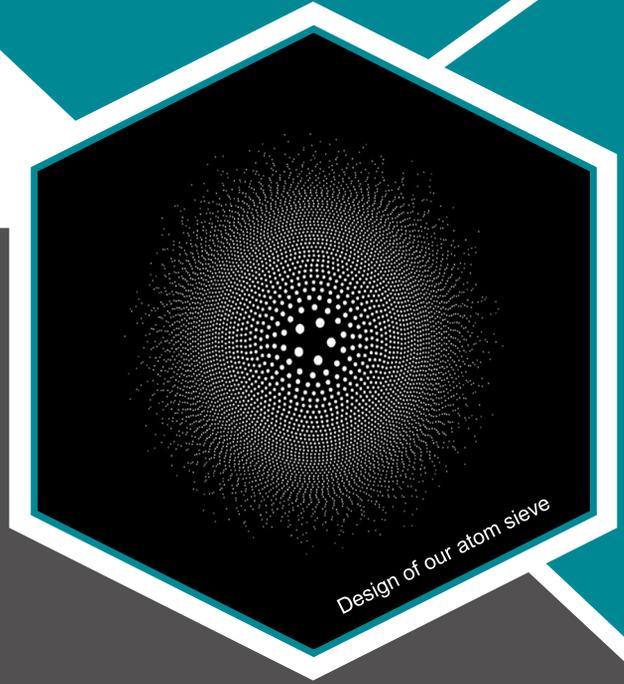




# Quantum Helium Atom Microscope (qHAM)

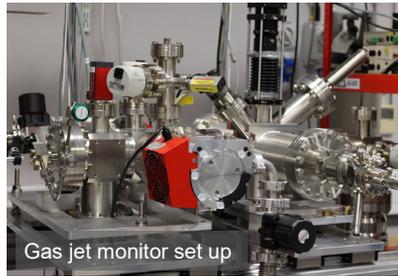
## The Challenge

Particle accelerators are used globally to help answer some of the biggest fundamental physics questions. They also drive the development of new medicines, treat cancer, and improve progress in chemistry and environmental sciences. Developing novel diagnostic solutions for accelerator and clinical facilities, increases their output, reliability and cost efficiency.



## The State of the Art

The QUASAR Group at the University of Liverpool is a recognised leader in the development and use of collimated gas jets. The underpinning technology was originally developed for the low energy antiproton beams, and most recently, adapted for profiling the beams in the world's highest energy accelerator, the Large Hadron Collider at CERN.

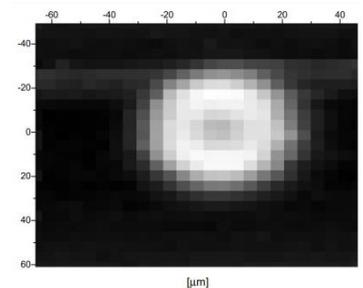


## The Future

The Group has recently carried out proof-of-concept studies into an optimized jet design for a high-resolution quantum helium atom microscope. A custom-built atom sieve was successfully used to generate a quantum helium gas jet with a micrometre focus. This novel design now forms the basis for a compact, high resolution, high contrast and tabletop surface imaging microscope with superior imaging capabilities.

We see helium microscopy as a new tool for imaging fragile or insulating structures, as well as structures with large aspect ratios. It is an ideal probe for such systems owing to an energy of less than 0.1 eV, the lack of a net charge or spin, and a short de Broglie wavelength of only 0.1 nm. This means that the atoms can probe the outermost electron density distribution of a sample without penetrating into the solid material, giving access to surface sensitive and non-destructive imaging.

We are looking for partnerships with companies that are interested in developing and testing our quantum helium atom microscope in their own application environments and collaborate with us in joint R&D to enhance and improve the microscope's capabilities. We see applications particularly in the areas of bio-medical, material science and bio-chemistry, but are open to collaboration in other areas as well.



Measurements showing the 35  $\mu\text{m}$  (FWHM) spot size for our atom sieve

The Quantum Systems and advanced Accelerator Research (QUASAR) Group is an internationally structured research group. We are amongst the world-leaders in beam instrumentations development, beam dynamics studies for accelerators and light sources.

[www.quasar-group.org](http://www.quasar-group.org)

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