Search for

$H \rightarrow \gamma^{*}\gamma \rightarrow \mu\mu\gamma$

With full Run-2 Data

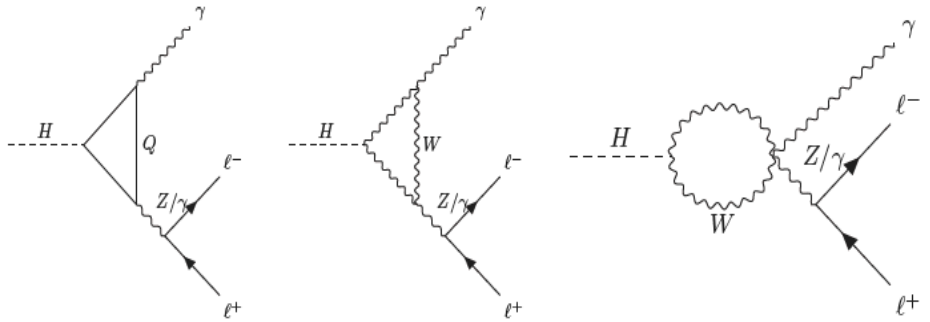
John Adams S. Villamoran , Chia-Ming Kuo

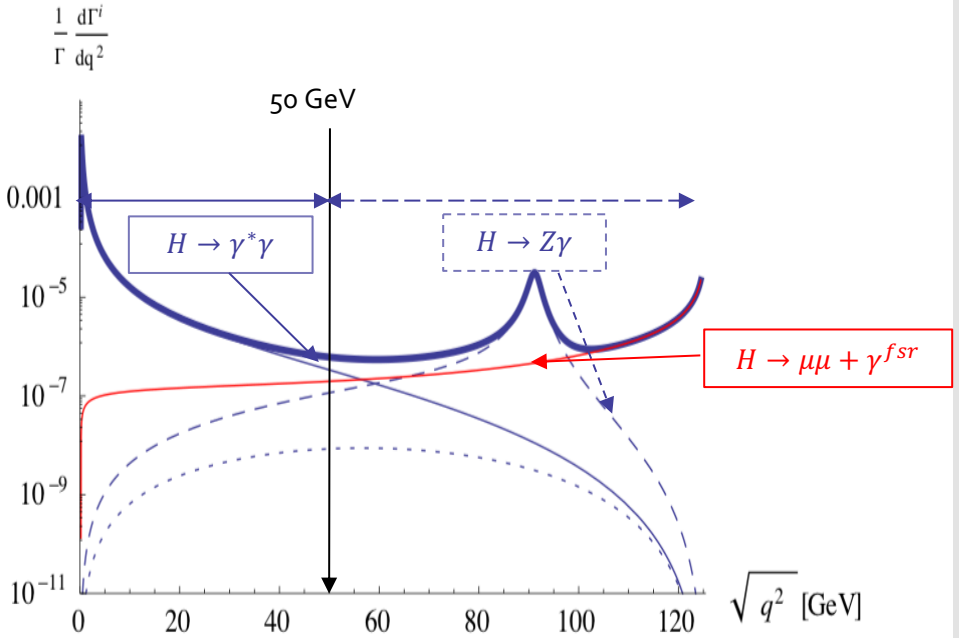
National Central University, Taiwan

Higgs Dalitz Decays

- **Higgs Dalitz decays**
  - Rare $H \to f\bar{f}\gamma$ decays of the Higgs boson
  - Huge contributions coming from **loop-induced processes ($H \to Z\gamma$ & $H \to \gamma^*\gamma$)**
- **$H \to \gamma^*\gamma$**
  - Complimentary to $H \to Z\gamma$
  - Investigates the lower end of the $m_{\mu\mu}$ spectrum
  - Will provide a complete picture of the loop-induced Dalitz processes.
- **Motivation:** test SM and probe BSM through rare Higgs decays
  - **SM Physics**: CP violation properties
  - **BSM physics**: enhanced decay through exotic BSM couplings

