Report on the use of Loan-Pool Ge detectors at the ILL

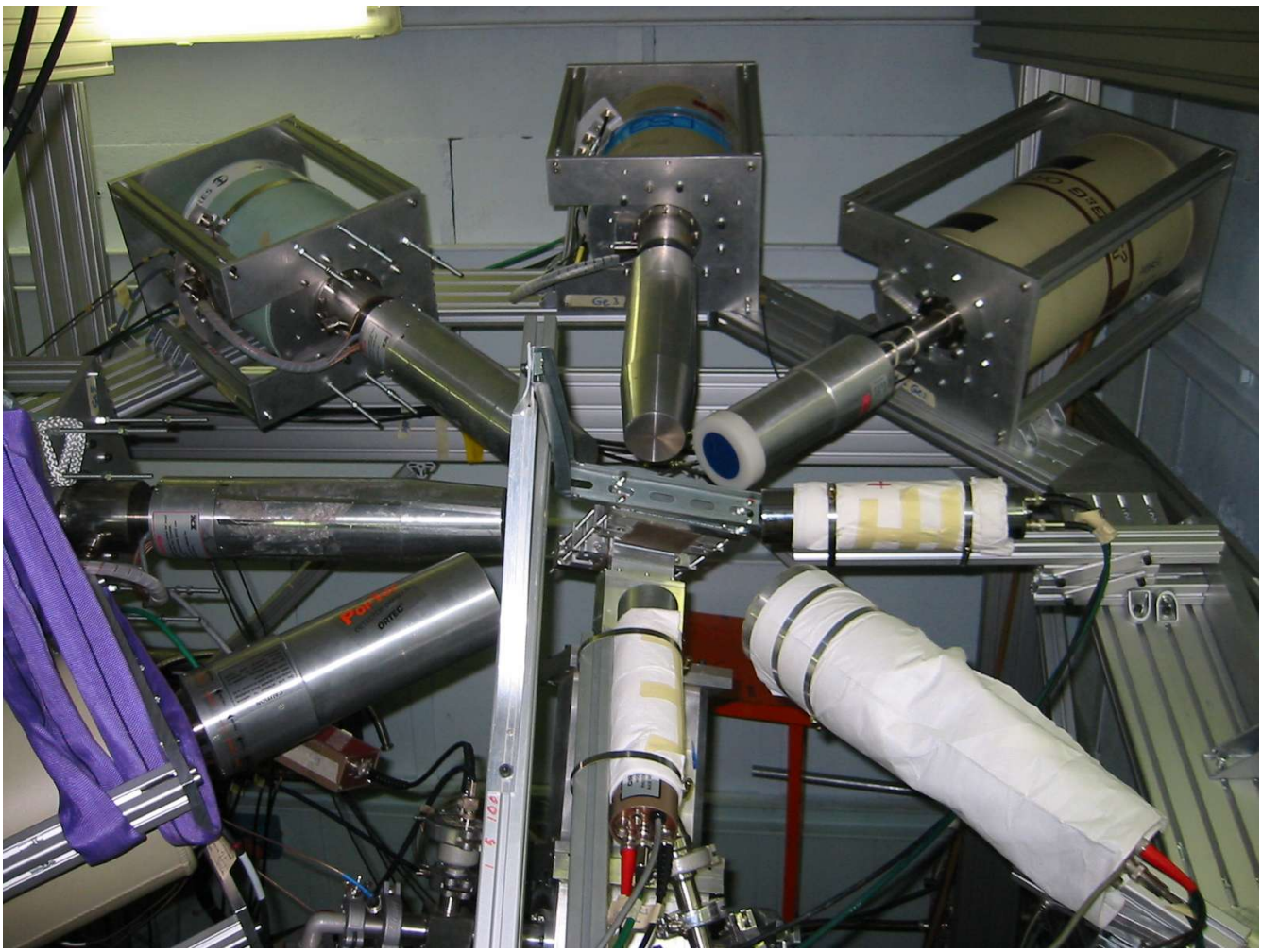
The use of loan-pool Ge detectors has been greatly appreciated. Detectors have been borrowed from the loan pool on four separate occasions.

- In November 2001 two 60 % germanium detectors were borrowed to perform an experiment to search for microsecond isomers in the neutron-rich mass 100 region at the Lohengrin mass spectrometer. The loan-pool detectors worked fine, but unfortunately the data acquisition system used in the experiment did not. Problems with the data acquisition system were found during offline analysis. The use of loan pool detectors was very much appreciated as, at that time our project to build a gamma-ray spectroscopy setup on Lohengrin had its funding refused and hence we had no Ge detectors or funding. Without these detectors we would not have been even able to perform experiments and our instrument was at risk of closure.

- In March 2002 five germanium detectors and BGO shields were rented for six months. These detectors were used at the Lohengrin mass spectrometer. The first experiment, by J. A. Pinston, searched for microsecond isomeric states in the neutron-rich nuclei between mass 90 and 100, to examine the role of unique-parity states in neutron-rich nuclei in this region. A new microsecond isomer was found in ^{92}Y during the first two days of the experiment. A few days later the target changer on Lohengrin broke down, and the spectrometer was unable to function. Lohengrin was out of action for several months. The isomer found by J.A. Pinston has not yet been published as he has since concentrated his studies on the ^{132}Sn region, where he has had lots of recent success and several good publications. Plans are afoot to return to this region in the future and the ^{92}Y isomer will be published when further studies have been completed.
  Two of the loan-pool detectors were then used in an experiment to measure the thermal-neutron capture cross-section of ^{209}Bi at the PF1A neutron guide. These data are important for evaluating the possible use of Pb-Bi eutectic as a material for spallation neutron source targets and accelerator-driven transmutation systems. The results of this experiment are published in [1].

