

WP 80: **Synoptic Observations: Solar Physics Research Integrated Network Group (SPRING)**

Lead Institution: **Kiepenheuer-Institut für Sonnenphysik, Freiburg, Germany**

Participants: **IAC, KIS, INAF, MPG, QUB, AISAS, AIASCR, IGAM, UoB, NSO, HAO**

Objectives:

Real-time full-disk data showing the large-scale dynamics and magnetism at different layers of the solar atmosphere are crucial to understand the global behavior of solar phenomena. However, despite the amount of information coming from space and ground-based full-Sun telescopes, real-time information about the variation of important parameters such as velocities, magnetic field and intensity at different solar layers is still lacking.

To this aim, the first steps towards a new network of ground-based solar telescopes were taken that provides invaluable data to answer crucial questions of solar physics.

Science Requirement Study

Solar physics currently aims at solving the following big scientific questions:

- How is the solar magnetic field generated, maintained and dissipated?
- How are the solar corona and the solar wind maintained and what determines their properties?
- What triggers transient energetic events?
- How does solar magnetism influence the internal structure and the luminosity of the Sun?

To define the scientific objectives to be achieved by high-quality synoptic observations four working groups were formed:

Group 1: Synoptic magnetic fields

Chair: A. Pevtsov

Group 2: Solar seismology

Chair: R. Jain

Group 3: Transient events

Chair: M. Sobotka

Group 4: Solar Awareness

Chair: I. Ermolli

Workshops held:

Synoptic Network Workshop, April 22– 24, 2013, Boulder

1st SPRING Meeting, November 25 – 28, 2013, Titisee

2nd SPRING Meeting, November 25 – 28, 2015, Tatranska Lomnica

3rd SPRING Meeting, May 16 – 18, 2016, Boulder



Result:

