XXXII International Symposium on Multiparticle Dynamics
September 7-13, 2002 Alushta, Crimea, Ukraine

Strangeness Production in Minimum Bias Events at CDF

Niccolò Moggi
University and I.N.F.N., Bologna
for the CDF Collaboration

- **Introduction**
- **experimental setup**
- **data selection and correction**
- K_s^0 **and** $\Lambda^0/\bar{\Lambda}^0$ **inclusive distributions**
- K_s^0 **and** $\Lambda^0/\bar{\Lambda}^0$ **correlations**
- **conclusions**

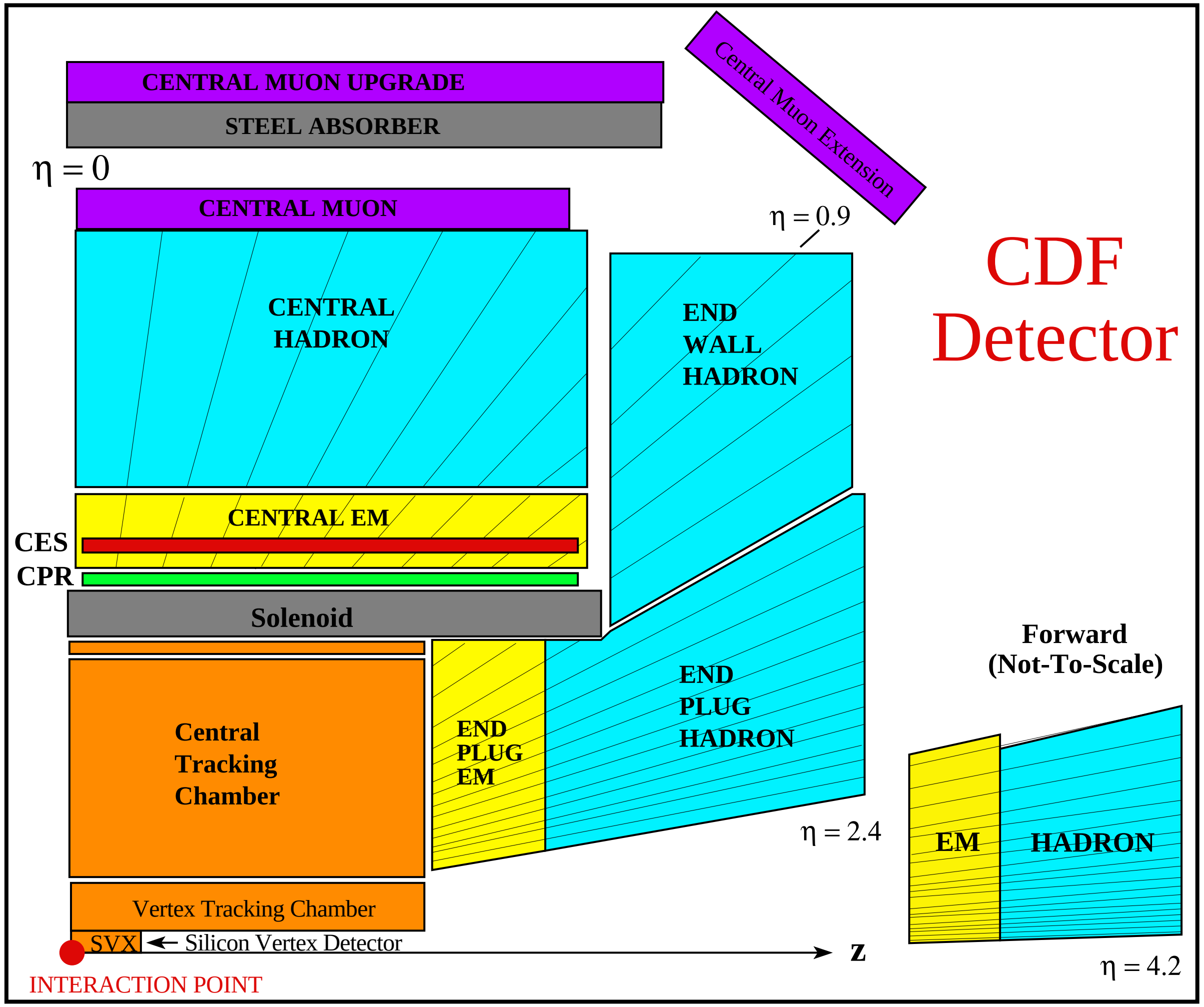
INTRODUCTION

The analysis of minimum-bias sample at 1800 and 630 GeV :

- ◇ K_s^0 and $\Lambda^0/\bar{\Lambda}^0$ multiplicities
- ◇ K_s^0 and $\Lambda^0/\bar{\Lambda}^0$ p_T inclusive distributions
- ◇ Correlation between $\langle p_T(V^0)\rangle$ and event charged multiplicity
- ◇ Correlation between $\langle N(V^0)\rangle$ and event charged multiplicity
- + MB is splitted in a SOFT and HARD subsamples

$\Rightarrow$ **the analysis is repeated and compared.**

THE CDF APPARATUS



VTX: primary vertices

CTC: $|\eta| \leq 1.0$ primary tracks

$|\eta| \leq 1.5$ V^0

CAL: $|\eta| \leq 4.2$ E_T clusters

BBC: trigger $3.2 \leq |\eta| \leq 5.9$

@ 5.8 m from origin

DATA SAMPLES AND EVENT SELECTION

Data samples:

1800 GeV: run 1A+1B+1C $\sim$ 3,300,000 triggers $\rightarrow$2,079,558 events

630 GeV: run 1C $\sim$ 2,600,000 triggers $\rightarrow$1,963,157 events

Offline event selection rejects events with:

- ▷ cosmics (out of time CHA deposits)
- ▷ no tracks
- ▷ known calorimeter problems
- ▷ some CTC track but no central CAL tower $>$100 MeV
- ▷ $>$1 primary vertex
- ▷ Z^{vertex} $>$60 cm away from detector center
- ▷ no primary vertex

TRACK SELECTION

“Primary” tracks are selected by:

- **quality of the track (minimum number of hits and layers in the CTC)**
- $|d_0| <$ **0.5 cm**
- $|Z_0^{track} - Z^{vertex}| <$ **5 cm**
- **full CTC efficiency and acceptance:**
  - ▷ $p_T \geq$ **0.4 GeV/c**
  - ▷ $|\eta| \leq$ **1.0**

$\Rightarrow$ **”Multiplicity” of the event = num. of selected tracks.**

V^0 RECONSTRUCTION

- use full sample of reconstructed CTC tracks;
- look for opposite sign track pairs converging to a common secondary vertex;
- fit secondary vertex with both the hypotheses of K_s^0/Λ^0 decays and keep best fit (in this fit the V^0 candidate is constrained to point to the event primary vertex);
- do not distinguish $\Lambda^0/\bar{\Lambda}^0$;
- finally apply selection cuts.

V^0 SELECTION CUTS

- secondary vertex fit has probability $>$ 5%
- fitted mass within 3σ from V^0 mass
- vertex displacement projected in $x - y$ plane $L_{yx} > 1$ cm
- decay products in $p_T > 0.250$ GeV/c and $|\eta| < 1.5$
- $|Z_0(V^0) - Z^{vertex}| < 6$ cm
- $p_T(V^0) \geq 0.4$ GeV/c
- $|\eta(V^0)| \leq 1.5$

EFFICIENCY

Use MC to estimate the efficiency:

- generate Pythia MB events
- detector simulation and full event reconstruction
- check results by embedding generated V^0 into real events
- efficiency obtained inclusively for each single distribution
- “fake” V^0 attributed to reconstruction errors are subtracted

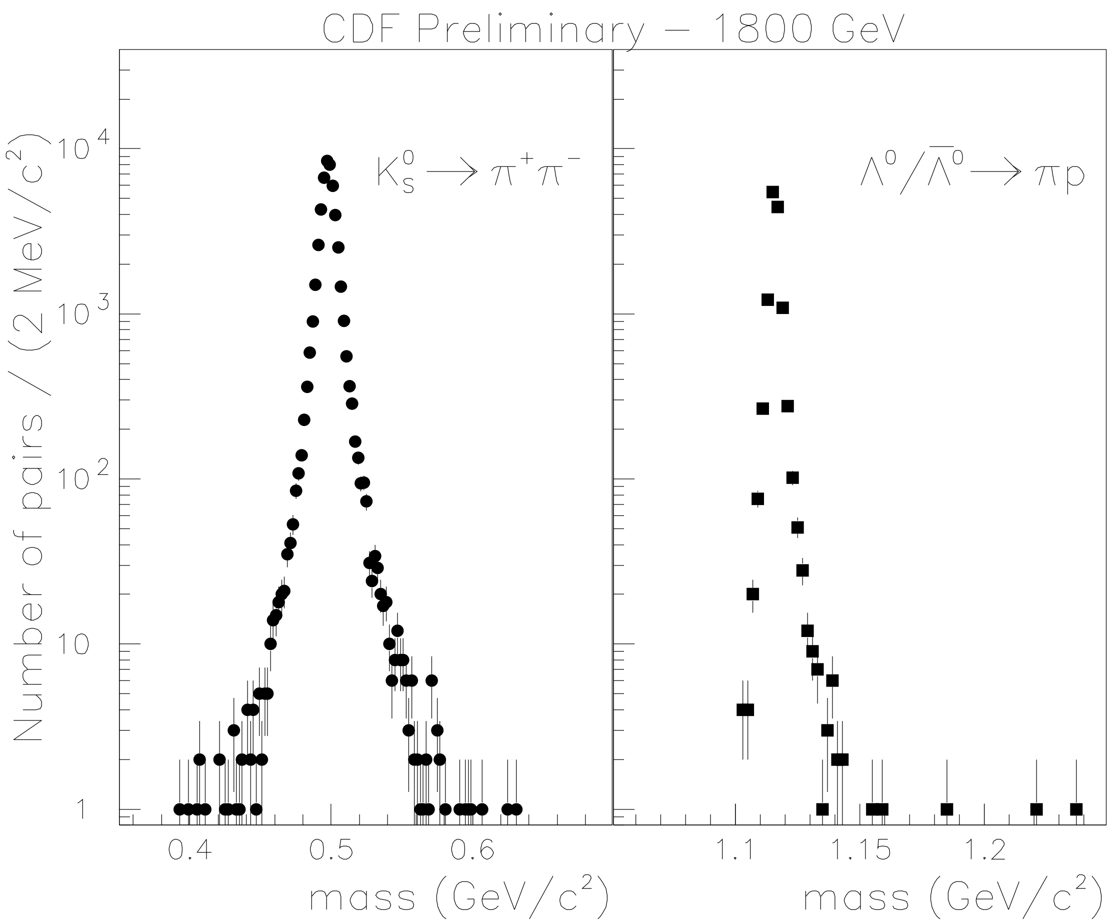
EFFICIENCY II

1. **Efficiency for 1 V^0 is almost constant $\simeq$ 60% in:**
   $|\eta(V^0)| < 1$
   $p_T(V^0) > 2$ **GeV/c;**

