Some First Artemis Standard Model Measurements

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What we will do with the first data at $\sqrt{s}$=14 TeV

Detector performance calibration and alignment

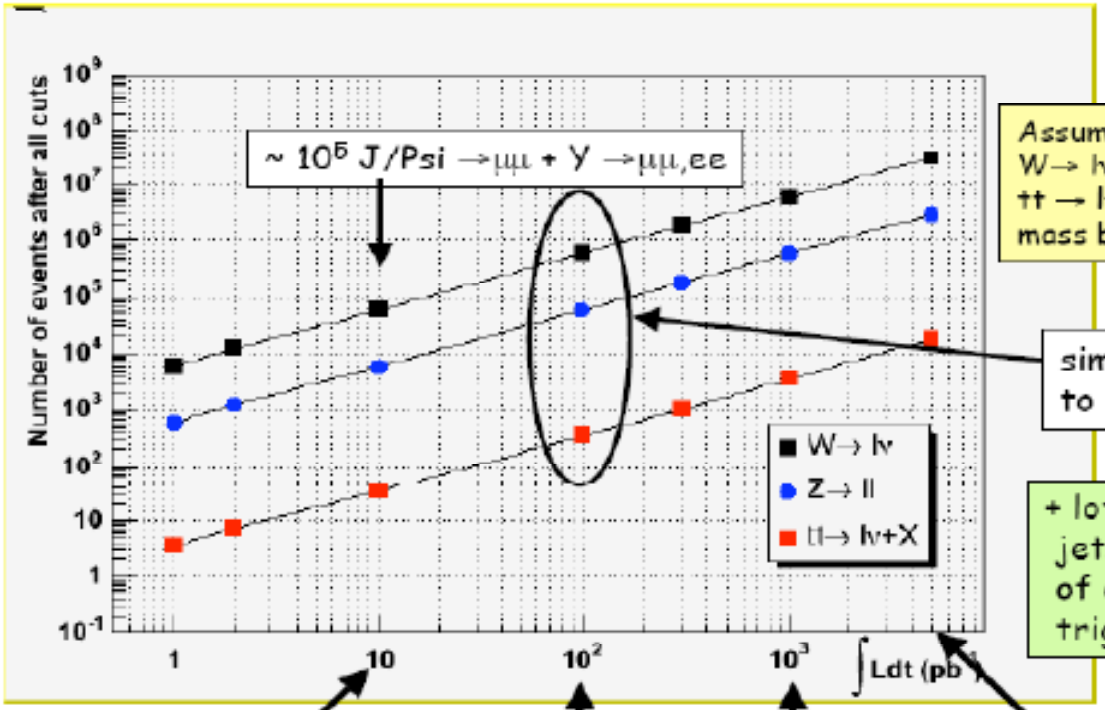
- Common strategy to all sub-systems
- Use of Z,W,top for most of the studies
- Fortunately LHC is a Z,W,top factory !

- For calorimeter calibration
  - J/ψ ->e^+e^- and Z->e^+e^- for electromagnetic calorimeter
  - Z->l+l- γ mass constraint to set γ energy scale
  - W->jj from Top and Z/γ + 1 jet events Jet Energy Scale
  - Z→νν、W→lν Missing ET calibration
- For momentum calibration
  - J/ψ -> $\mu^+\mu^-$ and Z->$\mu^+\mu^-$ - for Muon momentum
- To Determine E/P matching
  - Isolated tracks (W->lν, **t** decay)
- b-jet tagging efficiency
  - tt events

Precision we expect to have in the beginning		Desired precision
Inner tracking alignment 20-200 μm		10 μm
e/m calo Uniformity ~1% e/γ scale ~1-2 %	→	7‰(unif) 1‰ (scale)
Jet Energy Scale ~10%		1 %

Number of events at the first 10-100 pb^{-1} of LHC

How many events per experiment at the beginning ?



l = e or μ

Assumed selection efficiency:
W→ lν, Z→ ll : 20%
tt → lν+X : 1.5% (no b-tag, inside mass bin)

similar statistics to CDF, D0 today

+ lots of minimum-bias and jets (10^7 events in 2 weeks of data taking if 20% of trigger bandwidth allocated)

