WG simulation - Summary

Antonio, Ivana, Zhenwei, Michael, Frederic, Laure, Barbara,
Andry, Rune, Cynthia, Stéphane, Livio, Roberta, Enrico

- Organisation
- Tasks:
  - Simulation framework
  - Generators in pp, pA, AA
  - Detector design
  - LHCb SMOG and luminosity
  - Transport of 7 TeV beam in H (Pb) target with GEANT4 → See Ivana
+Antonio's talk

Organisation

WG simulation + physics:
- Mailing list (who is interesting in joining the effort?)
- Meeting proposed every 2 weeks (first choice: wednesday 10 am) $\rightarrow$ doodle
- Documentation on after.in2p3.fr
- Deadline: get few figures of merit (need to be carefully defined) by september

Specific to simulations
- Simulation root file on after.in2p3.fr if possible (?)
- cern svn:
  - AFTER software [will be] on http://svnweb.cern.ch/world/wsvn/aftersoft
  - README files or comments needed (aim of the code, instructions how to run the code, compilation on a specific platform, ...)
  - Simple test macros to be provided in order to compile/test the each part of code
  - Compile the code with SL6 as an ultimate test before committing

AFTER software on svnweb.cern.ch

aftersoft - Révision 2
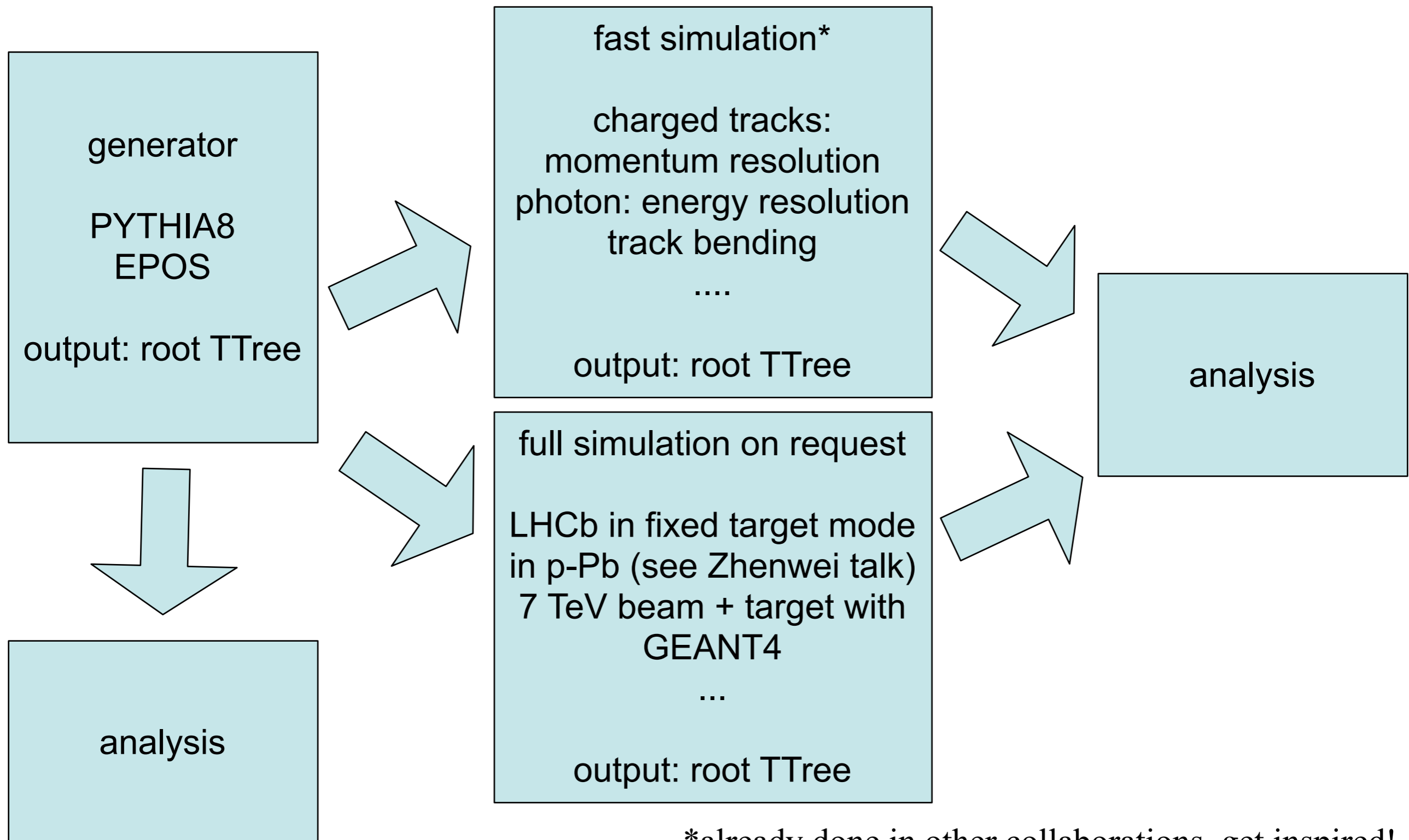
(root)/v1/src/FULLSIMU/

