Search for central exclusive production of top quark pairs with the CMS and TOTEM experiments.

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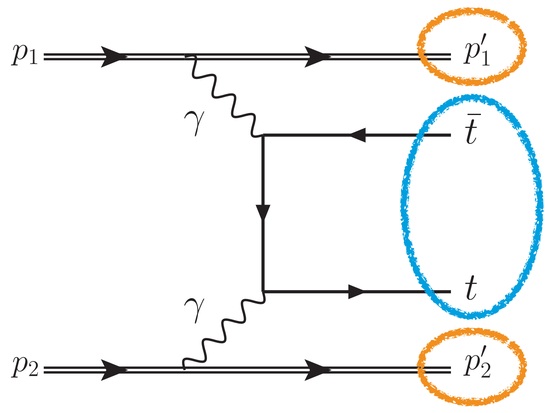
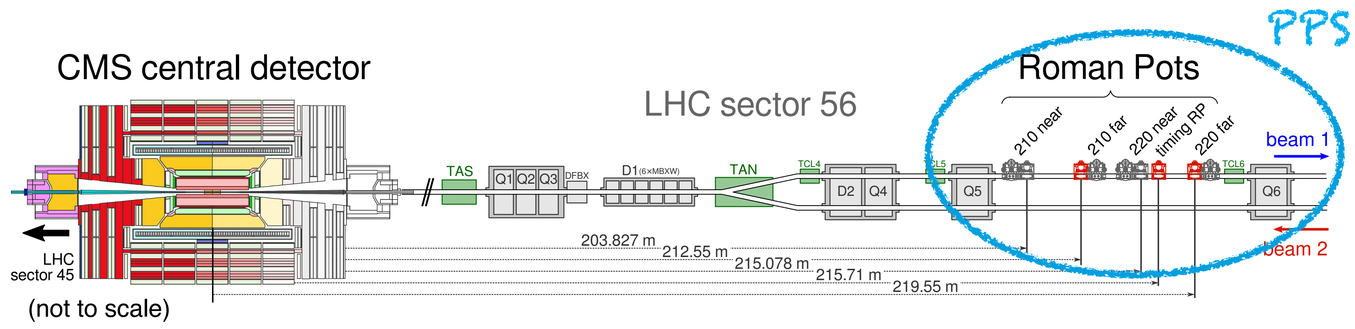
Create top quarks out of light

- LHC collisions where protons remain intact
- $t\bar{t}$ produced by **photon-photon** interactions



- SM expected **cross section ~0.29 fb**

Detect forward protons with CMS and TOTEM



- Intact protons remain in beam pipe
- Use the **Precision Proton Spectrometer (PPS)**
  - Proton detector stations located ± ~200 m from the interaction point
  - Measure $\xi = \dfrac{\Delta p}{p_i}$ — fraction of proton momentum loss

Event selection

ℓ+jets channel

1. =1 lepton
   ≥2 b-jets, ≥2 light jets
   =1 proton on each side of PPS

Dilepton channel

2. ≥2 leptons (=1 OS pair)
   ≥2 b-jets
   =1 proton on each side of PPS

Estimate background from data

- Main background: $t\bar{t}$ matched with unrelated proton tracks (e.g. from pileup)
- **Not modelled in MC!**

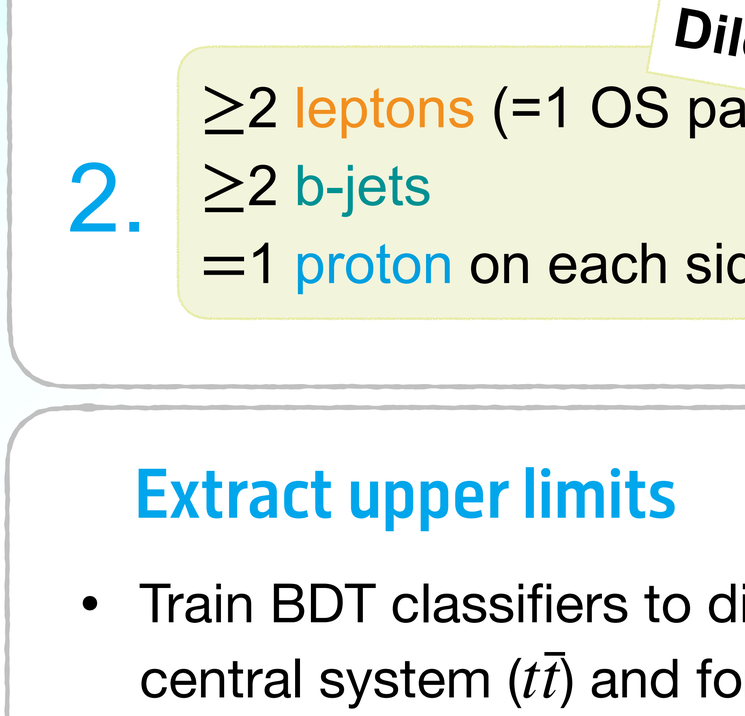
data-driven method:

