Jet quenching at $\sqrt{s_{NN}} \approx 20$ GeV ?
High p_T production in A+A collisions at SPS revisited

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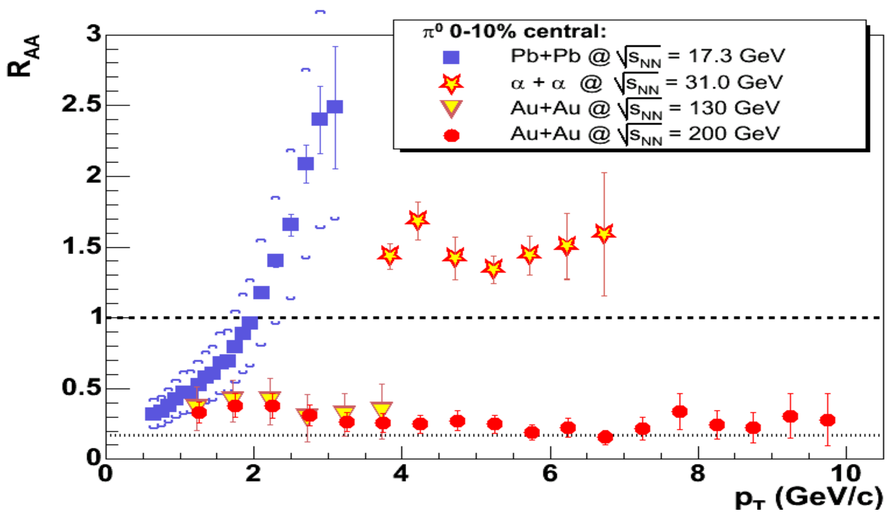
NUCLEAR MODIFICATION FACTORS: HIGH P_T π^0 @ SPS, ISR, RHIC



Ratio of A+A to p+p high p_T data:

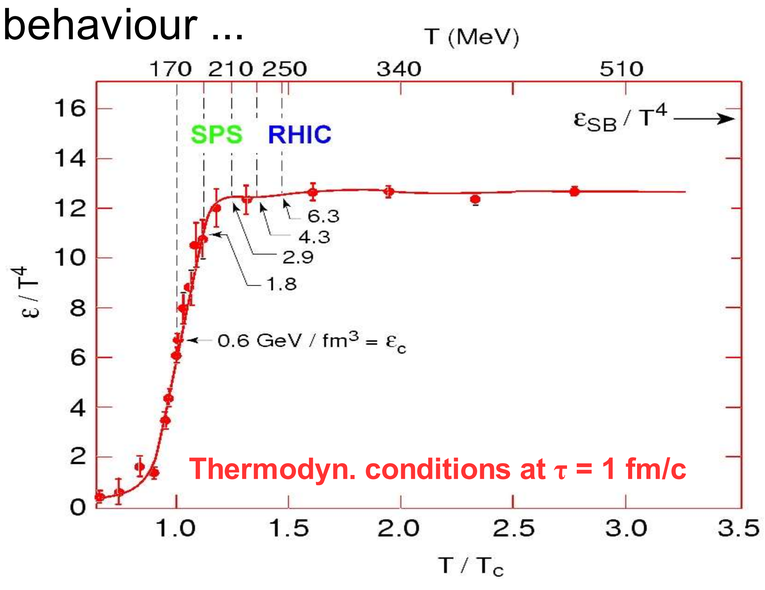
$$R_{AA}(p_T,b) = \frac{d^2N^{\pi^0}_{AA}(b)/dydp_T}{\langle T_{AB}(b)\rangle \cdot d^2\sigma^{\pi^0}_{pp}/dydp_T}$$

- SPS ($\sqrt{s}$ = 17.3 GeV): Strong Cronin enhancement: $R_{AA} \approx 3.$ [1]
- ISR ($\sqrt{s}$ = 31 GeV): Moderate Cronin enhancement: $R_{AA} \approx 1.5$
- RHIC ($\sqrt{s}$ = 200 GeV): Strong suppression: $R_{AA} \approx 0.20$

Consistent with parton energy loss in dense deconfined medium.

WHERE IS THE "JET QUENCHING" AT SPS ?