2. **strongly decreasing outside this region, expecially vs:**
   p_T **of** V^0
   number of V^0 **in the event.**

3. **overall efficiency $\simeq$ 23% (K_S^0) and $\simeq$ 19% (Λ^0).**

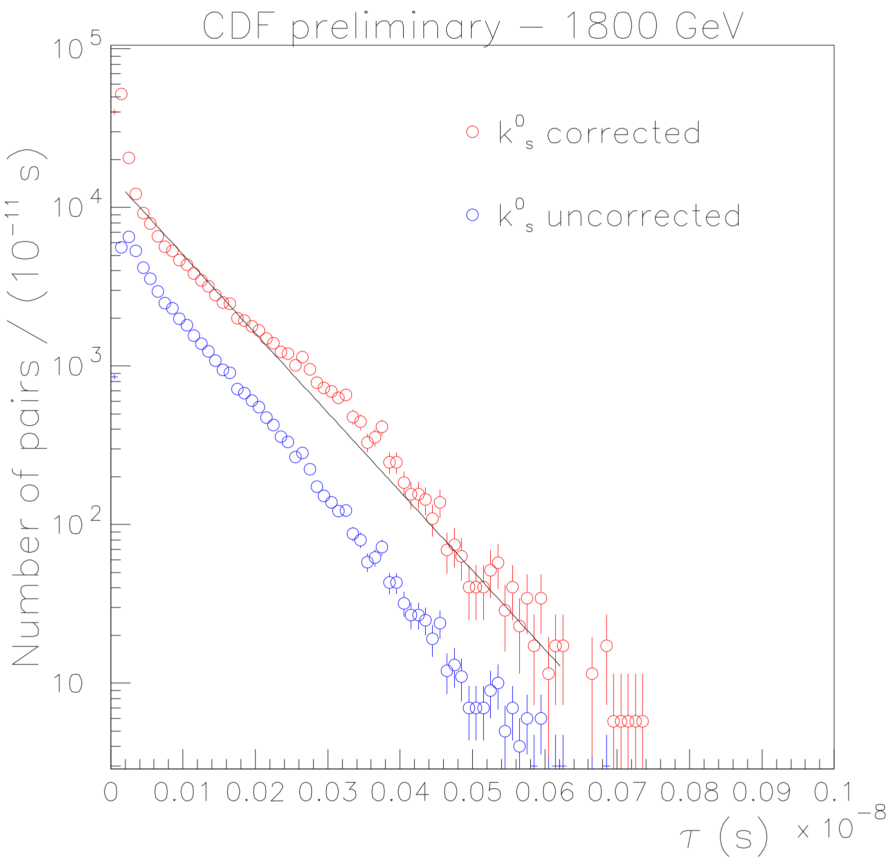
MASS DISTRIBUTIONS



Mass distributions after all selection cuts (no correction for efficiency is applied here).

Negligible background after selection cuts.

LIFETIME DISTRIBUTIONS

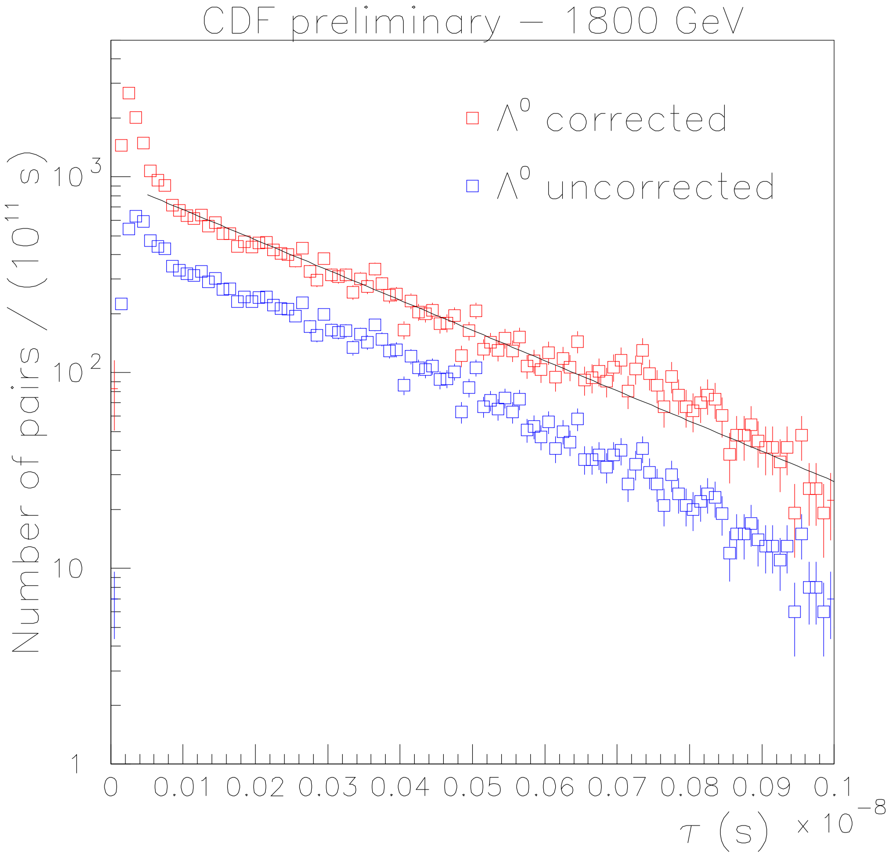


K^0_S lifetime distribution.

Fit gives:

$\langle\tau\rangle = (0.87 \pm 0.05) \times 10^{-10}\ s$

LIFETIME DISTRIBUTIONS



$\Lambda^0/\bar{\Lambda}^0$ lifetime distribution.

Fit gives:

$\langle\tau\rangle = (2.82 \pm 0.15) \times 10^{-10}\ s$

EVENT CLASSIFICATION

MB is splitted in two sub-samples:

Hard = events with $\geq$1 energy cluster anywhere in the calorimeter ($|\eta| \leq 4.2$).

Soft = anything else

We define a cluster as: two contiguous calorimeter towers of transverse energy 1 + 0.1 GeV in a cone $\sqrt{\Delta\eta^2 + \Delta\phi^2}$=0.7

.OR.

track clustering in calorimeter cracks

$\Longrightarrow$ **Soft is $\sim$ 46% of MB (1800) and $\sim$ 58% (630)**

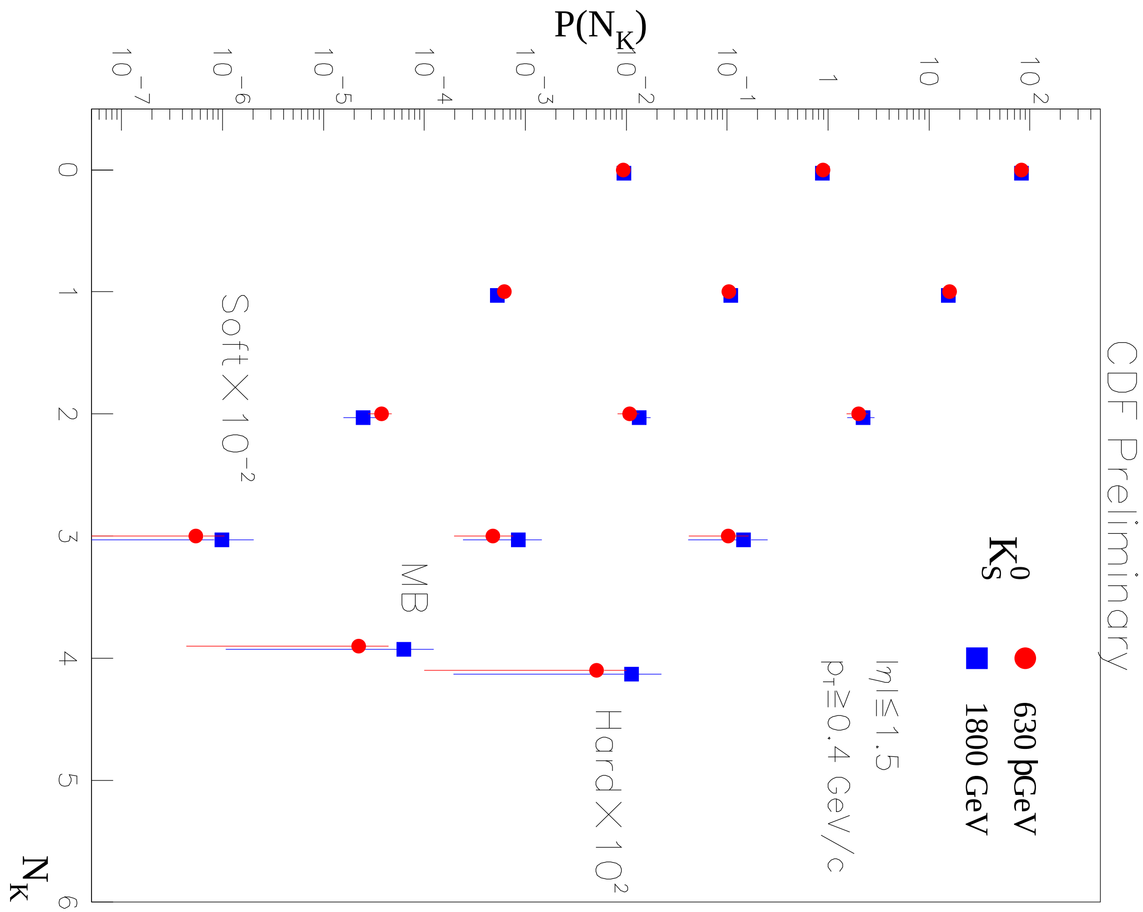
SOME NUMBERS

	1800 GeV	630 GeV	
full MB	51059	44858	k_s^0
	13117	9993	$\Lambda^0/\bar{\Lambda}^0$
soft	10220 (20%)	14313 (32%)	k_s^0
	1752 (13%)	2226 (22%)	$\Lambda^0/\bar{\Lambda}^0$
hard	40829	30545	k_s^0
	11365	7767	$\Lambda^0/\bar{\Lambda}^0$

