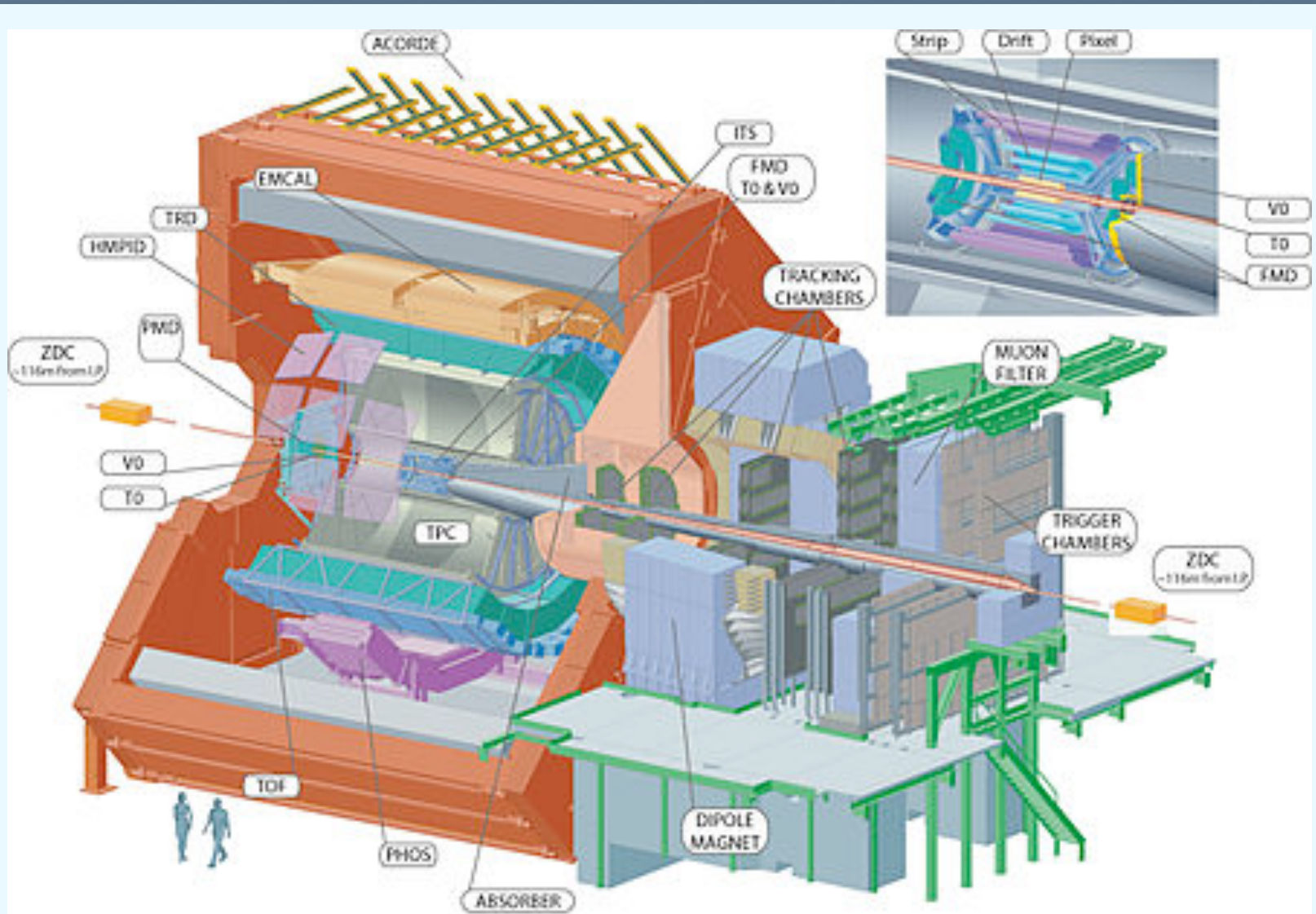


# **PHY397K - NUCLEAR PHYSICS - 2**

**PHY397K - NUCLEAR PHYSICS**  
**Spring 2015, Unique numbers: 57115**  
**RLM 5.116, TTH 12:30 - 2:00 pm**

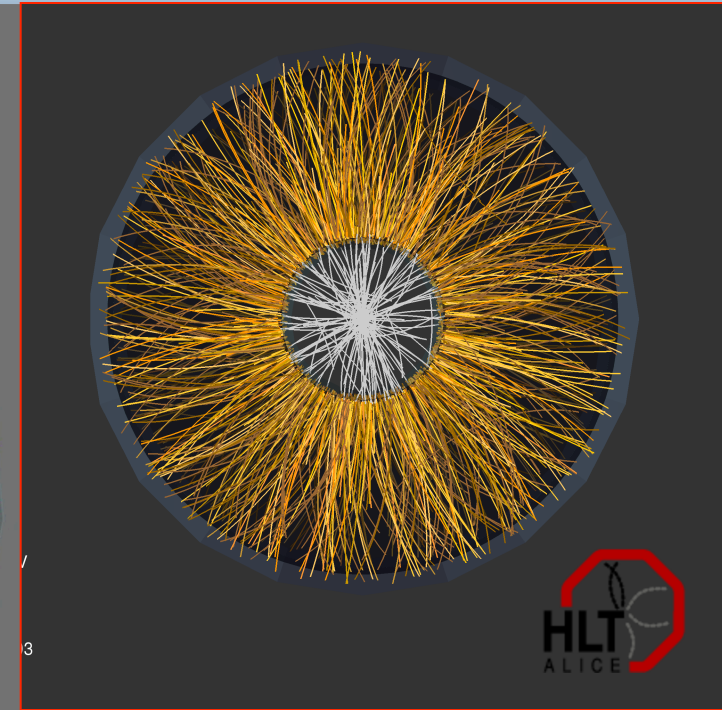
