

Measurement of heavy flavour production via semi-muonic channel at forward rapidity in pp collisions at 7 TeV and Pb- Pb collisions at 2.76 TeV with ALICE

Xiaoming Zhang for the ALICE Collaboration

Institute of Particle Physics, CCNU, Wuhan, China

Key Laboratory of Quark & Lepton Physics, MoE, China

Laboratoire de Physique Corpusculaire, CNRS/IN2P3, Clermont-Ferrand, France

5th France China Particle Physics Laboratory Workshop
Paris, France, March 21-23, 2012



A Large Ion Collider Experiment

European Organisation for Nuclear Research



Outline

- Physics motivation
- Production cross section of muons \leftarrow HF in pp collisions at 7 TeV
- Suppression of Single Muons in Pb-Pb collisions at 2.76 TeV
- Summary of My Activities
- Conclusion

Heavy Flavour Production at the LHC

Heavy flavours in pp collisions:

- baseline for pA and AA collisions;
- test NLO pQCD in a new energy regime: large theoretical uncertainties.

Heavy flavours in pA collisions:

shadowing & anti-shadowing; kt broadening of partons; color glass condensate (CGC).

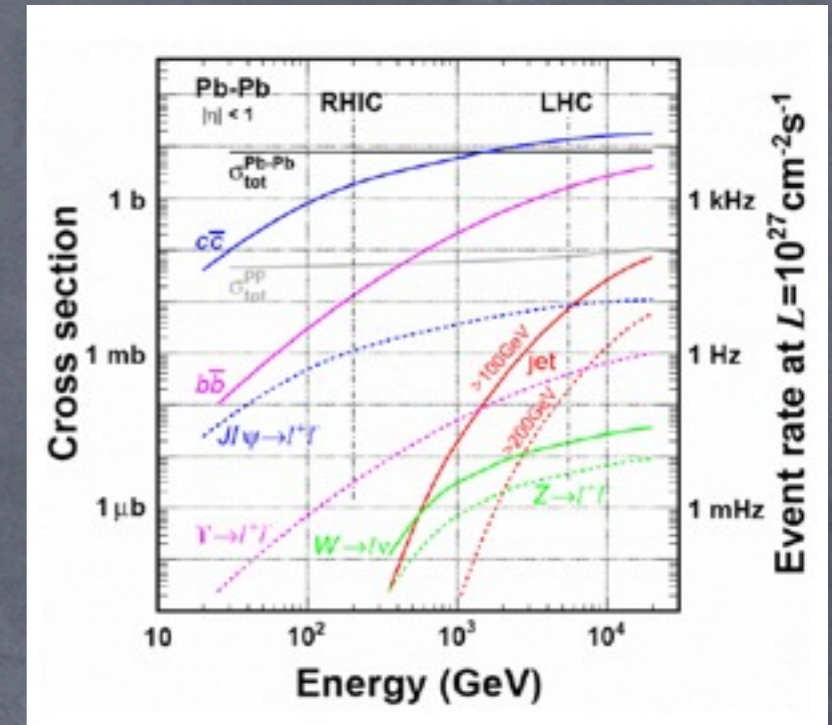
Heavy Flavours in AA collisions, tomography of QCD medium:

- quenching in QCD medium,

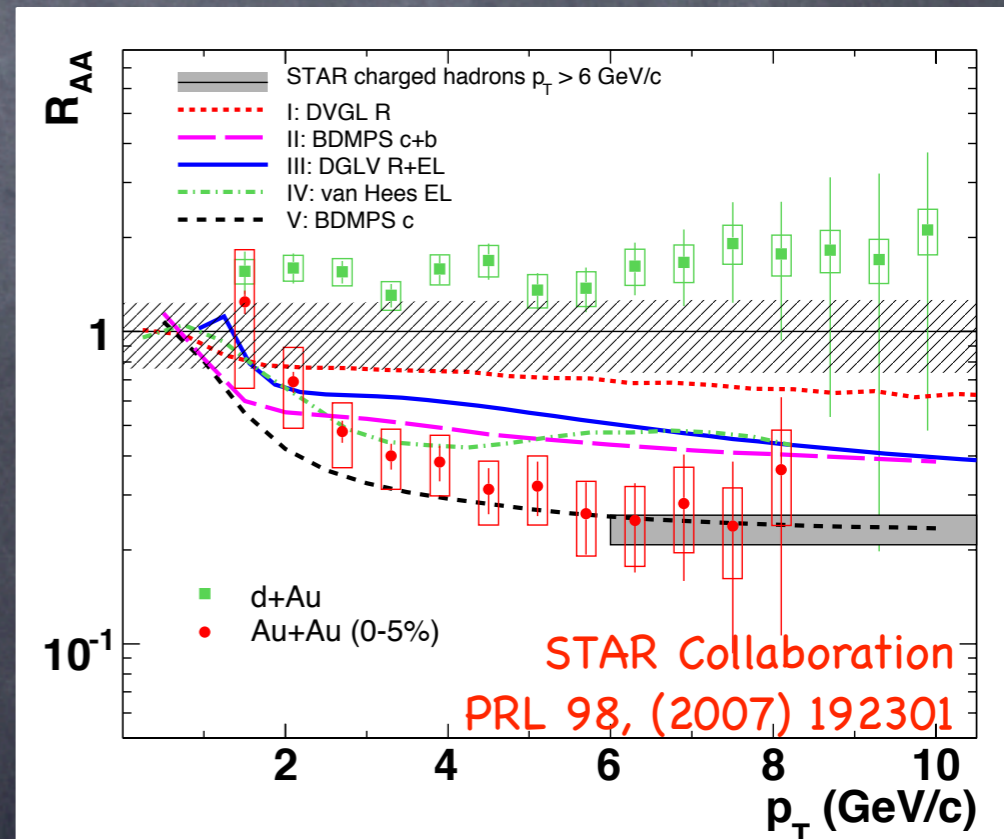
$$R_{AA}(p_t) = \frac{1}{\langle T_{AA} \rangle} \times \frac{dN_{AA}/dp_t}{d\sigma_{pp}/dp_t}$$

understand heavy quark in medium energy loss mechanism and test the mass & color charge dependence of parton energy loss;

