B-JET IDENTIFICATION USING A DEEP NEURAL NETWORK

BRIAN STONE

MENTORS: DONATELLA LUCCHESI, LORENZO SESTINI

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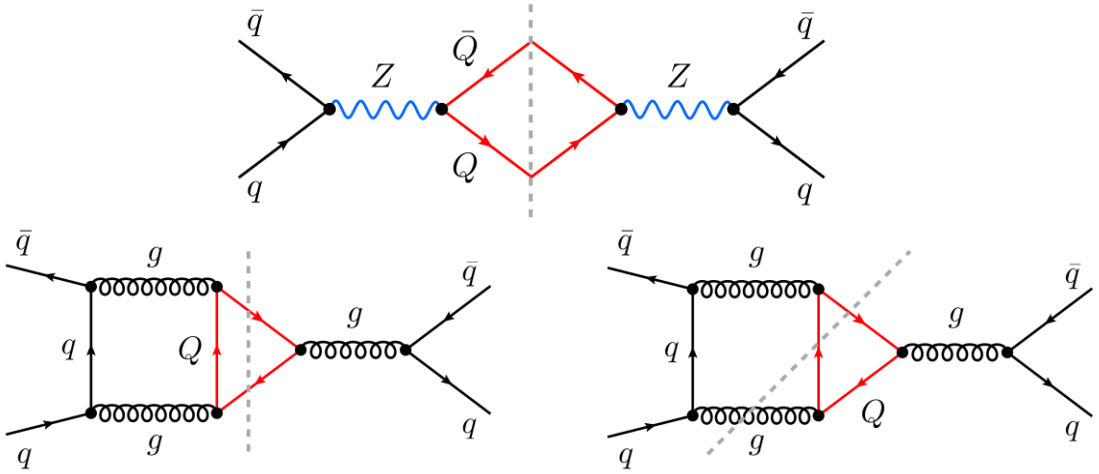
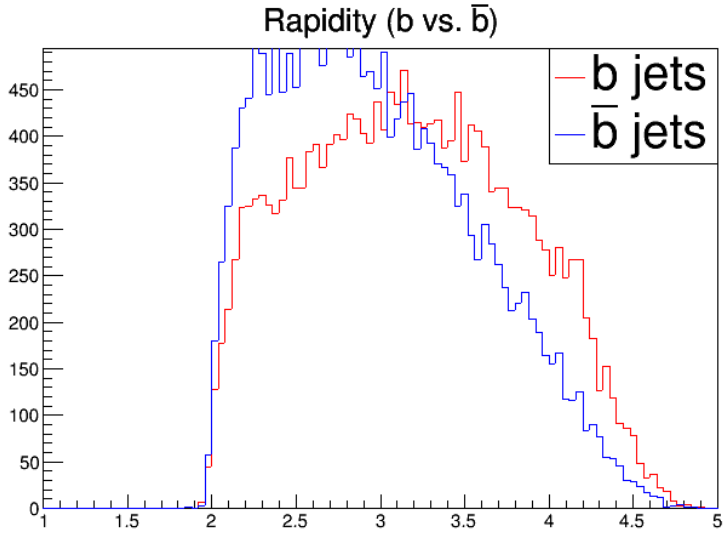
ASYMMETRY IN B AND ANTI-B JETS

- Forward-backward asymmetry means b quarks behave differently from anti-b quarks
- Deviation from Standard Model indicates new particles in loops:



- Measured in terms of rapidity difference per event:

