Monitoring of the beam geometry during the measurement cycle at COSY-11

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In the previous year we developed a method for monitoring the geometrical dimensions of a synchrotron beam at the target position for internal target installations [1]. The technique is based on the analysis of the momentum distribution for elastically scattered protons and its comparison with the distributions simulated with different beam and target conditions. The information of the changes of the size and position of the beam relative to the target during the measurement allows to improve the precision of the momentum reconstruction of the charged particles, which consequently leads to a better resolution of the identification of an registered events. The applicability of the technique is demonstrated here for controlling the size and position of the proton beam relative to the target when stochastic cooling was used at the synchrotron COSY for the first time in February 1998. The horizontal stochastic cooling [2] is used to squeeze the proton beam in the horizontal direction until it reaches an equilibrium between the cooling and the heating due to the target. The size of an uncooled beam increases during the cycle, as can be seen in Figure 1a, which shows the spreading of the beam in the vertical plane during the 60 minutes cycle. This was expected since stochastic cooling in the vertical plane was not used in this case. The influence of the applied cooling in the horizontal plane is clearly visible in Figure 1b. During the first five minutes of the cycle the horizontal size of the beam of about $2 \cdot 10^{10}$ protons was reduced by a factor of two, reaching the equilibrium conditions, and remaining constant for the rest of the COSY cycle. The movement of the beam relative to the target during the cycle is quantified in Figure 1c. The shift of the beam denotes also changes of the average beam momentum, due to the nonzero dispersion at the target position. The beam reaches stability after $\leq$15 minutes. This can be understood as the equilibration between the energy losses when crossing $1.6 \cdot 10^6$ times per second through the H_2 cluster target and the power of the longitudinal stochastic cooling which does not only diminish the spread of the beam momentum but also shifts it as a whole.

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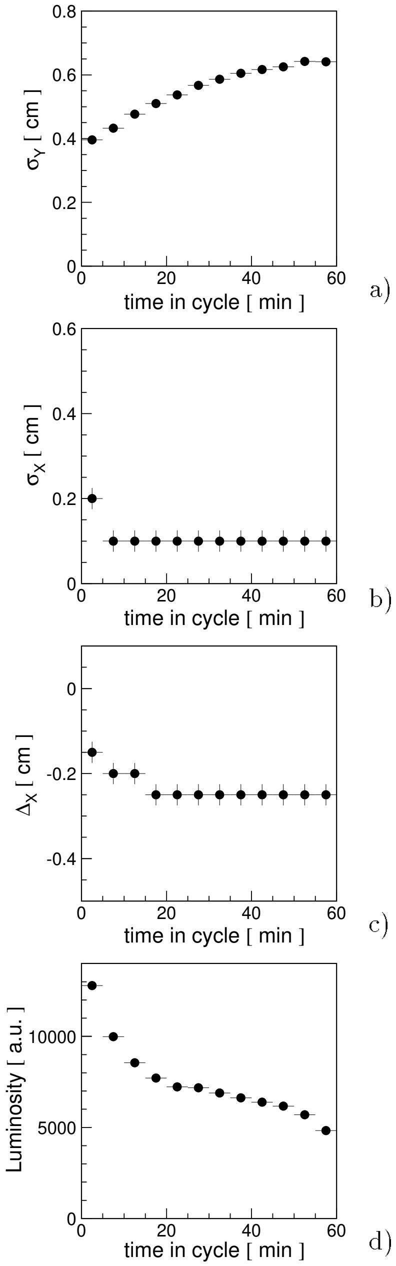

Figure 1: The vertical a) and horizontal b) beam width (one standard deviation) determined for each five minutes bins of the COSY cycle.
c) Relative settings of the COSY proton beam and the target centre versus the time of the measurement cycle.
d) Changes of the luminosity during the cycle. A steep decrease on the beginning is caused by the movement of the beam out from the target centre.

References:

[1] P. Moskal et al., Nucl. Instr. & Meth. A in print, e-Print Archive: nucl-ex/0010010

[2] D. Prasuhn et al., Nucl. Instr. & Meth. **A 441** (2000) 167