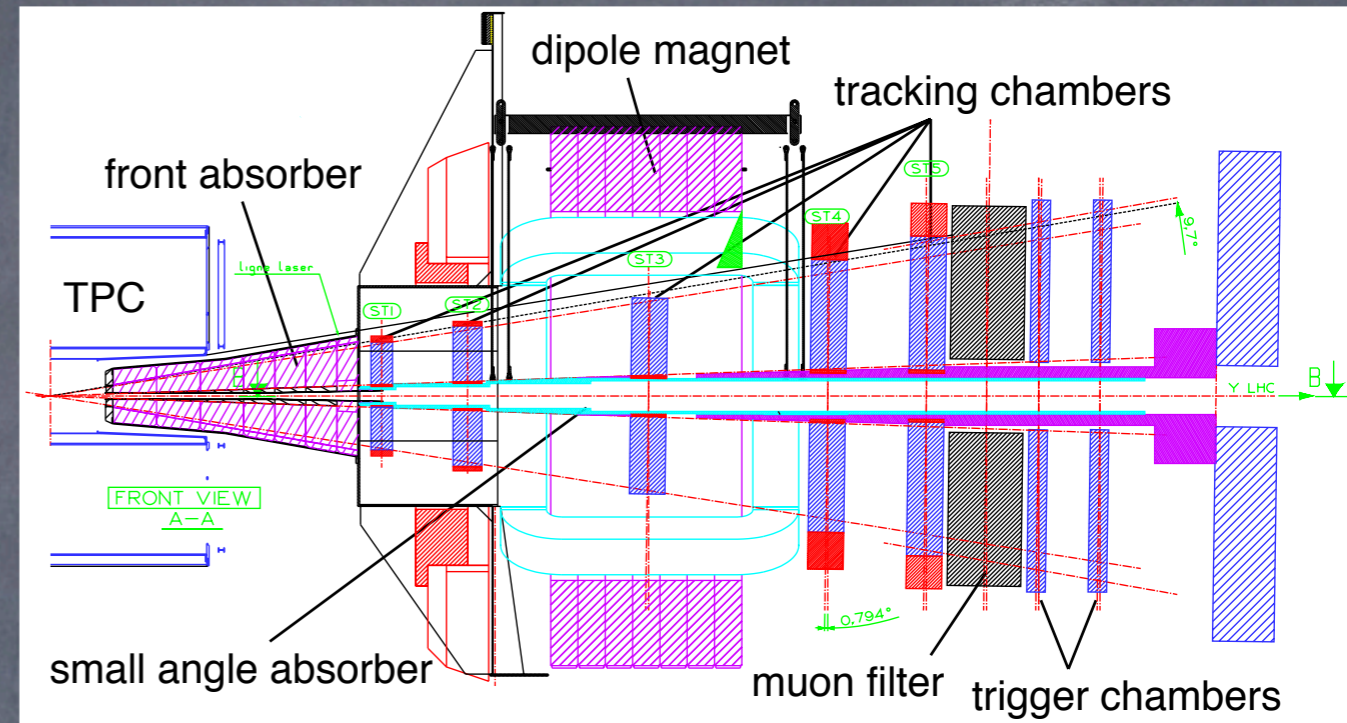
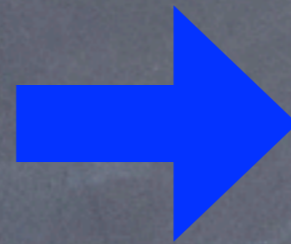
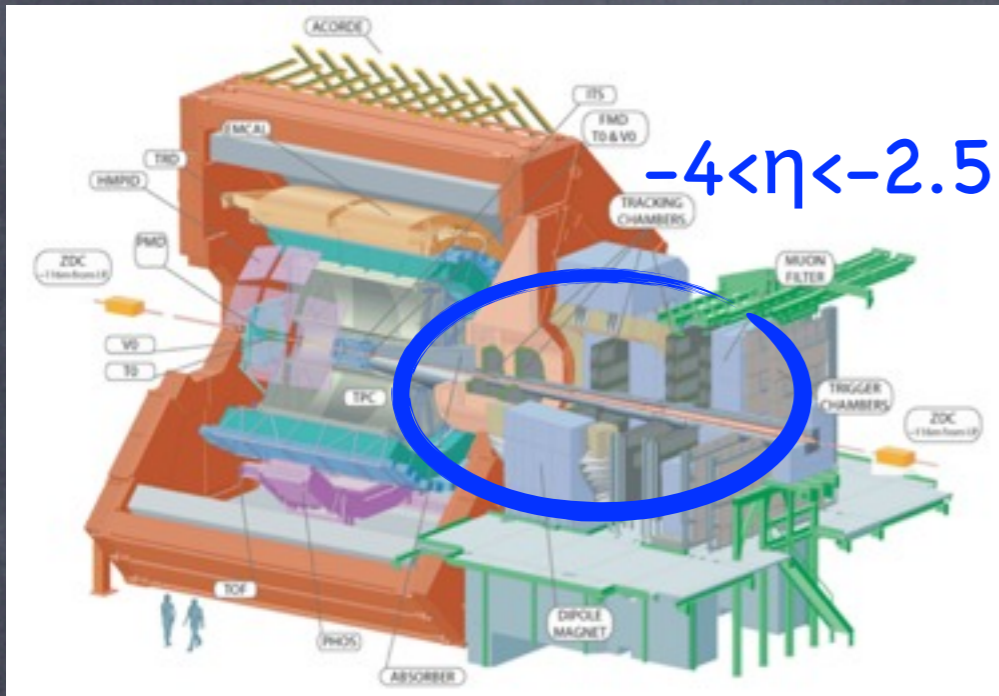
- collective flow, reflects the initial condition of the QCD medium and the degree of thermalization of heavy quarks in QGP.



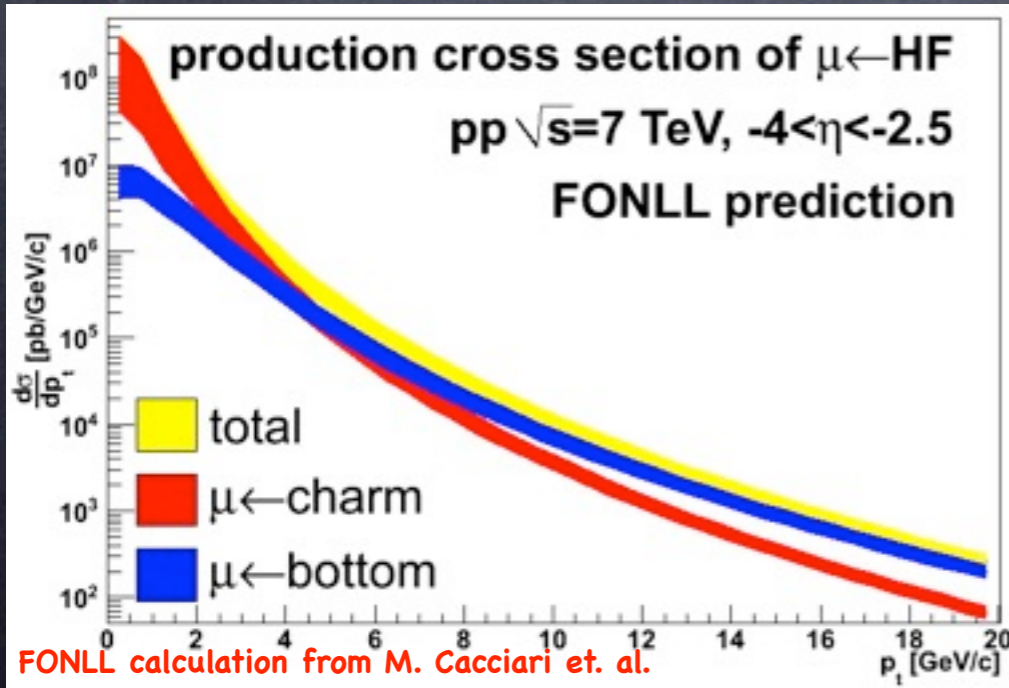
Large HF production rate at LHC!



