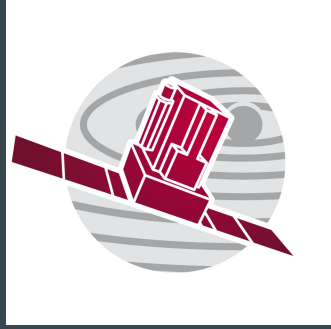
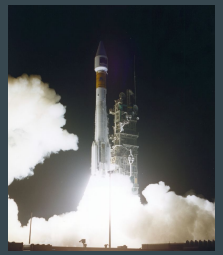
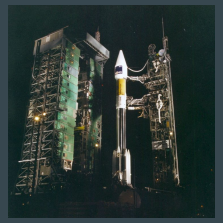


SOHO

Solar and Heliospheric Observatory

Basic Facts





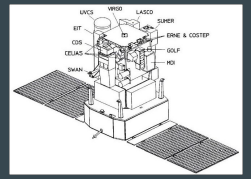
launched 2 December 1995

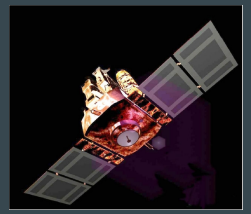
Initial lifetime: 2y, observing the Sun for 25 years

ESA and NASA collaboration

spacecraft built in Europe, equipped with 12 instruments

Costs a 100 mil Eur





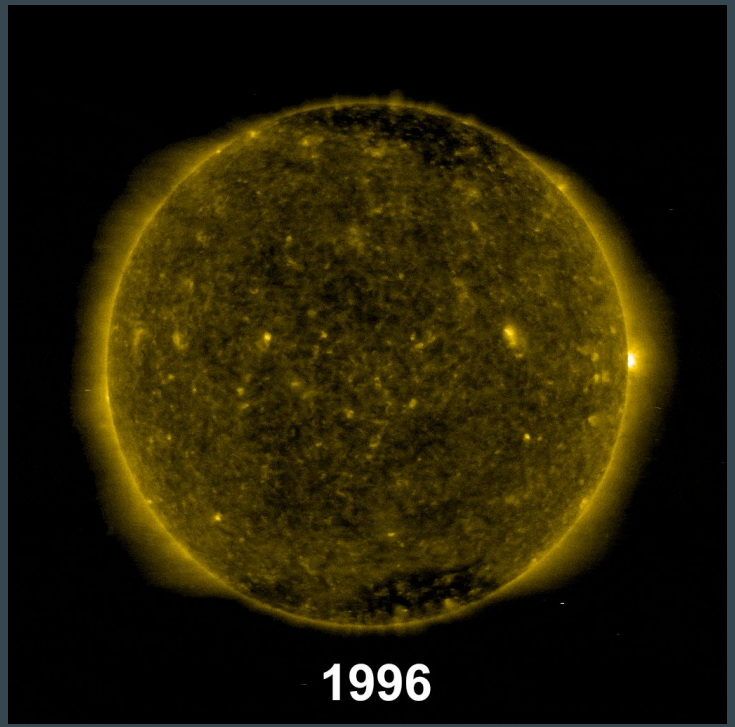
Objectives

What is the structure and dynamics of the solar interior?

Why does the solar corona exist and how is it heated to the extremely high temperature of about 1 000 000°C?

Where is the solar wind produced and how is it accelerated?

Designed to study...



- the internal structure of the Sun
- its extensive outer atmosphere and the origin of the solar wind
- the stream of highly ionized gas that blows continuously outward through the Solar System

