find $|G_Y|^2 < 0.02|G_F|^2$.

In conclusion, we see no evidence for a charged positive heavy muon (lepton number = +1) coupled to muon neutrinos. It now appears, in contrast to very simple gauge models, that if such a heavy lepton exists it either is very massive or has a small effective coupling constant.

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Approximate Scaling of Multiplicity Distributions as a Function of Missing Mass

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Data from $p+p \to p+X$ at 102, 205, and 405 GeV and from $\pi^- + p \to p + X$ at 205 GeV exhibit an approximate scaling property in the charged-prong multiplicity distributions as a function of the missing mass for the range $5 \leq M_X \leq 13$ GeV.

A well-known empirical fact[1] is the approximate scaling of the charged-particle multiplicity cross sections $\sigma_N(s)$ in the reaction $p+p \to X$:

$$P_N(s) = \frac{\sigma_N(s)}{\sigma(s)} \cong \frac{1}{\langle N(s)\rangle}\psi\left(\frac{N}{\langle N(s)\rangle}\right), \qquad (1)$$

where $\sigma(s)$ is the inelastic cross section and $\langle N(s)\rangle$ the average charged multiplicity. Although the variation of the scaling function ψ with the center-of-mass energy $\sqrt{s}$ is definite,[2-4] it is small, hence the usefulness of Eq. (1). Based upon a geometrical picture,[5] Barshay and Yamaguchi[6] suggested looking for a more difficult scaling behavior in the reaction $p+p \to p+X$. In particular they suggested looking for scaling of multiplicity distributions as a function of the missing mass of X, hereafter denoted by M:

$$P_n(M^2, s) = \frac{\sigma_n(M^2, s)}{\sigma(M^2, s)} \cong \frac{1}{\langle n(M^2, s)\rangle}\tilde{\Psi}\left(\frac{n}{\langle n(M^2, s)\rangle}, s\right). \qquad (2)$$

Here n is the associated multiplicity, $n = N-1$.

We have examined data on associated charged-prong multiplicities as a function of missing mass from pp and $\pi^- p$ interactions in the energy range 102 to 405 GeV. Details of event identification in the reactions $p(\pi^-)+p \to p+X$ are given by Chapman *et al.*,[7] Barish *et al.*,[8] and Winkelmann *et al.*[9] We give results from 205-GeV pp interactions for all multiplicities and for the M^2 interval $0<M^2<150$ GeV^2. We use published results for multiplicities $n<10$ in the M^2 interval $0<M^2<70$ GeV^2 for pp interactions at 102 and 405 GeV,[7] and $0<M^2<120$ GeV^2 for $\pi^- p$ interactions at 205 GeV.[9] In all cases M^2 is below the value where experimental losses set in as a result of detection inefficiency of the slow proton. Where not given, the experimental errors for $\langle n(M^2,s)\rangle \times P_n(M^2,s)$ are estimated from the known microbarn equivalents of the experiments and the published $d\sigma_n/dM^2$ distributions. The M^2 bins are chosen such that statistical errors are about the same.

Figure 1 shows $\langle n(M^2)\rangle P_n(M^2,s)$ for the pp data. An approximate scaling behavior as in Eq. (2) is exhibited. There is no marked s dependence. As has been noted,[10] the scaling function in $p+p\to X$ [Eq. (1)] is not very sensitive to details of the multiplicity distributions. We therefore give in Table I the values of various moments of the multiplicity distributions in different M^2 bins for the 205-GeV pp data. If Eq. (2) holds,

$$C_k = \langle n^k(M^2)\rangle / \langle n(M^2)\rangle^k$$

must be independent of M^2. Except for the low-mass bin, the data are consistent with such a trend. It would be valuable to study the low-mass region more differentially. Note that $\langle n(M^2)\rangle$ varies by more than a factor of 2 over the M^2 region studied.

In Fig. 2 we show the 205-GeV data on $\pi^-+p\to p+X$. The curve represents the pp data from Fig. 1. The distributions are quite similar.

It has been noted[8,11] that the M^2 dependences of $\langle n(M^2)\rangle$ and $\langle n^2(M^2)\rangle$ in $p+p\to p+X$ are similar to the s dependences of $\langle [N(s)-1]\rangle$ and $\langle [N(s)-1]^2\rangle$ in $p+p\to X$, provided one postulates[11] a suitable relation between M and an "equivalent" $\sqrt{s}$. We emphasize however, that approximate scaling properties for $P_{(N-1)}(s)$ and $P_n(M^2)$ are independent empirical results since at any *given* s one sums over *all* M^2.

