



Fermilab



*LARP LHC 4.8 GHz Schottky
System Initial commissioning
with Beam*

*Ralph J. Pasquinelli
Fermilab*



Fermilab **LARP LHC Schottky**



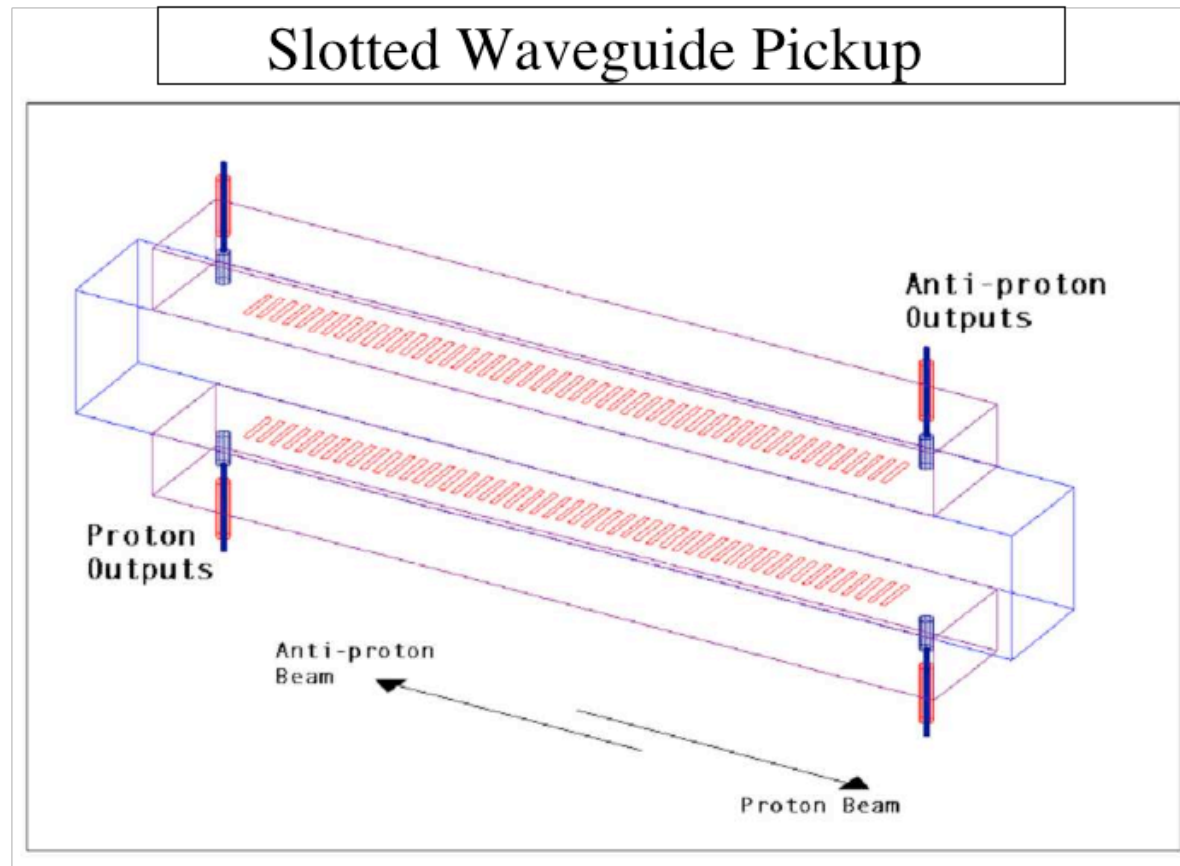
*Tevatron Schottky System
Operational 2003*

*LHC Schottky System
Approved by LARP 2004*

R. J. Pasquinelli



Fermilab *LARP LHC Schottky*



R. J. Pasquinelli



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Pickup Designed @ Fermilab in 2005

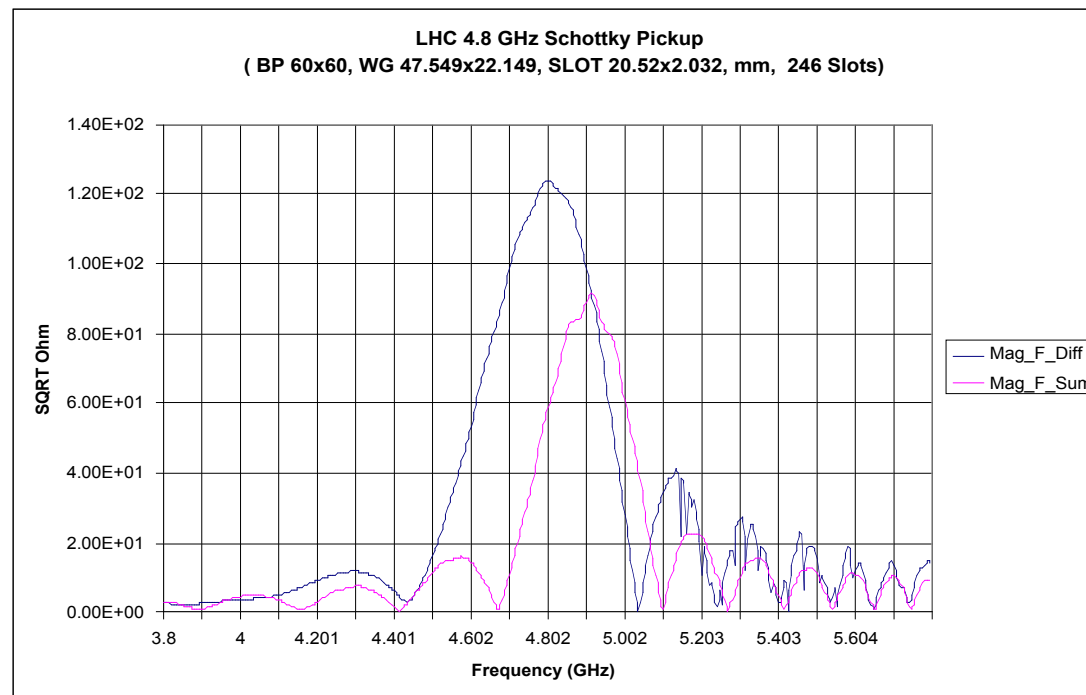
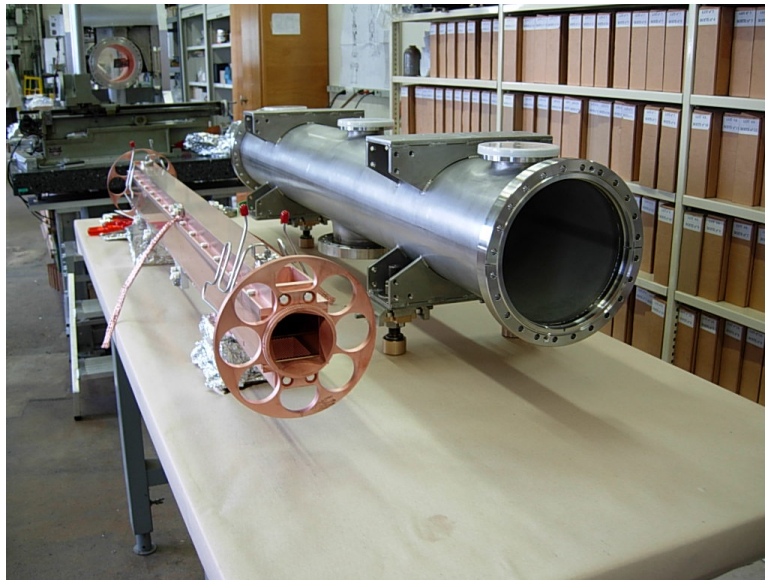


