I am currently a research associate with the Astrophysics Group at Imperial College London working in the field of NLTE radiative transfer. My work is concerned with the NLTE Spectral SYnthesis code (NESSY) development and its application to solar and stellar brightness variability modeling. It started back in 2011 when I graduated from the Astronomical Department of Saint Petersburg State University and commenced my PhD studies at Physical-Meteorological Observatory Davos, where the code had been used for solar irradiance calculations. The purpose of my project was to apply the code for understanding the connection between the UV and radio variabilities of the solar spectrum. In order to achieve this goal, the code had to be upgraded and tested. Hence, my PhD dissertation was naturally divided into three parts: code development, its verification and application.

The first part was devoted to upgrading the code's NLTE block. NESSY was originally created for synthesizing the spectra emergent from Wolf-Rayet stars and its NLTE scheme was inefficient for the solar conditions, especially in the upper parts of the solar atmosphere where radio and UV radiation forms. After the upgrade the code became much faster, more reliable and applicable to both solar and stellar spectrum calculations. In the second part, I tested the code by comparing the center-to-limb variations of solar brightness calculated with it to the ones obtained from the solar eclipse observations by PREMOS instrument on-board the PICARD satellite. To this end, a procedure for extracting the center-to-limb variations from the eclipse observations was developed. Finally, in the third part, I applied NESSY together with HMI/SDO observations to model the solar variability in the UV and radio spectral domains and analyzed the correlation between them.

I published the results of the first part of my thesis in Astronomy & Astrophysics and defended my dissertation at ETH Zürich in the beginning of 2017. At that time I was already working at Imperial College, continuing to develop the code in collaboration with Dr. Yvonne Unruh to make it suitable for the so-called 1.5D solar and stellar variability calculations. In these calculations the advantages of 1D-NLTE radiative transfer are combined with the ability of the current 3D-MHD models to capture the dynamics of stellar interiors. I have made NESSY capable of switching between NTLE and LTE radiative transfer regimes for different chemical elements, and now I am working on merging the NLTE block of NESSY with the spectral synthesis block of the LTE radiative transfer code ATLAS9. The objective of these projects is to make NESSY fast enough to handle the computationally taxing 1.5D calculations.

My second project is devoted to NLTE validation of the Spectral And Total Irradiance REconstruction (SATIRE) model with the NESSY code. SATIRE is currently one of the most prominent and successful solar variability models. However, up until now it has been based on the ATLAS9 radiative transfer code, which operates under the LTE assumption. The LTE radiative transfer approach gives erroneous solar spectrum below 200 nm and therefore the SATIRE output had to be empirically corrected at the corresponding wavelengths using available solar spectrum observations. In this connection, the SATIRE model has been criticized. The purpose of my project is to develop a version of SATIRE based upon the NLTE solar spectrum calculated with NESSY, that is to make it independent of observations, and show that the empirical adjustment has been done correctly.

My work has been accompanied by teaching, which gives me an opportunity to explore other areas of physics, and by frequent collaboration visits to Max-Planck Institute for Solar System Research, where I contribute to the efforts of the ERC research group SOLVe (Connecting Solar and Stellar Variabilities) led by my former PhD supervisor Dr. Alexander Shapiro.