PhD Qualification Report

Senjie Zhu(朱森杰)

Supervisor: Yifei Zhang

20th April, 2022

Outline

- Resume
- Scientific research
  - Simulation Setup
  - J/ψ reconstruction
  - Λ_c^+ reconstruction
- Summary and Future research plan

Resume

- Basic information
  - Name: Senjie Zhu
  - Student ID: SA20004063
  - Master Supervisor: Yifei Zhang
  - PhD Supervisor: Yifei Zhang
- Education:
  - 2016-2020: NTU
  - 2020- : USTC

Course

课程名称	成绩	学分	学时
中国特色社会主义理论与实践研究	通过	2	36
自然辩证法概论	通过	1	20
研究生综合英语	通过	2	40
日常交流英语	通过	2	40
高等量子力学	82	4	80
量子场论	82	4	80
粒子探测技术	78	4	80
原子核物理导论	82	4	80
粒子物理导论	86	4	80
现代数学物理方法	85	4	80
对撞物理	93	4	80
高能物理实验数据分析	75	4	80
核与粒子物理实验方法	83	4	80

学号：SA200040630	姓名：朱森杰	校验结果：尚未合格
您适用的培养计划标准：	物理学硕士	重新进行培养计划校验
培养计划校验详情：	缺学位论文开题报告；	
培养计划标准备注：		

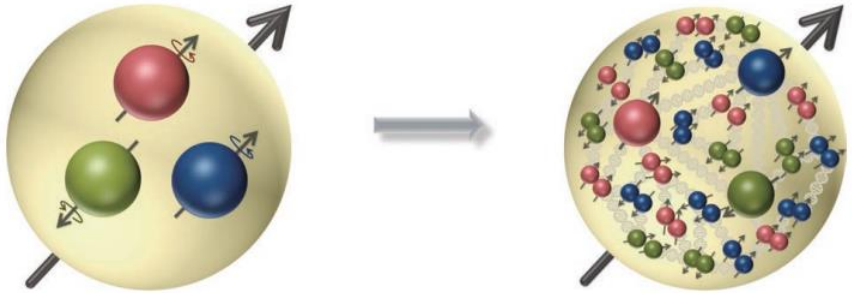
培养计划要求	已经获得学分	是否合格
总学分(带必修环节)>=35	总学分=43	合格
基础课加权平均>=75	基础课加权平均=83	合格
基础课学分>=16	基础课学分=36	合格
学科基础课学分>=8	学科基础课学分=16	合格
公共必修课学分=7	公共必修课学分=7	合格
基础英语课学分>=2	基础英语课学分=2	合格
应用英语课学分>=2	应用英语课学分=2	合格
学位论文开题报告		尚未合格

