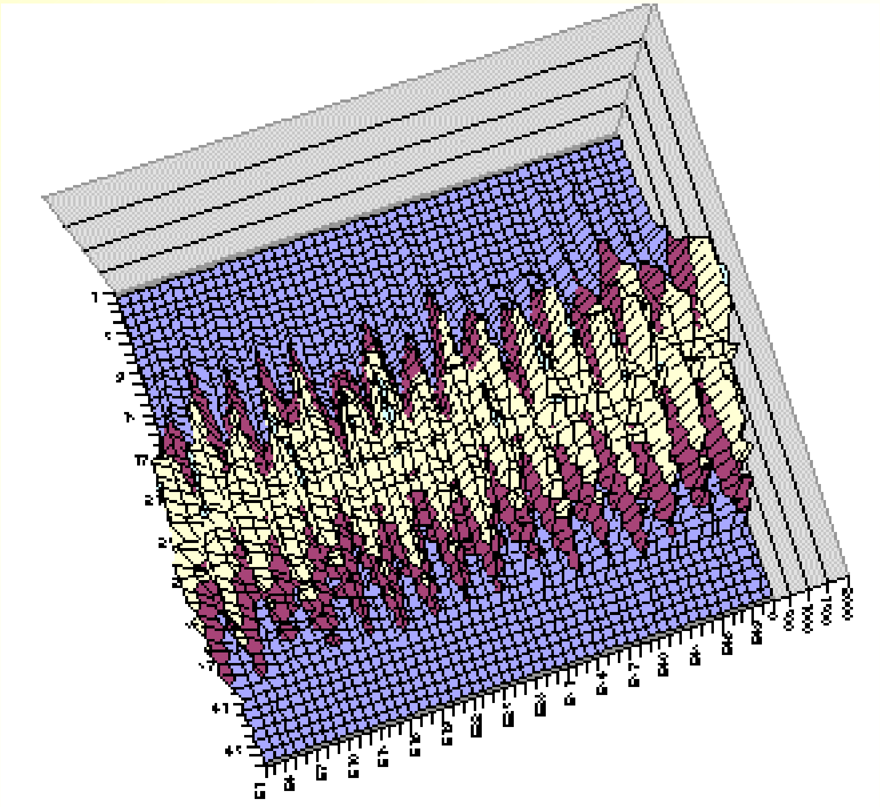
RHIC IPM

Electrons from ionization give accurate profiles.

We have demonstrated single-bunch profiles.

Mountain-range of one bunch at injection



Detector channels are plotted on the vertical axis and turn number is on the horizontal axis. Data contains both tune frequencies and quadrupole oscillation.

