tγq+$t\bar{t}$γ — methodology

Background estimation ($t\bar{t}\gamma$ as signal):

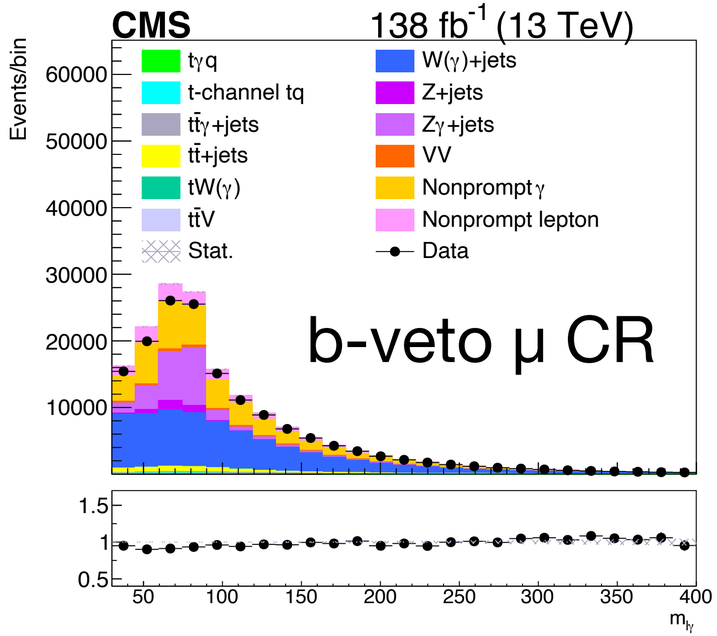
- Simulation: $t\bar{t}$, V+Jets/Vγ+Jets, tW/tWγ, TTV, VV
  - Brief overlap removal explanation
- Data-Driven backgrounds:
  - j→γ (nonprompt γ) from data-driven
  - j→ℓ (nonprompt ℓ) from data-driven
  - e→γ (mainly in e channel) from fit