Information sur la Révision	
Dernière modification:	Révision 2 - cynthia - 2014-01-17 11:47:59
Message du journal:	structure

Dernière modification - Afficher le Journal - Télécharger - RSS

Chemin
☐ 📁 v1/
☐ 📁 src/
☐ 📁 ANALYSIS/
☐ 📁 EPOS/
☐ 📁 FASTSIMU/
☐ 📁 FULLSIMU/
☐ 📁 TARGET/
☐ 📁 PYTHIA8/

Comparer les dossiers

Simulation framework

generator

PYTHIA8
EPOS

output: root TTree

fast simulation*

charged tracks:
momentum resolution
photon: energy resolution
track bending
....

output: root TTree

full simulation on request

LHCb in fixed target mode
in p-Pb (see Zhenwei talk)
7 TeV beam + target with
GEANT4
...

output: root TTree

analysis

analysis

*already done in other collaborations, get inspired!

Generators: PYTHIA8, EPOS

PYTHIA8 (Laure, Andry, Barbara)
- Min. Bias pp collisions
- Signal events: $J/\psi \rightarrow \mu^+\mu^-$, $\Upsilon \rightarrow \mu^+\mu^-$, $\chi_c \rightarrow J/\psi \gamma \rightarrow \mu^+\mu^- \gamma$
- Still using dummy PYTHIA pdfs $\rightarrow$ try CTEQ10 pdfs
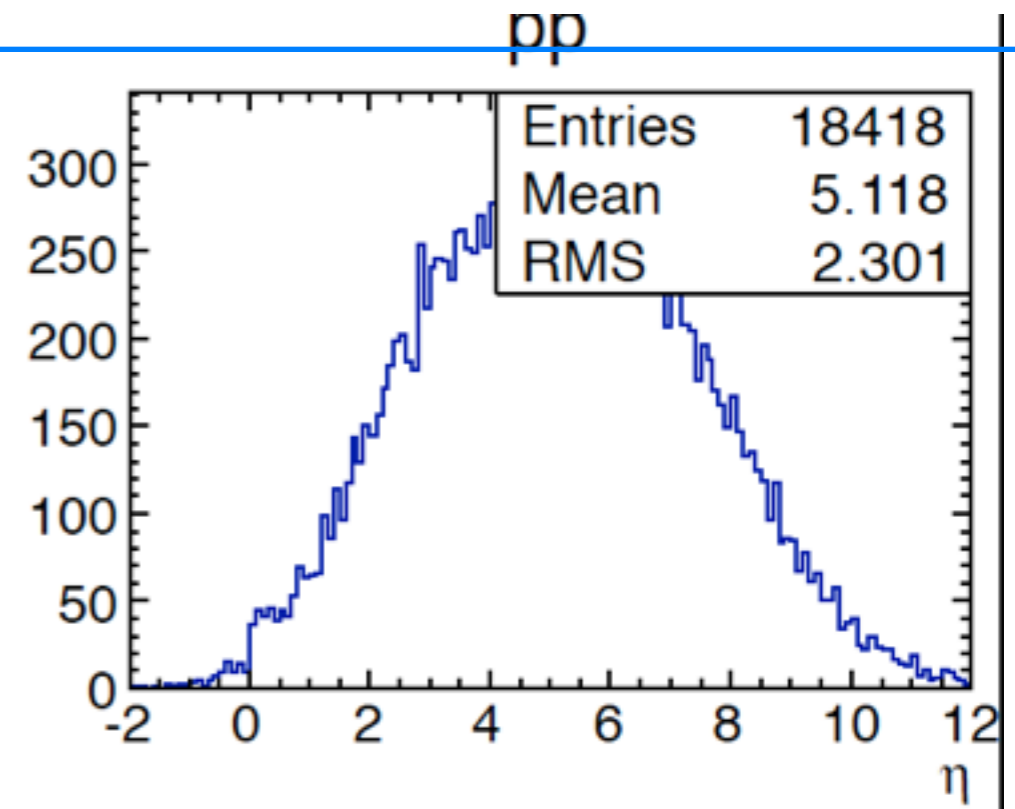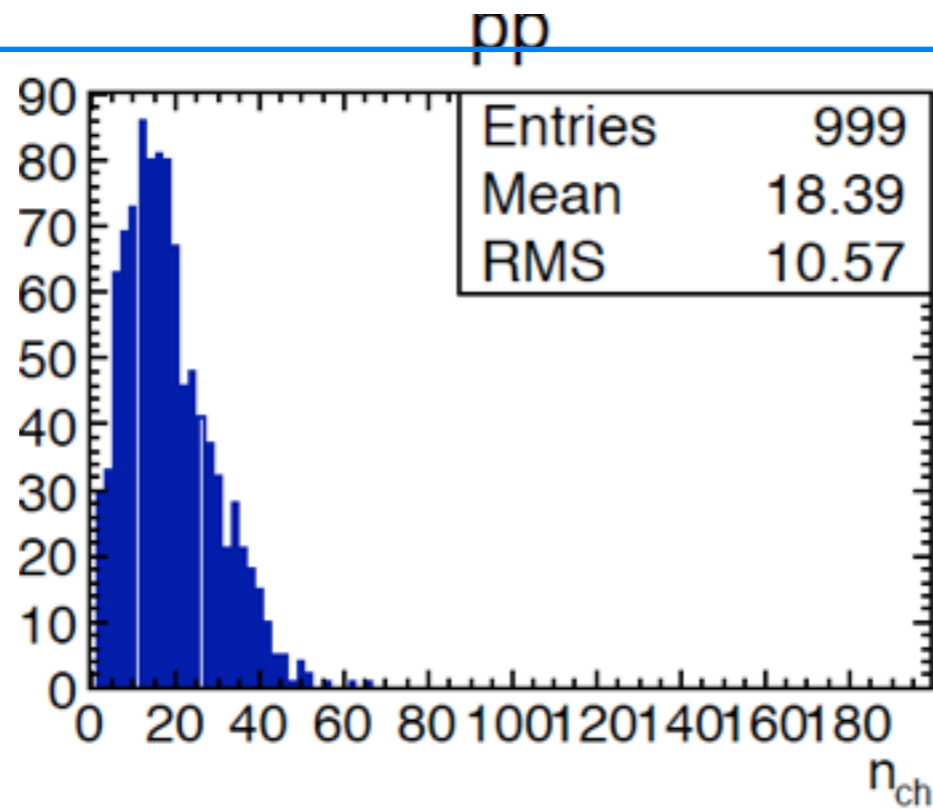
EPOS (Frederic, Zhenwei, Michael)
- Min. Bias pp, pA, AA (note: J/ψ not generated)
- Multiplicity studies
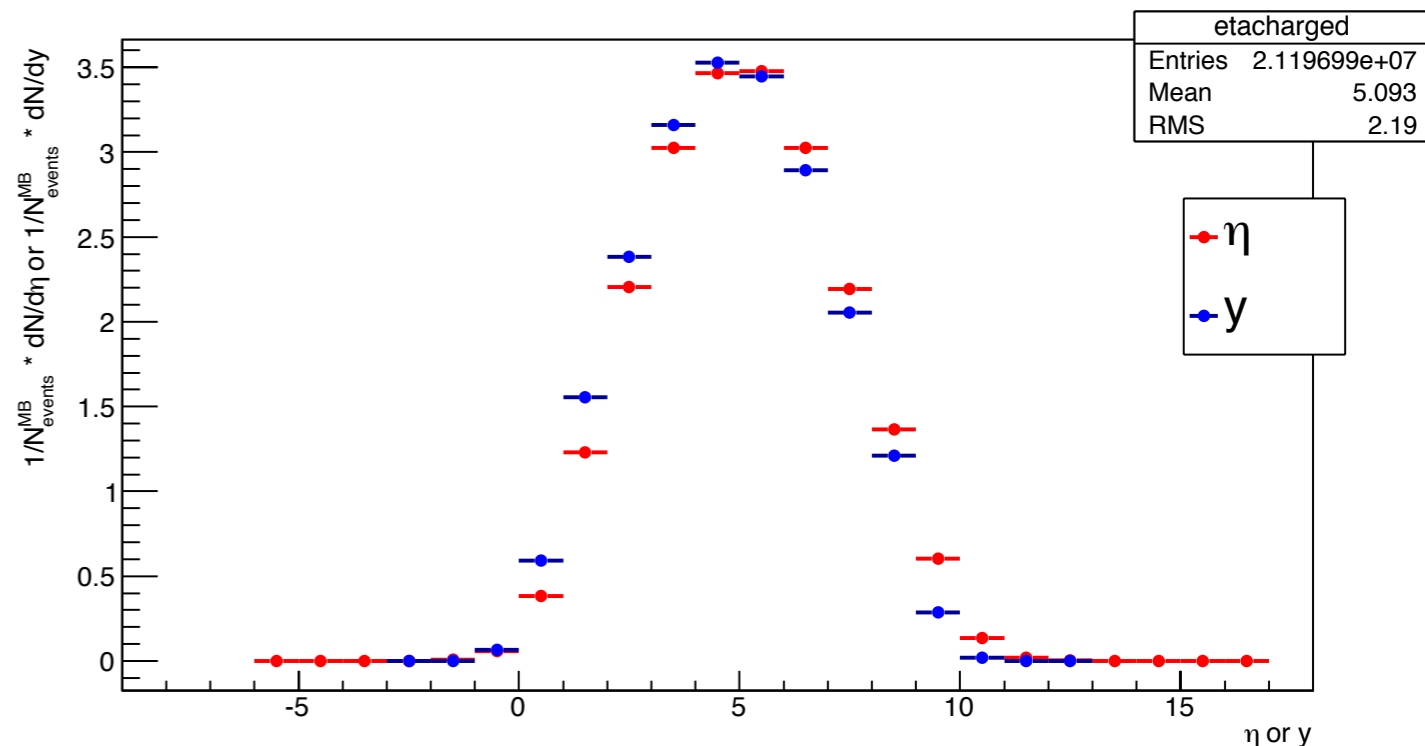
Same format for the output of PYTHIA8 and EPOS

