Prospects for a study of strangeness production at NICA/MPD

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MPD meeting 30.11.2018

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Previous papers

ISSN 1547-4771, Physics of Particles and Nuclei Letters, 2015, Vol. 12, No. 4, pp. 618–627. © Pleiades Publishing, Ltd., 2015.

COMPUTER TECHNOLOGIES IN PHYSICS

Reconstruction of Multistrange Hyperons with the MPD Detector at the NICA Collider: a Monte Carlo Feasibility Study[1]

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Abstract—One of the main tasks of the NICA/MPD physics program is a study of strangeness production in nuclear collisions. In this paper the MPD detector performance for measurements of Λ, Ξ^- and Ω^- hyperons and their antiparticles $\bar{\Lambda}$, $\bar{\Xi}^+$ and $\bar{\Omega}^+$ in central Au+Au collisions at NICA energies is presented.

DOI: 10.1134/S1547477115040160

1. INTRODUCTION

The main goal of studying heavy-ion collisions is to explore the properties of nuclear matter under extreme density and temperature conditions. Lattice QCD cal-

that from a hadron gas (HG). The enhancement of the strangeness was experimentally observed at SPS [5] and RHIC [6], and it is more pronounced for hyperons with larger strangeness content (cascades and omegas). However, in order to prove or rule out the

ISSN 1547-4771, Physics of Particles and Nuclei Letters, 2015, Vol. 12, No. 1, pp. 100–112. © Pleiades Publishing, Ltd., 2015.

METHODS OF PHYSICAL EXPERIMENT

Evaluation of the MPD Detector Capabilities for the Study of the Strangeness Production at the NICA Collider[1]

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Abstract—One of the main tasks of the NICA/MPD physics program is the study of the strangeness production in nuclear collisions. In this paper the MPD detector performance is presented for measurements of K^0_S-mesons, $\Lambda(\bar{\Lambda})$-hyperons and hypertritons in central Au + Au collisions at NICA energies.

DOI: 10.1134/S1547477115010136

1. INTRODUCTION

The primary goal of the NICA (Nuclotron-based Ion Collider fAcility) heavy-ion program [1] is the study of the properties of nuclear matter under extreme conditions. At sufficiently high temperature

detecting both the hadronic (π, K, p, Λ, Ξ, Ω) and non-hadronic (e, γ) probes.

Study of (anti)hyperon production is of particular interest because of several reasons. First of all, the strangeness enhancement in heavy-ion collisions rela-

New papers

Paper about realistic simulation, reconstruction and PID to be published

Paper about new hyperon reconstruction is under preparation

METHODS
OF PHYSICAL EXPERIMENT

Towards a Realistic Monte Carlo Simulation of the MPD Detector at NICA[1]

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Received August 17, 2018

Abstract—During the preparation of the physics program of any experiment it is very important to perform a realistic simulation of the detector, i.e. to describe real detector effects with as many details as possible. In this paper the current status of such a simulation of the MPD TPC (Time Projection Chamber) is demonstrated, including description of relevant processes. Data reconstruction approaches are also presented along with the main results on detector performance.

DOI: 10.1134/S1547477119010084

1. INTRODUCTION

The NICA heavy-ion program is aimed at the experimental investigation of the nuclear matter properties under extreme conditions [1]. It implies a detailed energy and system size scan with beam species varying from protons to gold nuclei in the center-of-mass energy range from 4 to 11 GeV per nucleon. The NICA physics program addresses variety of the fundamental phenomena in the strongly interacting matter: needs to measure particle production practically up to the fragmentation region.

In order to fulfill the NICA physics program goals the MPD detector is designed as a large acceptance spectrometer providing high-efficiency tracking performance, precise vertex reconstruction (including the primary and secondary vertices), powerful particle identification (PID), as well as careful determination of the event centrality and event plane [2].

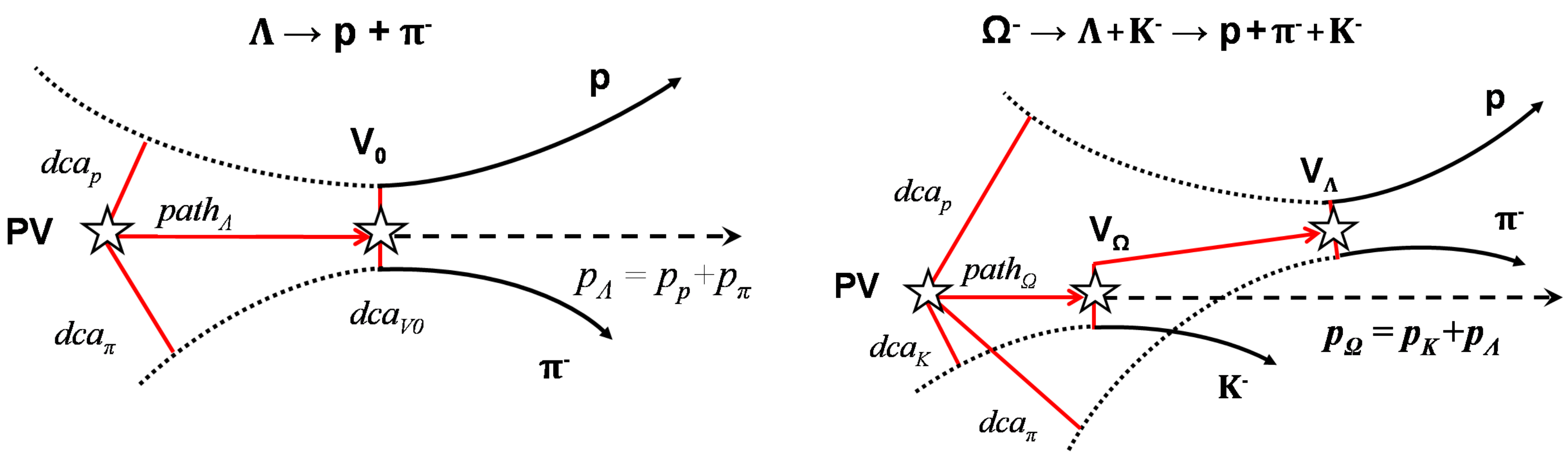
What`s new?