SOHO IN NUMBERS

esa

30 000
coronal mass ejections

2 solar cycles

4 000
comets

0
gyros

25
years

20 million
images

15
years on ground stations

300
PhD theses

2.4 million
command blocks sent

50 TB
data in SOHO archive

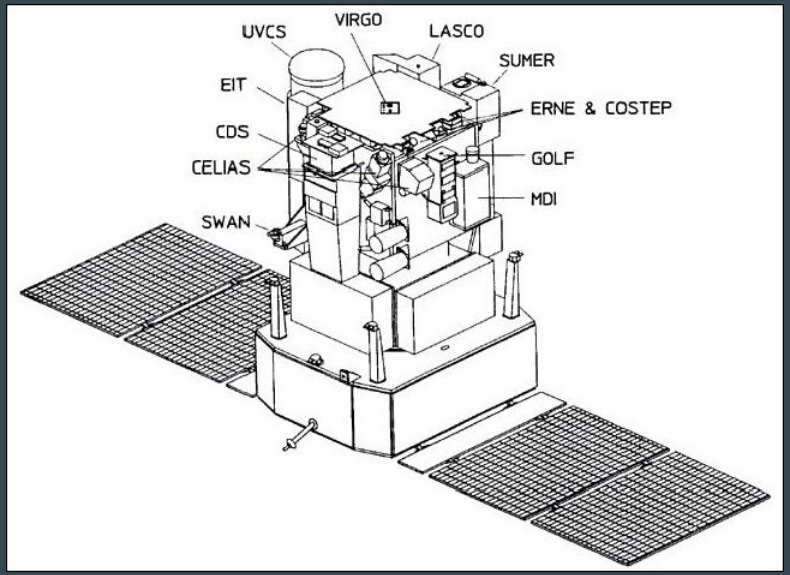
6 000
papers published

#SpaceCare #ExploreFarther

ESA | NASA
soho

Onboarded Instruments

Coronal Diagnostic Spectrometer (CDS)
Charge, Element, and Isotope Analysis System (CELIAS)
Comprehensive Suprathermal and Energetic Particle Analyzer (COSTEP)
Extreme ultraviolet Imaging Telescope (EIT)
Energetic and Relativistic Nuclei and Electron experiment (ERNE)
Global Oscillations at Low Frequencies (GOLF)
Large Angle and Spectrometric Coronograph (LASCO)
Michelson Doppler Imager/Solar Oscillations Investigation (MDI/SOI)
Solar Ultraviolet Measurements of Emitted Radiation (SUMER)
Solar Wind Anisotropies (SWAN)
UltraViolet Coronograph Spectrometer (UVCS)
Variability of Solar Irradiance and Gravity Oscillations (VIRGO)

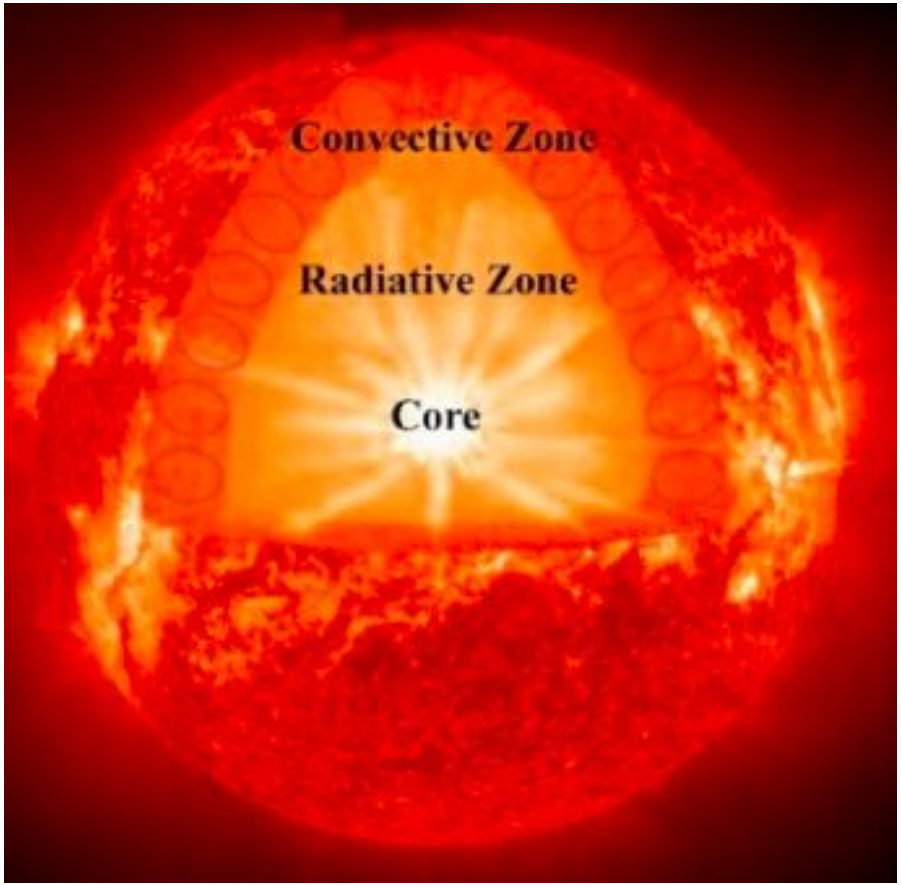


Dimensions: 4.3×2.7×3.7m (9.5m with solar arrays deployed)

