Electron Cloud Measurement Summary for the April 2014 Run

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and Others

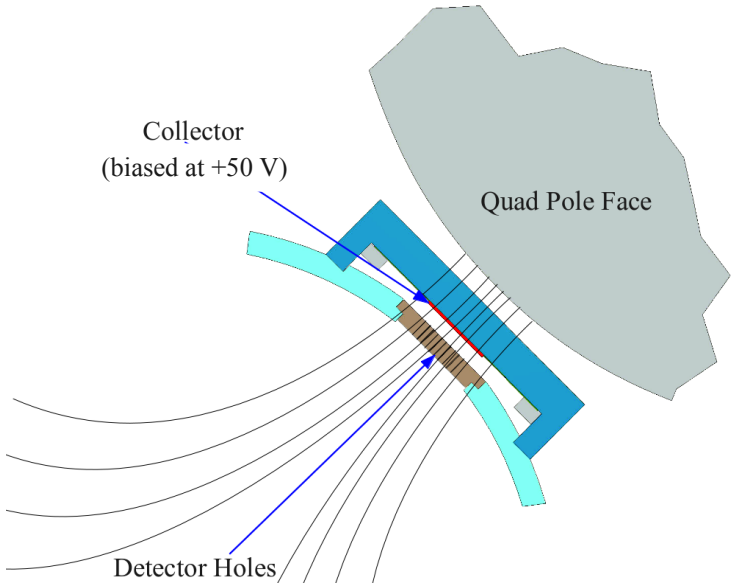
Electron Cloud Measurements: April 2014

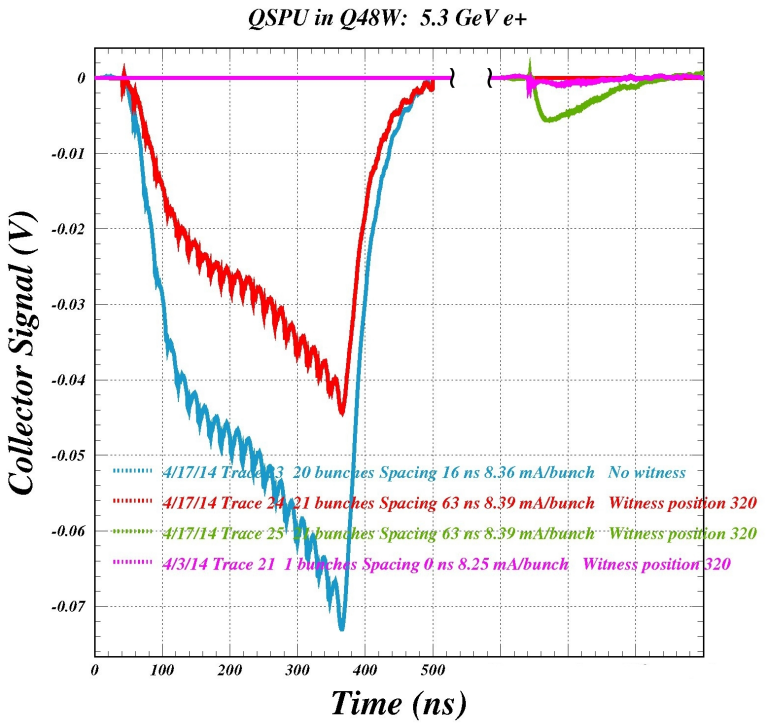
Overview of 5.3 GeV Data

- **Instruments:** ** First Time Measurements **
  - Quad Shielded Pickup in Q48W (QSPU)
  - Time-Resolved Retarding Field Analyzers in the L3 Chicane (TR-RFA)
  - TE Wave measurements in the L3 Chicane, *13E*-15E and *Q48E* (TEW)
  - Shielded Pickups at 15E/15W (SPU)
  - Retarding Field Analyzers (34) – *Cross-calibration measurements (SPU-15E/W, TEW-15E)*
  - There are also some *turn-turn CBPM measurements of witness bunches* by KGS.
- **Beam Configurations:**
  - Positrons: 10-bunch and 20-bunch trains, with and without a witness bunch
    - Data versus total current and chicane field (QSPU, TR-RFA, SPU *(20 dB)*, TEW, RFA)
    - Data versus witness spacing and current (QSPU, TR-RFA, SPU, TEW)
    - Data versus bunch spacing: *4*, *8*, *12*, 14, *16*, *20*, *24*, *28* ns (QSPU, TR-RFA, SPU, TEW)
  - *Electrons: 20-bunch train*
    - *Data versus total current and chicane field (SPU, TEW)*
    - *Data versus witness bunch spacing and current (SPU, TEW)*
  - Positrons and electrons 2-bunch (SPU, long-term TiN and Al conditioning)

