



Some results on intermittency and particle correlations in p-p and Pb-Pb collisions.

M. Mohsin Khan (AMU) & Indranil Das (Orsay)

- **One of the proposed signals for the occurrence of collective phenomenon in relativistic heavy-ion collisions is large fluctuations in the number of produced particles in local regions of phase space**
- **The most intensively studied aspect of multiparticle production might be the nature of multiplicity fluctuations in restricted domain of phase space.**

- In such studies the starting assumption is always that the observed events can be decomposed into self-similar clusters distributed according to Poisson process. These can result from intermittent particle emission by several independent sources (string, fireballs, quark-gluon plasma droplets or whatever). Further the particles of common ancestry constitute the same cluster and if this happens, Bialas Pointed out that the intermittency indices characterizing the events should vary inversely with particle density.

The intermittency study is important (physics) to understand the correlation length of the medium and many interesting properties.

If normalized factorial moments , $\langle F_q \rangle$ can be used as quantitative measure of local fluctuation. $\langle F_q \rangle$ is defined by

$$\langle F_q \rangle = \frac{M^{q-1}}{N_{\text{evt}}} \sum_{N_{\text{evt}}} \sum_{m=1}^{N_{\text{evt}}} \frac{n_m (n_m - 1) \dots (n_m - q + 1)}{\langle N \rangle^q}$$

M is the partition number in the available rapidity space, q is the order of the moment, $\langle \dots \rangle$ represents average obtained for the entire event and n_m is the number of particles in m^{th} bin.

“Intermittency” refers to the following power-law behavior and has been observed in many system of collisions.

$$\langle F_q \rangle \propto \left[\frac{\Delta\eta}{\delta\eta} \right]^{\phi_q} \quad (\delta\eta \rightarrow 0)$$

Reference:

- R.C. Hwa, C.B. Yang, *Phys. Rev. C* 85, 2012.
- W. Kittel, E.A. De Wolf, *Soft Multihadron Dynamics*, (World Scientific Singapore), p. 429.
- A. Bialas, R Peschanski, *Nucl. Phys. B* 273, 703(1986); B308, 857(1988).

Data

**proton-proton at 2.76 TeV
/LHC11 a (ESDs)**

**Pb-Pb at 2.76A TeV
/LHC11h_2(AOD)**

Centralities: 0-90, 0-10, 10-50, 50-90.

