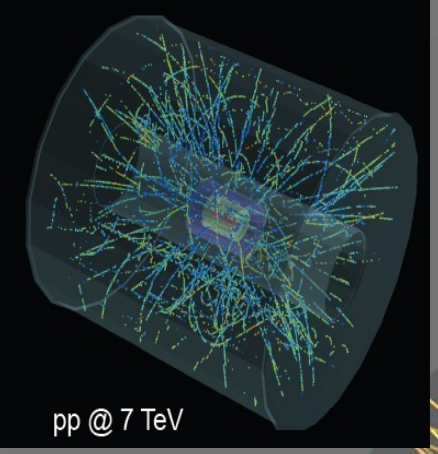
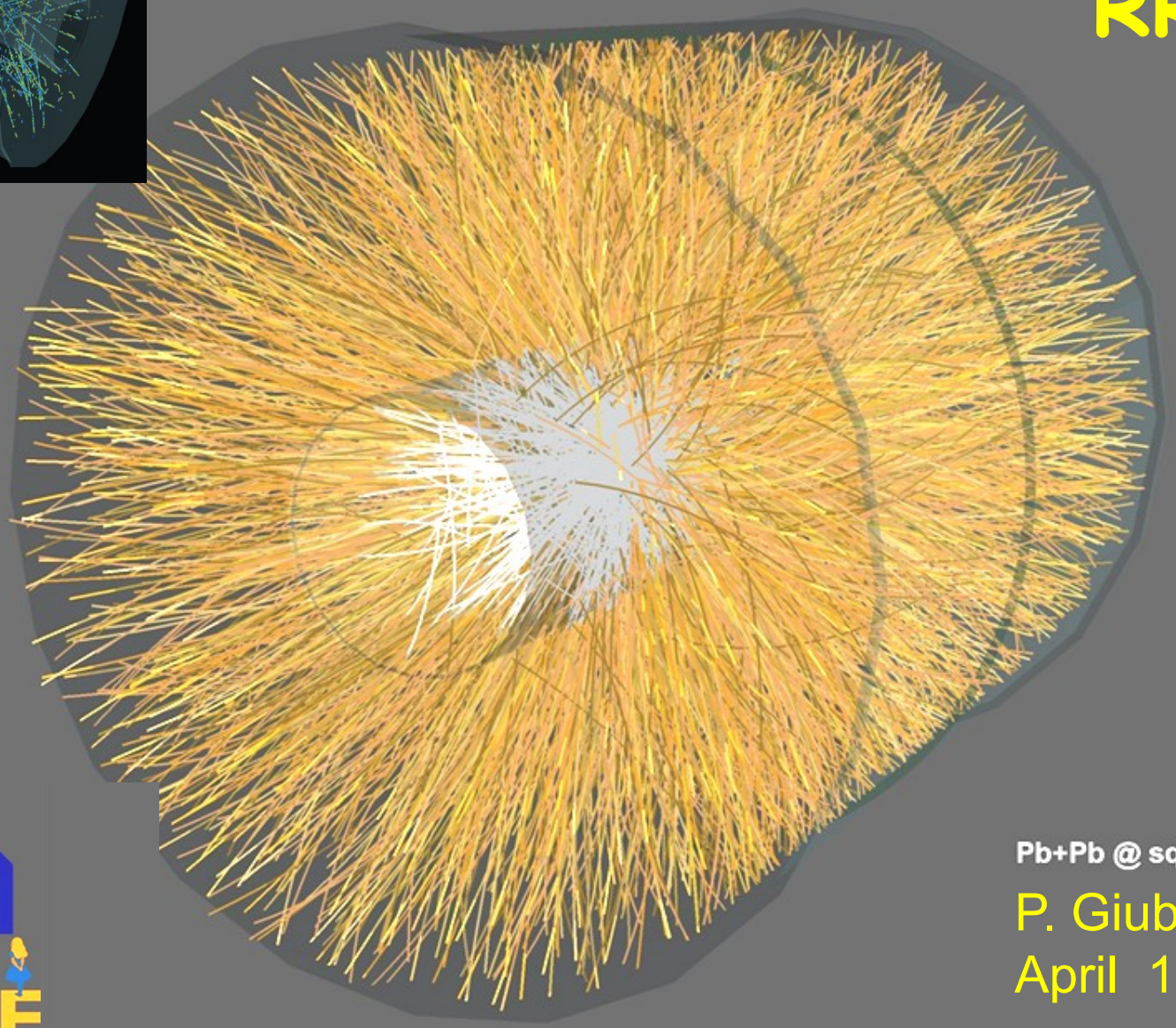


30th ALICE RRB



P. Giubellino

April 13, 2011

ALICE

An eventful six months!

- **The first Heavy Ion run!**
  - The Accelerator complex worked wonders: very fast startup and excellent performance
  - The detector worked beautifully
  - The "first Physics" did marvels: five papers by the end of 2010
    - Confirmed ALICE readiness
- **A short but fruitful shutdown**
  - The EMCAL installation was completed successfully
  - 3 more TRD modules
  - Upgrade of the DAQ and more…
- **A fast restart**
  - Recommissioning + run-in of new detectors and trigger optimization
  - 2.76 TeV pp run to accumulate reference data for PbPb comparison at the same energy
    - 35 hours of running
      - Excellent LHC performance
      - Excellent ALICE response with 94% running efficiency
- **Now running, while…**
  - Strong thrust for data analysis in view of QM conference in May
  - Progressing on 7 TeV more complex analyses
  - Organizing the preparation for upgrades

Collaboration News

Detector Status

Physics Results

Outlook

Collaboration News

- **New Institutes**
  - Gahauti Univ (Assam, India) & Bose Institute (Kolkata, India)
    Physics, Upgrades
  - KISTI (Korea) : 'associate member status'
    Computing
- **Applying**
  - Suranaree University of Technology (SUT) (Thailand) 'associate member'
    Computing
- **Ongoing Discussions**
  - Pinstech (Pakistan) :'associate member status',
    Physics, Computing
    - small computing cluster now up & running
  - Egypt (initially via JINR),
    Lebanon (small group, associated via other ALICE institutes),
- **Worry: UK Funding**
  - still concerns about the UK funding ALICE after this July. We won't know if the UK continues to fund ALICE and at what level until sometime mid-July

More Collaboration News

- Elections: 2 Management Board Members
  - W. Carena (CERN) and T. Nayak (VECC)
- Appointments:
  - Deputy Spokesperson:
    - J. Wessels (Munster) and Y. Schutz (Nantes)
  - Deputy Chairperson of the Collaboration Board:
    - G. Zinovjev (Kiev) and J. Harris (Yale)
  - Upgrade Coordinator:
    - T. Peitzmann (Utrecht)
  - Deputy Physics Coordinator:
    - F. Antinori (Padova)
  - Co-conveners of
    - PWG1: D. Miskowiec (GSI),
    - PWG2: B. Hippolyte (Strasbourg)
    - PWG3: A. Dainese (Padova)
    - PWG4: H. Bueshing (Frankfurt)
- New Project Leaders:
  - ITS: L. Musa (CERN),
  - Muon Spectrometer: A. Baldisseri (CEA Saclay)
  - TPC: H. Appelshaeuser (Frankfurt)

In addition, the Spokesperson, CB chair, CC and EB Chair and Run Coordinator all started Jan 1 their mandate

Organizational efforts

- ALICE had a structure optimized for the construction phase. The data taking phase has called for a considerable reorganization. Some steps have been taken, some are ongoing, more will have to be taken. Here just the main ones.
  - Transformation of **PWG1** mandate: assure all elements necessary for analysis, each with a well defined structure with 2 (or 3) persons in charge
    - **Quality assurance, calibration, event characterization, PID, event and track selection, tracking and alignment, run conditions, embedding / mixing**
  - **Physics Board** and all four **PWGs** meet weekly, so as to ensure continuous follow up and steering of the analysis efforts and fast feedback to Offline on physics priorities
    - Special effort in view of QM, coordinated by K. Safarik and F. Antinori
  - General optimization of Reconstruction and Calibration procedures, to provide better load balancing of computing resources with respect to analysis
  - Initiatives to promote junior scientists and students in the Collaboration (eg Junior's day each Alice Week)
  - Initiatives to improve transparency of decisions and availability of information

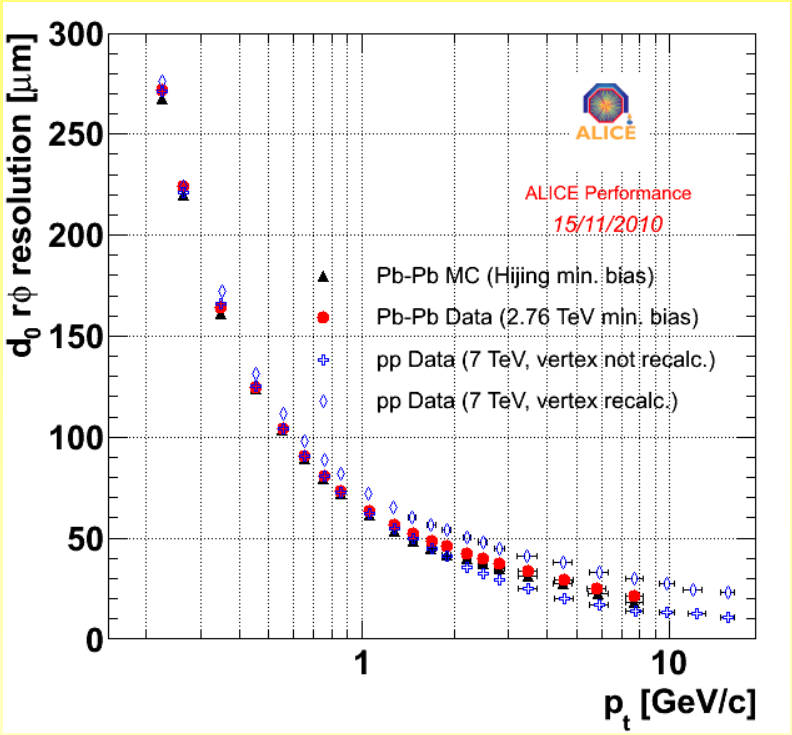
Detector Status

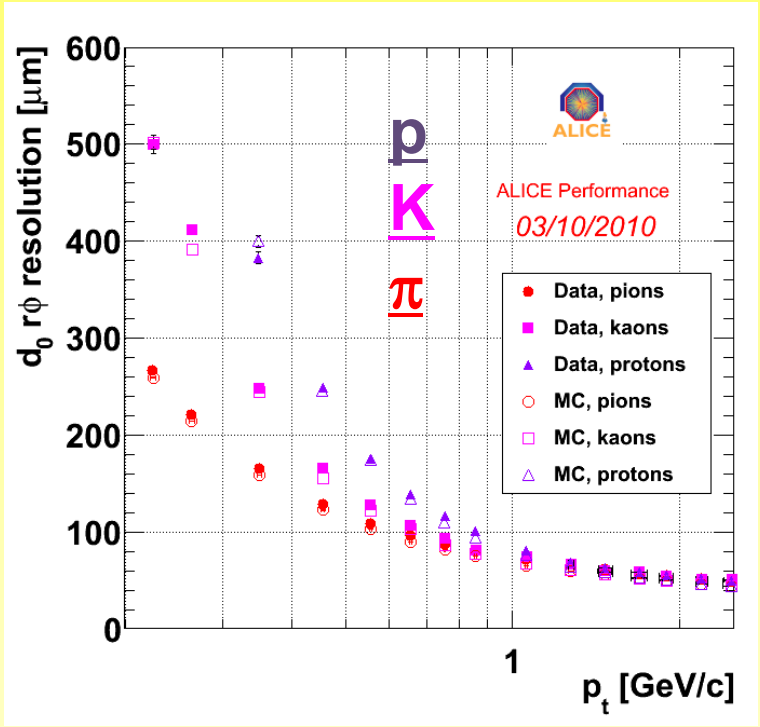
- Remarkable performance in 2010 with both protons and Pb beams, which has allowed very fast Physics results
- Some issues solved
  - A scheme for SSD and SDD ventilation providing acceptable humidity conditions to both has been found
  - The Air Cooling in the Magnet has been optimized and since then the PMD is running stable
- Few issues still open
  - SPD cooling: attempts to improve during the Christmas break did not succeed. Stable yet not satisfactory (10% to 20% of the detector not operational) => need to wait for the long shutdown for major intervention (being planned and prepared)
  - TPC Chambers: new gas mixture (pure Ne/CO_2) has improved the operation at high rate, but still some sparks appear. A dedicated study is planned for the next two weeks, with in sight a solution which will allow routine high-rate running

Few Examples of ALICE performance: vertexing

- Track-based alignment with MillePede2 (cosmics + collisions)
- Alignment quality: transverse d_0 resolution from pp collisions

includes prim. vertex resolution (with beam constr. and without the track under test)



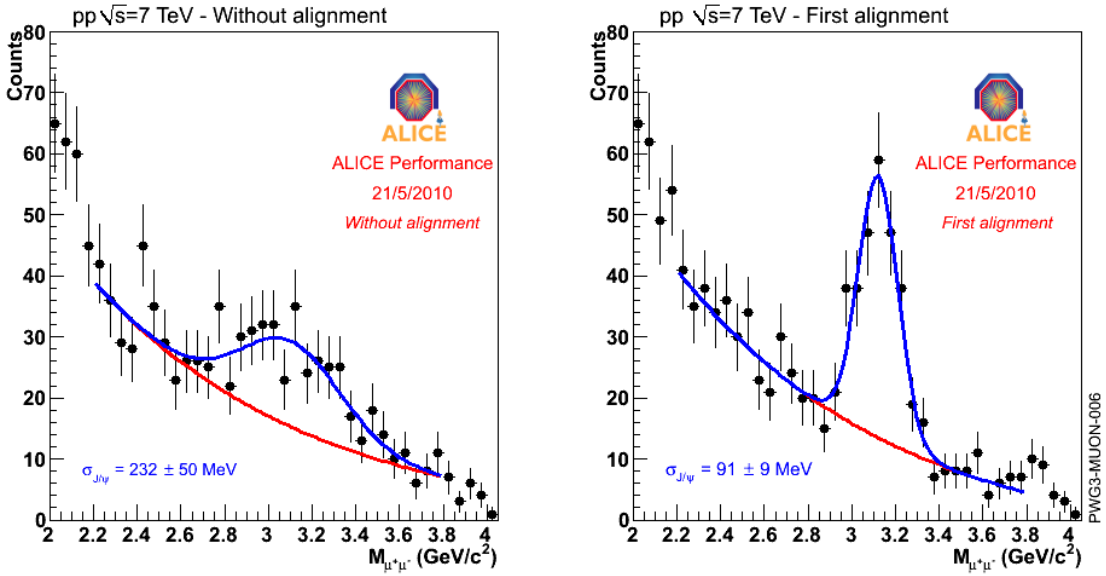


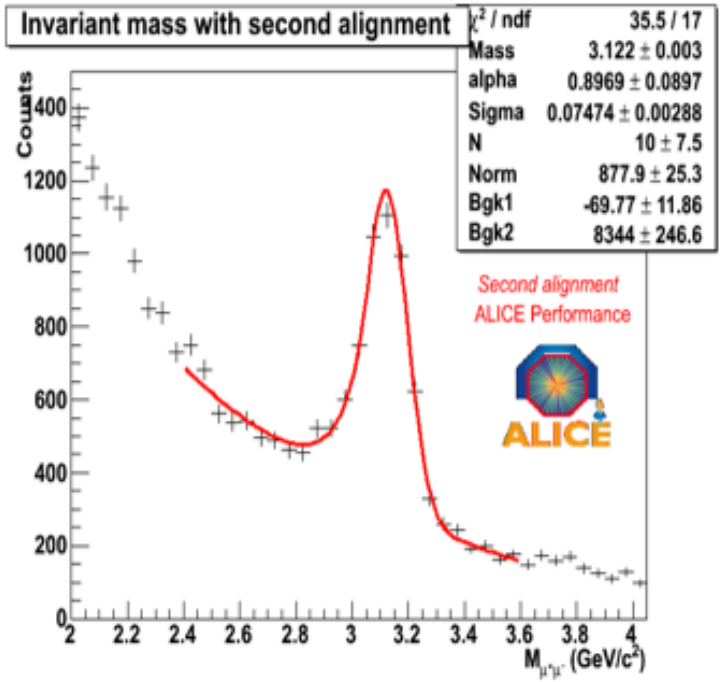
- Resolution better than 75 μm above 1 GeV/c, and very close to target performance, essentially the ***same in PbPb and pp***
  - **Residual misalignment < 10 μm**
- Particle mass dependence as in MC → material corrections OK

