ZZ→4ℓ Cut Flow

- Analysis summary:
  - $\ell \in (e, \mu)$
  - $p_T^e > 7$ GeV, $|\eta_e| < 2.5$
  - $p_T^\mu > 5$ GeV, $|\eta_\mu| < 2.4$
  - $60 < m_Z < 120$ GeV
  - Loose combined relative isolation (PU-corrected)
  - Vertex compatibility cut causes larger loss in CSA14/PHYS14 than 8 TeV MC
Vertex Matching Efficiency

- Unexpected inefficiency: primary vertex impact parameter cut

\[ \text{SIP}_{3D} = \left| \frac{\text{IP}_{3D}}{\sigma_{\text{IP}_{3D}}} \right| < 4.0 \]

- IP\(_{3D}\): impact parameter with vertex
- \(\sigma_{\text{IP}_{3D}}\): its uncertainty

- Intended to reject pileup-related backgrounds from independent pairs of Drell-Yan interactions and combinatorics

SIP\(_{3D}\) for gen-matched muons in ZZ→4\(\mu\) samples
SIP$_{3D}$ Efficiency

- Doesn’t depend on pileup or $p_T$ more strongly than at 8 TeV
- Eta dependence suggests endcap issue in PHYS14 and barrel/endcap overlap issue in PHYS14 and CSA14
- Phi dependence is ambiguous – needs larger sample

SIP$_{3D}$ efficiency for signal muons passing analysis-like ZZ→4μ cuts
Tracker Vs Global

- Global muons have much higher $\text{SIP}_{3D}$ efficiency than tracker muons
- Electrons also degrade, but change less with respect to 8 TeV
Kinematics: $P_T$
Kinematics: Eta

- Low-eta peak in tracker muons corresponds to gap between drift tube stations

- Higher-eta peak is presumably barrel-endcap overlap. Why is it shifted from 8 to 13 TeV?
SIP2D vs SIP3D

- PHYS14 only
SIP3D With Non-Gen Vertex

- PHYS14 only
- Gen vertex closest to non-selected primary vertex