LHC: Physics overview

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- Physics opportunity ?

  Thoroughly discussed 1980 →

- Evolution in 5-10 y ?

  I will look back!

- Specific detector capabilities ?

acap!

$$\frac{5500}{200} = 27.5$$

remarkable results already from here!

1. Physics opportunity?

The big ratio

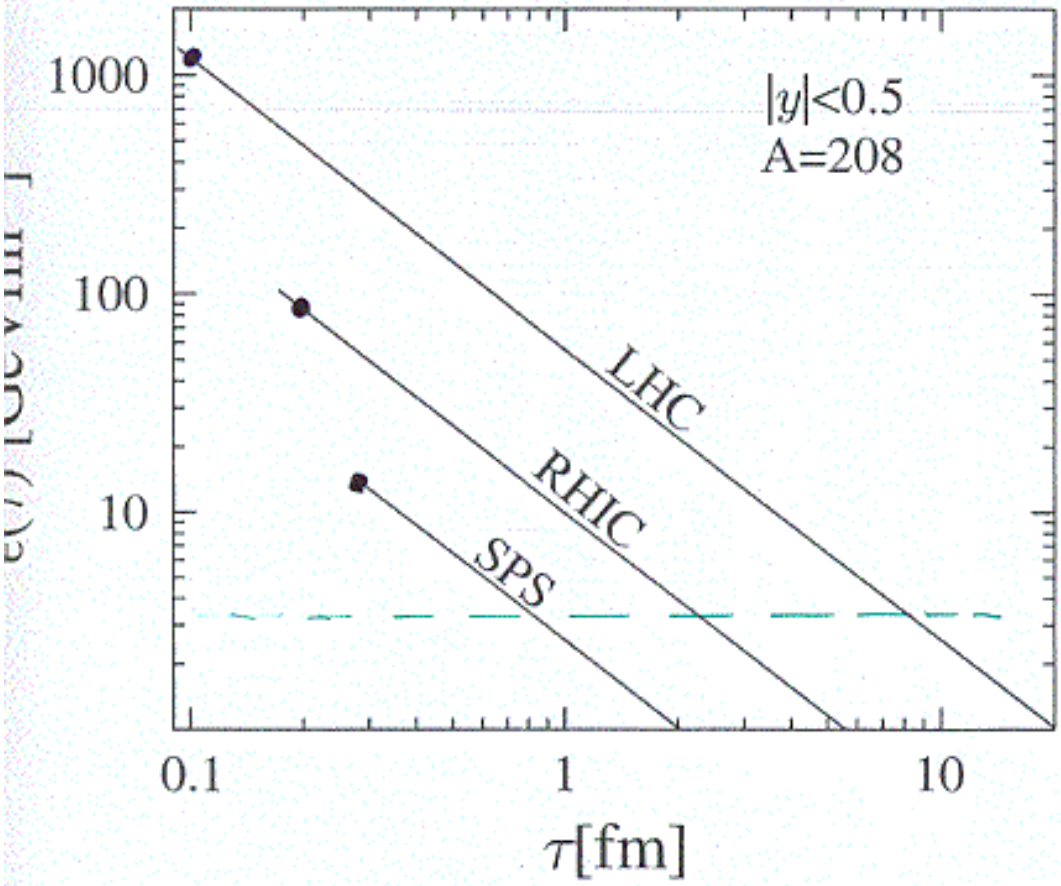
$\frac{q}{7.5}$

gives rise to big effects:

- hotter
- longer-lived
- bigger

theorists' prejudices!

Hotter, longer lived:



Adiabatic expansion!

