Scientists have demonstrated a key technology in making next-generation high-energy particle accelerators possible. Particle accelerators are used to probe the make-up of matter in colliders like the Large Hadron Collider, and for measuring the chemical structure of drugs, treating cancers and manufacturing silicon microchips.

So far, the particles accelerated have been protons, electrons and ions, in concentrated beams. However, an international team called the Muon Ionization Cooling Experiment (MICE) collaboration, which includes Imperial College London researchers, are trying to create a muon beam.

Muons are produced by smashing a beam of protons into a target. The muons can then be separated off from the debris created at the target and directed through a series of magnetic lenses. The collected muons form a diffuse cloud, so when it comes to colliding them, the chances of them hitting each other and producing interesting physical phenomena is really low.

To make the cloud less diffuse, a process called beam cooling is used. This involves getting the muons closer together and moving in the same direction. However, so far magnetic lenses could only get the muons closer together, or get them moving in the same direction, but not both at the same time.

Credit: Imperial College London
The MICE Collaboration tested a completely new method to tackle this unique challenge, cooling the muons by putting them through specially designed energy-absorbing materials. This was done while the beam was very tightly focused by powerful superconducting magnetic lenses.

After cooling the beam into a denser cloud, the muons can be accelerated by a normal particle accelerator in a precise direction, making it much more likely for the muons to collide. Alternatively, the cold muons can be slowed down so that their decay products can be studied.

Dr. Chris Rogers, based at STFC's ISIS facility and the collaboration's Physics Coordinator, explained: "MICE has demonstrated a completely new way of squeezing a particle beam into a smaller volume. This technique is necessary for making a successful muon collider, which could outperform even the Large Hadron Collider."

"Demonstration of cooling by the Muon Ionization Cooling Experiment" is published in *Nature*.

**More information:**


Provided by Imperial College London