- New MPD geometry
- Realistic simulation and reconstruction in TPC
- New PID
- New model - PHSD
- Extraction of physics observables

Data set & Analysis

- **Generator:** PHSD, Au+Au @ 11 GeV, minbias, 2M events
- **Detectors:** TPC & TOF
- **Track reconstruction:** with clustering in TPC
- **Track acceptance criterion:** $|\eta| < 1.3$, $N_{hits} \geq 10$
- **PID:** TPC & TOF

Secondary Vertex Finding Technique

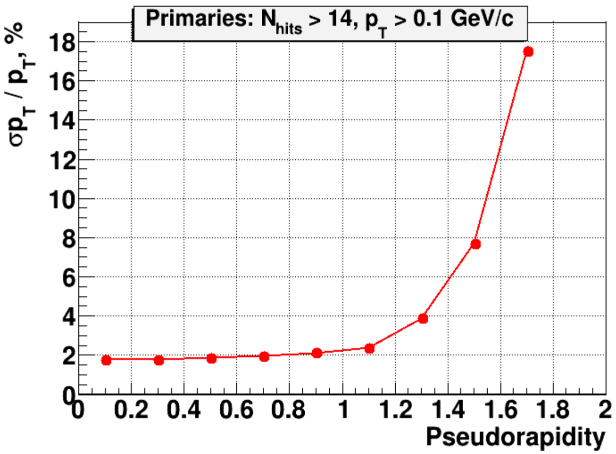


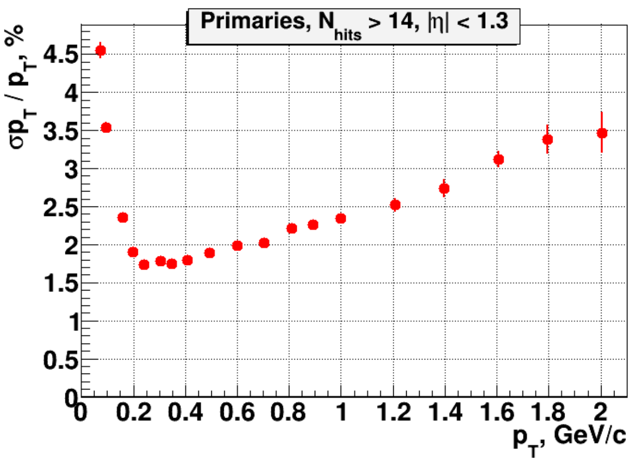
Event topology:

- PV – primary vertex
- V_0 – vertex of hyperon decay
- dca – distance of the closest approach
- path – decay length