Figure 2. Impedance of LHC Schottky pickup

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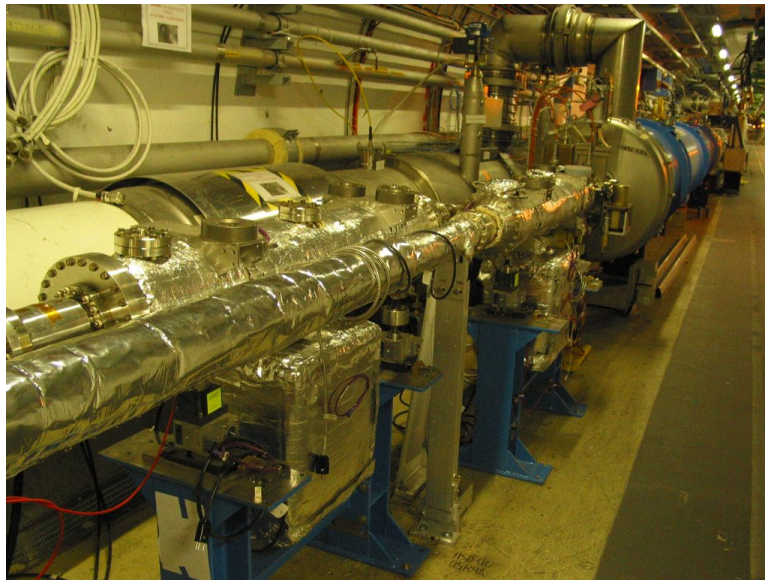
*Pickups Fabricated
at CERN Autumn 2006*



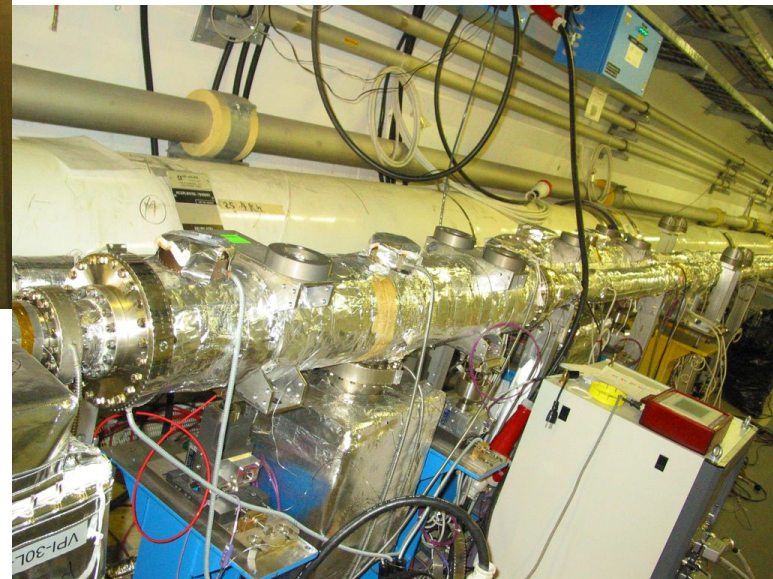
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*Pickup tanks installed
at LHC Point 4, Spring 2007*



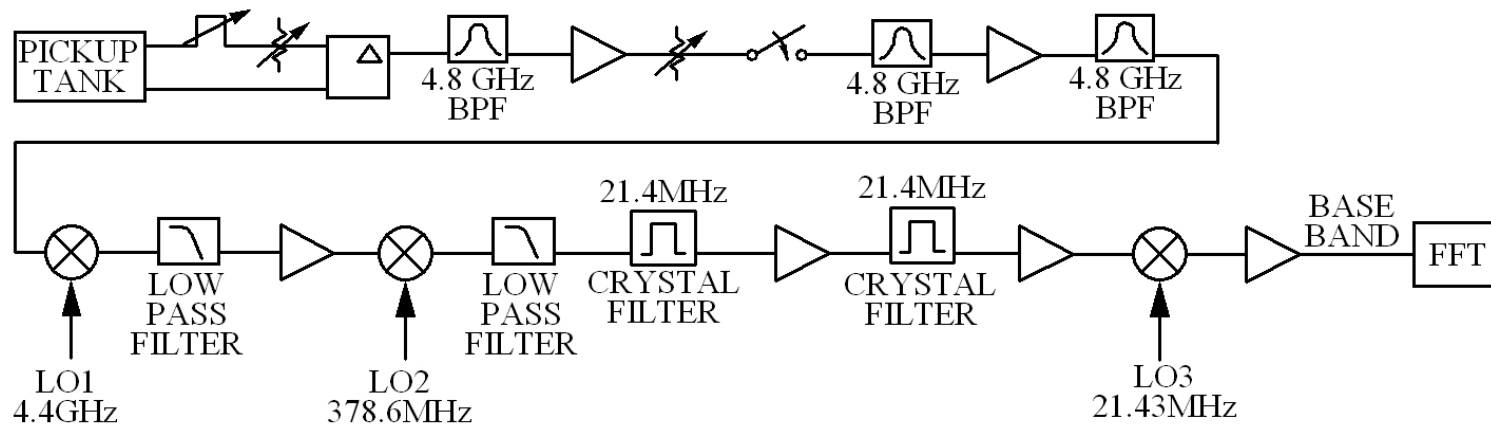
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LHC Schottky Triple Heterodyne Block Diagram

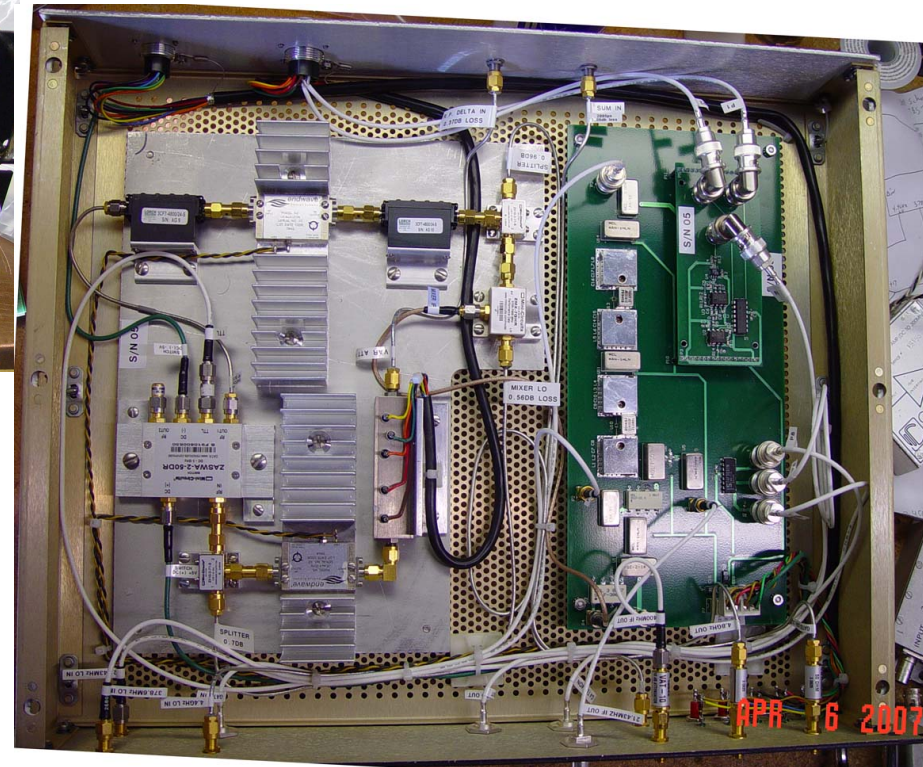
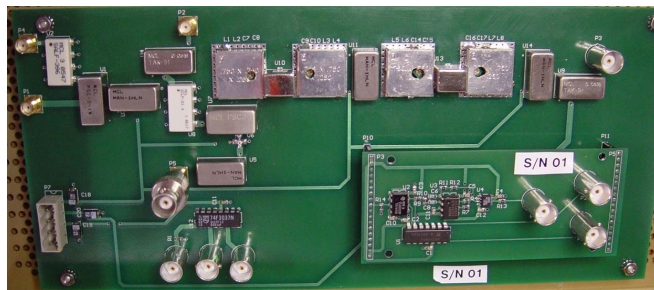
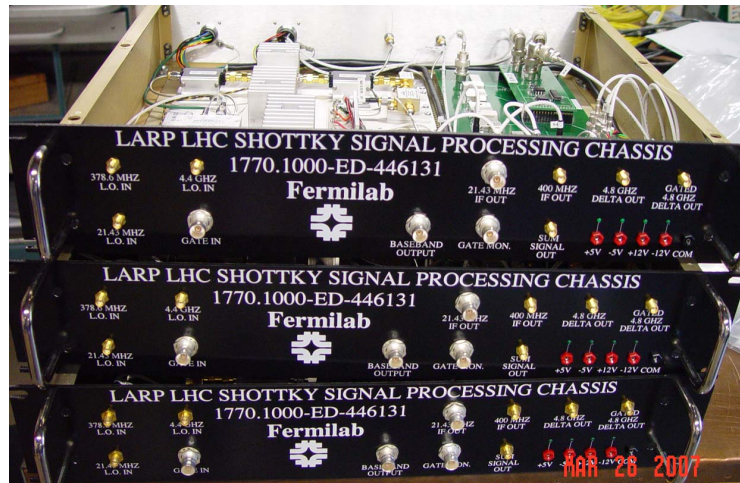




