

Relativistic Heavy Ion Physics with ALICE

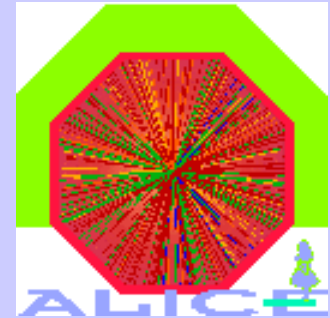
By

Bjørn S. Nilsen

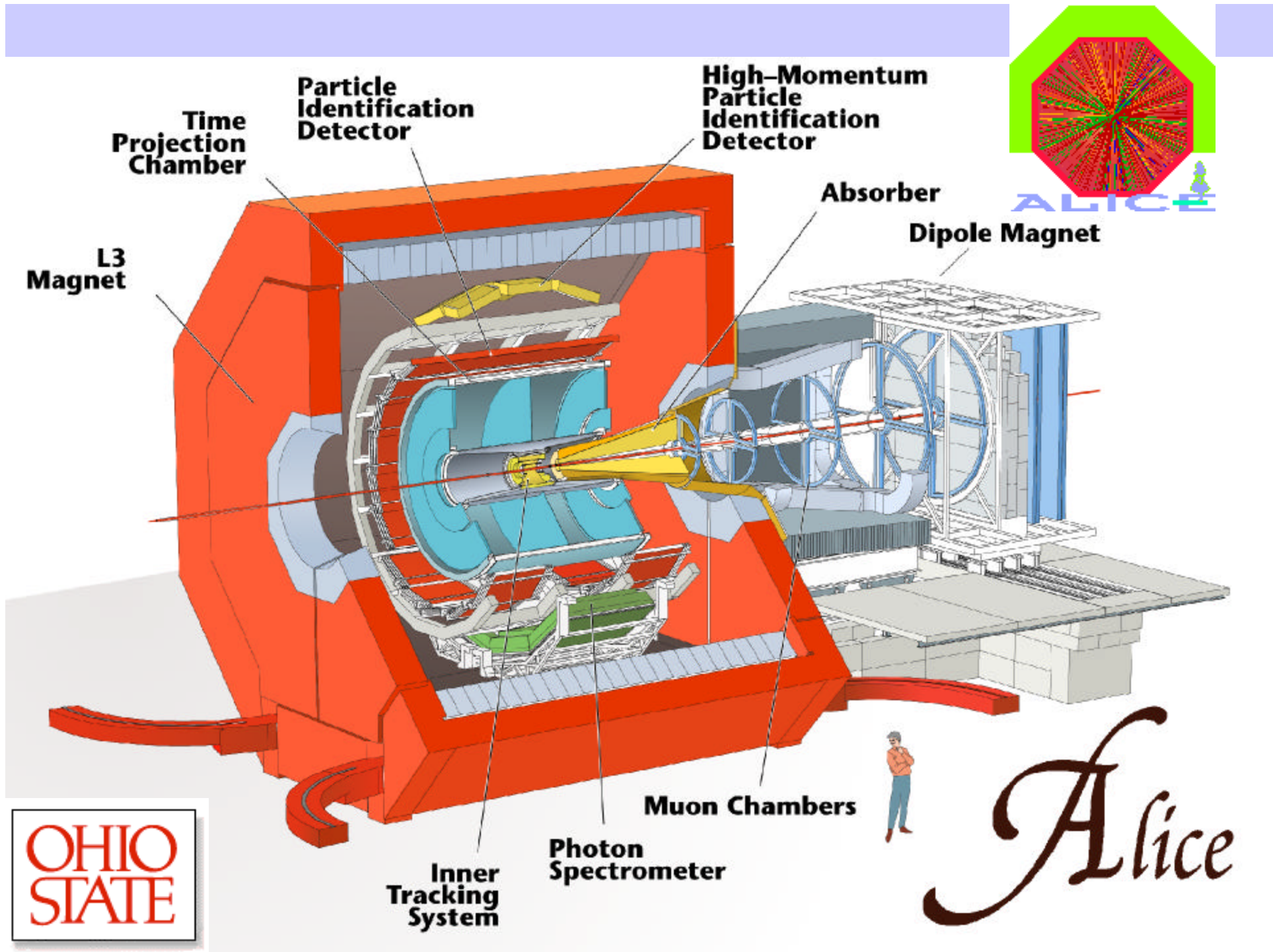
The Ohio State University



Outline

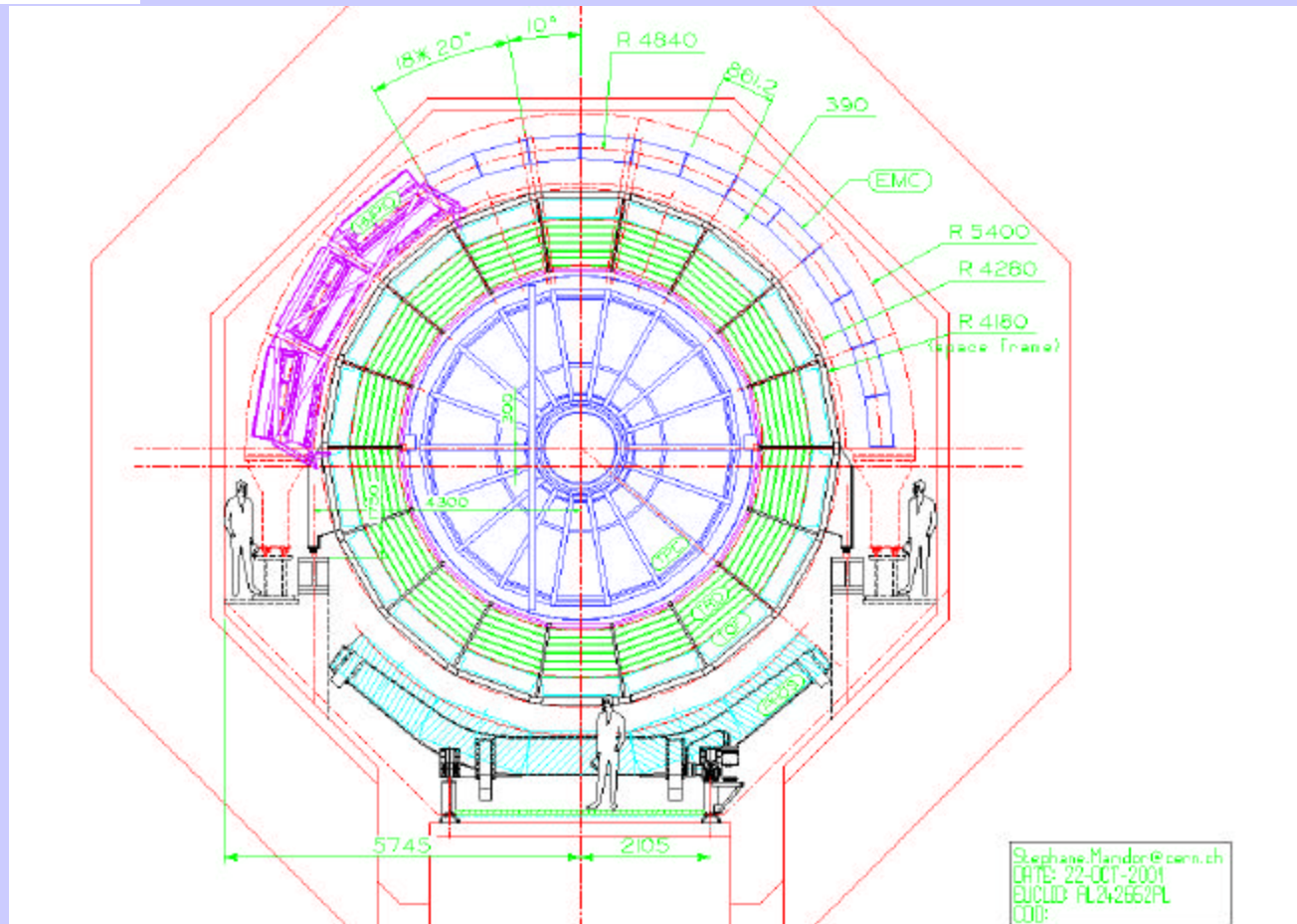
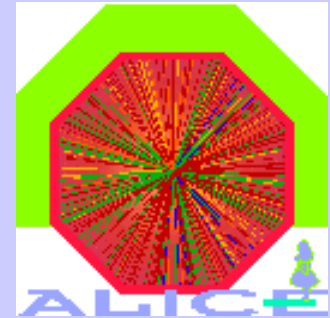