Heavy Flavour Measurements via Single Muons at Forward Rapidity



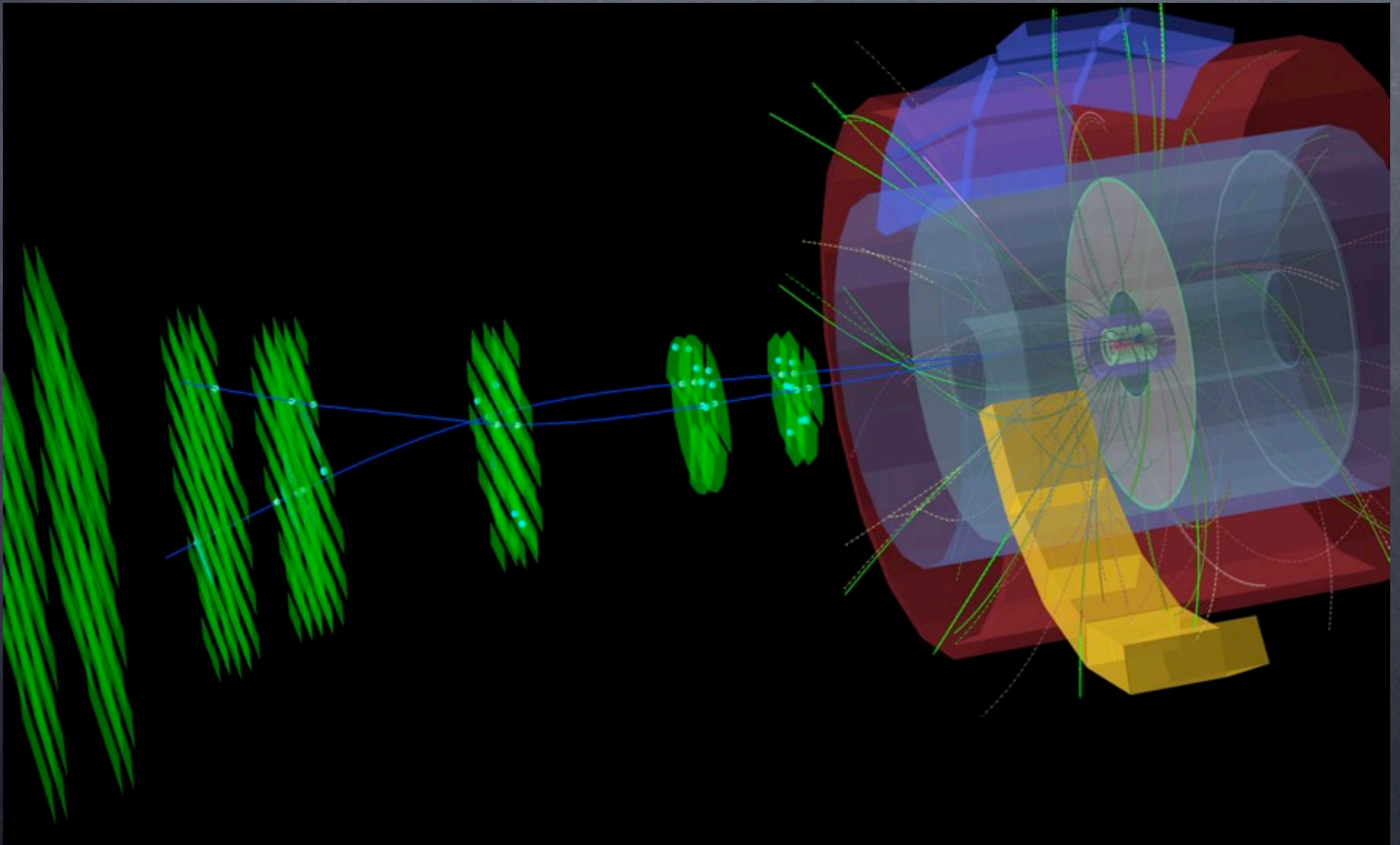
system	energy	N_{event}	N_{track}	data taking period
pp	7 TeV	1.3×10^7	7.9×10^6	Jul/2010–Aug/2010
Pb–Pb	2.76 TeV	2.0×10^7	3.9×10^7	Nov/2010



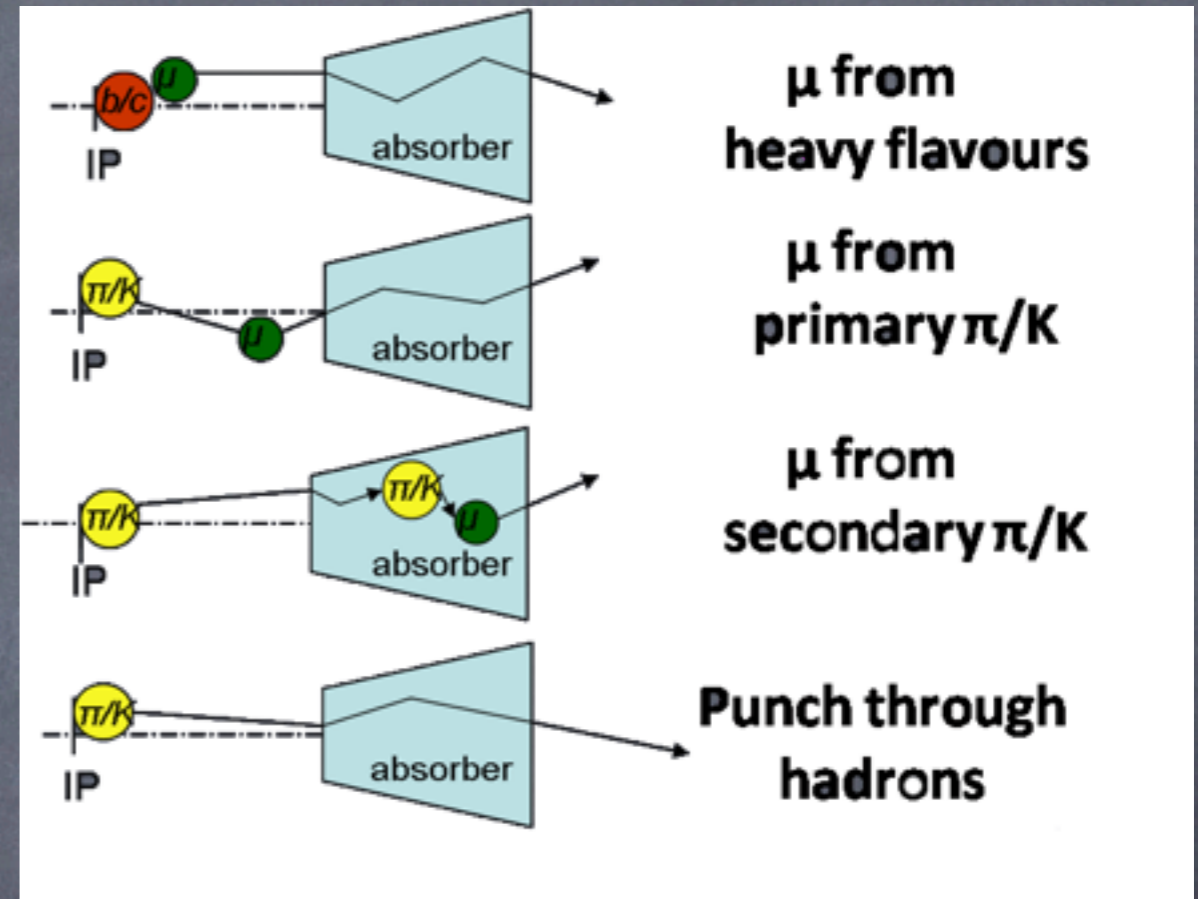
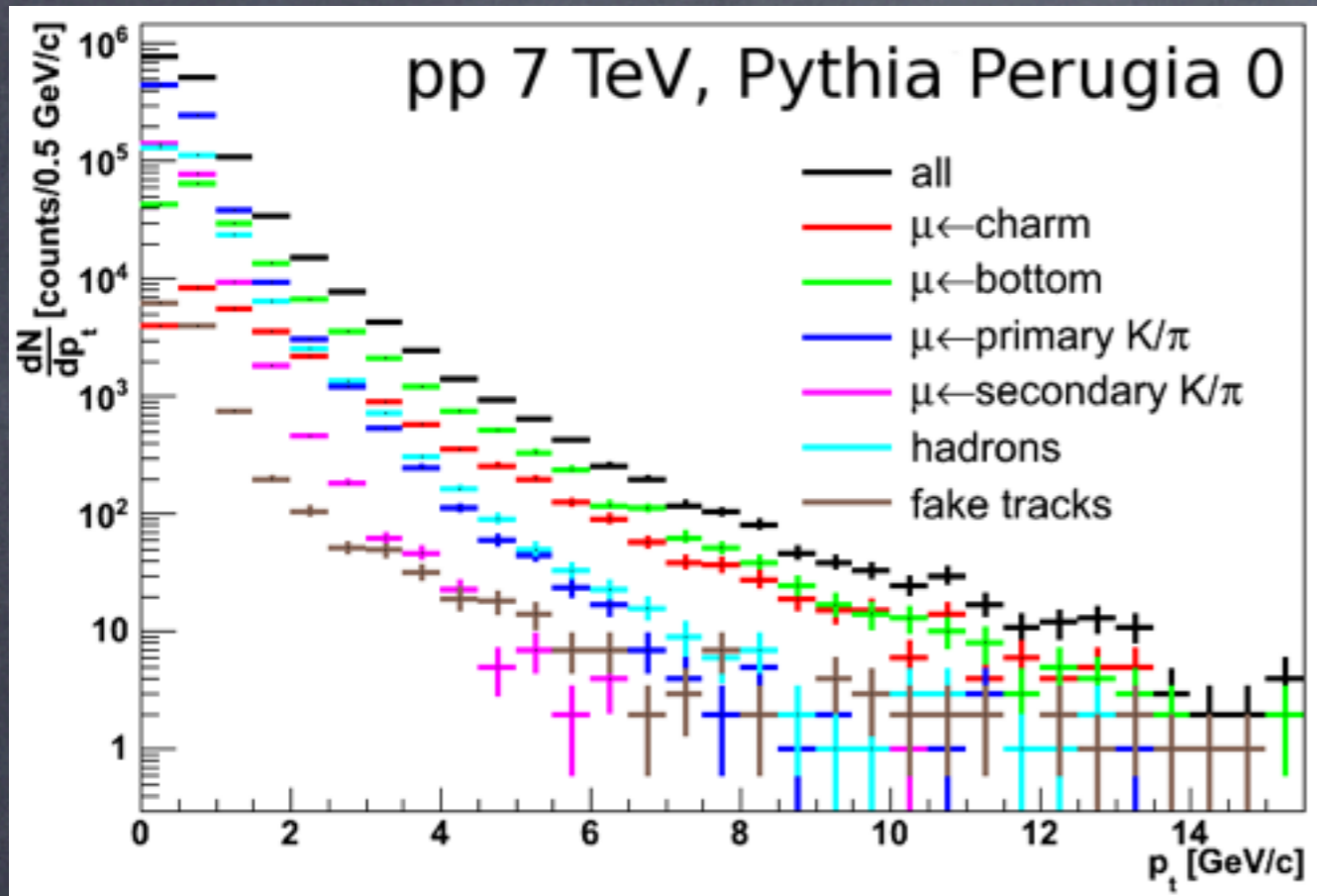
We provide the measurement of muons from charm and beauty decay, without separation.

