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# Emittance Measurements of 200 MeV Proton Beam in the LTB Transfer Line

T. Roser

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Collider Accelerator Department  
**Brookhaven National Laboratory**

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<b>AGS STUDIES REPORT</b>	
<b>Date(s) of Study:</b>	June 9, 1992 and June 29, 1992
<b>Time(s):</b>	Various
<b>Experimenter(s):</b>	T. Roser and J. Skelly
<b>Reported By:</b>	T. Roser
<b>Subject:</b>	Emittance Measurements of 200 MeV Proton Beam in the LTB Transfer Line

Measurements of the beam emittance in the LTB line were performed by varying one or three quadrupole magnets and observing the change in the beam profile measured with one of the two multi-wire profile monitors MW035 or MW107. The profile measurements were analyzed by transporting a Gaussian beam from upstream of the varied quadrupoles, typically the start of the line segments LTB1 or LTB3, to the profile monitor and comparing it there to the measured profiles. A non-linear fitting routine "MINUIT" from the CERN library was used to find the initial beam parameters that fit all, typically 20, measured profiles simultaneously. Six parameters were used to characterize the initial beam: RMS emittance ( $\epsilon_{RMS}$ ), Twiss parameters ( $\alpha$ ,  $\beta$ ), initial position and angle ( $x_0, x'_0$ ), and the beam intensity (I). A chi-square minimum was generally very well defined, fitting simultaneously to  $20 \times 32 = 640$  data points. Note that this global fit is insensitive to beam tails that were outside of the profile monitor for some of the measurements. On June 9, 1992, measurements were done in both segments LTB1 and LTB3. A comparison of these two measurements by transporting the LTB1 measurement to the start of LTB3 shows quite good agreement. For the transport, the quadrupole settings of the LTB3 measurement were used:

QH1 = 169A  
 QV2 = 213A  
 QH3 = 114A  
 QV4 = 156A  
 QH5 = 203A  
 QH6 = 184A  
 QH7 = 161A

A measurement performed on June 29, 1992, in LTB3 with the same beam line tune as on June 9, gave results that are consistent with the June 9 measurement.

Table I summarizes the results, and Figures 1 and 2 show a typical fit to the measured data for horizontal and vertical profiles, respectively.

TABLE I

Date / Time	6/9/92 14:10	6/9/92 14:10	6/9/92 12:27	6/29/92 14:00
Location	Start of LTB1	Transported to Start of LTB3	Start of LTB3	Start of LTB3
Profile Monitor	MW035	MW035	MW107	MW107
Quads Varied	QV2, QH3, QV4		QH10	QH10
$\beta_x$ [m]	$5.8 \pm 0.4$	8.5	$9.4 \pm 0.4$	$6.8 \pm 0.3$
$\alpha_x$	$-0.8 \pm 0.1$	-0.9	$-1.3 \pm 0.1$	$-0.8 \pm 0.1$
$\epsilon_{RMS}^x$ [ $\pi \mu\text{m}$ ]	$2.1 \pm 0.1$	$2.1 \pm 0.1$	$2.0 \pm 0.1$	$1.8 \pm 0.1$
$\beta_y$ [m]	$7.0 \pm 1.0$	31.0	$37.0 \pm 3.0$	$29.0 \pm 2.0$
$\alpha_y$	$0.4 \pm 0.1$	2.7	$2.6 \pm 0.02$	$2.0 \pm 0.2$
$\epsilon_{RMS}^y$ [ $\pi \mu\text{m}$ ]	$1.8 \pm 0.3$	$1.8 \pm 0.3$	$1.5 \pm 0.1$	$1.3 \pm 0.1$

