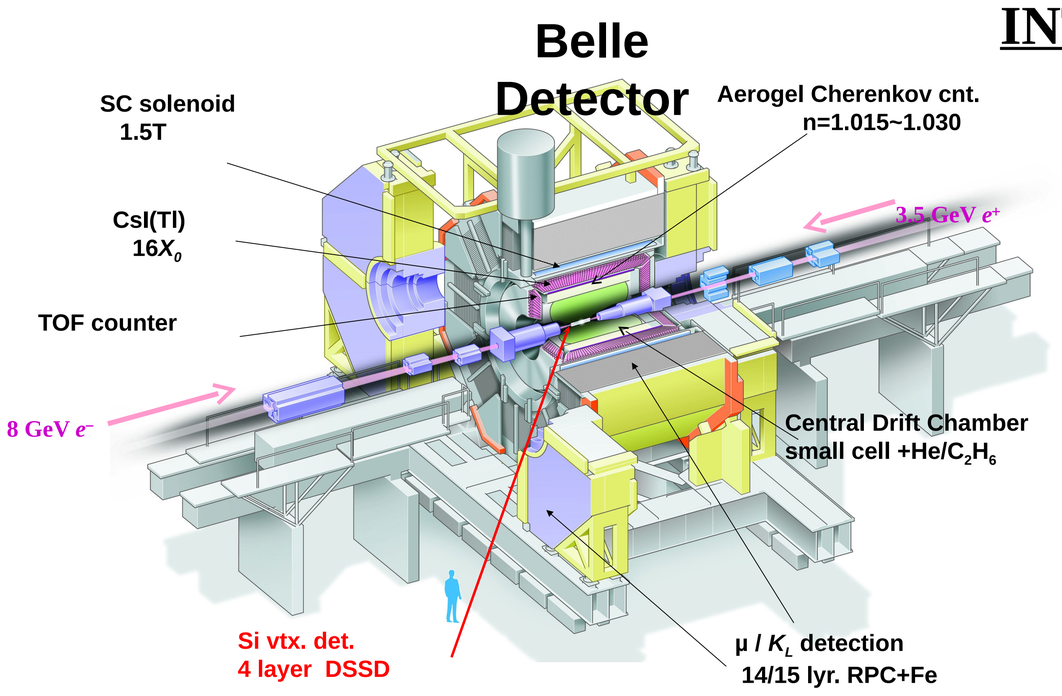
DISCLAIMER

Poster from January 2007

Evaluation of the Time of Flight Electronics Upgrade for the Belle Detector at the KEK B-Factory