muon trigger events

Production Cross Section of Muons \leftarrow HF in pp Collisions at 7 TeV



Analysis Strategy



- Event & track selection;
- background subtraction;
- correction for acceptance and reconstruction efficiency;
- obtain p_T spectrum of muons from heavy flavour decay;
- convert muon p_T spectrum to muon differential cross section.

Event & Track Selection

Event selection:

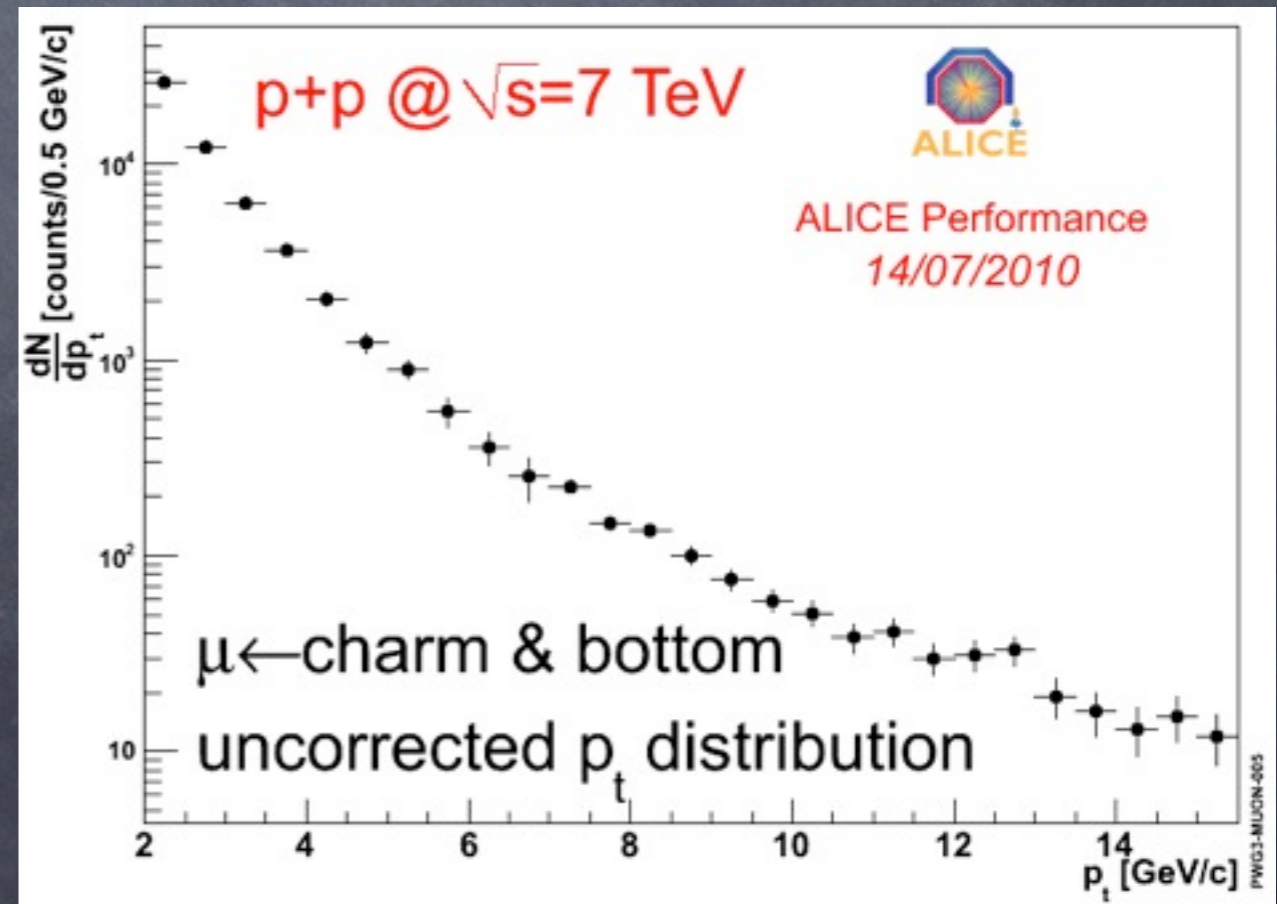
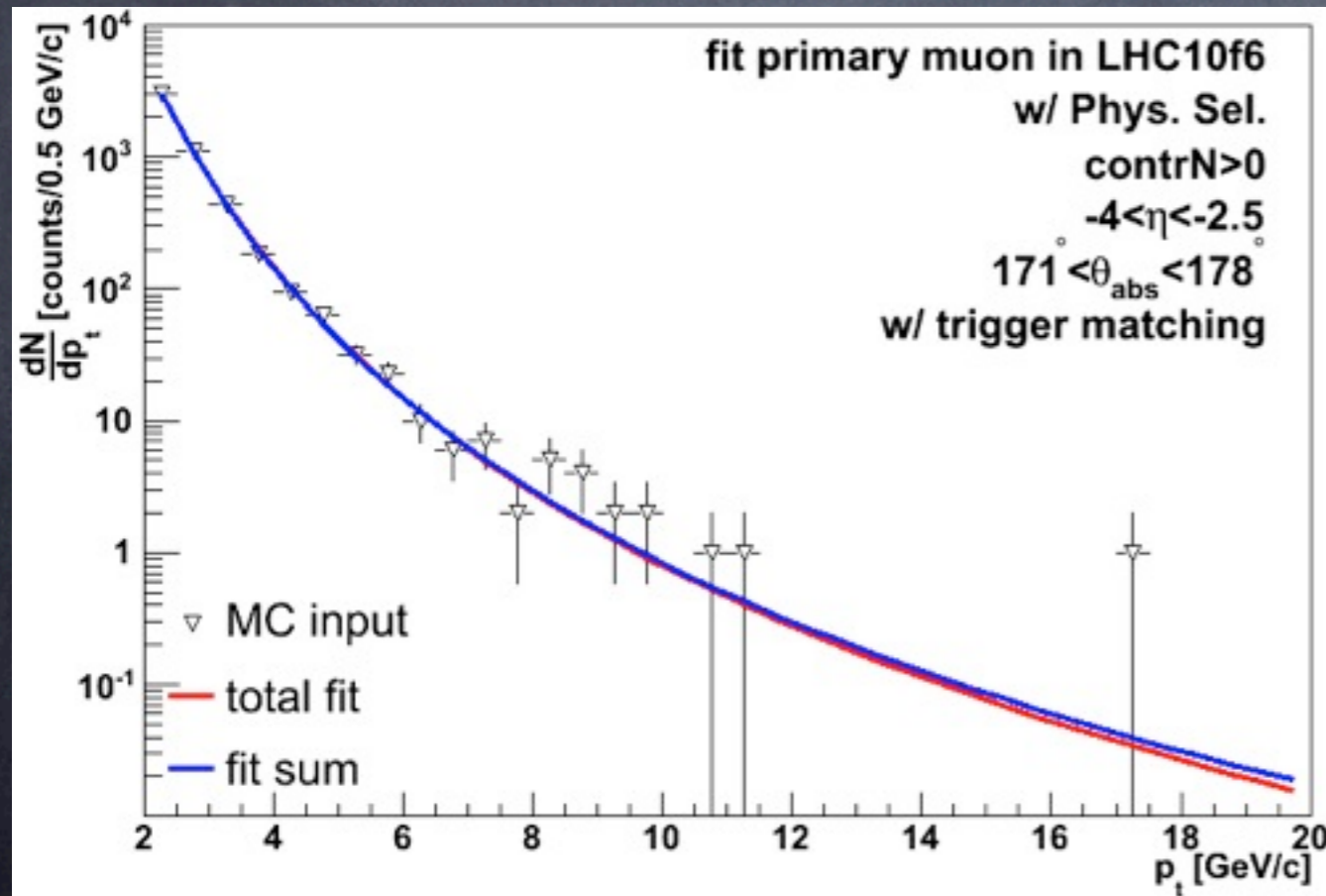
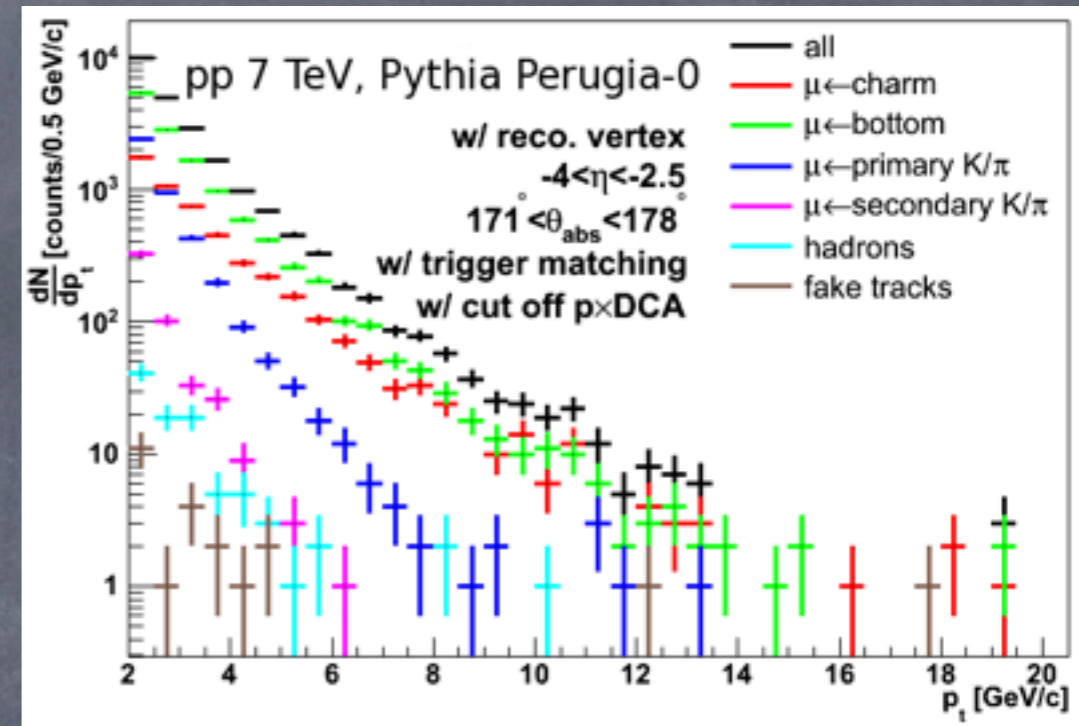
- minimum bias trigger and MUON trigger events.

