Preparazione per il run 2017: EGamma POG

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15 Dicembre 2016

CMS Italia - Spoleto

Disclaimer: i risultati mostrati oggi sono tutti preliminari. Not yet approved !

The EGM group

(leaving)
(new)

- **L2**: M. Sani (left in 2016), F. Couderc, R. Paramatti
- **L3 EGM ID**: I. Kravchenko (leaving at the end of 2016), R.S. Lu, L. Soffi
- **L3 EGM Reco/Commissioning**: G. Zevi della Porta (leaving at the end of 2016), R. Lopes de Sa, S. Jain
- **L3 EGM Trigger**: A. Anuar (leaving at the end of 2016), G. Pasztor.
- **MC contact**: M. Weinberg, F. Rezaei
- Calls are still open for:
  - L3 Trigger Convener
  - Electron data certification expert
  - Higgs contact (electrons)

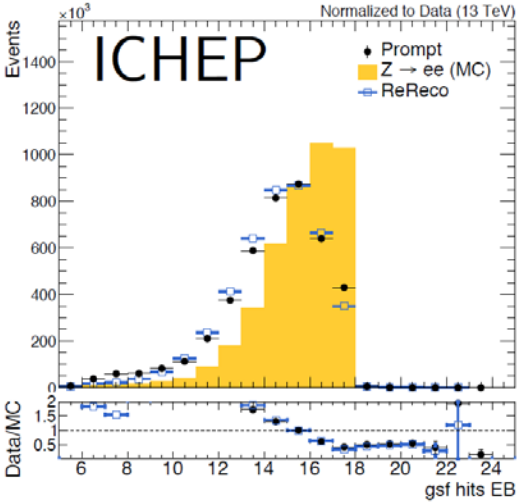
Data collected in 2016

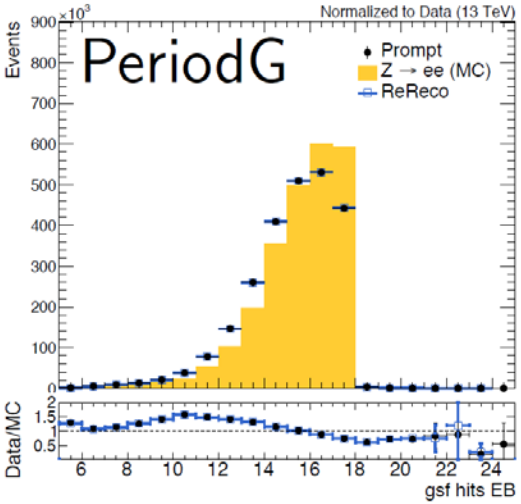
Main issues in 2016 data-taking:

- Strip dynamic inefficiency
  - affecting GSF track parameters in RunB-F
  - mitigation in rereco does not help too much
- Transparency loss in the Endcaps
  - higher single channel noise w.r.t. to simulation
  - more energy in the isolation cone
    - mainly affecting photon ID → tuned for Moriond17 to avoid efficiency loss.
  - special MC samples with ECAL EOY conditions requested to further investigate
    - thanks to ECAL DPG for quickly providing the tags
    - use case for run dependent MC

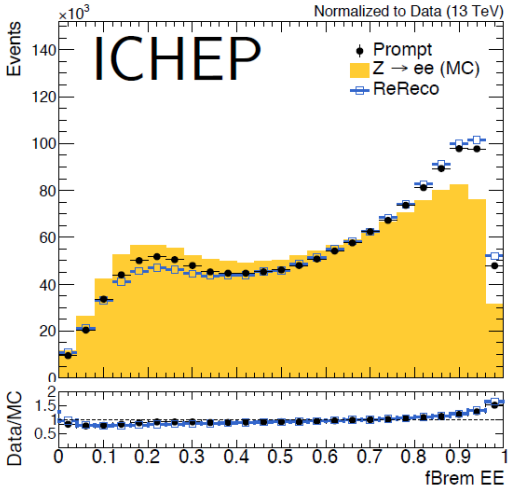
GSF-related variables:
improved in G-H, no effect on rereco

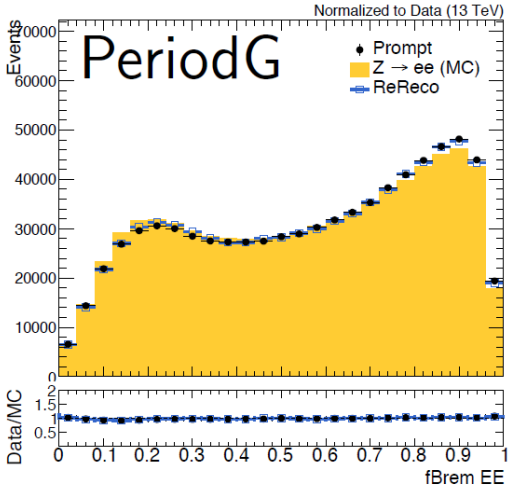
GSF Hits (EB)





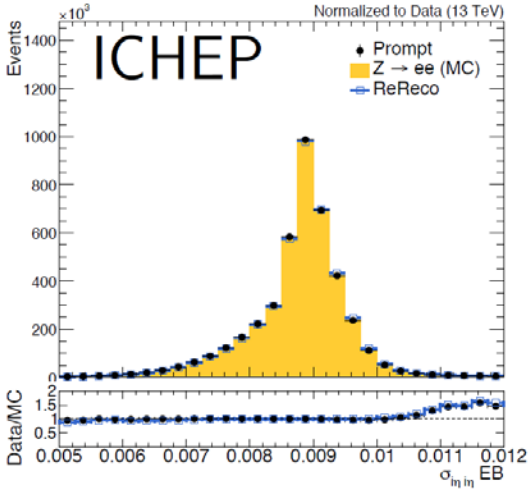
Bremsstrahlung Fraction (EE)