10 pb^{-1} = 1 month at 10^{30} and < 2 weeks at 10^{31}, ε=50%

100 pb^{-1} = few days at 10^{32}, ε=50%

1 fb^{-1} = 6 month at 10^{32}, ε=50%

5 fb^{-1} = 3 month at 10^{32} and 3 month at 10^{33}, ε=50%

Muon Spectrometer Performance

- Quantities measuring the spectrometer performance
  - Momentum resolution.
  - Track-reconstruction efficiency.
- Quantities deteriorating the performance
  - Chamber inefficiencies.
  - Miscalibration of the MDT chambers.
  - Misalignment of the MDT chambers.
  - Errors of the magnetic-field map.

Measurement of Efficiencies in Data

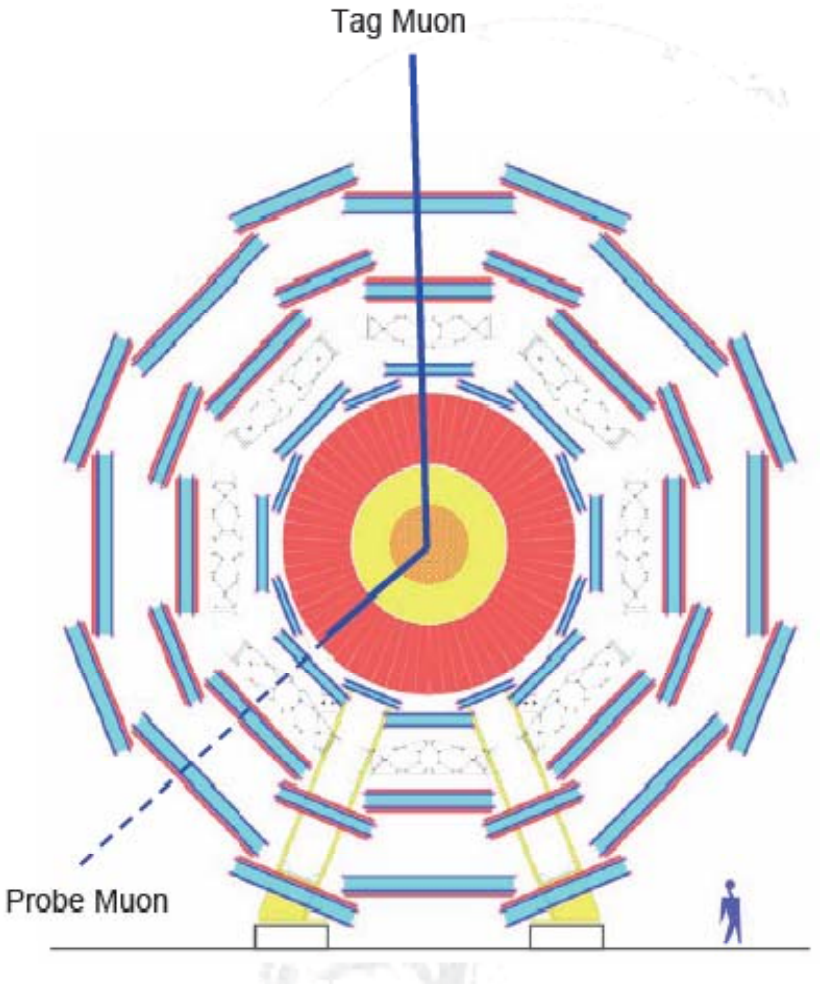
N. Benekos, M. Schott, A. Wilson

Tag and Probe Method to determine Efficiencies in Data

- Tag Muon: Track in Inner Detector AND Muon Spectrometer (+Isolation and pT-Cuts)