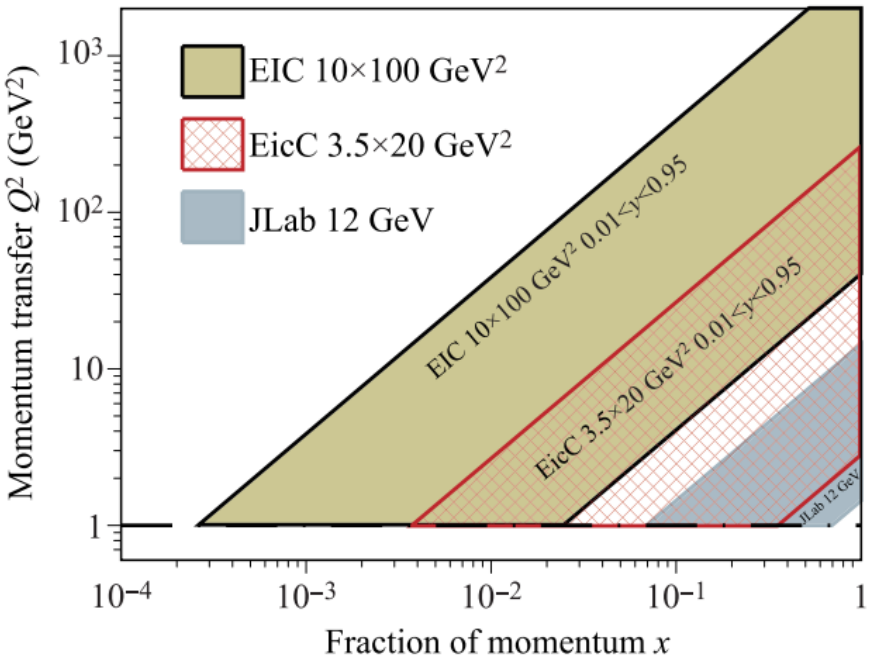
GPA: 3.37

Average score of basic course: 83

Total Credit: 43

EicC(Electron ion collision of China) and Nuclear Structure

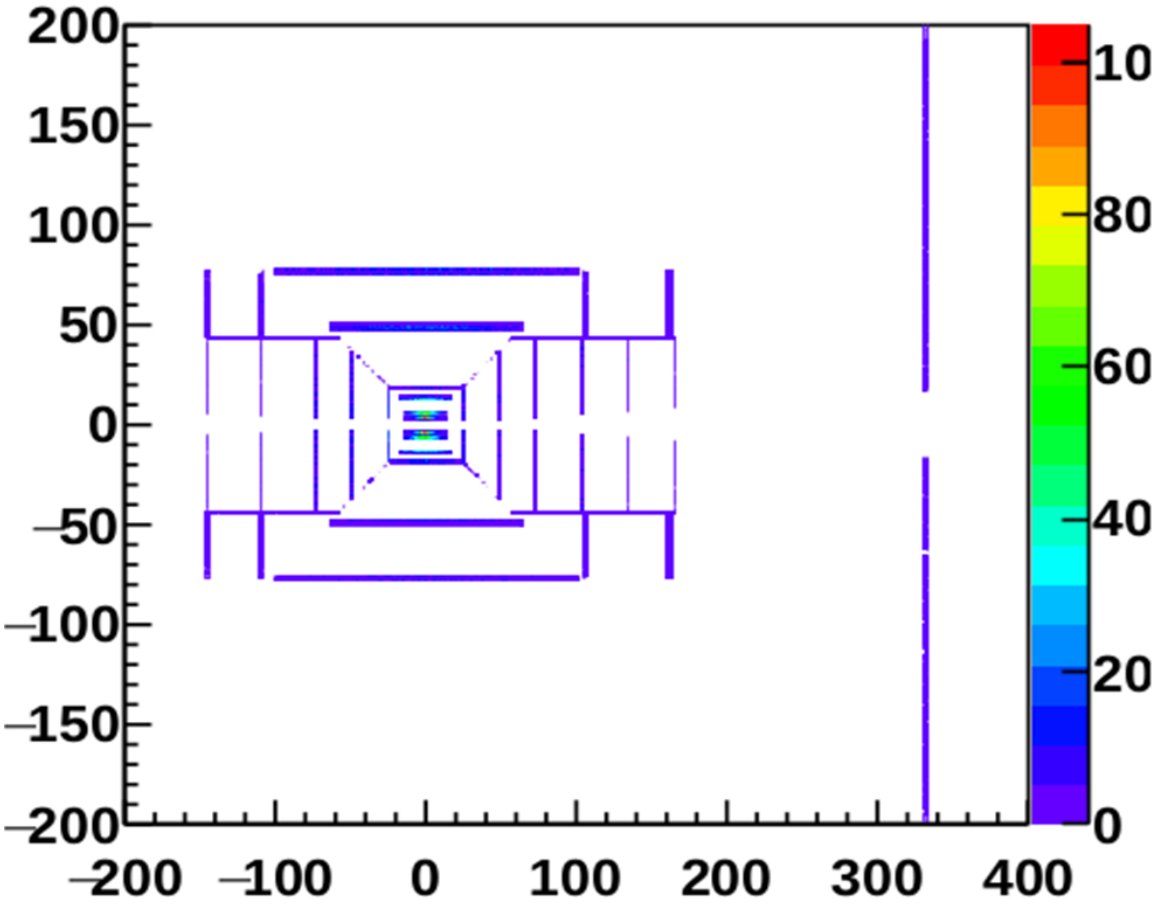




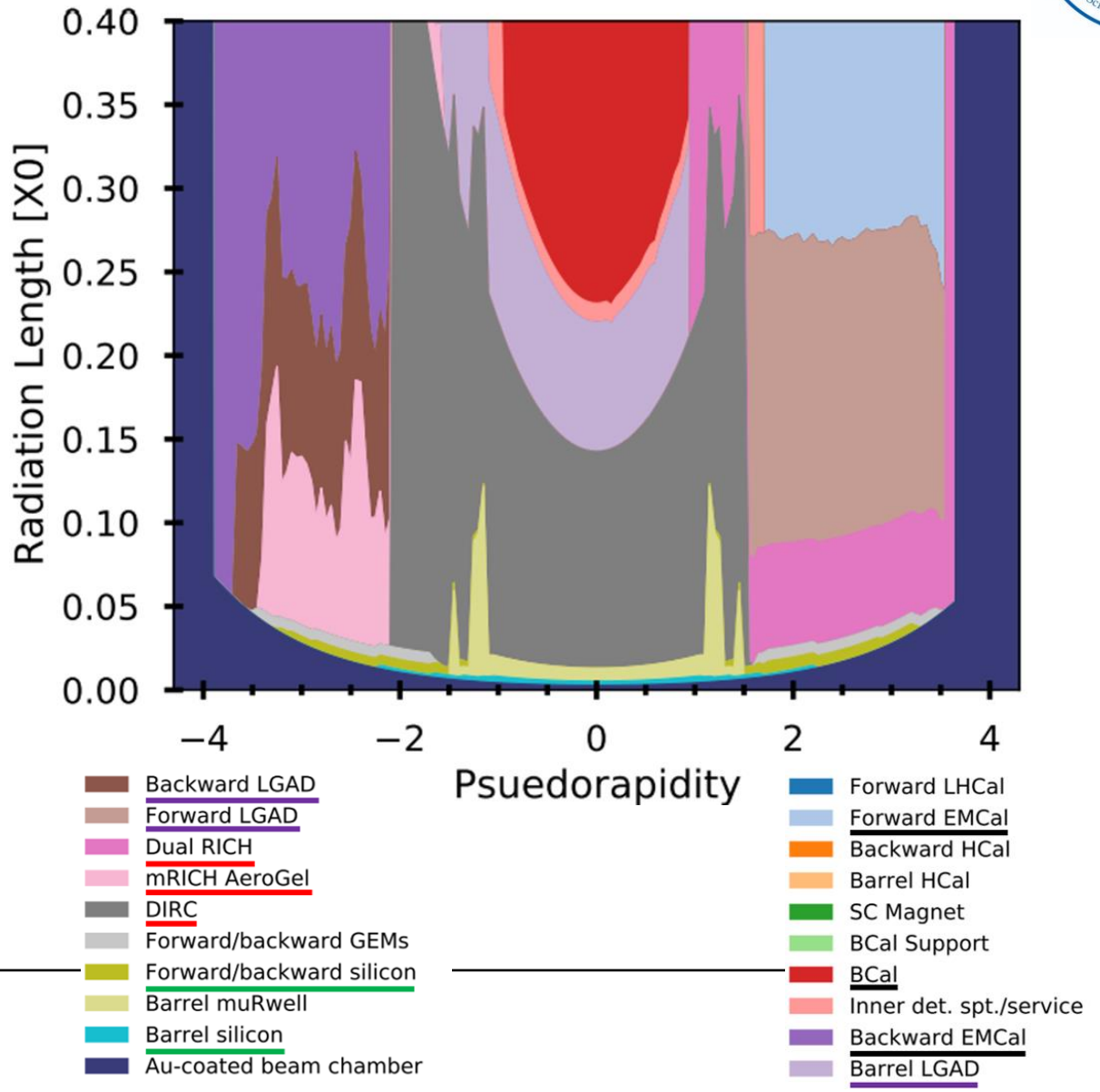
- How does the spin of proton arise? (Spin puzzle)
- What are the emergent properties of dense gluon system?
- How does proton mass arise?
- How does gluon bind quarks and gluons inside proton?
- Can we map the quark and gluon inside the proton in 3D?
- Proton radius puzzle.
- Hadronization and parton energy loss in nuclear medium.

