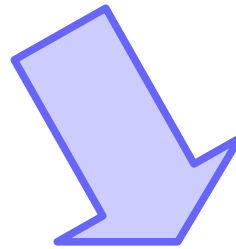


Me and my Research Activity

Dr. Michele Pinamonti



*INFN Trieste, Gruppo Collegato di Udine
SISSA, Trieste*



Università di Roma Tor Vergata

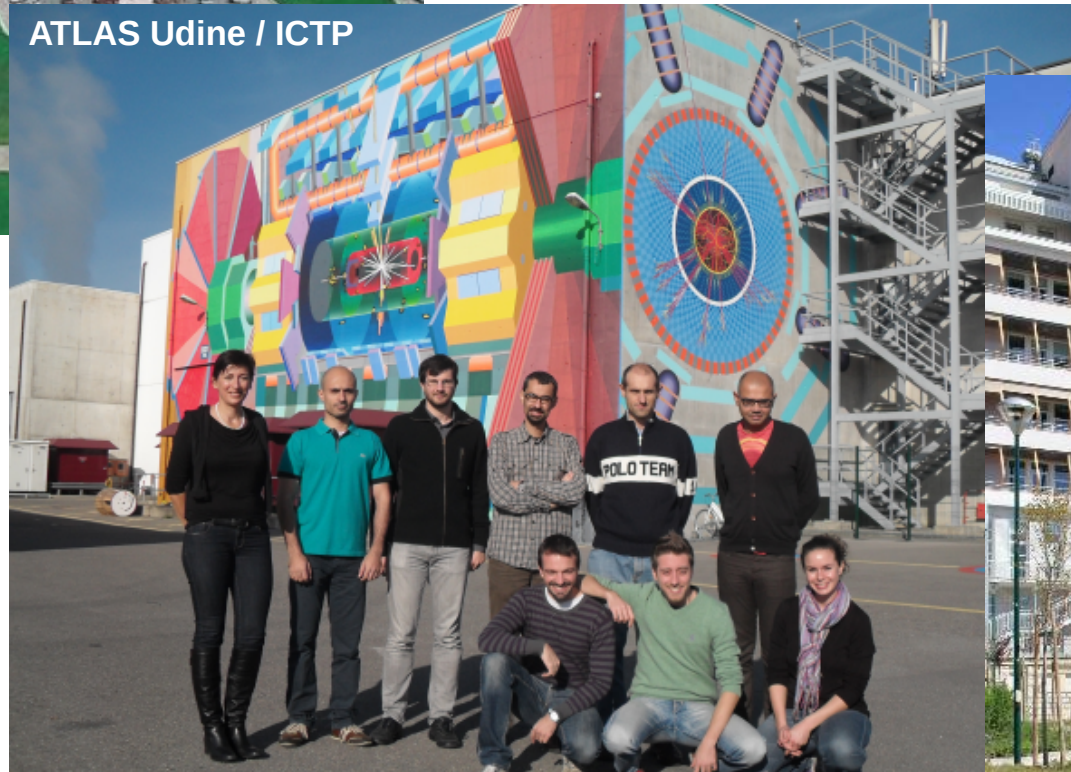


Roma Tor Vergata, 16th Dec 2016

From where do I come from?



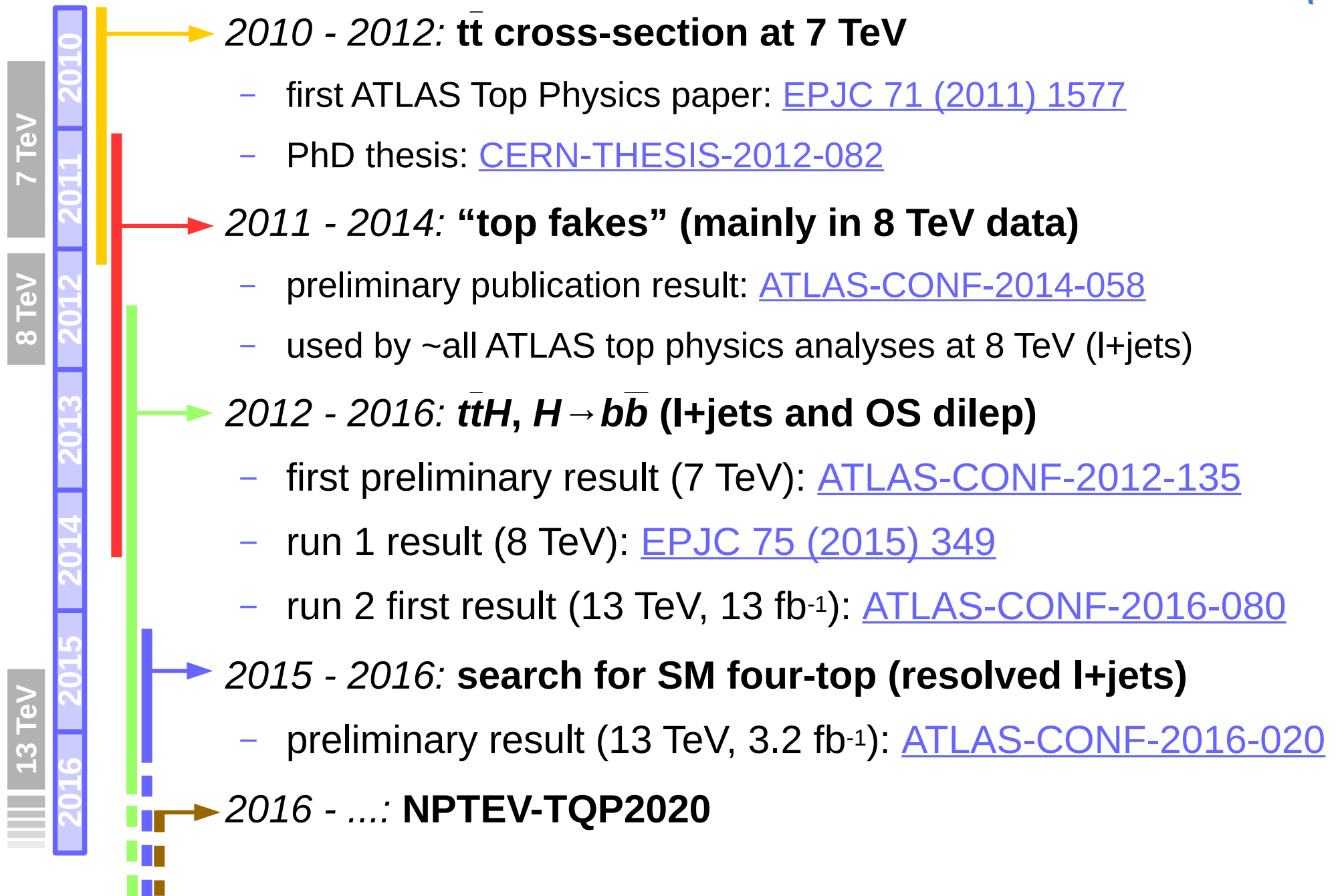
- University studies in Physics & PhD at Trieste University
- Working within ATLAS Udine / ICTP group since 2009