$\frac{1}{\tau_i} \approx Q_s = 0.2\,\text{GeV}\; A^{0.12}\; \sqrt{s}^{\,0.2}$

Most surprising: RHIC (v_2) in agreement with this naive (?) picture

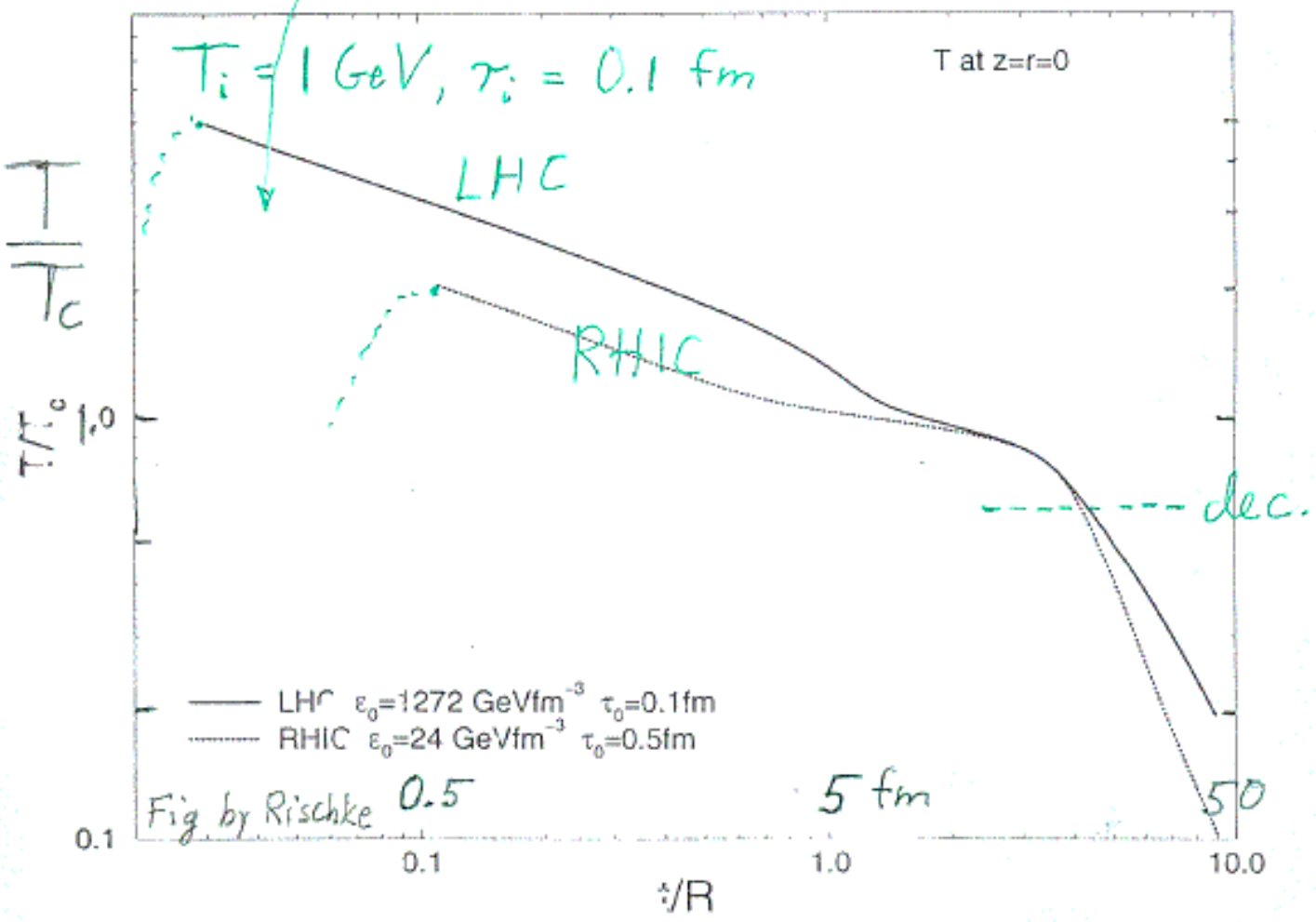
$\frac{\eta}{s} = \text{small} \stackrel{?}{=} \frac{1}{4\pi}$

$N=4$ SuSy YM

LHC?

