What I have done before 2001.

• Took part in the 97 and 99 runs of HyperCP
• Monitored our Calorimeter during both runs
• Setup the Calorimeter for the 99 run
• Helped prepare for the farming of our 99 data
• Monitored the output histograms during Farming (Made sure our data looked good)
• Studied the Calorimeter efficiency
What I did during 2001

- Helped finish the farming of our data
- Began initial studies of the Calorimeter and Hodoscope Systematic Errors
- Presented a talk at CHEP 2001 on our farming process
- Wrote my version of the Monte Carlo the $\Xi$ Hybrid Monte Carlo ($\Xi$HMC).
- Did an initial study of my analysis method using the Fermilab farms
## Data Volume of Selected Experiments

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Aleph</th>
<th>Babar</th>
<th>HyperCP</th>
<th>CDF</th>
<th>CMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event Size (MB)</td>
<td>0.25</td>
<td>0.05</td>
<td>0.0005</td>
<td>0.25</td>
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<td>Data/yr (TB/yr)</td>
<td>1</td>
<td>330</td>
<td>120</td>
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<td>Collab.</td>
<td>300</td>
<td>500</td>
<td>42</td>
<td>600</td>
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</table>
What am I studying again?

• I am looking for CP violation in comparing the decays of $\Xi \rightarrow \Lambda \pi$ and $\Lambda \rightarrow p\pi$ and their anti-mater counterparts.

• C (charge) P(parity) violation would exist if there was a difference in the $\alpha$ parameters for the $\Xi$ and anti-$\Xi$ or in the $\alpha$ parameters of the $\Lambda$ or anti-$\Lambda$.

• Our approach is to match the two samples, so that they have the same inputs.

• I hope to reach a statistical sensitivity of $6 \times 10^{-4}$
How do we measure the asymmetry

- The proton distribution in the $\Lambda$ helicity frame is:

\[
\frac{dP}{d\Omega} = \frac{1}{4\pi} (1 + \alpha_\Lambda \vec{P}_\Lambda \cdot \hat{p}_p)
\]

- If the polarization of the $\Xi$ is 0 then:

\[
\vec{P}_\Lambda = \alpha_\Xi \hat{p}_\Lambda
\]

- So the proton distribution is now:

\[
\frac{dP}{d\cos\theta} = \frac{1}{2} (1 + \alpha_\Lambda \alpha_\Xi \cos\theta)
\]

- For a non-perfect detector we must add an acceptance term:

\[
\frac{dP}{d\cos\theta} = \frac{1}{2} A(\cos\theta)(1 + \alpha_\Lambda \alpha_\Xi \cos\theta)
\]
Measuring the asymmetry (cont.)

- If we take a ratio of the 2 distributions the acceptance cancels:
  \[ \text{Ratio} = \frac{1 + (\alpha_\Lambda \alpha_\Xi)_- \cos \theta}{1 + (\alpha_\Lambda \alpha_\Xi)_+ \cos \theta} \]

- If we then take an expansion of the lower term we get:
  \[ \text{Ratio} = 1 + ((\alpha_\Lambda \alpha_\Xi)_- - (\alpha_\Lambda \alpha_\Xi)_+) \cos \theta \]

- So the slope of the ratio will give us an asymmetry measurement
  \[ \delta(\alpha\alpha) = (\alpha_\Lambda \alpha_\Xi)_- - (\alpha_\Lambda \alpha_\Xi)_+ \]
How do we measure $\cos \theta$?

We look at how the $\Xi$ and $\Lambda$ decay in their rest frame.
What does theory say?
Data Sample Matching

• We need to make the acceptances the same.
• Match the Ξ momentum, X and Y position at the collimator exit, and the X and Y slope at the collimator exit.
• Split 3 variables and 2 combined variables to into 20 bins each.
• Throw out events in bins were the other sample has zero events.
• Weight events so that each bin has the “same” number of events.
Data Analysis

- data
+ data

+ binning 20^5 bins
- binning 20^5 bins

+ weights, to balance bins
- weights, to balance bins

fill - histograms using weights
fill + histograms using weights
Hybrid Monte Carlo

- Take $\Xi$ momentum, and XY position at Collimator exit.
- Store in intermediate files.
- Simulate 5 $\Xi$HMC events for each real event.
**HMC results**

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<thead>
<tr>
<th>Input δ(αα)</th>
<th>0</th>
<th>-1E-2</th>
<th>1E-2</th>
<th>-5E-3</th>
<th>5E-3</th>
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</thead>
<tbody>
<tr>
<td>Measured δ(αα)</td>
<td>-5.8E-4</td>
<td>-9.7E-3</td>
<td>9.5E-3</td>
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<tr>
<td>error</td>
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<td>6.5E-4</td>
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<td>Chi^2/ndf</td>
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<td>1.7</td>
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<tr>
<td>Matched</td>
<td>Raw</td>
<td>Measured $\delta(\alpha\alpha)$</td>
<td>error</td>
<td>$\sigma$ from zero</td>
<td>$\chi^2$/ndf</td>
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<td>1.2E-3</td>
<td>5.7</td>
<td>1.3</td>
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</table>
What am I going to do in 2002.

• Split off my fraction of the data (10%) with the help of an undergrad Fred Ross.
• Run my analysis on the data at the Fermilab Farms.
• Simulate my data using the $\Xi$HMC at the Fermilab Farms.
• Measure my systematics here and at Fermilab.
• Write my dissertation!
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</table>
Conclusions

• I have done an initial study of my analysis method which gives us confidence that our approach will work.
• Our farming has gone well, and we will soon split off our fraction of the data for analysis.
• I hope to complete my analysis at $6 \times 10^{-4}$ level.
• I am hopeful of finishing by the end of 2002.