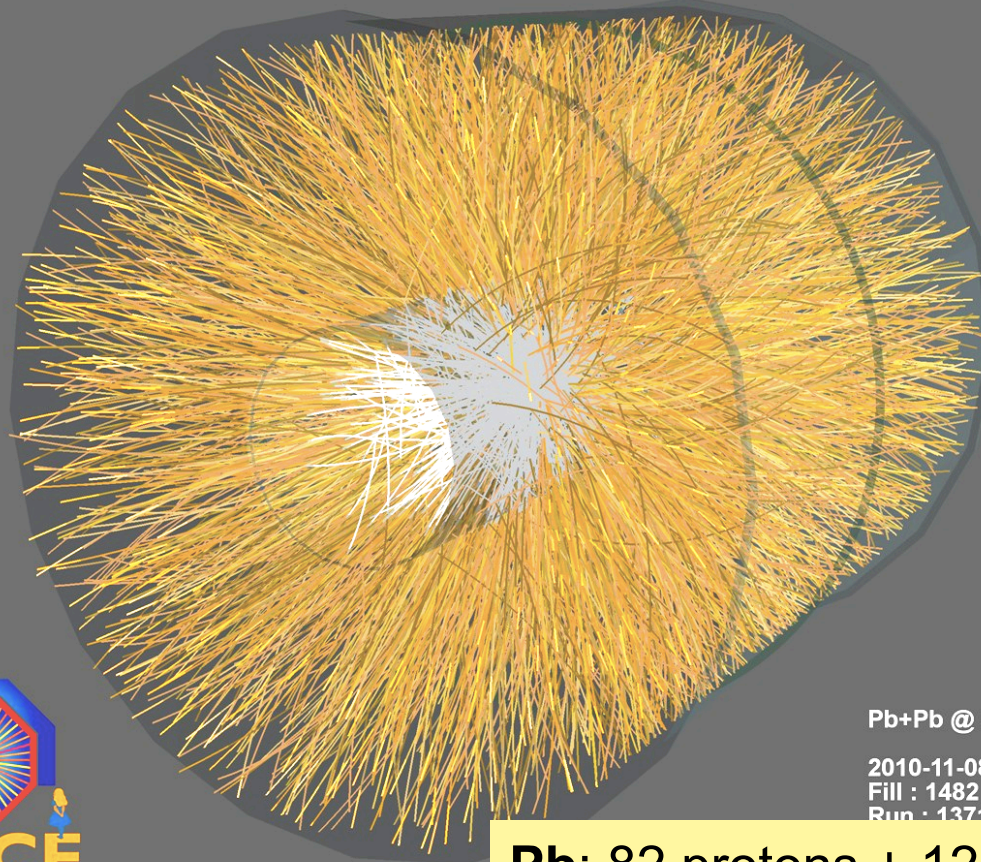
**Christina Markert**  
**Office: RLM: 10.305**  
**Phone: 512 471 8834**  
**Email: [cmarkert@physics.utexas.edu](mailto:cmarkert@physics.utexas.edu)**

