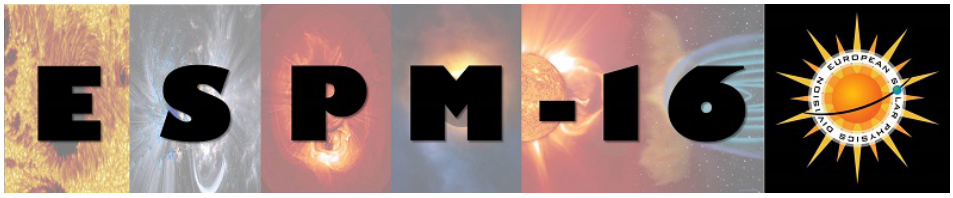

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Cross-Validating and Interpreting Results of Magnetic Helicity Calculation Methods in Eruptive NOAA Active Region 10930

Wednesday, 8 September 2021 11:00 (13 minutes)

In this ISSI-supported series of studies on magnetic helicity in the Sun, we implement and systematically compare different magnetic helicity calculation methods on high-quality solar magnetogram observations. We apply finite-volume, discrete flux tube (in particular, connectivity-based), and flux-integration methods to magnetogram series from Hinode's Solar Optical Telescope. Finite-volume and connectivity-based methods yield instantaneous budgets of relative magnetic helicity (and free magnetic energy) in the active-region corona, while the helicity injection rate provided by the flux-integration methods yields an estimate of the accumulated helicity during the studied time interval. The observational target is the well-studied NOAA active region 10930 during a 1.5 day interval in December 2006 that included a major eruptive flare (SOL2006-12-13T02:14X3.4). The objectives of our work are twofold: a cross-validation of methods, as well as an interpretation of the complex events leading to the eruption. To the first objective, we find (i) strong agreement among the finite-volume methods, (ii) a moderate agreement between the connectivity-based and finite-volume methods, and (iii) an excellent agreement between the flux-integration methods. To the second objective, our analysis shows that the photospheric helicity flux significantly contributed to the coronal helicity budget, and that a previously emerged and/or formed right-handed structure (sheared arcade) erupted from a predominantly left-handed corona in the course of the X-class flare.

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