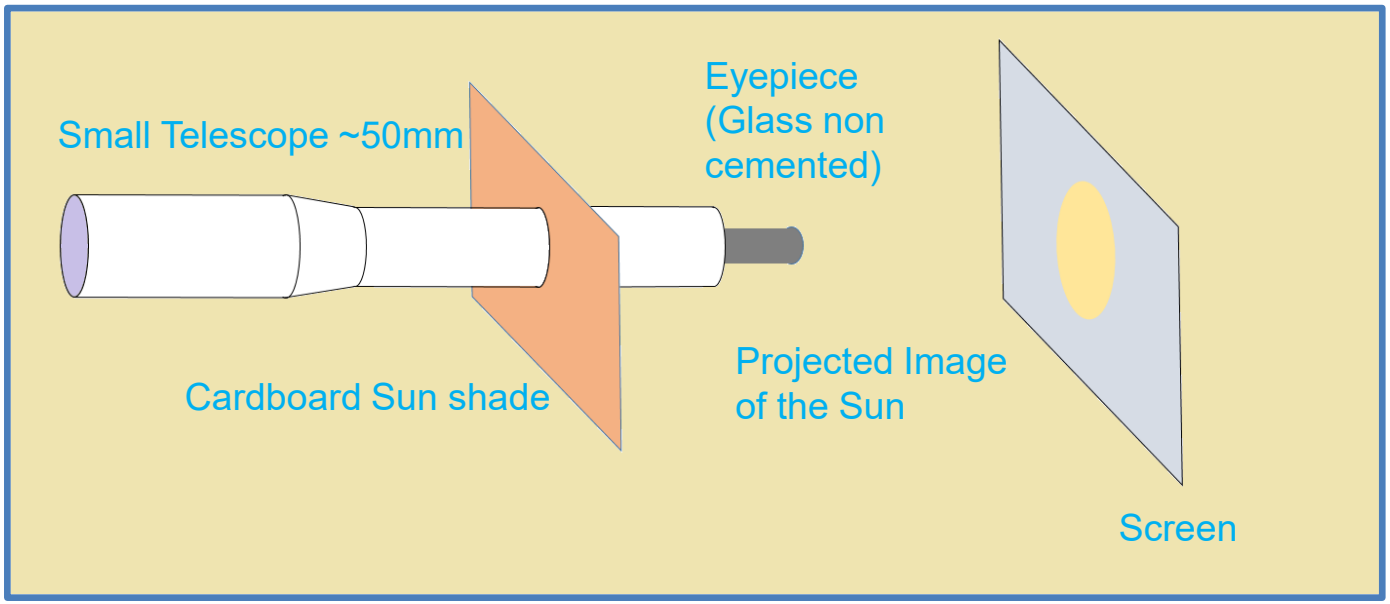
Awesome Scale of the Sun







Observing the Sun
White Light Solar Projection



White Light Solar Projection

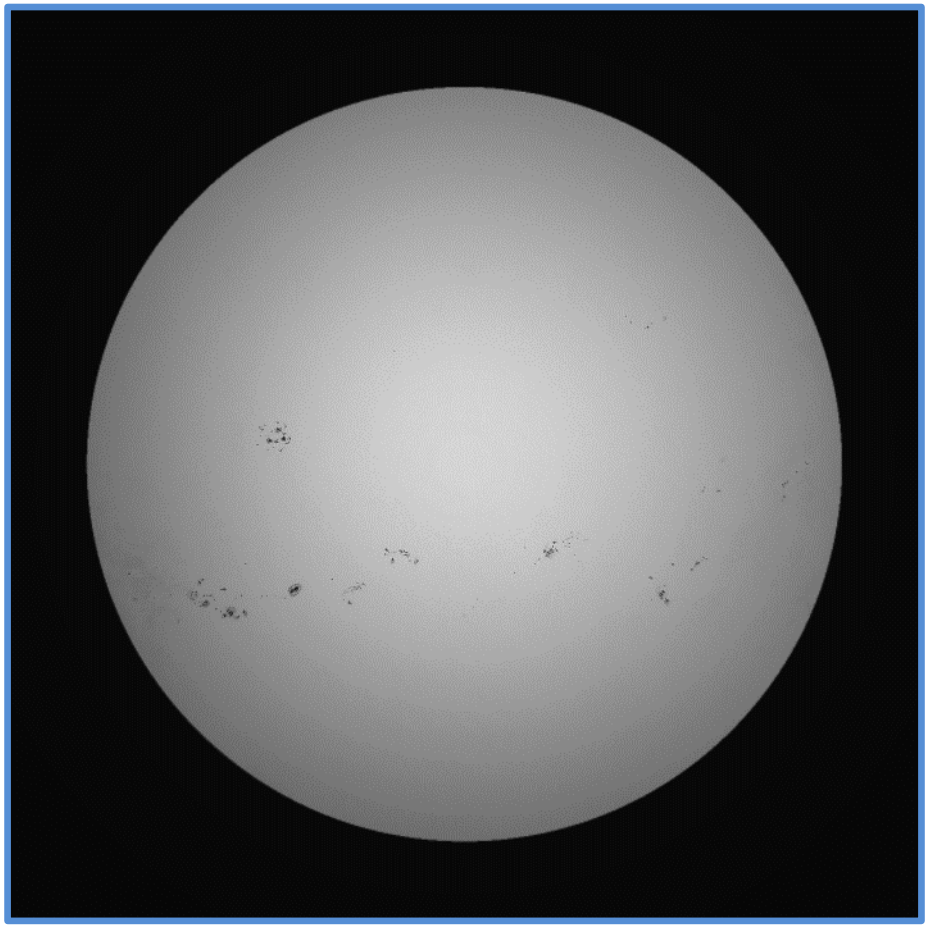
Credit:
Mark Parrish

White Light Solar Projection

Sun Funnel – Fienberg, Bueter & Mayo

https://aas.org/files/resources/build_a_sun_funnel_v3.2.pdf

Pencil Sketch of Sun



Credit:
Marios Ioannou

Observing the Sun
White Light Solar Filters

Solar Film Sheets

