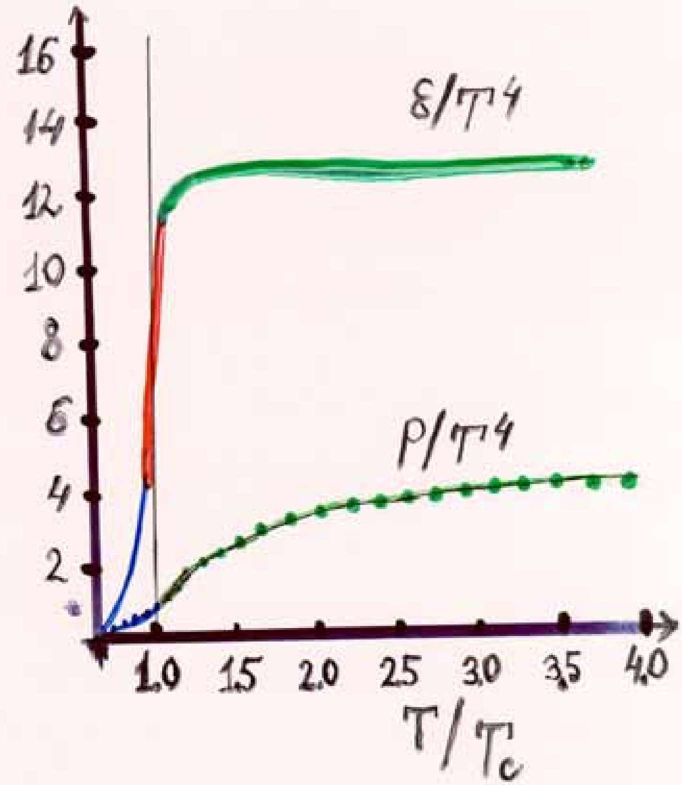
Lattice QCD

$T \gg T_c \qquad \varepsilon \simeq \sigma T^4, \quad p \simeq \frac{1}{3}\varepsilon$

$$\sigma = \frac{\pi^2}{30}\Big(\underset{N_c^2-1}{8}\cdot 2 + \frac{7}{8}\cdot\underset{(2j+1)}{2}\cdot\underset{N_c}{3}\cdot\underset{n_f}{3}\cdot\underset{\bar{q}}{2}\Big)$$



$T_c \simeq 170$ MeV

"generalized" mixed phase

Strangeness to Pion Ratio

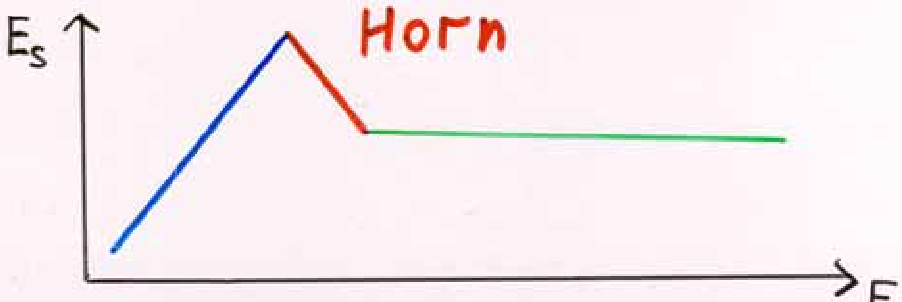
$$\frac{\text{Strangeness}}{\text{Entropy}} \longmapsto \frac{\langle K + \bar{K} + \Lambda \rangle}{\langle \pi \rangle} \equiv E_s$$

