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# *LHC 4.8 GHz Schottky Commissioning*

*Ralph J. Pasquinelli*

*Andreas Jansson*

*April 8-15, 2010*



**Schottky Monitor Application (BEAM2)**

Menu: RBA: andja | Exit | Text/Icons | [Icons]

**Device Selection**  
 BEAM2-H  
 Selected: BEAM2-H

**Running & Setting Mode**  
☐ Read Only  
☒ Read and Set  
 Authorized User: andja/CWE-CCR-VMW214  
 Time left: 27670 sec.  
☐ Default  
☒ Manually Change Settings  
☐ StandBy/Pause

**Beam Mode**  
 Beam Mode: INJDUMP  
 Monitor Idle: 1 sec.

**Subscriptions**  
 Rec'd: BEAM2/LHC.BQB9Q.UA47.BQS...  
 Time: Wed Apr 14 17:11:15 CDT 2010  
 [Show History]

**Beam Conditions: Now**  
 Flags: [Icons]  
 B1 Intensity: 0.00E00  
 B2 Intensity: 9.00E10  
 Energy: 450.24 @ Wed 17:11:16

**Circuit Diagram for BEAM2-H, RUN\_AND\_SET**

The circuit diagram illustrates the RF path for the BEAM2-H system. It starts with a 4.2 GHz CAL SIGNAL input. The signal passes through a series of components including switches (H1 SW1 #1, H1 SW2 #2, H1 SW3 #3, H1 SW4 #4, H1 SW5 #5, H1 SW6 #6), attenuators (0-10dB, 3dB), and amplifiers (H1 SW56 -38db). The diagram also shows a section for Local Oscillators with settings for Output\_B2\_21MHz and Output\_B2\_400MHz. The output of the circuit is connected to a BASEBAND GAIN stage.

**Local Oscillators**

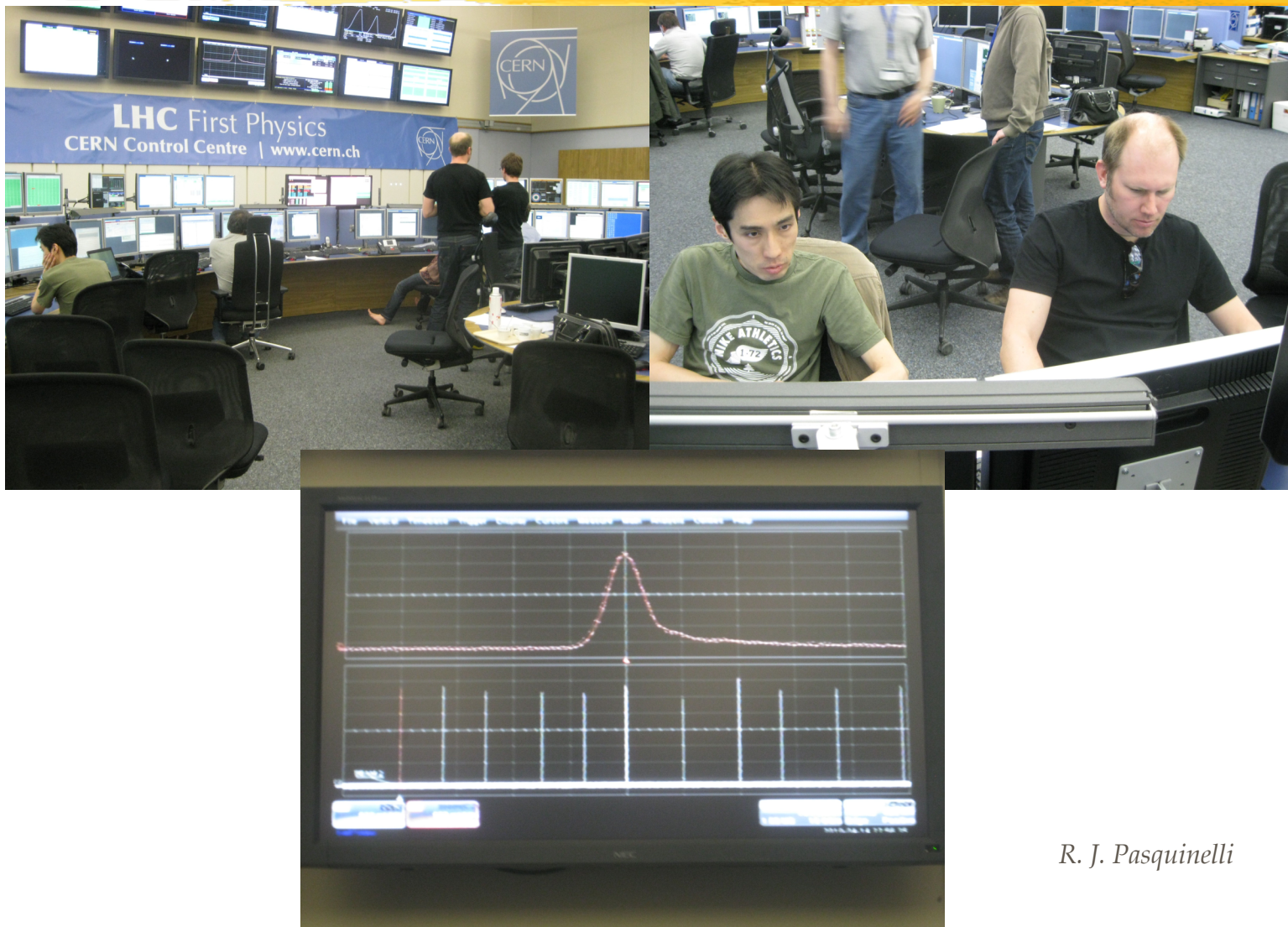
Parameter	Value
Output_B2_21MHz:	ON
Frequency_B2_21MHz:	21.38884925842285
Power_B2_21MHz:	0.0
Ref_Oscillator_B2_21M...	EXT
Output_B2_400MHz:	ON
Frequency_B2_400MHz:	378.50048828125
Power_B2_400MHz:	0.0
Ref_Oscillator_B2_400M...	EXT

Last Update: Wed Apr 14 17:11:15 CDT 2010  
 Device Name: BEAM2-H



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CCC



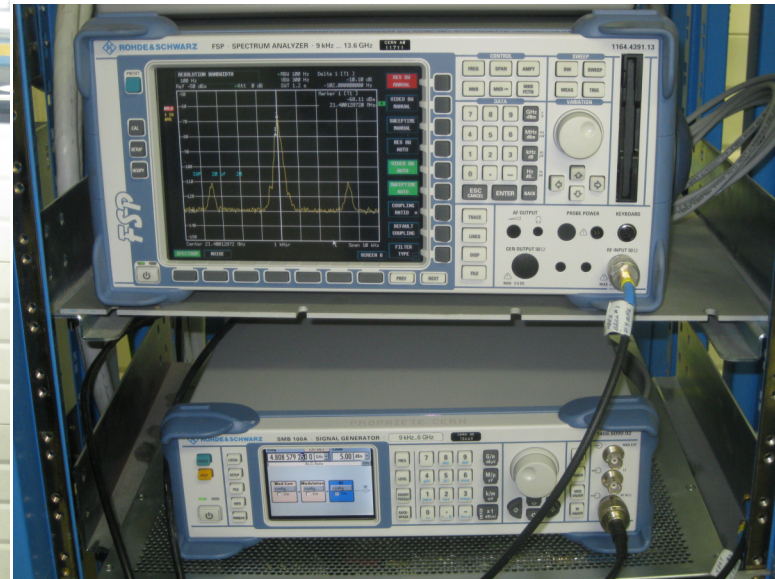
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*Service Building Point 4*