$$H \to (Z/\gamma^*)\gamma \to l\bar{l}\gamma$$

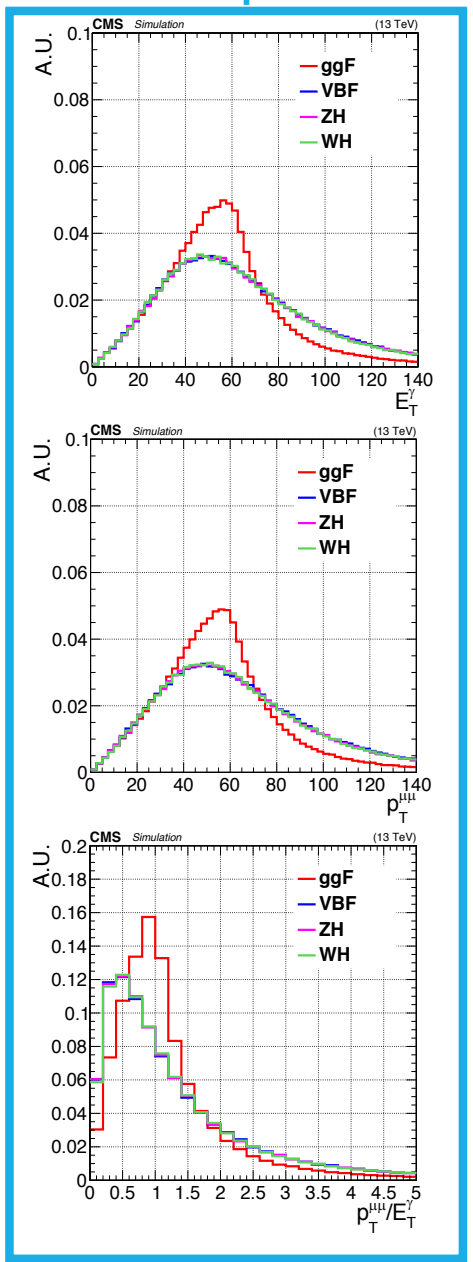




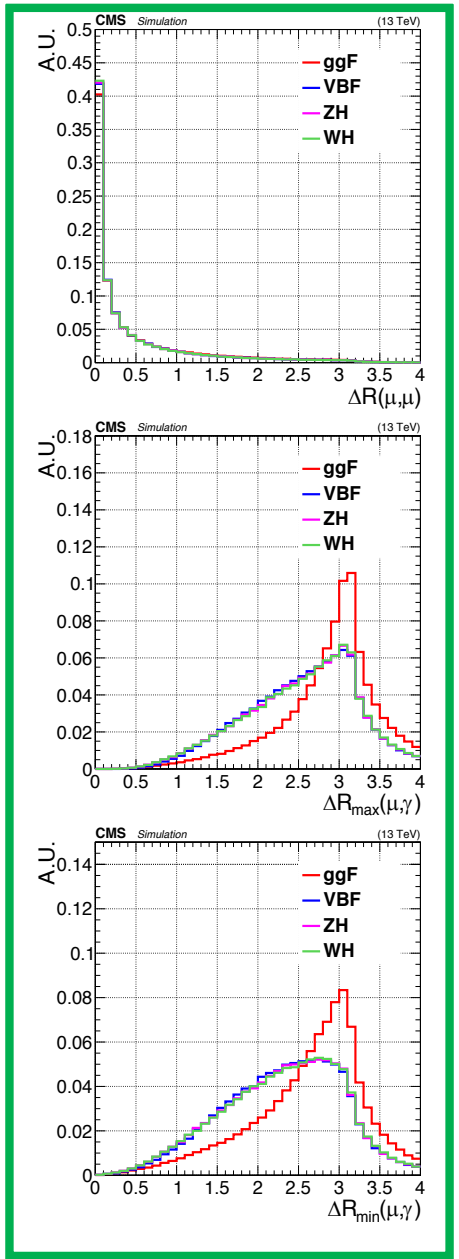
Normalized to $H \to \gamma\gamma$ decay rate
arxiv:1303.2230v2

Event Signatures

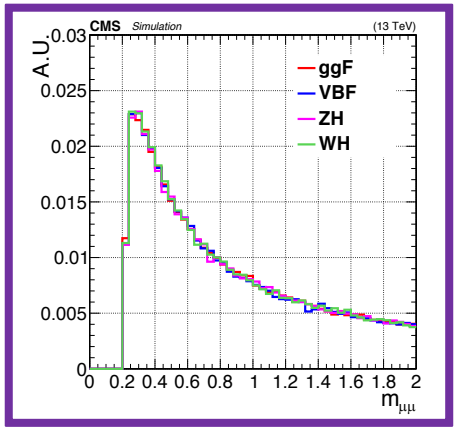
Highly-boosted and practically massless **real and virtual photons**



