Development of Beam Diagnostic Devices

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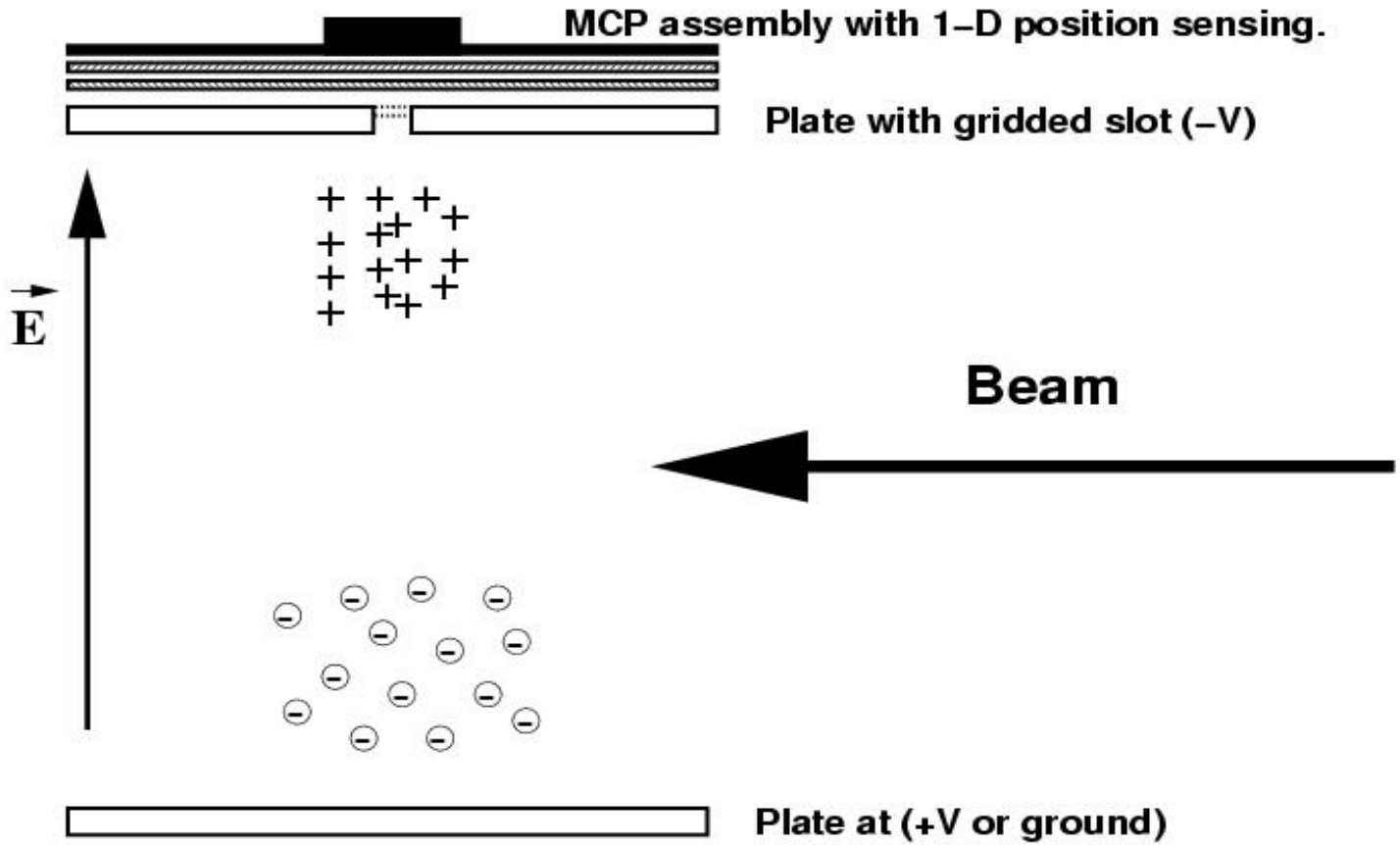
Outline

- Beam intensity and profile monitoring for High Intensity driver beam.
  - A ~zero mass sampling device.
- Beam profile and counting for low intensity RIB beams.
  - Low Mass.
  - High efficiency.
  - Based on single particle counting (good for tracking)