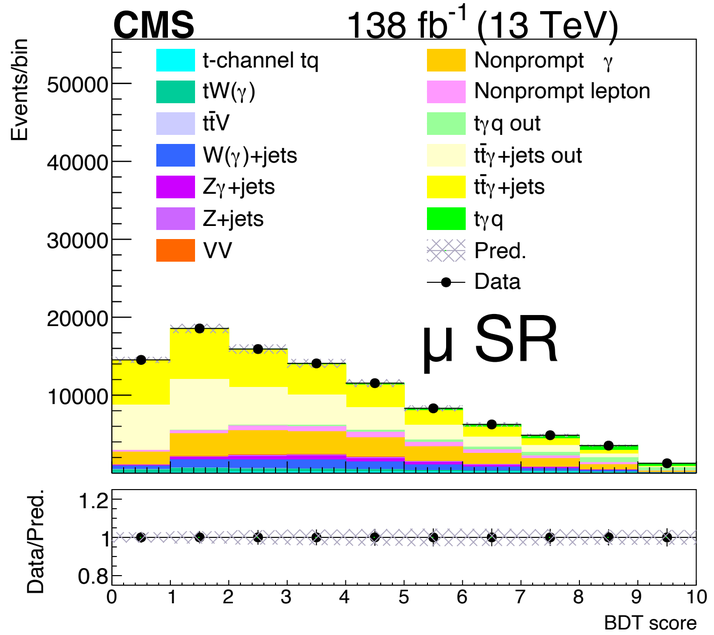
Separate signal and background

- Train **BDT** to separate tγq, $t\bar{t}\gamma$ and others

Signal and control regions definition

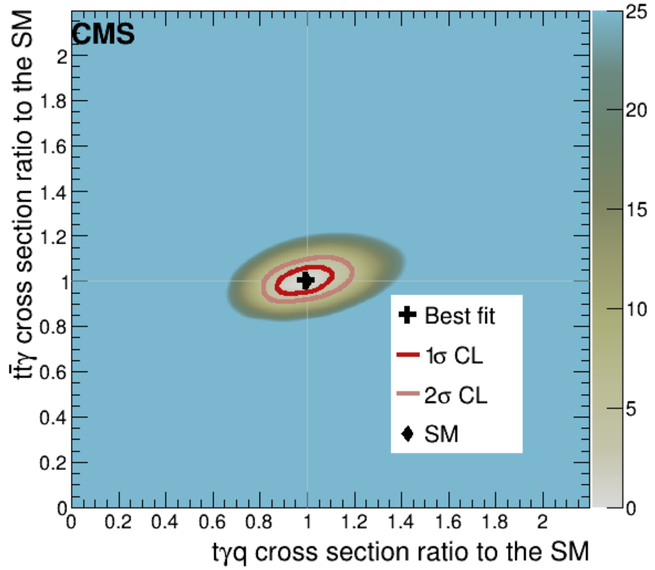
- Signal regions in e or μ channel
- b-veto control region in e or μ channel
- Vγ validation region in e or μ channel





tγq+$t\bar{t}$γ — Fit and Results

- Perform a simultaneous fit for events in the **signal** and **b-veto control regions**
  - The signal region uses the BDT distribution
  - The control region uses the $m_{\ell\gamma}$ distribution
- Float Z+jets (e→γ) normalisation in electron channels
- Differential fits are as functions of photon p_T, lepton p_T, and $m_{\ell\gamma}$ in particle level
  - Top related variables will be added in parton level

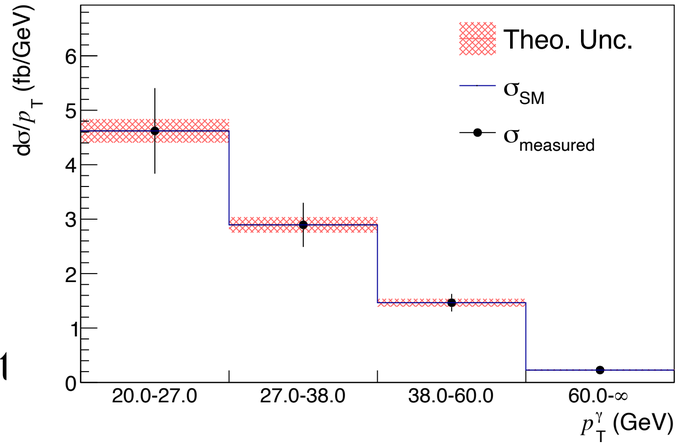


$$r_{t\gamma q} = 1.0^{+0.077}_{-0.077}$$

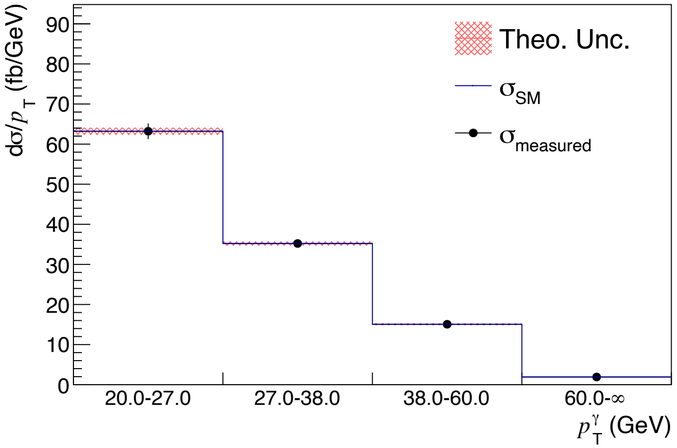
$$r_{t\bar{t}\gamma} = 1.0^{+0.040}_{-0.041}$$

TOP-18-010:

$r = 1.0 \pm 0.009\,\text{stat}$
$\pm 0.062\,\text{syst}$



1.0 ± 0.17 | 1.0 ± 0.14 | 1.0 ± 0.11 | 1.0 ± 0.09



1.0 ± 0.05 | 1.0 ± 0.04 | 1.0 ± 0.04 | 1.0 ± 0.04