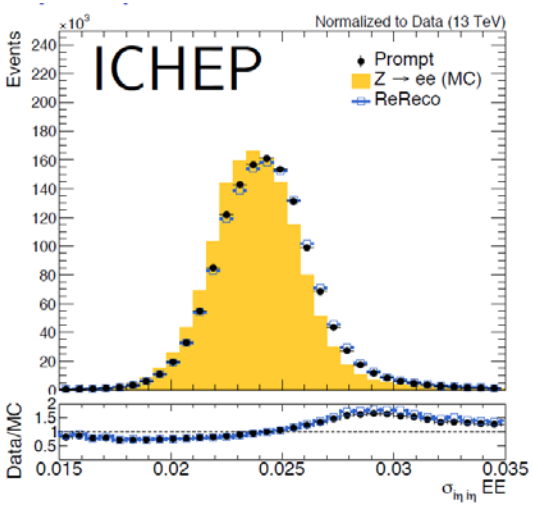


Cluster shape: perfect in EB, growing disagreement in EE

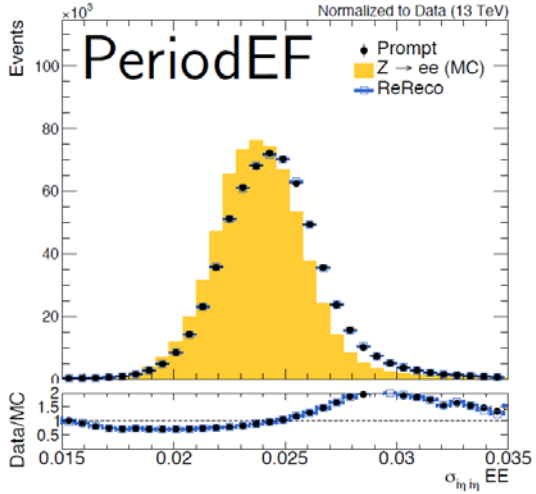
$\sigma_{i\eta i\eta}$ (EB)

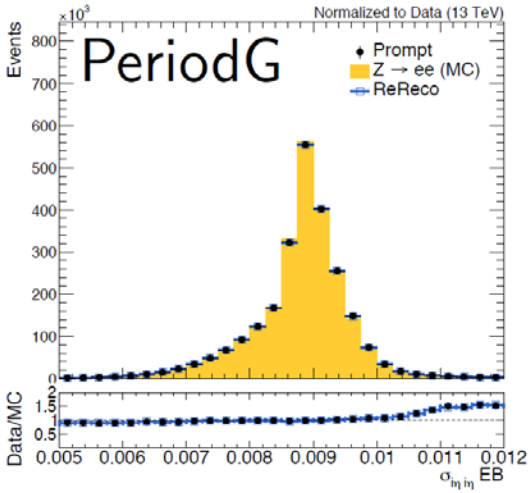


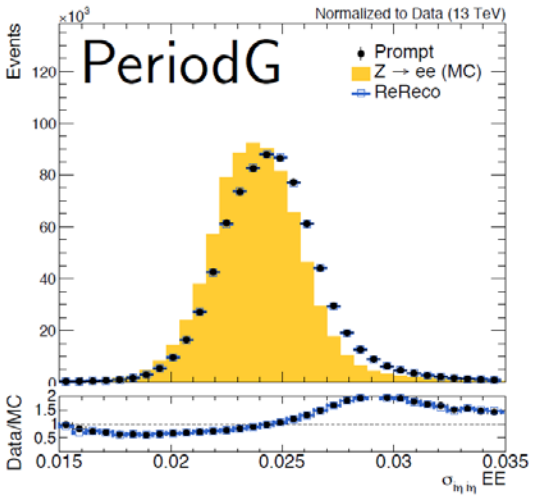
$\sigma_{i\eta i\eta}$ (EE)

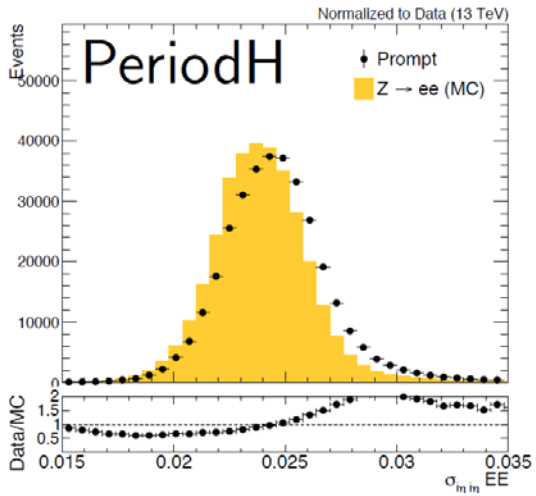


$\sigma_{i\eta i\eta}$ (EE)



