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A REAL-TIME VISUALIZATION OF BEAM PROFILES FOR VERY LOW-ENERGY ANTIPROTONS USING A POSITION-SENSITIVE PHOTOMULTIPLIER-II

V. Agoritsas[1], P. Fessler[1], M. Jacotin[2], J.F. Kepinski[2],
K. Kuroda[3], M. de Saint Simon[2]

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1 CERN, Geneva, Switzerland,
2 CSNSM, Orsay, France,
3 LAPP, Annecy-le-Vieux, France.

This note presents briefly a series of tests recently carried out on S3 beam line in collaboration with PS-PA and PS189 experiment groups: It consists of :

1) visualization of a 105 MeV/c pbar beam (run of June 15th),
2) several runs with H^- at 80-100 KeV (runs of July 17-19th).

Compared to the preceding set-ups[1], the present one is characterized by a new detector, entirely mounted inside vacuum, in front of the spherical sector SS1 located inside the radio-frequency mass-spectrometer. It consists of a glass scintillator 1 mm thick (or P11 type phosphor for H^- beam) coupled directly onto the photocathode of a position-sensitive photomultiplier (R2486-01). The interconnections of the tube are achieved by using a multipin ultra-high vacuum feedthrough (37 pins).

As shown in Fig. 1, 12 central anode wires in each X and Y plane are connected to a resistor chain with an interval of 1 kΩ between adjacent anode wires. The reconstruction of impact points was done by an electronic system of charge division, consisting of commercially available modules. The acceptable counting rate is limited, at present time, to $\sim 10^4$/sec due to the dead time of the divider circuit.

The pbar beam from LEAR was focused with the aid of the electric triplet TR11. Fig. 2 shows a typical example of the beam profile. A calibration of the horizontal scale was performed by moving the beam with the aid of the last bending magnet DVHN02. Four peaks in Fig. 3, projection of events in horizontal plane, correspond to different currents varying from 0 to -3 Amp., with a step of 1 Amp. From BL of the magnet, the distance between the peaks is estimated to be 5 mm, and thus the horizontal size of the beam spot is $\sim$ 2 mm in FWHM.

For the visualization of H^- beam profile, we were finally conducted to use a fluorescent layer of P11 type due to a very small energy deposit of low energy H^- particles (80-200 KeV). The fluorescent layer is deposited onto an optical fiber disk 28 mm in diameter. Fig. 4 shows a typical example of spectrum for 200 KeV H^-, which is well separated from the amplifier noise. Some examples of beam spots are shown in Fig. 5 for different beam energies (80-200 KeV).

In order to study the intrinsic space resolution of the device, we also carried out a series of measurements by putting two parallel fine

