

Tau Embedding in CMS

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Motivation

Largest Background in $H \rightarrow \tau \tau$ stems

from Z → ττ

Best knowledge about Z → ττ is essential

Embedding allows to have a datadriven estimate with minimal input

from simulation

Embedding was extremely successful in Run I



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Concept of Embedding









Embedding tools



- Particle Flow (PF) merge
 after particle reconstruction
- RecHit merge after
 - calorimeter hit- and track-
 - reconstruction
- PF embedding was used during Run I





RH embedding





Replace μ signature:

- Inner tracks
- Calo energy
- Muon chamber hits





Remove energy deposit of muon:

- Extrapolate muon track into Calorimeter
- Calculate deposit $\Delta E = \frac{dE}{dx} \rho l$
- Apply correction factor obtained from simulation
- Subtract value from Calorimeter deposit



Mirroring

- Bias from the selection of two good muons
- Affect PF and RH embedding
- Solution mirror the muons in the r- φ plane
 - Transform $\phi \rightarrow -\phi$
 - Z-decay stays untouched
 - η and p_{τ} are conserved
- Particles will be embedded into an unbiased environment





Validation of embedding process



Study effects of embedding in Simulation

- First step replace μμ → μμ
 - This approach is most sensitive to the embedding process, since we expect orginal = embedded event
- Second step replace $\mu\mu \rightarrow \tau\tau$
 - Some effects will be washed-out/hidden due to the differences of muons and taus

Recent studies





Results shows $\mu\mu \rightarrow \mu\mu$ embedding

Does not include up to date event reconstruction, large improvements are expected

Lessons learned:

- Isolation is most crucial variable (at least for $\mu\mu \rightarrow \mu\mu$ embedding)
- RH mirroring is the most prominent candidate to give results with smallest uncerts.

Summary and Outlook



- Embedding was very successful during Run I
 - Many studies had been made
 - A lot of well tested code was produced
 - \rightarrow no need of new developments to run embedding
- Still need to adjust some technicalities to get embedding working with the newest data format
- Embedding will help to understand the process $Z \rightarrow \tau \tau$



Backup Slides