$-0.9 \leq \eta \leq 0.9$

no cent

$$\langle N_{\text{ch}} \rangle = 1375.0$$

0-90%

$$\langle N_{\text{ch}} \rangle = 1480.0$$

0-10%

$$\langle N_{\text{ch}} \rangle = 4600.0$$

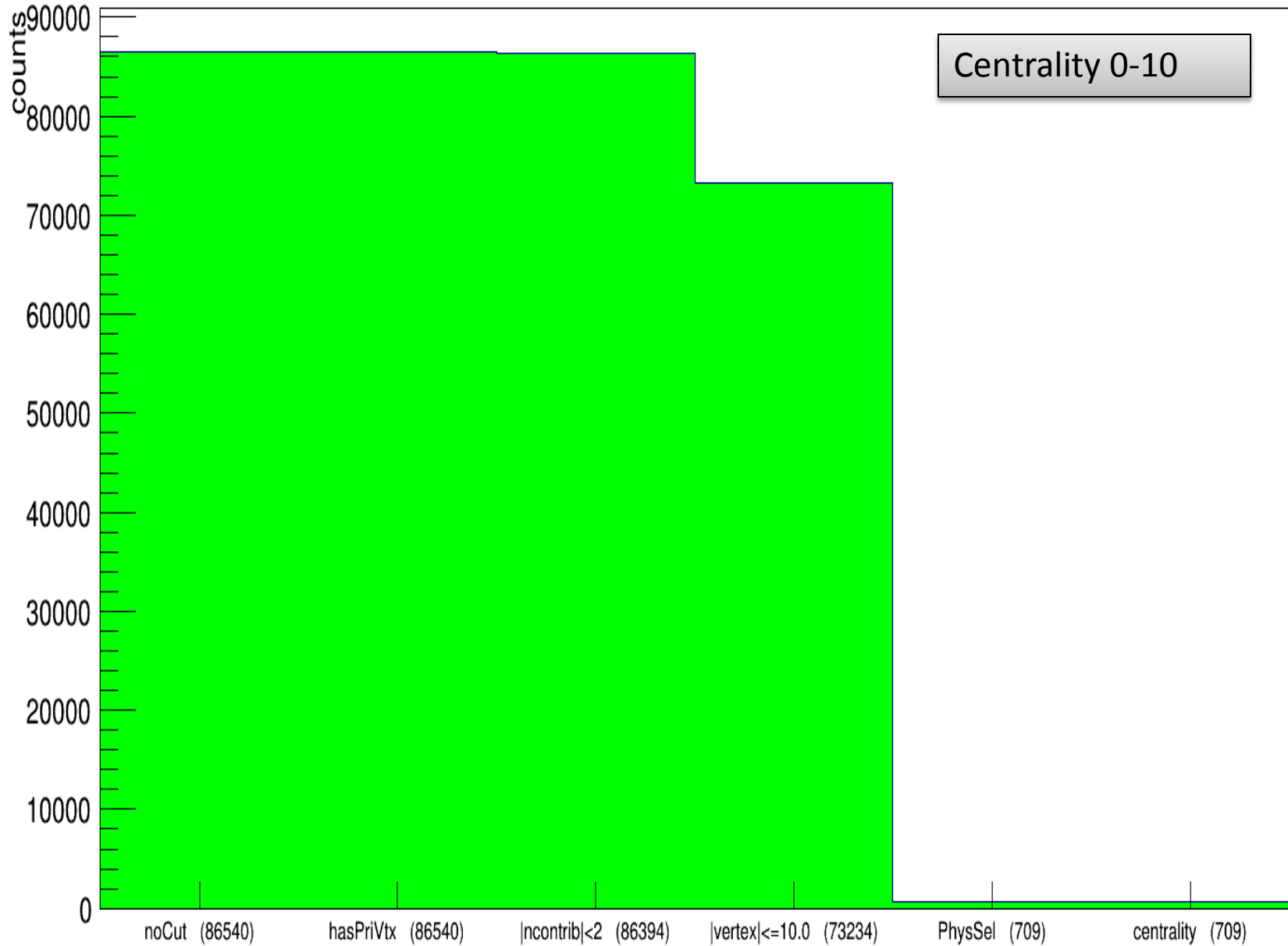
10-50%

$$\langle N_{\text{ch}} \rangle = 1735.0$$

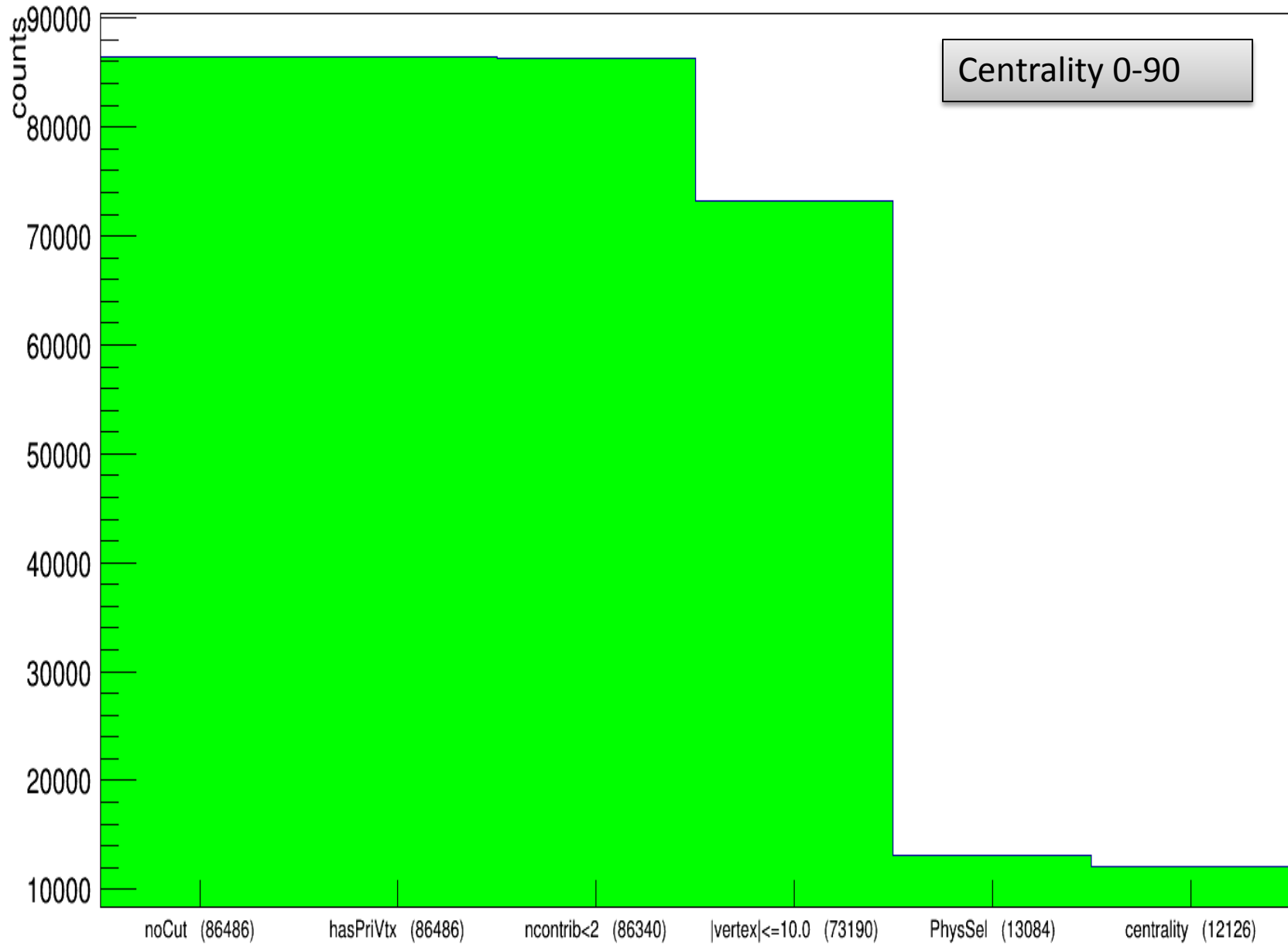
(50-90%)

$$\langle N_{\text{ch}} \rangle = 1165.0$$

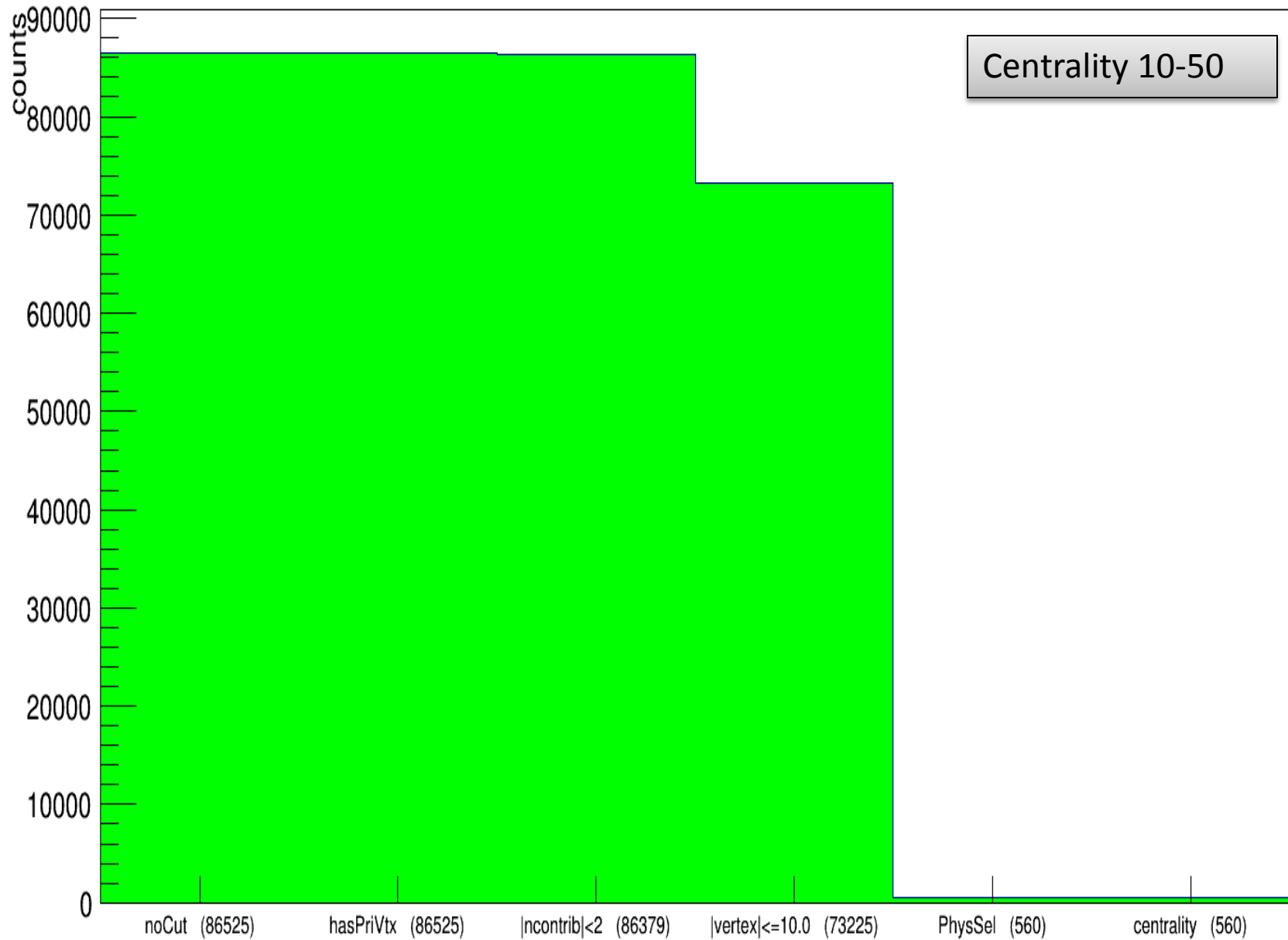
Event counter for different analysis cuts