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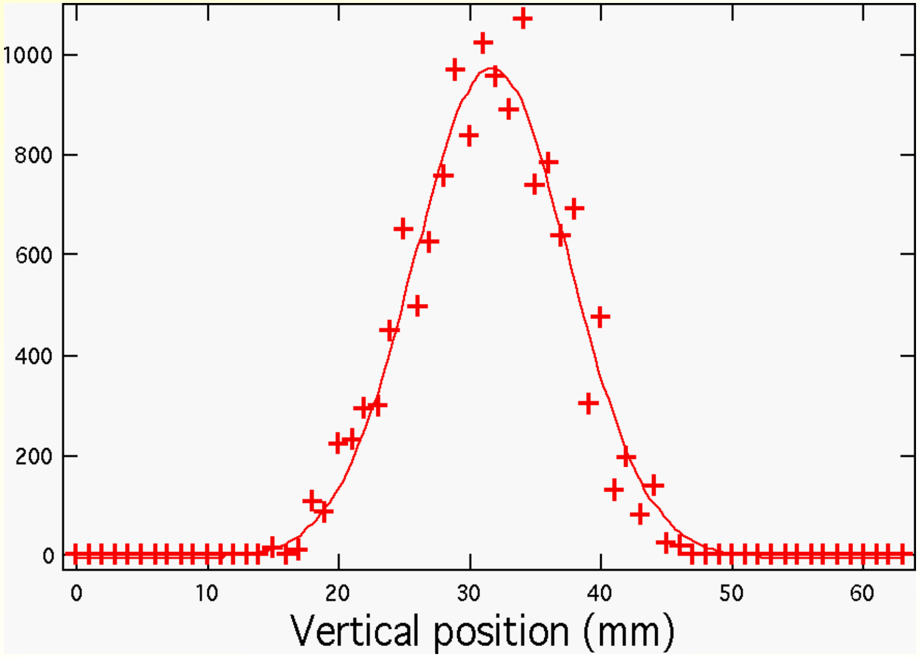
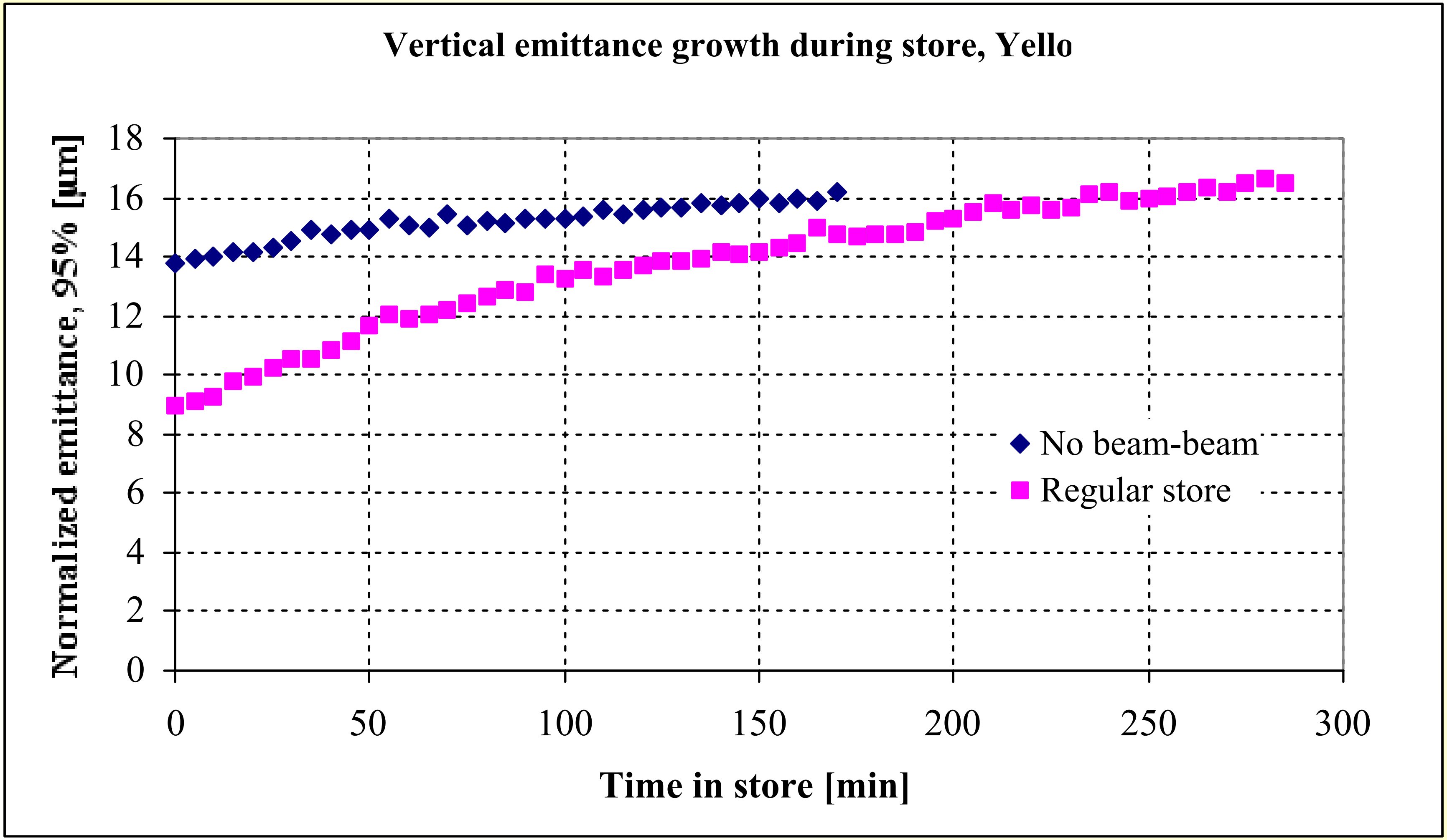
Single-bunch profile



One profile from the mountain-range data set. The markers are the measured points and the curve is a Gaussian fit to the data. This is a measurement of a single bunch passing once through the detector. The fitted curve has a width of σ=5.9±0.2 mm.