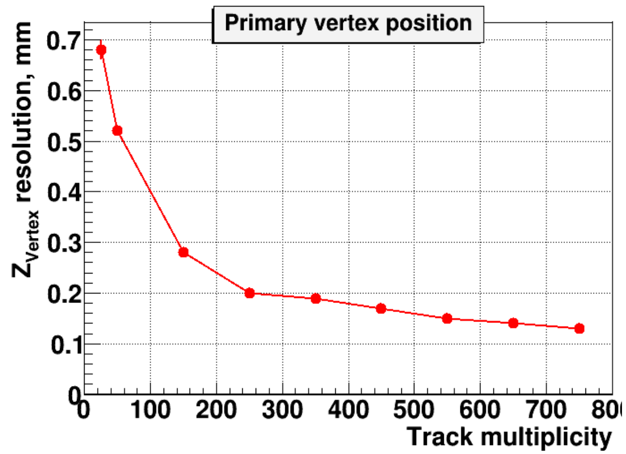
Track reconstruction in TPC

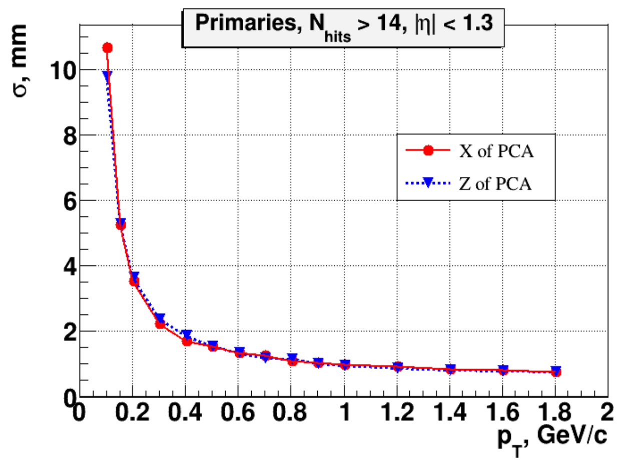
Momentum resolution



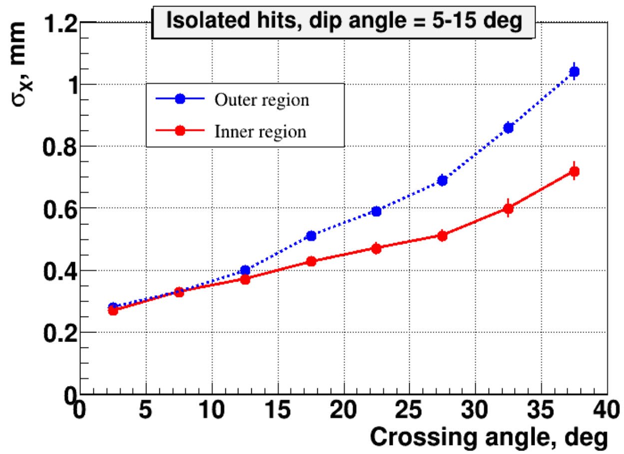


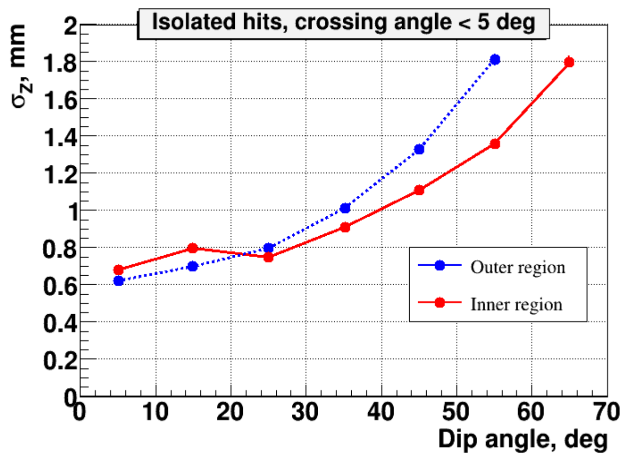
Track pointing accuracy





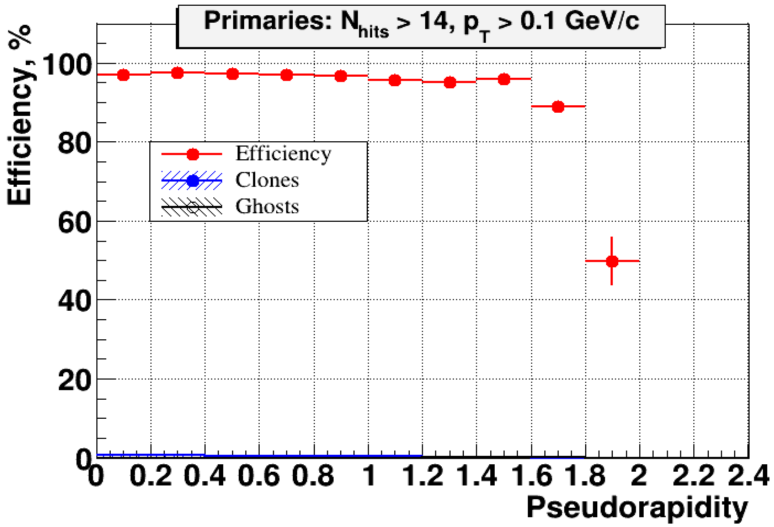
