



## *Boosted $W$ 's inside of jets*

*Collinear  $W$  emission as background to new physics searches  
and SM measurements at very high energies*

David W. Miller

work ongoing with James Ferrando, Clement Helsens,  
Joey Huston, Michael Spannowsky, Miles Wu

Enrico Fermi Institute



THE UNIVERSITY OF  
**CHICAGO**

30 October, 2014



# The issue: W-strahlung

The question(s): Can we see this and it is a “problem” for boosted particle searches?

## ● Issue(s) for Searches:

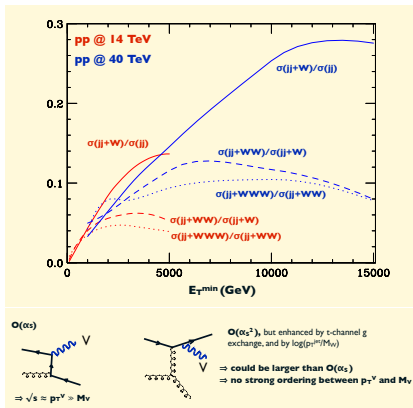
- High- $p_T$  SM processes with boosted  $W$ 's represent a major background for boosted top and  $W$  signals
- $W$ 's produced in close proximity to a jet can look almost identical to a boosted top
- Careful discussion of this in **Rehermann and Tweedie, arXiv:1007.2221**

## ● Issue(s) for Measurements:

- Potentially large theoretical uncertainties on production
- Interesting to go after these  $W$  and  $Z$ s, and verify their production properties

## ● Relevance to this group/discussion:

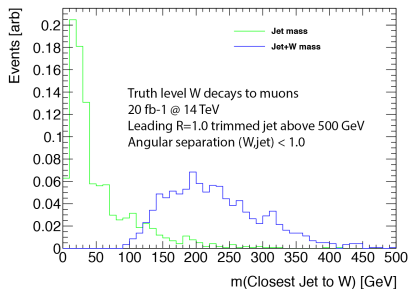
- Does this process(es) pose a problem at an FCC for boosted top (single/pair) searches or  $WW$  scattering measurements?
- Can improvements and measurements at the LHC improve predictions and modeling for future colliders?



Michelangelo Mangano

## Further Discussion and Issues

- **W emission as a background**
  - How severe is the background to top tagging?
    - **Right:** What is the impact on jet mass?
  - Can we use leptonic decays as *proxy* for the hadronic decays that will constitute a background for top tagging?
  - Can we discriminate between the W-strahlung background and true tops using angular information?
- **Potential ideas for the report**
  - What can we expect for various top taggers in terms of background yields?
  - How does this depend on calorimeter granularity (e.g. for jet substructure)?



Truth-level “mass” formed by using the  $\mu$  from W decay as a proxy for the W and adding to the nearby jet’s mass

$$P(W - \text{strahlung}) \approx \frac{1}{4} \frac{\alpha^2}{\pi} \log^2 \frac{p_T}{m_W}$$

# Additional Material

# *Outline*

## 2 *Backup slides and additional information*