- Since then mainly working on **ATLAS data analysis**
- In the last years, being a post-doc at SISSA, collaborating with theorists on **LHC phenomenology**



Timeline





Timeline

- LHC Phenomenology activity in collaboration with theorists from SISSA and ICTP-SAIFR “covering” LHC shutdown

2013 - 2014: **Top-gluon coupling** [arXiv:1307.5750](https://arxiv.org/abs/1307.5750)

- Limits on top-quark compositeness from $t\bar{t}$ cross-section

2014: **Top-Wb coupling** [arXiv:1406.5393](https://arxiv.org/abs/1406.5393)

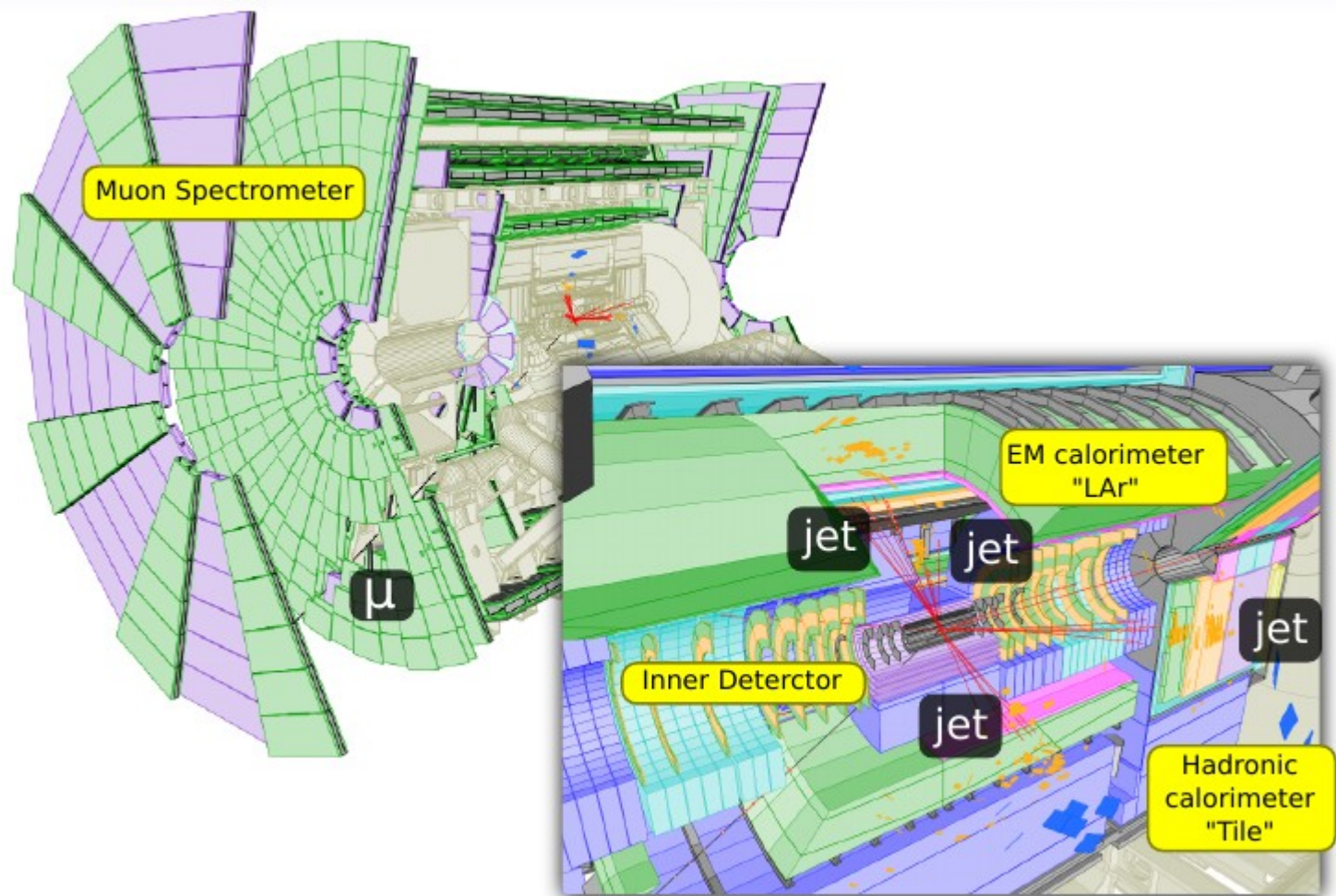
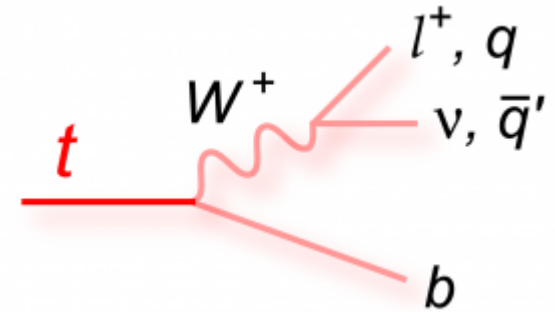
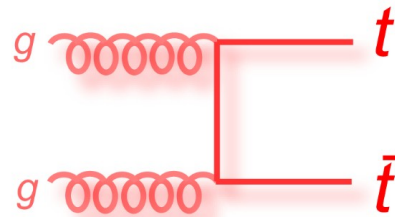
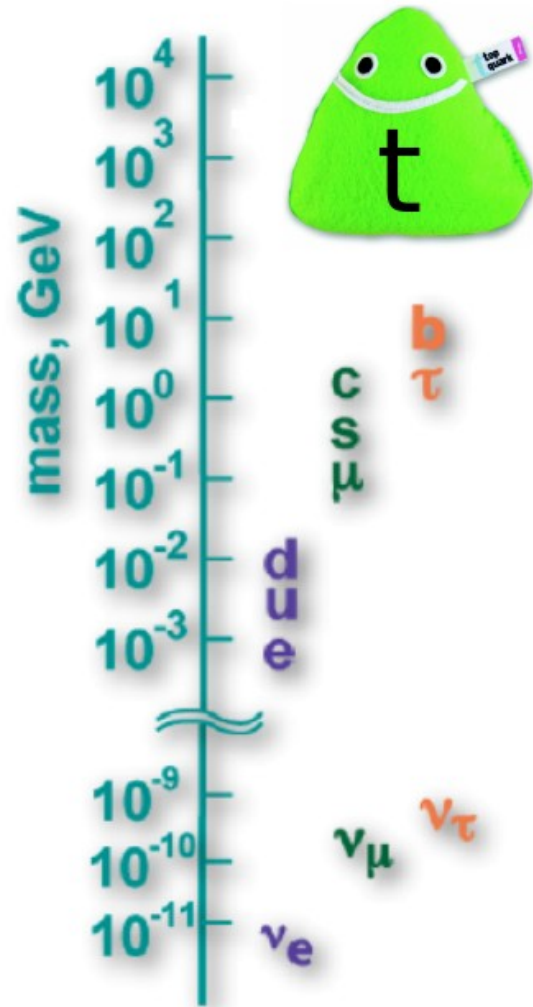
- Limits on top-quark couplings from single-top and top decay

