LCFIVertex + Kinematical Variables

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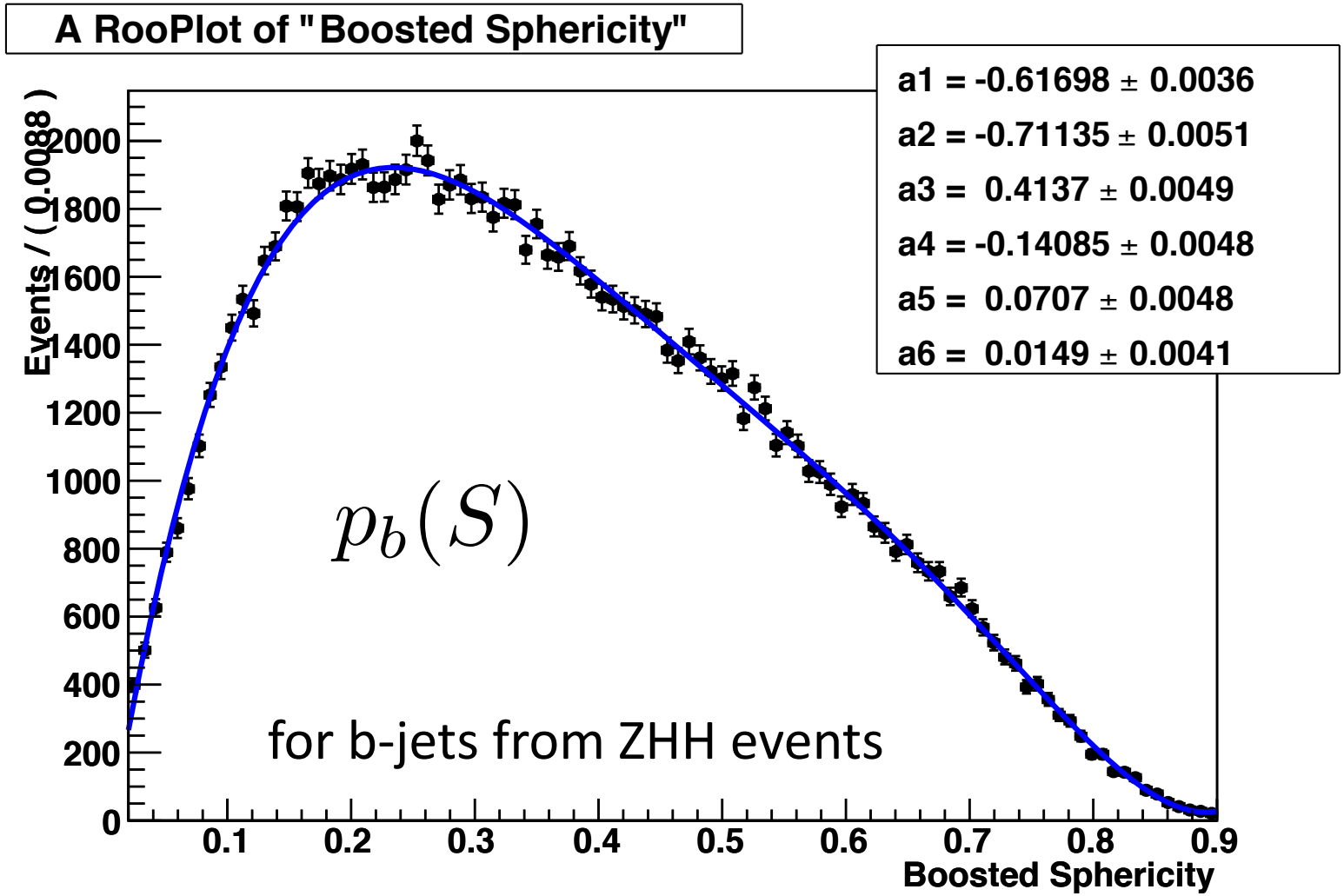
Kinematical Variables in Flavor Tagging

- In our presentation last week, we showed that kinematical variables (boosted sphericity, lepton pT) offer promising prospects for improving flavor tagging (in the context of LCFIVertex)
- Today we show preliminary results of the effect of including the boosted sphericity into flavor tagging.

LCFIVertex and ANN

- LCFIVertex uses ANN with 6 inputs and produces b-tag and c-tag output variables
- We tried adding the boosted sphericity as a 7th variable. However, getting NN training to work proved to be challenging
  - produces NaN output; code is hard to follow since LCFIVertex implements its own ANN
- For this talk, we combine the output of ANN and the boosted sphericity using the likelihood method

Modeling PDFs



The boosted sphericity distributions were modeled using a Chebyshev polynomial (order 6)

Likelihood Method (1)

- We take the probability from the shape of the sphericity distribution

$$f_b^S = p_b(S)$$

- We assume the NN output is proportional to probability (need to confirm this)

$$f_b^{\mathrm{NN}} = \mathrm{NN\ output\ (BTag)}$$

$$f_{uds}^{NN} = 1 - f_b^{NN} - f_c^{NN}$$

This sometimes gives a negative number… (why?) It's forced to zero in such cases.

