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Measurements of Beam Halo by Wire Scanner Monitor*

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Abstract

A wire scanner is used in the beam halo experiment at the Institute of High Energy Physics (IHEP) to measure the beam halo for the study of beam halo dynamics. The beam energy in the FODO transport line is 3.5 MeV and the peak current is 24 mA. Firstly we get the emittance value for the vertical and the horizontal plane respectively by measuring the matched beam. Then we measure the beam halo of the mismatched beam.

Introduction

The beam halo formation is an important characteristic of high intensity beams. Beam halo particles are more easily lost on the walls and increase unwanted radioactivity[1]. The experimental study of beam halo formation is very important and necessary. So we built a 28-quadrupole beam transport line after the IHEP RFQ[2]. We have designed a beam profile and halo measurement system and have installed the system in the transport line[3]. In the experiments we used the measured beam profile data to character the proton beam with quadrupole scans method, firstly[4]. Then we measured the RMS matched beam profiles. We also measured the mismatched beam profiles and beam halos, lastly.

In this paper, we introduce the beam profile and halo measurement system and the beam halo experiments. Then we present the measured RMS matched beam profiles with beam halo and the measured mismatched beam profiles with beam halo.

The Wire Scanner Monitor

The wire scanner

The 32micron diameter carbon wire is selected for use.

Figure 1: The schematic view of the wire scanner.

Beam Halo Experiment

The transport line

The 28-quadrupole beam transport line is installed at the end of the IHEP RFQ, which accelerates the proton beam to 3.5MeV and operates at the frequency of 352MHz[2]. The block diagram of this transport lattice is shown in Fig.2.

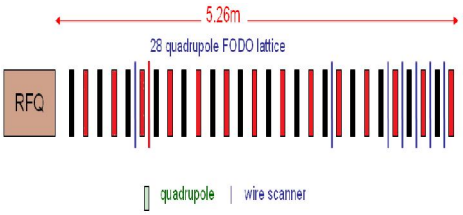

Figure 2: Block diagram of beam halo experiment transport line

The Measured Matched Beam Profiles

The matched beam profiles are shown in Fig.3.

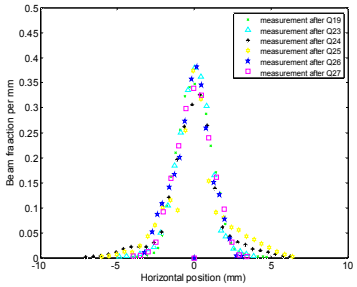

Figure 3: The measured equilibrium horizontal profiles at different locations..

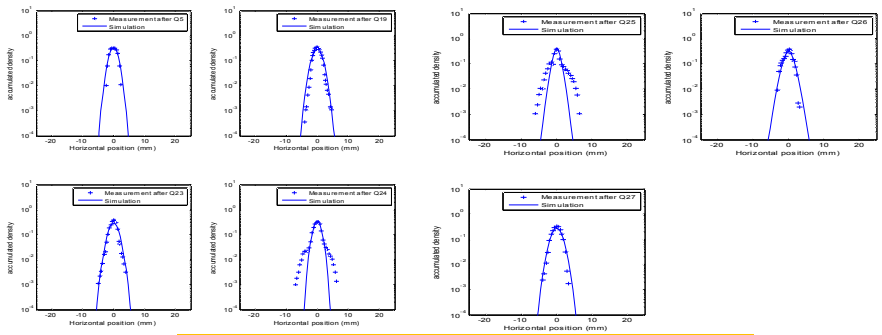

Figure 4: The measured and simulated matched beam profiles at different locations

The Measured Mismatched Beam Profiles

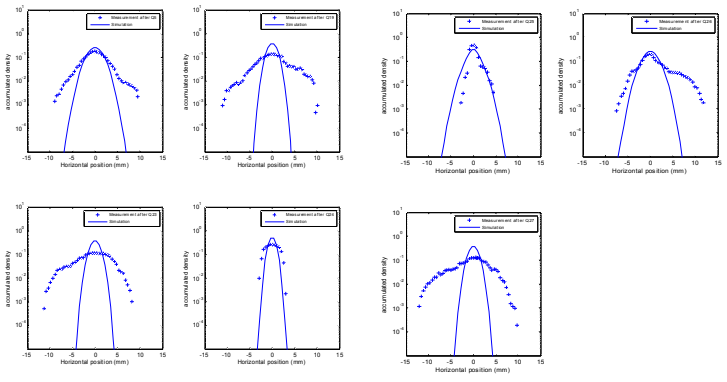

Figure 4: The measured and simulated mismatched beam profiles

CONCLUSION

We have built a transport line and designed a wire scanner system to measure the transverse beam profile and the emittance. We find dynamic range of the wire scanner is enough for us to measure the beam halo. And if we want to know there are beam halo particles or not in beam phase space, we need change the strength of the quadrupole to measure more 1-D beam profiles, the different projections of the 2-D phase space, because there are still a little halo particles in two locations for the matched beam profiles.

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