CURRENT MEASUREMENTS OF SLOWLY EXTRACTED IONS FROM A SYNCHROTRON

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Abstract

The talk reports on low intensity measurements during slow extraction from the heavy ion synchrotron SIS using various detector systems. Due to the variation in the extraction time (0.1 to 10 s) and the various ions species, the current varies about five orders of magnitude.

Until now the standard detectors for the current measurement are scintillators for low, ionization chambers for medium and secondary electron monitors for high currents. There performances are briefly discussed. In particular the linearity and the calibration of ionization chambers provided for medium intensities and secondary emission monitors for higher currents are discussed.

Results from new developed diamond particle counters, which have 2 orders of magnitude higher rate capability than scintillators are reported. Due to the short pulse length of 1 ns (FWHM) an average count rate capability up to 10^8 particles per second is possible. These detectors can be used for fast ions (minimum ionizing particle) as well as for slow ions delivered by the LINAC. For high ion currents above 1 nA a super-conducting SQUID based device is used, which measures the magnetic field (about some fT) of ion currents. The performance of it is shown.

With the described detectors careful investigations are done concerning the variation of the current with high time resolution (20 mus binning). High fluctuations are seen, which shows the sensitivity of the resonance extraction due to power supplier ripple. The time structure can be smoothed drastically by bunching the ion beam inside the synchrotron due do a ’smearing’ of the transverse phase space region close to the separatrix.

As an application of position measurement devices the computer aided beam alignment between the synchrotron and the target places is presented.

The synchrotron delivers a large variety of ion kinds and energies. Since the settings of the extraction elements is mainly determined by extraction efficiency rather than beam position, some individual adjustment is needed in order to put the beam exactly on the various targets.

To accomplish this the ion optics program MIRKO used for the design of rings and beam lines was extended to an online version, which reads the beam positions and reads/writes the beam line magnets directly. From two positions in both transverse planes the starting conditions of the beam are calculated and from these the settings of two correction elements per plane are determined and sent directly to the magnets.

This is done using a simple dialog box on the control console which in addition allows manual entry of beam positions that cannot be read by computer, e.g. fluorescent screens or halo counters. Normally the beam position is corrected in one or two steps and the time for compuation is negligible.