Multiplicity distributions for Pb-Pb and p-Pb from a simple model

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Heavy Ion Collisions at the LHC: Last call for predictions
– CERN, 29 May 2007 –

the model

J. Dias de Deus, JGM [hep-ph/0701215]

- a very simple model for distribution of rapidity extended objects (SPM strings or colour glasma fields) created in heavy ion collision

[Glasma] ~ [Effective Strings] ~ [Particle Density]

- linear growth with distance to beam rapidity + asymptotic saturation

$$\frac{\partial \rho}{\partial(-\Delta)} = \frac{1}{\delta}(\rho - A\rho^2)\,, \qquad \Delta = |y| - Y$$

- standard (1845-1847) logistic equation for dynamics of populations

↻ the model

- Y-dependent limiting value of ρ determined by saturation condition

$$\frac{\partial \rho}{\partial(-\Delta)} = 0 \longrightarrow \rho_Y = \frac{1}{A}$$

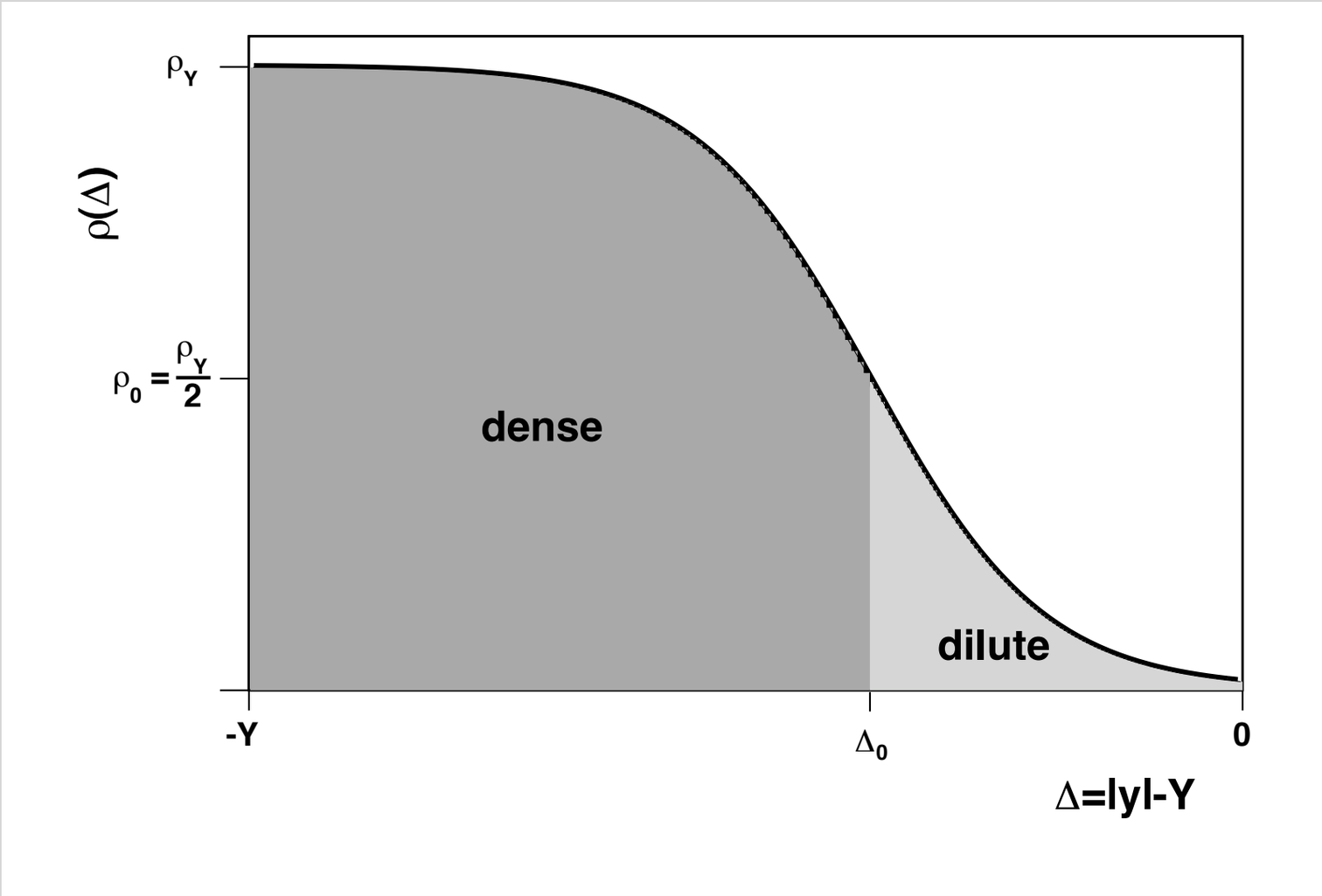
- separation between positive curvature (low density) and negative curvature (high density)

$$\left.\frac{\partial^2 \rho}{\partial^2(-\Delta)}\right|_{\Delta_0} = 0 \longrightarrow \rho_0 \equiv \rho(\Delta_0, Y) = \frac{\rho_Y}{2}$$

- integrating the logistic equation ...

the model

$$\rho(\Delta, Y) = \frac{\rho_Y}{e^{\frac{\Delta - \Delta_0}{\delta}} + 1}$$



↻ symmetric nucleus-nucleus collisions

- in the SPM particle density is proportional (once colour reduction factor taken into account) to the average number of participants from one nucleon in both dense and dilute regimes.

$$\rho \propto N_A$$

- normalized particle density at mid-rapidity related to gluon distribution at small-x.

