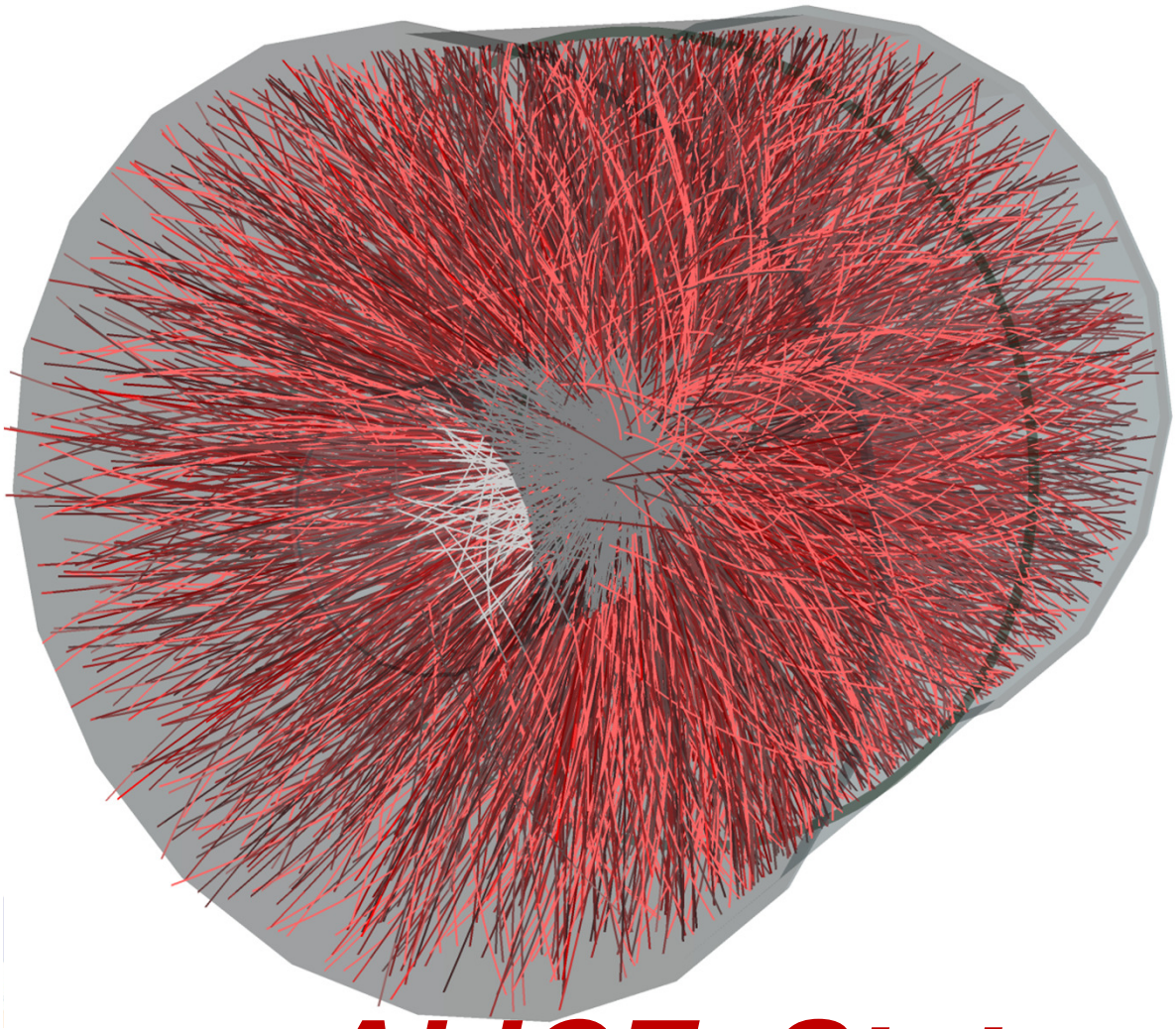


Winter shutdown activities
Preparation of 2012 run

News on Pb-Pb 2011 analysis

New ALICE publications

ALICE Status Report

109th LHCC Meeting - Open Session , March 21st 2012

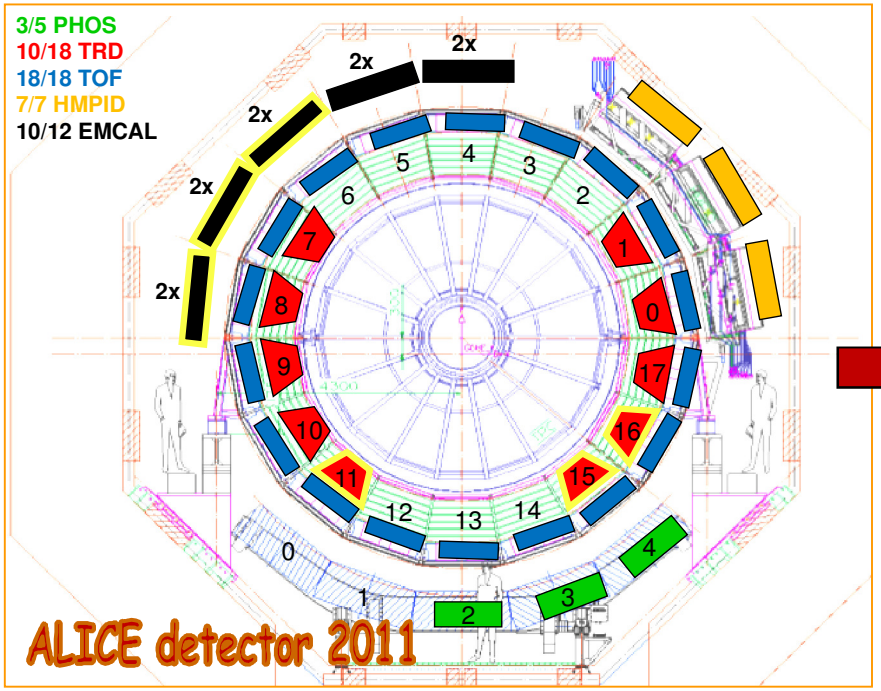
Francesco Prino

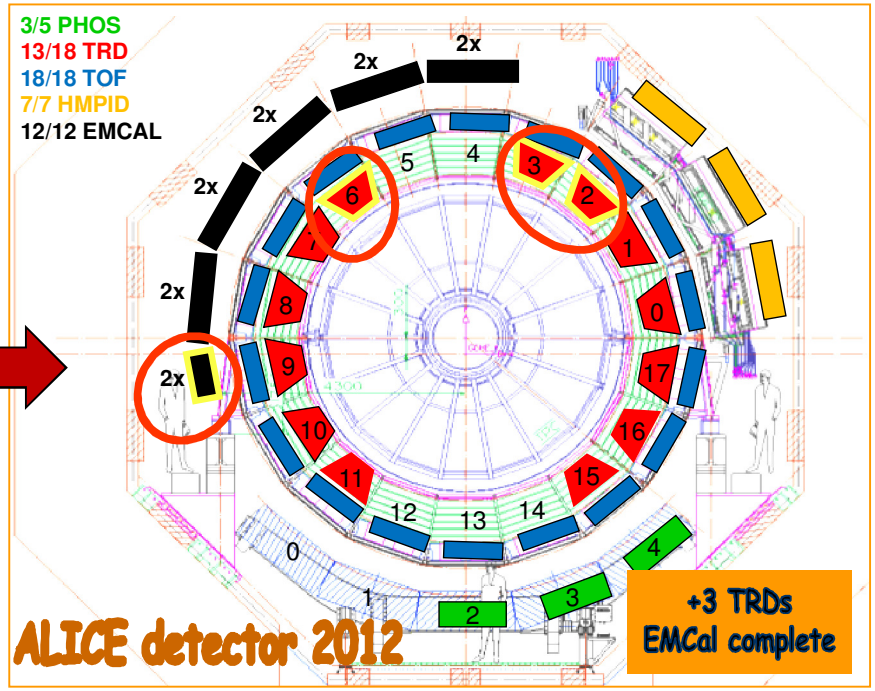
on behalf of the ALICE Collaboration

Towards 2012 run

2011-2012 winter shutdown

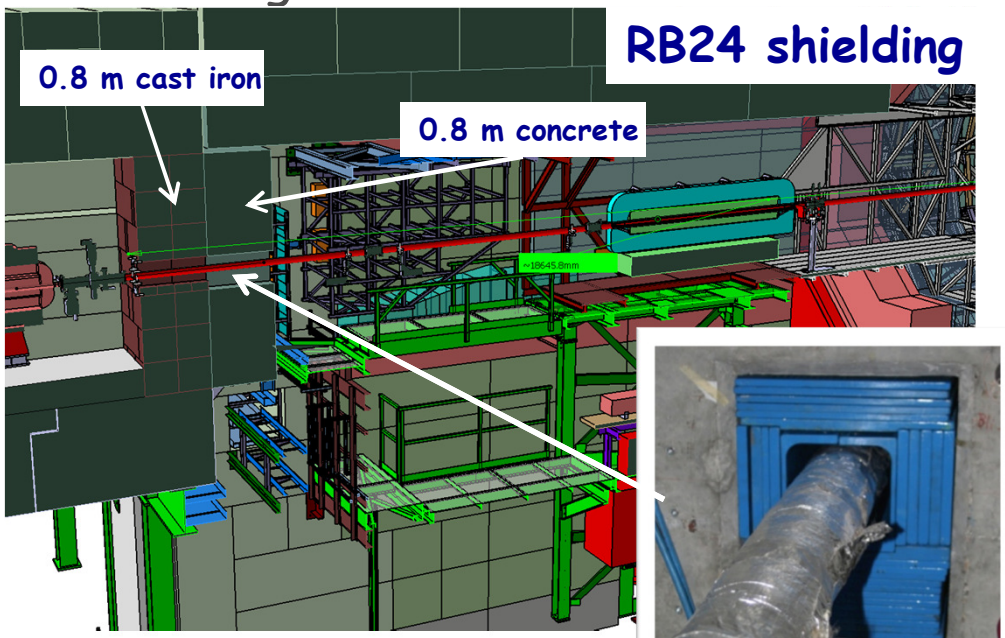
- 2 EMCal and 3 TRD detectors installed





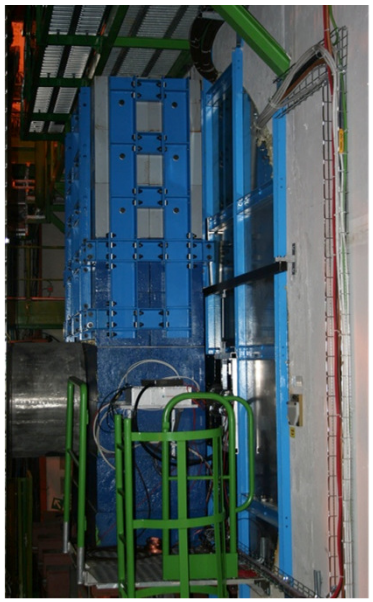
2011-2012 winter shutdown

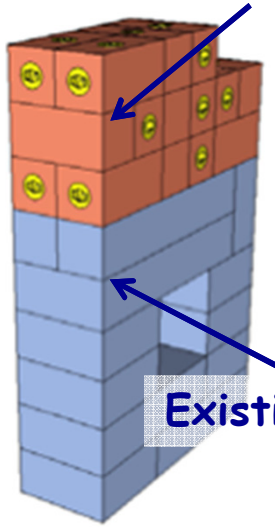
- 2 EMCal and 3 TRD detectors installed
- Improve shielding to reduce machine induced background (beam-gas) that strongly affected 2011 ALICE operation
  - ⇨ Hole in RB24 shielding filled with steel plates
  - ⇨ SAA3 shielding (RB26) modified
  - ⇨ Additional shieldings in LHC tunnel: simulation in progress, new detailed model of LSS2 under implementation in FLUKA for beam background studies



RB24 shielding

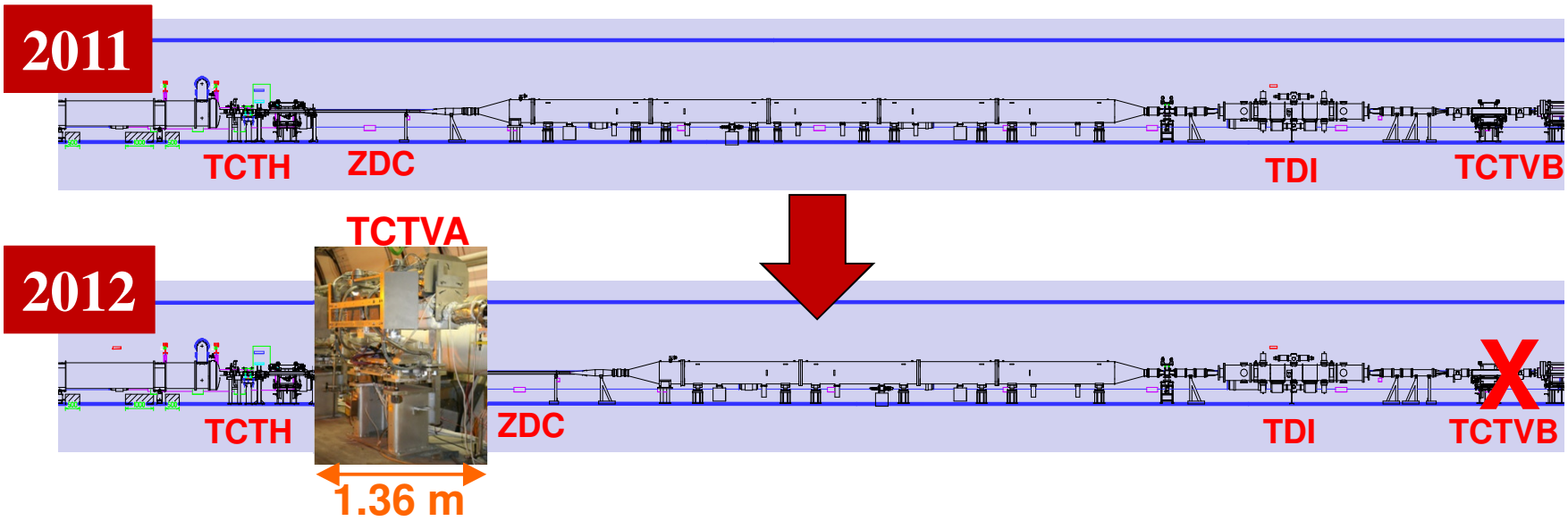
SAA3 shielding (RB26)





2011-2012 winter shutdown

- 2 EMCal and 3 TRD detectors installed
- Improve shielding to reduce machine induced background (beam-gas) that strongly affected 2011 ALICE operation
- Displacement of LHC collimators shadowing ALICE ZDCs
  - ⇨ Several collimators were shadowing the ALICE ZDCs, with serious impact on the detector performance up to last year
  - ⇨ TCTVBs removed and TCTVAs displaced behind ZDCs on both sides
  - ⇨ The two ZDCs have been displaced by 1.36m towards IP2



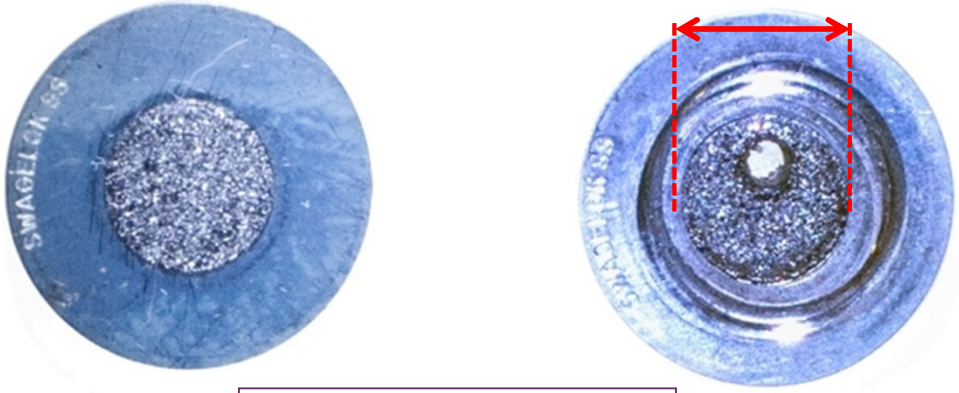
2011-2012 winter shutdown

- 2 EMCAL and 3 TRD detectors installed
- Improve shielding to reduce machine induced background (beam-gas) that strongly affected 2011 ALICE operation
- Displacement of LHC collimators shadowing ALICE ZDCs
- Capacitors removed from all TPC ROC
  - ⇨Reduce possible damage on FEE from occasional discharges

