



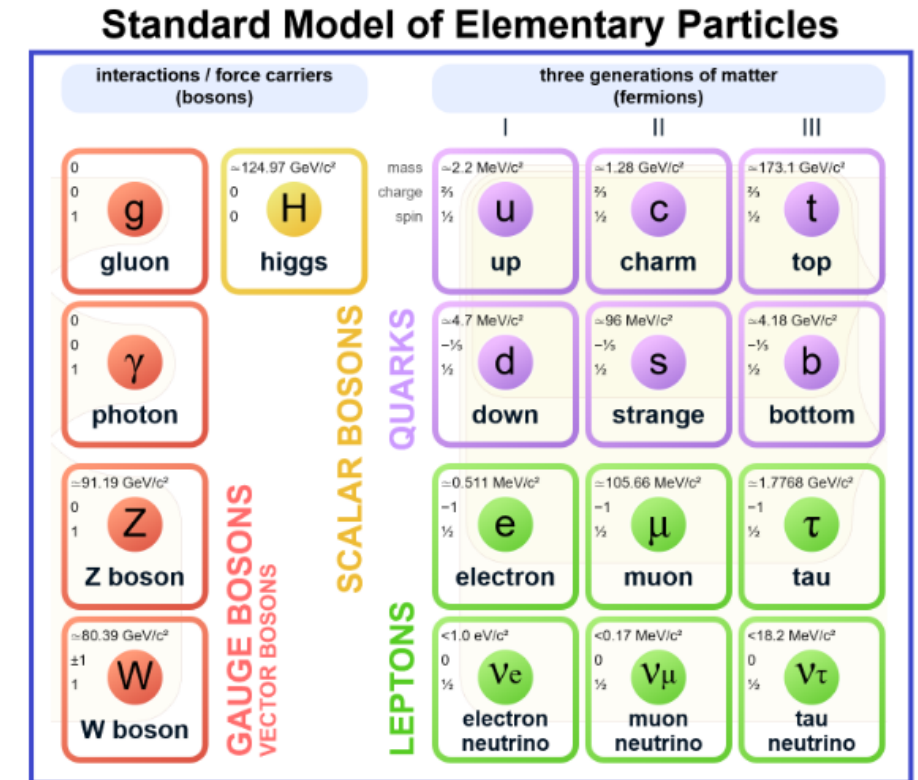
# $tbH^+$ ( $H^+ \rightarrow W^+H$ , $H \rightarrow \tau\tau$ ) Search Using CERN ATLAS Data

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6 December 2024

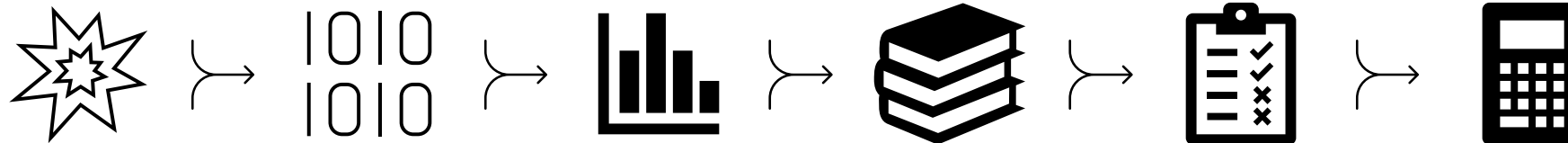
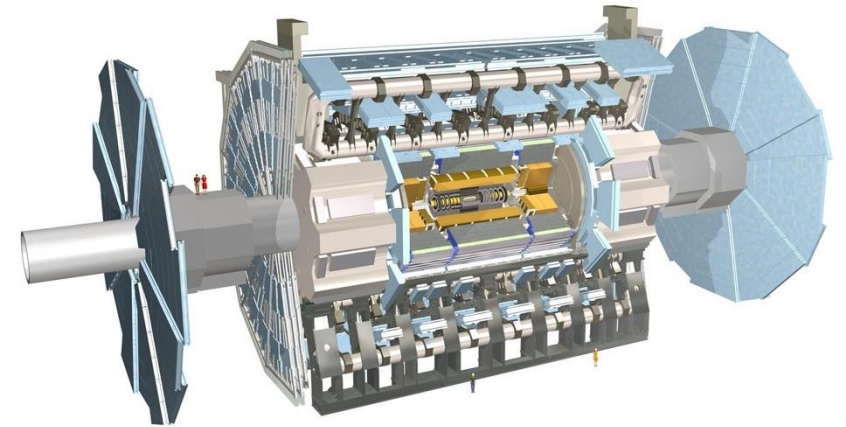
# Motivation