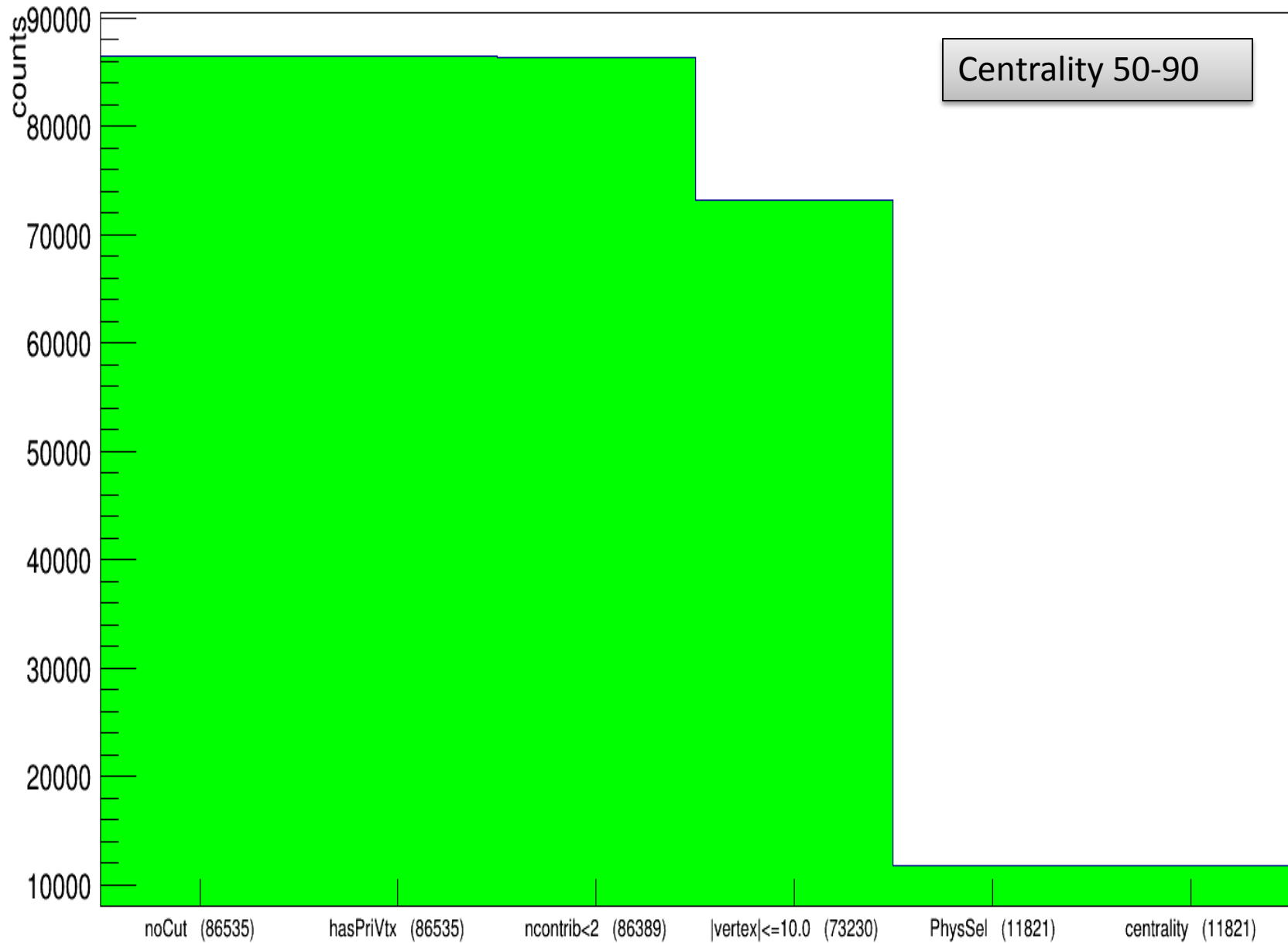
Event counter for different analysis cuts



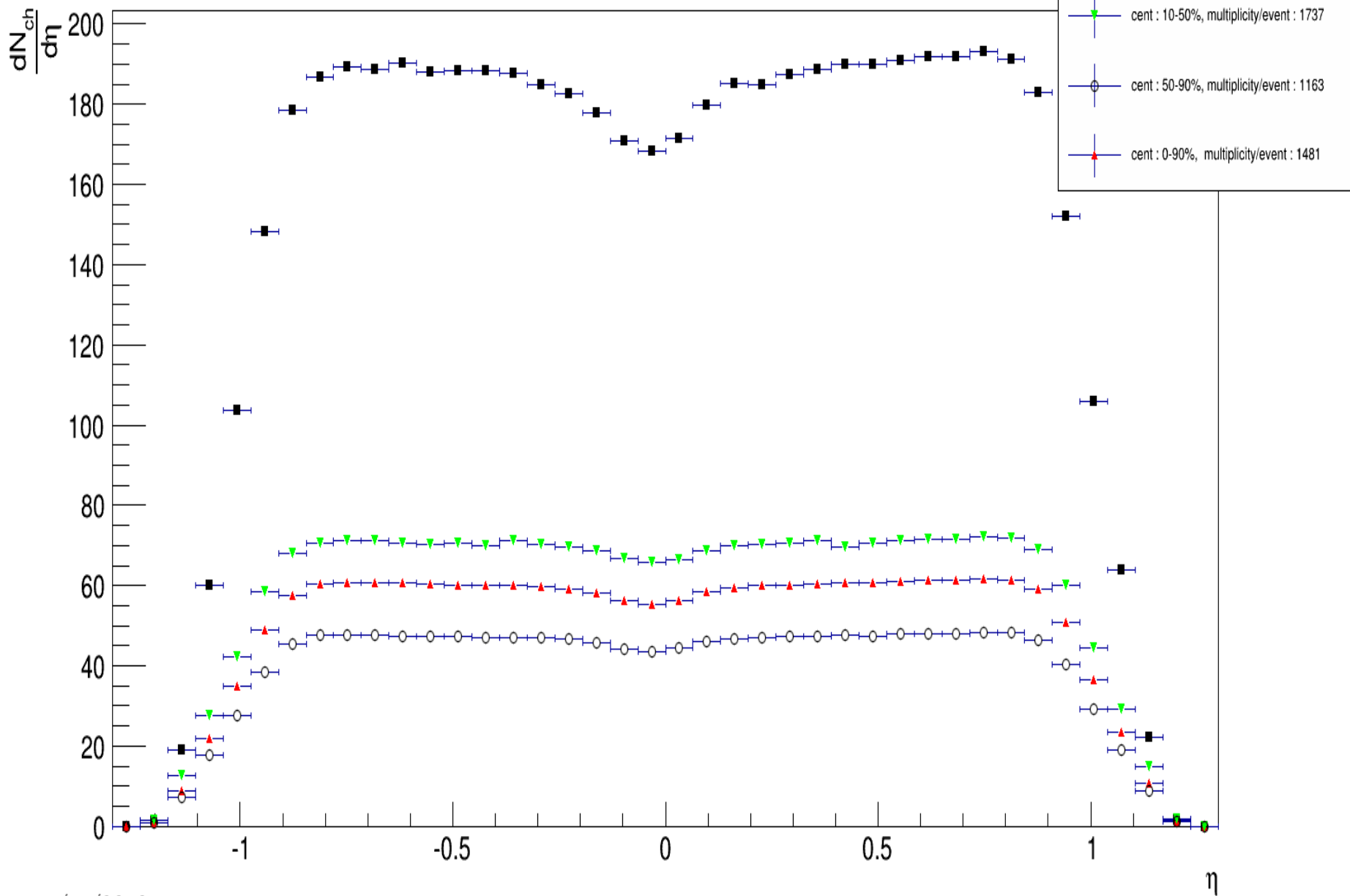
Event counter for different analysis cuts



