Objective 2: How do solar transients drive heliospheric variability?

The dynamic Sun exhibits many forms of transient phenomena, such as flares, CMEs, eruptive prominences, and shock waves. Many directly affect the structure and dynamics of the outflowing solar wind and thereby also eventually affect Earth's magnetosphere and upper atmosphere, with significant consequences for society through hazards to, for example, space-based technology systems and surface power systems. Understanding these impacts, with the ultimate aim of predicting them, has received much attention during the past decade and a half under the banner of 'space weather.' However, many fundamental questions remain about the physics underpinning these phenomena and their origins, and these questions must be answered before we can realistically expect to be able to predict the occurrence of solar transients and their effects on geospace and the heliosphere. These questions are also pertinent, within the framework of the 'solar-stellar connection,' to our understanding of other stellar systems that exhibit transient behavior such as flaring (e.g., Getman et al. 2008).

Solar Orbiter will provide a critical step forward in understanding the origin of solar transient phenomena and their impact on the heliosphere. Located close to the solar sources of transients, Solar Orbiter will be able both to determine the inputs to the heliosphere and to measure directly the heliospheric consequences of eruptive events at distances close enough to sample the fields and plasmas in their pristine state, prior to significant processing during their propagation to 1 AU. Solar Orbiter will thus be a key augmentation to the chain of solar-terrestrial observatories in Earth orbit and at the libration points, providing a critical perspective from its orbit close to the Sun and out of the ecliptic.

In the following sections, we discuss in more detail three interrelated questions which flow down from this top-level question:

How do CMEs evolve through the corona and inner heliosphere? How do CMEs contribute to solar magnetic flux and helicity balance? How and where do shocks form in the corona and inner heliosphere?

SAP meeting on Objective 2 (13-14 April 2016) presentations:

David Berghmans: Generic RS observing sequences for Objective 2

Russ Howard: CMEs: origin & structure

Robin Colaninno: Are all CMEs flux ropes?

Miho Janvier: ICME evolution and properties

Vratislav Krupar: Radio observations of transients

Daniele Spadaro: METIS input for discussion on Objective 2