RGBPM for High Intensity Beams

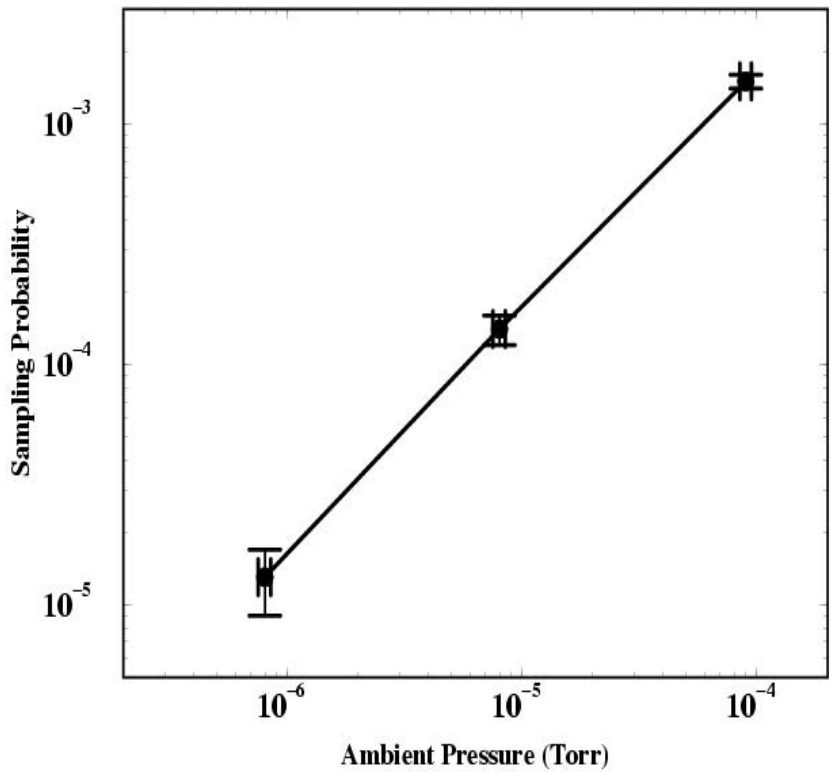


Use TOF to acquire position along ion drift direction
or Add an orthogonal set of sampling electrodes upstream.

Sampling Rates in RGBPM

- Sampling rate can be controlled (with pressure, sampling path length and ionization cross sections)
- 1 μA H^+ beam passing through 1mm of Hydrogen gas at 10^{-7} torr (STP) will result in ~10^4 samples/sec.

