EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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PHYSICS I

ELECTRONICS EXPERIMENTS COMMITTEE

BOSON SPECTROMETER, CERN

PROGRESS REPORT

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M. Martin, C. Nef, P. Schübelin and A. Weitsch

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(CERN-Geneva University-Bern University Collaboration)

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BOSON SPECTROMETER, CERN

P R O G R E S S   R E P O R T

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NOTE: The following data on the A_2 meson are preliminary and should not be quoted.

1. INTRODUCTION

Since September 1967, the boson spectrometer has been operated in a test beam, with the intention of proving both the reliability of the equipment and the method (proposal of 10 April, 1967). Presented below is a very brief summary of part of the work done in the period from September 1967 to March 1968, and some preliminary results.

2. METHOD AND SET-UP

The method is to measure the momentum of the recoil proton produced in $p\pi^{\pm} \rightarrow pX^{\pm}$ of 0° in the lab. (Fig. 1); the mass of X^{-} can then be calculated.

The apparatus was designed to cover a mass range of 2 to 5 GeV (Figs. 2 and 3). It consists essentially of two parts: a magnetic spectrometer to measure the momentum of the recoil proton from such interactions, and large area wide-gap spark chambers to determine the number and directions of charged decay products. The system is fully automatized. The spark chamber data are recorded on magnetic tape; the data acquisition system (IBM 1800) performs, in addition, a reconstruction of one event per burst, and gives detailed diagnostic on all counters and wire chambers. Typically, 80,000 events are produced per day. The processing speed on the IBM 3800 is 24,000 events/hour.

3. RESULTS

The technical performance of the system has been very satisfactory.

Data on the A_2 meson have been collected. However, as the system has been designed for high masses, but operated in a low energy test beam, only A_2 mesons produced near threshold with a correspondingly low cross-section (Fig. 5) could be detected. For the same reason, any detailed decay analysis was impossible.

Figures 4 to 11 illustrate the performances and some preliminary results.

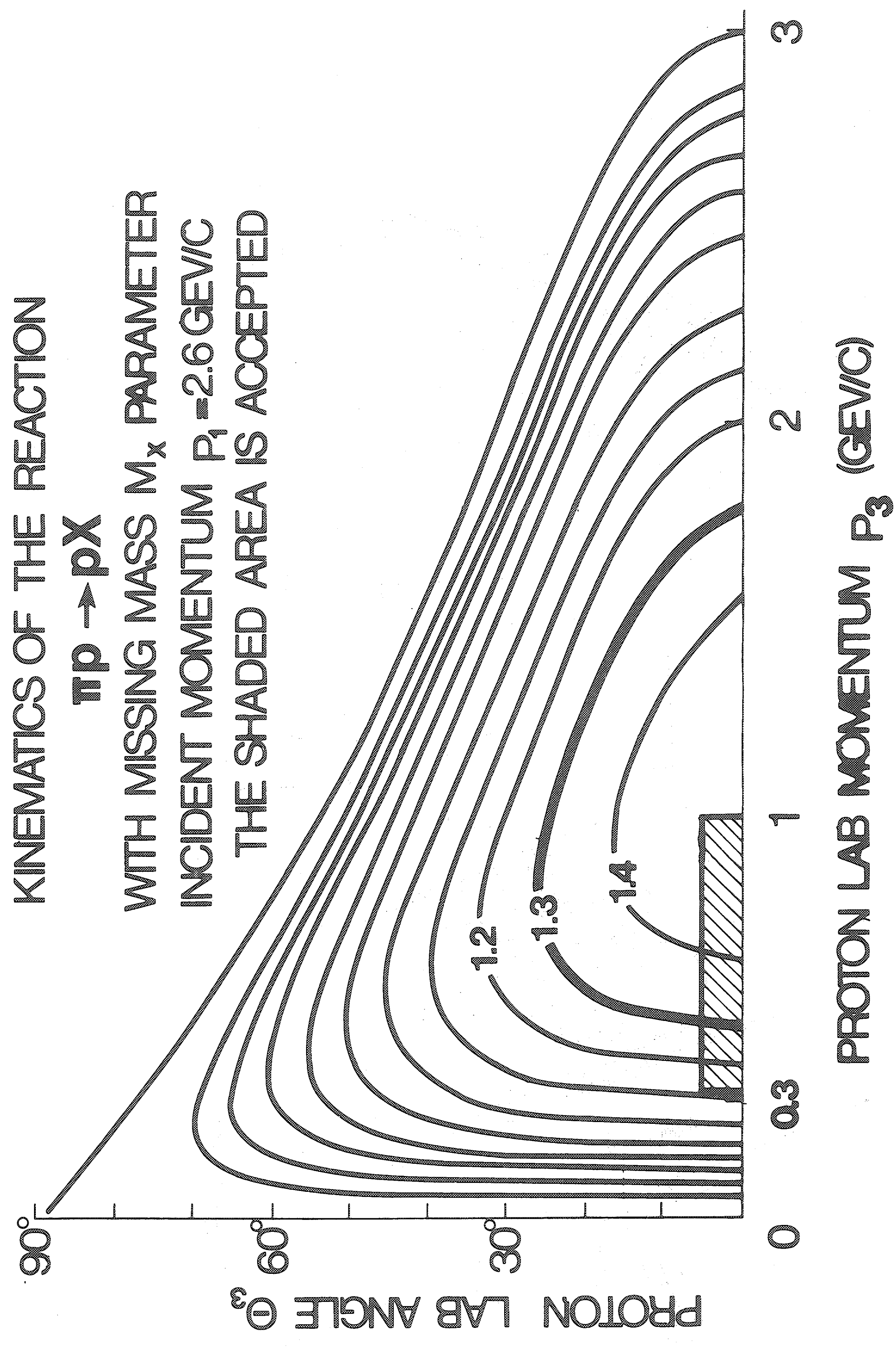


Fig. 1

Lab. angle versus lab. momentum for the recoil proton in $\pi^- p \rightarrow pX^-$ at 2.65 GeV/c. The region covered in the January run is shaded.