Ready-to-Use Solar Film

Glass Solar Filters

Camera Lens Solar Filters

Attaching Solar Film Sheet

Credit: Pete Lawrence

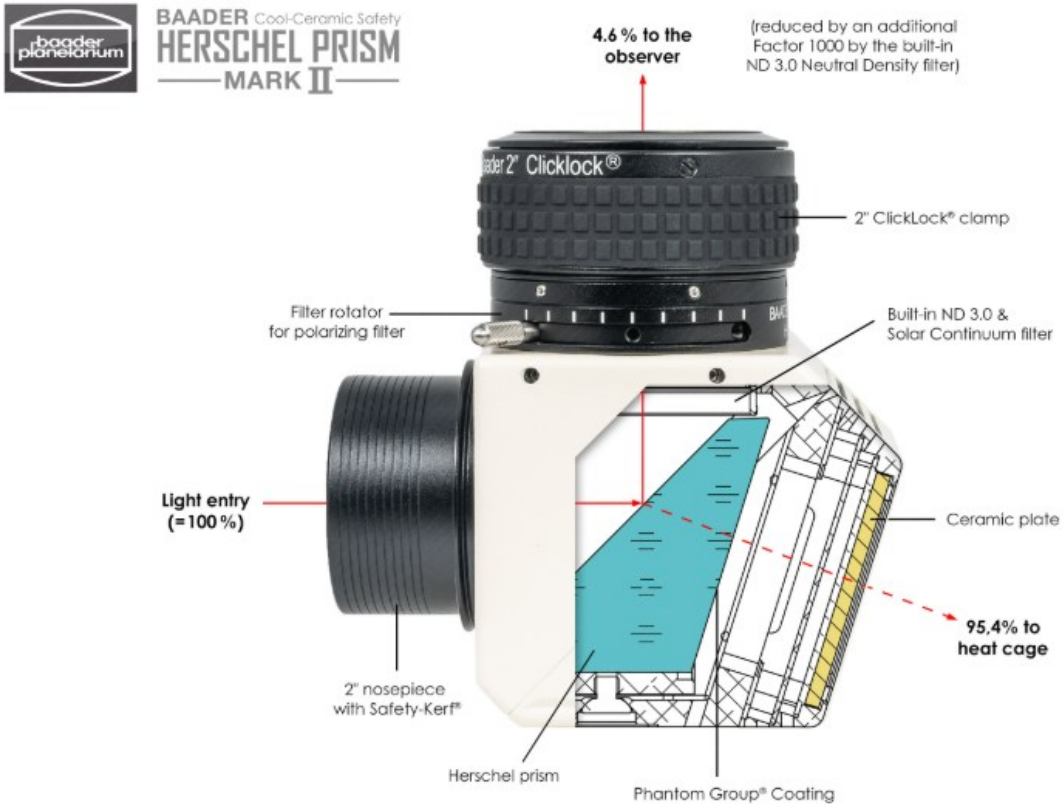
Solar Wedge


BAADER 2" Cool-Z
Herschelprisma


LACERTA Herschel Prism
with Brewster Angle
Must be used with a ND3 filter!
IR-blocking filter is also recommended!
Total light reduction with ND3 filter is ND4.07.
If additional polarising filter is used,
continuous dimming is possible.
www.teleskop-austria.at