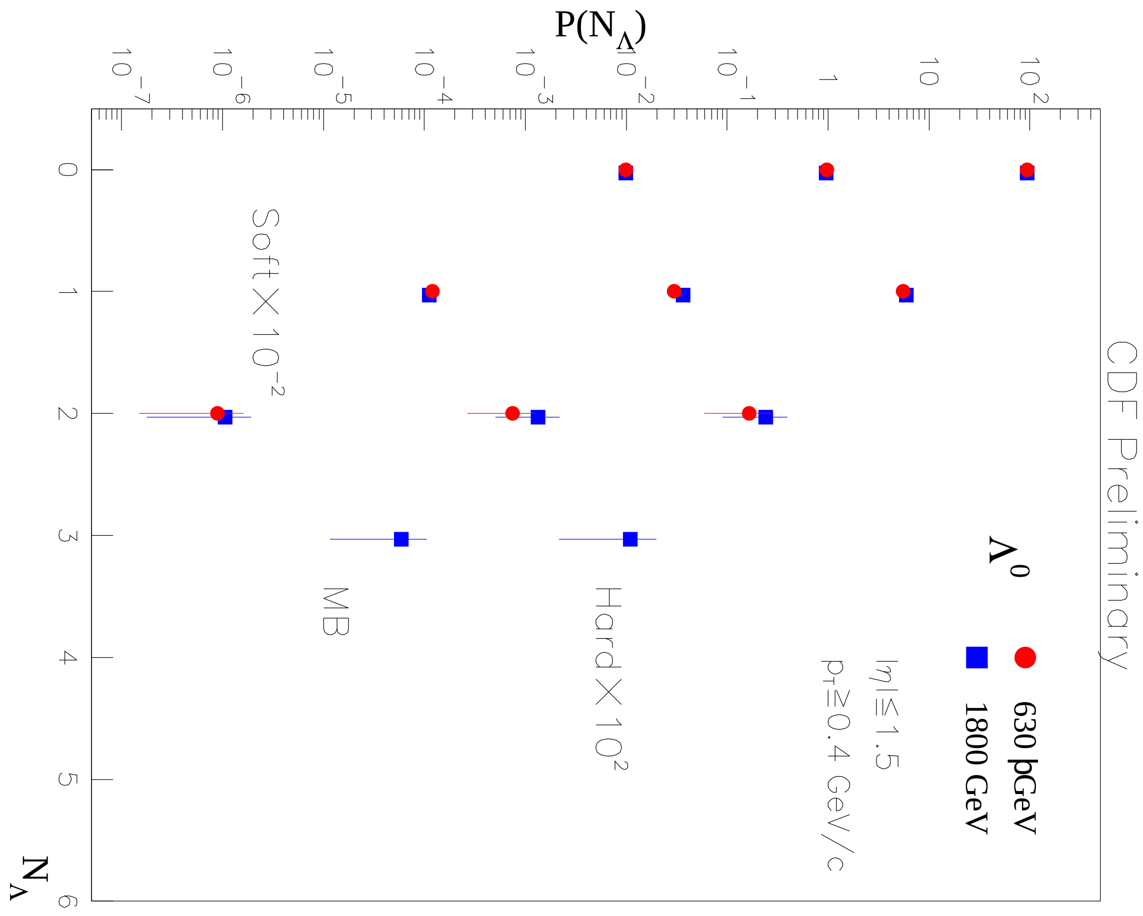
Raw V^0 countings after all selection cuts (no efficiency corrections).

Notice that the V^0 fraction in the soft sample *increases* with *decreasing* energy.