T(τ):

- more "hard probes" at LHC
  "non-equil. signals"

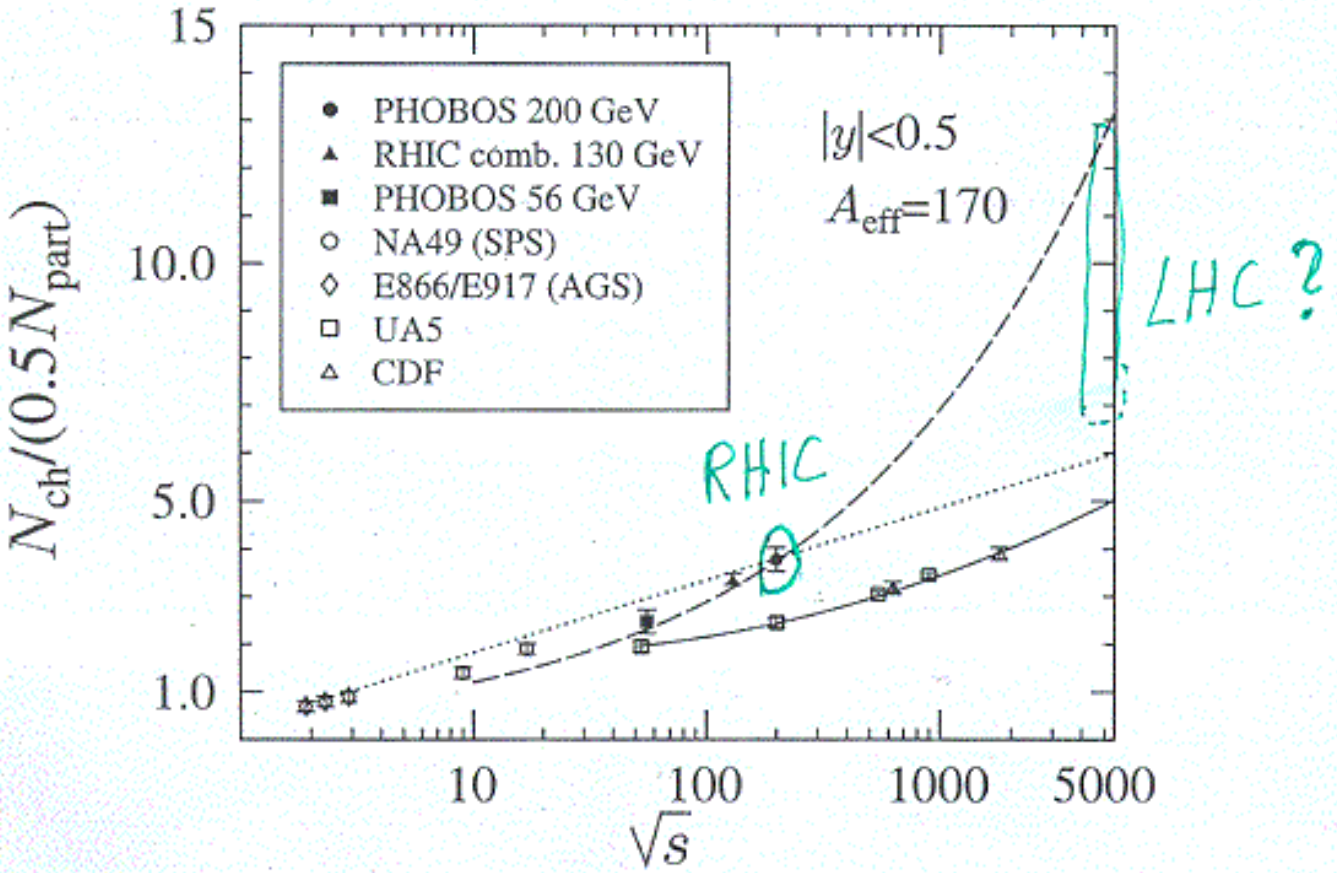


- if late thermalisation, one has to hit the same curve

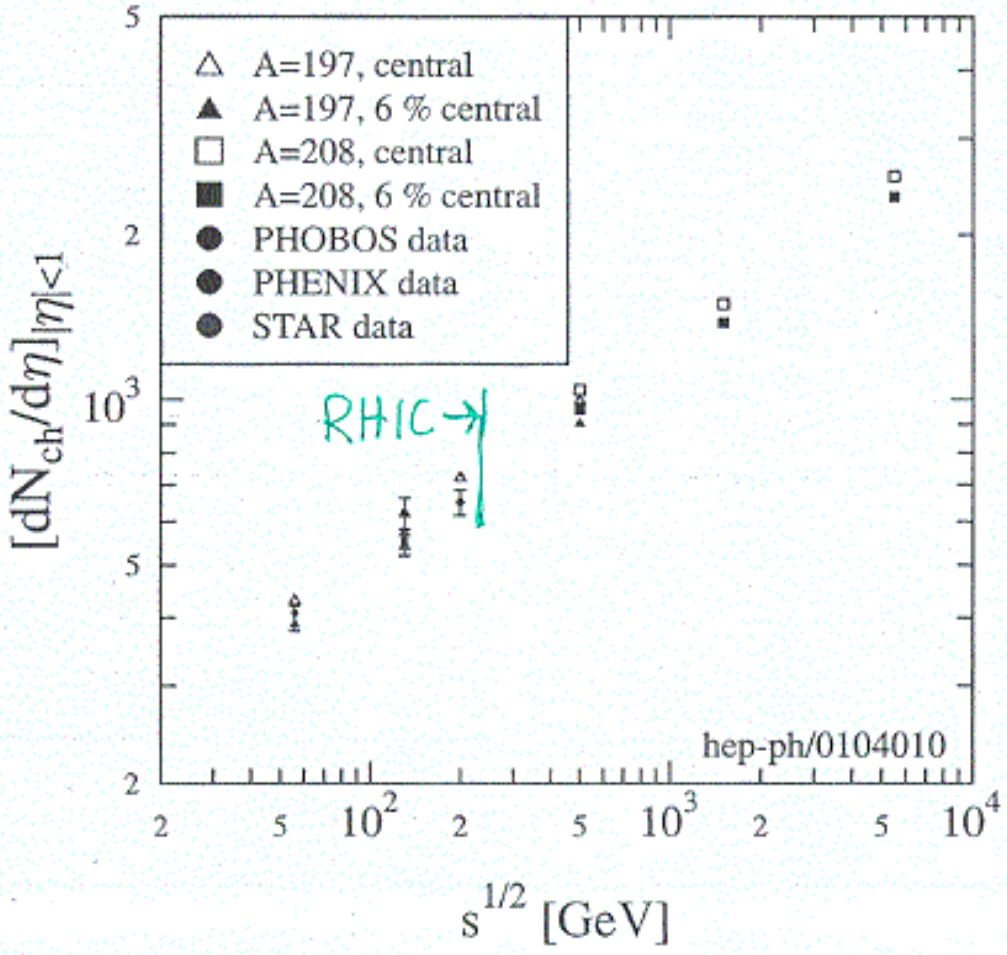
- RHIC & LHC may be very similar at decoupling at $z=0$, but
  different earlier!

Bigger (in N_{ch}):

This is soft QCD, no way to make a reliable reproducible generally accepted prediction !

