Oqtant’s cloud-accessible quantum design platform, “Oqtant”, enables research and development of quantum technologies based on ultracold atoms. The hardware is programmed by remote users, including control of dynamically reconfigurable optical fields that are applied to the atoms. This “painted potential” capability enables exploration of quantum dynamics and development of quantum sensing techniques. The platform includes tutorials, demos, and simulations acting as a digital twin, enabling users ranging from novices to experienced researchers to explore potential applications before running them on hardware.

**WHAT IS OQTANT QUANTUM MATTER SERVICE?**
Oqtant Quantum Matter Service (QMS) is a platform that provides users the ability to create, control, and measure quantum matter in the form of a Bose–Einstein condensate (BEC). Access is provided via our Python API, Oqtant, or using a web application. Oqtant can be used to programatically manipulate quantum matter to explore a range of quantum phenomena including:

- Tunneling
- Atomtronics
- Nonlinear behavior
- Superposition
- Superfluidity
- Coherence and Interference

Oqtant can be used to explore a variety of topics including atomtronics and the emulation of other complex quantum systems (including Hawking radiation from black holes).

**Job Submission**
Users submit experimental parameters either through Oqtant Python API (left) or an easy-to-use web application (right). Oqtant provides a high degree of flexibility and programmatic control over job submission, including BEC formation, dynamic manipulation, and data retrieval. The Oqtant QMS Web Application offers a graphical user interface designed for users of all experience levels.

**Output Data**
To analyze experimental results, Oqtant uses two different types of imaging techniques: in-trap and time-of-flight (TOF).

- **In-Trap Imaging:** Images are created by exposing the trapped atoms to a pulse of 780 nm light to reconstruct a density profile. In-trap imaging shows the direct impact of the 1D painted potential barriers on the atoms within the magnetic trap.
- **TOF Imaging:** Images are captured after the atoms are released from the trap and allowed to freely expand for a user-defined amount of time. By varying the TOF, different points in the expansion process can be observed to witness the differences in quantum and classical matter evolution.

**TOF Imaging**
A series of time-of-flight (TOF) images were acquired to demonstrate thermal expansion and aspect-ratio inversion of a BEC after it has been released from the cigar-shaped trap. This anistropic expansion is a result of the coherent/quantum nature of the BEC compared to the classical/incoherent nature of the thermal cloud.

**REFERENCES:**