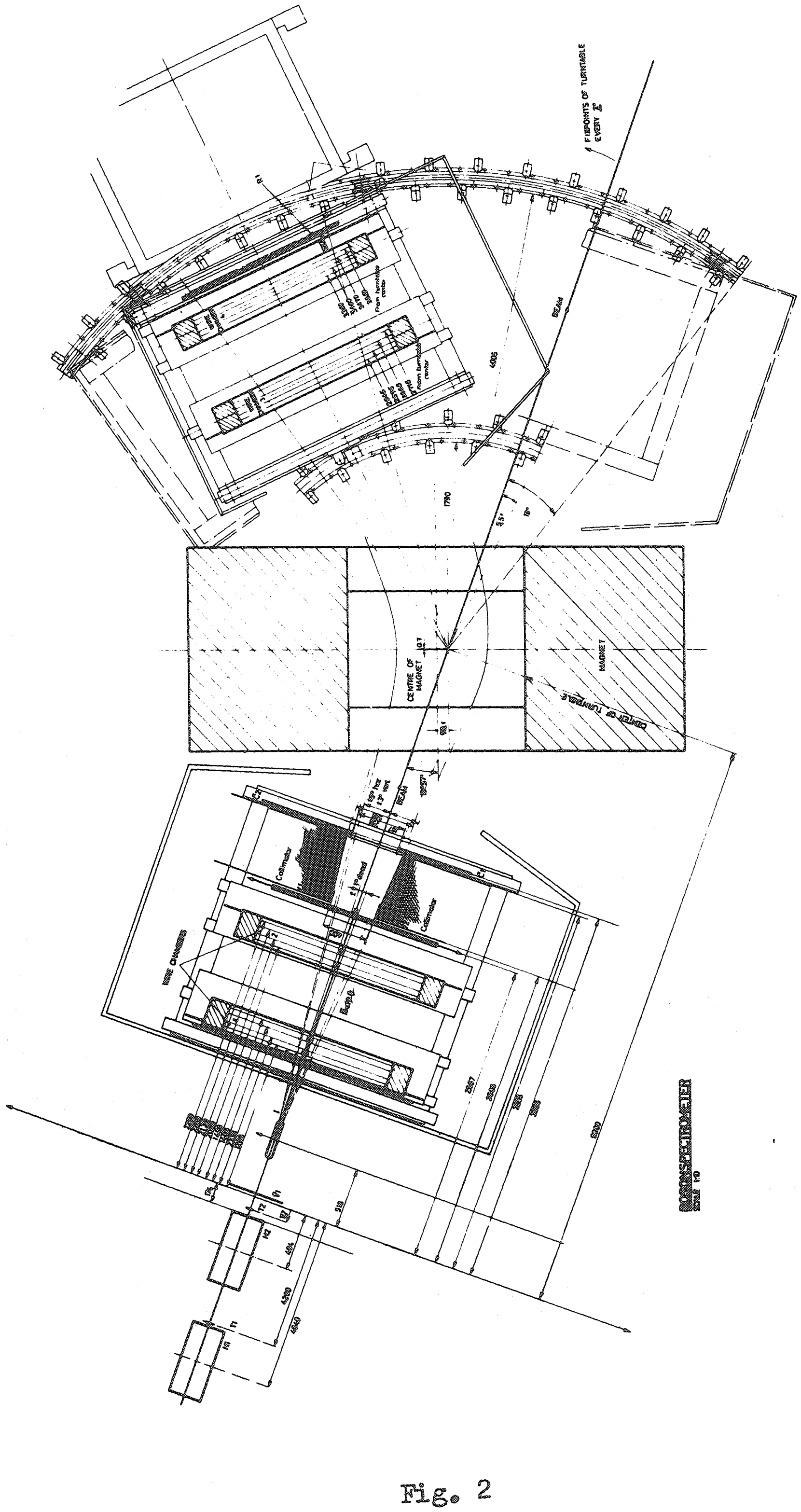
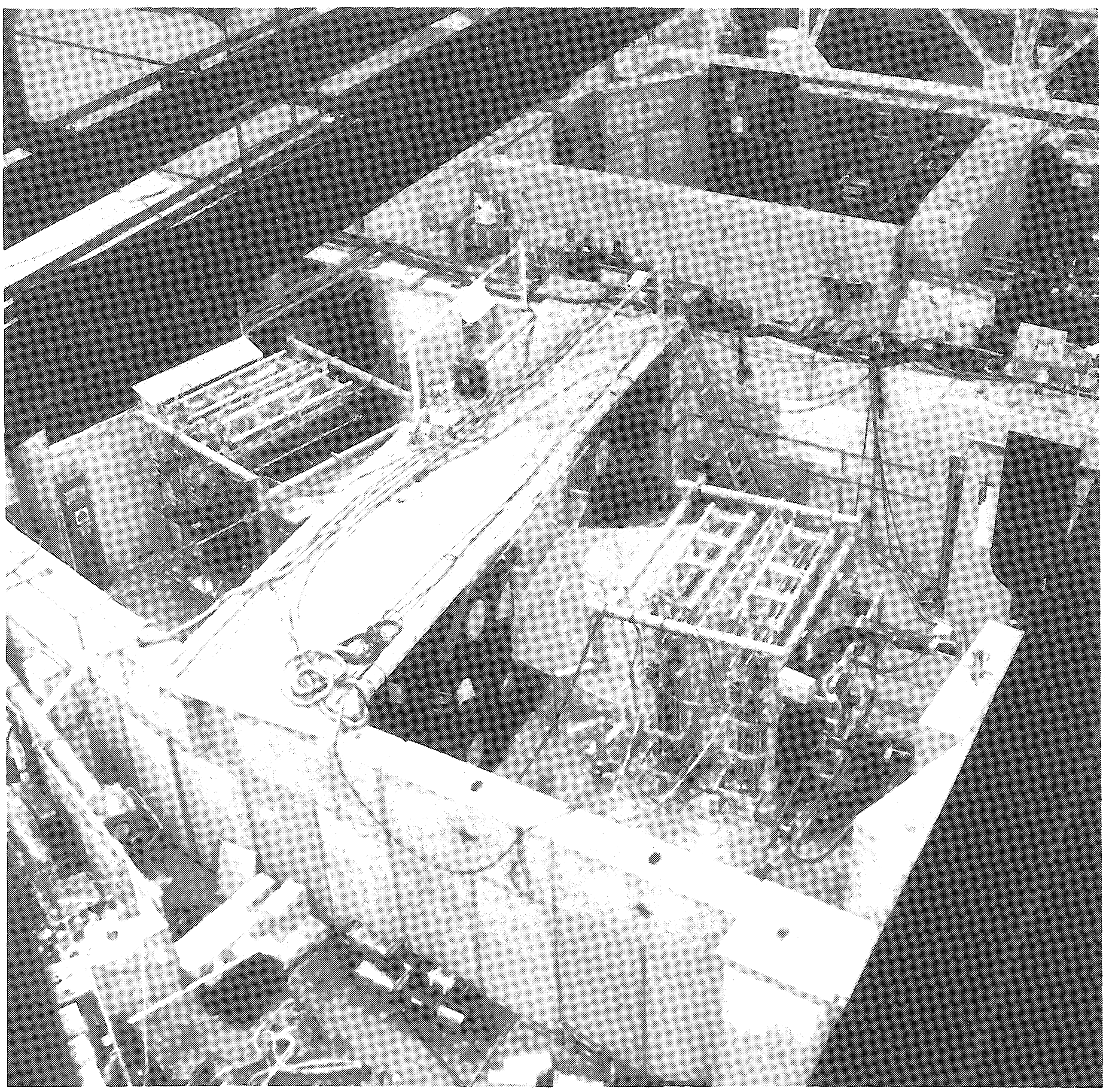