Coordinate resolution

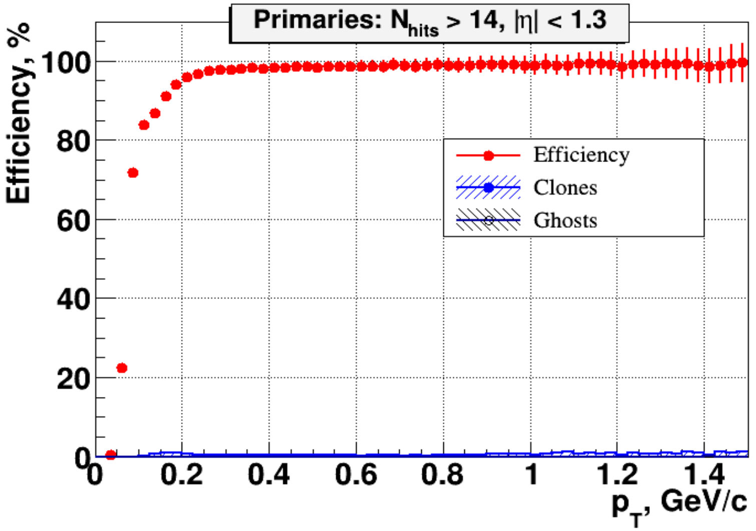


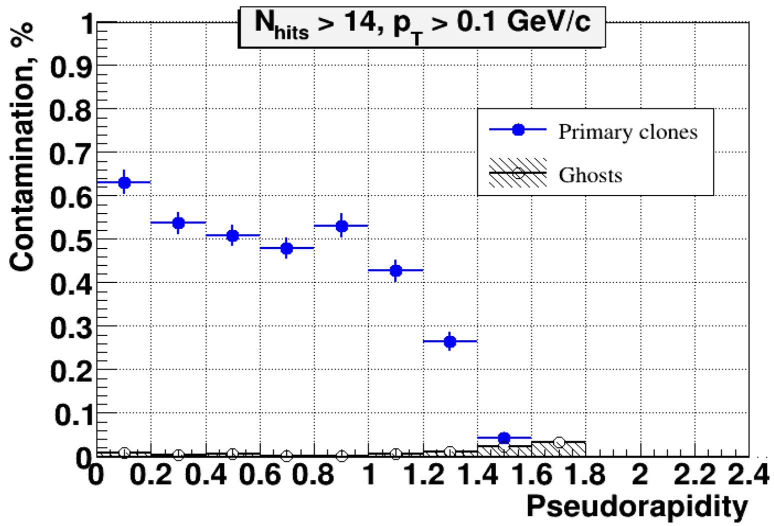


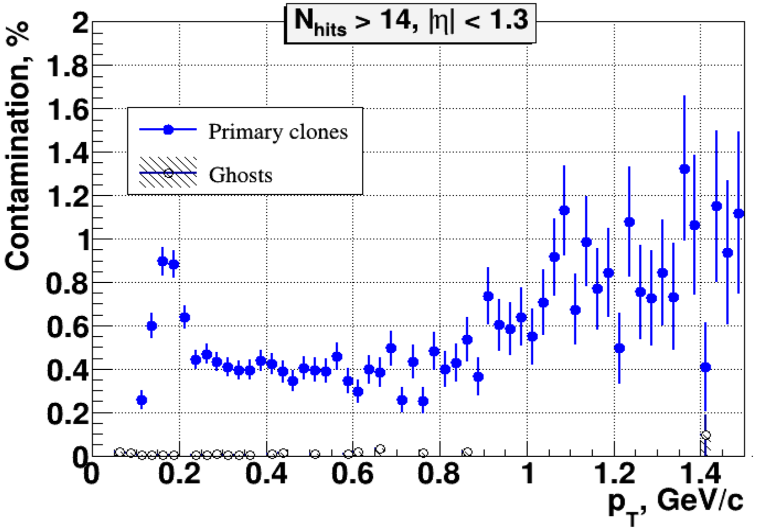
Track reconstruction efficiency

Primary tracks

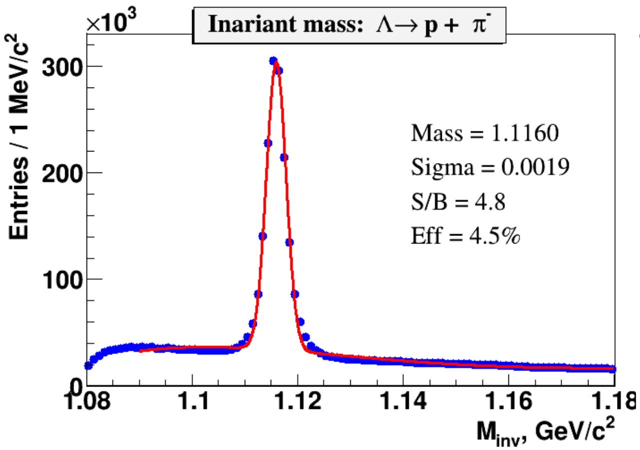


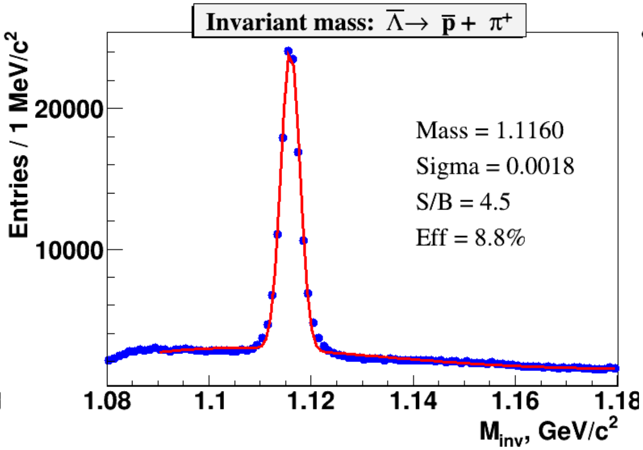