Data Examples from April 2014

QSPU in Q48W

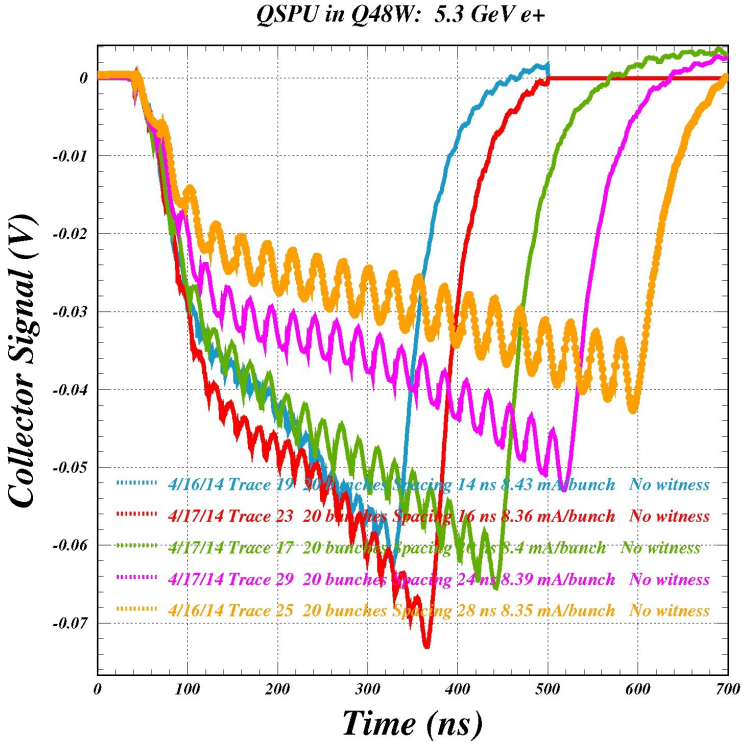


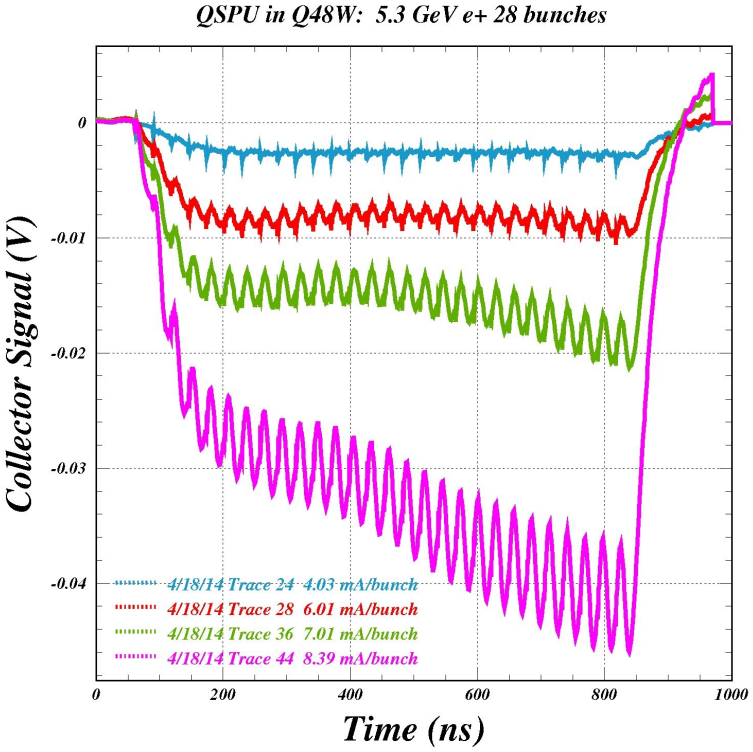


- With a single positron bunch at 8 mA there is almost no signal (magenta trace)
- 20-bunch positrons with 16 ns spacing at 8mA/bunch with no witness bunch (blue trace).
- Then add an 8 mA witness bunch about 1 μs after the train (green trace).
- Witness signal is much larger than that of a single bunch, and
- The 20-bunch signal decreases when the witness bunch is added (red trace).