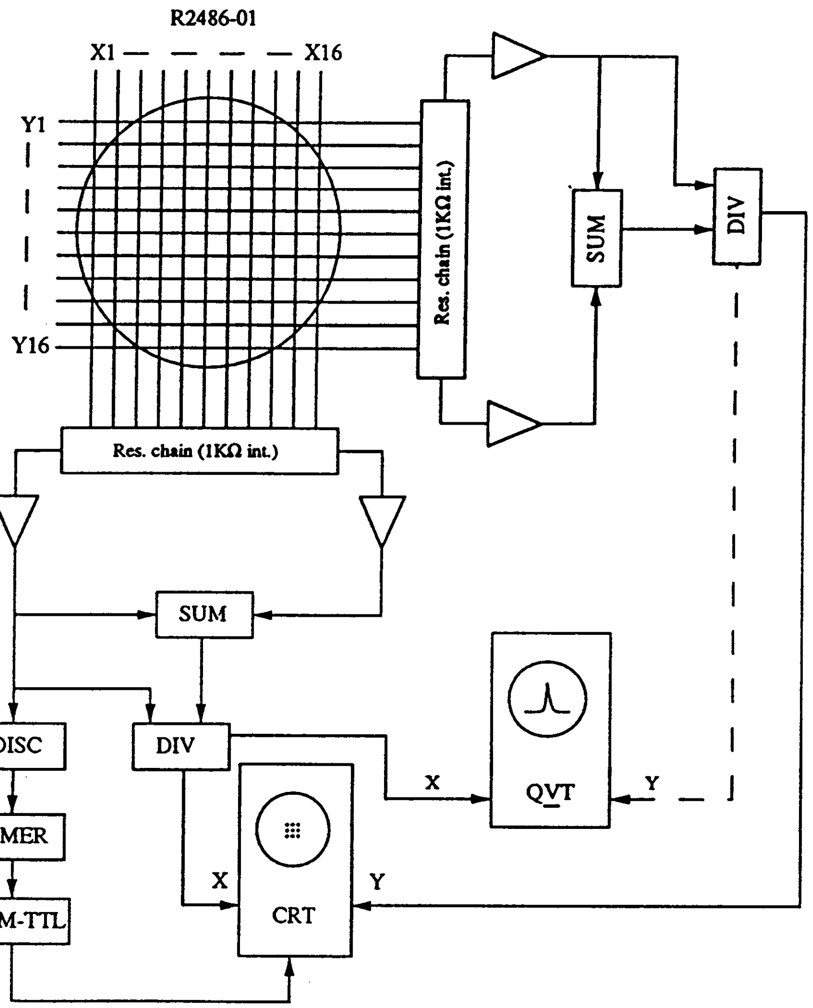

Fig.1 Associated electronics.

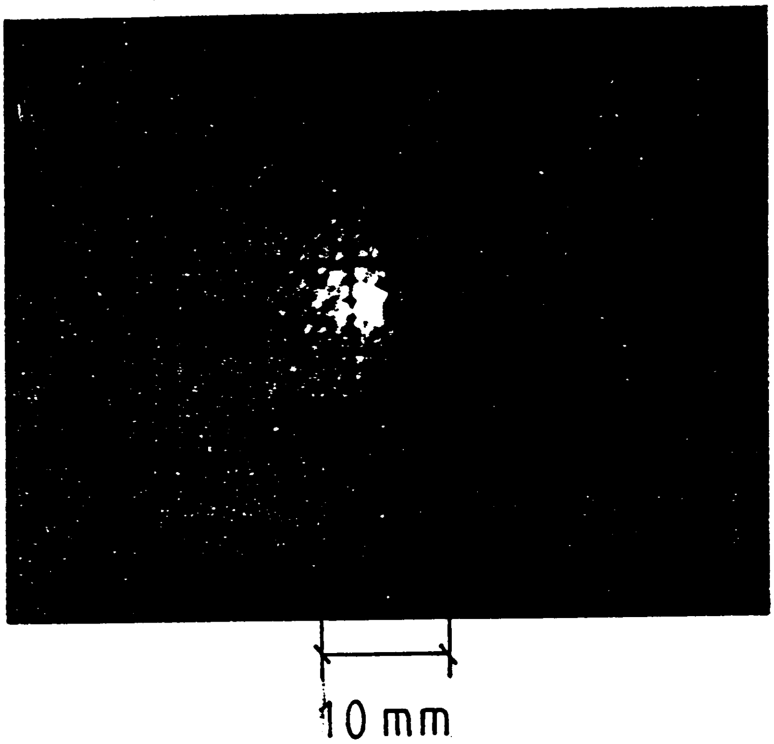

Fig.2 Beam profile of 105 MeV/c antiprotons.