2014 - 2015: **Vector boson scattering** [arXiv:1509.06378](https://arxiv.org/abs/1509.06378)

- Prospects for new Physics discoveries in longitudinal WW scattering



A guideline in my research: The Top Quark

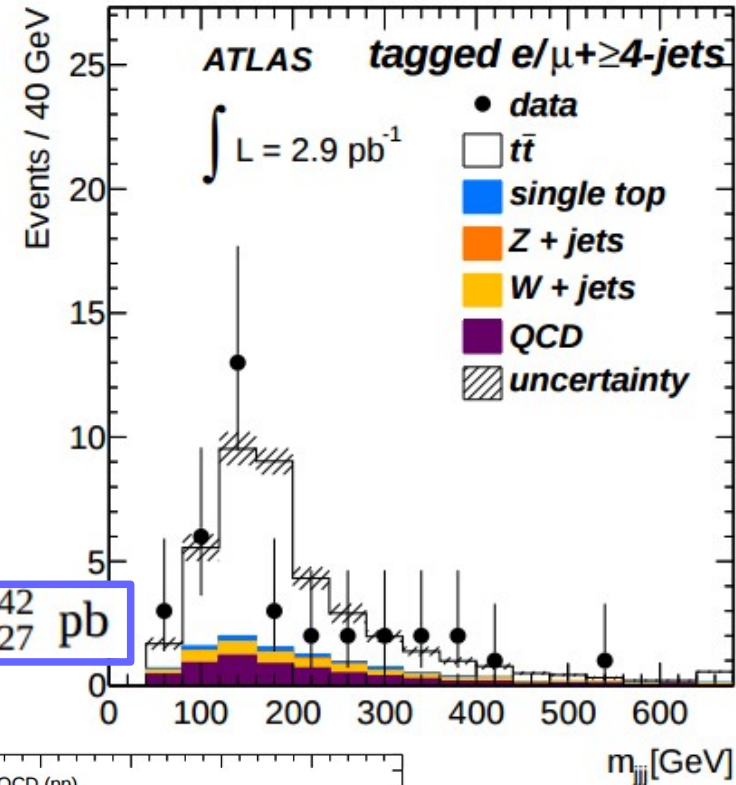




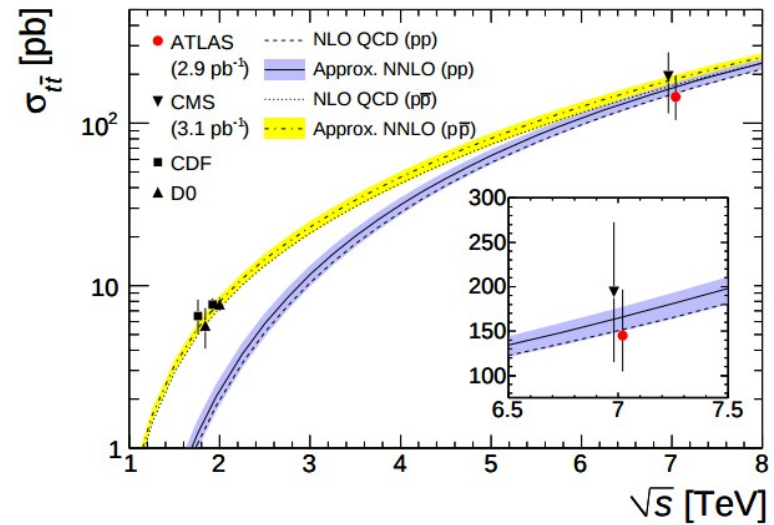
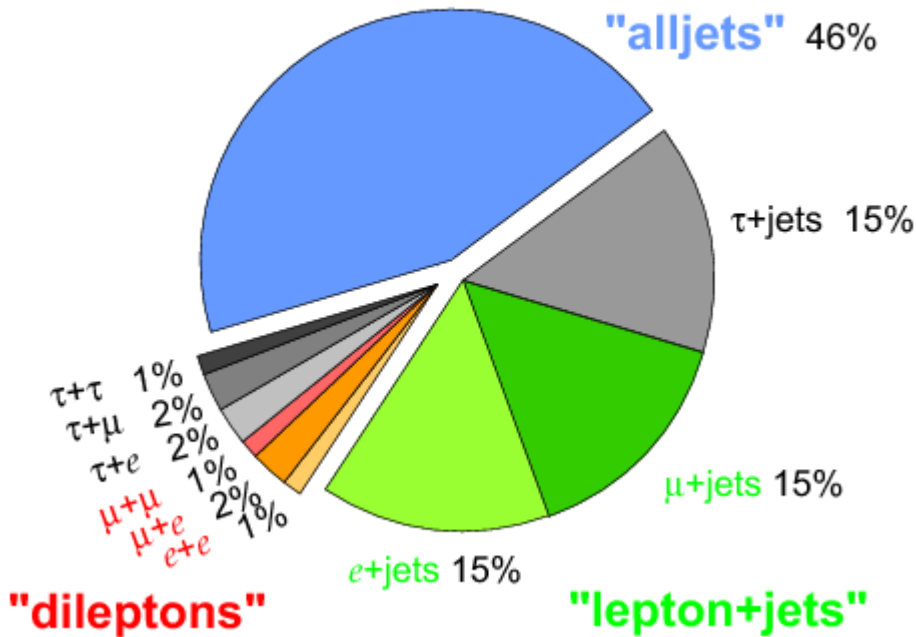
tt Cross-Section Measurement