Data Examples from April 2014

QSPU in Q48W



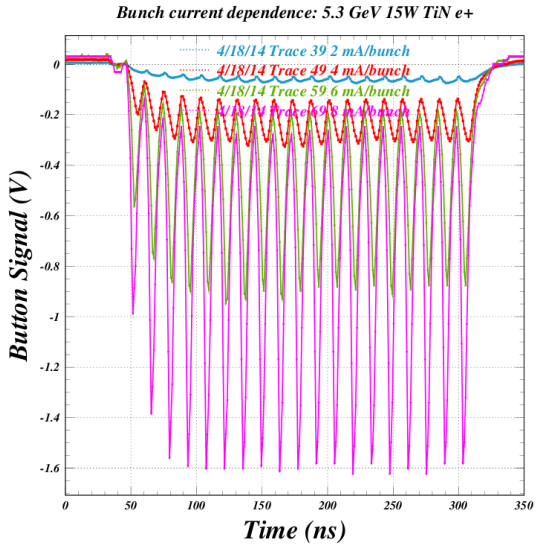


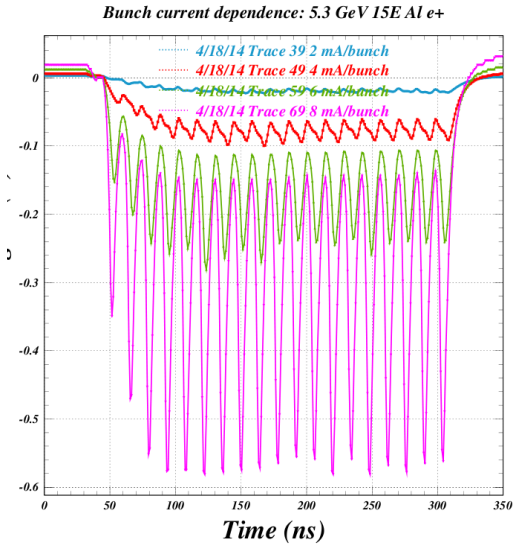
QSPU signal with 20-bunch positrons at 8 mA/bunch with different bunch spacings. The largest signal is produced by a train with 16 ns spaced bunches (red trace).

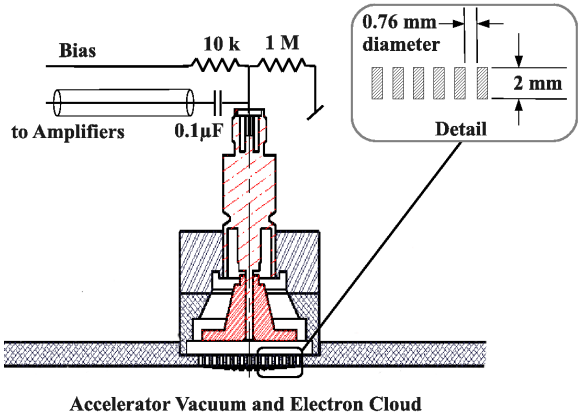
QSPU signal with 28-bunch positrons (14 ns) versus bunch current

Data Examples from April 2014

SPU at 15W (TiN) and 15E (Al)



