It is undoubted that the key technology behind the nowadays information revolution is the **optical fiber based signal transfer**, which principle significantly affects both the telecommunication and internet sharing domains of the global society. Exchanging the copper wires for optical cables has improved the data transfer rates by order of magnitudes and therefore the scientific community pay a large attention to continue in this trend in the case of all data processing devices. The keyword of this effort is **all-optical**, which means realizing the all data processing tasks, like amplification, switching, computing and storage in the **optical domain without converting to electric signal**. The ultimate goal of these efforts is an **optical computer**, which can outperform the electrical ones again by orders of magnitudes. The basic element of the computer is a transistor and a widely accepted way of its realization in the optical domain is the **nonlinear optical signal transformation**.

Our planned research aims to contribute significantly to this field focusing on investigation of fundamentals of the **dual-core optical fiber based all-optical nonlinear switch**. The general principle of a switch is steering the input signal between two (or more) output ports by a control signal. There are already many ways, how to realize such task in the optical domain, however we would like to explore its simplest possible form, which means an optical fiber containing two parallel cores with transferable optical signal between them. One motivation of this research is exactly the fiber format switch because the high speed data transfer by optical fibers is already matured task and we would like to ensure the easy **integrability of our approach into the standard communications systems**. Therefore, the signal switching principle using the dual-core optical fibers is investigated already more than 3 decades, but even though up to now it was not demonstrated in applicable manner. Large amount of theoretical works addresses this goal even in the recent years, however there are just a few experimental investigations of the fiber based dual-core nonlinear switching and all of them just by partial successes.

The main reason of this unsuccessful research is that the proper dual-core fibers should have a precise combination of linear and nonlinear properties. This requirement is hard to fulfil by the standard fiber technology. From this cause we started the investigation of **photonic crystal fibers** (PCF), those have in its cross section a periodic microstructure, and allow more tailoring of its linear and nonlinear properties by engineering the microstructure. By this way we already demonstrated an effective all-optical switching in the dual-core PCFs in limited spectral domains of the input pulses and motivated by our previous successes we aim now to extend our approach for the whole input pulses. In order to reach our goal, we would like to establish a new technology in the frame of this project, fabrication of a new generation of the dual-core PCF namely the **all-solid approach**. The standard PCFs have a periodic system of air capillaries embedded in glass material along the fiber axis, however we plan to use **combination of two glass materials with complementary properties** instead the standard air-glass structures. This approach ensures more precise periodicity of the microstructure, which feature has a key importance for the effective switch and moreover provide better compatibility with the standard optical fibers, those are most often also all-solid structures.

The work plan of the project contains three main tasks: **designing** the all-solid dual-core PCF structures by computer simulations, **fabricating** the fiber samples and finally experimentally **investigate the switching possibilities** of the samples. The successful realization of the project is ensured by the host institution which has already many year experiences with the all-solid PCF structures, however this technology will be first time exploited for dual-core fibers. The second important aspect is the research experience of the applicant who conducted already such type of research in the past and has the necessary know-how for the nonlinear optical experiments. The investigation will be performed with **lasers generating short pulses in range of 100-300 fs (fs is 10^{-15} s) at telecommunication wavelength**. There will be tested series of dual-core PCF samples with different output diameters and lengths at different input energies and polarization directions. We expect that during the project period we will be able to demonstrate that we can **exchange the majority of the input pulse energies between the two output ports by slight change of the input energy or by rotating the input polarization by 90°**. Finally, we would like to utilize special highly nonlinear glass as basic material, which allows establish the all-optical switch at sub-nanojoule pulse energies and sub-cm fiber lengths. In the case of success we will be able to offer a new platform for optical data processing tasks in **compact low energy consumption form at data rates above Tb/s**.