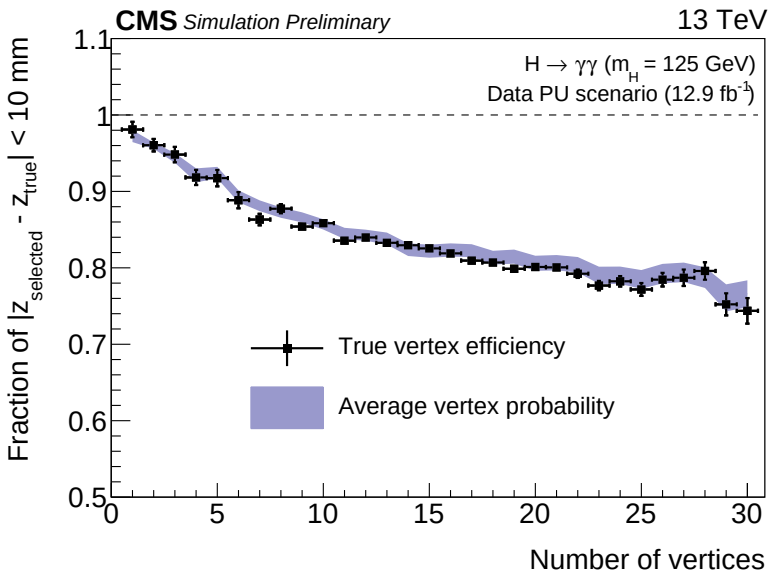
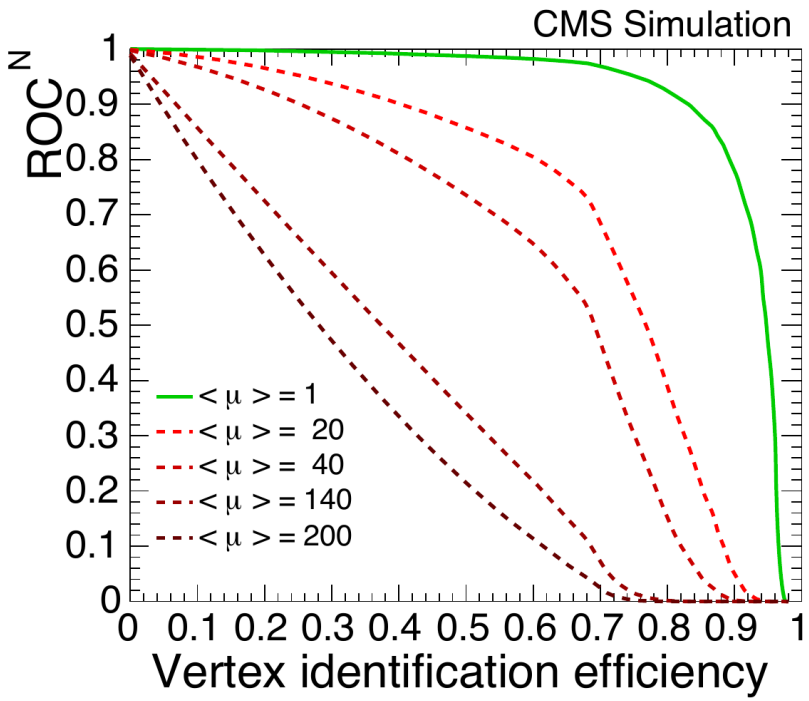
Primary vertex identification in $H \to \gamma\gamma$

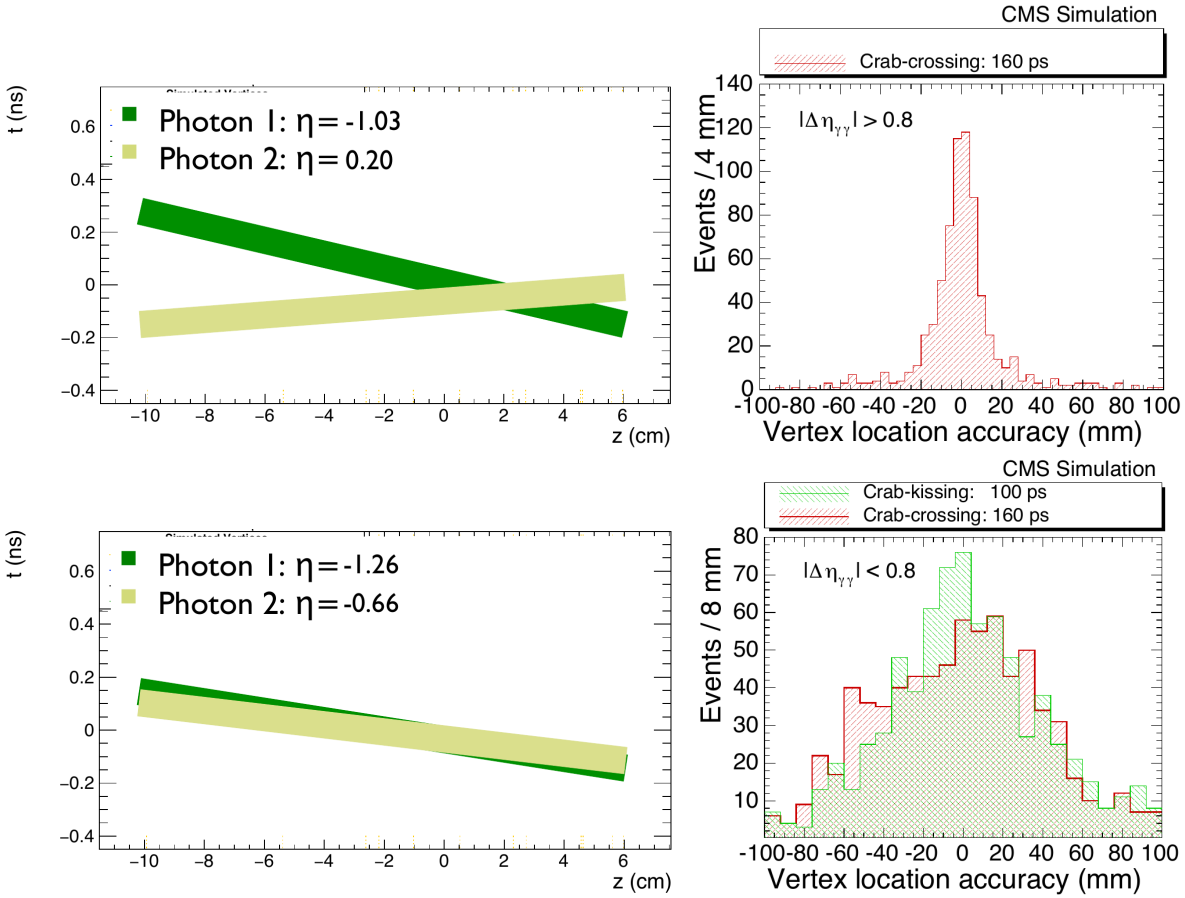
- No pointing information from ECal$\to$ CMS relies on hadronic recoil balancing and conversion pointing to locate primary vertex in $H \to \gamma\gamma$ events
- Becomes increasingly difficult to locate the primary vertex at very high pileup
- Vertex selection efficiency drops from $\sim$80% in current conditions to $\sim$30% at 200 PU