2011-2012 winter shutdown

- 2 EMCal and 3 TRD detectors installed
- Improve shielding to reduce machine induced background (beam-gas) that strongly affected 2011 ALICE operation
- Displacement of LHC collimators shadowing ALICE ZDCs
- Capacitors removed from all TPC ROC
- Muon tracker LV repair (bus-bars)
- New ventilation unit for ITS detector
- Drilled 3 filters in the SPD cooling circuits

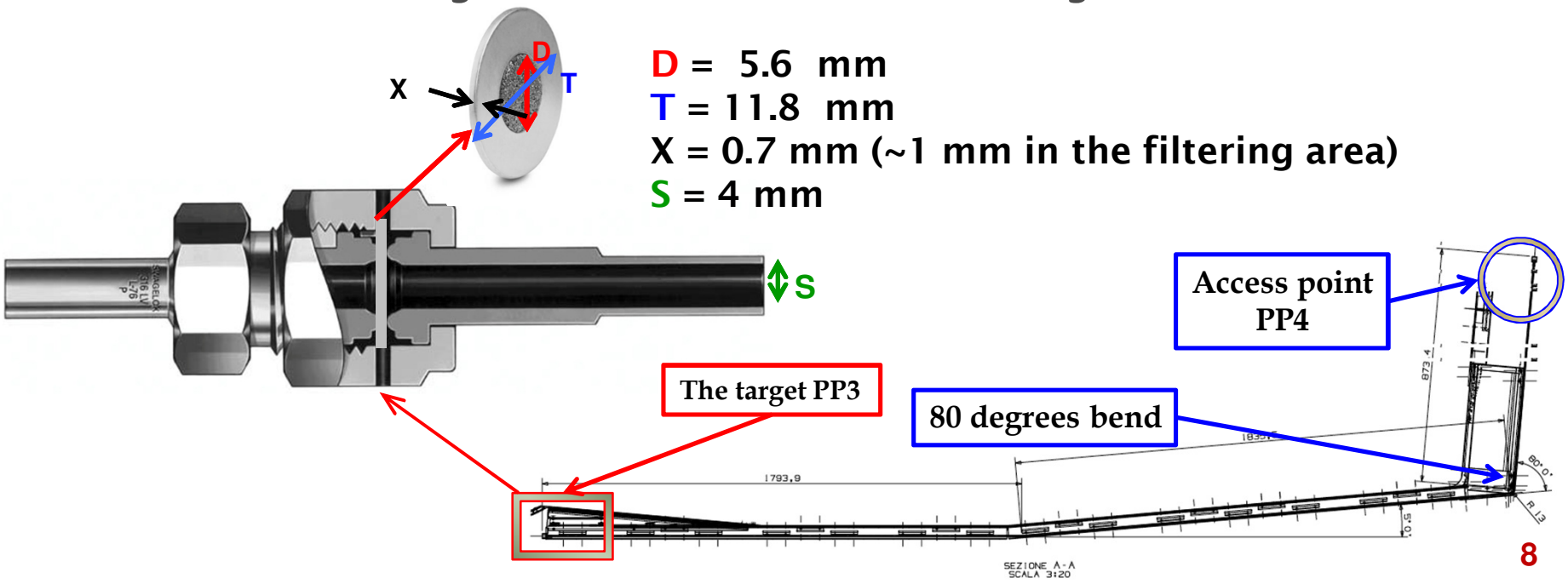
⇨see next slides



new and drilled filter

SPD filters : the issue

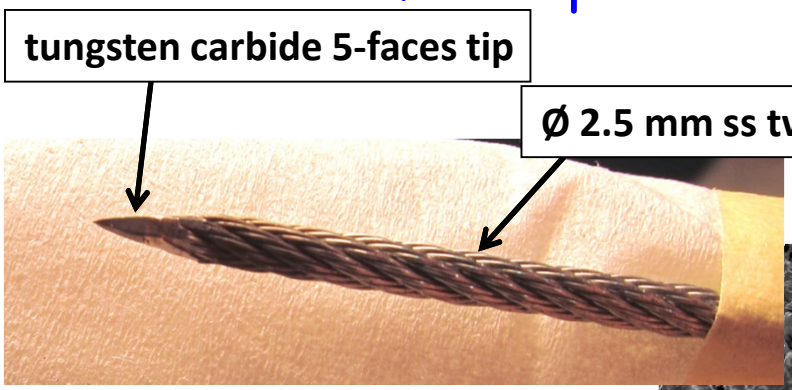
- Pollution from plant and environment clogged filters in unreachable positions
- The acceptance has degraded because of lack of cooling down to 62.5%
- Difficulty: position of the clogged filters:
  - ⇨ At the end of a stainless steel 4.5 m pipe, i.d. 4 mm, with a bend of 80°
- Several attempts have been done, with partial success, in the last 4 years
  - ⇨ Different cleaning fluids, ultrasounds, subcooling

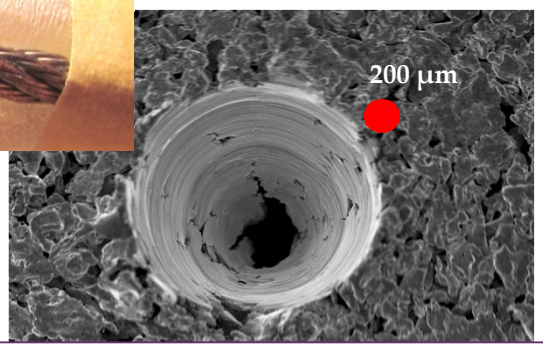


SPD filter drilling: procedure

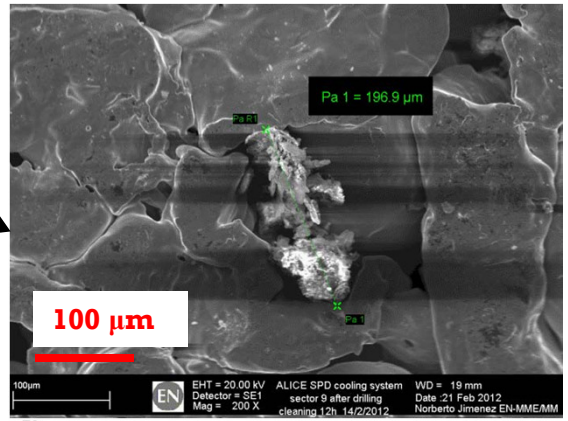
-> SOLUTION: DRILLING

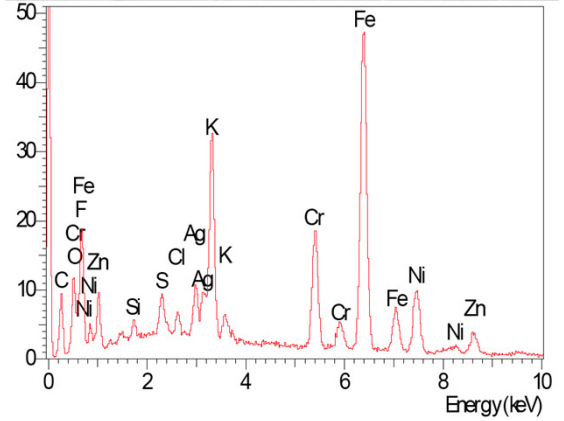
- Drill the filter by a milling tool welded on top of a 5 m long stainless steel twisted cable, rotation operated by a drill
  - ⇨ cleaning procedure applied before drilling
- Cleaning procedure
  - ⇨ 5 cycles: vacuum cleaning + magnetic pick-up + counter-flow w/liquid
  - ⇨ 1 long cycle of counter-flow (12 h)
- Results analyzed by SEM on an accessible filter placed downstream





SEM image of a partial hole

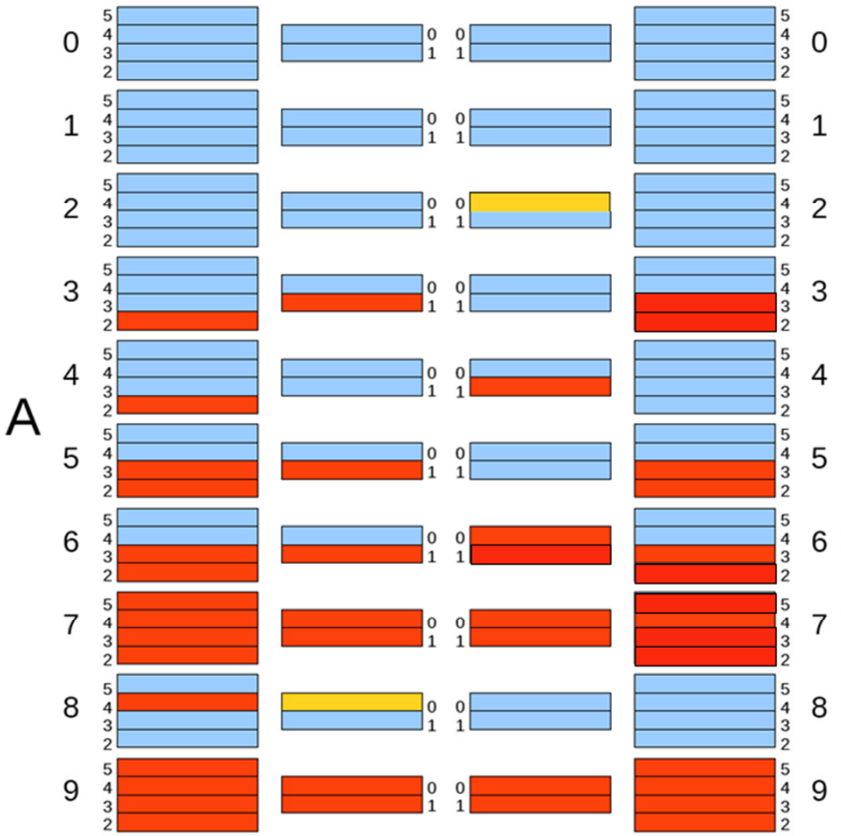




SPD filter drilling: results

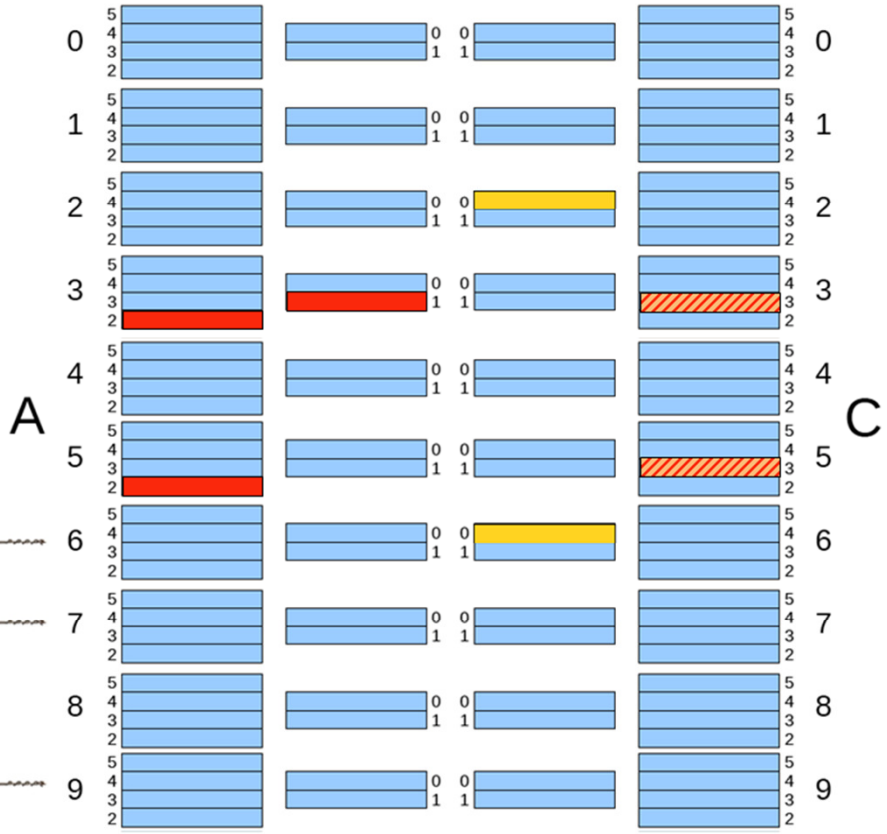
Acceptance changed from this…

62.5% (75/120 on) - Nov, 30 2011



to this! (and more to come!)

94% (113/120 on) - Mar, 15 2012



cannot be recovered
could be recovered
hot

Sectors 6,7 & 9 had the filters drilled
All the others had pre-drilling cleaning procedure

Plans for 2012 run

System	√s (TeV)	Days of running	Integrated luminosity
pp	8	145	5 pb^{-1}
p-Pb	3.5-4	24	20-30 nb^{-1}

pp collisions:

- Running scenario:
  - ⇨ Main-satellite collisions ; Beta* = 3m
- Trigger strategy and physics goals:
  - ⇨ ~30 days: minimum bias -> Baseline MB sample (few 100M events) at new energy
  - ⇨ ~100 days: rare triggers -> 3.5-4 pb^{-1} for pp reference
    - ✓ *(Di-)muon triggers*
    - ✓ *Jets (EMCAL) and photon (EMCAL/PHOS) triggers*
    - ✓ *High p_t particle triggers with TRD (-> heavy flavours at high p_t)*
    - ✓ *High multiplicity trigger (-> charm production in high multiplicity events)*
  - ⇨ + test backgrounds in low B configuration (0.2 T)

Plans for 2012 run

System	√s (TeV)	Days of running	Integrated luminosity
pp	8	145	5 pb^{-1}
p-Pb	3.5-4	24	20-30 nb^{-1}

p-Pb collisions:

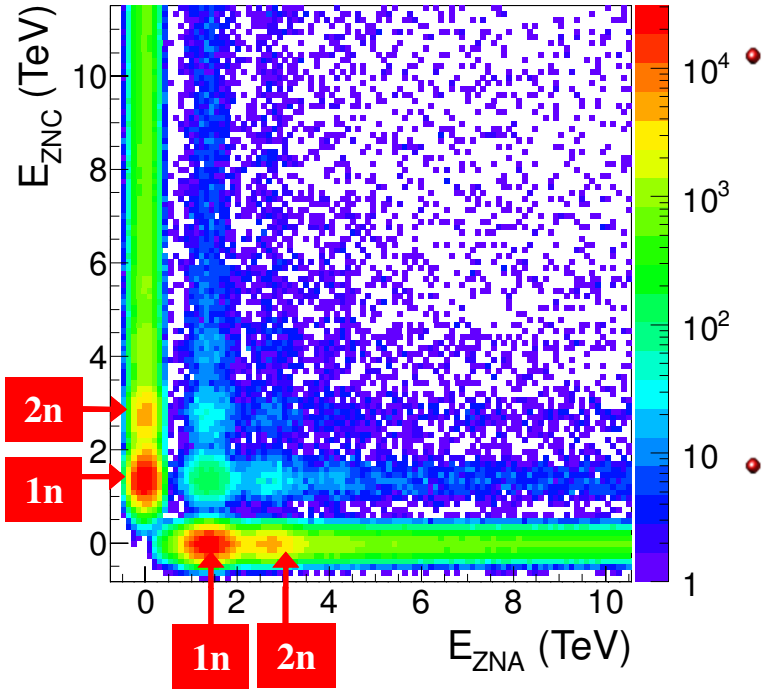
- Running scenario:
  - ⇨Collect similar statistics of p-Pb and Pb-p
- Physics goals:
  - ⇨Separation of initial and final state effects on PbPb measurements (-> parton saturation/shadowing)
    - ✓ *Heavy flavor production*
    - ✓ *Quarkonia*
    - ✓ *Jet rates*
    - ✓ *Direct photons*
    - ✓ *Drell-Yan cross sections*

