Identifying jets through the leading particle in the isolated leading particle approach

I. Domiguez, E. Cuautle, E. Garcia, A. Ortiz and G. Paic

Abstract:

In Heavy ion there are many methods to study the created matter in the collisions. The jets has been of interest for many years, however, the development of technics of analysis on with the subject up to days are not enough understand, due to unclear definition of jets. We propose to look more in details at the leading particles and the remaining associated particles in the so called isolated leading particle approach. The simple technics show a power tools of analysis in heavy ion collisions.

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Identifying jets through the leading particles in the isolated leading particles approach

E. Cuautle[1], , I., Dominguez[1],, E. Garcia[2],, A. Ortiz[1], G., and Paic[1]

Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Apartado Postal 70-543, México Distrito Federal 04510, Mexico.
[2]University of Illinois at Chicago

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1 Introduction

The parton energy loss has been the center of attention now for several years. Many methods have been developed to extract the maximum of information on the ways the parton loose energy in the dense medium and on the manifestation of these processes in the experiments. The analysis of spectra compared with the scaled proton-proton data in the well known R_{AA} variable, as well as the dihadron analysis yielded a wealth of important observations. Specifically the analysis of the dihadron correlation relies on trigger particles chosen in a certain momentum range and subsequent plotting of the so called ässociated particles: The relationship between the trigger momentum interval and the one of the chosen associated particle not explained. One usually encounters two types of intervals: 1) a high range where the associated particle is chosen in a range of 1.5-2 GeV/c below the lowest limit of the triggering range and 2) the low range where the lower limit of the associated particle momentum is at low momentum and the high end is again adjacent to the triggering range. In the present article we propose to look more in details at the leading particles and the remaining "associated particles" in the so called Isolated leading particle approach (ILPA) In the first part we will present the Isolated Leading Particle Approach (ILPA) results obtained by PYTHIA [1] and HIJING [2] particle event generators at energies of RHIC and LHC. In the second part we will discuss the sensitivity of the leading particle spectra to the ingredients applied to the generators e.g. different fragmentation functions and/or parton distribution functions. In the third part we will apply some models of jet quenching to the spectra and will discuss the implications of the findings on the extraction of the parton energy loss in heavy ion collisions.

2 The isolated leading particle approach (ILPA)

We plot, see Fig. 1 the momentum spectra of all the charged hadrons in all the events and then extract for every event the particle with the highest momentum and plot it in the same plot with the momenta of all hadrons. We see that at momenta above 3-4 GeV/c the curve of the momentum spectra joins perfectly with the total momentum spectrum. This is not unexpected since we expect exactly in that momentum range the events being governed by hard parton processes. The limit has been extracted in more elaborated ways but this one seems to us a very convincing and simple argument. In the next step we choose events that have their leading particle in a restricted range. We plot then for these events the momentum spectrum. The results obtained for a simulation of Pythia at 14 GeV and 200 GeV is shown in Fig. 2 and Fig. 3

The figures indicate pictorially very clearly the process of particle production in hard processes where the event is triggered. *i.e.* the event is chosen to have a high probability to be in the tail of the distribution of the leading particle spectrum due to the fact that the steepness of the production spectrum of jets. In other words it is easier to encounter a high z particle (were $z = p_t/\hat{p}_t$) *i.e* a low energy jets which generates a high momentum particle than a high energy jets with the same momentum for its leading particle. Now if we have a high z leading particle all the other particles have $1 - z$ momentum to distribute among themselves. This explains the disconti-

Conten:

1.- Introduction

2.- The isolated leading particle approach (ILPA) in pp collisions

2.1.- Effects from Fragmentation Function

2.2.- Effects from Parton Distribution Functions

3.- ILPA applied to heavy ion collisions

3.1.- Sensitivity to the energy loss in the leading particle

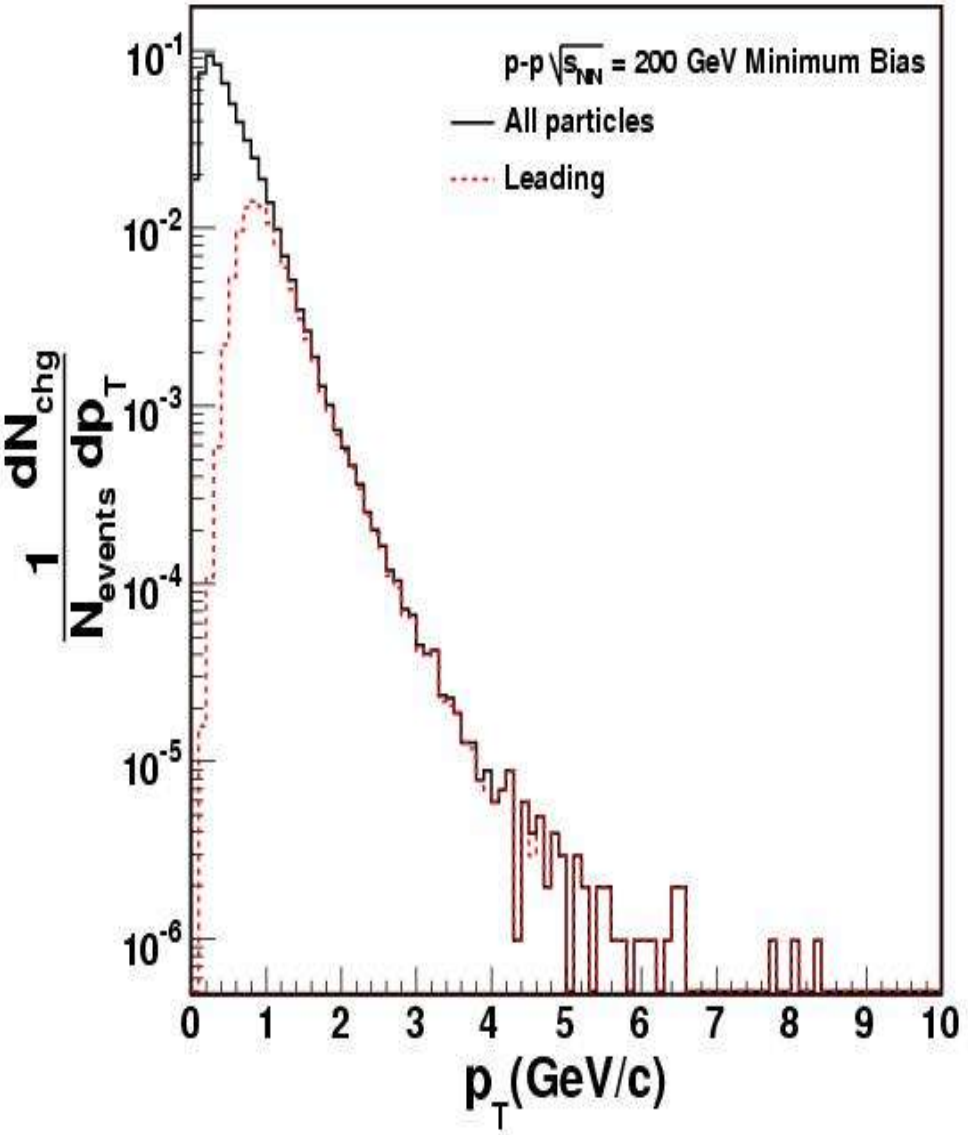
3.1.- splitting into quark and gluon jets

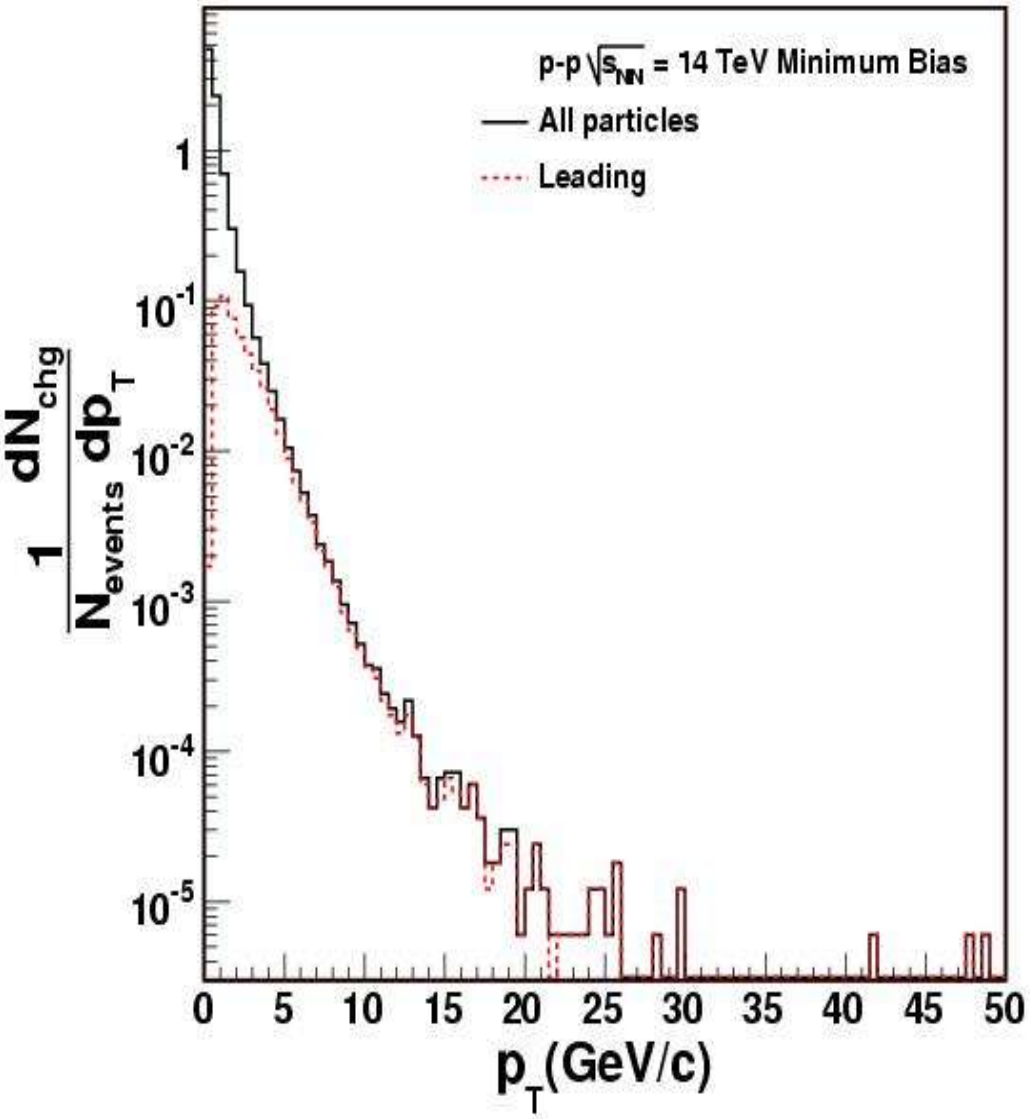
? are we missing something?