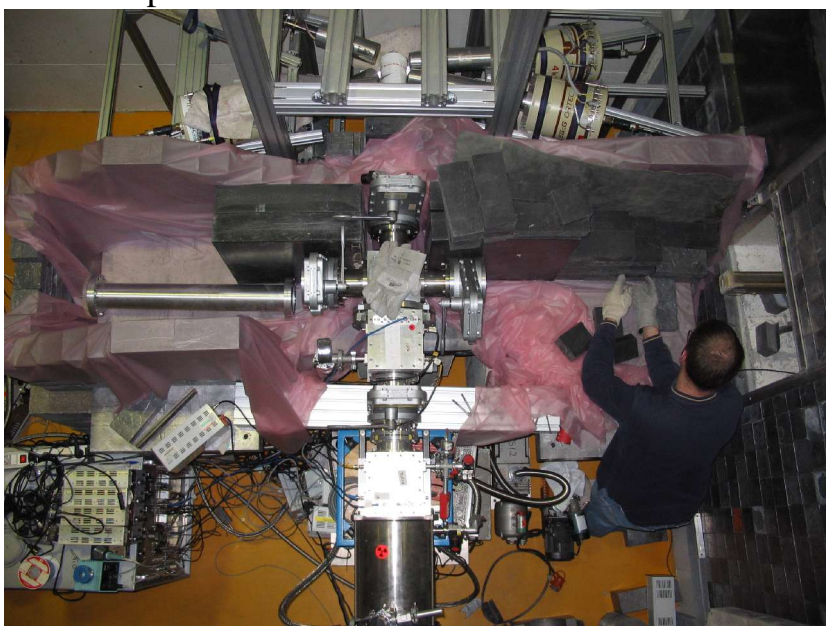
- In the Autumn of 2002 three detectors were again borrowed from the loan pool. These detectors were used in an experiment which tried to measure g-factors in ^{98}Y. The spins and parities of several states in this nucleus are not known and it was hoped that a g factor measurement could resolve some of the questions regarding the single particle orbits making up these states. The neutron-rich mass 100 region is especially interesting as rapid shape changes are known to occur here. The

occupation of deformation-driving orbitals is thought to be responsible for this effect, though more data are still needed to confirm this. 98Y nuclei from the Lohengrin spectrometer were implanted into and annealed Pb foil, which was subjected to a magnetic field of about 0.2 T. TDPAC of the gamma rays emanating from isomeric decays would allow Larmor precessions to be determined, and hence the g factors of several excited states. The experiment failed to produce any results as again we had problems with data acquisition systems. First we tried to use the J. A. Pinston's acquisition system from the ISN, but it could not handle the high rates from so many Ge detectors. Previously this system had worked fine with two detectors, but we had been unable to try it with more detectors until this experiment. We then tried to implement our new XIA DGF acquisition system, but as this system was new we encountered too many problems get reasonable data out. This experiment is scheduled to be repeated in June 2005, though with a different setup. Below is a photograph of the experimental setup.



- Five detectors were borrowed from the beginning of February 2005 until the end of March 2005. These detectors were used at the PF1B neutron guide for experiment 3-07-186 and formed part of an array of ten gamma-ray detectors. The experiment aimed to search for sub-microsecond isomeric states in neutron-rich nuclei far from stability in the mass range ~80 to ~150. These nuclei are difficult to access and very few techniques exist which can give access to isomeric states in this time range in these nuclei.

  The detector array was focused on an evacuated tube, which was connected to a cube containing 2 mg of ^{235}U. On the opposite side of the target sat the FiFi spectrometer. The FiFi spectrometer consists of a time-of-flight measurement section and a Bragg chamber. This allows mass identification to be performed for fission fragments entering the spectrometer. The complementary fission fragments, to those detected by the FiFi spectrometer, flew down the evacuated tube, where they were stopped in an aluminium foil. As the time of flight in the evacuated tube is ~70 ns for the light fission fragments and ~140 ns for the heavy fission fragments isomeric states in the time range 50 ns to 5 s should be able to be identified and assigned to specific nuclei. This time range is complementary to that available at Lohengrin, where the flight time of ~2 s allows isomeric states down to 0.5 s in lifetime to be identified. The use of neutron-induced fission gives access to very neutron-rich nuclei, which are currently the focus of intense study in the nuclear structure community. The region around ^{132}Sn and the region just above ^{78}Ni should be accessible with this experiment. Evaluation of these data will start soon. A picture of the experiment during the construction phase is shown below.



[1] A. Letourneau *et al*. “Thermal Neutron Capture Branching Ratio of 209Bi using a Gamma-Ray Technique”, Proceedings of the Eleventh International Symposium on Capture Gamma-Ray Spectroscopy and Related Topics, 2-6 September, 2002, Prague, Czech Republic, published by World Scientific. Editors J. Kvasil, P. Cejnar and M. Krticka.