Muon spectrometer alignment

No and 1st alignment

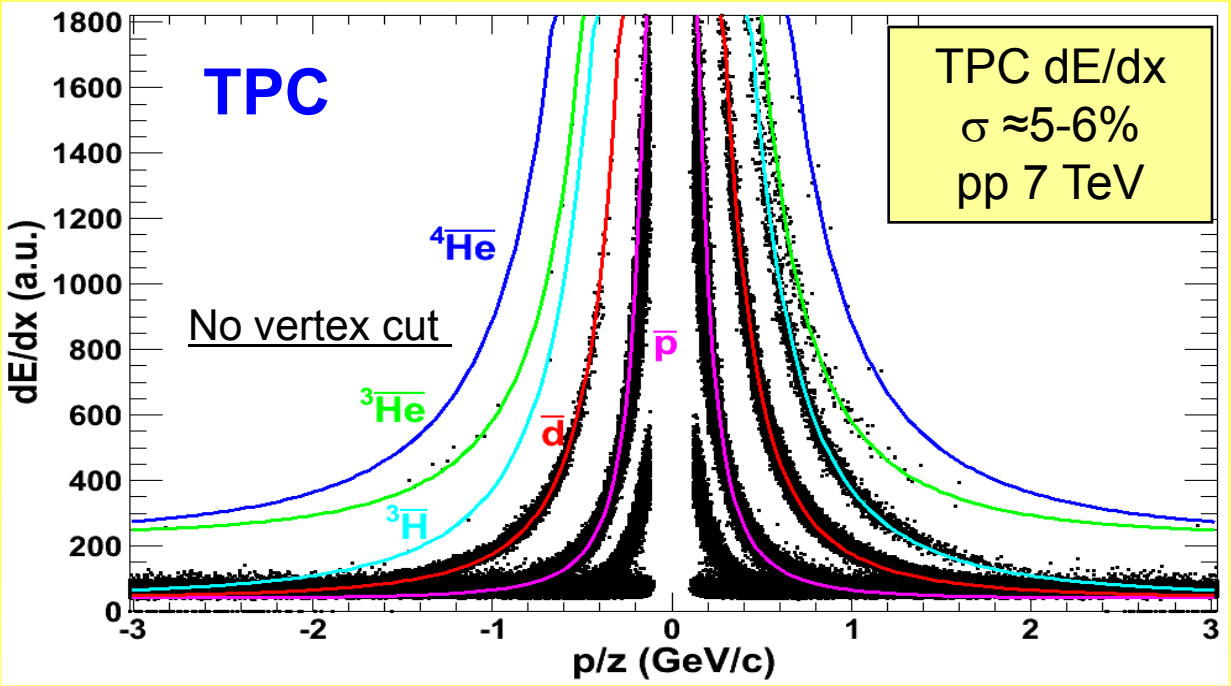
2nd alignment

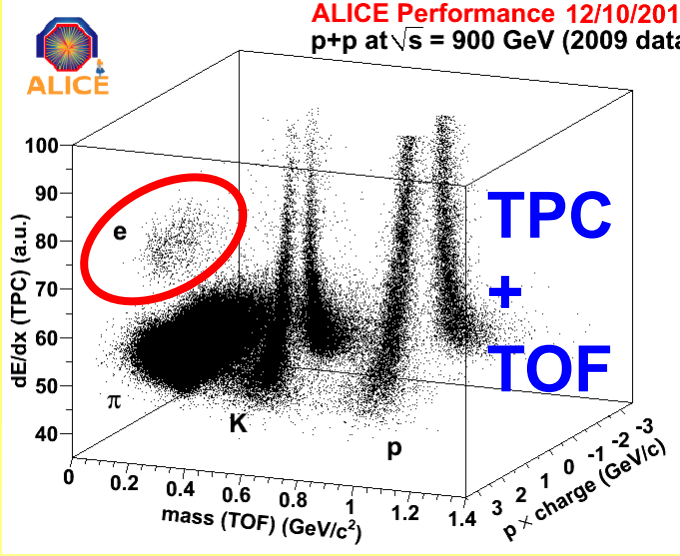




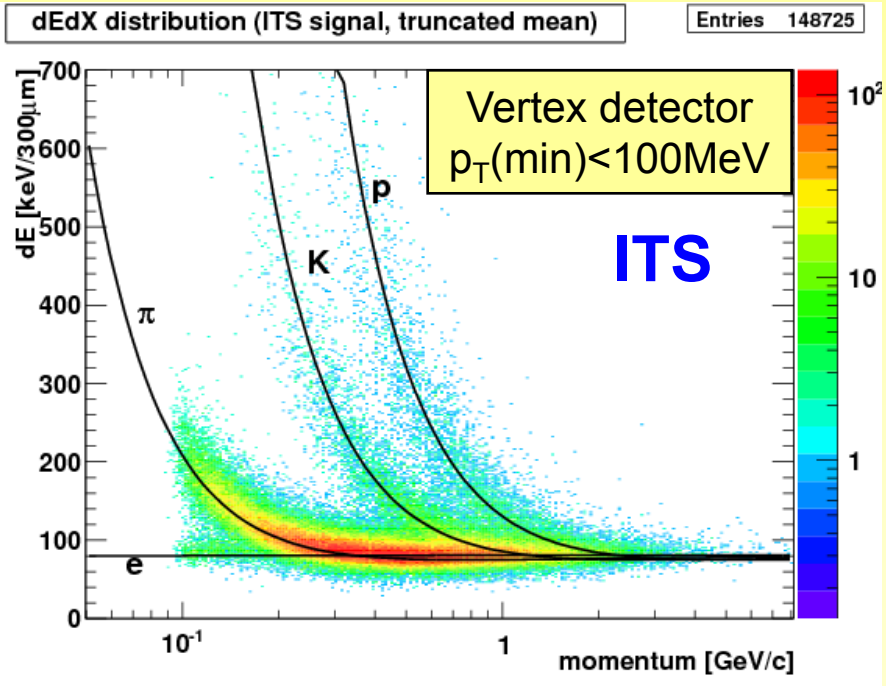
To be compared with expected performance with perfect alignment of 70 MeV

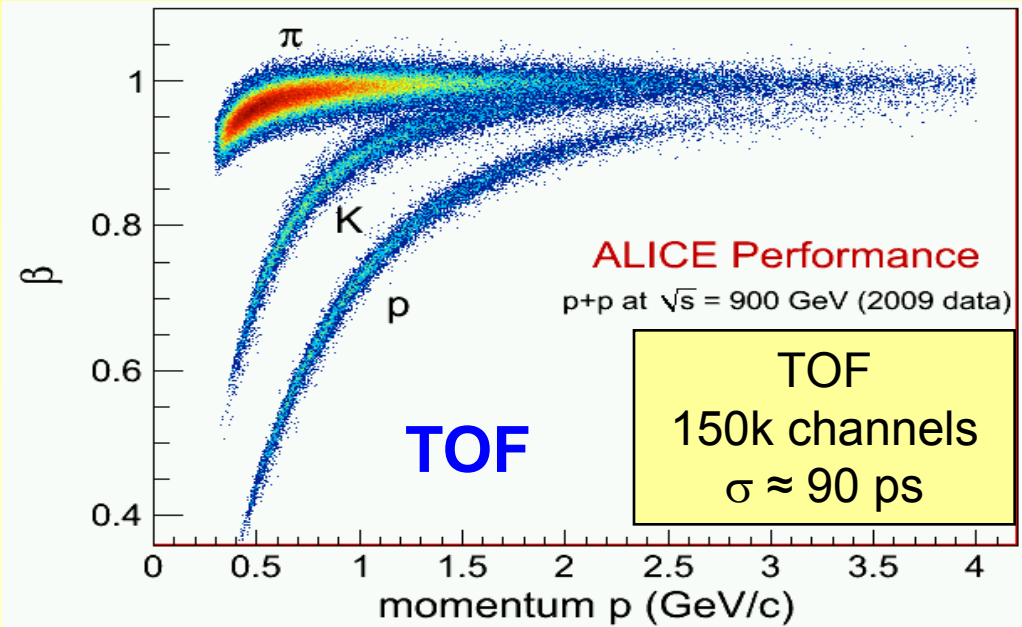
$\sigma_{J/\psi} = (75 \pm 3)\ \mathrm{MeV/c^2}$


TPC
TPC dE/dx
σ ≈5-6%
pp 7 TeV
No vertex cut
$^4\overline{He}$
$^3\overline{He}$
$^3\overline{H}$
$\overline{d}$
$\overline{p}$
dE/dx (a.u.)
p/z (GeV/c)

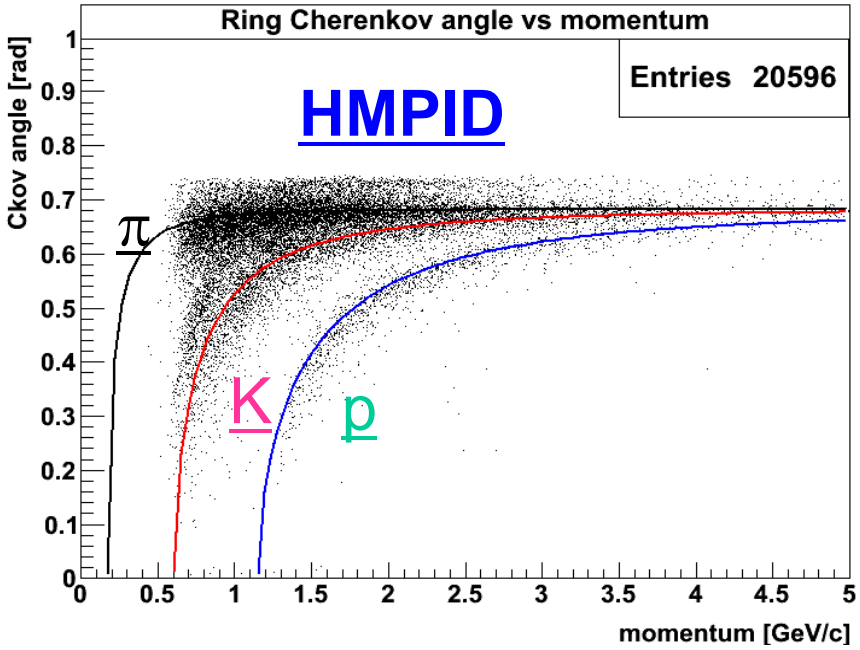

ALICE Performance 12/10/201
p+p at √s = 900 GeV (2009 data
ALICE
TPC
+
TOF
dE/dx (TPC) (a.u.)
mass (TOF) (GeV/c²)
p × charge (GeV/c)
e
π
K
p

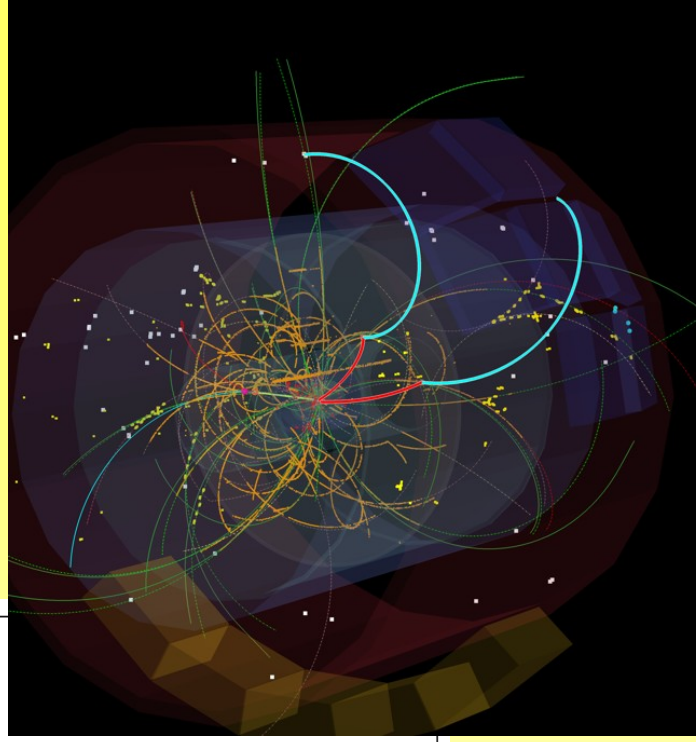
PID

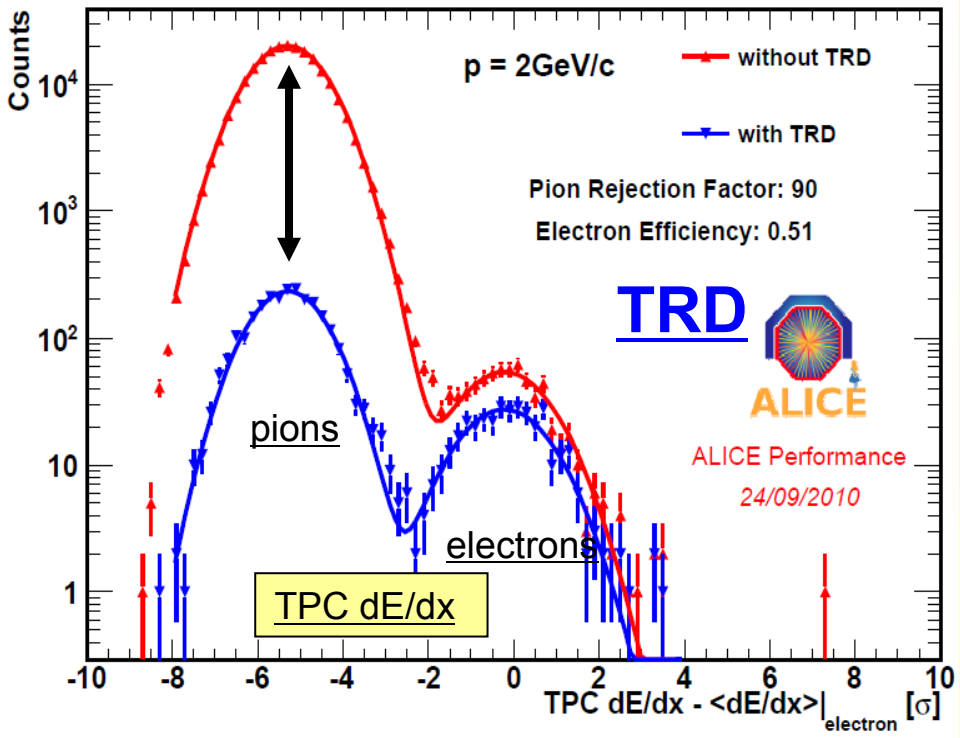

dEdX distribution (ITS signal, truncated mean)
Entries 148725
Vertex detector
p_T(min)<100MeV
ITS
dE [keV/300μm]
momentum [GeV/c]
π
K
p
e