:: will be reduced by r.c. effects in evolution [Albacete's talk]::

$$\rho \propto e^{\lambda Y}$$

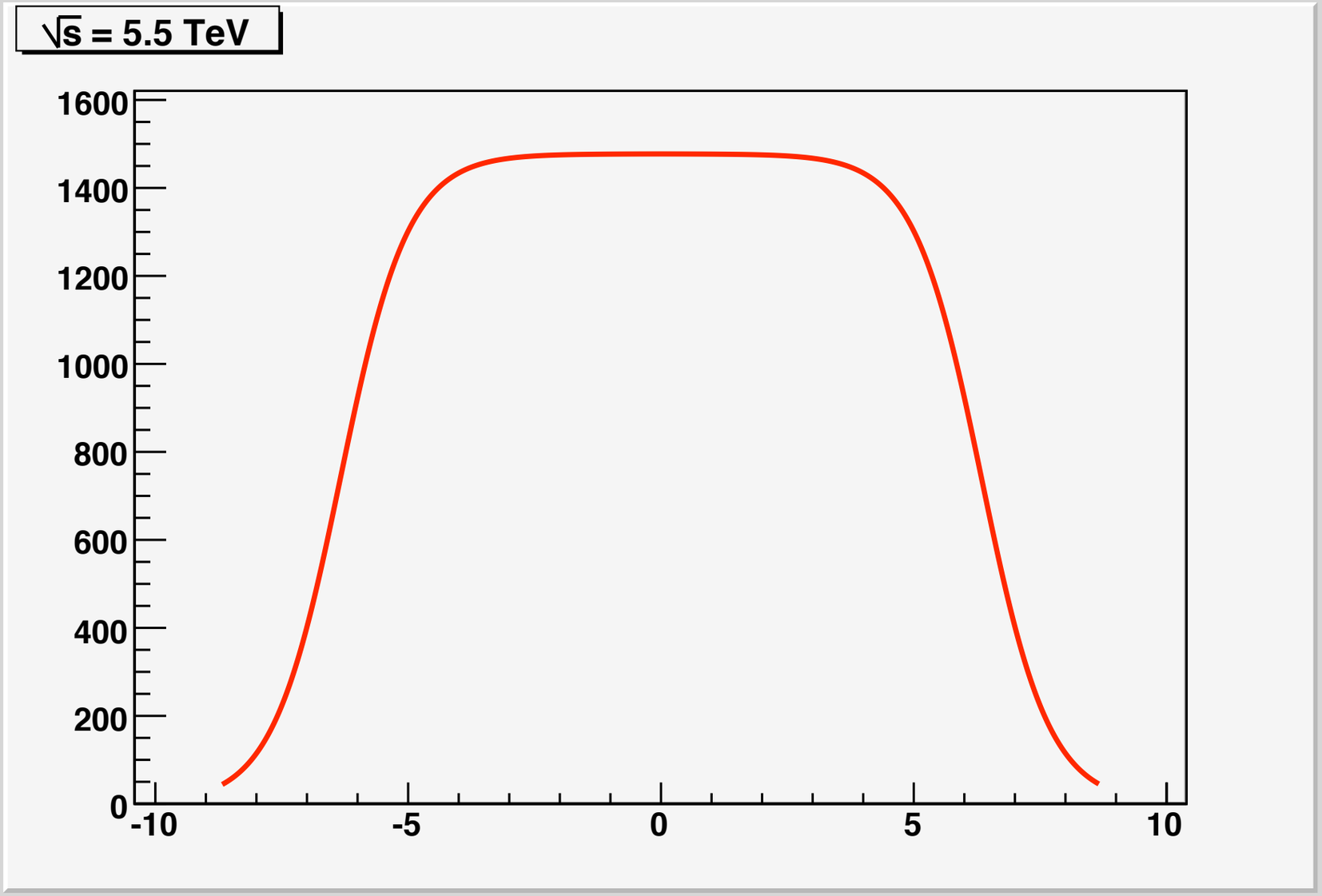
- dense-dilute separation scale linearly decreasing with Y (from energy conservation).

$$\Delta_0 = -\alpha Y\,, \quad 0 < \alpha < 1$$

- re-writing particle density in rapidity

$$\rho \equiv \frac{dN}{dy} = \frac{N_A \cdot e^{\lambda Y}}{e^{\frac{|y|-(1-\alpha)Y}{\delta}} + 1}$$