Detector Geometry

- Tracking & vertex Detectors

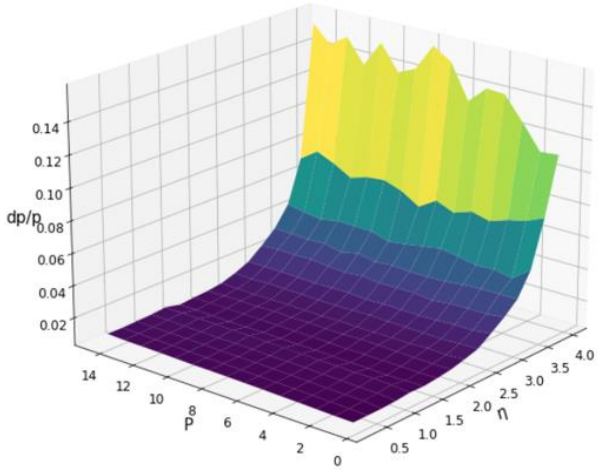


- PID Detectors(ECCE)

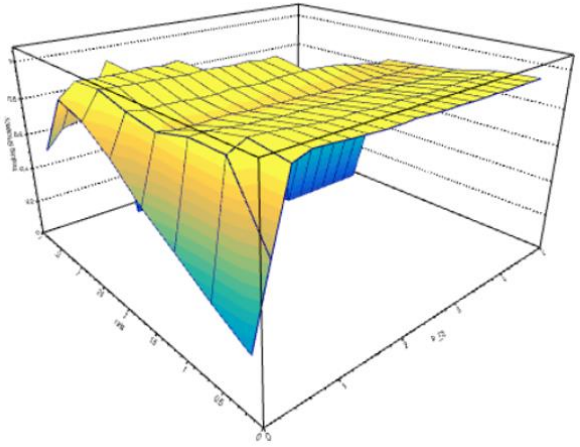


Simulation Setup

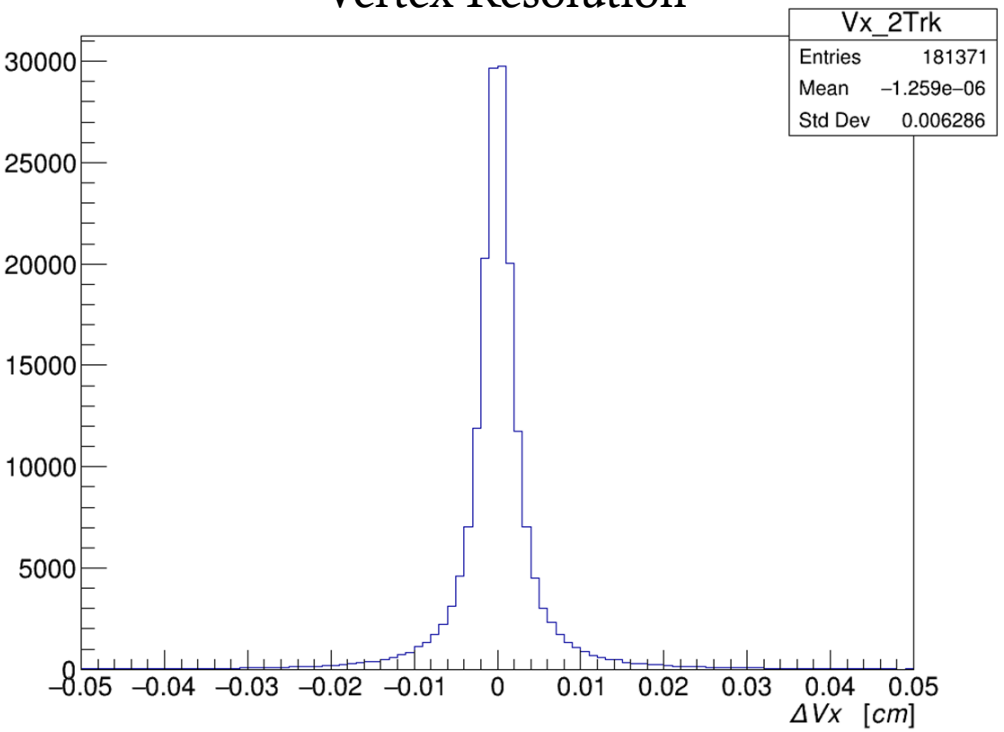
Momentum Resolution



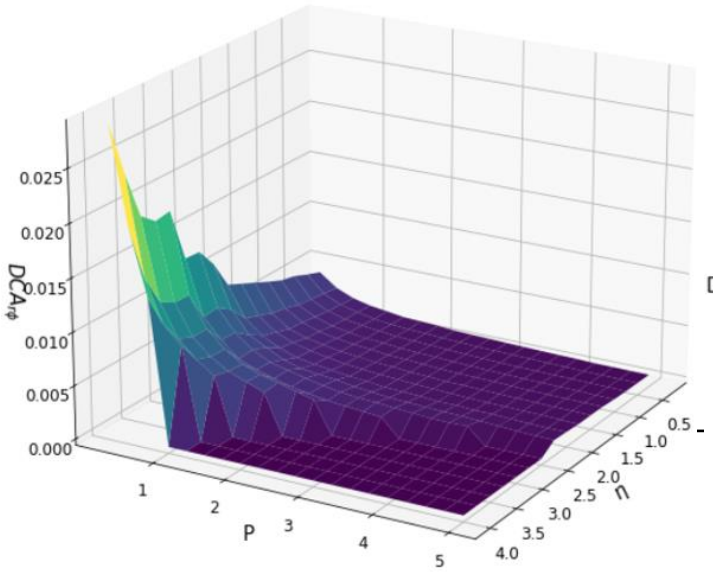
Tracking Efficiency



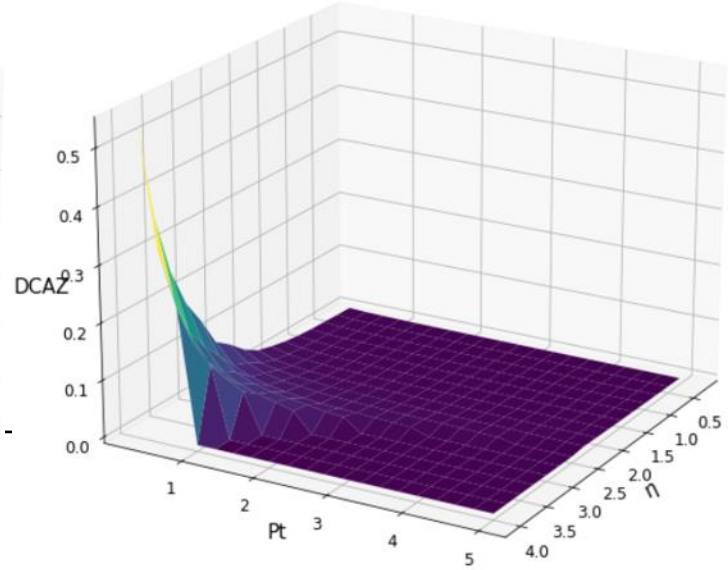