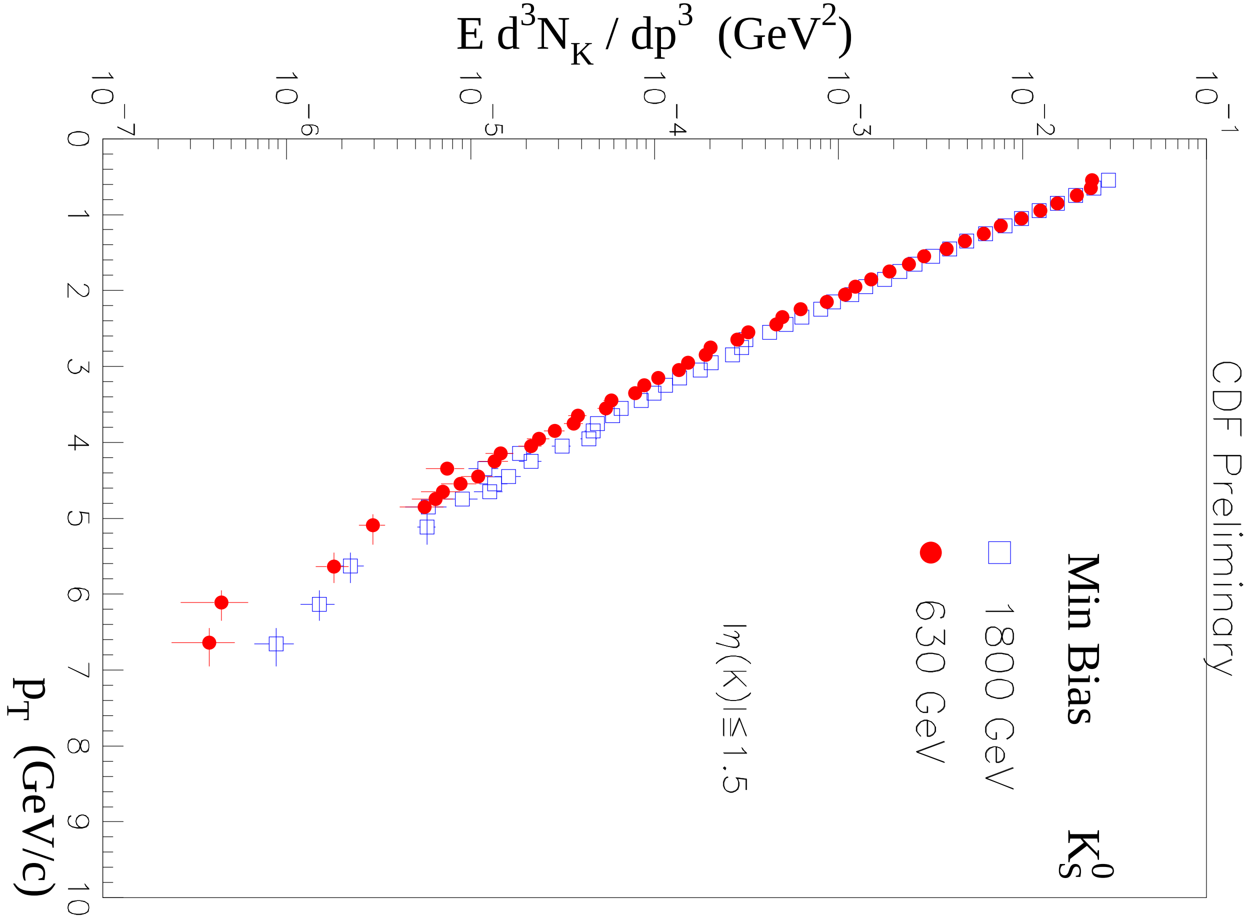
K_s^0 MULTIPLICITY DISTRIBUTIONS



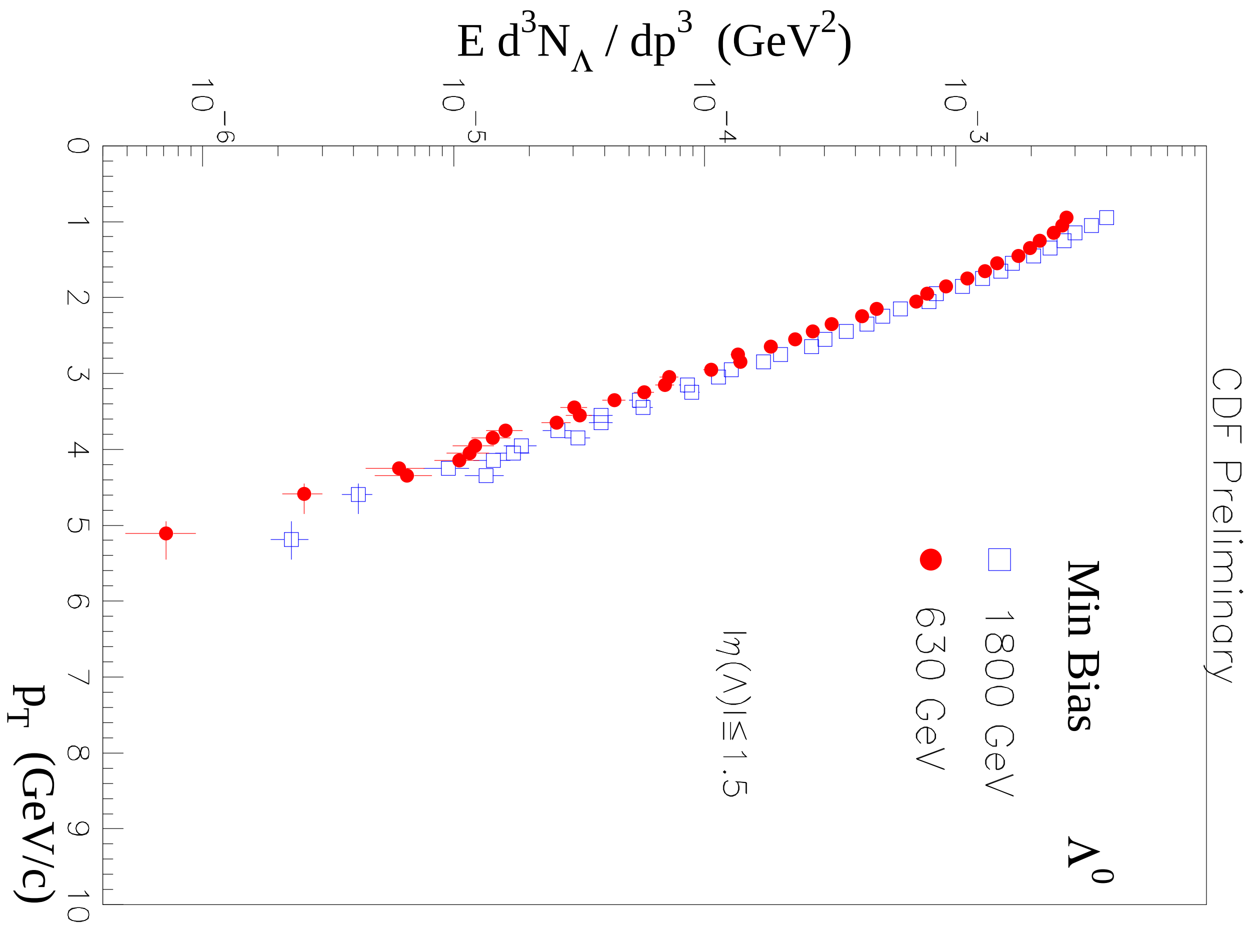
$\Lambda^0/\bar{\Lambda}^0$ MULTIPLICITY DISTRIBUTIONS



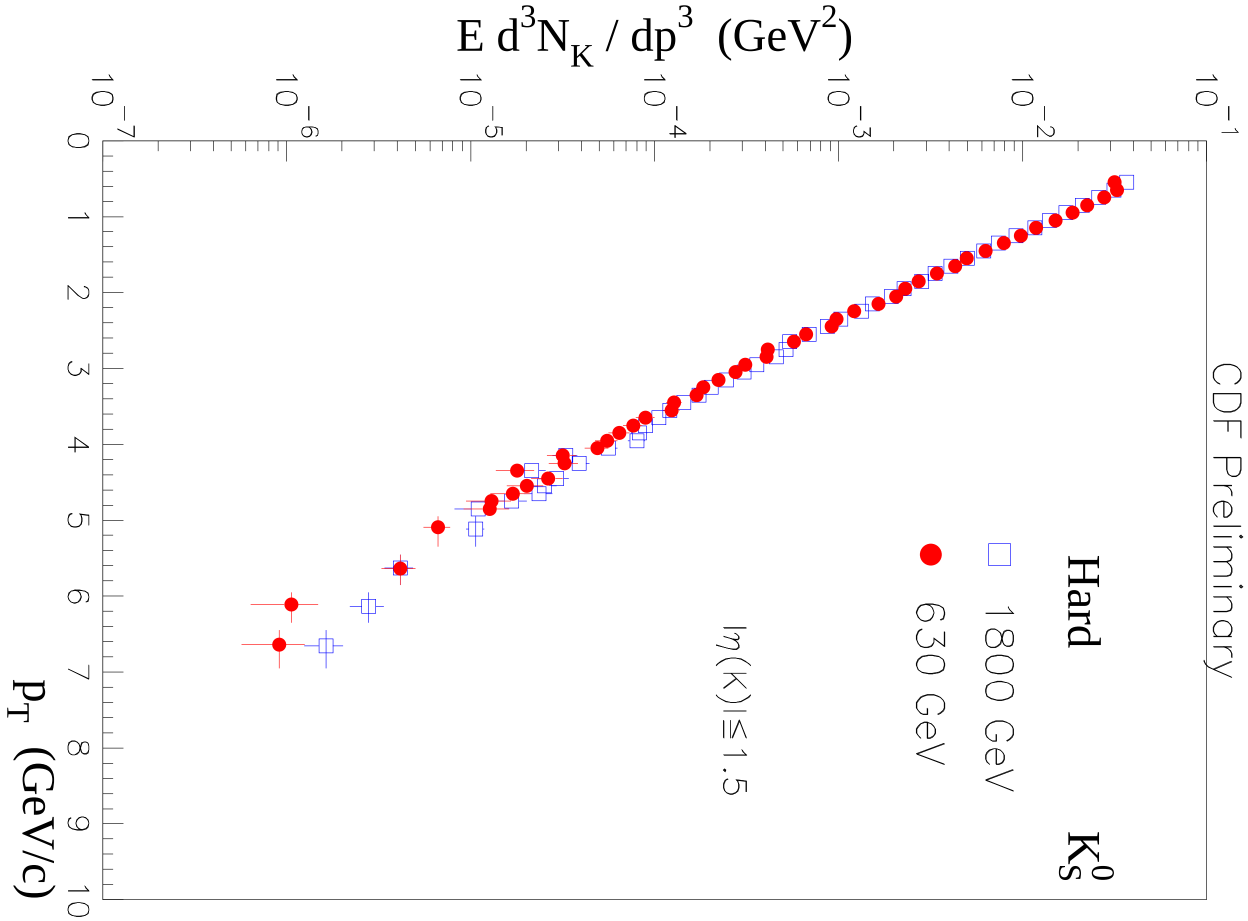
K_S^0 INCLUSIVE p_T DISTRUBUTION



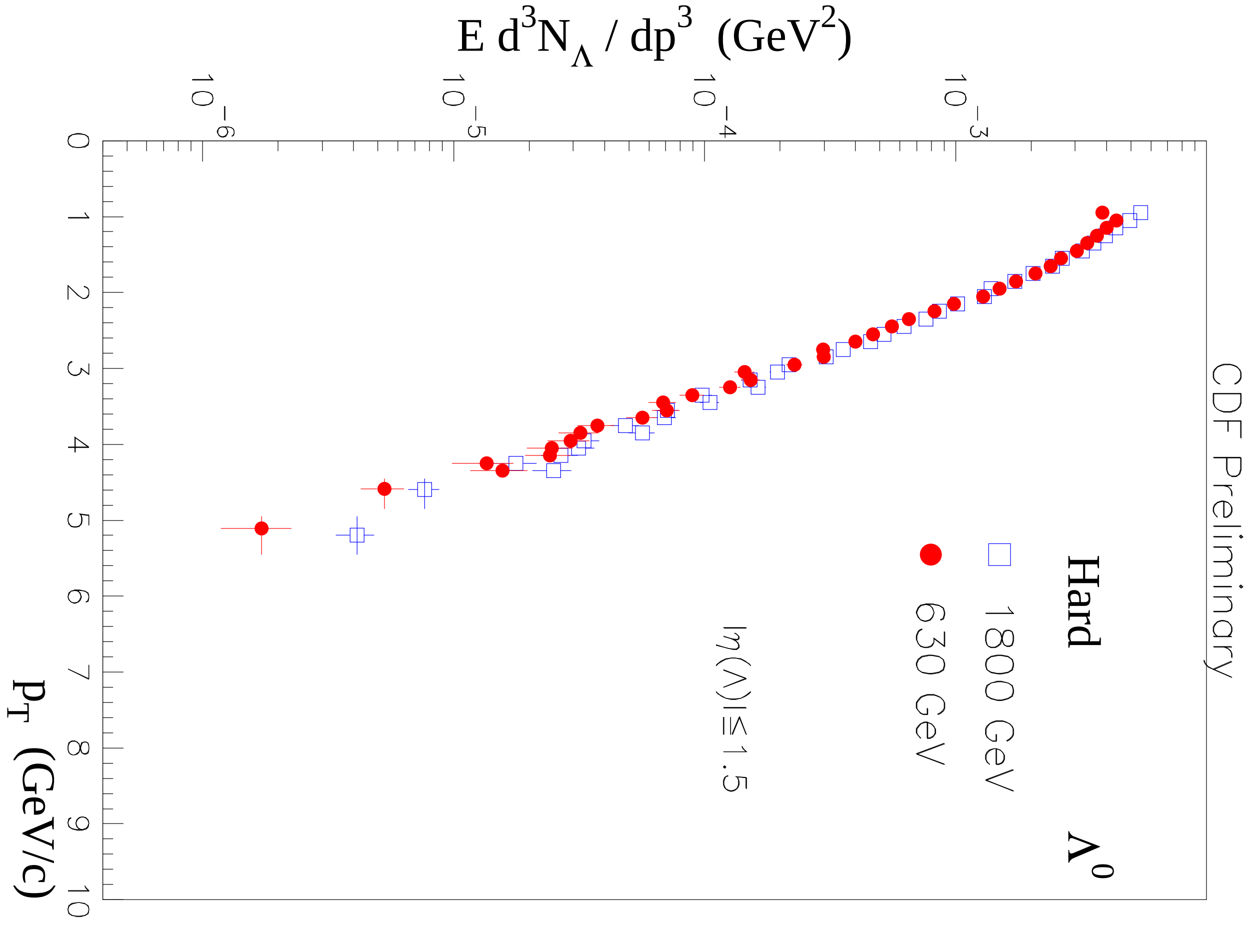
$\Lambda^0/\bar{\Lambda}^0$ INCLUSIVE p_T DISTRIBUTION



