Radiation Magnetohydrodynamics (MHD)

**Observation with the 1.4m GREGOR telescope**

**Non-magnetic simulation**

**Magnetic simulation**

**What comprise those simulations?**

(Magno-)hydrodynamics equations are solved with an explicit method based on Roe and HLL Riemann solvers. The (M)HD step is alternated with a radiative transfer step (operator splitting). We use the CO5BOLD code of Freytag et al. (2012).1

1Freytag et al., 2012, JCP 231, 919

**Computation of opacities**

- (M)HD simulation
- CO5BOLD code

**Scattering polarization**

The thermal radiation under the deep layers of the solar atmosphere is unpolarized and is in a very good approximation the radiation of a black body.

When light interacts with the plasma in the photosphere and in the chromosphere, its spectrum is modified and partially polarized.

We study the continuous spectrum of the Sun at (near-)visible wavelengths. Its polarization is ultimately due to the scattering of light by free and bound electrons.

**Radiative Transfer**

In this context, radiative transfer (RT) describes how light propagates and interacts with the solar plasma. The PORTA MPI-parallel code2 (Polarized Radiative TrAnTransfer) was run at CSCS for producing the polarization maps shown on this poster from our 3-D models of the solar atmosphere. These “virtual observations” are now compared with real observations.1 Štěpán & J. Trujillo Bueno, 2013, A&A 557, A143

**Centre-to-limb variation of polarization**

The presence of linear polarization indicates an asymmetry around line of sight. At disc centre the polarization signal is mainly due to the granulation pattern and is very faint. In the limb the scattered light provides a more important signal, which is a consequence of the difference of radiation directed radially out and into the Sun.

**Stokes Q component of the polarization vector**, which is one of the two components of linear polarization.

The map on the right is representative of disc centre, and the maps on the left are closer and closer to the solar limb. Red (resp. blue) colour indicates linear polarization parallel (resp. perpendicular) to the limb. For linearly polarized light we observe limb brightening, as opposed to the limb darkening observed for the total intensity (polarized and unpolarized radiation).