THE OTR SCREEN BETATRON MATCHING MONITOR OF THE CERN SPS

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Abstract
In order to satisfy the tight emittance requirements of LHC, betatron matching monitors, based on multturn beam profile measurements, have been proposed for the SPS and LHC. A test monitor has been installed for evaluation in the CERN SPS two years ago. It is based on a OTR screen and a fast beam profile acquisition system. It has been used with proton beams to assess the quality of the betatron matching of the PS to the SPS. Experience and results will be presented.

1. INTRODUCTION
In order to satisfy the tight emittance requirements of LHC (12% blow up allowed from PS extraction to LHC injection), betatron matching monitors, based on multturn beam profile measurements, have been proposed for the SPS and LHC. A test monitor has been installed for evaluation in the CERN SPS two years ago and has since been tested and improved. It has been used to assess the quality of the matching of the PS to the SPS.

2. THE INSTRUMENT
With correct betatron matching, the size of the injected beam in the SPS remains constant. Any mismatch leads to a modulation of the beam size at twice the betatron frequency, and eventually to beam blown-up through filamentation. The monitor measures the beam size over many turns and quantifies this modulation. The Instrument is based on an OTR screen (12 μm Ti) imaged onto a CCD sensor operating in “Burst mode”. One CCD acquisition records four SPS beam images each separated by 8 turns (fig1). The corresponding H and V profiles for each image are extracted and analyzed to retrieve the beam sizes (fig 2).

Fig1: Acquisition of SPS turns 1, 9, 17, 25
Fig2: the V and H Profiles (with fits) of turn 1.

By shifting the first turn acquired at each SPS injection, a complete beam size evolution during the first 32 turns (Fig.3) can be acquired after 8 injections (approx. 2 min), provided that the injection conditions remain stable during the measuring period. It is then possible to evaluate the amplitude of the modulation and also to measure its evolution when changing the matching conditions. (Fig.4).
3. CONCLUSION

The tests made during the 1998 SPS Machine Development periods showed that the instrument is able to measure modulations of the order of 3% and to detect a minimum during tuning operations. These measurements will continue next year and will hopefully lead to the development of a closed loop system to optimize the beam matching.

Fig. 3: Vertical beam size evolution over 13 turns  
Fig. 4: Size Modulation as a function of matching