$T \lesssim T_c \;, \quad m_s^H \gg T$

$$E_s \propto \frac{\exp(-m_s/T)}{T^3}$$ increases with T

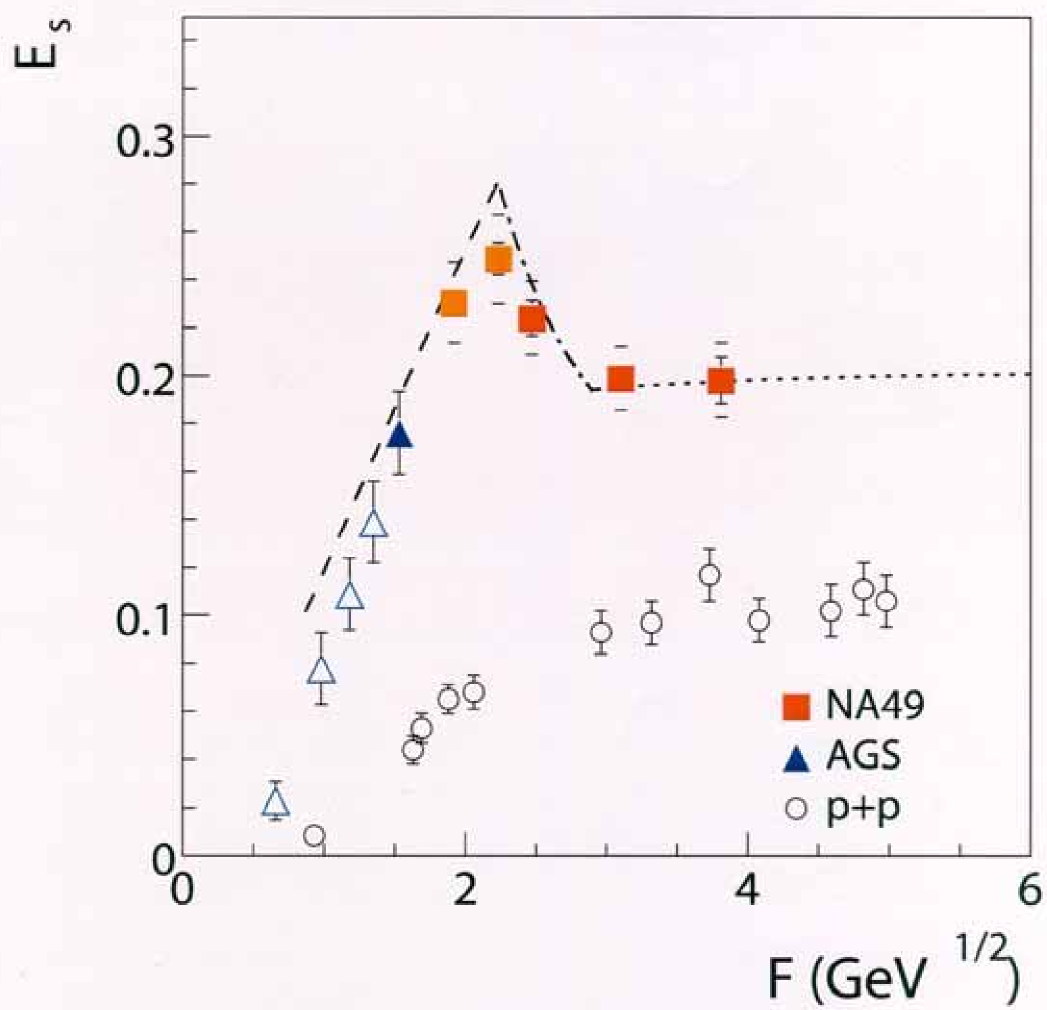