Solar Wedge

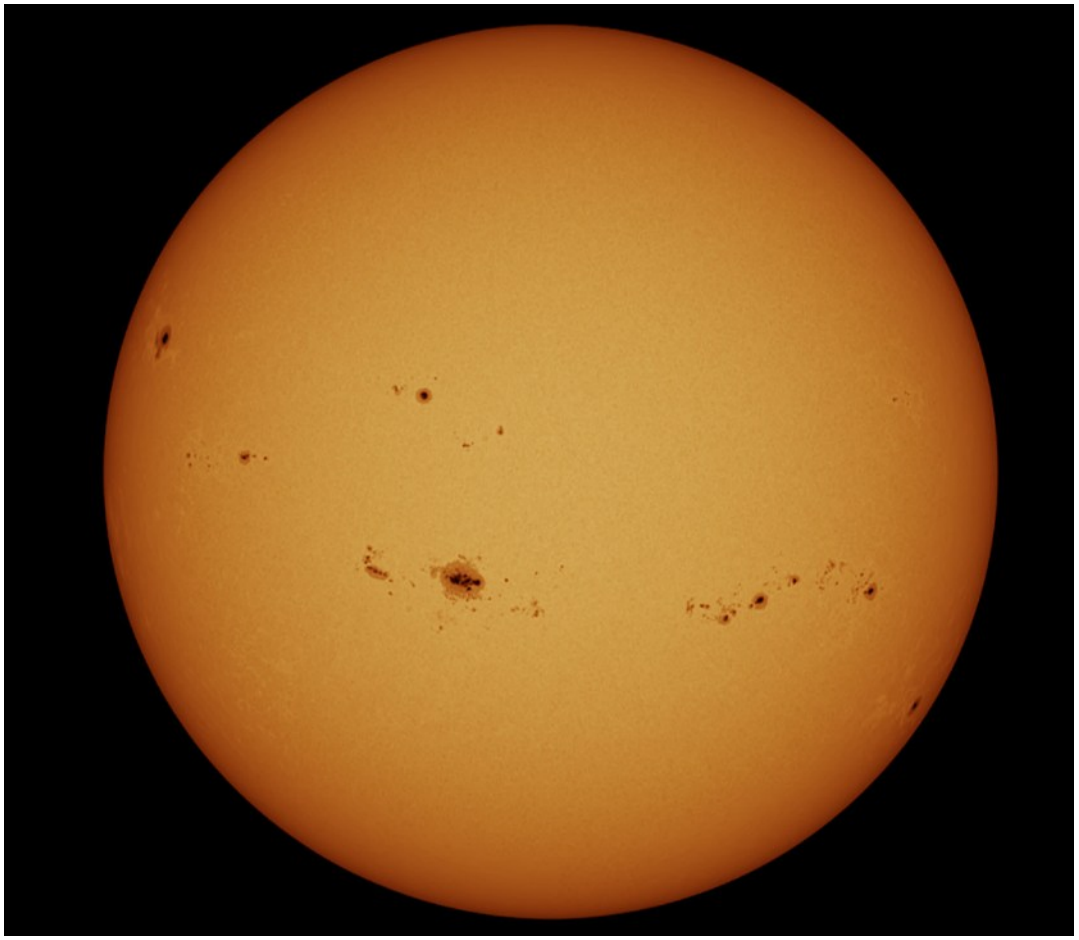
Baader 2" Cool-Ceramic Safety Herschel Prism Mark II – (Visual / Photo)



Imaging the Sun
Solar Imaging using Smartphone

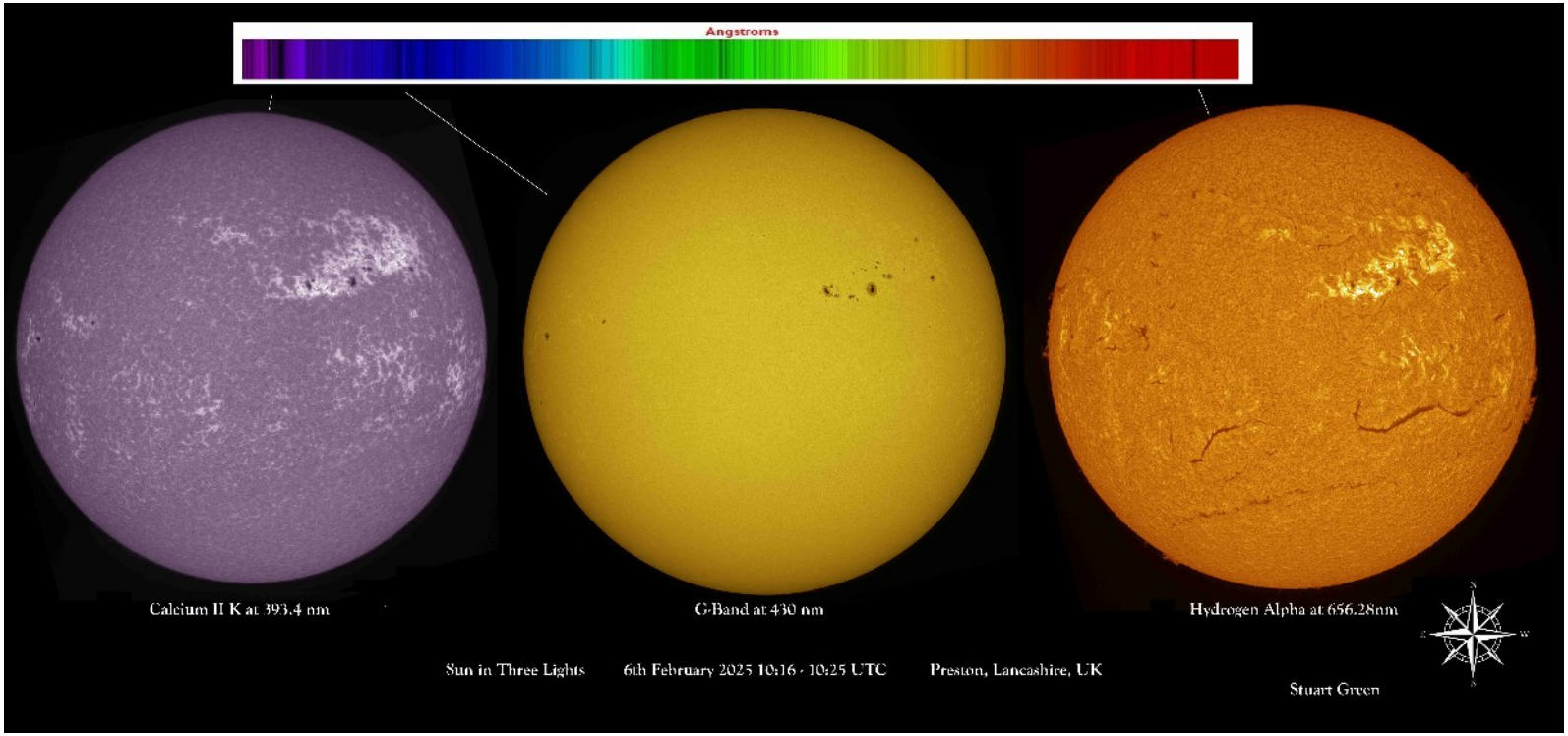
ZWO Seestar S50 all-in-One Smart Telescope