--Aaron Koga



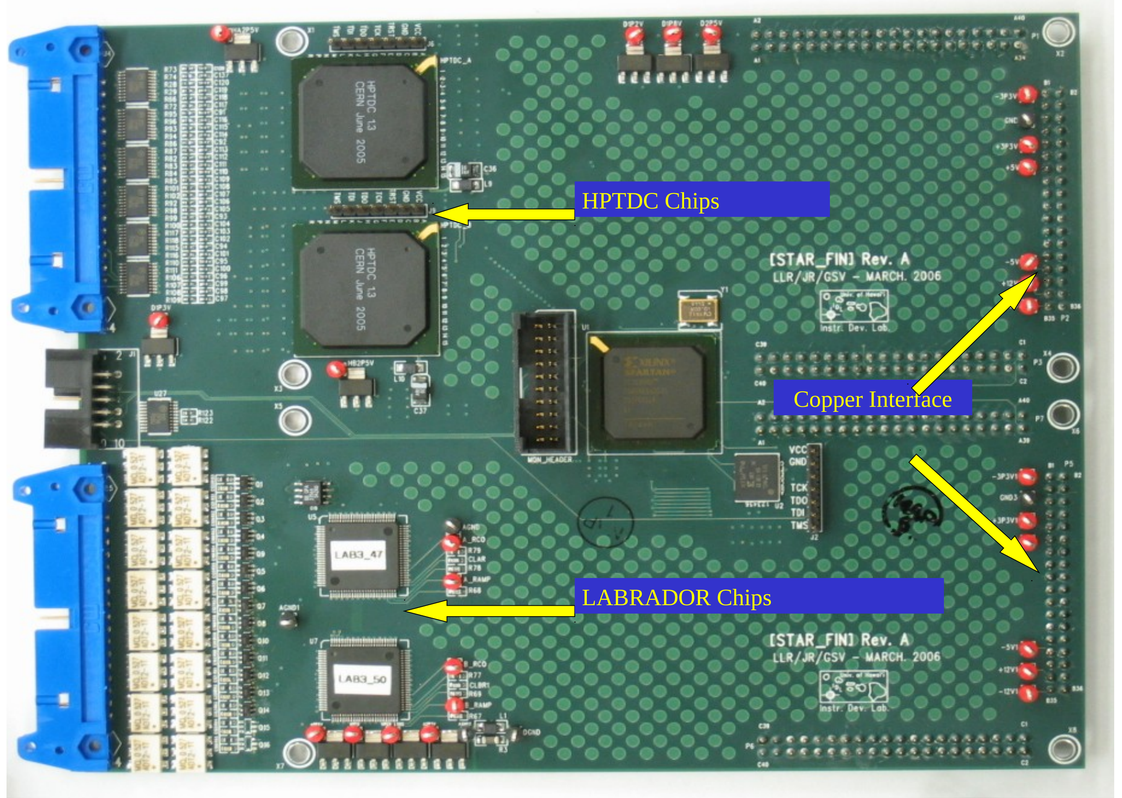
INTRODUCTION

A world-wide collaboration uses the Belle detector to study CP violation in B-meson decays. This detector, located at KEK High Energy Research Institute in Japan, is the world's highest luminosity particle collider, producing more than one million B-meson pairs per day. Plans to upgrade the detector are projected to increase the luminosity by a factor of 30-50 over the next 8 years. Although more data can be taken in less time, higher luminosities also lead to more background hits. This interferes with particle identification, negatively impacting the system performance and efficiency. Basically, each time the current system gets a hit, time is needed to readout that hit. This is known as dead-time. To remedy this, a new circuit board called **STAR** (Signal Timing And Readout board) has been designed.

STAR (**S**ignal **T**iming **a**nd **R**eadout Board)**:**

- Facilitates particle identification for research:
- "**Pipelined**" to remedy problems in current electronics (namely dead-time)
- Combination of two previously existing designs:
  - **HPTDC** (High Precision Time to Digital Converter): measures time with high accuracy
  - **LABRADOR** (Large Analog Bandwidth Recorder and Digitizer with Ordered Readout): measures integrated charge
- Interfaces a readout system known as the **COPPER** (Common Pipelined Platform for Electronics Readout):
  - 1000 individual COPPER modules
  - ~100 channels in each module
- Overall system logs ~80 TB/second