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Signal Processing Chassis Spring 2007



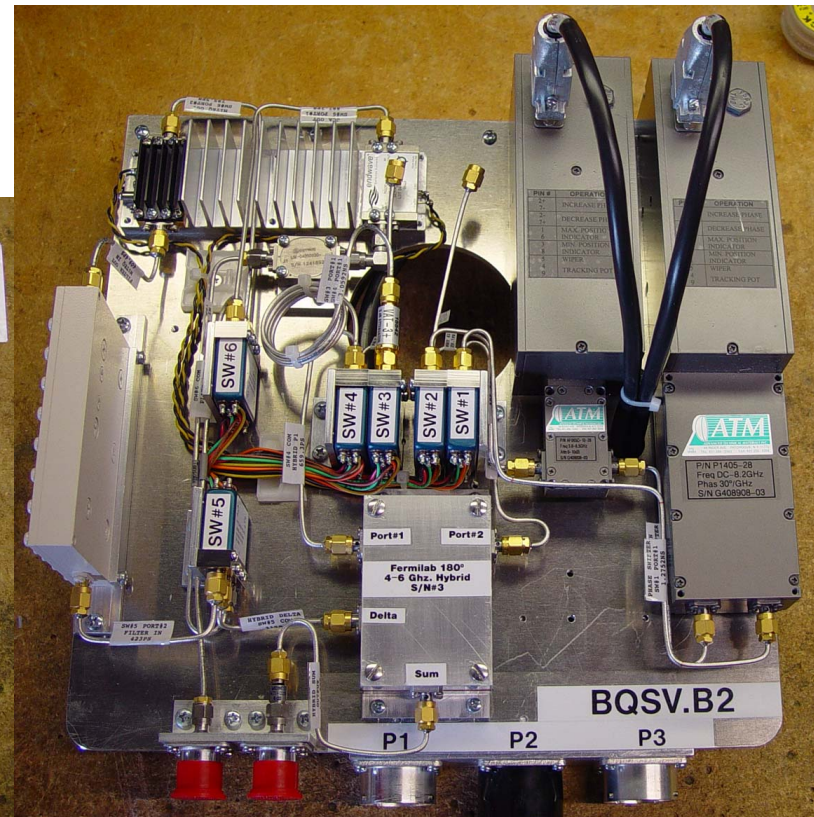
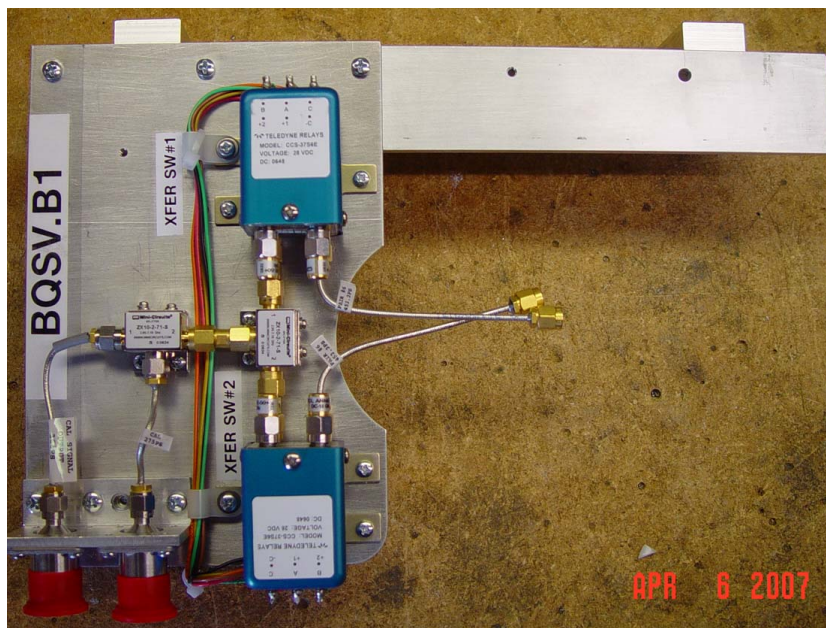
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Pickup Plate Hardware



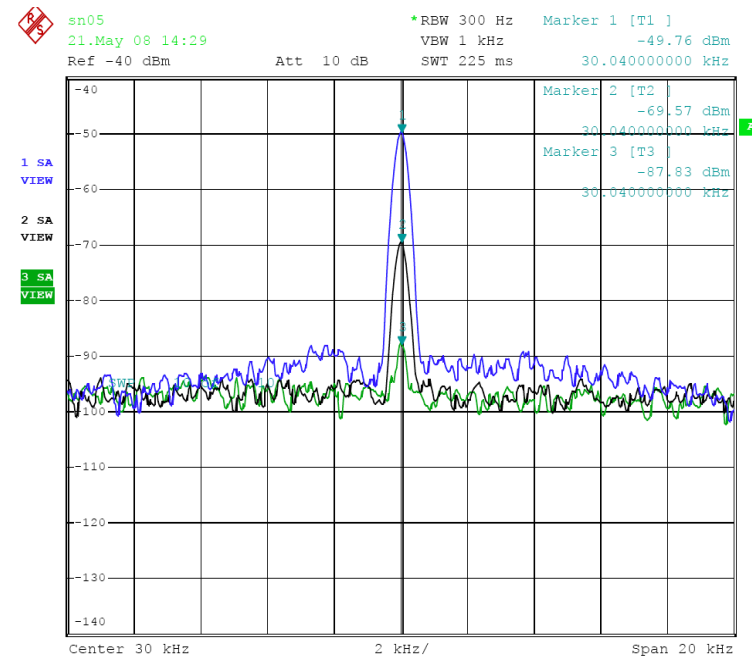
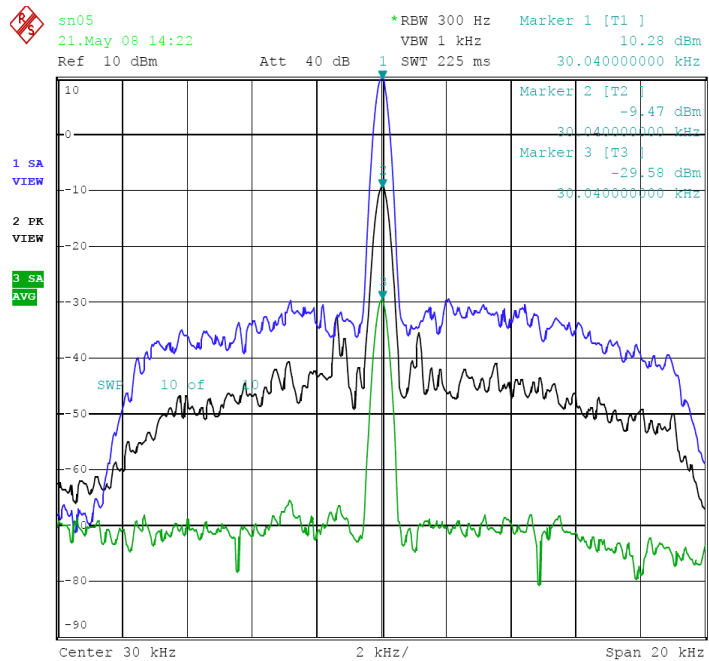
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Measured 100 dB instantaneous dynamic range in
Signal processing, +10 dBm to -90 dBm input



