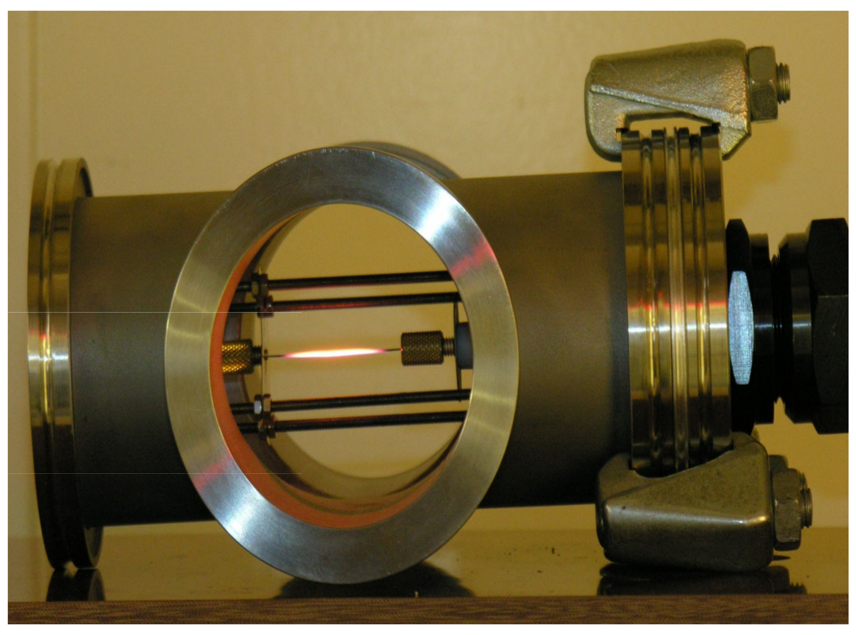
UK Neutrino Factory Design Effort - Status

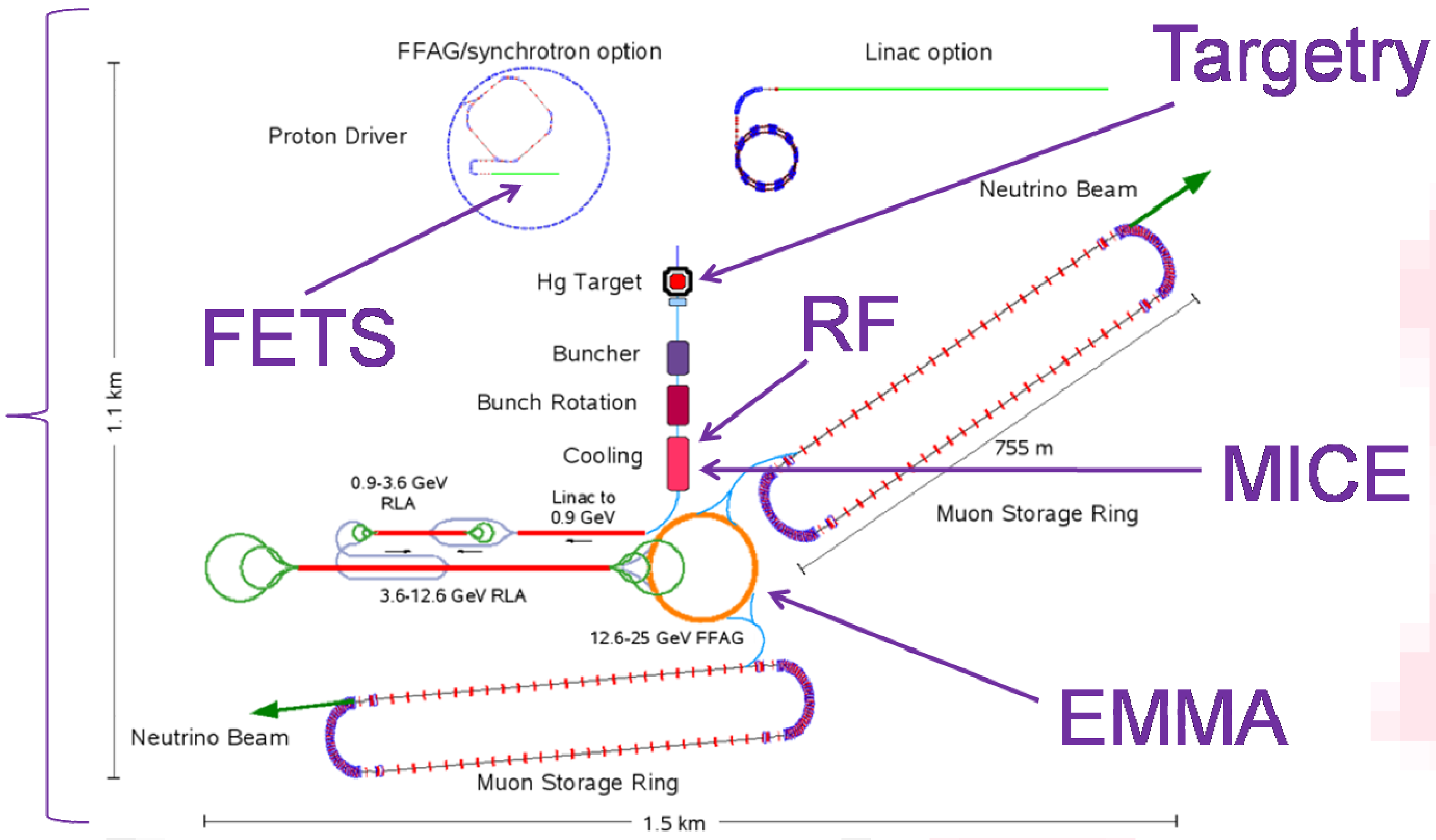
The UK Neutrino Factory (UKNF) collaboration has established an R&D programme that encompasses: the development of capability in the key technologies required to generate high-power proton beams; the detailed investigation of the effect that beam-induced thermal shock will have on the high-power, pion-production target; and the demonstration of ionisation cooling through the MICE experiment. This work has been carried out in the context of the development of a complete conceptual design for the facility. The UKNF collaboration's programme. The UKNF collaboration is contributing strongly to the International Design Study for the Neutrino Factory (the IDS-NF) and the EUROnu FP7 Design Study