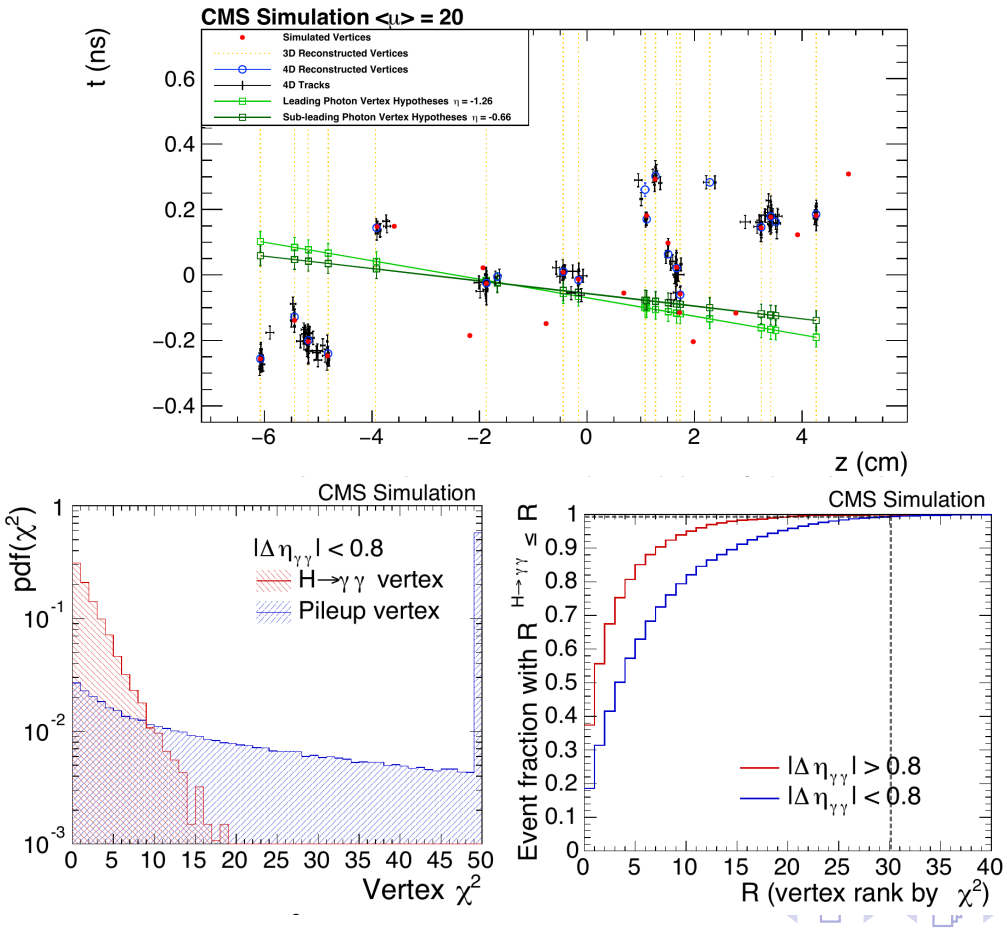
Precision timing for High Energy Photons - $H \to \gamma\gamma$

- Precision timing measurements for the high energy photons allows triangulation back to the primary vertex (30 ps resolution assumed here)
- Triangulation breaks down for small rapidity gap. In the absence of a known t_0 for the hard interaction, triangulation is ambiguous



Precision timing for High Energy Photons - $H \to \gamma\gamma$

- Calorimeter timing-based triangulation can be matched to 4d reconstructed primary vertices to resolve the ambiguity and restore the performance $\to$ Simple χ^2 matching provides a 5x reduction in the effective amount of pileup even for small rapidity gap events



Precision timing for High Energy Photons - $H \to \gamma\gamma$

- Without precision timing, $H \to \gamma\gamma$ primary vertex selection efficiency is reduced from ∼80% in Run 2 conditions, to ∼40% at 140 PU
- Reduction in primary vertex selection efficiency has a dramatic (30%) effect on effective mass resolution when incorporated into projections
- Partially recovered by calorimeter timing alone, and almost fully recovered by calorimeter + MIP timing (∼ 30% improvement in effective integrated luminosity for stat. limited differential cross sections)