RHIC Emittance Measurements

1. Primary emittance measurement tools have been the Ionization Profile Monitors and vernier scans.

2. Total power in betatron Schottky band is proportional to the number of particles in the beam and to the square of the r.m.s. oscillation amplitude . Last run Kurt Vetter did some work toward developing emittance measurement capability with Schottky cavity. This work will continue in next run.

3. The beam transfer function between a quadrupole kicker and quadrupole pickup can be used to obtain emittance.

4. A wiggler to give synchrotron light is planned for the next shutdown period.

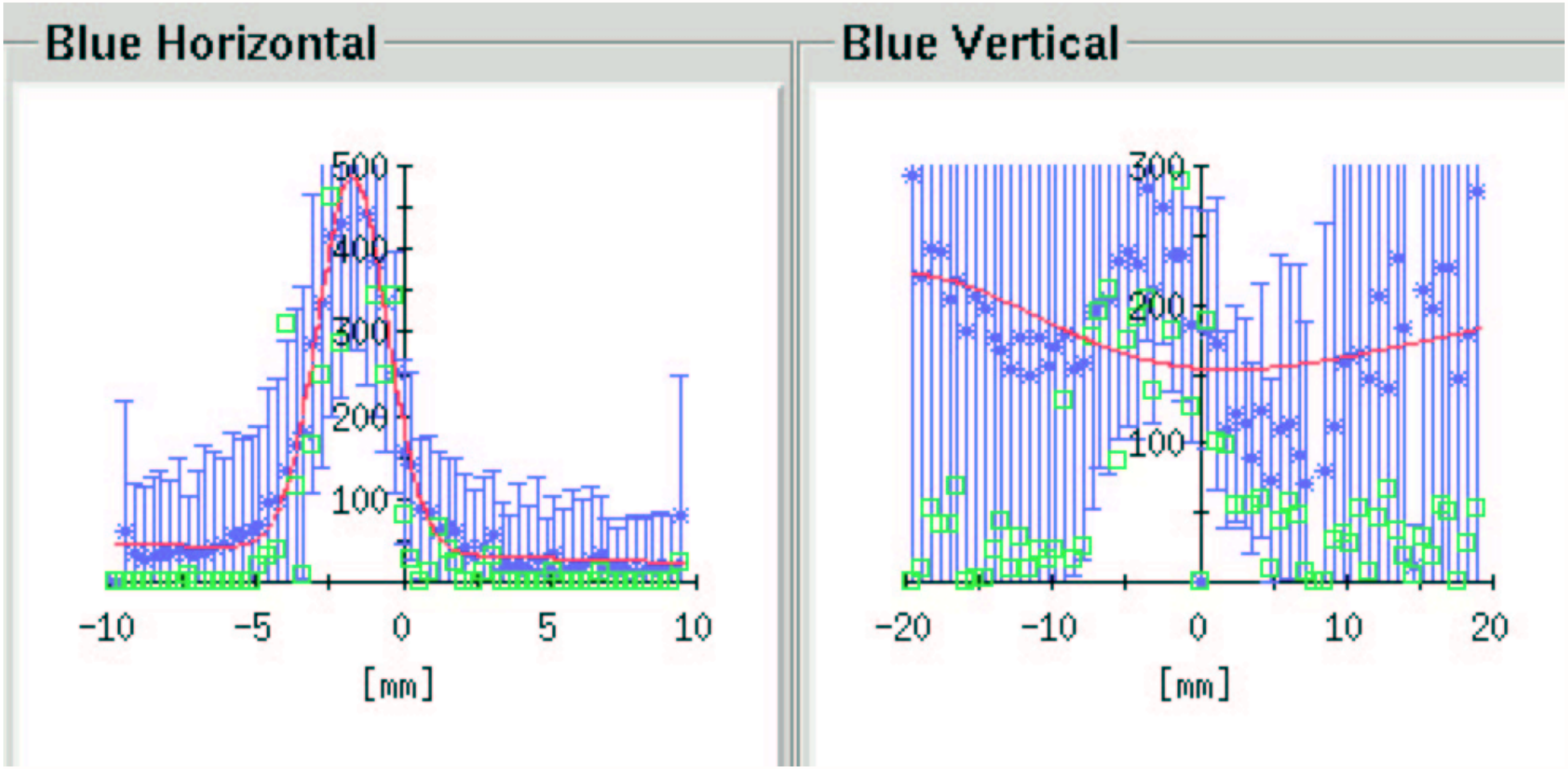
RHIC 2003 Run, IPM status

New horizontal IPMs were built.
These IPMs were far less sensitive to rf, radiation, and electron backgrounds than the original design.