First outputs: EPOS vs pythia in pp
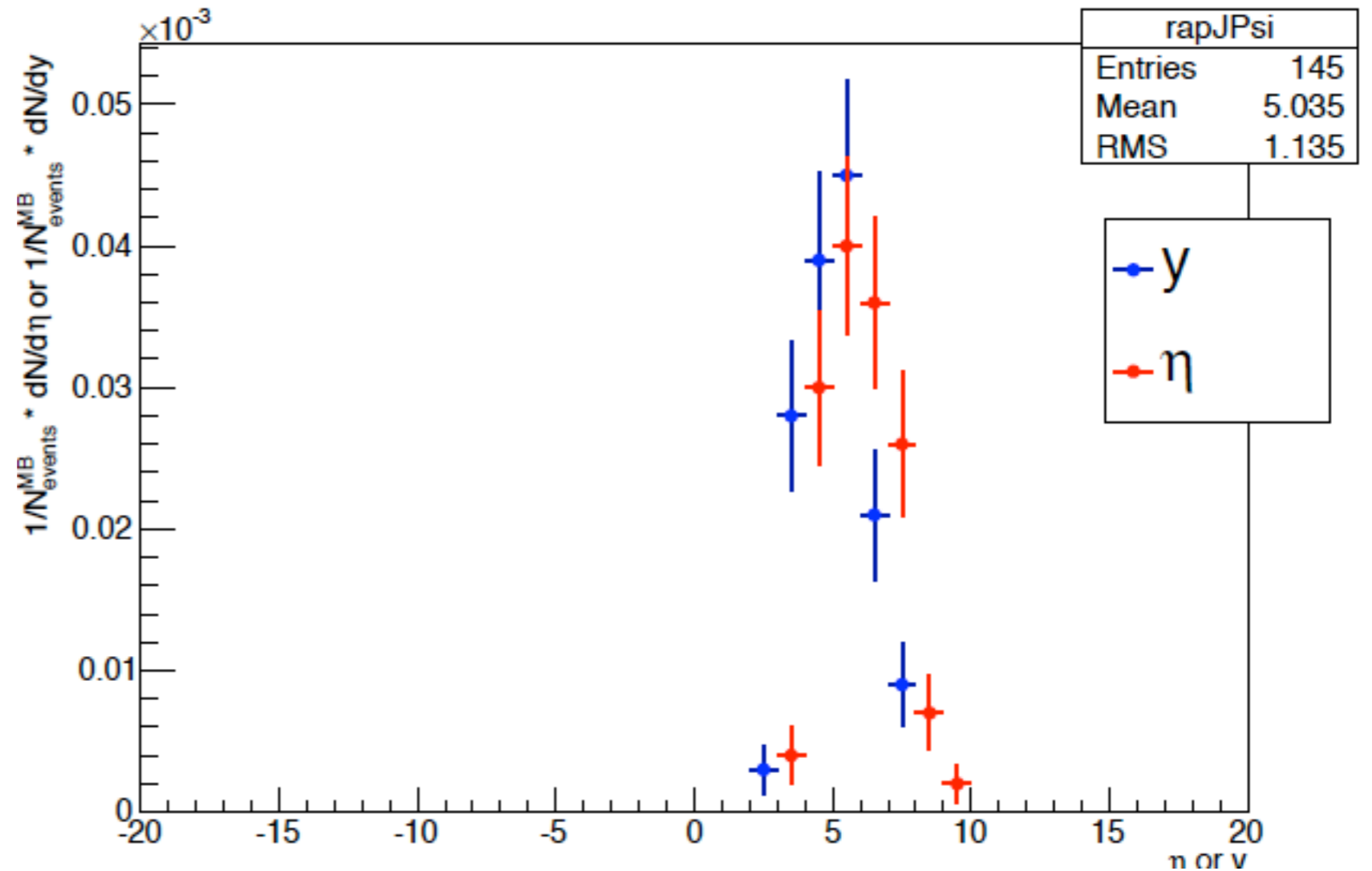

EPOS 1.6.5
Nevents = 1k
