Particle Physics

STFC Rutherford Appleton Laboratory

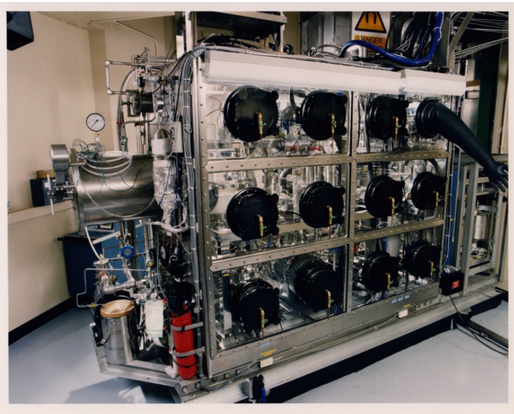
Particle Accelerators: What are they good for?
Energy Applications.

For energy production, accelerators can be used for fusion in a variety of ways and for the reduction in the waste created by fission reactors.

Fusion

Fusion works by bringing together two forms of hydrogen, deuterium and tritium. For efficient energy production, these must be heated to high temperatures and compressed. In the most commonly studied technique, they must be heated to 100 million °C and confined using a strong magnetic field. It is envisaged that accelerators will contribute to the heating by providing extraordinarily high currents of neutral ions, more than 100000 times bigger than used in ISIS, but at much lower beam energies.

Test facility for a neutral ion source in Italy.



Muon catalysed fusion test facility once at RAL.

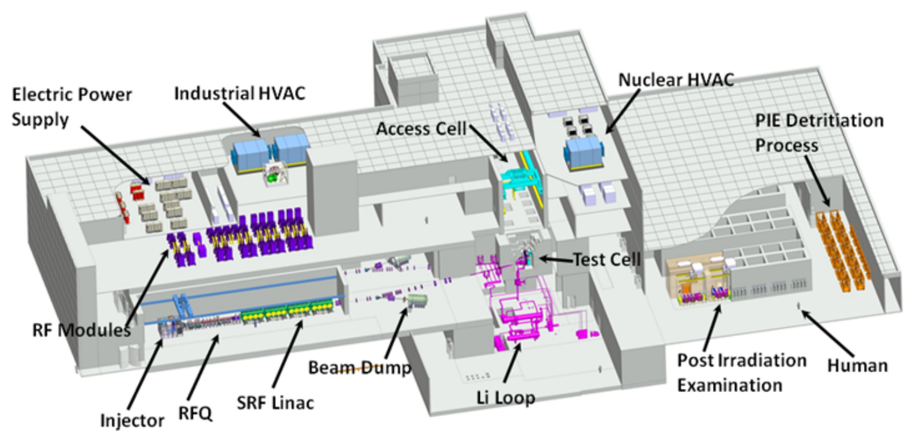
Accelerators have also been studied for two other types: muon catalysed fusion and heavy ion fusion.

Heavy ion fusion test accelerator in the US

Materials studies

Fusion reactors will produce a vast number of neutrons and there are concerns about the amount of damage these will do to the surrounding structural materials. A large accelerator called IFMIF is being built in Japan to produce neutrons to study different materials.
In addition, it is planned to develop a much smaller facility in Birmingham for some initial studies for both fusion and fission reactors.

IFMIF facility under construction in Japan



We are working on the design of the neutron production target for the Birmingham facility.

Waste transmutation

A big issue for fission reactors in the amount of radioactive waste they produce. Accelerators can be used to make neutrons to break down this waste. This could reduce the amount of time the waste needs to be stored by a factor of 1000 and the volume by a factor of 100.