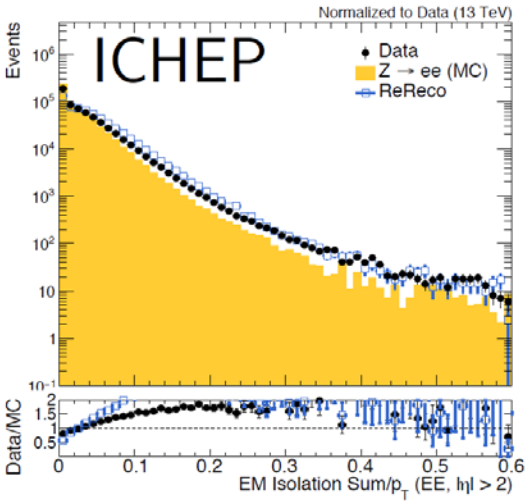


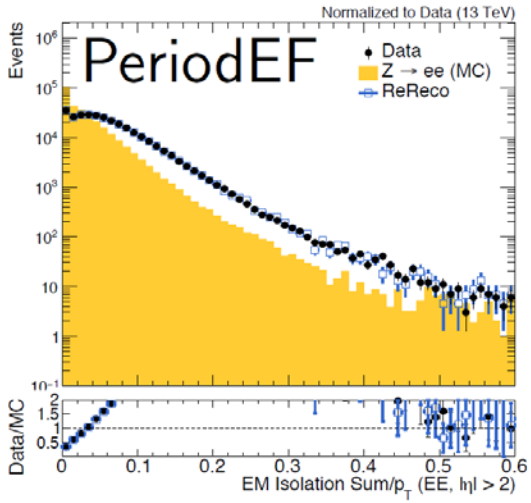


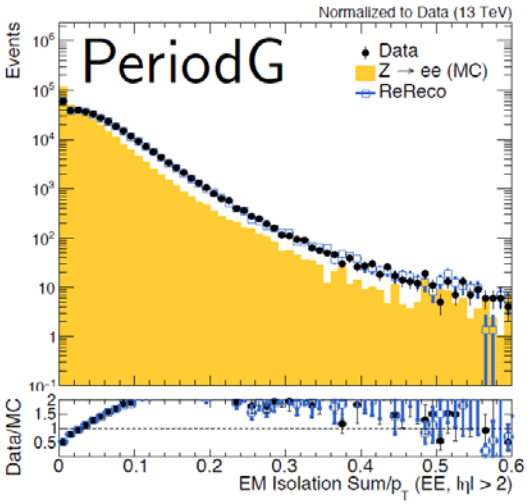


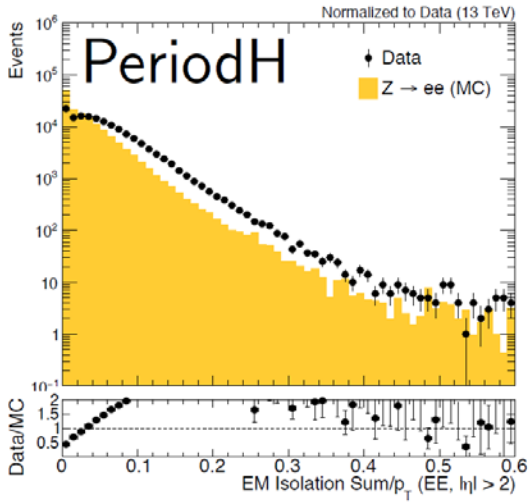
PF EM Isolation affected by higher noise in crystals

Rel. EM Isolation (EE, $|\eta| > 2.0$)







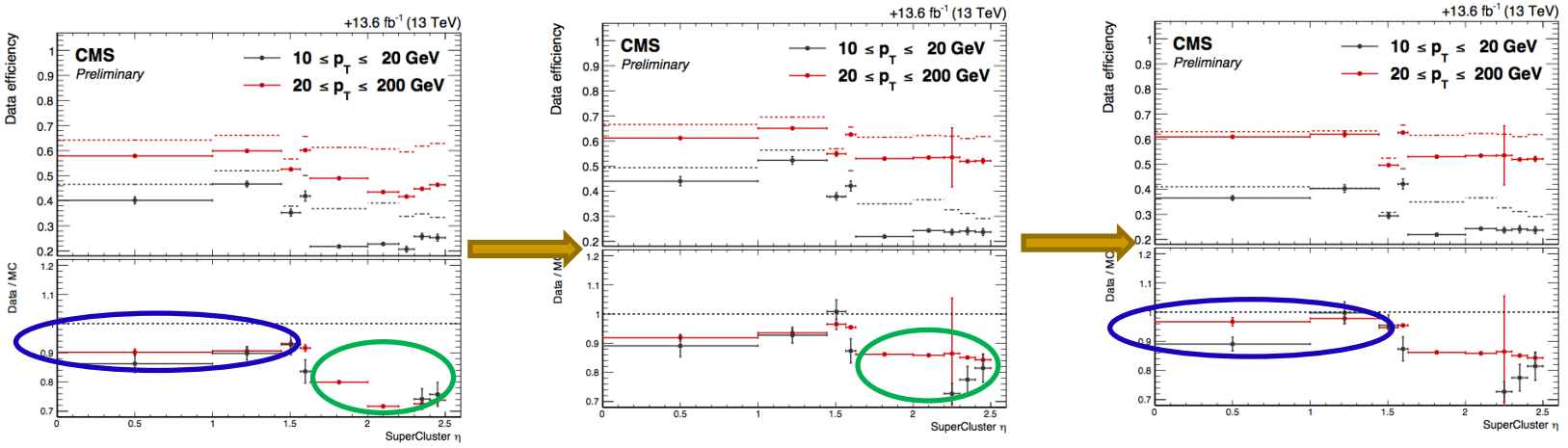


80X Electron and Photon ID

- This year a new strategy has been adopted:
  - in the past, the IDs tuned fully on MC before enough data becomes available to derive scale factors.
  - this time, given strong time-dependent effects in 2016 data and considerable data/MC disagreement, we started by looking at data and figuring out strategies to mitigate time-dependent effects and bring scale factors closer to 1.
- A similar procedure will be needed in 2017.
- New training (MVA and cut-based) for Moriond17 released and announced one week ago.
- HEEP and other non-general EGM IDs are developed outside with regular communication in EGM meeting.
- Electron IDs to be retuned/retrained with the phase1 detector.

EGM Scale Factors

- Electron and photon SFs both for cut based and MVA ID will be presented today at the PPD (Moriond17 data vs old 2016 MC). Waiting for new MC (DYee – MiniAOD).
  - privilege tunings with SFs close to one (performances as expected + good data/MC agreement)
  - cut tighter on variables well modelled, relax cuts on remaining variables