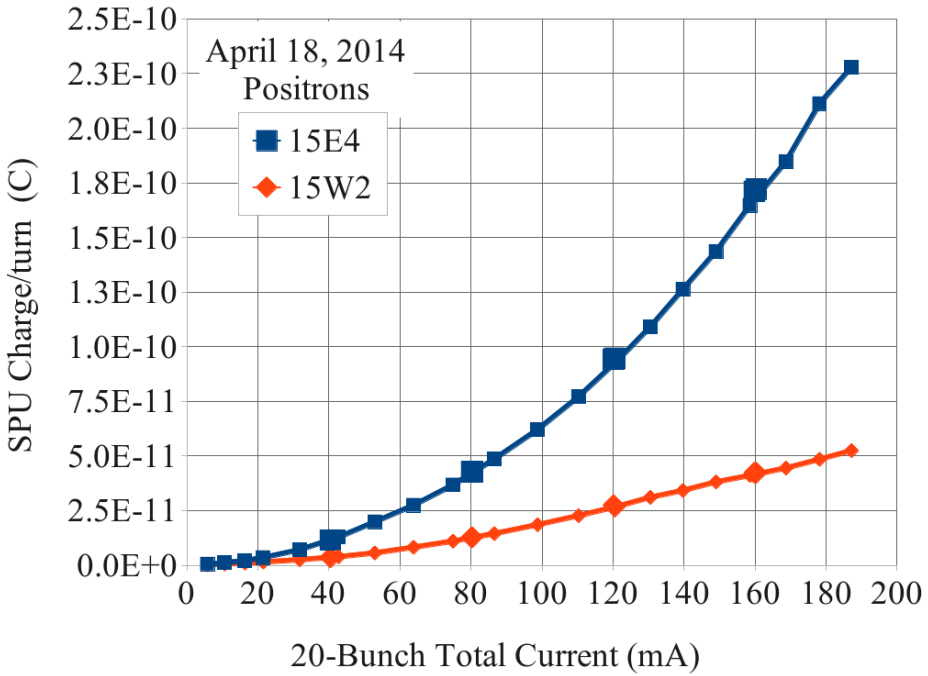


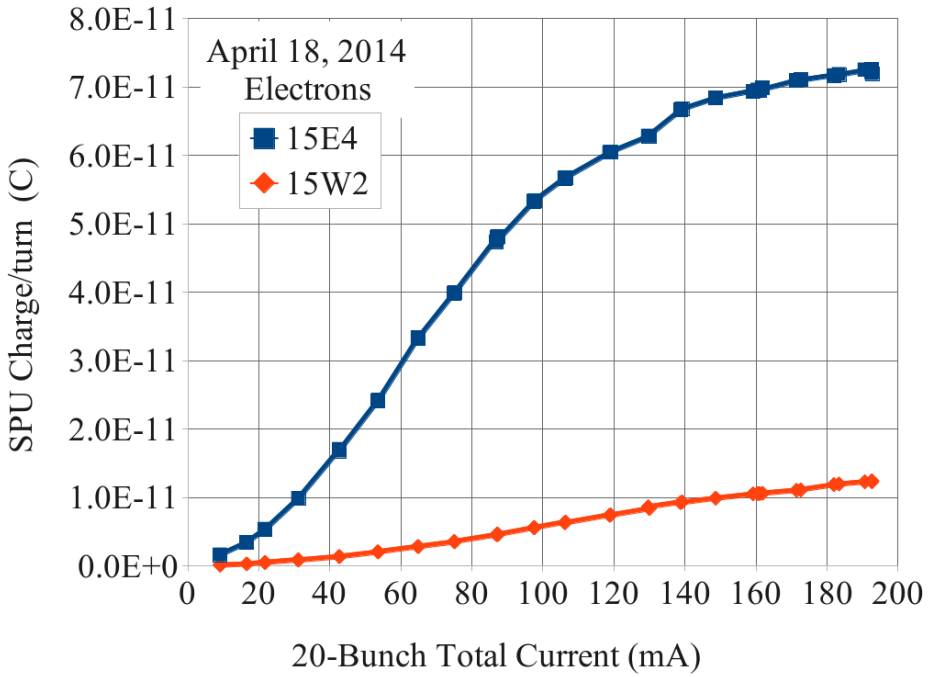


SPU signals were recorded at a large number of bunch patterns and currents. Signals from 15E with 20-bunch positrons at four currents are to be used for cross-calibration the SPU, RFA and Microwave measurements.

