Search for High-mass Resonances in Z(ll)γ Final State at 13 TeV in the CMS experiment

CMS-EXO-16-034 **Kyungwook Nam** *on behalf of the CMS Collaboration*

Introduction

- ✓ This poster describes the results of **a search for heavy resonances decaying to Zγ, with further decay Z → e^+e^- / $\mu^+\mu^-$**, in the narrow width (0.014%) scenario.
- ✓ The search is based on **13 TeV proton-proton collision data collected by the CMS experiment in 2016**, corresponding to **12.9 fb^{-1}** of integrated luminosity.

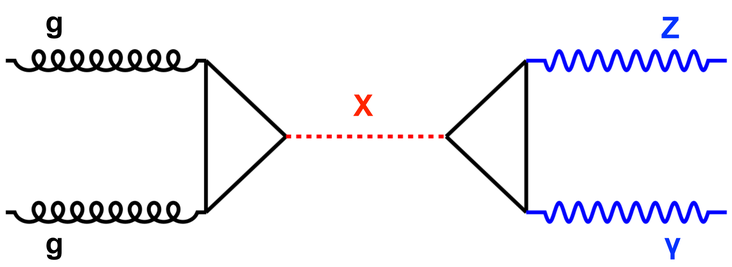

Figure1. Feynman diagram for the signal process

Event Selection

Events are selected with **exactly two opposite-sign electrons or muons with a photon**. Events are required to pass either double-lepton or single-lepton trigger paths.

- **Dilepton**
  - ➡ Leading lepton p_T > 25 GeV (subleading: 20 GeV), $|\eta|$ < 2.4
  - ➡ 50 GeV < m_Z < 130 GeV
- **Photon**
  - ➡ p_T > 40 GeV, $|\eta|$ < 2.5
  - ➡ ΔR > 0.4 from both leptons
- **Zγ**: $p_T(\gamma) > (40/150) \cdot m_{Z\gamma}$

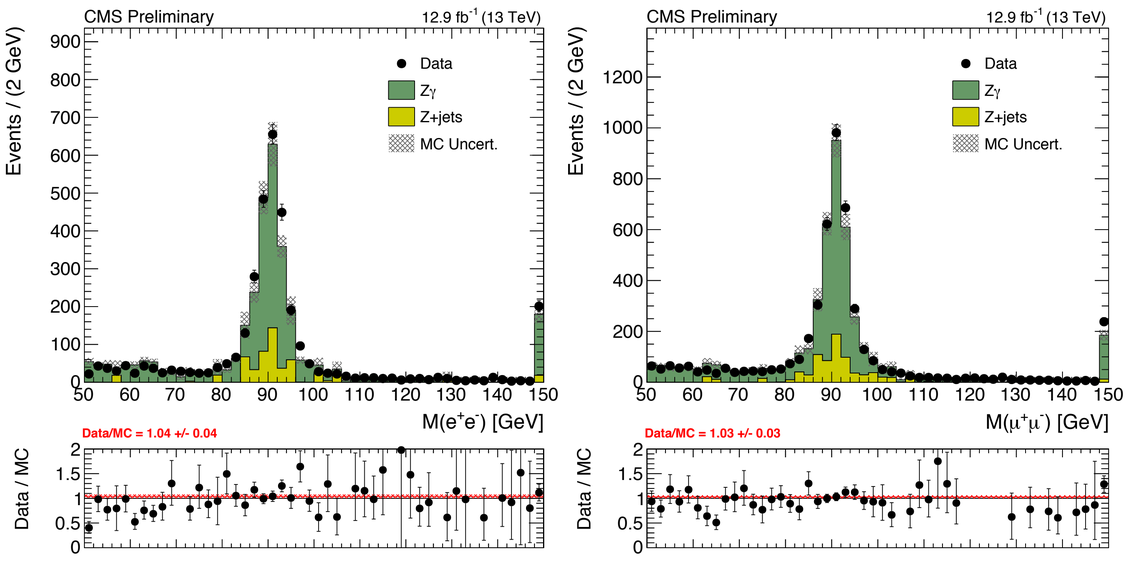

Figure2. m_Z distributions of data and the Monte Carlo simulation in electron (left) and muon (right) channels

Background Fit

The non-resonant background $m_{Z\gamma}$ spectrum can be extracted by an **unbinned likelihood fit** with a parametric function of $m_{Z\gamma}$:

$$f(m_{Z\gamma}) = m_{Z\gamma}^{a+b \log m_{Z\gamma}}$$

The background bias is studied using Monte Carlo simulations.