4.- Conclusion (not yet)

Total versus leading pt spectrum from RHIC to LHC

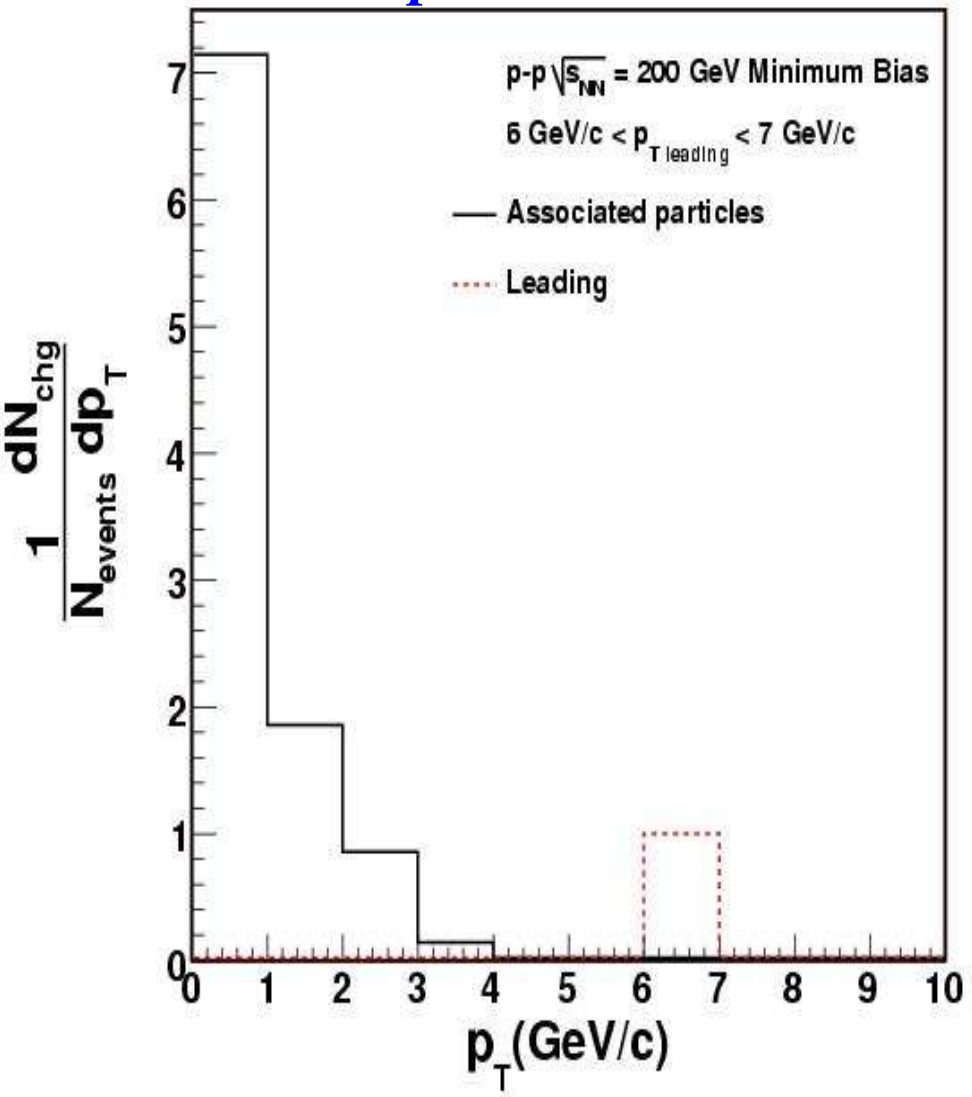
The superimpose point increase with the energy