Fig. 2

Experimental set-up for the January run. For the March run, the system was contracted in order to gain solid angle.



BOSON SPECTROMETER
(q5 beam, South Hall)

Fig. 3

Experimental set-up.

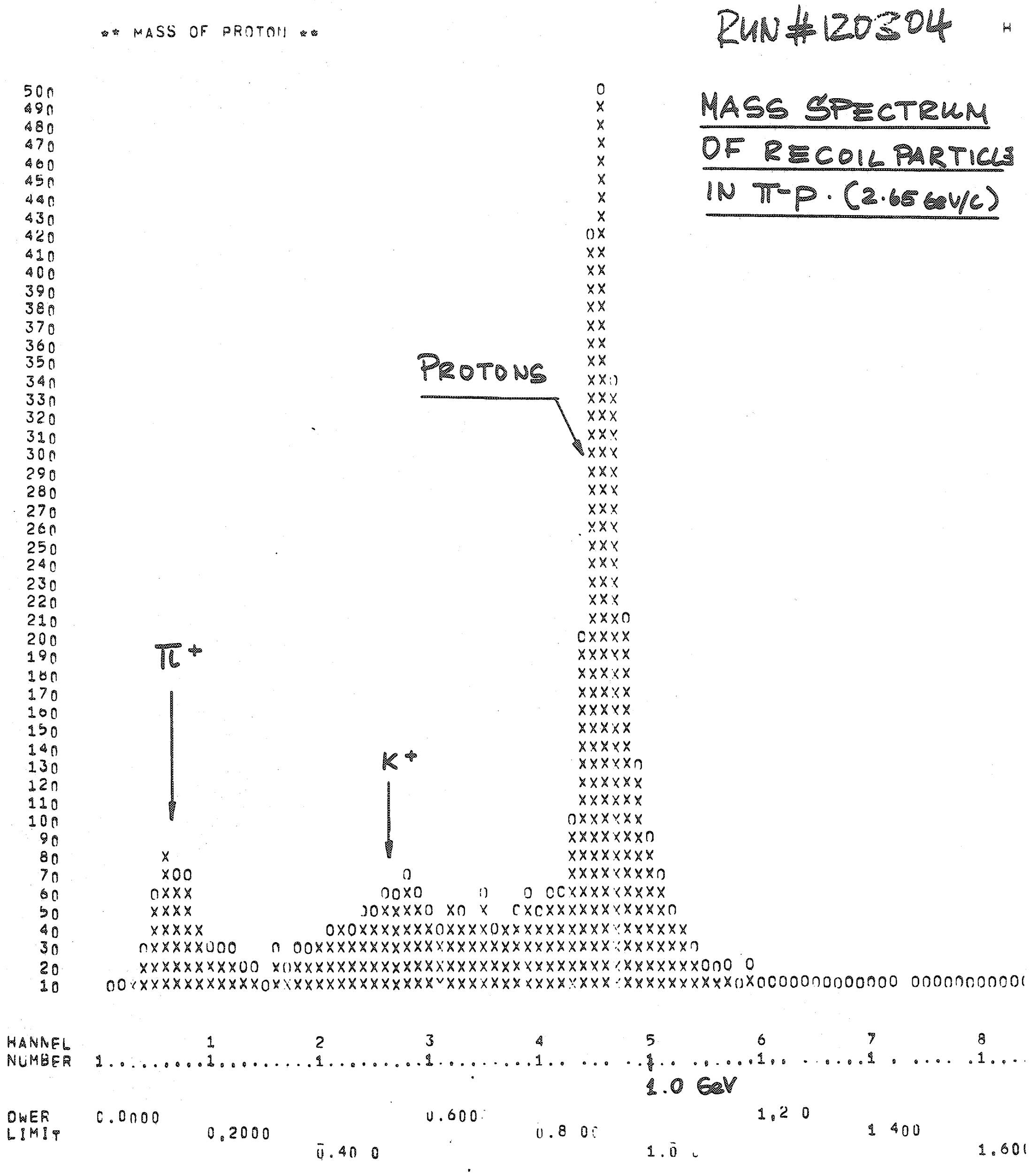


Fig. 4

Mass spectrum of recoil particles in π^-p collisions at 2.65 GeV/c. The mass is obtained by dividing the momentum measured by the magnet by $\beta\gamma$ obtained from time-of-flight from T_2 to R_1 (Fig. 2).