- The ALICE detector
 - MUON Arm, and “new” TRD.
 - PHOS, and a Proposed EMCAL.
- The Quark Gluon Plasma
 - How we can use Heavy flavor states, and jets to study the QGP.
 - What the “new” detectors allow us to do.
- Conclusion





With EMCAL

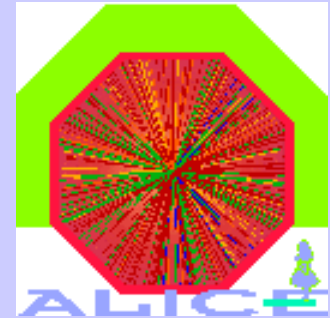


January 6 2002

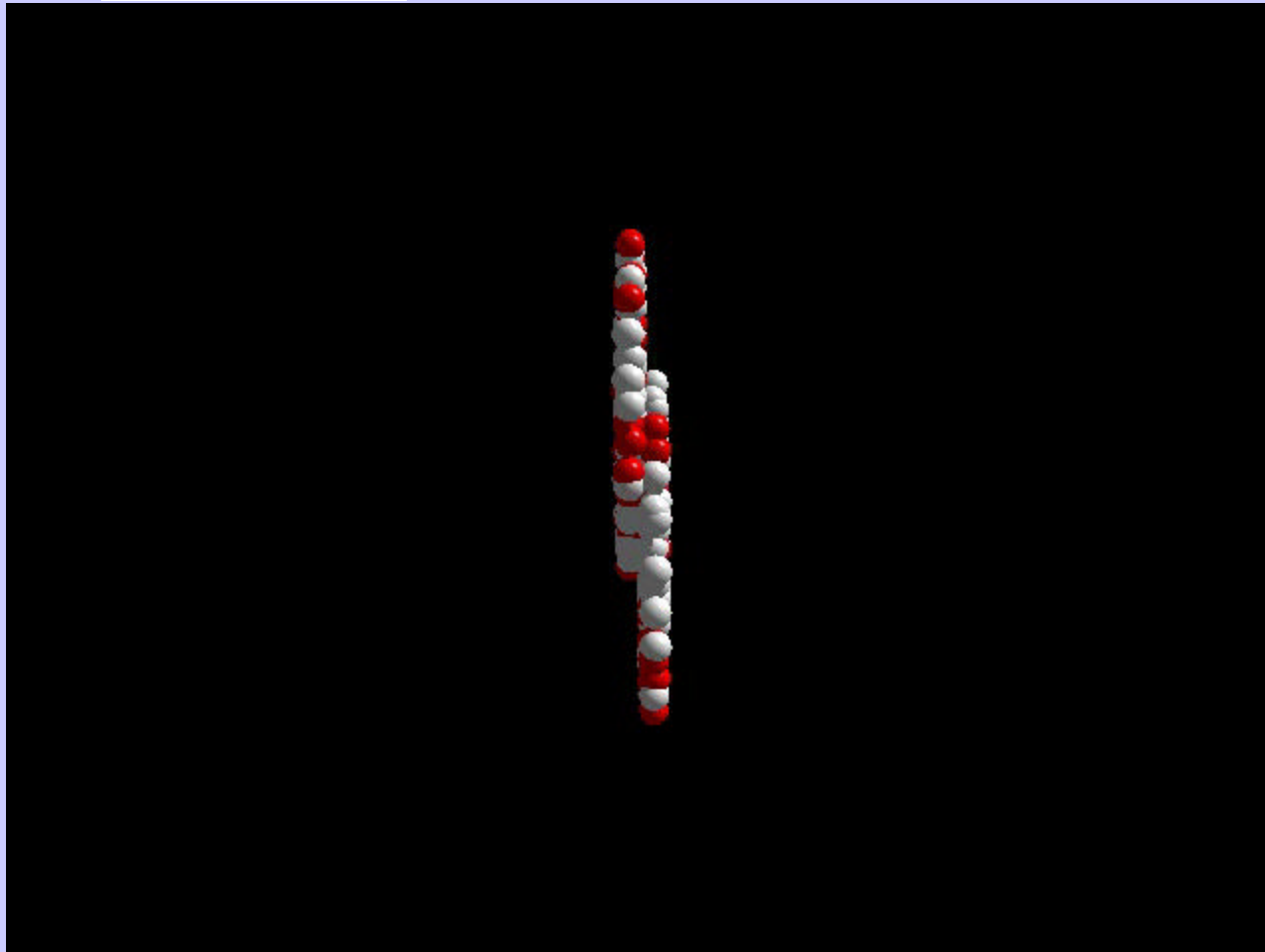
Presented by Bjørn S. Nilsen



Interacting Nuclei

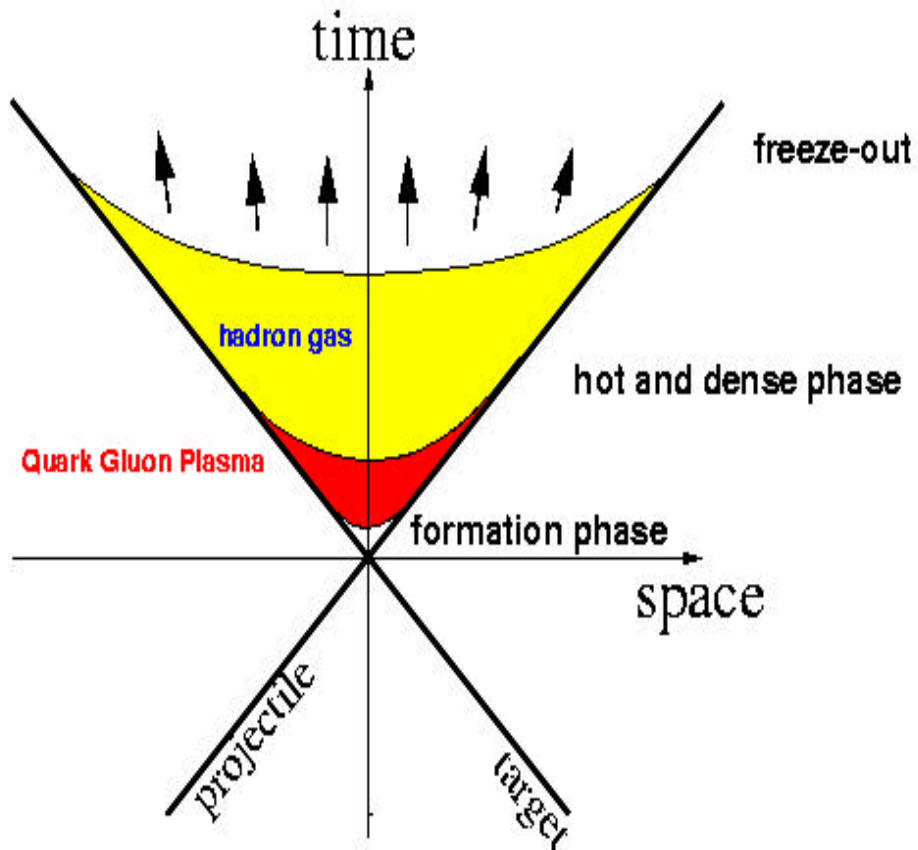


- RQMD simulation
- 5 TeV/n
- Au+Au
- B=5 fm





Space-Time Evolution Pre-equilibrium



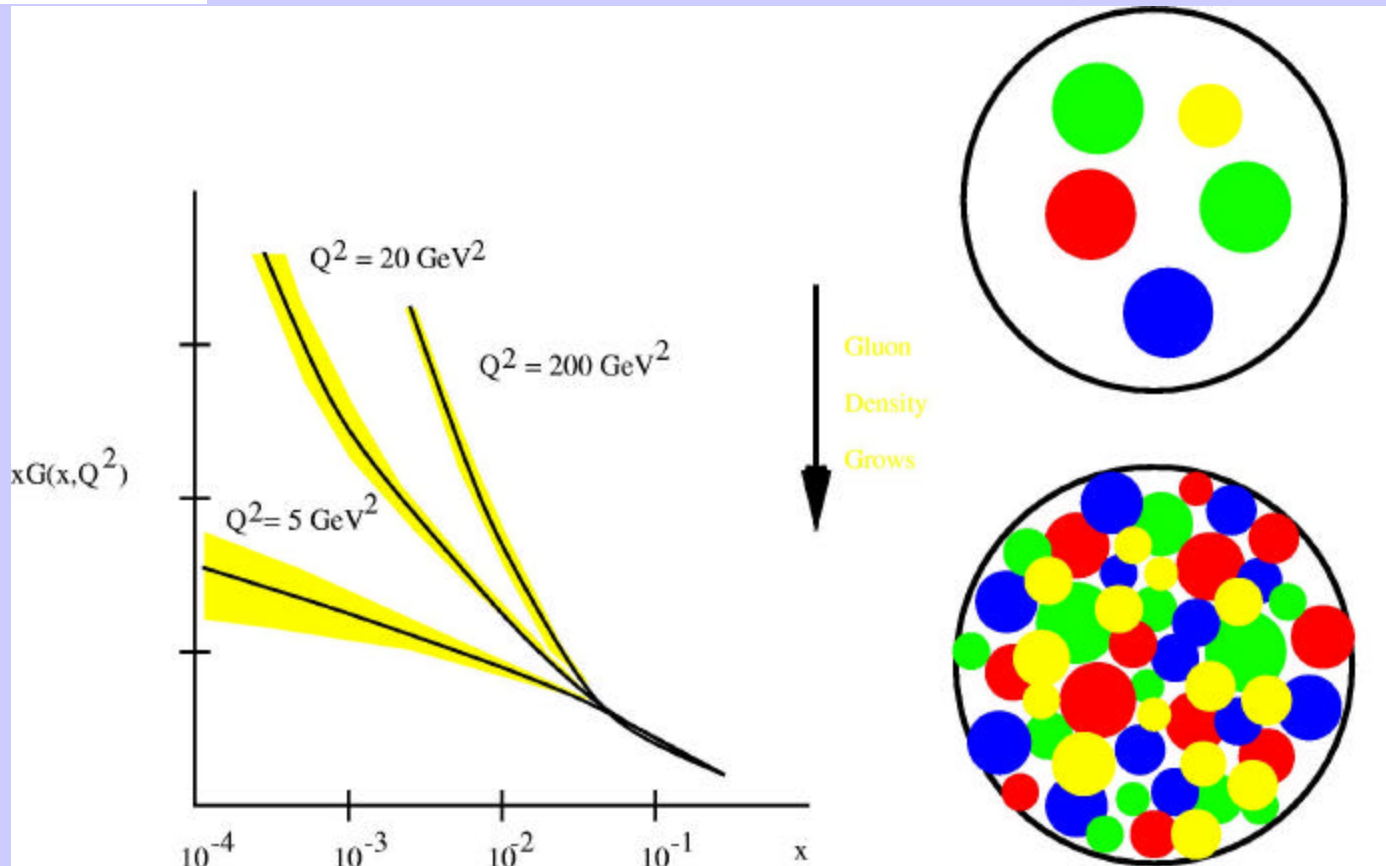
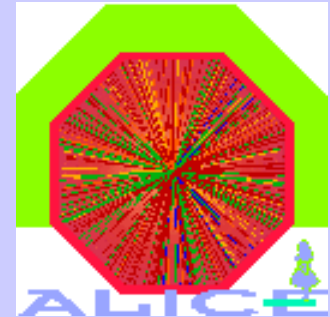