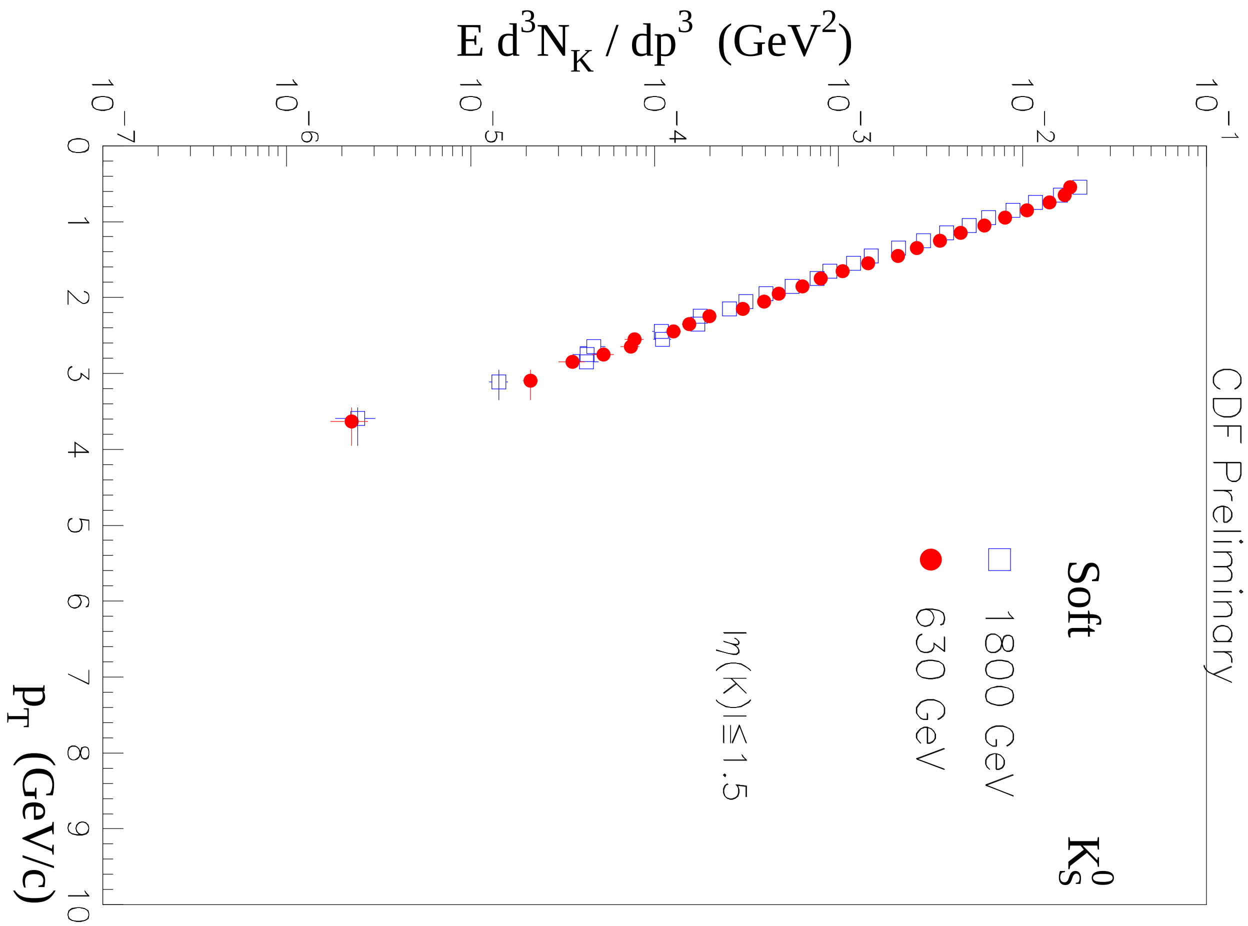
K_S^0 p_T DISTRIBUTION



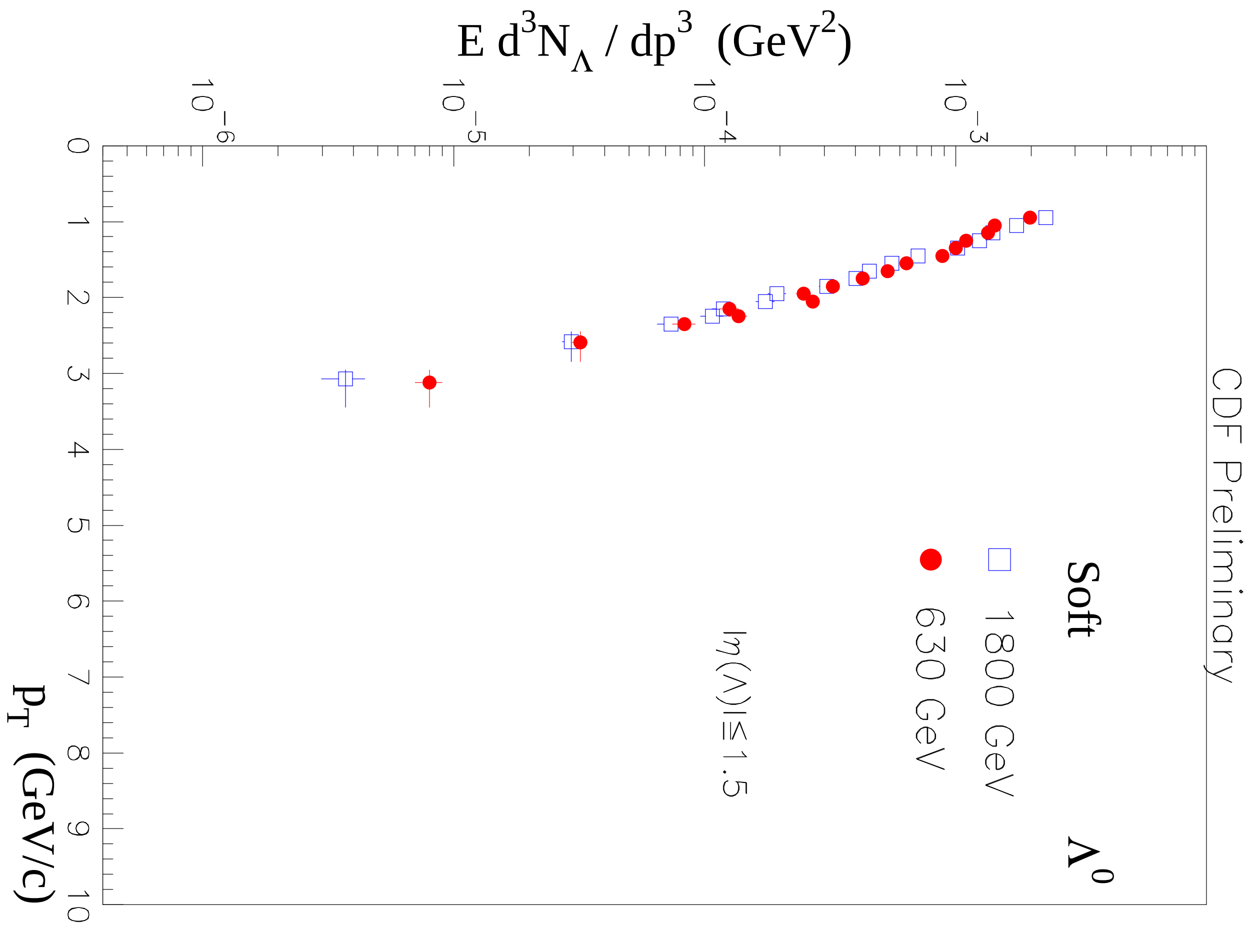
$\Lambda^0/\bar{\Lambda}^0$ p_T DISTRIBUTION