Results

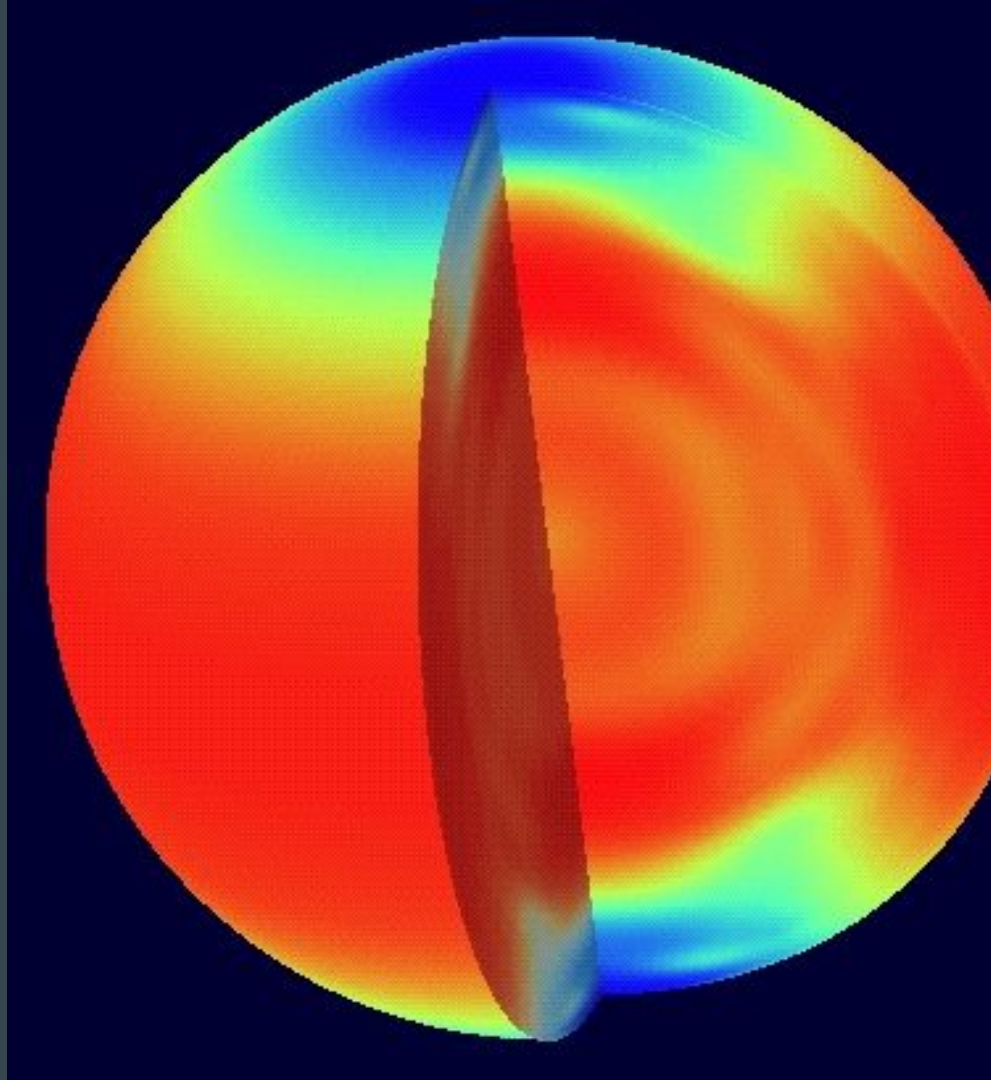
Star's Convection Zone

Revealing the first images ever of a star's convection zone (its turbulent outer shell) and of the structure of sunspots below the surface



