

**The aim of this project** is to explore the interaction of broadband quantum light with atomic vapor in the presence of magnetic field, aided with novel technological possibilities brought by ultra-fast cameras able to observe single photons.

**Previous studies** showed that certain kinds of *quantum light* – light exhibiting properties that cannot be described with classical physics – with a single color (*narrowband*) can interact with alkali atoms trapped as a vapor in a small glass cell, in a way that let us learn very precisely the magnitude of the magnetic field in the cell – perform the task of *magnetometry*. Quantum properties of this faint light let us *estimate* – reconstruct from measurement data – the magnetic field with precision higher than any classical light (such as produced with a laser or a bulb) would allow. This is often known as surpassing the Standard Quantum Limit (SQL).

**In the proposed project** we will experimentally and theoretically investigate whether using multicolor (*broadband*) quantum light and separating each color with a diffraction grating (analogous to a prism splitting white light into the rainbow of colors) only before the detection with a *single-photon camera* would allow to better sense the magnetic field or provide a more experimentally robust setup.

**We expect the project** to deepen the understanding of how broadband quantum light interacts with atomic vapor, especially in the context of atomic sensing (including magnetometry). The technological capabilities to perform such a study only recently became available, and we envisage both fundamentally new insights at the borderline of quantum optics, atomic molecular and optical physics, estimation theory and ultra-fast phenomena, as well as unveiling new prominent applications.