- Other SPS data (claimed) consistent with QGP: QQbar suppression, $\varepsilon > \varepsilon_{QCD}$ = 0.6 GeV/fm^3, bulk thermal behaviour ...



- Parton energy loss: $\langle\Delta E_{loss}\rangle \propto dN^g/dy$

  Lattice EOS: $dN^{q+g}/dy = \rho \cdot \tau \cdot A_T = \varepsilon/(3T) \cdot \tau \cdot A_T$, with $T = (\varepsilon/15)^{1/4}$
- Parton densities (q+g) in central A+A at τ = 1 fm/c :

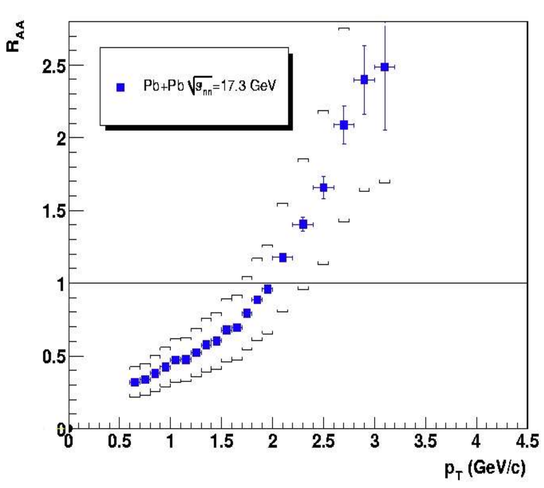
  SPS: $\varepsilon_{Bjorken} \approx 3$ GeV/fm^3 $\Rightarrow$ $dN^{q+g}/dy \approx 700$

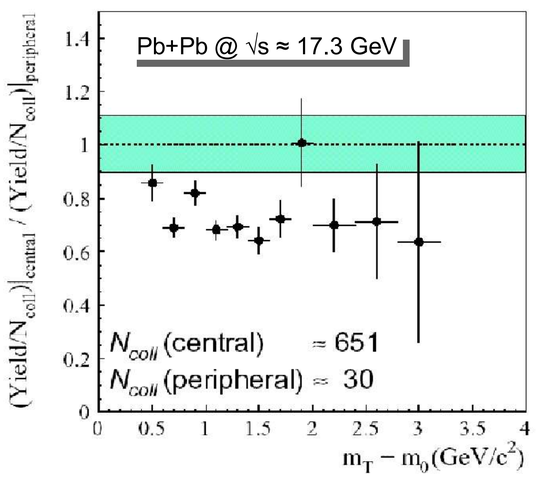
  RHIC: $\varepsilon_{Bjorken} \approx 5$ GeV/fm^3 $\Rightarrow$ $dN^{q+g}/dy \approx 1100$

  $\Big\}$ $(dN^{q+g}/dy)_{SPS} / (dN^{q+g}/dy)_{RHIC} \approx 0.65$
- "Expected" energy loss at SPS (at τ = 1 fm/c): $\langle\Delta E_{loss}\rangle_{SPS} \approx 0.65 \cdot \langle\Delta E_{loss}\rangle_{RHIC}$
- Usual explanations for null suppression at SPS: short QGP lifetime, quark-dominated plasma, Cronin >> hard scattering, ...