Muons in very close proximity for the bulk of events

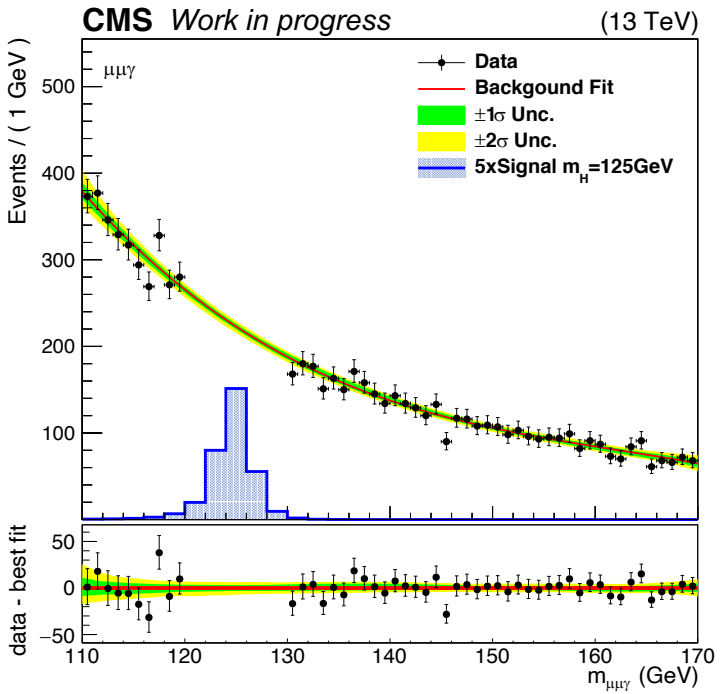


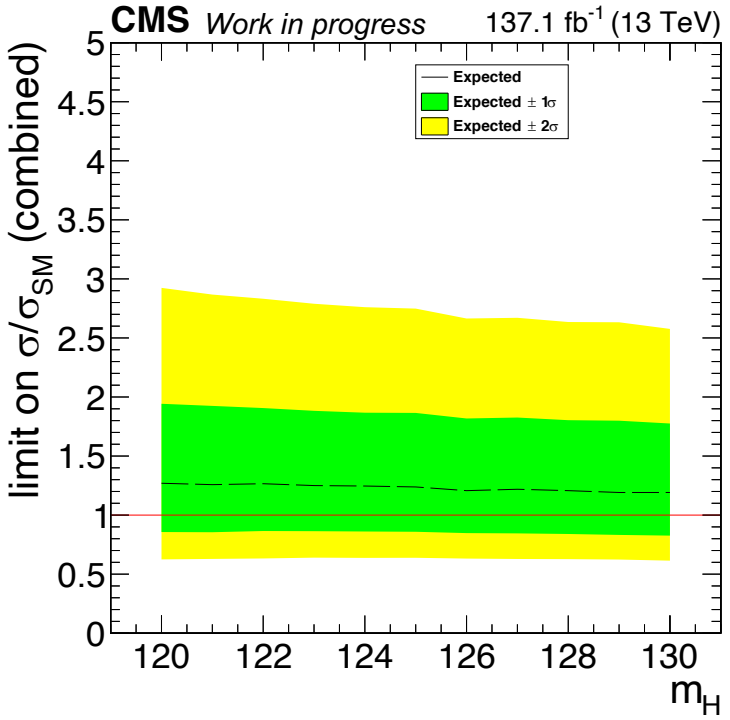
$m_{\mu\mu}$ close to **photon pole mass**



- **Events selected** must require:
  - **Two muons** with **small $m_{\mu\mu}$**
  - **Highly-energetic** photon
  - Muons sufficiently far from the photon
- Events are then classified **based on $m_{\mu\mu}$**
- Utilize **event categories** collecting:
  - Events with **high-purity photons** (further classified based on η)
  - Events that exhibit **VBF-like topologies**
  - Events with **boosted three-body systems**

