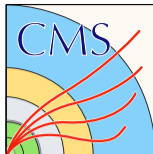# Automated assembly of PS modules for the Phase II Tracker & search for $t\bar{t}H(\to b\bar{b})$ in dilepton events

Marino Missiroli (DESY Fellow)

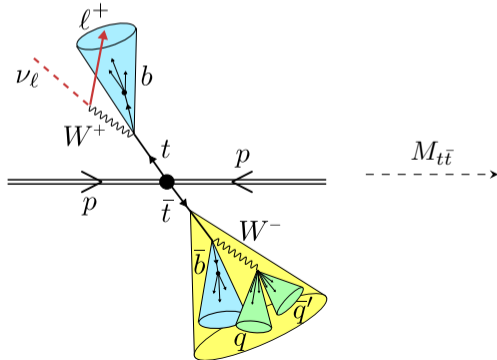27 February 2018

Speaker's specs

Background, past activities

- from ~Rimini, Italy

- Physics degree from University of Padova

- PhD from Universidad Autónoma de Madrid (March 2017)
    - Searches for top-antitop quark resonances in semileptonic final states with the CMS detector

- joined DESY-CMS group in August 2017
    - involved in both physics analysis and detector upgrade

PhD Thesis

Search for $X \to t\bar{t}$ **($\ell + \mathrm{jets}$) at** $\sqrt{s} = 8$ TeV **and** $\sqrt{s} = 13$ TeV

CMS-B2G-13-008 $L = 19.8 \ \mathrm{fb}^{-1}$ (8 TeV)

CMS-B2G-16-015 $L = 2.6 \ \mathrm{fb}^{-1}$ (13 TeV)

- search for resonances in $M_{t\bar{t}}$ spectra in $\ell + \mathrm{jets}$ events
- introduction of jet top-tagging for boosted tops
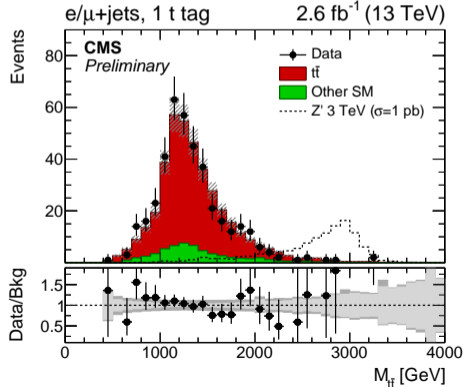 - → improved sensitivity to high-M_X signals

no significant excess in data

state-of-the-art limits on $\sigma(pp \to X \to t\bar{t})$

Current work

Involvement in DESY-CMS group

- Detector Upgrade:
  - Automated Assembly of PS Module for the CMS Phase II Tracker

- Physics Analysis:
  - search for $t\bar{t}H(\to b\bar{b})$ in dilepton events
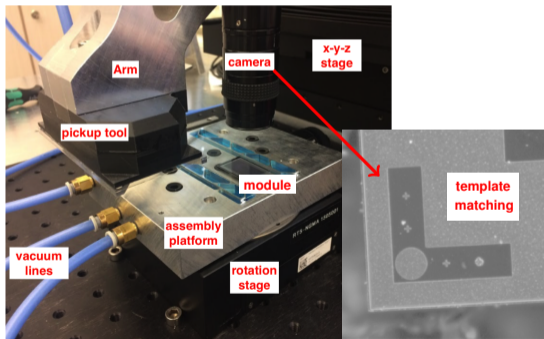
Automated Assembly of PS Module for CMS Phase II Tracker

looking to the future …

- novel stacked Pixel-Strip modules providing track p_T discrimination at module level

  - rejection of low-p_T tracks, tracking info to L1-Trigger

- automated method for module assembly based on pattern-recognition on fiducial markers

- sensors to be aligned within 800 μrad (45 mdeg)

