# A toy model of J/Psi suppression at RHIC

Y. Akiba, KEK
Light/Heavy PWG
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# Motivation

- NA50 observed "anomalous" J/Psi suppression in Pb+Pb collisions at SPS

- They interpret the data as
  $\chi_c$ (30-40% of J/Psi) melts at $\varepsilon$ = 2.3 GeV/fm$^3$
  J/Psi (rest) melts at $\varepsilon$ = 3.2 GeV/fm$^3$

- If those interpretation is correct, then, what is expected at RHIC Au+Au collisions
  - What fraction of J/Psi survive?
  - What is dN(J/Psi)/dEt?

- As an attempt to answer those question, I made a toy model of J/Psi suppression

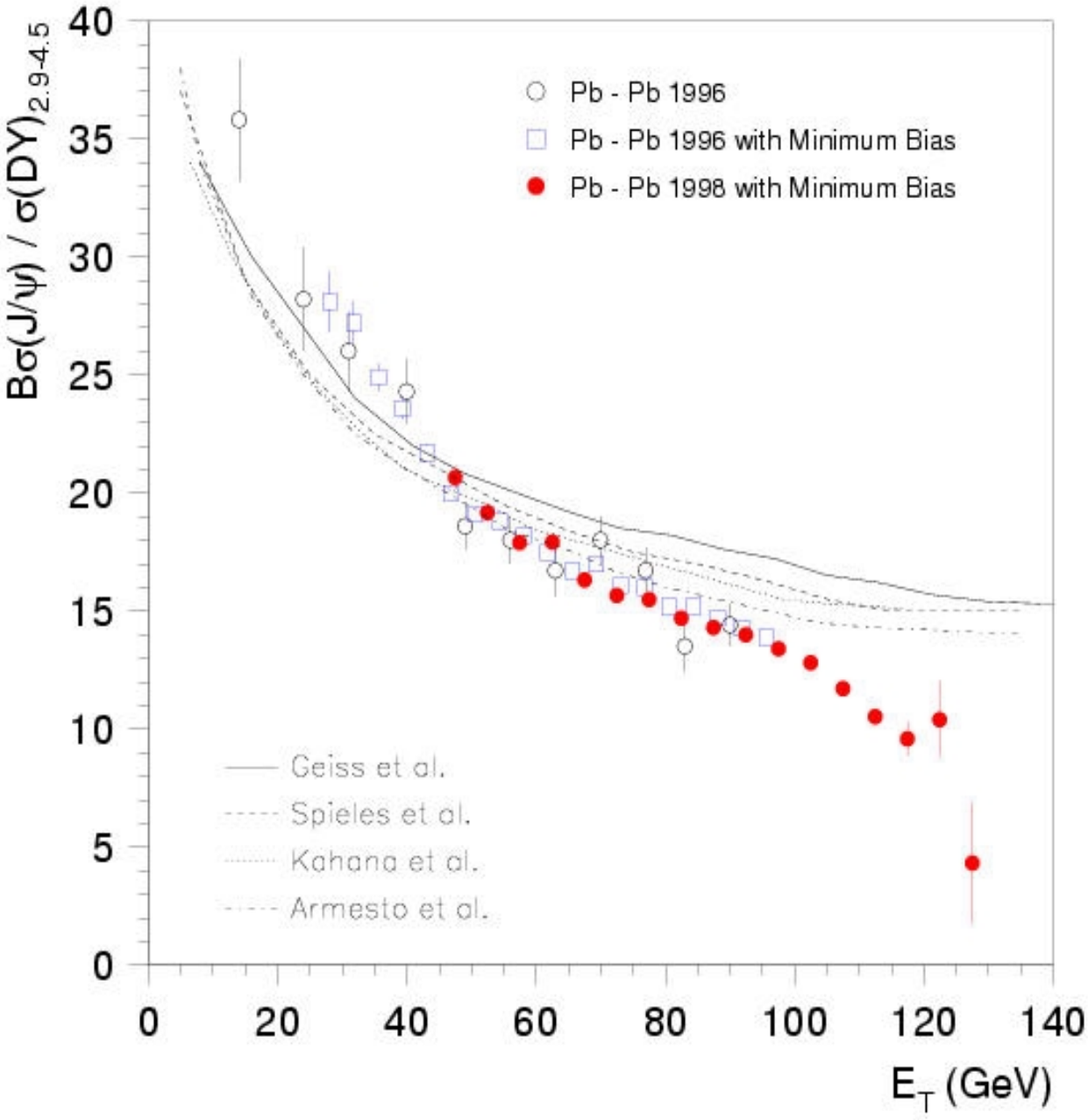
# A toy model

- Use a realistic nuclear geometry to calculate number of participants and number of nucleon-nucleon collisions in A+A collision
- The calculation is 2-dimensional. The energy density in a transverse plane (normal to the beam direction) is considered
- For simplicity of the caluculation, the transverse plane of the nuclear collision is divided into cells of 0.5 fm x 0.5 fm, and number of participants and number of N+N collisions in each cell is calculated.
- Calculate the Et produced in each cell as
  - Each participant nucleon (wounded nucleon) produces Et of 1.0 GeV
  - Each N+N collision produces Et of
    - 0 GeV at SPS
    - 0.8 GeV at RHIC
- The produced Et is distributed over a certain area around the cell. The size of the area where the Et is distributed is a parameter of the model. The size of the area from 3x3 cells to 13x13 cells are tried. For simplicity of the calculation, it is assumed that the energy is distributed uniformly over the area.

# A toy model (2)

- The initial production of J/Psi in each cell is assumed to be proportional to number of N+N collisions in the cell.
- If the energy density in the cell exceeds a certain threshold, J/Psi's in the cell is killed. The threshold value is also a parameter of the model. The value of the threshold is adjusted so that NA50 data is approximately reproduced. Then, the same threshold value is used for RHIC case.
- There are two threshold. At lower threshold, 35 % of J/Psi is killed (suppression of $\chi_c$). At higher threshold, the rest of J/Psi is killed
- J/Psi is also absorbed by nucleons. This was calculated from the number of participants in each cell, assuming the nuclear absorption cross section of 6 m barn.

