The solar atmosphere, i.e. the medium above the visible surface, can be classically described as a stack of 3 layers which are permeated by magnetic field and characterize by a diversity of physical phenomena, making the Sun a highly interesting natural plasma physics laboratory. The lowest solar atmospheric layer is called the photosphere with its temperature of 5600 K, and characteristic granulation pattern. Right above, the chromosphere is located, which is about 1500 km thick. The temperature surprisingly rises in this layer until higher up in the corona it reaches a magnitude of about 1-3 MK. The corona extends to about 2-3 solar radii and it passes smoothly in the solar wind which is the stream of solar particles, reaching the Earth and beyond. Apparently, as a result of their low temperatures the photosphere and chromosphere consist of a number of (neutral) atoms, while the corona is essentially fully ionized, containing electrically charged particles such as protons, helium nuclei, and electrons.

The treatment of energy flow from deeper and colder solar layers and the heating of the outer and hotter regions is the main conundrum of solar physics, and it is still in its infancy-understanding. Solar observations reveal multitude of waves propagating throughout the solar atmosphere. Most of these waves seem to be generated by solar granulation, and they were recently found by the UMCS group to be capable to heat the chromosphere and low corona and generate the solar wind; in particular, it was showed that: (a) energy of these waves is deposited in the form of heat which is sufficient to balance energy and momentum losses and to sustain an essentially stationary solar atmosphere and (b) plasma outflows are efficiently generated by solar granulation. However, the developed models require urgent improvements on more realistic cases with the addition of helium, ionization and recombination, which are expected to emphasize atmospheric heating and the solar wind generation.

The intellectual merit of the proposed project is its unique capability to solve the important longstanding problem of the heating of the solar atmosphere and the solar wind generation. Our proposed studies will establish the role played by different waves in the heating of the solar atmosphere. To achieve this goal, comprehensive studies of the propagating waves, their dissipation and the associated plasma outflows will be performed by using the numerical JOANNA code. The proposed research will be used to explain a wide range of activities occurring in the solar atmosphere, develop a theoretical basis for interpretation of the current and future solar observations, and identify the principal energy sources for heating the chromosphere and low corona. Thus, the suggested science is timely, certainly far at the forefront of the current academic research in the field of heliophysics, extremely important, and of the highest scientific level. The contemporarity of the proposal, the novelty of the approach, and the capacity of the group members ensure that the obtained results will be published in the high-quality journals. It is our hope that the *proposed studies will likely unravel the mystery of the heating problem of the solar atmosphere and the solar wind origin!*

The proposed project will have a broad impact since the obtained results will be widely disseminated by various venues, including journal publications and special sessions at major conferences. All demonstrations and preprints will be made available for other interested researchers. We shall enhance education by involving PhD, graduate and undergraduate students in this project, and incorporating the research accomplishments of this project into existing courses in heliophysics and solar system physics.