3D inversion of a solar prominence

A. Vicente Arevalo[1] J. Stepan[2] T. del Pino Aleman[3]

[1] KIS Institute fur Sonnenphysik
[2] ASU Astronomical Institute of the Czech Academy of Science
[3] IAC Instituto de Astrofisica de Canarias

contact e-mail: *andres.vicente.arevalo@gmail.com*

Solar prominences, dense plasma structures suspended in the million-degree corona, are critical to understanding solar magnetic fields and their dynamics. Traditional spectropolarimetric inversions, relying on one-dimensional or slab geometries, have been limited by their inability to capture multidimensional radiative transfer effects and resolve the 180° ambiguity in magnetic field orientation, leading to conflicting reports. This talk presents the first application of POLARIS, a consistent 3D inversion code, in real prominence observations. This novel approach overcomes the limitations of prior methods by simultaneously imposing the three-dimensional radiative transfer equations and inferring the full magnetic vector. Using spectropolarimetric data of a prominence, we reconstructed the magnetic field, temperature, density, and velocity fields within a prominence, providing insight into its three-dimensional structure and dynamics. In addition, uncertainty estimation was performed, highlighting the importance of high-quality data with high S/N and resolution. This method accounts for complex physical processes, including the Hanle and Zeeman effects, and ensures physical consistency across the model. Our results reveal the intricate interplay of magnetic and plasma properties, offering new perspectives on prominence stability and topology. This pioneering work paves the way for future studies to resolve long-standing debates about prominence magnetic configurations and their role in solar activity, enhancing our understanding of the Sun's dynamic atmosphere.