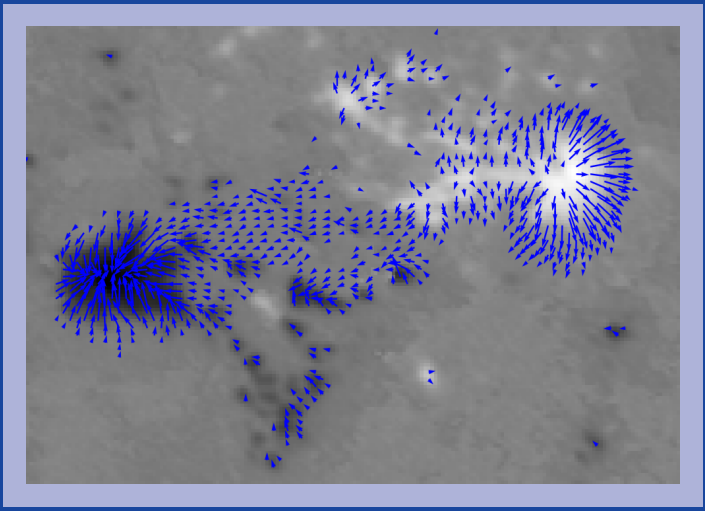
The tilt and twist of emerging solar active regions



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Joy's law, the tilt of active regions relative to the solar equator, plays an important role in understanding the origin and dynamics of the solar magnetic field. In this thesis, a systematic study of the evolution of Joy's law during and after active region emergence reveals that, unlike popular theories, active regions are observed to emerge on average with zero tilt angle. Their tilts increase according to Joy's law within two days after the emergence. Further insights can be gained by studying the twist of the magnetic field. A second study investigates the robustness of various twist proxies to a fluctuating magnetic field. For this purpose we modelled a uniformly twisted magnetic field in a sunspot and its spatially correlated fluctuations. Monte-Carlo simulations show that most twist proxies provide robust measurements under a fluctuating magnetic field. The third part of this thesis studies the twist proxies when applied to a set of emerging active regions observed by SDO/HMI. This study exposes systematic effects that question the reliability of these measurements and require further investigation.

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