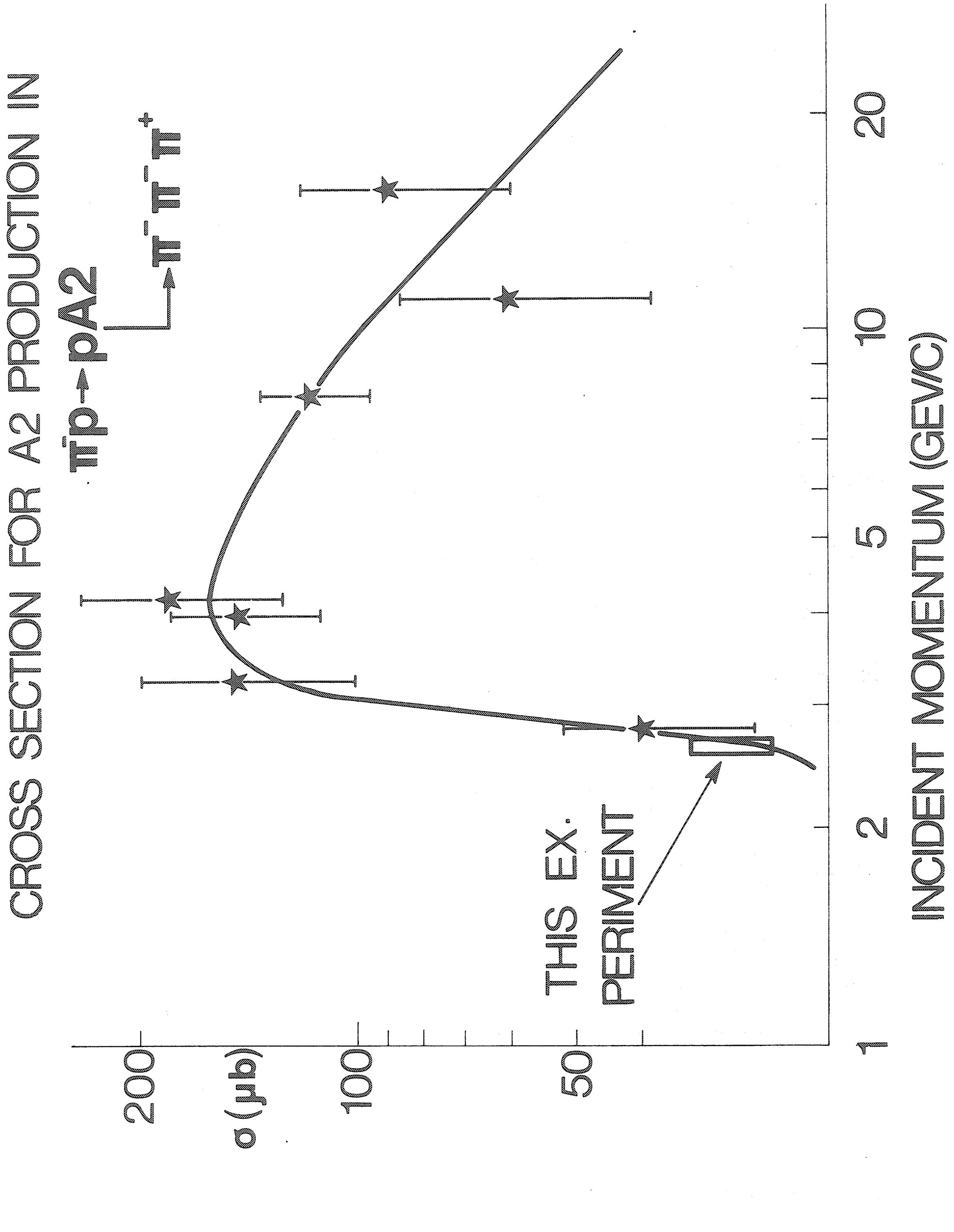


Fig. 5

Excitation curve for A_2 production in $\pi^- p \rightarrow pA_2$ ($A_2 \rightarrow \pi^-\pi^-\pi^+$).