↻ Pb-Pb at the LHC (0-10% central)



$$\lambda = 0.247$$
$$\alpha = 0.269$$
$$\delta = 0.67$$

from fit to RHIC data

[PHOBOS] Nucl.Phys.A757, 28 (2005)

Brogueira, Dias de Deus, Pajares,
Phys. Rev. C75:054908 (2007)

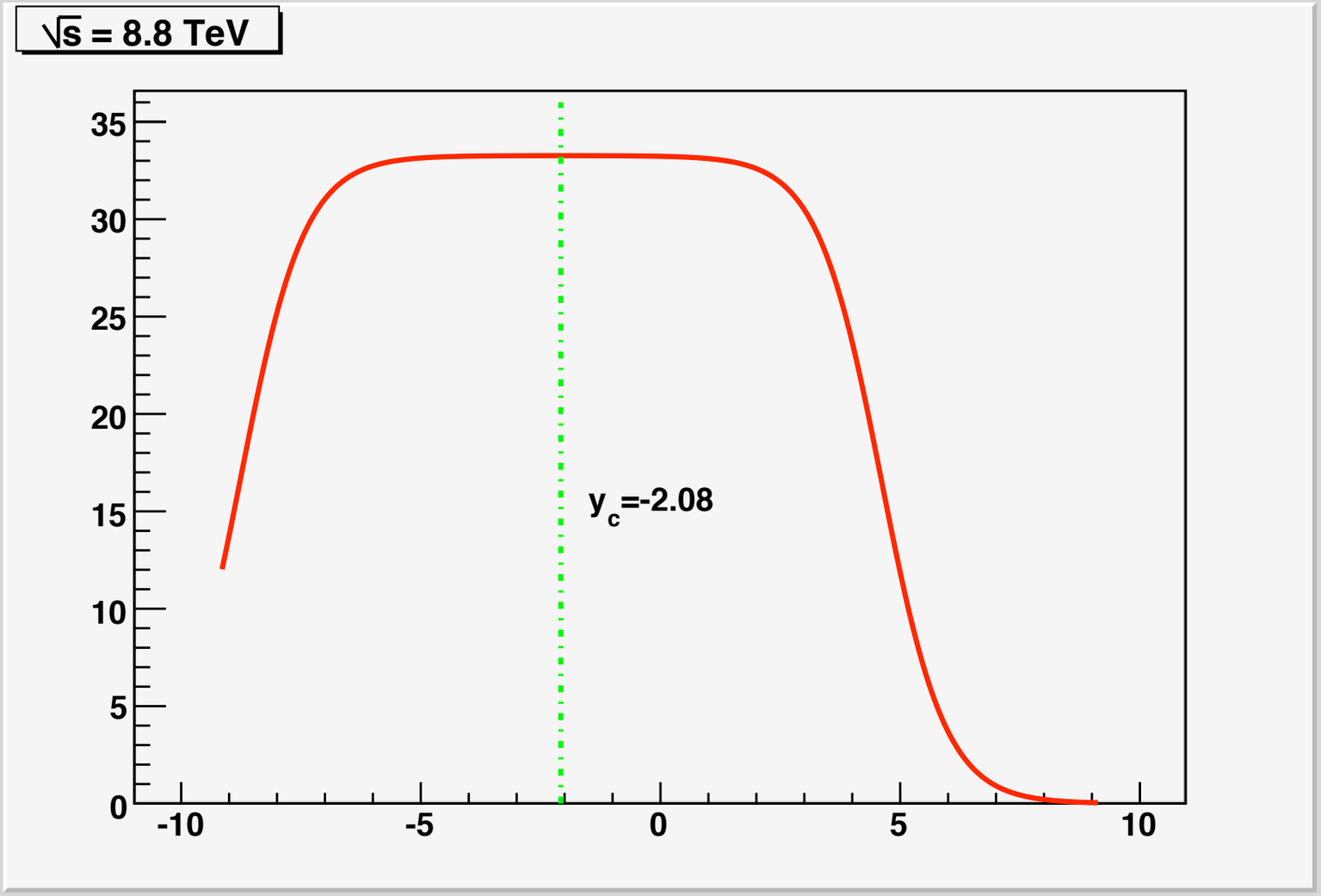
$$N_{Pb} = 173.3$$

from Glauber calculation

Kharzeev, Levin, Nardi,
Nucl. Phys.A747, 609 (2005)

↻ p-Pb at the LHC (0-20% central)

- formulae changed to account for asymmetric geometry, and shift of system CM relatively to LAB CM.



$$N_{part} = 13.07$$

from Glauber calculation

Kharzeev, Levin, Nardi,
Nucl. Phys. A747, 609 (2005)

↻ pseudo-rapidity distributions

- very large uncertainties: just pictures not predictions