Collage 2020 : Homework 3

April 4, 2020

To respect your other out-of-class commitments, a flexible deadline for this homework is 04/25/2020. However, the sooner you get to it, the easier it will be.

Problem 1: In the Milne-Eddington approximation, the source function is assumed be linearly depend on some referent optical depth:

$$S = a + b\tau.$$

To model a spectral line, we can assume the monochromatic optical depth is related to the referent optical depth as:

$$\tau_\lambda = r_\lambda \tau$$

where:

$$r_\lambda = 1 + \eta\phi_\lambda$$

where η is the so called line strength, and ϕ_λ is, wavelength dependent, line profile, that can be modeled as a Gaussian or Voigt function.

- Show that, for outgoing intensity, the following relationship is valid:

$$I_\lambda = a + \frac{b}{r_\lambda}$$

- Using the model that has a, b, η and line profile parameters (Doppler broadening and damping coefficient), as free parameters, fit an example HINODE spectrum (only the intensity, akka Stokes I), and infer the values of the model parameters.

You can find example of Voigt function in our notebook where we tried to model Hα line.

Problem 2: Take a small subset of HINODE data (or a large one, if you prefer) and infer the line-of-sight magnetic field using 6301 and 6302 lines, separately, relying on weak-field approximation. Plot the maps of the magnetic fields inferred from the each line and plot the differences. Infer uncertanties in the magnetic fields using MCMC for a few selected pixel and compare measurement uncertainties with difference in the magnetic field resulting from the two lines.

Notes: You do not have to submit the code, but it is certainly easier to grade if you submit it as a jupyter notebook or something similar.