# ALICE detector



# Central Pb+Pb collision (energy = 2.76 TeV)

Head-on Pb+Pb collision in ALICE TPC



Pb+Pb @ sqrt(s) = 2.76 ATeV

2010-11-08 11:30:46

Fill : 1482

Run : 137124

**Pb:** 82 protons + 126 neutrons = 208 hadrons

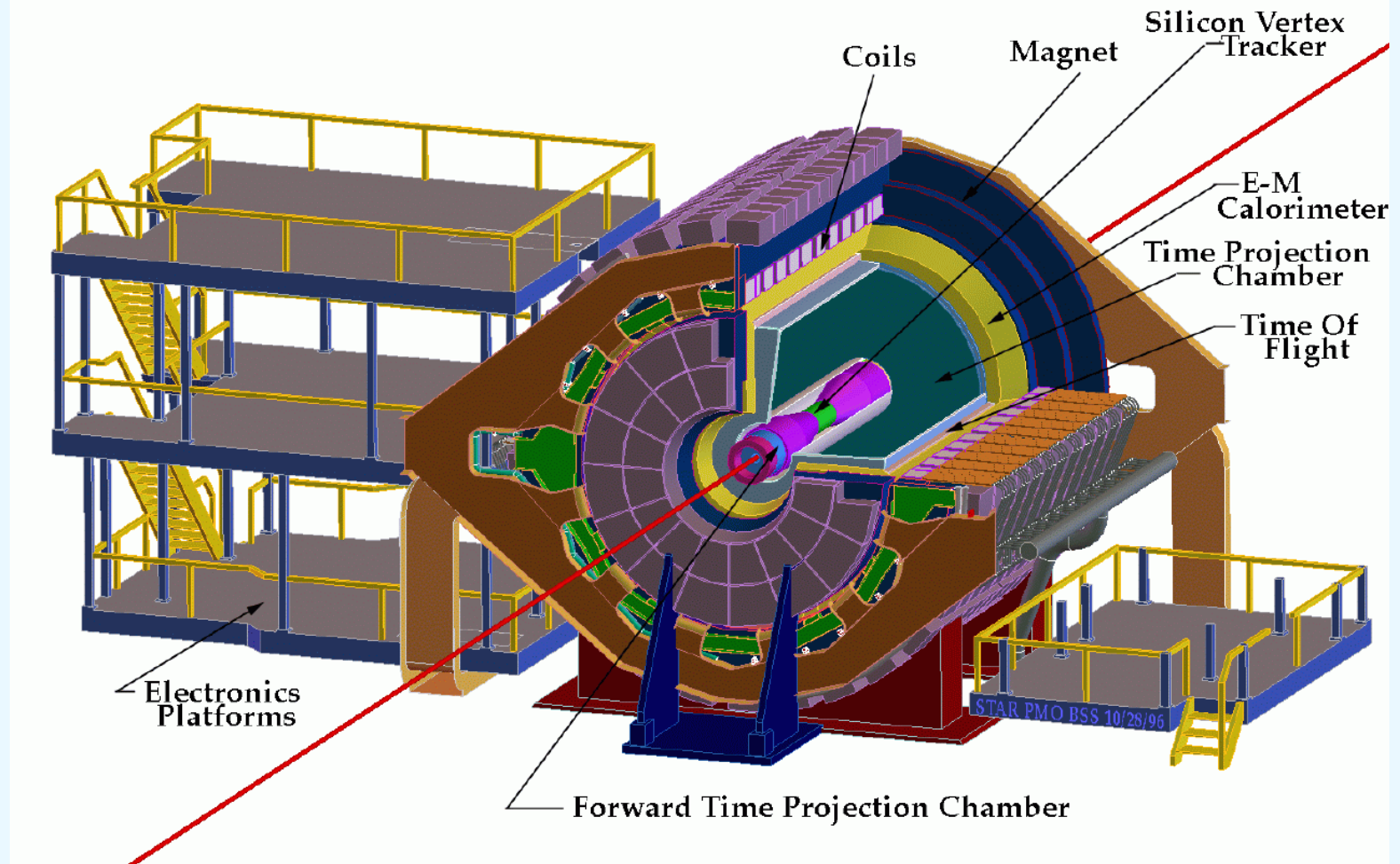
**Pb+Pb:** 18,000 particles are produced