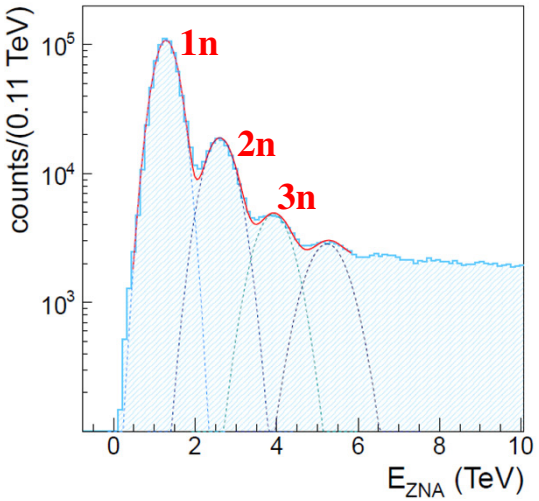
Publications

Physics publications since last LHCC

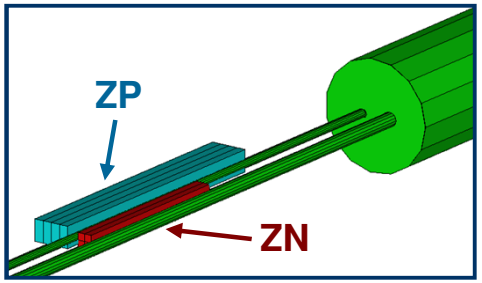
- 8 papers submitted to journal (and arXiv):
  - ⇨ Heavy flavour decay muon production at forward rapidity in proton-proton collisions at $\sqrt{s}$ = 7 TeV
    Phys. Lett. B 708 (2012) 265
  - ⇨ Underlying Event measurements in pp collisions at $\sqrt{s}$ = 0.9 and 7 TeV with the ALICE experiment at the LHC
    arXiv:1112.2082
  - ⇨ Light vector meson production in pp collisions at $\sqrt{s}$ = 7 TeV
    arXiv:1112.2222
  - ⇨ J/ψ Production as a function of charged particle multiplicity in pp collisions at $\sqrt{s}$ = 7 TeV
    arXiv:1202.2816
  - ⇨ J/ψ Production at low transverse momentum in PbPb Collisions at $\sqrt{s}_{NN}$ = 2.76 TeV
    arXiv:1202.2816
  - ⇨ Suppression of high transverse momentum prompt D mesons in central Pb--Pb collisions at $\sqrt{s}_{NN}$=2.76 TeV
    arXiv:1203.2160
  - ⇨ Measurement of the Cross Section for Electromagnetic Dissociation with Neutron Emission in Pb-Pb Collisions at $\sqrt{s}_{NN}$ = 2.76 TeV
    arXiv:1203.2436
  - ⇨ Inclusive J/psi production in pp collisions at $\sqrt{s}$=2.76 TeV
    arXiv:1203.3641
- 15 papers at various stages of collaboration review
  - ⇨ Plus other 19 papers in preparation

EM dissociation cross section for neutron emission at the LHC





- Dedicated run in 2010 to measure EMD cross sections with neutron emission for SINGLE (at least 1 n emitted) and MUTUAL (at least 1 n emitted from BOTH nuclei) EMD processes
  - ⇨ Main emission mechanism is neutron emission following GDR excitation
- Measurement based on neutron ZDC detectors
  - ⇨ Trigger: signal over threshold in one of the two neutron ZDC
- Motivation:
  - ⇨ EMD processes limit heavy-ion beam life-time
  - ⇨ Can be exploited to measure luminosity with the ZDCs



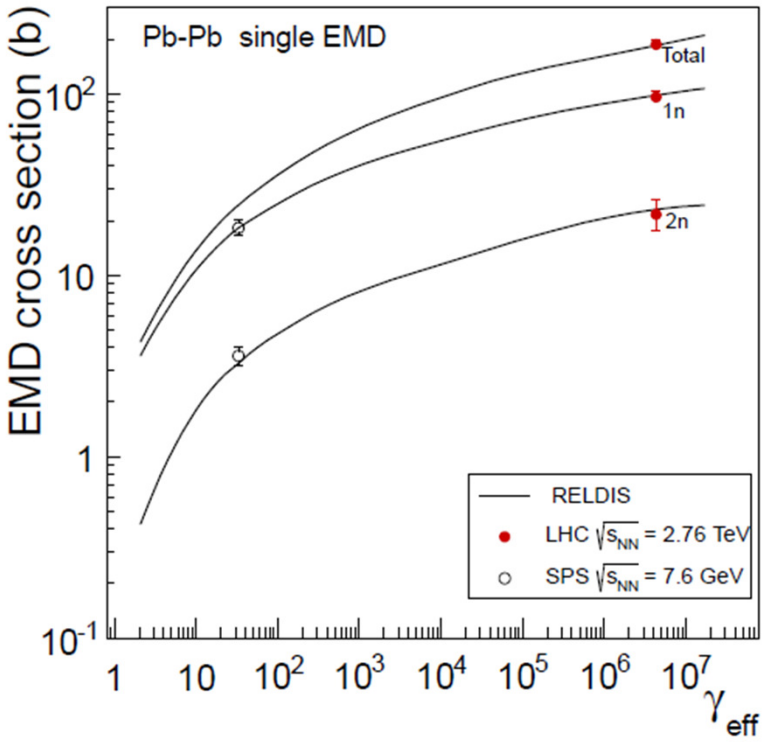
arXiv:1203.2436

EM dissociation cross section for neutron emission at the LHC

- Results:

$$\sigma^{\text{single}}\ \text{EMD} = (187.2 \pm 0.2\ \text{stat.}\ ^{+13.8}_{-12.0}\ \text{syst.})\ \text{b}$$

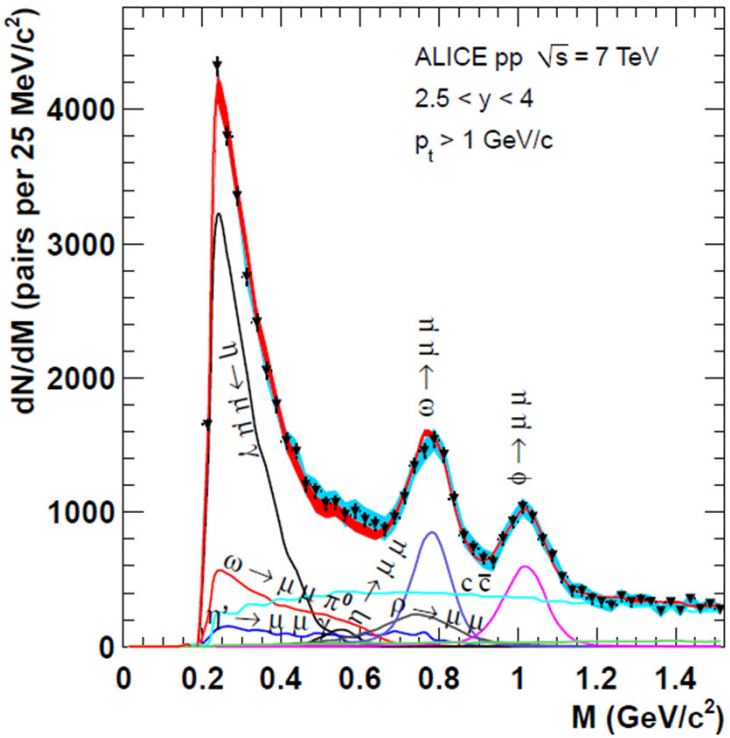
$$\sigma^{\text{mutual}}\ \text{EMD} = (6.2 \pm 0.1\ \text{stat.} \pm 0.4\ \text{syst.})\ \text{b}$$



- ⇨ good agreement with predictions from RELDIS model [I..A. Pshenichnov et al. Phys.Rev. C 60 044901(1999)] both for total and for partial (1n, 2n) cross section values
- ⇨ 2n to 1n ratio in single EMD = 22.5%, larger than the 19.7% reported for Pb-Pb collisions at 30 A GeV at the CERN SPS
  - ✓ ***Due to additional 2n events produced by more energetic equivalent photons at the LHC***
- ⇨ 3n yields: worse agreement with RELDIS
  - ✓ ***Model tuned on 1n and 2n data***

arXiv:1203.2436

Light vector mesons in pp

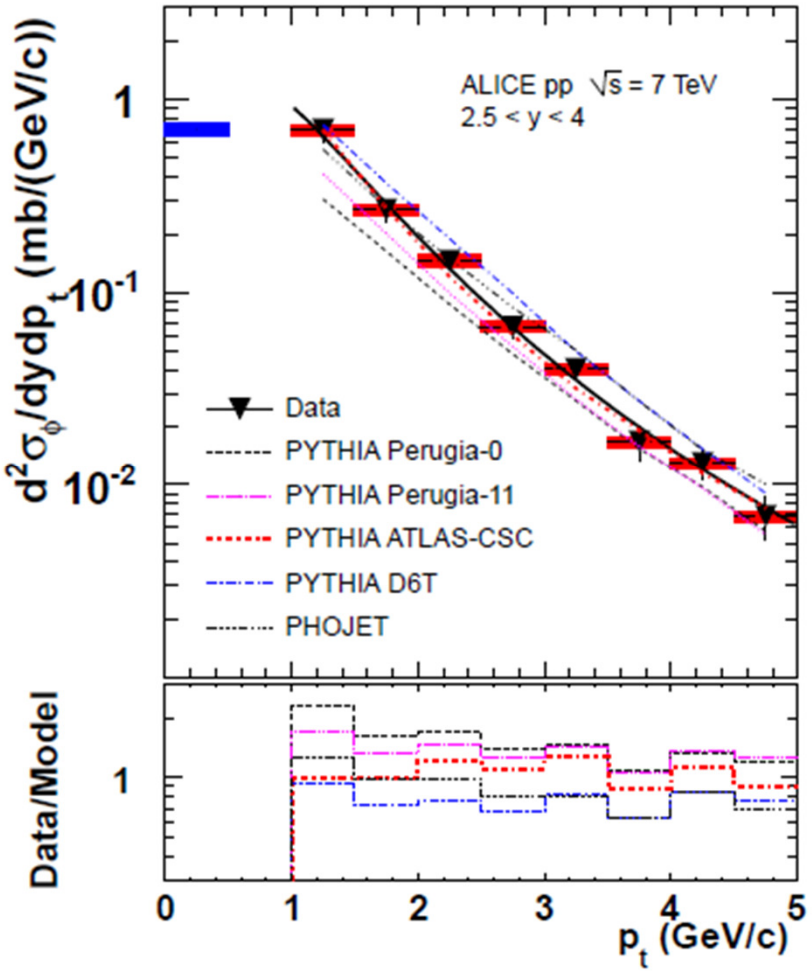


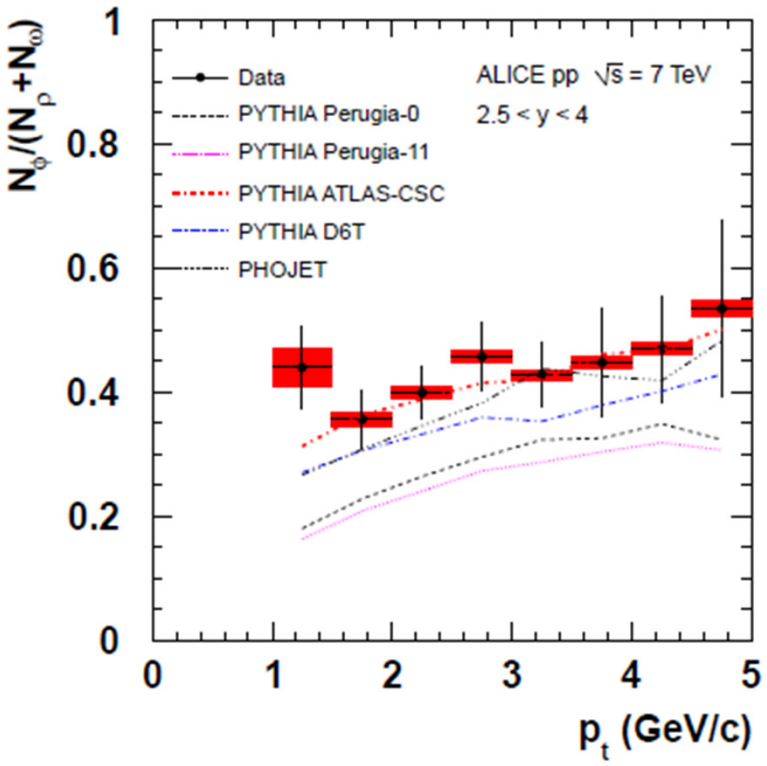
- Low mass dimuons measured at forward rapidity (2.5<y<4) in the p_t range $1<p_t<5$ GeV/c
  - ⇨ Uncorrelated background subtracted with event mixing
- Extract production cross-section for ϕ and ω and $\phi/(\rho+\omega)$ ratio
  - ⇨ Comparison with phenomenological models
  - ⇨ Reference for Pb-Pb

	σ_ϕ (mb)	σ_ω (mb)	$\frac{N_\phi}{N_\rho+N_\omega}$	$\sigma_\rho/\sigma_\omega$
ALICE $\mu\mu$ measurement	$0.940 \pm 0.084 \pm 0.078$	$5.28 \pm 0.54 \pm 0.50$	$0.416 \pm 0.032 \pm 0.004$	$1.15 \pm 0.20 \pm 0.12$
PYTHIA/Perugia-0	0.50	5.60	0.22	1.03
PYTHIA/Perugia-11	0.62	7.81	0.20	1.03
PYTHIA/ATLAS-CSC	0.91	6.50	0.35	1.05
PYTHIA/D6T	1.12	9.15	0.30	1.04
PHOJET	0.87	6.89	0.30	1.08

arXiv:1112.2222

Light vector mesons in pp

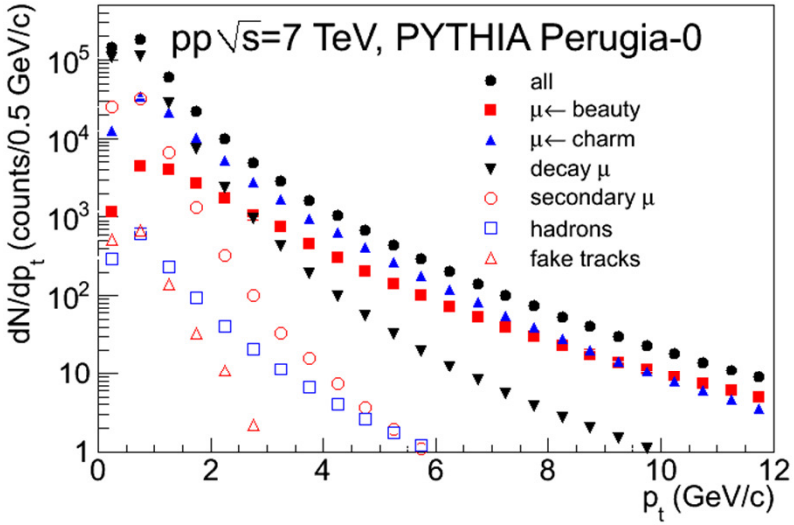




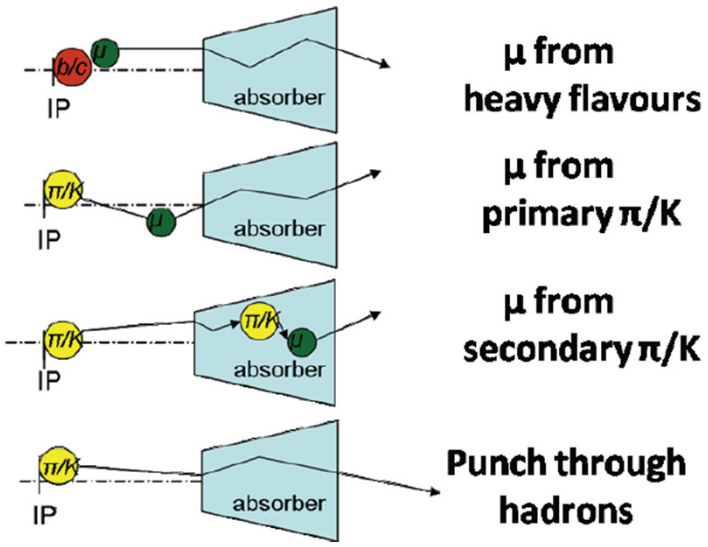
- Provides further constraints for phenomenological model
- $d\sigma/dp_t$ in good agreement with LHCb measurement