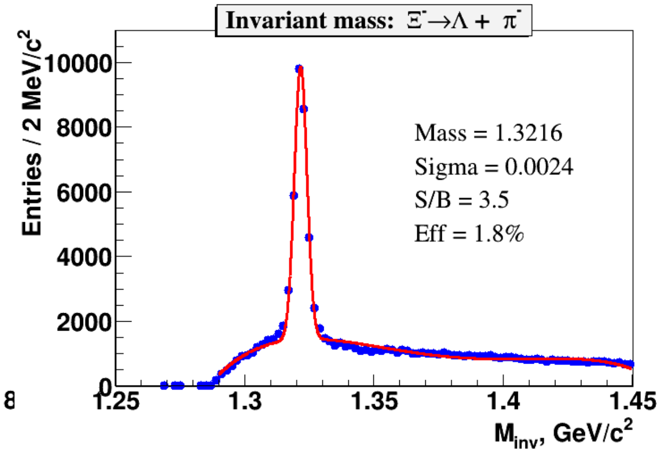




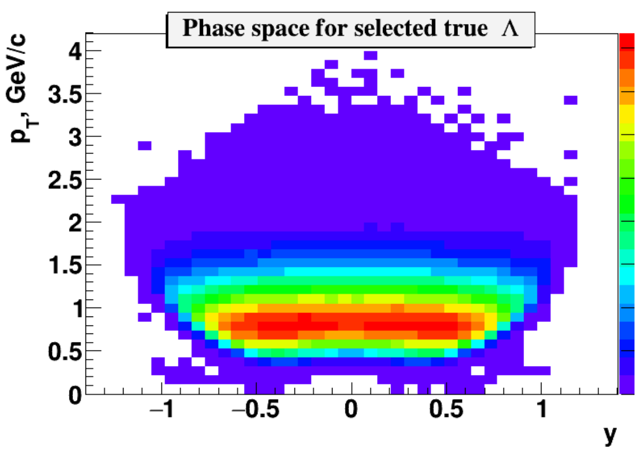
Hyperon reconstruction

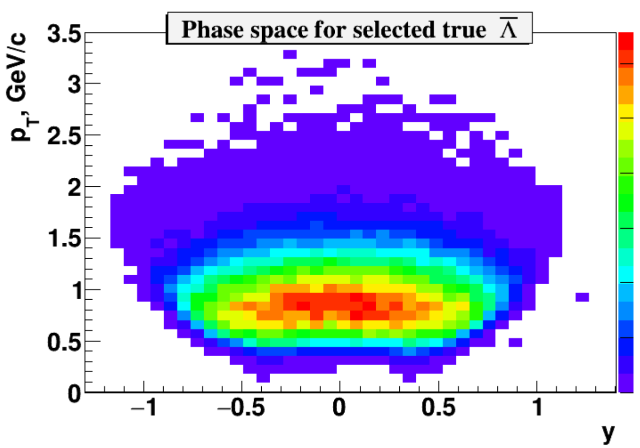


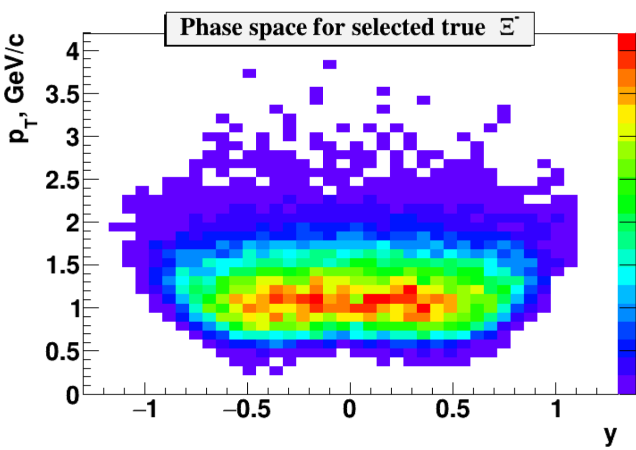




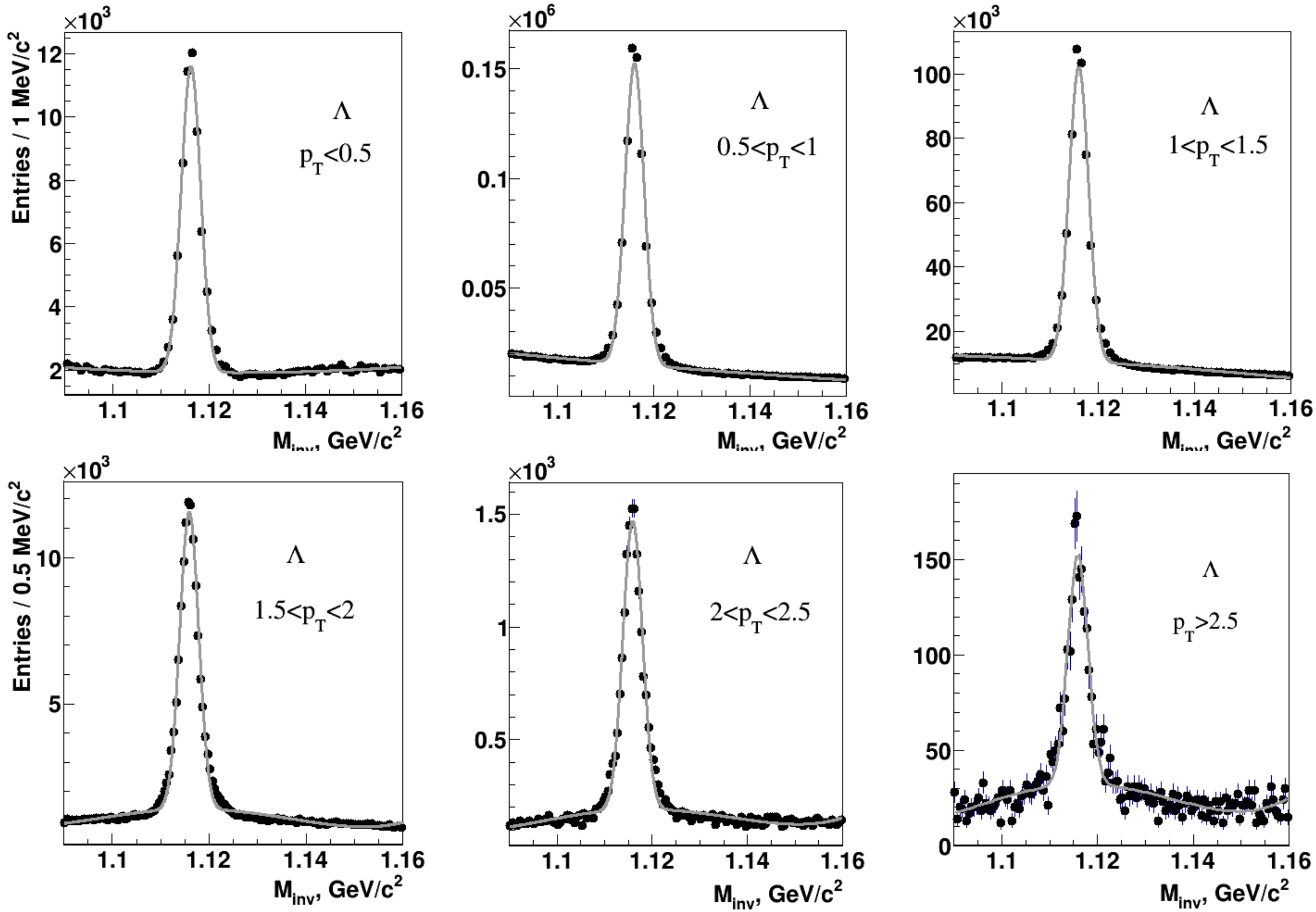
Phase space for reconstructed and selected true hyperons