Emittance growth from beam-beam



IPM problems/solutions?

1. Horizontal detectors: Collector channels too wide
2. Dead channels
   A. In vacuum: 3-5 channels/detector
   B. One amplifier board out (8 channels)

New collector boards for horizontal detectors. Better connectors and damping resistors directly on boards to reduce threshold of ringing.

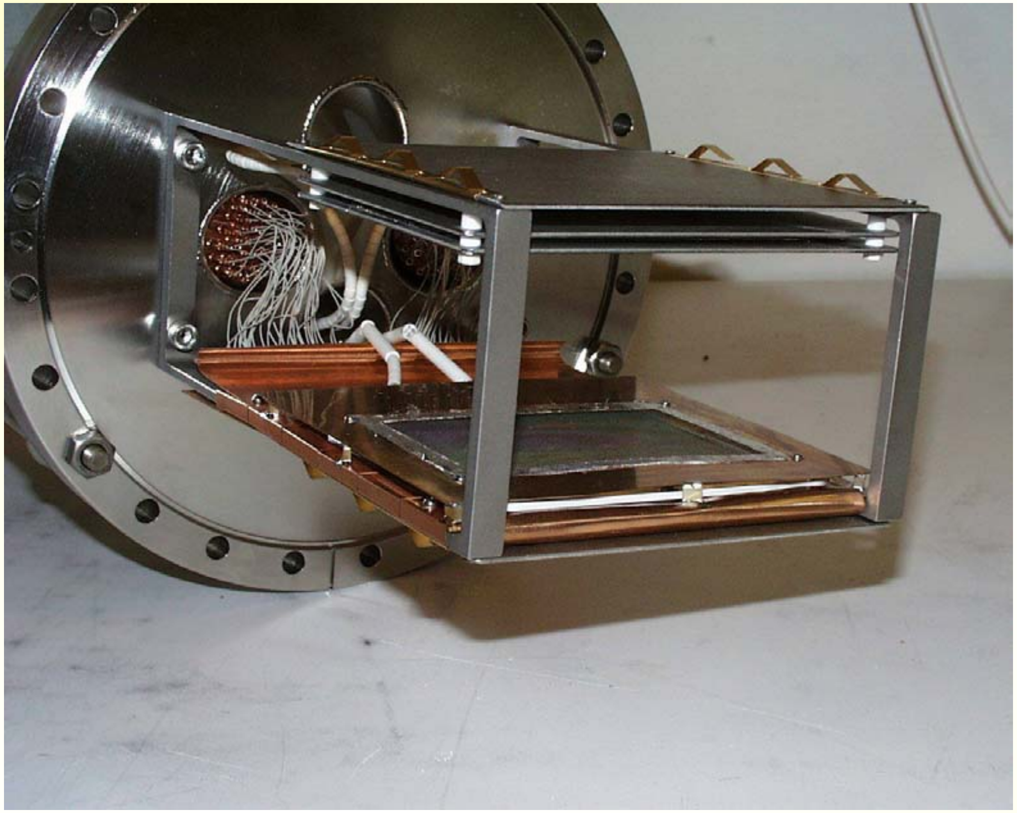
3. Spray: Turn on/off with MCP bias NOT with sweep field
4. RF pickup from beam: Each year shielding has worked up to a threshold.
5. Electrons: Turn on/off with sweep field
   A. Secondaries from detector chamber: Peak that does not move but changes height with beam steering.

Modified vacuum chambers and head assembly. Beam will see uniform cross section image current path. All electron collection components will be outside of "transmission line".

   B. Electrons from the beamline(?): Baseline offset

Suppression magnets.