Solar Image- ZWO Seestar S50



Credit: Pedro Re’

Imaging the Sun
Across the Spectrum



Example Solar Telescopes and Filters

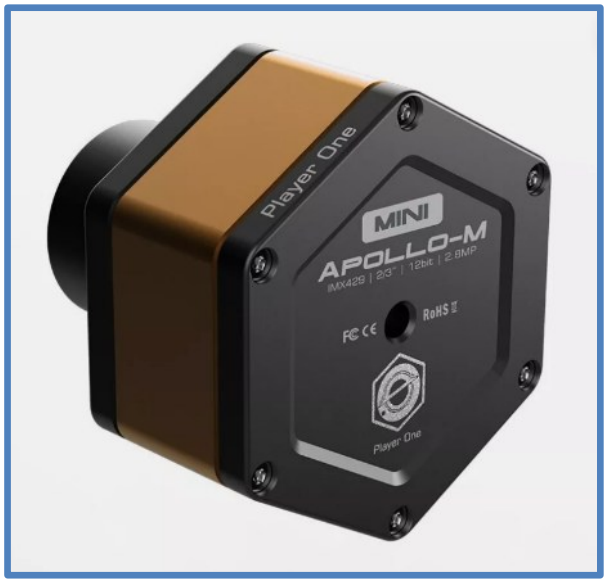
ANTILIA

LUNT

Solar Imaging in Hydrogen Alpha

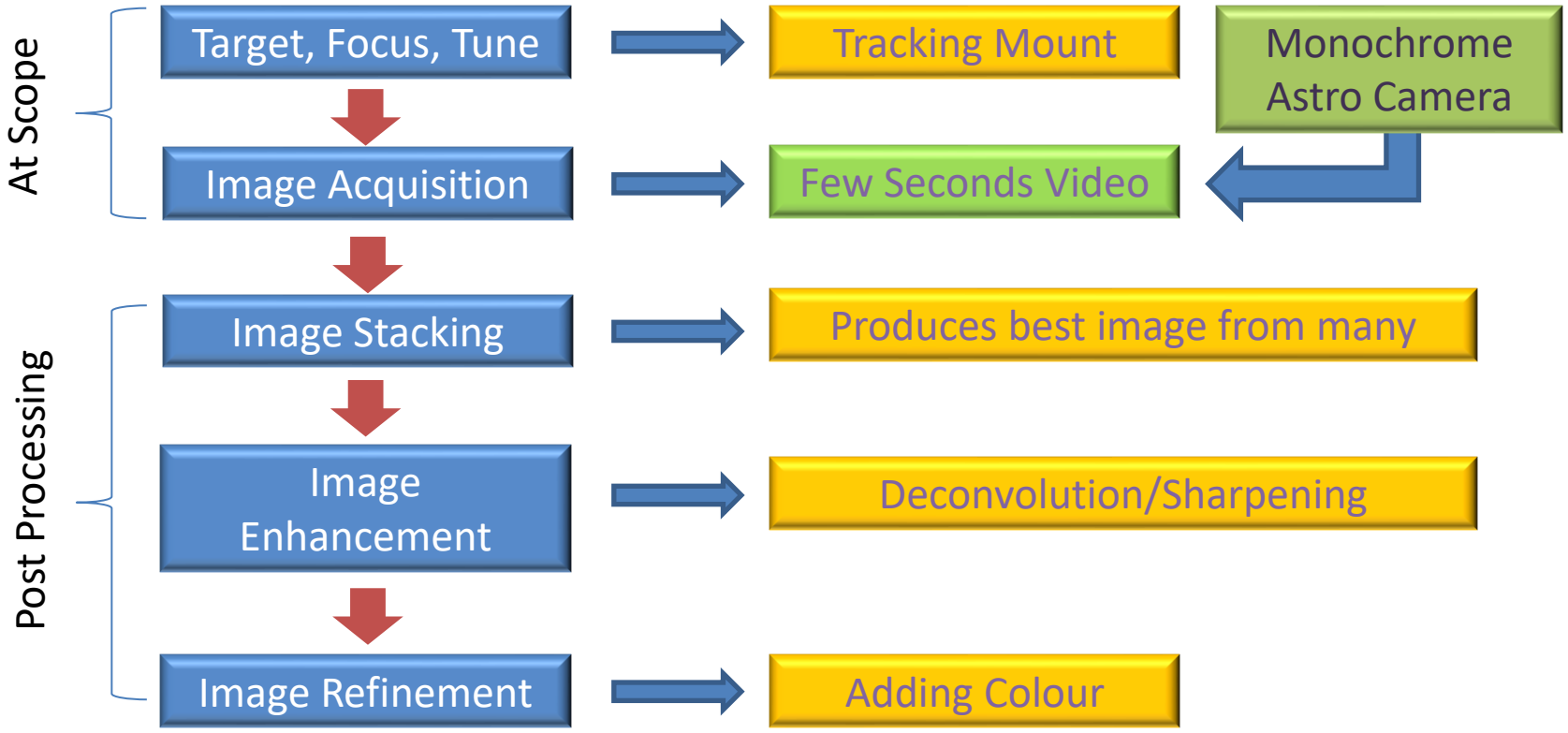