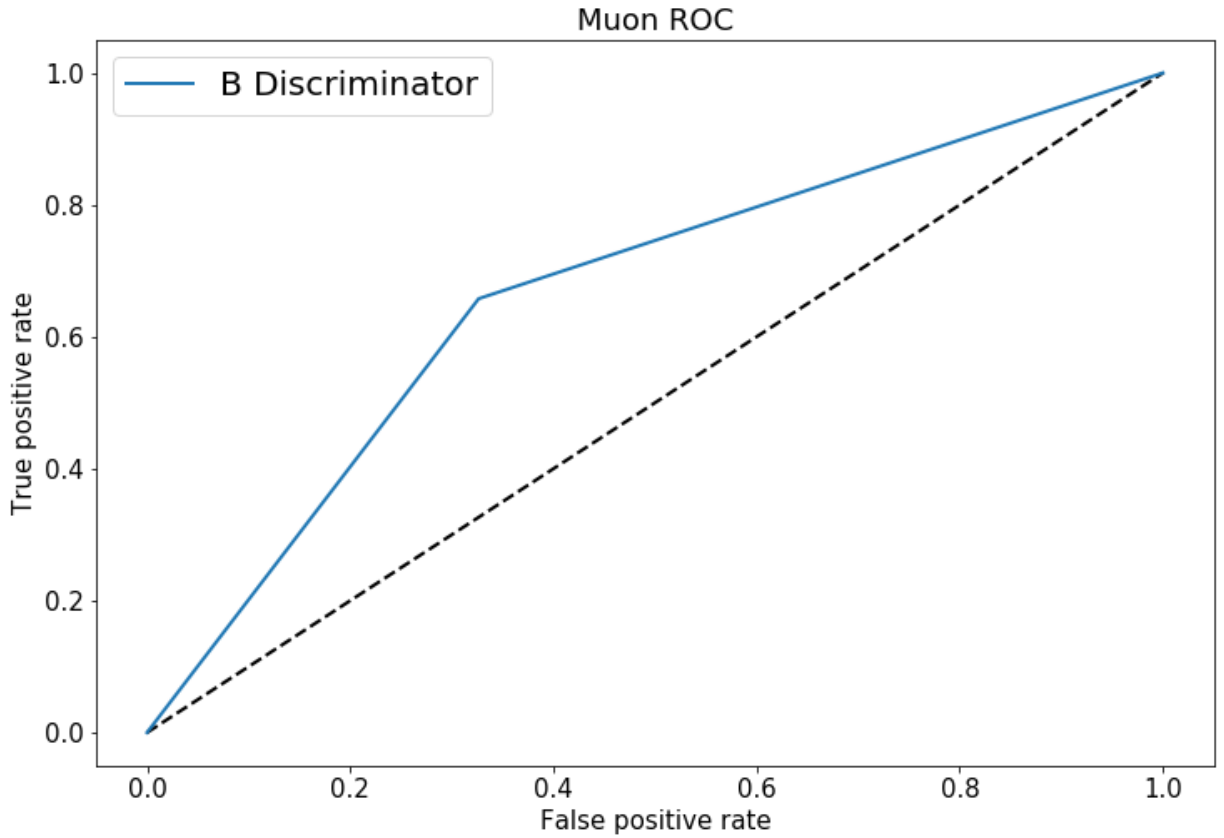
$$\Delta y = y_b - y_{\bar{b}},\ A = \frac{N(\Delta y>0) - N(\Delta y<0)}{N(\Delta y>0) + N(\Delta y<0)}$$



The asymmetry is apparent in the measured rapidities of Z -> b b decays.

CHARGE TAGGING

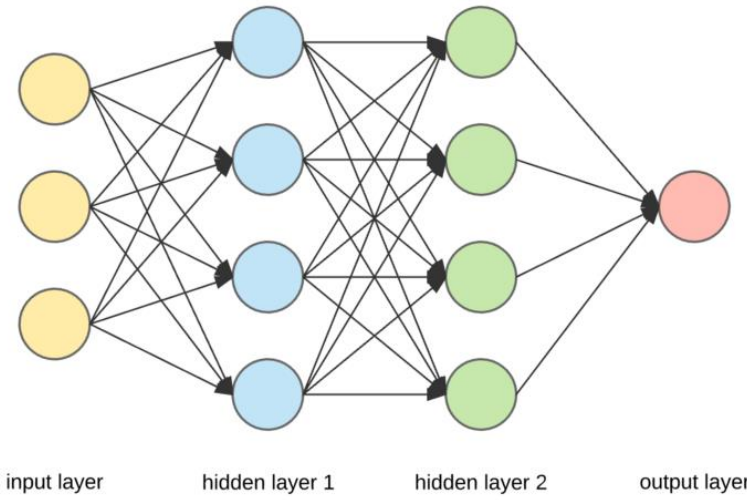
- Use the charge of some particle in the jet to determine the jet flavor