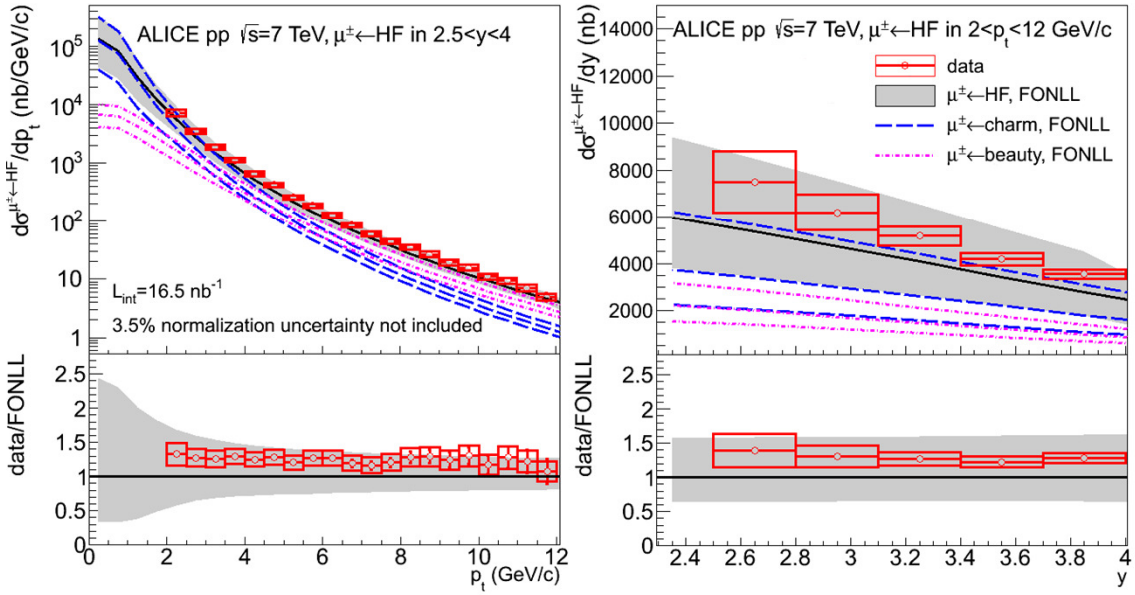
arXiv:1112.2222

Heavy flavour decay muons in pp



- Muons measured at forward rapidity (2.5<y<4) in the transverse momentum range $2<p_t<12$ GeV/c
- Remove muons from π and K decays by subtracting MC dN/dp_t normalized to data at low p_t

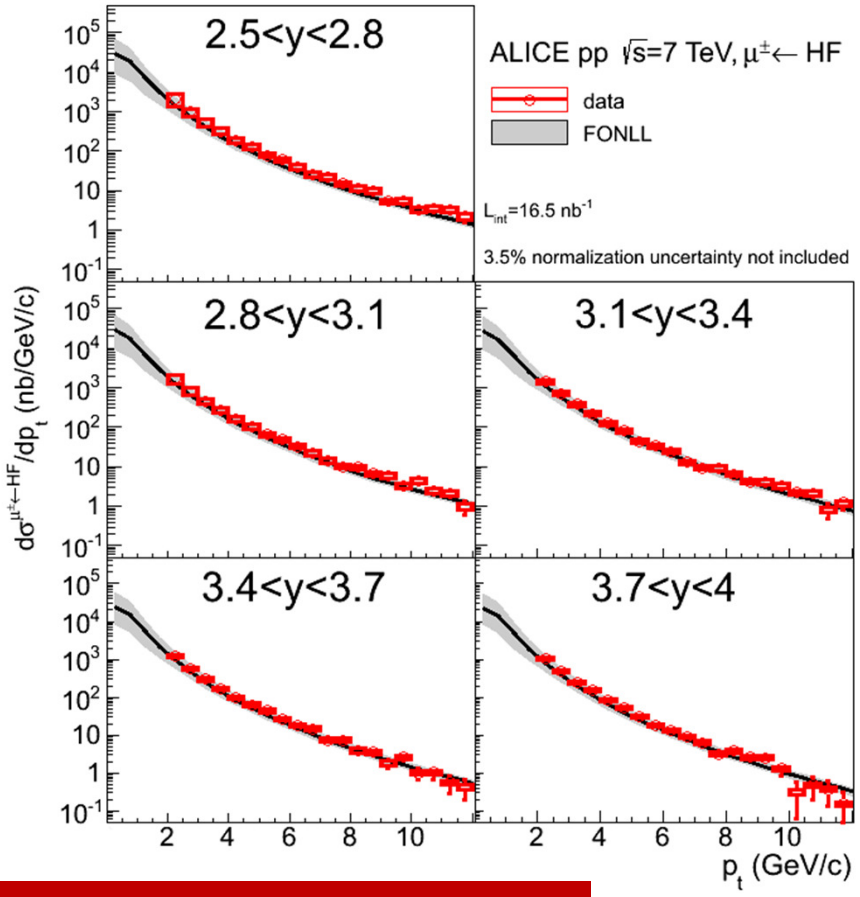


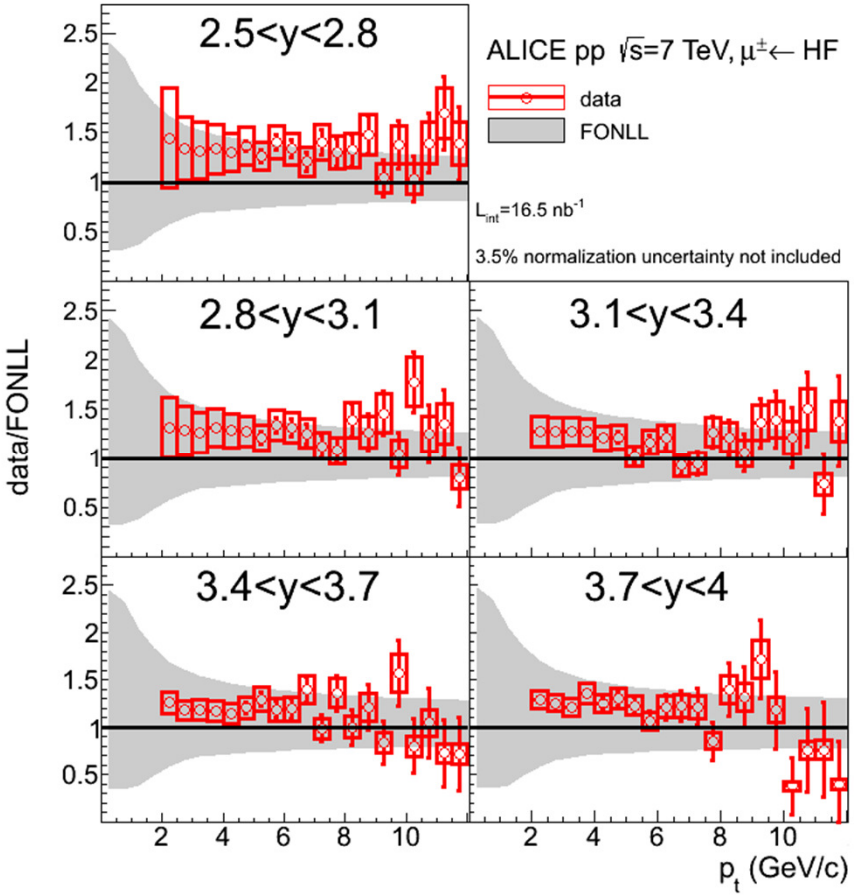


Phys. Lett. B 708 (2012) 265

Heavy flavour decay muons in pp

- Comparison of measured p_t differential cross sections in 5 rapidity intervals with pQCD prediction (FONLL)
  - ⇨ FONLL agrees with data within uncertainties
  - ⇨ Baseline for measurements in Pb-Pb

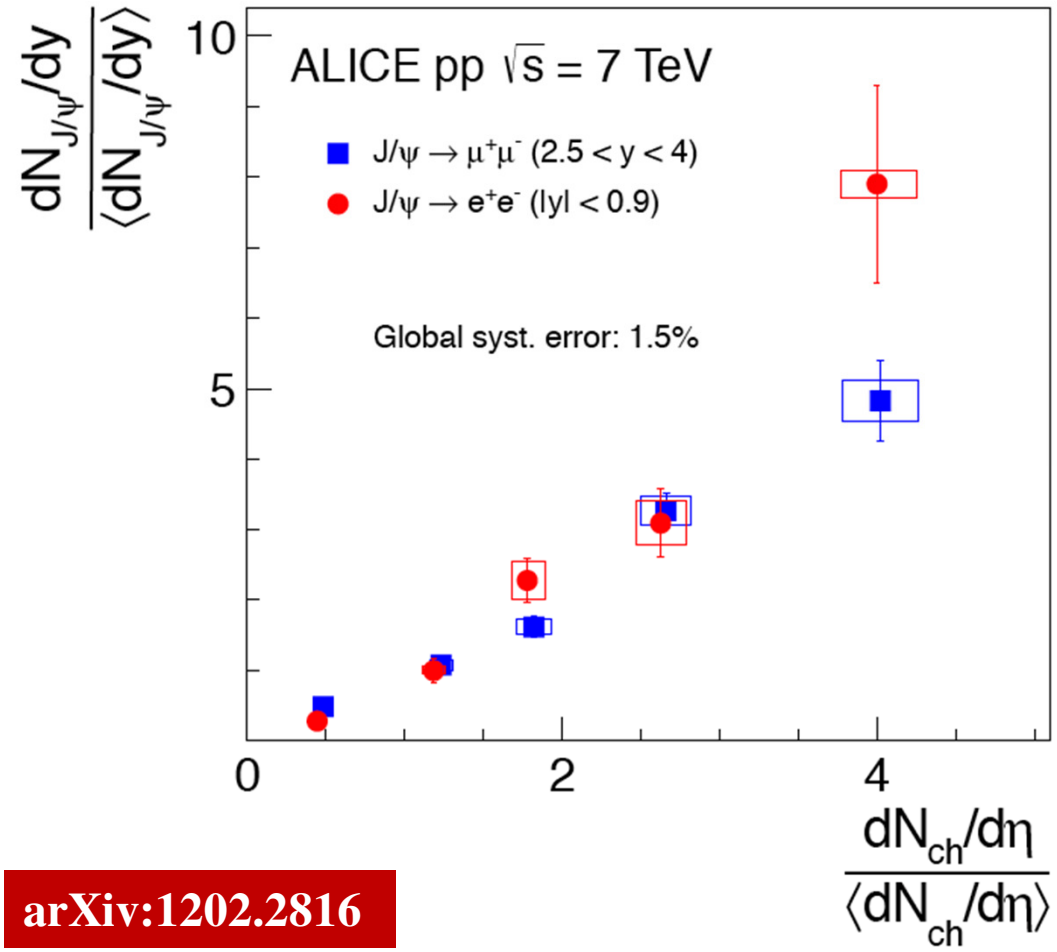




Phys. Lett. B 708 (2012) 265

J/ψ yield vs. multiplicity in pp at √s=7 TeV

- J/ψ yield (normalized to that of minimum bias collisions) measured as a function of charged-multiplicity in pp collisions at √s=7 TeV

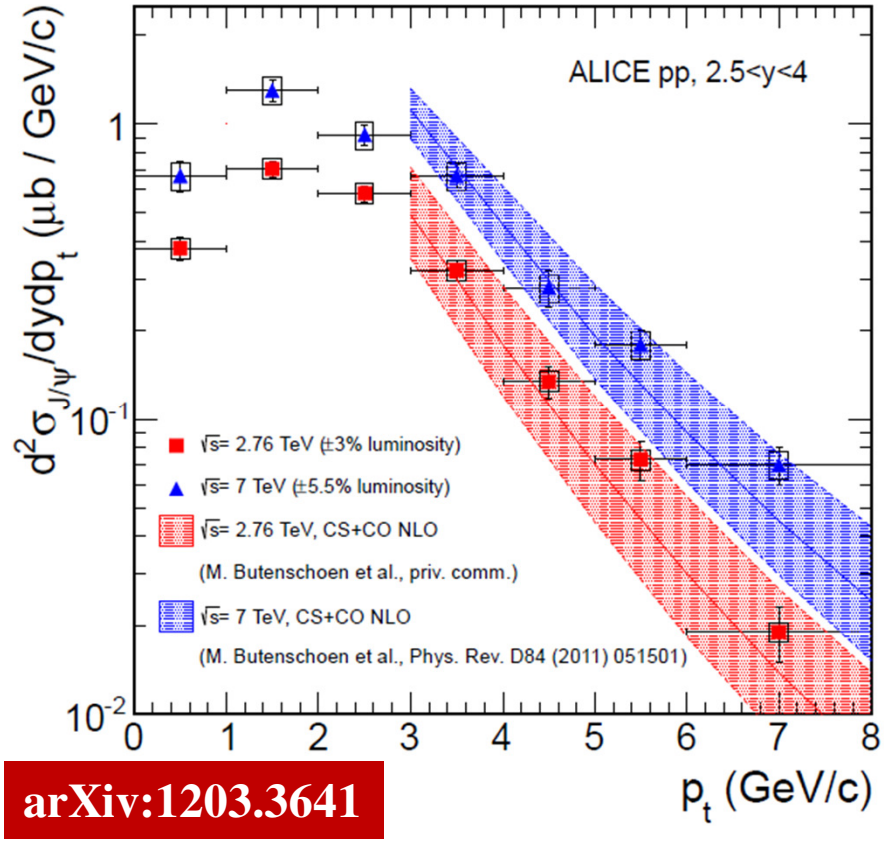


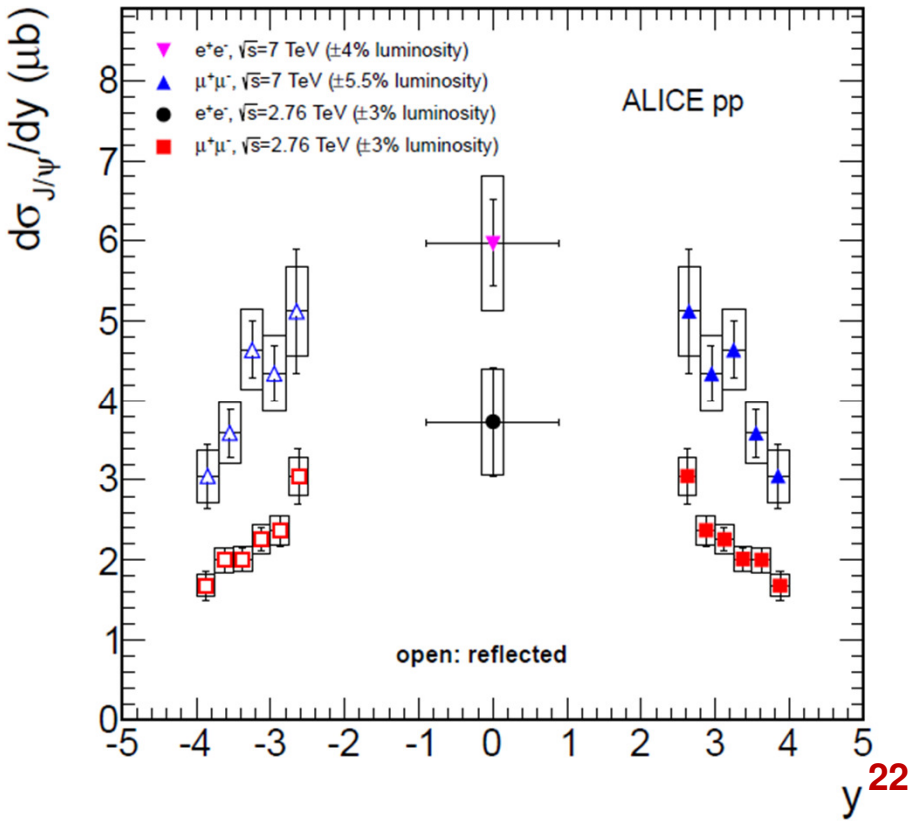
- ⇨ pp multiplicity similar to Cu-Cu collisions at RHIC
- ⇨ Linear increase of J/ψ yield with $dN_{ch}/d\eta$
- ⇨ Similar behaviour in two different rapidity ranges
- ⇨ Hints for multi-parton interactions at a hard scale in pp

arXiv:1202.2816

J/ψ production in pp at √s=2.76 TeV

- Inclusive J/ψ production measured in pp collisions at s=2.76 TeV at central rapidity (|y|<0.9) via e^+e^- decay and at forward rapidity (2.5<y<4) via $\mu^+\mu^-$ decay
  - ⇨ From integrated luminosities of L_{ee}^{int} =1.1 nb^{-1} and $L_{\mu\mu}^{int}$ =19.9 nb^{-1} for the two channels