- Standard Model (SM) of particle physics
  - One Higgs boson
- Beyond Standard Model (BSM)
  - Several Higgs bosons
  - Simplest extension:
    - Three neutral Higgs bosons
    - **Two charged Higgs bosons ( $H^\pm$ )**
  - Discovery of a charged Higgs boson would be evidence for physics beyond the SM

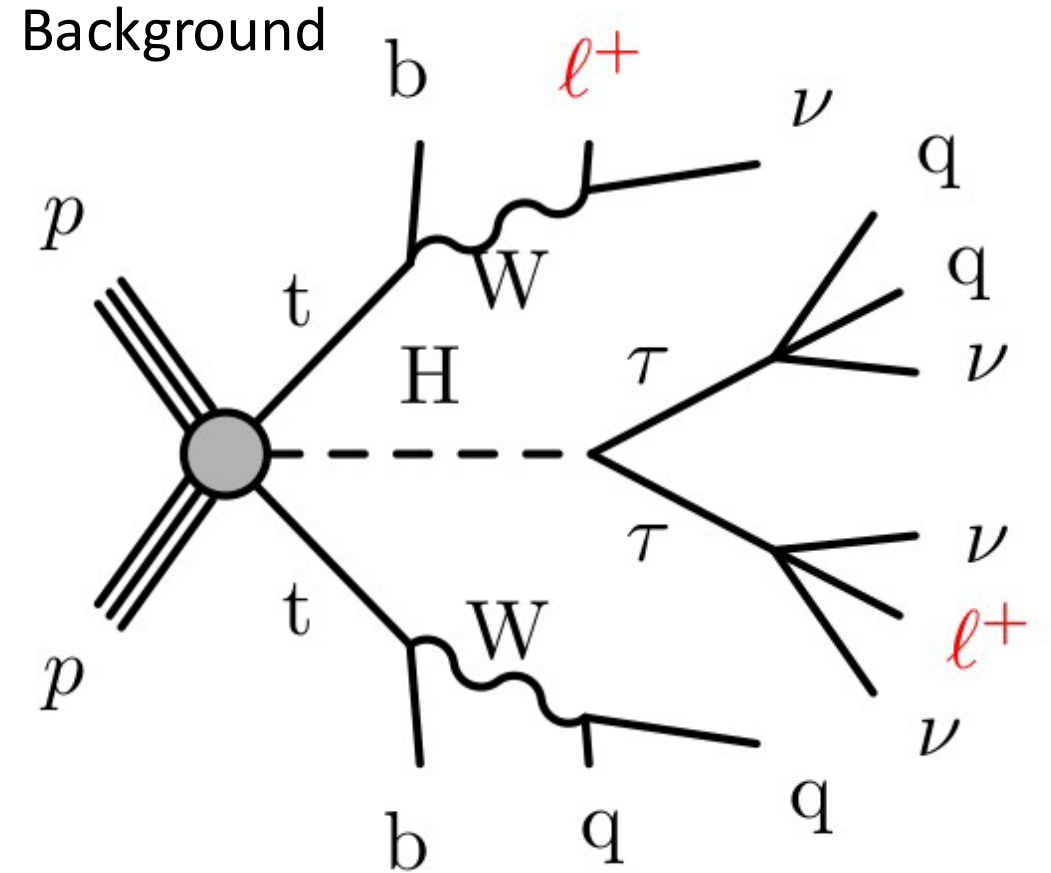
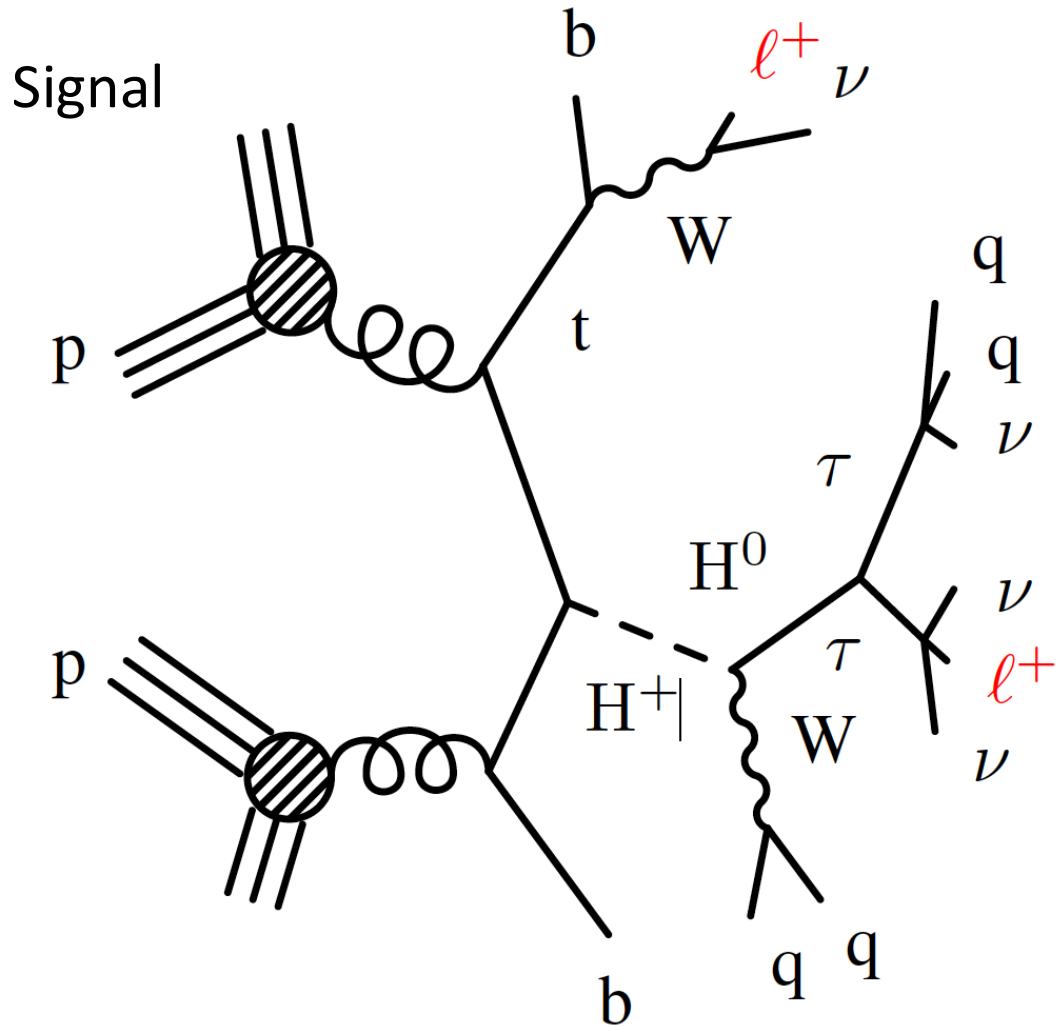