**ALICE (TPC):** ~4000 charged hadrons and leptons



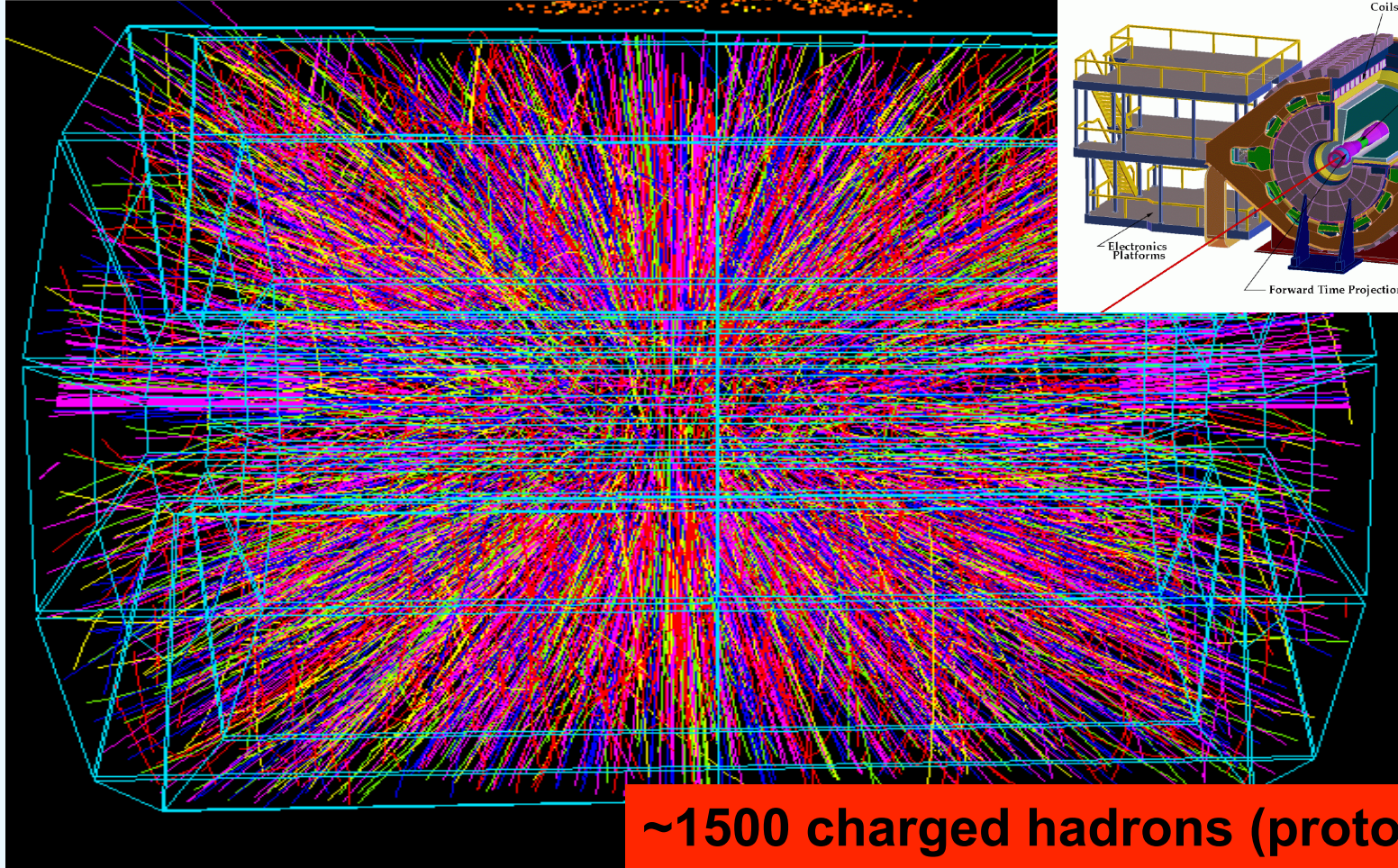
# STAR Experiment at the RHIC Collider

## STAR Detector



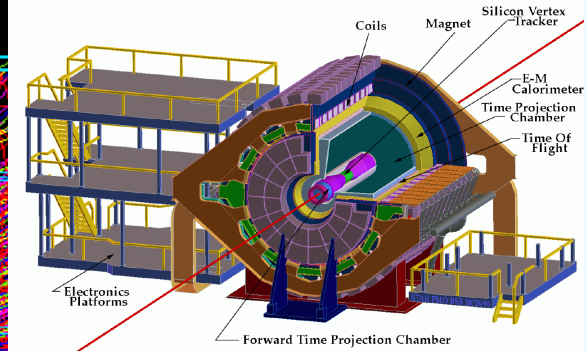
# Particle Tracks in the Detector

**Head-on Au+Au collision**