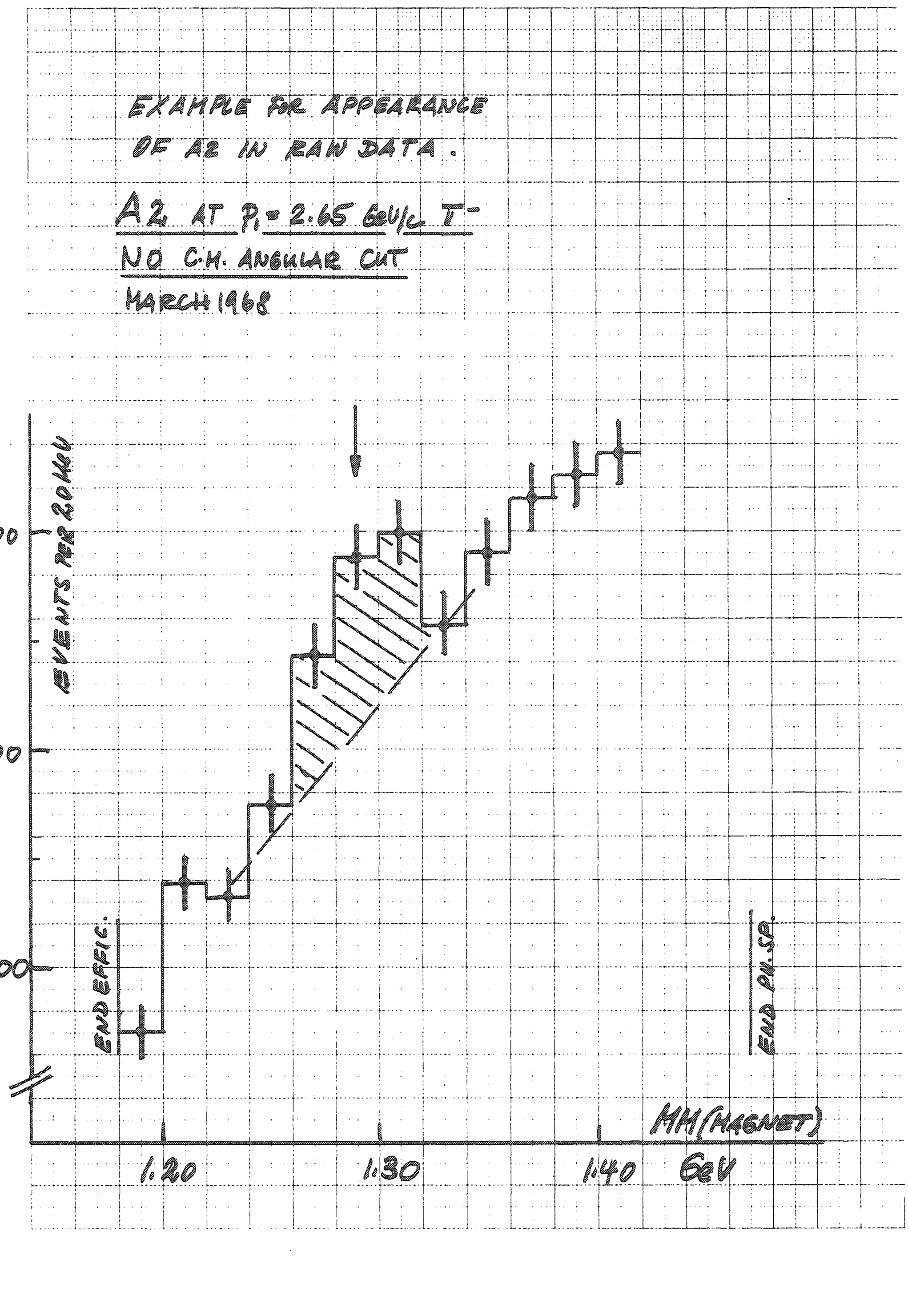


Fig. 6

Example of the missing-mass spectrum from raw data, before any centre-of-mass angular cut. The proton momentum was measured by magnetic analysis.