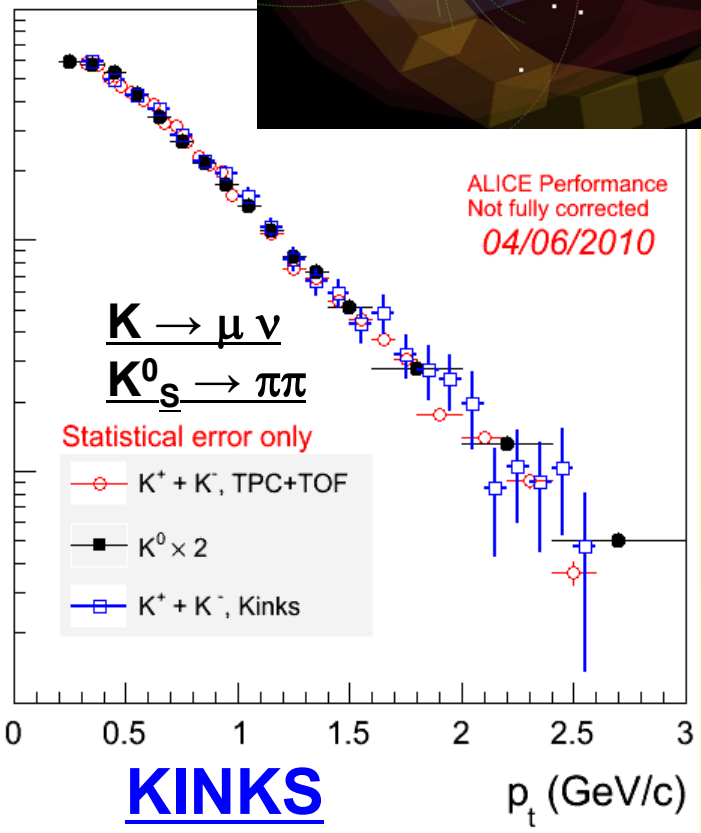

ALICE Performance
p+p at √s = 900 GeV (2009 data)
TOF
150k channels
σ ≈ 90 ps
β
momentum p (GeV/c)
π
K
p

More PID





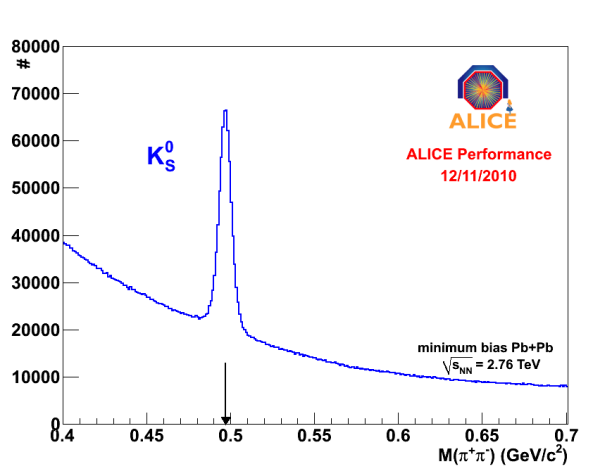


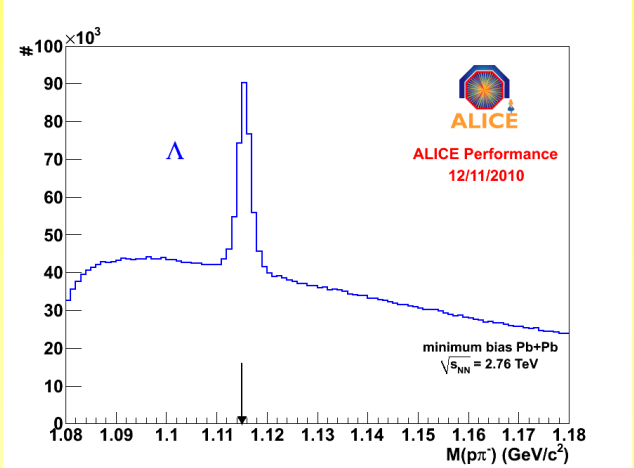


Kaon p_T dist. stable & decays

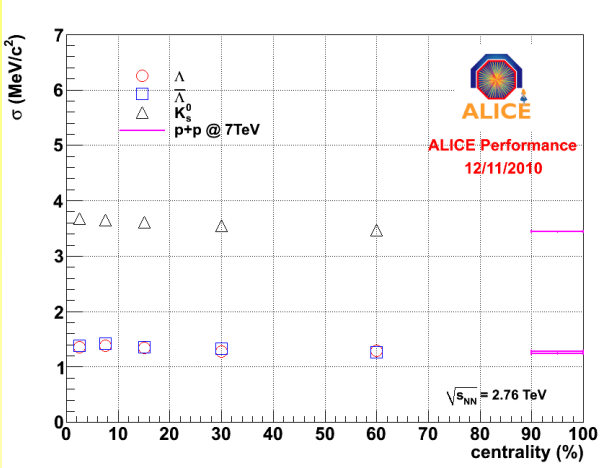
Strange particle signals in Pb-Pb: check of tracking/vertexing quality

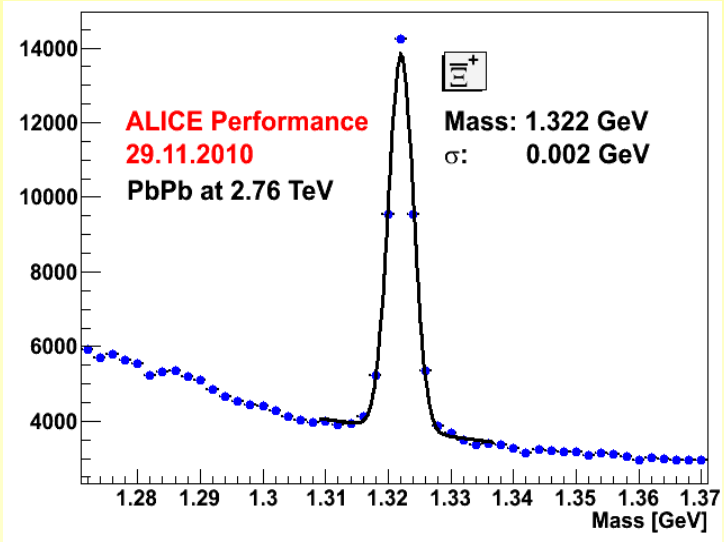
K^0_S, Λ in TPC+ITS:

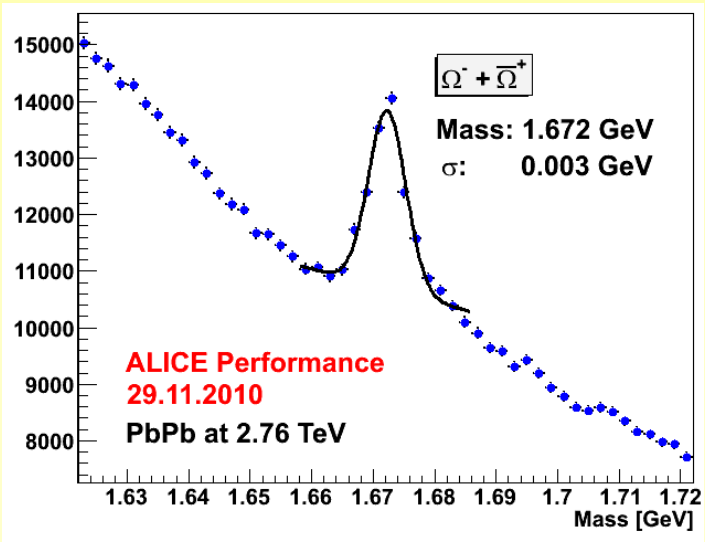




Mass widths are independent of centrality

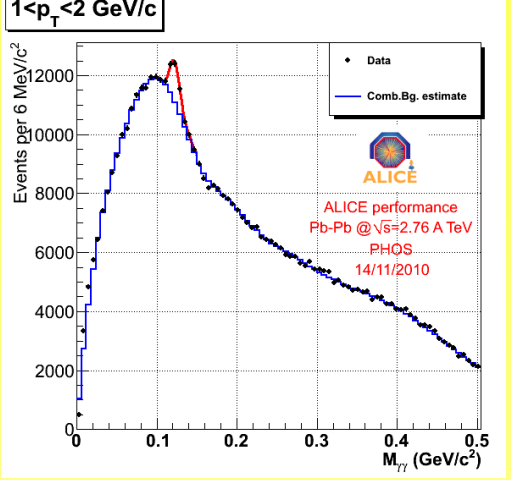


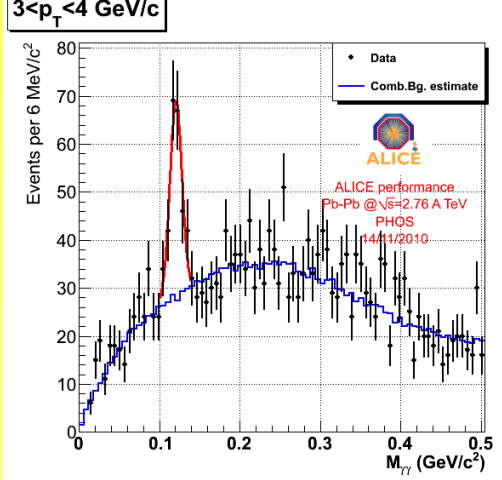




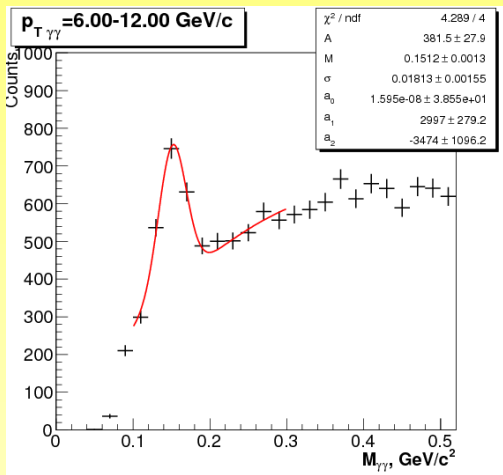
π^0 inv. mass peaks in Pb-Pb

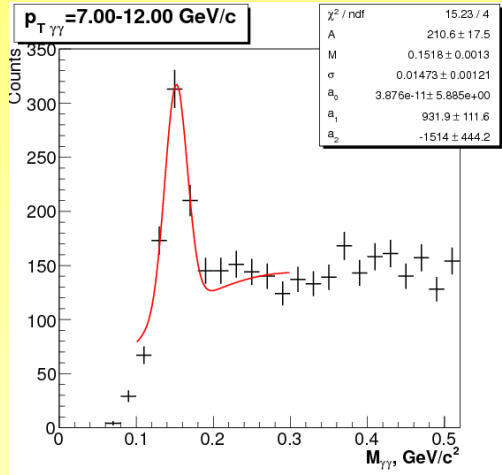
$\pi^0 \rightarrow \gamma\gamma$ in PHOS:



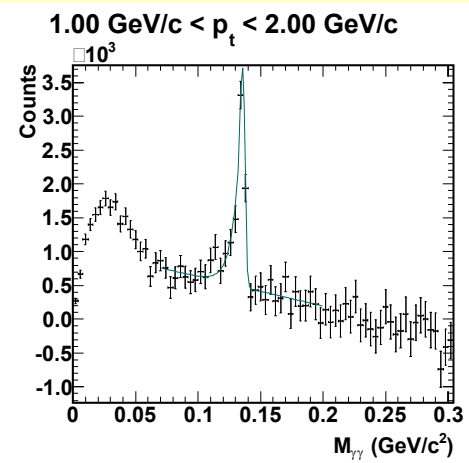


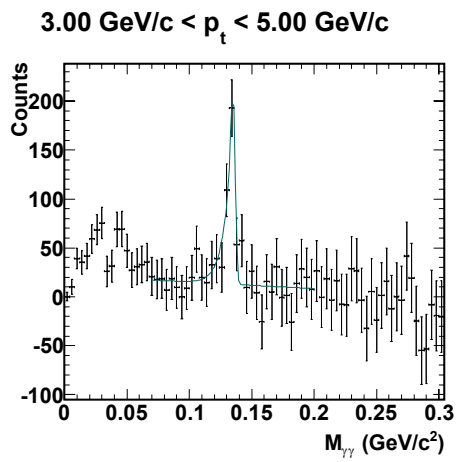
$\pi^0 \rightarrow \gamma\gamma$ in EMCAL:





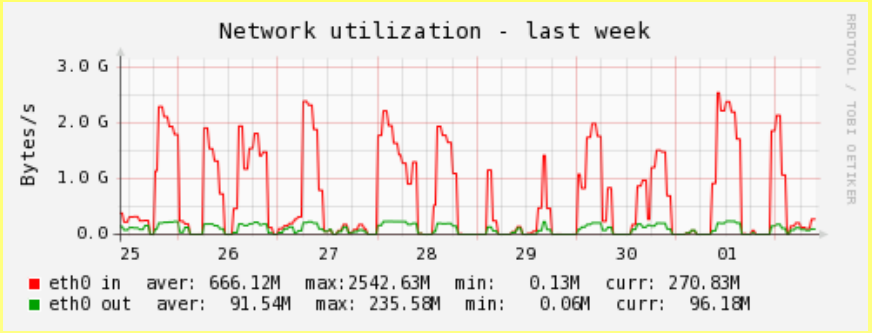
$\pi^0 \rightarrow \gamma\gamma$ -> e^+e^- e^+e^- TPC:

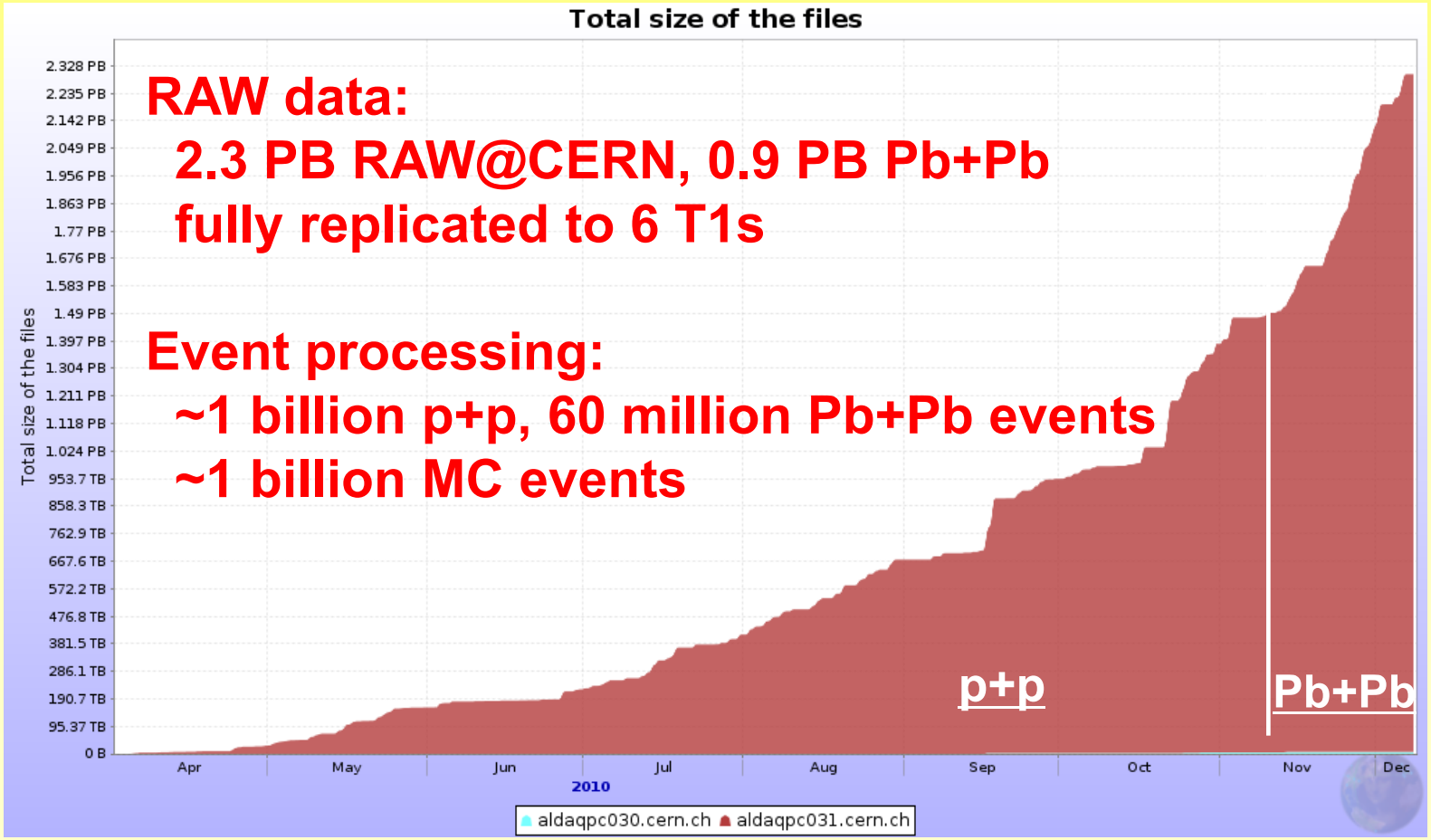




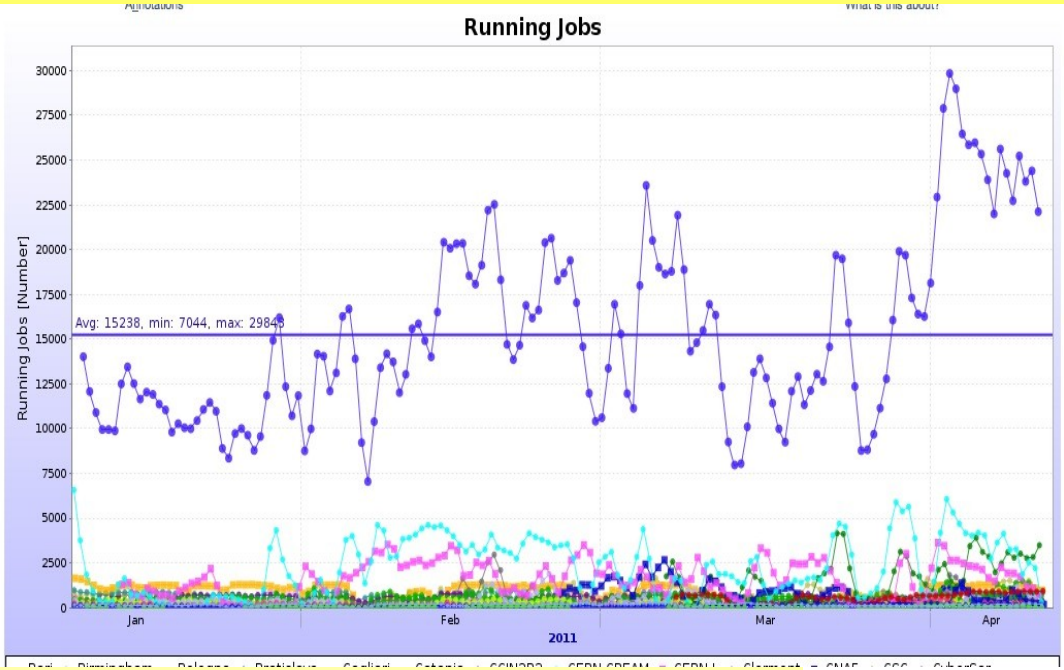
2010: Data Acquisition and processing

DAQ Performance
Peaks up to 2.5 GB/s





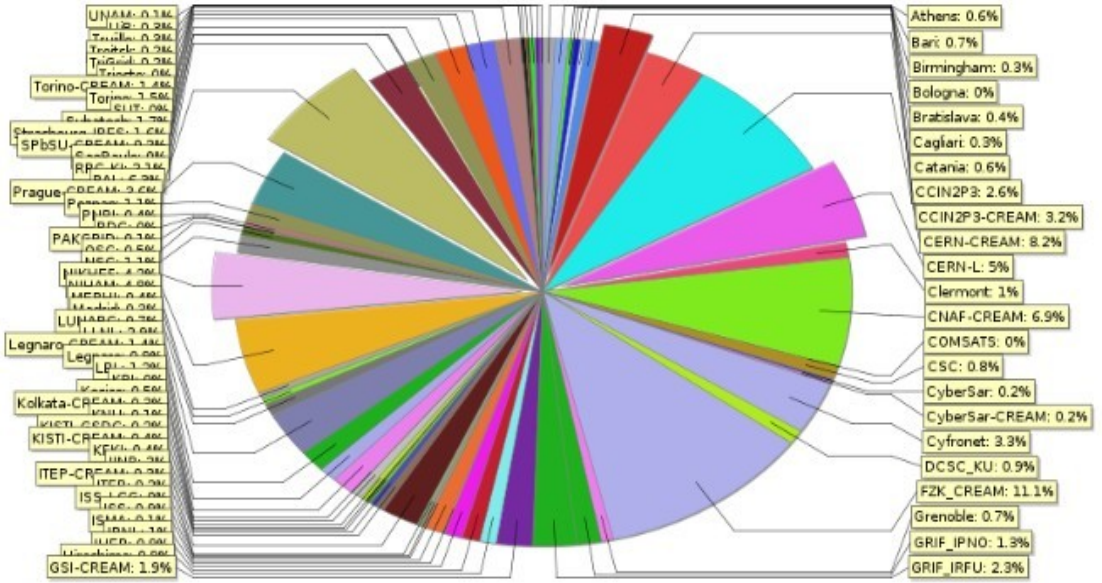
Computing: Resources usage



ALICE has ~ 15-16k job slots, consistent with average use. Excellent stability of the central GRID services. Dips: occasional fluctuations in the workload due to job dependencies and data availability for analysis, and to the fluctuations in the centre's availability. Peaks: opportunistic use of free resources for which our system is particularly efficient.

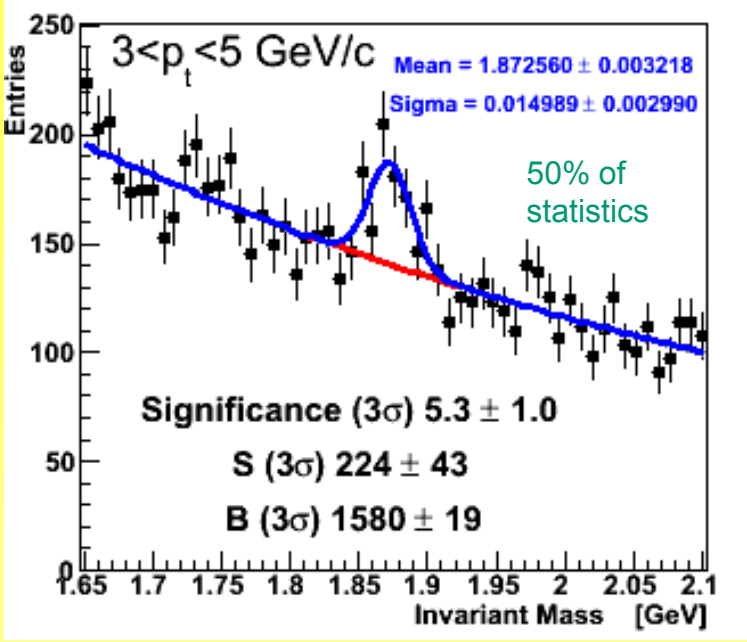
Grid power – computing centres contribution

62 T2s, 6T1s, 20K CPU cores running in parallel
10PB of disk and tape storage… expanding! (*thanks Funding Agencies..)*

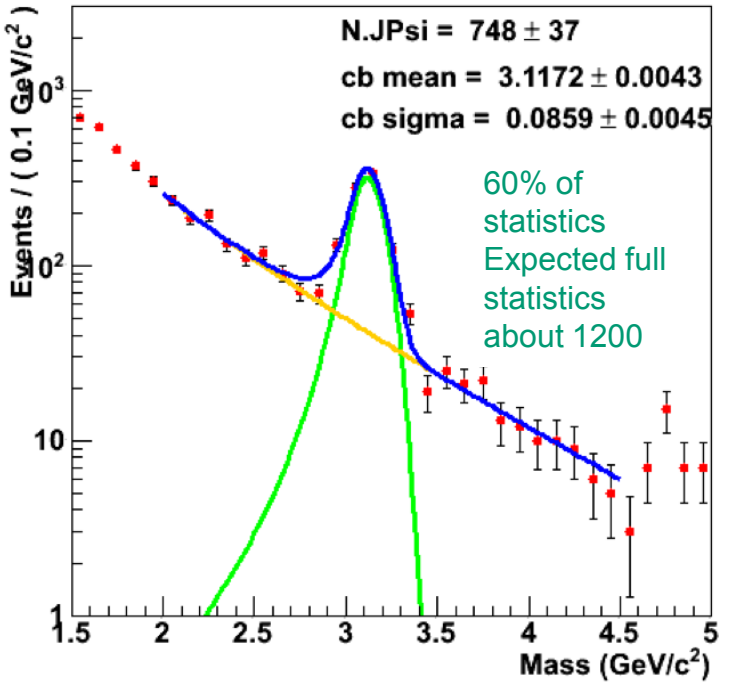


The 2.76 TeV pp Run

- Aim: 35 hours of data taking to achieve
  - > 50 Million MB events after physics selections
  - A van der Meer scan
- **ACCOMPLISHED (in record time, essentially all during the weekend of March 26-27 congratulation to the LHC team!)**
- High running efficiency, collected 74 M minimum bias events and 10 M of rare triggers (Muon, EMCAL: 18 nb^{-1}), enough for J/psi and charm
- Analysis proceeding very fast (reconstruction already complete) => even rare probes OK

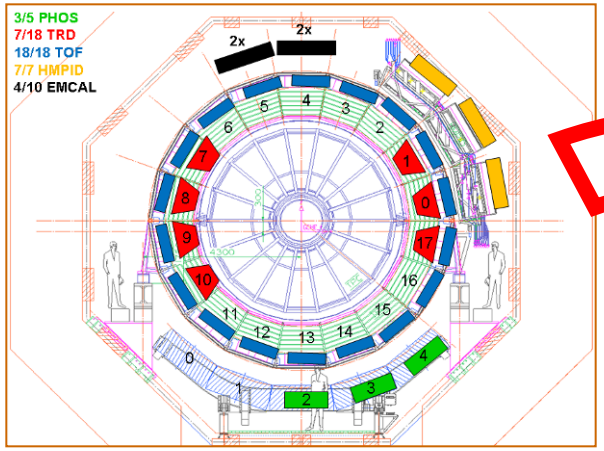


J/ψ and D^0 signals

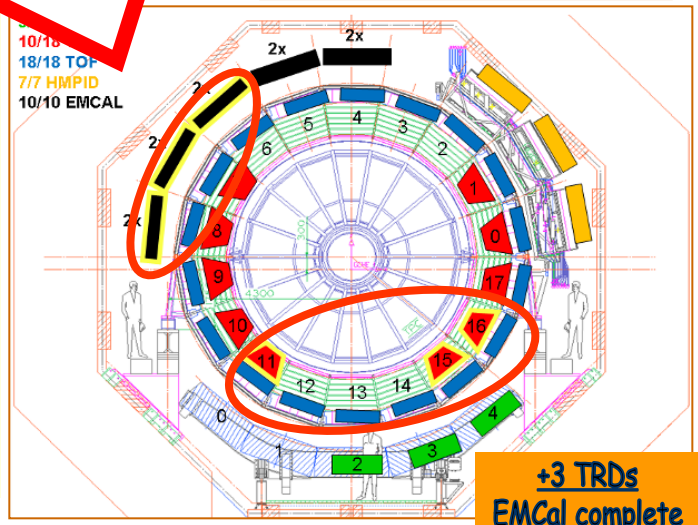


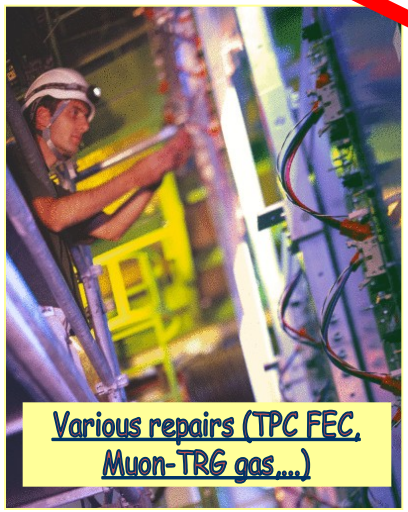
ALICE shutdown work

ALICE detector 2010



ALICE detector 2011





ALICE has made a very efficient use of the Xmas break:

- Installation EMCal and TRD (work during Xmas and NY)
- Upgrades (DAQ) and repairs (TPC FEC)
- Maintenance on CV and gas equipments
- New cooling system for PMD

Wonderful support from Survey, Transport, VAC, CV and EL groups !

ALICE Results with pp

- **AIMS:**
  - collect 'comparison data' for heavy ion program
    - many signals measured 'relative' to pp
  - comprehensive study of MB@LHC
    - tuning of Monte Carlo (background to BSM)
  - soft & semi-hard QCD
    - very complementary to other LHC experiments
    - address specific issues of QCD
  - very high multiplicity pp events
    - $dN_{ch}/d\eta$ comparable to HI => mini-plasma ?

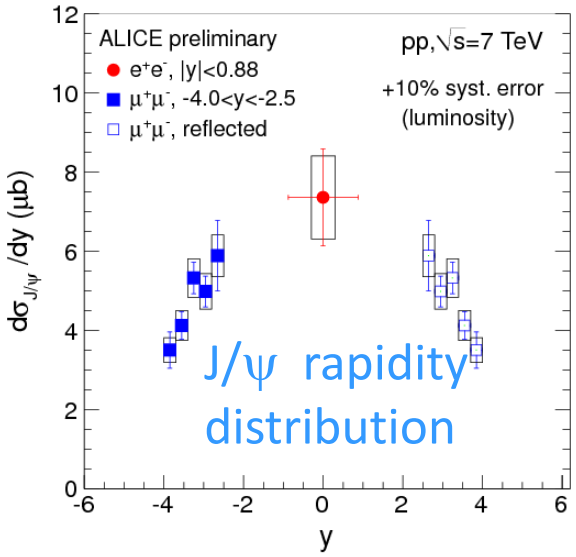
- **Final Results**
  - ⇨ N_{ch} multiplicity & distributions
    - ✪ 900 GeV: **EPJC**: Vol. 65 (2010) 111
    - ✪ 900 GeV, 2.36 TeV: **EPJC**: Vol. 68 (2010) 89
    - ✪ 7 TeV: **EPJC**: Vol. 68 (2010) 345
  - ⇨ pbar/p ratio (900 GeV & 7 TeV) **PRL**: Vol. 105 (2010) 072002
  - ⇨ Momentum distributions(900 GeV) **PLB**: Vol. 693 (2010) 53
  - ⇨ Bose-Einstein correlations (900 GeV) **PRD**: Vol. 82 (2010) 052001
  - ⇨ Strangeness (K^0,Λ,Ξ,Ω,ϕ) **EPJC** Vol. 71 (2011) 1594
  - ⇨ Identified charged particle spectra in pp at 900 GeV accepted by **EPJC**
  - ⇨ Pion Bose-Einstein correlations in pp at 0.9 TeV and 7 TeV subm to **Phys.Rev.D**

- **Under Final Collaboration Review**
  - ⇨ J/ψ –> μμ, e^+e^-

- **Ongoing analyses (selection)**
  - ⇨pQCD: jet fragmentation, …
  - ⇨Central Diffraction
  - ⇨Photon multiplicity, anitnuclei production, ….