$T > T_c \;, \quad m_s^Q < T$

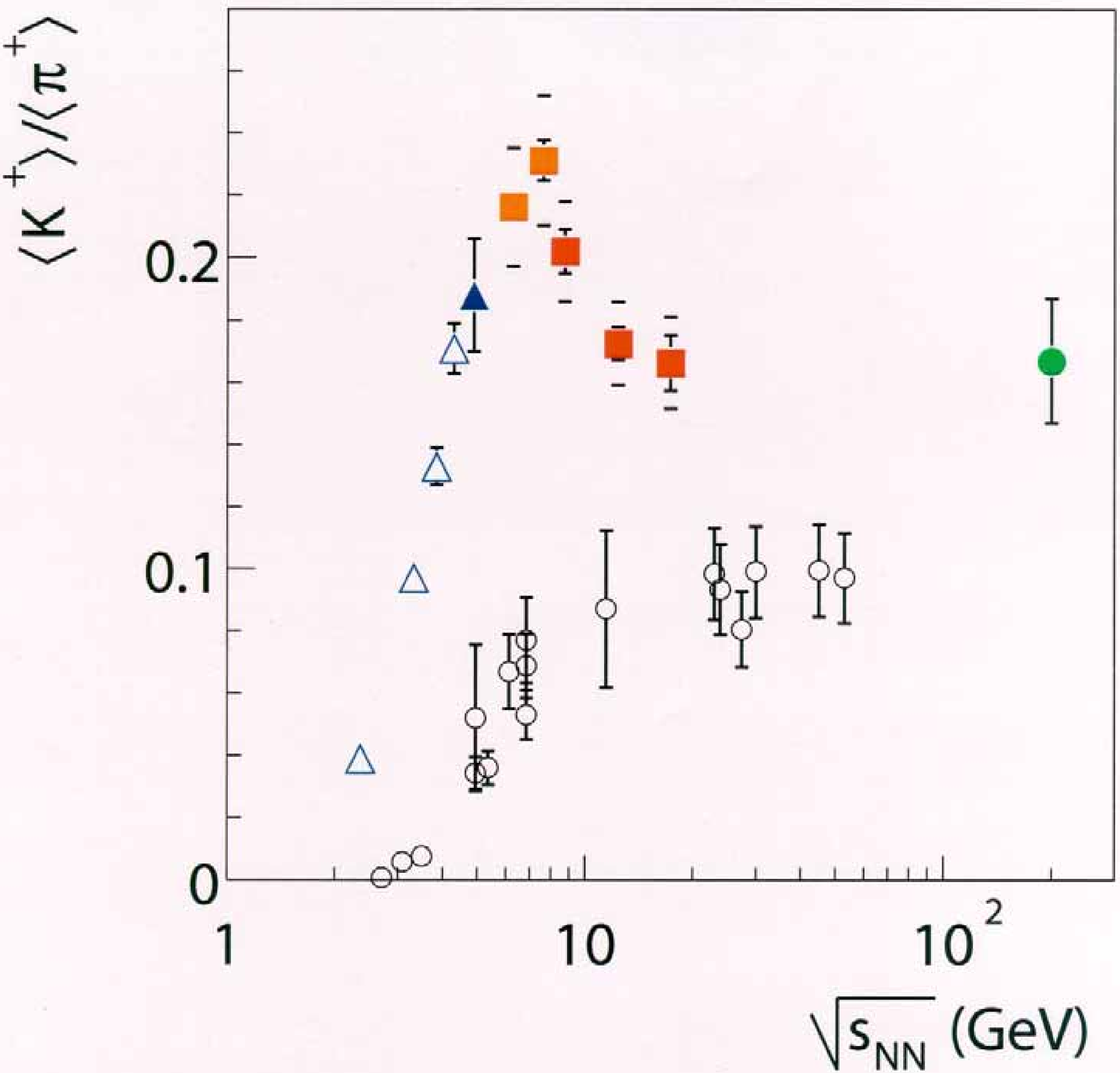
$$E_s \propto \frac{T^3}{T^3} = \text{const}$$