NEURAL NETWORKS: INPUT AND ARCHITECTURE

"Form follows function" - network architecture reflects intuition

Lack of nonlinear relationships suggests a simple structure:



Input

For each particle type (muon, kaon, etc.), calculate:

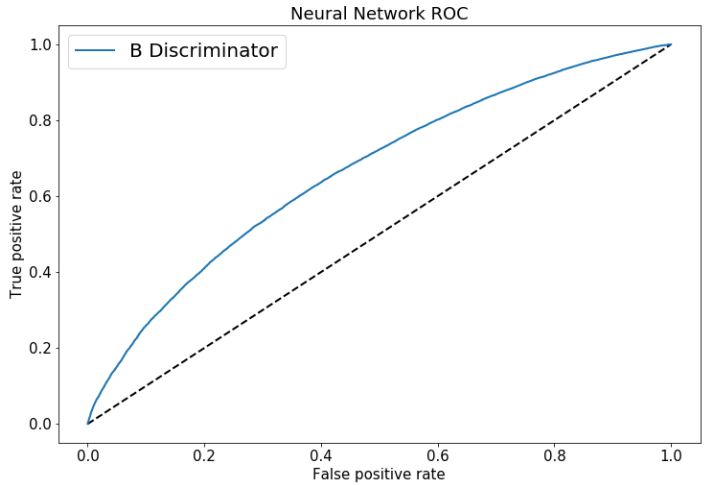
- $\sum_i \frac{q_i p_{T_i}}{p_{T_i}}$
- Charge, p_T, and distance from jet center of highest-energy particle

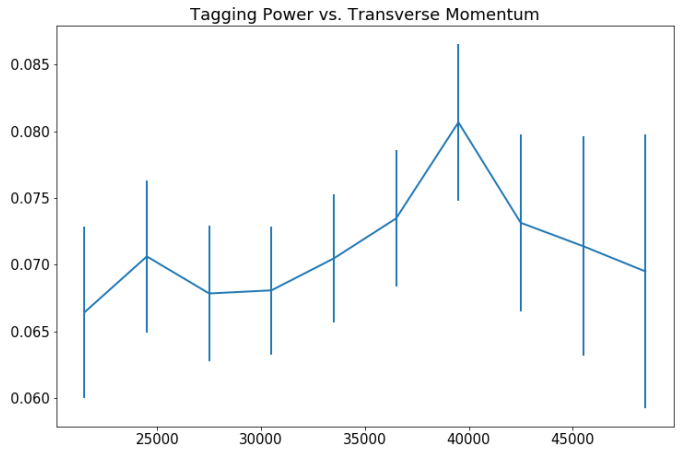
Using the entire jet as input is difficult due to varying number of particles, etc.

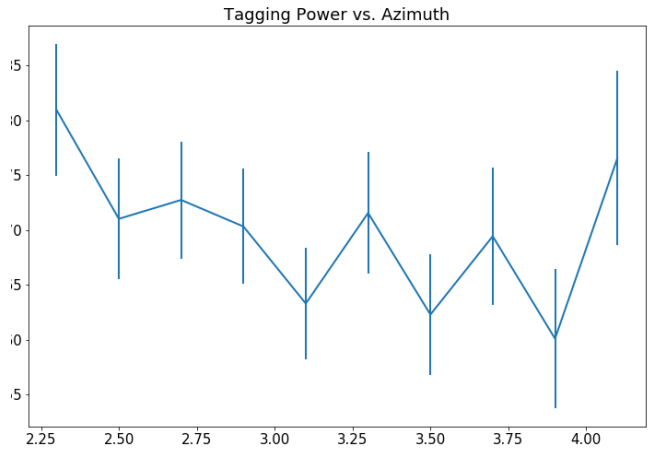
TRAINING RESULTS

- NN tagging not as accurate overall as muon tagging; however, better efficiency leads to higher tagging power ($\varepsilon_{eff} = \varepsilon_{tag}\mathcal{D}^2$)