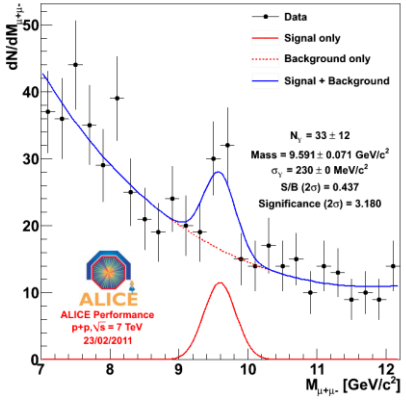
- **(Advanced) Drafts**
  - ⇨ 7 TeV event properties: spectra, identified particles, strangeness, high multiplicity
  - ⇨ pQCD: di-hadron correlations
  - ⇨ pQCD: Event topology, Underlying event
  - ⇨ Heavy flavour: charm (D^0,D^+, D^*), heavy quarks (c,b) –> μ, e^-
  - ⇨ π^0 spectra

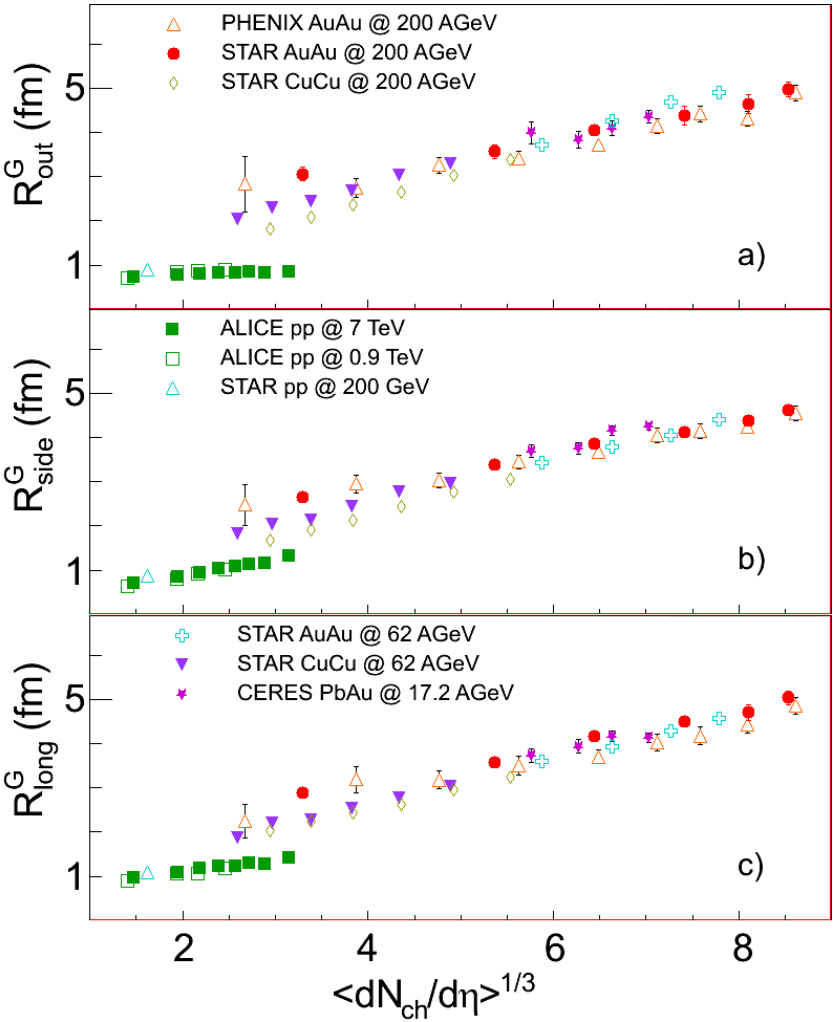
Few recent results…



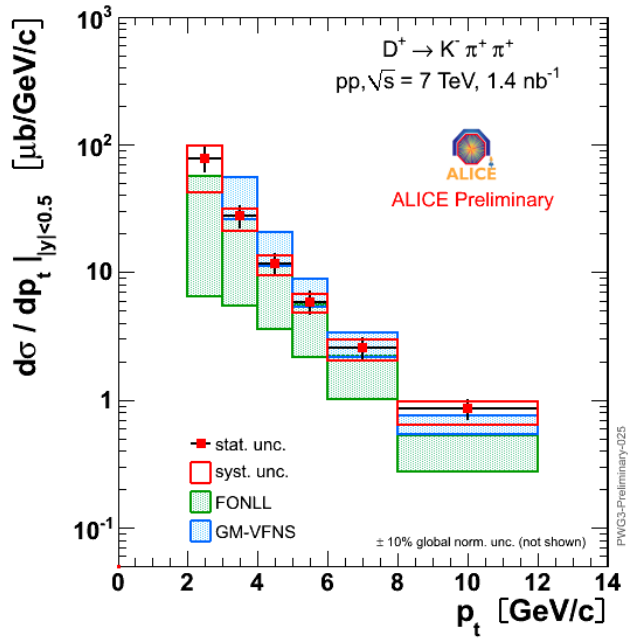
J/ψ rapidity distribution

First Υ signal



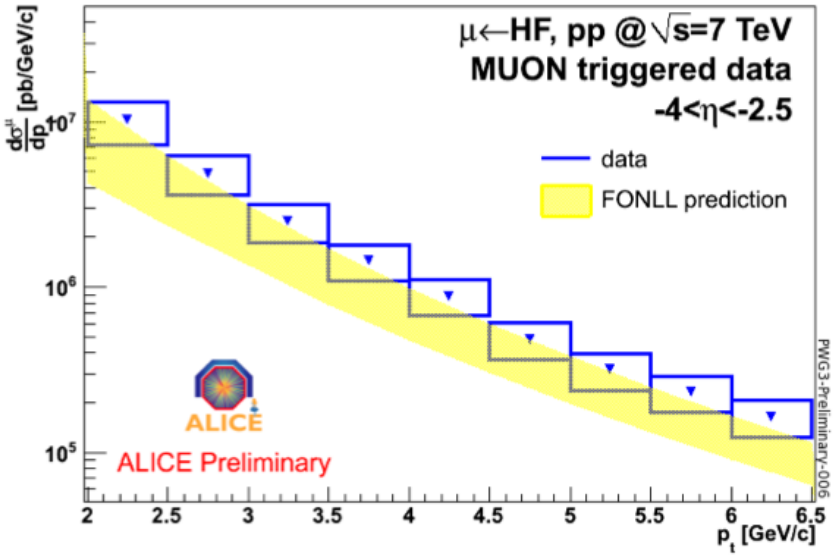


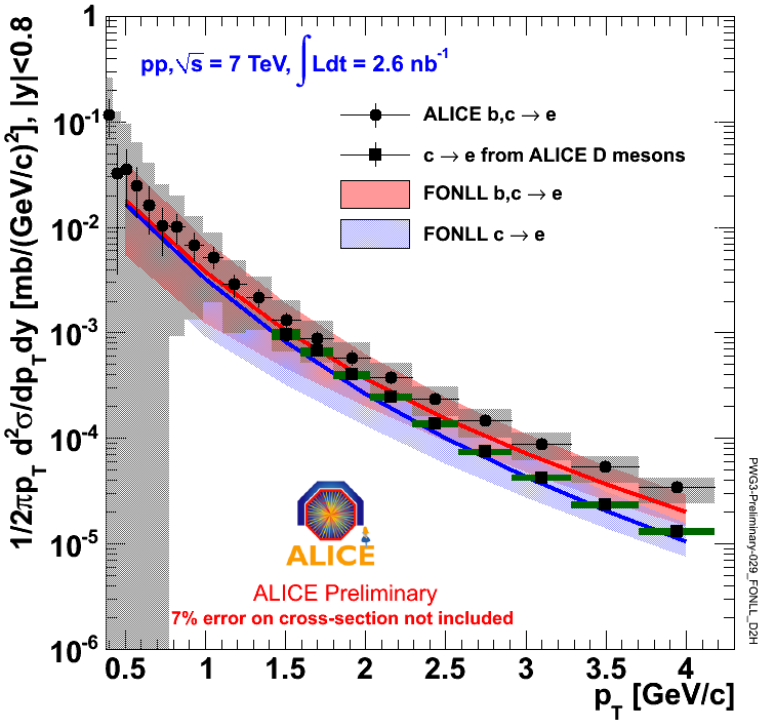
Multiplicity dependence of HBT parameters



D^+ (and D^0) cross section $|y|<0.5$

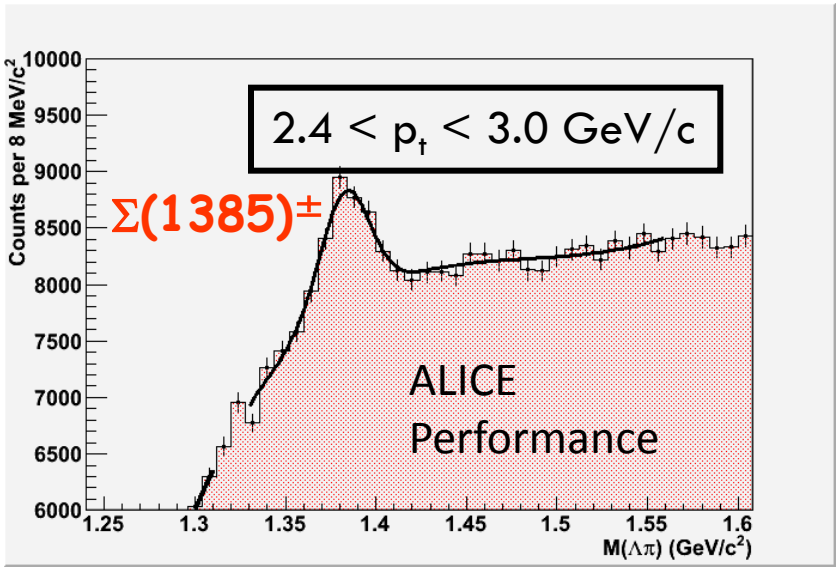
Charm and Beauty to leptons



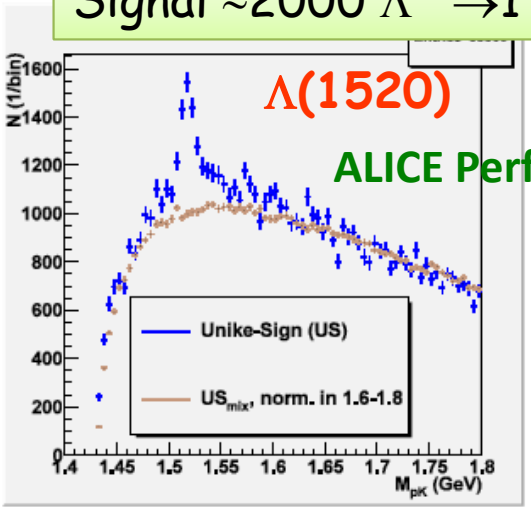


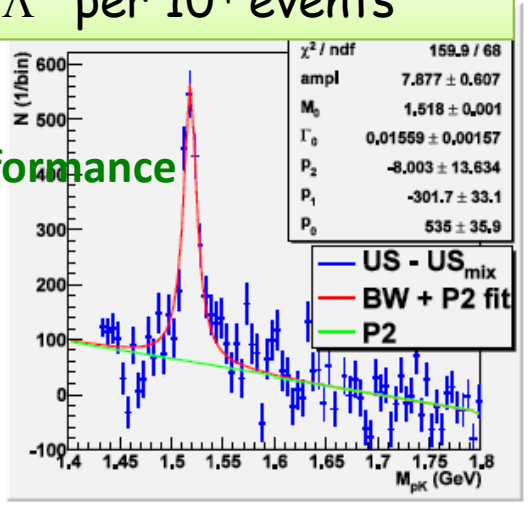
Particle production

After $\phi \rightarrow K^+K^-$, $\Sigma^* \rightarrow \Lambda\pi$,
$\Omega \rightarrow \Lambda K$, $K^* \rightarrow K\pi$, $\Xi \rightarrow \Lambda\pi$



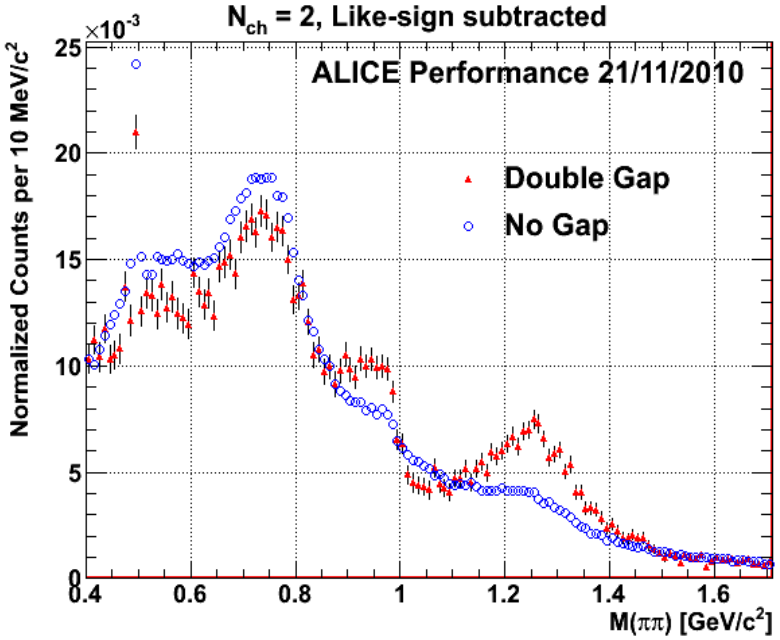
Signal ~2000 $\Lambda^* \rightarrow 1$ Λ^* per 10^4 events

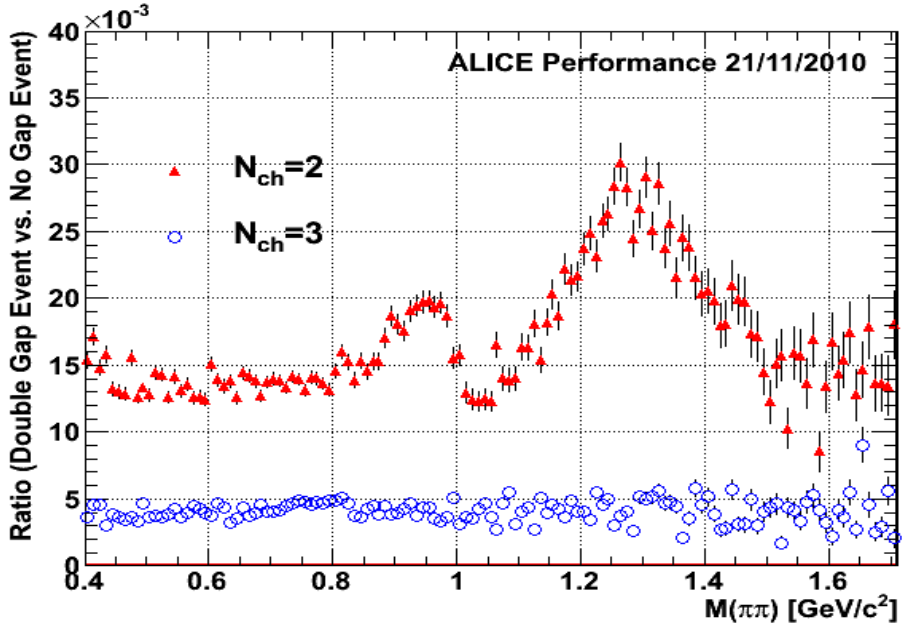




Central diffractive production in ALICE central barrel

ALICE: good acceptance at low transverse momentum, rapidity gap defined with V0 and SPD





→ enhancement of $f_0(980)$, $f_2(1270)$ in double gap evts with N_{ch}=2

→ no enhancement of $f_0(980)$, $f_2(1270)$ in double gap evts with N_{ch}=3

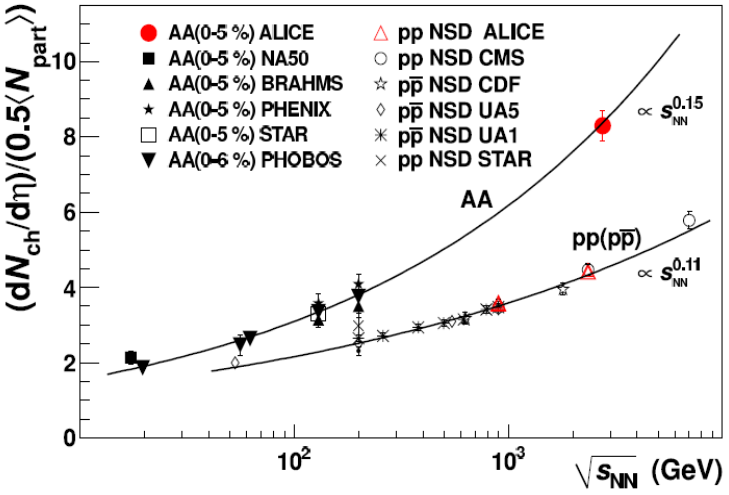
→ **central *exlusive* production of f_0,f_2**