Lunt Hydrogen Alpha

Digital Monochrome Camera - Video Capable

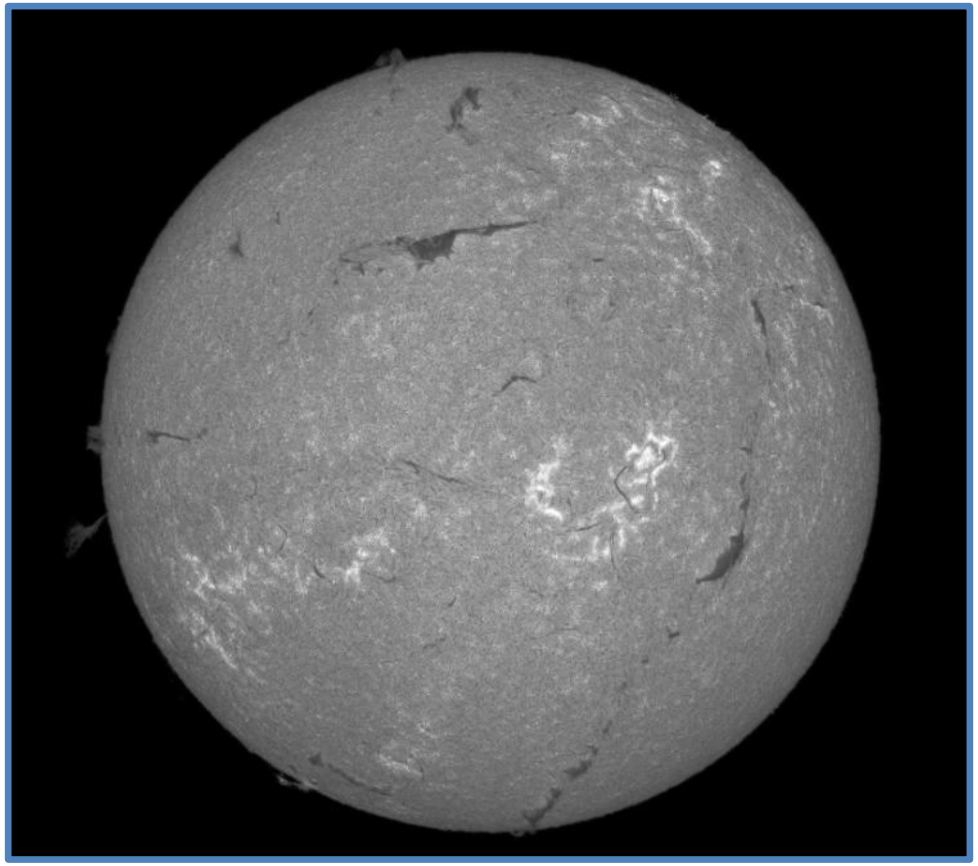


MONOCHROME

Solar Imaging and Processing



Solar Imaging in Hydrogen Alpha



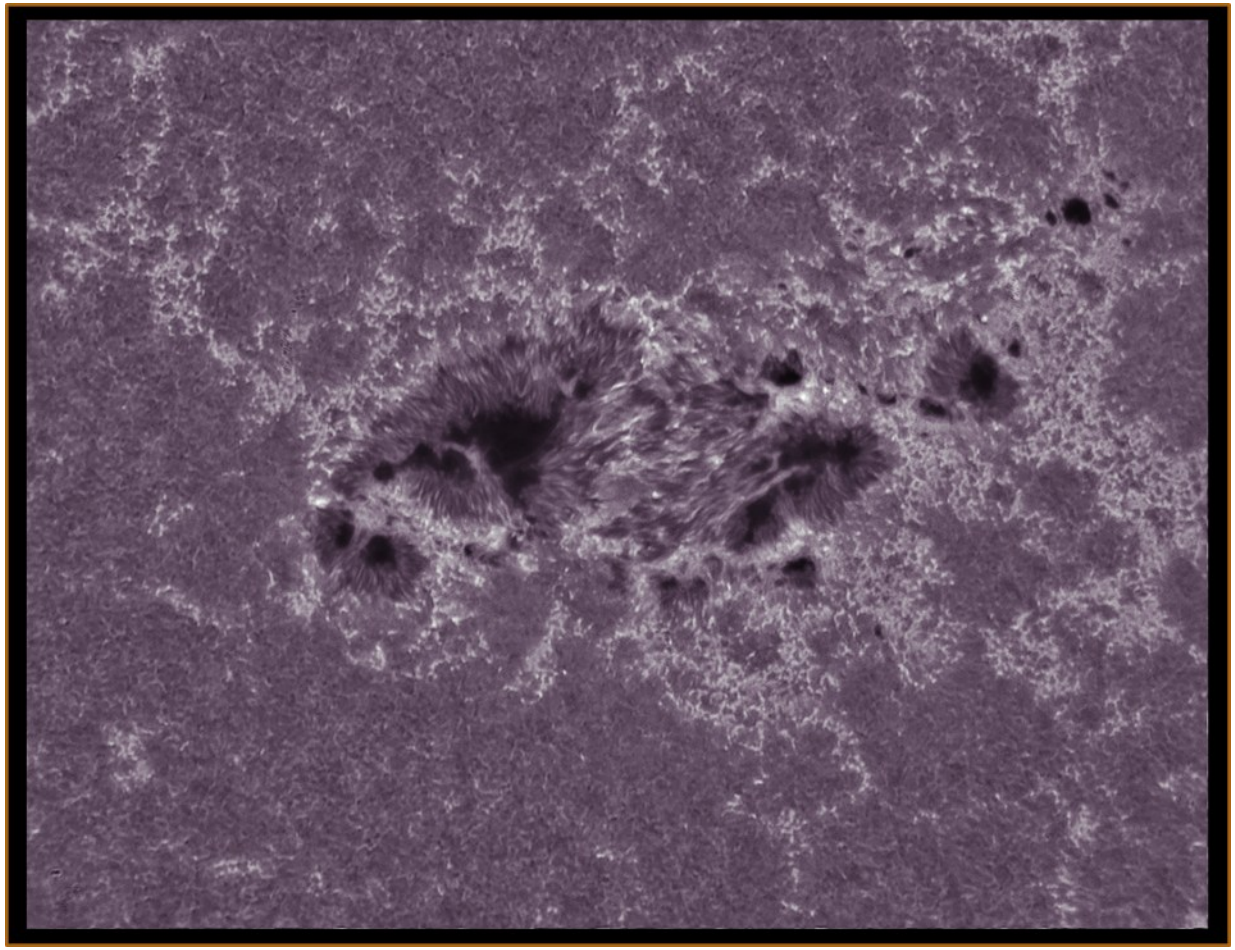
Heliostar Image of the Sun
Credit: Alexandra Hart