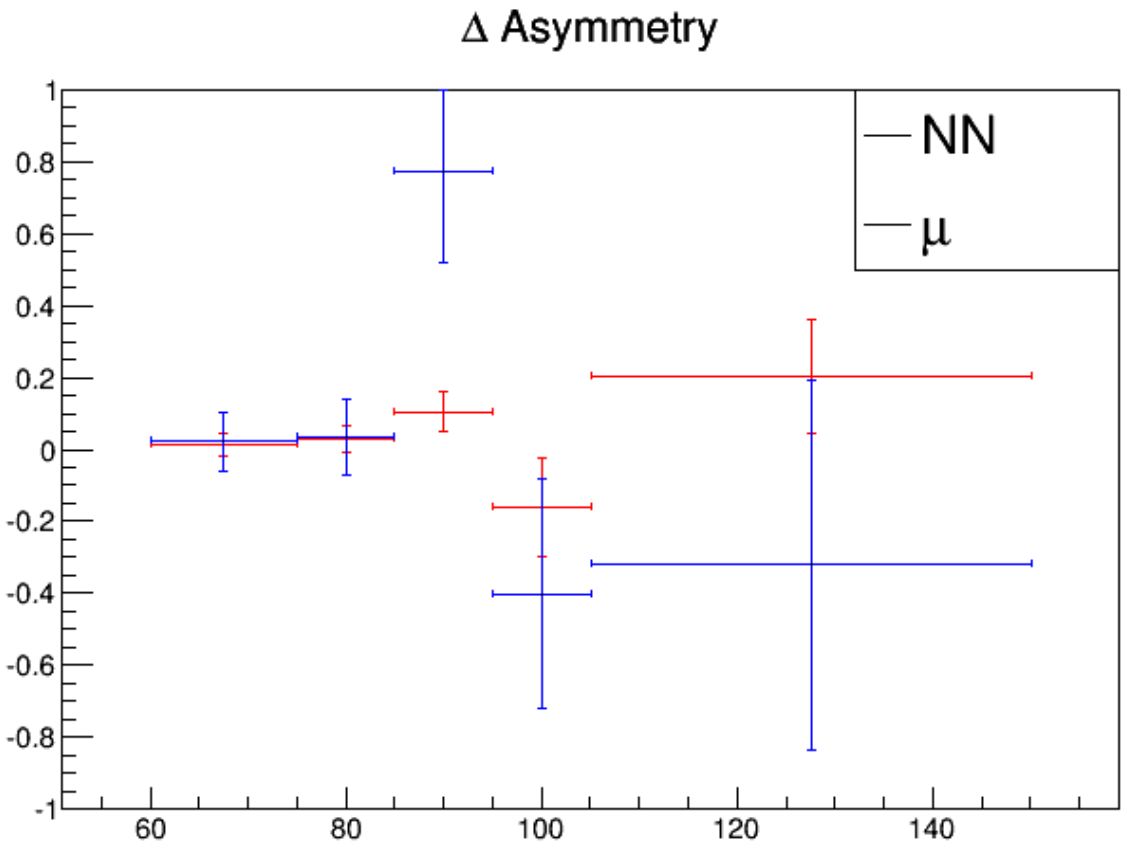
Muons	Brian's NN
$\varepsilon_{tag} = 0.046$	$\varepsilon_{tag} = 1$
$\mathcal{D} = 0.33$	$\mathcal{D} = 0.21$
$\varepsilon_{eff} = 0.005$	$\varepsilon_{eff} = 0.043$