tight ID ichep16 | tight ID 80Xv1 | tight ID 80Xv2

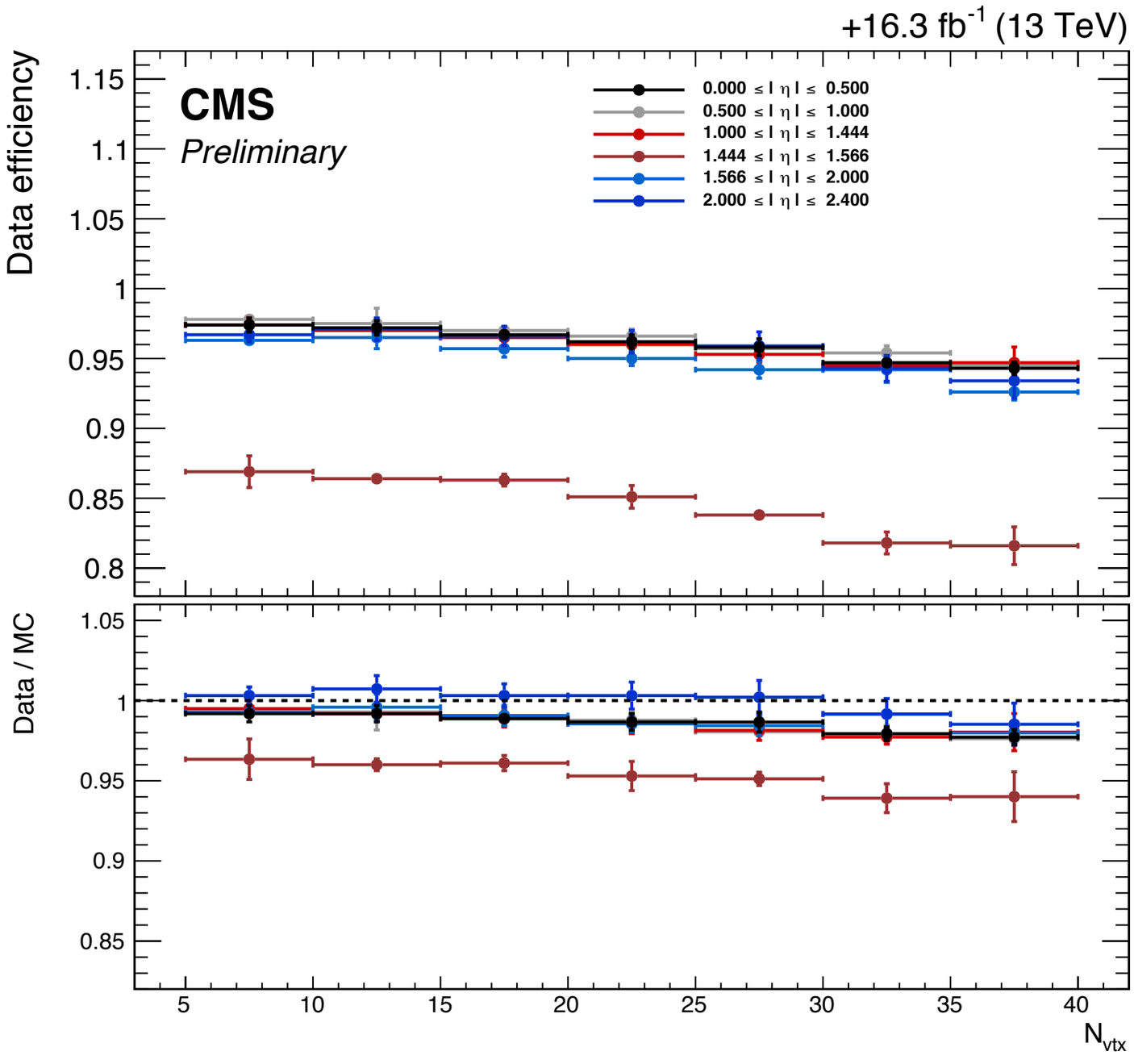
NB: pho ID relevant for p_T > 20GeV

EGM performance vs PU

From the EGM presentation at the last PPD

- Study effect of PU on gsfTracking efficiency, EGM identifications
- Dataset
  - ✓ Data ReReco run G + Prompt run H: 16.3/fb
    - ✦ tracker hit inefficiency solved
  - ✓ MC
    - ✦ Ichep16 for ID comparison
    - ✦ Moriond17 for gsfTracking comparison
- Only quick study available
  - ✓ Efficiency and scale factor vs nPV (probe pT > 30 GeV)
    - ✦ Standard EGM Tag and probe method
- High PU run under study, no result yet
  - ✓ would like to compare with high PU MC

gsfTracking efficiency



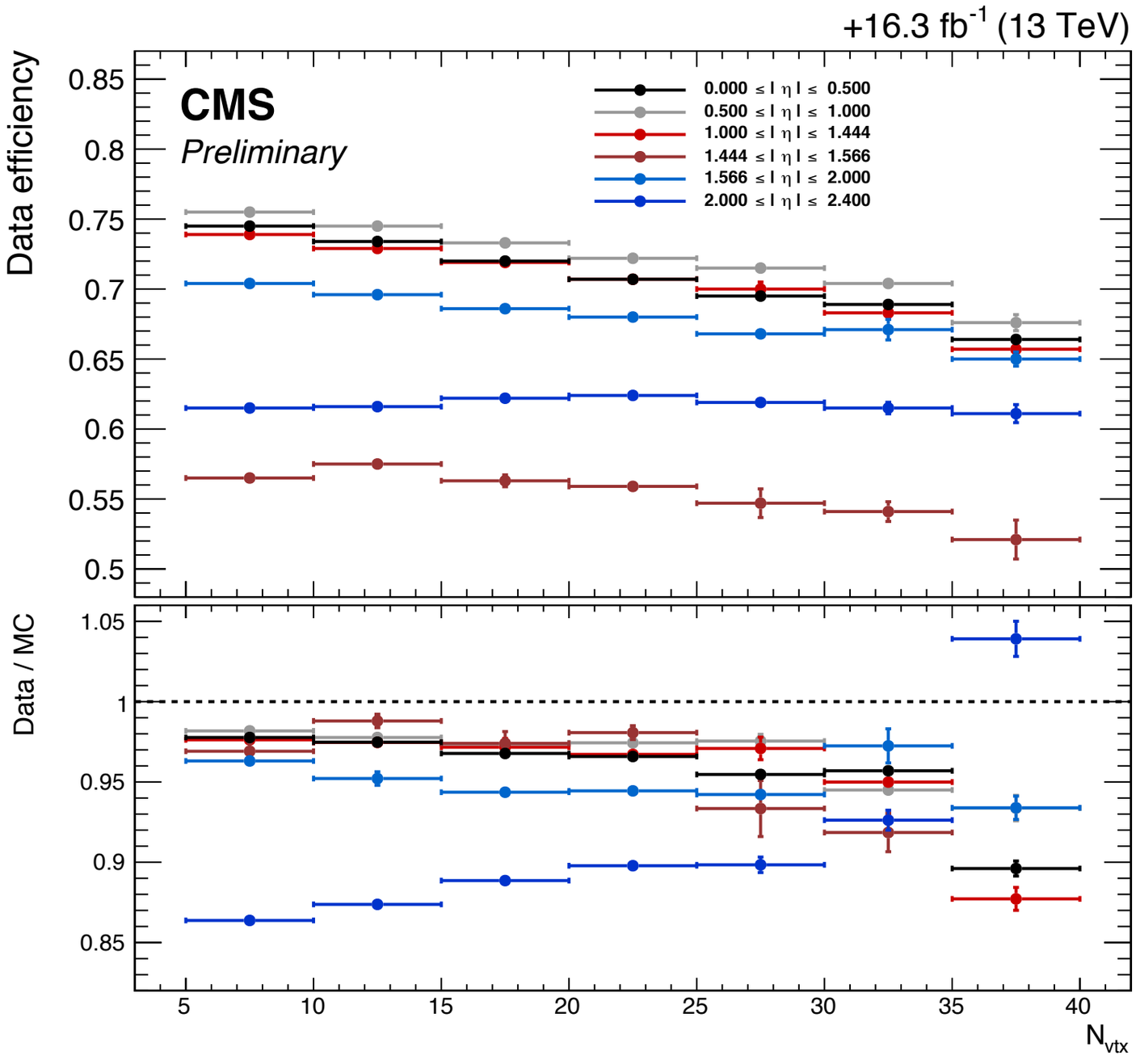
gsfTracking

4% loss of efficiency from 5 to 40 #PV (≃ 0.1%/PV)