Likelihood Method (2)

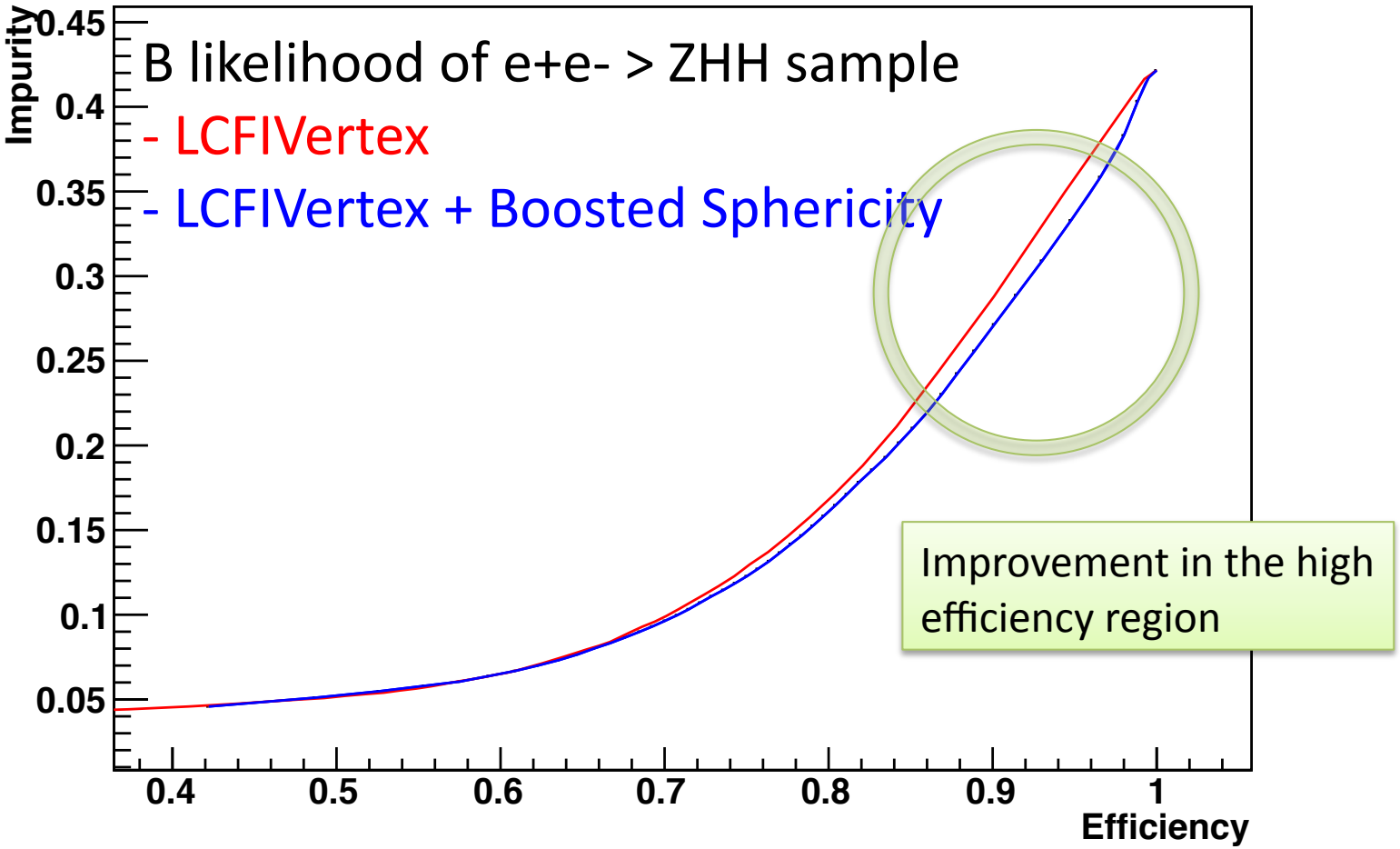
- The likelihood variable is defined in terms of the probabilities from NN output and boosted sphericity PDFs

$$\mathcal{L}_b = \frac{N_b f_b^{\mathrm{NN}} f_b^S}{N_b f_b^{\mathrm{NN}} f_b^S + N_c f_c^{\mathrm{NN}} f_c^S + N_{uds} f_{uds}^{\mathrm{NN}} f_{uds}^S}$$

- N_i is the fraction of events

Impurity vs Efficiency

Impurity is defined as ($L_c + L_{uds}$)/($L_b + L_c + L_{uds}$)



Summary

- Combining boosted sphericity with LCFIVertex ANN output resulted in an improvement in purity/efficiency in the high efficiency region
- Work on incorporating transverse lepton momentum next (to be done by Suehara-san)
- Need help from LCFIVertex experts with ANN