Track selection:

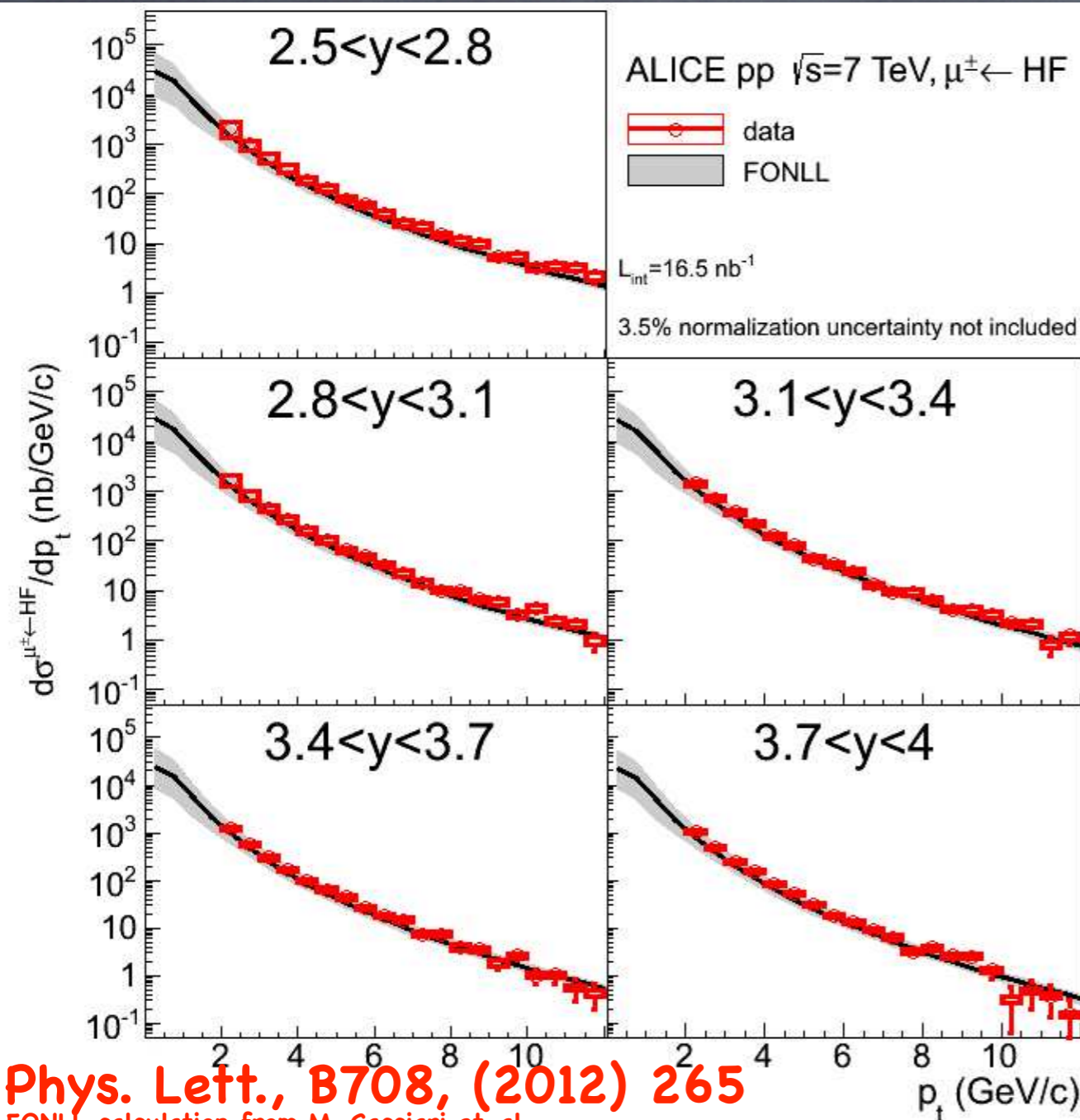
- **w/ reco. vertex**: improve muon track kinematic;
- **$-4 < \eta < -2.5$** : acceptance of ALICE MUON spectrometer;
- **geometrical cut**: cut off tracks coming out of the absorber;
- **with muon trigger matching**: reject hadrons that cross the absorber;
- **pointing angle to the vertex**: remove beam-gas.

