Study of Λ, Ω and Ξ production on pp collisions at LHC energies in the SPM framework.

Alejandro Contreras Munive*[1], Irais Bautista Guzmán[1,2]

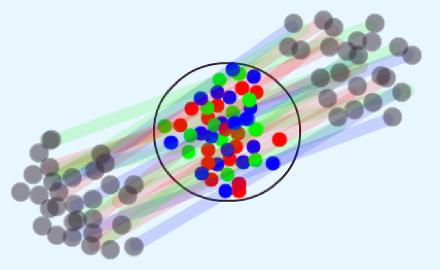
[1] *Facultad de Ciencias Físico Matemáticas, Benemérita Universidad Autónoma de Puebla.*

[2] *Cátedra Conacyt*

Abstract

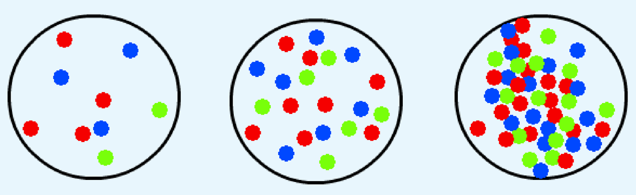
QGP an exotic state of matter is created on heavy Ion collisions (nuclear collisions), recent results show some signals that indicate a phase transition in pp collisions, it's well known that in the presence of QGP the production of baryons and mesons shows a clear modification, we study this observable as a signal of a deconfinament in the system, in concrete, the production of multi-strange baryons, by using the String Percolation Model.

The Model



The String Percolation Model, is based on a two-dimentional percolation theory, which assumes that the color fields created at the time of a collision are strings, when this strings are projected in the impact parameter plane they form small discs[1][2] with radius $r_0 = ,25$ fm taking from QCD bilocal correlation functions.

When the system reaches a critical density of strings, a cluster is formed, which indicates the presence of a geometrical phase transition and a connected system. In the model we define a quantity related with the fraction of area occupied by the discs, the Critical Parameter of String Color Density, defined as: $\zeta^t = (S_0/S)\overline{N}^s$, where $\overline{N}^s$ is the average of the number of strings in the cluster: $\overline{N}^s = 2 + 4\frac{S_0}{S}\left(\frac{\sqrt{s}}{m_p}\right)^{2\lambda}$ and is evident that depends on the energy directly.



For this system the geometric scaling gives the *Factor Reduction Color*: $F(\zeta^t) \equiv \sqrt{(1-e^{-\zeta^t})/\zeta^t}$[1]. Where the transverse momentum distribution is given by:

$$\frac{1}{N}\frac{d^2N}{d\eta dp_T} = \frac{a\left(p_0\frac{F(\zeta_{pp})}{F(\zeta_{HM})}\right)^{\alpha-2}}{\left[p_0\sqrt{\frac{F(\zeta_{pp})}{F(\zeta_{HM})}}+p_T\right]^{\alpha-1}}. \quad (1)$$

In this equation, a,p_0 y α are parameters obtained fitting minimum bias distributions for fixed energies:

$\sqrt{s}$	a	p_0	α
0.9	23.29 ± 4.48	1.82 ± .54	9.40 ± 1.79
2.76	22.48 ± 4.20	1.54 ± .46	7.94 ± 1.41
7	33.11 ± 9.31	2.31 ± .87	9.78 ± 2.53

Cuadro 1: Parameters for transverse momentum distributions.

By including the differentiation for the spectra by species for kaons (κ) and protons (p) [3],[4] we get:

$$\frac{1}{N}\frac{d^2N}{d\eta dp_T} = \beta \exp\left(\frac{-m_{\kappa,p}{}^2F(\zeta_{pp})}{\langle p_T\rangle^2+\langle p_{\kappa,p}\rangle^2}\right)\frac{1}{N}\frac{d^2N}{d\eta dp_T}\bigg|_{\pi}. \quad (2)$$

Where β is a normalization parameter corresponding to the species production and energy, obtained fitting experimental data from CMS [5], for Minimum Bias and peripheral events, we obtain the following parameters:

$\sqrt{s}$	$F(\zeta_{pp})$
0.9	0.91456144
2.76	0.885818608
7	0.852129259

Cuadro 2: Values for $F(\zeta_{pp})$ at different energies.

$\sqrt{s}$	β
0.9	.5 ± .02
2.76	.3 ± .01
7	.31 ± .02

Cuadro 3: Normalization parameters by energy for transverse momentum distribution.