STAR



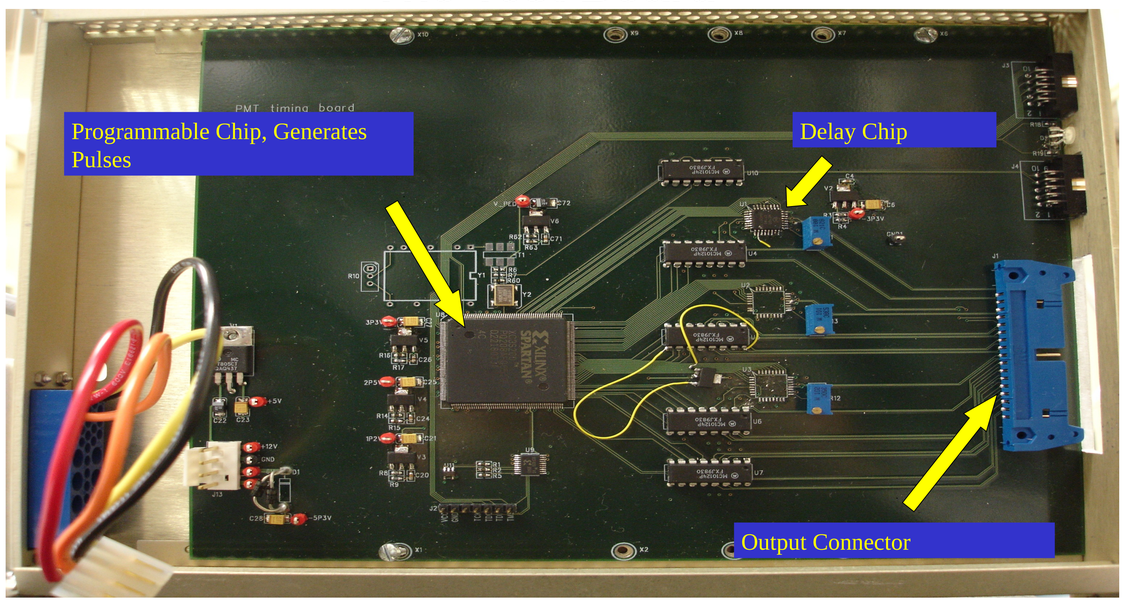
SUMMER RESEARCH

Test Board for STAR:

For the purpose of testing the STAR board, I built a test board with the following characteristics:

- Outputs precision timing pulses, which can be read by the HPTDC on the STAR board
- Has a channel with programmable delay of 2-10ns

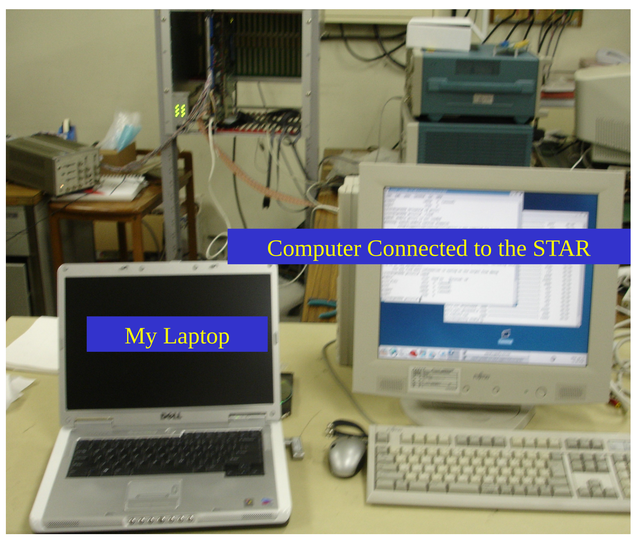
The Test Board



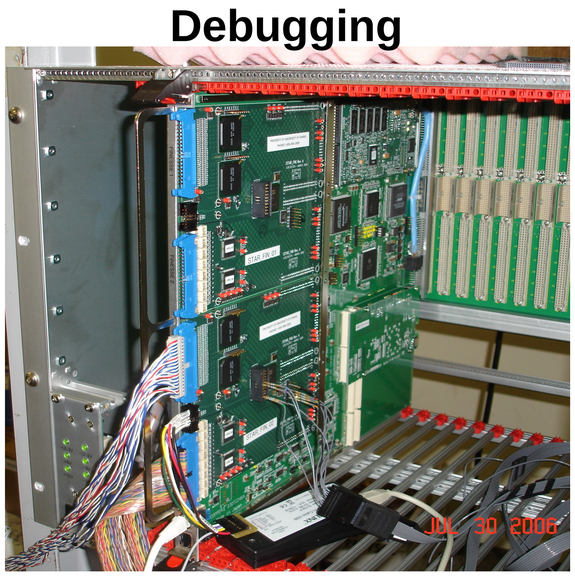
Work at KEK:

In July, one graduate student, a professor, and I went to KEK. Although we were unable to test the STAR board because it was not fully operational, we made progress towards getting it operational.