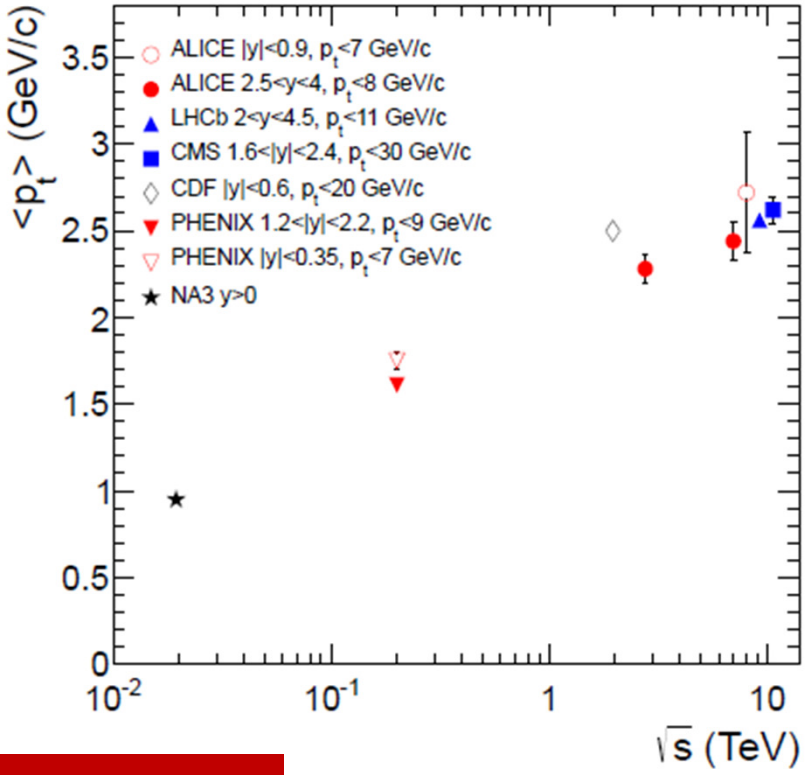


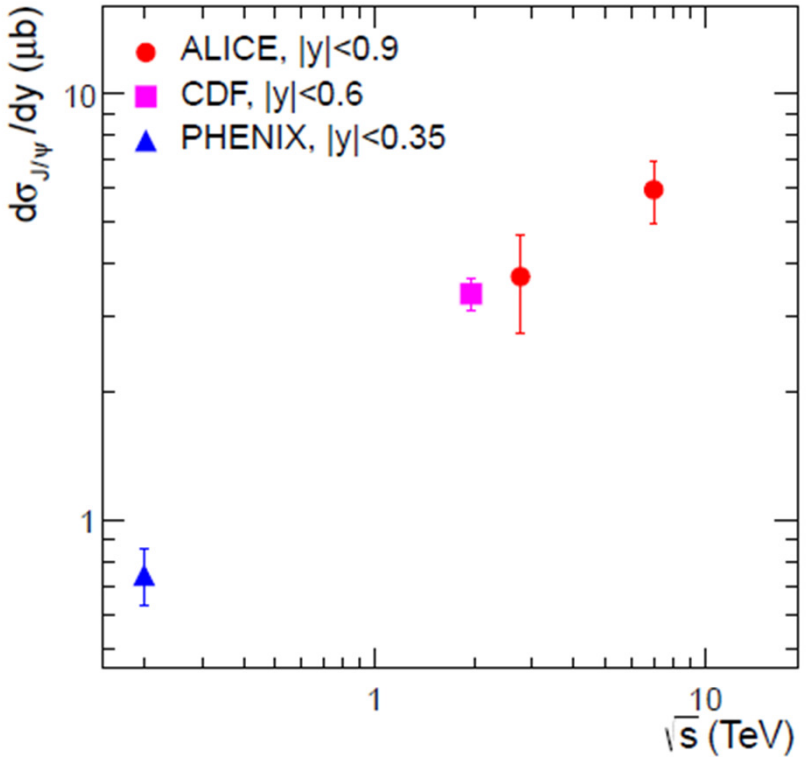


arXiv:1203.3641

J/ψ production in pp at $\sqrt{s}$=2.76 TeV

- Inclusive J/ψ production measured in pp collisions at $\sqrt{s}$=2.76 TeV at central rapidity ($|y|<0.9$) via e^+e^- decay and at forward rapidity ($2.4<y<4$) via $\mu^+\mu^-$ decay
  - ⇨ Important intermediate point between Tevatron and top LHC energy
  - ⇨ Crucial reference for the measurement of J/ψ production in Pb-Pb

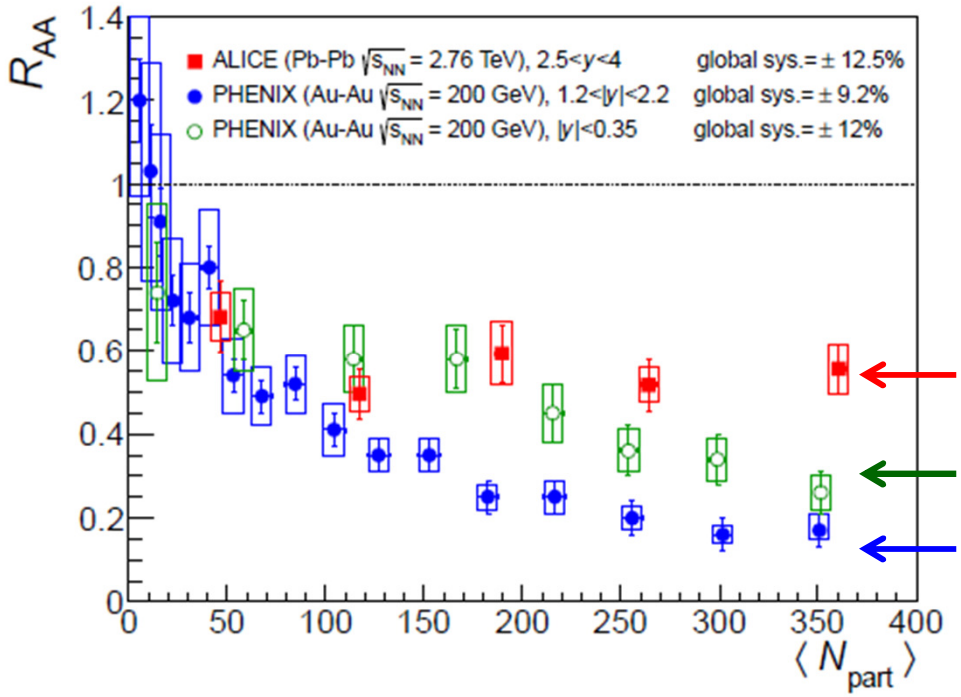




arXiv:1203.3641

J/ψ production in PbPb

- Inclusive J/ψ measured down to p_t=0 in PbPb collisions at $\sqrt{s}$=2.76 TeV at forward rapidity (2.5<y<4) via $\mu^+\mu^-$ decay
  - ⇨ Quarkonia melting in the QGP -> sequential suppression pattern
  - ⇨ J/ψ regeneration from deconfined charm quarks in the medium
- Nuclear modification factor:



$$R^i_{AA} = \frac{Y^i_{J/\psi}(\Delta p_t, \Delta y)}{\langle T^i_{AA} \rangle \times \sigma^{pp}_{J/\psi}(\Delta p_t, \Delta y)}.$$

ALICE, LHC, forward rapidity

PHENIX, RHIC, mid-rapidity

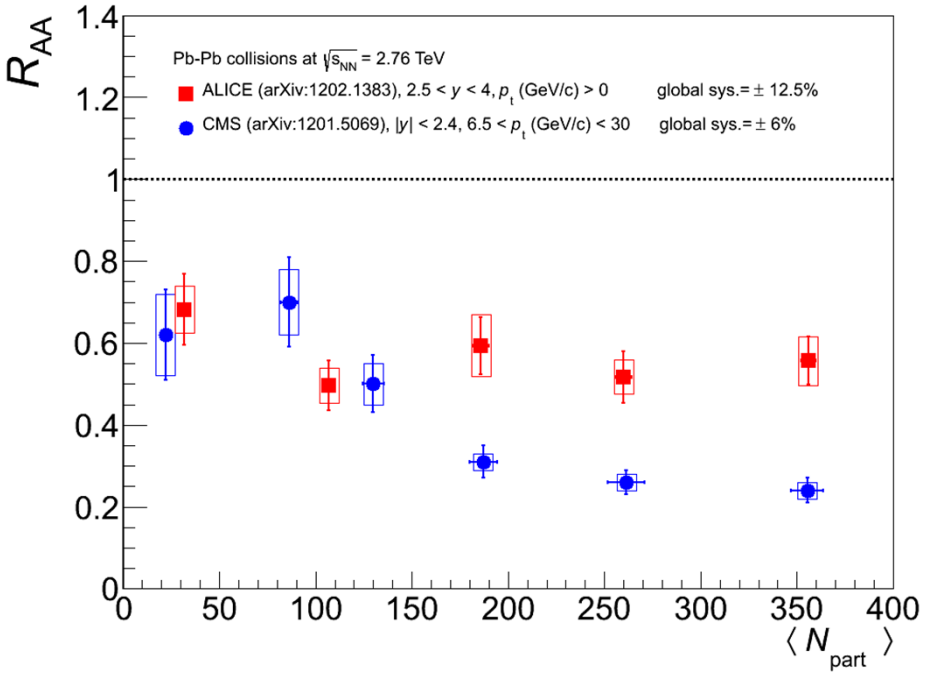
PHENIX, RHIC, forward rapidity

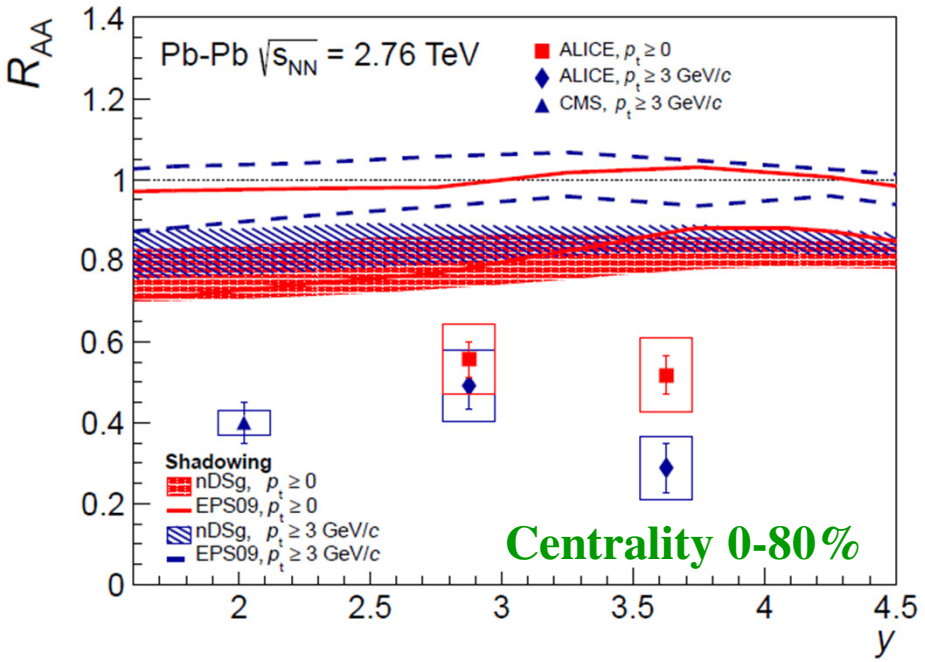
- ⇨ No significant centrality dependence
- ⇨ Less J/ψ suppression at the LHC than at RHIC

arXiv:1202.1383

J/ψ production in PbPb

- Comparison with CMS and studies in different p_t and rapidity regions
  - ⇨ Centrality dependence of J/ψ suppression different at low (ALICE) and high (CMS) p_t
  - ⇨ Hint of J/ψ production component from charm quarks in the QGP
  - ⇨ Cold nuclear matter effects need to be evaluated from p-Pb collisions

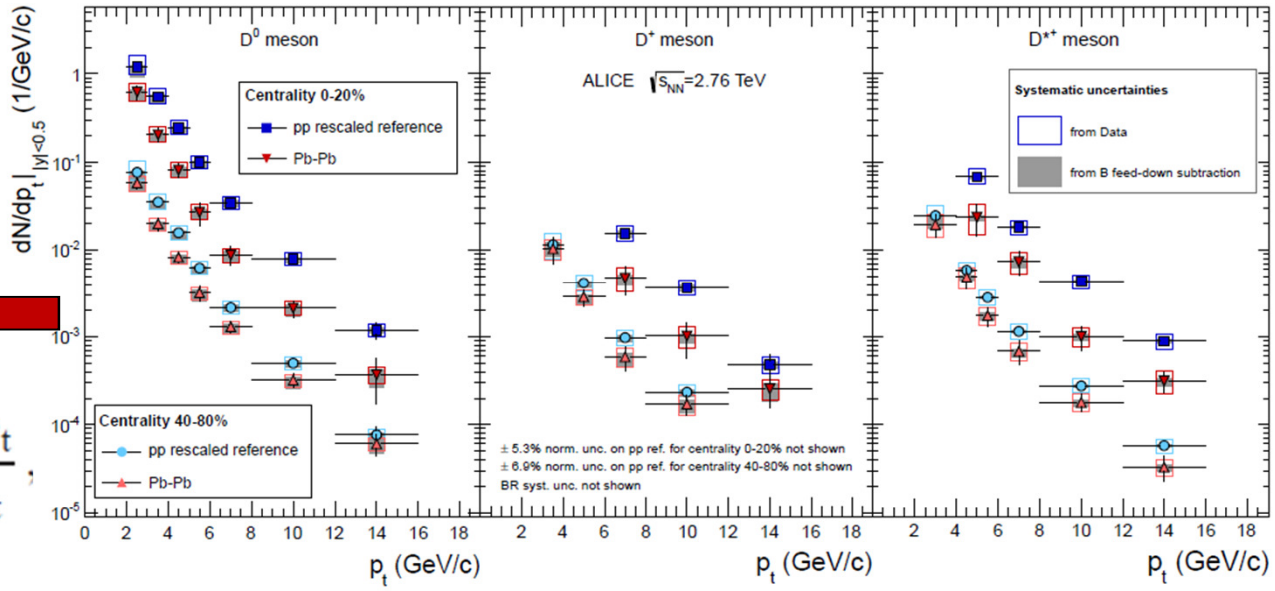




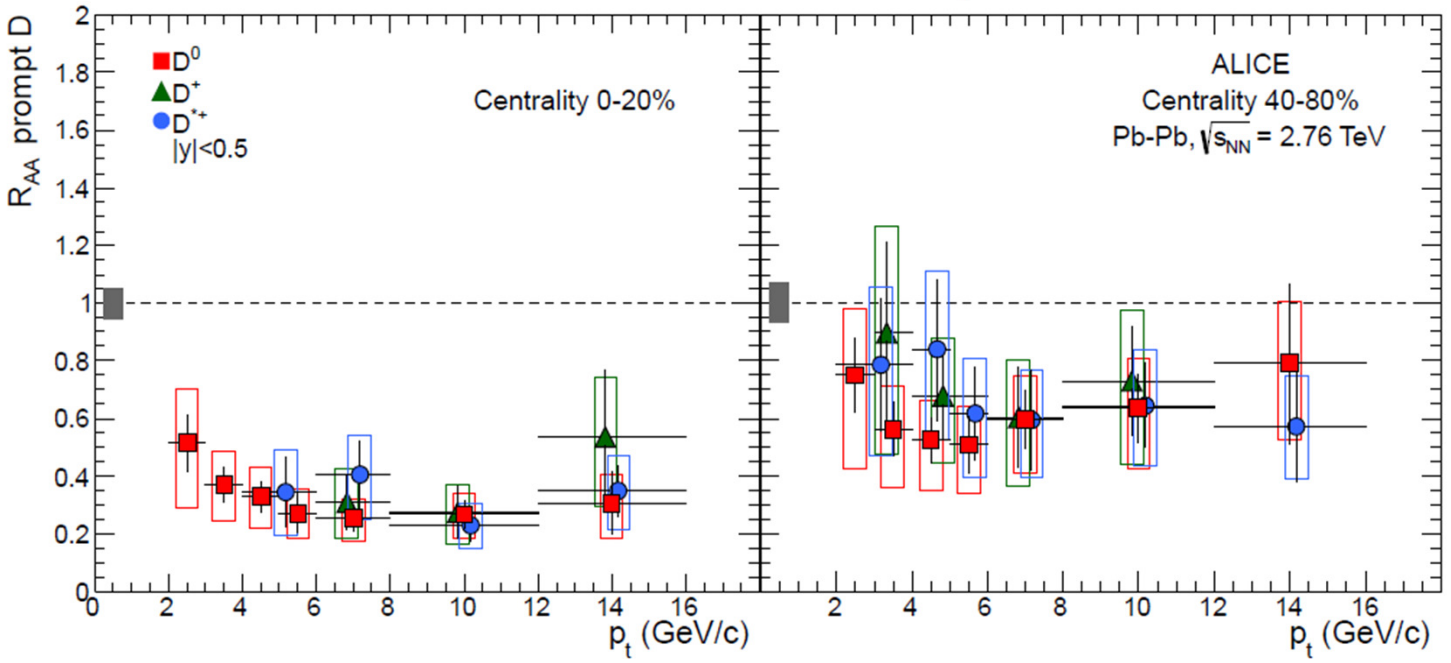
arXiv:1202.1383

Prompt D mesons in PbPb

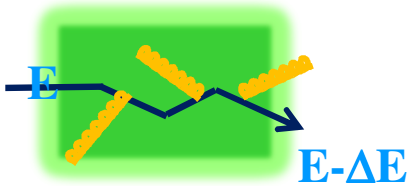
- $D^0 \rightarrow K\pi$, $D^+ \rightarrow K\pi\pi$, $D^{*+} \rightarrow D^0\pi$ recontructed at midrapidity



$$R_{AA}(p_t) = \frac{1}{\langle T_{AA} \rangle} \cdot \frac{dN_{AA}/dp_t}{d\sigma_{pp}/dp_t},$$