Data Examples from April 2014

SPU at 15W (TiN) and 15E (Al)

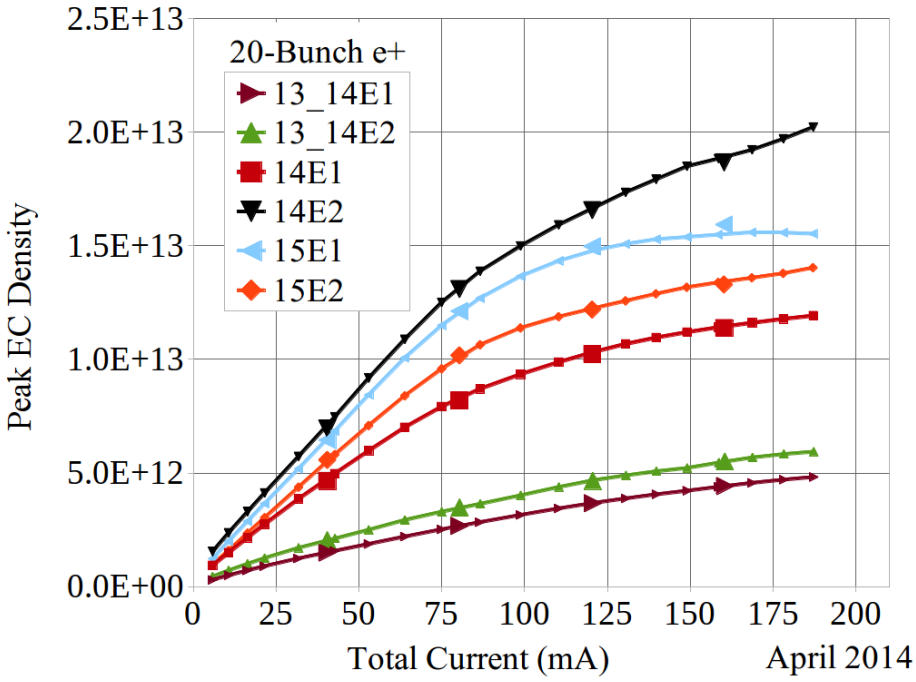


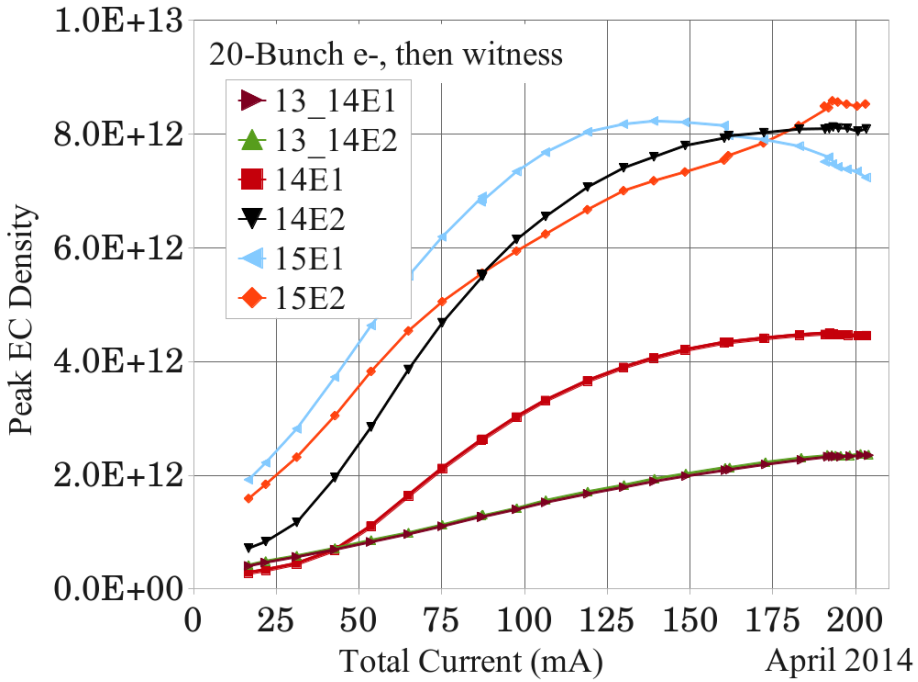


One way to view the data is by integrating the SPU signal to obtain the charge/turn into the detector. This is plotted versus current for a 20-bunch train of both positrons and electrons with data taken at both 15W and 15E. The larger symbols in the positron data are the four currents at which the cross-calibration data was taken.