Vertex Resolution



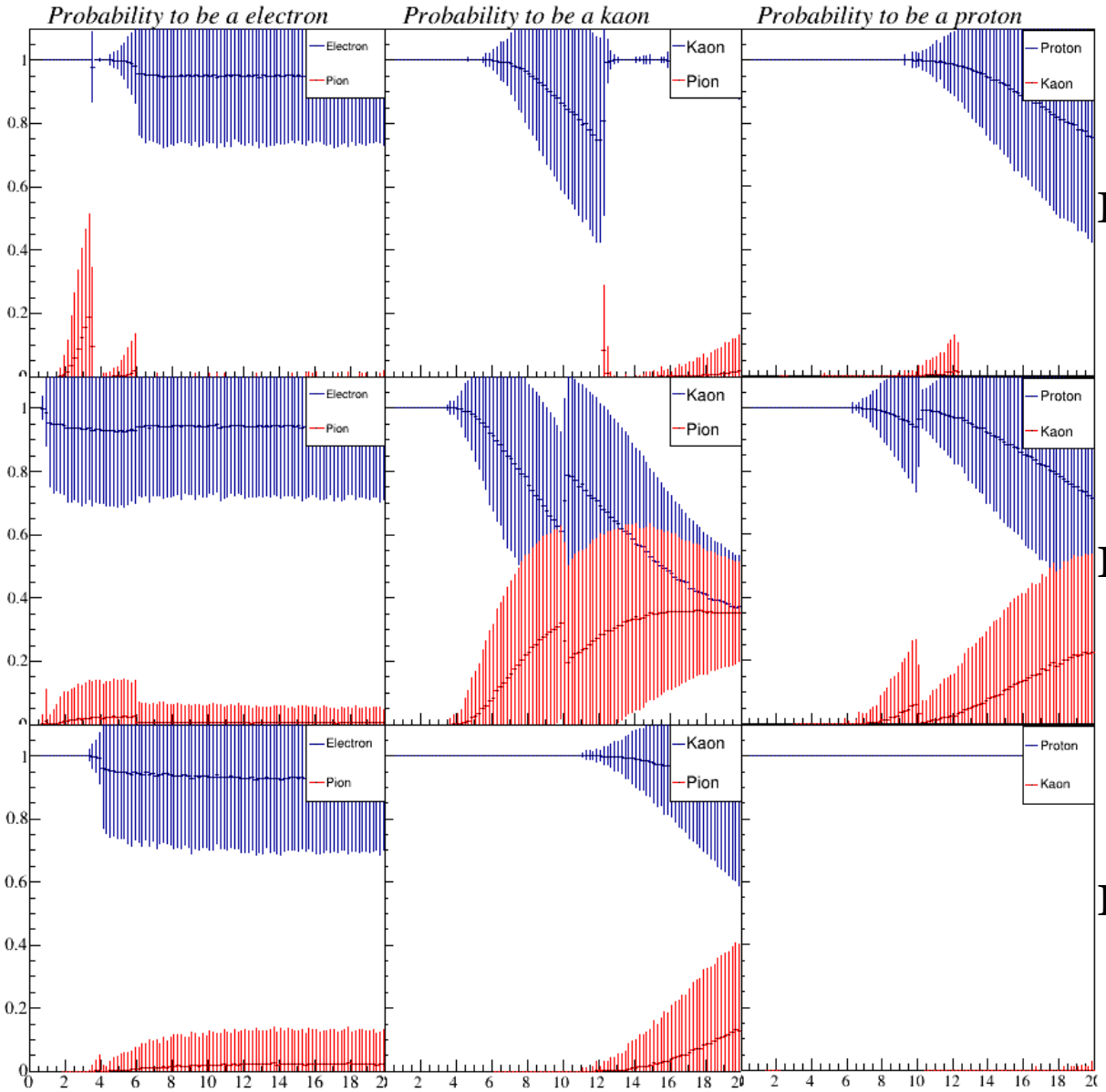
$DCA_{r\phi}$ Resolution



DCA_z Resolution



Simulation Setup



$P(PID|A)$:Probability to be with PID in situation A

$P(PID|A)$:Probability of situation A if the particle is with PID

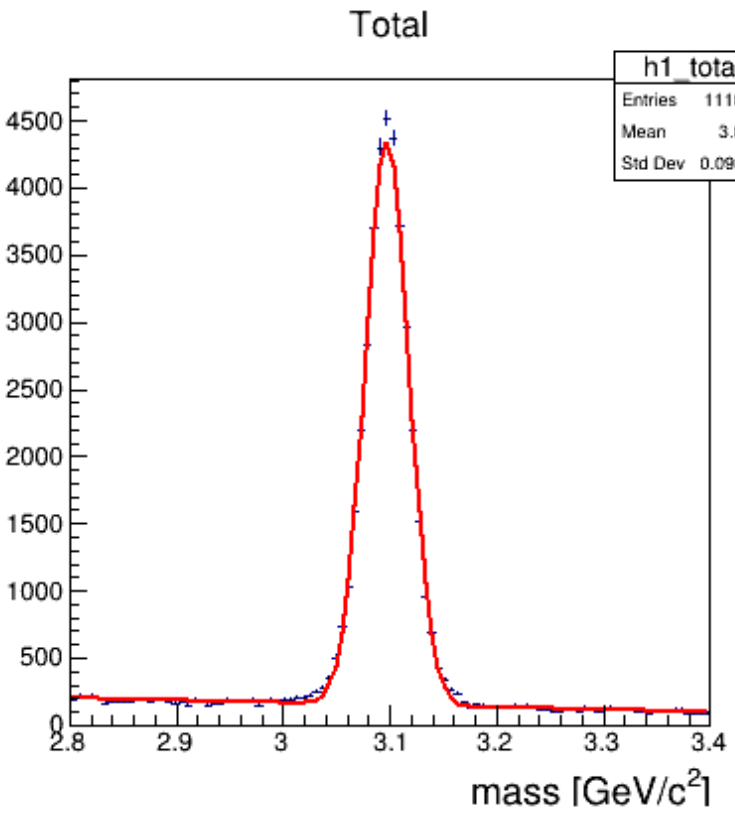
$$P(PID|A) = \frac{P(A|PID)}{\sum_{PID_i} P(A|PID_i)}$$