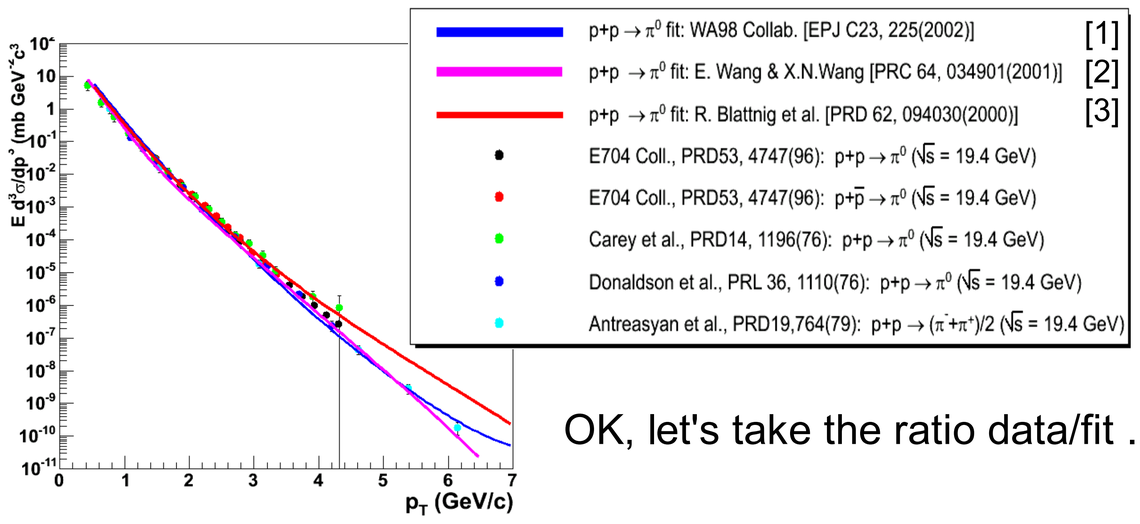
IS THE p+p → π^0 REFERENCE AT SPS REALLY UNDER CONTROL ?

- R_{AA} is enhanced but R_{cp} is suppressed (?!) [1]





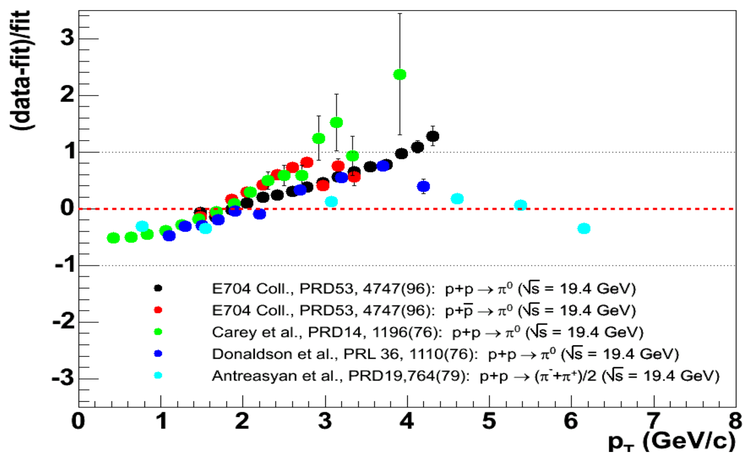
- High p_T A+A data measured at $\sqrt{s}$ = 17.3 GeV, but p+p data available for comparison only at $\sqrt{s}$ = 19.4 GeV.
- $\sqrt{s}$-dependent p+p parametrizations at hand:

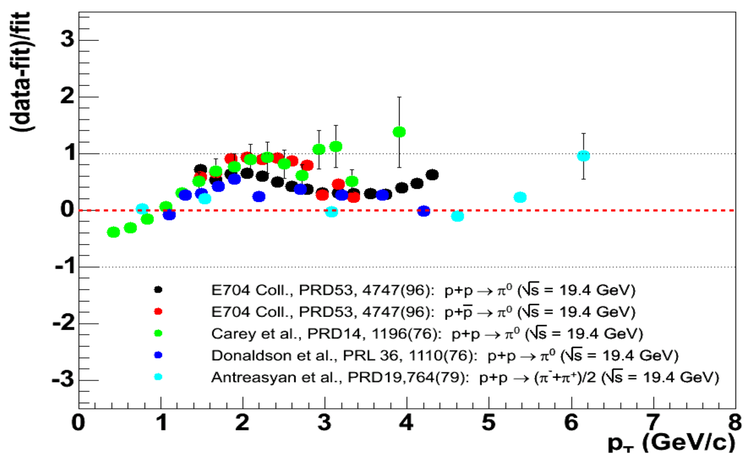


OK, let's take the ratio data/fit ...