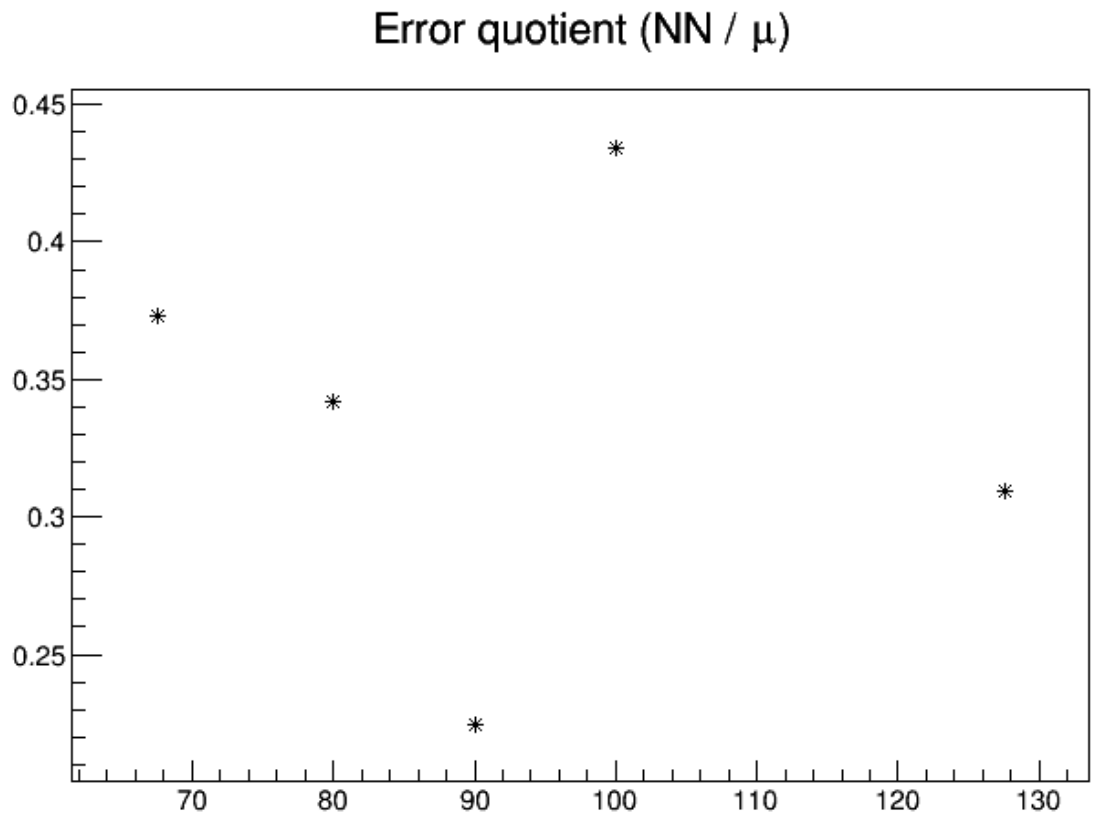




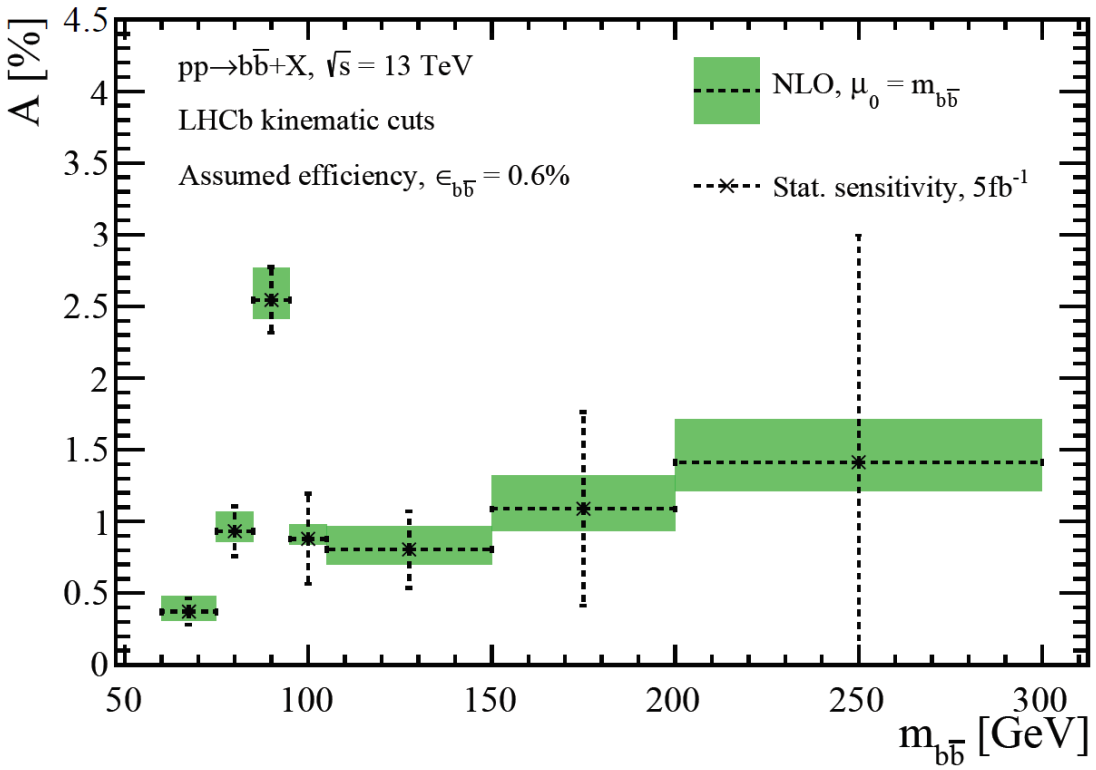


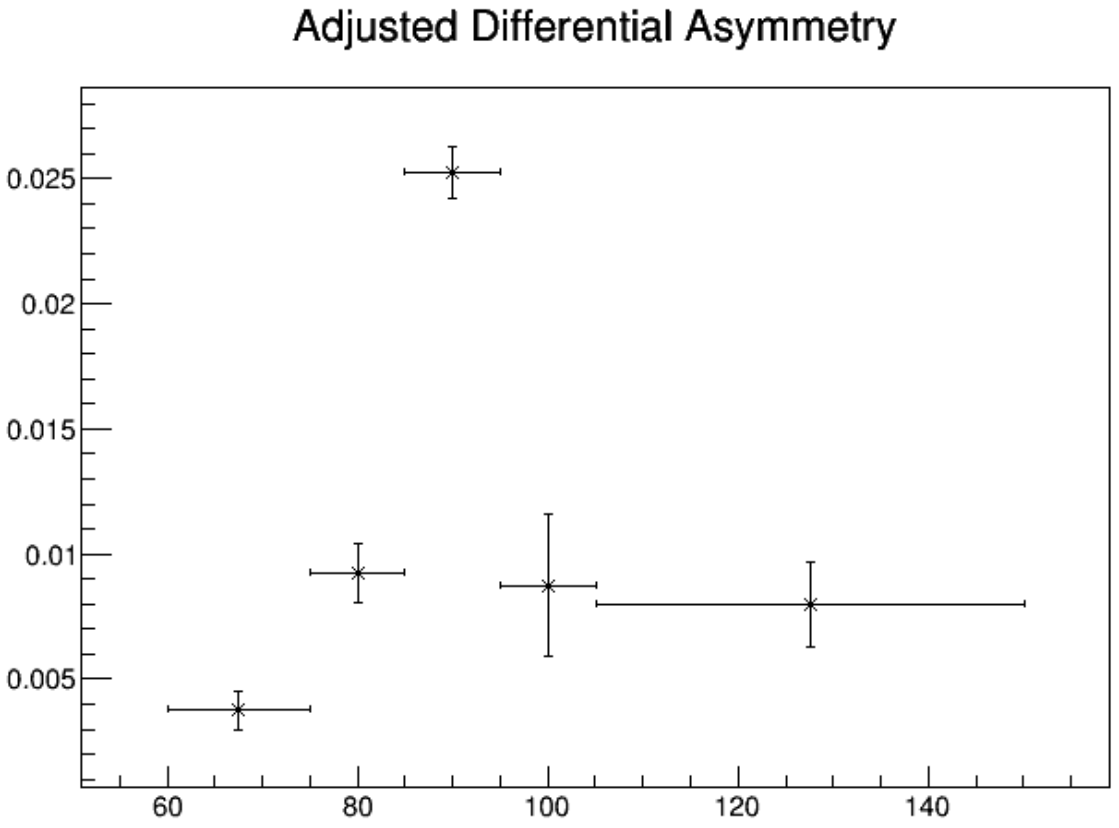
MEASURING THE ASYMMETRY





COMPARISON WITH OTHER METHODS





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