$dNch/d\eta|_{\eta=0} \sim 3$

PYTHIA8.170
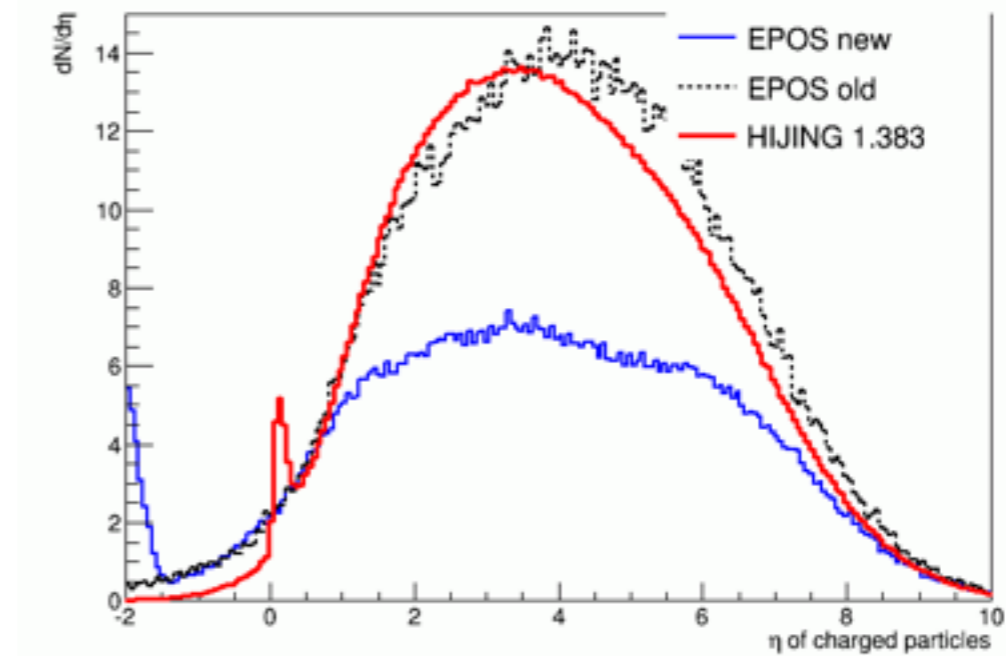Nevents = 1M
$dNch/d\eta|_{\eta=0} \sim 3.5$