Because the magnetic field was reduced when the gap was increased, there was steering by the transverse electric field.
Transverse electric field was too small to collect all of the signal electrons.
Both the measured beam width and the signal amplitude varied with beam position in the new detectors. This is not resolved but it might be related to the transverse electric field.

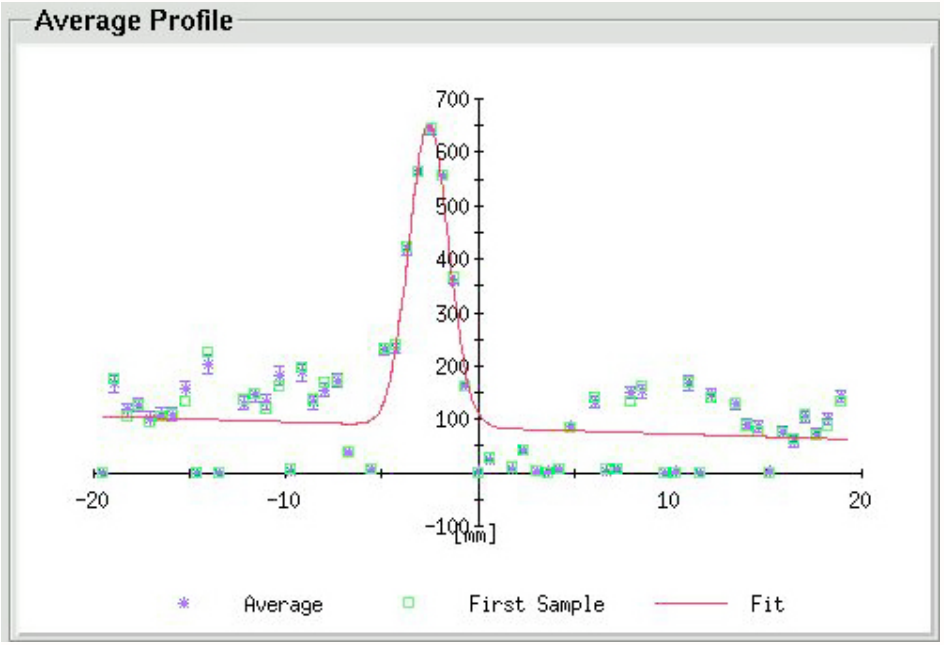
Vertical IPMs (old design, wide beam) gave beam widths which agreed with vernier scans.
Horizontal IPMs (new design, narrow beam) gave beam widths which were 50%-100% wider than indicated by vernier scans and model β functions.

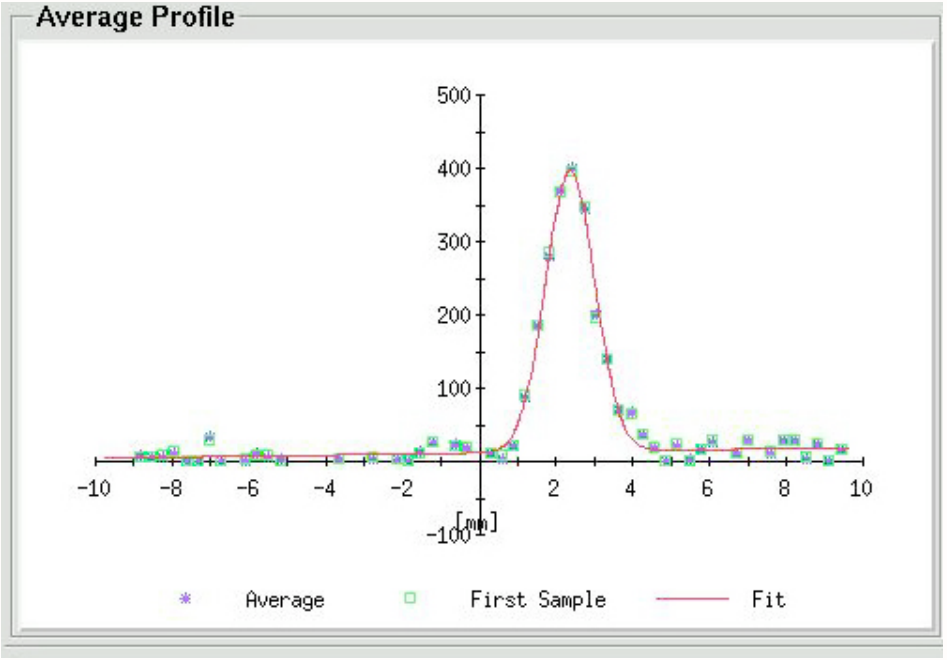
Both detectors in a single ring were measuring the same object. β functions at the IPMs should be measured.