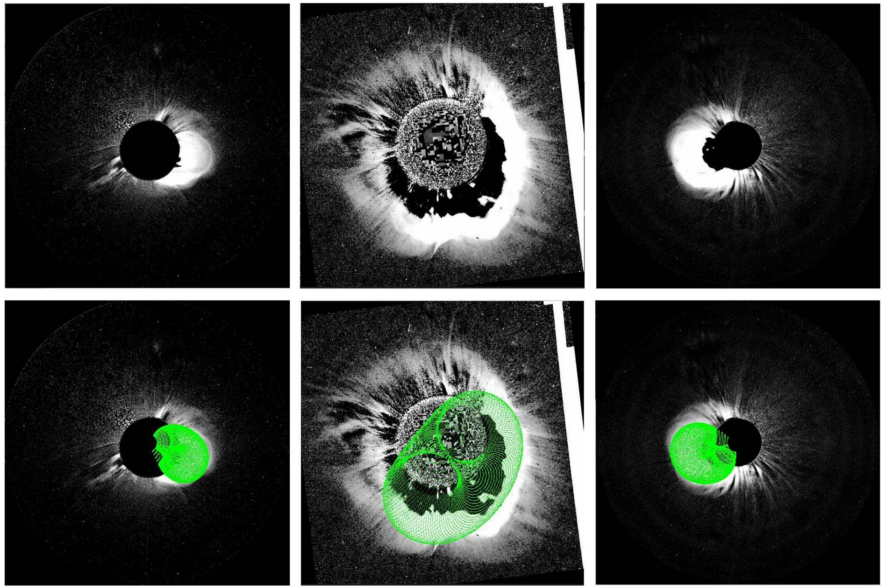
Precise Solar Interior

Providing the most detailed and precise measurements of the temperature structure, the interior rotation, and gas flows in the solar interior



