April 2002
University of Oregon
Chris Potter and Jim Bren

Higgs Boson Branching Ratios at the Linear Collider
### Relative Branching Ratio Errors

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### Event Parameters and Their Discriminative Values

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<tr>
<th>Parameter</th>
<th>Value</th>
<th>100 GeV</th>
<th>Value</th>
<th>100 GeV</th>
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<tr>
<td>(\phi)</td>
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<tr>
<td>(d)</td>
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**Simulator v2.4**

The event generator was used to simulate the LHC data from the MC model with the following parameters:

- \(N_{\text{gen}}\) = 300 events
- \(\phi\) and \(d\) were measured for each event.

**The PandaRoot v3.1 generator with the following parameters:**

- \(N_{\text{gen}}\) = 300 events
- \(\phi\) and \(d\) were measured for each event.
Comparison to Other Studies
The B decay chain and cylinder.

**The SLD ZTOP Algorithm for Vertex Finding**

**Vertex Finding**

- **Cylinder dimensions**
  \( C(Y^b - \exp(Y^b)) \) - (a) \( \Lambda \) \( \rightarrow \) \( \Lambda \)
- **Weighting function for angle with respect to jet axis**
  \( d\Lambda dY \) - (b) \( d\Lambda \) \( \rightarrow \) \( d\Lambda \)
- **Interaction point weighting function**
  \( \chi^2 \) maximal vertex \( \chi^2 \)

**Tuning Parameters**

Order found vertices by distance from interaction point
- Jet axis where fakes vertices are hidden
- Maximal \( \Lambda \) for in regions outside a cylinder around the
  - \( \Lambda \), \( \chi^2 \)
  - Each track is assigned uniquely to the vertex with the
  - \( \chi^2 \)
  - In which no contributing track exceeds a maximal vertex
  - Search for vertices in the spatially resolved maxima of \( \Lambda \), \( \chi^2 \)

Include the interaction point as a Gaussian dispersive
- Where each \( \chi^2 \) is a Gaussian probability
  - \( \chi^2 \) \( \Lambda \) \( \chi^2 \) \( \Lambda \)
  - Gaussian vertex significance function

**Search**

- Each track
The jet axes. The relative abundances are not normalized.

Spatial distribution of peak origins verified as coming directly
from $B$ and $D$ decays associated by ZTJOP to vertices.

ZTJOP was used in combination with other algorithms.

No optimization of tune parameters was performed for
the NLD500 environment. It is not known how sensitive

The ratio analyses.

ZTJOP tune parameters values for the STD environment.
The $c$-tag efficiency for $b$-jet vs $c$-tag efficiency for $c$-jet for monojets and $h_{SM} \rightarrow q\bar{q}$. The monojets were generated by Pythia at 45 GeV. The $h_{SM}$ decays were generated with Pandora-Pythia in the NLD500 environment.

Spatial distribution of track origins verified as coming directly from $B$ and $D$ decays but left unassociated to vertices in the $rz$-plane in $h_{SM} \rightarrow b\bar{b}$ events. The $z$-axis is aligned with the jet axis. The Monte Carlo $B$ or $D$ parent momentum is closely aligned with the jet axis in the top plot and is not in the bottom plot.
ZVTOP (Oregon study)

- The c-tag efficiency is higher in the ZVTOP algorithm compared to the ZVTOP3 algorithm.
- The c-tag purity is also higher in the ZVTOP algorithm.
- The efficiency and purity are improved when using ZVTOP together with the ZVTOP3 algorithm.
- The efficiency and purity are improved when using ZVTOP together with the ZVTOP3 algorithm.
- The ZVTOP4 algorithm improves the efficiency and purity of the ZVTOP3 algorithm.

ZVTOP3+NN (T. Abe) ZVTOP+NN (Oregon)

**Improvement in the SLD Environment**

- The c-tag efficiency is lower than 0.1.
- The c-tag purity is lower than 0.1.
- Assign tracks to vertices by interacting with clusters.
- Set the width of the ghost track so that the maximum vertex direction is in the vertex direction.
- Identify the ghost track with the ghost track and minimize the axes.
- Identify the ghost track with the jet or charm.

**Vertex Finding**

- Improve on ZVTOP by exploiting the strangeness of the c-tag track.

The SLD Ghost Track Algorithm for Vertex Finding
Algorithm should be finished by the Santa Cruz Conference, Summer 2002.

- New Higgs boson branching ratio errors incorporate a tuned ZVTOP and the Ghost Track.

The Ghost Track Algorithm will improve the $b$ tagging.

- New Higgs boson branching ratio errors incorporate a tuned ZVTOP and the Ghost Track.

1. Phone decays.

- $B$ decay tracks assigned to the correct jet may still be left unassigned to vertices if they come from decay tracks assigned to the correct jet.

- $B$ decay tracks are left unassigned to vertices if they have been assigned to the wrong jet.

- $ZVTOP$ should be tuned to the NLD00 environment in order to maximize reconstruction efficiency.

- The $B^{*}$ is not a branching ratio error is dominated by misassigned $q\bar{q}$ events in which decay tracks are unassociated to vertices.

- The $B^{*}$ is not the exception.

- The North American, Asian and European Higgs boson branching ratio studies are largely in agreement.

Conclusions and Plans