- First $t\bar{t}$ cross-section measurement in ATLAS (2010 data, 7 TeV)
 - Top-quark "re-discovery"
 - simple "**cut & count**" technique

$$X\text{-sec} = \frac{N(\text{data}) - N(\text{background})}{\text{eff}(\text{signal}) \cdot \text{Lumi}}$$



$$\sigma_{t\bar{t}} = 145 \pm 31^{+42}_{-27} \text{ pb}$$



PhD & Post-Doc - ATLAS Data Analysis

Fake lepton background

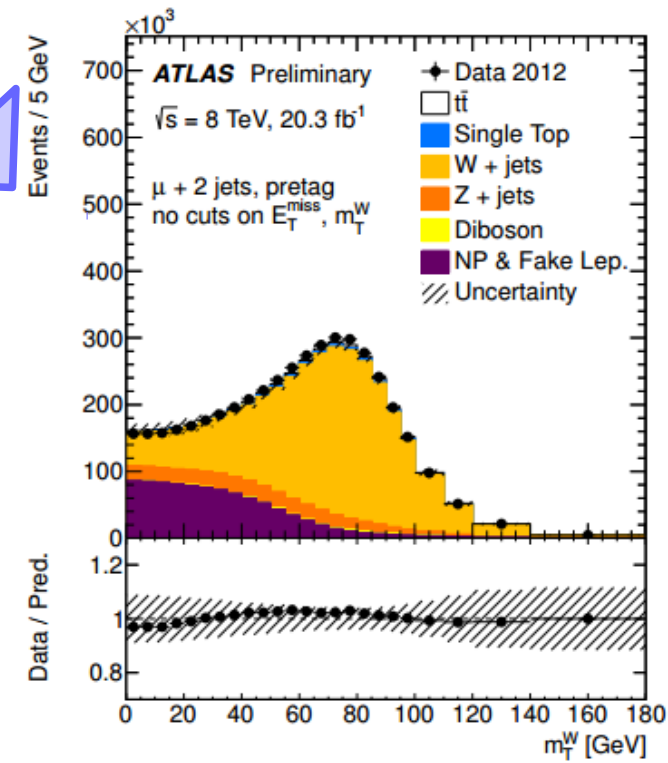
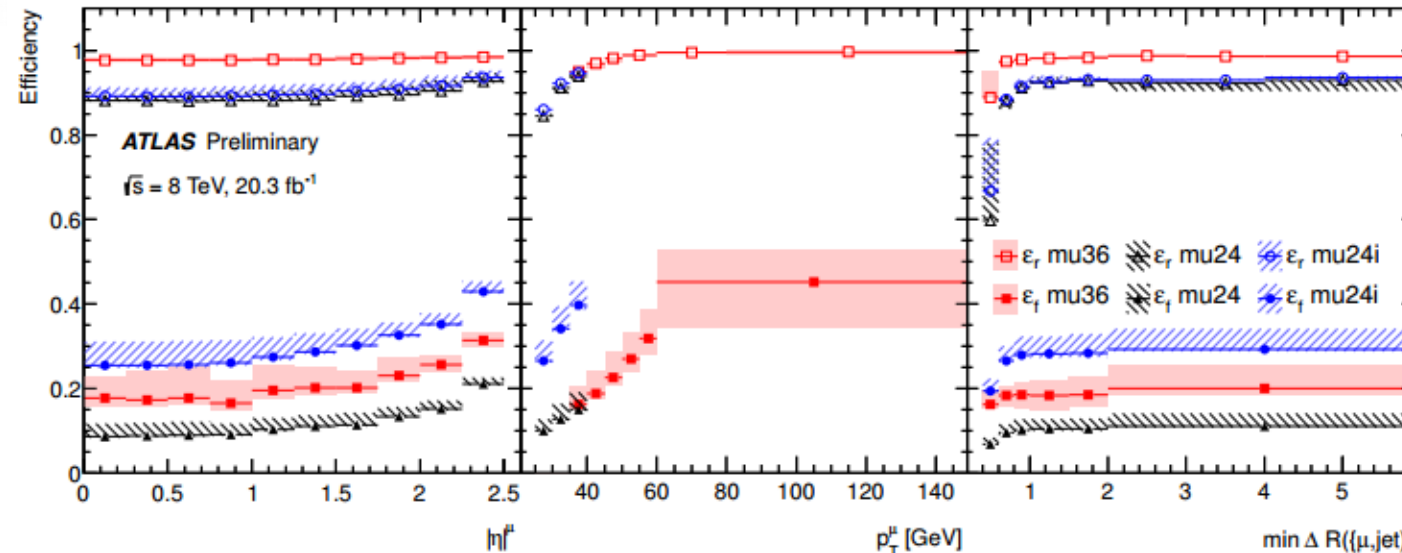
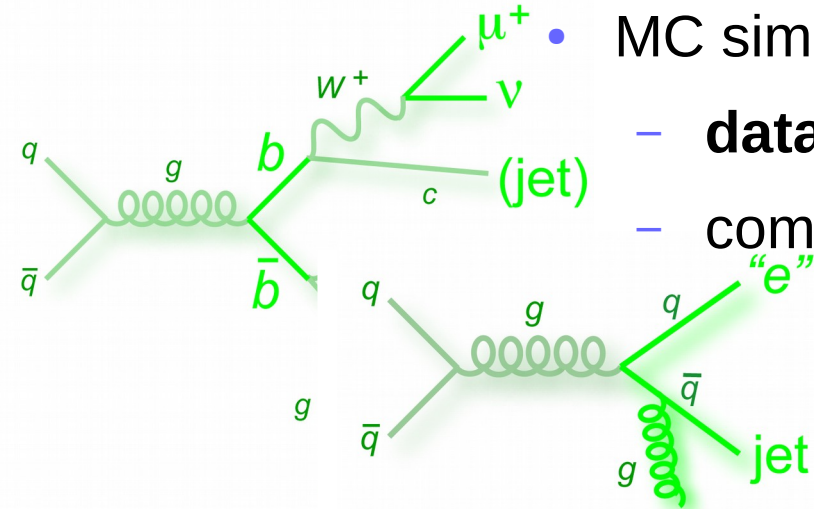


- Top physics analyses, usually ask for 1 or 2 *prompt* e or μ :
 - **non-prompt leptons, jets or photons** can pass lepton selection
 - “fake & non-prompt lepton” background

• MC simulation often *not* suitable for its estimation:

– **data-driven methods** used (e.g. “Matrix Method”)