First outputs: J/ψ
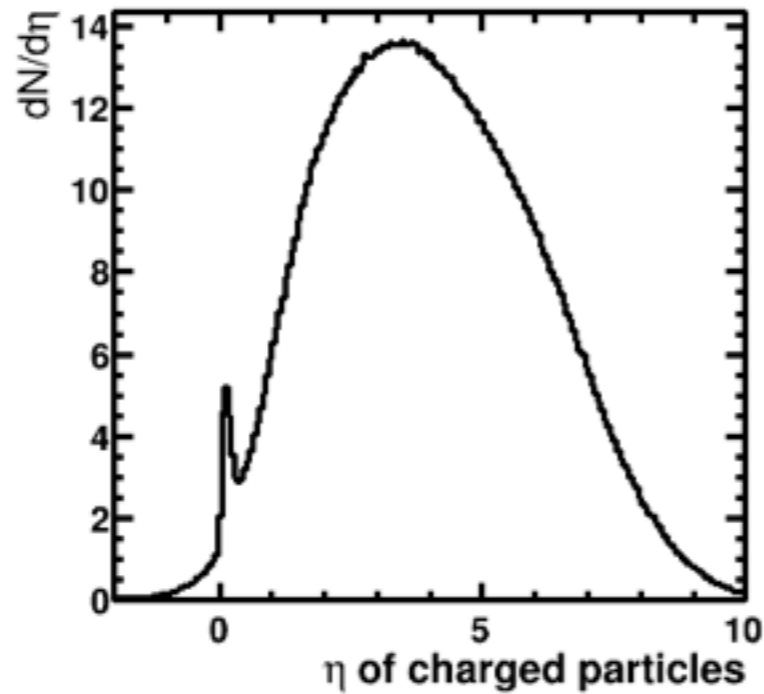
PYTHIA8.170
Nevents = 1M
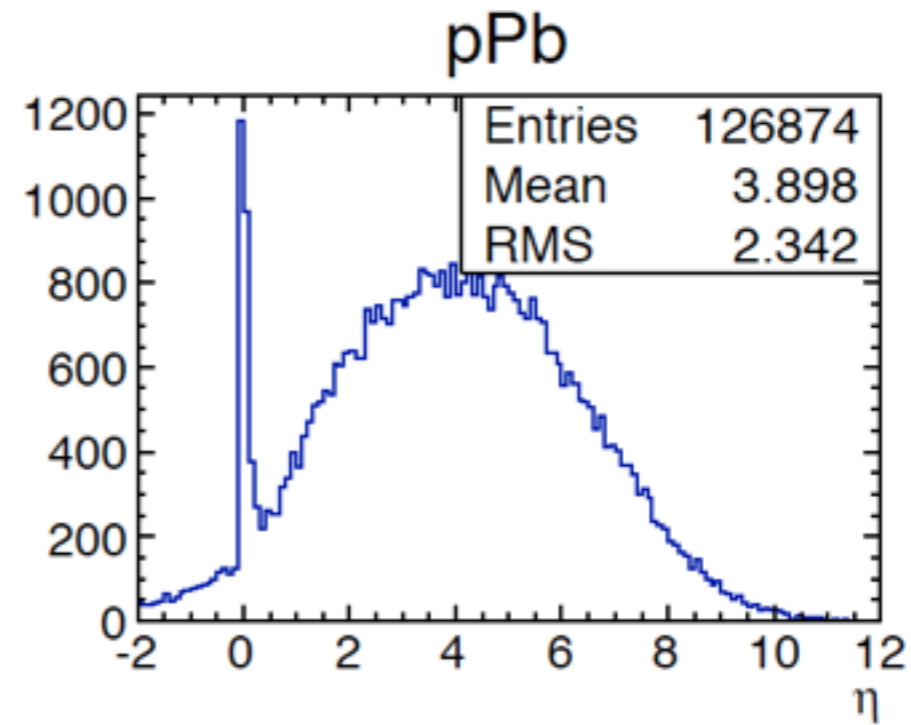$dNch/d\eta|_{\eta=0} \sim 3.5$
10^{-4} J/ψ per event
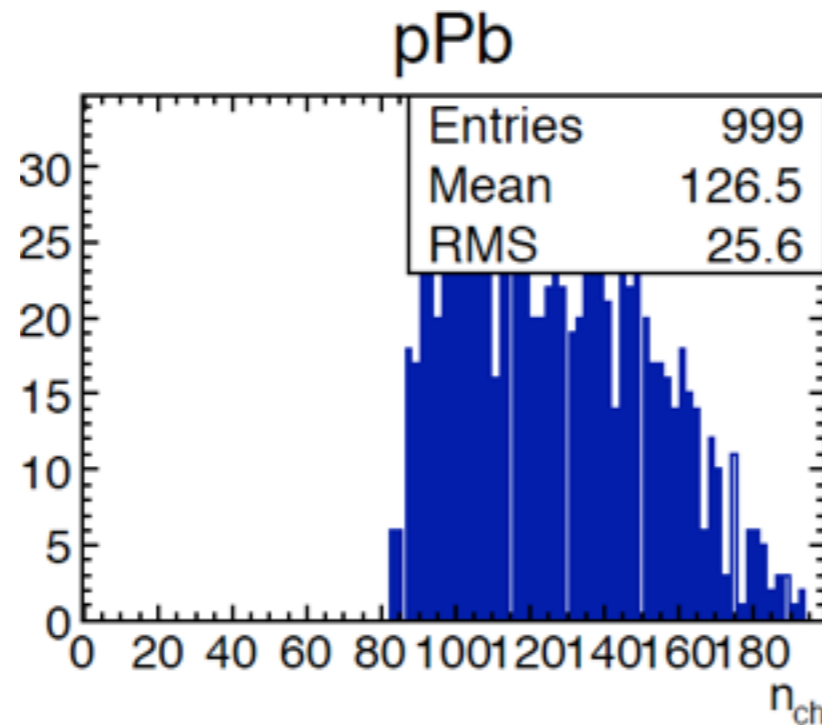
First outputs: Hijing vs EPOS in pA