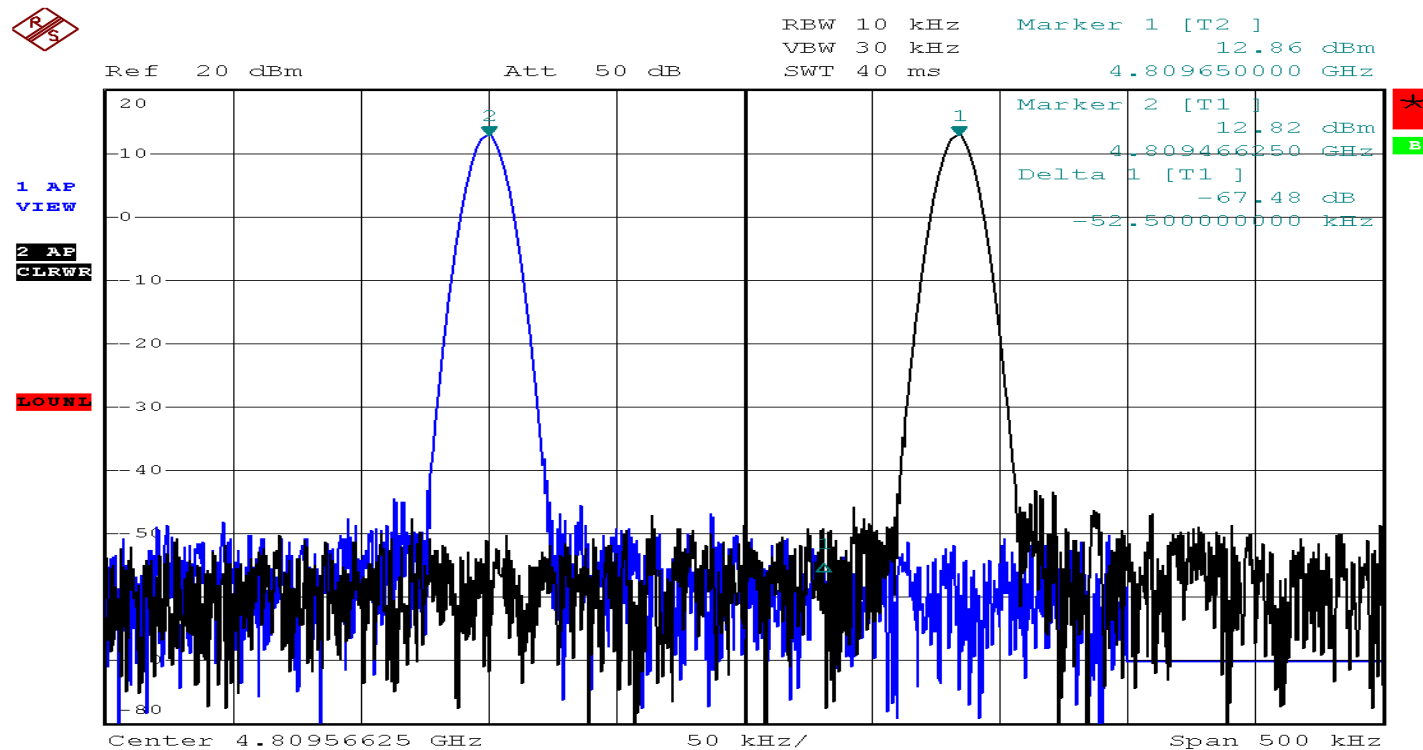
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# Calibration signal generator with 10 MHz ext ref from Beam 1 Tracking RF frequency change



10mhzB1

Date: 9.APR.2010 11:49:10

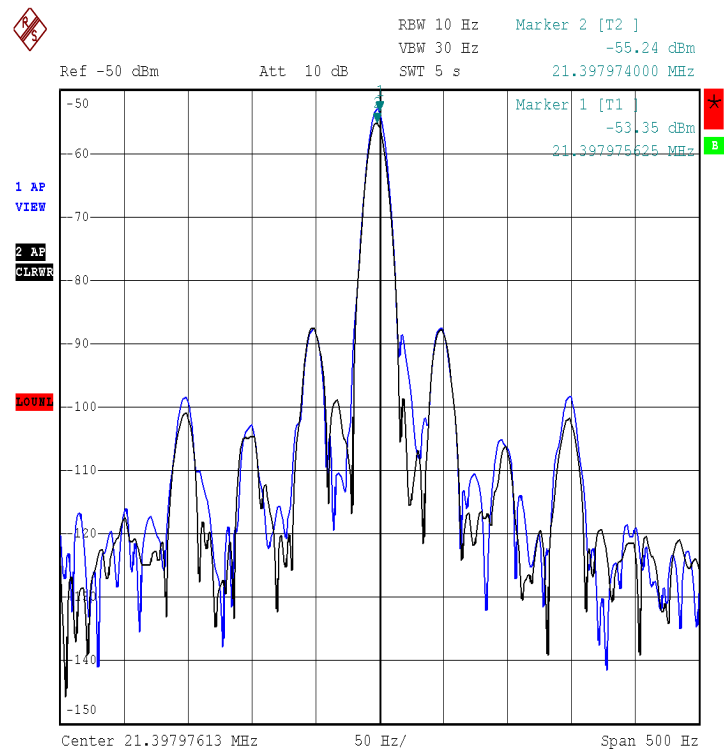
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Beam 2 cal signals to 21.4 MHz IF  
Sidebands are line harmonics on sig gen  
Vertical higher IL due to 7/8" cable plant