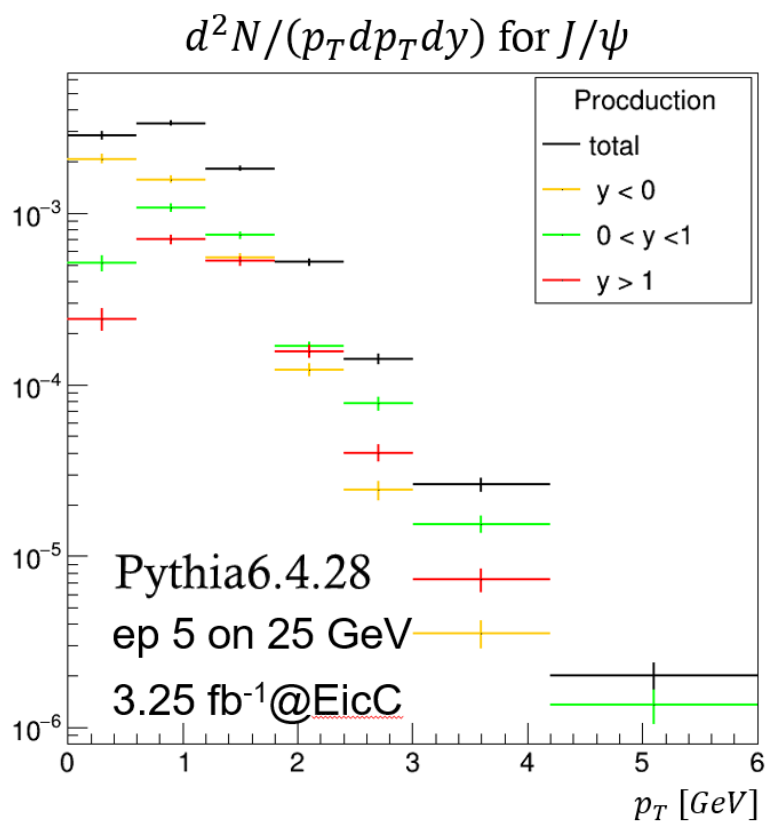
PID_i: e, π, k, p

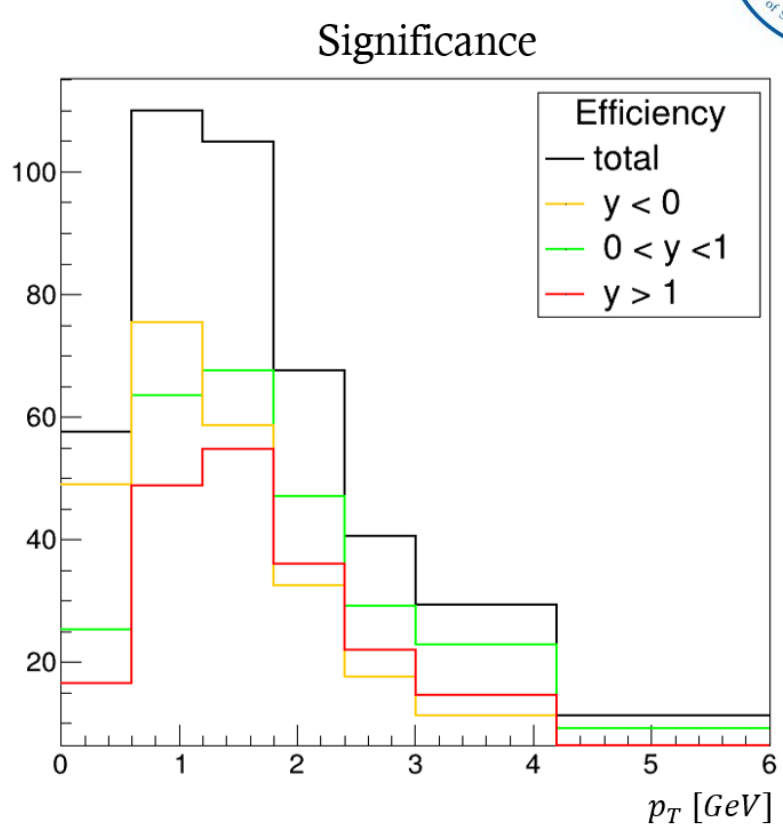
$P(PID|A)$ is calculated with the chi-squared distribution of n dimensions(n is the number of used detectors)
where $\Sigma^{n}_{detector}\sigma^{2}_{detector}(A|PID)$ is the variable

$$\sigma_{detector} = \frac{situation\ A - expected\ detector\ response\ of\ specific\ PID}{resolution\ of\ the\ detector}$$

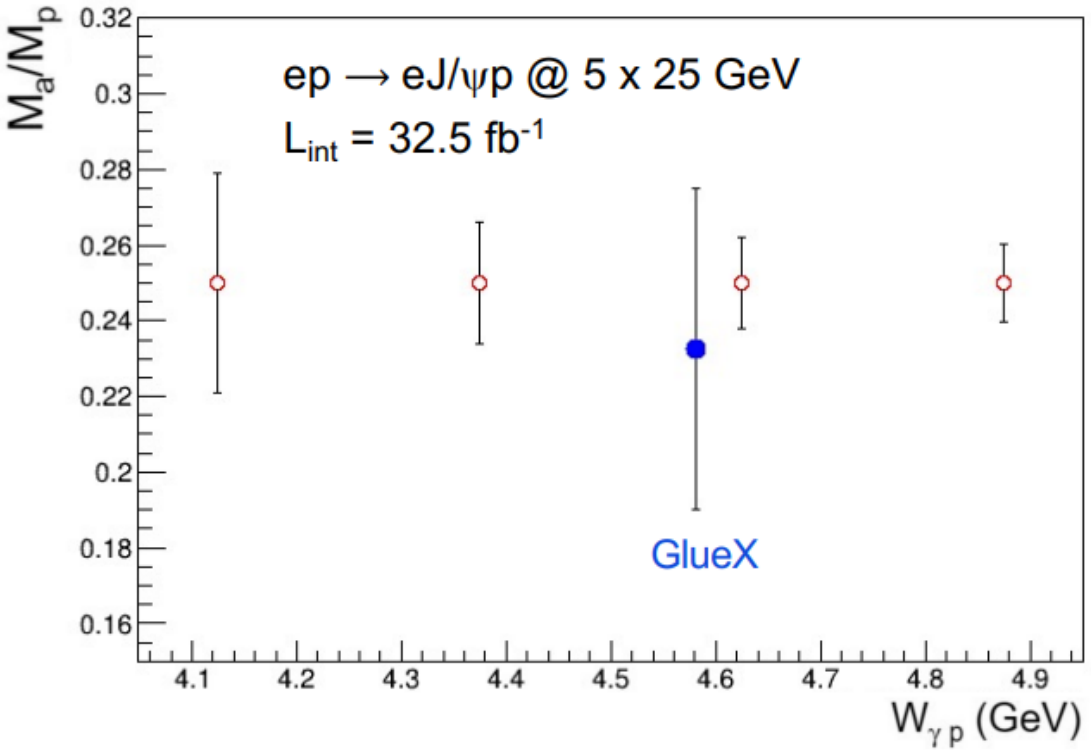
J/ψ reconstruction







J/ψ reconstruction and Trace anomaly



Guzey, Zhalov, JHEP 10 (2013) 207; JHEP 02 (2014) 046

- Input from Glauber model
- Statistical error projection of trace anomaly parameter b