ALICE results with PbPb

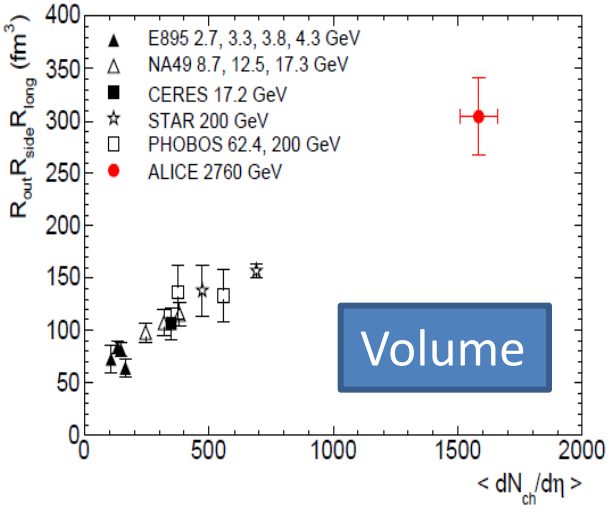
- **Final Results**
  - ⇨ N_{ch} multiplicity
    - ✪ Rapidty density — **PRL**: Vol. 105 (2010) 252301
    - ✪ Centrality dependence — **PRL**: Vol. 106 (2011) 032301
  - ⇨ FLOW of charged particled — **PRL**: Vol. 105 (2010) 252302
    - ⇨ together with ATLAS di-jet paper, got **PRL "Viewpoint", first for LHC**
  - ⇨ Suppression of high-p_T (R_{AA}) — **PLB**: Vol. 696 (2011) 30
  - ⇨ Bose-Einstein correlations — **PLB**: Vol. 696 (2011) 328
- **Advanced Drafts**
  - ⇨ Identified particles: Baryon/meson ratio
  - ⇨ Flow with identified particles
- **Ongoing analyses**
  (a few out of very many => aiming to submit about 40 papers to QM Conference in May)
  - ⇨ $J/\psi \rightarrow \mu\mu$, e^+e^-
  - ⇨ Event structure from autocorrelations
  - ⇨ Azimuthal Correlations of high-p_T particles
  - ⇨ Identified particles: strangeness, resonances …
  - ⇨ π^0 spectra
  - ⇨ Heavy flavour: charm (D^0,D^+, D^*), heavy quarks (c,b) $\rightarrow \mu$, e^-

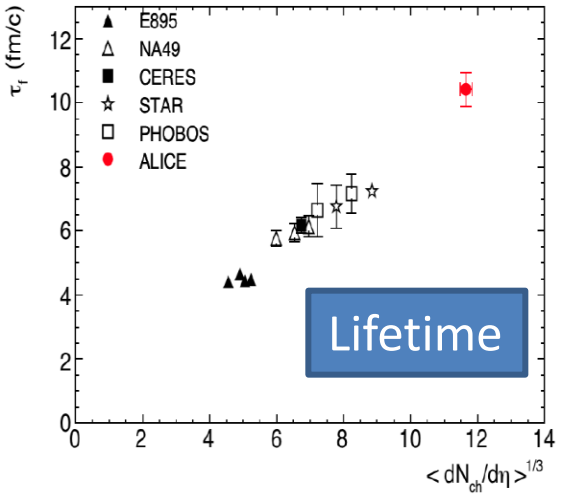
Characteristics of Central Pb+Pb Collisions at 2.76 TeV

- **Energy density from $dN_{ch}/d\eta$**
  - $dN_{ch}/d\eta = 1599 \pm 4$ (stat.) ± 80 (syst.)
  - constrains / rules out models
  - 100 times cold nuclear matter density
  - ~3 times the density reached at RHIC ($\varepsilon \approx 15$ GeV/fm^3)



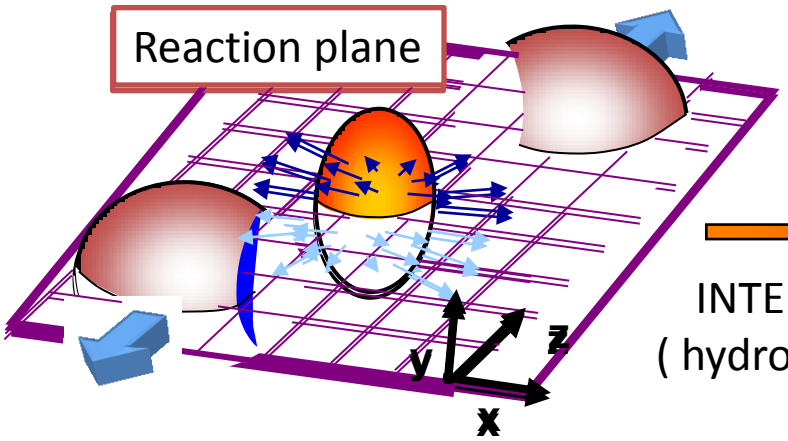
- **Volume and lifetime from HBT interferometry**



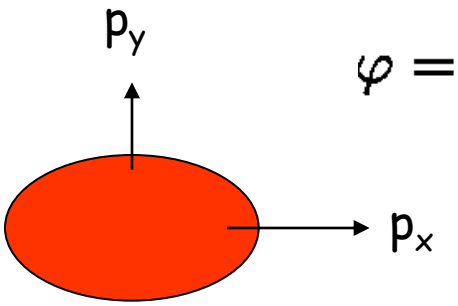


- Freeze-out volume ~ 300 fm^3
- ~ 2 times the volume measured at RHIC (AuAu@200 GeV)
- Lifetime until freeze-out ~ 10 fm/c

Particle production in Pb-Pb: Azimuthal anisotropy



INTERACTIONS
(hydrodynamics?)



$$\varphi = \arctan \frac{p_y}{px}$$

$$\varepsilon = \frac{\langle y^2 \rangle - \langle x^2 \rangle}{\langle y^2 \rangle + \langle x^2 \rangle}$$

Initial spatial anisotropy

$$v_2 = \frac{\langle p_x^2 \rangle - \langle p_y^2 \rangle}{\langle p_x^2 \rangle + \langle p_y^2 \rangle}$$

Final momentum anisotropy

Reaction plane defined by "soft" (low p_T) particles

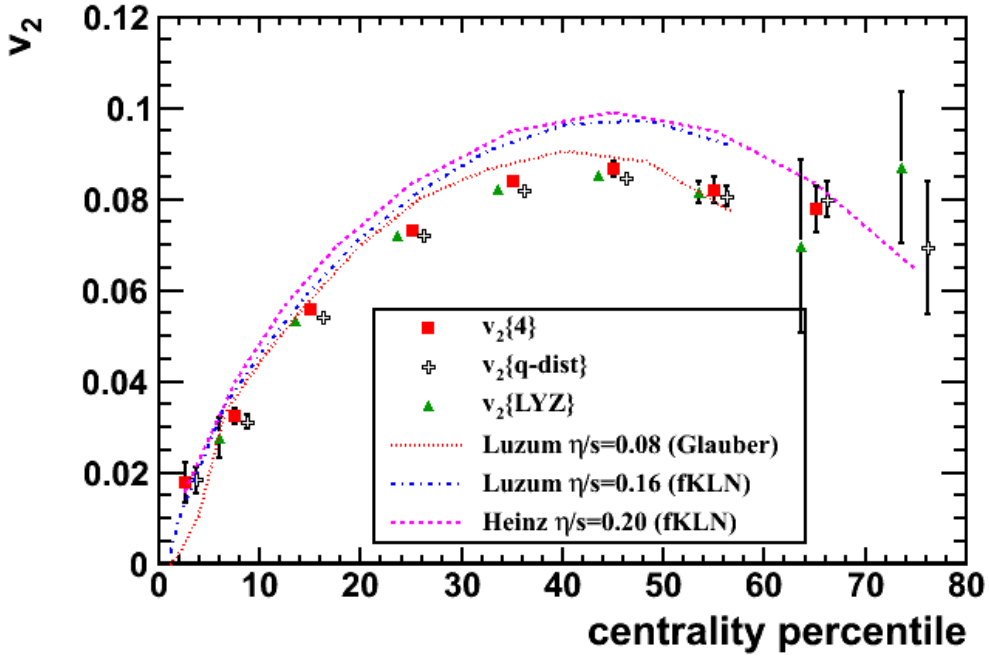
$$\Delta\varphi = \varphi - \varphi^{Reaction\ Plane}$$

Elliptic flow

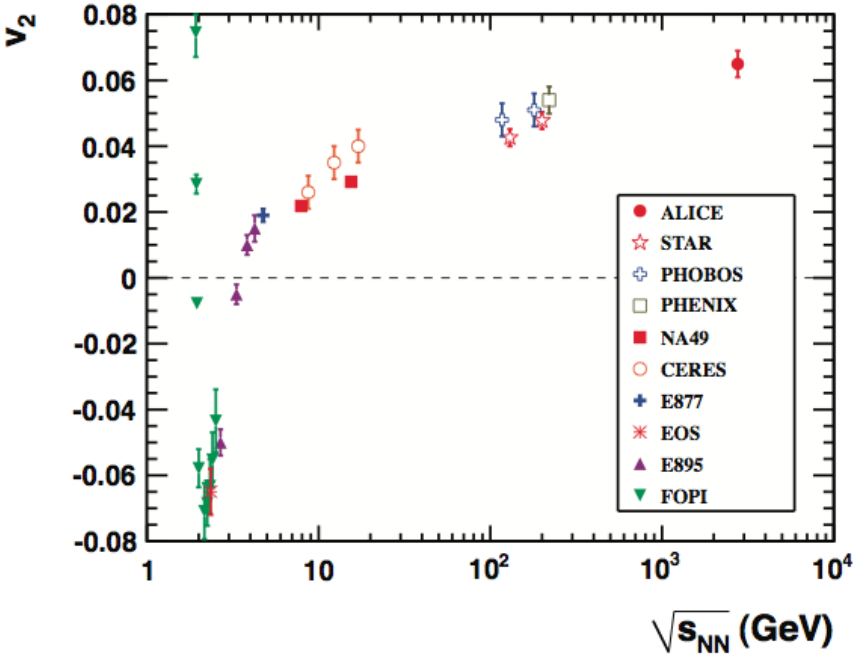
$$\frac{dN}{d\Delta\varphi} \propto 1 + 2v_2 \cos(2\Delta\varphi)$$

Measure Properties of the Medium Created in Pb+Pb Collisions

Most extreme state of matter ever created in the lab …



PRL 105, 252302 (2010) [36 citations]

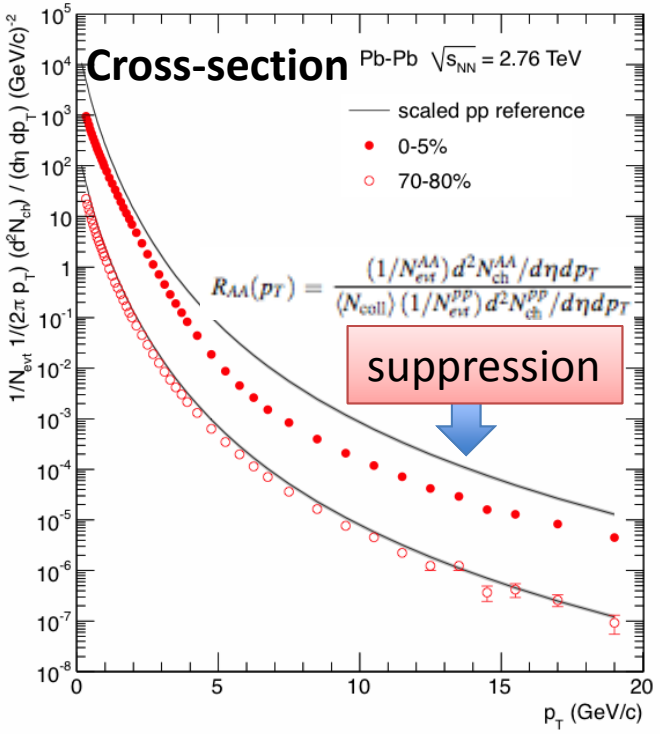


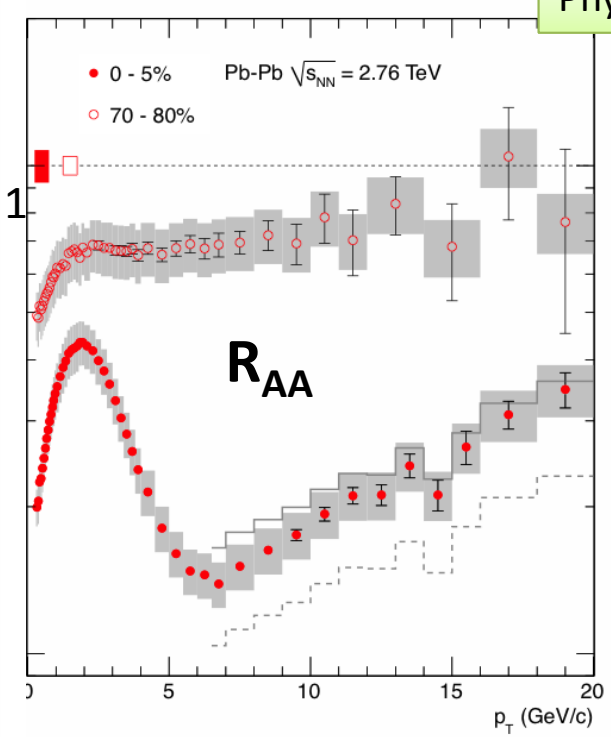
1. Collective behavior observed in Pb-Pb collisions at LHC (+0.3 v_2^{RHIC})
   $v_2(p_T)$ similar to RHIC – almost ideal fluid at LHC ?
2. New input to the energy dependence of collective flow
3. Additional constraints on Eq-Of-State and transport properties

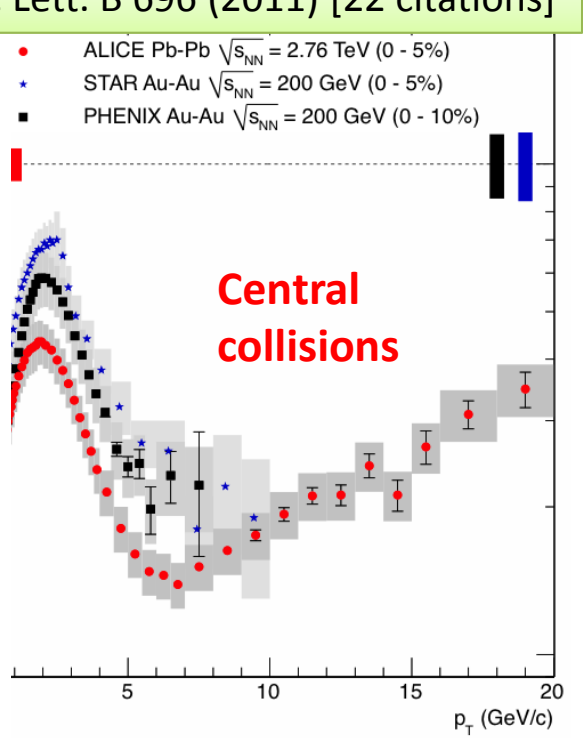
Jet quenching via hadron suppression

Ratio = #(particles observed in AA collision per N-N (binary) collision) / #(particles observed per p-p collision)

Phys. Lett. B 696 (2011) [22 citations]