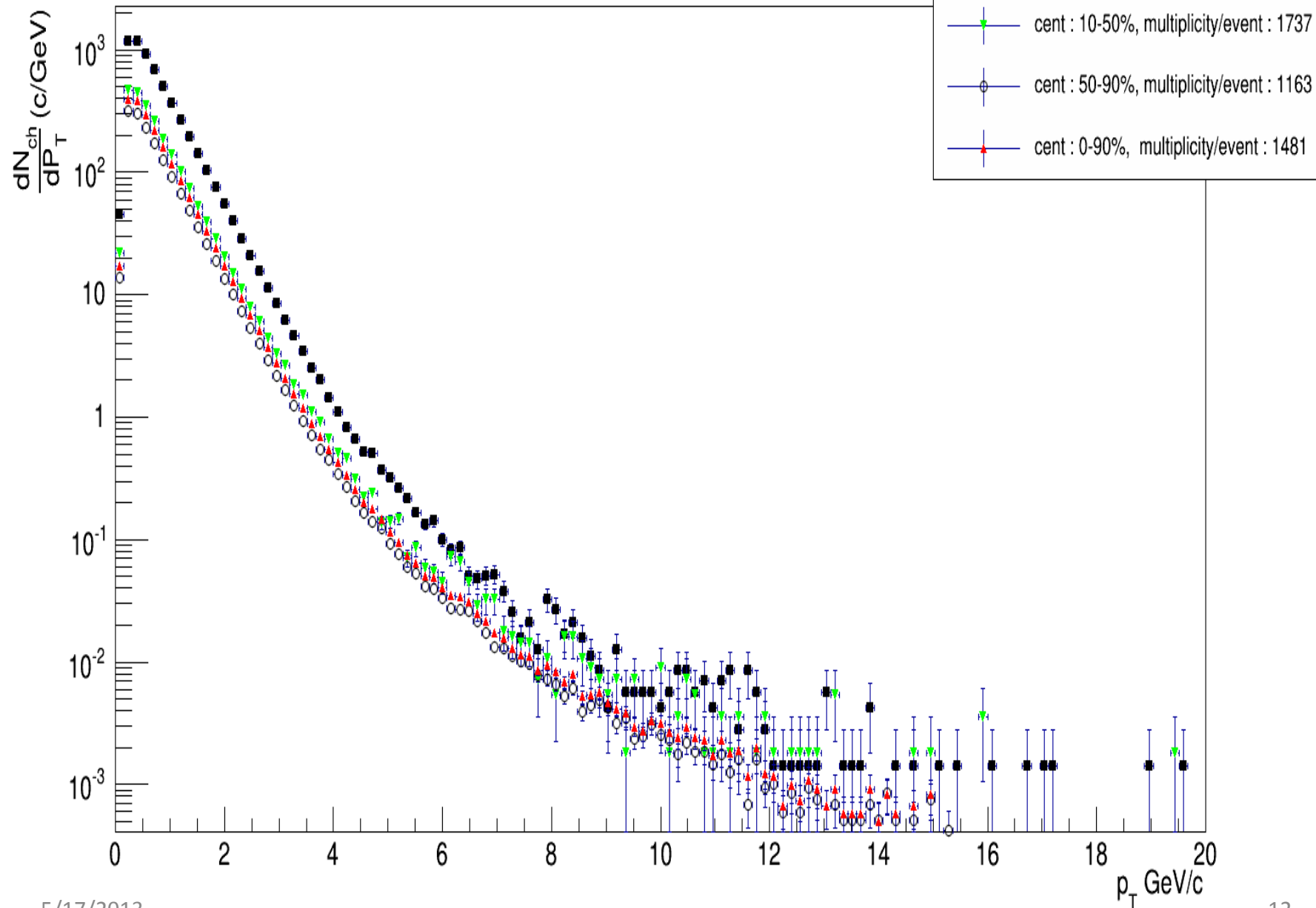
Event counter for different analysis cuts