– common effort in ATLAS TopWG to produce estimates

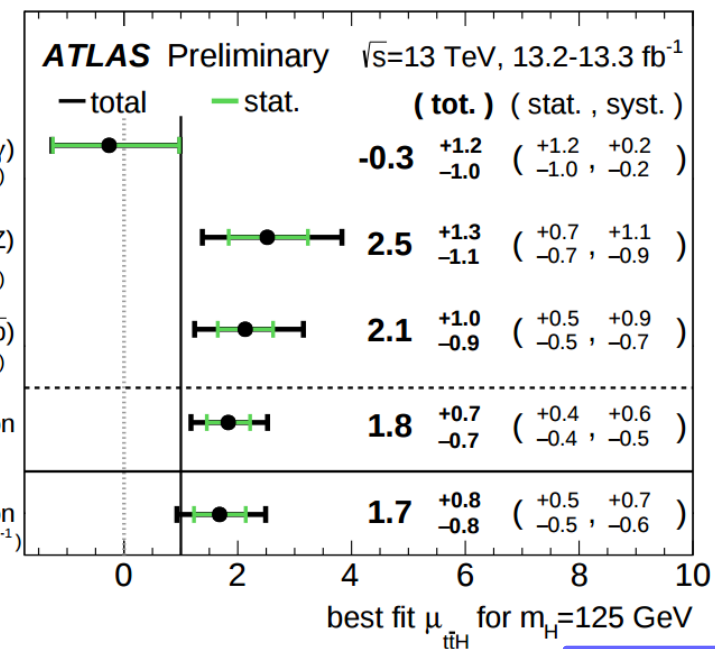
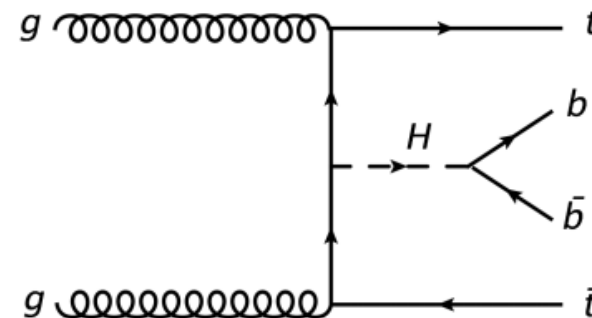


Post-Doc - ATLAS Data Analysis

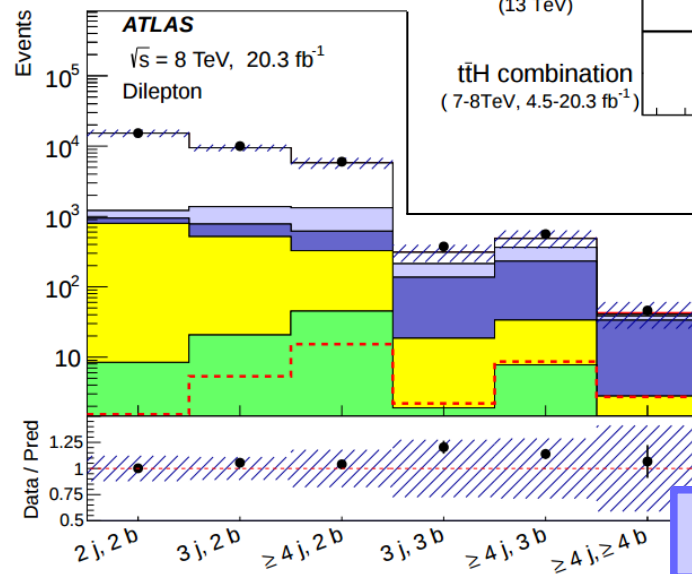
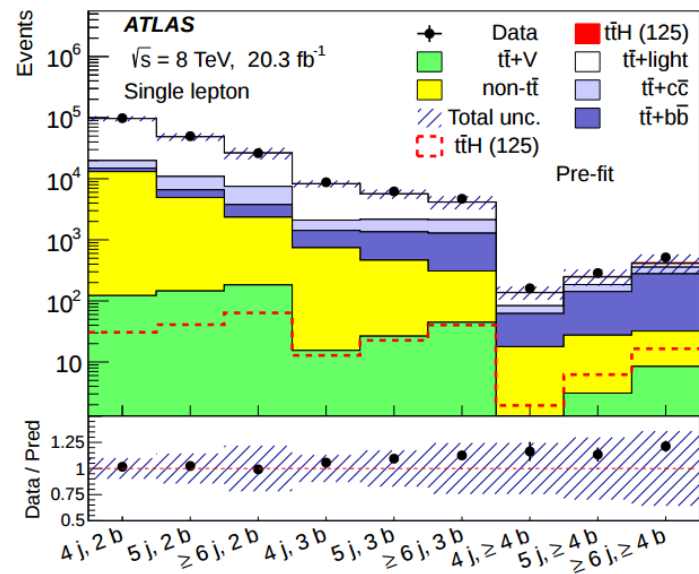


$t\bar{t}H, H \rightarrow b\bar{b}$

- $t\bar{t}H$ important for **directly assessing y_t**
- $H \rightarrow b\bar{b}$ channel:
 - largest Branching Ratio
 - overwhelming **background from $t\bar{t}$ +jets** (esp. heavy-flavour jets)
 - sophisticated analysis based on **simultaneous profile likelihood fit** on several *signal* and *control regions* defined by (N_j, N_b)



Run II



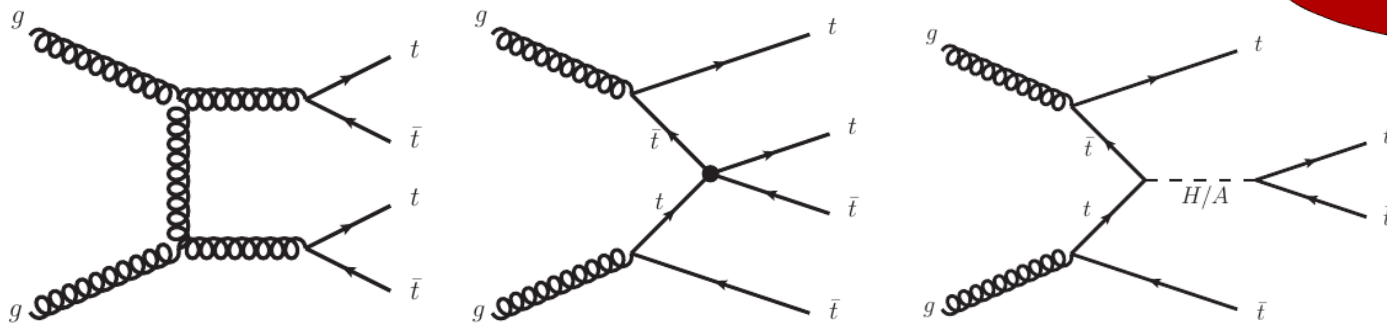
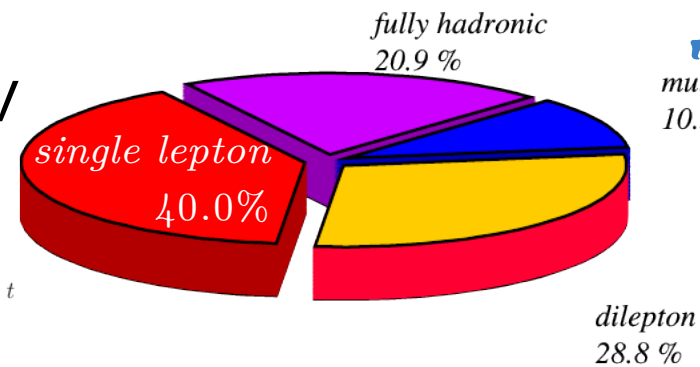
Run I