Targetry

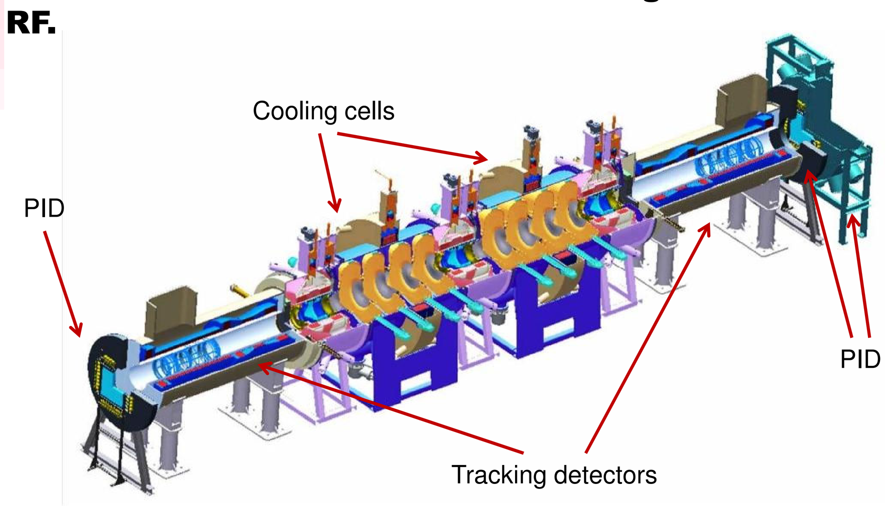
Colliding the proton beam with a dense target is currently the only known way to produce enough muons for the Neutrino Factory. This deposits 1MW of heat into the small volume of the target, requiring engineering beyond the current state of the art. The UK is investigating the use of a simpler solid target to complement liquid target studies at CERN and elsewhere. Solid targets may reach temperatures of 2000°C, at which the response to thermal shocks induced by the proton pulses is largely unknown.

To test the candidate materials' resilience over the target lifetime, the UKNF targetry team is producing thermal shocks by passing a fast current pulse through a wire of the material (left). The wire may be heated to the temperature of interest and the pulses repeated at 50Hz to put it under similar conditions to the target of a real proton driver.