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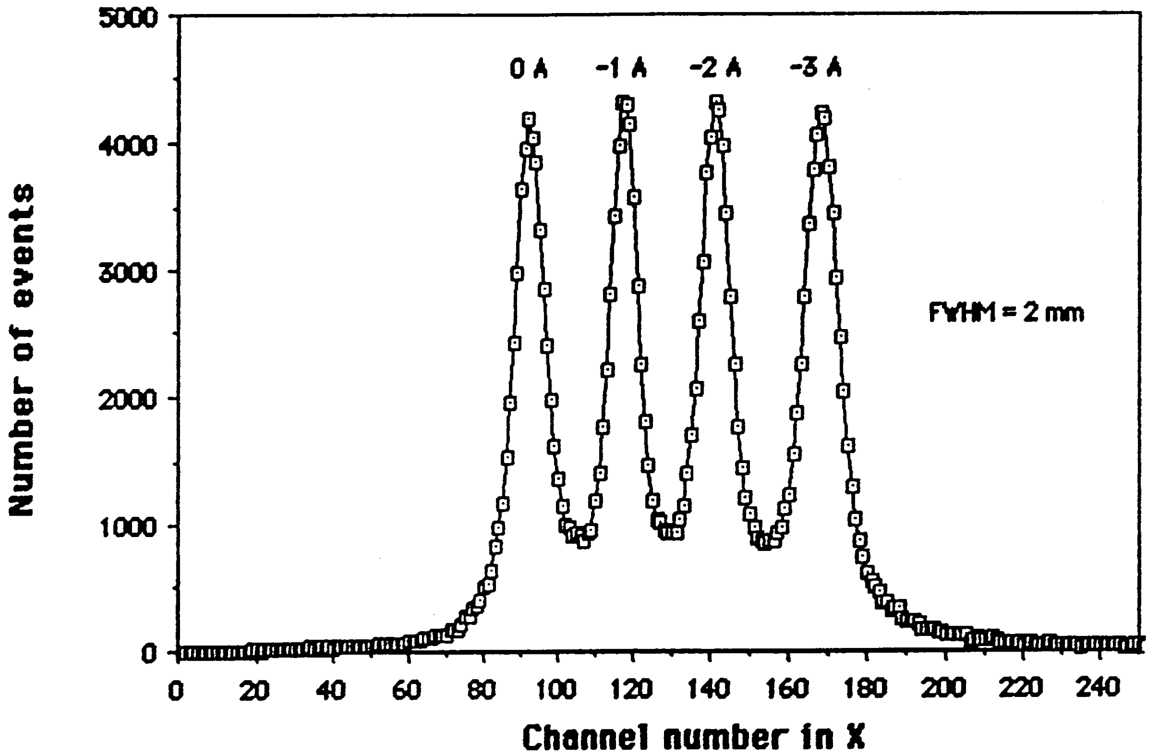

Fig.3 Projection of beam profile for different currents of the bending magnet DVHN02.

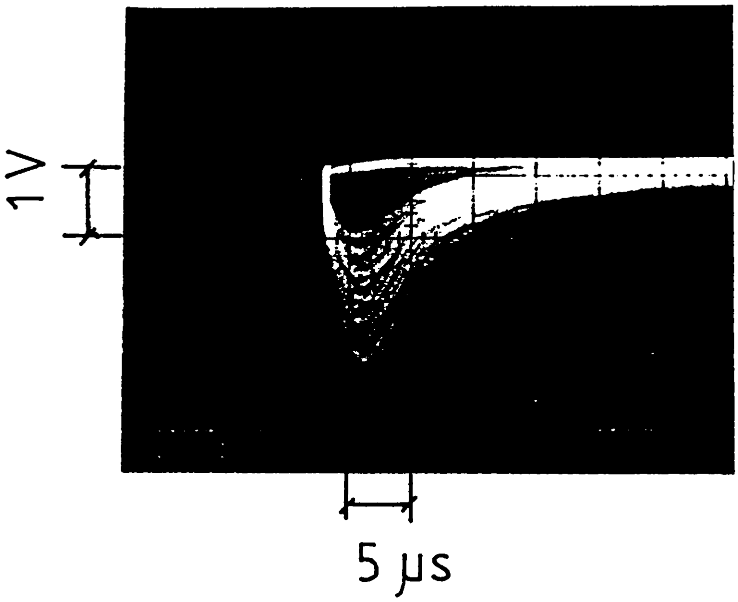

Fig.4 Signal of 200 KeV H^- beam at the output of amplifier.