Fits for κ, p, π, Ω[6] and Ξ[6] at $\sqrt{s} = ,9, 2,76$ y $7\ TeV$

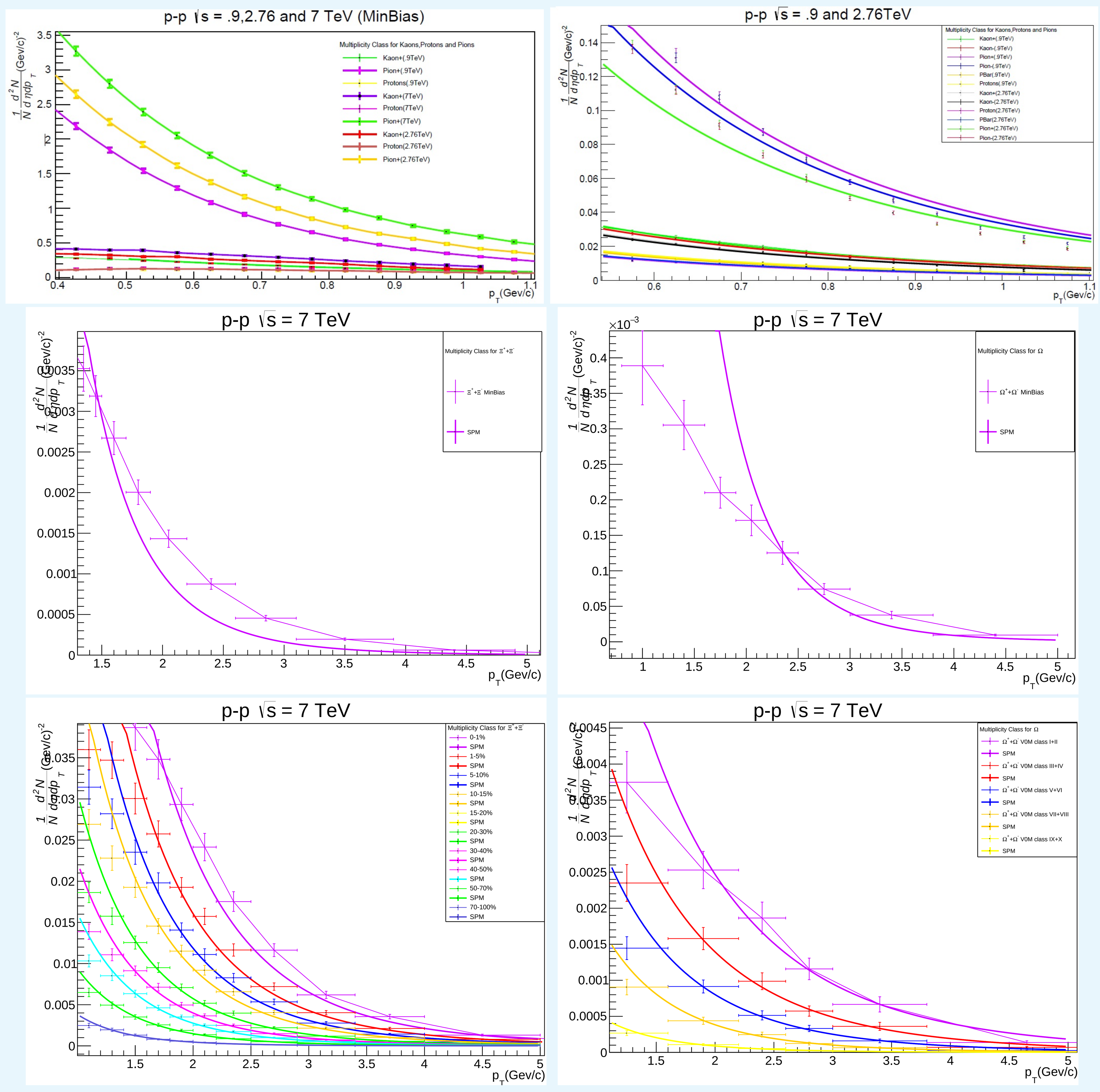


Figura 1: Fits of momentum distribution for $,9TeV$,$2,76TeV$ and $7TeV$ on peripheral, MinBias collisions, and different multiplicities.