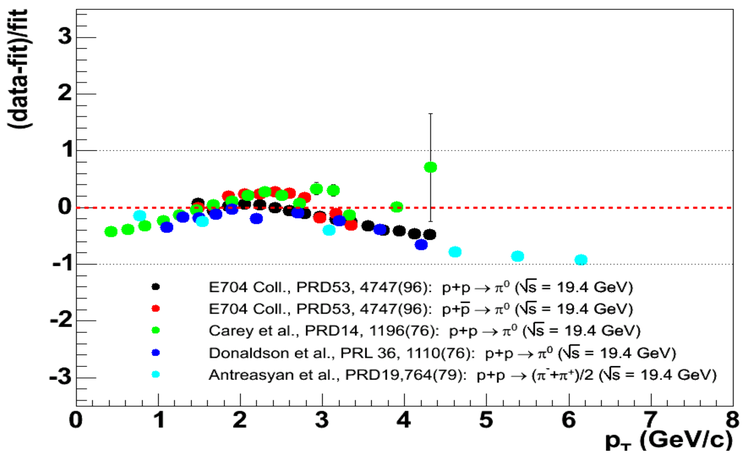
p+p → π^0 $\sqrt{s}$-DEPENDENT PARAMETRIZATIONS VERSUS DATA AT $\sqrt{s}$ = 19.4 GeV

- WA98 [1] and Wang&Wang [2] fits overshoot the data...



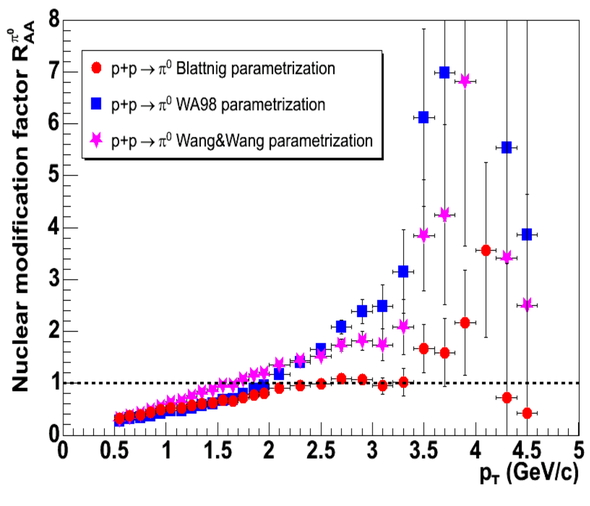


- Blattnig *et al.* [3] fit describes better the available results at $\sqrt{s} \approx 20$ GeV :

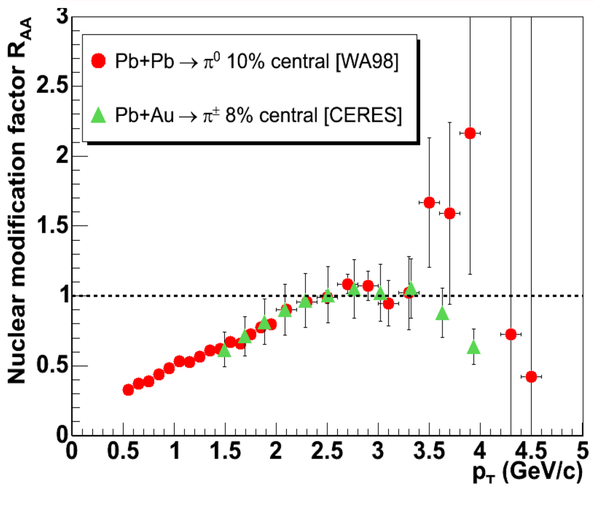


NUCLEAR MODIFICATION FACTOR AT $\sqrt{s}$ = 17.3 GeV REVISITED

- R_{AA} for the 3 different p+p references: [1] & [2] yield a large Cronin enhancement



- R_{AA} for central Pb+Pb,Au @ SPS [1,4] with (better) p+p reference [3] is consistent with N_{coll} scaling (no "Cronin effect").



- Within errors there is even room for (small) "jet quenching" at SPS.
- Run at RHIC (Au+Au at $\sqrt{s} \approx 20$ GeV) to look for the onset of parton energy loss: probably worth a try ...

[1] WA98 Collab., EPJ C23, 225 (2002)
[2] E.Wang, X.N.Wang, PRC 64, 034901 (2001)
[3] R. Blattnig *et al.*, PRD 62, 094030 (2000)
[4] CERES Collab., hep-ex/0003012