Scale Factors: loss only partially reproduced by MC (SF drop by 1.5%)

NB: Moriond17 MC

Electron ID



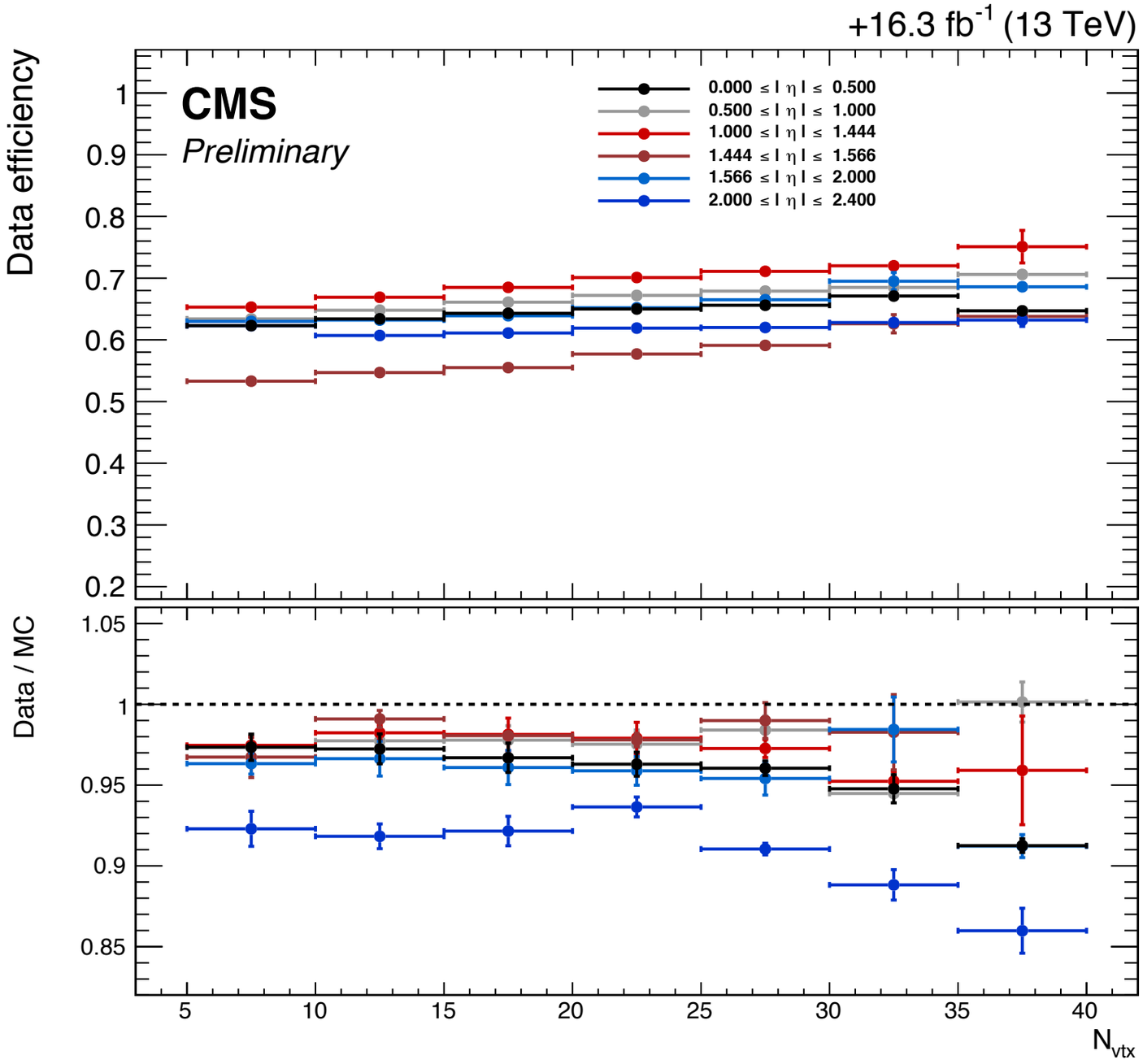
electron tight cut-based ID

Loss of efficiency vs nPV can be mitigated

Data/MC trend for high nPV:
scale factors dropping by 3-5% in EB for nPV > 30

NB: Ichep16 MC

Photon ID



photon tight cut-based ID

increase of efficiency vs nPV due to tuning in isolations (PU correction)