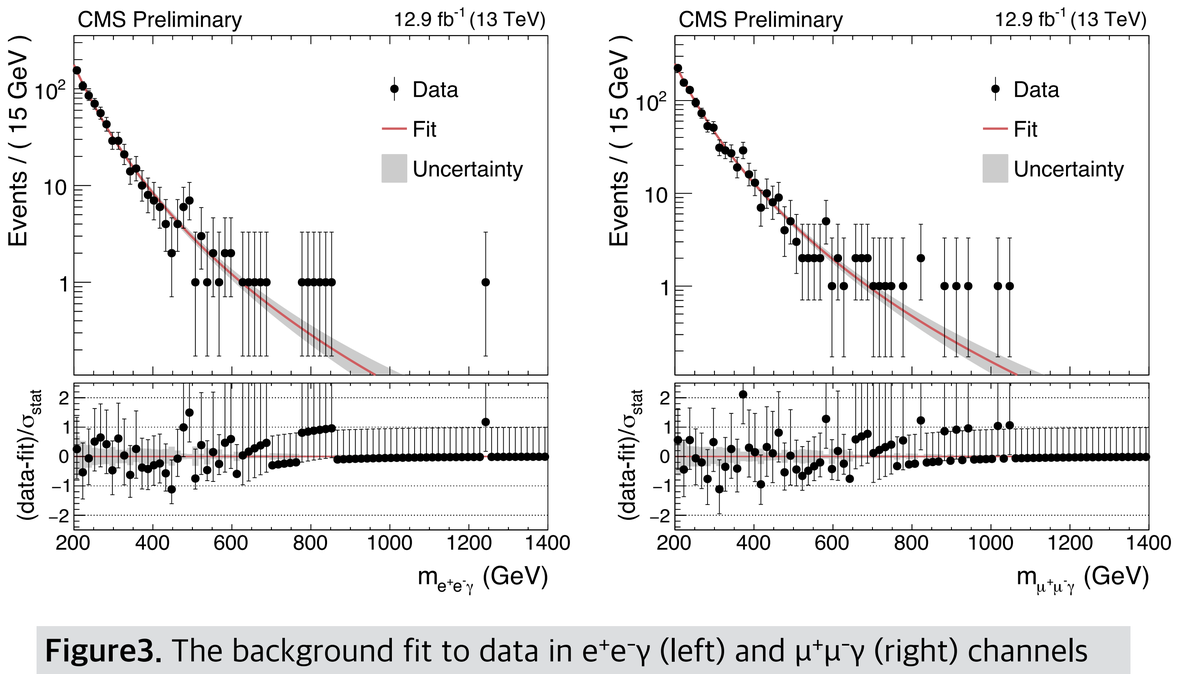

Figure3. The background fit to data in $e^+e^-\gamma$ (left) and $\mu^+\mu^-\gamma$ (right) channels

Signal Modeling

The signal distribution in $m_{Z\gamma}$ is described by the Monte Carlo simulation:

1. **Signal resonance shape**
2. **Signal selection efficiency**

They are measured at each mass point and **interpolated with a function of the signal mass.**

