Optical attosecond pulses are the shortest events created and controlled by humans. 1 attosecond is to 1 second, like 1 second to around 2.3 times of estimated age of the Universe. Such short light pulses possess a large number of applications connected to spectroscopy, imaging, gas detection or food products qualitative analysis. The last decades brought a huge progress of light pulse amplification techniques, initiated with developing of CPA (*chirped pulse amplification*) method in 1985 (Nobel Prize in physics, 2018). This technique assumes temporal stretching of the pulse and requires a proper type of dispersion, which is a property related to a dependence of refractive index on wavelength. A medium used for this purpose should possess a normal dispersion, which means red light components are propagated faster than blue ones.

Supercontinuum generation is a nonlinear optical phenomenon allowing for obtaining so-called white light from – simplifying – a one-color laser beam. Unlike classical light bulb, such a white light preserves a number of features of laser light, including very high brightness and spatial coherence. Supercontinuum light can be obtained illuminating a large variety of optical materials by a laser light. Nonetheless, usually optical fibers are chosen, which due to a small cross-section area of propagated light and possible high optical nonlinearity, allow for a big efficiency of the process. Commercially available supercontinuum sources typically lack in temporally coherence, which is a required property for covering a band (so-called seeding) of fiber amplifiers. An appropriate medium providing a full coherence of generated supercontinuum is highly nonlinear optical fiber with all-normal dispersion profile. Moreover, it should be birefringent, *i.e.* having two different refractive indices along two perpendicular axes. Then the generated supercontinuum is also polarized (simplifying having only one direction of electromagnetic field vibrations), which would allow avoiding an interaction of components with different polarizations, which might result in losing the temporal coherence of the spectrum.

The project is aiming at development of optical fiber for a double application – for dispersion compensation in ultrafast amplifiers systems and as a medium for generation of polarized, temporally coherent supercontinuum. Realization of the first task necessitates a low nonlinearity of the used optical fiber. For fulfilling the two contradictory requirements, we propose utilizing an optical fiber with a highly differing nonlinearity along two perpendicular directions (so-called "dispersion of nonlinearity"). Then taking advantage of both light polarizations a different nonlinear properties can be achieved. A type of fiber developed in the project will be a microstructured fiber, *i.e.* possessing elements of the cladding (an area around a core (in which in turn the light is being guided) with a size of the order of micrometers, which is dozens times lower than human hairbreadth. The all-normal profile of dispersion can be achieved by a proper design of the cladding. Whilst a birefringence and nonlinearity contrast is possible due to a proper nanostructuring of the core of the fiber. It will consist of stripes made from two types of glasses with differing refractive indices and nonlinear properties. A preliminary calculation results, done for a soft-glass (with a low temperature of transition to liquid state) fiber design showed a large birefringence possible to be obtained and also a different nonlinearity for both directions.

Nonlinear coefficient depends on nonlinear refractive index (a distinctive feature of a given material) and effective area of a mode (a distribution of electromagnetic field) of light in a certain medium (which value in turn is defined by a given optical fiber). In such a structure a different preferred areas of light localization were noticed for both polarizations – for the one in parts of higher, in the other one – with lower nonlinear refractive index. This is the first mechanism of appearing of a nonlinearity contrast (material one) – a higher nonlinear refractive index means a higher nonlinearity. The second mechanism (waveguide one) is connected to different effective mode areas with different polarizations. The higher is the mode area, the lower is nonlinearity (light is less concentrated, which means its lower power).

The aim of planned works is achieving a highest possible nonlinearity contrast between both polarizations. The realization of whole scope of the project is planned at Faculty of Physics, University of Warsaw. The works will contain a designing (searching for proper geometrical parameters and glasses) of the fibers by numerical simulations. First two tasks are concerning soft-glass fiber. Third task is optimization of fiber made from silica glass, partially doped with germanium. The fourth task is technological attempt of fabricating of the designed structure and – in case of success – experimental verification of its properties.