Lepton Asymmetry

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1. '96 Analysis
2. '97 First Look
3. Future Plan
1.0 $A_1$ measurement for '96

The main problem of previous '96 results

Too small $A_\tau$

'96 $A_1$ results presented by last Col. meeting:

<table>
<thead>
<tr>
<th></th>
<th>$A_e$</th>
<th>$A_\mu$</th>
<th>$A_\tau$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e$</td>
<td>0.167 +- 0.035</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.130 +- 0.033</td>
<td>0.164 +- 0.047</td>
<td>-</td>
</tr>
<tr>
<td>$\tau$</td>
<td>0.141+-0.033</td>
<td>-</td>
<td>0.066+-0.046</td>
</tr>
</tbody>
</table>

$2\sigma$ far from SM expectation ($\sim$0.15)!

These results are obtained assuming no background in selected event samples (From '93-'95 study, purities of each modes are higher than 95% for $|\cos\theta|<0.7$).

However '96 results are containing data beyond $|\cos\theta|>0.7$.

-> Check background effect!

($\tau$ selection)

- Event Mass (remove $\mu$-pair).
- Cal. Energy (remove WAB)
- Acollinearity, Hemisphere mass (remove 2$\gamma$)
Huge background (WAB) at high $\cos\theta$!

Why do WAB events pass $\tau$ selection criteria?

Check the observable to reject WAB.
Two Peaks in WAB!

To remove WAB, we require $E_{\text{clus}} < 27.5 \text{GeV}$

Max. Cluster Energy associated to track

Why there are two peaks?
Angular dependence of cluster energy!

Need rescaling and smearing.
After rescaling and smearing, the cluster energy distribution is depicted. The data distribution is characterized by a mean of 16.79 GeV and an RMS of 10.70 GeV.

Max. Cluster Energy...<27.5 GeV for |cosθ|<0.7
Max. Cluster Energy...<20.0 GeV for |cosθ|>0.7
Reject 0.82<|cosθ|<0.84
data '96 τ

BKG

\[ A_t = 0.103 \pm 0.046 \quad (\hat{A}_{FB}) \]

\[ A_e = 0.146 \pm 0.033 \quad A_t = 0.106 \pm 0.049 \quad (\text{Max. Likelihood}) \]

\[ A_e = 0.140 \pm 0.039 \quad A_t = 0.108 \pm 0.059 \quad (B. Panvini) \]
2.0 First Look for '97 data

\[
\begin{align*}
A_e &= 0.147 \pm 0.031 \\
A_\tau &= 0.148 \pm 0.042 (B. Panvini)
\end{align*}
\]

\[
\begin{align*}
A_{\tau} &= 0.173 \pm 0.031 (\hat{A}_{FB}) \\
A_e &= 0.130 \pm 0.024 A_\tau = 0.180 \pm 0.034 (\text{Max. Likeli.})
\end{align*}
\]
$A_e = 0.174 \pm 0.020 \quad (\text{Max. Likelihood})$
data

'BKG

$A^\mu = 0.098 \pm 0.030$ ($\hat{A}_{FB}$)

$A_e = 0.151 \pm 0.024$ $A^\mu = 0.096 \pm 0.033$ (Max. Likelihood)

Lepton Asymmetry
February 12, 1998
## Future of $A_i$ Analysis

<table>
<thead>
<tr>
<th></th>
<th>LEP $A_e$</th>
<th>0.1465 ± 0.0059</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LEP $A_\mu$</td>
<td>0.1496 ± 0.014</td>
</tr>
<tr>
<td></td>
<td>LEP $A_\tau$</td>
<td>0.1466 ± 0.0062</td>
</tr>
<tr>
<td>1993-1997</td>
<td>SLD $A_e$</td>
<td>0.1523 ± 0.008</td>
</tr>
<tr>
<td></td>
<td>SLD $A_\mu$</td>
<td>0.115 ± 0.021</td>
</tr>
<tr>
<td></td>
<td>SLD $A_\tau$</td>
<td>0.172 ± 0.022</td>
</tr>
<tr>
<td>LEP $A_e$ Proj.</td>
<td></td>
<td>±0.0055</td>
</tr>
<tr>
<td>LEP $A_\mu$ Proj.</td>
<td></td>
<td>±0.014</td>
</tr>
<tr>
<td>LEP $A_\tau$ Proj.</td>
<td></td>
<td>±0.0055</td>
</tr>
<tr>
<td>SLD $A_e$ (500kZ)</td>
<td></td>
<td>±0.0059</td>
</tr>
<tr>
<td>SLD $A_\mu$ (500kZ)</td>
<td></td>
<td>±0.012</td>
</tr>
<tr>
<td>SLD $A_\tau$ (500kZ)</td>
<td></td>
<td>±0.012</td>
</tr>
</tbody>
</table>

Errors on $A_e$ and $A_\mu$ are smaller than a single LEP measurement.
3.0 Future Plan

3.1 Forward tracking

Now tracking group is trying to improve tracking acceptance using 2-hit VXD3 Vector Hit.

-> Increase the acceptance of lepton asymmetries.

(Now radiation damage was recovered. And it should/must improve tracking acceptance.)
Angular distribution of VXD3 VH combined with a track:

2 hit VH was really used to find a track at very forward region.
3.2 Special Tracking for $\mu$-pair event

Thanks to WMT, we can measure di-$\mu$ events up to $|\cos \theta| < 0.95$. Find di-$\mu$ events using VXD3 VH information at forward region. (work with J. Jaros and R. Cassell.)
Charge Separation: (this representation was originally considered by R. Cassell)

We found 133 di-\(\mu\) candidates in '96 data.
Obtained asymmetry is

\[ A_\mu (\text{Data measured}) = 0.22 \pm 0.12 \]
\[ A_\mu (\text{SM}) = 0.15 \]

\( \chi^2/\text{ndf} = 3.064 / 2 \)
\( p = 0.2150 \pm 0.175 \)

\( \cos \theta \)

(At this time, I do not estimate efficiency and purity...)?

Right now efficiency of VXD3 at layer 1 was recovered.

Therefore, we expect more signal in '97-'98 data.
4.0 Summary

1. $A_{\tau}$ problem for '96 data seems to be solved.

2. $A_{\tau}$ and $A_e$ look good for '97 data. But $A_\mu$ may have some problem. Need further study using '97 MC.

3. Errors on $A_e$ and $A_\mu$ for '93 to '97 are lower than a single LEP experiment. Error on $A_\mu$ should be smaller than combined LEP result, if we get 500K $Z^0$.

4. Forward tracking is underway. It should reduce error of lepton asymmetry and it may open the window of new physics at SLD.