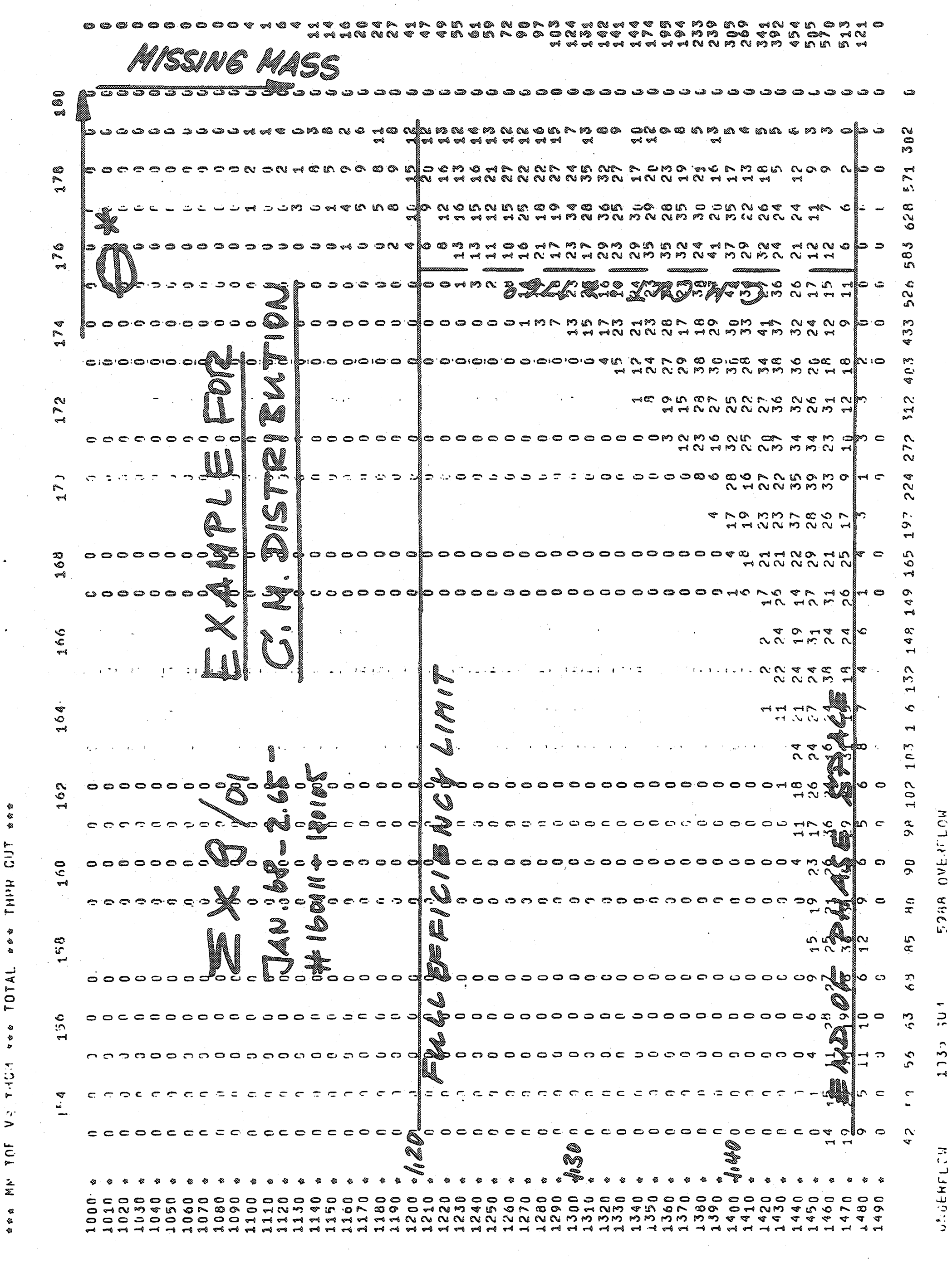


Fig. 7

Example of the acceptance in the c.m. system corresponding to the shaded region of Fig. 1. The c.m. angular cut applied in the following histograms to get a uniform c.m. solid angle is indicated. In the March run, an approximately uniform c.m. solid angle was obtained from the geometry of the system.

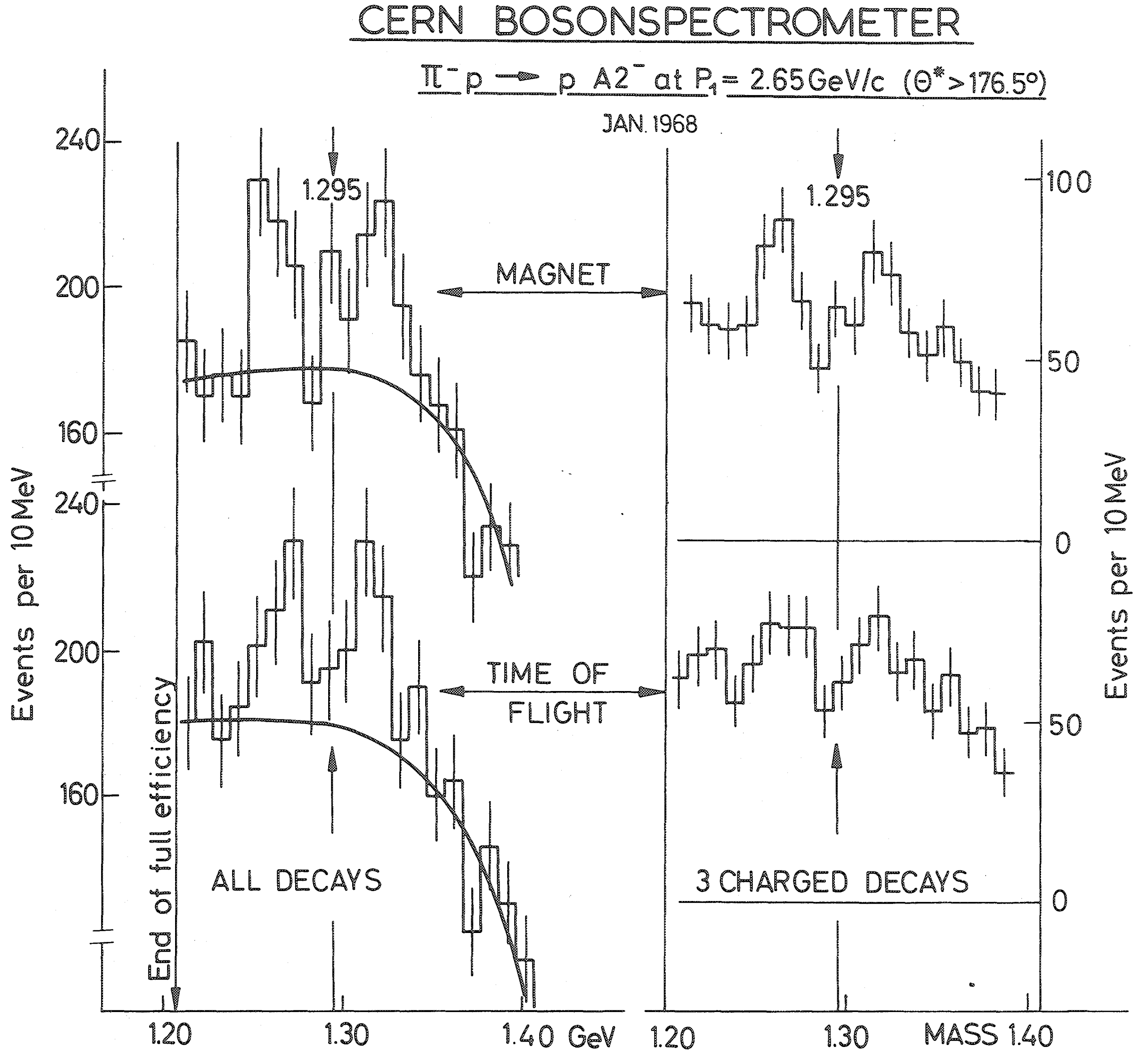


Fig. 8

Missing-mass spectra obtained in January at 2.65 GeV/c incident momentum. Only events with a recoil proton c.m. angle greater than 176.5° are accepted. Shown on this figure are missing-mass spectra obtained by two independent methods: magnetic analysis, and time-of-flight measurement of the recoil proton momentum. Histograms to the left show the total spectra, to the right the spectra where three charged particles are observed in the first spark chamber.

