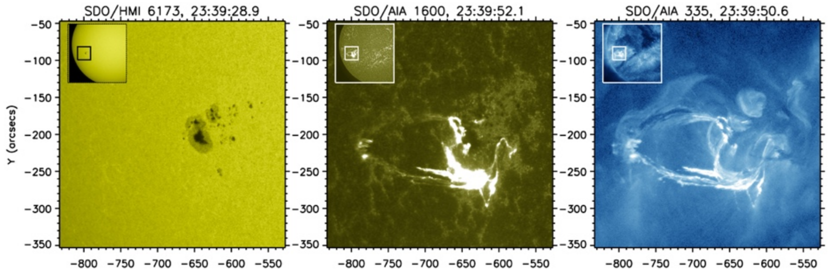


UNIVERSITÄT BERN

Philosophisch-
Naturwissenschaftliche Fakultät

Astronomisches Institut

Bern, 29. November 2023

Masterarbeit Astronomie, Gruppe Spaceweather:

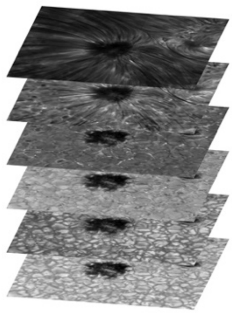
Analysis of unique flare observations from the Swedish Solar Telescope

MOTIVATION

Solar flares are extremely powerful eruptions that affect space weather, which on Earth can cause aurorae, power outages, and problems with satellites. Solar magnetism drives the evolution of solar activity, particularly the appearance and decay of sunspots, but also of flares. Yet so far, we are unable to predict when the next active region may form, or the next flare occur, which indicates that our understanding of their physics is incomplete. The goal of this project is to study the magnetic field in different layers of the solar atmosphere to better understand active region formation and decay and its rapid changes during flares.

We obtained high-resolution observations of various targets on the Sun, including flares, at the Swedish Solar Telescope. To translate these data (polarized spectra) into physical observables (temperatures, densities, velocities, magnetic field strength) modeling is required. The modeling is done with so-called inversion codes that iteratively modify an assumed solar atmosphere and thus simulated spectra until a match to the observations is achieved.

TASKS



- Learn the theory on radiative transfer and polarimetry, physics of the solar atmosphere, and the solar magnetic field.
- Derive the magnetic field on the Sun with various methods, including inversions.
- Investigate the temporal evolution of the magnetic field and of changes in inclination, azimuth and field strength at different atmospheric heights in the solar atmosphere.
- Learn and apply a machine learning method called normalizing flows to automate the retrieval of atmospheric parameters from observed spectra and test its applicability.
- Solve open questions on sunspot formation and/or the evolution of the solar atmosphere during flares.

You will learn dealing with large data sets and sophisticated computational and statistical methods in python or IDL; analyzing, and interpreting results in relation to complex physical processes. Depending on the preferences, this thesis can include machine learning (normalizing flows) and/or classical analysis methods.

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