Solar Imaging in Calcium II K

ANTILIA

LUNT

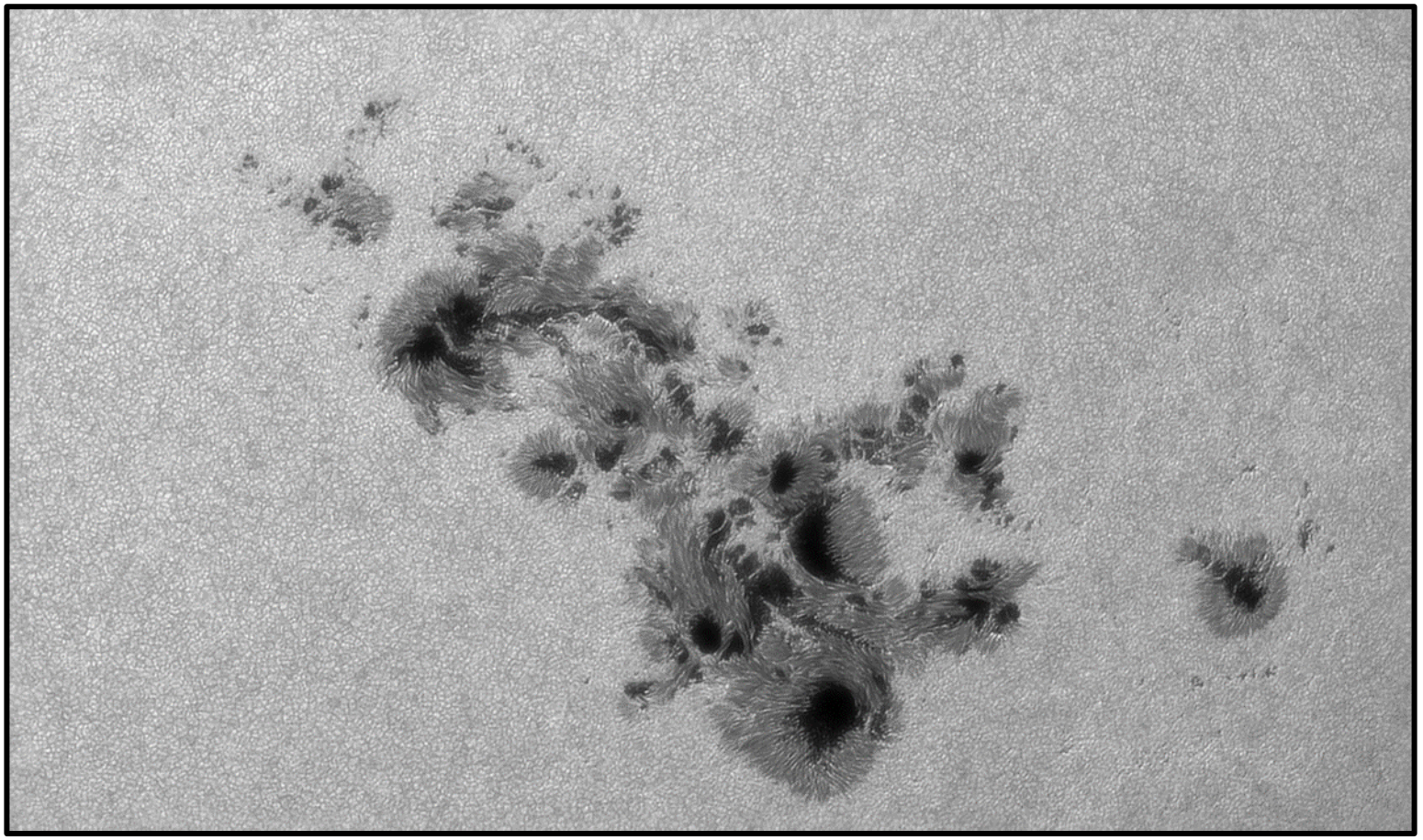
Solar Imaging in Calcium II K



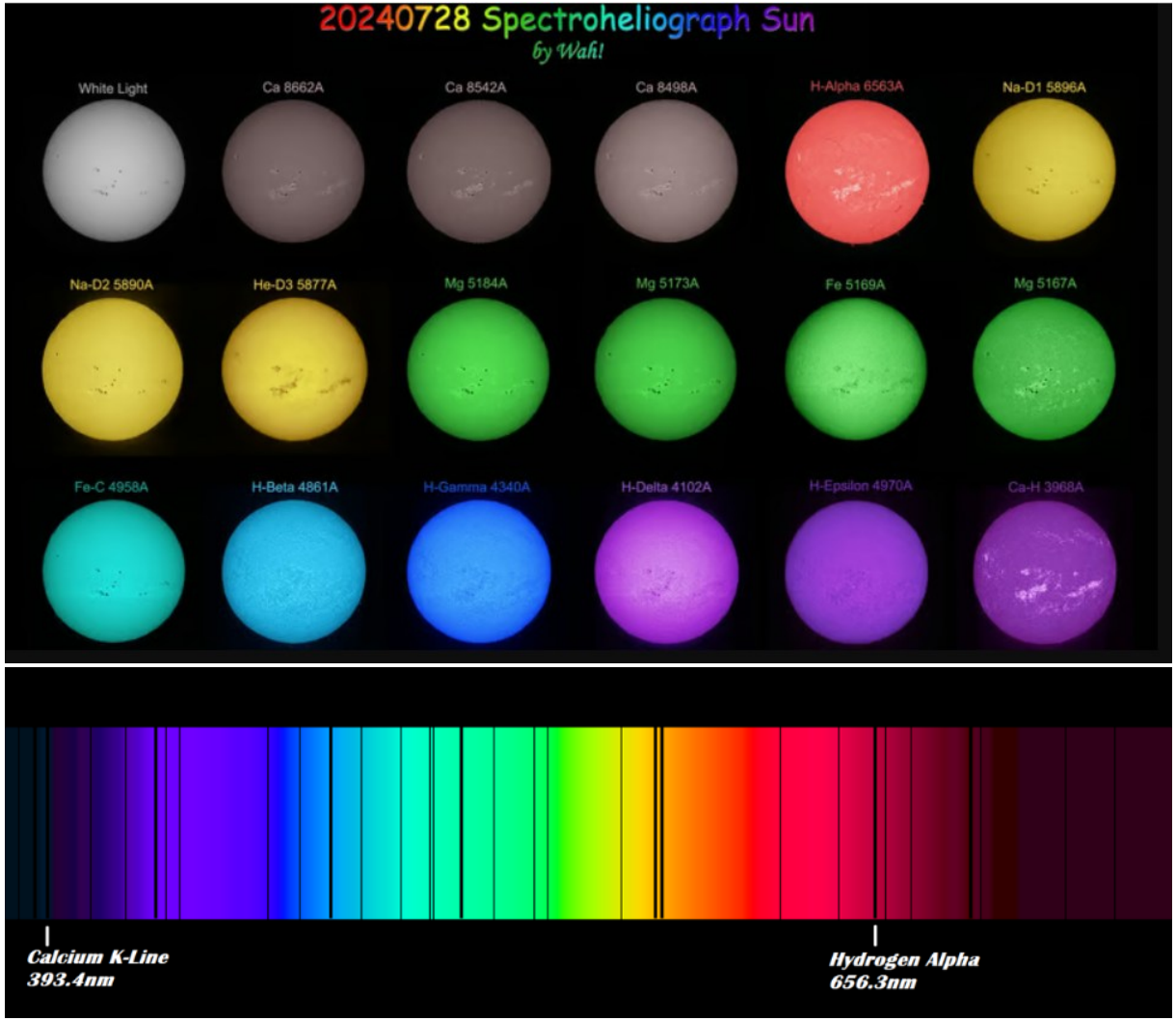