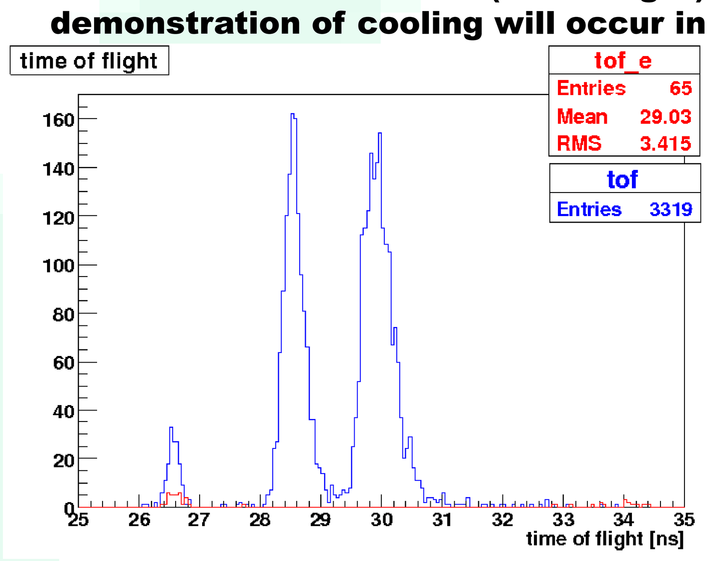


MICE

The MICE experiment (below) is designed to demonstrate that it is possible to reduce the emittance of a beam of muons in one pass by directing them through a medium which becomes ionised. The longitudinal momentum is then restored with RF.



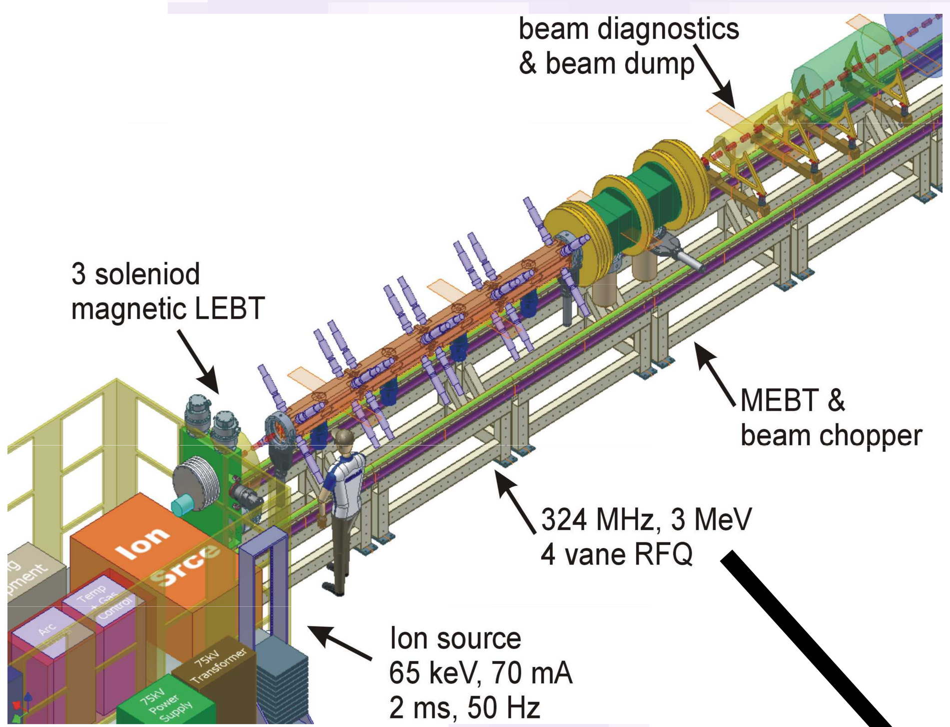
Currently, the MICE beamline is functional, muons have been seen and the cerenkov and time-of-flight detectors which are used for particle identification are operational (below left). The development of the experimental hall is very far advanced and target issues are being addressed. The tracker has been tested with cosmics. Of the cooling cells themselves, only 1 has been funded to date. The magnets and RF are under construction and one of the liquid Hydrogen absorbers has been built (below right). It is anticipated that the first demonstration of cooling will occur in 2010/11.