Data Examples from April 2014

Microwave Measurements

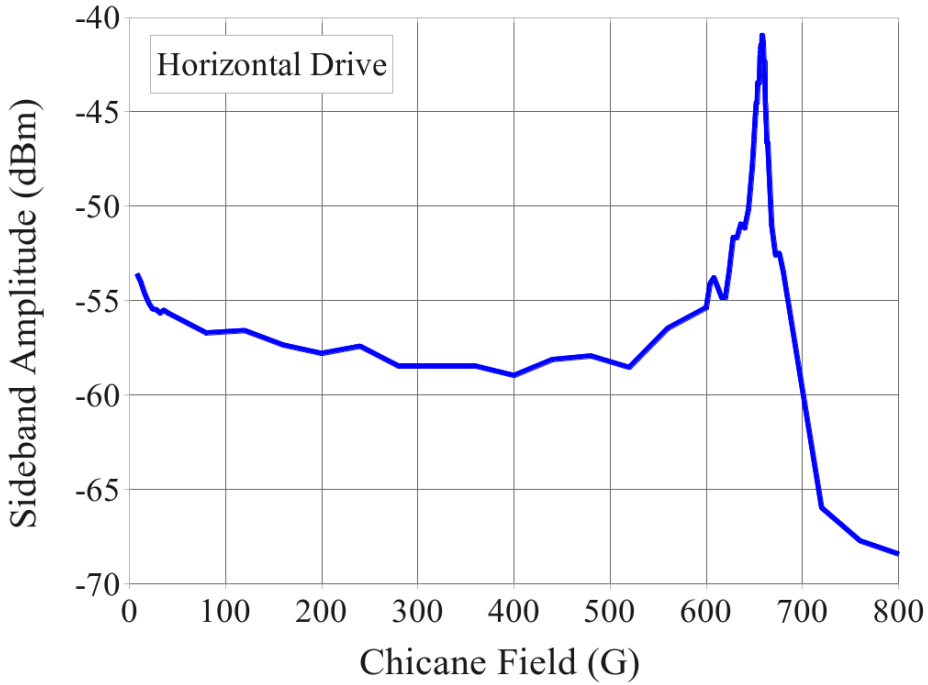


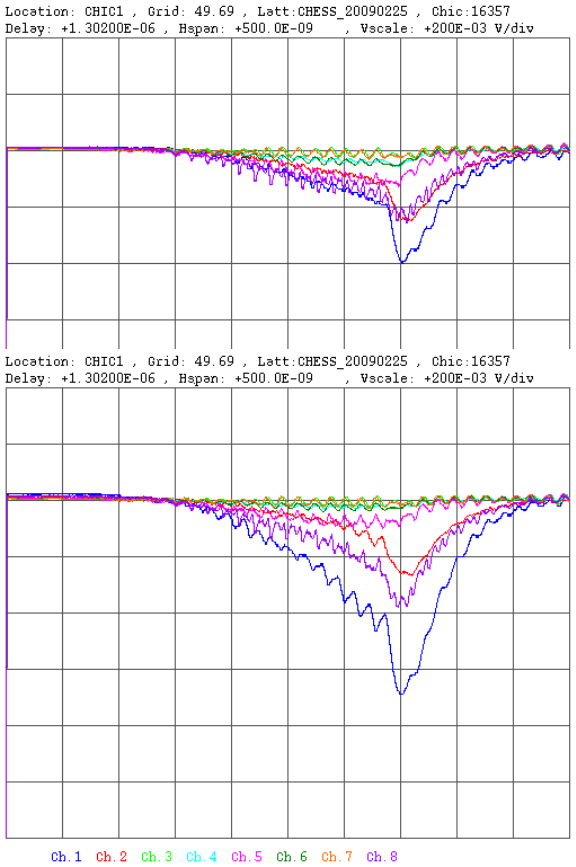


- Data was taken in three regions between 13E and 15E
- At the same time, SPU 15E data was also taken.
- RFA data was taken with positrons at the points with large symbols.
- EC density from both positron and electron beams show (cloud) saturation, but the electron data has more "features".