New Detector Design

Old Detector Design





Profiles from the horizontal detectors in the yellow ring with gold beam.
The left profile is from the old design IPM (Oct. 2001) and shows a large background.
The right profile is from March 2003. The new design eliminates most of the background.
With gold beam the background is about 2-3% of peak.

2003 Rebuild

All four detectors have been rebuilt.

An electron calibration source was added. This will give a uniform electron signal to the detector. This will be used to check MCP aging and to calibrate the filtered amplifiers. It might be usable for the pulse amplifiers.

Higher transverse sweep electric field will ensure that all signal electrons are detected. The higher field will also further suppress background electrons.

New electrode design will give parallel transverse electric field. This should correct transverse-position dependent effects. Also it will allow accurate collection of ions if the electron background is a problem.

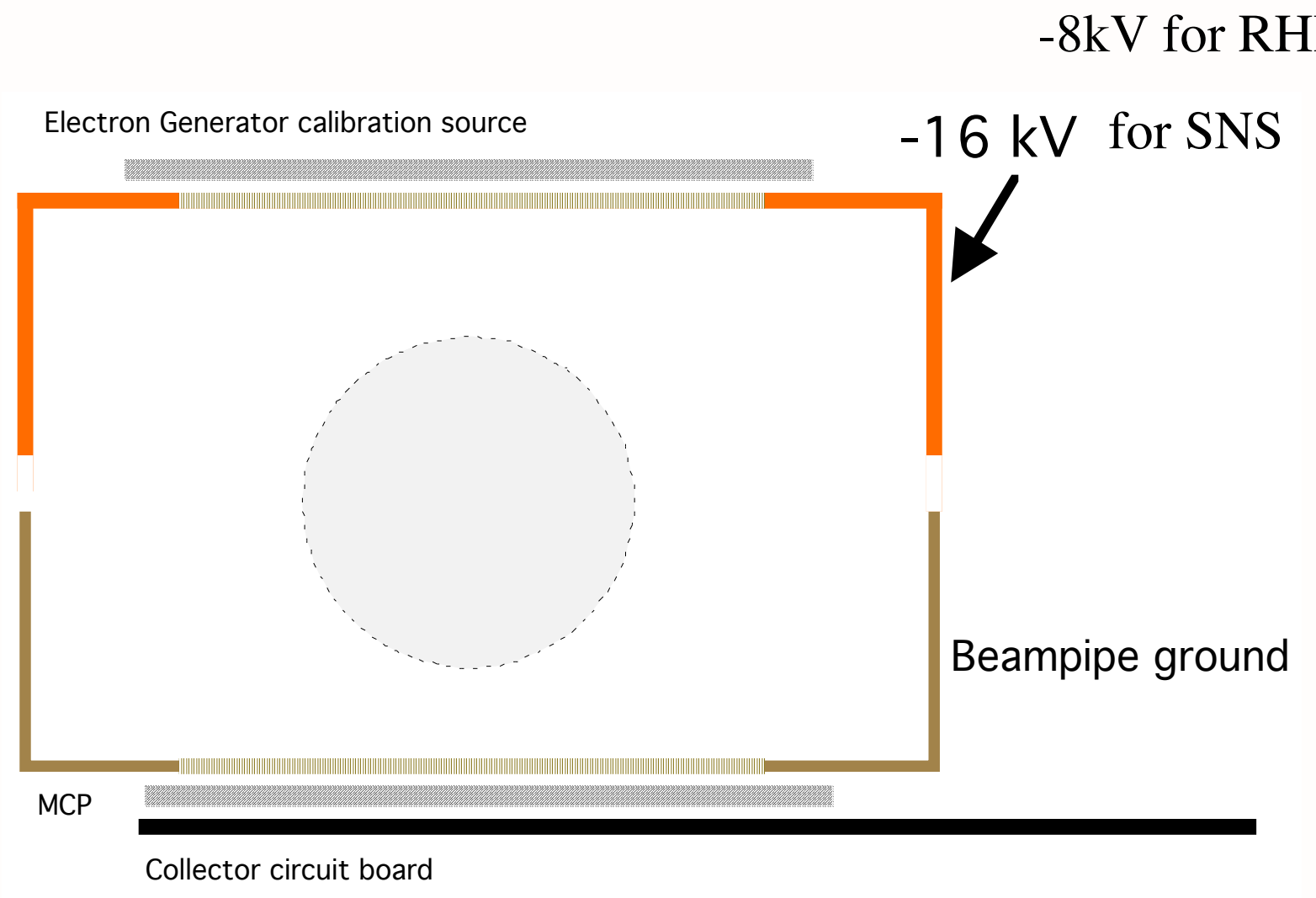
Software changes (Steve Tepikian)

Dialog box has been improved. It should be more user friendly.