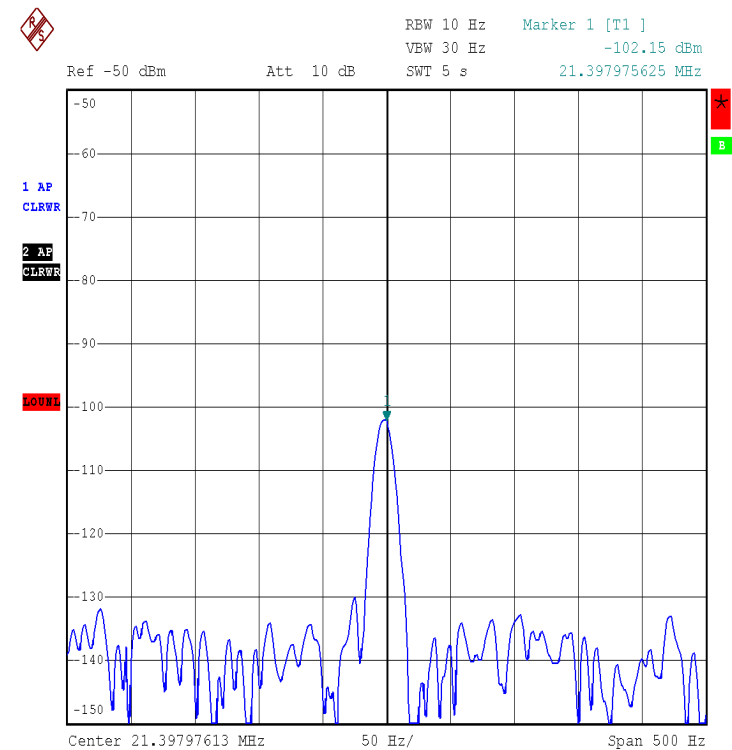
Horizontal



10mhzB1

Date: 9.APR.2010 12:32:00

Vertical



10mhzB1

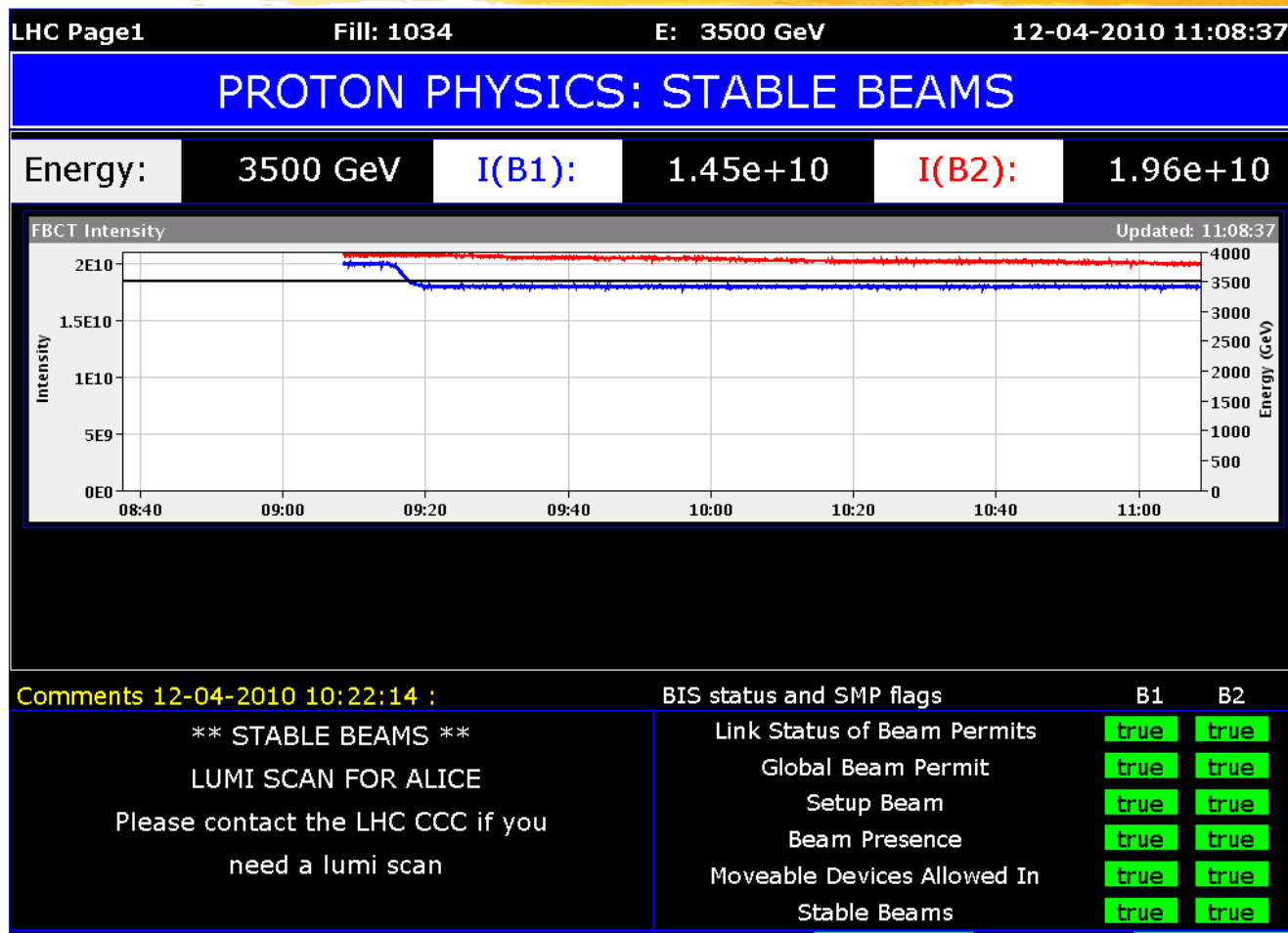
Date: 9.APR.2010 12:29:17





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*2x2 store 3.5 TeV*

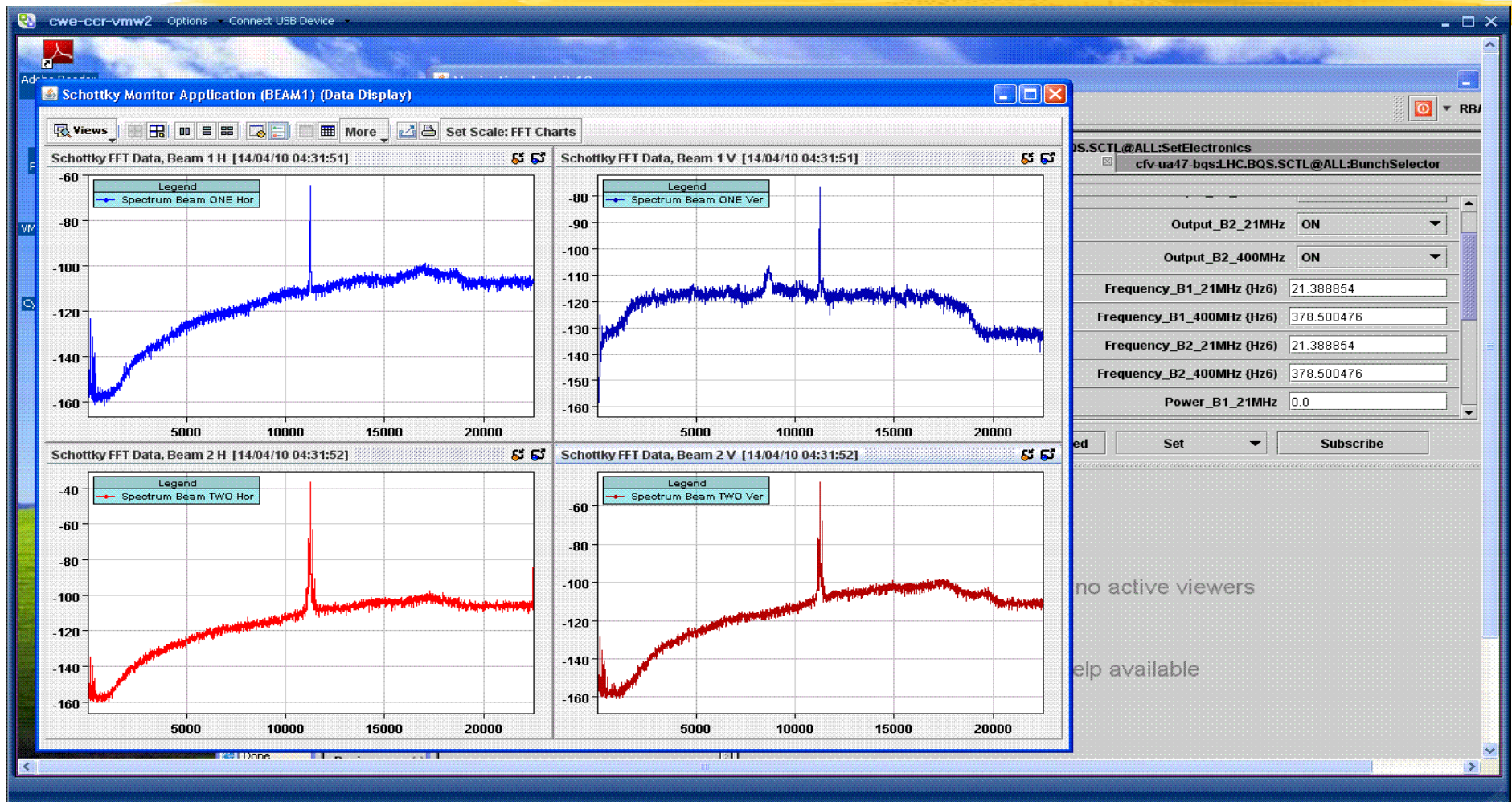


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*Un-gated base band signals 2x2 store  
NOTE LO frequencies set for revolution  
Frequency of 11245 Hz*



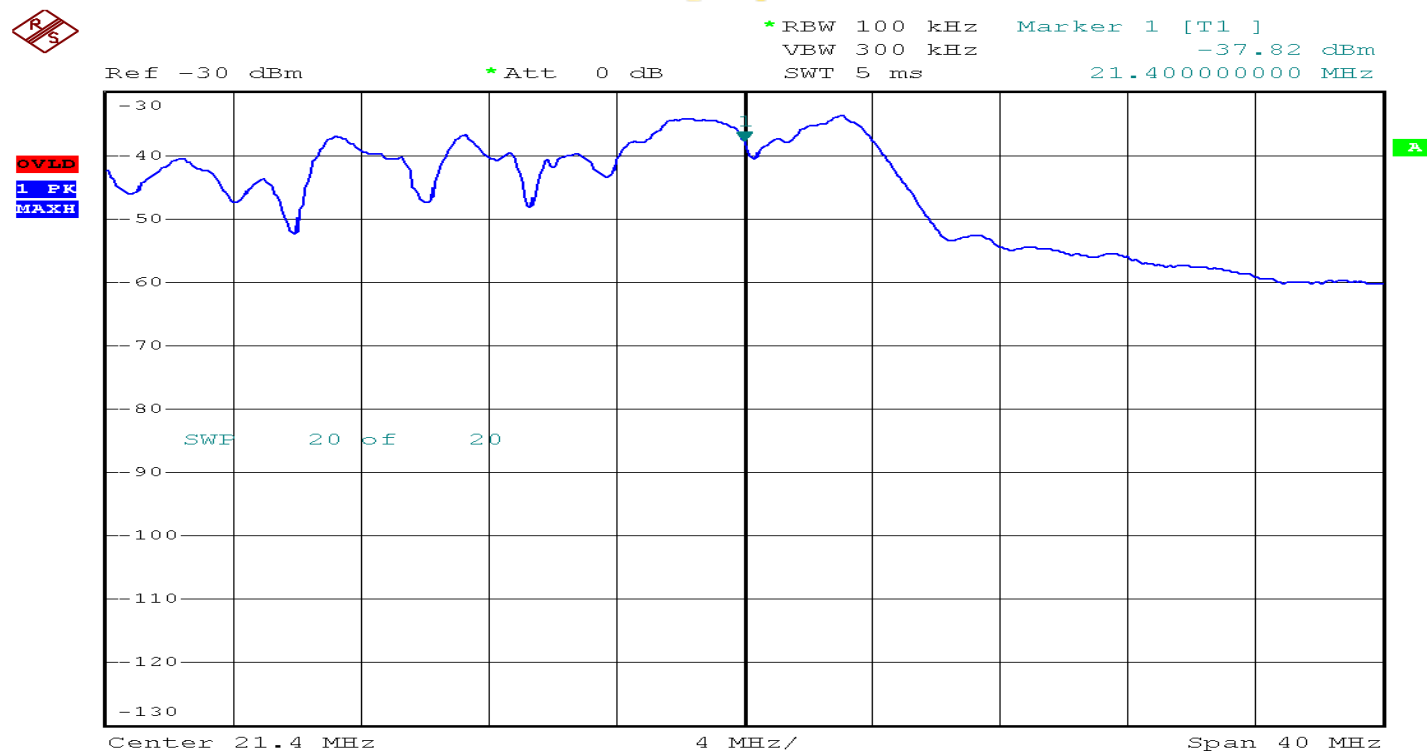
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*HB2 21.4 MHz IF with arbitrary  
378 MHz LO*



