Session 4

The reliable noise reduction method for the Stokes spectral profiles

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The Stokes profiles inversion technology based on the spectra-polarimetry of the magnetic sensitivity spectrum has become the most mainstream tool to obtain the magnetic field and thermodynamic information in the solar atmosphere (refer to the classic monograph of Stenflo, del Toro Iniesta, and Landi Degl'Innocenti & Landolfi). The core idea of Stokes profiles inversion is to fit the synthetic Stokes spectrum which is generated based on the polarization radiation transfer(PTE) process under a certain atmospheric model with the observation data. Then adjust the input physical parameters (including vector magnetic field, dynamics, thermodynamics, etc.) in turn, and iterate until the optimal solution of each physical parameter is reached.

Magnetic field inversion assumes ideal spectral profiles for fitting, but the actual data will be affected by noise. The noise level of the Stokes spectrum will directly affect the inversion accuracy of the vector magnetic field. This problem is more serious when processing weak magnetic field regions. It is an ingenious, feasible, and low-cost solution to seek a reliable noise reduction method adapted to the Stokes spectrum in the inversion (fitting) process, and then to improve the inversion accuracy of the vector magnetic field.

In this presentation, the deviations(statistical error) between the physical parameter inversion results (the theoretical Stokes spectrum, the noised Stokes spectrum, and the denoised Stokes spectrum) and the original input physical parameters under the ME atmospheric model have been compared. The noise reduction results of spectral noise reduction algorithms such as frequency domain, spatial domain, convolution, wavelet, and data rank reduction have been analyzed. We aim to find one or more reliable noise reduction methods for the Stokes spectrum in inversion.