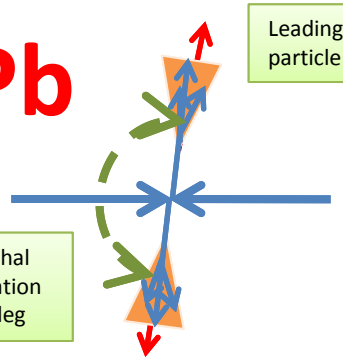






1. Strong depletion of high-pT hadrons in A-A collisions – parton energy loss (jet quenching)
2. Qualitatively new feature : evolution of R_{AA} as a function of p_T
3. New, much anticipated constraint for parton energy-loss models

Di-hadron Correlations in PbPb



Two-particle correlations

- **conditional [per-trigger] yields**

$$\frac{1}{N_{trig}}\frac{dN_{assoc}}{d\Delta\varphi} \quad \text{and} \quad \frac{1}{N_{trig}}\frac{d^2N_{assoc}}{d\Delta\varphi d\Delta\eta}$$

At Low-p_T :

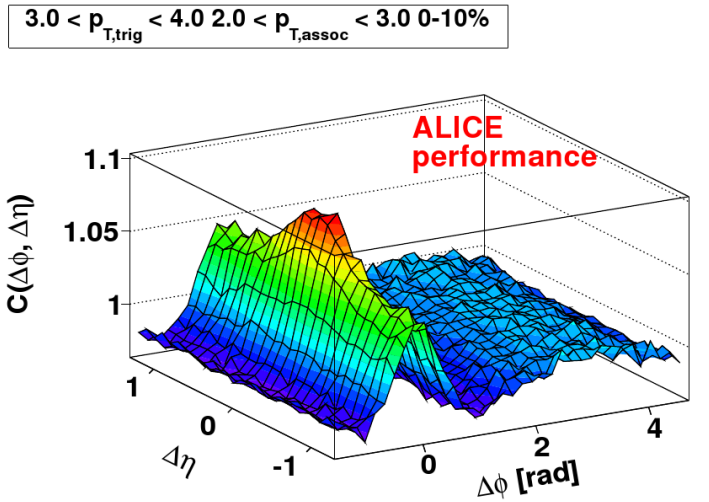
Ridge

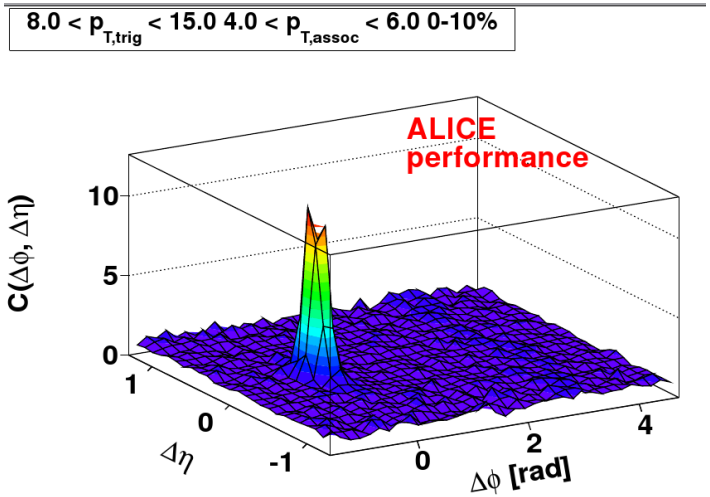
Hydrodynamics, flow

At High-p_T :

Quenching/suppression, broadening

Powerful instrument to study system characteristics, including Jet Quenching (recoil jet suppression)





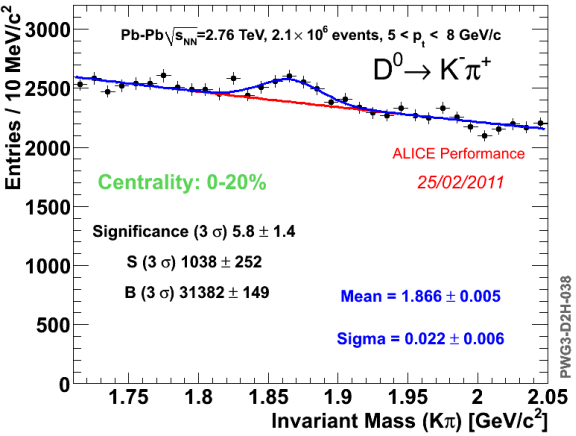
Heavy quarks in Pb-Pb

- Charm via D mesons, beauty via leptons (e, μ):

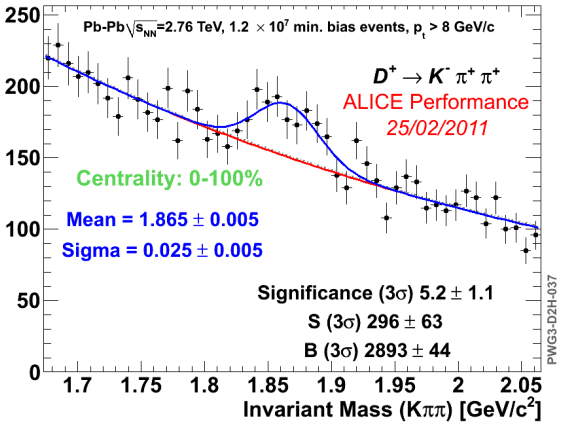
→ colour charge and mass dependence of energy loss

$D^0 \rightarrow K\pi$, $D^+ \rightarrow K\pi\pi$ via secondary vertex reconstruction

central Pb-Pb!

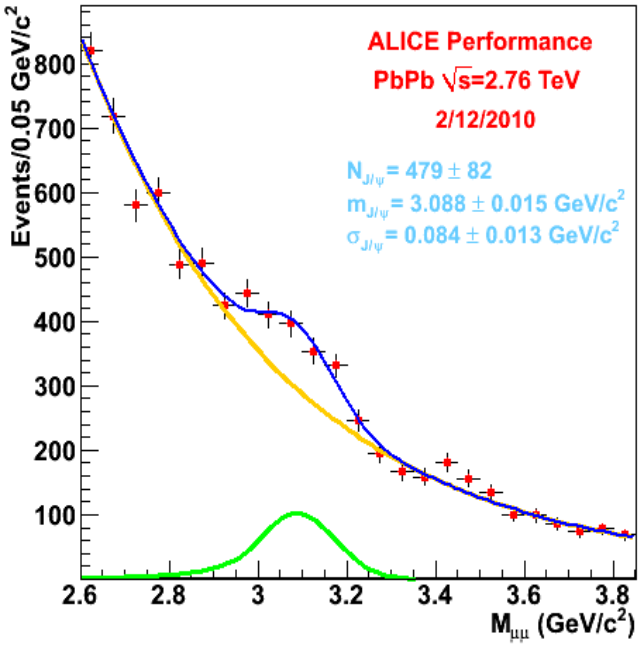


minimum bias Pb-Pb



- Quarkonia: suppression or regeneration?

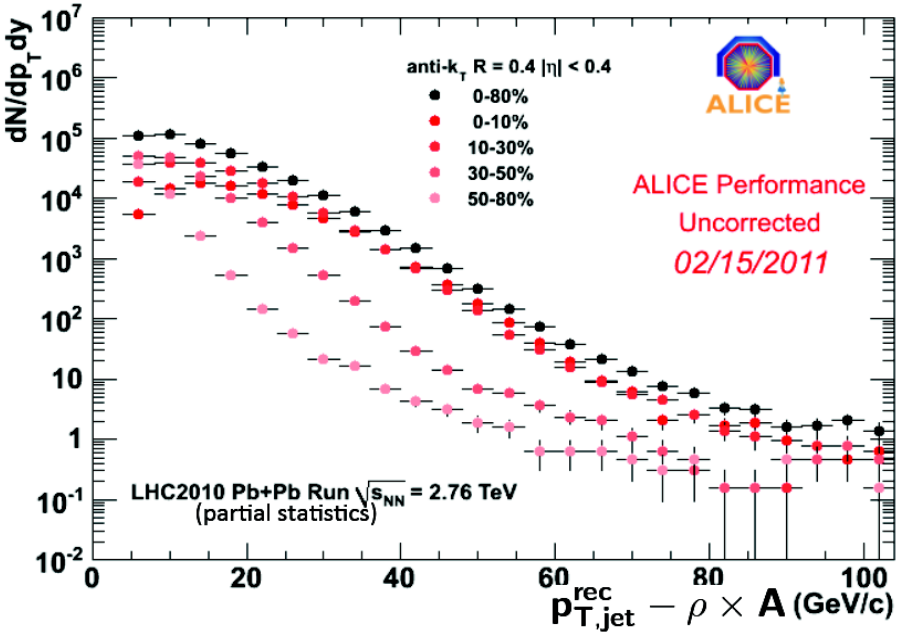
$J/\psi \rightarrow \mu\mu$ at forward rapidity, starting from $p_t \sim 0$



Expect ~2000 J/ψ from full 2010 statistics

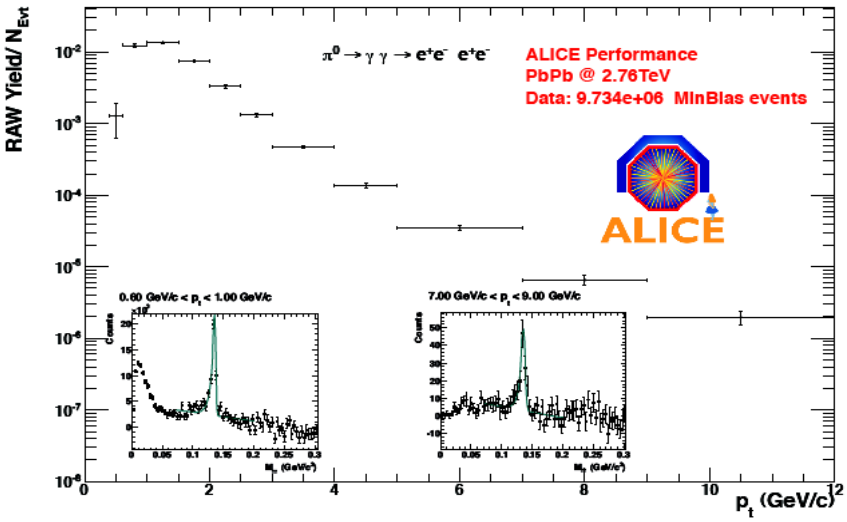
Charged Jets in PbPb

Detailed characterization of the background
is a prerequisite for jet reconstruction in PbPb



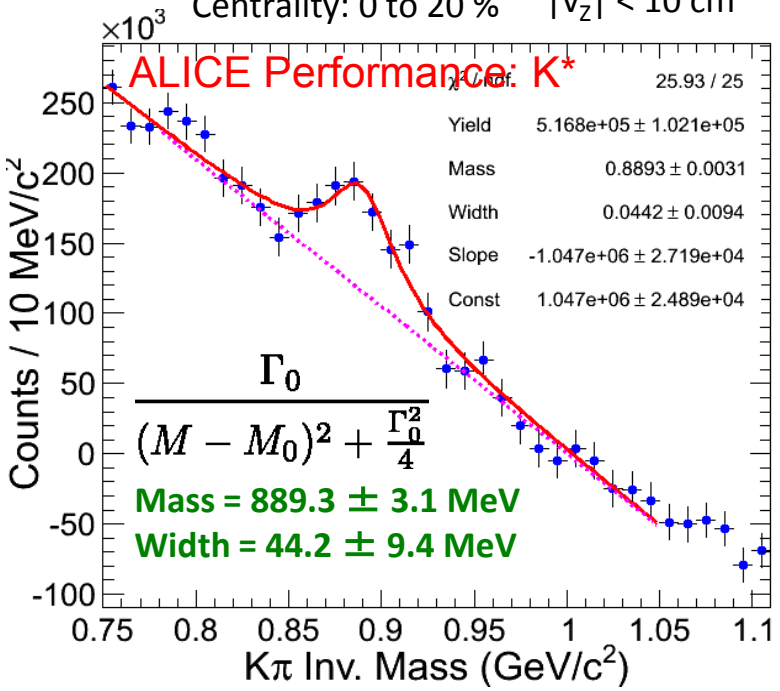
Event-by-event background subtracted, Not unfolded.
Effect of background fluctuations/ smearing apparent.
Detailed correction currently under preparation.

Pb+Pb π^0 via conversions



And more…

Centrality: 0 to 20 % $|v_z| < 10$ cm



Single and mutual EMD with ZDC

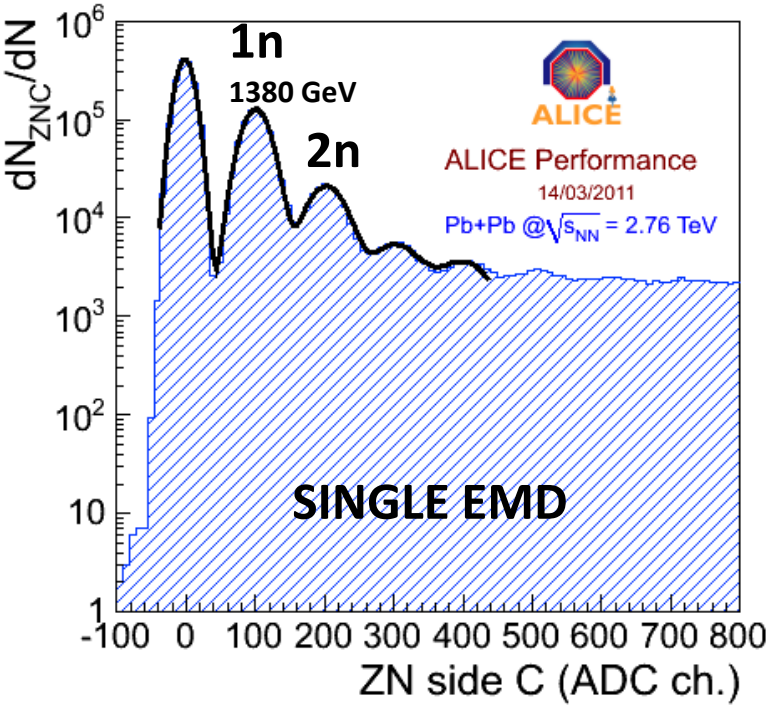
ZDC signal: Single EMD + Mutual EMD + Nuclear effects

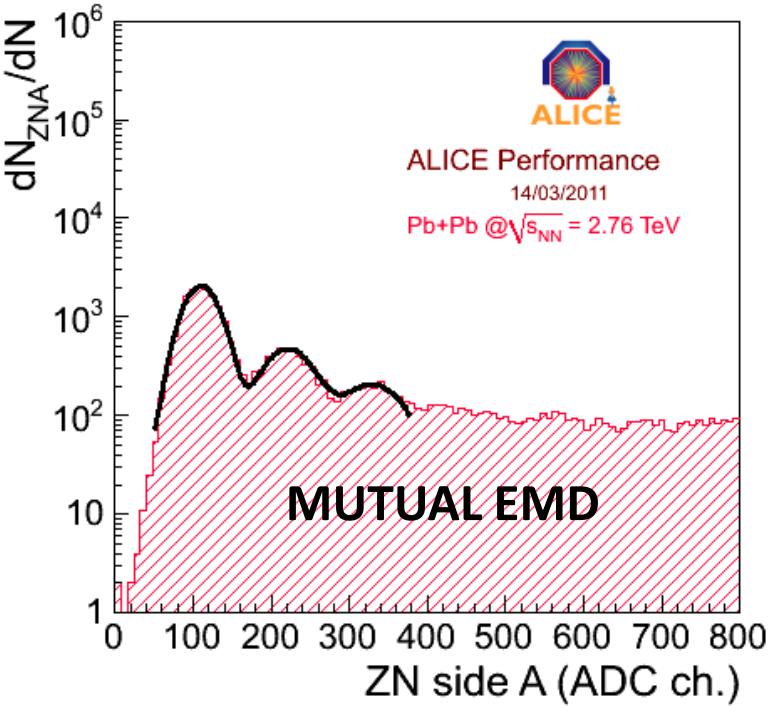
Mutual EMD event selection: ZNC && ZNA + ZDC time selection +