Hijing 1.383bs.2

Nevents = 10k
$dNch/d\eta|_{\eta=0} \sim 14$

EPOS 1.6.5
Nevents = 1k
$dNch/d\eta|_{\eta=0} \sim 8$

Detector design

Performance requested
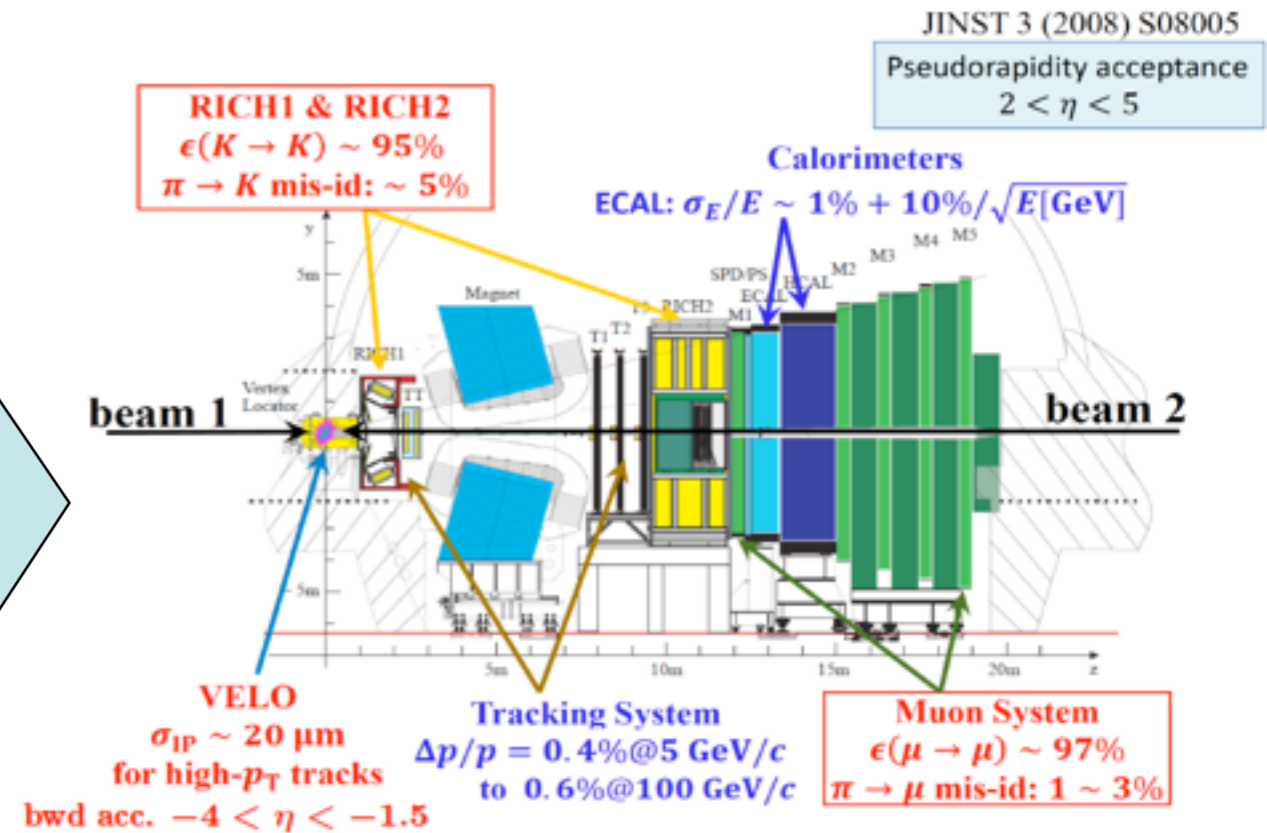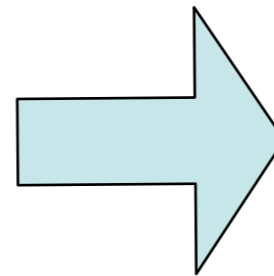
charged tracks: momentum resolution
$\Delta p/p = 1\%$
track bending
$B = 2$ Tesla
photon: energy resolution
$\Delta E / E = 20 \% / \sqrt{E}$

....

