# TOFp Status Report

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Introduction: system overview

Functional requirements

Analysis status

- track extrapolation & matching
- start time
- stop time
- identified hadrons

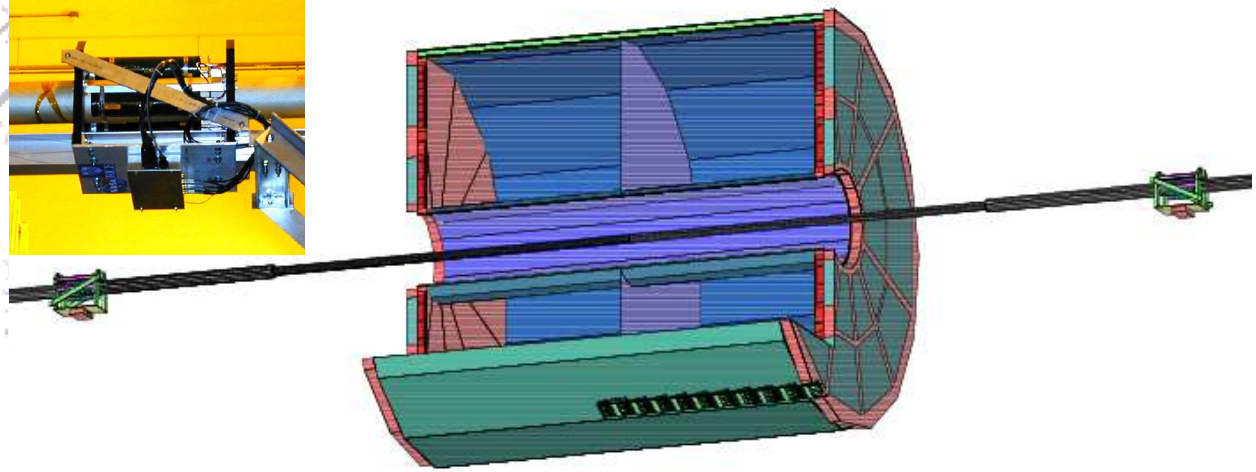
} single slat

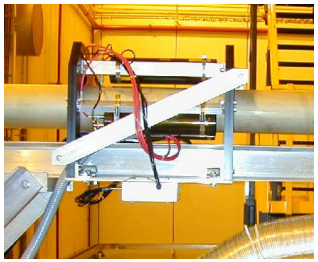
- full system

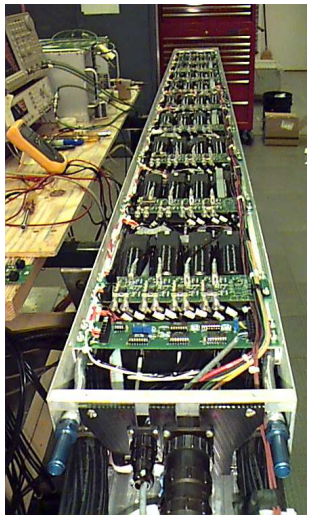
Summary & Outlook

# TOFp System Overview









## pVPD

Two pVPD assemblies, located at a5.7m from TPC center

Each pVPD assembly consists of 3 cylindrical PMT assemblies

PMT assemblies: 1.4" Pb converter, 1cm BC420 and 2" R2083

Magnetic shielding against STAR magnetic field (few 100G)

PMT assemblies symmetrically mounted around the beam

Coverage: ~32% azimuthal, forward rapidity 4.5<||<5.2

provides local coincidence trigger

## TOFp

replaced one of the 120 trays in the CTB layer around the TPC

tray form factor: 242 x 22 x 9 $cm^3$ at R=2.1m

41 slat assemblies, ordered in -groups of 4 slats (5 slats at =0)

slat assembly: 20 x 4 x 2 $cm^3$ BC420 and Hamamatsu R5946

HV generated locally, a remote control interface

Coverage: azimuthal 6°, mid-rapidity 0 < < 1

## Operations

PMT signals locally amplified and discriminated

logic and analog signals transferred over ~220ft RG-58/U and re-discriminated

pVPD coincidence triggers readout and digitization

Au+Au coincidence level: 2.AND.2 (100% efficient)