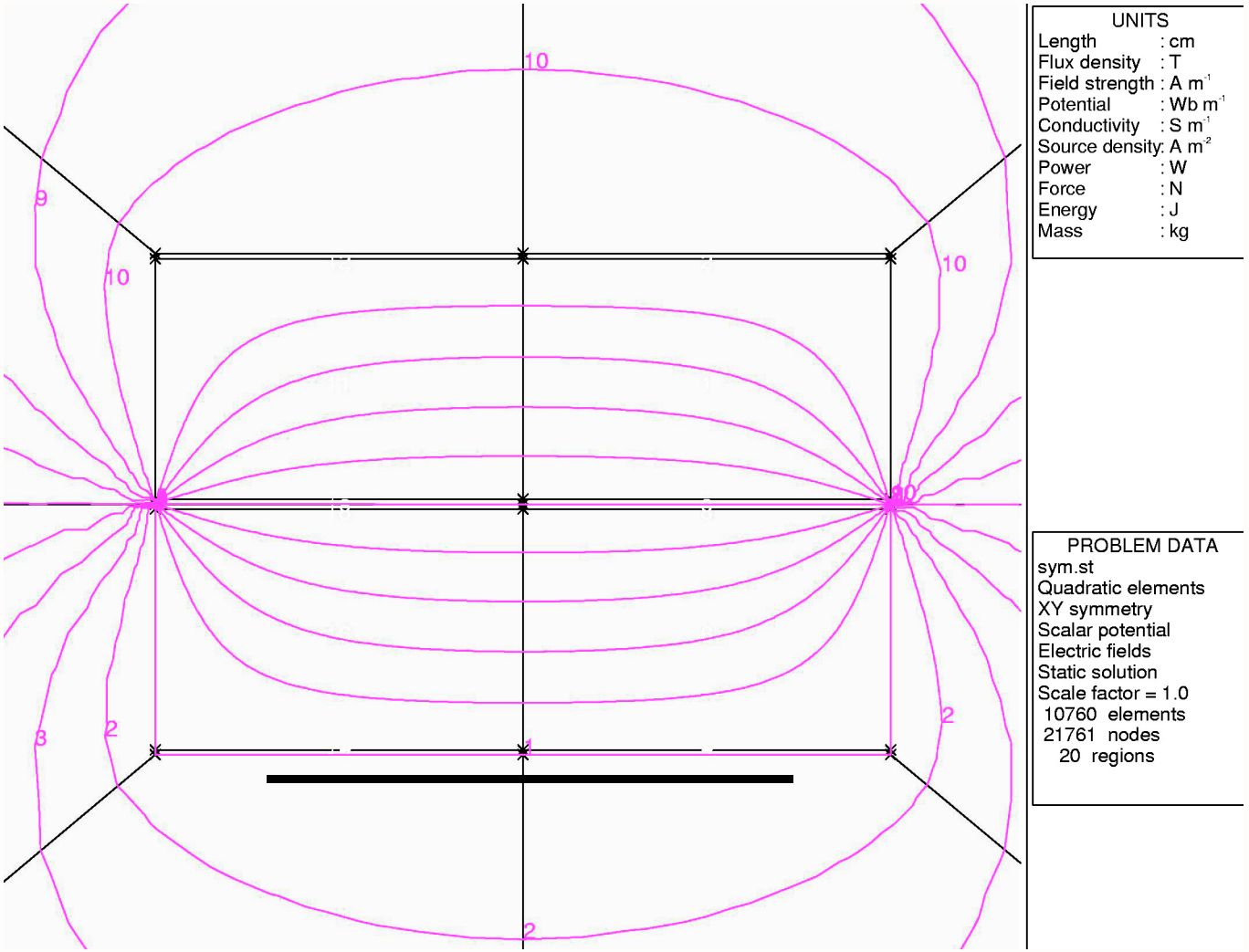
If pulse amplifiers can be used, single bunch TBT data can be analyzed for dipole and quadrupole power spectrum. This might be useful for injection matching.

Profiles of more than one bunch can be collected.

Detector cross section



Electric sweep field shaping



Emission Uniformity and Beam Definition
50 X 8 mm Array, Z Configuration

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