SO/PHI data request form

Flux sources and sinks of the magnetic network

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Science case (stay on one slide):

Please also state, why is PHI needed; why is the science unique?

The network contains about 85% of the total quiet Sun magnetic flux (e.g., Gosic et al. 2014). What is the origin of this flux? Until recently, it was believed that ephemeral regions (ERs) are the main source of flux for the network. Martin (1990) reported that 90% of the network flux comes from ERs, while Hagenaar et al. (2003) found that the entire network flux can be replaced by ERs in only 8-19 hours.

However, using long-duration, high-cadence Hinode NFI magnetograms, Gosic et al. (2014) discovered that the internetwork transfers to the network as much flux as the network contains in only 14 hours. Indeed, the IN would contribute 1.6×10^{24} Mx day^{-1} to the network over the entire solar surface.

This is an enormous amount of flux. Since the network flux does not increase indefinitely, there must be a way to get rid of the flux supplied by the internetwork. We still do not know the exact mechanisms, but the network must be a place where flux cancellation/flux disappearance occurs continually.

The goals of this observing campaign are the following: (1) study the evolution of the magnetic network over the lifetime of supergranular cells; (2) determine the sources and sinks of network flux; (3) assess the contribution of internetwork fields to the network; (4) Study surface processes occurring in the network and their influence in upper layers.

To achieve these goals we propose to carry out a dedicated campaign to follow the evolution of several network cells from birth to death, at high cadence, high spatial resolution, high sensitivity, and with full Stokes polarimetry, including the linear signals that could not be observed with the Hinode NFI. A mimimum duration of 24 hours is required, with a goal of 48 hours. The observations should be complemented with simultaneous high-resolution EUI measurements over the same FOV and IRIS spectroscopic and imaging measurements, to obtain seamless coverage of the atmosphere. The IRIS data span a range of heights and are useful even with vantage points differing by 40 degrees. An apppropriate time to carry out the coordinated observations is the beginning of the perihelion window in the third orbit (April 5, 2023).

The proposed observations can solve an important problem in solar physics, namely the origin and fate of the network flux. They are truly unique, since no other existing or planned space asset has the sufficient sensitivity or FOV to provide the required measurements. This science problem cannot be tackled using observations from the ground because of their too short durations and small FOVs.

Requirements/data (use additional slide if needed)

Besides best guess requirements, you may also list minimum requirements on the data

- Type of solar feature: Quiet Sun
- HRT or FDT: HRT
- Physical parameters needed (available: B_LOS, vector B, v_LOS, I_c, raw data): Vector B, v_LOS, I_c
- Total length of observation: 48 hours (minimum 24 h) -> third orbit with IRIS or second orbit without IRIS
- Cadence (maximum 1 dataset/min): 1 dataset/min
- Pointing needs (disc centre, limb, active region location, particular μ): Disk center (tracking on)
- Orbit needs (spatial resolution/co-rotation/angle to Earth/angle to other spacecraft): Observations within perihelion window for highest spatial resolution and partial co-rotation
- Total number of datasets: 2880 (minimum 1440, **equivalent to 360 full datasets** because of partial FOV)
- Full frame 2k x 2k or partial frame 1kx1k, 0.5kx0.5: 1k x 1k
- Full resolution or 2x2, 4x4 binned data: Full resolution
- noise level (default 10^{-3}): 10^{-3}
- Co-observations with other instruments: EUI observations at same spatial resolution and cadence, plus IRIS spectroscopic and imaging measurements, to study effects of network evolution in high atmospheric layers (first priority) . Low cadence SPICE maps to complement atmospheric coverage (second priority).