Not such a clear trend for high nPV

NB: Ichep16 MC

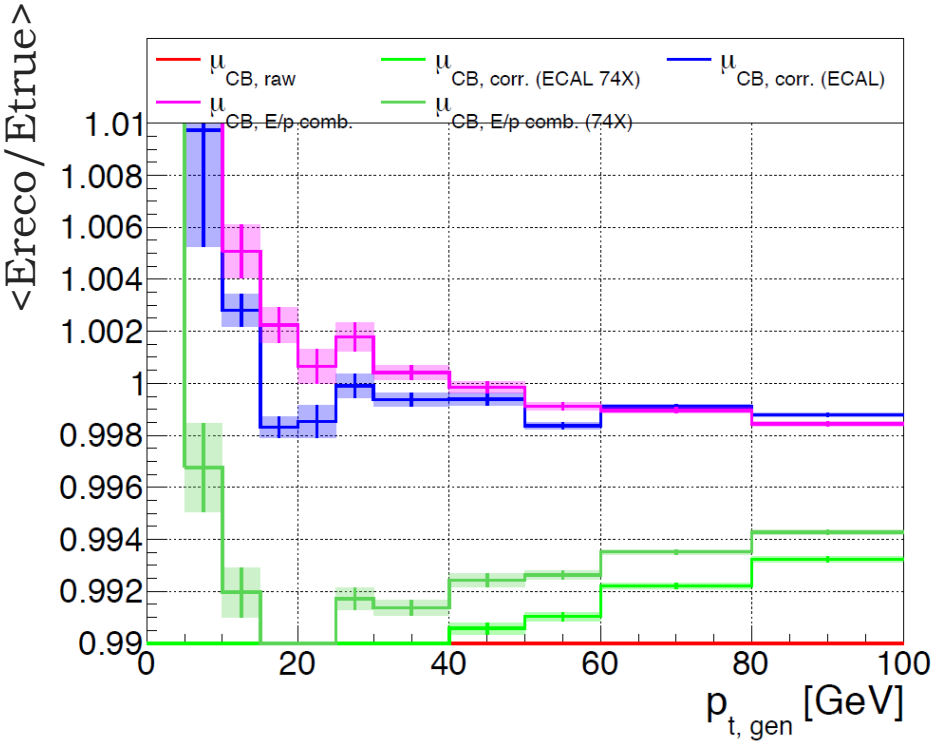
E/γ energy corrections

- Energy correction (regression) revisited:
  - consistent set of inputs for electrons and photons
  - training on simulation up to 6.5 TeV transverse energy (was 200 GeV) including SuperCluster with saturated crystal(s)
  - same semi-parametric regression for the two steps:
    - ecal only energy estimation for electron and photons
    - E/p combination for electrons
- Better linearity at low and very high ET
- Much better resolution at high ET
- To be revisit with the 2017 detector

E/γ energy corrections

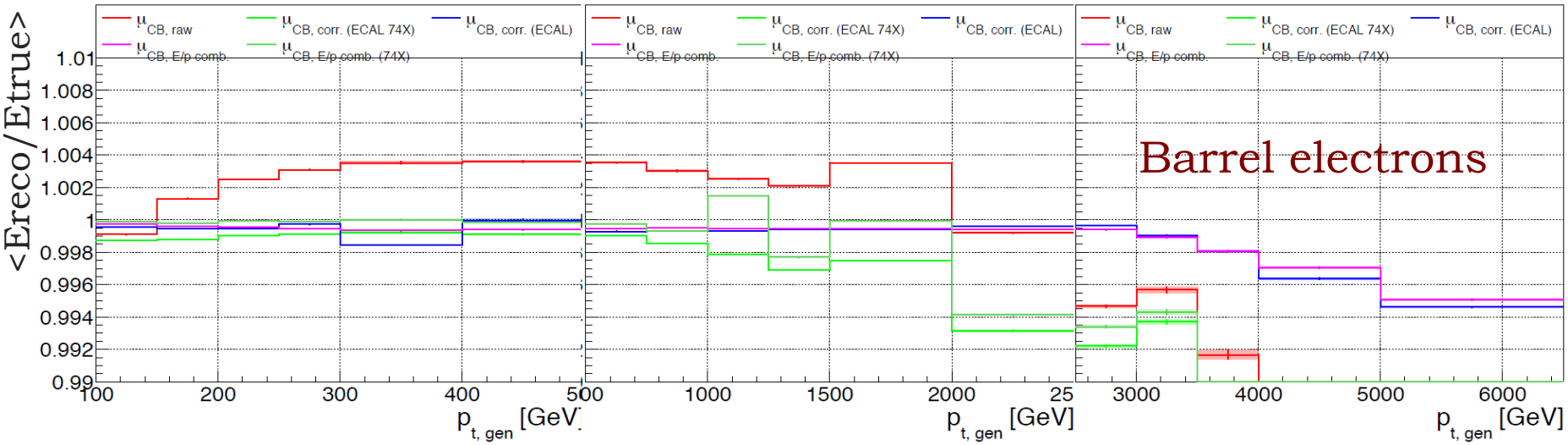
- Three different regressions available:
  - for photons
  - for electrons with ECAL only
  - for electrons with E/p combination.

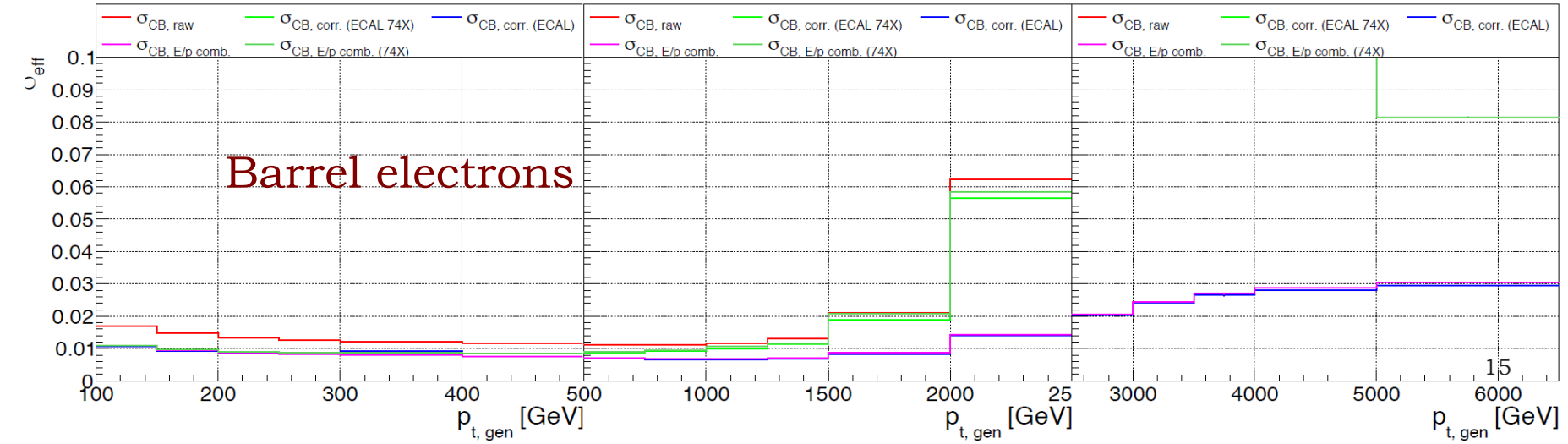
Low pT electrons in EE



- User interface to run over AOD and miniAOD

Energy regression with saturated crystals.