Subtraction of Muons From Primary K/ π Decay

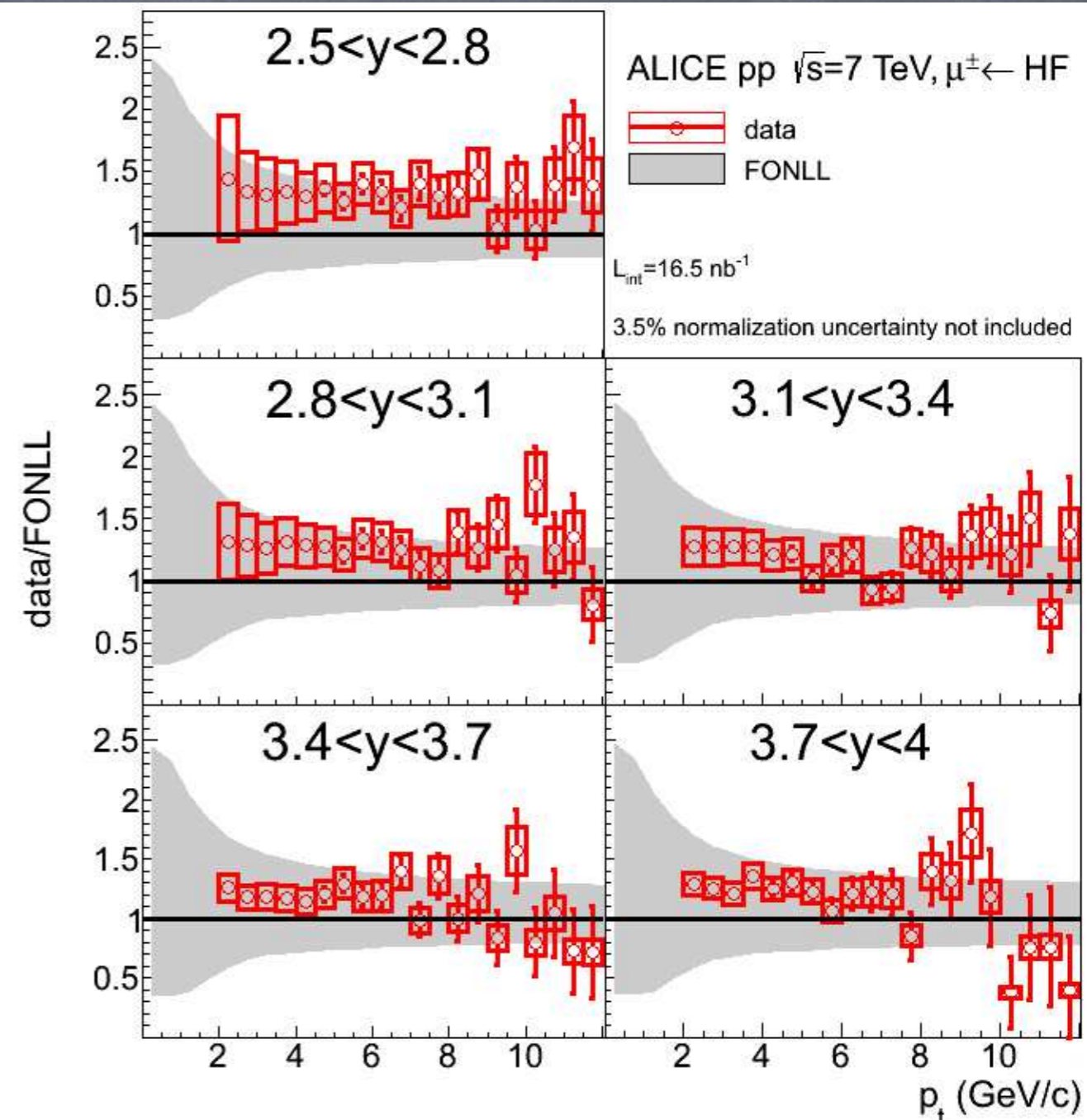
- based on realistic MC simulations;
- yield of muons from primary K/ π decay is $\sim 25\%$ for $p_t > 2$ GeV/c;
- systematic uncertainties:
 - models: estimated by using different inputs;
 - transport code: estimated by varying yield of muons from secondary K/ π within $\pm 100\%$.



