Lublin 2 April 2020

ABSTRACT

Title: Numerical simulations of magnetically dominated atmosphere of the Sun

Despite centuries of observation and decades of dedicated space missions, the atmosphere of the central star of our planetary system remains relatively poorly understood. Particular attention of the scientific community is currently directed towards two, still unsolved puzzles, one related to the so-called "Solar corona heating problem" and second to solar wind – its origins and further acceleration.

These thesis presents comprehensive numerical simulations of the magnetically dominated solar atmosphere. Research carried out using a single-fluid magnetohydrodynamic model, as well as using an innovative JOANNA two-fluid numerical code created at the Maria Curie-Skłodowska University in Lublin shed new light on the processes taking place in the Sun.

Simulations of spicules and plasma jets have shown their complex nature and likely involvement in energy transport in active areas. Simulations of Alfven and two-fluid acoustic waves indicated wave processes and ion-neutral collisions as at least partially responsible for heating of the chromopsheric plasma, thus in the area between the solar surface and the corona. The culmination of this work are simulations of waves and outflows generated by granulation taking place in the photosphere. Their significant influence on heating of the solar atmosphere and direct participation in the solar wind origins was successfully demonstrated.

Błażej Kuźma