Extract optimal information about beam position from left and right signals.

- Optimal Filtering
- PFIR Filter
- CFIR Filter
- CIC Filter
- DownConversion
Graychip Signal Processing

- Graychip down-converter shifts 2.5 MHz (7.5Mhz) to DC
- Acts as envelope detector
- Followed by three stage digital filter
Simulation

- Matlab simulation
  - Beam Induced signal
  - Cable Dispersion
  - Digitization
  - Graychip Signal processing
Optimal Filter

- **Optimal Linear Filter** – “Matched Filter”
  - Optimal detection of known signal in presence of noise
  - Maximizes signal to noise ratio
  - Equivalent to correlating input signal with known signal
- **Output of envelope detection** – square pulse
  - Correlate with square pulse of same duration
Optimal Filter

- Correlator can be implemented in the PFIR filter of Graychip.
- Requires only one of the four available Graychip channels.
Optimal Calibration

- Determine gain and offset for each channel
- Calibrate using a signal as close as possible to beam induced signal
- Match left and right channels as closely as possible
Fermilab

Existing Preamp

- Calibration fed to two channels separately
- Accuracy limited by 1% tolerance components
Improved Calibration

- Switch one signal between left and right channels
- Accuracy limited by the matching of insertion losses between the two switches
Switch Insertion Loss

- Minicircuits MSW-2-20
  - Insertion Loss matched to 0.01 db or better between 1 and 15 MHz
Waveform Generation

- Several VME arbitrary waveform generators available
  - Joerger VWG
    - 100 MHz 12-bit
  - VXI Technology VM3640
    - 50 MHz 12-bit
Timing

- FIFO in Graychip can hold 16k samples
- Time to beam by searching FIFO for peak

![Graph showing signal magnitude after FIR filter]