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Successful beam test on ISIS for new acceleration system after a 15 year wait

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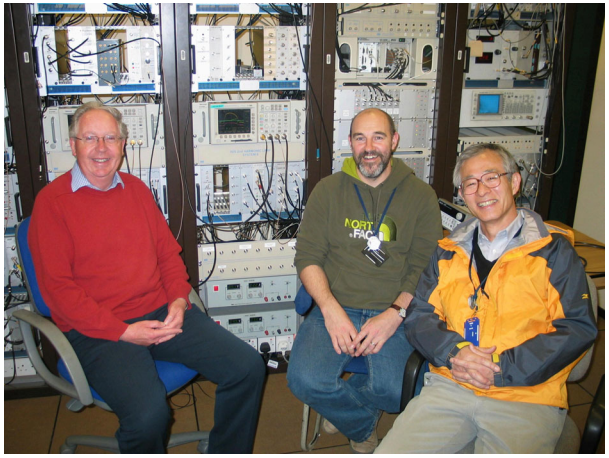
After 15 years of waiting Dr. Yoshiro Irie (KEK/JPARC) has finally completed the first tests of a novel Low Output Impedance (LOI) acceleration system with beam in the ISIS synchrotron.

Future accelerator projects will require higher beam power and beam current than is available at the moment. It has always been assumed that beam current will be limited because a fraction of the available acceleration potential is used to overcome the voltage that the beam current develops in the acceleration system – this is called “beam loading”. As current – and hence beam loading – increases, eventually there will no longer be enough potential left to accelerate the beam. Dr. Irie’s new system, however, overcomes this problem by decreasing the amount of beam loading a given beam current produces, and perhaps opens the door for a new generation of particle accelerators.



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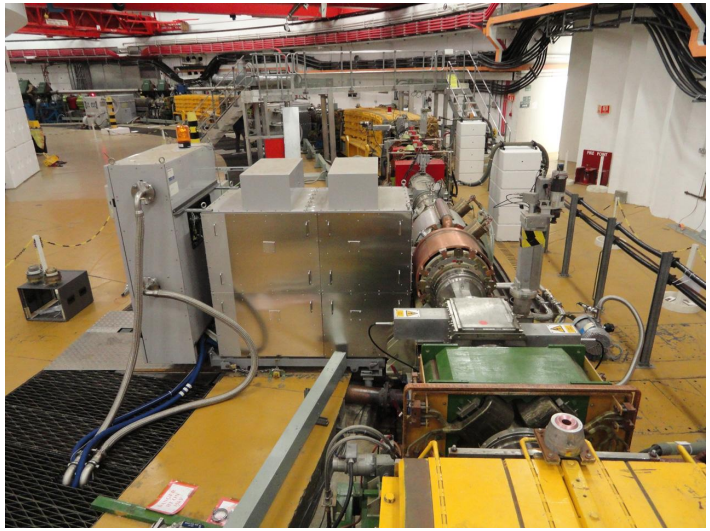

Ian Gardner and Andy Seville (ISIS) and Dr. Irie (KEK/JPARC) celebrate first beam results.

The LOI amplifier in the ISIS synchrotron

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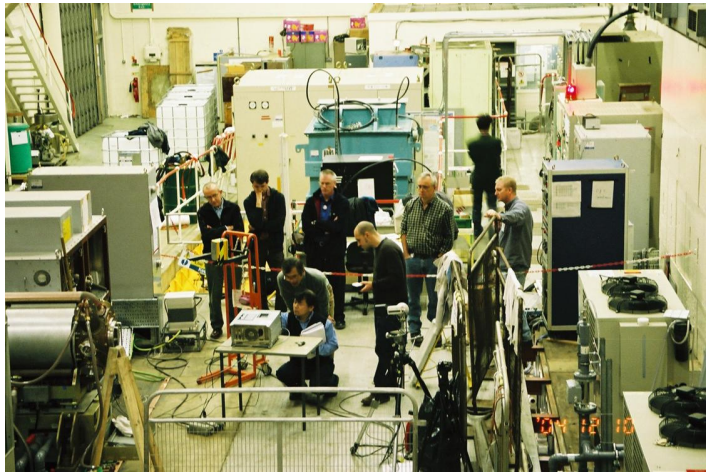
This collaborative work started back in 1996 with an informal agreement between the KEK High Energy Research Organization in Japan, Argonne National Laboratory (ANL) in the USA and ISIS here at the Rutherford Appleton Laboratory. Over the next seven years a prototype amplifier was designed and built at KEK, and was then shipped over to ISIS for further testing and optimisation. Dedicated experimental time has been severely limited by having to fit visits from KEK and ANL scientists around the busy ISIS operational schedule, but in January 2011 the LOI system was finally ready for tests in the ISIS synchrotron and was installed in place of one of the existing acceleration systems. This involved a large amount of work from the ISIS water plant section, as the cooling requirements of the LOI system are roughly double those of the existing systems.



ISIS, KEK and ANL staff testing LOI equipment at Rutherford Appleton Laboratory
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On April 17th 2011 Dr. Irie attended the machine physics session at which the LOI system was first run with beam. Initial tests show that the beam loading in the new system is about 40 times lower than that in the existing acceleration systems, and that in addition, the new system may help to stabilise the beam elsewhere in the synchrotron. This suggests that an LOI system could possibly be used to accelerate up to 40 times more beam current than any acceleration system presently in operation.

There is still much more work to do to make this system – or something like it – an operational part of ISIS, but the initial results are very promising. This approach may help ISIS accelerate much higher beam current in the future, and points the way towards acceleration systems for future ISIS upgrades and high power proton drivers for projects such as the Neutrino Factory.