**~1500 charged hadrons (protons,...)  
and leptons (electrons,..)**

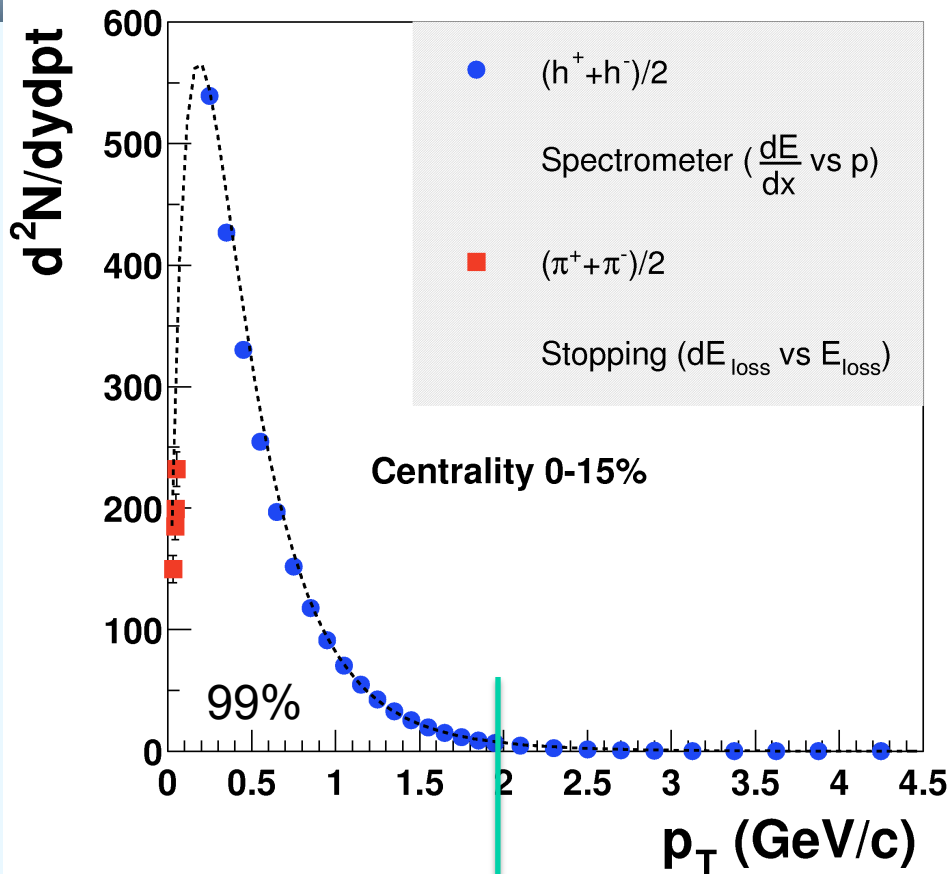
**STAR Detector**



# What do you want to measure ?

Which detector do you need to measure the particles (...) and their observables (...)?

