MODELING THE PHOTOSPHERIC MAGNETIC FIELD OF SOLAR ACTIVE REGIONS

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Abstract:

Active regions (ARs) appear in the solar atmosphere as a consequence of the emergence of magnetic flux tubes. The observation of elongated magnetic polarities in active-region (AR) line-of-sight (LOS) magnetograms indicates the presence of magnetic twist in these flux tubes, being then called magnetic flux-ropes (FR) (**Fan 2009**). The elongations, a.k.a. magnetic tongues, can affect the measurement of AR characteristics, such as their tilt angle, obtained during their emergence phase. In particular, tilt angle evolutions and spatial variations play a key role in constraining flux-transport dynamo models, as Joy's law is fundamental for the formation and evolution of the polar field. In this work, we aim to develop a new method: first, to model the intrinsic properties of FRs that give origin to bipolar ARs, and second, to gain insight on how these parameters affect the photospheric field distribution of ARs observed in LOS magnetograms, and hence, measured quantities such as their tilt angle. We study the full emergence of NOAA AR 10268 and we model its magnetic field distribution with a half-torus FR model. We propose a probabilistic scheme based on the Bayes theorem to infer the most probable model parameters. This allows us to estimate expectation values for the tilt angle, magnetic helicity and magnetic flux which are consistent with the observations. We discuss the relevance of the sampling algorithms in order to explore the order of degeneracy of the model parameters and how they affect the target posterior probability distribution.

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