Solar Polarimetry from the Stratosphere:

The SUNRISE Mission

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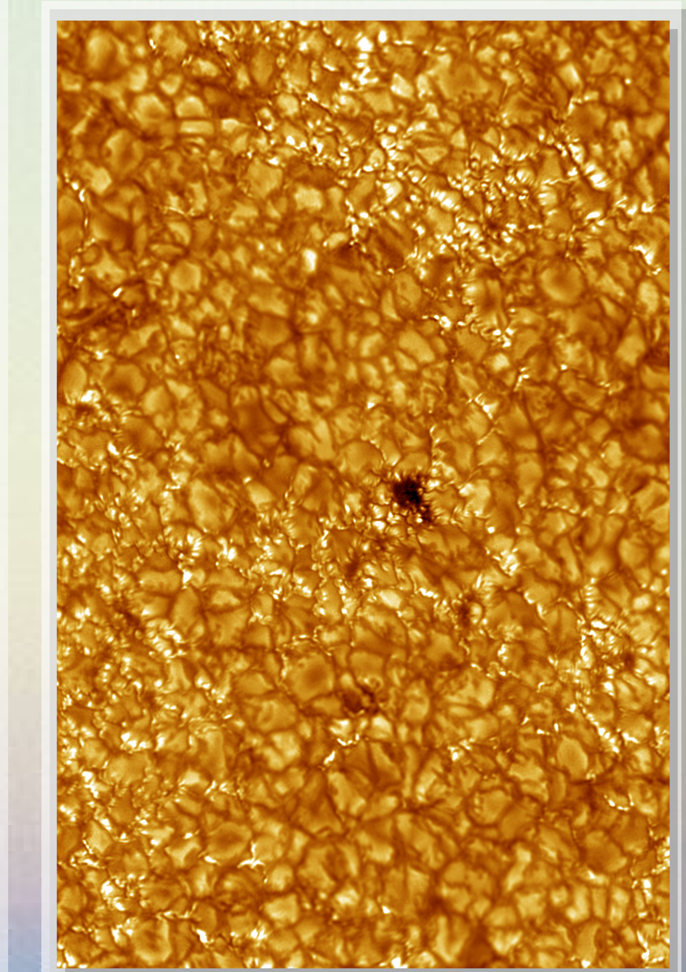
SUNRISE science goals

The strong structuring of the magnetic field in the lower solar atmosphere is the key to understanding the physical processes underlying solar activity. The central aim of the ***Sunrise*** project is therefore to determine the relevant physical quantities (magnetic and velocity field, temperature, …) on the intrinsic spatial scale of the magnetic structure (~100 km and below), over extended time periods (days, for active region development) and over large areas of the solar surface (50-100 Mm to follow the magnetic connectivity).

Measurements made by the ***Sunrise*** instruments will allow us to address a number of basic scientific problems of solar and stellar astrophysics:

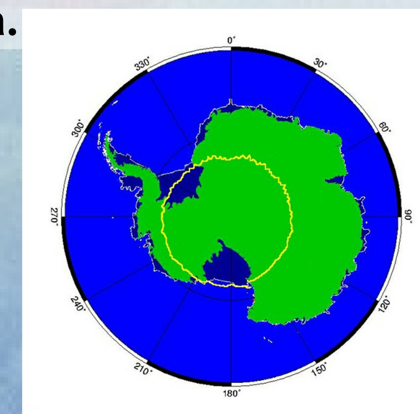
- **What are the origin and the properties of the intermittent magnetic structure?**
- **How is the magnetic field brought to and removed from the solar surface?**
- **What is the physical nature of the chromosphere?**
- **How does the field provide momentum and energy for the outer solar atmosphere?**
- **How does the magnetic field variation modify the solar brightness?**



SUNRISE mission concept

SUNRISE is an international project for planning, construction, and operation of a balloon-borne solar telescope under system lead of the Max-Planck-Institute for Solar System Research (MPS) in Germany.

starting from 2008 the SUNRISE telescope will fly in a series of long duration balloon flights (10-14 days) over Antarctica.