# Momentum distribution of hadrons



~90% pions (ud)  
 ~10%  
 Kaons (us)  
 Protons (uud)  
 Lambdas (uds)  
 .....

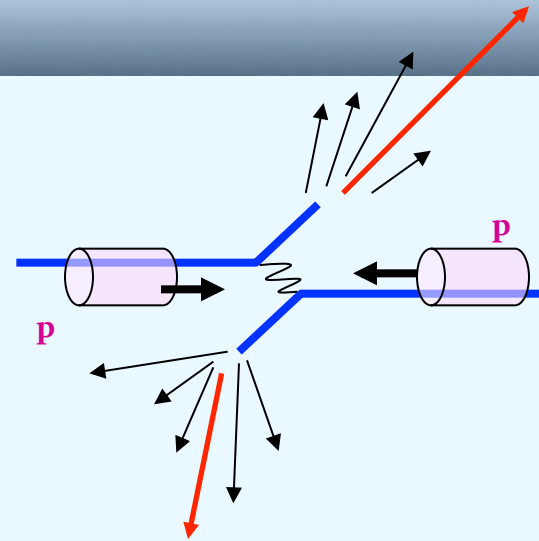
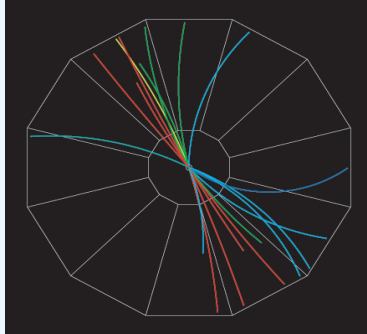
**Boltzmann distribution**  
 → temperature ~ 120 MeV  
 at kinetic freeze-out

Low momentum  
 hadrons  
 Bulk matter

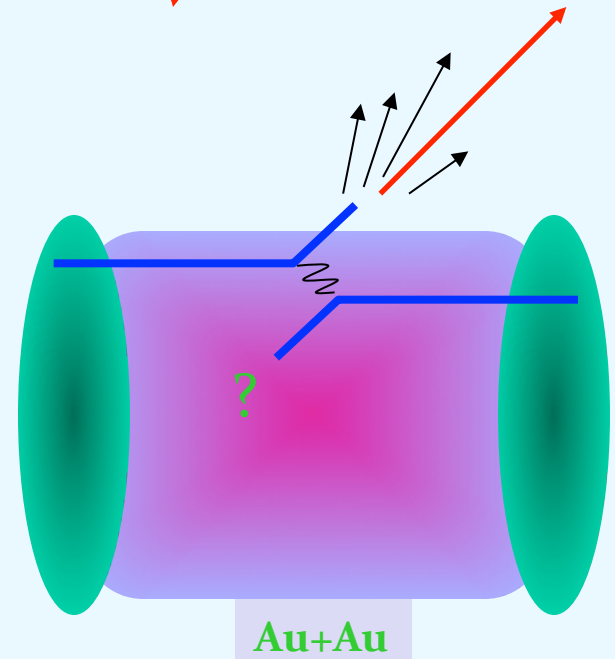
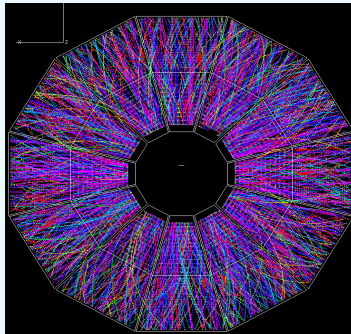
High momentum  
 hadrons

# Probing the medium with high momentum particles (jets)

p+p collisions  $\leftrightarrow$  no medium



what happens in Pb+Pb to jets which pass through medium?