Calcium II K Image of an Active Region on the Sun
125mm Refractor with Lunt CaK Module

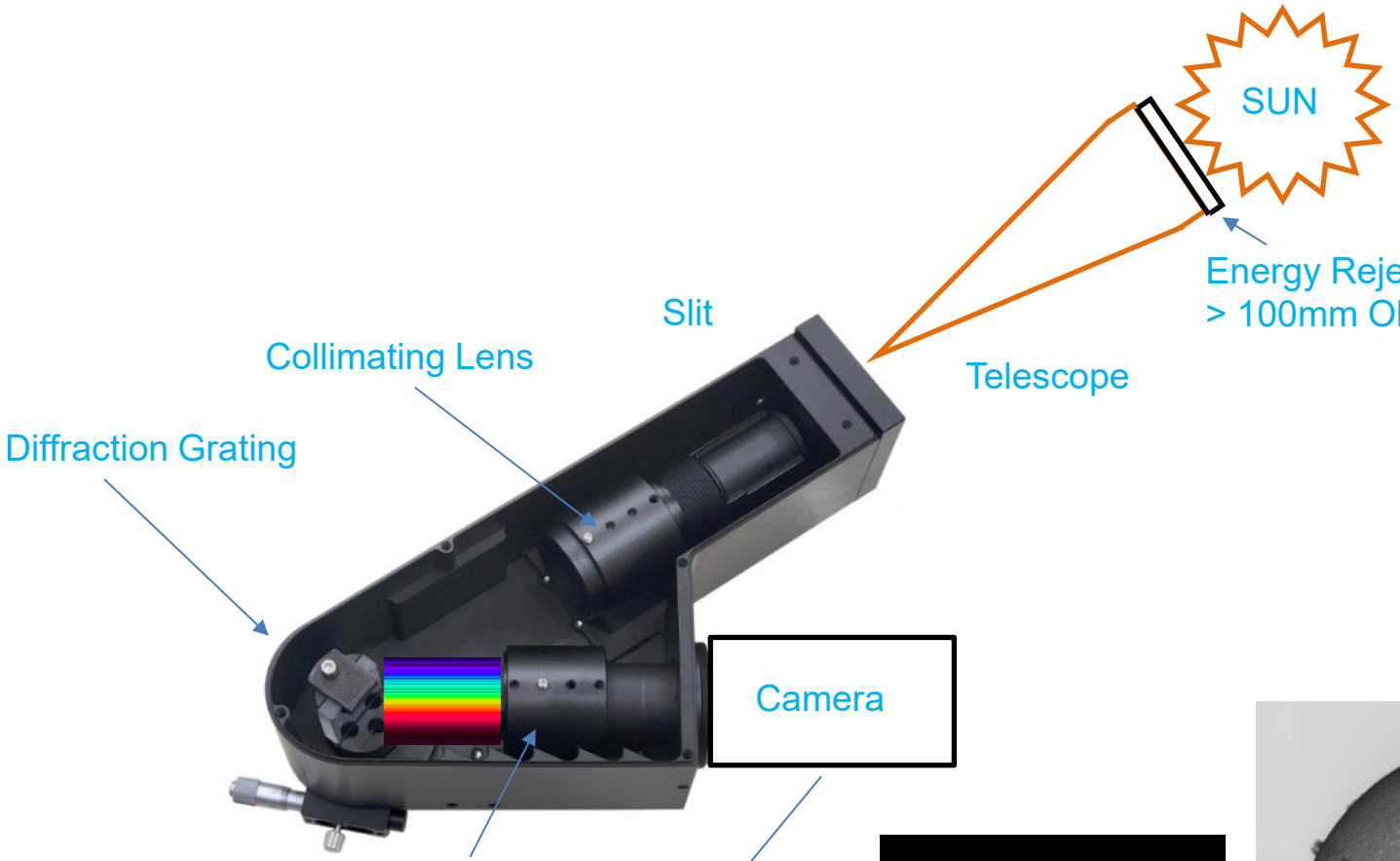
Solar Imaging in G-Band (430nm)