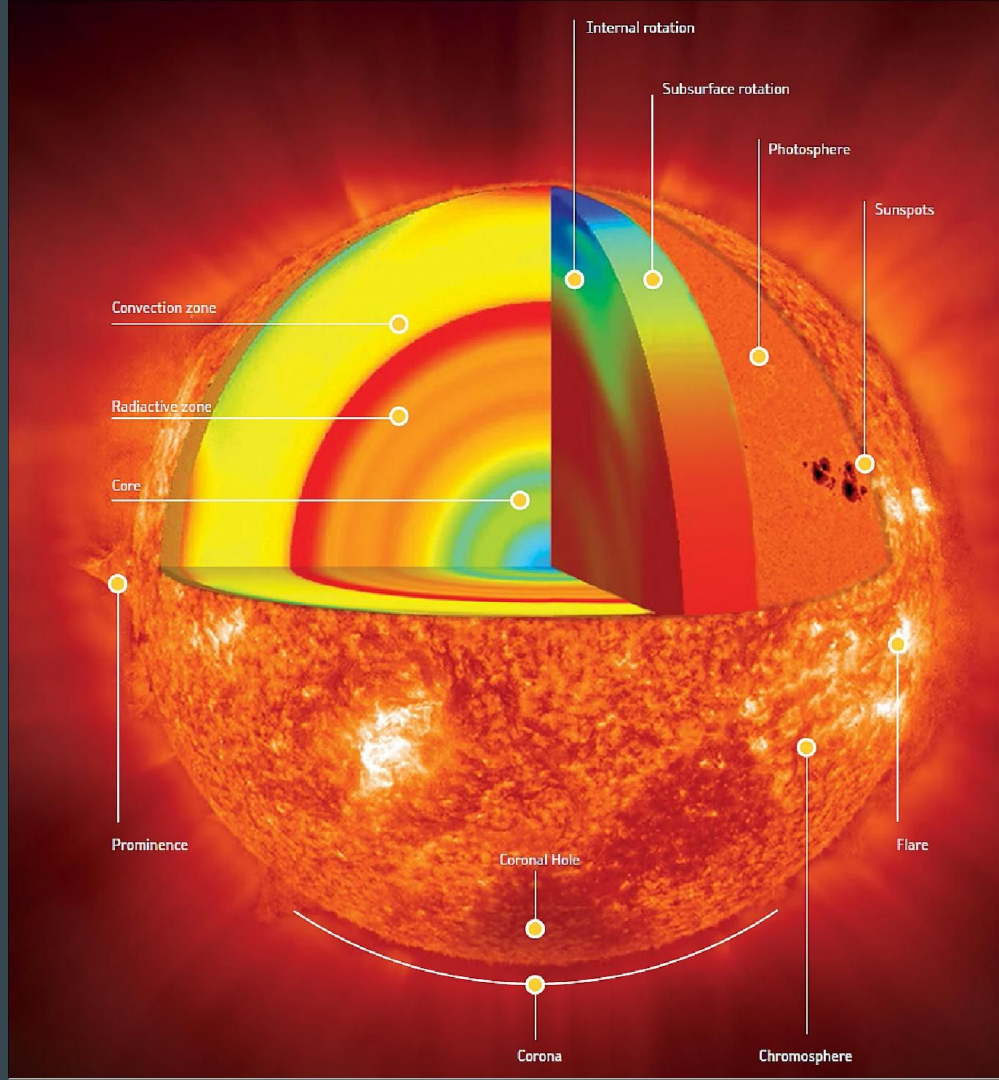
Solar Wind Acceleration

Measuring the acceleration of the slow and fast solar wind



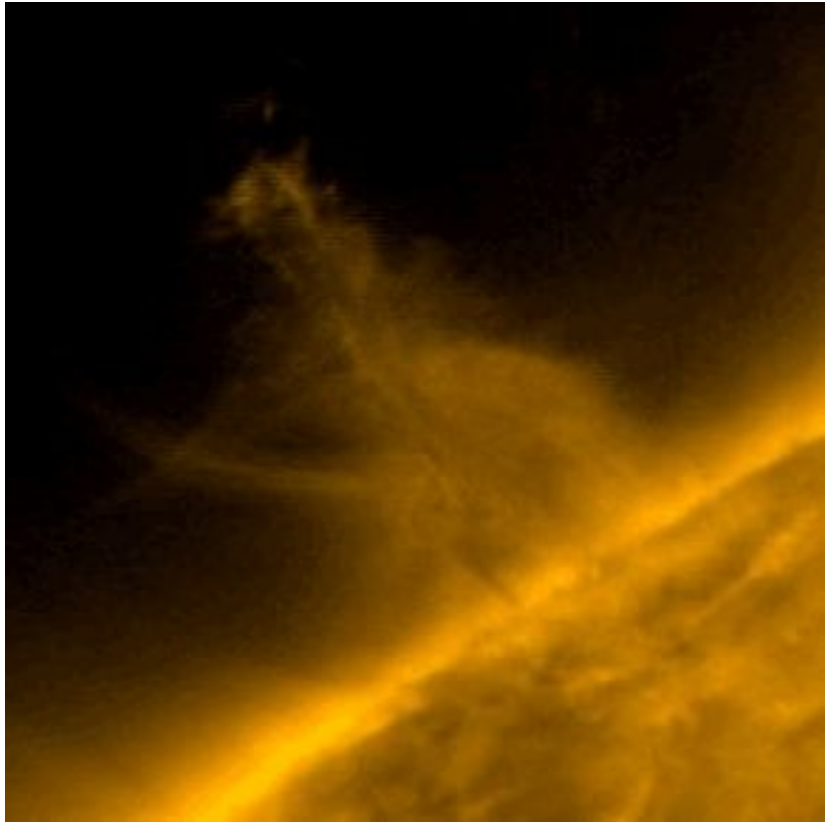
Magnetically "Open" Regions

Identifying the source regions and acceleration mechanism of the fast solar wind in the magnetically "open" regions at the Sun's poles