Formation phase.

Creation of Probes into the QGP.

- **Hard scattering**
 - Heavy flavor production
 - Quark/Gluon jet production
 - Direct Photon production



Gluon Saturation?

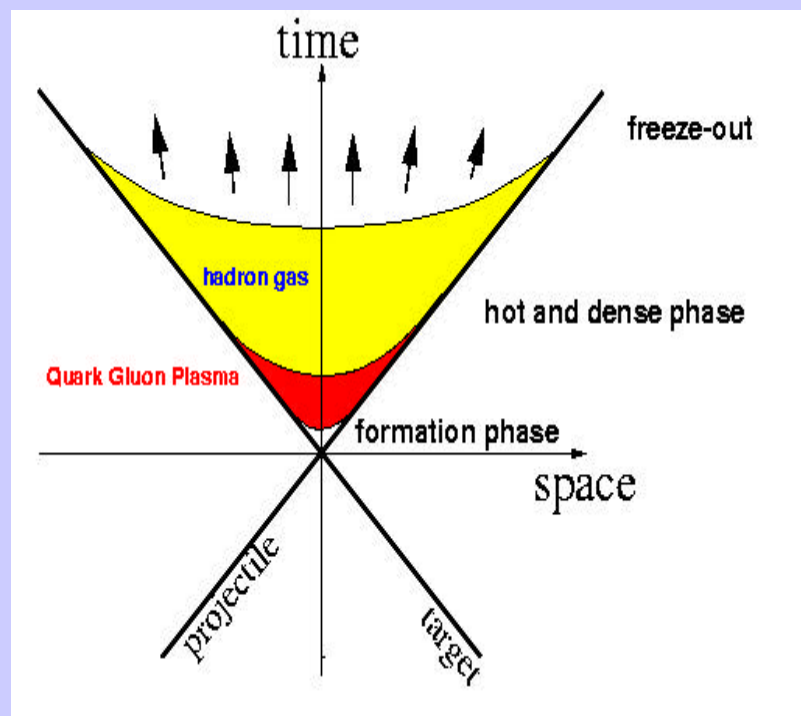
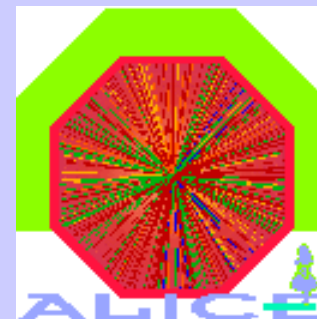


$$Q_{\text{sat}}^2 = 8\pi\alpha_s N_c / (N_c^2 - 1) \rho_A xG(x, Q_{\text{sat}}^2)$$

$$\rho_A \propto A/pR^2 \propto A^{1/3}$$



Space-Time Evolution QGP



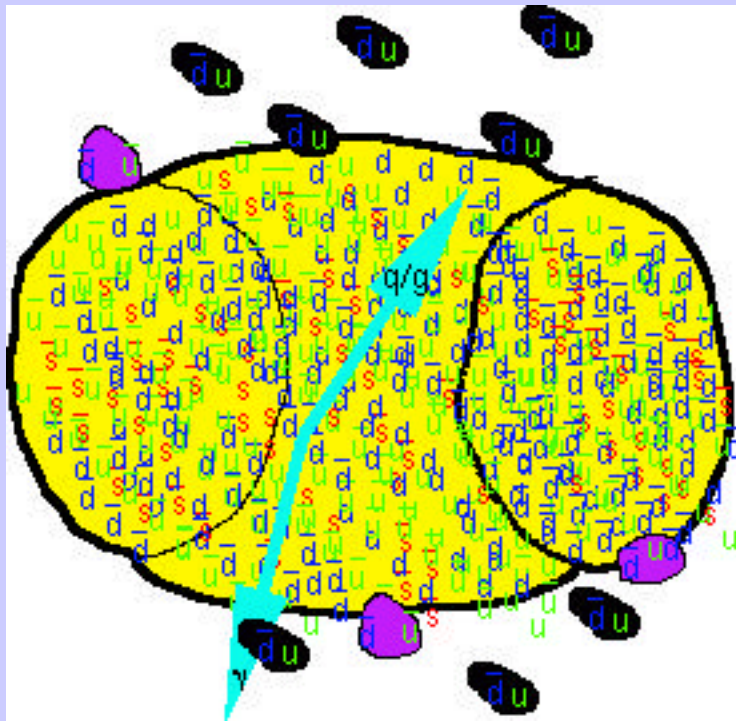
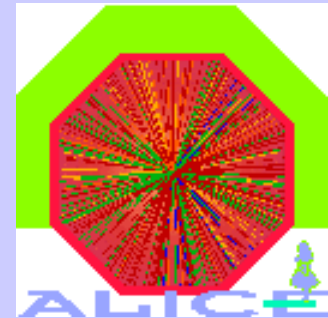
Quark-Gluon Plasma Phase

The Phase to be studied.

- Deconfined Quarks and Gluons.
- Chiral Symmetry resorted?