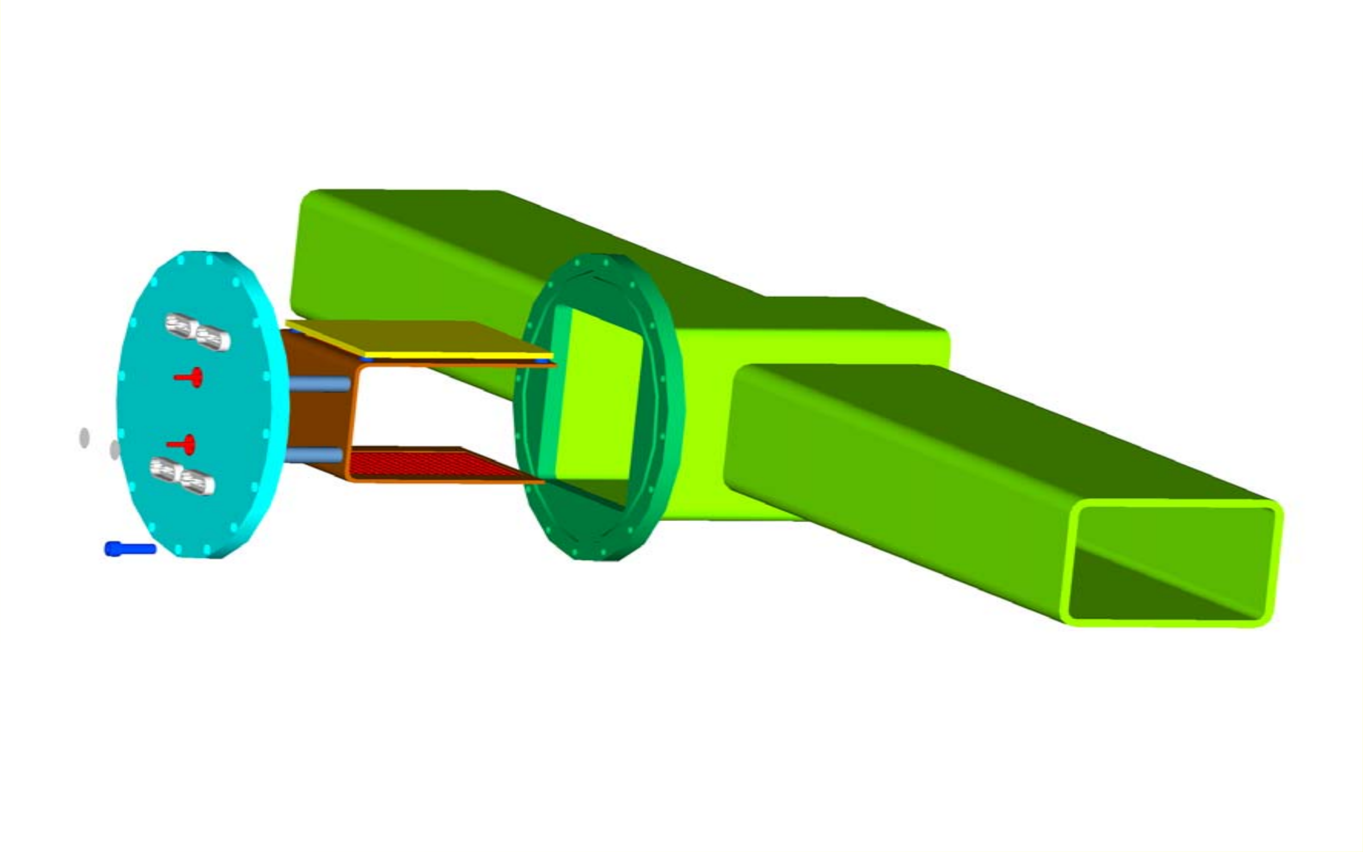
Photograph of original detector head



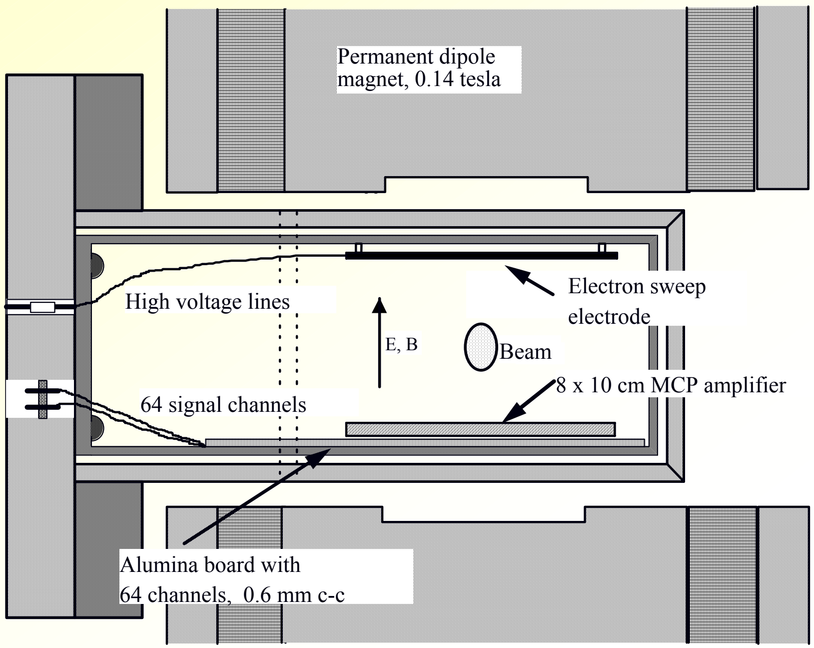
Attached to the top of the brackets are the electrodes which sweep electrons toward the collector. At the bottom is the anode-MCP assembly. The rectangular brackets have been replaced by open ended