M. Gaździcki, M.I.G, Acta Phys. Pol. (1999)

$$E_s = \frac{\langle K + \bar{K} + \Lambda \rangle}{\langle \pi \rangle}$$



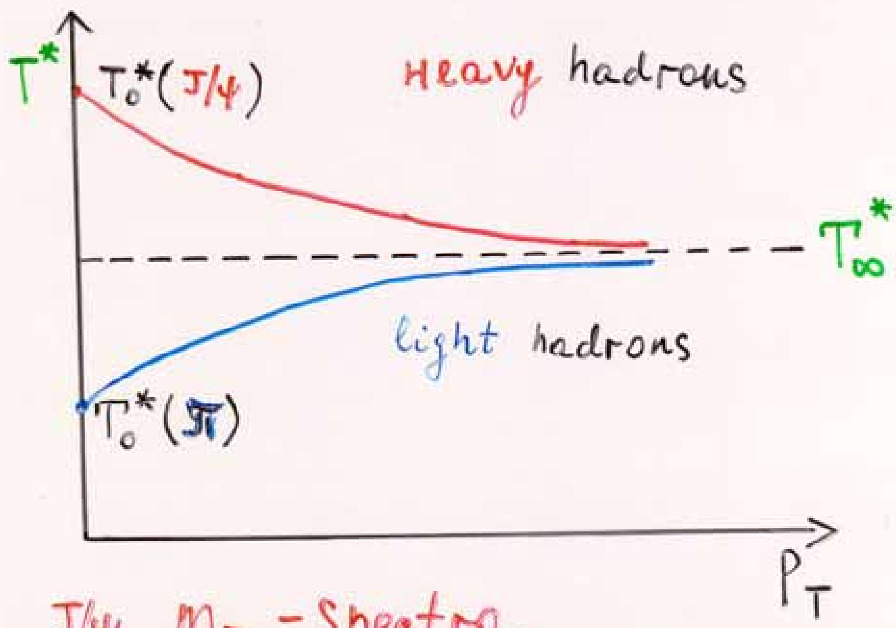


⟨K+⟩/⟨π+⟩
0.2
0.1
0
1
10
10^2
√s_NN (GeV)

$$\frac{dN}{m_T\, dm_T} \propto m_T^{1/2}\, e^{-m_T/T^*}$$

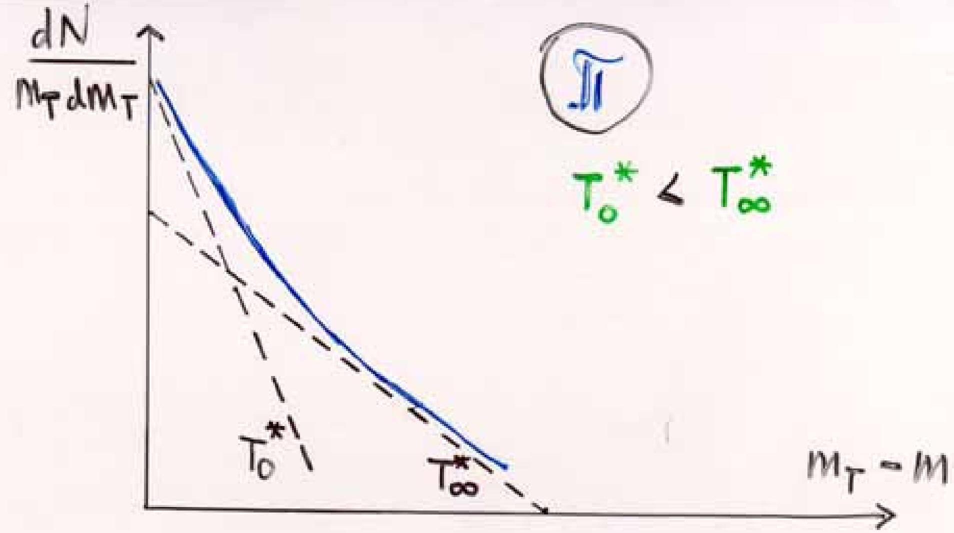
$$T_0^* \equiv T^*(p_T \mapsto 0) = T + \frac{1}{2} m \overline{v_T^2}$$

$$T_\infty^* \equiv T^*(p_T \mapsto \infty) = T \sqrt{\frac{1 + v_T^{max}}{1 - v_T^{max}}}$$