The QGP



$$e_{\text{LHC}} \sim 20 e_{\text{RICH}}$$

$$e_{\text{LHC}} \sim 15\text{-}40 \text{ GeV}/\text{fm}^3$$

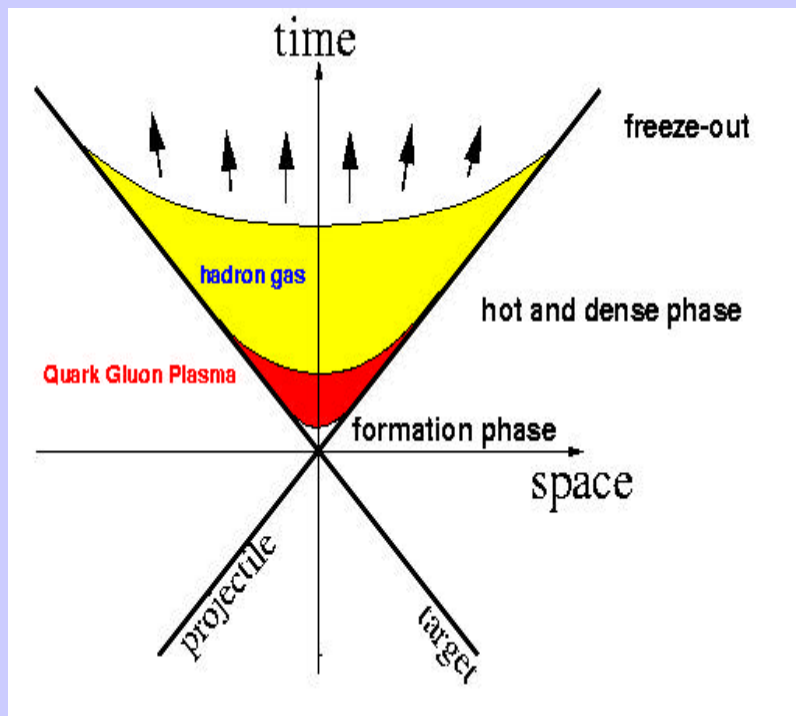
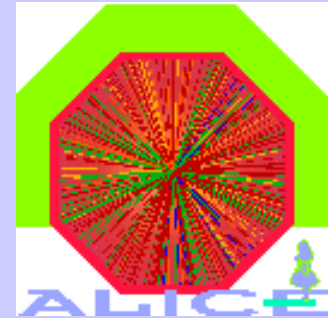
$$t_{\text{QGP-LHC}} \sim 2 t_{\text{QGP-RICH}}$$

$$t_{\text{QGP-LHC}} \sim 4\text{-}10 \text{ fm}/c$$

$$\left. \frac{t_{\text{QGP}}}{t_{\text{Therm}}} \right|_{\text{LHC}} \sim 10 \left. \frac{t_{\text{QGP}}}{t_{\text{Therm}}} \right|_{\text{RICH}} \geq 30$$



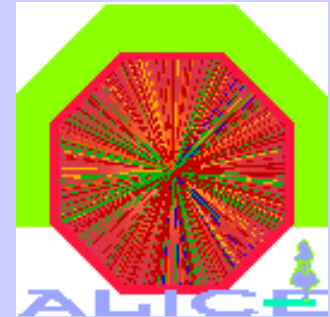
Space-Time Evolution Post QGP



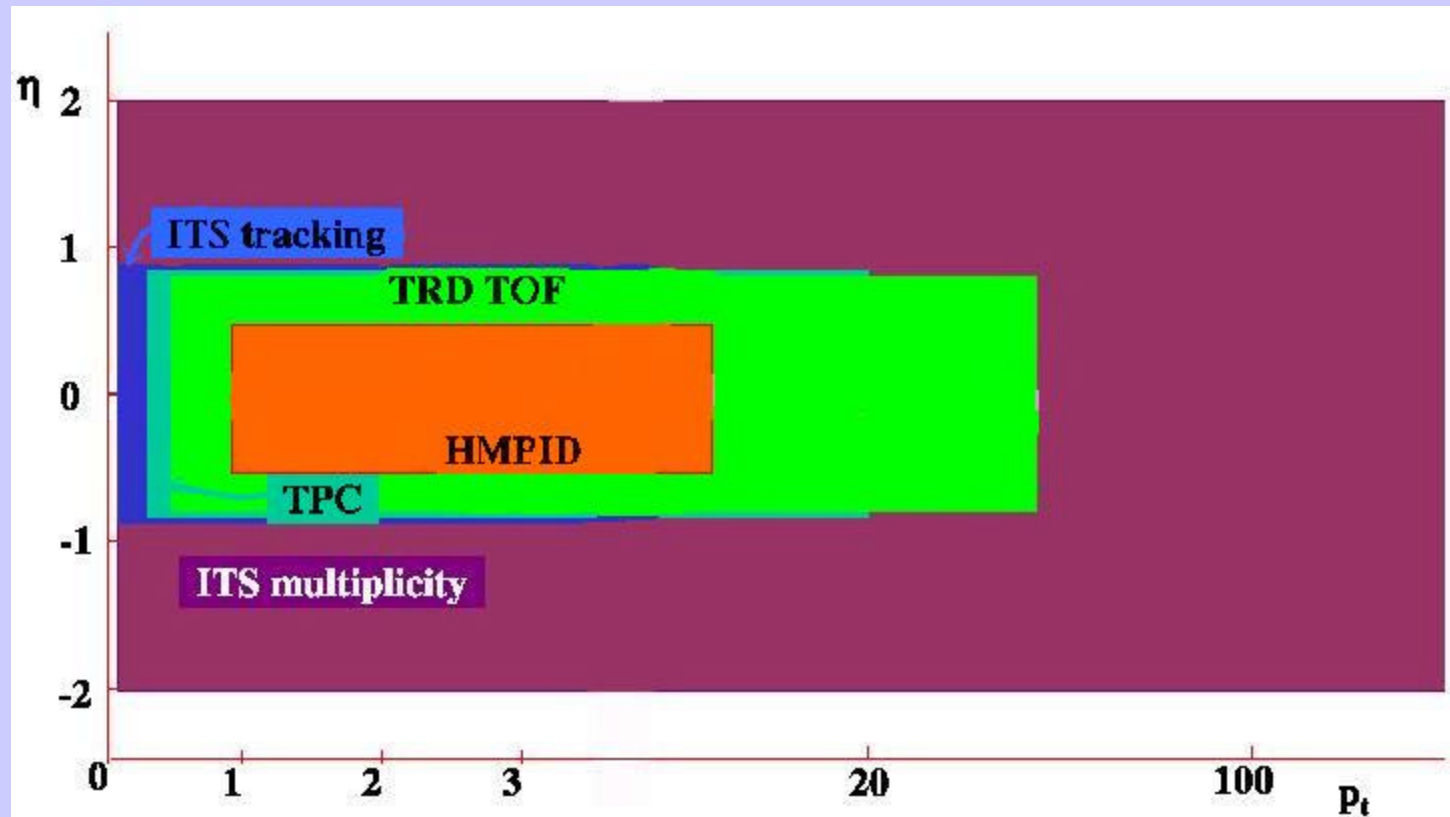
- Hadron Gas
 - Hadron formation
 - Secondary interactions
- Free Streaming
 - No Interactions
 - Resonance decays
 - Standard Vacuum



ALICE

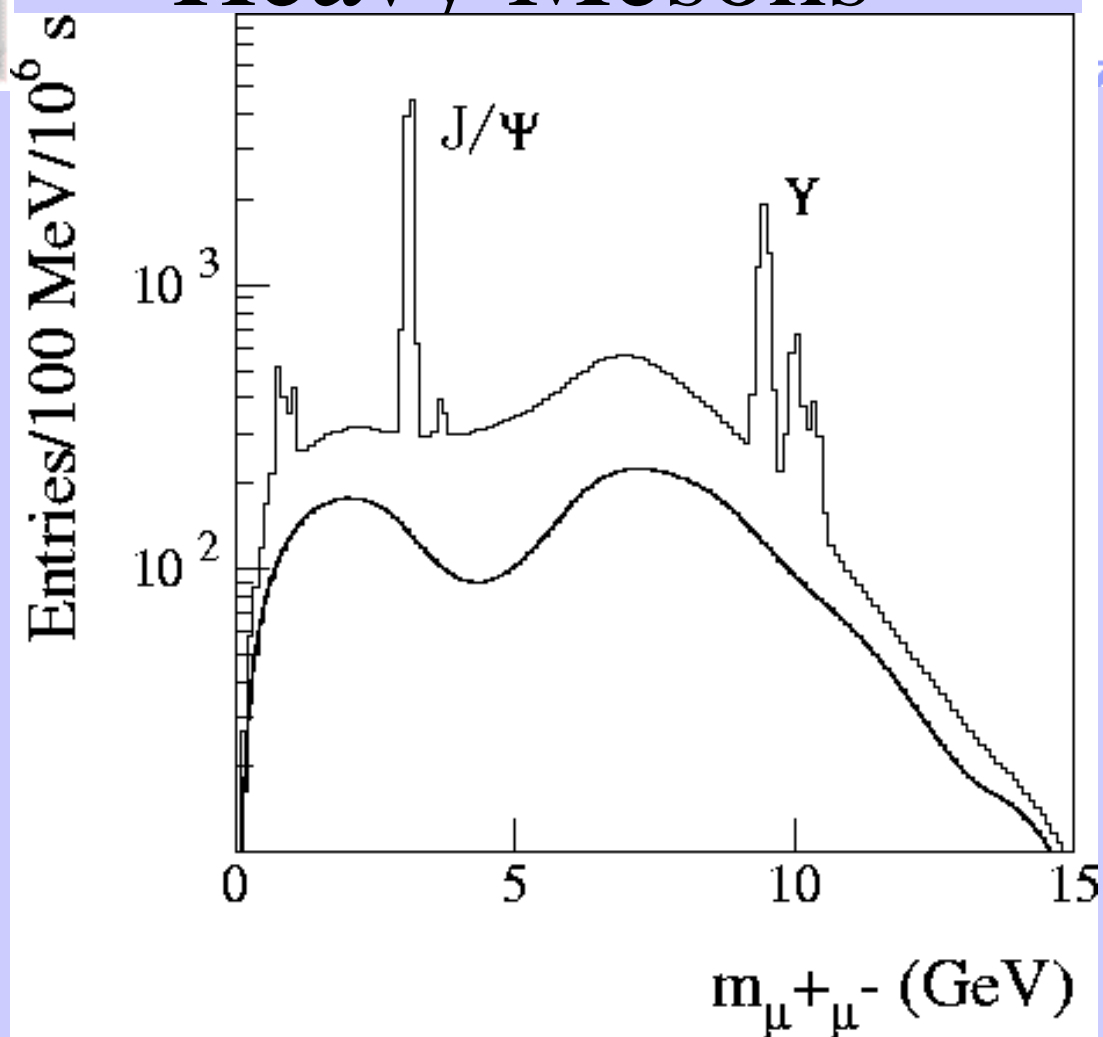
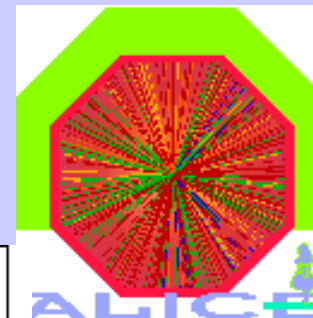