brackets and a continuous EMI shield has been placed over the entire anode-MCP-feedthrough assembly.

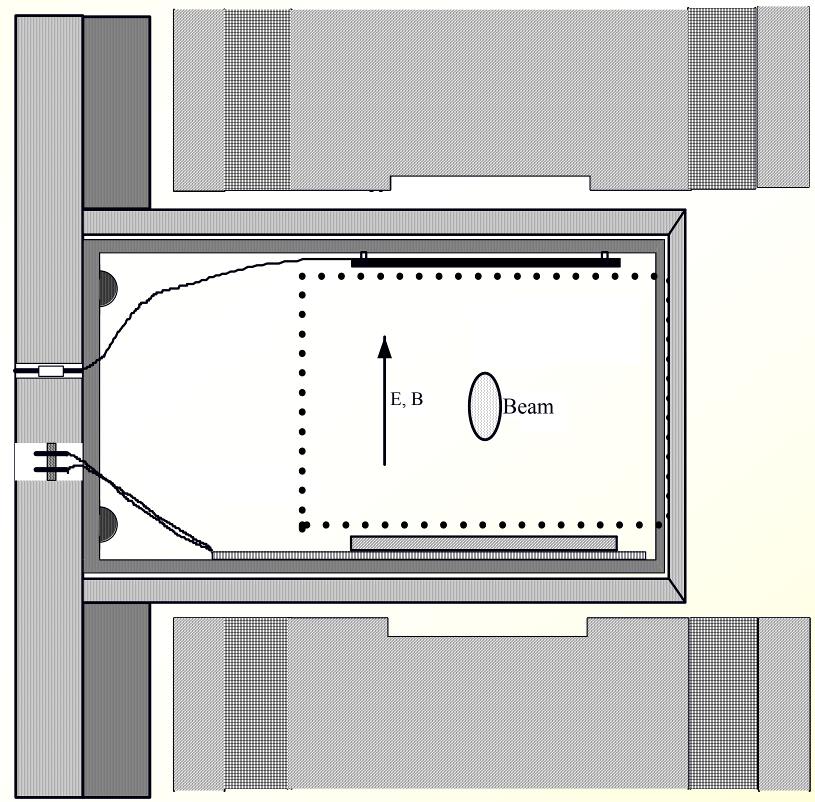
Modified IPM.

Image-current shield (red) forms rf seal with chamber. All collector electronics are outside of shield. Rf screen over MCP will be more robust than present screen.



