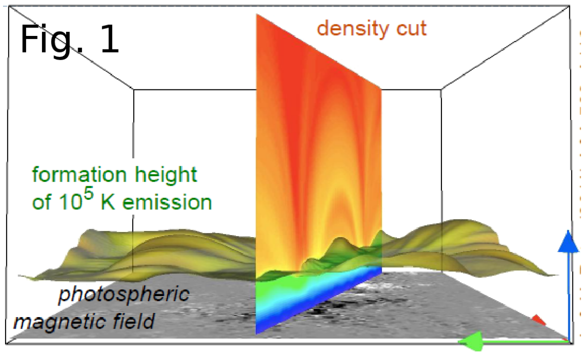
Large scale magneto-hydrodynamic model of the solar corona

The aim of the project is to understand the heating and temporal evolution of the magnificent solar corona. The corona, usually only seen during solar eclipse, shows a plasma at around one million degree. Observing the corona in different wavelength not only reveals phenomena such as coronal mass ejections but also it shows that the corona is highly structured and dynamic. Plasma at these high temperatures is highly ionized and particles are forced to follow magnetic lines of force. These magnetic fields, anchored in the solar surface, e.g. the photosphere, are responsible for the heating and driving of the solar corona. In a simple picture granular motions in the photosphere shuffle around the foot points of magnetic field lines leading to their braiding and thus to currents in the upper atmosphere. The dissipation of currents then heats the coronal plasma highly structured in space and transient in time.

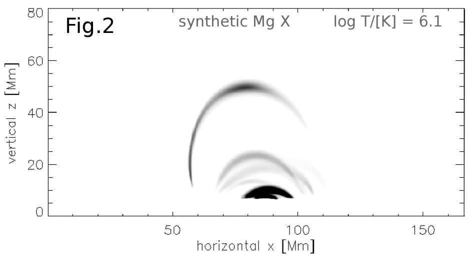
The model we present describes the solar corona above an observed active region. We use a six hour observation by HMI on board the Solar Dynamics Observatory (SDO) satellite. Together with the time depend observation granular like random motions in the photosphere drive the system. We solve the MHD equations, e.g. the conservation of mass, the balance equation for momentum and energy for an ideal gas, along with the induction equation.



The emphasis of this model lies on the proper treatment of the energy equation where we include the anisotropic Spitzer heat conduction and optical thin radiative loss. This is needed to get the correct coronal pressure what allows us to synthesize optical thin coronal emission lines. Fig. 1 shows a snapshot of the highly structured transition region and a dense loop in such a 3D MHD model.

The numerical model successfully produces a hot corona where basic features such as average doppler shifts as well as differential emission measures are comparable to observations.

Additionally the synthesized emission of Mg X shows several loops at temperatures over one million Kelvin (c.f. Fig. 2 shows the line of side integration). The loops with a length up to 150 Mm spread in the three dimensional volume. This is the first model which produces several distinct emission loops which are not, i.e., an projection effect.



"My name is Sven Bingert and I'm currently working at the Max Planck Institute for Solar System Research in Lindau, Germany. I was born in a small village in Germany and went to school there. I studied Physics at the Technical University of Karlsruhe in Germany where I graduate with a Diploma in Astroparticle Physics. The topic is about the so called air shower of secondary particles induced by high energy cosmic particles and their detection. During my study I spend one year at Royal Institut of Technology in Stockholm, Sweden where I took courses at the famous Hannes Alfven laboratory. After my Diploma I changed to Solar Physics and made my PhD at the Kiepenheuer Institute for Solar Physics. There I investigate the heating of corona employing numerical three dimensional magneto-hydrodynamical models."