10mhzB1

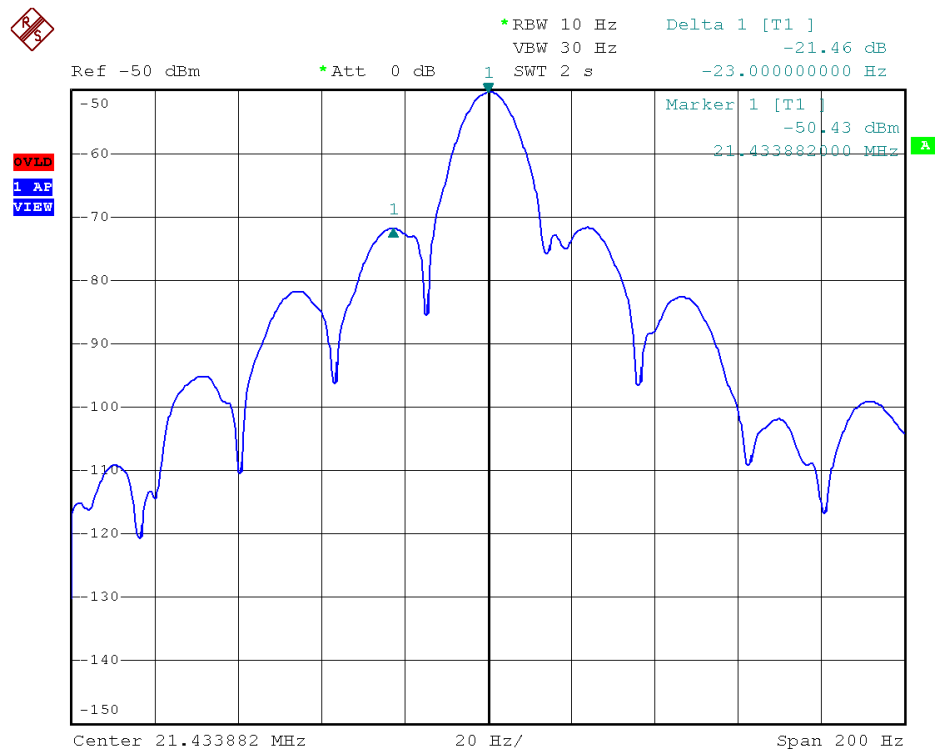
Date: 12.APR.2010 11:10:30

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*HB1 21.4 MHz IF*



*Synchrotron f @ 3.5 TeV*  
*Freq=23 Hz*

10mhzB1

Date: 12.APR.2010 16:13:25

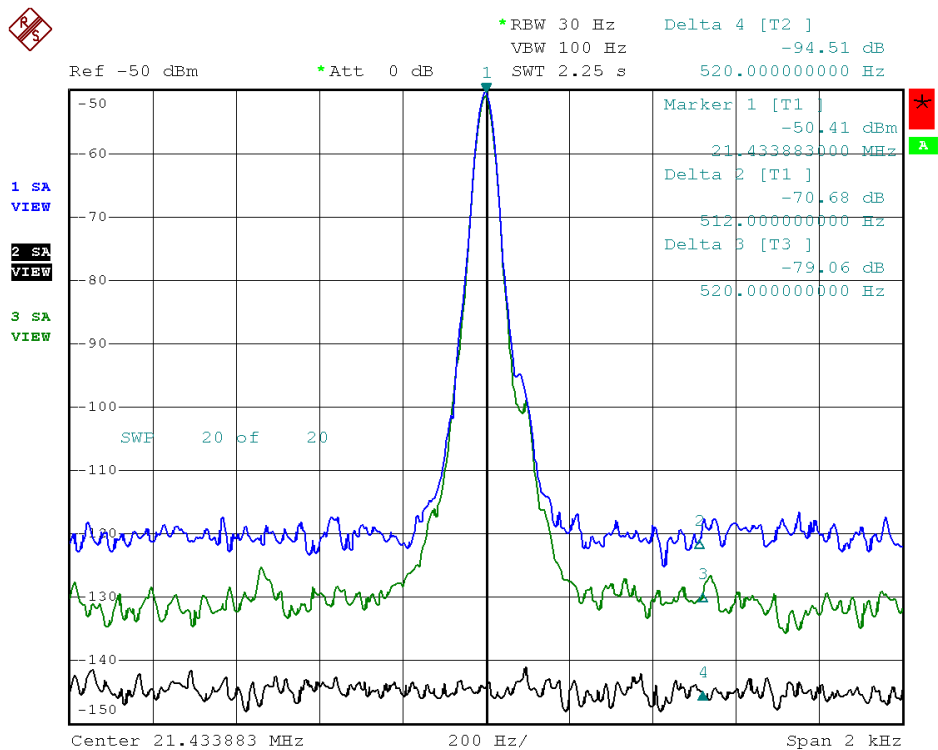
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## HB1 21.4 MHz IF



*Gate on full time blue*  
*Gate Table green*  
*SA noise floor black*  
*Max noise reduction*  
*with gating observed*  
*to be approximately*  
*10 dB*