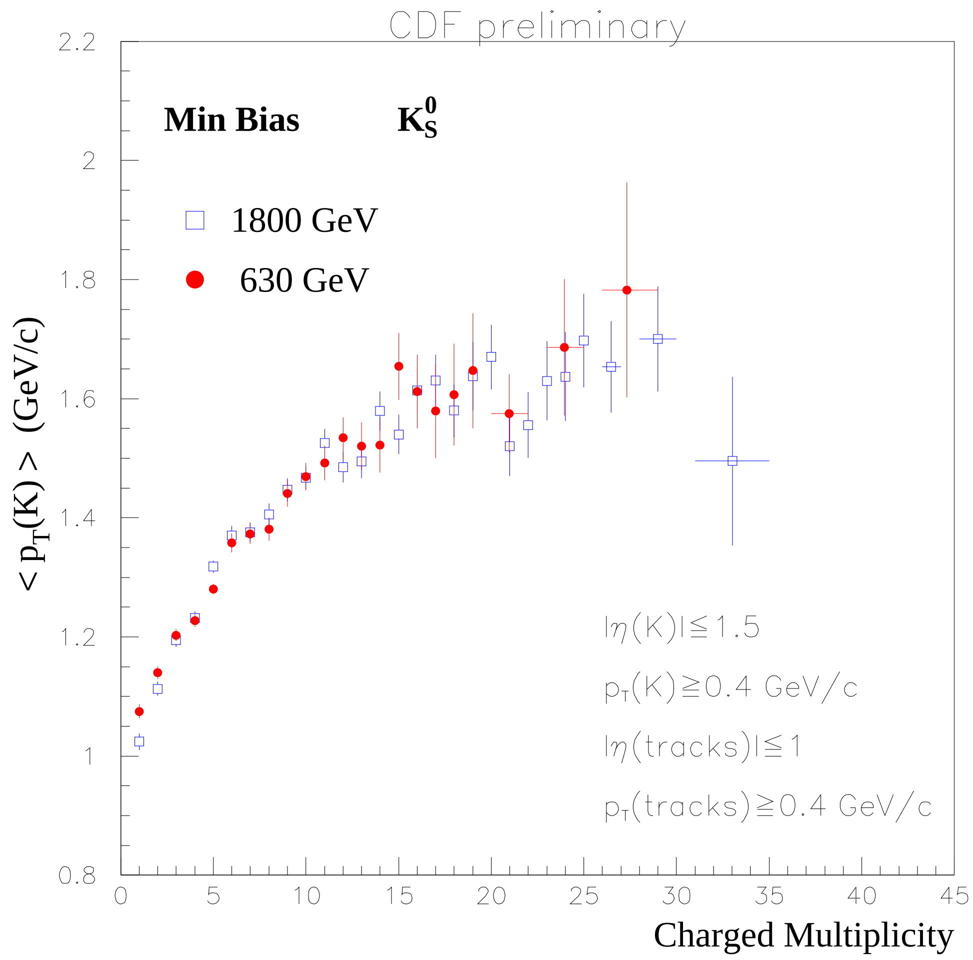
K_S^0 p_T DISTRIBUTION



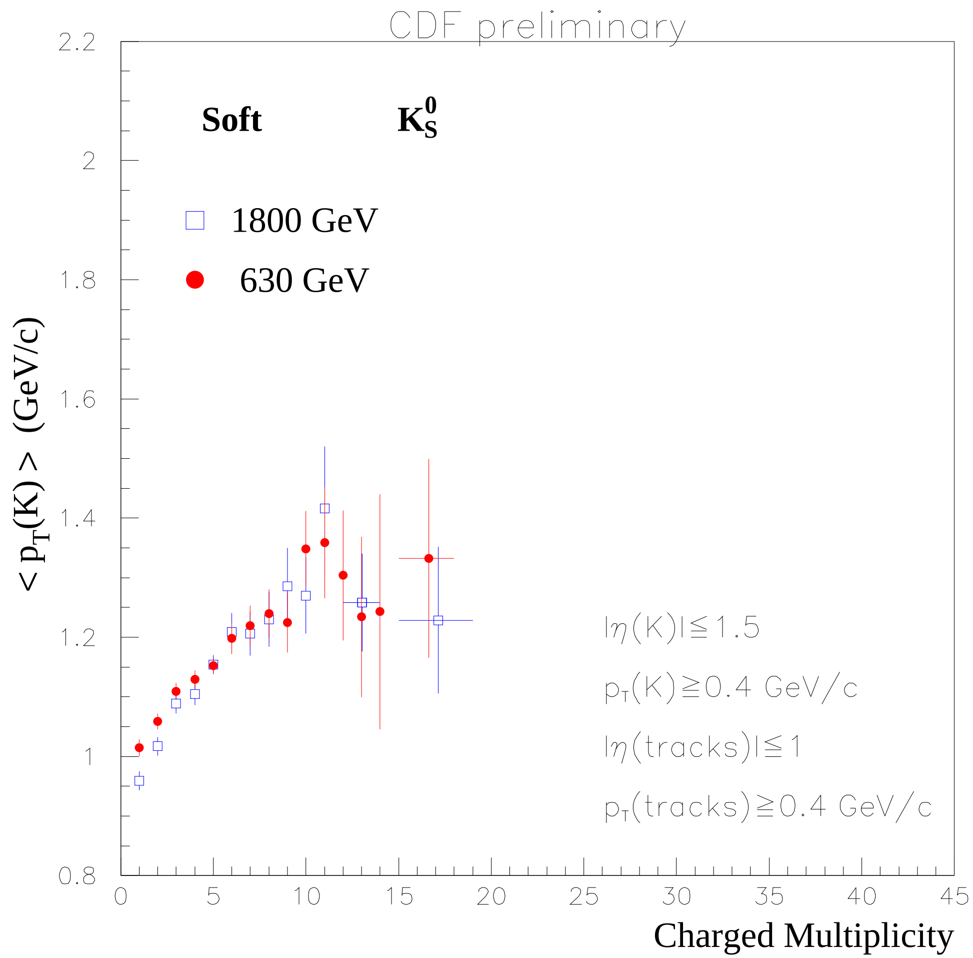
$\Lambda^0/\bar{\Lambda}^0$ p_T DISTRIBUTION