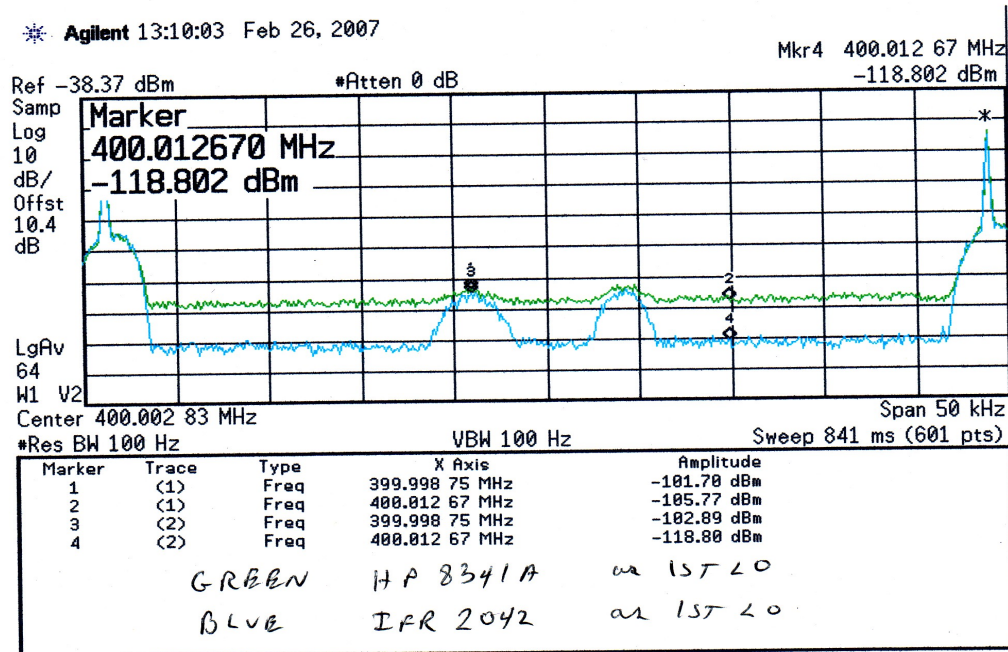
10 dB per division



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Importance of low phase noise in local oscillators



400 MHz IF FRONT PANEL



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Crated up and on its way to CERN April 2007!



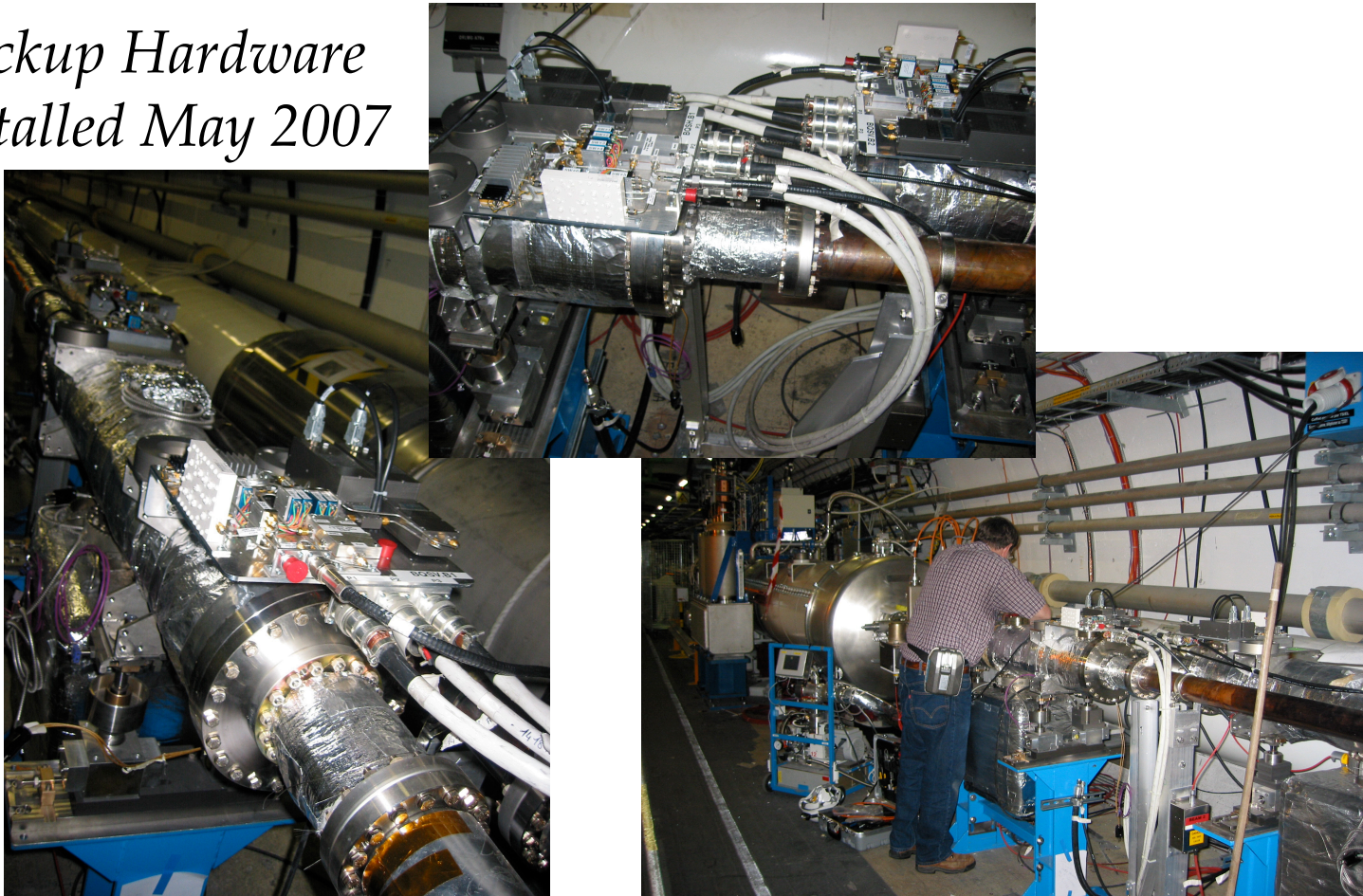
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*Pickup Hardware
Installed May 2007*



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*Point 4
Alcove
Hardware
May 2007*



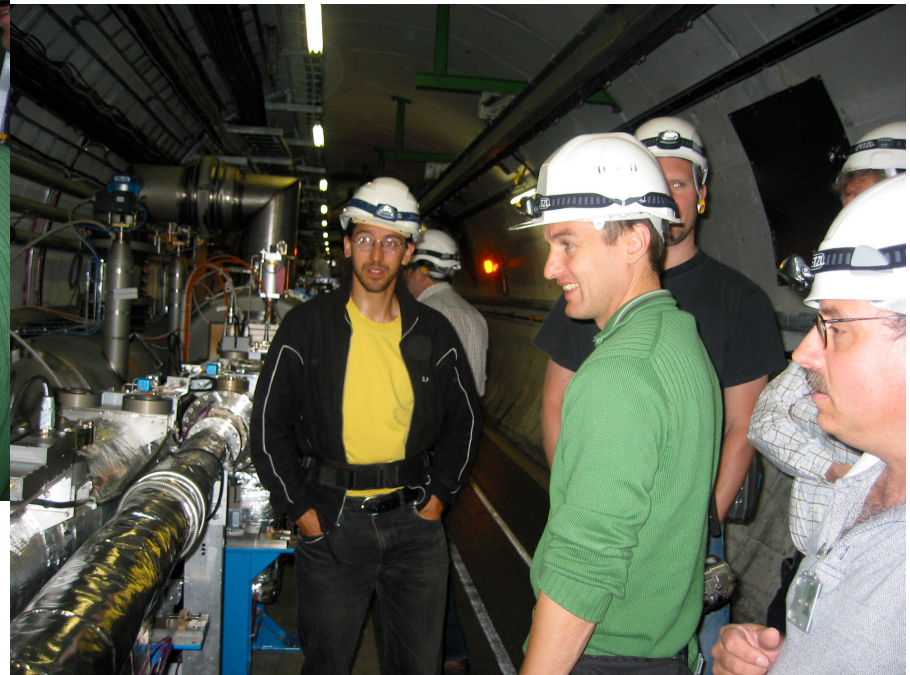
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*Touring Hardware Installation
May 2007*



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Installation of controls interface



May 2008



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*Two Beam
Commissioning Trips
to
CERN*

*April 2010
October 2010*

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Interactive Graphics Control of Hardware

The screenshot displays the Schottky Monitor Application interface. The main window shows a circuit diagram for Beam ONE H, which includes components like switches (SW1-M4), attenuators (Attu), and amplifiers. The interface also features a 'Local Oscillators' section with controls for Output, Frequency, and Power for B1 and B2 at 21MHz and 400MHz. The status bar at the bottom indicates '09:13:52 - READONLY and AUTO'.

