Thin Target on Primary Collimator, M.Seidel

At HERA variations of the loss rate at the primary collimators are observed that increase during the course of a luminosity run, presumably due to the development of beam tails. To illustrate these observations we include a graph of a typical loss rate recording at the HERA collimators that shows variations of the loss rate by up to a factor 10 already for a relatively large 1 second integration time of the counting rate. It is possible that these variations are considerably larger on a millisecond time scale.

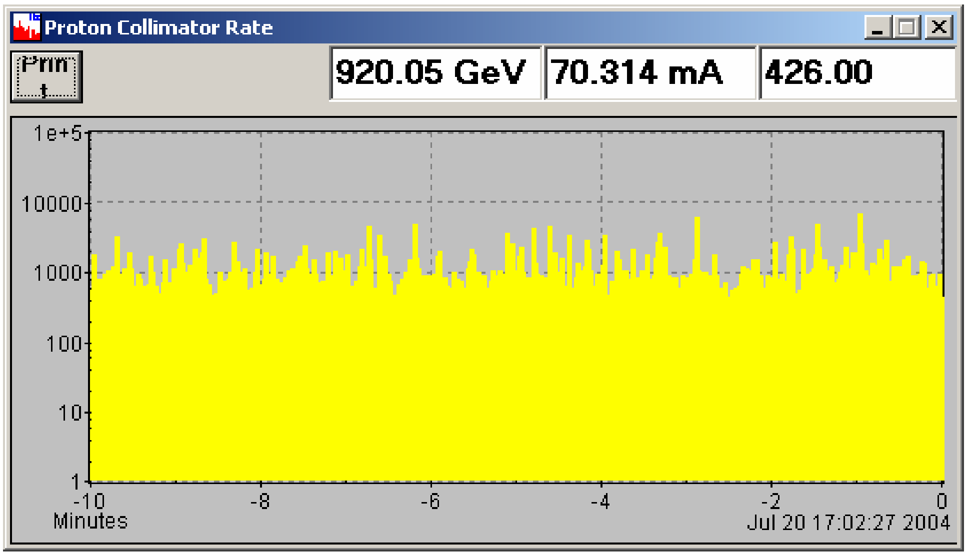

Fig.: Collimator loss rate recording at HERA-p.

Stochastic and harmonic motion of the beam at the primary collimator leads to modulation of the loss rate. A small modulation depth is obviously desirable for smooth operation. If we assume that the particle motion in the beam halo can be characterized by a diffusion process in the particle action *I*, the loss rate is proportional to the diffusion rate *D* and the slope of the distribution function *f*(*I*):

$\dot{N} \propto -D(I) \cdot \left. \frac{\partial f(I)}{\partial I} \right|_{I=I_c}$. I_c is the amplitude corresponding to the collimator position.

After some time of operation under collisions the beam will be blown up and the distribution at the edge will become rather steep. This enhances the average loss rate but also the sensitivity of the rate against small beam motion. With a steep edge the collimator cuts into dense halo regions already for small displacements. A thin pre-target would act like “bad vacuum” beyond a certain particle amplitude. In this region *D* would be much larger, while the average loss rate will roughly stay the same as without the target. This implies that the slope of the distribution should be smaller beyond the target amplitude which decreases the sensitivity against beam motions. The transverse thickness of the target has to be somewhat larger than the expected beam motions, i.e. 100µm?, and its longitudinal thickness a small fraction of a radiation length. The principle is demonstrate in the second figure.

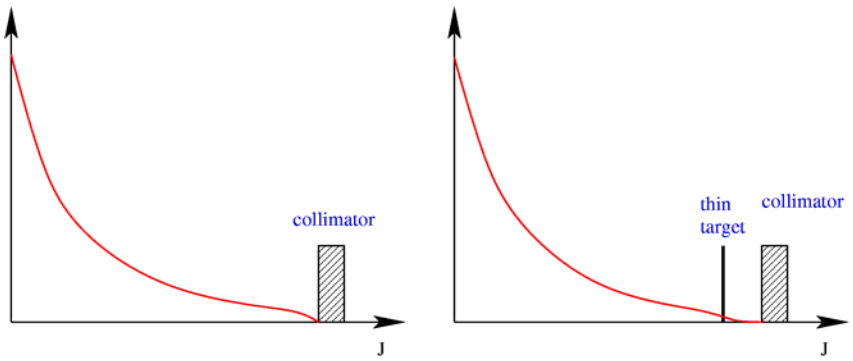

Fig.: Qualitative particle density distribution with and without thin target.

The function of this concept is not really proven in practice, although at HERA we had the experience that background spikes were suppressed when the HERA-B experiment operated wire targets at smaller amplitudes than the primary collimators. I would recommend to study this numerically as a possible option. A little step machined out of the graphite at the leading edge of the jaw would be sufficient.

A thin target was also proposed in the SSC design, although not for the purpose of smearing out losses in time, but for increasing the average impact parameter.

It would certainly be helpful to study the typical time distribution of the losses at existing accelerators. One possibility is HERA and we would be happy to collaborate with CERN colleagues on this subject.