10mhzB1

Date: 12.APR.2010 15:30:02

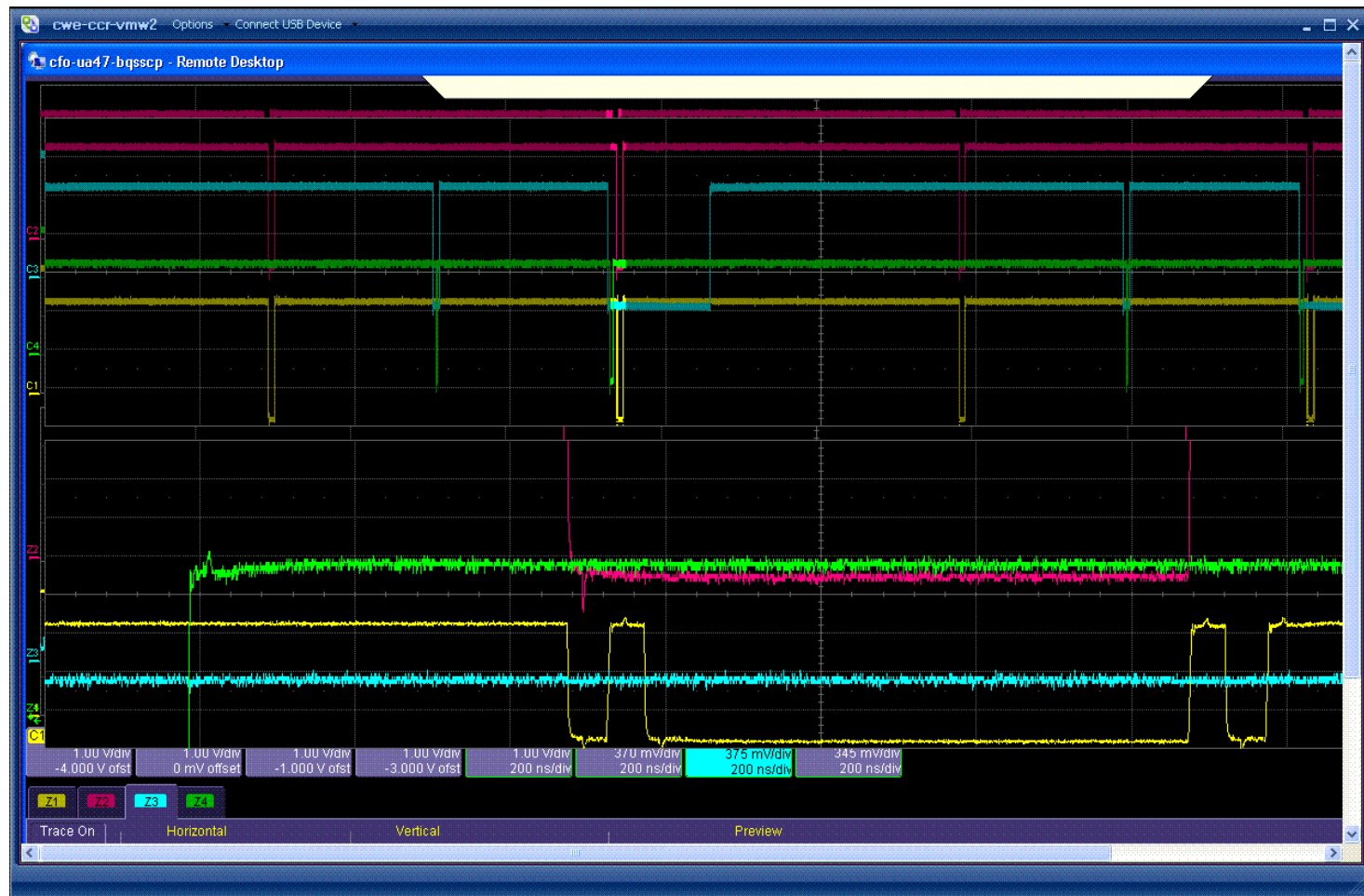
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# *Debugging Gates using Tunnel Scope*

## *Fermilab Bouncing (yellow) was a software error*

### *Scope is essential for gating studies*



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## *Bunch loading table for 2x2 store*

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Scheme 2x2\_a, december 2009, 1 colliding pair in all IPs:

(NB: maximum acceptable now: B1 30986, B2: 30950)

```
*****
* NOTE: to get the same scheme without overinjection:          *
* - just add +1000 to all RF bucket numbers                    *
* - in addition there will be a pilot bunch (5e9 p/bch)        *
*   in RF bucket 1 for each beam                               *
*****
```

			RF Bucket		
inj 1	1	ring_1	1	25	1
inj 1	2	ring_2	1	25	1
inj 2	3	ring_1	17851	25	1
inj 2	4	ring_2	8911	25	1

Bunch crossings:

d = displacement relative to IP in meters  
(negative is anticlockwise)

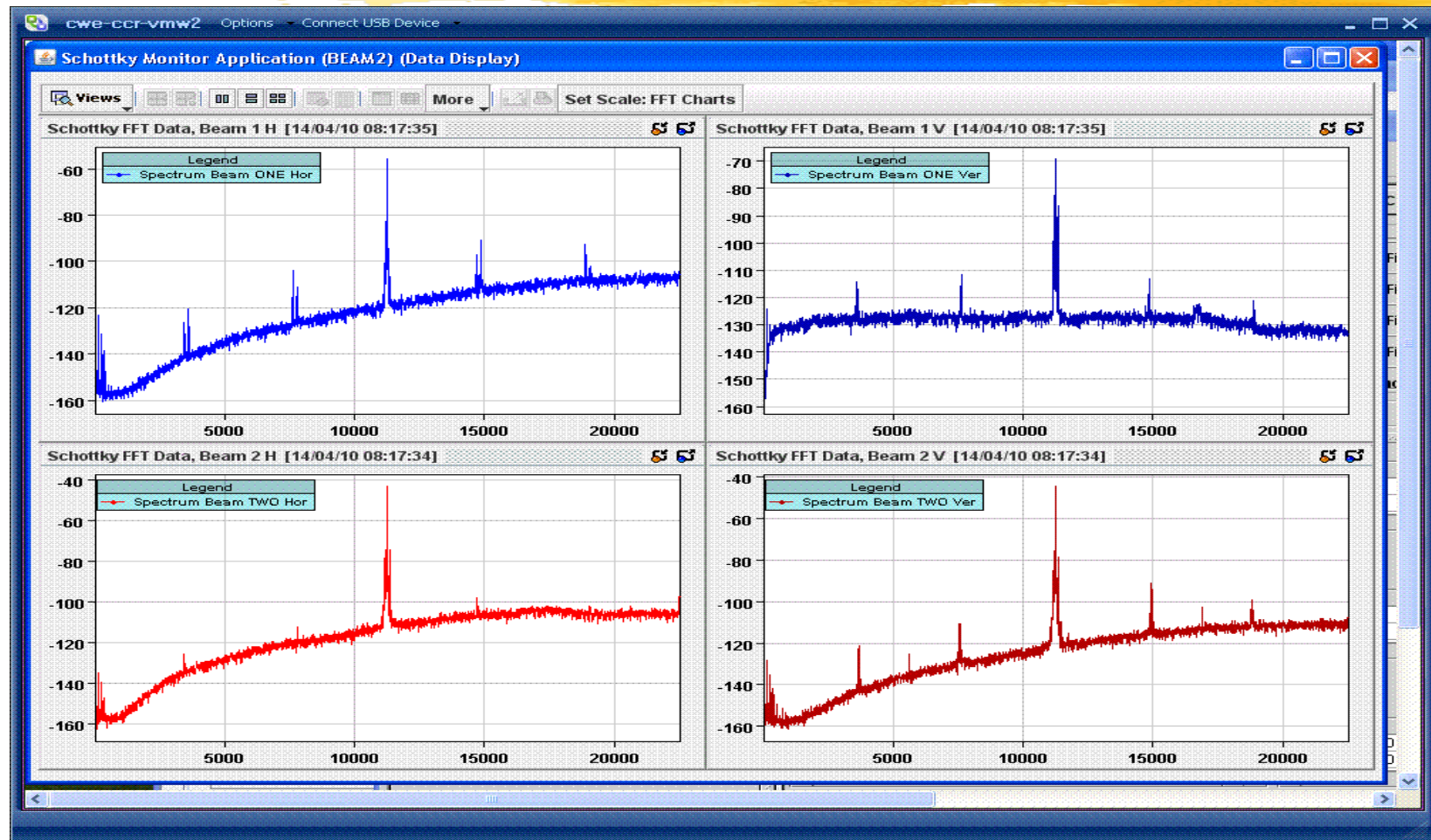
	d	Beam1	Beam2
good collision in IR1:	0 m	bucket 1	and bucket 1
good collision in IR2:	0 m	bucket 1	and bucket 8911
good collision in IR8:	0 m	bucket 17851	and bucket 8911

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*Baseband 2x 2 store 3.5 TeV with gating. Vertical Band 1 has modified daughter card which looks good. Need to modify others.*