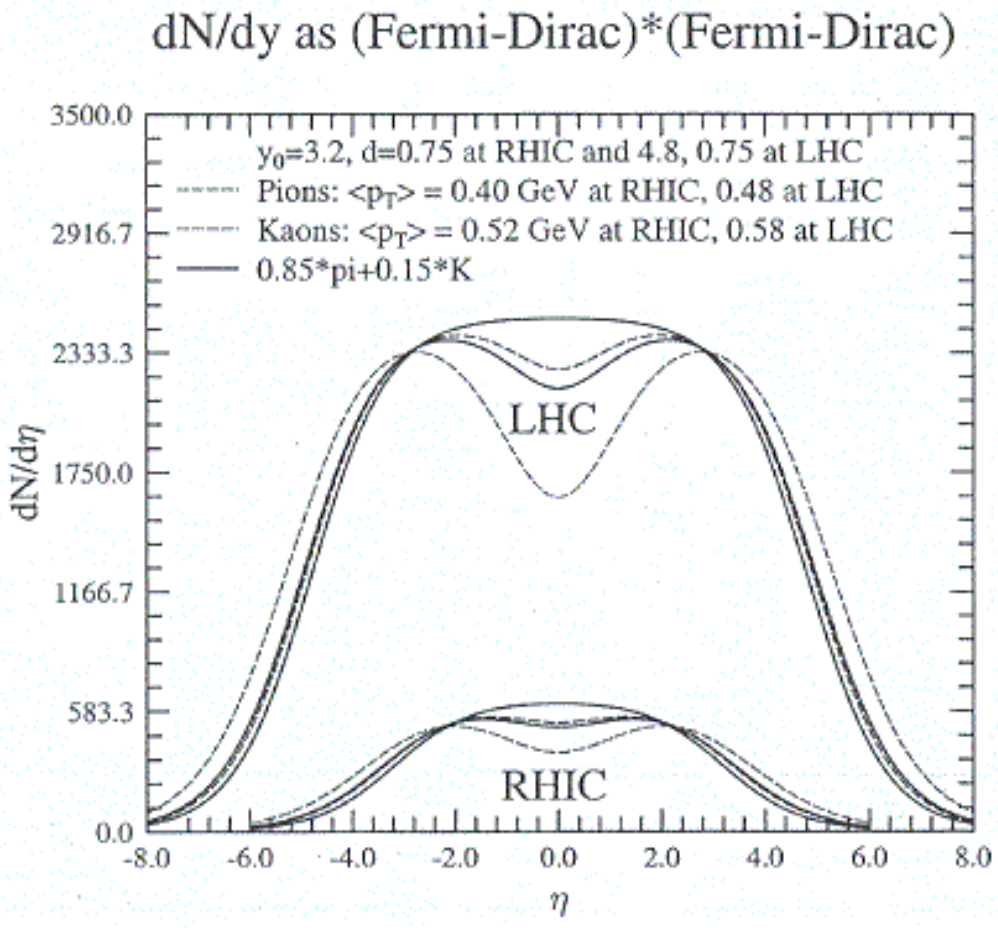


Converted to N_{ch}:

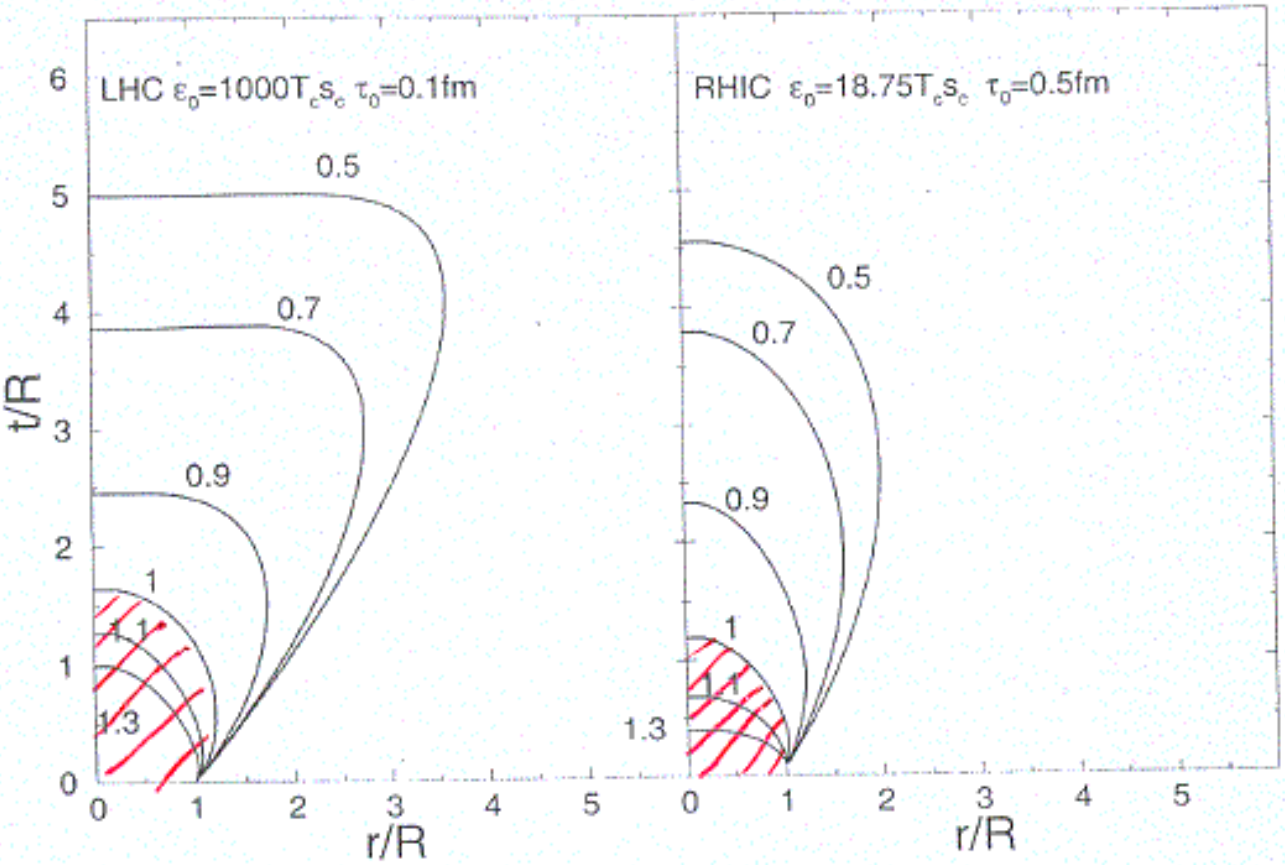


2000

To rapidity distribution:



Bigger in size:



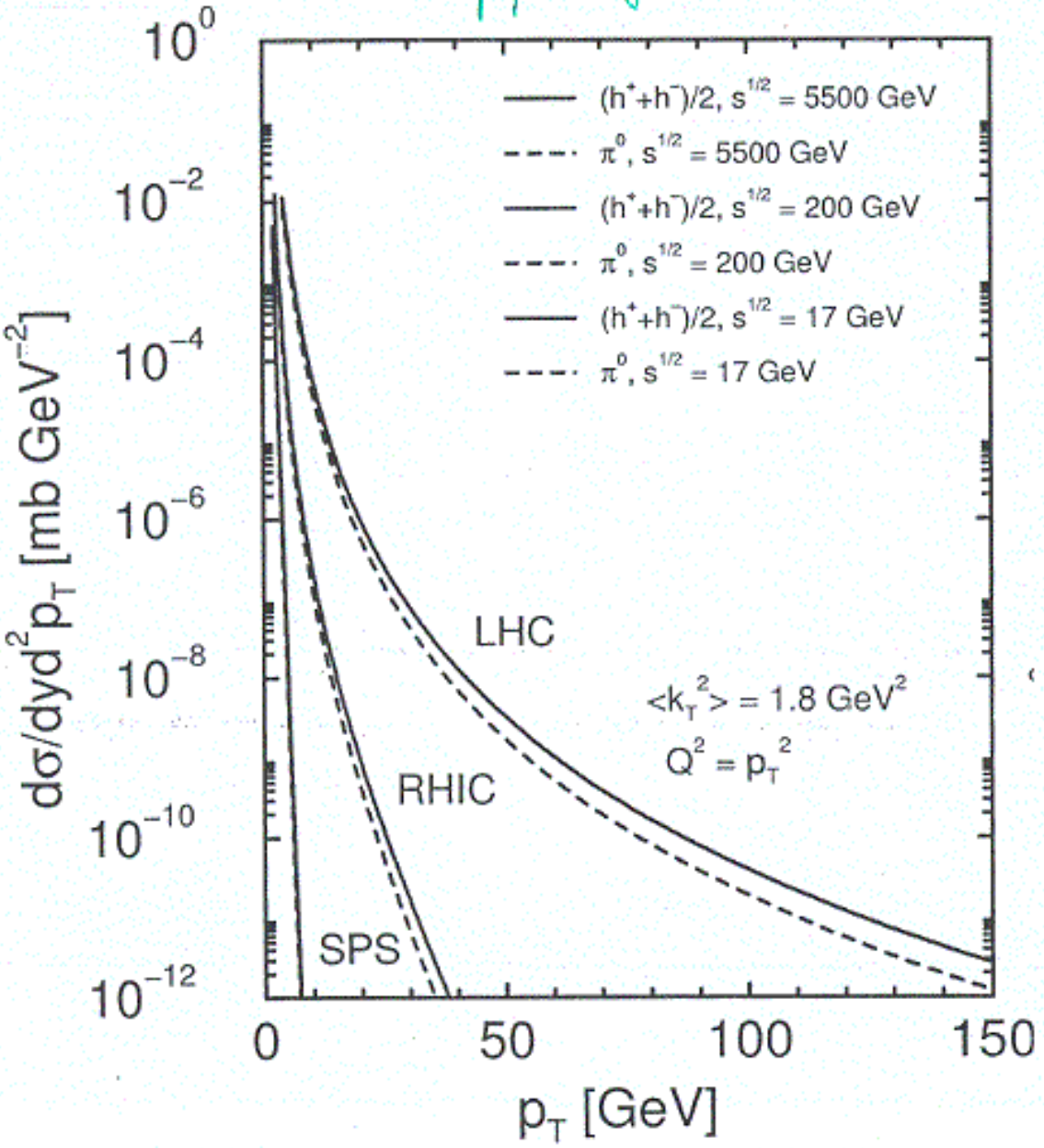
RHIC problem:
understand
HBT $\Leftrightarrow$ hydro