Post-Doc - ATLAS Data Analysis

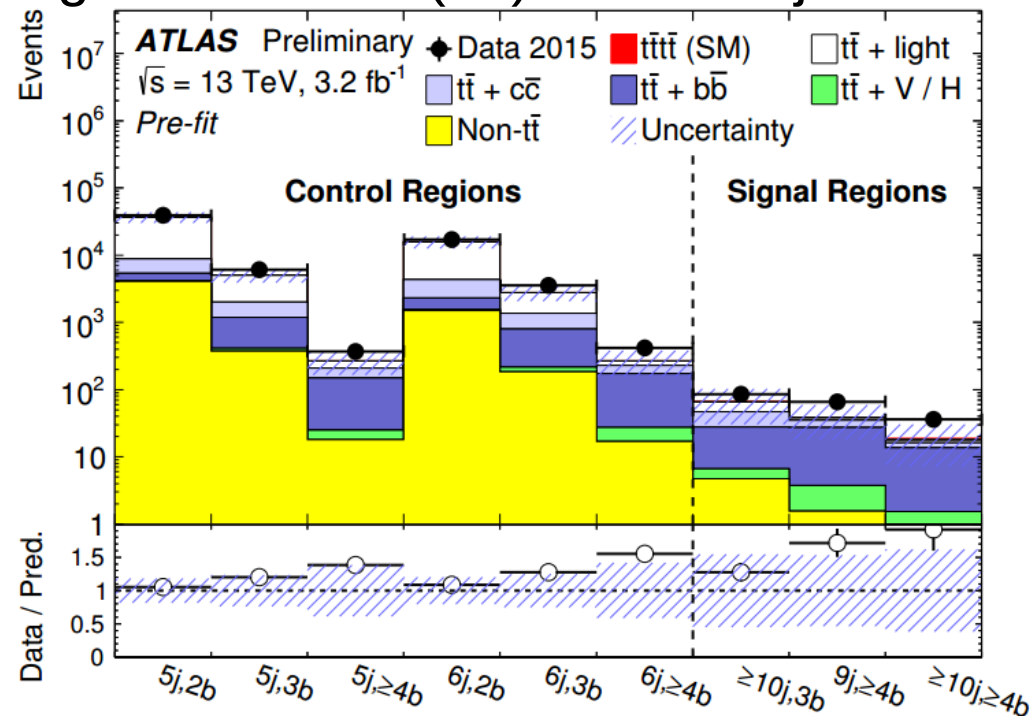
Search for Four Tops



- $t\bar{t}t\bar{t}$ in SM \rightarrow tiny x-section ~ 10 fb @ 13 TeV
 - larger signal predicted in BSM scenarios



- **Single lepton** largest BR, similar signature as $t\bar{t}H(b\bar{b})$ but more jets
 - **Validation Regions** (not fitted) to validate bkg. model extrapolation
 - simple $H_T = \sum p_{T,jet}$ as **discriminant** in each region



Post-Doc - LHC Phenomenology

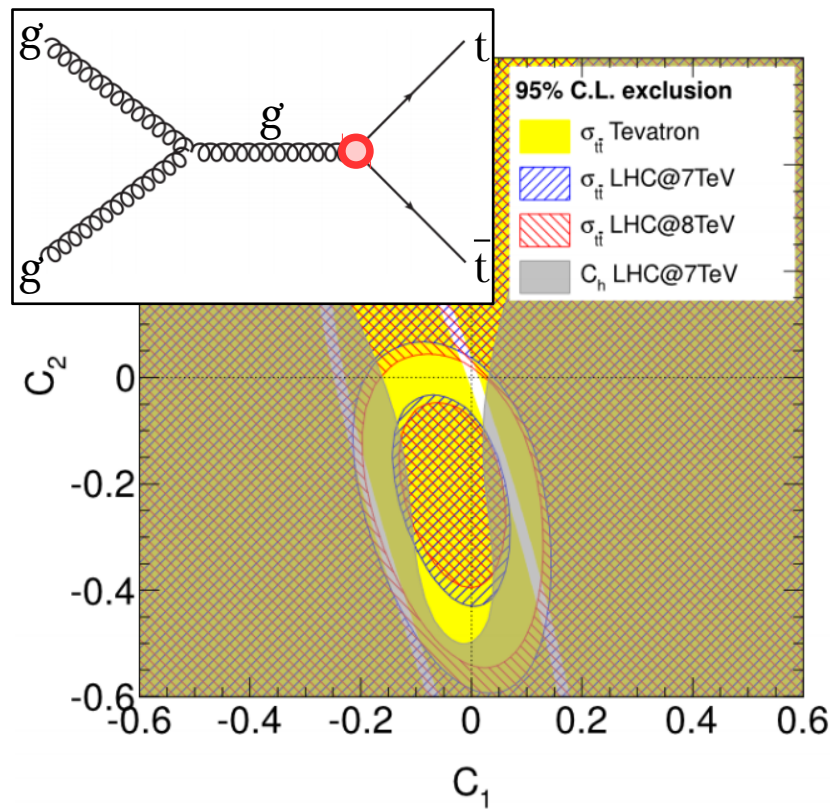
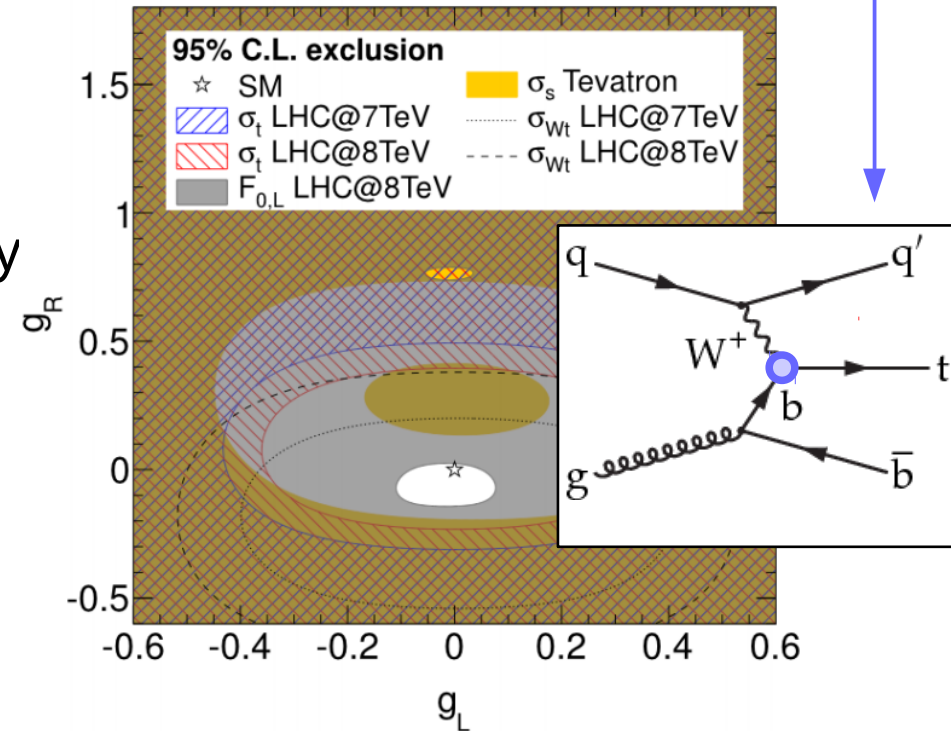