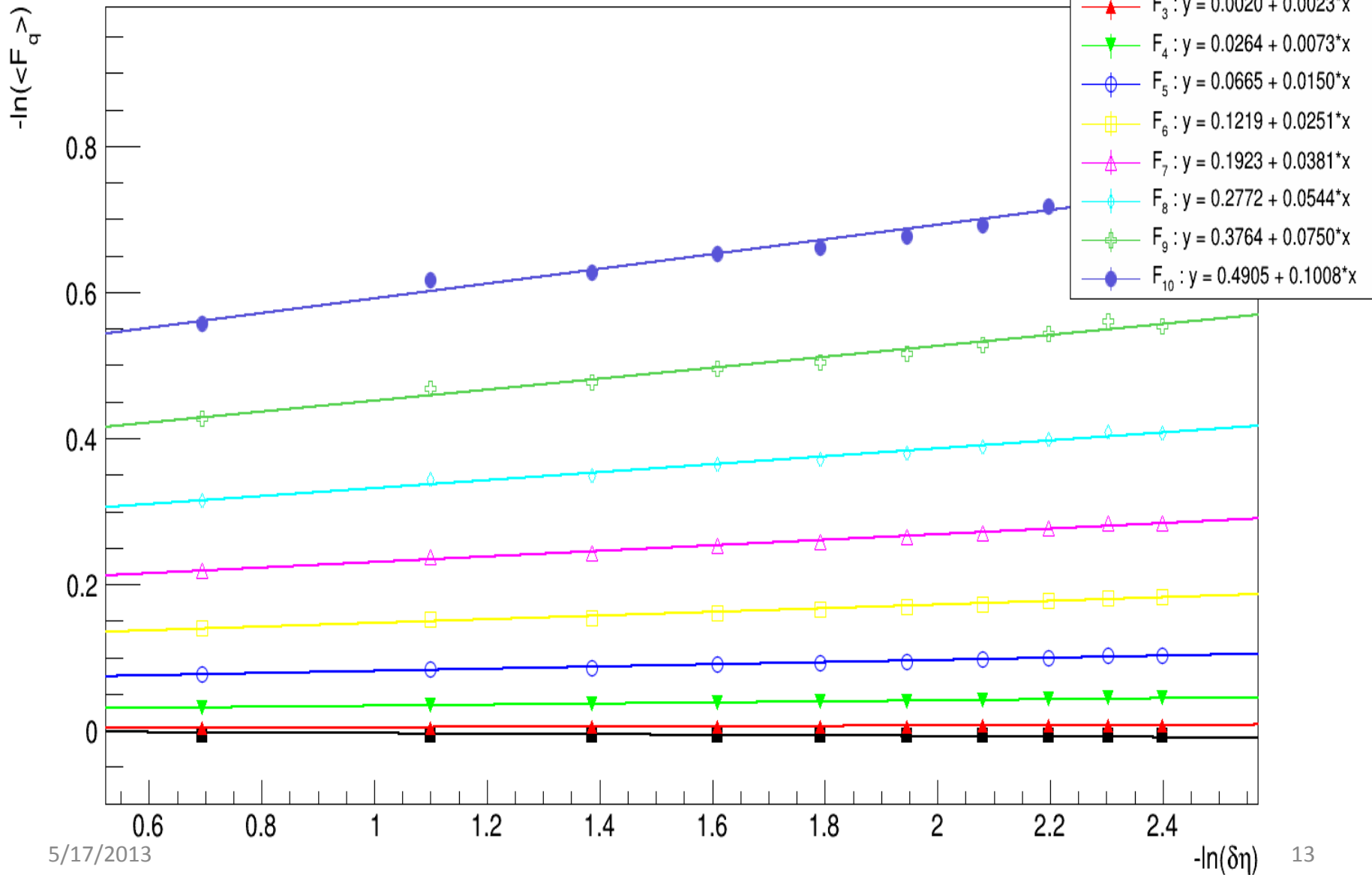


Pseudorapidity distribution

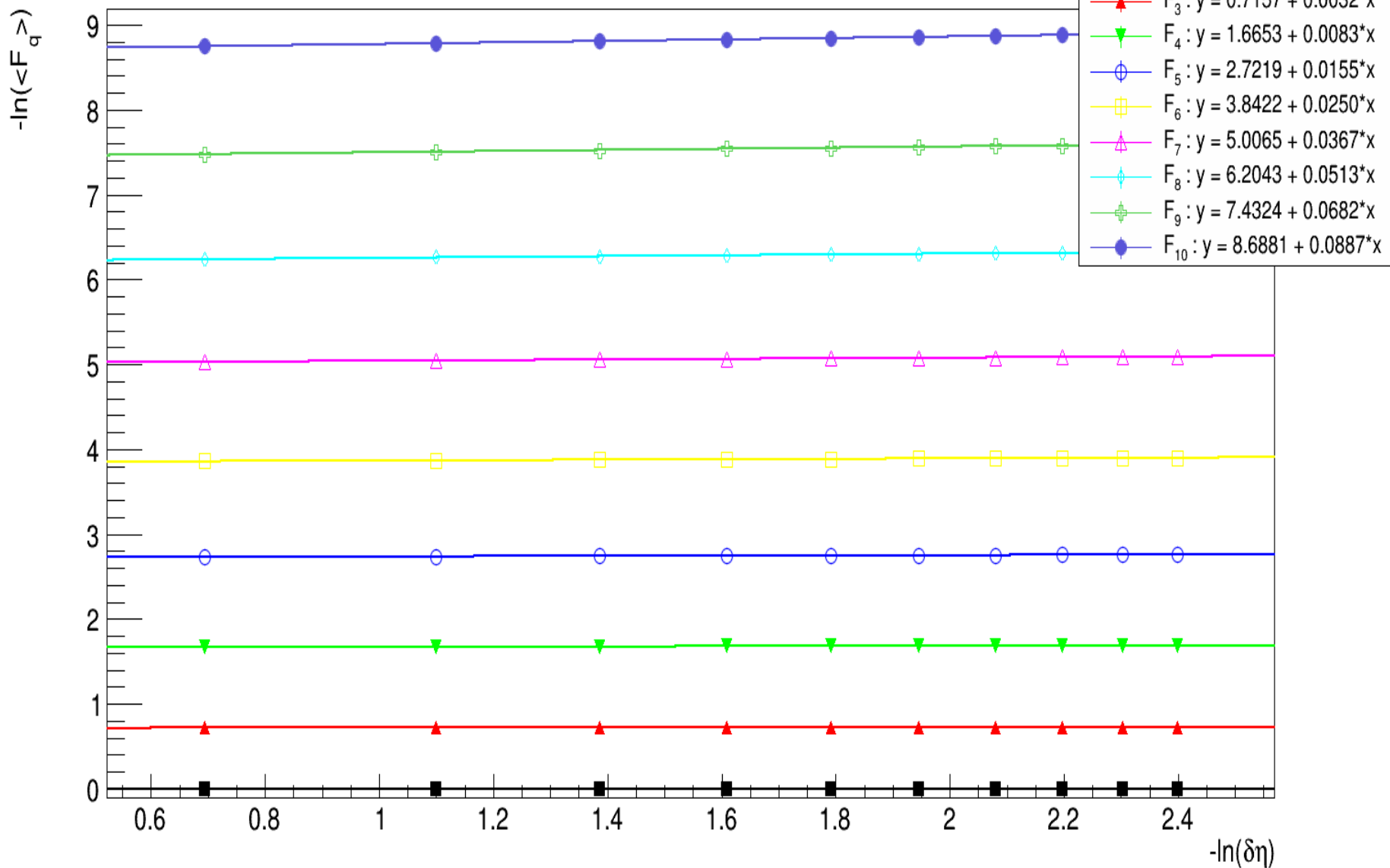


Transverse momentum distribution

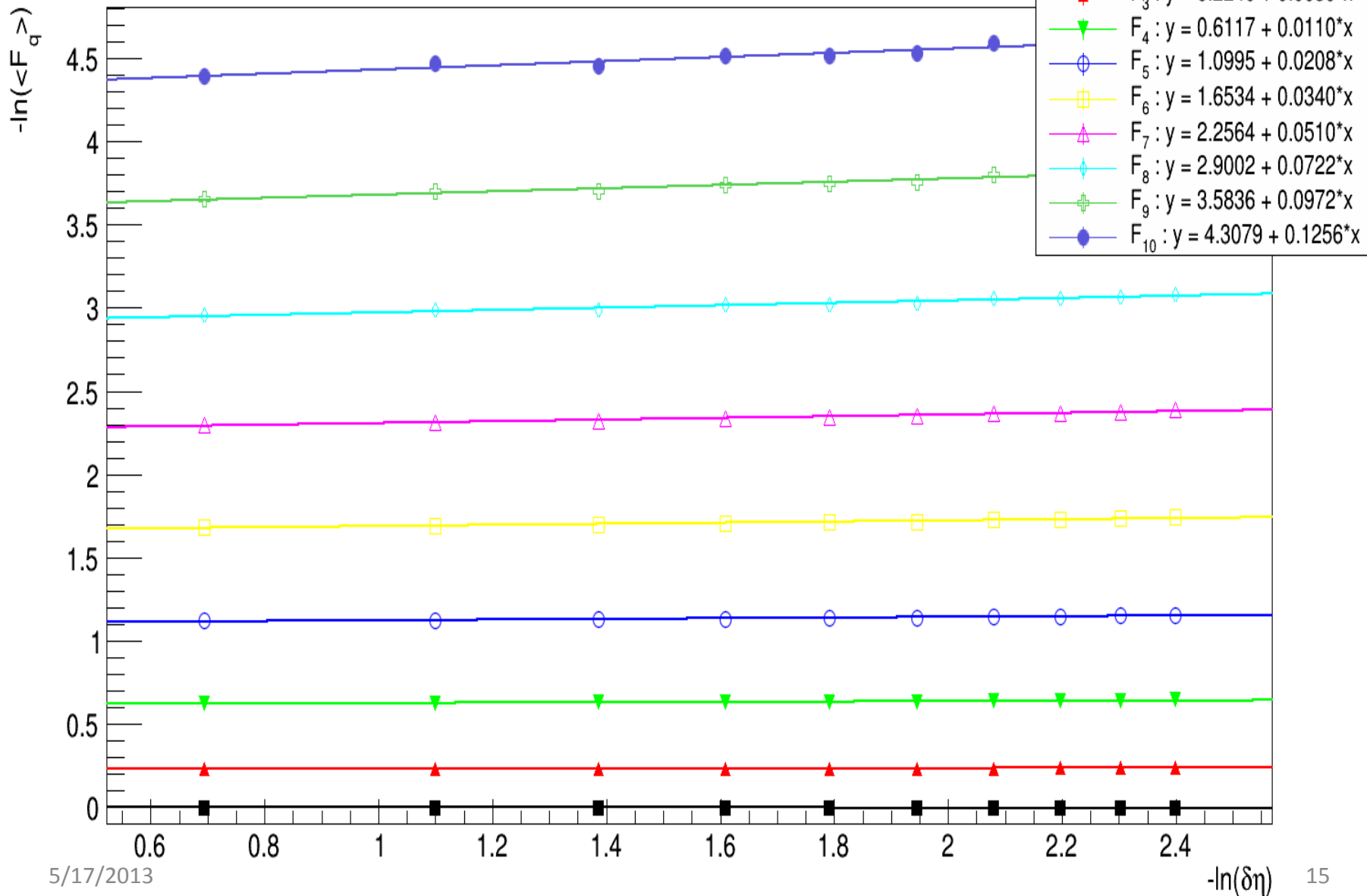


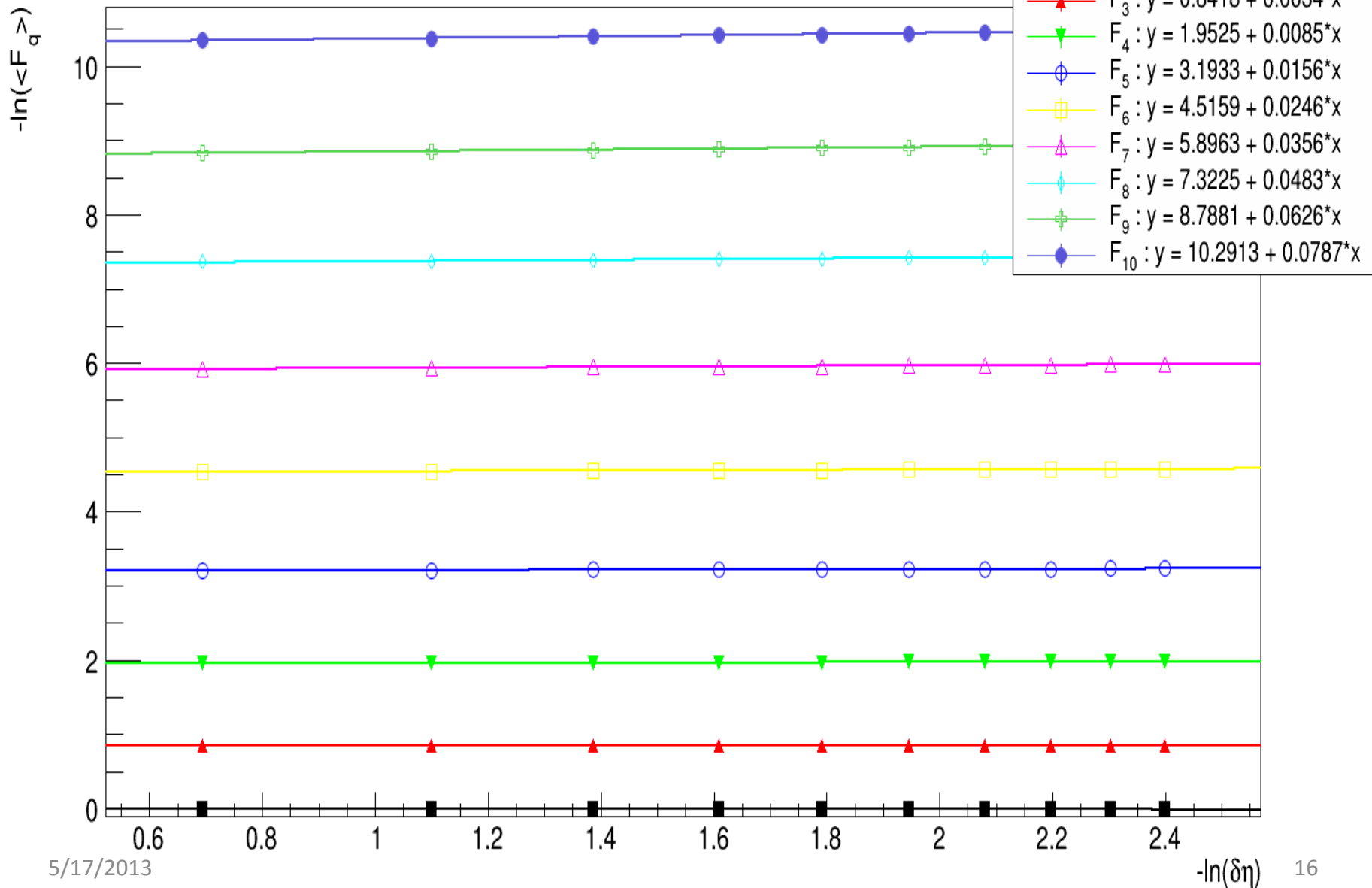
Variation of F_q -moments with q 

Variation of F_q -moments with q

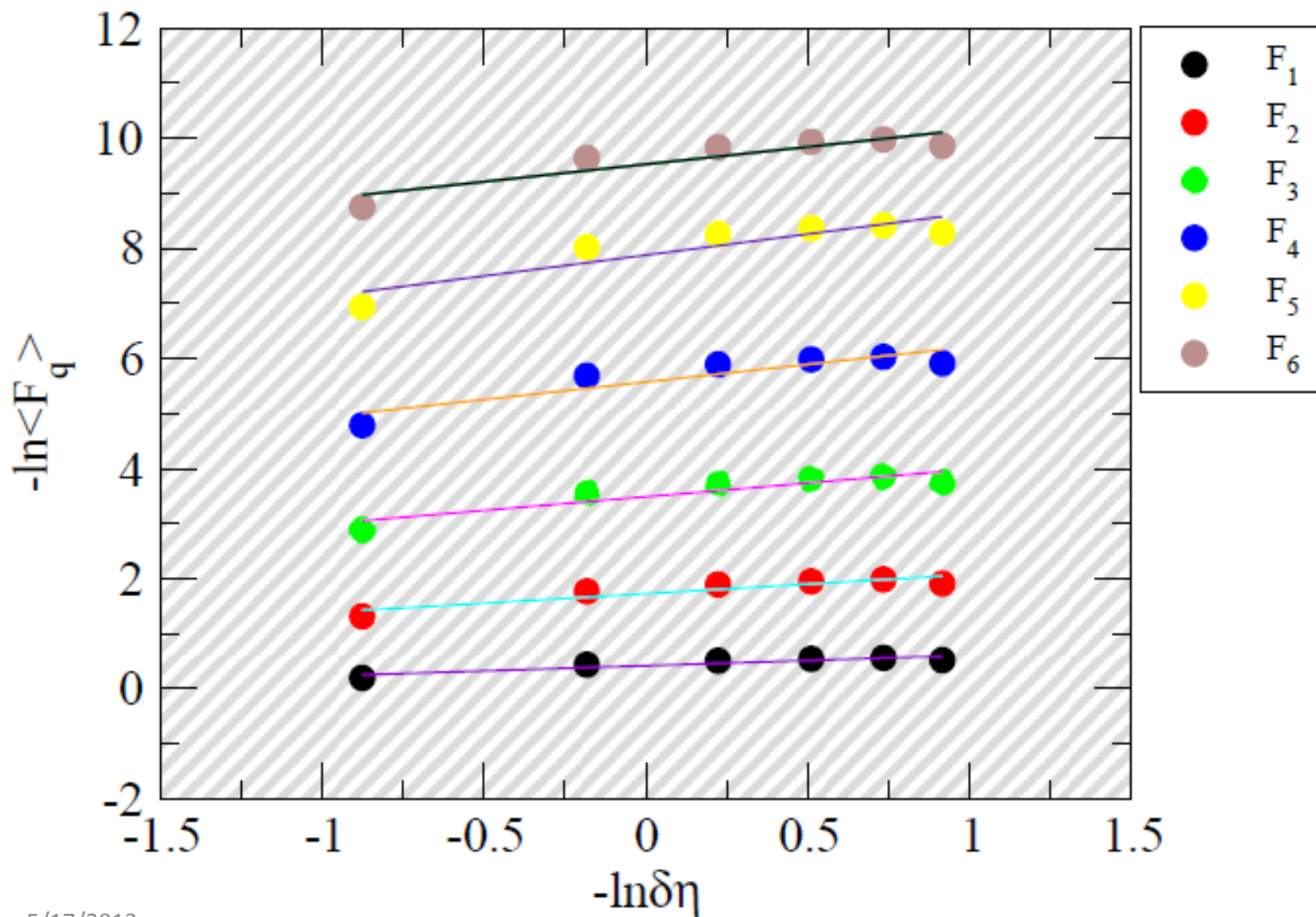


Variation of F_q -moments with q

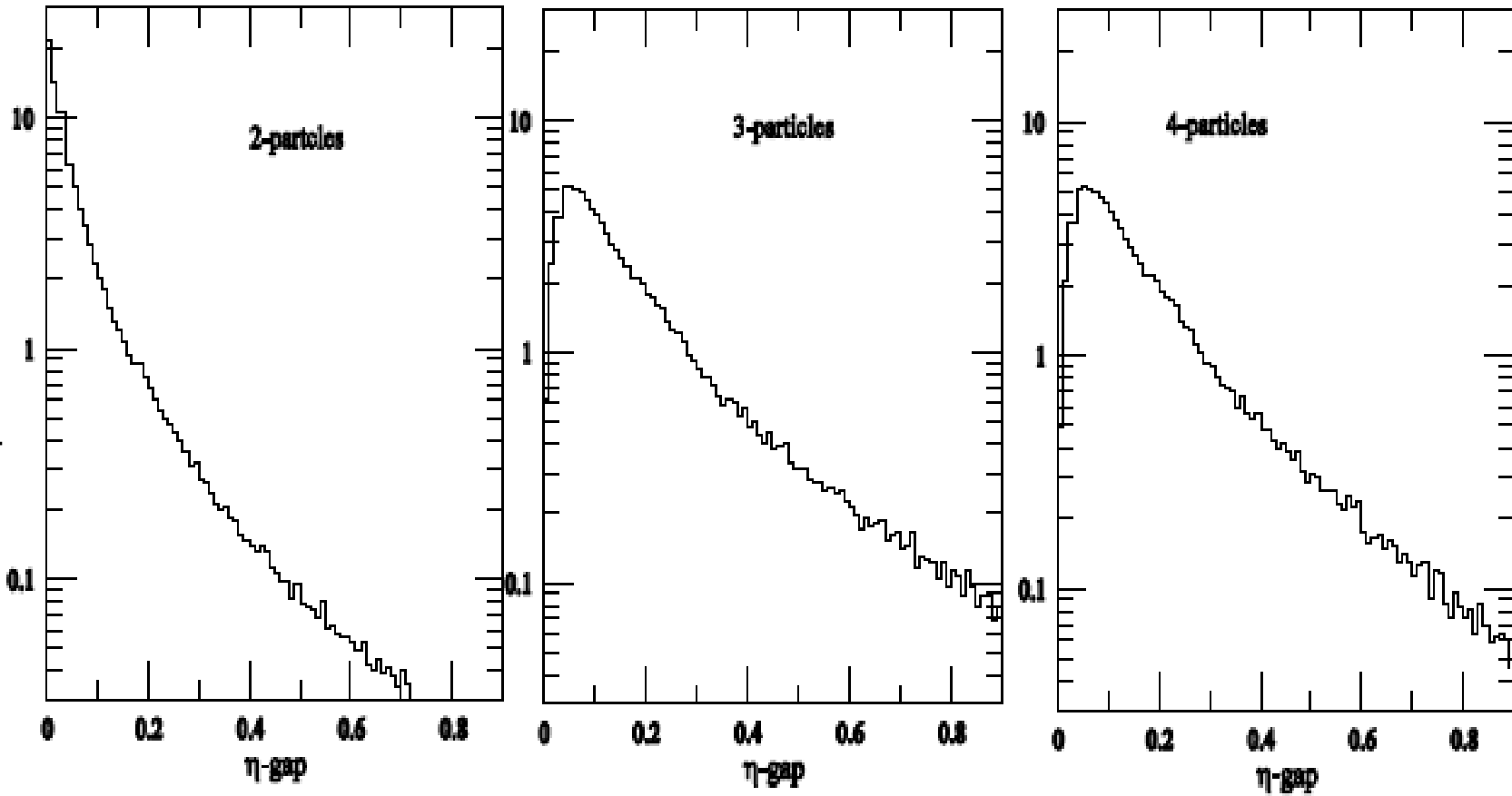


Variation of F_q -moments with q 

Variations of F_q -moments with η -bin for
pp collisions at 2.76 TeV (684000 events)