Setting Mode

- Read Only
- Read & Set
- Authorized User: _____
- Time left: 0 sec
- Default
- Manually Change Settings
- StandBy/Pause

Beam Mode FLATTOP

- Beam Mode: FLATTOP
- Daemon Idle: 0 sec.
- Daemon Status: OK

Single Slot Selection

Beam Conditions

Flags: ● ● ● ● ● ●

- B1 Intensity: 15.3E12
- B2 Intensity: 15.34E12
- Energy: 3500.16 @ Mon 09:15:00

Local Oscillators

Parameter	Value
Output_B1_21MHz	ON
Output_B1_400MHz	ON
Frequency_B1_21MHz	21.37
Frequency_B1_400MHz	379.393
Power_B1_21MHz	0.0
Power_B1_400MHz	0.0
Ref_Oscillator_B1_21MHz	INT
Ref_Oscillator_B1_400MHz	INT
Output_B2_21MHz	ON
Output_B2_400MHz	ON
Frequency_B2_21MHz	21.37
Frequency_B2_400MHz	379.393
Power_B2_21MHz	0.0
Power_B2_400MHz	0.0
Ref_Oscillator_B2_21MHz	INT
Ref_Oscillator_B2_400MHz	INT

LO Frequency up/down stepper, step size in Hz

Frequency	Value	Hz	up	down
B1-21MHz	10.0	Hz	up	down
B1-400MHz	11245.0	Hz	up	down
B2-21MHz	10.0	Hz	up	down
B2-400MHz	11245.0	Hz	up	down

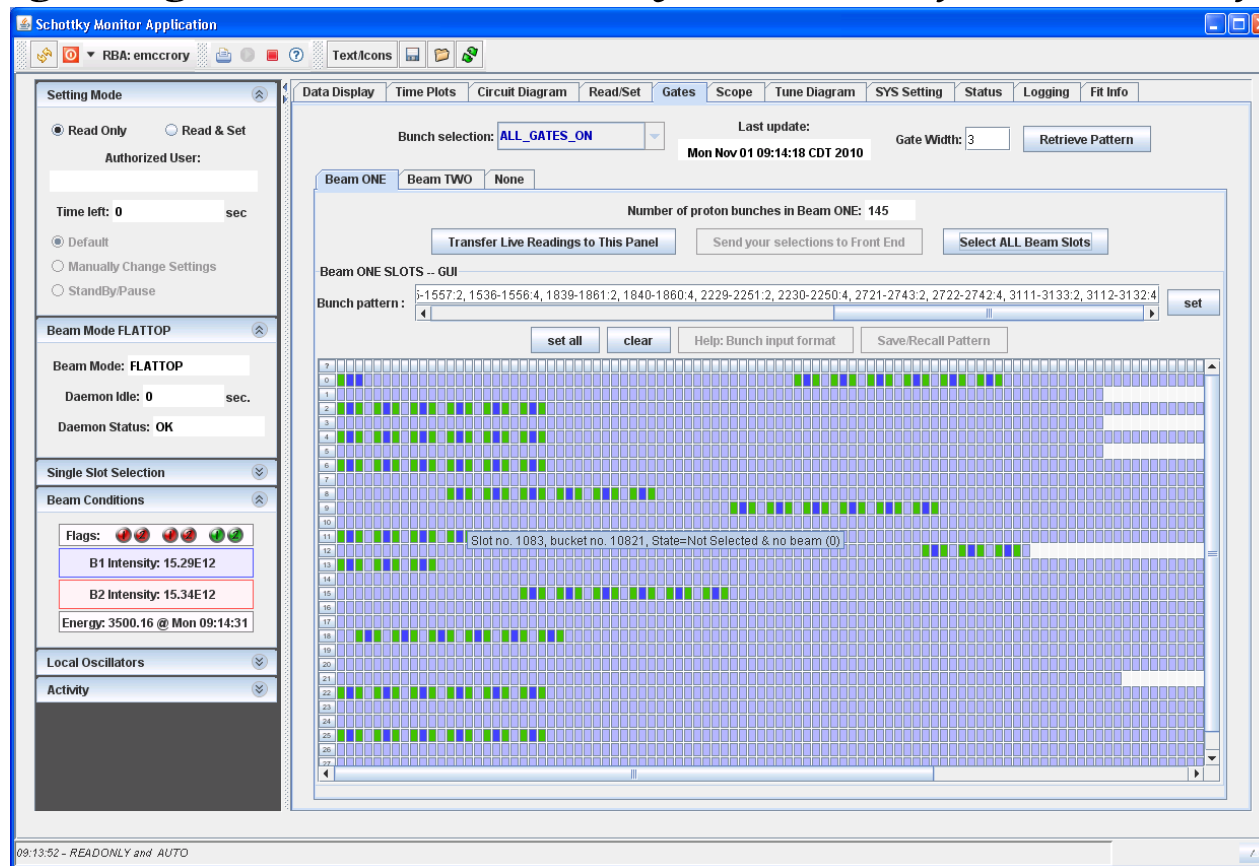
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Automated gating control allows any number of bunch configurations



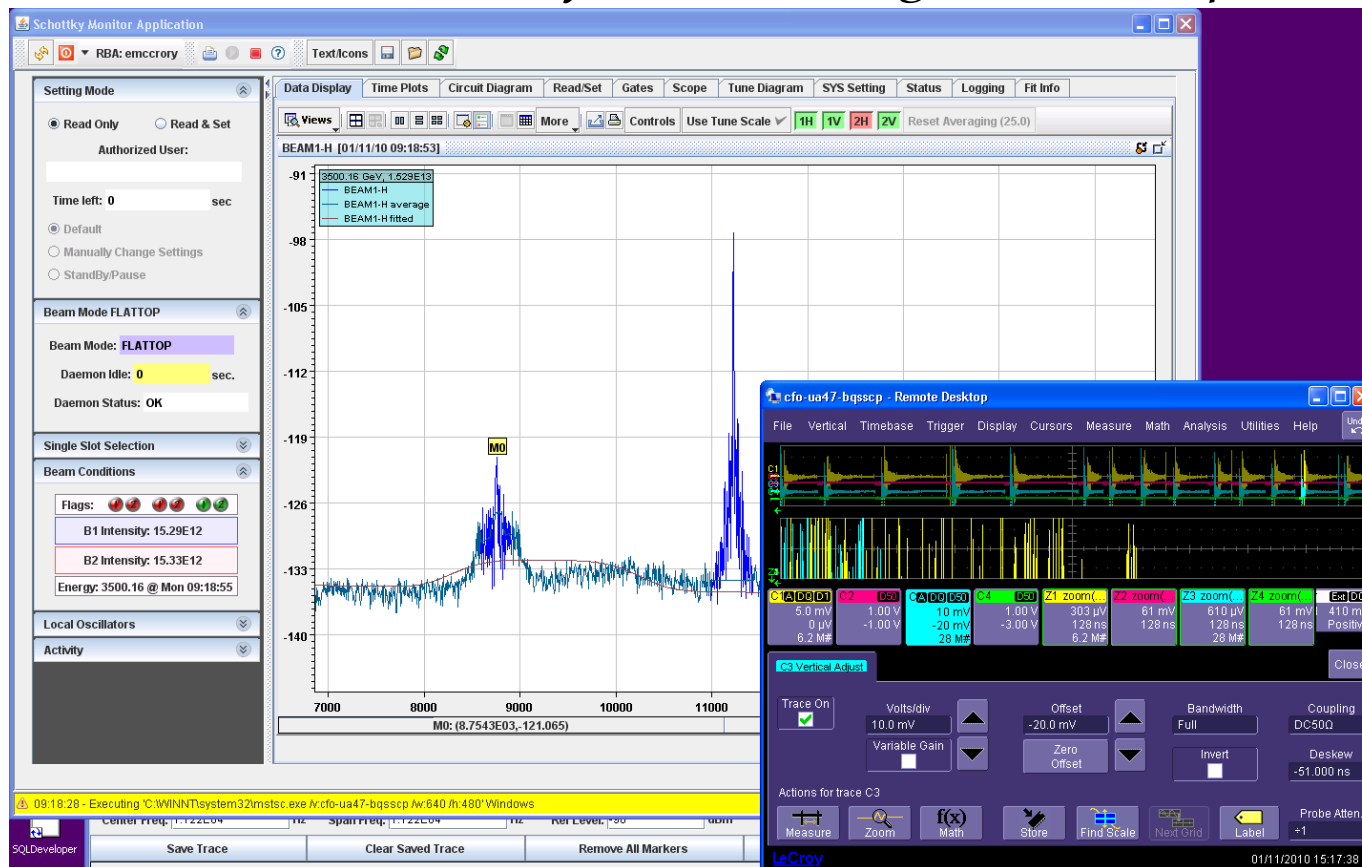
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Remote Control of Gate Timing Oscilloscope