Automated Assembly of PS Module for CMS Phase II Tracker

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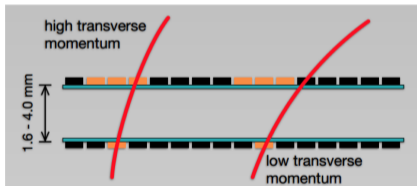
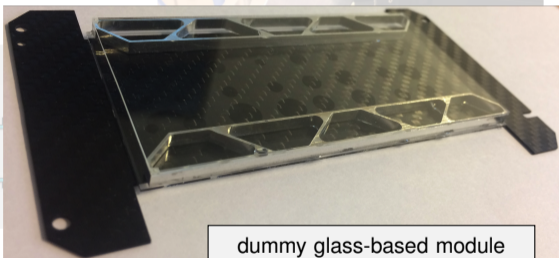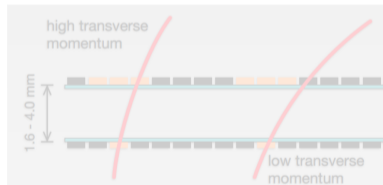- sensors to be aligned within 800 μrad (45 mdeg)

- automated method for module assembly based on pattern-recognition on fiducial markers

template matching

dummy glass-based module assembled at DESY within ang. tolerance: 175 μrad

Search for $t\bar{t}H(\to b\bar{b})$ in dilepton events

. . . and staying in the present

- ttH production allows direct measurement of Top-Higgs coupling

- small SM cross section: $\sigma_{t\bar{t}H} \simeq 0.5$ pb ($\sqrt{s} = 13$ TeV)

  . . . but many different final states ($t\bar{t}$ and H decay modes),
  and reconstructed objects → handles to reduce/control SM bkgs

- now is an important time for $t\bar{t}H$ at the LHC

  - 5σ observation mark should be within reach
    with $2016 + 2017$ data sets and combination of all $t\bar{t}H$ channels

- joined DESY-CMS effort in $t\bar{t}H(\to b\bar{b})$ dilepton analysis

  - working on analysis of full $2016 + 2017$ data set
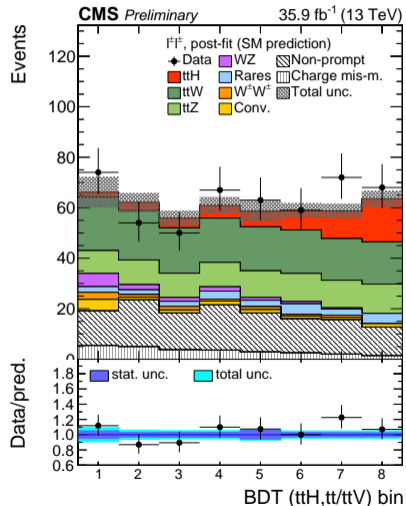

CMS-PAS-HIG-16-038

MEM discriminant
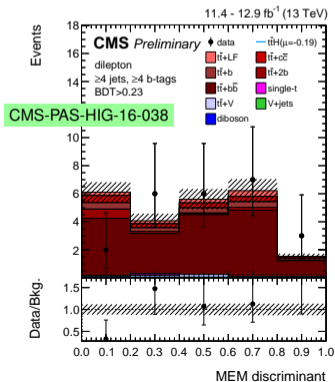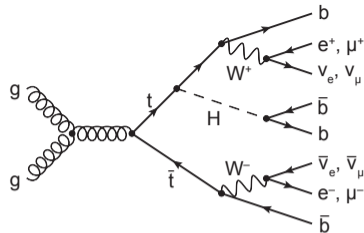
Summary

- joined DESY-CMS group in August 2017

- currently involved in 2 projects:

    - Phase II Tracker Upgrade: automated assembly of PS modules

    - Physics Analysis: search for $t\bar{t}H(\to b\bar{b})$ with $2016 + 2017$ data sets

BACKUP

CMS $t\bar{t}H$ multilepton: 2ℓ same-sign channel

CMS-PAS-HIG-17-004

- CMS $t\bar{t}H$ multilepton analysis (full 2016 data set)

- combination of BDT outputs (post-fit) in 2ℓ same-sign events

- combined obs. (exp.) significance for $t\bar{t}H$: 3.3σ (2.4σ)