Data for N_2 trace gas



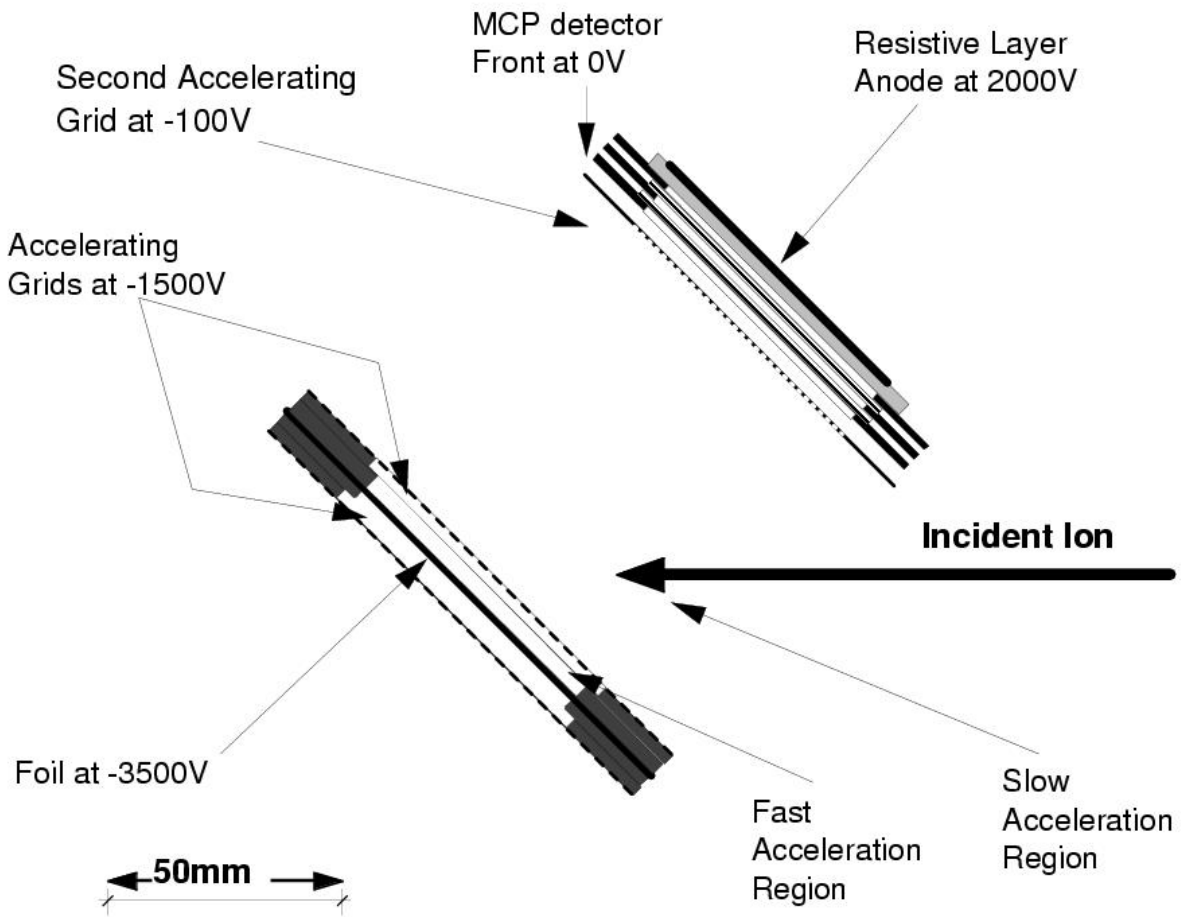
Development Tasks

- Radiation hardness.
  - How close to ISOL target can it be placed?
  - Electronics & material resistance to n-flux.?
- Surprises at high intensities.
  - Space charge screening (10KV H^+ ions v~1mm/ns).
  - H excited state τ~5ns, for 100μA beam particles arrive at ~fs intervals (two step processes increase sampling rate?).
- Optimize position measurment.
  - Radiation hardness / Rates / Resolution.

For low intensity beams: PSTD based on secondary electron emission

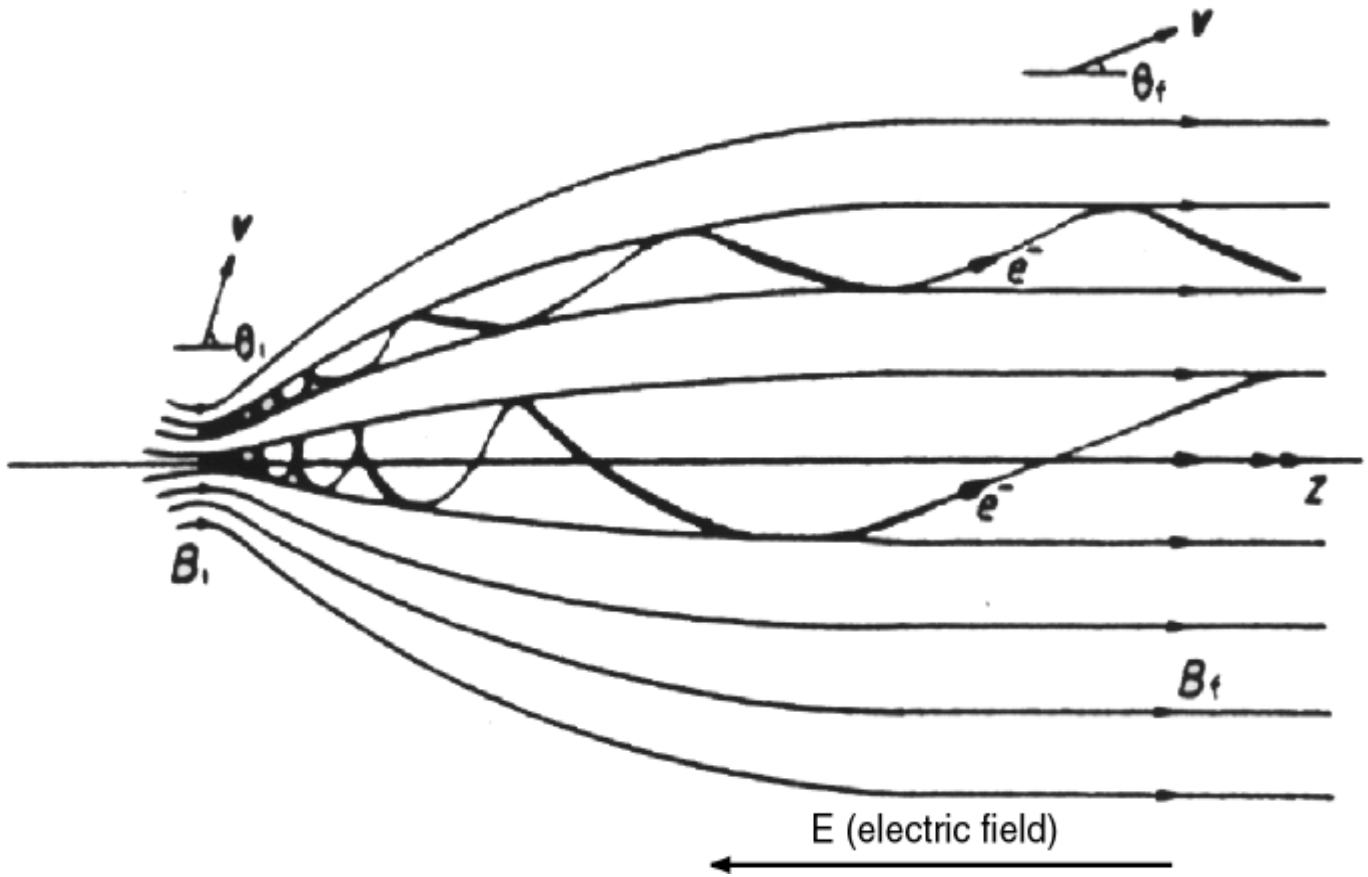
FAST, Low Mass Position Resolution: ~2-3mm. (few percent of drift distance!)