Top Couplings in Effective Field Theory

- Constraints on NP in the context of **EFT**, on coefficients of dimension 6 operators, for **g_{tt}** and **Wtb** vertices

- Measurements from **Tevatron** and **LHC Run 1** used as inputs:

- $t\bar{t}$ and *single top* total x-sections
- $t\bar{t}$ spin correlations
- W helicity fractions in *top* decay



- Limits interpreted as constraints on new state masses, size of top quark...

$$m_{\star} > \begin{cases} 1.2 \text{ TeV} & (\text{Tevatron}) \\ 0.9 \text{ TeV} & (\text{LHC@7}) \\ 0.9 \text{ TeV} & (\text{LHC@8}) \end{cases}, \quad \dots \quad \sqrt{\langle r^2 \rangle} < 4.6 \times 10^{-4} \text{ fm} \quad (95\% \text{ CL})$$

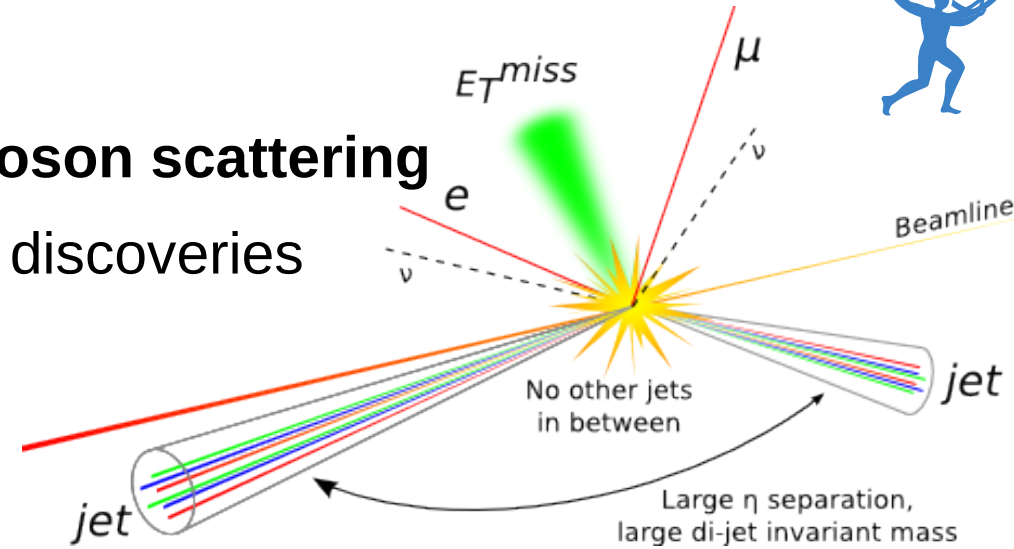
Post-Doc - LHC Phenomenology



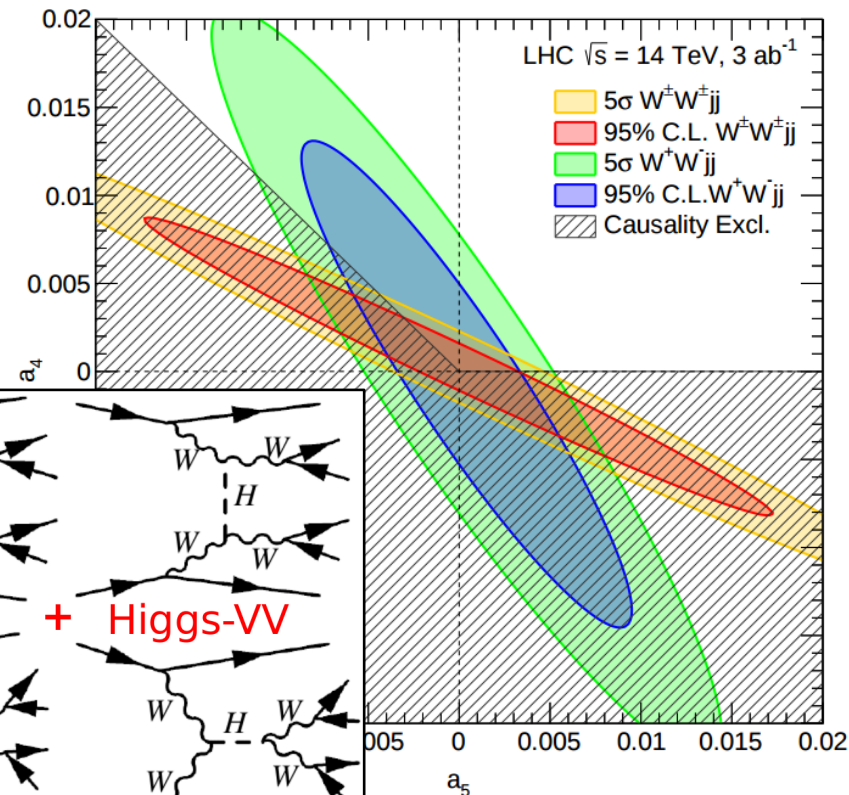
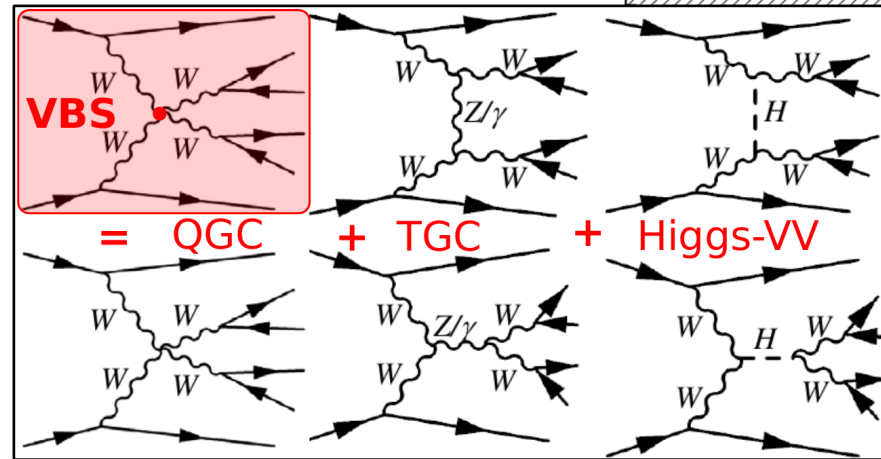
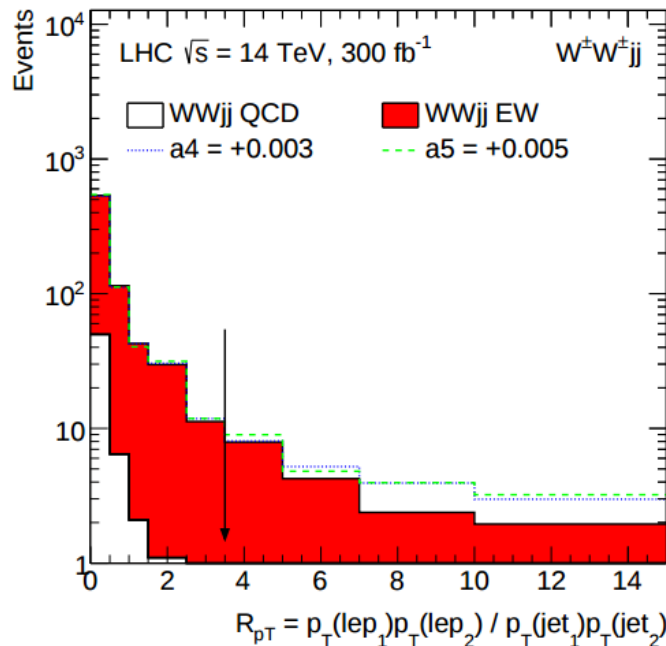
WW Scattering

