**Host organisation:** Comenius University  
**Country:** Slovakia  
**Organisation role:** Beneficiary  
**Project Acronym:** TWOSENS  
**Project start and end date:** 01/01/2018 – 31/12/2019  
**Type of MSC action, H2020:** IF

Your story:

**Project objectives and research field:**
The main goal was to provide material chemists with rational design of novel sensitisers displaying very high two-photon absorption (TPA) cross-sections within a confined chromophore space, with a particular focus on $S,N$-heteroaromatic dyes, which can be exploited in deep-tissue laser scanning microscopy with a high 3D resolution (bioimaging) and/or two-photon-excited photodynamic cancer therapy.

**Tell us why the topic is important and/or how it brings to advancement in your research field:**
Based on computer-aided screening, we identified a library of heteroaromatic motives displaying excellent TPA cross-sections within a confined chromophore space. Small size of target molecules makes the synthesis easier, cheaper and allows
to avoid practical difficulties connected with limited solubility and low cell permeability. In addition, we developed new efficient synthetic pathways and transformations leading to valuable S,N-heteroaromatic building blocks, which were employed in the preparation of the most promising TPA candidates. Apart from the TPA activity alone, we also explored our metal-free photosensitisers for singlet oxygen generation – a phenomenon useful in laser photodynamic cancer therapy (PDT). In this regard, we found that some of the prepared dyes are suitable for PDT using both blue light irradiation (preferred in the treatment of skin cancer) and red light laser utilising two-photon excitation (PDT treatment, where a deep tissue penetration is required).

What are the benefits of participating in an MSC action?
The initial studies showed an application potential of the synthesised TPA dyes in bioimaging, namely by mapping the atherosclerosis reflected in aorta size and changes in its structure. The good TPA response along with possibility to combine two-photon-excited fluorescence (TPEF) images with second-harmonic generation (SHG) microscopy for non-centrosymmetric TPA dyes results in higher spatial resolution as obtained solely by TPEF technique. This can lead, for instance, to better understanding the plaque formation and mechanisms behind aorta narrowing using non-invasive, deep-tissue laser scanning microscopy and can be thus indirectly helpful in finding appropriate medication and preventive approaches.

Would you recommend others to apply? What useful advice/tips can you give them?
Definitely yes. The MSCA-IF action allows the researcher to acquire competencies in project and subgroup management, including supervision of Ph.D. students, as well as dissemination of the action results through a couple of outreach activities for academic and general audience. The excellence of the MSCA programme also gives the researcher and associated project a distinguished status, that allows a facile integration of the researcher into the host institution by pursuing own independent research topic and to build own small research team.

What strategies did your organisation use to attract the fellow/s? Are they in line with national strategies supporting the widening EC policy?
The Comenius University (CU) in general, and the Faculty of Natural Sciences of CU (FNS) in particular, have recently adopted an internal policy to attract excellent researchers, including researchers from countries outside the EU. Besides trying to improve the infrastructure, the measures towards this goal include direct co-financing of the hired excellent researchers from the funds of the Dean, which has been recently introduced into the legislation of FNS as Internal regulation of FNS No. 14/2020. Moreover, a highly competitive environment is established at FNS, as far as the basic financial (institutional) funds distribution is concerned. The budget
(including personnel costs) of each unit is re-evaluated every year based on the production of the unit in the previous five years, including research output and quality measures. This model is motivating the fellows to stay at FNS.