E/γ energy scale and resolution (Data vs MC)

- Scale and smearing delivered for Moriond17.
- New categorization needed to mitigate the effect of slew rate in ECAL and compensate the deviation from linearity at high energy:
  - run number, eta, R9, **seed energy**.
  - Very coarse correction
    Clear use case for legacy rereco.

→ ΔE (E≃250GeV) = 2.0%
ΔE (E≃350GeV) = 5.2%
ΔE (E≃450GeV) = 1.5%

- Recently added in the EGMSmearer twiki
  - recipe to evaluate the systematic uncertainties
  - recipe to apply the corrections both on miniAOD and at the rootuple level

Giuseppe Fasanella, Shervin Nourbakhsh

E/Gamma triggers in 2017

- Various issues identified at HLT that – with additional (wo)manpower – can be fixed / mitigated
  - Online – offline harmonisation (eg. PF HCAL iso)
  - Improvements of variable definitions taking also advantage of phase1 detector (eg. H/E using PF, Track iso…)
  - New tunings (eg. tighter cut in pixel matching could give not negligible reduction in fake rate with same efficiency)
  - Improved selection (eg. tighter L1 – HLT matching now that L1 has much better position resolution)

Electron reconstruction with new pixel detector

- Adjustment of electron algorithms to new pixel detector is needed. Very good moment for a comprehensive review of:
  - Seeding (including retuning of matching windows)
  - Tracking (GSF parameters untouched since many years)
  - Conversion reconstruction
  - Studies with new material
- Waiting for preproduction samples: electron gun w/o PU and with 2017 PU

Electron reconstruction with new pixel detector

Presentation by C. Charlot at the EGM meeting, two weeks ago. Very few people expressed the interest to work on it. Join us in this effort !

newCombinedSeeds in run 1 and 2 [1]

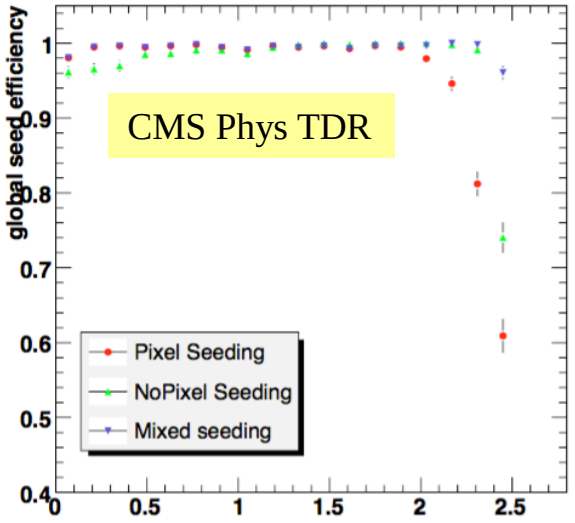
step
initial
pixelPair
mixedTriplet
pixelLess
tripletElectron
pixelPairElectron
stripPairElectron

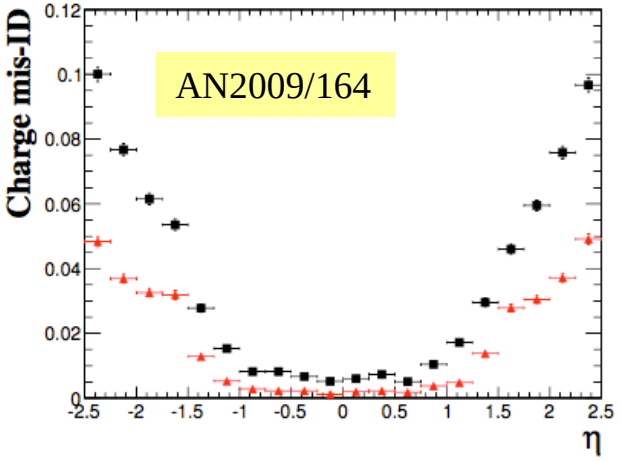
newCombinedSeeds in 90X [1]

step	layers
initial	pixel quadruplets
highPtTriplet	pixel triplets
mixedTriplet	pixels+strips
pixelLess	inner strip triplets
tripletElectron	BPIX+FPIX triplets, extended to new layers
pixelPairElectron	BPIX+FPIX pairs, extended to new layers
stripPairElectron	TIB+TID+TEC pairs

Electron seeding: forward coverage

- Limited BPIX coverage at high eta forced us to include TID/TEC layer pairs in the electron seeding to efficiently cover |eta|>2
  - Currently included in stripPairs steps
- pixelLess step also recovering some slight inefficiency in the central region
- TEC seeding is the main driver of fakes from conversion leg reconstruction and charge misID from converted brem
  - Leading to the development of the majority method for the charge assignment (GSF, KF,SC-pix)
- Requiring at least one BPIX layer would likely **strongly reduce fakes and q-misID** in the forward region





Tracker material description

- Huge uncertainty on material knowledge for systematics (e.g. Hgg mass):
  - 10%(20%) in eta<1(>1)
- Reduced to 5% in the whole eta range after material studies (mainly fbrem and low pT hadrons)
- Studies to be repeated in 2017 with the new detector.

