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Modelling of pre-eruptive magnetic structure: the need to get the electric currents right!

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To understand the trigger of solar flares and eruptions it is necessary to obtain an accurate description of the 3D pre-eruptive coronal magnetic configuration. The latter is not directly observable and one must rely either on static modelling/extrapolation from 2D photospheric measurements, and/or on relatively idealized time-evolution of a magnetic model from numerical simulations. The limitations of both approaches has not permitted to produce magnetic models sufficiently reliable to solve the eruption trigger issue.

Meanwhile, flares are characterized by brightenings in the Ultraviolet and X-ray domains. The distribution of these brightenings is not random, and are, according to the standard model for flares, tightly related to the magnetic field structure. Such a link has received strong confirmations by studies of the magnetic topology, which positively correlated the spatial distribution of UV and X-ray emission with magnetic structures.

Based on a detailed study of a confined circular flare, we will show how the flare emissions can provide a critical information in order to properly model the magnetic configuration and how it can help to have an insight on the trigger mechanism of flare. We will address how critical the measure of vertical electric currents is for the proper modelling of the magnetic field. We will finally discuss the hope that new high-resolution instruments as well as new observation strategies, and in particular stereoscopic magnetic field measurement with SolO/PHI, will provide key information such as fine flare dynamics and next-generation current distribution maps, for advance model of the eruptive magnetic system.

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