ICANS-XIII
13th meeting of the International Collaboration on
Advanced Neutron Sources
October 11-14, 1995
Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

ISIS: THE FIRST 10 YEARS

A D Taylor

ISIS Facility, Rutherford Appleton Laboratory, Chilton, OXON OX11 0QX, UK

ABSTRACT

Recent progress at ISIS is reviewed.

1 Introduction

At 7.16 pm on the 16 December 1994, ISIS celebrated its 10th Anniversary of first producing neutrons. These first 10 years have been a period of remarkable growth both in terms of the source performance and of the scientific exploitation of the source. ISIS is now widely acknowledged as being one of the foremost neutron sources in the world, and has played a major part in establishing the pulsed spallation technique as the technology of choice for the next generation of neutron sources for condensed matter research. A major achievement has been the expansion of science capabilities from acknowledged areas such as powder diffraction and high energy spectroscopy to the exploitation of cold neutrons for reflectometry, diffraction and high resolution inelastic studies. Recently significant advances in studying coherent excitations in single crystals using time-of-flight techniques have also been made.

The scientific progress made in these first ten years has been remarkable, with almost all of the science anticipated in the original ISIS proposal being realised. What was not anticipated has been a source of great satisfaction: the whole field of reflectometry, the use of muons for condensed matter research, the quality of information available from powder diffraction on a pulsed source, diffuse studies using white beams, very detailed information on the liquid state, stress measurements on engineering components, magnetic excitations in single crystals and the power of cold neutrons -- all of which are now established as major components of the ISIS programme -- were not even mentioned in the original proposal.

2 Source

The ISIS accelerator now routinely operates at currents of 180 μA, averaged over a 28 day cycle, with an efficiency between 85% and 90%. (Whilst currents in excess of 200 μA are possible, the increased beam loss jeopardises hands-on maintenance of key accelerator components). In six operational cycles in 1994 ISIS delivered some 653 mA-hr of protons onto a tantalum target. At

Keywords: ISIS, Pulsed Spallation Source, Instruments, Science

these power levels, radiation damage in methane severely limits the lifetime of the 100K methane moderator. Improved flow characteristics in the latest design and regular flushing of the methane to limit the build up of higher hydrocarbons has extended operation of the moderator to an acceptable 2-3 cycles before it is necessary to replace it. The lifetime of the new micrograined uranium target is, however, at one cycle, unacceptable. A tantalum target will be used routinely until the damage problem in uranium is better understood. The performance of the accelerator is summarised in Figure 1.