Current Status:





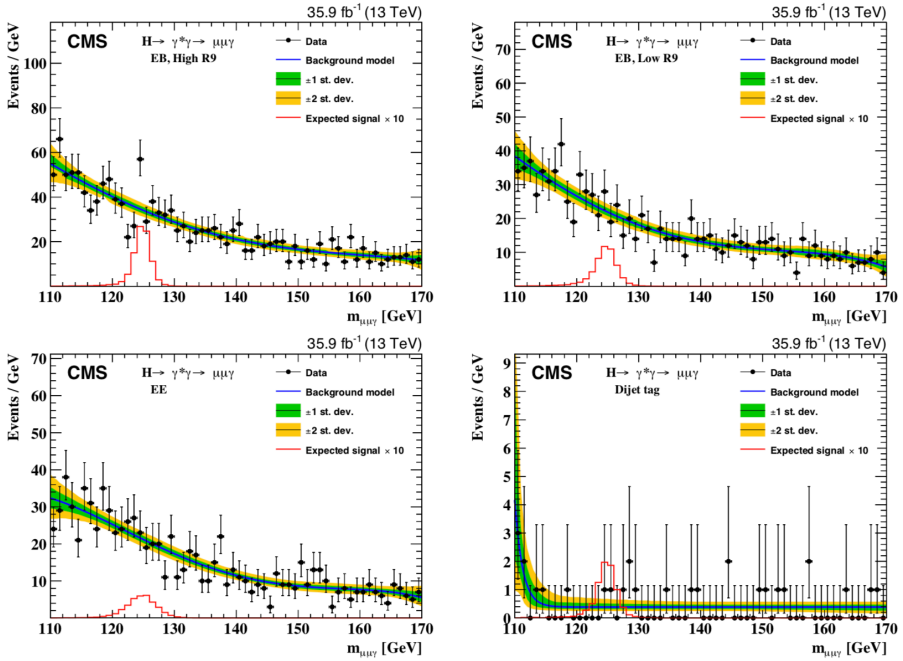
- **Expected Limit** @125 GeV: **1.24**
  - **~7% improvement** w.r.t. previous analysis strategy

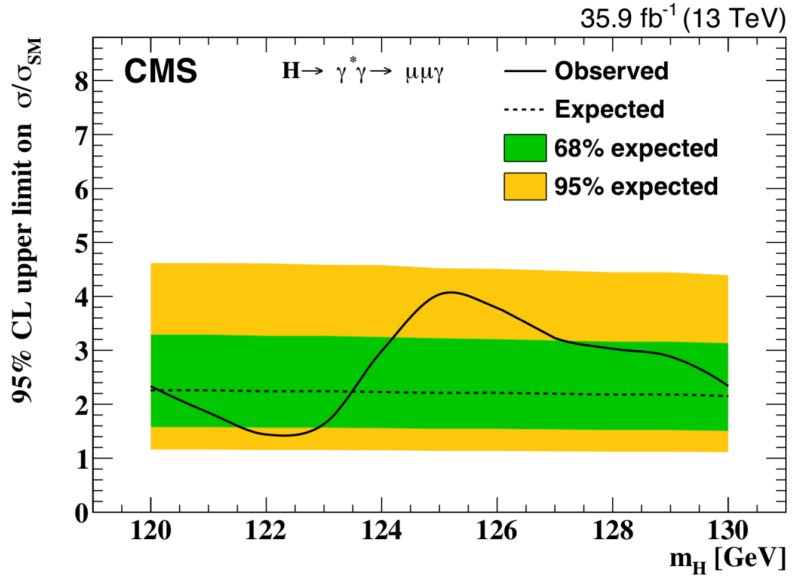
Back-up

Previous Results

Review of Previous Results

- **JHEP11(2018)152**: $H \to \gamma^* \gamma$ is part of the $H \to ll\gamma$ search along with $H \to Z\gamma$
- $(110 < m_{\mu\mu\gamma} < 170)$ & $(m_{\mu\mu} < 50)$





- Expected (Observed) 95% CL UL on σ/σ_{SM} $\sim$**2.1 – 2.31(1.4 – 4.0)** for $H \to \gamma^* \gamma$