# Outline of Analysis Process

1. Simulation of signal and background processes
2. Study of features describing the events
3. Preselection and normalization
4. Machine Learning development
5. Training & hyperparameter optimization
6. Testing
7. Calculation of significance and cross-section sensitivity



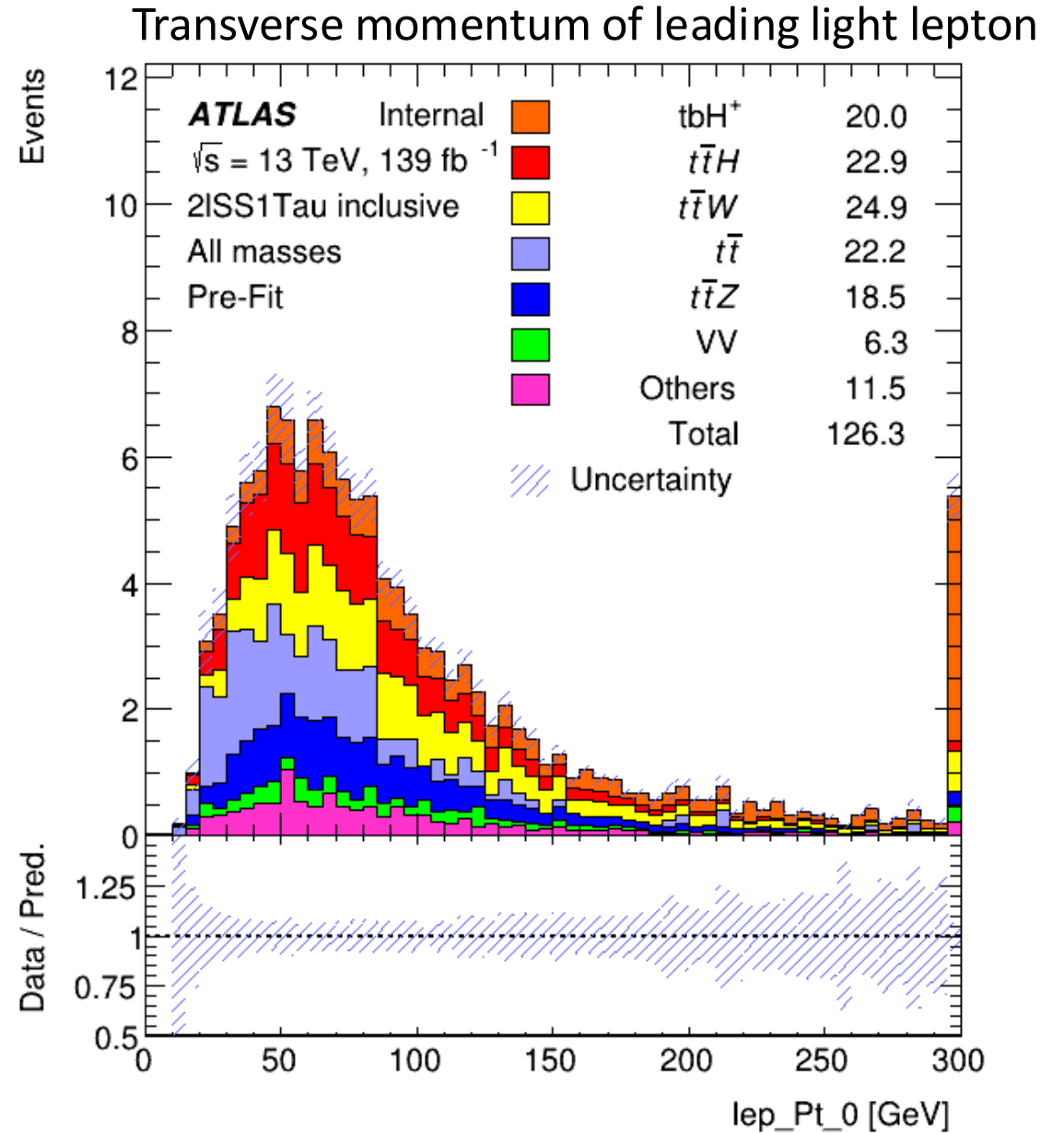
# tbH<sup>+</sup> production and ttH production can have the same final state



# Signal and Background

- H<sup>+</sup> mass (GeV)      Number events
 

300	1.2M
800	0.8M
1500	0.6 M
2000	0.4 M
- Main background reactions
  - ttH
  - ttW
  - tt
  - ttZ
  - VV
- Use event features to separate signal and background



# Remarks

- $tbH^+$  ( $H^+ \rightarrow W^+H$ ,  $H \rightarrow \tau\tau$ ) search using CERN ATLAS data
- Search for physics beyond the Standard Model of particle physics
- Theoretical framework: extended Higgs boson model
- Application of machine learning to separate  $tbH^+$  signal events from other reactions (background events)
- Simulated signal and background events provided
- Goal: using Machine Learning to increase the sensitivity for a  $tbH^+$  signal by increasing the ratio of the number of expected signal /  $\sqrt{\text{number of expected background events}}$

Related projects:

$t\bar{t}H$  measurement and  $WHH$  measurement