Charged Particle Acceptance



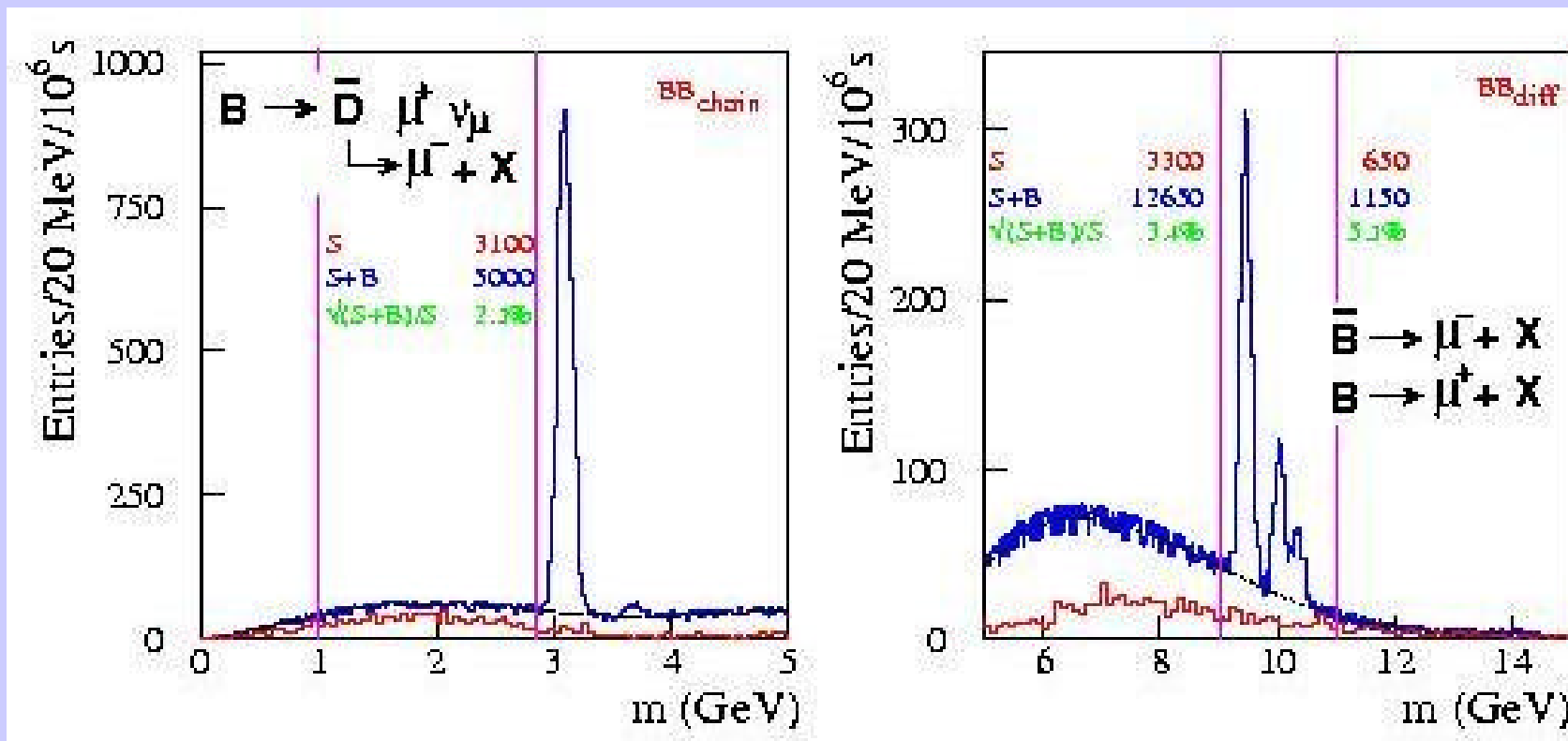
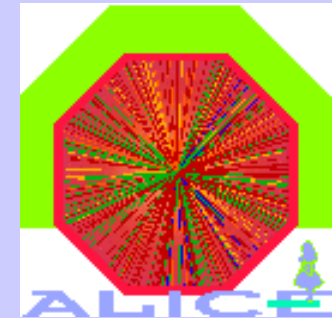


DiMuons Heavy Mesons



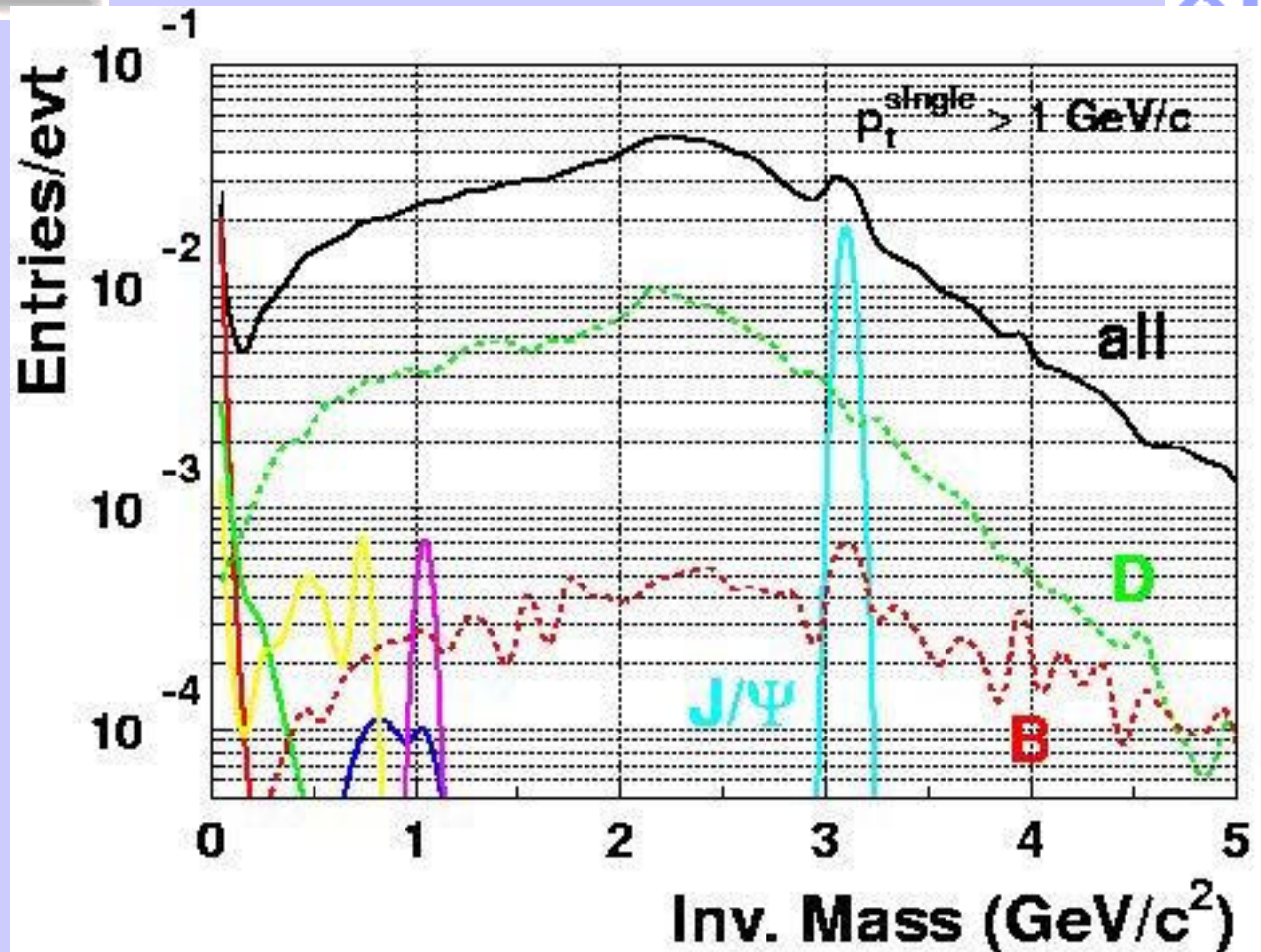
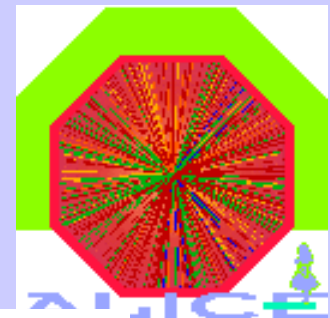