Data Examples from April 2014

Microwave Measurements





Drive OFF

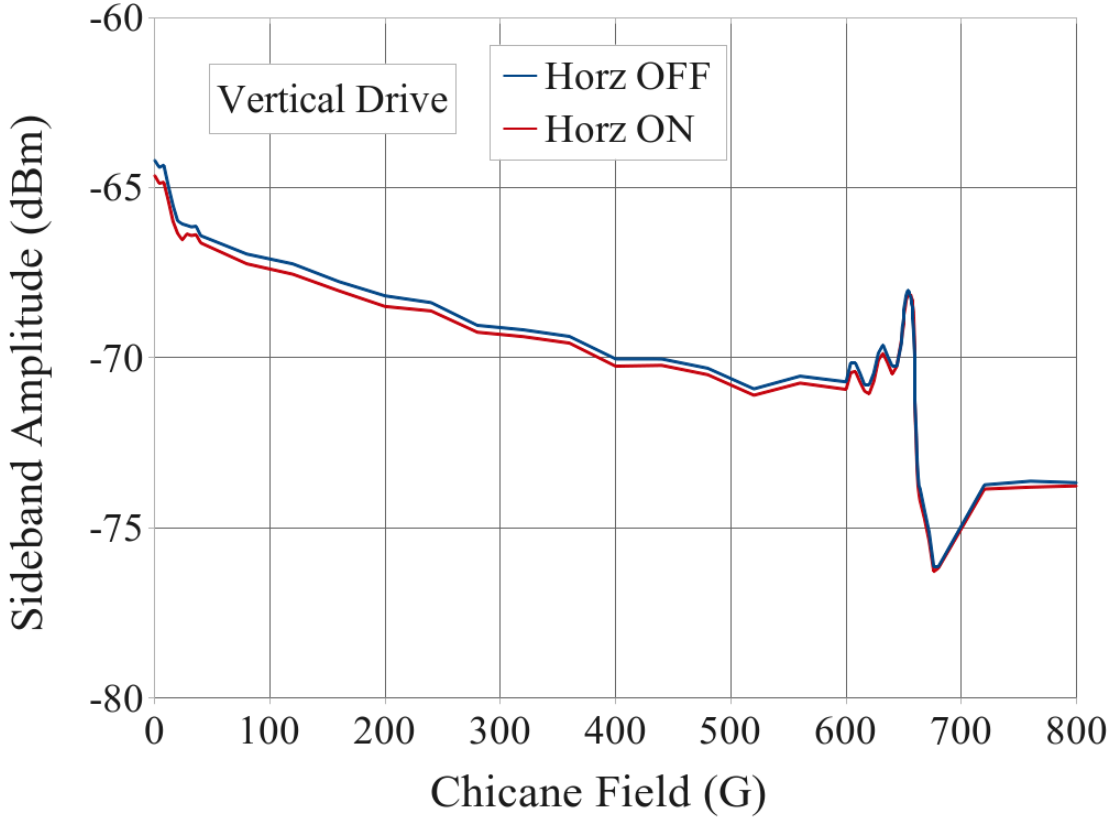
Drive ON

A scan of Chicane (dipole) field shows that the sidebands have a sharp peak at the cyclotron resonance.

At the cyclotron resonance, the TR-RFA signal in the same chamber increases when the microwaves are turned ON

Data Examples from April 2014

Microwave Measurements



However, the sidebands that are measured using an independent mode (vertical) in the same chamber do NOT show a significant change in amplitude at the cyclotron resonance when the horizontal drive is turned ON/OFF. This indicates that the EC density does not actually change with horizontal excitation.

Summary and Comments

- More than 60 hours were dedicated to 5.3 GeV data collection.
- Transitions in energy, totaling 11 hours, generally went smoothly.
- There was also an 8 hour shift of 5.3 GeV setup and a 6 hour RFA only data shift.
- We harvested large quantities of data from a variety of detectors with both positron and electron beams.
- This data will be used both for comparison with simulations and with complementary detectors where that is possible.
- Data taking software for SPU, QSPU, and TR-RFA were running on Linux for this run. (Only TEWave software remains to be ported).