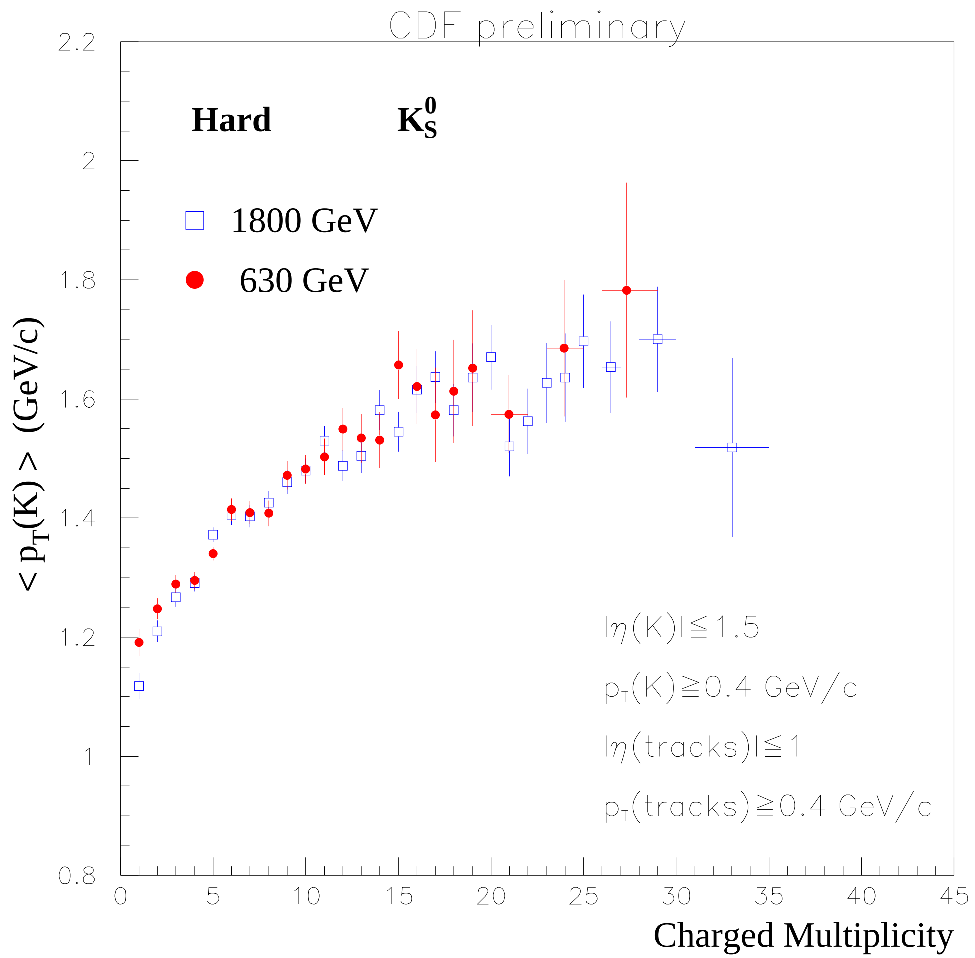
K^0_S MEAN p_T VS MULTIPLICITY



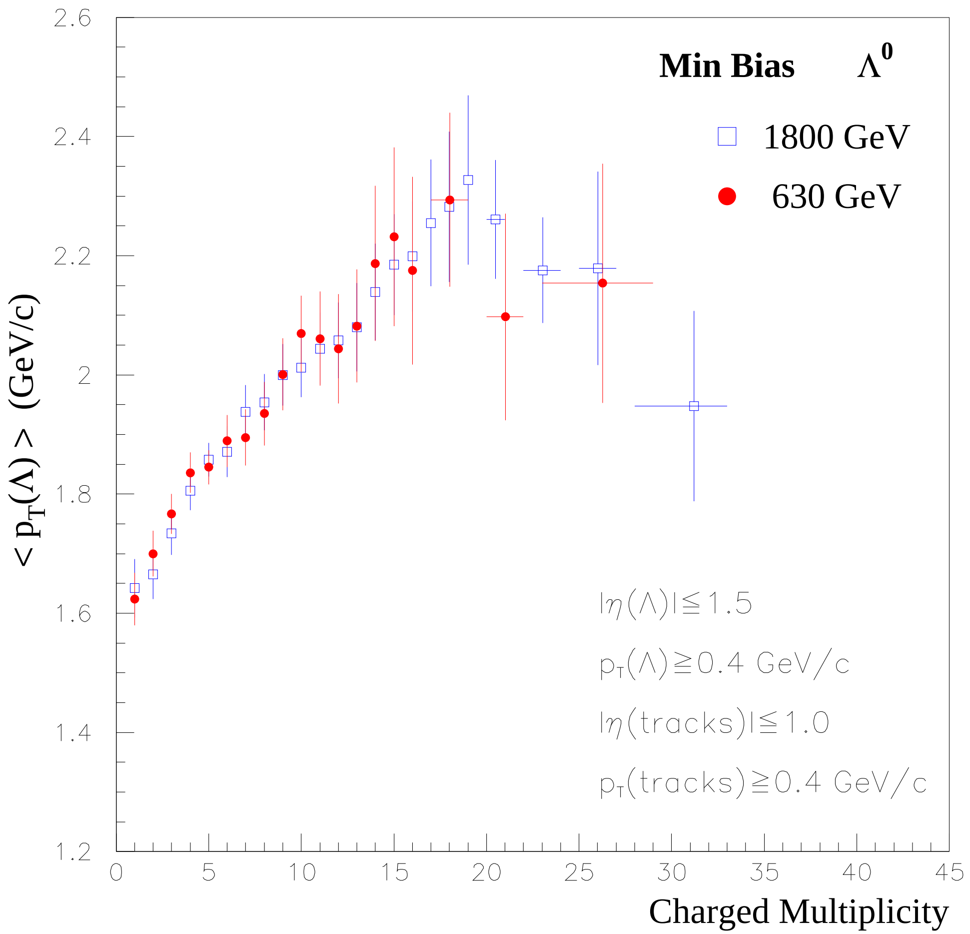
K_S^0 MEAN p_T VS MULTIPLICITY



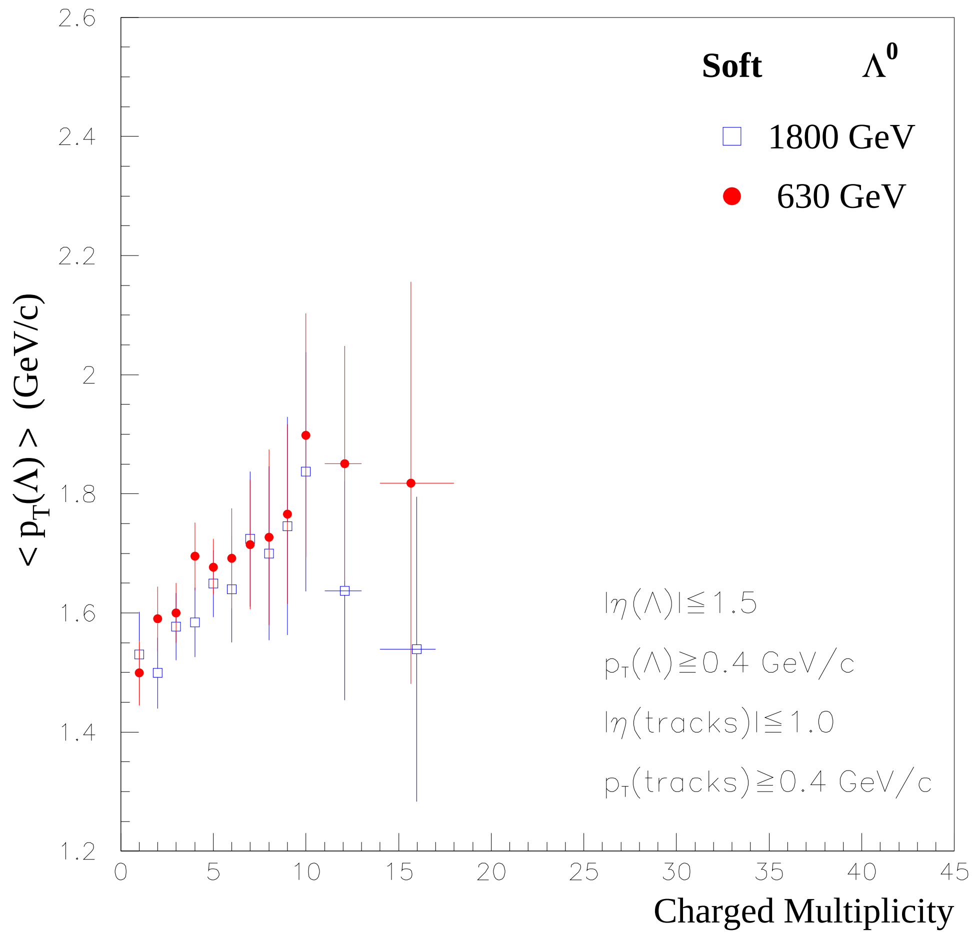
K_S^0 MEAN p_T VS MULTIPLICITY



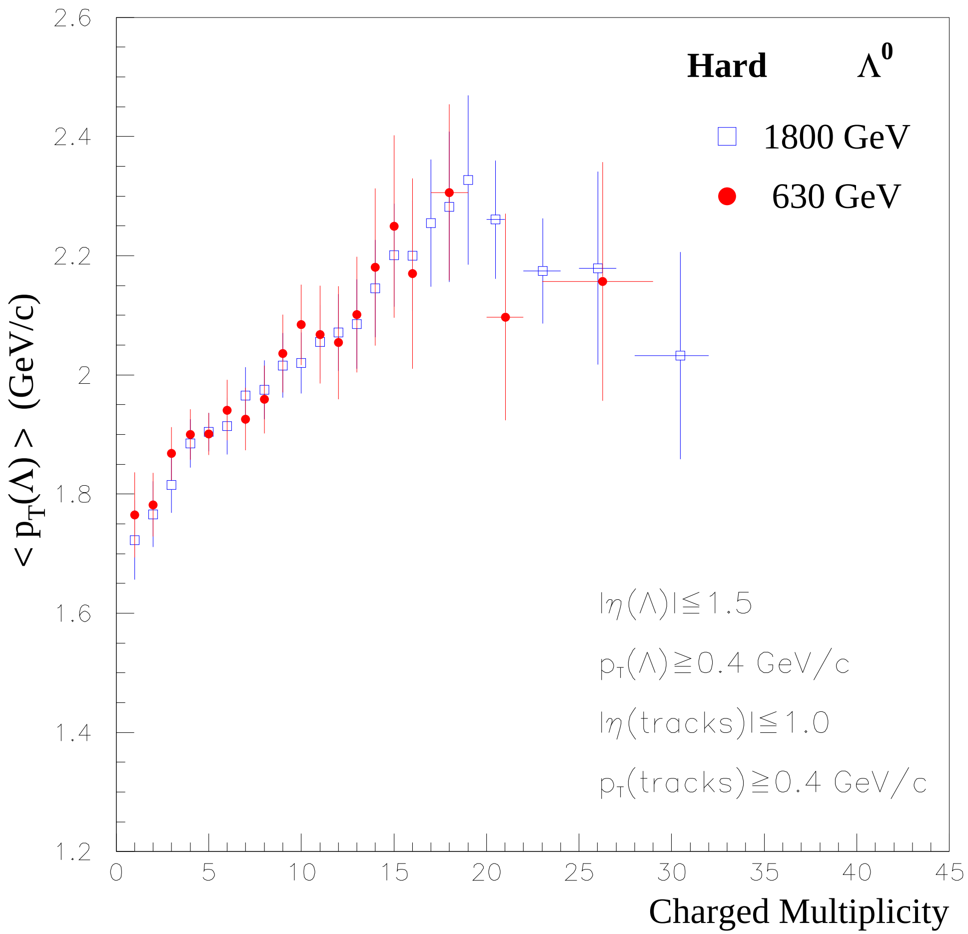
$\Lambda^0/\bar{\Lambda}^0$ MEAN p_T VS MULTIPLICITY



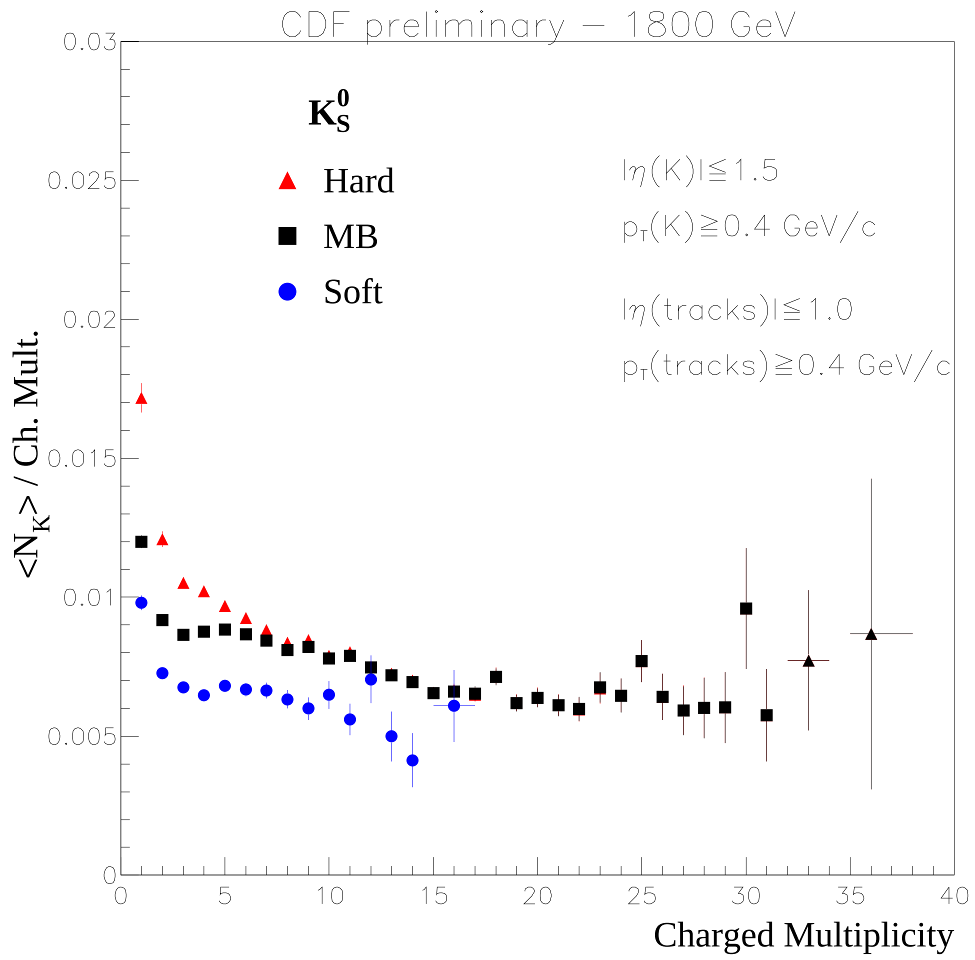
$\Lambda^0/\bar{\Lambda}^0$ MEAN p_T VS MULTIPLICITY