Although not designed for p+p, 1.OR.1 coincidence level 60% efficient (13% efficient in offline 1.AND.1)

digitization in CAMAC with LeCroy 2228A TDCs and 2249A ADCs

thermocouples along the full signal path

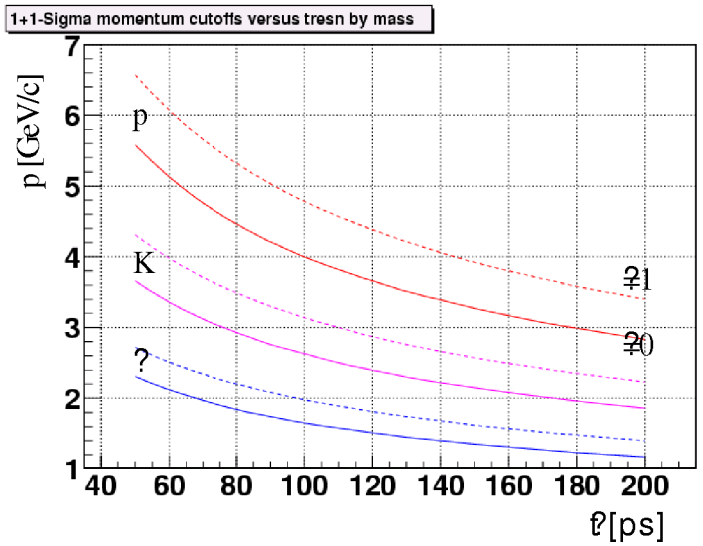
# Functional Requirements

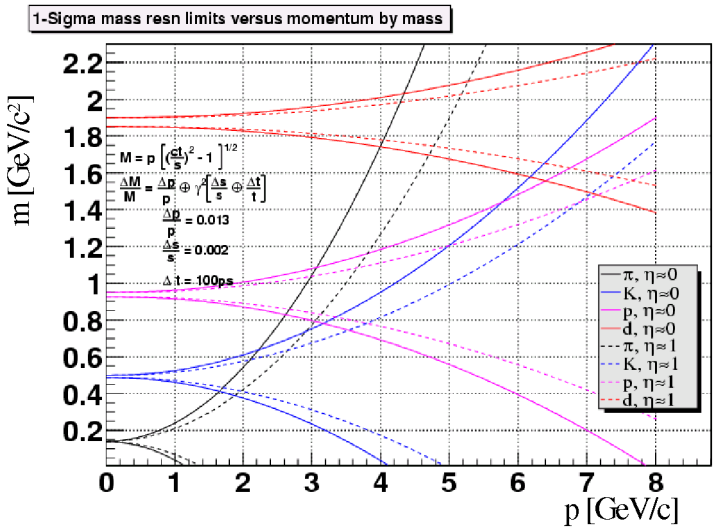
$$m = p\sqrt{\left(\frac{ct}{s}\right)^2 - 1}$$

- momentum $p$ from tracking
- path length $s$ from track extrapolation
- time $t$ from *time of flight*: $t_{start}$-$t_{stop}$

mass resolution: $\frac{\Delta m}{m} = \frac{\Delta p}{p} \oplus \gamma^2\left[\frac{\Delta s}{s} \oplus \frac{\Delta t}{t}\right]$

- $\Delta p/p = 1.3\%$
- $\Delta s/s = 0.2\%$
- $\Delta t$ ~100ps and $7 < t < 25$ns