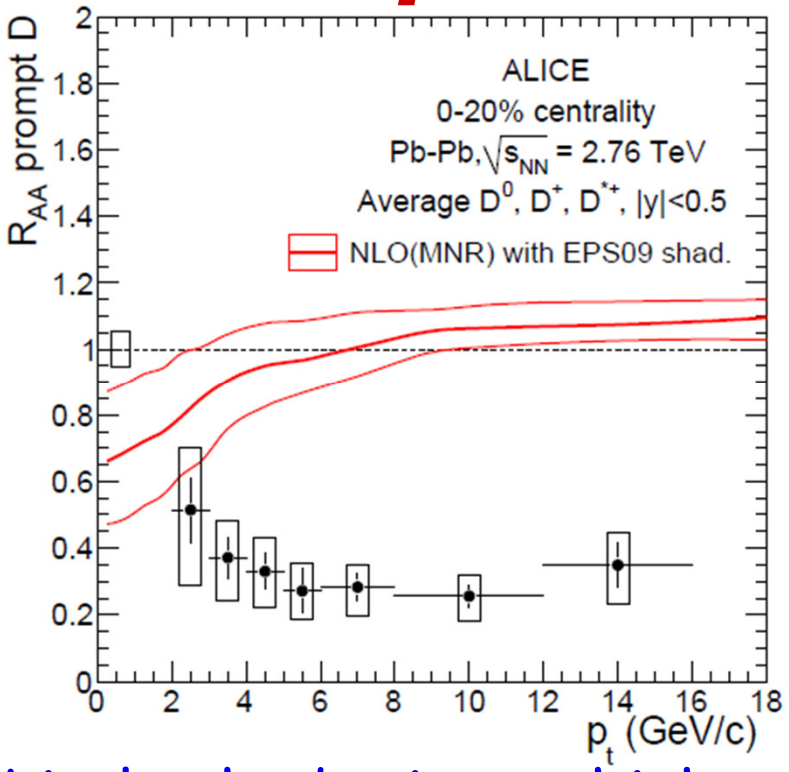


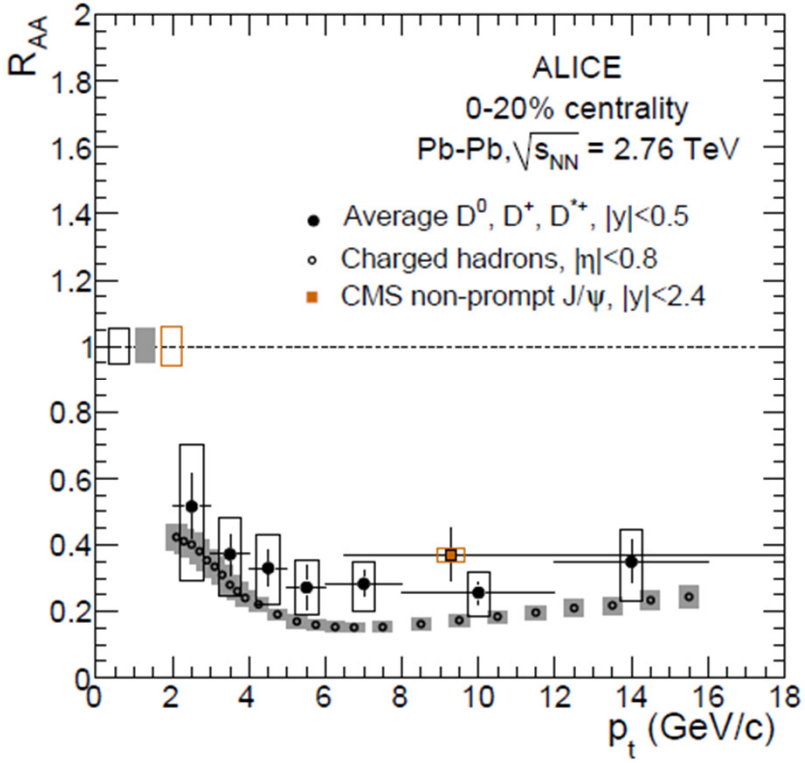
⇨ Sensitive to parton energy loss in QCD medium



arXiv:1203.2160

Prompt D mesons in PbPb





- Little shadowing at high p_T
  - ⇨ Suppression is a hot matter effect
- Compare R_{AA} of D, B and light hadrons to check hierarchy predicted by energy loss models: $R_{AA}(\pi) < R_{AA}(D) < R_{AA}(B)$
  - ⇨ Hint of $R_{AA}(D) > R_{AA}$(charged hadrons)
    - ✓ R_{AA}(charged hadrons) ≈ $R_{AA}(\pi)$ for p_t>5 GeV/c
  - ⇨ Hint of $R_{AA}(B) > R_{AA}(D)$ from non-prompt J/ψ by CMS

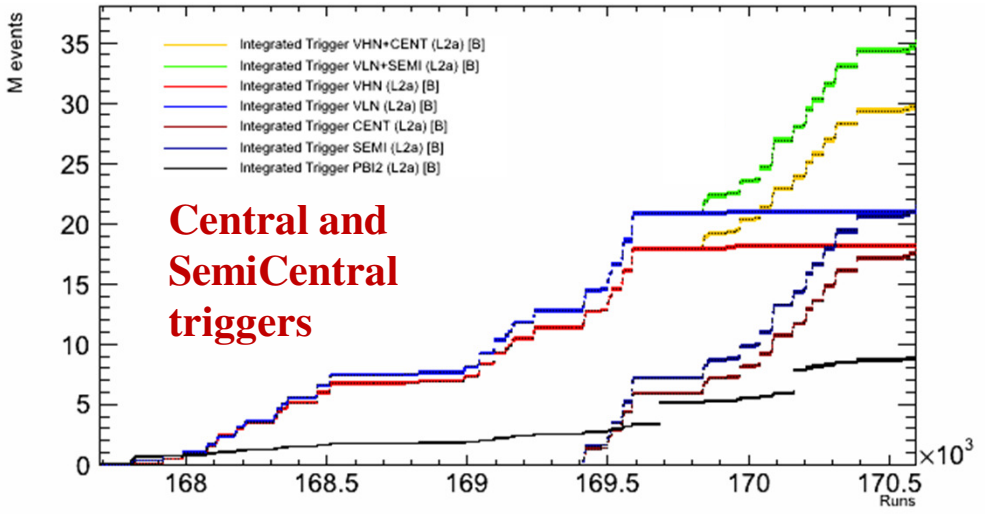
arXiv:1203.2160

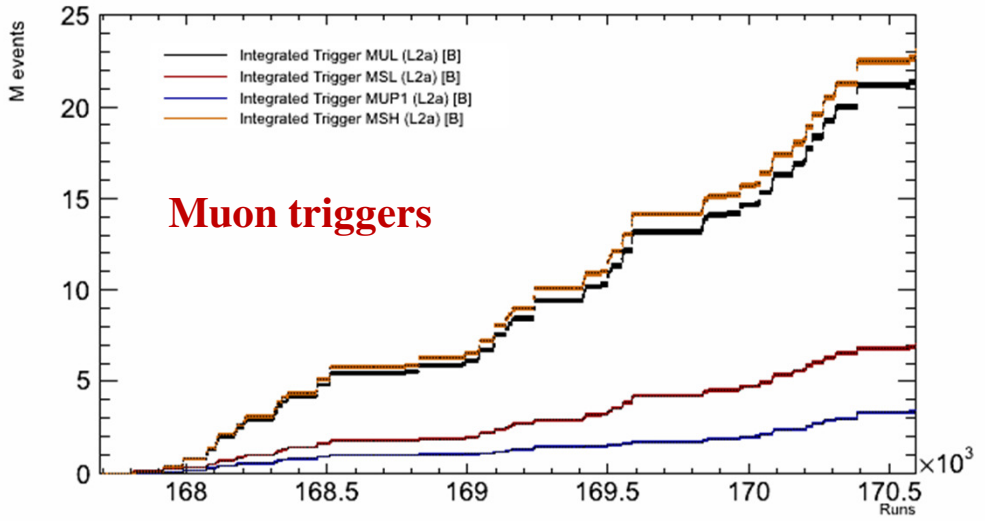
Pb-Pb 2011 data sample and analysis

Pb-Pb 2011 run statistics

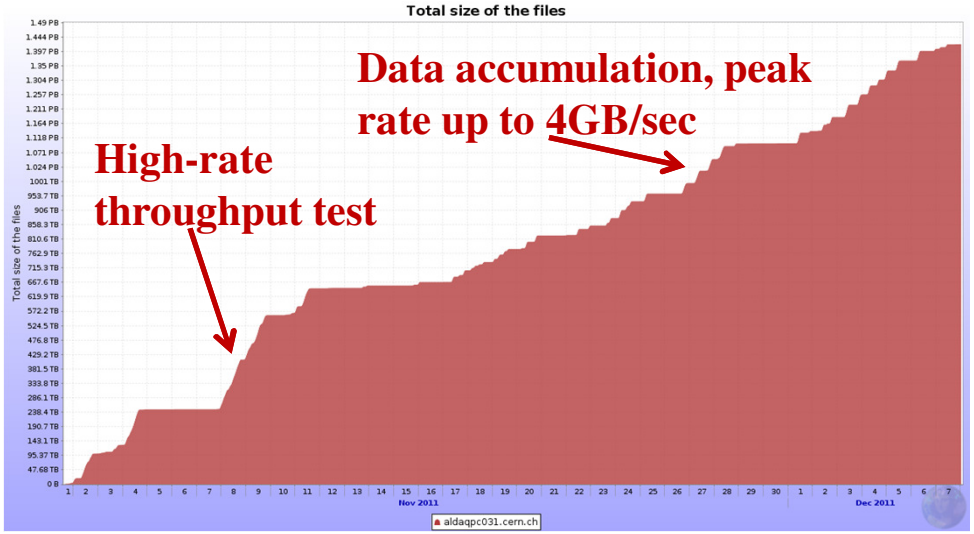
- Collected events:
  - ⇨132.4M physics events
  - ⇨7.7M calibration events

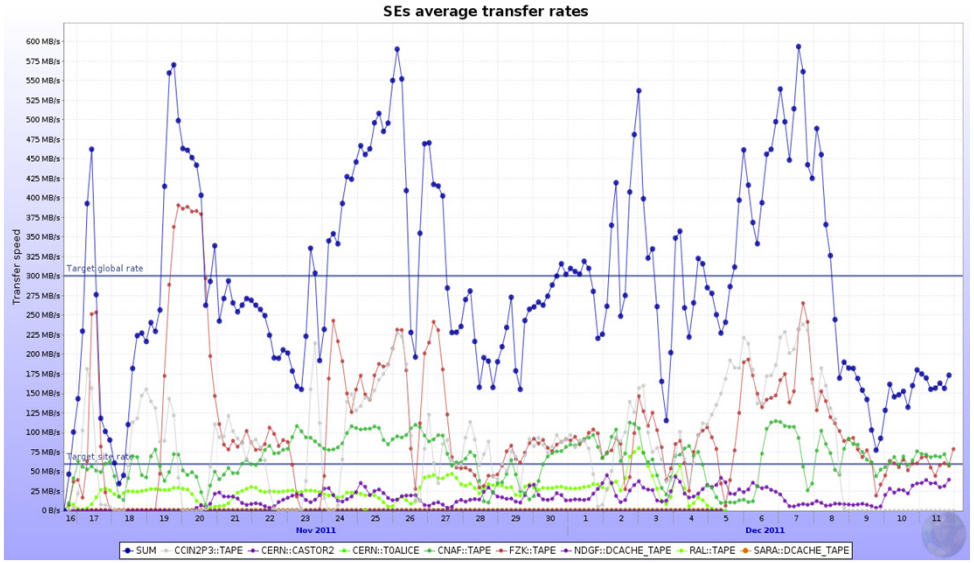
Physics	L2a Counts
MinBias	8798.8 k events
Central	29985.4 k events
SemiCentral	35020.4 k events
EMCAL Jet	10765.1 k events
EMCAL Gamma	7928.3 k events
Barrel UPC (SPD)	7880.7k events
Barrel UPC (EMCAL)	18.4 k events
PHOS	948.6 k events
MUON Single Low	6947.0 k events
MUON Single High	22978.3 k events
MUON UPC	3368.8 k events
DiMUON unlike	21634.2 k events





Pb-Pb data taking and services





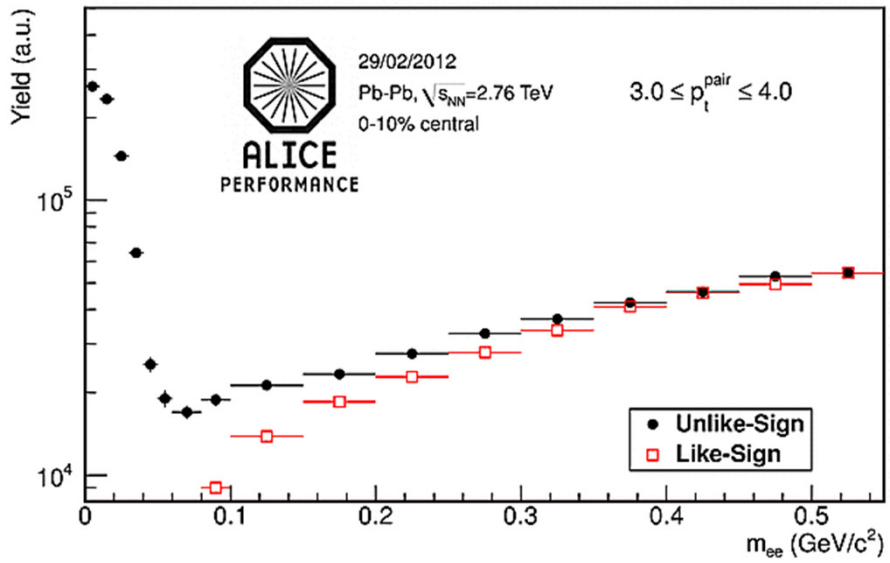
- Very successful data taking period:
  - ⇨ 140 million events, enriched with rare triggers
  - ⇨ HLT compression operational, x4 reduction of RAW data volume
  - ⇨ Reconstruction and fast QA of ~50% of the data during the data taking period
- Excellent performance of data services:
  - ⇨ CASTOR2@CERN supported unprecedented data transfer rates (up to 4GB/sec)
  - ⇨ Steady performance of tape storages T1s
  - ⇨ Data replication completed 4 days after end of period
  - ⇨ Average rate 300MB/sec

Offline reconstruction

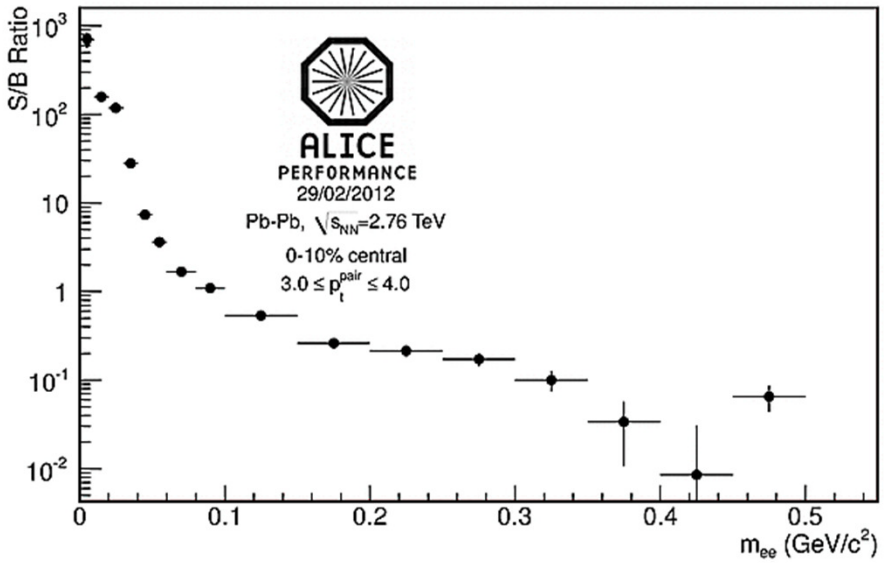
- Completed full reconstruction of 2011 pp data
- PbPb 2011: reconstruction pass 2 completed
- CPU usage efficiency of production jobs >80%
- Presently doing:
  - ⇨Analysis, MC, Cosmic & Calibration
  - ⇨Waiting for beam…
- Resources still tight but…
  - ⇨New "prototype" T1s for ALICE in South Korea (KISTI) and soon Mexico (UNAM)
  - ⇨InGrid2012 in Mumbai will also discuss Indian T1
- Storage is critical
  - ⇨Reducing number of replicas for less-frequently-used files will help in the short term