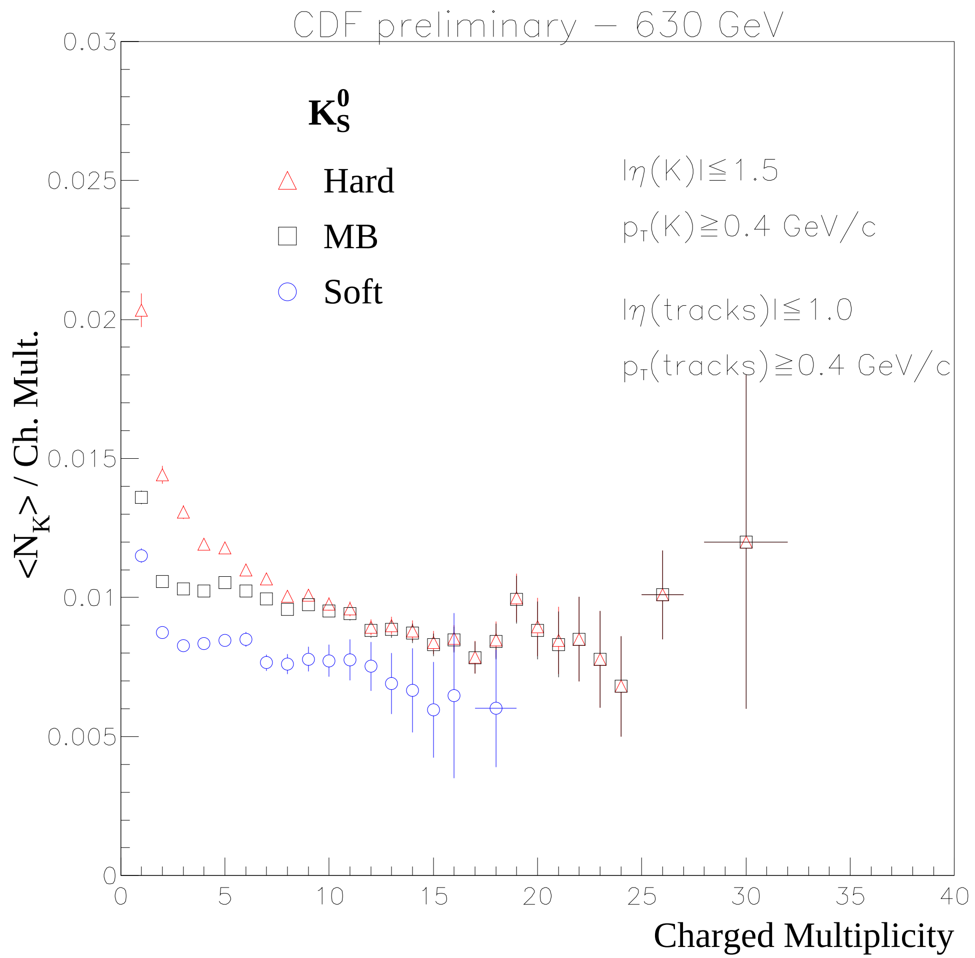
$\Lambda^0/\bar{\Lambda}^0$ MEAN p_T VS MULTIPLICITY



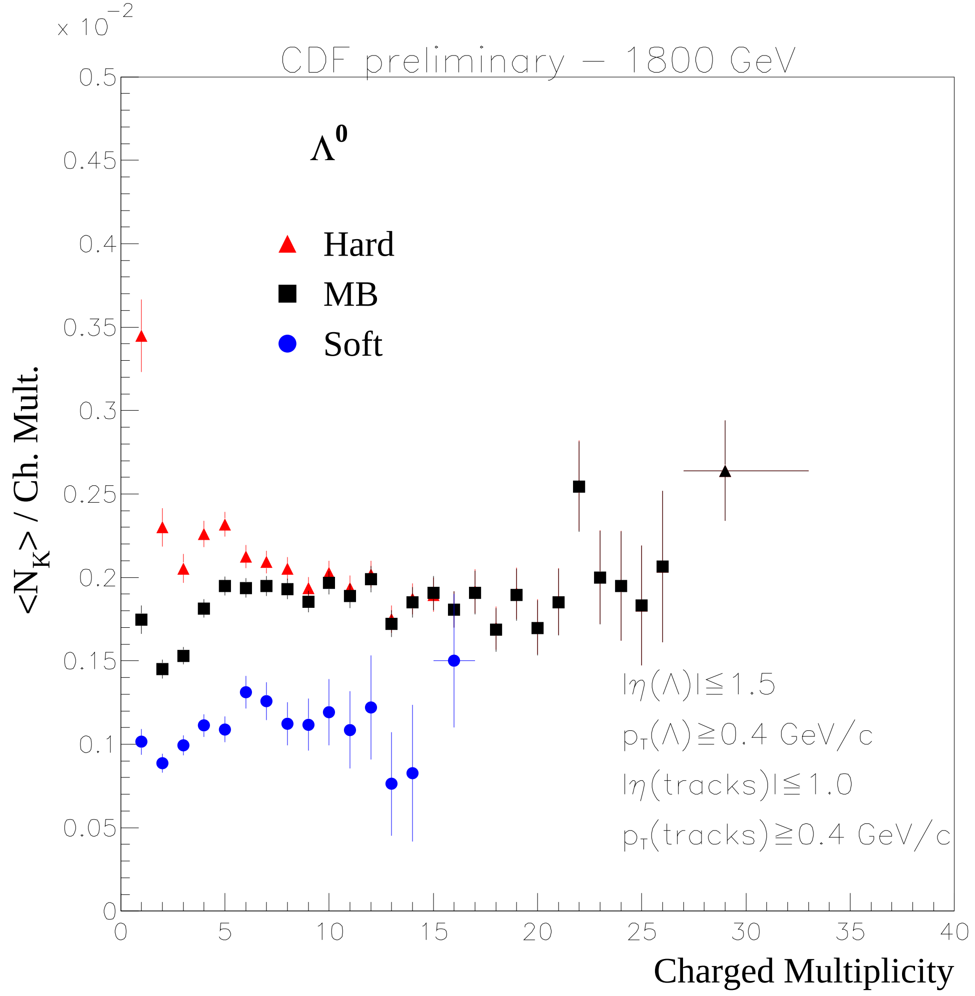
K_S^0 PRODUCTION VS MULTIPLICITY



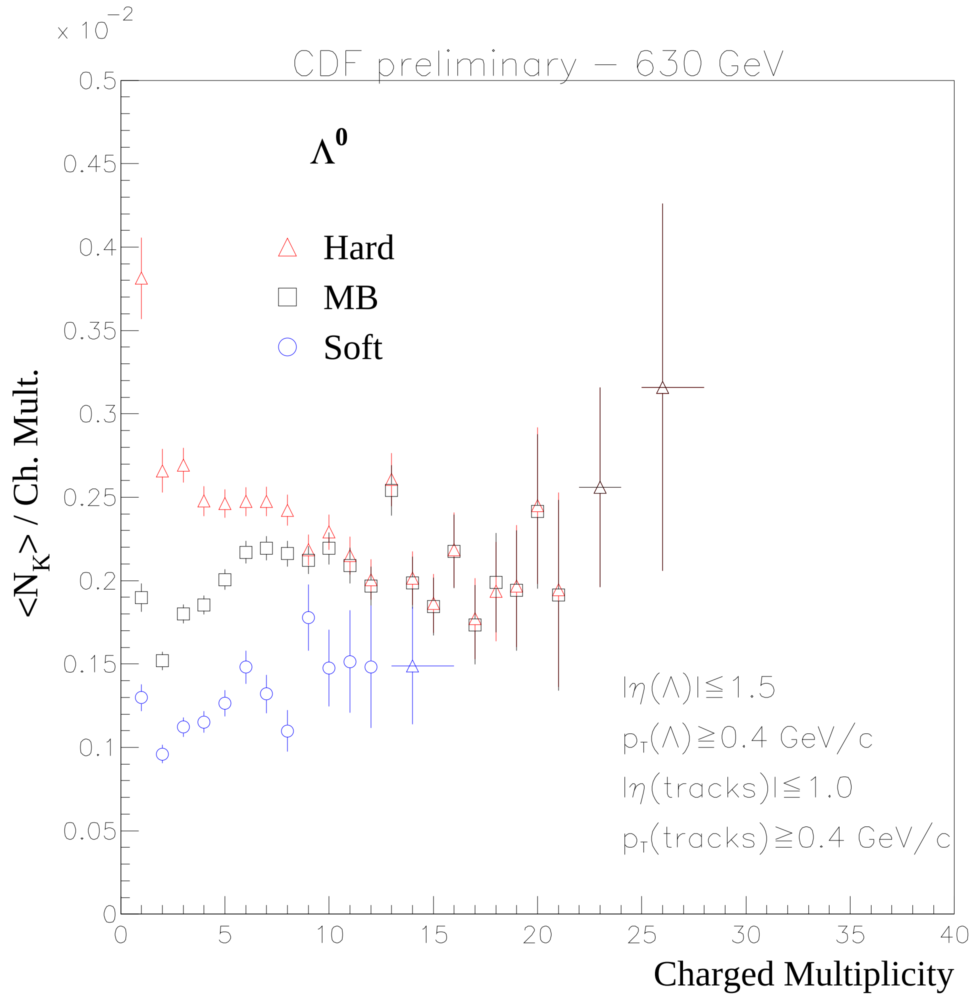
K_S^0 PRODUCTION VS MULTIPLICITY



$\Lambda^0/\bar{\Lambda}^0$ PRODUCTION VS MULTIPLICITY



$\Lambda^0/\bar{\Lambda}^0$ PRODUCTION VS MULTIPLICITY



CONCLUSIONS

- ⋆ we have analyzed some features of S production in minimum bias;
- ⋆ previous measures have been extended in range (p_T inclusive distributions), and some new ones done (multiplicity of V^0);
- ⋆ interesting features are showing up in the plots of correlations vs event charged multiplicity.

This is a preliminary analysis. In the more long term the goal of these studies is to compare strangeness production at the two available energies and investigate for new properties and c.m. energy invariances (as was previously done for charged hadron production). PRD 65, 072005, 2002