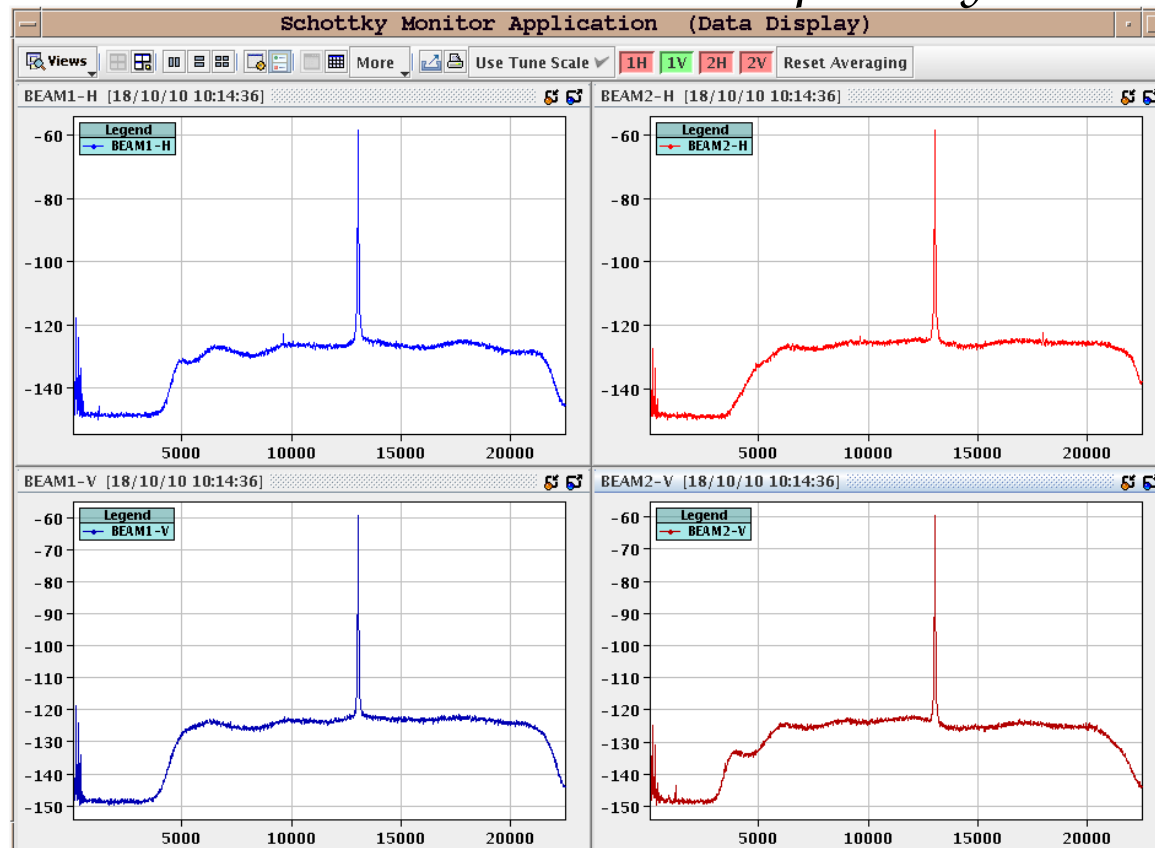
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Built In Calibration Capability



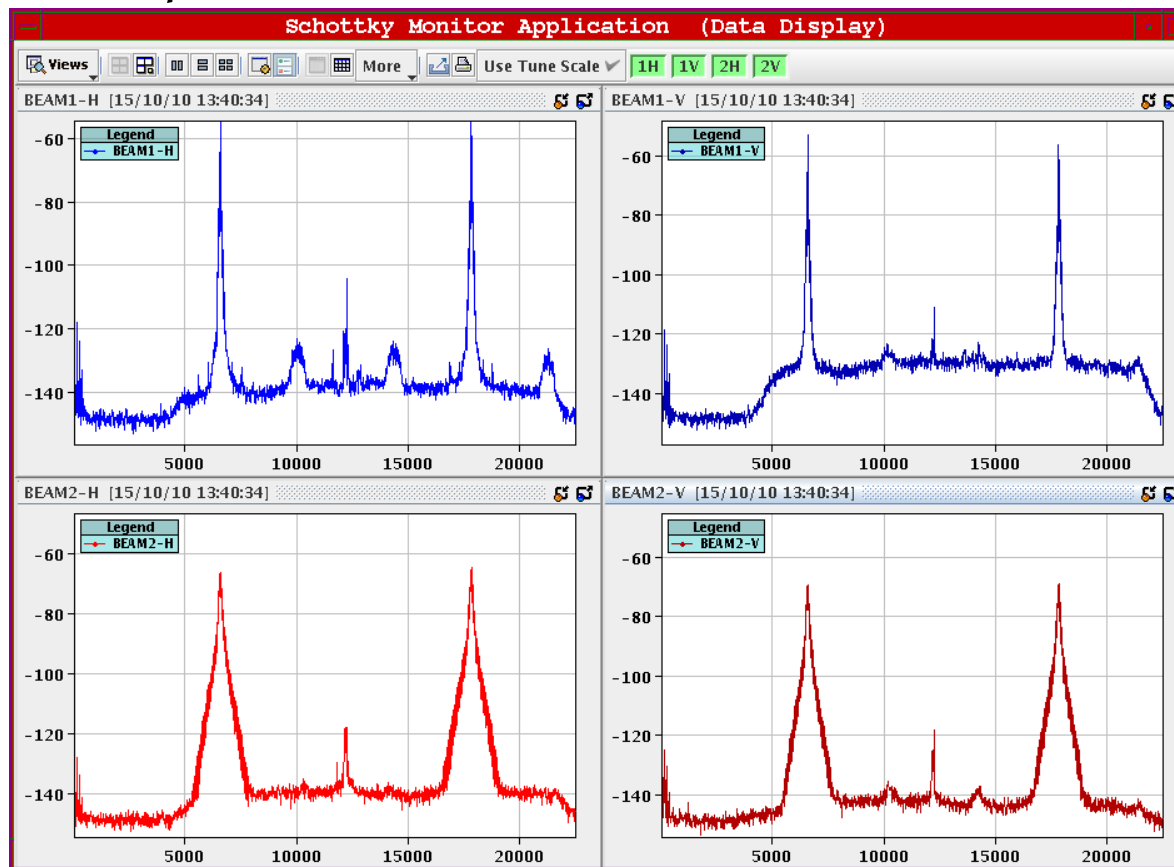
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Spectra Reveal Coherent Phenomena