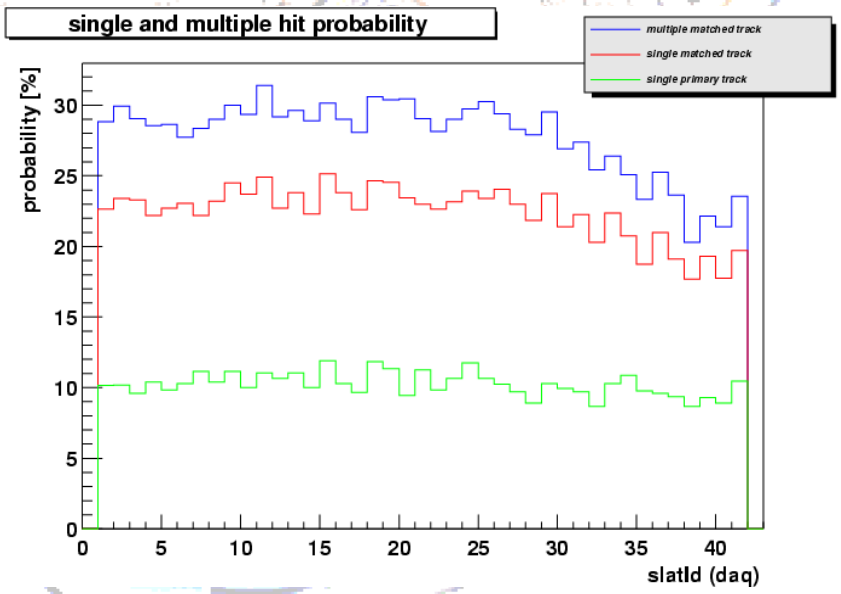



(1+1) particle separation (100ps):

| | π | 1 |
|---|---|---|
| π/K | 1.6 GeV/c | 2.0 GeV/c |
| (π+K)/p | 2.6 GeV/c | 3.2 GeV/c |
| (π+K+p)/d | 4.0 GeV/c | 4.8 GeV/c |

# Track Extrapolation & Matching

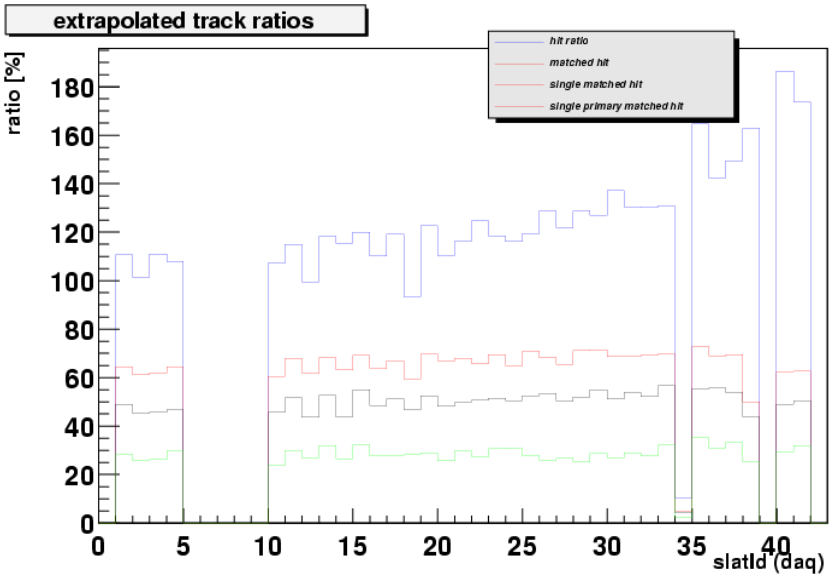



1. identify hit TOFp slats with valid TDC and ADC signals
2. identify matches by extrapolating valid global TPC tracks

   valid helix fit, minimum #hits/track and/or #fit-points/track
3. select slats with single track matches

   consider multiple hit slats in an advanced stage of the analysis
4. restrict to primary tracks

   tracks must originate from the primary vertex



# Start Time

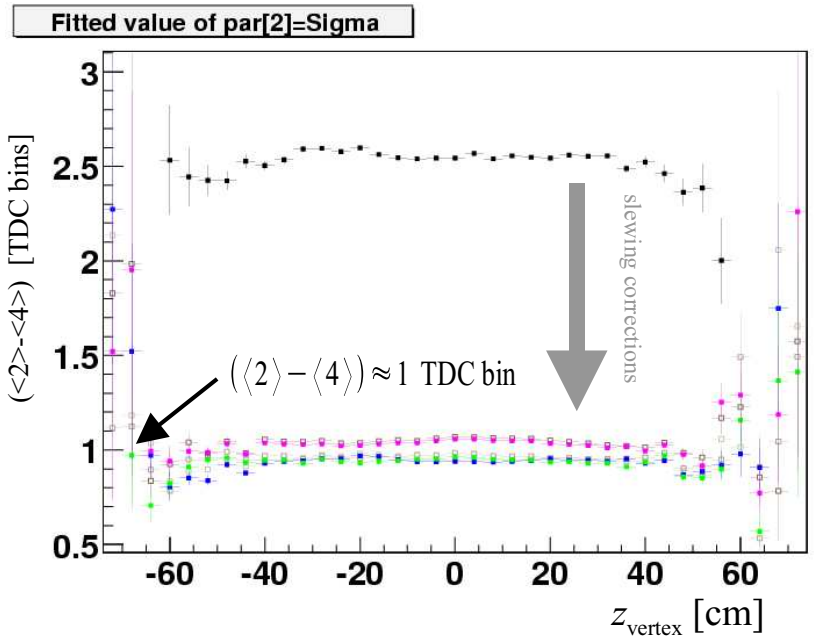
coincidence level in Au+Au: 2.AND.2

complicated start corrections: large time-amplitude dependence (slewing)