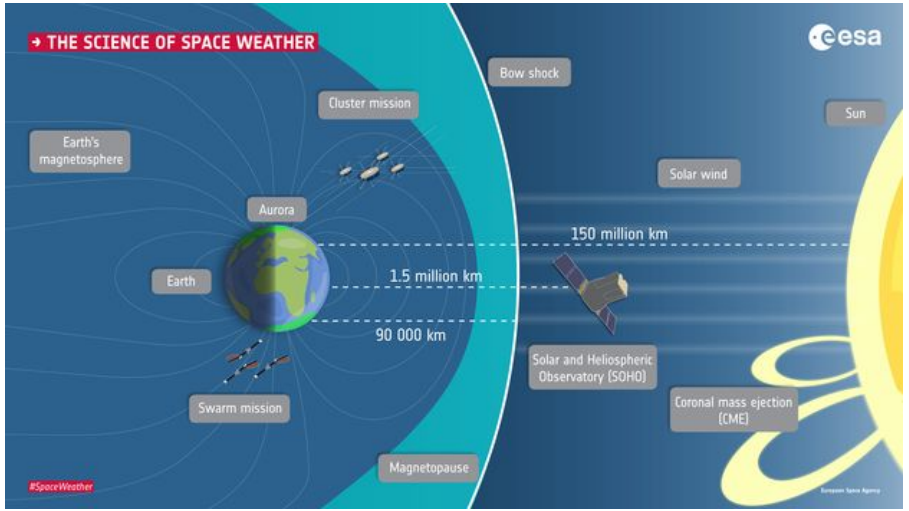
Solar Tornadoes

Discovering new dynamic solar phenomena such as coronal waves and solar tornadoes



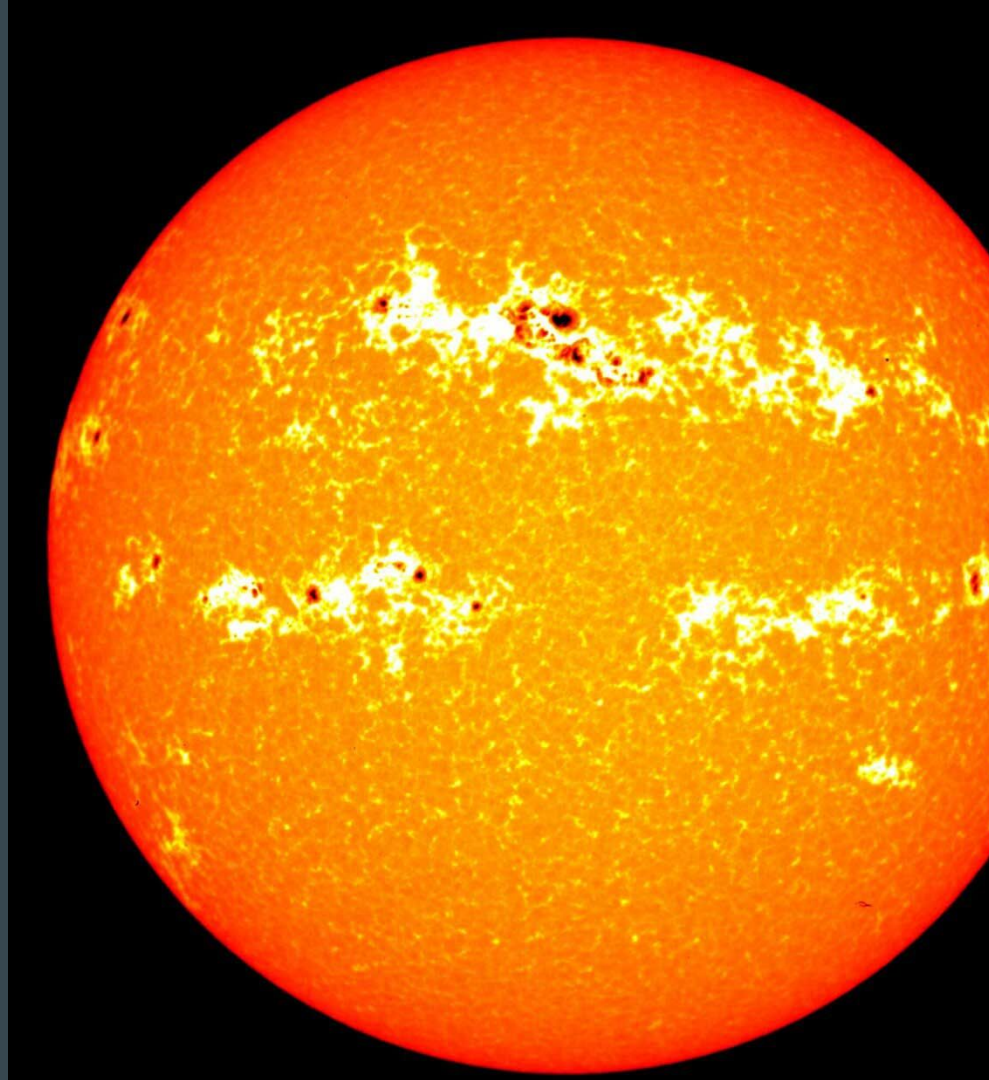
Space Weather Forecast

Revolutionizing our ability to forecast space weather, by giving up to three days notice of Earth-directed disturbances, and playing a lead role in the early warning system for space weather



