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Preface

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The magnetic fields that drive solar activity are complex and inherently three-dimensional structures. Twisted flux ropes, magnetic reconnection and the initiation of solar storms, as well as space weather propagation through the heliosphere, are just a few of the topics that cannot properly be observed or modeled in only two dimensions. Examination of this three-dimensional complex has been hampered by the fact that solar remote sensing observations have occurred only from the Earth – Sun line, and *in situ* observations, while available from a greater variety of locations, have been sparse throughout the heliosphere.

STEREO Science Results at Solar Minimum
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Studies of coronal mass ejections (CMEs) have also been difficult because the most important events are those heading straight at Earth. Such CMEs have only been observed as halos expanding around an occulted Sun, making the measurements of speed, morphology and even exact direction difficult. There has also been a mismatch of observations of CMEs and their source regions, because the easiest CMEs to observe are those coming off the solar limb where projection effects are minimal, but the underlying solar structures are best observed near the center of the solar disk. In a few cases, *in situ* measurements near Earth could be connected to specific CMEs, but a complete examination of a single event requires multiple viewpoints of the solar source regions, the CME itself, and the particles and fields in interplanetary space. From the understanding that a three-dimensional view was needed to progress in the exploration of activity on the Sun and in the heliosphere, the STEREO mission was conceived.

The *Solar TErrestrial RElations Observatory* (STEREO) is the third mission of the Solar Terrestrial Probes (STP) line in the Heliophysics Division of NASA. STEREO was launched from Kennedy Space Center on 26 October 2006 at 00:52 UT. STEREO consists of two nearly identical spacecraft, each of which carries 16 sensors that offer a wide range of remote sensing and *in situ* measurements. Using lunar gravity assists, the two spacecraft maneuvered into solar orbits near 1 AU with one orbiting the Sun in a period slightly shorter than a year and one slightly longer. Looking from the Sun, one of the spacecraft appears to move ahead of Earth while the other lags behind, both by about 22 degrees per year. Now, more than two years after the spacecraft achieved heliocentric orbit, they are more than 90 degrees apart.

The many instruments on the two spacecraft are designed to address the specific scientific objectives of the STEREO mission: *i*) understand the causes and mechanisms of CME initiation; *ii*) characterize the propagation of CMEs through the heliosphere; *iii*) discover the mechanisms and sites of solar energetic particle acceleration in the low corona and the interplanetary medium; and *iv*) develop three-dimensional, time-dependent models of the magnetic topology, temperature, density, and velocity structure of the ambient solar wind. The breadth of the science is clearly evident in the papers contained in this issue.

STEREO was launched during the long and calm solar minimum following Solar Cycle 23. Although the Sun has been extremely quiet since the commissioning of the two STEREO spacecraft, this topical issue of *Solar Physics* shows that a tremendous amount of science has been done during the prime phase of the STEREO mission. The results have not been limited to the science that STEREO was designed for; new unanticipated discoveries have included many surprises. We are confident that STEREO will continue to operate for many years to come and will contribute productive science and amazing discoveries as the Sun's activity increases with the start of Solar Cycle 24.