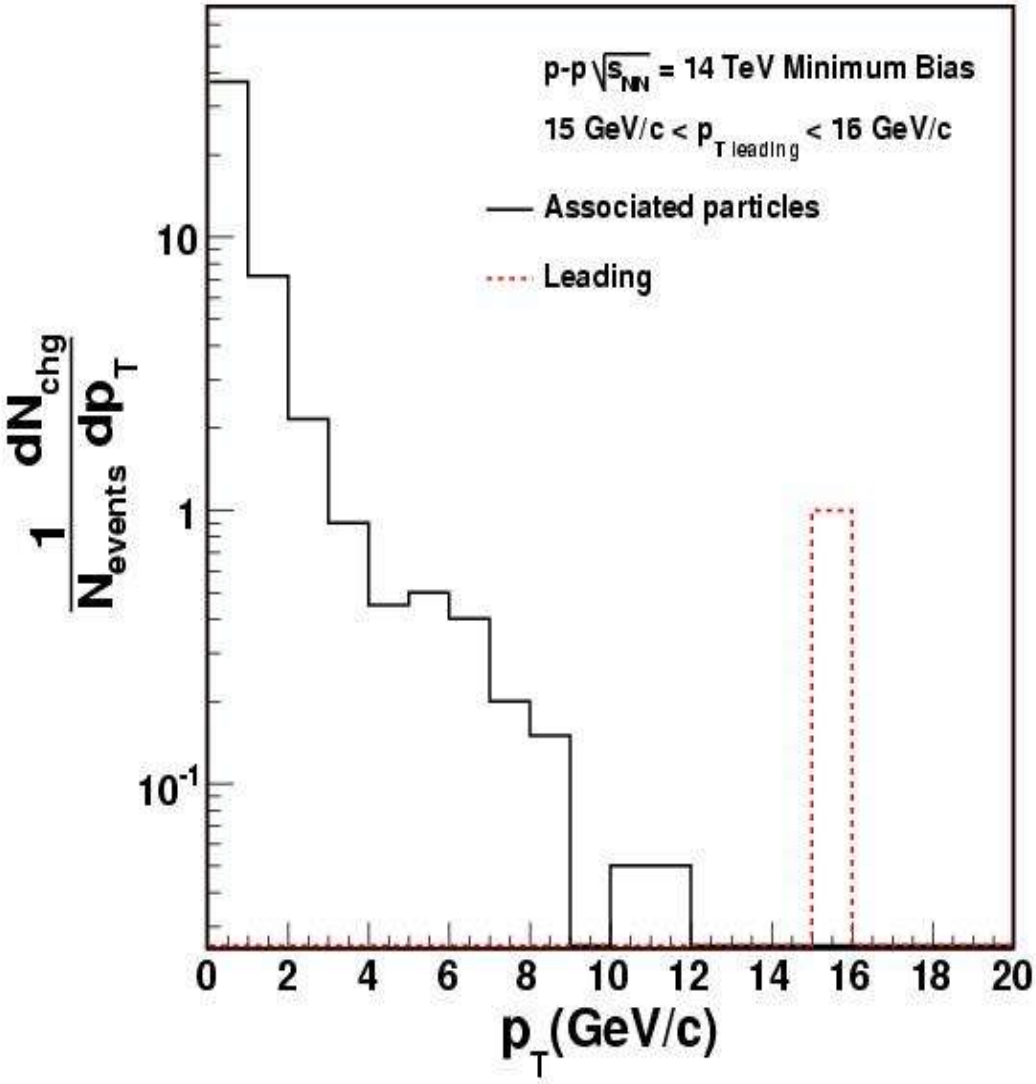




The Isolated leading particle from RHIC to LHC

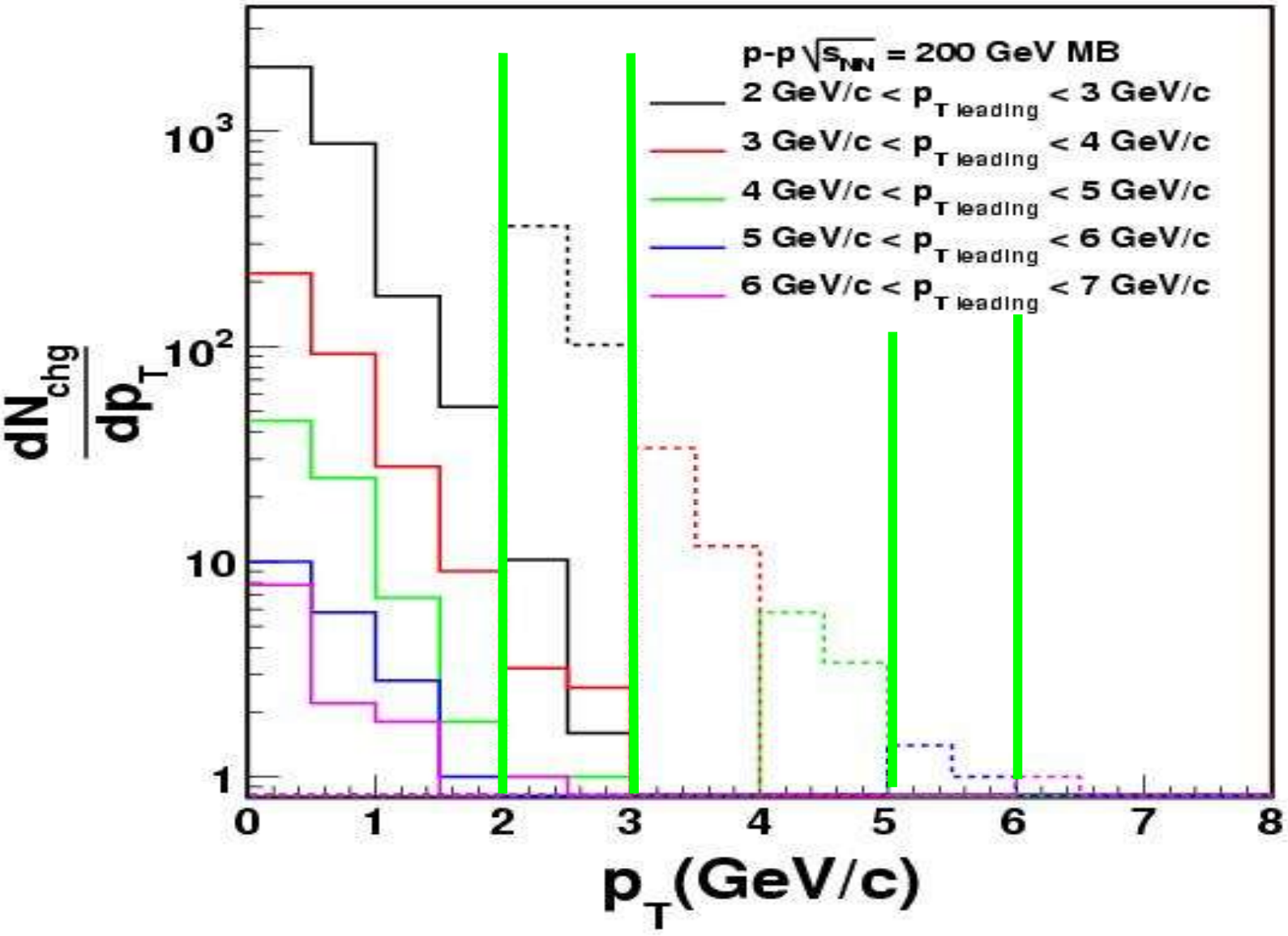
Leading particle in a bin provide us an empty range on pt spectrum for the associated particle to that bin! How large is this empty space?