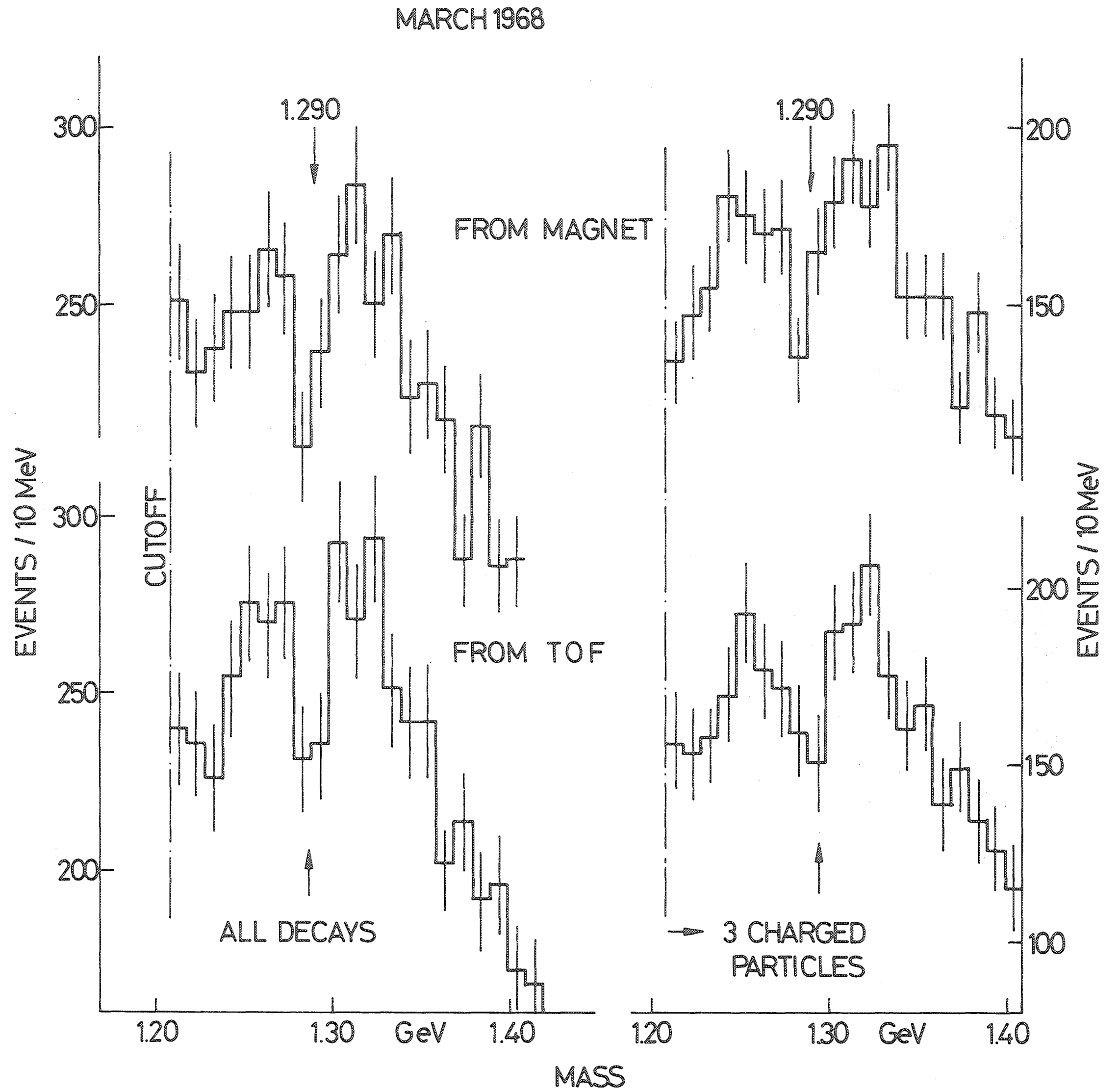


Fig. 9

Missing-mass spectra for part of the data obtained in March. The spectra correspond to those of Fig. 8, except that the three charged selections now contain a larger fraction of the total due to the addition of vertex counters.