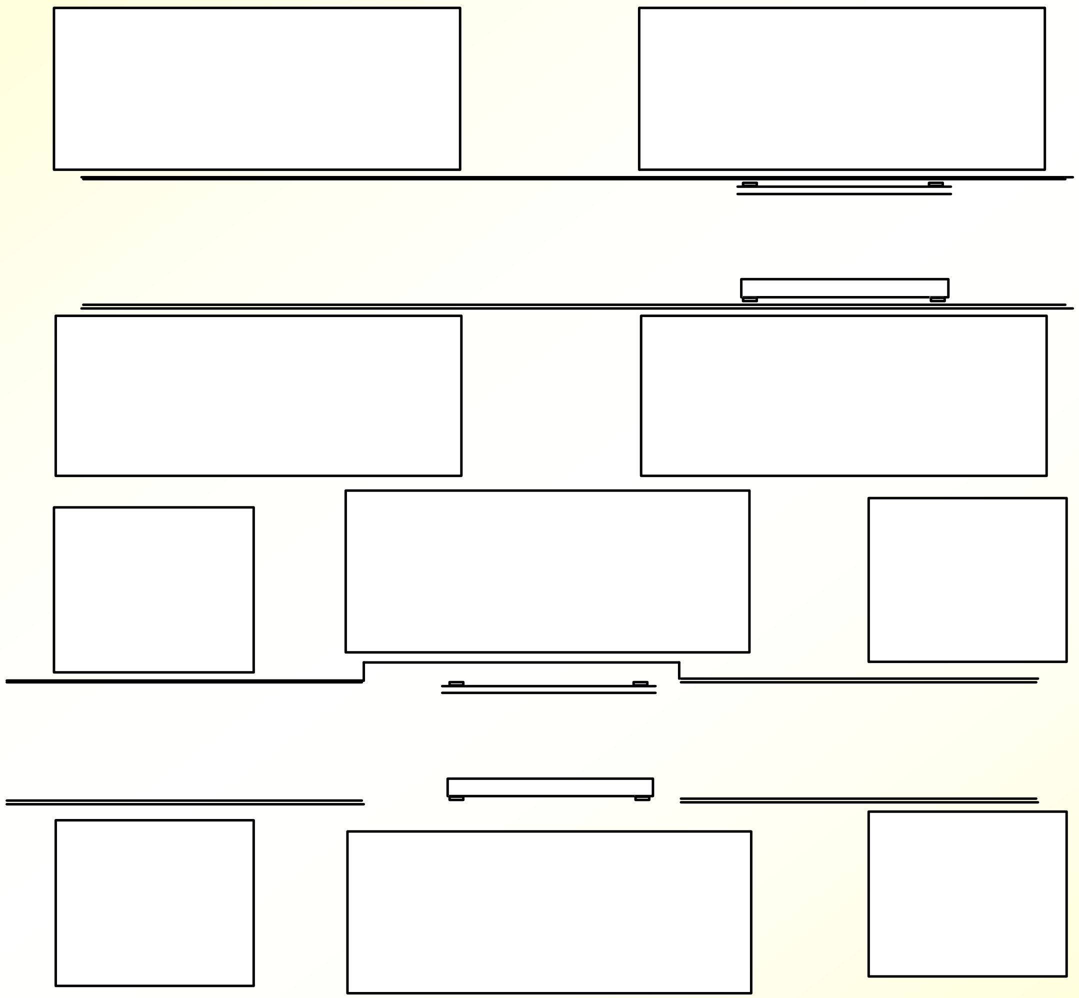
Modification of transducer





Now the detector components are inserted inside the beamline. This restricts aperture and makes detector components vulnerable to stray beam. A new detector chamber will allow the detector components to be outside of the cross section of the pipe.

Three magnet orbit correction to eliminate electrons



Optical detection of electrons

Replacing the electron collector board with a fast phosphor (P47, decay time ~100ns) would eliminate EMI coupling to the beam.

We are planning to place this experiment in the linac HEBT line just past the Laser Profile Monitor to measure phosphor response to electrons.

This should give a profile which is wider than the actual beam since there is no magnet.

Technique may be applicable to profiles (getting this inside a magnet is tricky) and to detection of beam-generated electrons.

Optical IPM test

Plans

Modify two chamber and rebuild both horizontal IPMs. New circuit board will have channel-channel spacing 1/3 of present board. Better wiring design should eliminate dead channels in vacuum and reduce threshold for detector ringing from EMI.

All collector electronics will be outside of an image current path which is exactly the beam line cross section. This will eliminate secondaries in chamber and reduce vulnerability to radiation spray.

A uniform cross-section image current path will reduce amount of energy left behind in detector chamber. Also detector screening can be improved.

A third magnet added to side of detector opposite corrector magnet should protect chamber from beam-generated electrons. A solenoidal field between detector and corrector magnets might help.

Optical detection of electrons to be studied in hope of future application.