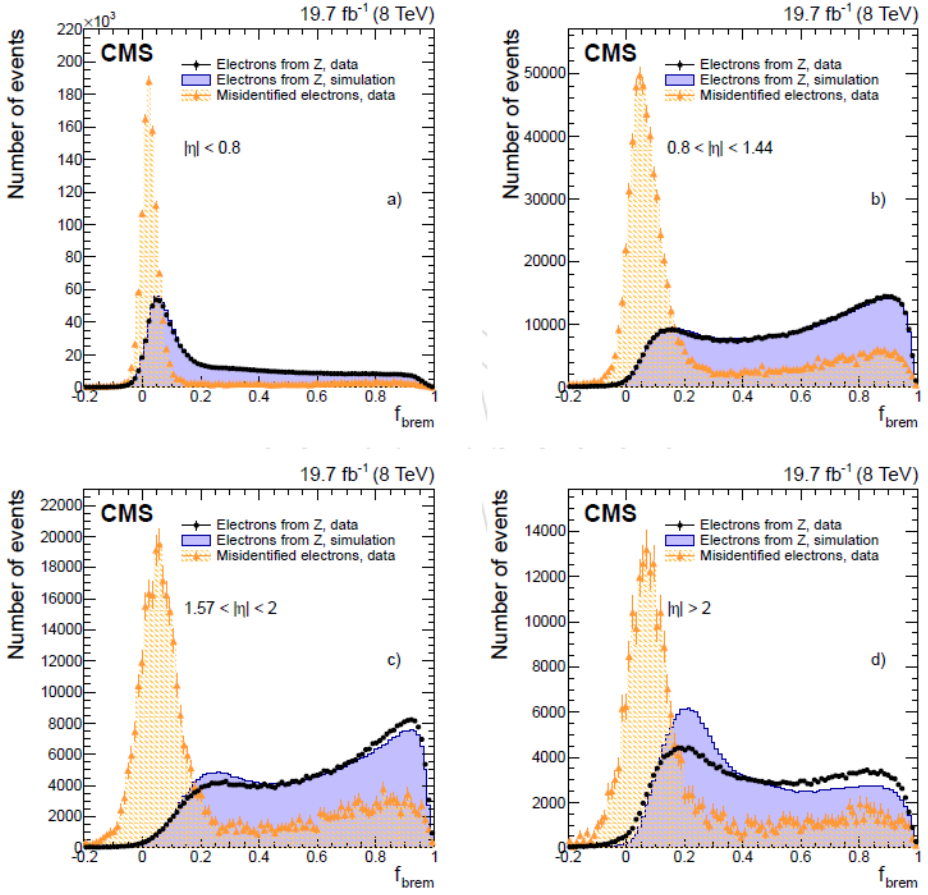


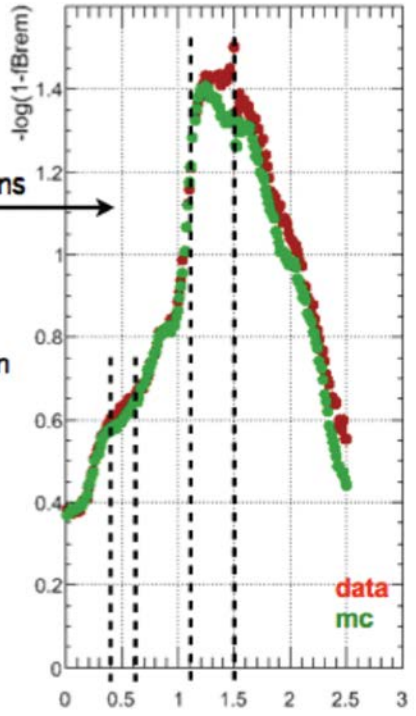
Figure 7: Distribution of f_{brem} for electrons from $Z \to e^+e^-$ data (dots) and simulated (solid histograms) events, and from background-enriched events in data (triangles), in a) the central barrel $|\eta| < 0.8$, b) outer barrel $0.8 < |\eta| < 1.44$, c) endcaps $1.57 < |\eta| < 2$, and d) endcaps $|\eta| > 2$. The distributions are normalized to the area of the $Z \to e^+e^-$ data distributions.

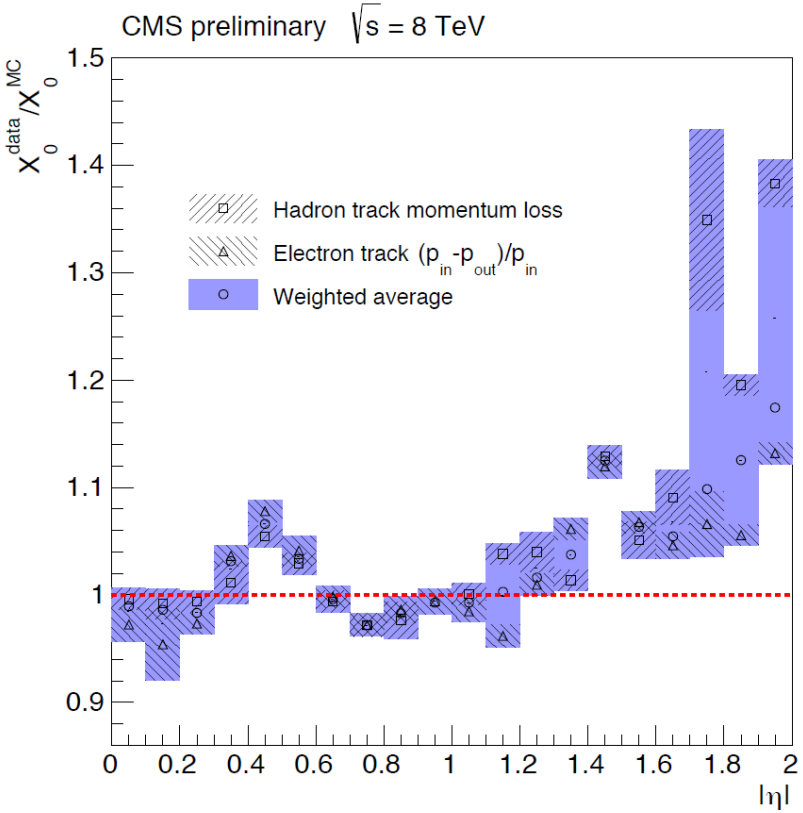
New tracker material

- First step is to compare out of the box data and MC.
- Then produce MC samples with different material scenario to calibrate the methods.

DATA-MC high stat
~10^6events (with electrons from Zevents)

- small differences between data-mc in eta 0.4-0.6 in eta 1.1-1.5





More on 2017 readiness

Additional tasks for the next months:

- Restore consistency between PF Zero Suppression vs ECAL ZS and Selective Readout (with ECAL DPG).
  - Thresholds have been updated this year in ECAL and now ZS is higher than in PF (factor of 2 in EB).
- Retune PF cluster energy corrections with new ECAL ZS and extending the training at higher energies.
  - Trained without any material.
  - Used only by JET/MET.

Considerazioni personali

- Molti punti toccati in questa presentazione sono in comune con il lavoro dell'ECAL DPG. Rischio di duplicare i task, i meeting, … (abbiamo un joint meeting DPG/EGM)
  Ha ancora senso tenere in piedi due gruppi per performance di detector e di oggetti ?

- Nel 2016 si sono visti grossi effetti (dovuti sia ai rivelatori sia alle condizioni) dipendenti dal tempo. Nel 2012 abbiamo avuto un assaggio di MC run dependent. E nel Run2 ?