size
lifetime

will be more
striking at LHC!

Bigger cross sections:

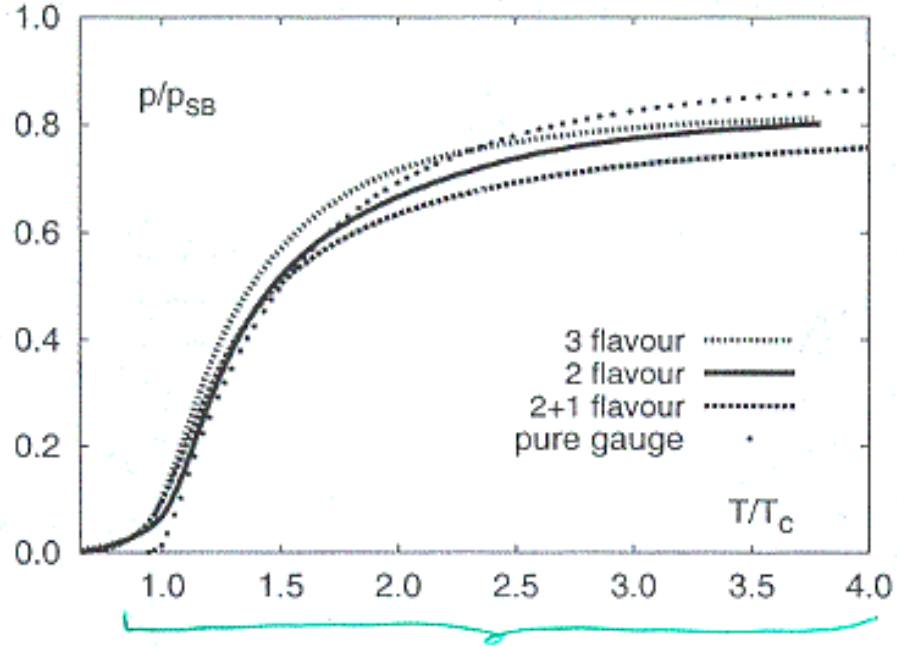
$pp \to jet(p_T) + \not{X}$



The goal should be to put error bars on the 1st principle prediction: QCD EOS:

LHC

RHIC



Effective dofs here?

Total theory chaos: hadrons(T), q, g modes(T), monopoles, instantons, calorons, unstable gauge field configurations, colored bound states, giant collective vibrations, dynamics given by classical gravity (!) in some higher dim space....

At $T \gtrsim 1000\,T_c$ theory under control but:

complicated!

$$\frac{P}{T^4} = 1 + g^2 + g^3 + g^4 \ln g + g^5 + g^6 \ln g + \# g^6$$

effect of varying this # is huge!