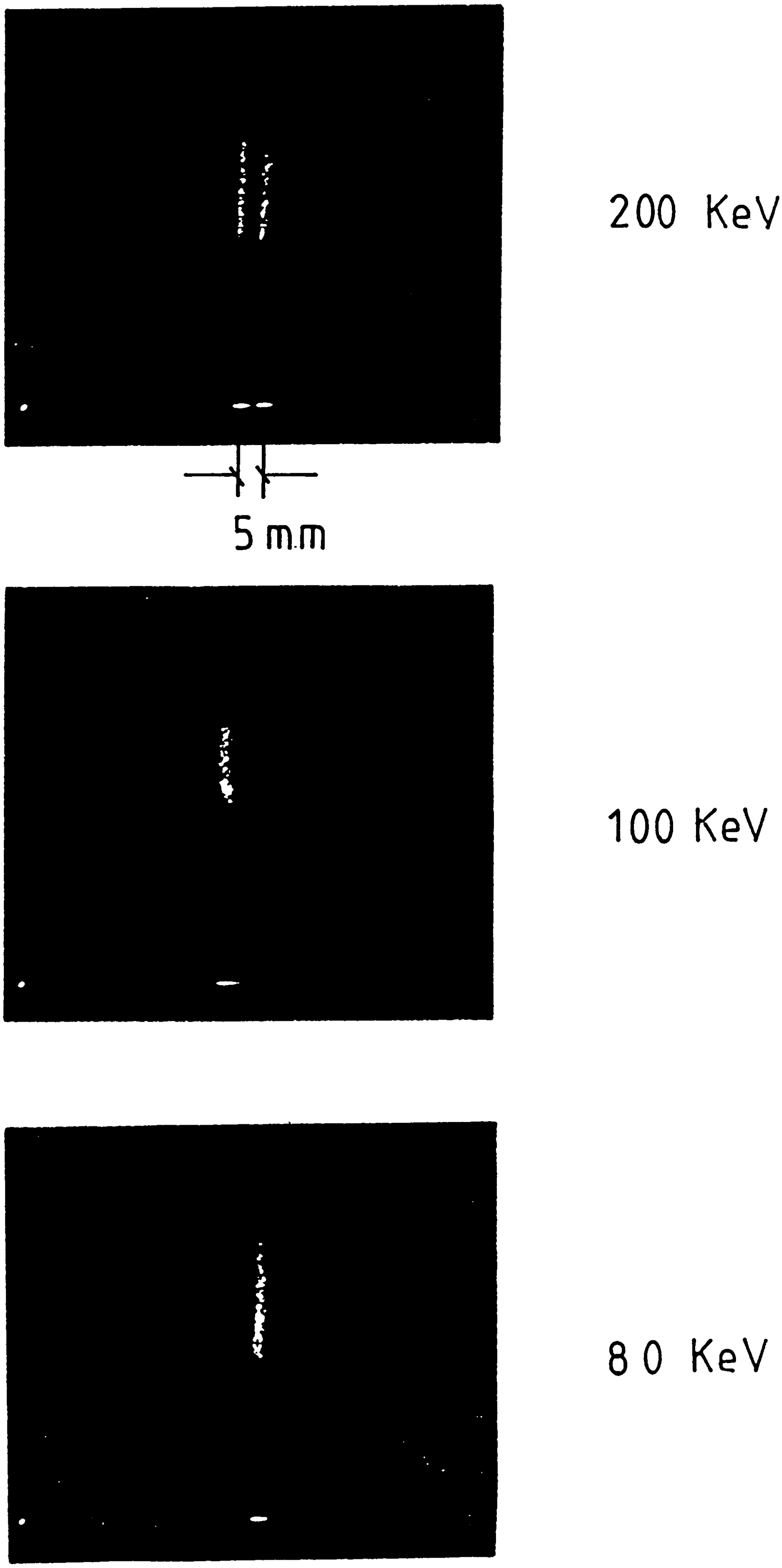

Fig.5 Typical examples of beam profile at different energies.

slits, 0.2 mm wide, distant from each other by 10 mm. For a given beam momentum, the resolution depends on the impedance ratio of the resistor chain, which is relevant to the divider sensitivity. It can be improved by reducing the total value of resistance with respect to the variation over unit intervals (1 kΩ). As shown in Fig. 6, a resolution of 0.7 mm FWHM was obtained with 6 anode wires (instead of 12) terminated at both ends of the chain by the input impedance of the amplifiers, Z_0 = 1 kΩ. This means that, in some extent, the device can be optimized by a compromise between the resolution and the size of sensitive area (~20 x 20 mm^2 for 6 anodes).

From the present results, we consider that such a simple device is perfectly operational under ultra-high vacuum conditions and provides a general purpose profile monitor not only for very low energy pbar but also for p and H^- beams. It goes without saying that such a device can also monitor profiles of high energy beams.