- **EFT** context, considering **vector-boson scattering**

- sensitivity studies for limits and discoveries at LHC and future pp colliders
- coefficients of anomalous *quartic-gauge, triple-gauge* and *Higgs-VV* couplings



- Analysis **selection cut** strategy developed

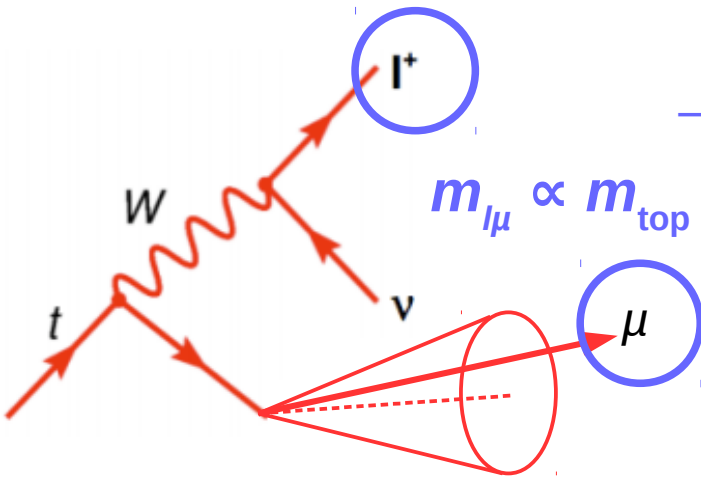
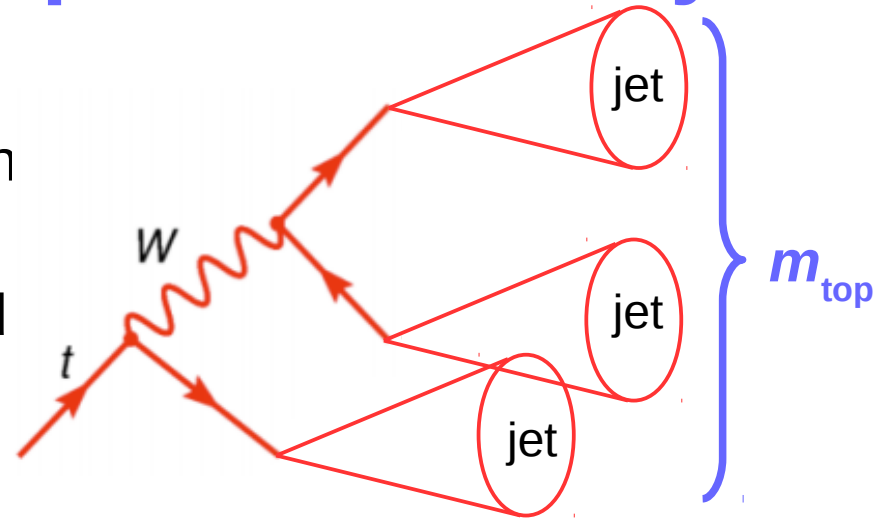


RTDa - ATLAS Data Analysis



Top Mass with semi-leptonic B decay

- Top mass measurements:
 - Standard measurements recon **full top decay**
 - exp. uncertainty dominated by **jet energy scale**

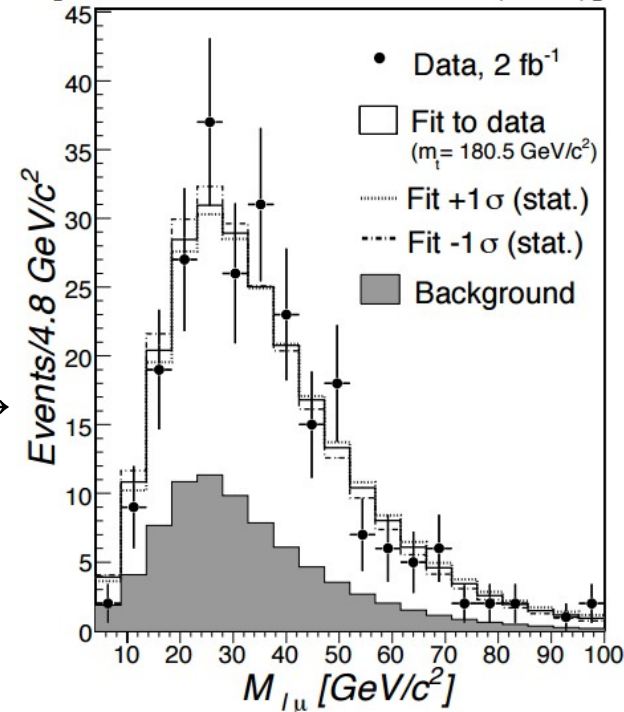


- Proposed method uses **only leptons**:

- prompt lepton from W
- **soft lepton** from B
- partial reconstruction of the decay

- “Proof of principle” at CDF →

[CDF Coll., PRD 79 052007 (2009)]



- Work in progress to see this in ATLAS!



Summary and Conclusions



- During PhD and Post-Doc working on **ATLAS data analysis** and **LHC phenomenology**
- A lot of expertise in ***Top*** and ***Top-related*** analyses
- Hope to continue to work with ***“the Top”***