$$M_q = \frac{3}{4}\left(a - \frac{b}{1+\gamma_m}\right) M_N,$$

$$M_g = \frac{3}{4}(1-a) M_N,$$

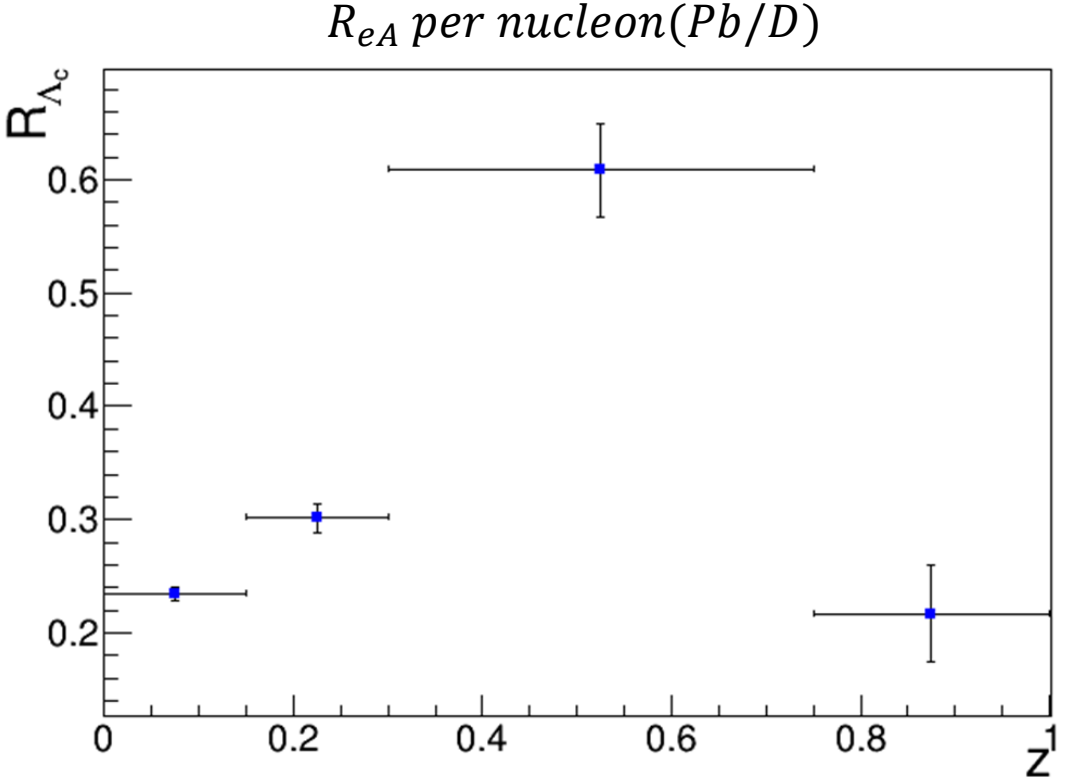
$$M_m = \frac{4+\gamma_m}{4(1+\gamma_m)} b M_N,$$

$$M_a = \frac{1}{4}(1-b) M_N,$$

$$\frac{d\sigma_{J/\psi\, N \to J/\psi\, N}}{dt}\Big|_{t=0} \propto (1-b)^2$$

Eur. Phys. J. C (2020) 80:507

Λ_c^+ reconstruction



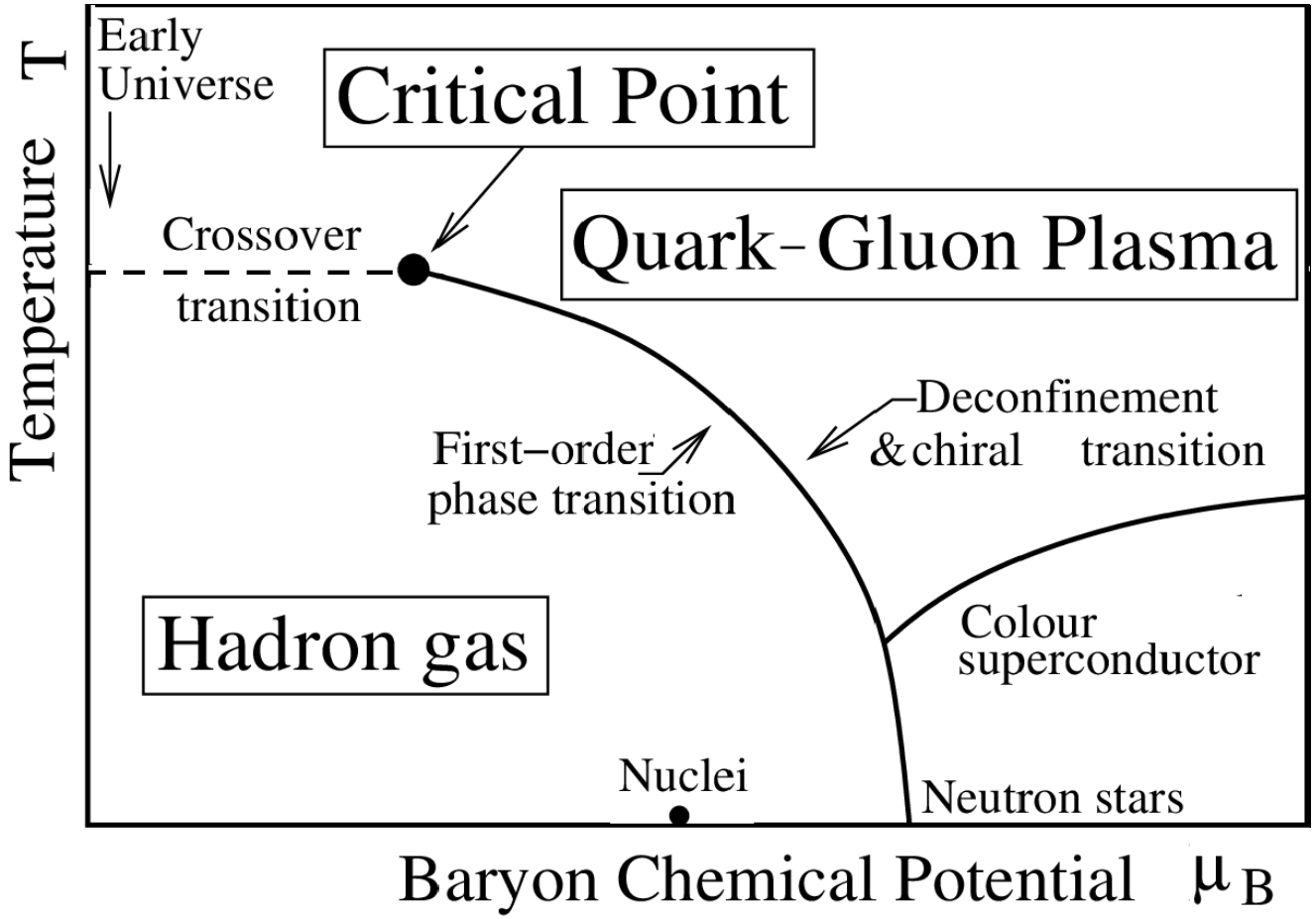
$L_{eD} = 5.4072\ fb^{-1}$ per nucleon
$L_{ePb} = 2.1727\ fb^{-1}$ per nucleon
e(3.5 GeV/c^2) and A(20 GeV/c^2 per charge)