Heavy Mesons in Dimuons



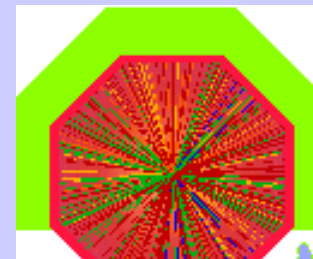


Dielectrons

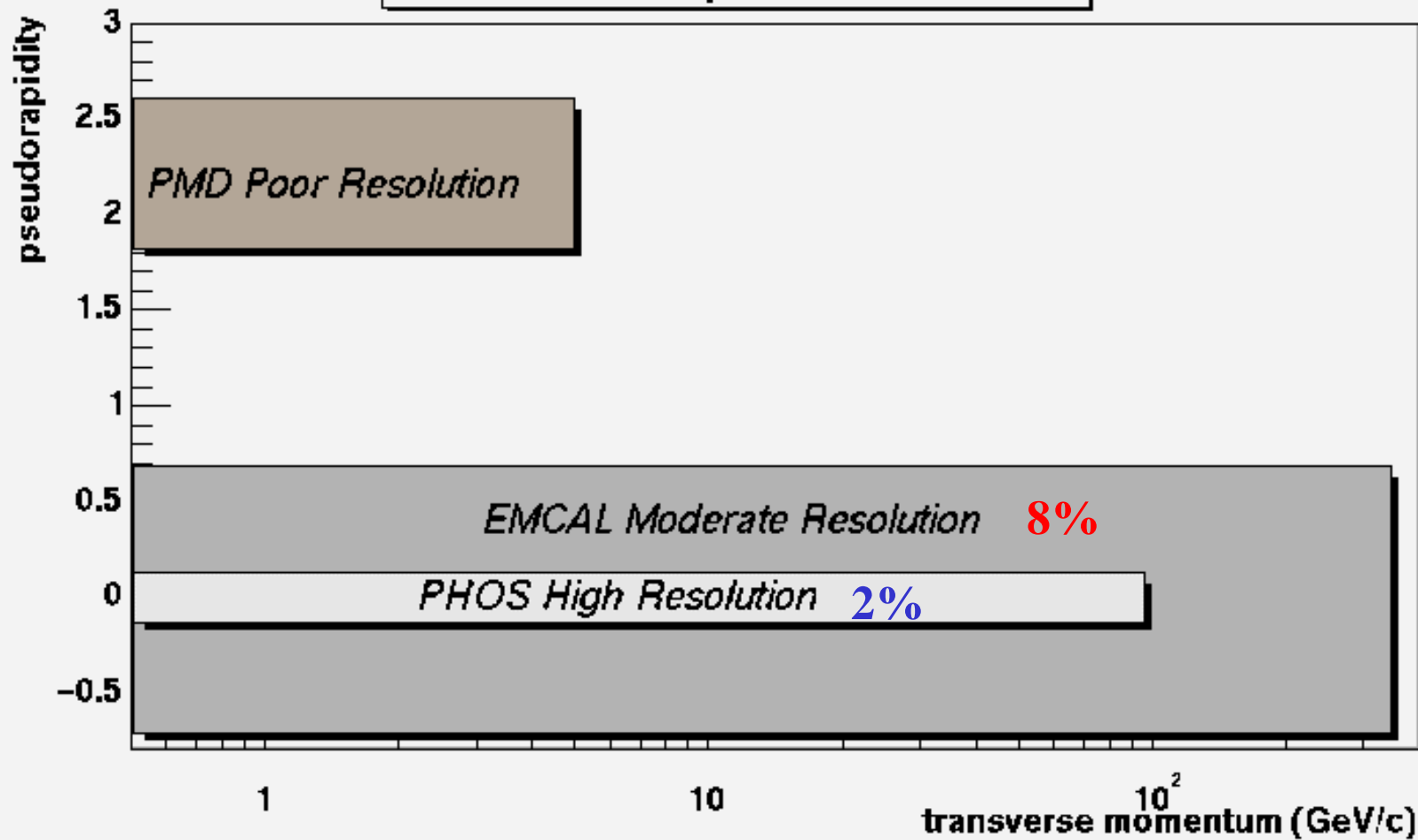




ALICE Photon Acceptance

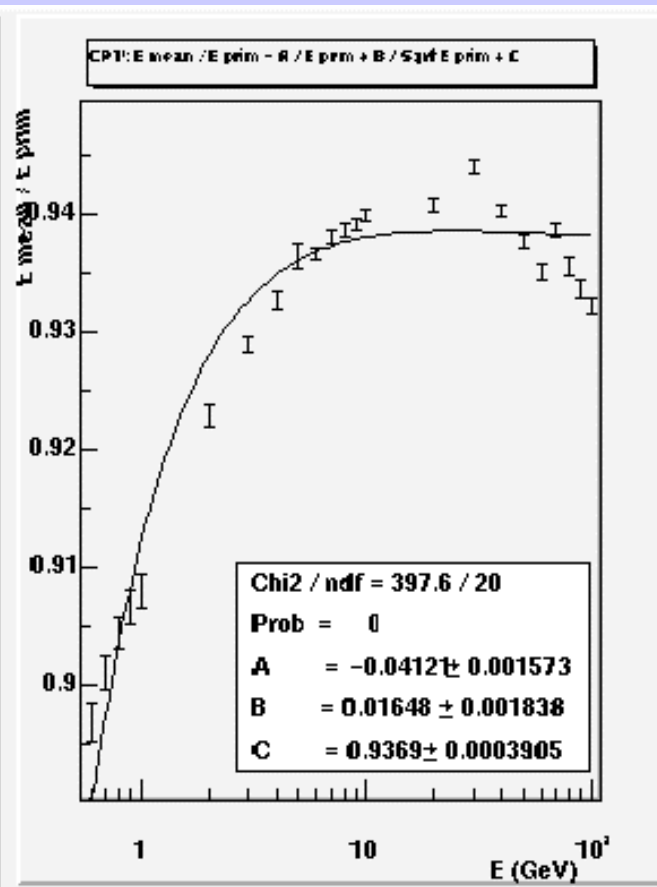
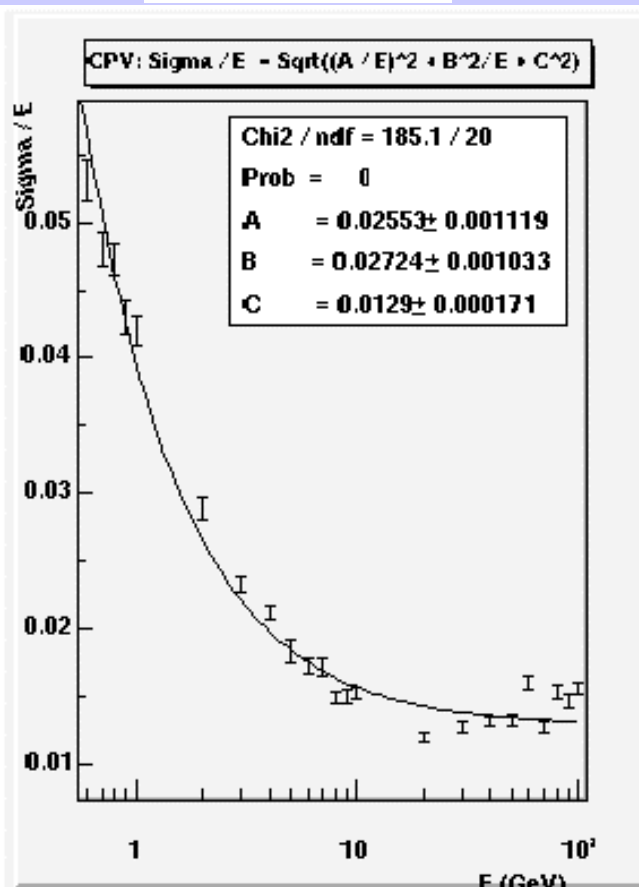
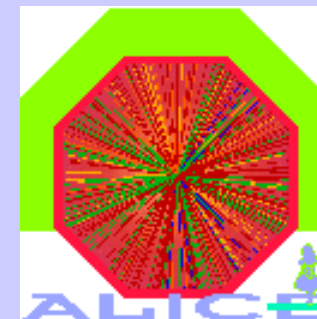