Production Cross Section of Muons \leftarrow HF

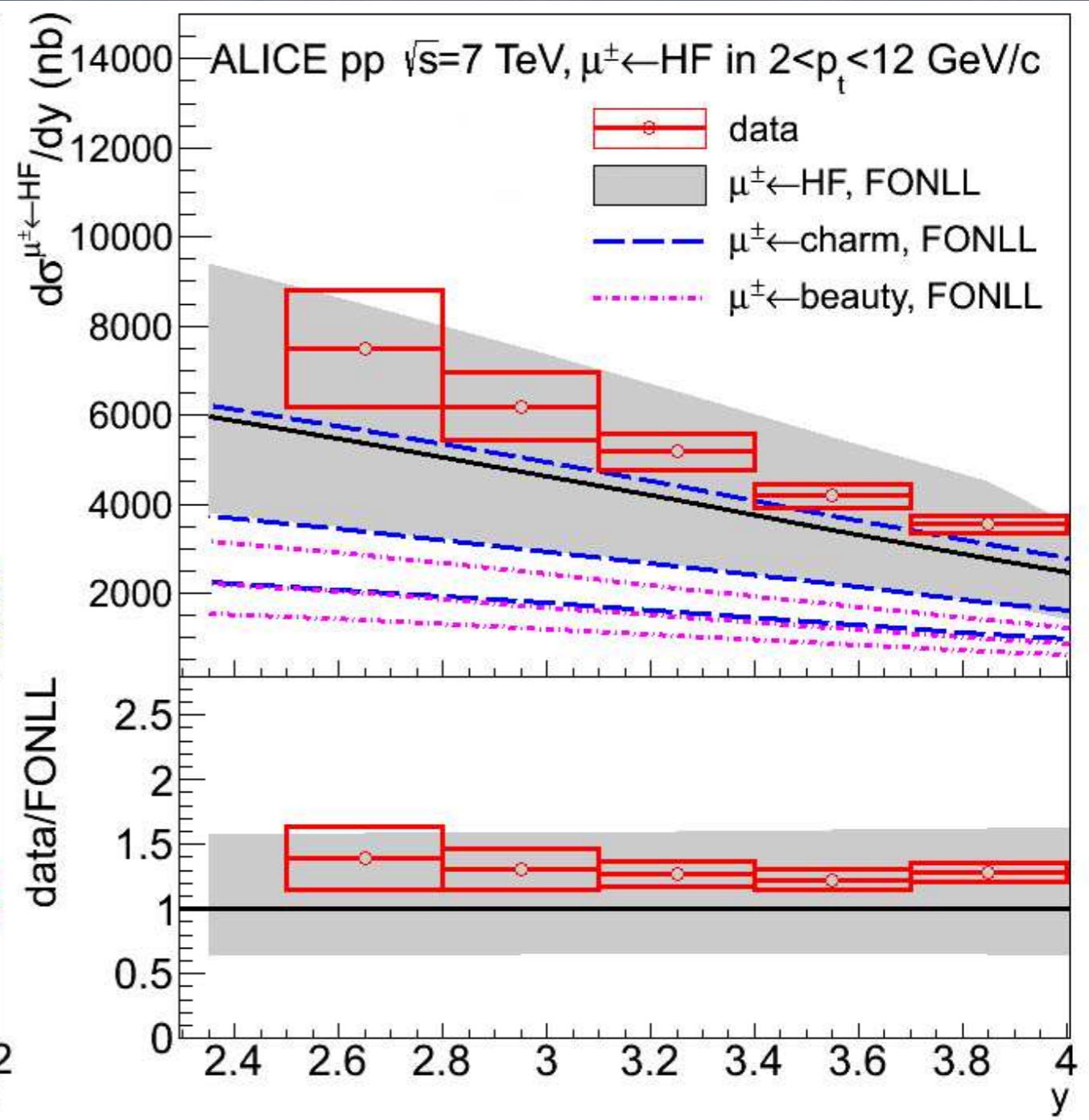
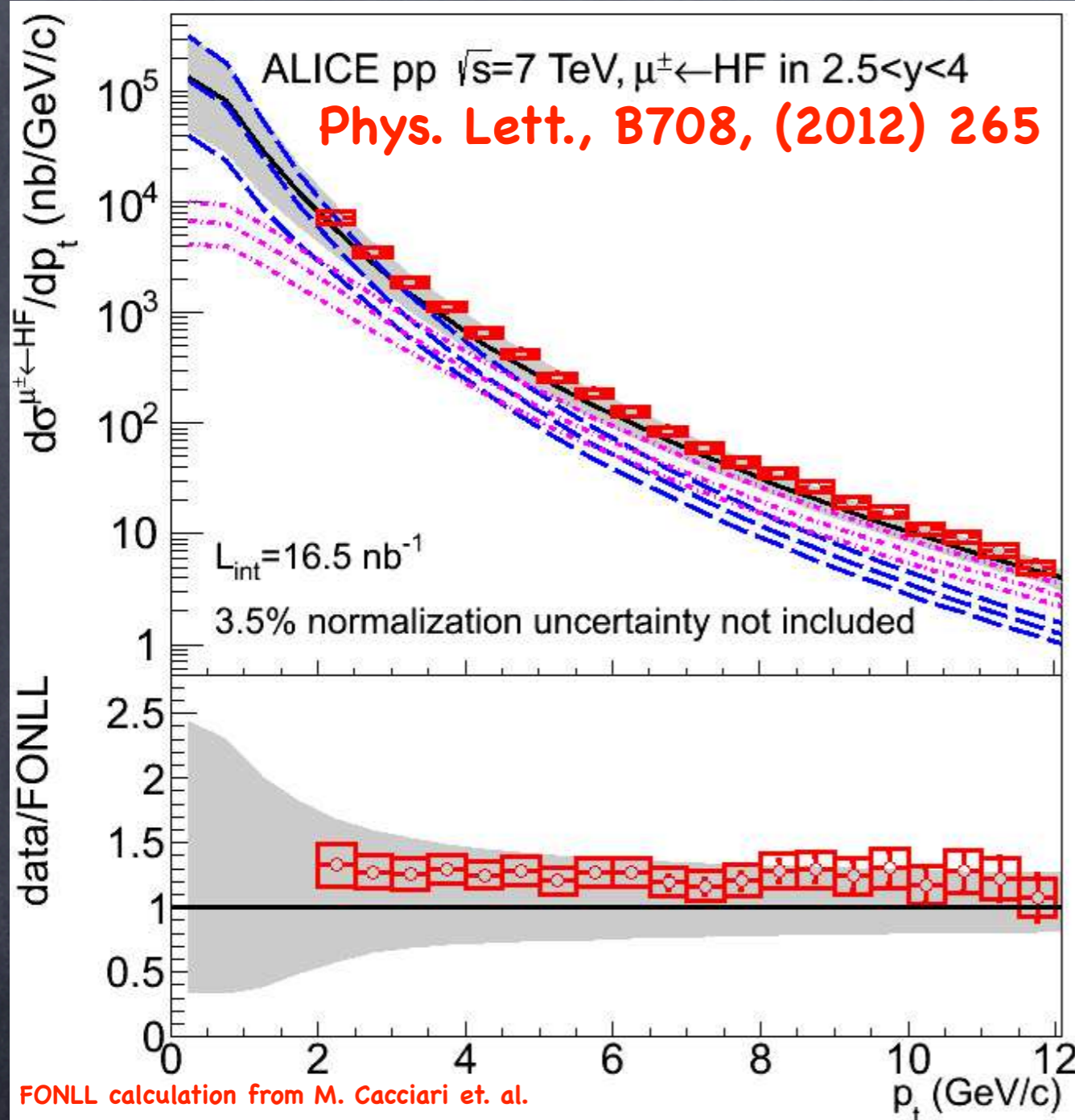


Phys. Lett., B708, (2012) 265
FONLL calculation from M. Cacciari et. al.



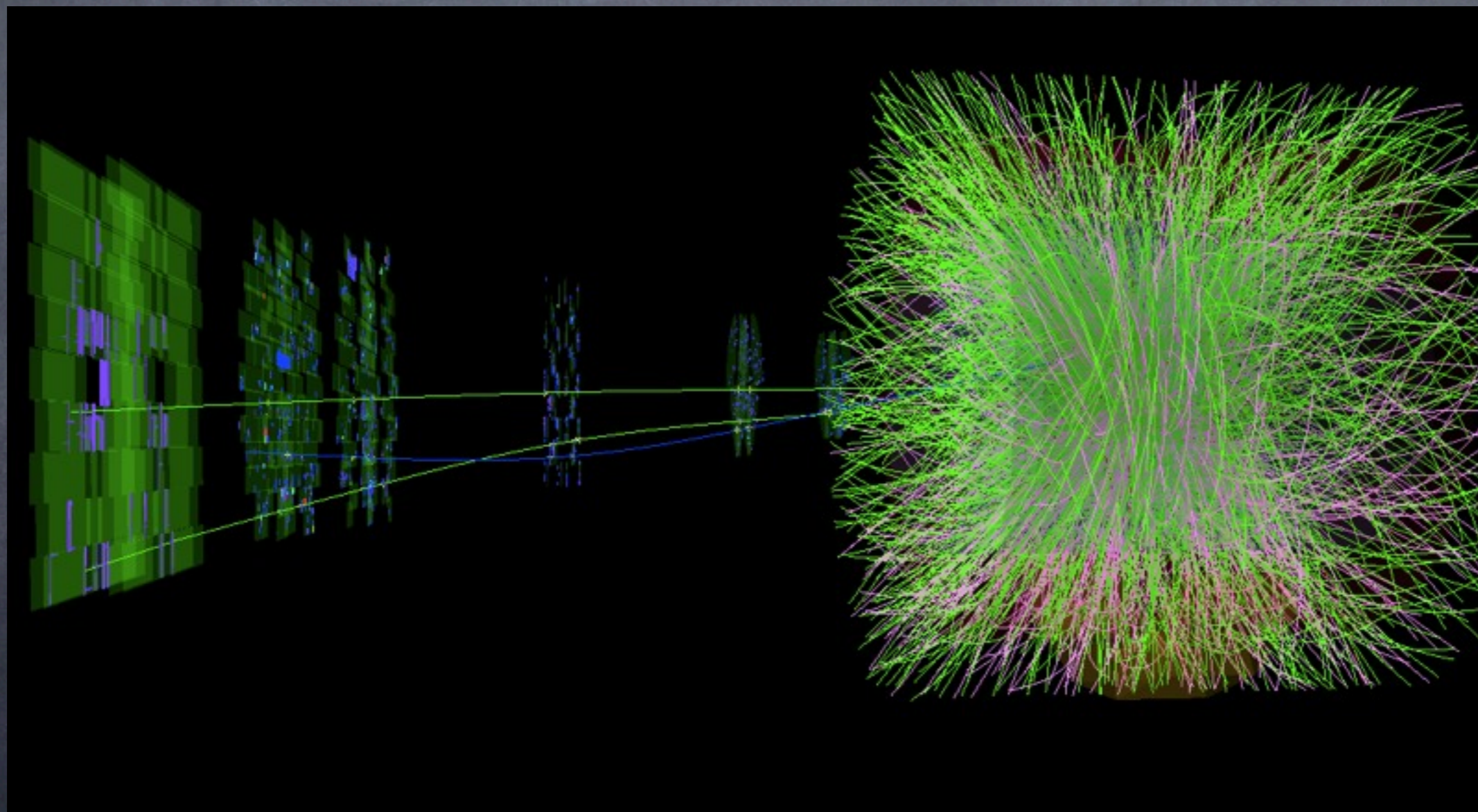
Good agreement between data and FONLL predictions up to 12 GeV/c in all η bins.