slewing corrections in terms of

$$\langle 2\rangle - \langle 4\rangle = \langle \frac{e_i + w_j}{2} \rangle - \langle \sum_{k \neq i,j} \frac{e_k + w_k}{2} \rangle$$

with $e_i$,$w_j$ east-*i*, west-j pVPD channel in TDC-bins




equivalent single channel resolution ~58 ps

pVPD system resolution t=24 ps

# Stop Time

41slats  individual sub-detectors, with different correction functions

7 dead channels: one FEE board (4 channels) and three HV-cells

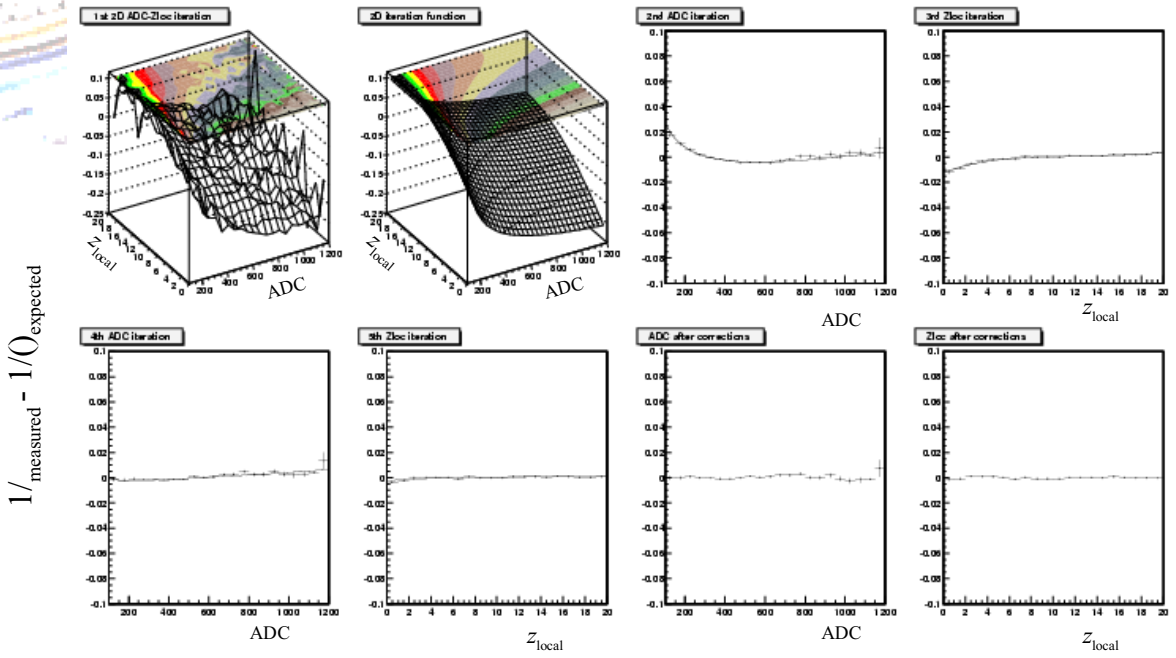
iterative hit-position and slewing corrections

slewing: 1/ dependence of $ADC_i$

scintillator propagation time: 1/ dependence of $z_{local}$

slat 29 uncorrected:

$\left(\frac{1}{-}\right) \approx 0.2$




slat 29 corrected:

$\left(\frac{1}{-}\right) = 0.013$

*Correction iterations for slat 29, central Au+Au data, year2 day 313-328*

# Identified hadrons

500k central events Au+Au $s_{NN}$=200 GeV data

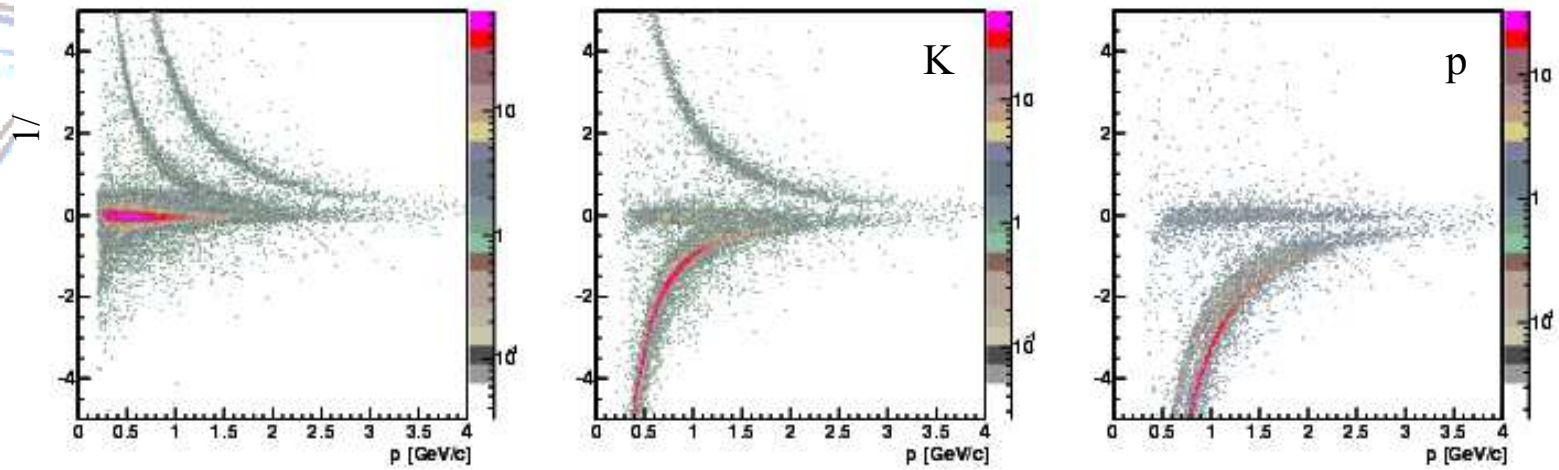
single slat (~44k slat-29 events)

time resolution 90ps

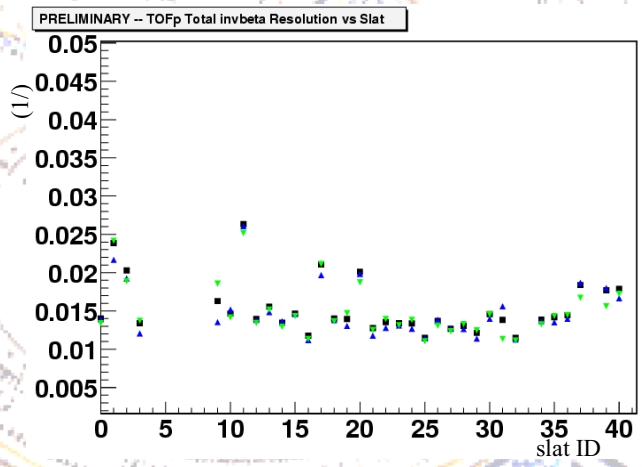
STAR year 2, day 313-328

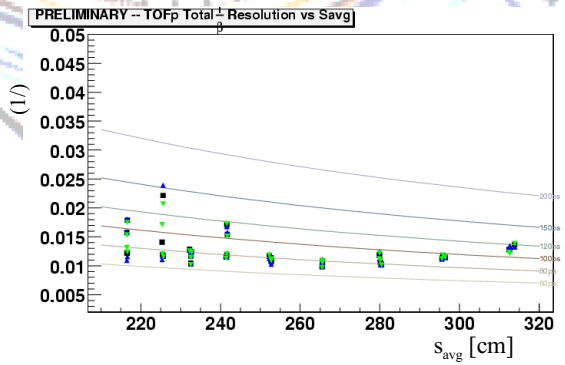
1/ versus momentum distributions for different mass hypothesis (log scale)

$$\frac{1}{'} = \left(\frac{1}{}\right)_{\text{measured}} - \left(\frac{1}{(m,p)}\right)_{\text{expected}}$$