Solution: Combined E and B fields



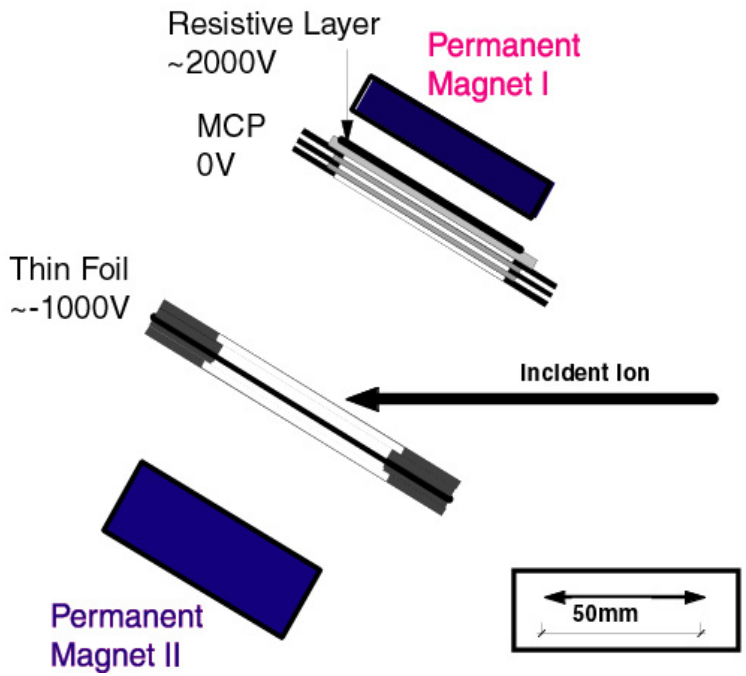
Beam Parallelizer

A combination of magnetic and electric fields improves resolution in mapping of ion hit position.



Position Sensitive Timing Detector (PSTD) - modified.