Photon Acceptance in ALICE





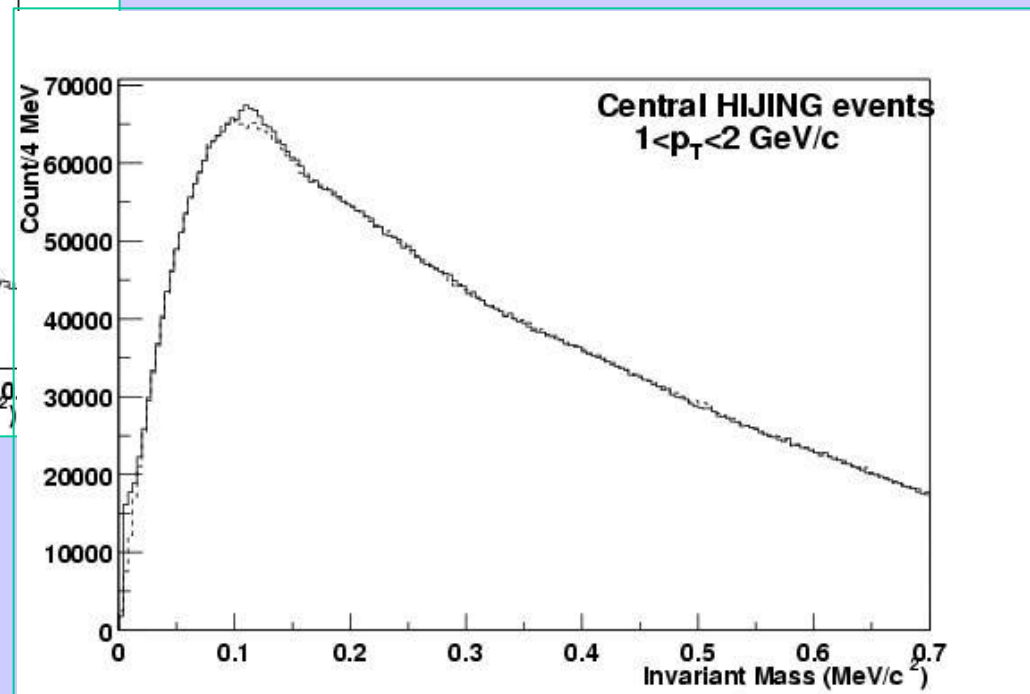
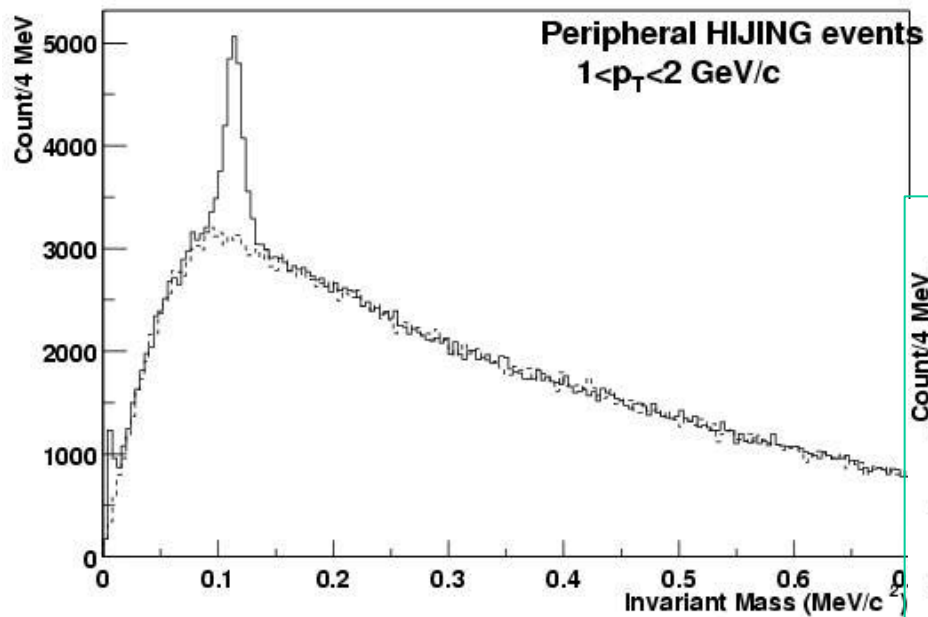
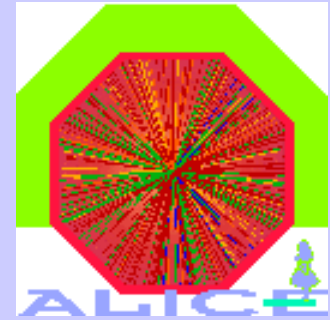
Photons PHOS