# NA50 data

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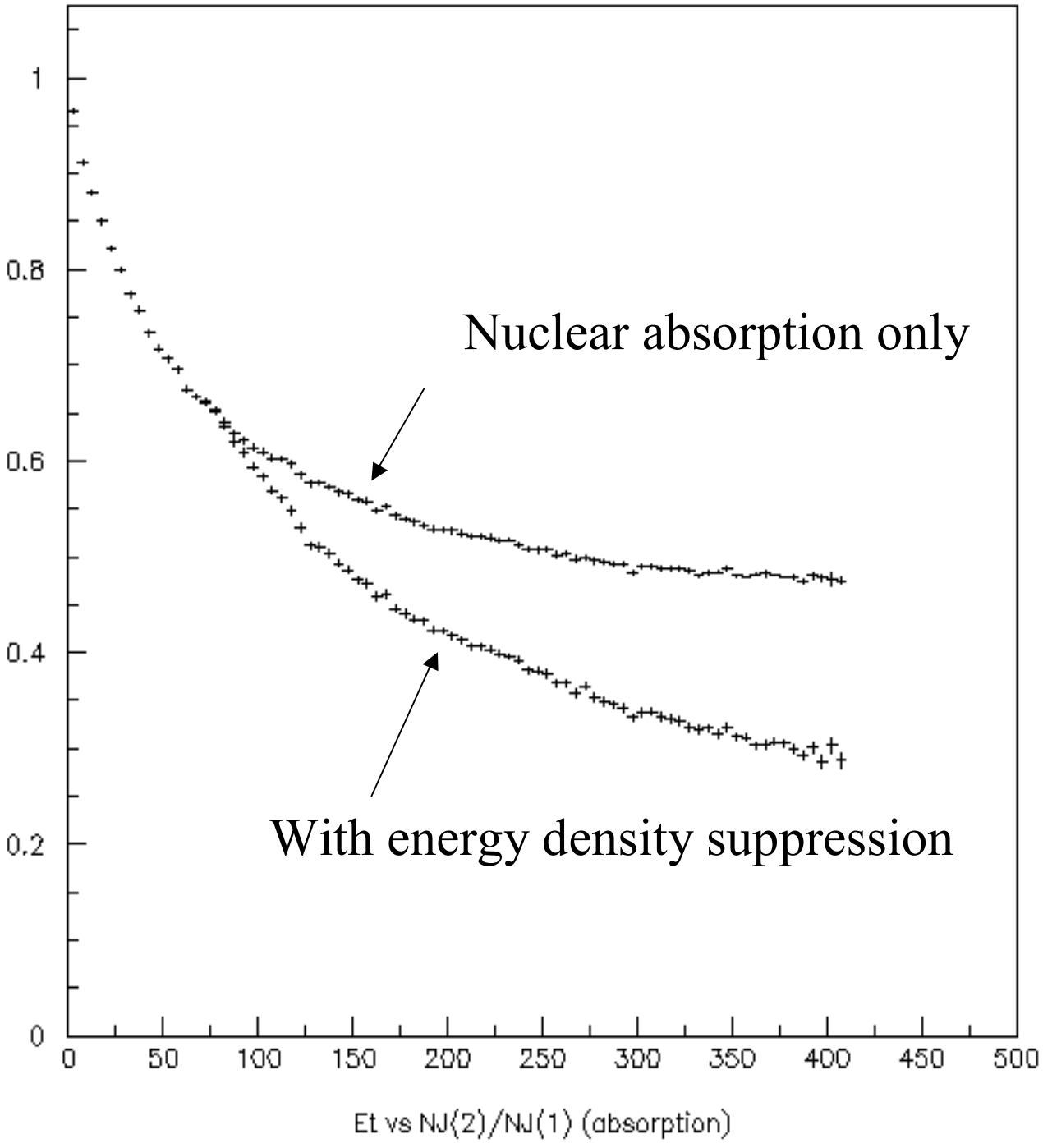
