Session 4

(Invited) Spectropolarimetric inversions including magneto-hydrostatic constraints

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The interpretation of solar spectropolarimetric observations are, arguably, the most insightful tool into the physical conditions of the solar atmosphere and specially the magnetic field that permeates it. This process relies on the assumption of some radiation-matter interaction model (radiative transfer equation –RTE) that, prescribed with some model parameters for the solar atmosphere, characterizes the outgoing radiation polarimetric properties. The inference of the model parameter from a set of observations is known as inversion, and some of the most advanced inversion codes (SIR, SPINOR, SNAPY, STiC, DESIRE, TIC) consider a thermodynamic and magnetic depth stratified atmosphere. An important issue that these inversion codes have to deal with is the fact that spectral lines are hardly sensitive to the gas pressure stratification, i.e. additional constraints are required in order to solve the thermodynamics of the model atmosphere. The most common one is to simplify the magneto-hydrodynamic (MHD) equation of motion to its simplest form, i.e., hydrostatic-equilibrium (HE), or consider only the term related to gravity. This approach leads to some limitations, among others, the inferred gas pressure stratification is as good as HE is representative of the real gas pressure and the physical properties of each pixel are retrieved independently of the neighbouring ones, i.e. there is no horizontal consistency.

It is possible to overcome some of these limitations using a less simplified MHD equation of motion than in HE, for instance by including the magnetic terms (magneto-hydrostatic approximation). In doing so, the inferred gas pressure is more consistent with the prediction from MHD and, for example, the Wilson-effect is retrieved in a consistent manner. In this invited contribution we will present the current status in the development of an spectropolarimetric inversion code (FIRTEZ-dz) that includes magneto-hydrostatic constraints in order to evaluate the gas pressure, validating its performance and application to real data.