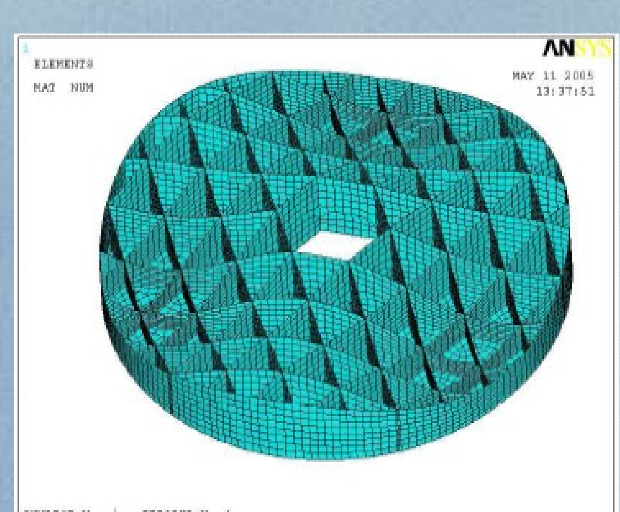


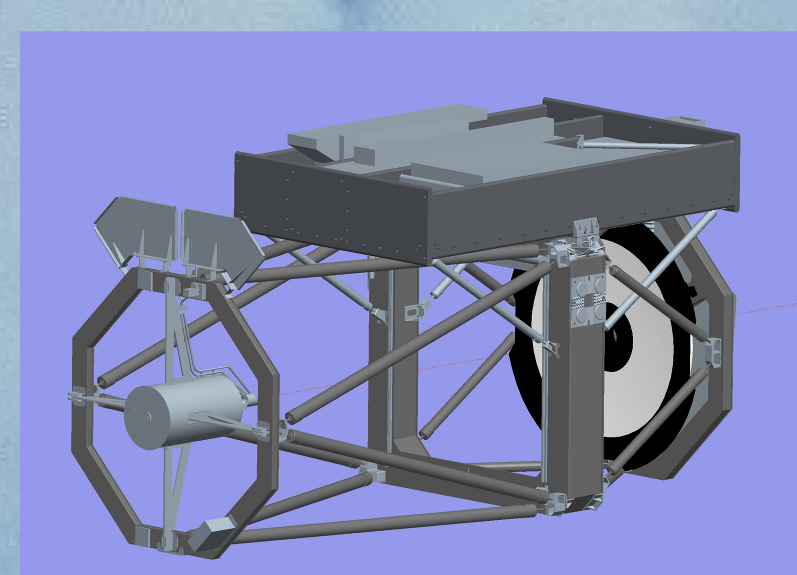
A stratospheric ballon flight offers:

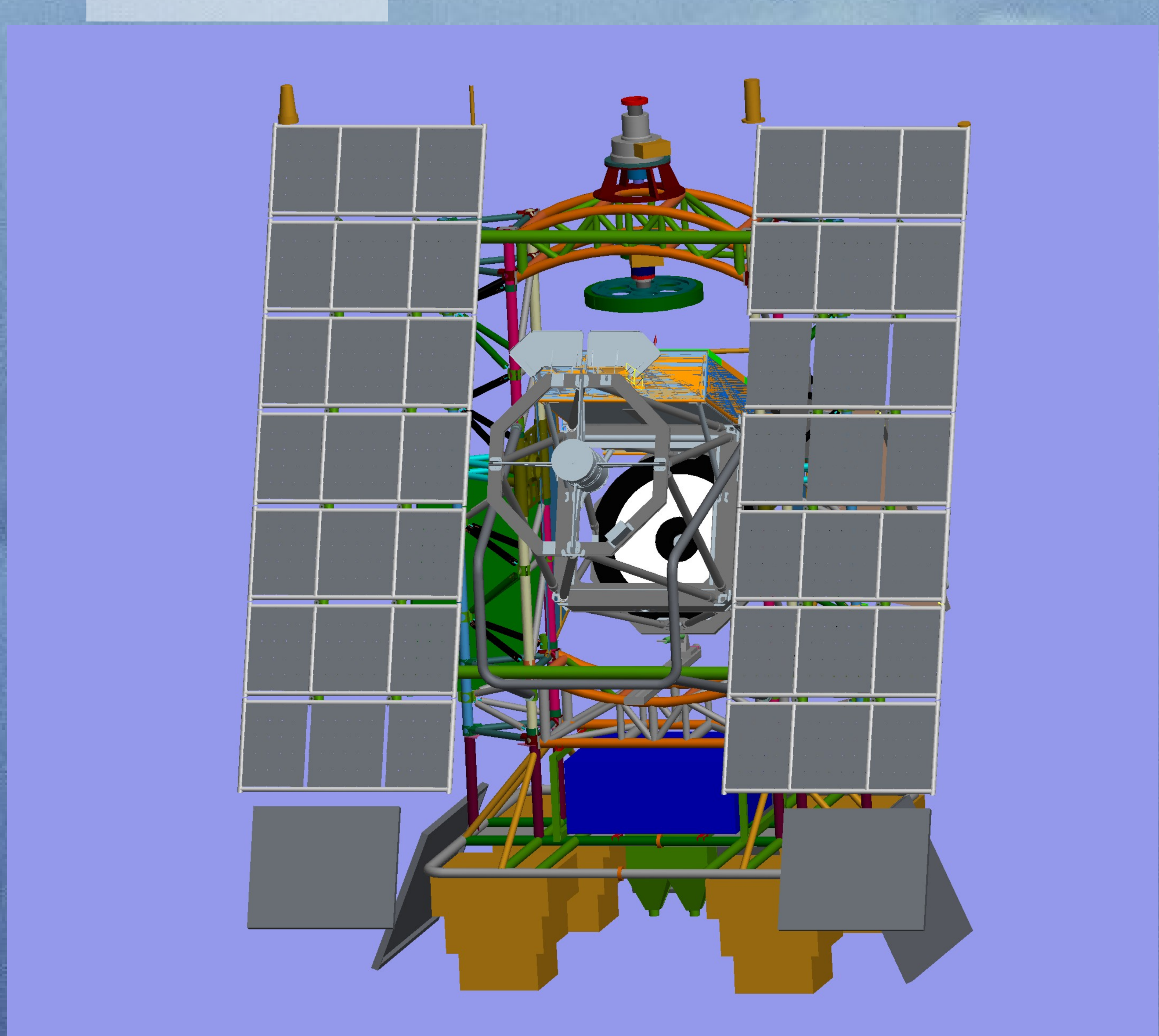
- access to the UV-B range including the chromospheric Mg II h&k lines
- observations of the solar surface free from seeing
- uninterrupted observations for several days to follow evolution of active regions
- spectroscopy and spectropolarimetry with constantly high spatial resolution
- possibility of multiple flights during different phases of the solar activity cycle
- possibility to fly large and complex science payload