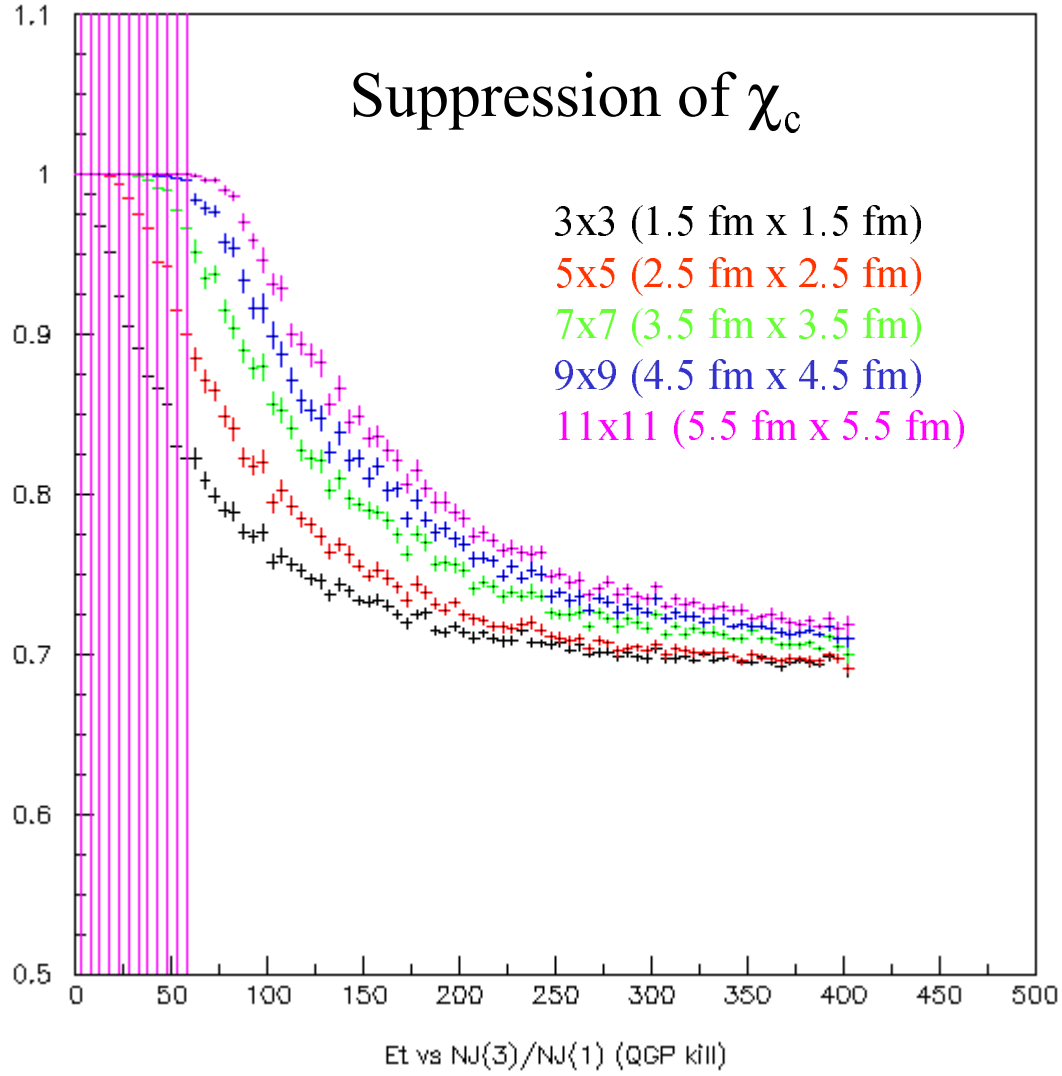
# Toy model calculation



