# FSR photon study in Zee MC

# Remind lineshape problem of Zee

Assumption:

data has higher left-tail than MC induced by different "hard" FSR photon (less in data).

"soft" FSR photons are supposed to fall in the electron EM cluster, while "hard" ones are not.

The mismodelling of hard FSR photons can lead to non-trivial scale difference and non-Gaussian like resolution difference.
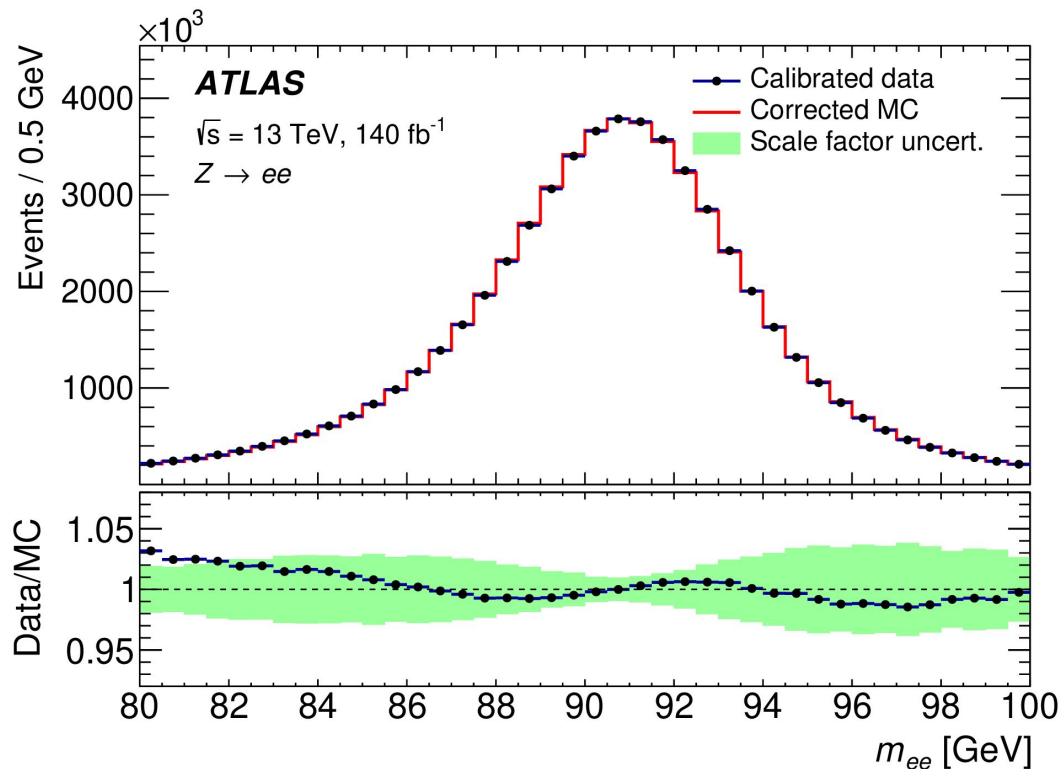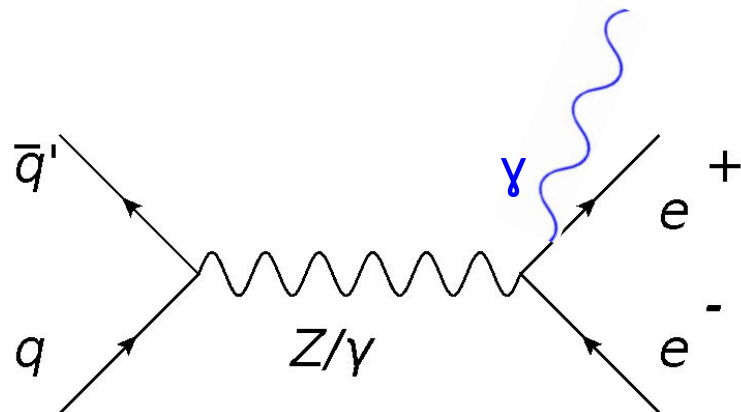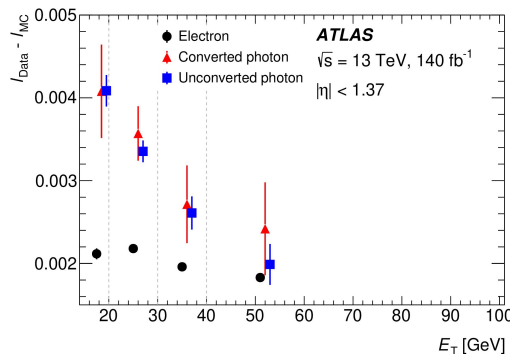
study Zee mass with different FSR photons
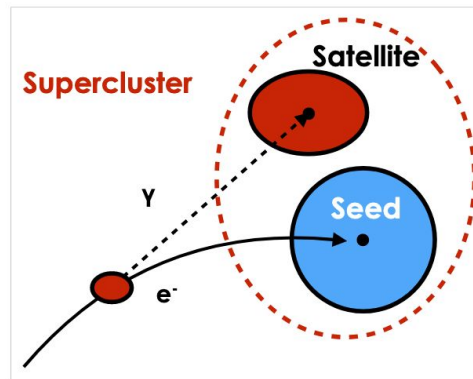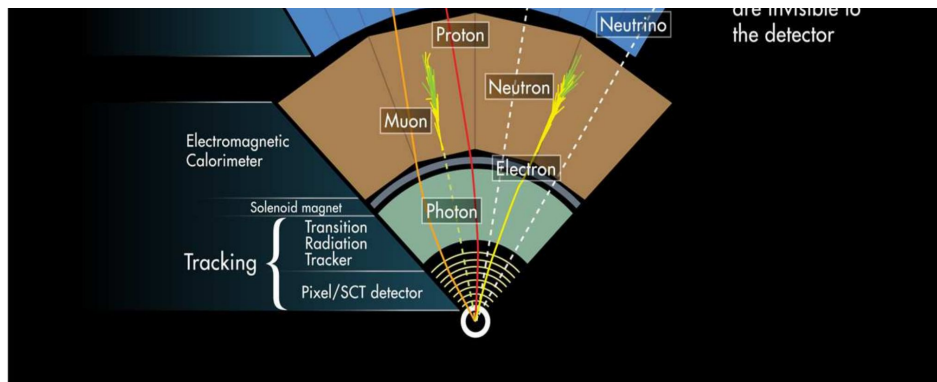
supercluster
captures "satellite"
photon but mostly
for bremsstrahlung,
while FSR photons
should be included
or around the seed