SUNRISE telescope

- **1 m ZERODUR light weight mirror**
- **“trefoil” design, open back**
- **edge thickness 175 mm**
- **mass 41 kg,**
- **3-point mirror mounting with flexures**







SUNRISE instrumentation

1m lightweight Gregory telescope with active alignment control

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3 scientific post-focus instruments:

-SUFI: SUNRISE filter imager:

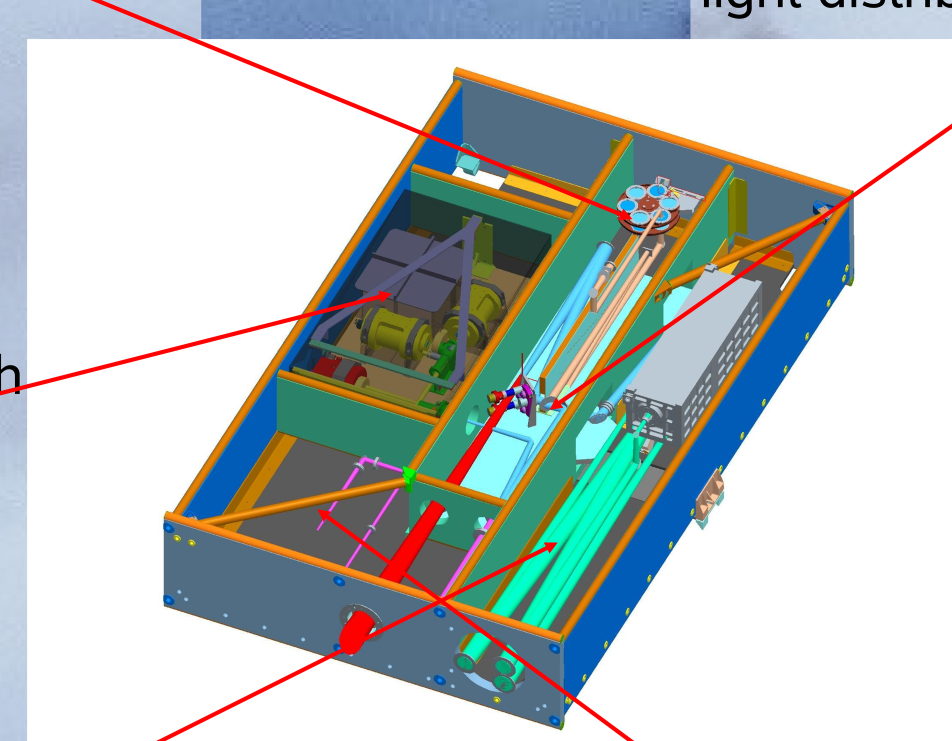
uses phase diversity to yield diffraction limited images of solar surface structures in four distinct wavelength bands: 225nm, 300nm, 313nm, 388nm

-IMaX: Imaging Magnetograph eXperiment:

narrowband-filtergraph to record Doppler maps and full Stokes magnetograms in Fe I 525nm line

-SUPOS: SUNRISE polarimetric spectrograph:

records full Stokes spectra in Fe I 630.2nm line pair to constrain magnetic field topology; simultaneously records intensity spectra in Mg II k line at 279.6nm



2 scientific support units:

ISLID : Image stabilization and light distribution unit

ensures ability of simultaneous observations with all three science instruments and corrects for image movement

-CWS: Correlation tracker and wavefront sensor

measures dynamic image shift and static wavefront errors to control pointing and telescope alignment