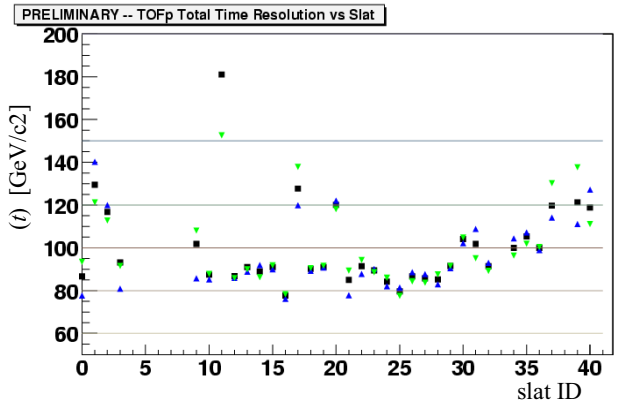
# Resolution plots for all slats

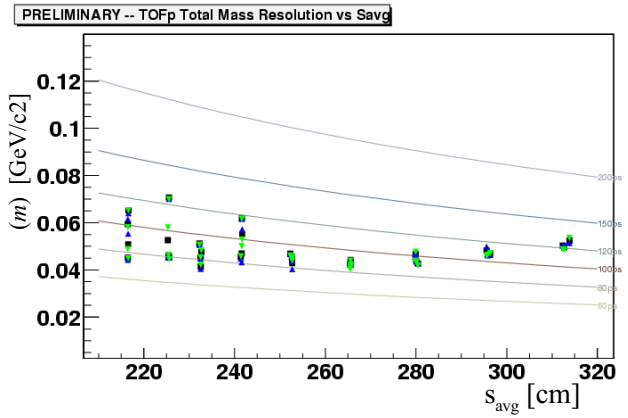



increase in (1/) at higher slat-ID (higher ) expected from design since average angle of incidence on slat approaches ~30

(*m*) nearly independent of



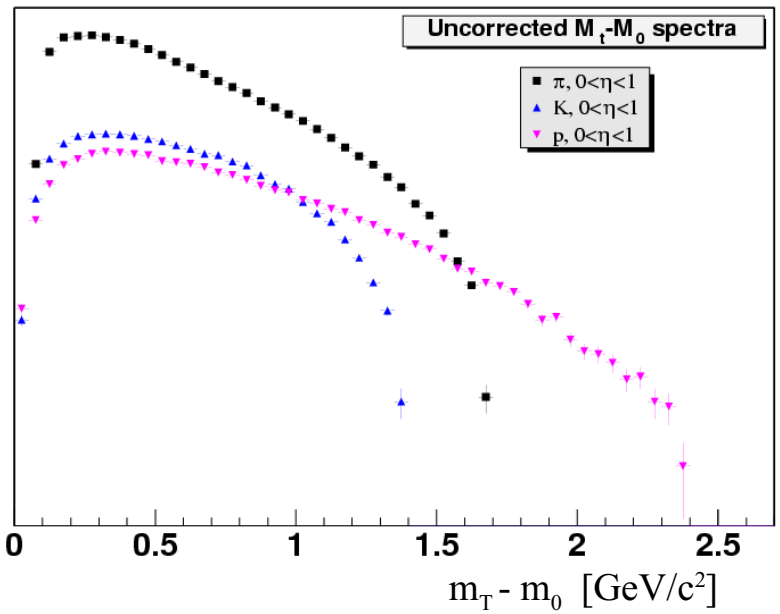

$$t_{\text{total}} = t_{\text{start}} \; t_{\text{stop}} \approx 90'' \text{ ps}$$

$$\Rightarrow t_{\text{stop}} \approx 87''\text{ps}$$

# Summary & Outlook

calibrations nearly complete for central Au+Au data

average $t$ ~ 90 ps, below design value of 100 ps




finalize calibration

formalize calibration

- move away from prototype calibration software
- StTofCalibrationMaker

other data sets to be analyzed:

- Au+Au mbias (~1.4M)
- Au+Au central (single pVPD mode)
- Au+Au @20GeV (~280k)
- p+p @200GeV (~13M)

switch from *calibration* to *physics* mode

- ($m_T$,y) spectra for , K and p
- particle ratios p/p, $K^-/K^+$, $^-/^+$, /p and K/p