We conclude that the multiplicity distributions

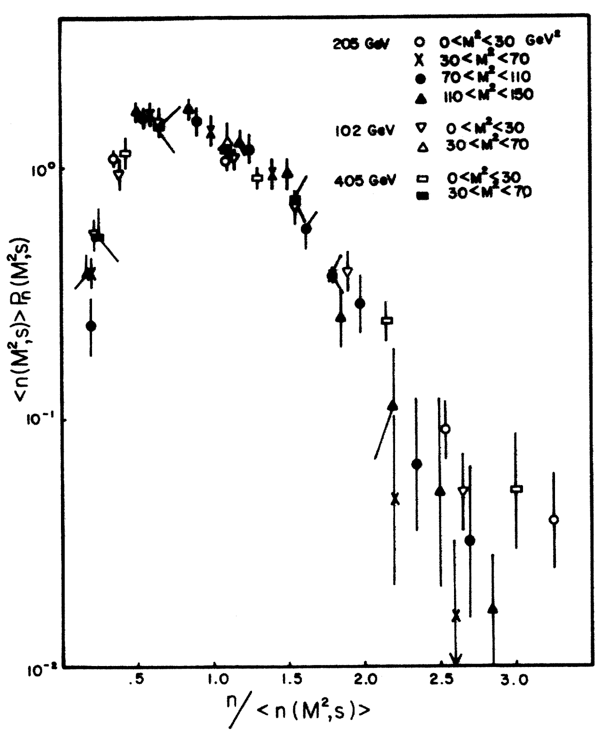

FIG. 1. $\langle n(M^2,s)\rangle P_n(M^2,s)$ versus $n/\langle n(M^2,s)\rangle$ for $p+p\to p+X$ in M^2 bins and at laboratory momenta as indicated.

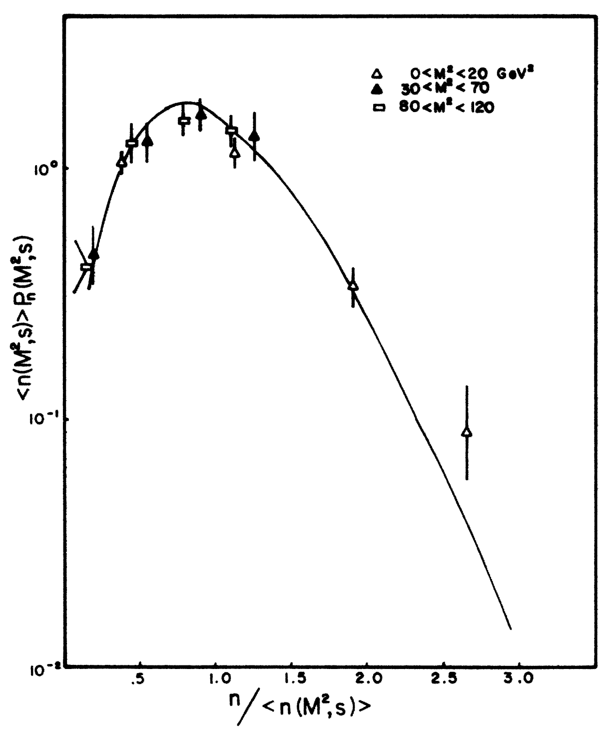

FIG. 2. Data for $\pi^-+p\to p+X$ at 205 GeV plotted as in Fig. 1. The curve represents the data in Fig. 1.

TABLE I. The average associated multiplicity $\langle n\rangle$ and the moments C_k of the multiplicity distribution in different M^2 bins for the 205-GeV data.

M^2 range (GeV^2)	$\langle n\rangle$	C_2	C_3	C_4
0–30	2.74 ± 0.09	1.41 ± 0.03	2.54 ± 0.17	5.54 ± 0.69
30–70	4.85 ± 0.13	1.22 ± 0.02	1.71 ± 0.06	2.66 ± 0.18
70–110	5.55 ± 0.14	1.23 ± 0.02	1.77 ± 0.07	2.87 ± 0.20
110–150	6.03 ± 0.15	1.23 ± 0.02	1.73 ± 0.06	2.70 ± 0.18

$P_n(M^2, s)$ in the reactions $p(\pi^-)+p\to p+X$ exhibit an approximate scaling behavior over a wide range of missing mass $5<M<13$ GeV. This feature does not change markedly with s (as shown for $p+p\to p+X$). We note that our empirical result would follow from (a) the existence (for given s) of multiplicity distributions at each four-momentum transfer to the proton $\sqrt{-t}$, of the form

$$P_n(\sqrt{-t},M^2)=\frac{\sigma_n(\sqrt{-t},M^2)}{\sigma(\sqrt{-t},M^2)}\cong\frac{1}{\langle n(\sqrt{-t},M^2)\rangle}\Phi\left(\frac{n}{\langle n(\sqrt{-t},M^2)\rangle},\sqrt{-t}\right),$$

with the *only* M^2 dependence coming through the average associated multiplicity $\langle n(\sqrt{-t},M^2)\rangle$; and (b) approximate *factorization* of $\langle n(\sqrt{-t},M^2)\rangle$ and $\sigma(\sqrt{-t},M^2)$.[6] It would be useful to investigate these properties with high-statistics data.[12,13]

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