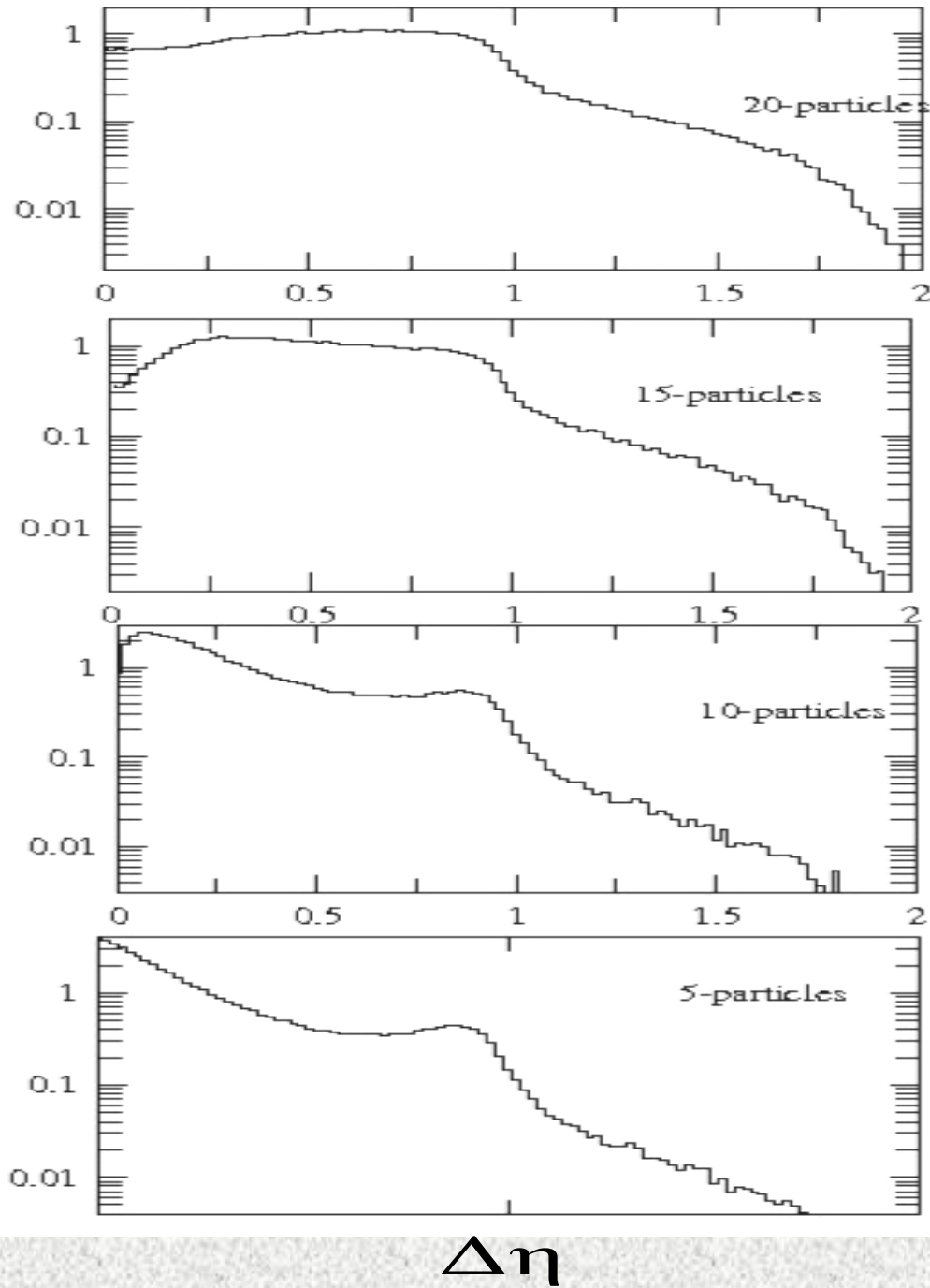


$$\frac{1}{N} \frac{dN}{d\Delta\eta}$$



$\Delta\eta$

$$\frac{1}{N} \frac{dN}{d\Delta\eta}$$



Conclusions:

- Intermittency seems to be present in central PbPb collisions at 2.76A TeV and in pp collisions at 2.76TeV
- Presence of cluster of particles (2,3,4 and even higher) is quite prominent
- A significant intermittency signal is observed in 630 GeV j5p collisions measured in the UA1 central detector. It occurs with similar magnitude in different variables: pseudorapidity, rapidity and azimuthal angle. The signal increases with decreasing charged particle multiplicity in the event. Its strength in a sample of low p_t tracks and its multiplicity dependence are not reproduced by commonly used Monte Carlo models of high energy interactions
- Phenomena of Multifractality and erraticity

INTERMITTENCY STUDIES IN $p\bar{p}$ COLLISIONS AT $\sqrt{s} = 630 \text{ GeV}$
UA1 Collaboration, CERN, Geneva, Switzerland, Nuclear Physics B345 (1990) 1—21

Future-plan

full statistics of PbPb-2011 (LHC11h period) has not yet been analysed, Analysis is ongoing.

we would like to continue this study for different particle species also for different p_t and ϕ bins.

Such analysis can be carried out in 2-dimensions also ($\eta\phi, \eta p_t, \phi p_t$).

A 3D visualization of a particle detector, possibly a synchrotron, with a central orange 'THANK YOU' text. The detector is a large, circular structure with a blue ring and several red and blue components. The background is a dark, textured surface.

THANK YOU