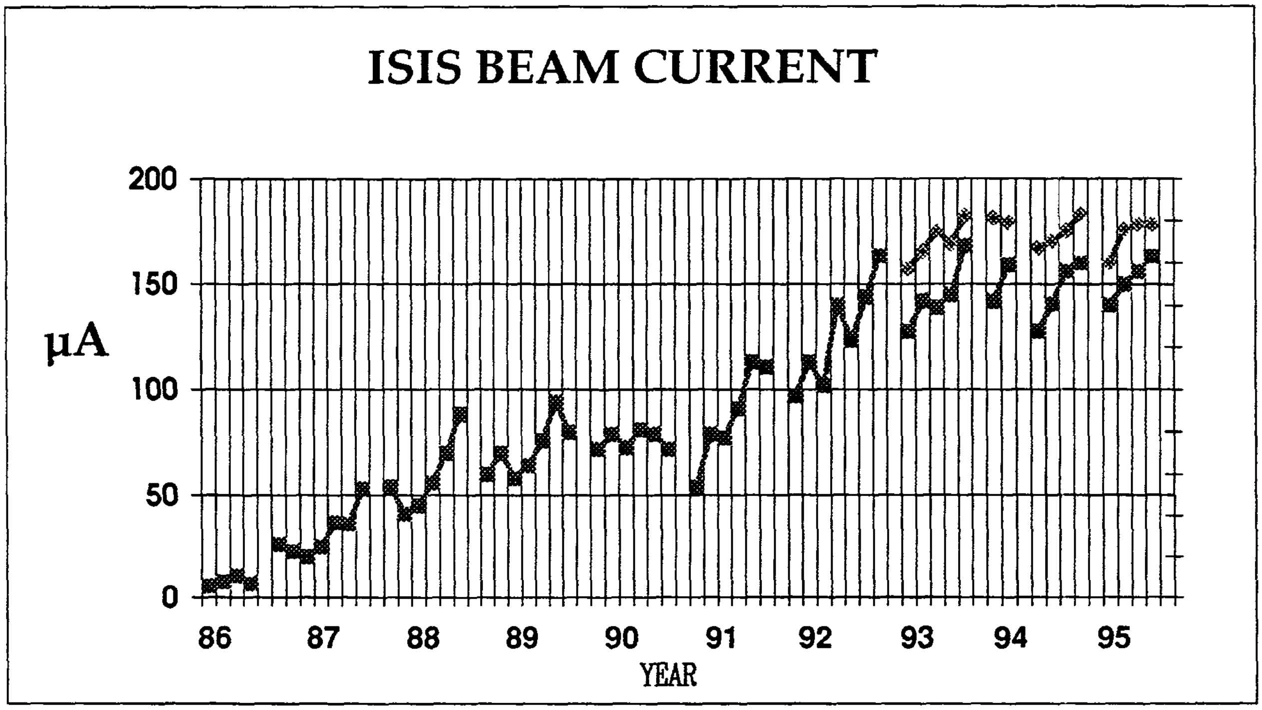


Figure 1 ISIS beam current. The main trace is the current averaged over each cycle as perceived by the end user. The upper trace for 1993 - 1995 is the actual beam current on target.