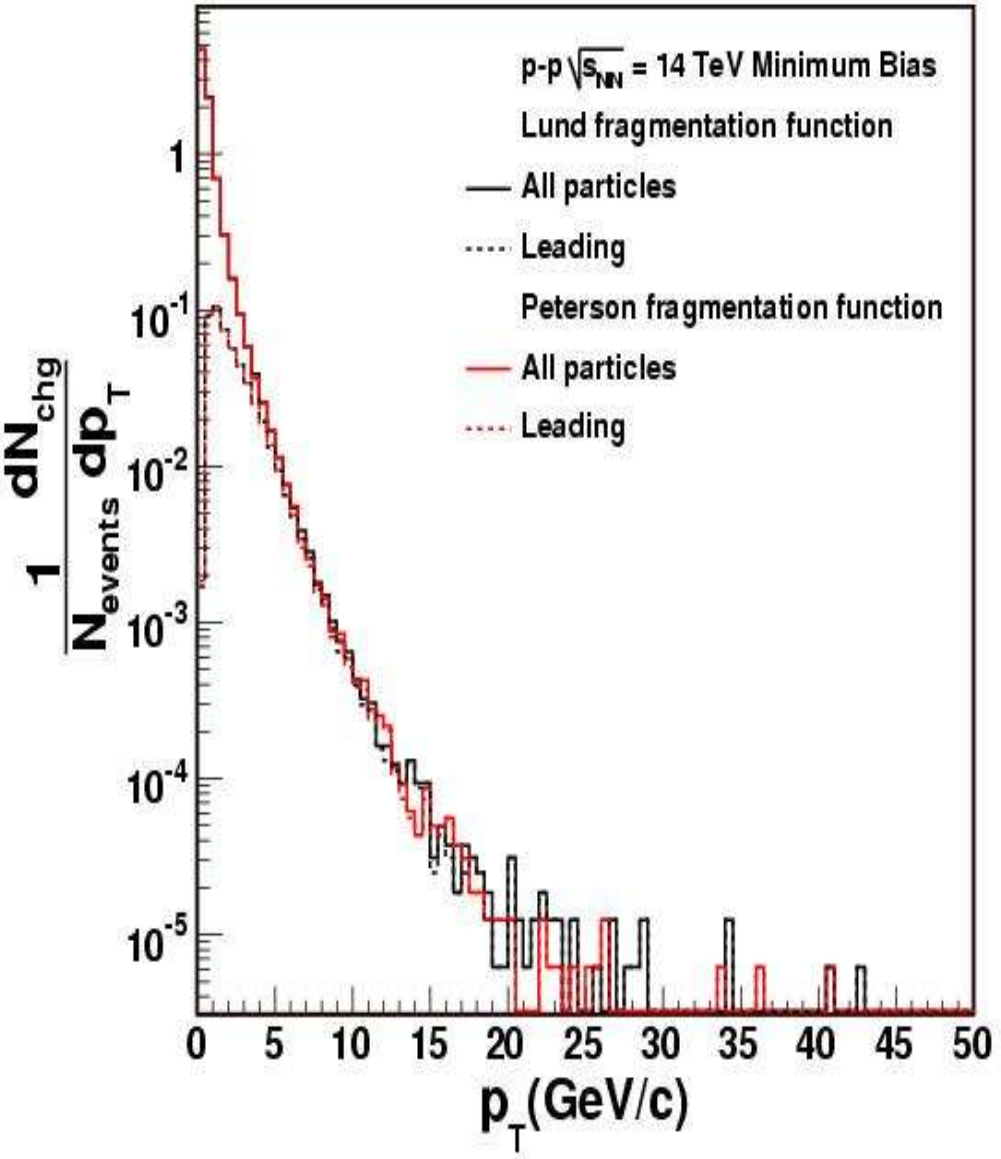
The power of the Isolated leading particles