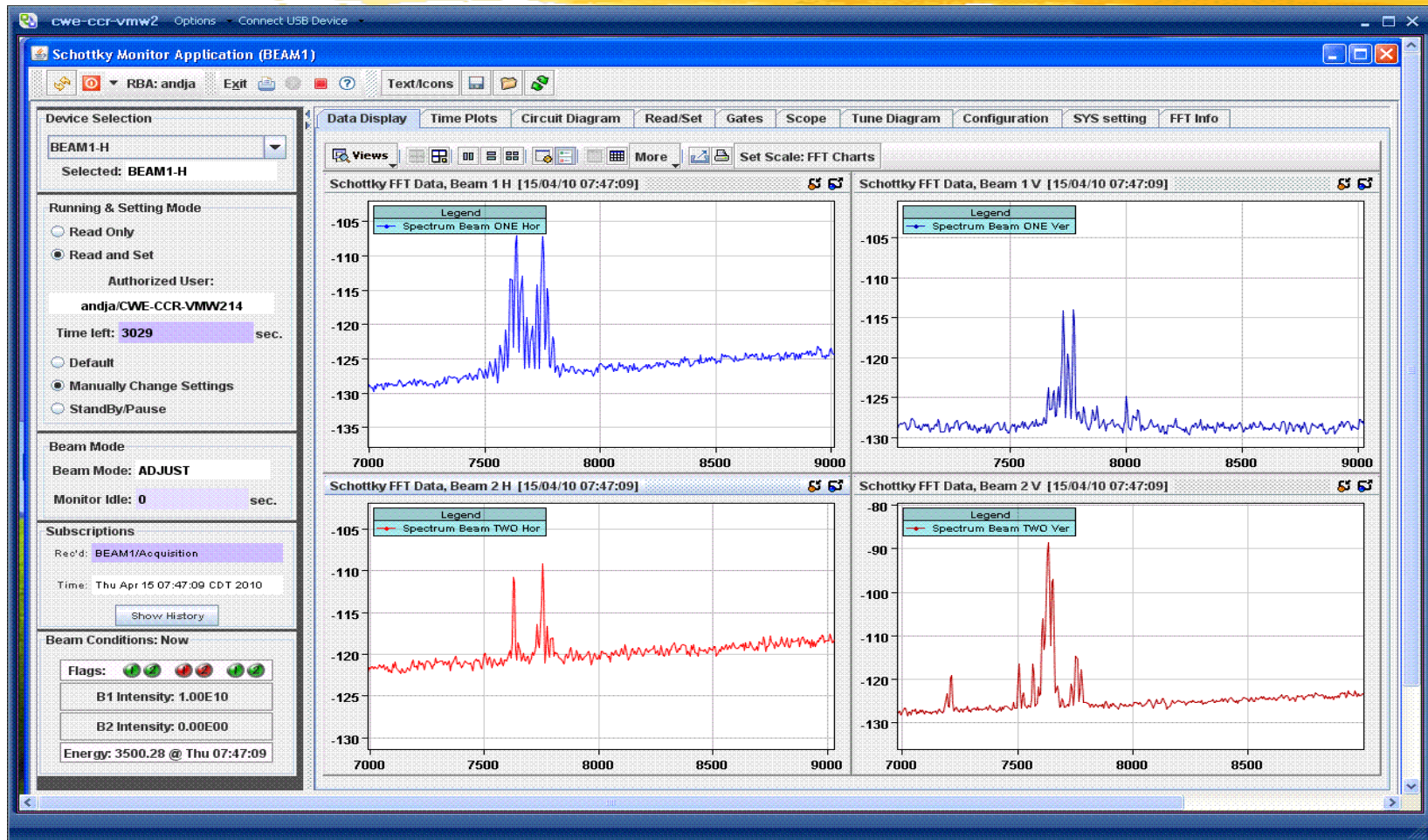


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*Zoom in on sideband with FNAL GUI*

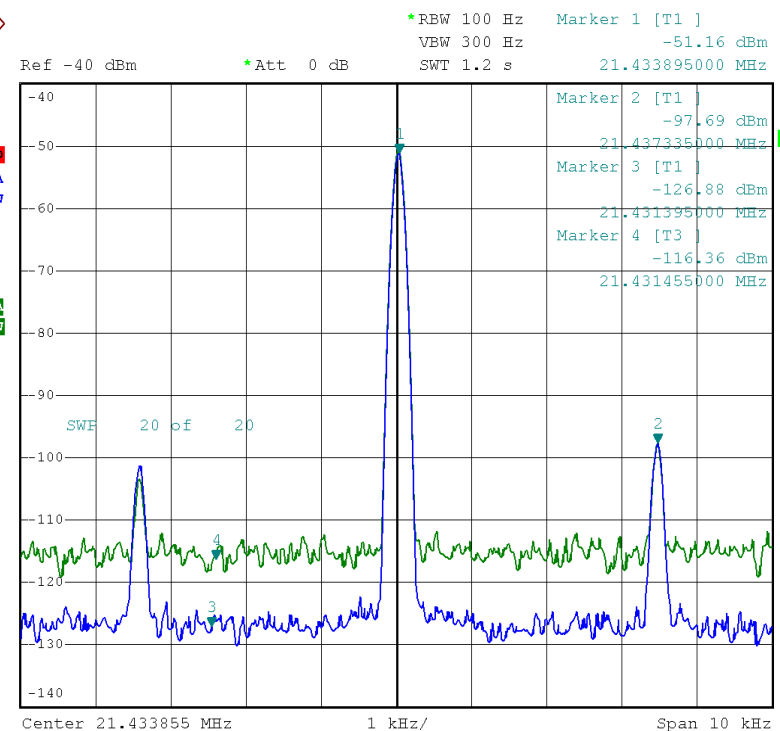
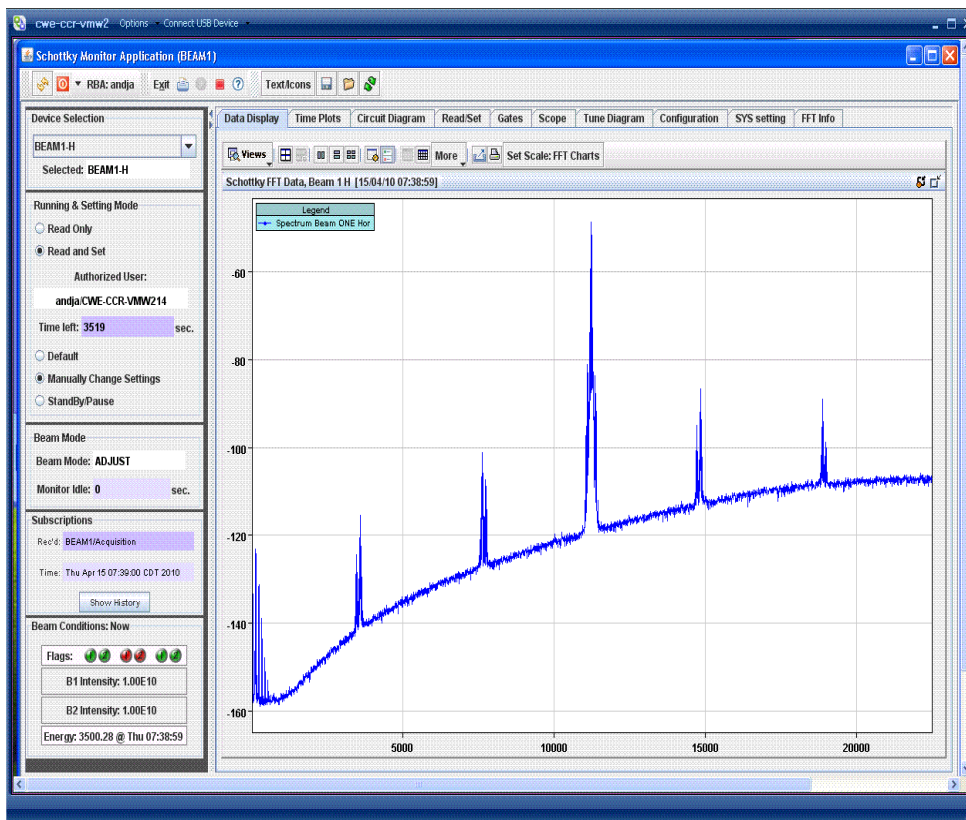


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# Fermilab HB1 Comparison of 21.4 MHz to Baseband