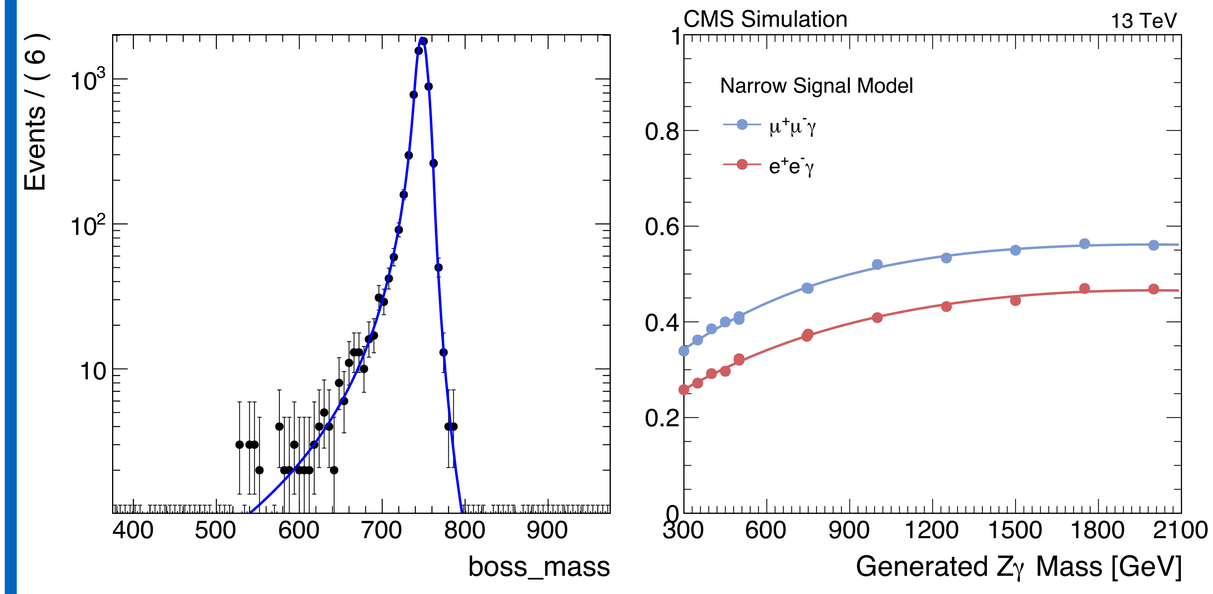

Figure4. The shape of 750 GeV signal in $m_{Z\gamma}$ spectrum in $e^+e^-\gamma$ channel (left) and the signal selection efficiencies (right)

Results

- ✓ **No significant excess above expected backgrounds is observed in $m_{Z\gamma}$ spectrum.**
- ✓ **Therefore, we set upper limits on the production cross section of heavy scalar resonances.**

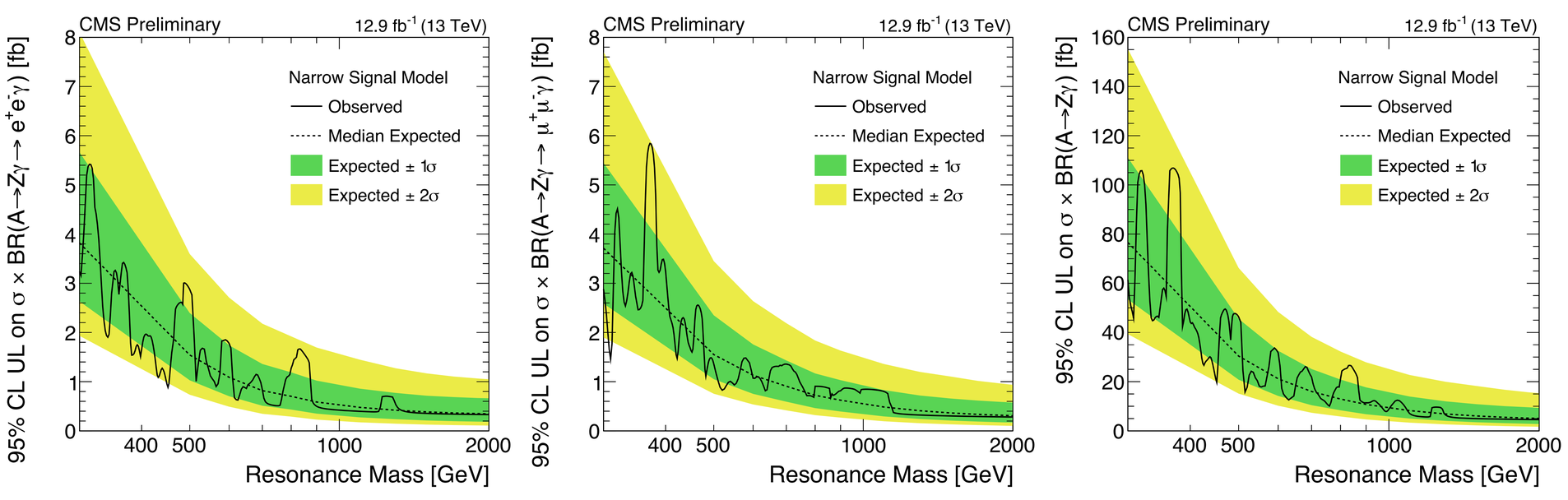

Figure5. Limits on σ x BR($l^+l^-\gamma$) in $e^+e^-\gamma$ (left) and $\mu^+\mu^-\gamma$ (middle) and limit on σ x BR(Zγ) obtained by combining two channels

Conclusions

A search for high-mass scalar resonances in the X → Zγ → e^+e^- γ / $\mu^+\mu^-$γ channel has been performed. No significant excess is observed above the background-only hypothesis. Upper limits are placed in the 300 < $m_{Z\gamma}$ < 2000 GeV range.