Science Requirement Document

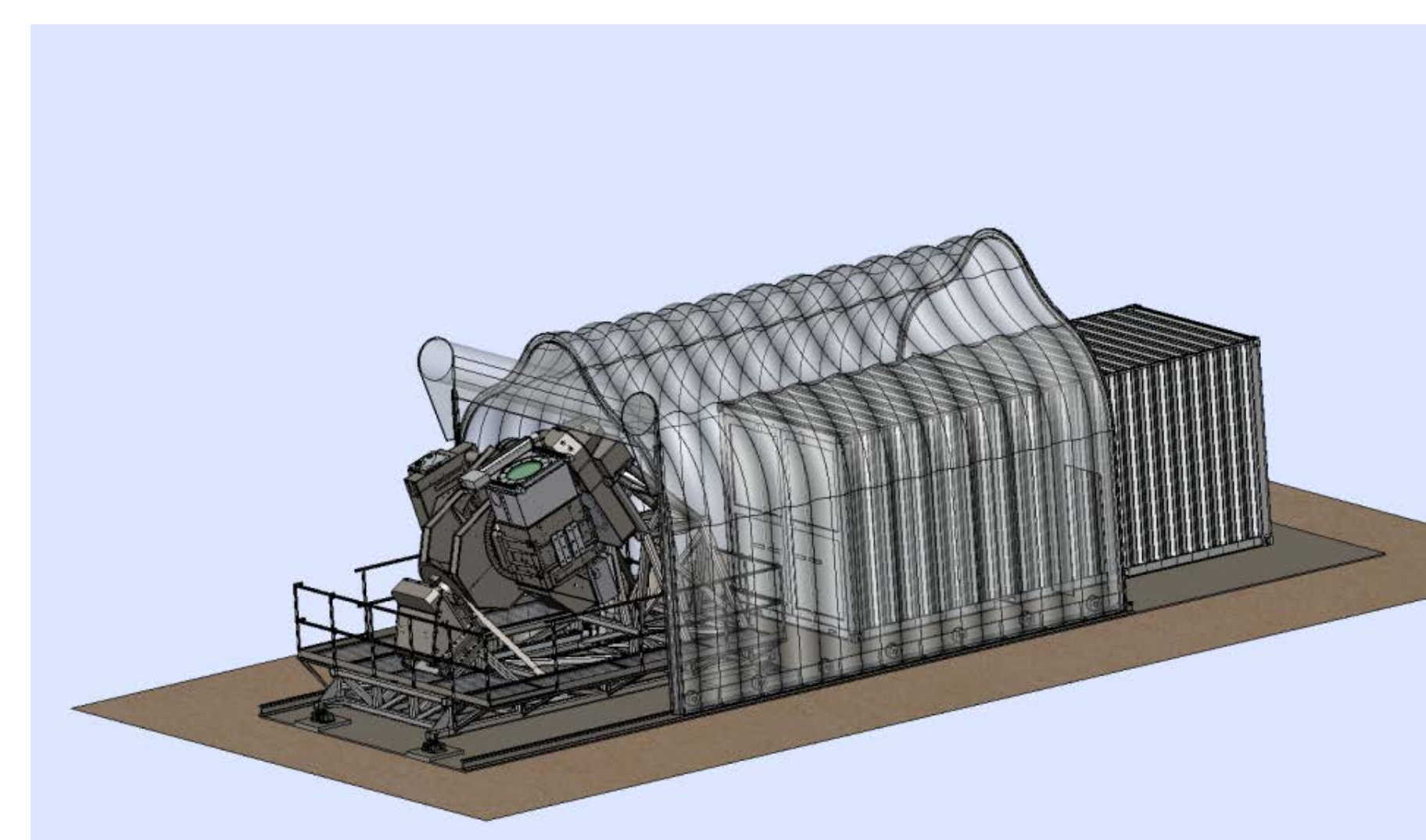
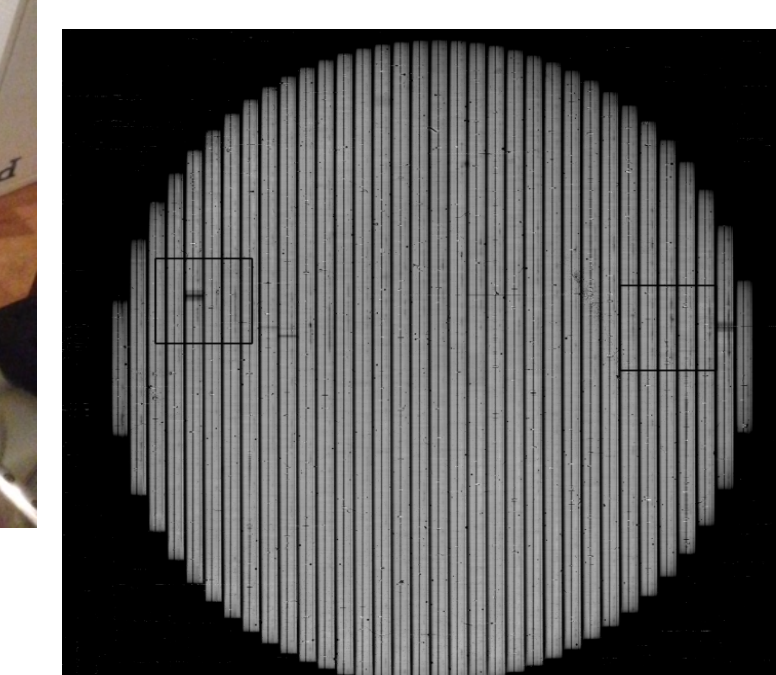
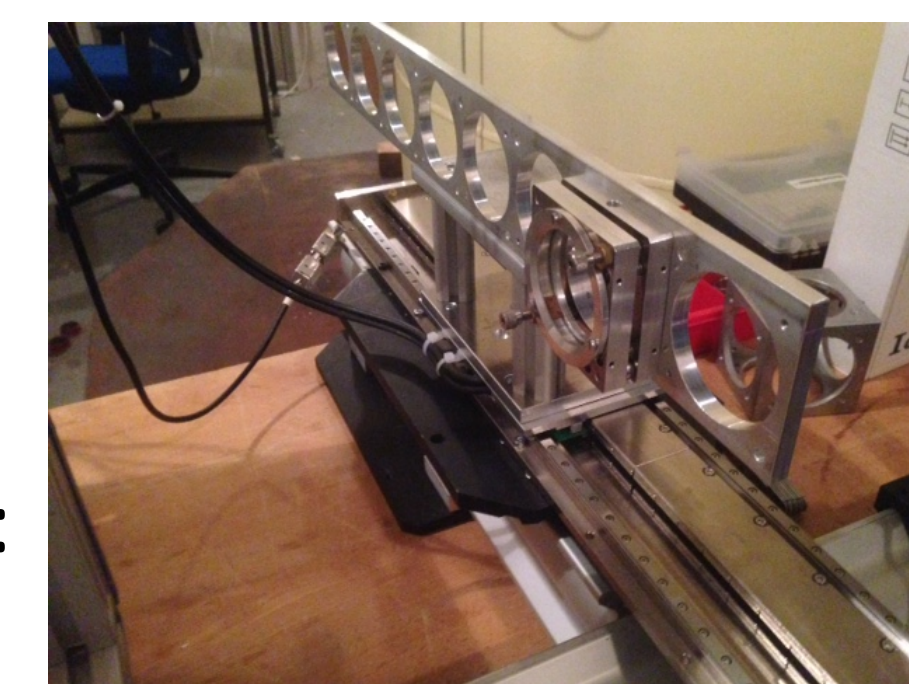
<http://www.science-media.org/paperPage.php?v=251>



Feasibility Study

Several technical concepts were studied.

- **Filtergraph** demonstration instrument: HELLRIDE @ VTT, Izana
- **Slit spectrograph** demonstration instrument: Multiplexed Slit Spectrograph, IfA, Hawaii
- **Interferometer** demonstration instrument: GONG, NSO



*Concept of a new ground-based synoptic network node:
A platform that carries multiple instruments*

Specifications of the expected observations:

1m telescope as a light bucket; 1" resolution, 4k x 4k camera

Five spectral lines; 20 wavelength bins per spectral line

Cadence: 10 sec; flare mode with higher cadence but only in case of events

Full Stokes vector (=4 components)

Estimation of the expected data rate: 150 GB/minute

After data compression: ~80 GB per minute

Expected advantages by continuous multi-line synoptic observations:

- Improved 3-D magnetic topology of active region magnetic fields
- Improved coronal field extrapolations in upper layers of solar atmosphere
- Vector magnetometry for near real time space weather predictions
- Flare related changes in magnetic fields & electric currents in the chromosphere
- Resolution of azimuth disambiguation of magnetic field
- Long-term magnetic field records with improved spatio-temporal resolution
- Improved accuracy and precision of helioseismology in vicinity of active regions
- Reduction in systematic errors (i.e., improved accuracy)
- Multi-height observation for seismic mapping of solar atmosphere
- Understanding of convective energy transport through solar atmosphere