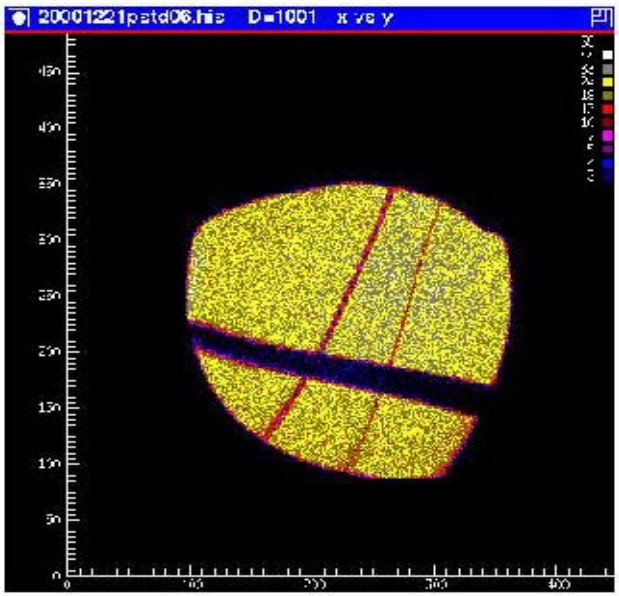
- Magnetic field strength near foil determines image resolution.
- Ratio of magnetic field intensities at foil surface and detector surface determine area-magnification or demagnification of image.



High resolution test - magnet close to foil

Image of a 2mm wide strip, a 0.25mm wire and a 0.1mm wire

Image Magnification x3



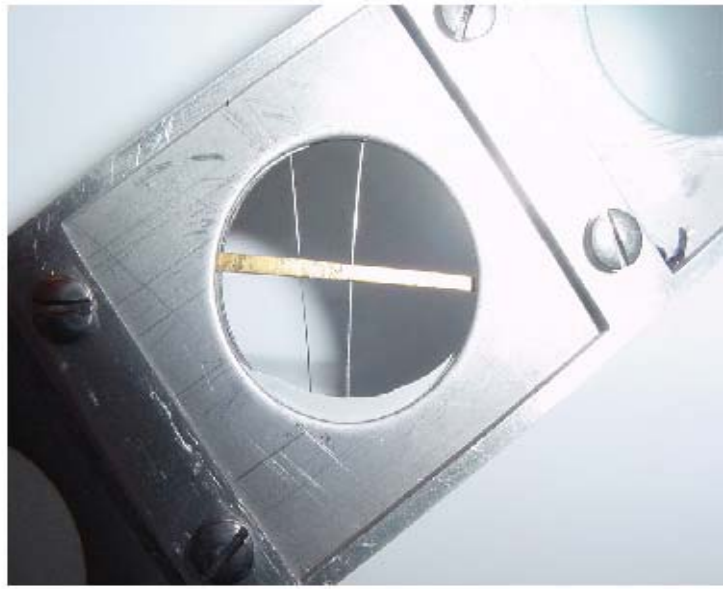
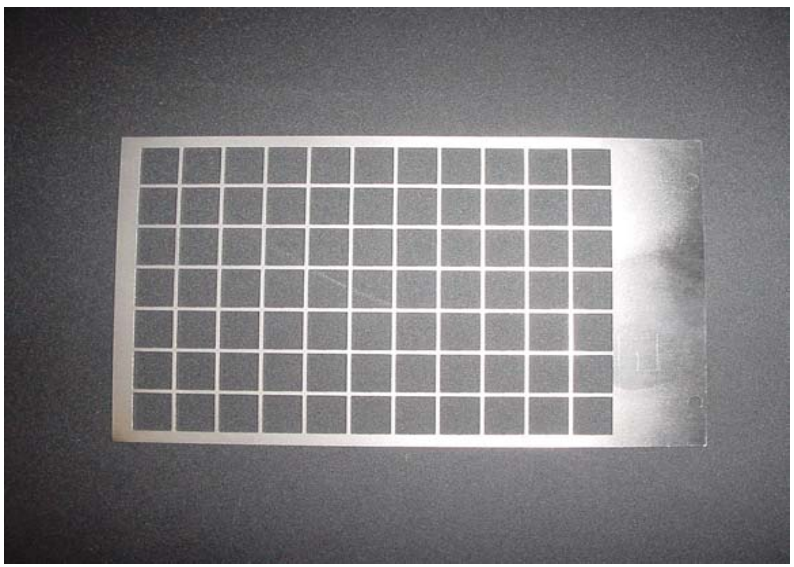