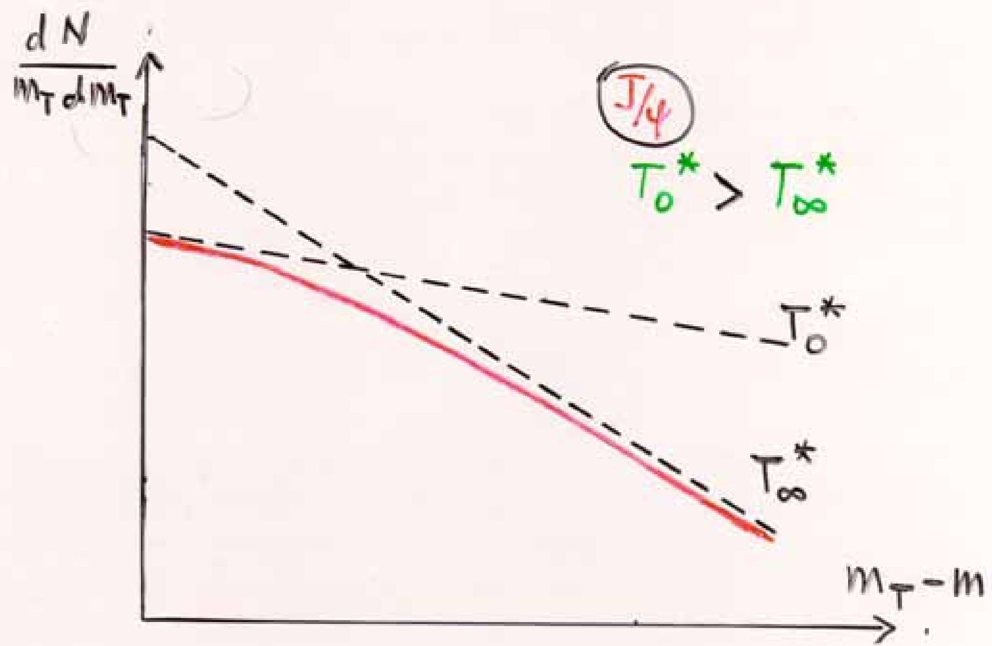


J/ψ m_T - Spectra

M. Gorenstein et al
Phys. Rev. Lett. 88 (2002)
132 301



$$T_0^*(\pi) < T_\infty^* < T_0^*(J/\psi)$$



$$\frac{dN}{m_T\, dm_T} = C \exp\left(-\frac{m_T}{T^*}\right)$$

$T^* = T^*(p_T)$ – ?

$$T^* \simeq T_f + \frac{1}{2}\frac{m v_T^2}{2} \qquad \text{small } p_T$$

$$T^* \simeq T_f \cdot \left(\frac{1+v_T}{1-v_T}\right)^{1/2} \qquad \text{large } p_T$$