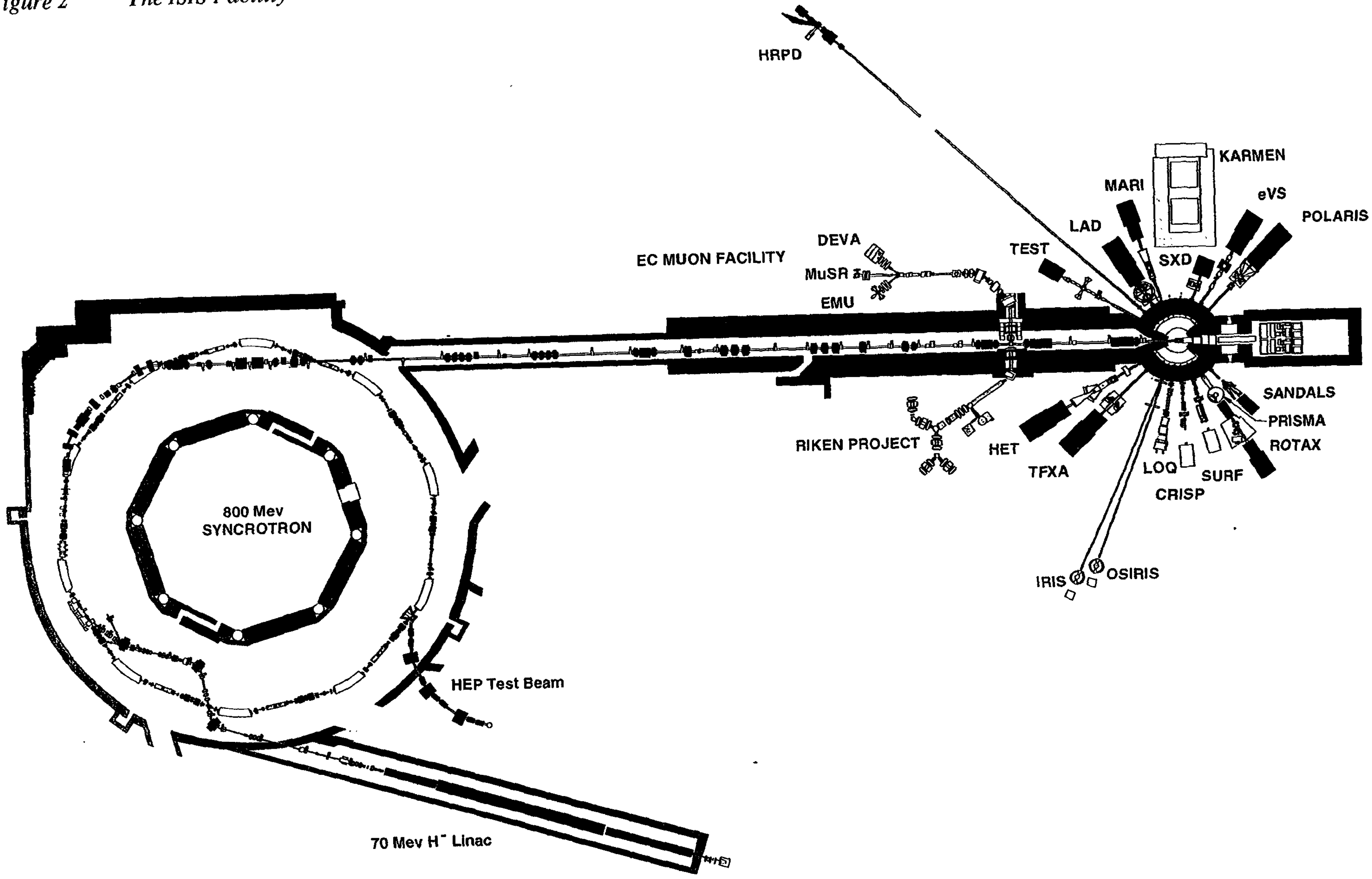
3 Instruments

Sixteen neutron and three muon instruments are now available to the ISIS community (Figure 2), and the RIKEN beamlines are being commissioned for muon catalysed fusion research as well as fundamental and condensed matter studies using both positive and negative muons.

Recent advances in instrumentation include a major pressure cell development programme based on the Paris-Edinburgh cell. Pressures of 100 kbar are routinely available to the user programme, and high quality diffraction data at pressures in excess of 250 kbar have been achieved by the development team. A time-of-flight strain scanner ENGIN has also been developed as part of an EU-funded programme. From 1996, the present TEST beam will be shared between the pressure diffraction programme and the strain programme. An increasing fraction of the beamtime on the direct geometry chopper spectrometers HET and MARI has been devoted to the study of coherent magnetic excitations in single crystals. The development of sophisticated visualisation and analysis routines, together with imaginative exploitation of the time-of-flight techniques, have shown that, in addition to the success already demonstrated in lower dimensions, the technique is immensely powerful for three dimensional systems, even at modest energy transfers.

A healthy instrument development programme has now been funded through the Collaborative Research Grant mechanism. A new reflectometer, SURF, is in its commissioning phase, and will

Figure 2 *The ISIS Facility*



be fully scheduled from 1996. SURF is optimised to study surfactants at the air-liquid interface and has an intensity gain of a factor 7 over its sister reflectometer CRISP. A second cold neutron guide will be extracted through the IRIS shutter to provide a beam for OSIRIS, which will serve as a testbed for developing several aspects of cold neutron instrumentation on a pulsed source. The initial phase will include a long wavelength diffractometer some 100 times more effective than IRIS and will be available in 1997. Later stages will develop polarisation analysis and μeV spectroscopy. Building on the success of the single crystal excitation programme on HET and MARI, a new chopper spectrometer, MAPS, is in the initial stages of engineering design (Figure 3). MAPS, with its large array of position sensitive detectors will be commissioned in 1998. A state-of-the art diffractometer, the General Materials Diffractometer GEM is the latest of these GRG-funded instrument. GEM will replace LAD, the first of the ISIS instruments, in early 1999 and will be particularly powerful for kinetic studies