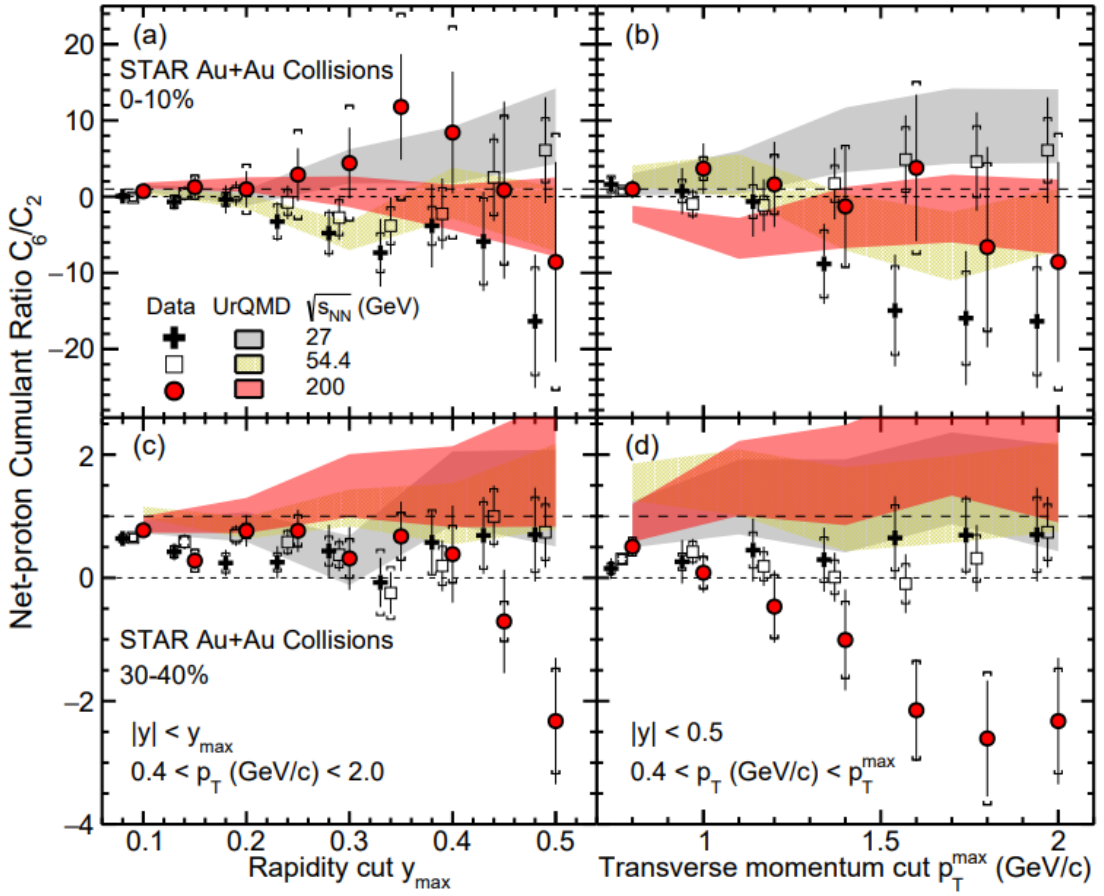
- Input from BeAGLE
- The hadronization dynamics will be affected and eventually leads to different hadron spectrum comparing to that in a vacuum.
- Calculation of the statistical error projection of R(Pb/D)

Summary and Future Plans

- Summary
  - The simulation framework of physics@EicC has been set up.
  - J/ψ and Λ_c^+ have been reconstructed.
  - The statistical error projection of trace anomaly parameter b has been calculated.
    - This result has been showed at EicC 1st CDR Workshop.
  - The statistical error projection of $R_{eA}(Pb/D)$ has been calculated.
- Future Plans
  - Models of hadronization will be studied to learn more about the EicC detector sensitivity.
  - STAR data analysis: C_6 of net proton

C_6 of net proton





Phys. Rev. Lett. 127, 262301

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