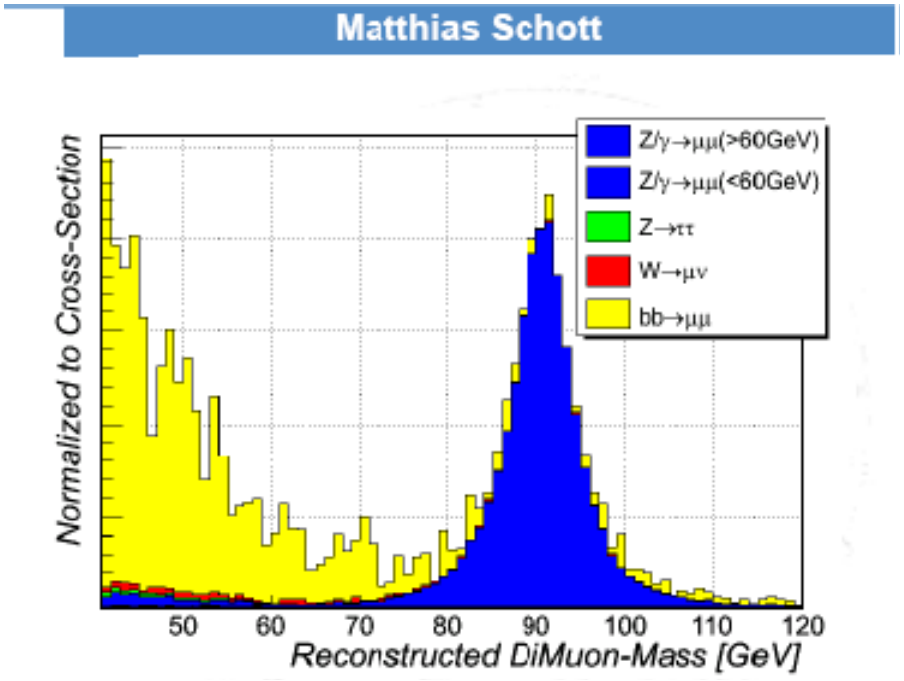
- Probe Muon: Track in Inner Detector (+Isolation and pT-Cuts)

- If this di-muon mass is 91GeV ±15Gev and $\Delta\varphi>2$, then the probe muon is assumed to be a real muon:
  - muon efficiency is given by the fraction of probe muons with tracks in the Muon Spectrometer