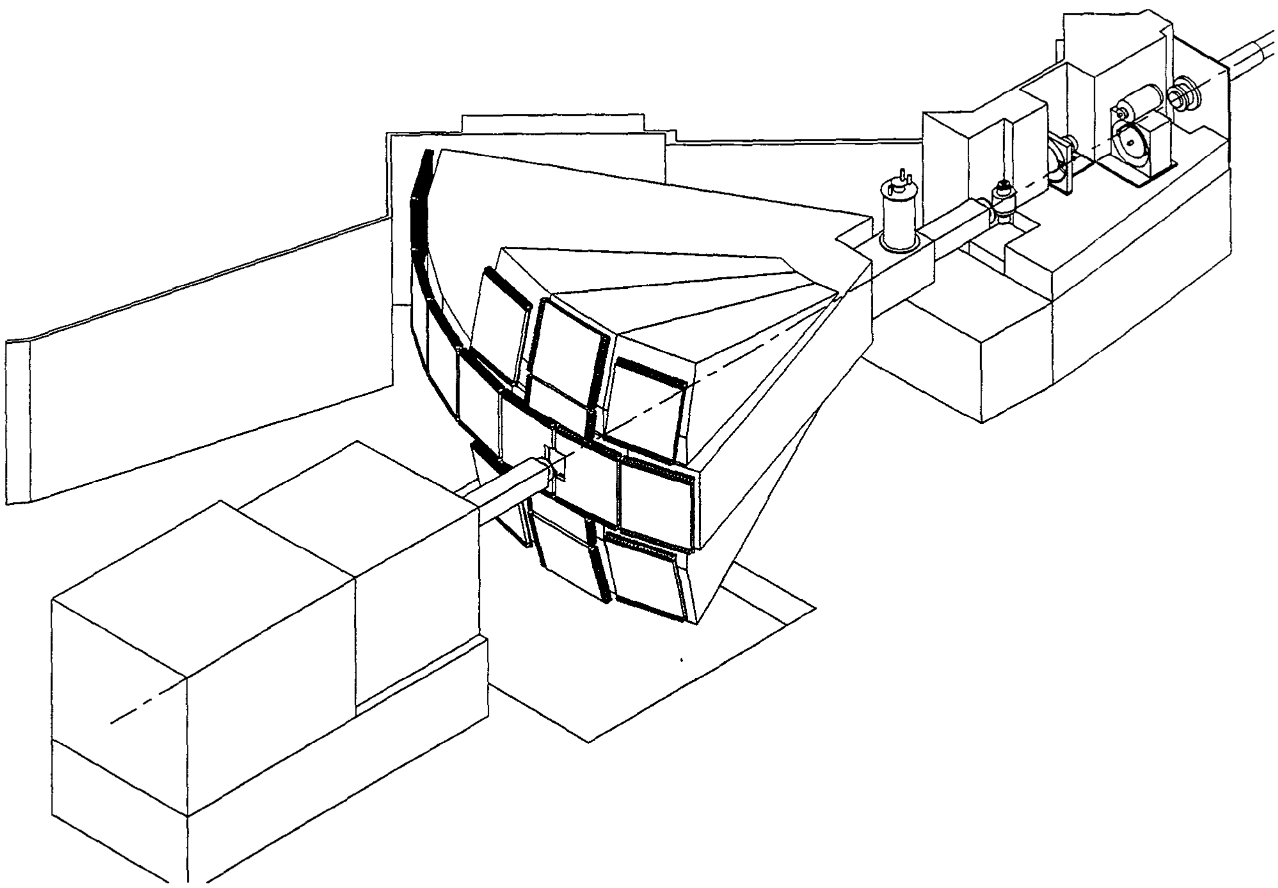


Figure 3   A preliminary layout of the MAPS spectrometer. The secondary flight path is 6 m and the detector area covers 14 m^2.

4 Science

The output of the ISIS source and instruments in the 2½ years between ICANS-XII and ICANS-XIII has been greater that the integral over all time up to the last meeting. This, combined with the increase in the sophistication of the user community who are now actively exploiting the features of pulsed sources in a very creative way, helps to explain the quality and quantity of science which can be found in the latest ISIS annual report.

It is not appropriate in these proceedings to single out a few of the five hundred experiments reported in ***ISIS 95***, nor is it appropriate to highlight any one of the ISIS instruments. The interested reader is referred to the latest annual report where details of the science programme and the instrumental and technical developments are given.