IAU COMMISSION E2 – SOLAR ACTIVITY

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ANNUAL REPORT 2019

IAUS 354: SOLAR AND STELLAR MAGNETIC FIELDS: ORIGINS AND MANIFESTATIONS, COPIAPÓ, CHILE, JUNE 30 – JULY 6, 2019

This symposium, coordinated by Division E, attracted over 200 registered participants. Its major focus was on observations and understanding of solar magnetic fields with emphasis on the context provided by other stars. Major themes included: diagnostics of solar and stellar magnetic fields; solar/stellar interior dynamics and dynamos; stellar rotation and magnetism; role of magnetic fields in solar and stellar variability; star-planet relations; formation, structure and dynamics of solar and stellar coronae and winds; mechanisms of flaring and CME activity on the Sun and stars; surface magnetic fields of cool stars; observations of solar eclipses and exoplanetary transits.
The meeting coincided with the total solar eclipse of July 2. Participants enjoyed excellent conditions for observing the eclipse from sites to the south of Copiapó.

MAJOR NEW FACILITIES

The year 2019 was momentous for studies of the Sun. The advent of three major solar observational facilities, one ground-based and two in space, will revolutionize and transform our understanding of solar activity for many years to come. With these facilities in place, the Active Sun is hoped to give up many of its secrets.

PARKER SOLAR PROBE

The Parker Solar Probe (operated by NASA/APL) launched in August 2018 and completed its fourth perihelion (inside 27 $R_\odot$) in January 2020. PSP will eventually dip below 10 $R_\odot$ during its last perihelia. First findings were announced in December 2019, with a major *Astrophysical Journal* supplement *"Early Results from Parker Solar Probe: Ushering a New Frontier in Space Exploration"* presenting around 50 science papers resulting from the mission.

The primary Science Goals are focussed on the corona and solar wind and are intrinsically linked to solar activity:

- Trace the flow of energy that heats and accelerates the solar corona and solar wind.
- Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind.
- Explore mechanisms that accelerate and transport energetic particles.

As well as performing *in situ* measurements, PSP carries an imaging instrument, WISPR, designed to explore the structure of the solar corona near the Sun.

DANIEL K INOUYE SOLAR TELESCOPE (DKIST)

DKIST (operated by NSO) is a four-meter solar telescope situated on the island of Maui, Hawaii, making it currently the world's largest. It saw first light in December 2019. DKIST provides unprecedented spatial, temporal and spectral resolution and dynamic range. Spatial resolutions of below 0.1 arcsec with a 5-second integration time in the near-infrared will allow researchers to resolve the fundamental scales of the magnetic solar atmosphere.

The fundamental science questions addressed by DKIST include:

- How are cosmic magnetic fields generated and how are they destroyed?
- What role do cosmic magnetic fields play in the organization of plasma structures and the impulsive releases of energy seen ubiquitously in the universe?
- What are the mechanisms responsible for solar variability (that ultimately affects the Earth)?

First-generation instruments available on DKIST include: Visible Broadband Imager (VBI), Visible Spectro-Polarimeter (ViSP), Visible Tunable Filter (VTF), Diffraction-Limited Near-InfraRed Spectro-Polarimeter (DL-NIRSP), and Cryogenic Near-InfraRed Spectro-Polarimeter (Cryo-NIRSP).

SOLAR ORBITER

Solar Orbiter (operated by ESA/NASA) launched in February 2020 (not quite fitting into 2019, but very close). It will take slightly less than 2 years to reach its operational orbit. SO carries ten scientific instruments, both *in situ* and imaging. It will move within 60 $R_{\odot}$ on a highly elliptic orbit, with an orbital inclination eventually reaching 24° (33° in the extended mission), enabling unprecedented access to the solar poles that are considered crucial to understanding the Sun's dynamo.

The objective of the mission is to perform close-up, high-resolution studies of the Sun and its inner heliosphere. These will address:

- How and where do the solar wind plasma and magnetic field originate in the corona?
- How do solar transients drive heliospheric variability?
- How do solar eruptions produce energetic particle radiation that fills the heliosphere?
- How does the solar dynamo work and drive connections between the Sun and the heliosphere?