Results

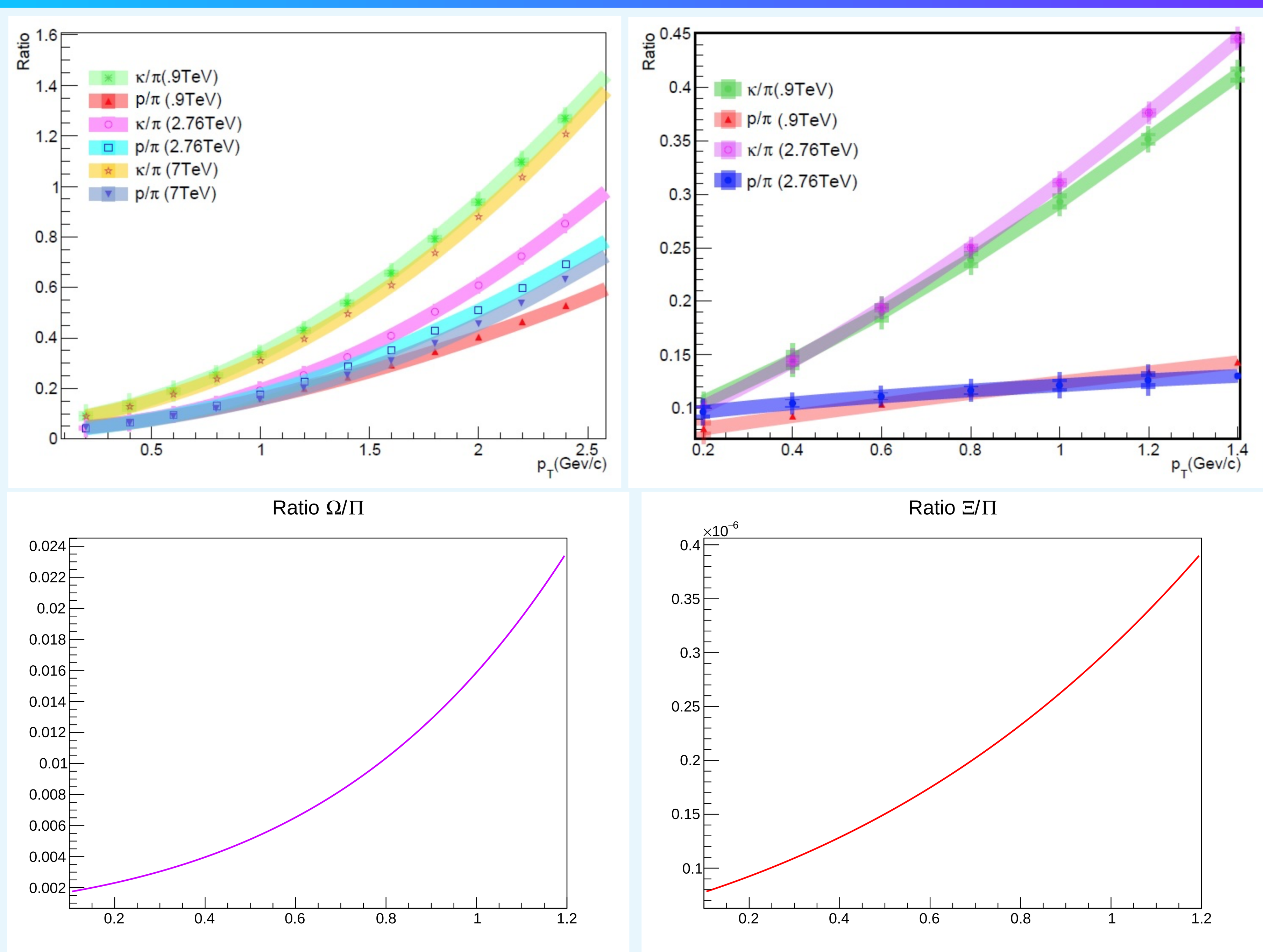


Figura 2: Ratio productions for proton/π and π/κ on peripheral an MinBias collisions, Ξ/π and Ω/π.

Conclusions

For the p/π and κ/π ratios, we can see an enhancement in the variation of the production of κ, p with respect to π, in both cases: MinBias and peripheral collisions, as we increase the p_t. For the multy-strange baryons, (Ω, Ξ) we just study the ratio of the most central events $(0-5\,\%)$ for $\Omega and \Xi$, with the data of MinBias for π, we can see a similar behaviour, but is necessary to study each multiplicity with its correspondant. So, as is evident in our fits, our model can reproduce in a good way the expetimental data,in consecuence, we have some signals of a phase transition, in the future, we hope to extend the analysis with the complete set of data for pions for different multiplicities.

References

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