# Threshold-like behavior and area size




In the toy model, the threshold-like behavior of the suppression is controlled by the size of the area the energy of from a wounded nucleon is spreaded. A large size is required to produce a sharper threhsold-like effect.

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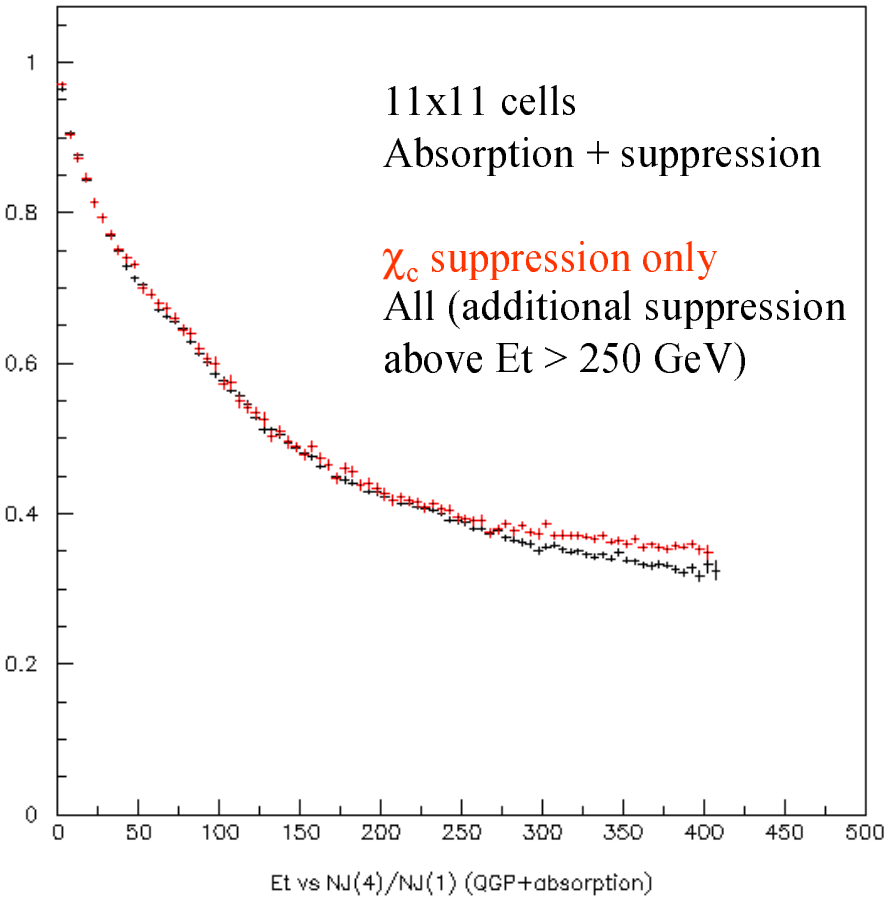
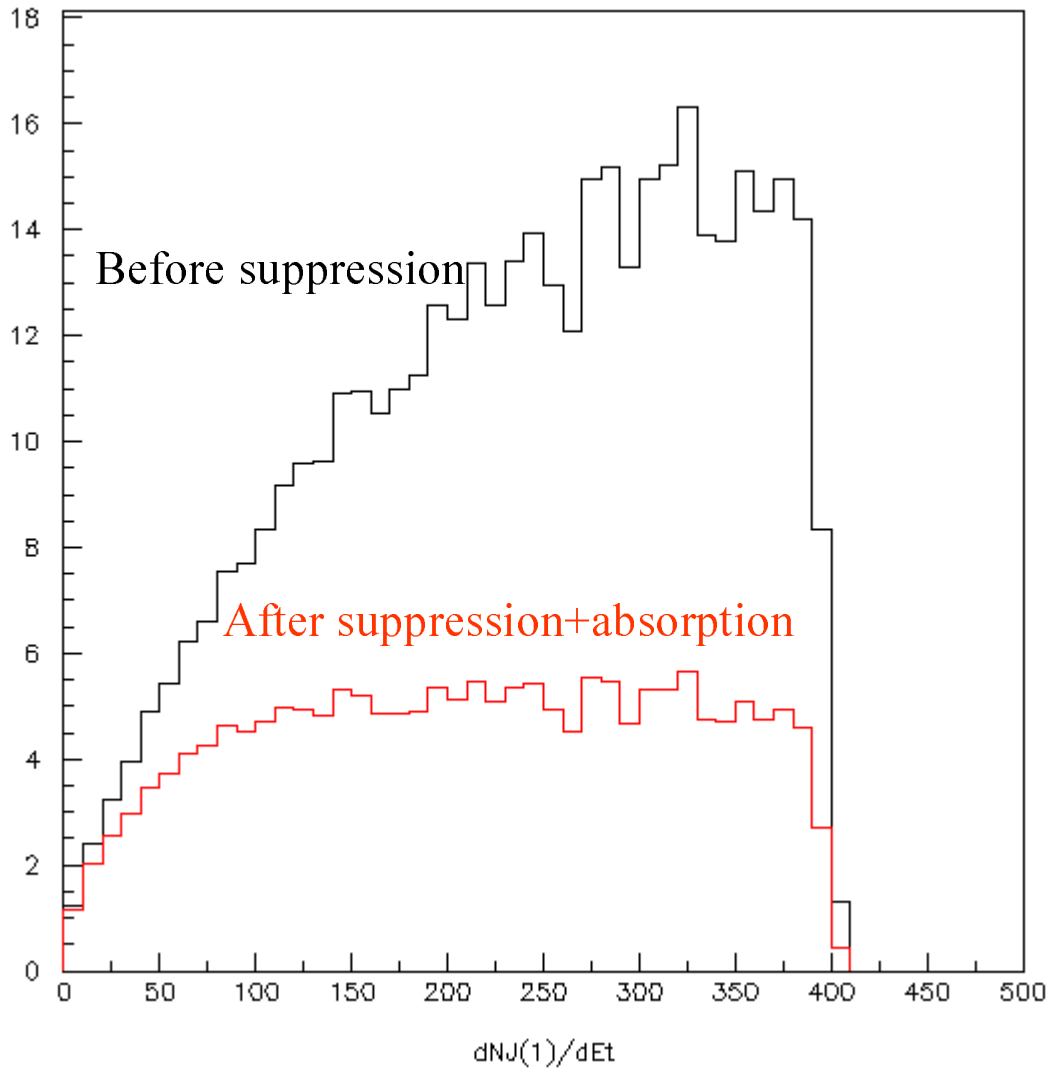
# Second suppression threshold?




It is difficult to reproduce the second sharp suppression.
The reason is not well understood.