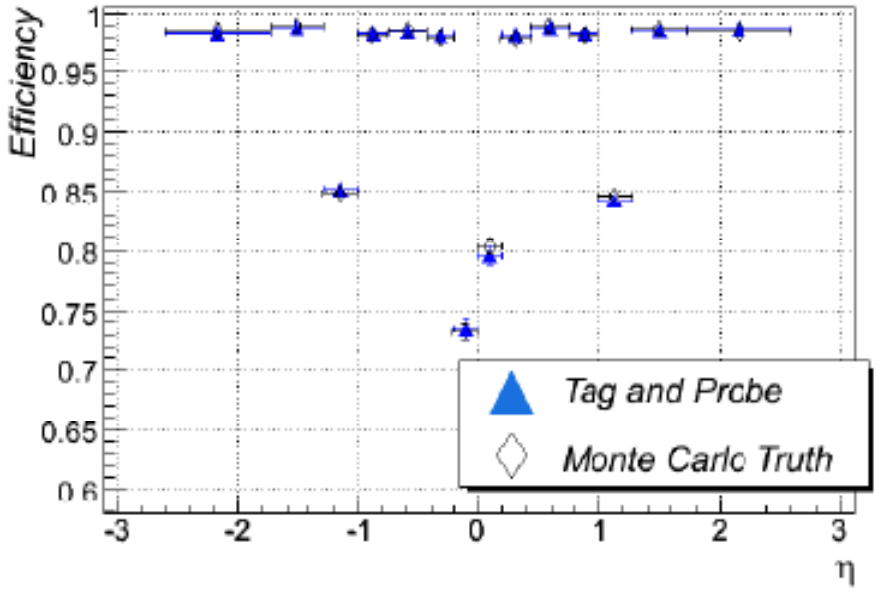
Z→μμ Signal Selection

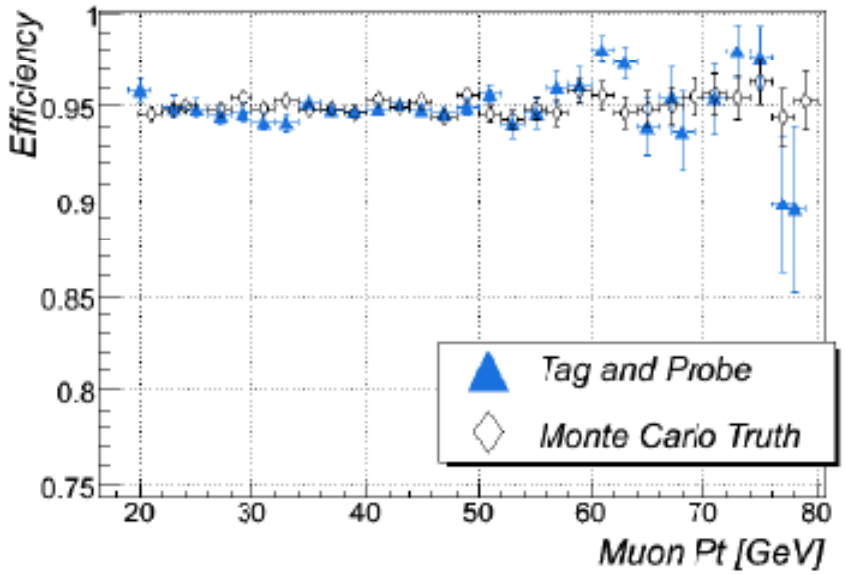
- Main Backgrounds
  - QCD: dominated by the decay of bb→μμ
  - W→μν+jets
  - Z→τ τ→μμ
- Selection cuts
  - Track PT > 20 GeV
  - Number of Tracks in Halo < 5
  - Jet ET in Cone with Radius 0.5 < 15 GeV
  - Track Isolation < 5 GeV
  - DiMuonMass:91GeV±15GeV
  - Δφ>2



Efficiencies from Data

Matthias Schott





Statistical Error on the muon reconstruction efficiency

∫ Luminosity [pb^{-1}]	5	10	20	30	40	50
$\Delta\epsilon_{ID}$	0.28%	0.21%	0.15%	0.12%	0.105%	0.095%

- The background contribution is significant, even for small integrated luminosities

Determination of the pT-Resolution with data

- Idea: Use (again) the Z-Boson Resonance.

- Try to smear the pT of Monte-Carlo generated muons in such a way, that they will **reproduce the measured Z-Boson distribution**.