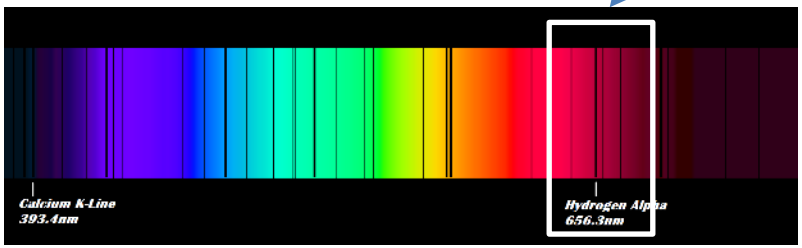
Solar Imaging in G-Band (430nm)



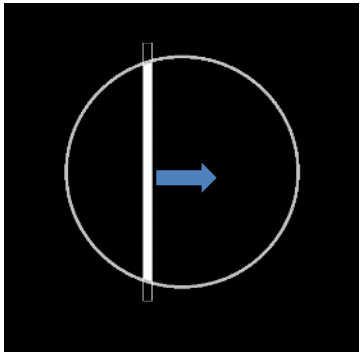
Sun Across the Spectrum
Spectroheliography



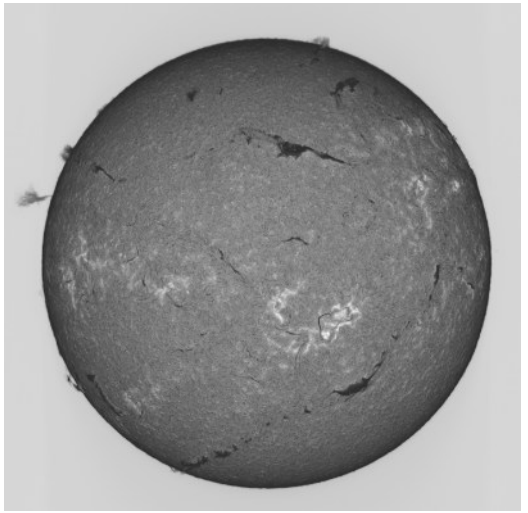




Region of Interest (ROI)



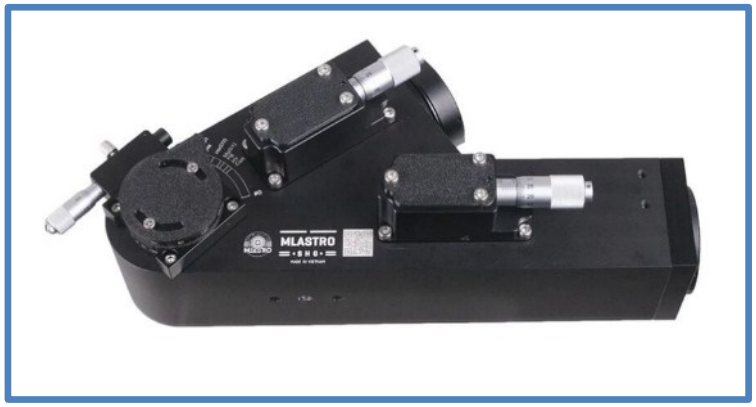
Slit Scanning Across Solar Disc



Recreated Image from multiple scans

Sun Across the Spectrum

MLAstro Spectroheliograph SHG700



Sol'Ex

Sunscan

https://mlastro.com/mlastro-shg

https://solex.astrosurf.com/sol-ex-presentation-en.html

https://www.sunscan.net/

Sun Across the Spectrum

Credit: Nic Spencer

Credit: The Sunscan Project

Helios (Luke Jerram)

Helios at Downham Estate, London. Photo (c) Luke Agbaimoni

https://my-helios.org/

Thank You