Production Cross Section of Muons \leftarrow HF



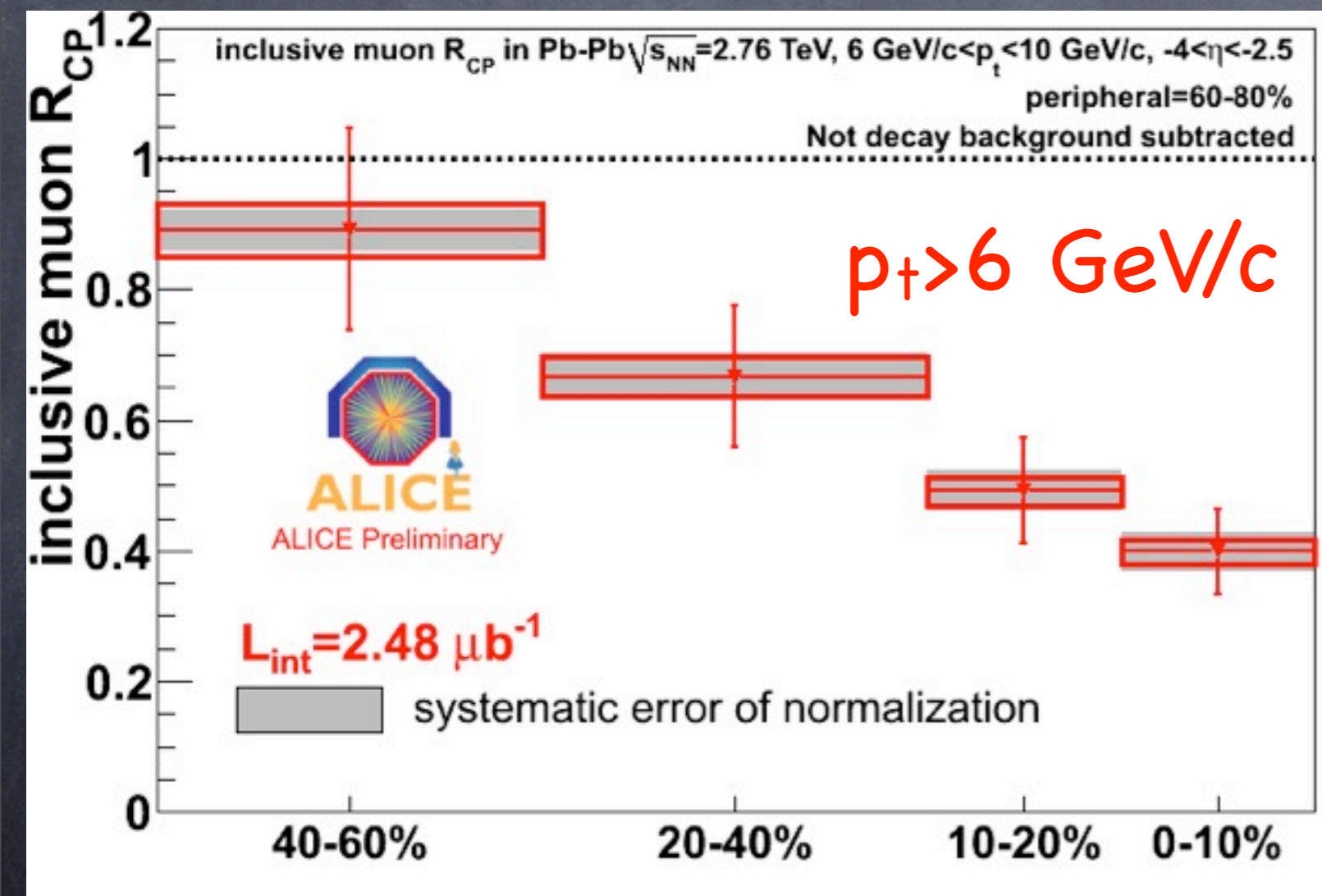
Good agreement between data and FONLL predictions up to 12 GeV/c and versus η .

Measurement of Suppression of Single Muons in Pb–Pb Collisions at 2.76 TeV



Nuclear Modification Factor

$$R_{CP}(p_t) = \frac{\langle 1/T_{AA} \rangle \times \frac{dN^\mu}{dp_t} |_{central}}{\langle 1/T_{AA} \rangle \times \frac{dN^\mu}{dp_t} |_{peripheral}}$$



- suppression increases with centrality;
- publication in preparation (target journal: Phys. Rev. Lett.)

Summary of Activities

- Joint PhD between:
 - CCNU, Wuhan, China & LPC, Clermont-Ferrand, France,
 - grant from France Embassy in Beijing.
- Supervisors:
 - Daicui Zhou (China),
 - Philippe Crochet & Nicole Bastid (France).
- Working in the MUON group of the ALICE Collaboration,
 - since September 2008 (master II),
- PhD defense: 23 May 2012, Wuhan;
- Data analysis completed;
- one paper published, another one in preparation;
- PhD manuscript: ready.

Summary of Activities

• **publications (with direct contribution):**

- Phys. Lett., B708, (2012) 265;
- J. Phys. G: Nucl. Part. Phys., 38, (2011) 124067,
- Indian J. Phys., 85, (2011) 1125,
- Chinese Phys., C34, (2010) 1538,
- International Journal of Modern Physics, E16, (2007) 2123,
- High Energy Phys. & Nucl. Phys., 31 (2007) 43,
- PoS (Bormio 2011) 030,
- ALICE-INT-2010-004,
- ALICE-INT-2011-XXX,
- arXiv:1107.3243.

• **Presentations:**

- ALICE Physics Week, Jyaskla, Finland, Aug 2011,
- Quark Matter, Annecy, France, May 2011,
- LHCC Student Poster Session, CERN, Mar 2011,
- XLIX International Winter Meeting on Nuclear Physics, Bormio, Italy, Jan 2011,
- First ReteQuarntonii Workshop, Nantes, France, Oct 2010,
- Rencontres QGP-France 2010, Etretat, France, Sep 2010,
- ALICE Physics Week, Paris, France, May 2010,
- FCPPL workshops in 2010, 2011 and 2012,
- many talks in ALICE-PWG3(HF) & ALICE-MUON meetings.

• **Member of two paper committees in ALICE:**

- "Heavy flavour decay muon production at forward rapidity in proton-proton collisions at $\sqrt{s}=7$ TeV",
- "Heavy flavour decay muon production at forward rapidity in Pb-Pb collisions at $\sqrt{s_{NN}}=2.76$ TeV"

• **Shifts for the ALICE MUON Spectrometer and for Data Quality Monitoring.**

Conclusion

- ALICE measured single muon production in pp and Pb-Pb collisions in the forward rapidity region at the LHC;
- pp collisions at 7 TeV: good agreement between data and FONLL predictions versus p_T and η ;
- Pb-Pb collisions at 2.76 TeV: suppression observed via R_{CP} . It increases with increasing centrality.

Thanks!