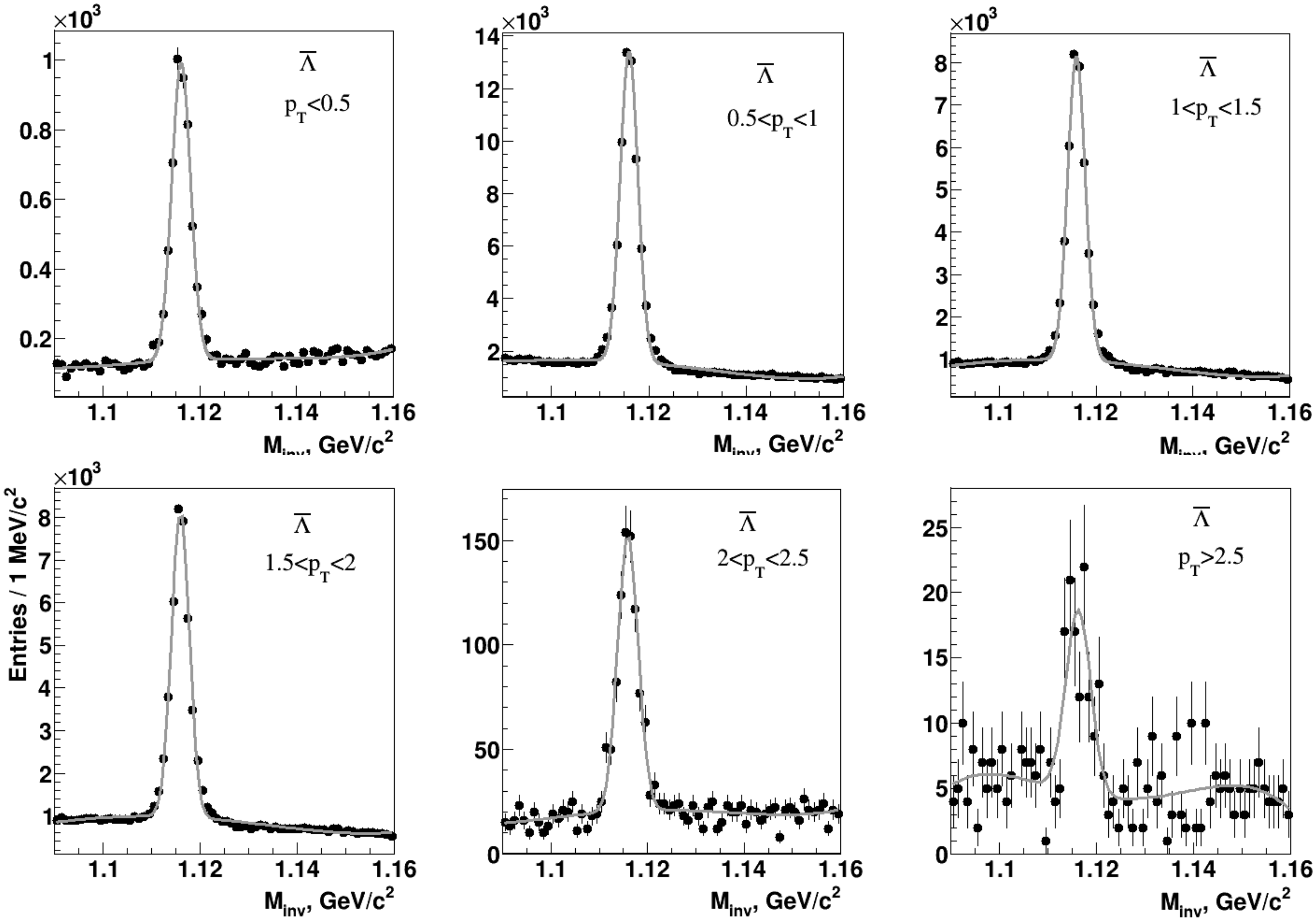




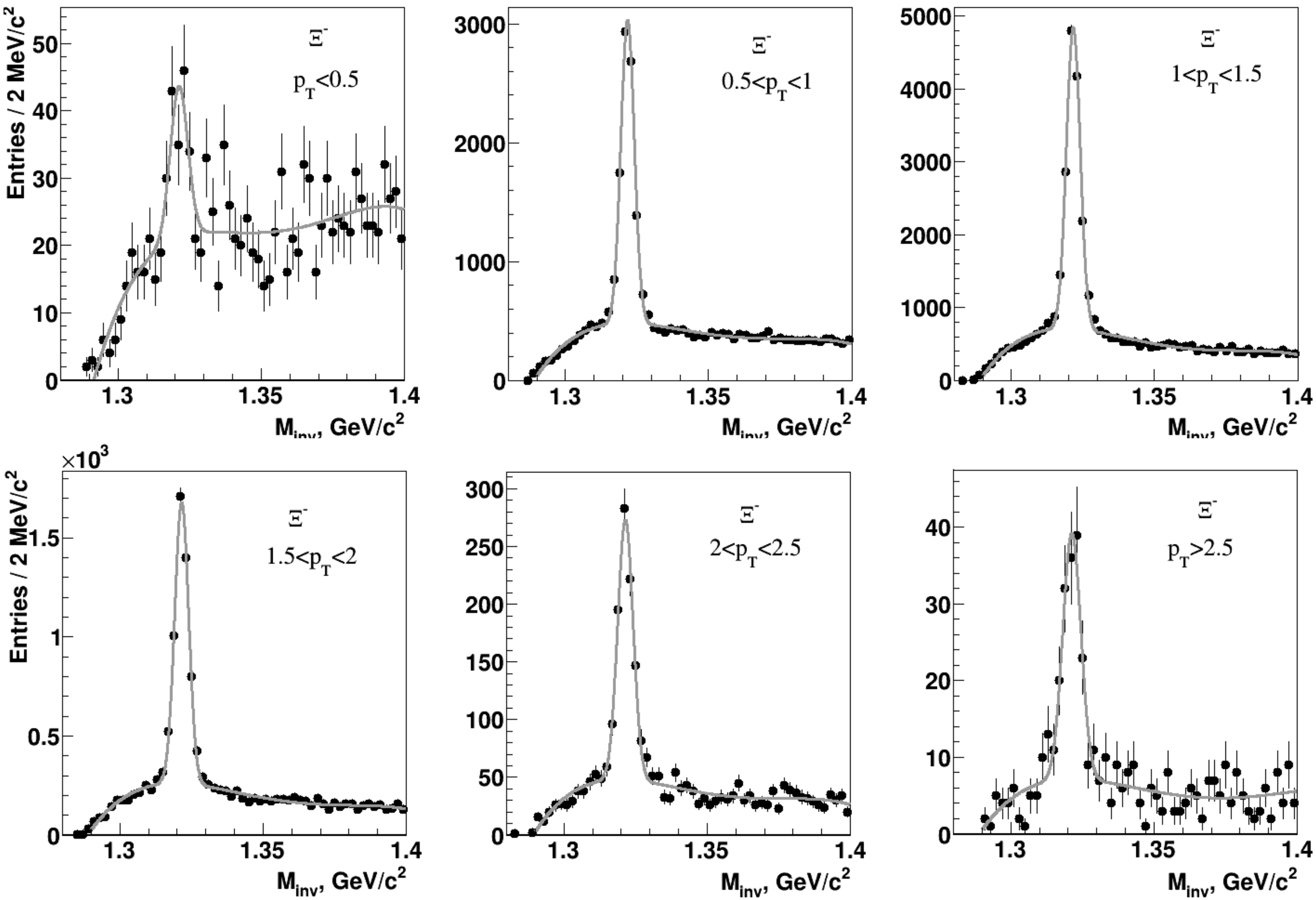
Λ reconstruction: p_T dependence



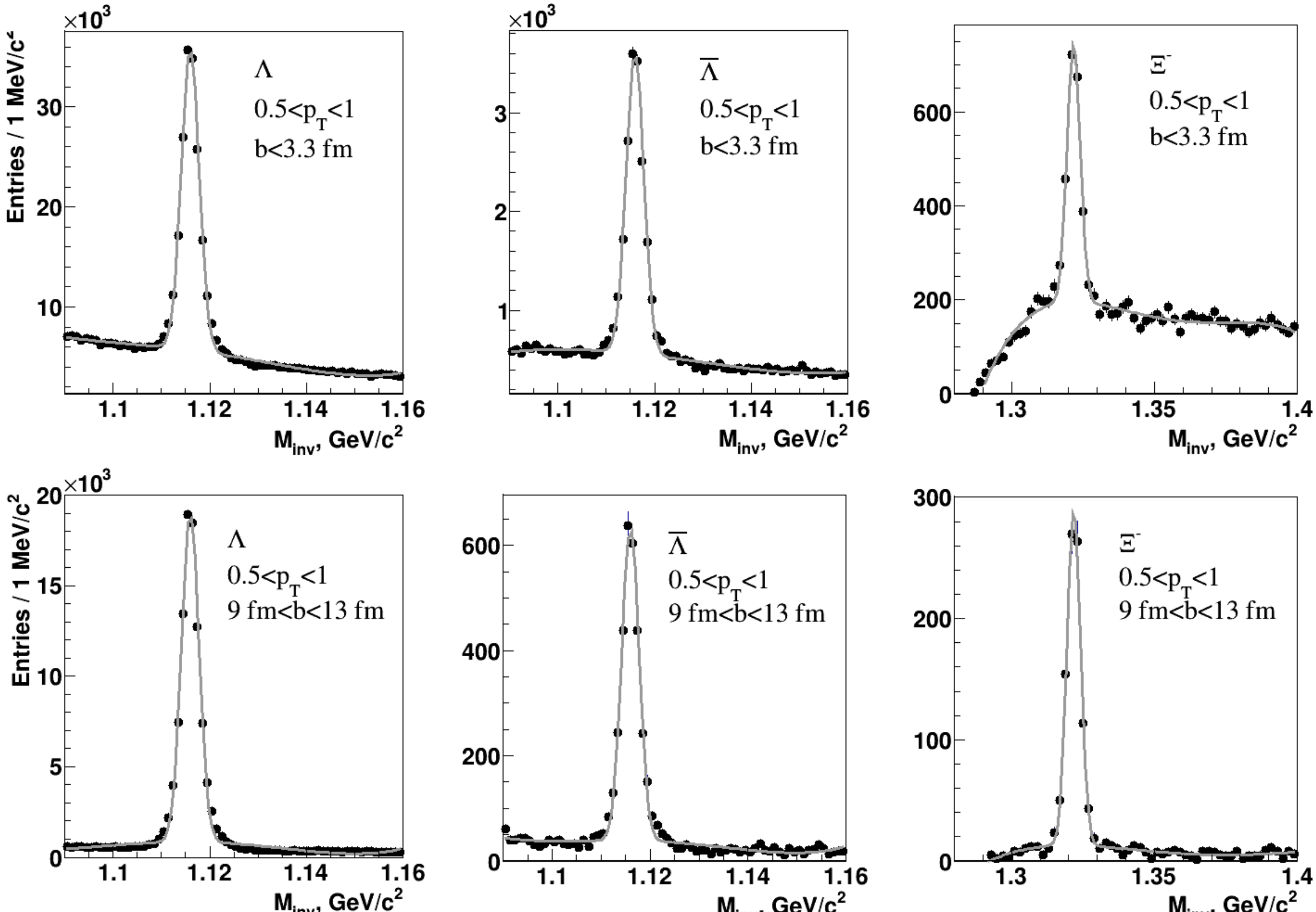
Λ_{bar} reconstruction: p_T dependence



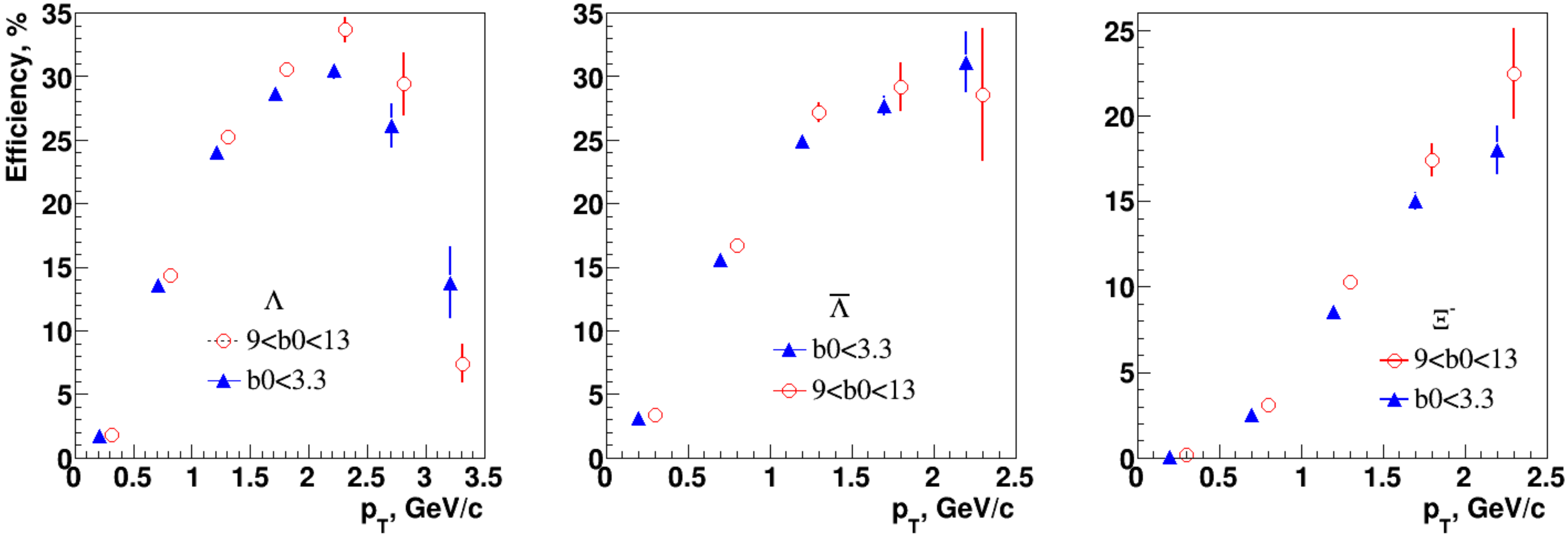
Ξ^- reconstruction: p_T dependence



Hyperons @ different b

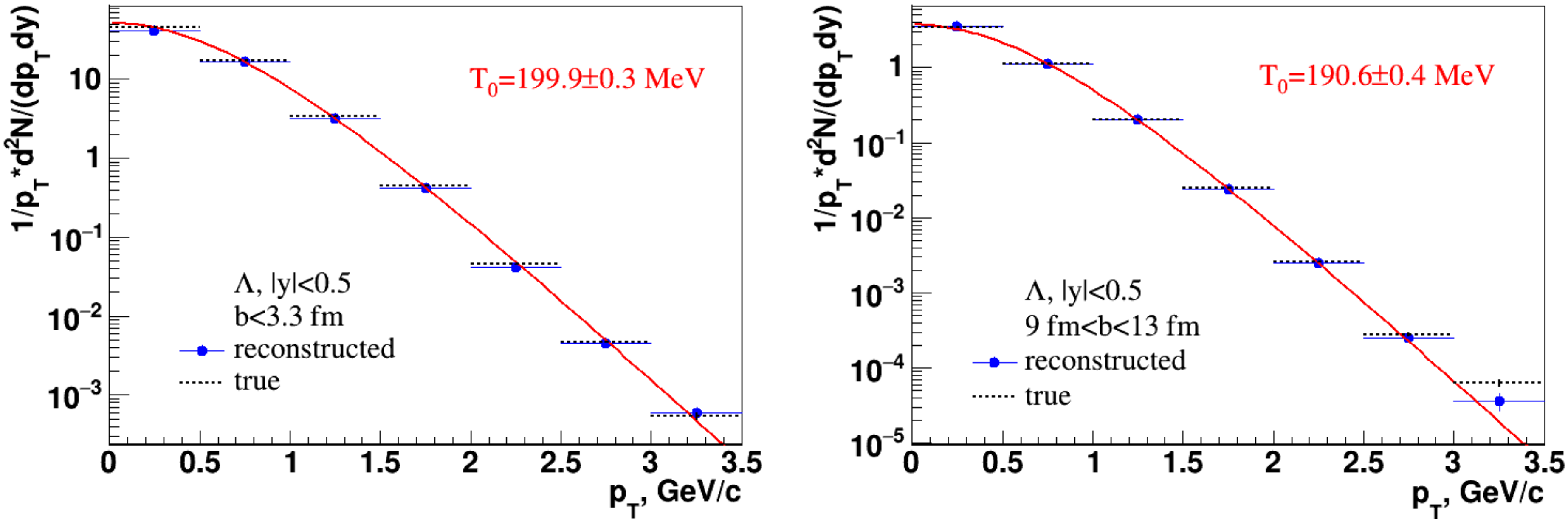


Efficiency of Λ reconstruction



Efficiency of true Λ in p_T&b bins for |y|<0.5: (reco & select Λ) / (all gen Λ)

p_T spectrum of Λ



$$\frac{1}{p_t}\frac{d^2N}{dp_t dy} = Const \cdot \exp\left(-\frac{\sqrt{p_t^2+m^2}-m}{T}\right)$$

where the slope parameter ***T*** is "effective temperature",
m is the hyperon rest mass

Summary and plans

- The MPD detector offers a good opportunity for a study of the strangeness production in heavy-ion collisions at NICA
- The event reconstruction software was created and tested on Monte-Carlo simulated event samples
- We are in the process of developing and testing of analyses procedures and obtaining well-grounded physics performance numbers

Thank you for attention!