Low-mass di-electrons

- Electromagnetic probe, containing information on:
  - ⇨ Thermal radiation emitted by the dense medium
  - ⇨ In-medium modifications of the light vector mesons properties (mass and/or width)
- TPC+TOF for electron identification
  - ⇨ Combinatorial background from Like-Sign electron pairs
  - ⇨ S/B comparable to RHIC experiments



ALI-PERF-13611



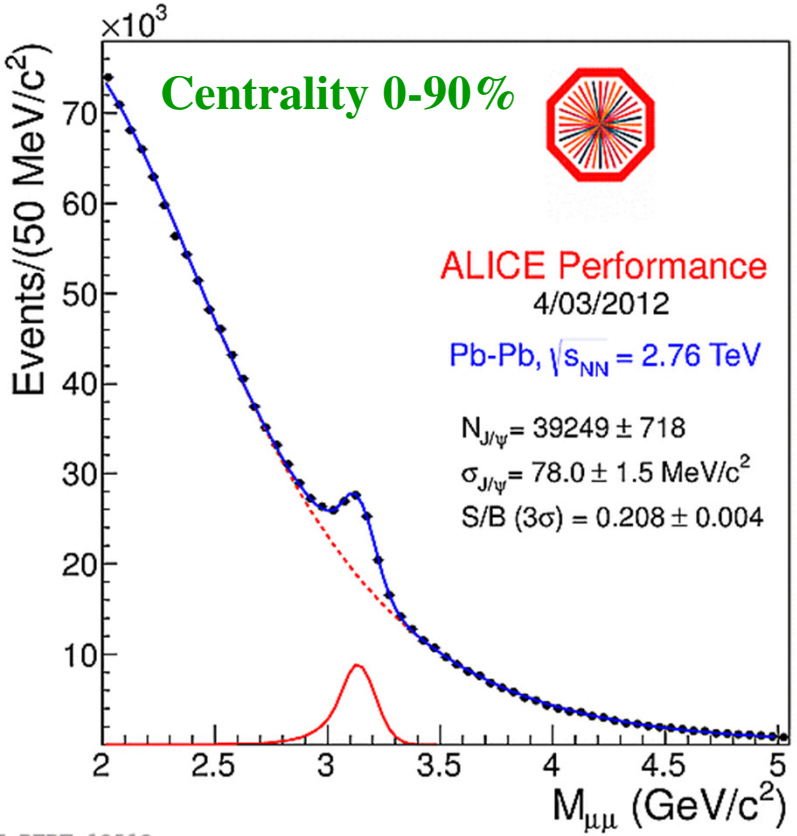
ALI-PERF-13619

$J/\psi \rightarrow \mu\mu$: Pb-Pb 2011 harvest

- Larger statistics allows to study J/ψ production as a function of the azimuthal angle relative to the reaction plane

$$v_2 = \langle \cos[2(\varphi - \Psi_{RP})] \rangle$$

⇨ Insight in charm thermalization and J/ψ production from charm quarks in the medium



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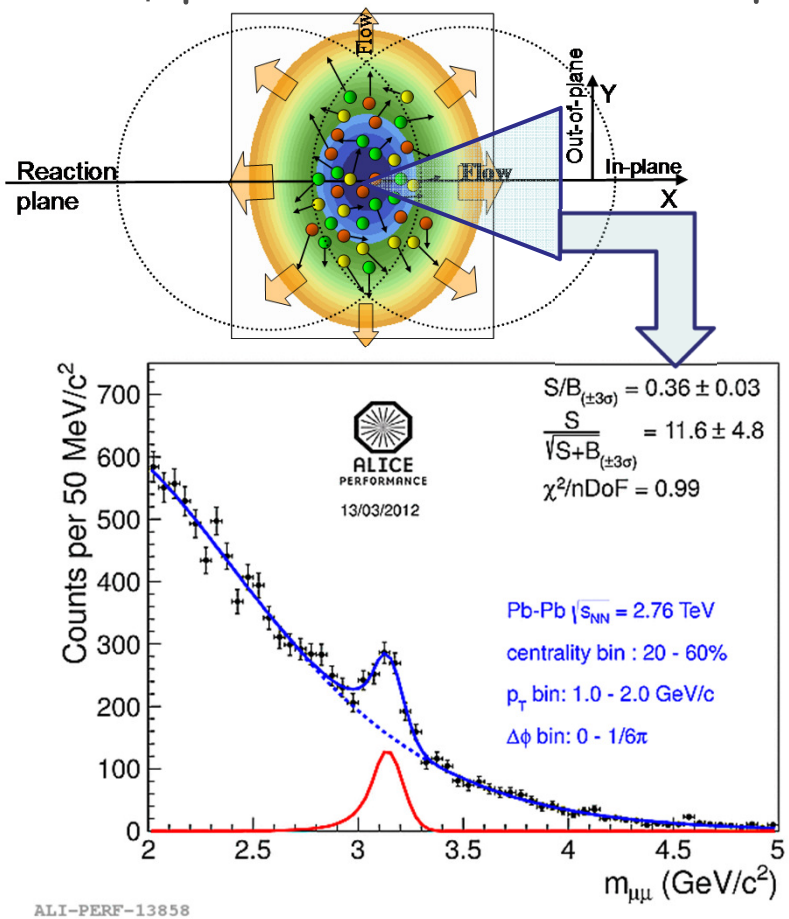

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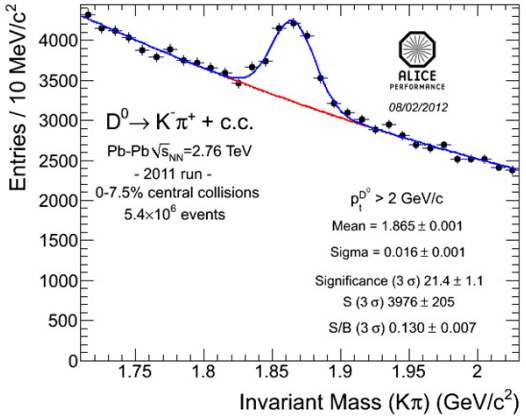
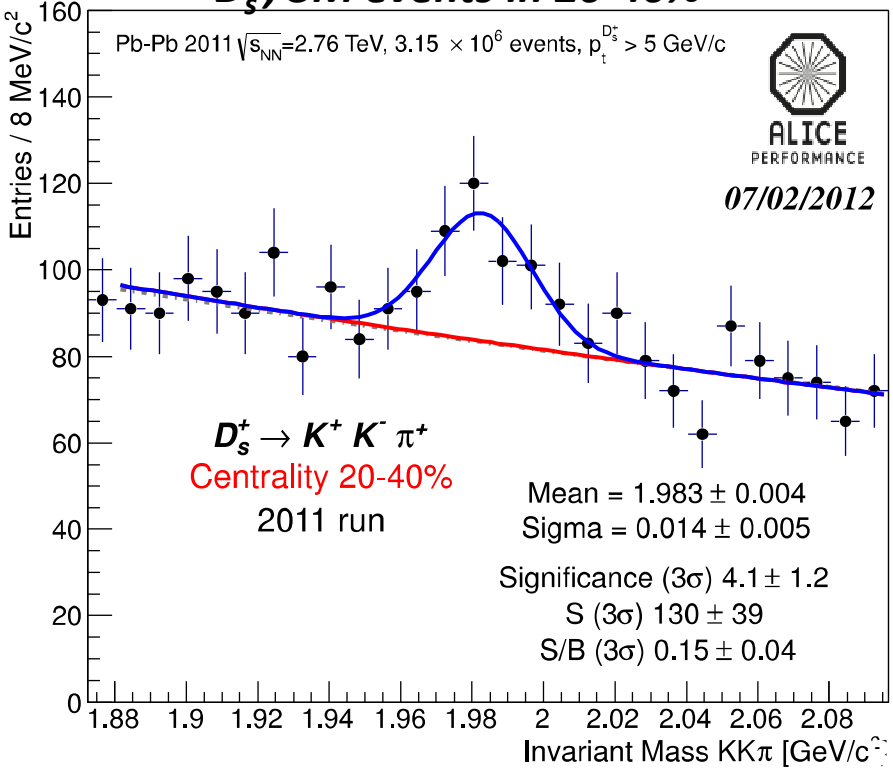
D mesons in Pb-Pb 2011

- Increased statistics for R_{AA} in central and v_2 in semi-peripheral collisions
- D_s/D sensitive to strangeness production and hadronization mechanism

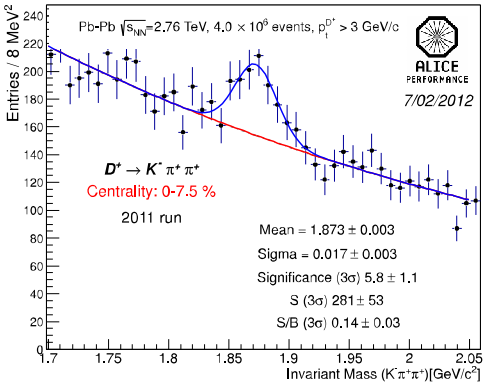


D^0, 5M events in 0-7.5%

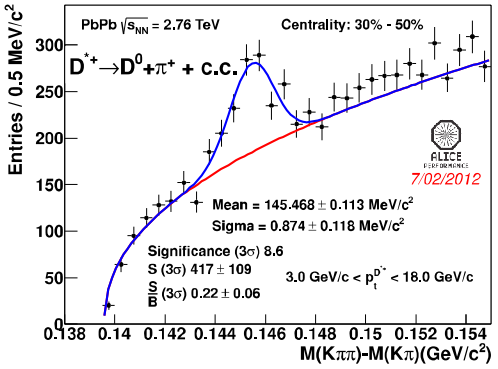
D_s, 3M events in 20-40%



D^+, 4M events in 0-7.5%



D^*, 7M events in 30-50%



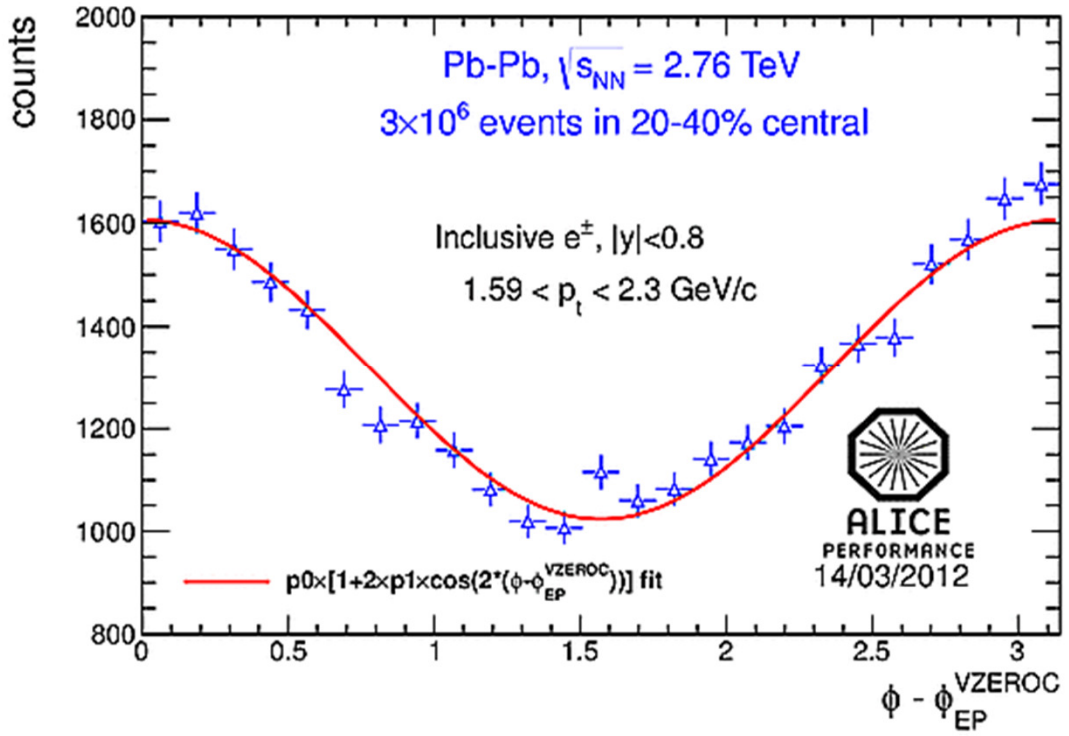
ALICE posters

- **Maxime Guilbaud**: *Material budget in ALICE with the displaced vertex technique*
- **Gian Michele Innocenti**: *D_s production at central rapidity in pp collisions at 7 TeV with the ALICE detector*
- **Markus Fasel**: *Measurement of electrons from semi-electronic heavy-flavour hadron decays in proton-proton collisions at $\sqrt{s}$ = 7 TeV with ALICE*
- **Fiorella Fionda**: *Measurements of prompt and non-prompt J/psi production at central rapidity in p-p collisions at sqrt(s) = 7 TeV with the ALICE experiment*
- **Livio Bianchi**: *J/Psi polarization in pp collisions at $\sqrt{s}$=7 TeV with the ALICE experiment*
- **Igor Lakomov**: *J/psi suppression in Pb-Pb collisions at $\sqrt{s}$=2.76 TeV at forward rapidity in ALICE*
- **Michael Linus Knichel**: *Suppression of Charged Particle Production at Large Transverse Momentum in Pb-Pb Collisions at $\sqrt{s}$ = 2.76 TeV*
- **Rongrong Ma**: *Jet measurements with the ALICE detector at the LHC*
- **Michal Broz**: *Baryon number transport at LHC energies with the ALICE experiment*
- **Igor Altsybeev**: *Long-range (Forward-Backward) Multiplicity Correlations in pp collisions at 900 GeV and 7 TeV*

Backup

Heavy flavour electron v_2

- Based on measurement of inclusive electron v_2 and subtraction of v_2 of cocktail of know non-heavy flavour electrons
  - ⇨ Analysis being developed on Pb-Pb 2010 sample,



