STSM Scientific Report

Applicant and home institution :

Jiří Štěpán

Astronomical Institute of the Academy of Sciences of the Czech Republic

Ondřejov, Czech Republic

Visited scientist and host institution :

Prof. Javier Trujillo Bueno

Instituto de Astrofísica de Canarias

La Laguna, Tenerife, Spain

Dates of STSM : June 7, 2015 – June 29, 2015

The goal of the STSM was to deepen the collaboration between the applicant and the scientists of the host institution in the field of numerical modeling and physical interpretation of polarized radiative transfer in multidimensional models of the solar atmosphere.

The first focus of this project was on an analysis of synthetic polarized spectra of the lines of the infrared Ca II triplet around 850 nm calculated in a snapshot of a radiation-magnetohydrodynamical (R-MHD) simulation of the enhanced network region provided by the group of Prof. Mats Carlsson (University of Oslo, Norway). The processes that play a role in the polarized line formation include scattering polarization, the action of Hanle and Zeeman effects, and the symmetry breaking phenomena due to the horizontal thermal inhomogeneities and the presence of gradients of plasma velocity fields.

In the frame of the current STSM, we have summarized the results obtained by the extensive numerical simulations performed recently by using the computing time provided by the MareNostrum supercomputer (Barcelona Supercomputing Center). Our analysis shows an interesting entanglement of

the actions of the velocity and plasma inhomogeneities on the emergent line polarization.

We have made a comparative study of formation of spectral lines of different species in the same model atmosphere. We have studied the role of multiple symmetry-breaking mechanisms on the emergent spectra of these lines. In particular, we have studied the line formation of Mg II k (280 nm), Ca II K line (393 nm), and Ca II infrared triplet lines (around 850 nm). Different lines are differently sensitive to various mechanisms and their simultaneous observation can therefore help to disentangle these mechanisms.

In collaboration with Mr. Tanausu del Pino Aleman (Ph.D. student at IAC), we have started a new investigation of the photospheric line Sr I 4607 in a snapshot of the novel MHD simulation with a very high resolution of the spatial grid (Rempel, M. 2014). This investigation is going to extend the previous results (Trujillo Bueno, J. 2004) by taking into account the effect of the small-scale dynamo on the scattering polarization signal.

In the frame of the STSM, we have started writing an ensuing paper containing the qualitative and quantitative analysis of the mechanisms involved in the Ca II IR triplet formation (Hanle effect, Zeeman effect, macroscopic velocity fields, etc.). The paper will be published in a peer reviewed journal (ApJ or A&A) and the results will be presented at international conferences.