Among the scientists, there is a common **consensus regarding existence of matter that does not interact electromagnetically** and thus **eludes experimental investigations**. If, however, it is indeed “invisible”, *why the idea of its existence is so broadly accepted*?

The problem of dark matter dates back to the 1930s, when certain anomalies in the movement of celestial bodies were first observed. It turned out that that large astronomical objects, such as stars in the galaxies, move as if the galaxies were filled with “invisible” dark matter. This hypothesis was successively supported by other observations, e.g., deflection of light by seemingly empty space or formation of stars and galaxies in the Universe. This made the **hypothesis of the dark-matter existence generally accepted**. In fact, modern astronomical observations seem to indicate that there is four times more dark matter than electromagnetically interacting matter. The only problem, however, is that **to-date all laboratory experiments searching for dark matter returned null results**.

For years, the main candidate for dark matter have been the so-called **weakly interacting massive particles** (**WIMPs**). Unfortunately, several decades of searches have brought no success and now we know that if WIMPs really exist, the mechanism of their formation and interaction with ordinary matter is more difficult than previously anticipated. Interestingly, the negative result of the WIMP searches had an important consequence, as it opened the field to searches for alternative dark-matter candidates. **Massive astronomical objects** such as black holes and neutron stars have emerged among potential candidates, but also **ultra-light particles**, with masses billions times smaller than the lightest know particle (neutrino), are also considered. In fact, over the past decade, this latter option has been steadily gaining more attention.

It should be noted that **ultra-light particles differ fundamentally from other dark-matter candidates**. Specifically, they do not behave as individual microscopic objects, but rather as coherent waves. Thus, in some ways, they resemble photons with their wave nature. In order to detect such fields, **new search strategies have to be developed**.

Within this project, we propose to **use quantum sensors to detect ultralight dark matter**. Such devices are based on laws of quantum mechanics, which allow them to measue various physical quantities with unprecedented sensitivity. A particular example of the quantum sensors are **atomic magnetometers**, the most sensitive magnetometric devices ever constructed. It turns out that atomic magnetometers can also be used to **detect** the so-called **spin couplings**, i.e. interactions that give similar effects to the magnetic field, but that are not the field. In our project, we will consider a scenario in which the **interaction with ultralight dark matter leads to the appearance of** such **spin-dependent interactions**. However, in order to increase reliability of the searches, we plan to **replace a single sensor with a network of sensors located in distant locations all around Earth**. By making synchronized measurements, these sensors will lead to a reduction of random noise, cross-verification of the obtained signals (consistency check) and triangulation, which will yield the direction of propagation of the perturbation. In our research, we will analyze the possibility that the sources of the coupling are, inter alia, dark-matter planets or bursts of dark-matter particles generated in cataclysmic astronomical events (e.g. collisions of black holes or neutron stars). Due to their transient/oscillatory nature, such signals escape all searches up to date.

To increase the search capabilities, we will **develop a novel class of quantum sensors** with reduced sensitivity to magnetic fields, and thus enhanced sensitivity to non-magnetic spin couplings. For this purpose, we will **capitalize on developments of modern atomic physics and quantum optics**. We will also increase our research capacity by **implementing data-processing algorithms that has never been used in the scope of dark-matter search**.

The main aim of this project is to **search for ultra-light dark matter**, the **discovery of which would be of paramount importance for modern science**. Still, even **null results** of the research **will allow verification of a number of theoretical models strongly limiting their parameter space**s. This will significantly contribute to the development of research on dark matter.