K^+, K^-

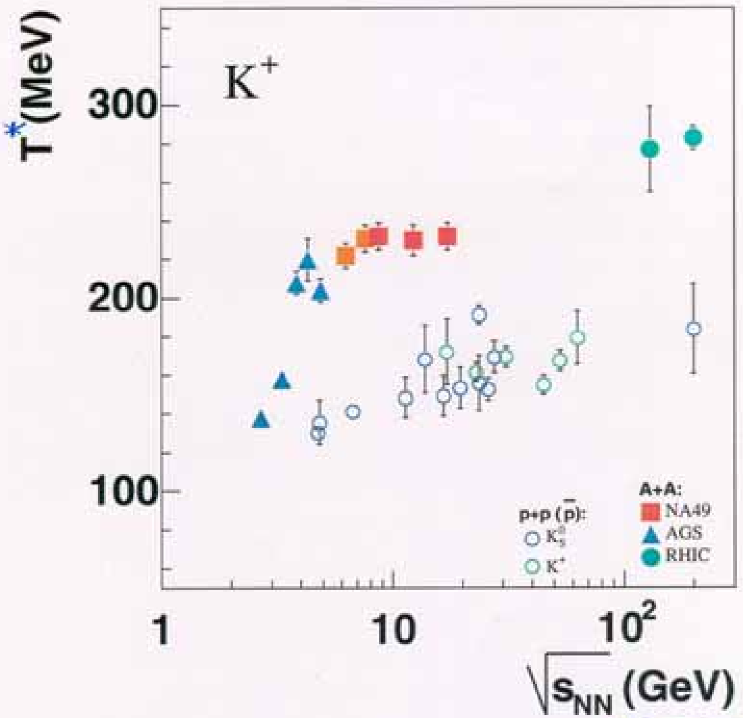
1). T^* is approximately p_T independent

2). m_T spectra is only weakly affected during the post-hydrodynamic hadron cascade: D. Teaney, J. Lauret, E.V. Shuryak Phys. Rev. Lett (2001) + nucl-th/0110037

3). The high quality data on m_T spectra of K^+ and K^- are available.

M. I. G., M. Gaździcki, K. A. Bugaev, Phys. Lett. B (2003), B567, p.175

Temperature Step



$$\frac{dN}{m_T\, dm_T} = C \exp\left(-\frac{\sqrt{m^2 + p_T^2}}{T^*}\right)$$

M.I.G., M.Gaździcki, K.Bugaev

Phys. Lett. B (2003)

B567, p.175

Nuclear Liquid-Gas Phase Transition

GSI

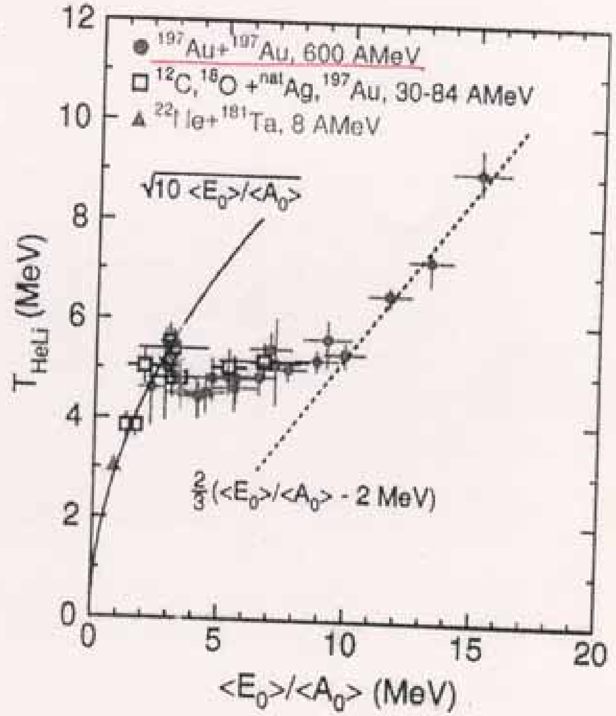


FIG. 2. Caloric curve of nuclei determined by the dependence of the isotope temperature T_{HeLi} on the excitation energy per nucleon. The lines are explained in the text.