## Signal to Noise Limitations with Gating



10mhzB1

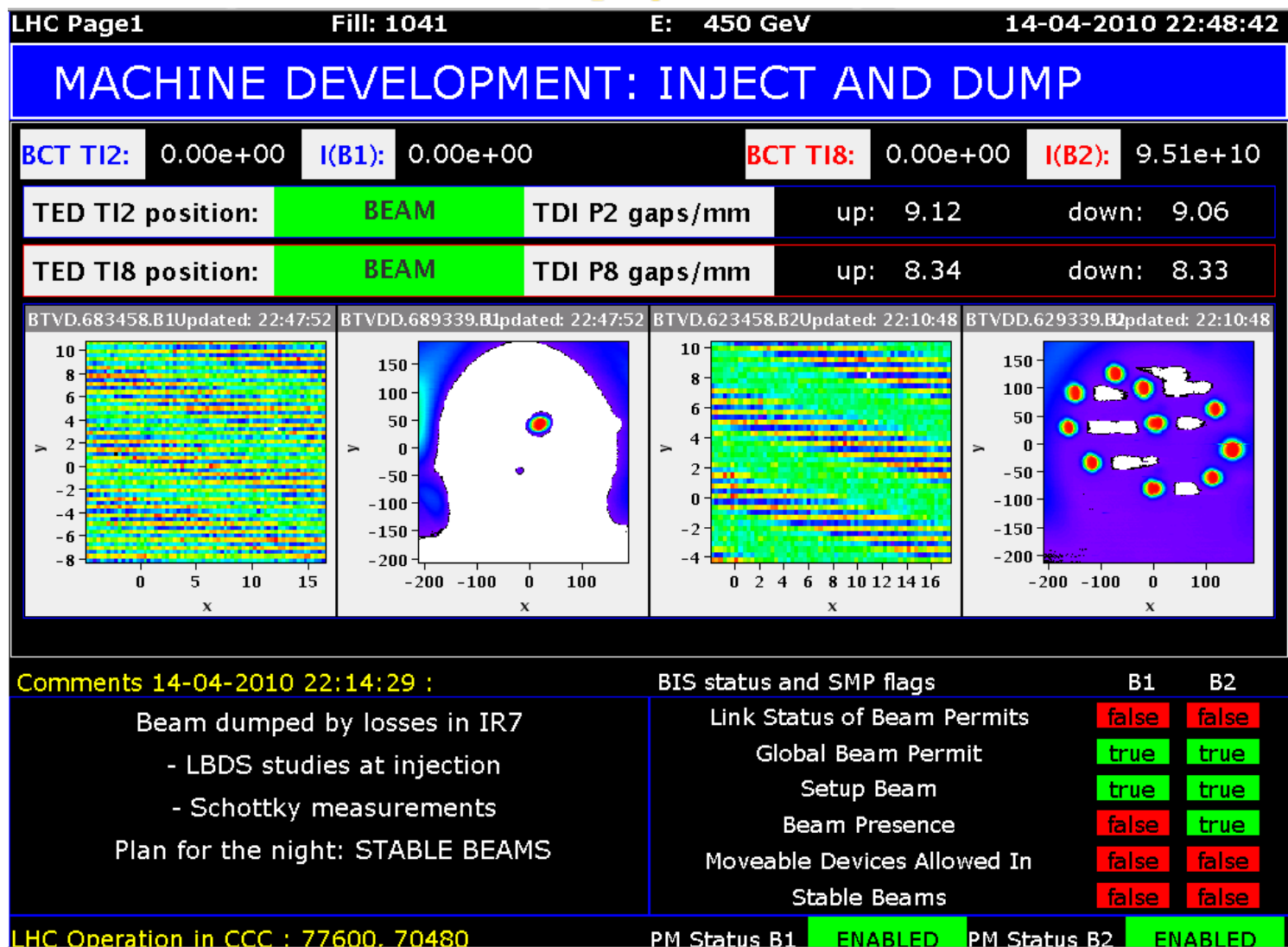
Date: 12.APR.2010 13:01:22





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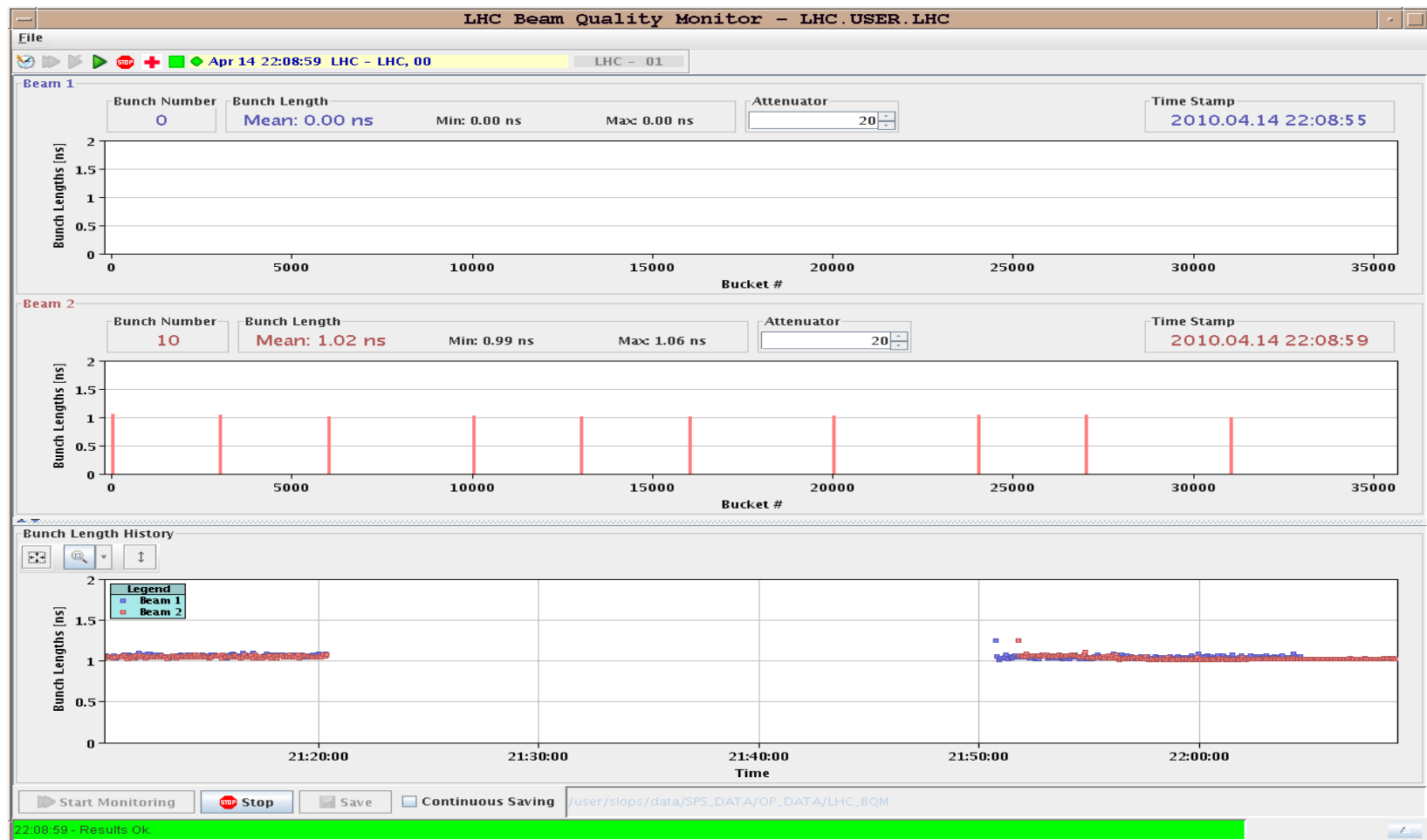
*Dedicated 10 bunch store 450 GeV*





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10 bunches approximately  $10^{11}$  total



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Beam 2: 10 Bunch store 450 GeV  
Vertical gate settings

cwe-ccr-vmw2 Options Connect USB Device

Schottky Monitor Application (BEAM2)

RBA: andja Exit Text/Icons

Device Selection  
BEAM2-V  
Selected: BEAM2-V

Running & Setting Mode  
☐ Read Only  
☒ Read and Set  
Authorized User:  
andja/CWE-CCR-VMW214  
Time left: 27600 sec.  
☐ Default  
☒ Manually Change Settings  
☐ StandBy/Pause

Beam Mode  
Beam Mode: INJDUMP  
Monitor Idle: 0 sec.