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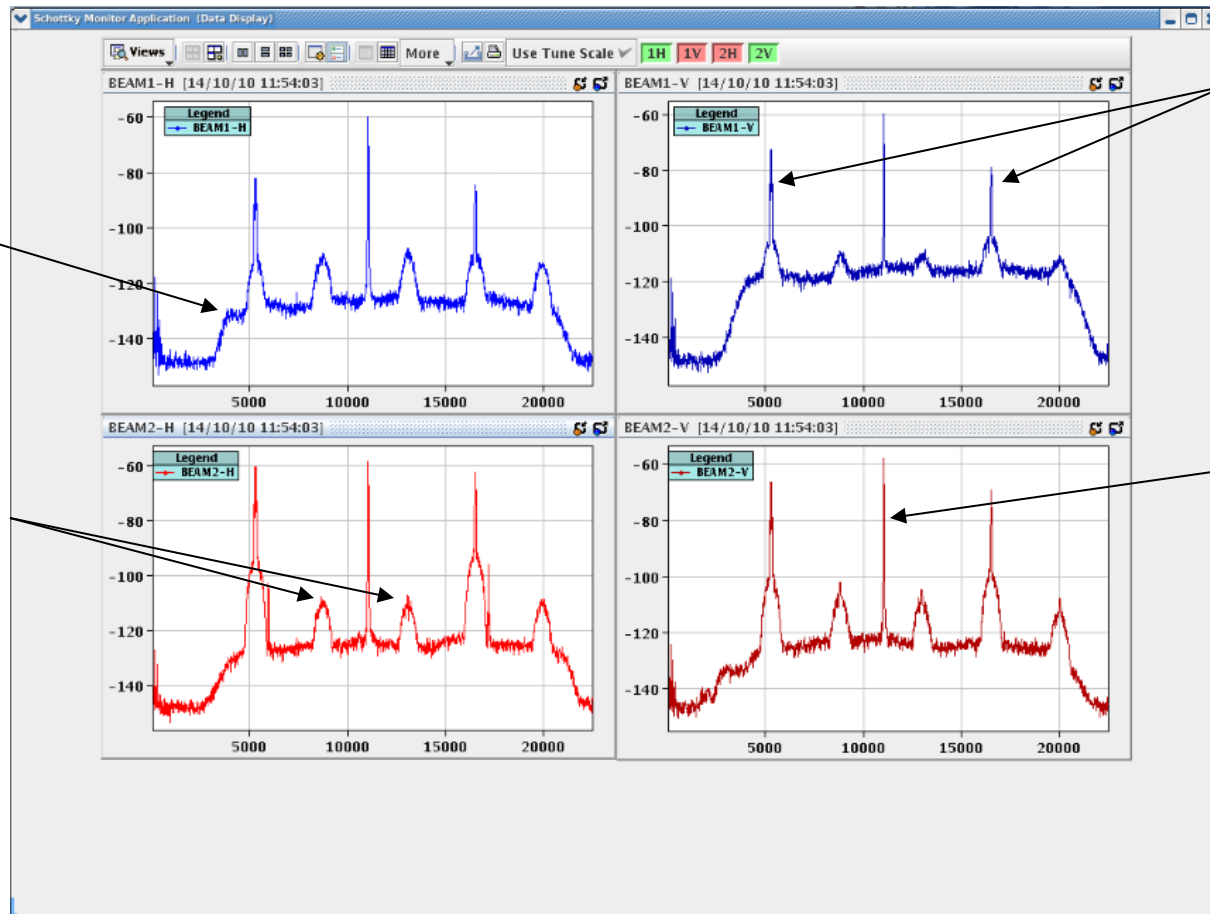


Noise Floor

Revolution Lines

Tune Sidebands

Calibration Signal

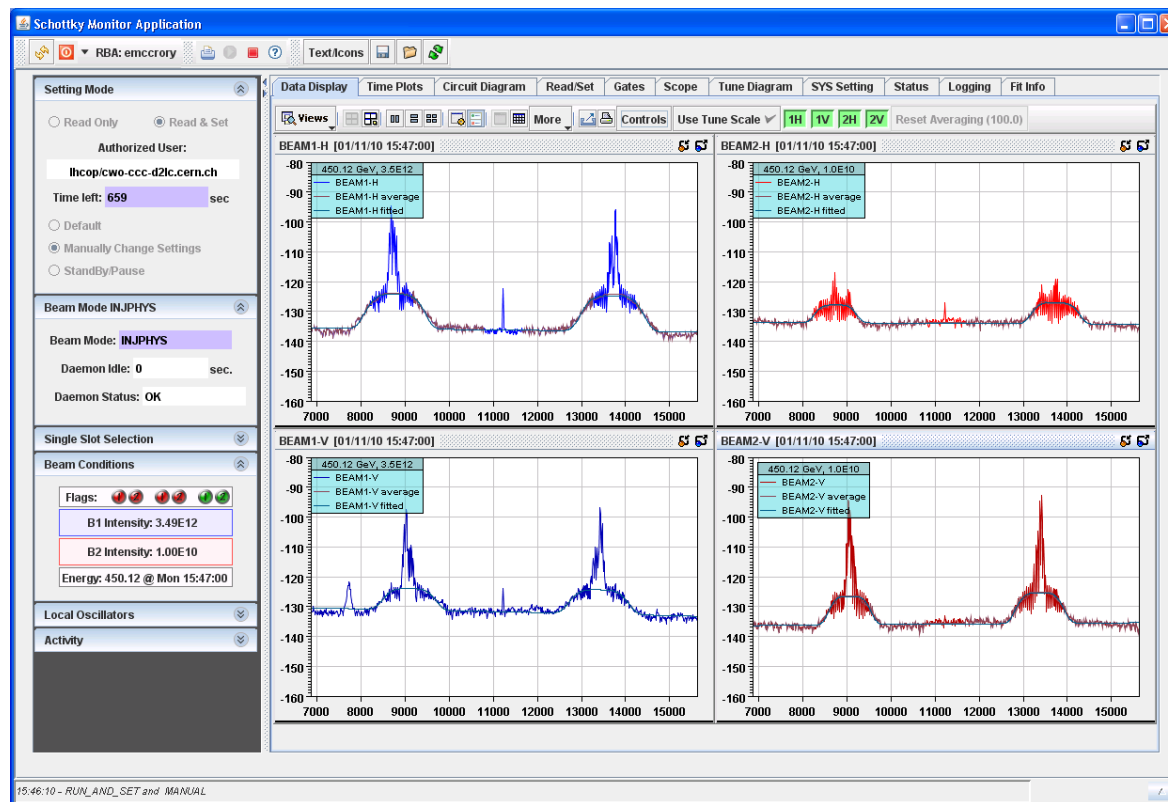




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3.4×10^{12} Protons 450 GeV
Fit eliminates coherence