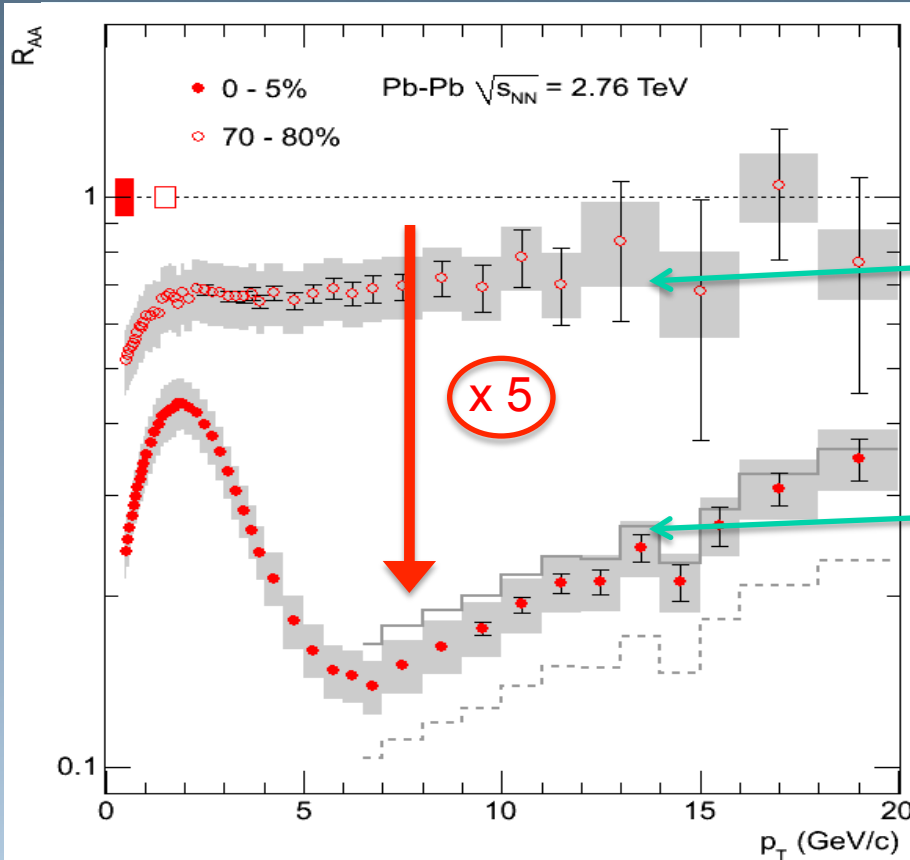


scattered quarks radiate energy ( $\sim \text{GeV}/\text{fm}$ ) in the colored medium:

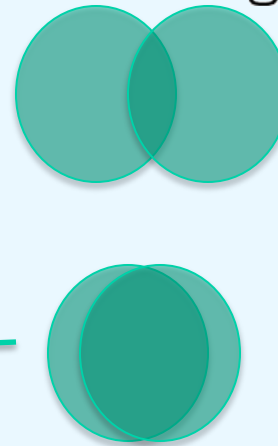
- $\rightarrow$  “quenches” high  $p_T$  particles
- $\rightarrow$  “kills” jet partner on other side

# High transverse momentum suppression

ALICE: Phys. Lett. B 696 (2011) 30.



$$R_{AA} = \frac{d^2N/dp_T d\eta \text{ (Pb+Pb)}}{T_{AA} d^2\sigma/dp_T d\eta \text{ (p+p)}}$$



High  $p_T$  suppression  $\rightarrow$  partonic medium (Jet modified by medium)

$\epsilon \approx 15 \text{ GeV}/\text{fm}^3$   
(e.g. X.N. Wang nucl-th/0307036)

At high transverse momentum ( $p_T$ ) the yield is only 1/5 of what we would expect from superposition p-p collision