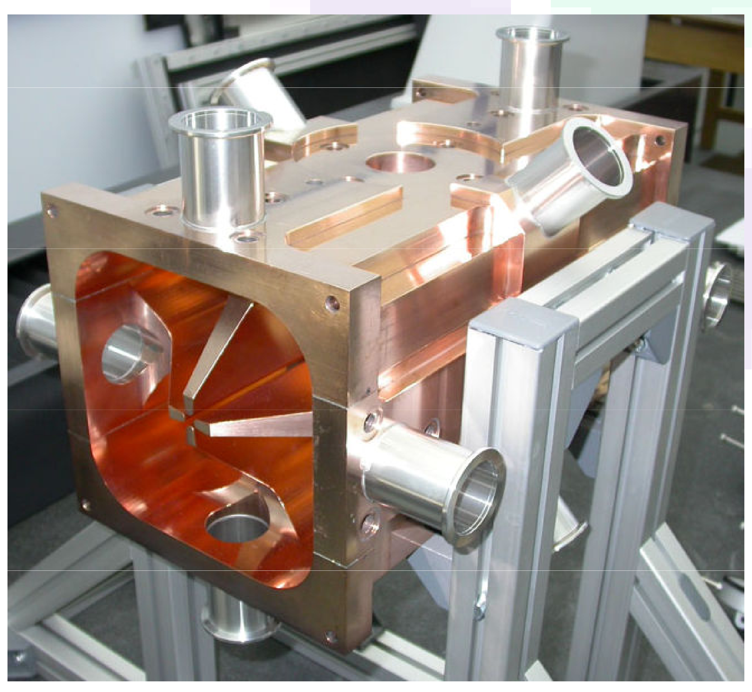


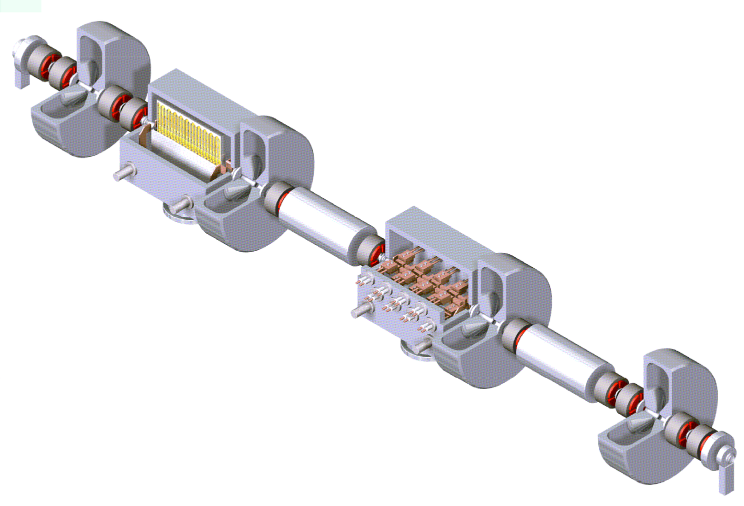
FETS

The Front End Test Stand aims to demonstrate key technologies for the front end of the next generation of high power pulsed proton accelerators. Apart from being the proton source of a potential neutrino factory, such technology could be used for future neutron spallation sources, waste transmutation etc.

The key components are shown in the figure below, many of which have been constructed or are operational. The Ion Source (below left) has delivered current and the upstream diagnostics are functional.

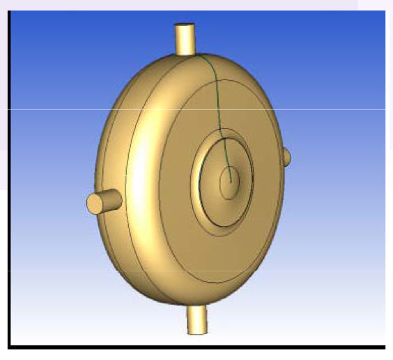


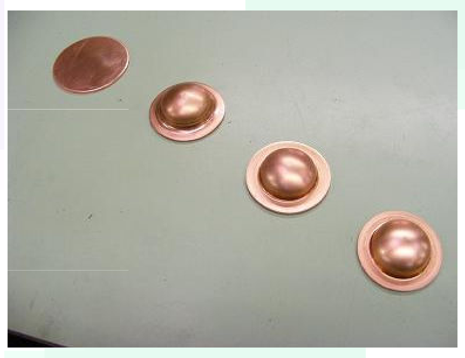




RF

The full MICE experiment requires 8 RF cavities in its cooling channel (see below left – CST MWS simulation). These cavities will be operated in a strong magnetic field which requires them to be normal conducting. The cavity design and construction are based on the successful experience and techniques developed for a 201 MHz prototype for the MuCool program.





Work is underway investigating various materials and coatings to improve the maximum sustainable surface electric field. Experiments and simulations are taking place to investigate the relations between surface defects and RF breakdown. Diagram above right: Button tests at MTA in Fermilab.