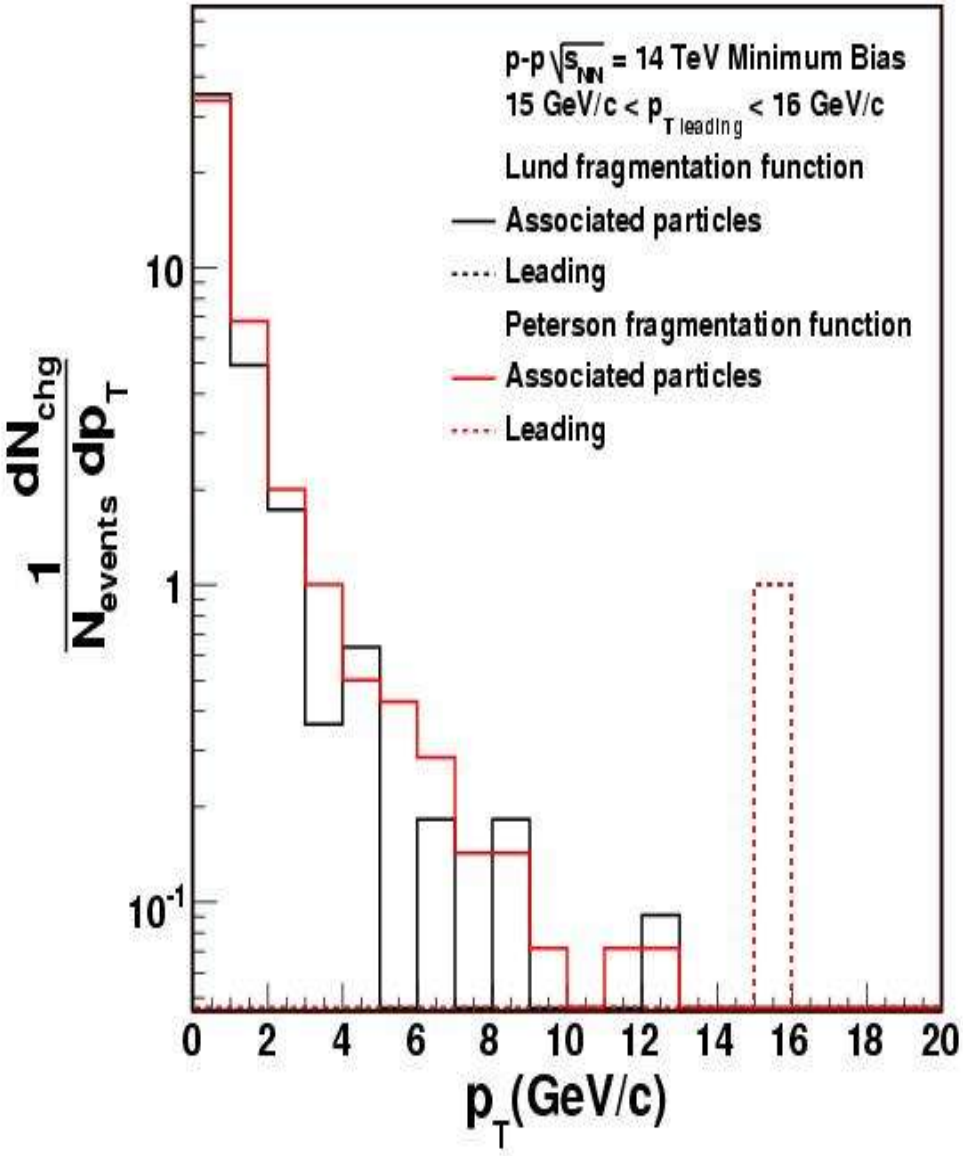
To quantify the empty space on pt spectrum, we need en equilibrium point between leading bin and multiplicity associated



Fragmentation function on ILPA

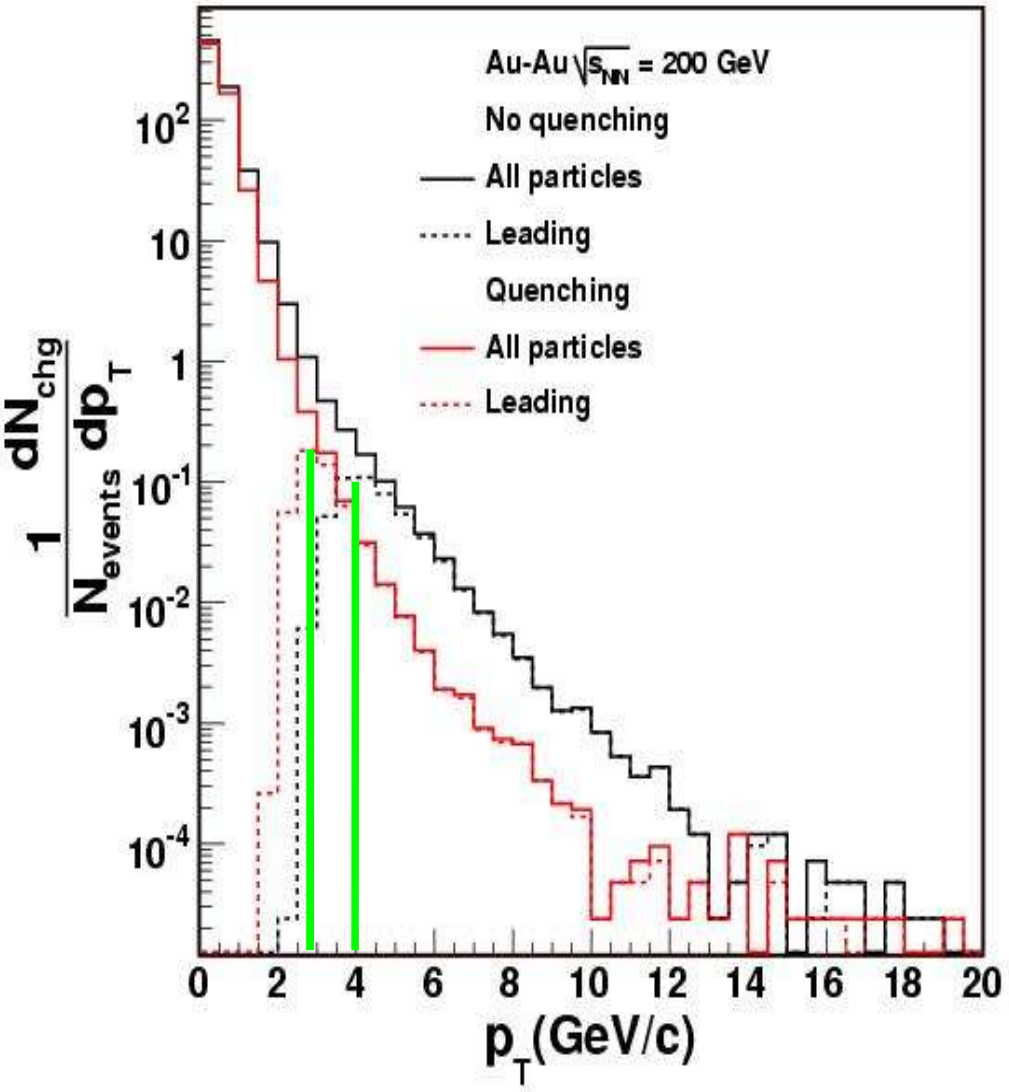
FF show a small but clear effect on the ILPA, beside that all pt spectrum shows not differences