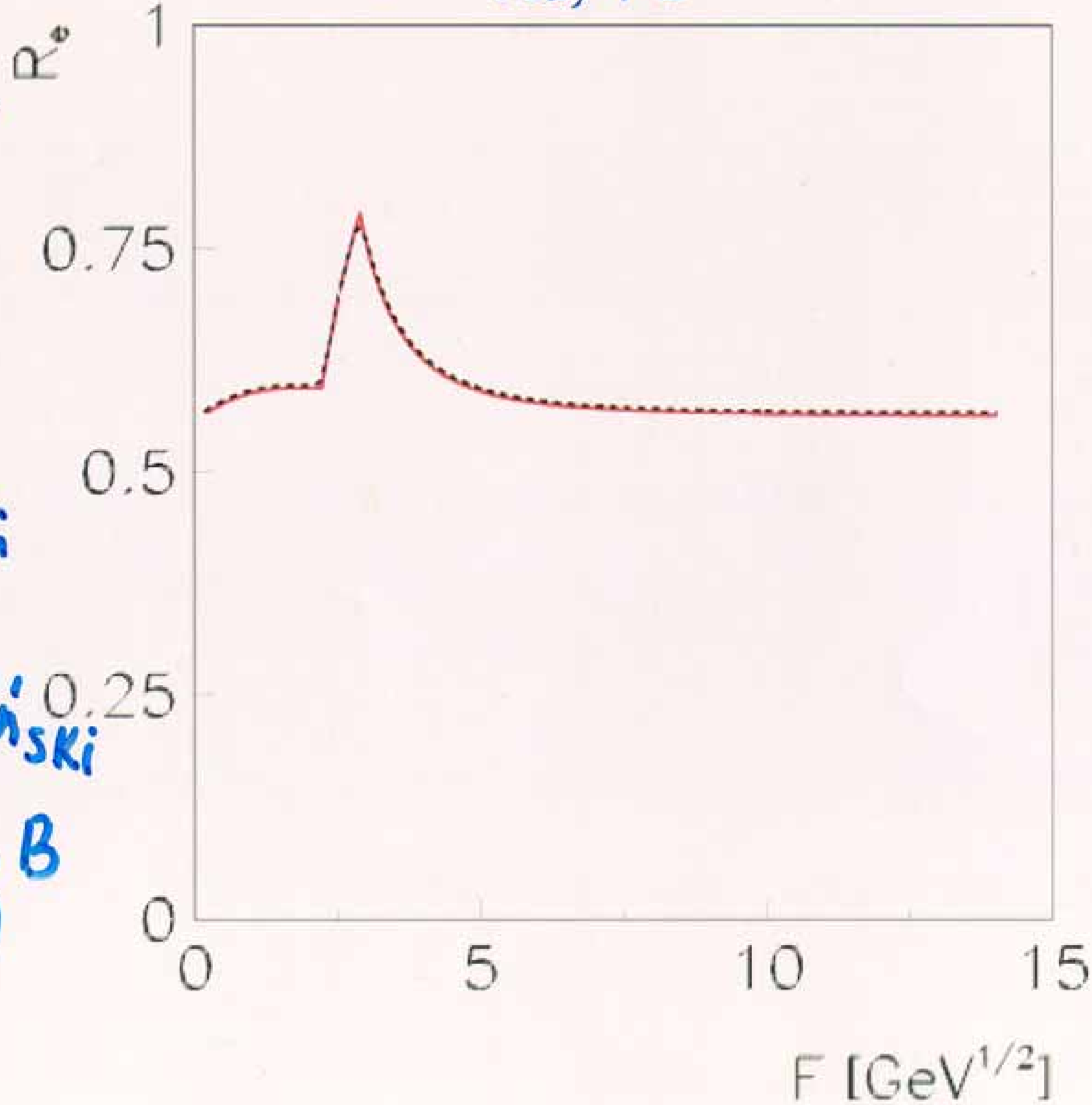
J. Pochodzalla et al

Phys. Rev. Lett. 75 (1995) 1040

$$R_e = \frac{(\delta \bar{N}_-)^2 / \bar{N}_-^2}{(\delta E)^2 / E^2}$$

$$(\delta N)^2 = \langle N^2 \rangle - \langle N \rangle^2$$

$$R_e = \left(1 + \frac{p}{\varepsilon}\right)^{-2}$$



M. Gaździcki
M. I. G.
St. Mrówczyński
Phys. Lett. B
(2004)