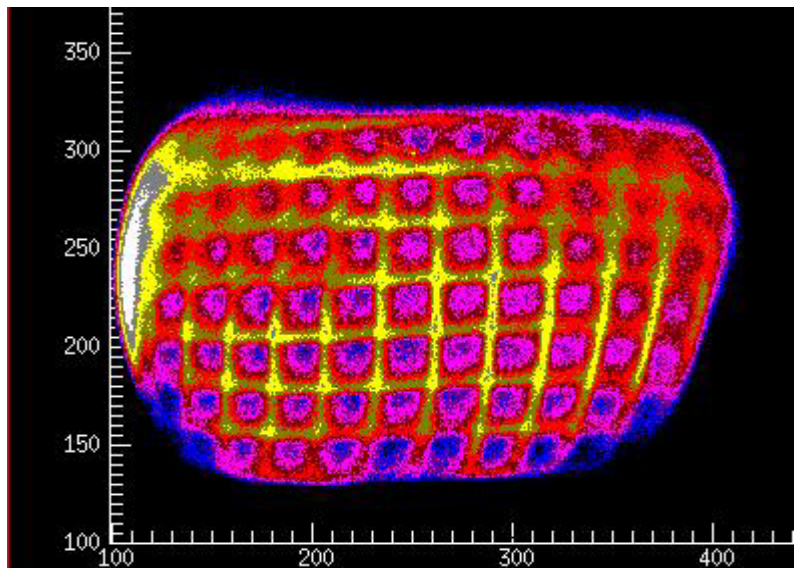
Image compressed by 3x

Projected onto a 44mm diameter MCP

11 x 7 cm grid

1mm wires

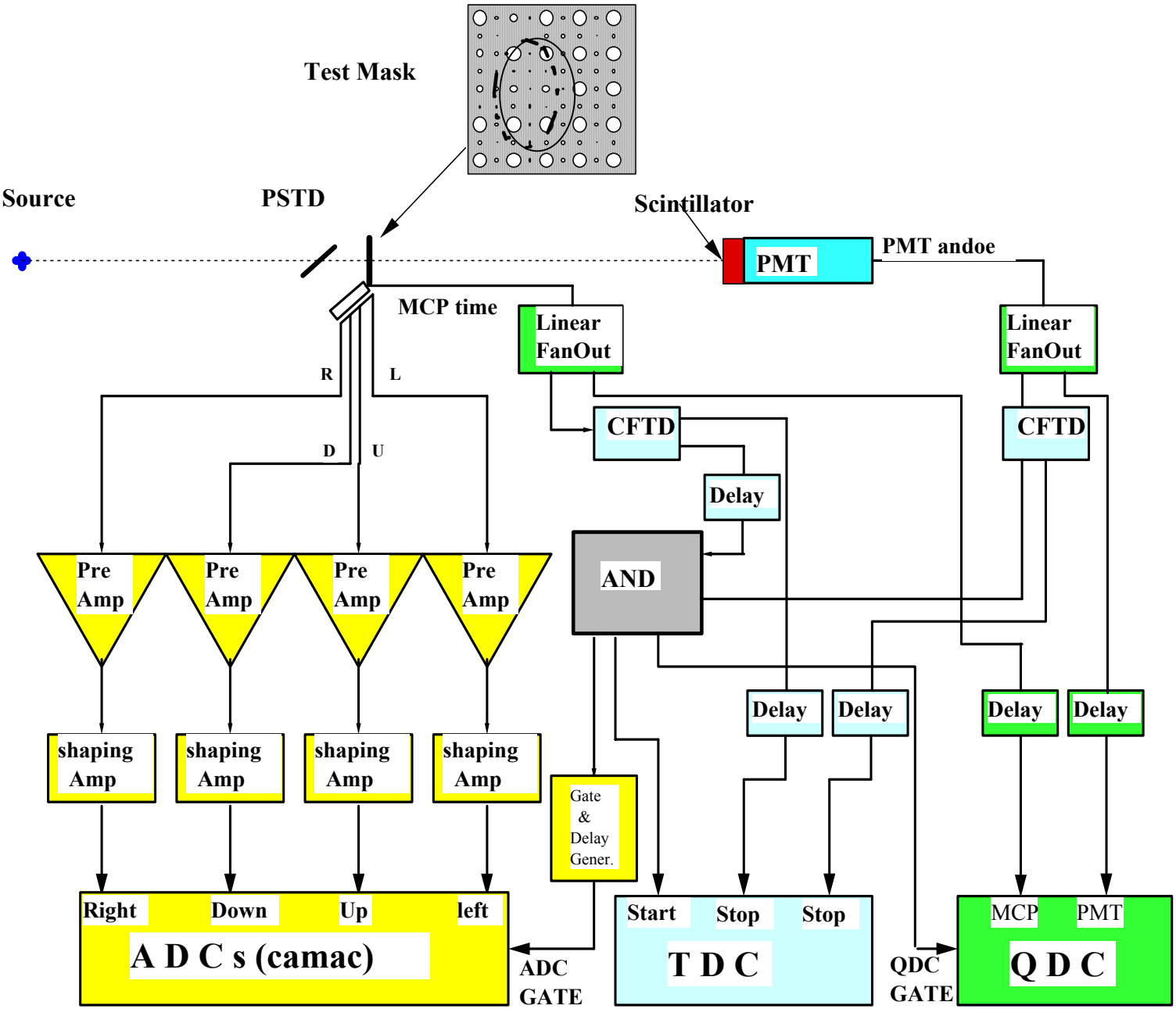




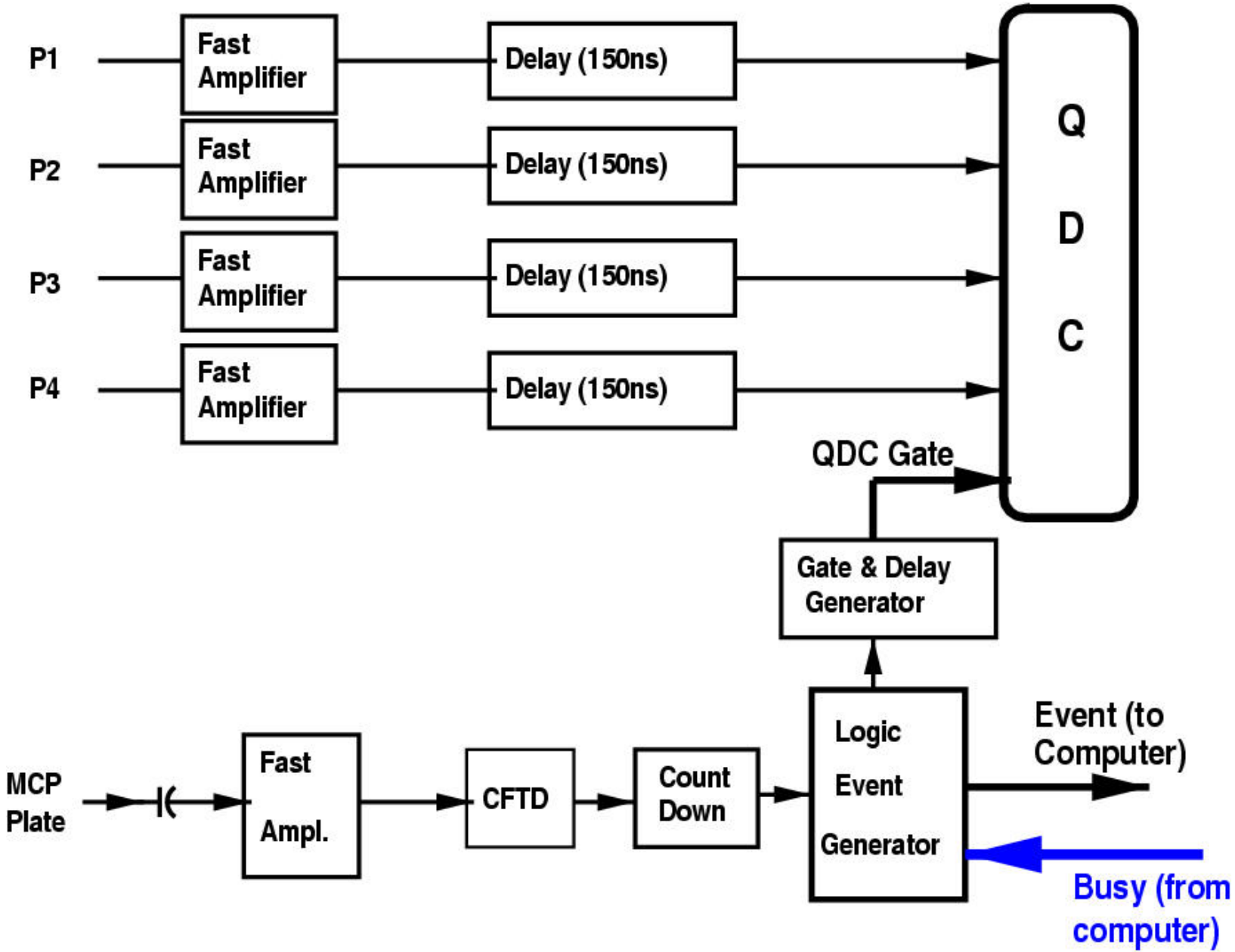
Future Features

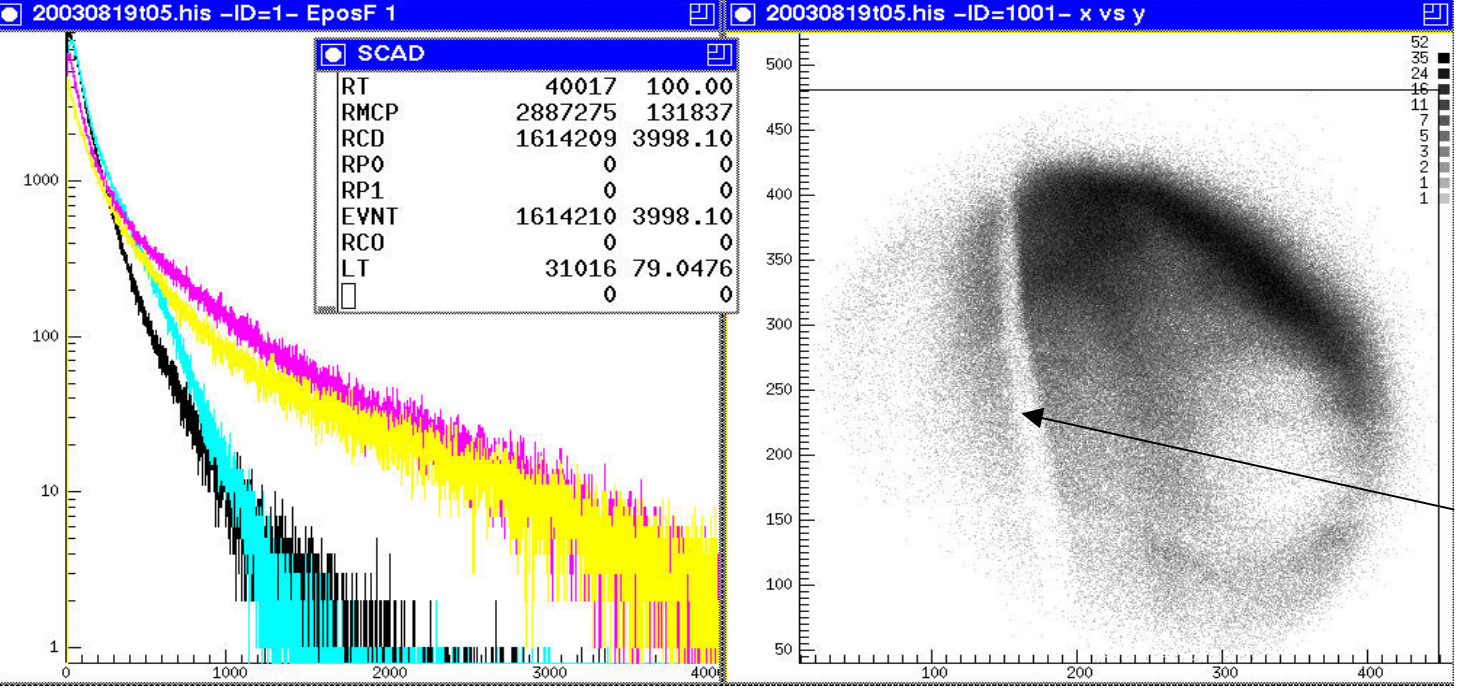
- Higher Count Rate Capabilities [>1 Mcps].
  - MCP recovery rate (hot plates? Higher density plates?).
  - Resistive layer (Low resistivity? Discrete components?)
  - Signal processing (faster/better electronics?)
- Larger Apertures [30 -60 cm].
  - Demagnification? larger MCP plates? Stacking?
- Tracking in real space.
  - De-warping image (2D image transformation software).
  - Calibration schemes.

Position and timing measurements



Modified electronics





150K/s

Image of 0.5mm wire

1500K/s