

**CMS** $\sqrt{s} = 13 \text{ TeV}$ 

$\sigma_{t\bar{t}W} = 0.75 \pm 0.05(\text{scale}) \pm 0.01(\text{PDF}) \text{ pb}$   
 arXiv:2306.16311  
 NNLO(QCD)+NLO(EW)

$\sigma_{t\bar{t}Z} = 0.86^{+0.07}_{-0.08}(\text{scale}) \pm 0.02(\text{PDF}) \text{ pb}$   
 EPJC 80 (2020) 428  
 NLO(QCD+EW)+NNLL

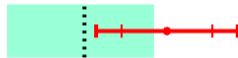
$\sigma_{t\bar{t}\gamma} \times 5 = 0.15 \pm 0.03(\text{tot.}) \text{ pb} \times 5$   
 MadGraph5\_aMC@NLO  
 NLO QCD

$\sigma_{t\bar{t}\gamma} = 0.77 \pm 0.14(\text{tot.}) \text{ pb}$   
 MadGraph5\_aMC@NLO  
 NLO QCD

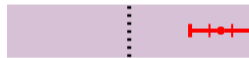
 $\sigma_{\text{meas.}} \pm (\text{stat.}) \pm (\text{syst.})$ 
 $t\bar{t}W$ 
 $0.87 \pm 0.04 \pm 0.05 \text{ pb}$ 


total stat.

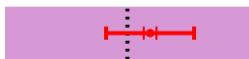
CMS,  $L_{\text{int}} = 138.0 \text{ fb}^{-1}$   
 JHEP 07 (2023) 219

 $t\bar{t}Z$ 
 $0.95 \pm 0.05 \pm 0.06 \text{ pb}$ 


CMS,  $L_{\text{int}} = 77.5 \text{ fb}^{-1}$   
 JHEP 03 (2020) 056

 $t\bar{t}\gamma$  dilepton
 $0.175 \pm 0.003 \pm 0.006 \text{ pb} \times 5$ 


CMS,  $L_{\text{int}} = 138 \text{ fb}^{-1}$   
 JHEP 05 (2022) 091

 $t\bar{t}\gamma$  l+jets
 $0.798 \pm 0.007 \pm 0.048 \text{ pb}$ 


CMS,  $L_{\text{int}} = 137 \text{ fb}^{-1}$   
 JHEP 12 (2021) 180

 $\sigma_{t\bar{t}X} [\text{pb}]$ 

0

0.2

0.4

0.6

0.8

1

1.2

1.4

1.6