- The smearing function can be taken from full simulation

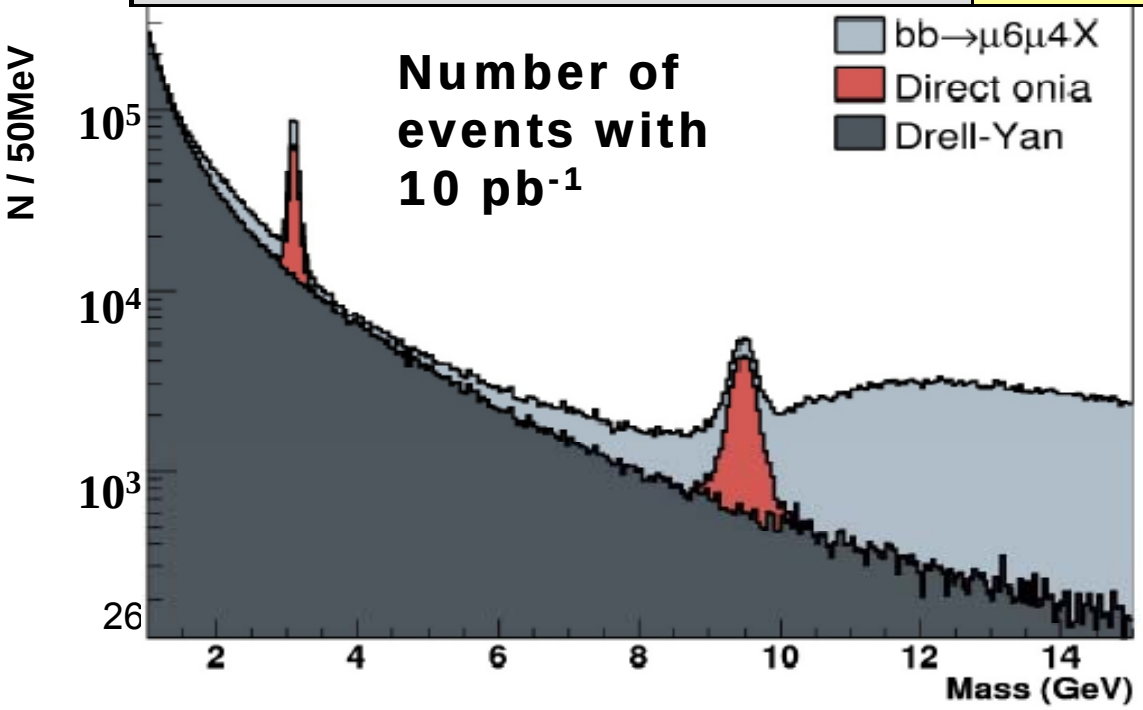
Muon Isolation Efficiency

- Use Tag and Probe Method to determine Muon Isolation Efficiency
- Tag Muon:
  - pT>15-20GeV
  - Isolated
- Probe Muon:
  - pT>15-20GeV
  - Together with Tag Muon gives
  - $\Delta\varphi>2$
  - $|91\text{GeV}-M_{\mu\mu}|<30$

Test if probe muon is Isolated

From B-physics Working group: J/psi's, Ypsilon expected with first 10 pb^{-1}

	Events 10 pb-1 including trig and offline efficiency
$pp \rightarrow J/\psi\ (\mu 6\,\mu 4)\,X$	156 000
$bb \rightarrow J/\psi\ (\mu 6\,\mu 4)\,X$	78 000
$pp \rightarrow \Upsilon\ (\mu 6 \mu 4)$	31 000
$B^+ \rightarrow J/\psi\, K^+$	1 600
$B^0 \rightarrow J/\psi\, K^{*}(K^+\pi^-)$	900



Results shown use mu6mu4 triggers

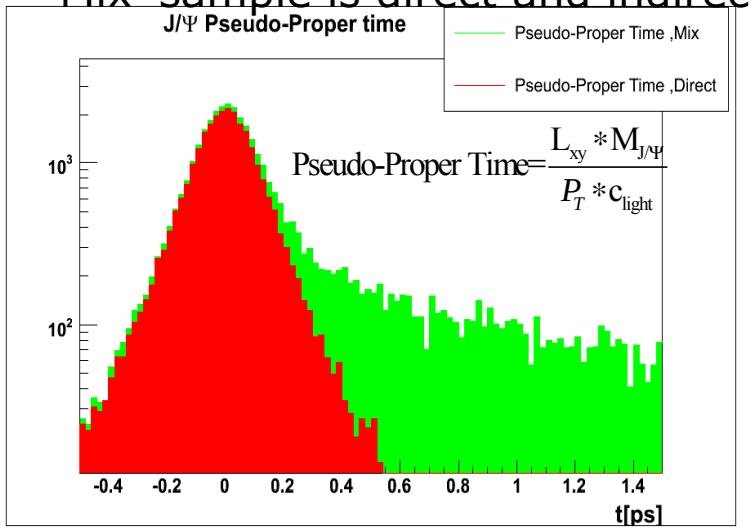
At $10^{31}\ cm^{-2}\ s^{-1}$ we may have more events with mu4mu4 triggers, but simulations not ready yet, so we show mu6mu4 here.

