Quantum imaging This keyword may be understood in a few different ways and most of them are quite fascinating. One of the most well known quantum imaging techniques is ghost imaging. It turns out that if we have a photon pair source, we do not need a camera to even be looking at an object. All you need to do is use correlations of photons. One photon from the pair is sent at an object. If it does not hit the object, it gets collected at a single-pixel bucket detector. Its twin photon is sent directly at a camera. When we look at coincidences between the bucket detector and the camera, we will see the object. Other quantum imaging techniques allow us to see the object better and with higher resolution.

Quantum memory The quantum memory we have constructed is unique. It is in fact quite similar to the photon pair source described above, however instead of a photon pair we create a photon and simultaneously excite one atom from the large ultracold (22 microkelvins) ensemble. The atoms holds a photon for as long as a few milliseconds. The memory precisely remembers directions at which the photons are emitted as well as their amount. This information can be retrieved on demand

During the project we will implement a protocol similar to ghost imaging, however our camera will detect photons only if quantum memory will emit a photon and this photon will be detected by the bucket detector. In turn, photon from the readout will form the image of an object on the camera directly, without the need of studying correlations. With this we will try to see how many photons are required to form an image. We also plan to develop our camera detector, to not only be sensitive to single photons, but also be able to collect at a much higher frame rate (perhaps even a million frames per second). Such a detector would enable us to turn our memory into a deterministic source of on-demand photons.