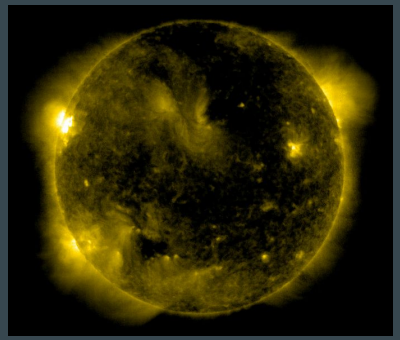
Solar Irradiance

Monitoring the total solar irradiance (the ‘solar constant’) as well as variations in the extreme ultra violet flux, both of which are important to understand the impact of solar variability on Earth’s climate.

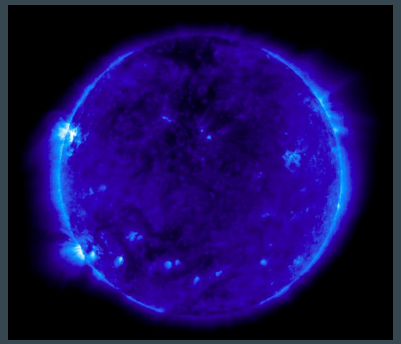


SOHO Webcam <link> / As of 22-Aug-2021

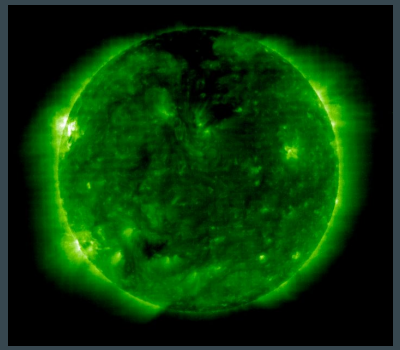
EIT 284



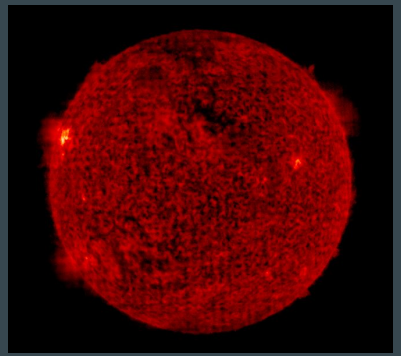
EIT 171



EIT 195



EIT 304



Data Processing

SunPy contains sample images from many instruments, including EIT at 195 Anstrom.

Libs — Map — Load — Show

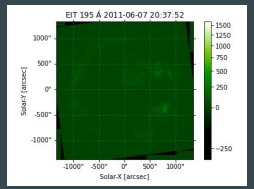
Imports

```
sunpy, sunpy.map,
sunpy.data.sample, Fido,
attrs

matplotlib.pyplot

from astropy.units import
AA
```

.

Data Mapping

```
eit =
sunpy.map.Map(sunpy.data.samp
le.EIT_195_IMAGE)

eit.peek()
```

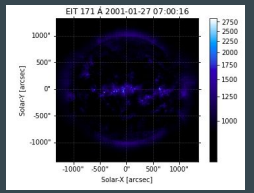


Data Load

```
qr = Fido.search(
a.Time(datetime(2001, 1, 1),
datetime(2010, 12, 31)),
a.Instrument.eit,
a.Wavelength(171 * AA)  )

files = Fido.fetch(qr[:, 100:101])
```

Visualization

```
img = sunpy.map.Map(files)

img.peek().
```



Links

- https://esamultimedia.esa.int/docs/science/soho/index.html
- https://www.geocam.ru/en/online/soho-eit-171/
- https://space.skyrocket.de/doc_sdat/soho.htm