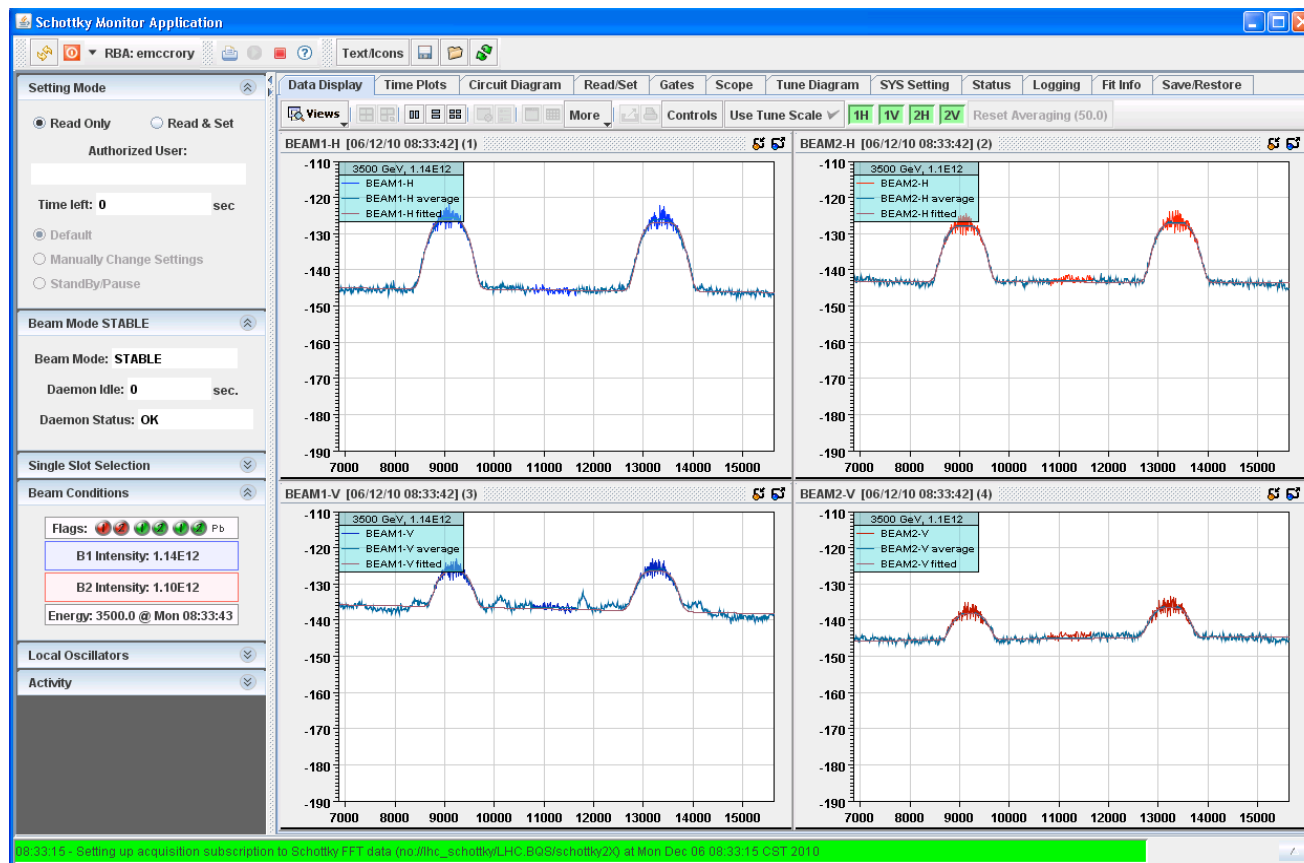




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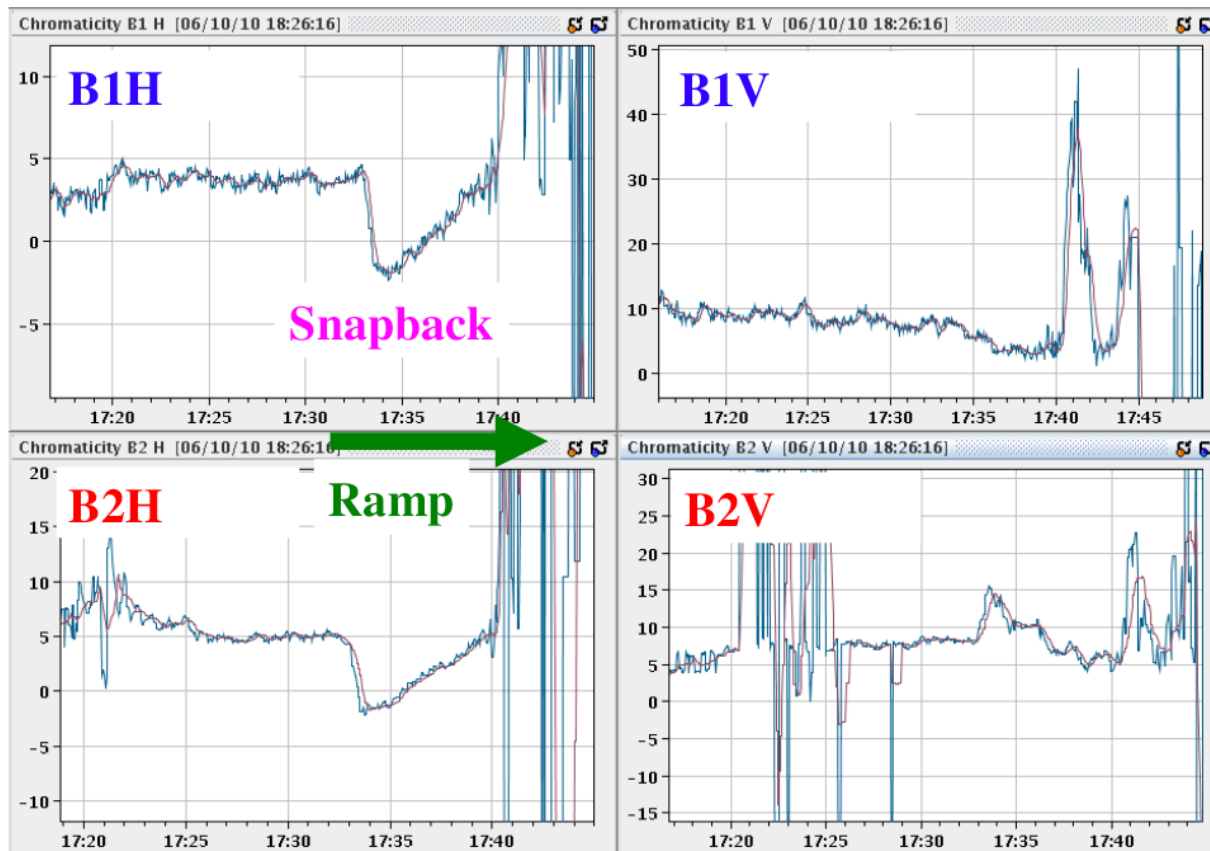
Lead Ions 1.1×10^{12} at 3.5 TeV



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Chromaticity Measurements Protons during Energy Ramp





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Data Logged Tunes

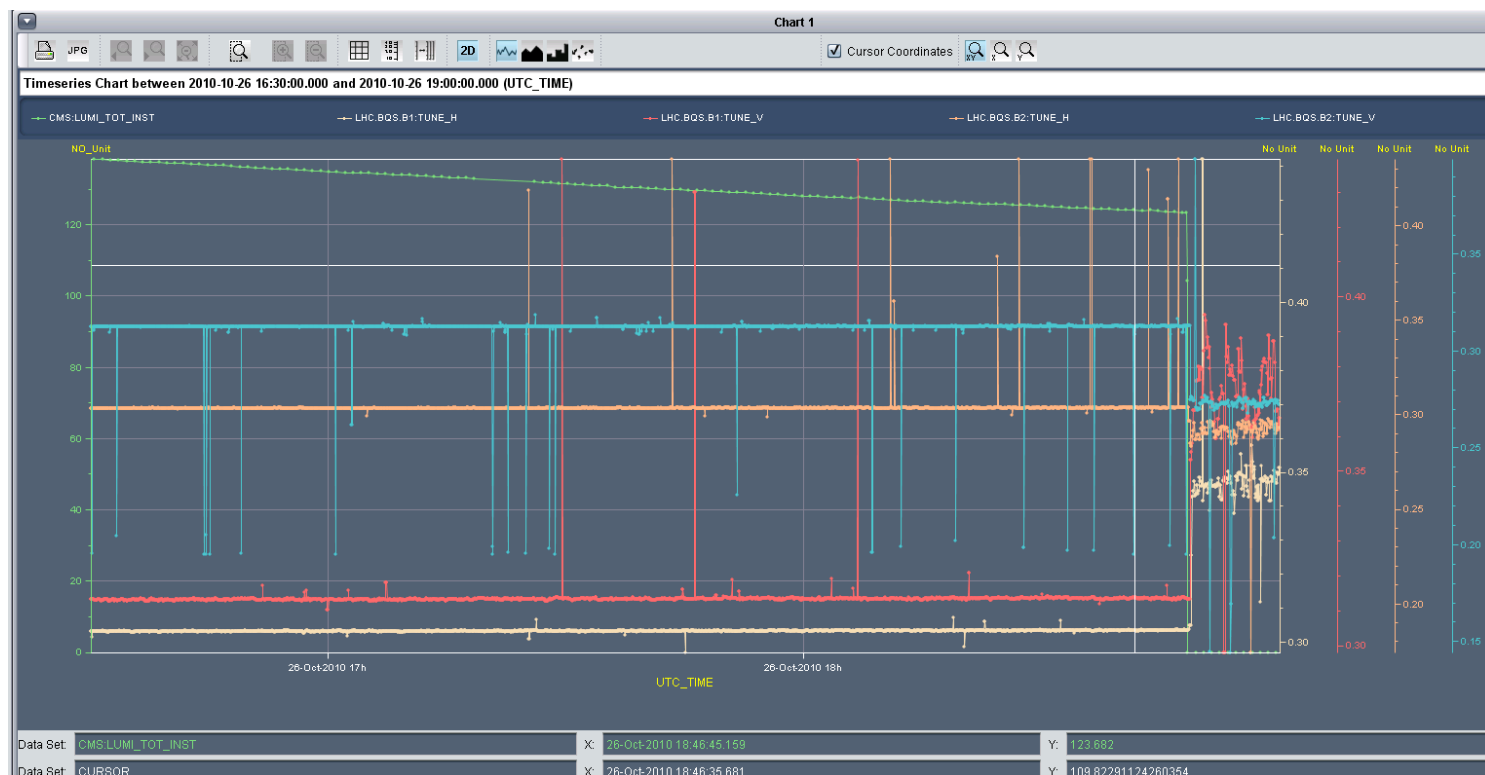
Luminosity

Beam 2V

Beam 2H

Beam 1V

Beam 1H



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■ *Capabilities and Commissioning*

- *Non invasive measurements*
- *Bunch by bunch transverse measurements*
- *Measures single bunch with 10^{11} protons/bunch*
- *Verified tunes track with other tune measurements*
- *Chromaticities and Momentum spread measured*
- *Signal tracking for ramped beam measurements*



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October 2010



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