Subscriptions  
Rec'd: BEAM2/Acquisition  
Time: Wed Apr 14 17:12:22 CDT 2010  
Show History

Beam Conditions: Now  
Flags:   
B1 Intensity: 0.00E00  
B2 Intensity: 9.00E10  
Energy: 450.12 @ Wed 17:12:22

Data Display Time Plots Circuit Diagram Read/Set Gates Scope Tune Diagram Configuration SYS setting FFT Info

Type of bunch selection: TABLES\_VER\_HOR Last updated: Wed Apr 14 17:11:24 CDT 2010 Gate Width: 10 Expert

Data  
0 301, 40 601, 40 1001, 40 1301, 40 1601, 40 2001, 40 2401, 40 2701, 40 3101, 40

Transfer Readings for TWO V to This Panel Send Selection for TWO V to Front End

0 -- Starting Bunch nbr:	1	Width:	40
1 -- Starting Bunch nbr:	301	Width:	40
2 -- Starting Bunch nbr:	601	Width:	40
3 -- Starting Bunch nbr:	1001	Width:	40
4 -- Starting Bunch nbr:	1301	Width:	40
5 -- Starting Bunch nbr:	1601	Width:	40
6 -- Starting Bunch nbr:	2001	Width:	40
7 -- Starting Bunch nbr:	2401	Width:	40
8 -- Starting Bunch nbr:	2701	Width:	40
9 -- Starting Bunch nbr:	3101	Width:	40

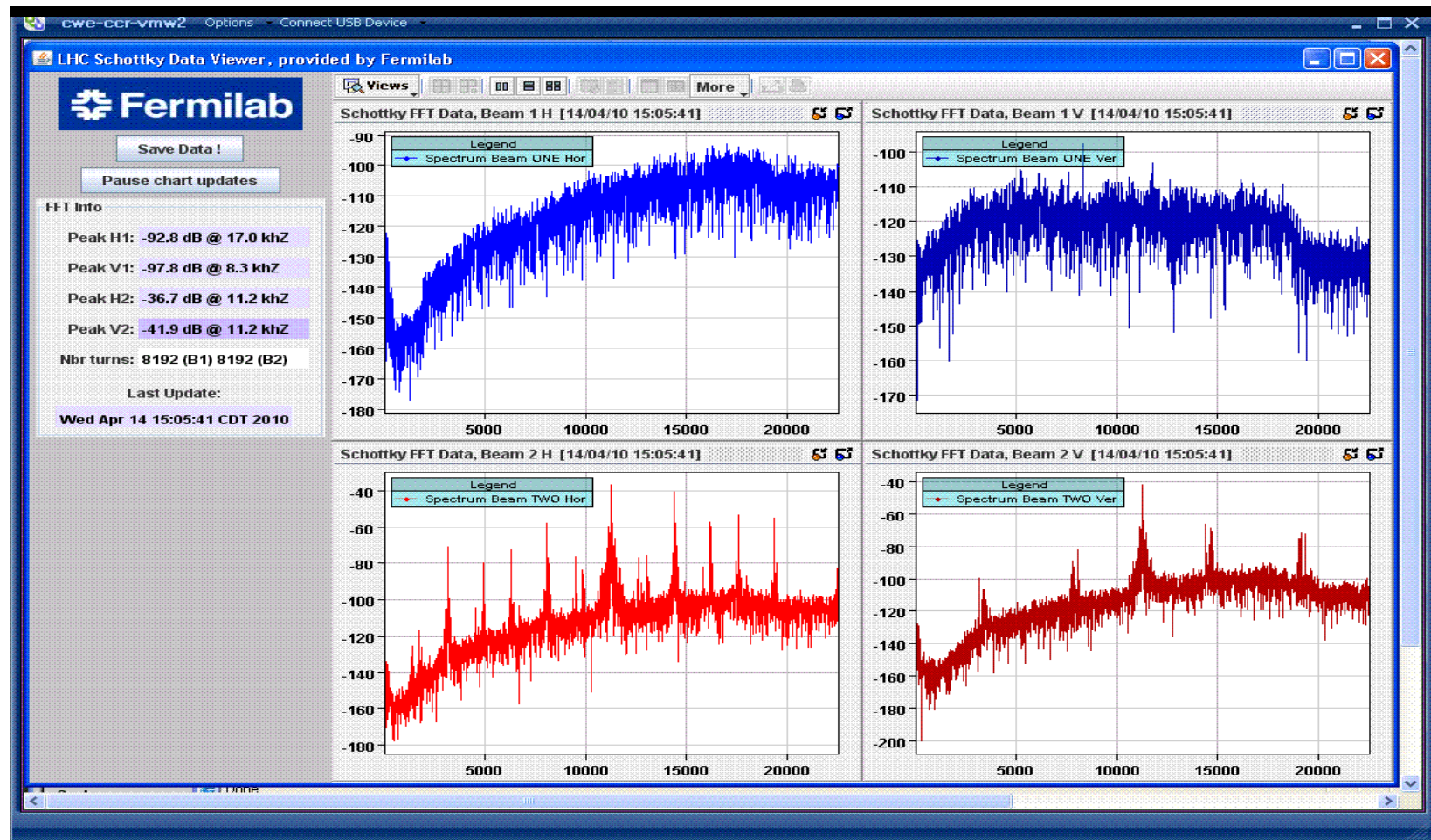




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# *First Schottky Signals FNAL GUI app*

## *10 Bunches Beam 2: 450 GeV*



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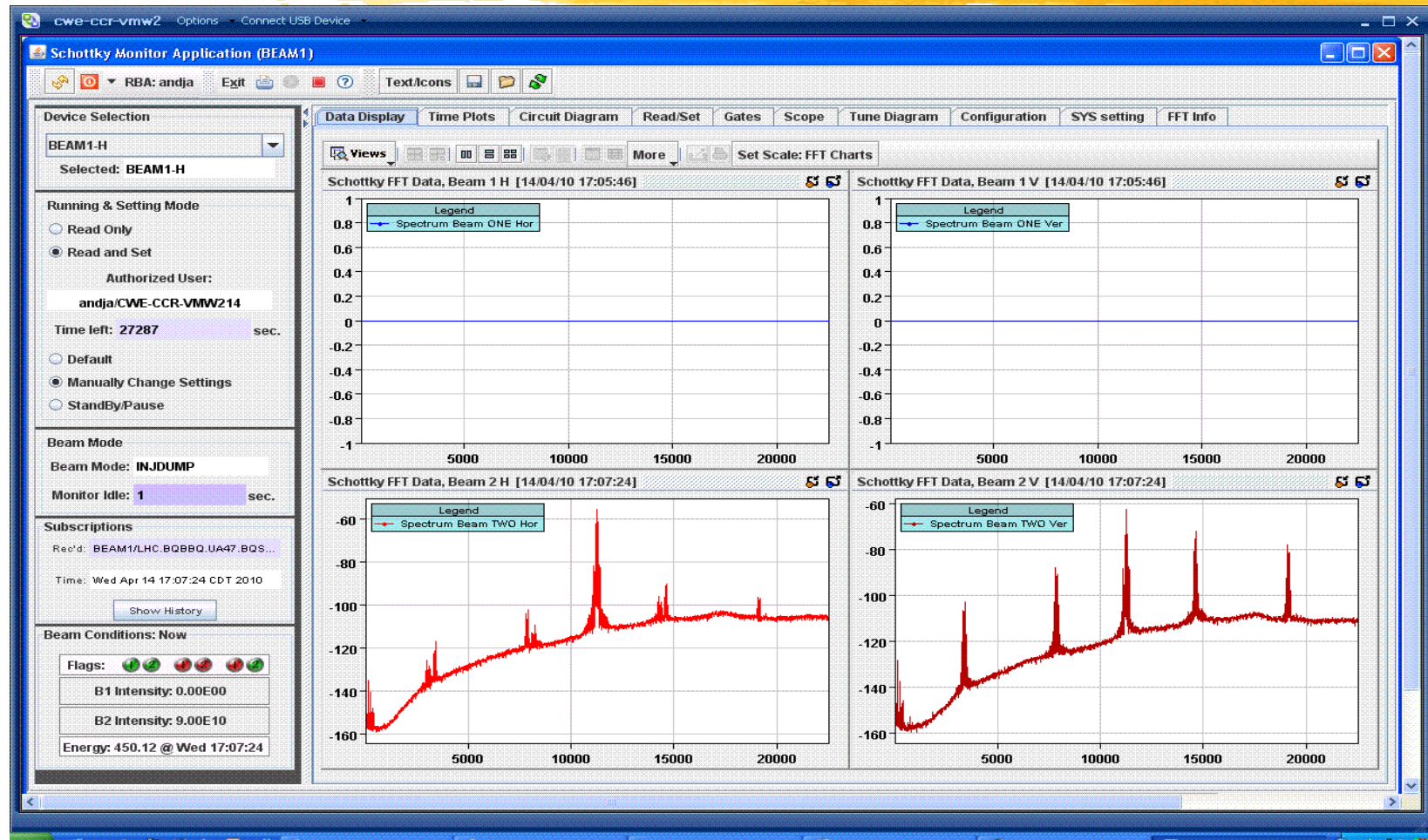


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# *First Schottky Signals 10 Bunches*

## *Beam 2: 450 GeV with averaging*

### *Measured Accurate Tunes*



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