Identified
Photon
spectrum
measured with
85-99 % purity



PHOS Pb-Pb p^0 resolution



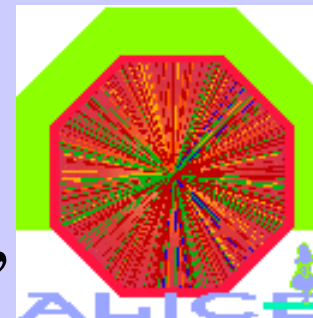
January 6 2002

Presented by Bjørn S. Nilsen

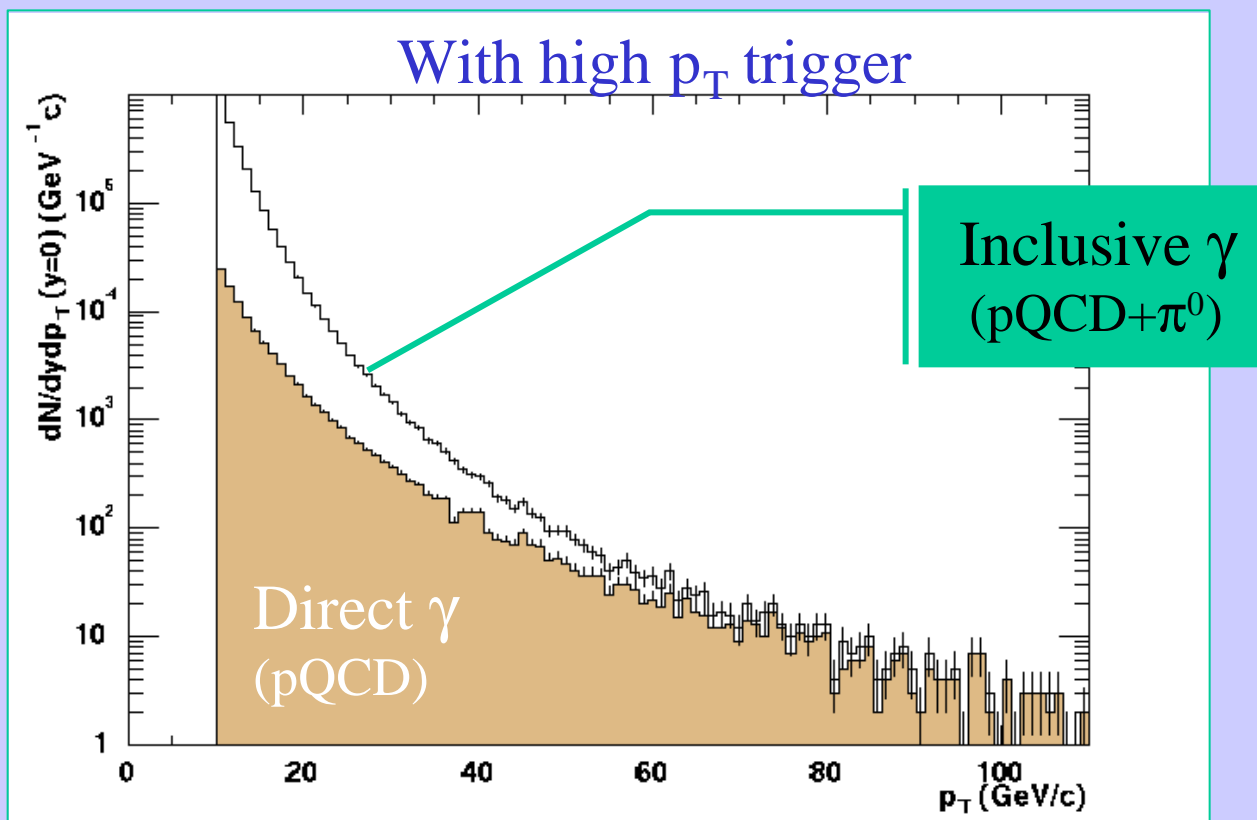
17



PHOS

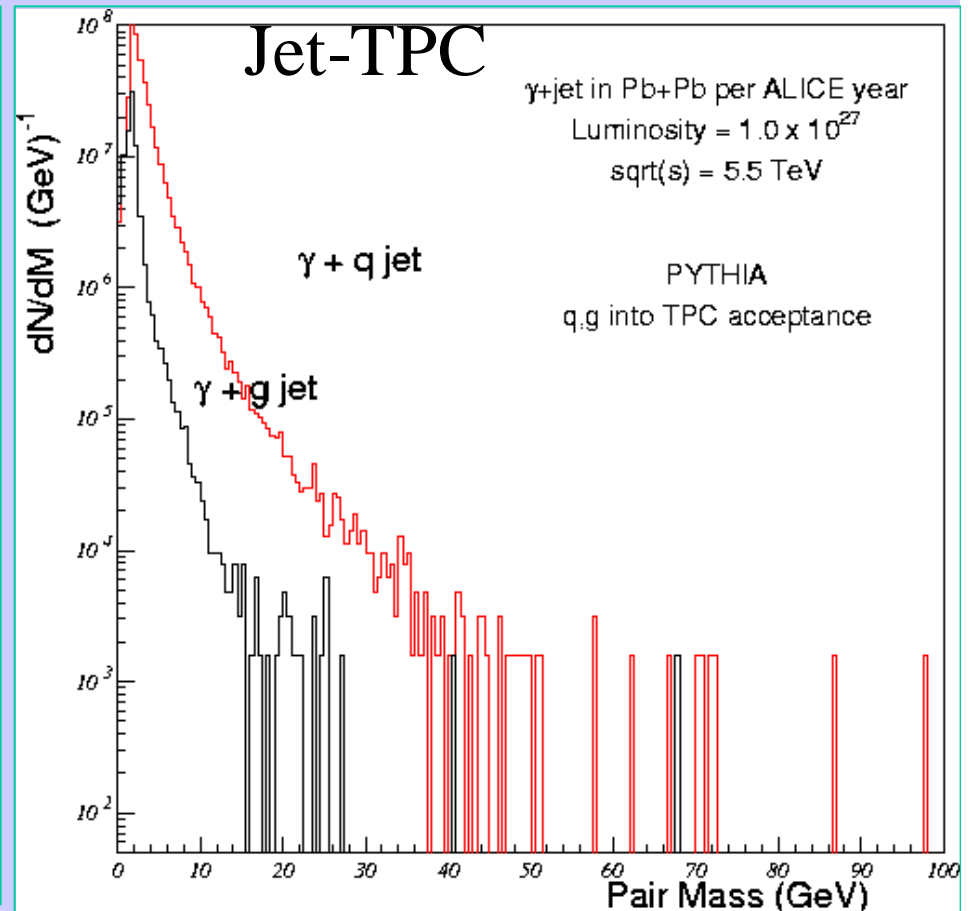
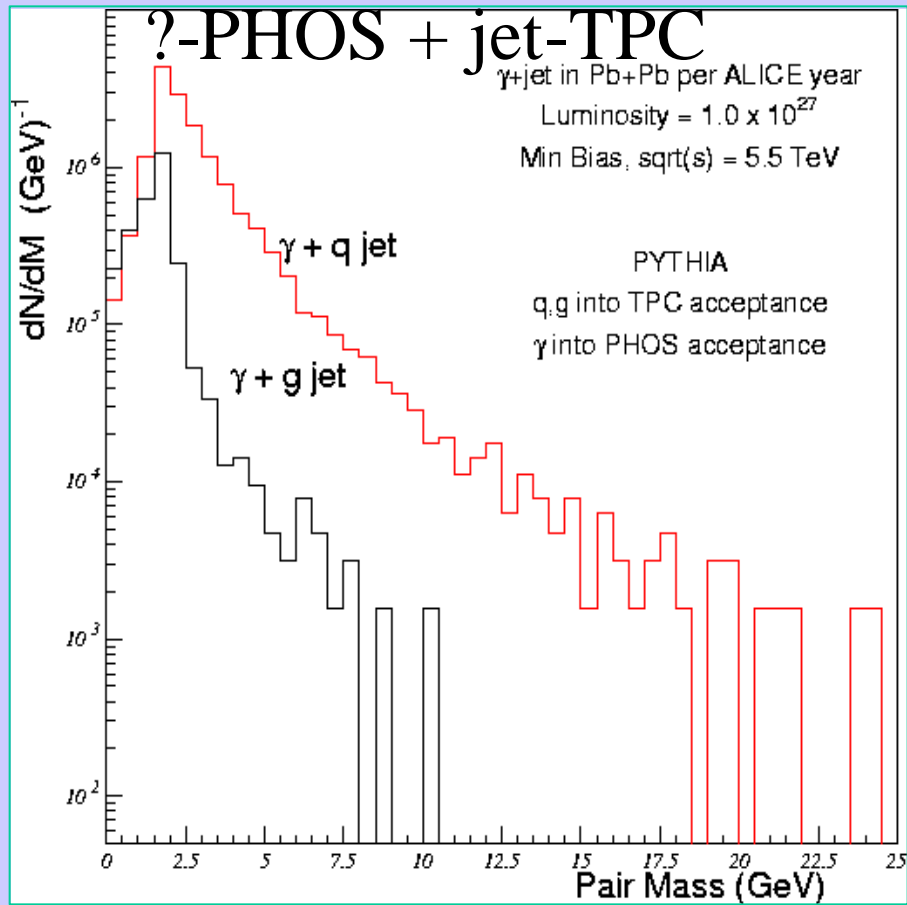
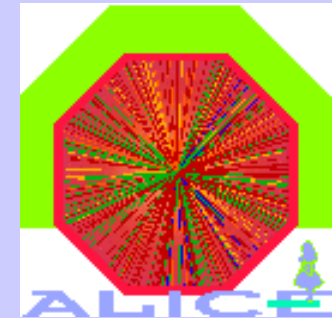


AA @ LHC $\sqrt{s_{NN}} = 5.5$ TeV,
10% central γ in one year





Expanded PHOS EMCAL



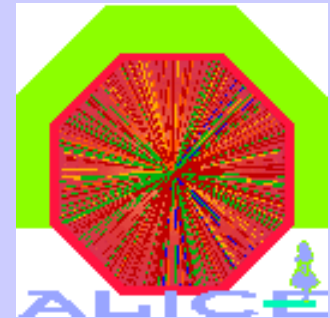
January 6 2002

Presented by Bjørn S. Nilsen

19



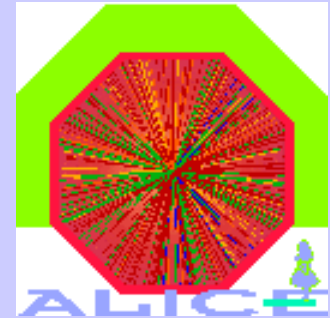
Further Studies Continue



- With our first in a series of Physics Challenges, presently on going, we are reevaluating the performance of the full ALICE detector.
- This leads to another challenge, that of distributing all of the needed computing in an effective way.



Conclusions



- With the PHOS, MUON arm, TRD, and the proposed EMCAL, ALICE will greatly improve its heavy flavor, direct photon, and jet physics capabilities.
- These new, more accessible, probes, along with ALICE's excellent soft physics capabilities, will help ALICE to study the Quark Gluon Plasma in greater detail.