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REFERENCES

[1] V. Agoritsas et al., CERN PS/88-75 (PA), Dec. 9th, 1988.

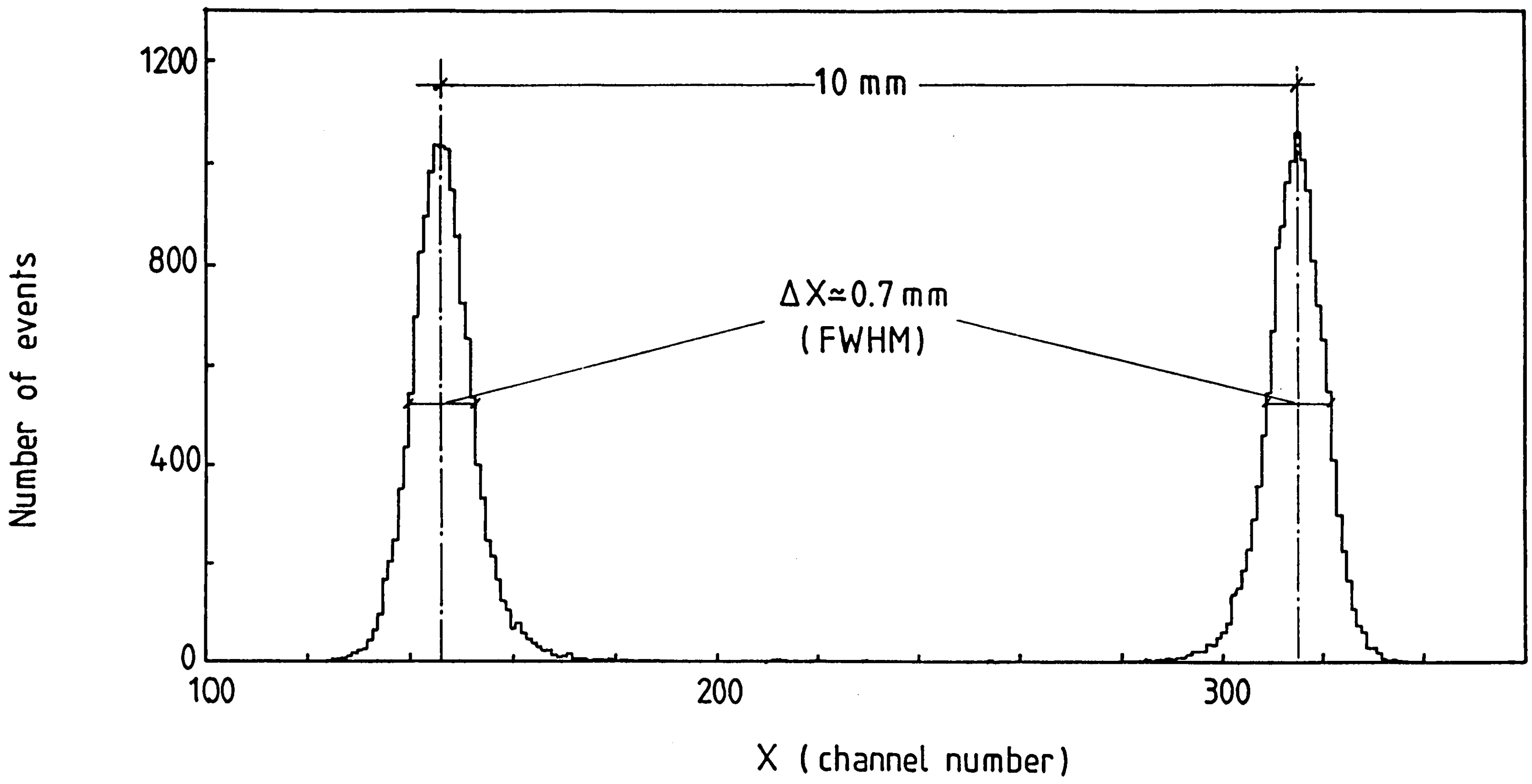

Fig.6 Measurement of spatial resolution for 200 KeV H^-.