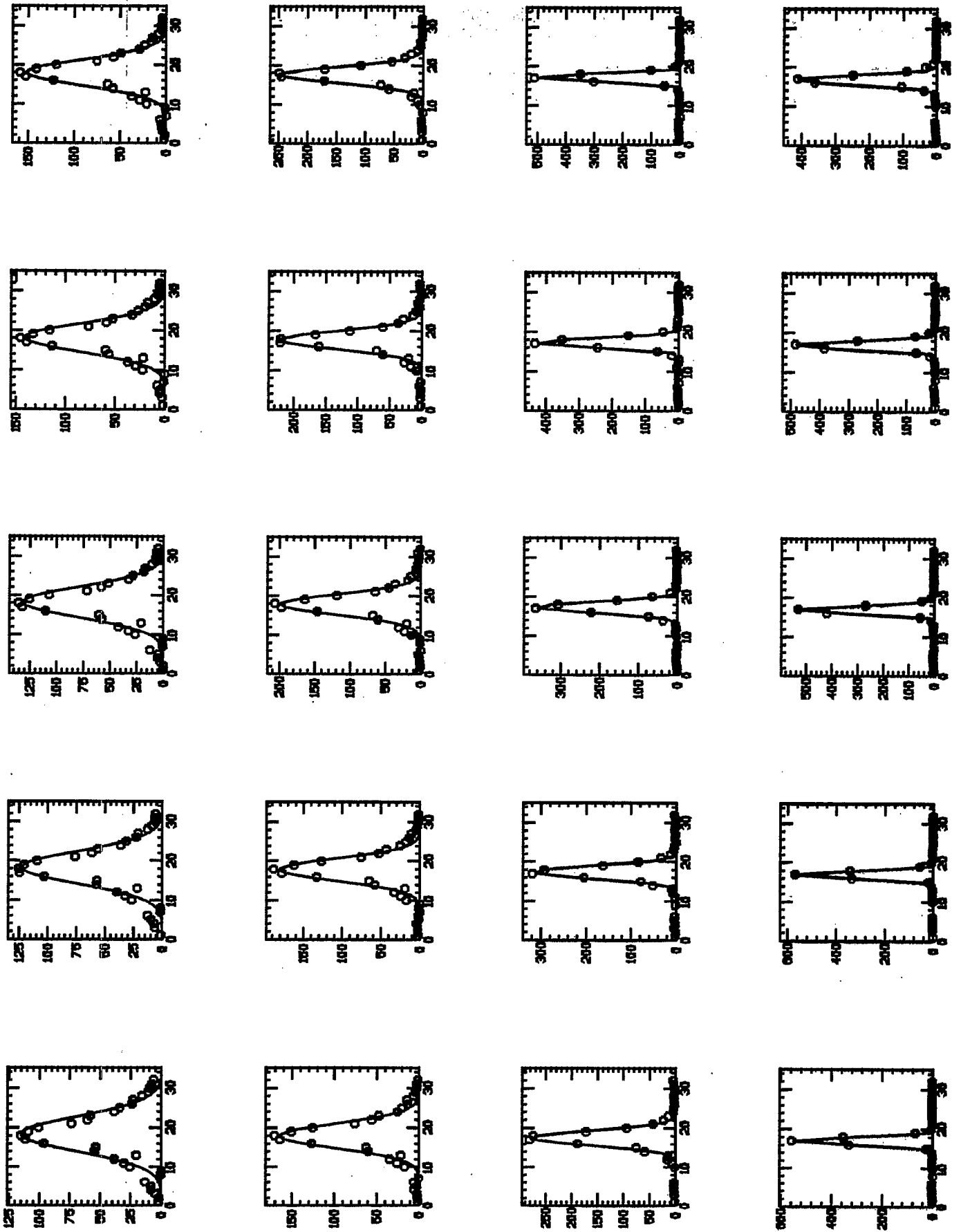


Fig 1: Horizontal Profiles of 6/29/92 Measurement

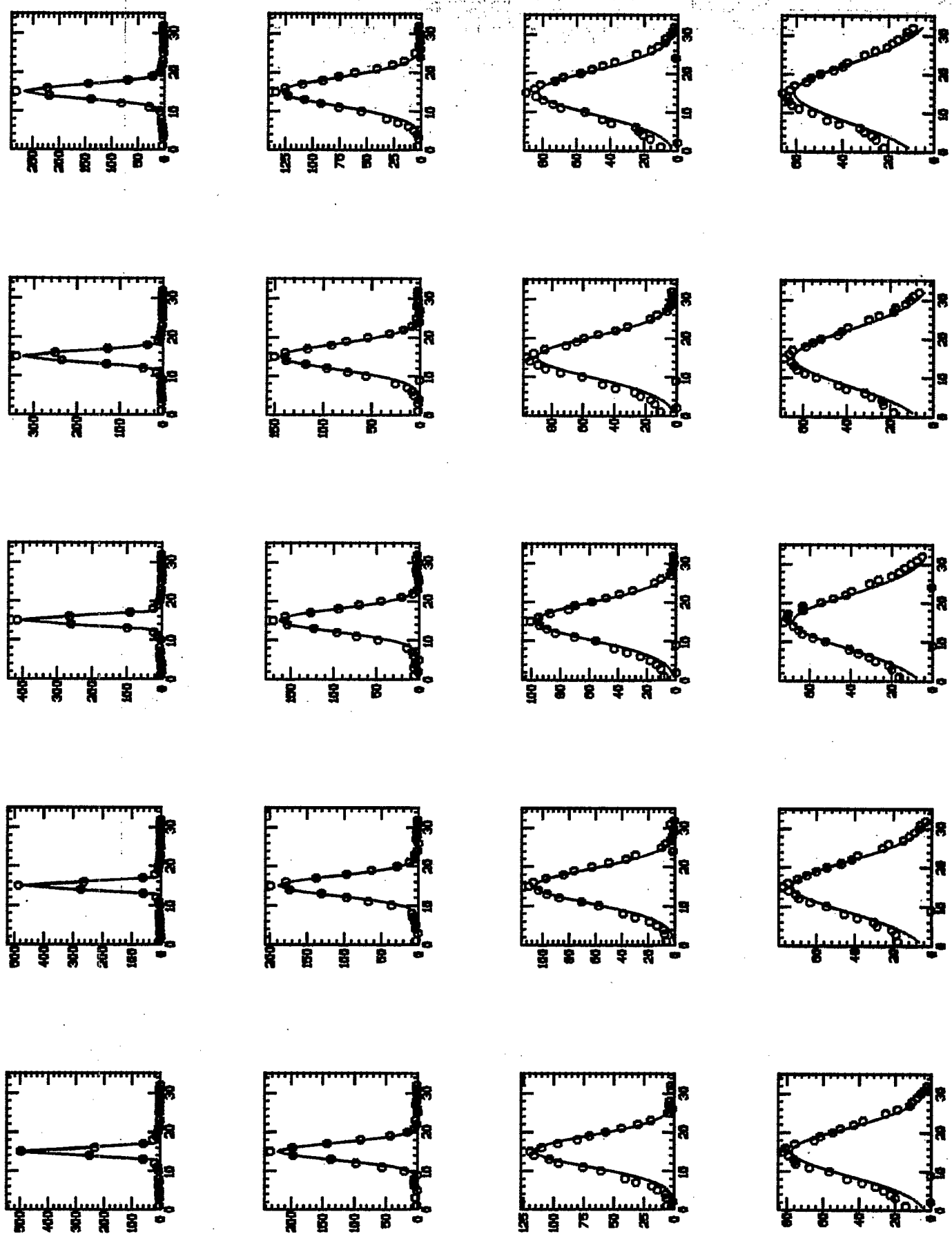


Fig. 2: Vertical Profiles of 6/29/92 Measurement