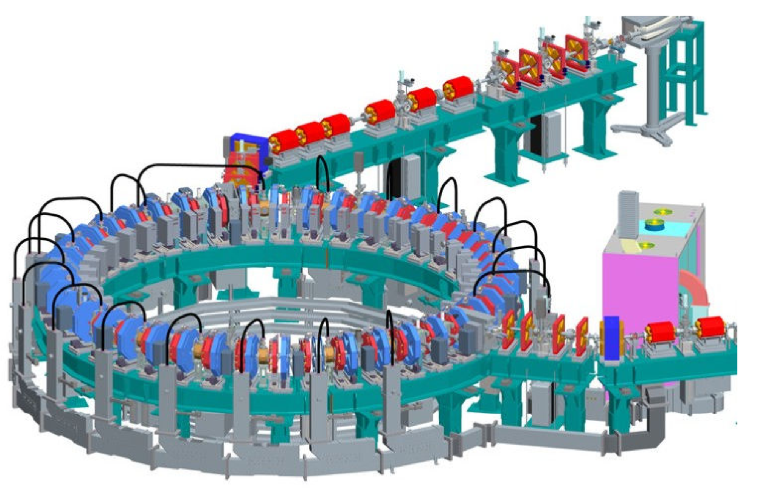
EMMA

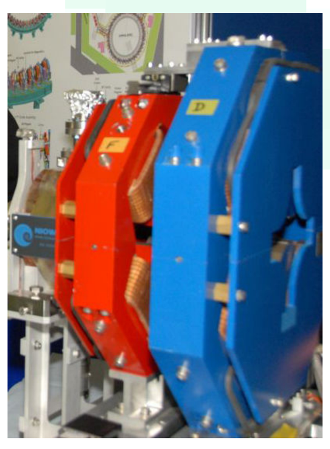
EMMA is a proof-of-principle prototype model of a muon Fixed Field Accelerating Gradient accelerator. Supported by the BASROC/CONFORM project via the Basic Technology fund, the accelerating technique has many possible applications such as proton and light ion cancer therapy, Accelerator Driven Sub-Critical Reactors and slow muon production for research. EMMA is almost completely built at Daresbury Laboratory in the UK and uses the ALICE Energy Recovery Linac Prototype as an injector. First beam is hoped for in late November - EMMA will accelerate electrons from 10 to 20 MeV. It is composed of 42 cells that are each 40cm long. The total circumference is 16.5m and the RF operates at 1.3GHz.

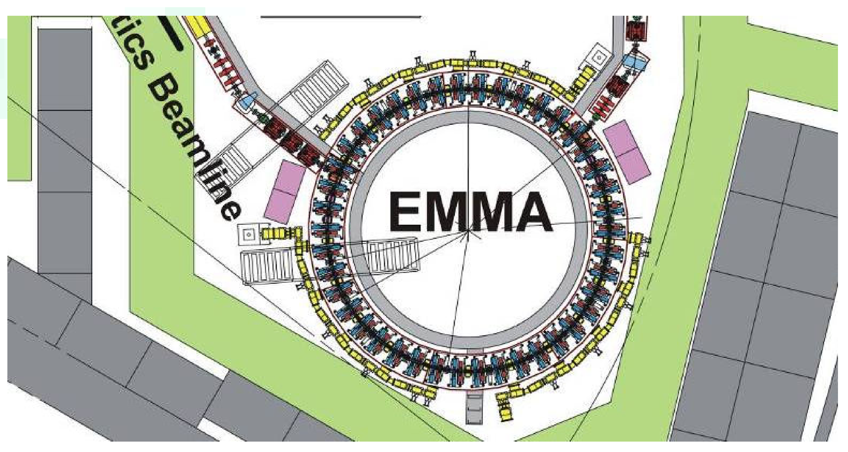
Below Right: Top view of the EMMA ring at Daresbury

Below: An F and D quadrupole pair

Right: The conceptual layout of the EMMA ring







The International Design Study for the Neutrino Factory aims to have completed an Interim Design Report by ~2010, followed by a Reference Design Report for ~2012. These documents will consolidate the details of the design of the accelerator and detector(s), the physics performance, the cost and scheduling and the "Risk" associated with the construction of the facility. The EUROnu fund has provided most of the EU contribution.

Thanks to: Graeme Burt, Rob Edgecock, Ken Long, Alan Letchford, Arash Zarrebini and the whole of the UK Neutrino Factory Collaboration.

The UK is playing a very important role in future neutrino projects by contributing to the leadership of Neutrino Factory accelerator R&D. As much as possible, this is done whilst creating Knowledge Exchange possibilities. This has been achieved by exploiting various funding sources, including the EC. UKNF & MICE funding is ring-fenced until March 2012. Through the IDS-NF and EUROnu the UK aims to contribute to the 2012 decision point identified by the Strategy Group of CERN Council

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