FCNC u/c→tγ

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Sensitivity of the upgraded CMS detector to FCNC transitions is estimated for:
- ➔ FCNC in *tqγ* vertex
- ➔ Single-top quark production in association with photon
- ➔ Final-state signature with single muon or electron, neutrino and photon
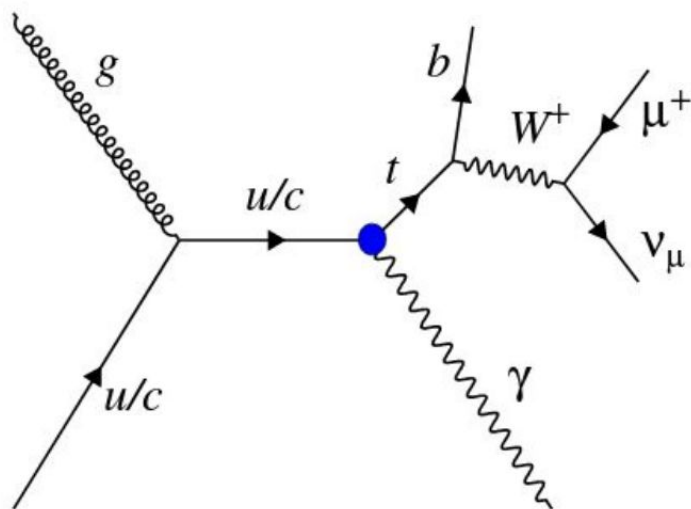
- ➔ FCNC are strongly suppressed in SM
- ➔ Top decays through FCNC are enhanced in many BSM models
- ➔ The most stringent constraints on the B($t\to q\gamma$) are set by the CMS experiment through single-top quark production in association with a photon

Selections:
- **Exactly one tight lepton** (*e* or *μ*) with P_T > 25 GeV, |η| < 2.8, relIso < 0.15
  (Electrons in the overlap region 1.4 < |η| < 1.6 are removed)
- No additional leptons with P_T > 10 GeV, |η| < 2.8, relIso < 0.25
- **Exactly one b-tagged jet** with P_T > 30 GeV, |η| < 2.8
  (DeepCSV algorithm for |η| > 1.5, cMVA algorithm for |η| < 1.5, anti-k T R=0.4, PUPPI)
- **At least one photon** with P_T > 50 GeV, |η| < 2.8
  (excluding photons within 1.4<|eta|<1.6)
- **MET** > 30 GeV
- Reconstructed top quark mass in the range of 130 to 220 GeV

- **Full simulation** of the upgraded CMS detector for **signals** and following **backgrounds**:
  - $t\bar{t}$, $t\bar{t}$ + γ
  - *W + jets, W + jets + γ*
  - *Single Top*
- Unfortunately, *Single top + γ* sample from Full simulation with ~300k events show a lack of statistics in signal region → **Delphes simulation** of *Single top + γ* with ~7M events is used

- High photon P_T / Energy regions are populated by signal events:
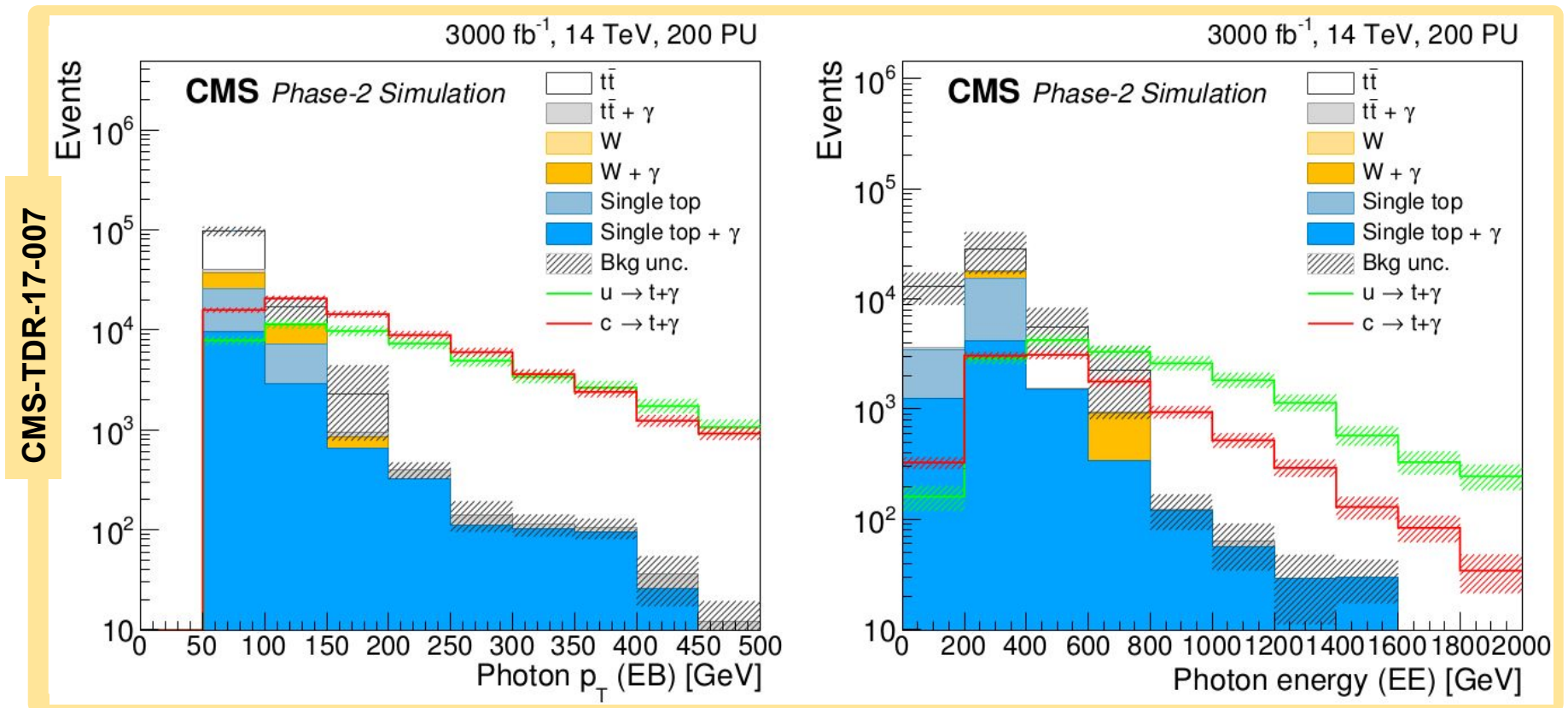
Expected limits extracted from the Asimov dataset of background-only model with asymptotic **CLs** method:

95% CL Upper Limits:

- **14 TeV 3000 fb-1**
  - Br ($t \rightarrow u + \gamma$) < 1.16×10^{-5}
  - Br ($t \rightarrow c + \gamma$) < 9.12×10^{-5}

  CMS-TDR-17-007

- **8 TeV 19.7 fb-1**
  - Br ($t \rightarrow u + \gamma$) < 1.3×10^{-4}
  - Br ($t \rightarrow c + \gamma$) < 1.7×10^{-3}

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- **Previous results for FCNC tqy searches based on fast simulation:**
  - Br ($t \rightarrow u + \gamma$) < 2.7×10^{-5}
  - Br ($t \rightarrow c + \gamma$) < 2.0×10^{-4}

  CMS-PAS-FTR-16-006

➔ Among the systematic uncertainties *Single Top* + γ cross section and $t\bar{t}$ + γ scale uncertainties are dominated → NLO is needed

➔ Number of events in Full simulation *Single top* + γ sample is critically small