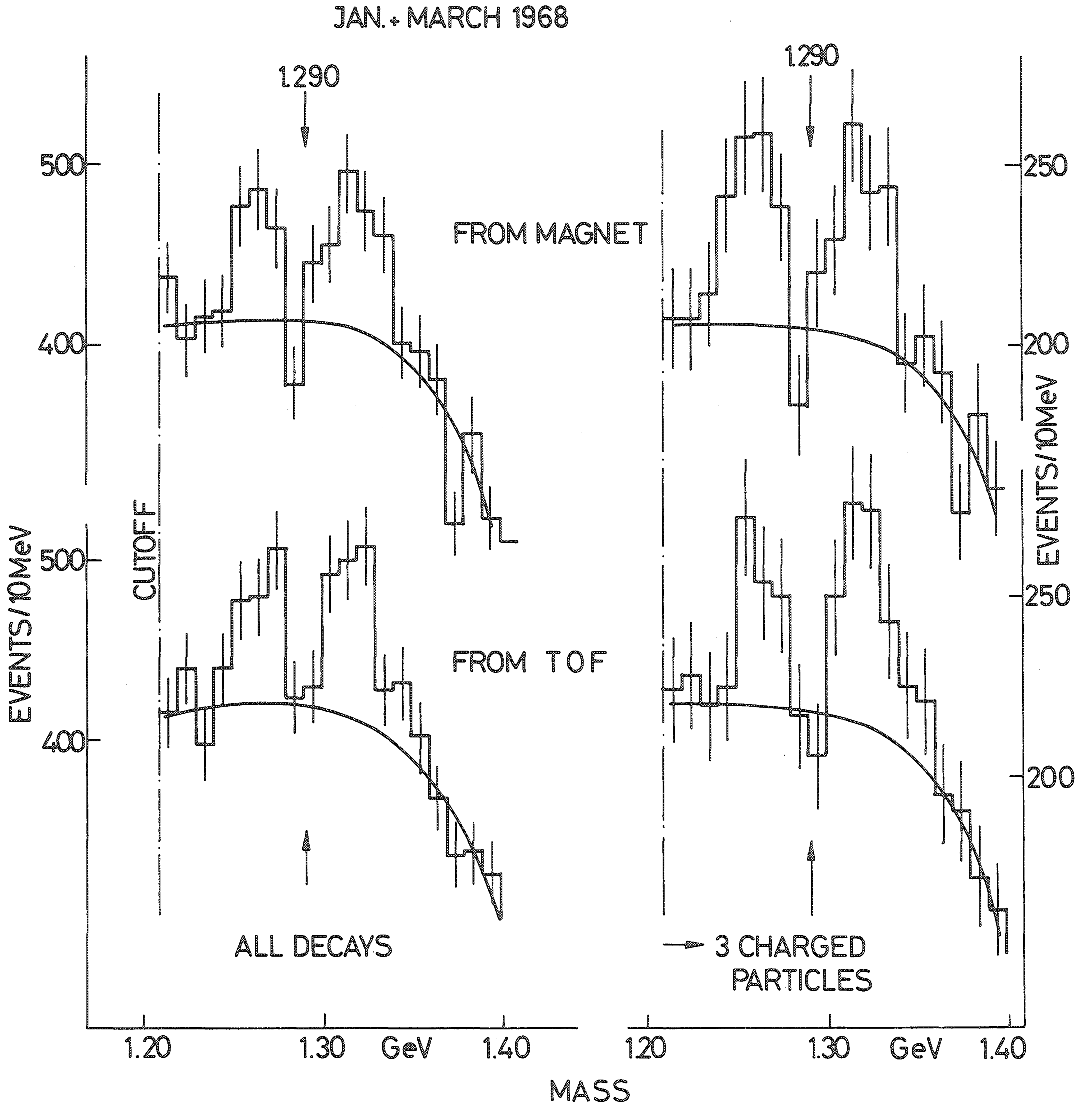


Fig. 10

The sum of the spectra from Figs. 8 and 9.

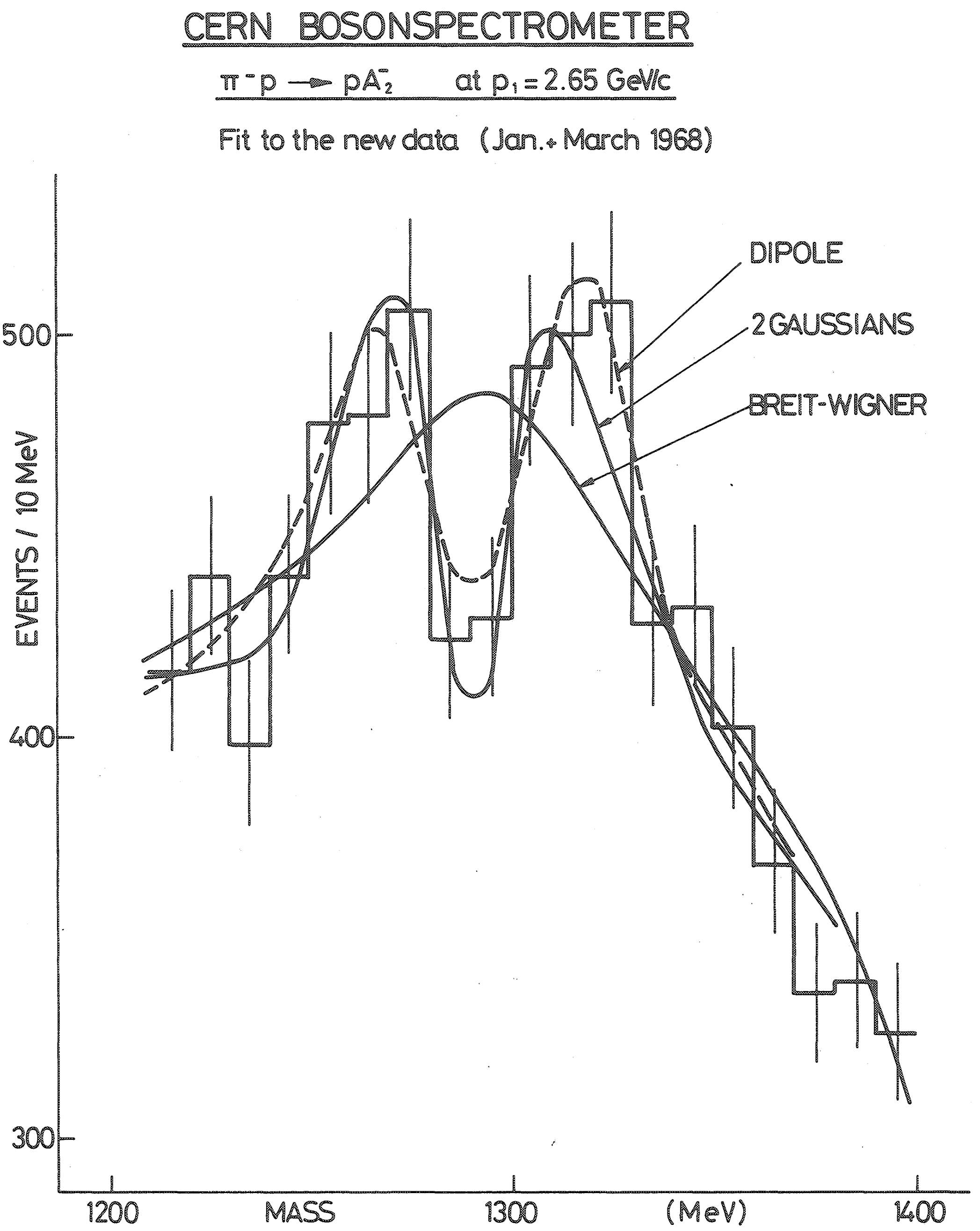


Fig. 11

Fit to the new data. The fitted parameters are:

Breit-Wigner M = 1295 MeV, Γ = 75 MeV, Confidence level ~ 10^{-3}.
2 Gaussians M = 1266 and 1318 MeV, Γ = 30 MeV, Confidence level ~ 0.5.
Dipole M = 1291 MeV, Γ = 38 MeV, Confidence level ~ 0.6.

The experimental resolution is 8 MeV.