# dN/dEt of J/Psi (SPS)

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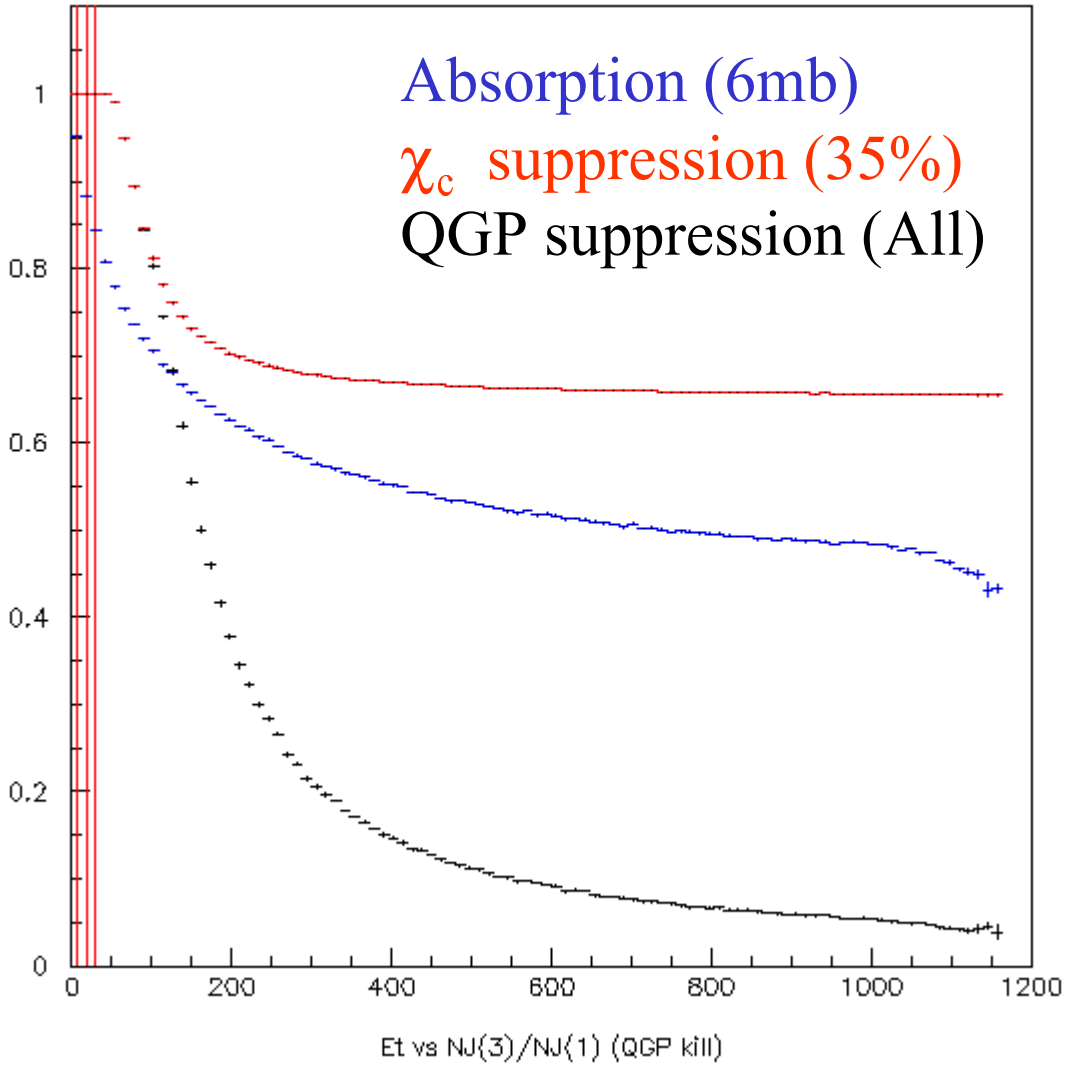
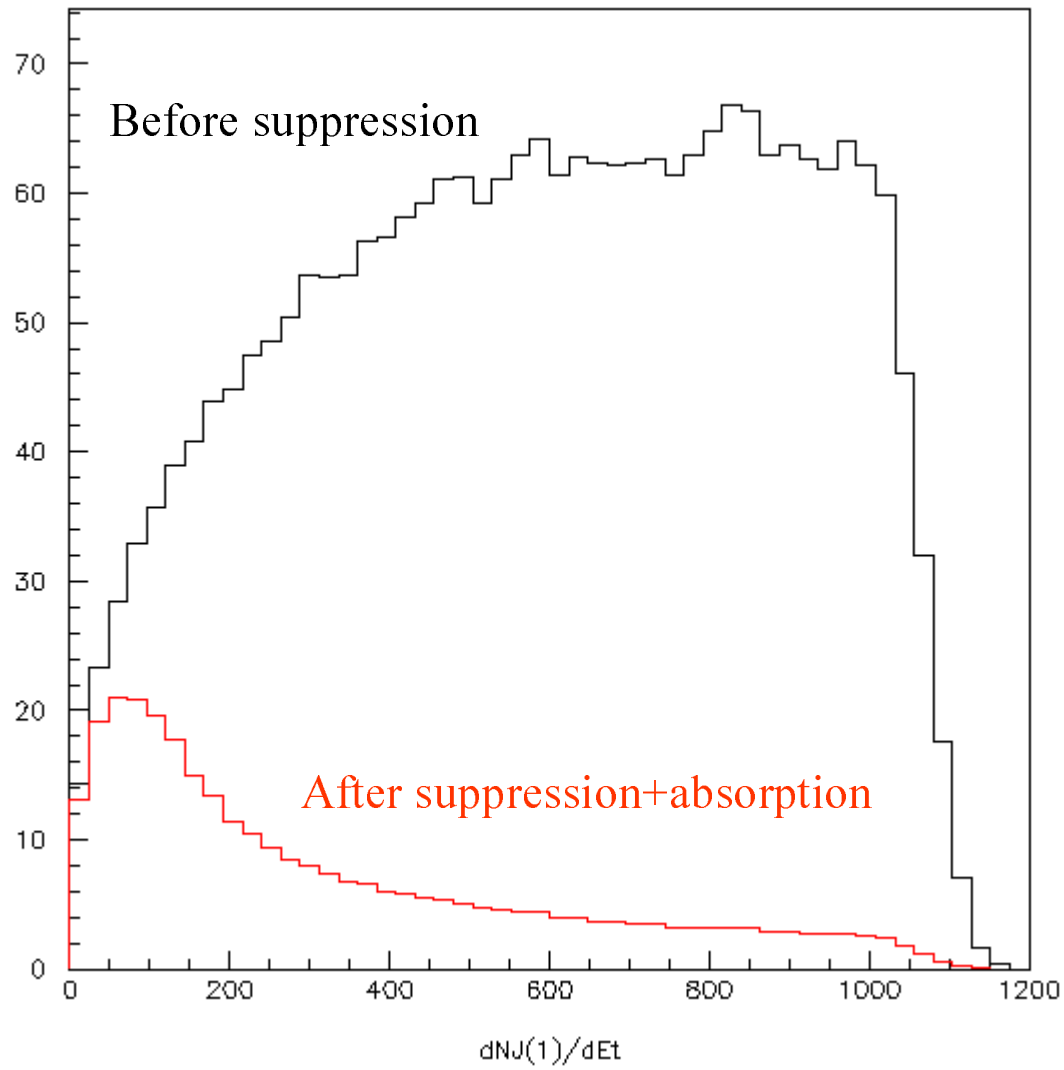
# Simple extrapolation to RHIC




At RHIC, suppression starts at very peripheral collision.
The suppression at the central collision is > 90%.
The threshold, in terms of Et, is almost the same point as the SPS case (about 100 GeV)

# dN/dEt of J/Psi (RHIC)




In this simple extrapolation, the suppression is so strong that only J/Psi's in peripheral events survive, and there is a peak of dN/dEt at Et~100 GeV

Total survival probability is about 13 %

# How many J/Psi we will observe?

For 20 $\mu b^{-1}$ integrated luminosity and 2 half arm configuration, # of J/Psi accepted in central arms is about 400, if there is no suppression or absorption.

If the suppression is as strong as the toy model suggests, the number of J/Psi's is then about 50 in the Year-1

The distribution (dN(J/Psi)/dEt) will be as follows

| | |
|---|---|
| 0 < Et < 120 GeV | 16 events |
| 120 <Et < 240 GeV | 11 events |
| 240 <Et < 480 GeV | 11 events |
| 480 <Et < 960 GeV | 12 events |

The statistics is not great, but we can probably make a dN/dEt plot in 4 or 5 bins. This will be sufficient to show the very strong suppression at RHIC

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# Lighter nucleus