Same problem
observed with
sliding window

If hard FSR photons are outside superclsuter (sounds like
lateral leakage ~ 0.002 for electron?)

But impact of FSR
photon is hard to see in
leakage as it is
dominated by show
shape modelling

study Zee mass with different FSR photons

In order to study of impact of less or more FSR ɣ on mass lineshape we can classify Zee MC events to **"soft FSR"** and **"hard FSR"**.

What we need:

- **For the 2 reco electrons, we need to find the corresponding truth**
  - **Ready**, we have
    - **bare** truth electrons (after FSR if there is) returned by *xAOD::TruthHelpers::getTruthParticle*
    - **born** truth electrons (before FSR) dR-matched to reco

- **We need truth FSR ɣ around the truth electron**
  - truth photons with pdgId == 22 && status == 1 && barcode < 200000 && !isFromHadron(particle) are stored
  - need to **match between FSR ɣ and truth electrons**
    - **can we do a dR matching?**
    - **can we use the truth mother link? (Zee is PowhegPythia8EvtGen)**
  - then we need to know **if FSR ɣ is in EM cluster**
    - Ideally one would **extrapolate FSR ɣ to ECAL (?)**, check if it matches to supercluster (not done yet)
    - alternatively study **dR(ɣ, e) and p_T** to find specific cut

study Zee mass with different FSR photons

Verbose remarks about **FSR photon and electron matching**:

- We want to study E_{reco}/E_{true} with **soft or hard FSR photons**:
    - need matching between reco and truth (this has been done)
    - need matching between FSR photons and born truth electron, by finding the electron with dRmin
    - need to study dR(γ, e) and pT, and profile of Ereco/Etrue as function of dR(γ, e) and pT

A fews plot for FSR photons

To add