JINST 3 (2008) S08005

Pseudorapidity acceptance
$2 < \eta < 5$

RICH1 & RICH2
$\epsilon(K \to K) \sim 95\%$
$\pi \to K$ mis-id: $\sim 5\%$

Calorimeters
ECAL: $\sigma_E/E \sim 1\% + 10\%/\sqrt{E[\text{GeV}]}$

beam 1

beam 2

VELO
$\sigma_{IP} \sim 20\ \mu m$
for high-p_T tracks
bwd acc. $-4 < \eta < -1.5$

Tracking System
$\Delta p/p = 0.4\%@5$ GeV/c
to $0.6\%@100$ GeV/c

Muon System
$\epsilon(\mu \to \mu) \sim 97\%$
$\pi \to \mu$ mis-id: $1 \sim 3\%$

LHCb-like ?
Larger in acceptance ?
....

?

Luminosity estimation with SMOG at LHCb

pp inelastic cross-sections
σ_{inel} ($\sqrt{s}$ = 70 GeV) = 30 mb
σ_{inel} ($\sqrt{s}$ = 115 GeV) = 40 mb

A-B inelastic cross-sections
$\sigma_{inelA-B}$ = σ_{inel} * $(A^{1/3} + B^{1/3})^2$
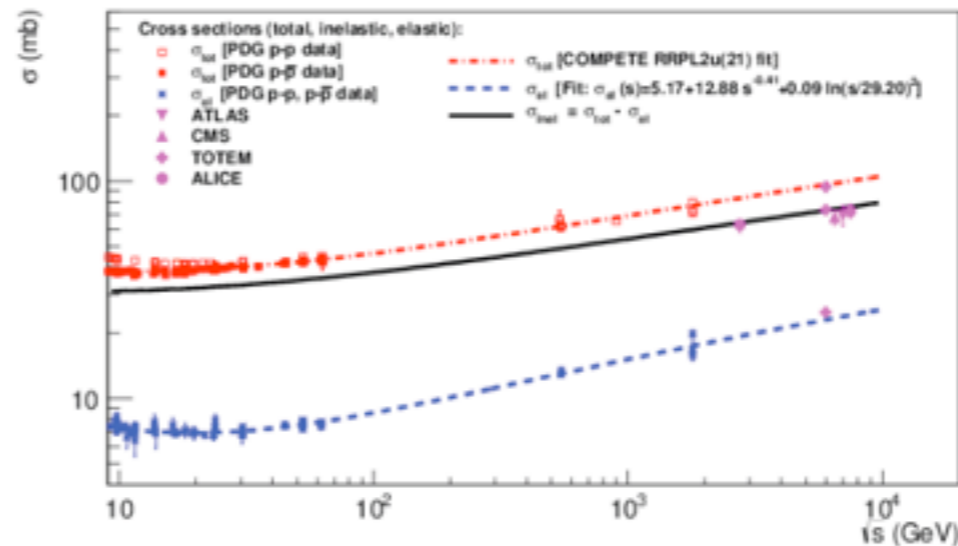
2012 pilot run p-Ne at $\sqrt{s}$ = 87 GeV
δt = 9600 s
N_{MB} = 300 kMB
bunches = 7
σ_{vis} = σ_{inel} = 40 mb

$\Rightarrow$ nominal LHC $\mathscr{L}$ = 0.04/μb/s
[AFTER on p-Be(Cu) $\mathscr{L}$ = 62(42)/μb/s]

2013 run Pb-Ne at $\sqrt{s}$ = 54 GeV
δt = 600 s
N_{MB} = 89 kMB
σ_{vis} = σ_{inel} = 30 mb

$\Rightarrow$ $\mathscr{L}$ = 0.06/mb/s
[AFTER on Pb-Be(Cu) $\mathscr{L}$ = 25(17)/mb/s]

Instantaneous luminosity higher in AFTER by 2-3 order of magnitude
Is it possible to:
  - increase the gas density?
  - run the SMOG with higher atomic mass number gas (rare gas only)?
  - run more than 3 hours [1 month] with LHCb in fixed target mode and proton nominal LHC beam?
....experts to be contacted...

Outlooks

Many tools developped for fast simulation on AFTER, analysis can/already start ;-)
- target size and multiple scattering
- vertex detector and resolution
- magnetic field
- trigger
- normalization
- ...

Instantaneous luminosity with LHCb in a fixed target mode: 2-3 order of magnitude lower than expectations in AFTER in p-Ne and Pb-Ne: SMOG experts to be contacted