(ZEM1<10 || ZEM2<10) estimated from simulations to reject nuclear events

Data: 1n peak resolution ~20% consistent with RELDIS calculation

Ratios: 1n/2n; 1n/3n; 2n/3n are under investigation

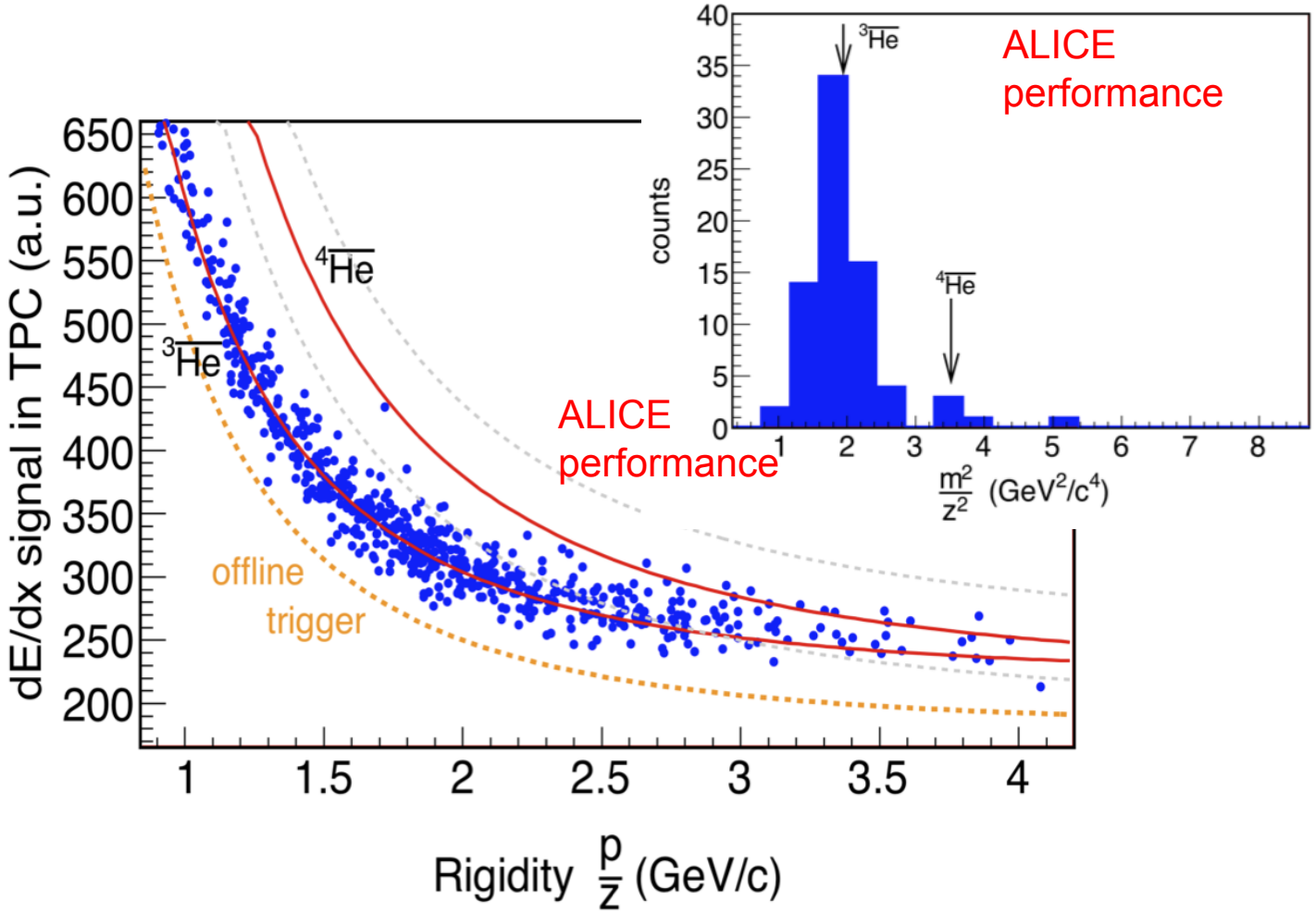




Anti Nuclei: Anti-Alpha candidates in Pb-Pb

Time of flight (sensitive to m/z-ratio): $m = \frac{z \cdot R}{\sqrt{\gamma^2 - 1}}$

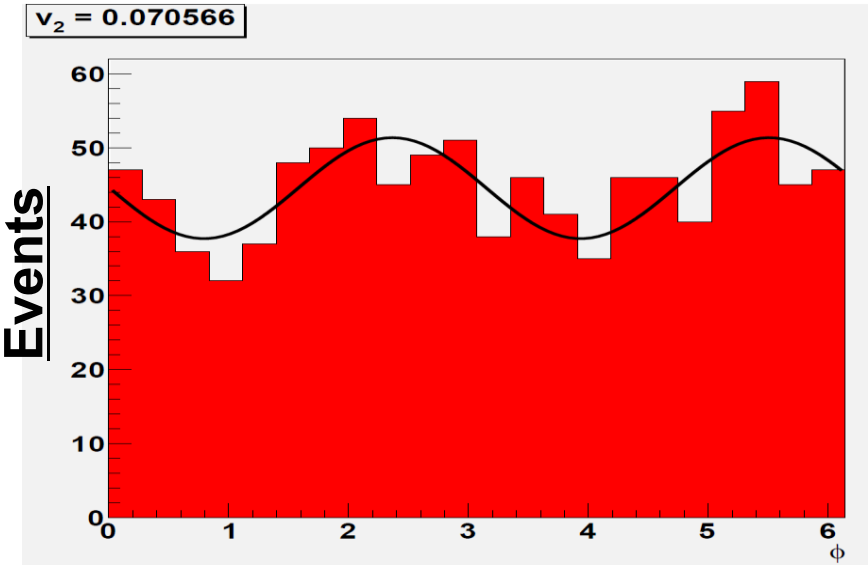
$$< \frac{dE}{dx} >= \frac{4\pi N e^4}{mc^2} \frac{z^2}{\beta^2} \left(\frac{1}{2} \ln \frac{2mc^2 E_{max} \beta^2 \gamma^2}{I^2} - \frac{\beta^2}{2} - \frac{\delta(\beta)}{2} \right)$$

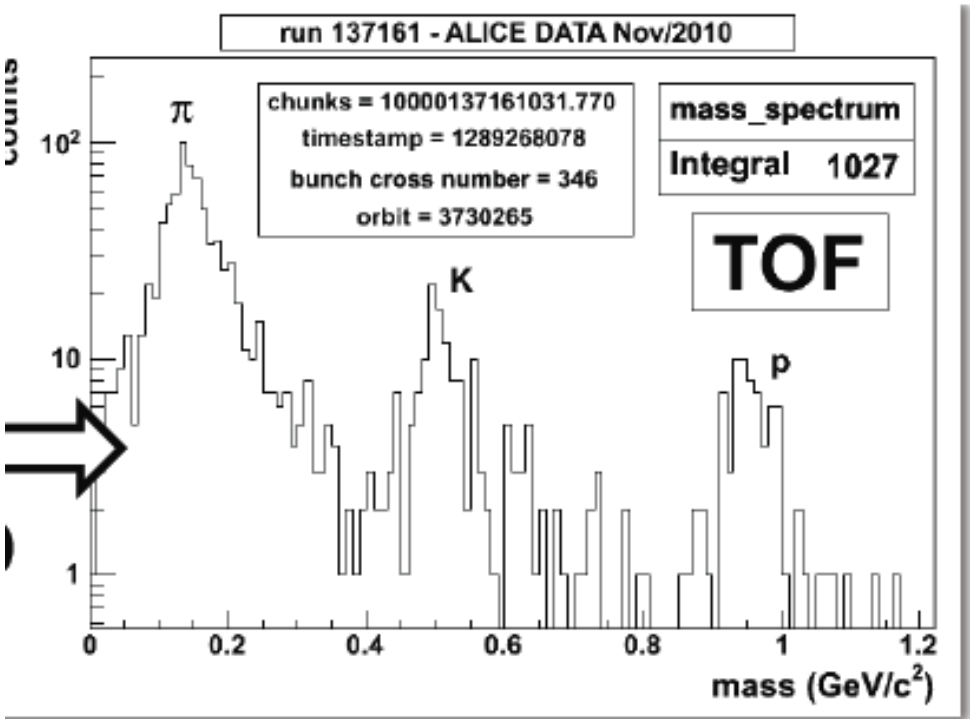


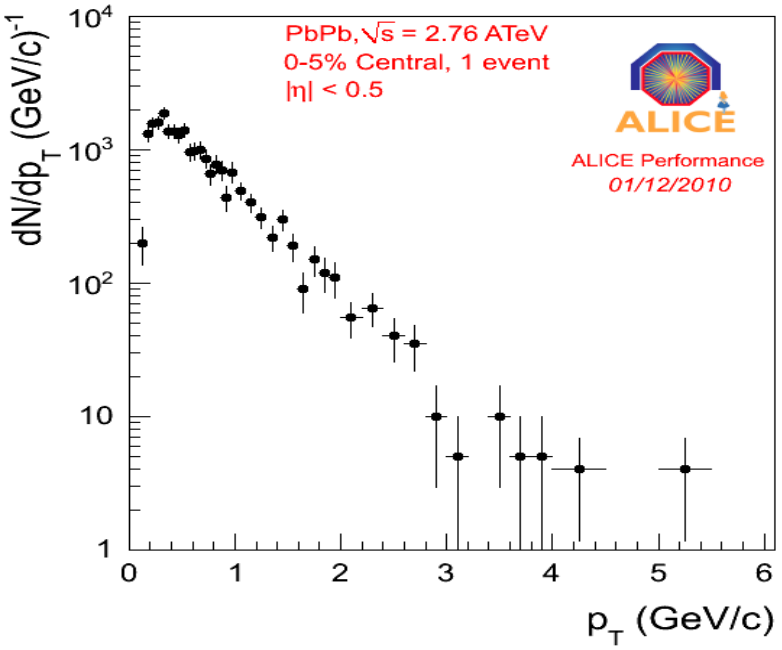
Three candidates confirmed by TOF analysis

‘Single Events’

- Study the individual event
  - Access properties characteristic of critical phenomena







OUTLOOK

Running Plans for pp in 2011

Aim: continue to collect integrated luminosity for comparison with the ~ 30 μb^{-1} foreseen in the 2010- 2011 Pb runs (more will be needed for the comparison of the future High-Luminosity HI runs)

- **Need:**
- double min bias statistics to reach original goal of ~ 10^9 events
  - in 2010, ~ 700 M min bias on logbook → ~ 500 M for good runs, physics selection
- At least ~ 2 pb^{-1} for rare triggers

- A possible scenario:
- ~ 135 days of pp physics
- min bias running
  - 10 kHz interaction rate
  - 800 Hz DAQ rate
  - → ~ 16 M ev/day
    - → 500 M min bias in ~ 30 days
- rare trigger running
  - Increase progressively interaction rate towards 100 kHz
  - 10% dead time (100 Hz trig rate)
  - → ~ 20 nb^{-1}/day (daily stat ~ total 2010)
    - → 2 pb^{-1} in 100 days

ALICE Program

- Baseline Program as in the original, approved ALICE proposal:
  - initial Pb-Pb run in 2010 (< 1/20th design L, i.e. ~ 3 x 10^{25})
  - 2-3 Pb-Pb runs (medium -> design Lum. L ~ 10^{27}, 2.75 TeV -> 5.5 TeV) **integrate at least ~ 1nb^{-1}** at the higher energy, and as close as possible to 1nb^{-1} at the lower one
  - 1-2 p A runs (measure cold **nuclear** matter **effects**, e.g. shadowing)
  - 1-2 low mass ion run (**energy density & volume** dependence) typ. ArAr
  - **running with pp** (comp. data, genuine pp physics)

=> Baseline Program more than fills the "HI runs" to ~ 2020

- Following or included:
  - lower energies (energy dependence, thresholds, RHIC)
  - additional AA & pA combinations
- **NEXT (after long shutdown at the end of the decade):**
  - details of program and priorities to be decided based on results, but **Increase int. Luminosity** by an order of magnitude (to **~ 10nb^{-1}**)

Address rare probes (statistics limited: for ex., with 1nb^{-1} :J/Ψ: excellent, Ψ': marginal, Y: ok (14000) , Y': low (4000), Y'': very low (2000))

Outlook of ALICE HI runs until 2020 (evolving!)

- 2011
  - PbPb at higher luminosity (~1.4x10^{26} $cm^{-2}s^{-1}$)
    3.5 TeV at intermediate (200ns) or nominal (100ns) bunch spacing
  - Feasibility test for p-Pb running (MD + ?)
- 2012
  - Either pPb/Pbp or further PbPb running
- 2013
  - Shutdown, relocation of collimators
- 2014
  - PbPb at higher luminosity and top energy 5.5 TeV
- 2015
  - Continue PbPb at top energy to get to 1 nb^{-1}
- 2016
  - Depending on outcome of runs in 2015/16 further running of PbPb or pPb
- 2017
  - Shutdown; installation of dispersion suppressor collimator at IP2 (if not done previously)
- 2018
  - PbPb at luminosity >5x10^{26} $cm^{-2}s^{-1}$ at top energy 7 TeV
- 2019
  - Physics with pPb
- 2020
  - Physics with ArAr at very high luminosity (up to 10^{29} $cm^{-2}s^{-1}$)
- 2021
  - Shutdown

ALICE Upgrades

- ALICE has evolved considerably from its Technical Proposal, in particular:
  - the **TRD** has been approved much later than the other central detectors
    - 7/18 installed
    - 3 more in winter 2010/2011
    - complete by 2012
  - a new **EMCAL** calorimeter (very important for jet-quenching) has been added recently
    - US project, with French and Italian (+ China and Japan for DCAL) involvement.
    - 4 SM installed in 2009 out of 11
    - Complete in winter shutdown 2010/2011
    - Further 6 SM on opposite side in phi (DCAL) approved in 2010
    - DCAL Complete by 2012, installed in 2013
- These additions have been handled through specific MoU addenda with the proponents of the projects

Upgrades roadmap

- ALICE is considering several improvements that would enhance its Physics Reach => not all will necessarily be approved and implemented
- Numerous groups have expressed interest and are active in design and R&D
- The Collaboration is discussing scientific priorities and feasibility to define a coherent global plan
  - Continuous process of internal review
  - Progressive definition of the costs
  - Definition of the procedures
    - Addendum to MoU for individual projects or Upgrade phases
    - Sharing procedure of Common Costs (typically about 10% of the project costs)
- A roadmap has been defined:
  - Expressions of Interest to be defined now (April)
  - Physics Workshop 12-13/7/2011 at CERN
  - LoIs in October
  - Decisions in the Collaboration
  - Submission to the LHCC

Upgrade projects

Detector Upgrades for >= 2013. ***Objectives:***

Extend the Physics reach (independent on $\mathscr{L}$)

Improve the rate capability (in view of higher AA $\mathscr{L}$)

- High rate upgrade:
  - increase rate capability of TPC (faster gas, increased R/O speed)
  - → rare hard probes (Υ, γ-jet, …)
- DAQ, TRIGGER & HLT upgrades:
  - → more bandwidth, more sophisticated and selective triggers
- Particle ID upgrade:
  - extend to p_T range for track-by-track identification to O(20) GeV/c
  - → new physics interest, based on RHIC results
- Forward upgrades (probably to be split into 2 phases):
  - new detectors for forward physics (tracking & calorimetry)
  - → low-x in pA, AA
  - → Extend ALICE coverage for diffractive Physics
- Inner Tracking upgrade:
  - 2^{nd} generation vertex detector (closer to beams, extended acceptance, capabilities)
  - → heavy flavour baryons, fully reconstructed B, …

Summary

- ALICE is now harvesting after 20 years of preparation!
  - 14 papers, some already with considerable impact
  - 18 more in advanced preparation stage
  - Many more to come
- The Detector continues to provide excellent performance, and ALICE as a whole confirms its readiness and commitment
- More challenges ahead!

We count on your continued support…

THANK YOU!