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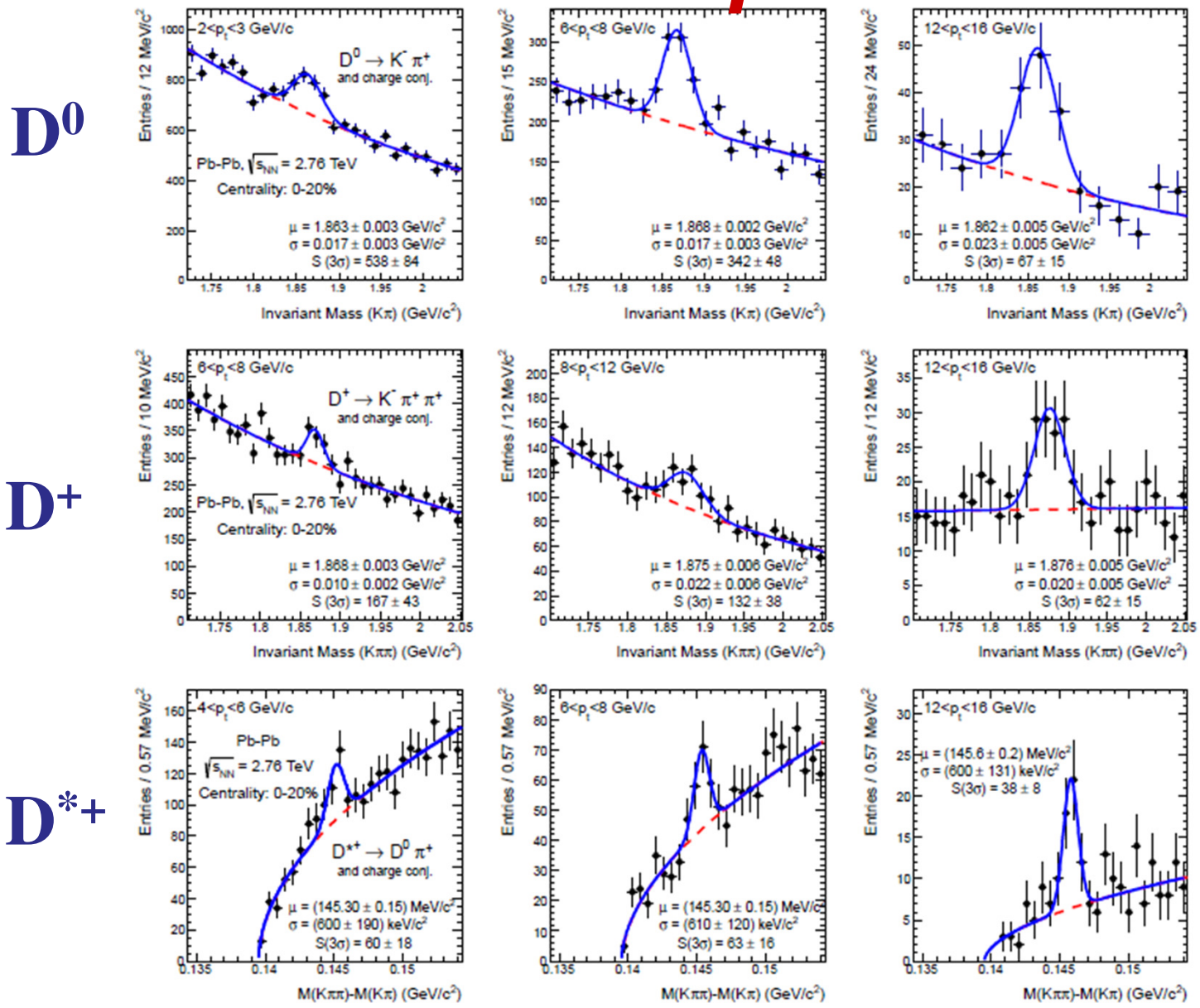
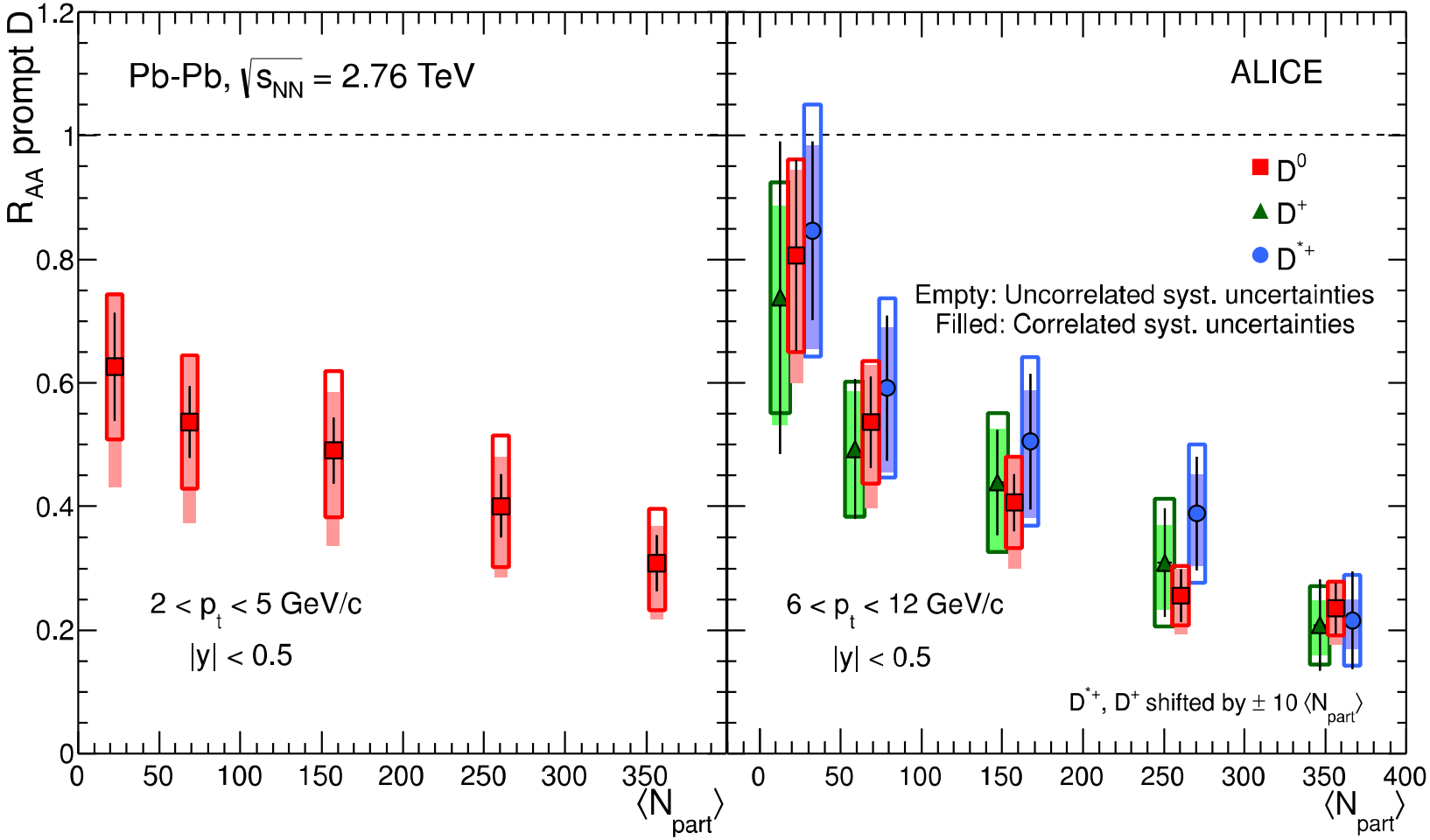
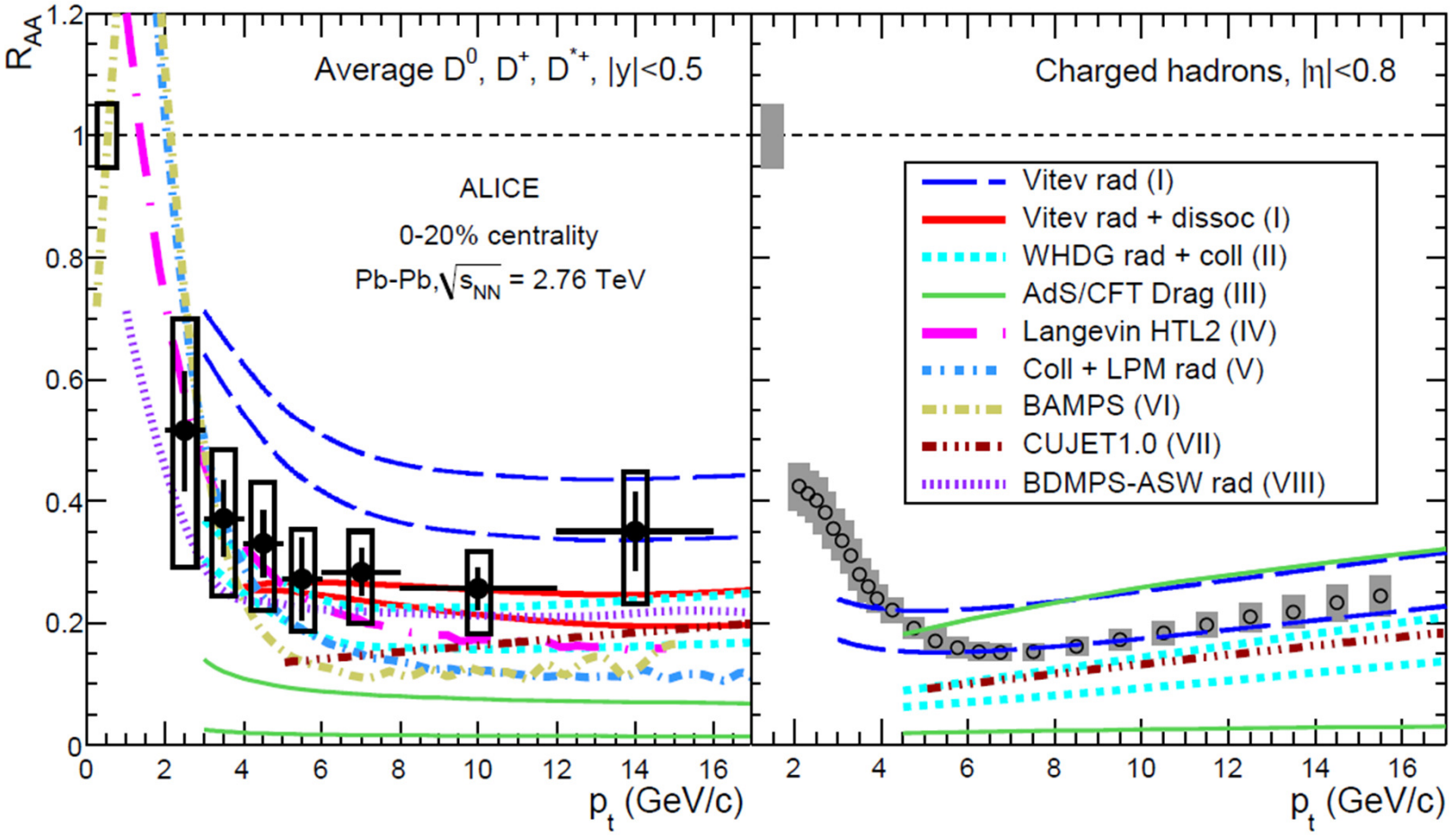
Invariant mass spectra in PbPb



D mesons vs. centrality

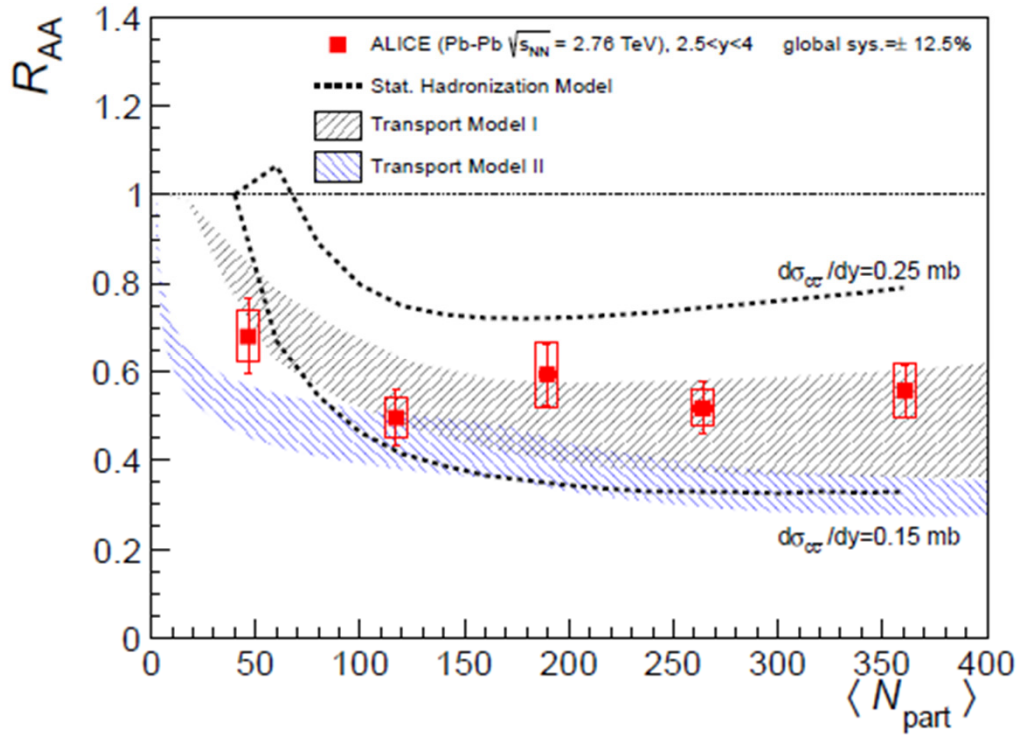


D meson R_{AA} vs. models



- Comparison to theoretical predictions
  - ⇨Several models on the market
  - ⇨Only few have predictions for D mesons and light hadrons

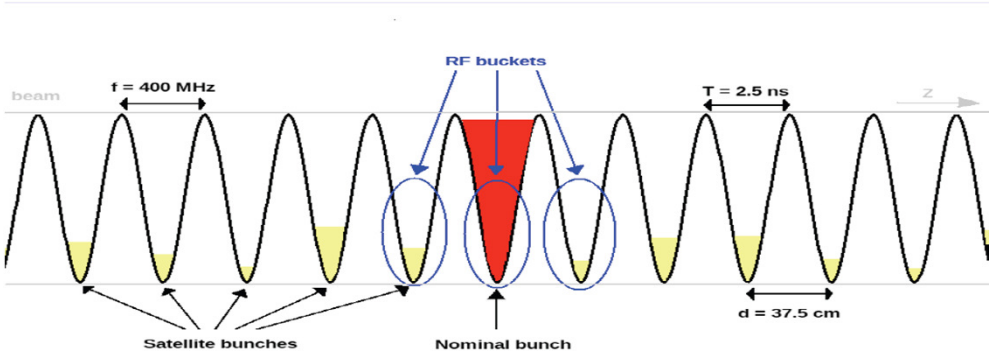
J/ψ R_{AA} vs. models

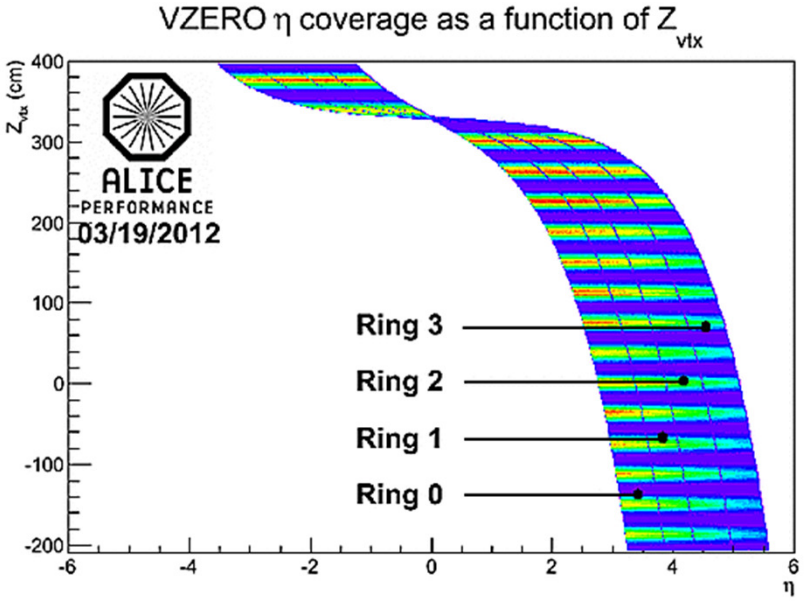


- Comparison to theoretical predictions
  - ⇨ Statistical hadronization model: charmonium production at the phase boudary by statistical hadronization of charm quarks
  - ⇨ Transport models: J/ψ dissociation and regenration in the medium

Multiplicity at large η

- Use satellite bunches and the measurement of multiplicity with the VZERO detector to scan the real material budget and improve its description in the MC
  - ⇨ Allows to extend the η range for the dN/dη measurement





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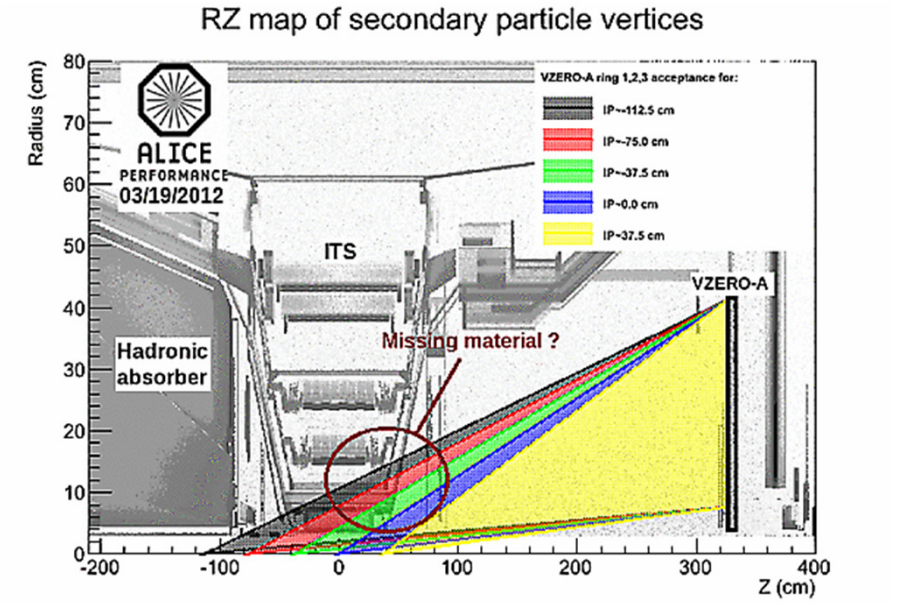

ALI-PERF-14103