Our Work Area at KEK

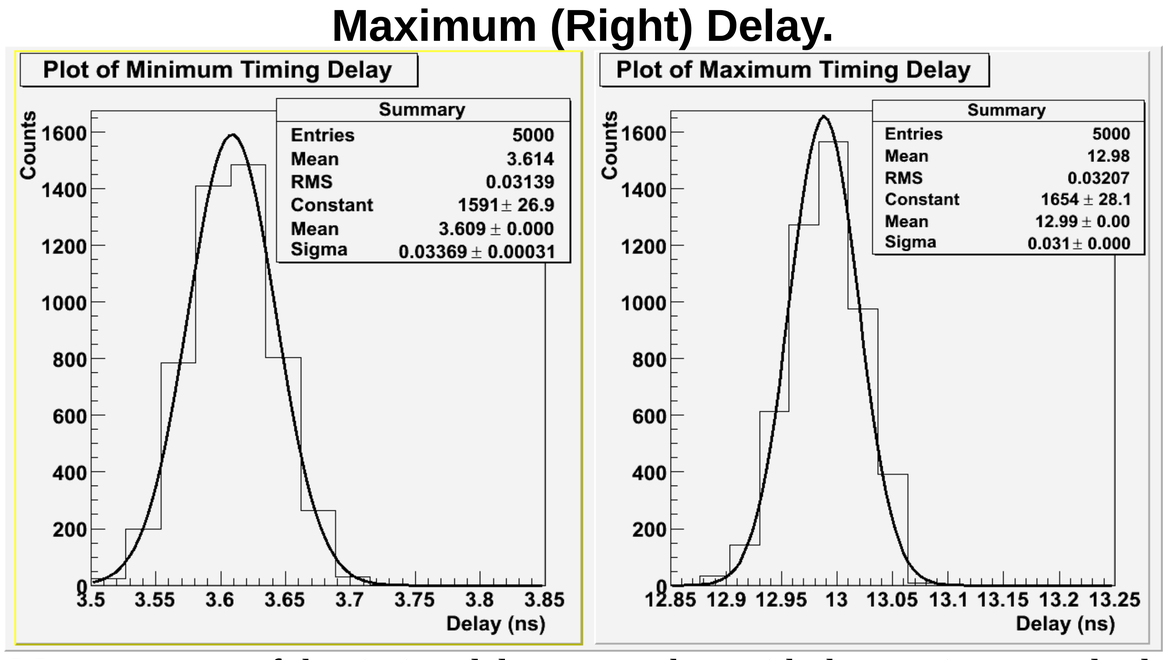


STAR Plugged in for Debugging



The graduate student worked on troubleshooting the STAR board and I assisted him as much as possible, spending most of my time setting up and troubleshooting the software used for reading data from the STAR board. Coordinating with the people who worked on the software at UH, I was able to install and run it on the test setup at KEK.

Plots of Measurements of the Minimum (Left) and Maximum (Right) Delay.

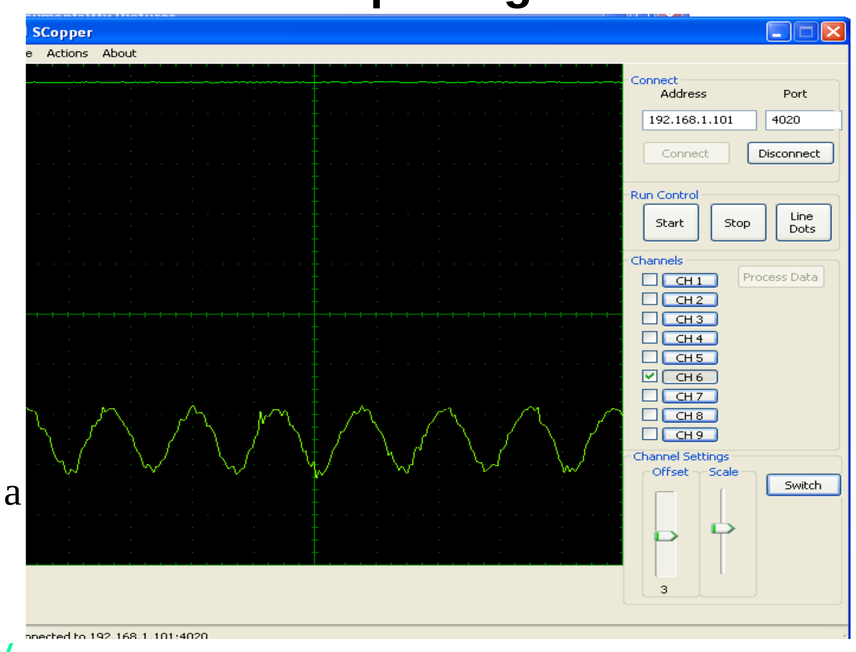


Measurements of the timing delay were taken with the previous standard electronics used in high energy physics, the CAMAC system. The measurements show **~30ps of noise**.

Software:

- Collects data in Copper System and sends it over network to a remote computer
- Displays data as a waveform
- Outputs charge and time measurements to a file

Software Outputting a Sinewave



Get more information about: STAR at www.phys.hawaii.edu/~idlab/
KEK/Belle at http://belle.kek.jp