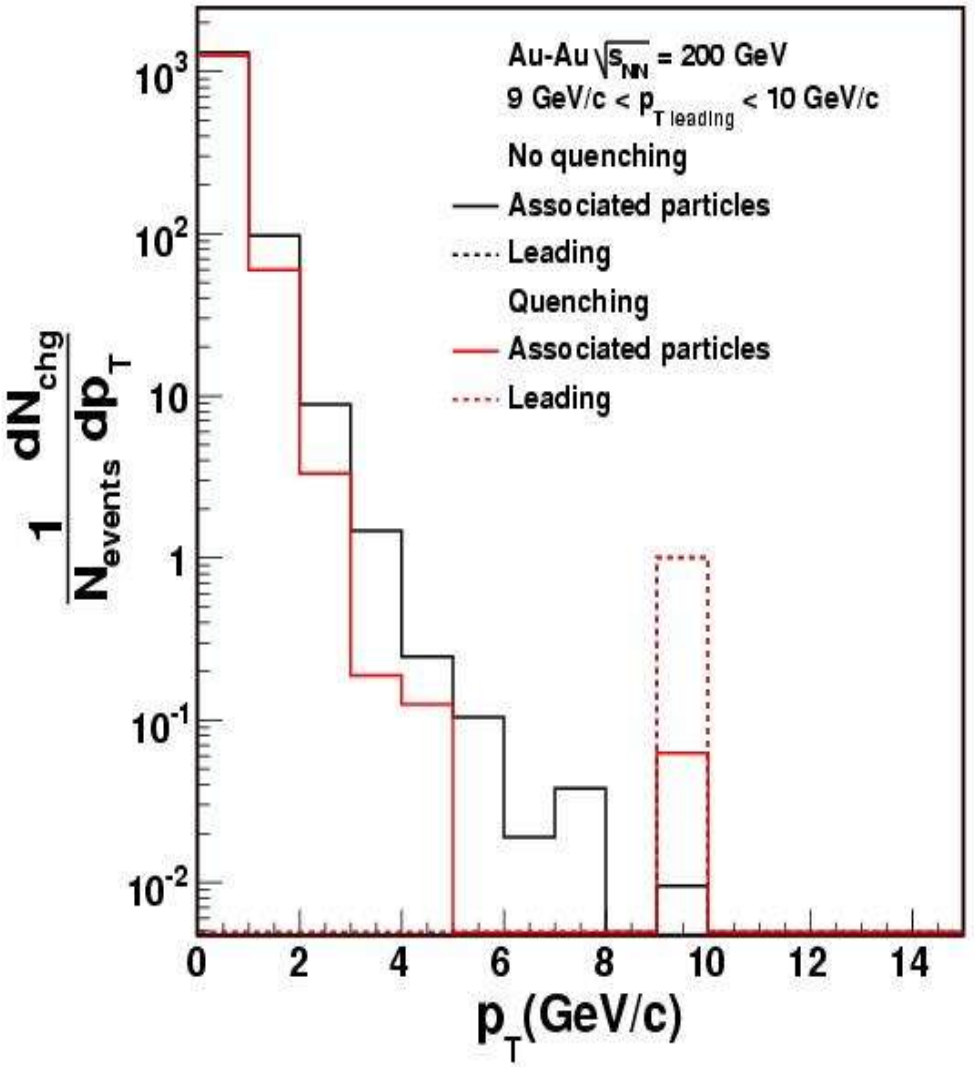




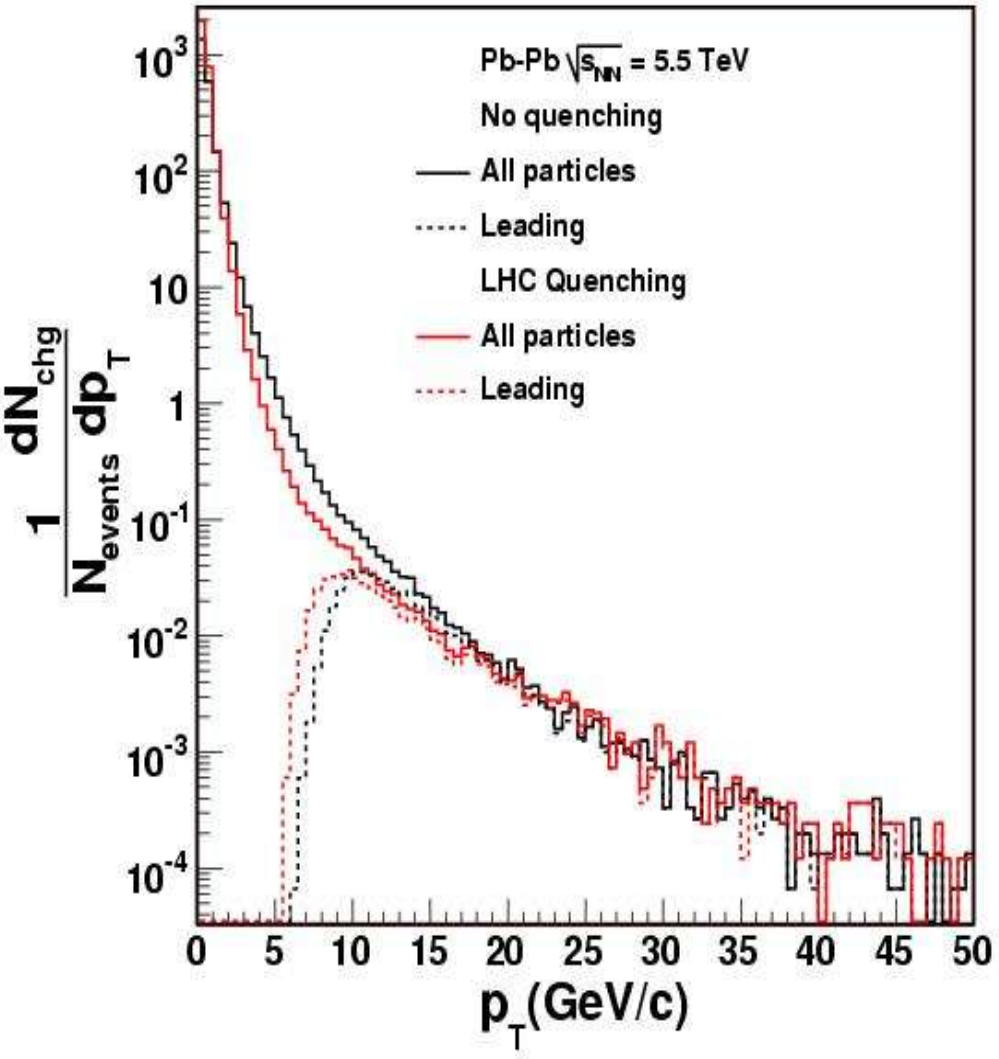
ILPA on heavy ions at RHIC : energy loss

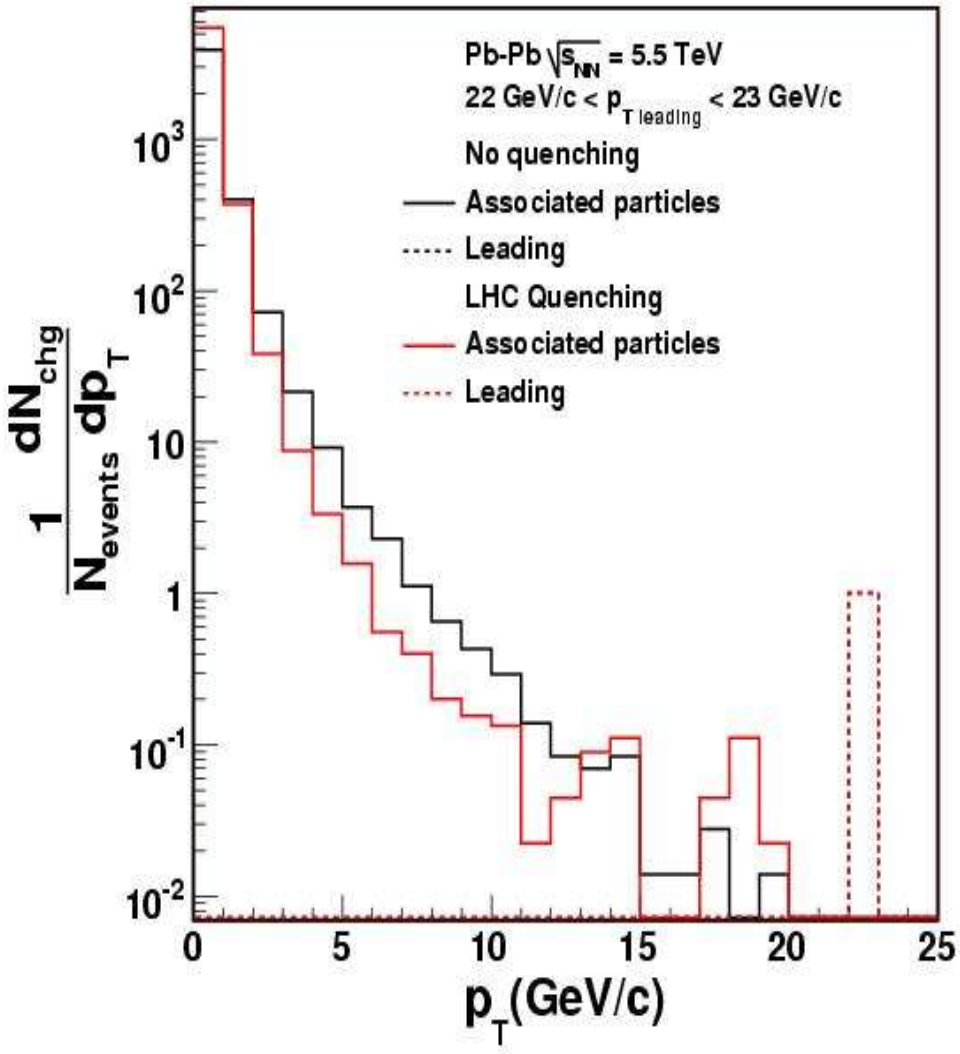
The quenching effect is present on the ILPA and in the leading pt spectrum





ILPA on heavy ions at LHC : energy loss





Splitting quark and gluon jets on ILPA