## Heliophysics

Understanding the Sun and its interactions with Earth and the solar system, including space weather

> Holly Gilbert Director, High Altitude Observatory National Center for Atmospheric Research





# Our Violent Sun

# Importance of Space Weather

July 2012: the most intense solar storm observed in 150 years

 Had it been 1 week earlier, it would have hit Earth

# March 13, 1989: A "Carrington"–like event

widespread power outages across the Northeast USA and Canada





### Heliophysics: a multi-scale challenge







### Transformational Innovations

#### **Thermal Protection System**



8ft-wide and 4.5in-thick Carbon composite shield Reaches 2,500 deg F











#### **State of the Art Instrumentation**

Exposed Solar Probe Cup Special material w/ M.P. 4,260 deg F Wiring suspended in sapphire crystal tubes



### **Solar Orbiter Payload**



#### **In-Situ Instruments**

- EPD Energetic Particle Detector
- MAG Magnetometer
- **RPW** Radio & Plasma Waves
- SWA Solar Wind Analyser

- Composition, timing and distribution functions of energetic particles
- High-precision measurements of the heliospheric magnetic field
  - Electromagnetic and electrostatic waves, magnetic and electric fields at high time resolution
- Sampling protons, electrons and heavy ions in the solar wind

#### **Remote-Sensing Instruments**

- EUI Extreme Ultraviolet Imager
- Metis Coronagraph
- PHI Polarimetric & Helioseismic Imager
- SoloHI Heliospheric Imager
- SPICESpectral Imaging of the<br/>Coronal EnvironmentSTIXSpectrometer/Telescope for<br/>Imaging X-rays



- High-resolution and full-disk (E)UV imaging of the ondisk corona
- Visible and UV Imaging of the off-disk corona
- High-resolution vector magnetic field, line-of-sight velocity in photosphere, visible imaging
  - Wide-field visible imaging of the solar off-disk corona
- EUV imaging spectroscopy of the solar disk and near-Sun corona
- Imaging spectroscopy of solar X-ray emission





### Solar Orbiter's 10-year journey in 35 seconds





# Thank you