From B-physics Working group: J/psi's, Ypsilon with first 10 pb^{-1}

One of first physics measurements may be the ratio of direct J/ψ to B →J/ψ and direct J/ψ to ϒ

- Proper time use to measure ratio J/ψ direct/indirect (B-decays)
- **Free from uncertainties in luminosity and trigger efficiencies…**
- **However needs validation of ID alignment to enable good vertexing**

'Mix' sample is direct and indirect J/ψ combined

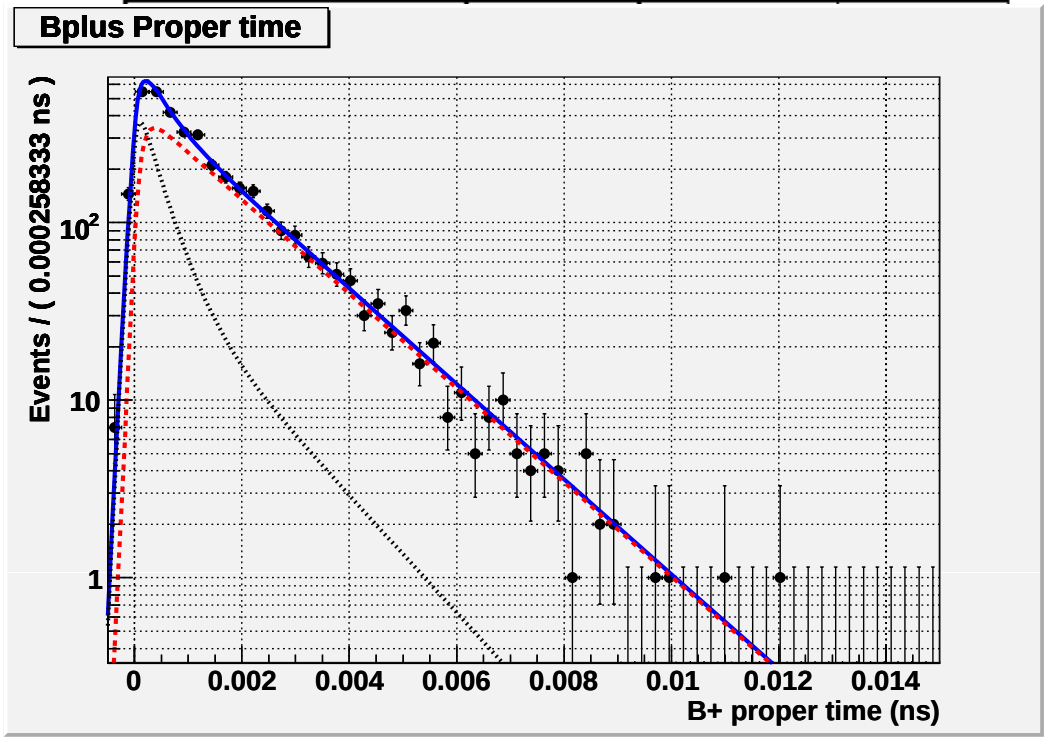


From B-physics Working group:

Reference channel $B^+ \rightarrow J/\psi K^+$ to be used as ID alignment tester already with 10 pb^{-1}

Petridou,. *Anastopoulos*

	$10pb^{-1}$	$100pb^{-1}$	$1fb^{-1}$
$B^+ \rightarrow J/\psi K^+$	1598.5	15985	159850



B+ proper lifetime fit red B+ signal, black background, blue all

- B mass - lifetime fit – sensitive tests of detector alignments
- No vertex displacement cuts (especially online) until ID alignments understood and validated.

Lifetime Fit Results	
Signal lifetime τ ps	1.637±0.036
Bkg1 lifetime τ_1 ps	1.320±0.24
Bkg2 lifetime τ_2 ps	0.370±0.067

(2.2%)

Table 11: Lifetime fit results based on a luminosity of $13.2pb^{-1}$

World precision today (0.67%)

First Artemis SM Measurement

- **For the Muon Spectrometer, we will be able to evaluate the:**
  - Muon reconstruction efficiency
  - Muon isolation efficiency
  - Precision of Muon pT-Resolution
  - Muon performance for low pT muon from Jpsi and Υ
- **For the Inner Detector, we can study the ID alignment using :**
  - B+ proper lifetime measurement