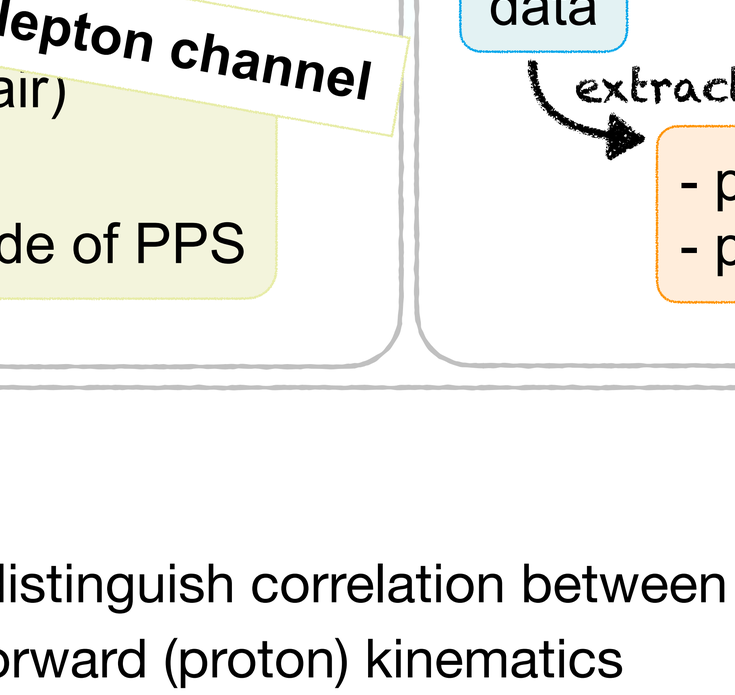
data → extract:
- probability of 0,1,2 proton tracks
- proton kinematic distributions

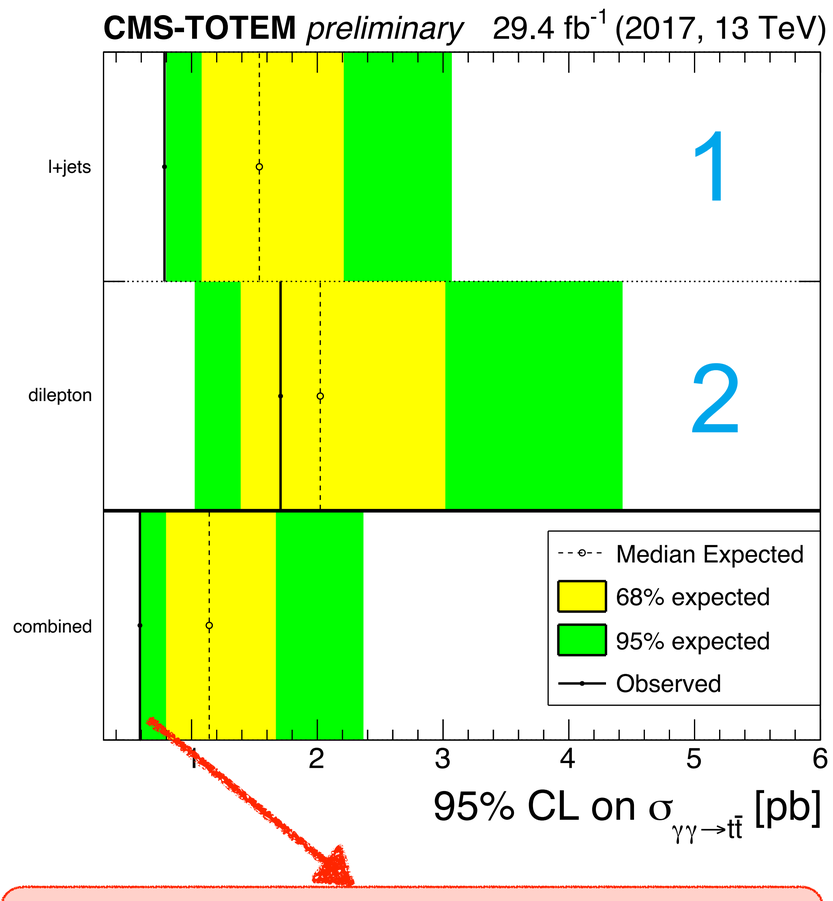
→ apply → MC

Extract upper limits

- Train BDT classifiers to distinguish correlation between central system ($t\bar{t}$) and forward (proton) kinematics
- Fit BDTs and extract first-ever upper limit for cross section







Result: Observed limit 0.59 pb

Reference: CMS PAS-TOP-21-007
TOTEM-NOTE-2022-002

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

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