Contribution ID: **48** Type: **Poster**

The 2 MeV Proton Linac Facility in Bern

Tuesday, 22 May 2012 18:57 (0 minutes)

The RFQ linac originally used at LEP has been recommissioned and put back into operation at the Laboratory for High Energy Physics (LHEP) of the University of Bern. The primary goals are to enable the elemental analysis of given targets via particle-induced gamma emission (PIGE), and the detection of potentially dangerous materials with high nitrogen content using the gamma-resonant nuclear absorption (GRNA) technique. The 425 MHz RFQ provides a 2 MeV H^- ion beam. At current settings, the beam repetition rate is 50 Hz with peak currents of 4–6 mA, yielding a particle flux of approximately 10^{13} ions per second. So far, beam instrumentation devices include an innovative R\&D beam profile monitor based on doped silica fibres, and a setup for emittance measurements using the pepper-pot technique. Furthermore, an adjustable focusing system with four permanent magnet quadrupoles (PMQs) was developed, capable of focusing the beam to millimetre spot sizes. For experiments, two options are currently available: For the PIGE technique, an extraction window with a 5 μm stainless steel foil is used to extract the beam to air. The resulting proton beam has a range of 50 mm in air, corresponding to energies up to 1.5 MeV. The second option uses a carbon-13 target in vacuum to create a 9.17 MeV gamma-source via the $^{13}\mathrm{C}(\mathrm{p},\gamma)^{14}\mathrm{N}$ reaction. This can be used for the detection of nitrogen using GRNA, and the calibration of detectors being developed at LHEP.

Optional extended abstract

The radio-frequency quadrupole linear accelerator (RFQ linac) originally used in the L3 experiment at LEP has been recommissioned and put back into operation at the Laboratory for High Energy Physics (LHEP) of the University of Bern. The primary physics goals are to enable the elemental analysis of given targets via particle-induced gamma emission (PIGE), and the detection of potentially dangerous materials with high nitrogen content using the gamma-resonant nuclear absorption (GRNA) technique for potential security applications.

The 425 MHz RFQ provides a 2 MeV H^{–} ion beam. At current settings, the beam repetition rate is 50 Hz with pulse widths of 10–20 μs and peak currents of 4–6 mA, yielding a particle flux of approximately 10^{13} ions per second. So far, beam instrumentation devices include an innovative R\&D beam profile monitor based on doped silica fibres, and a setup for emittance measurements using the pepper-pot technique.

Following the RFQ accelerator, the high-energy beam transport (HEBT) consists of an adjustable focusing system with four permanent magnet quadrupoles (PMQs) capable of reducing the transverse beam sizes to the order of millimetres. The end of the beam line is easily exchangeable, two different options are currently available: For the PIGE technique, an extraction window with a 5 μm stainless steel foil is used to strip the electrons and extract the beam to air. The resulting proton beam has a range of approximately 50 mm in air, corresponding to energies up to 1.5 MeV after extraction. The second option uses a carbon-13 target in vacuum to create a 9.17 MeV gamma-source via the $^{13}\mathrm{C}(\mathrm{p},\gamma)^{14}\mathrm{N}$ reaction. This gamma-source can then be used for the detection of nitrogen with the GRNA technique, and the calibration of detectors such as the liquid argon time-projection chamber (LAr TPC) being developed at LHEP.

The RFQ linac is a valuable asset for high-energy physics in Bern, the experience obtained will be put to good use at the 18 MeV cyclotron currently being commissioned at the Bern Inselspital.

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Session Classification: Applications - Poster Session

Track Classification: P2 - Applications