EXPERIMENTAL EVIDENCE FOR HADRON DECONFINEMENT IN $\bar{\mathrm{p}}-\mathrm{p}$ COLLISIONS AT $\sqrt{s}=1.8$ TeV IN THE FNAL CØ COLLIDER

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ABSTRACT

We have measured deconfined hadronic volumes, $4.4 < \mathrm{V} < 13.0$ fm^3, produced by a one-dimensional(1D) expansion. The volumes are directly proportional to the charged particle pseudorapidity densities $6.75 < \mathrm{dNc/d}\eta < 20.2$. The hadronization temperature is $T = 179.5 \pm 5$(syst) MeV. The hadronization energy density is $\epsilon = 1.10 \pm 0.26$ GeV/fm^3, corresponding to an excitation of 24.8 ± 6.2 quark-gluon degrees of freedom.

The deconfined hadronic matter has a threshold at $dNc/d\eta = 7$. Hadronization for all events above the threshold occurs at a constant energy density and temperature. The temperature is constant to 1% for $6.75 < \mathrm{dNc/d}\eta < 20.2$. If we treat all charged particles as pions then 1.57 ± 0.25(stat) pions/fm^3 are emitted from the volume. We can relate this number of pions/fm^3 emitted from the volume V to the number of gluons and quarks in the volume (see Fig.1).

$$\mathrm{n\ (pions)} \ = \ \mathrm{n\ (gluon)} + \frac{\mathrm{n(q)} + \mathrm{n}(\bar{\mathrm{q}})}{2} \tag{1}$$

We assume that two flavors of quarks and gluons are involved and that the number of quark and gluon degrees of freedom scale proportionally.

$$\mathrm{n(pion)} = \mathrm{V}\frac{\mathrm{G(T)1.202(kT)^3}}{\pi^2\hbar^3\mathrm{c}^3} \tag{2}$$

This corresponds to $G(T) = 23.5 \pm 6.0(\mathrm{stat})$ quark-gluon degrees of freedom. Similarly all charged particles contribute to the freeze out energy E .

$$E(freezout) = V \; \frac{G(T)\; \pi^2\; k^4}{30\; \hbar^3\; c^3} T^4 \; . \tag{3}$$

The freezout energy density emitted by the volume V is $\epsilon = 1.10 \pm 0.26(stat)$ GeV/fm^3 and we obtain $G(T) = 24.8 \pm 6.0(stat)$ quark-gluon degrees of freedom. In Fig.2. we compare our experimental results with Karsch's lattice gauge calculation [2], where $\frac{\epsilon}{T^4} = \frac{\pi^2}{30}\; G(T) = 8.15 \pm 2.0$ (stat).

References

1. T. Alexopoulos *et al*, Phys. Lett. **B528**, 43 (2002).

2. F. Karsch *et al*, Phys. Lett. **B478**, 447 (2000).

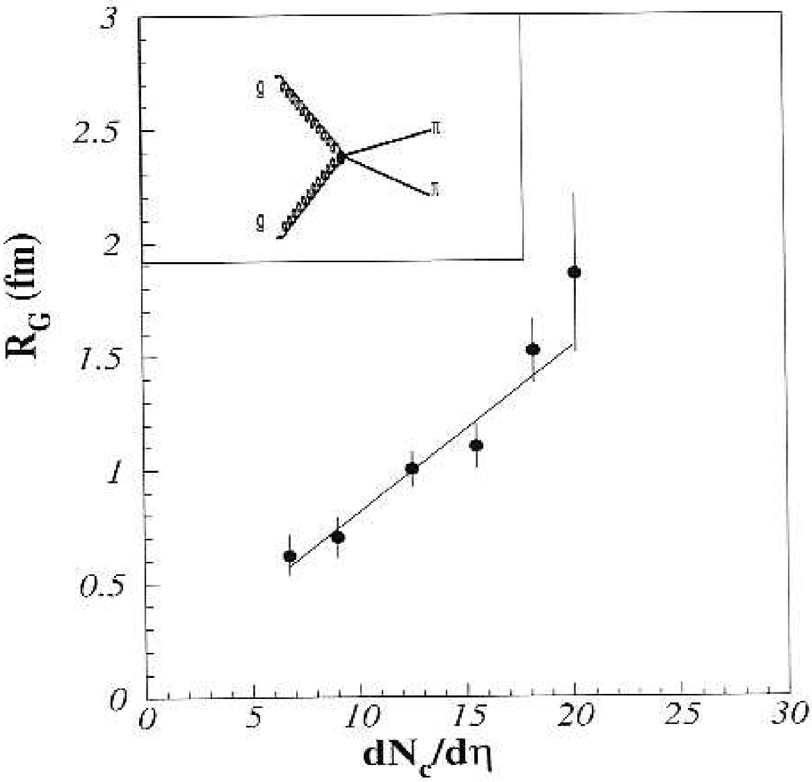

Figure 1: Dependence of the longitudinal Gaussian radius R_G on $dN_C/d\eta$.

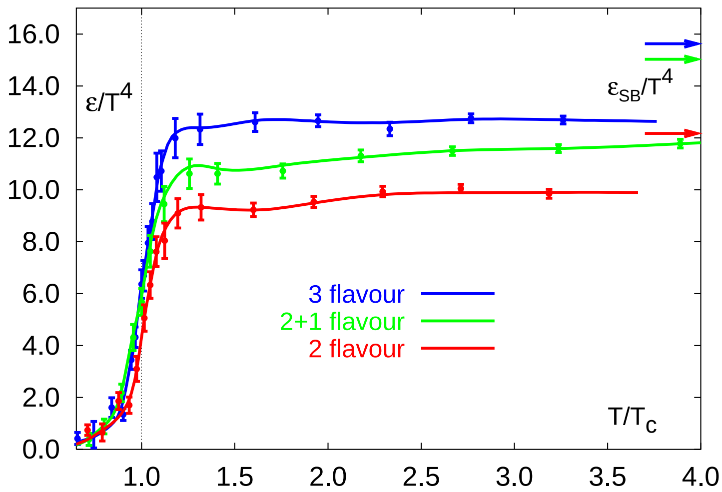

Figure 2: Lattice gauge calculation of [2]