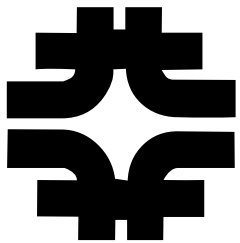
Tune Fitters Status,

mid-January 2004



P. Lebrun, Fermilab

January 14 2004

21.4 MHz & 1.7 GHz Schottky Monitors.

We are working on two distinct systems : the 21.4 MHz old Schottky, and the recently installed 1.7 GHz Schottky.

Sharing some computing methods: Java-D.A. and the refurbished and translated MINUIT fitter, in the C++/ROOT context.

"Front-end" systems are quite different, though.

We need two of them:

1.7 Ghz one is "broadband" and see individual bunches,

21.4 MHz is "narrow" band and can see synchrotron lines and give more accurate tunes for uncoalesced beams.

"We" means: C. Briegel, D. Still, A. Jansson, Z. Yuan, S. Panacek, J. Marraffino, J. You, Ron Moore, T. Meyers, D. Finstrom, T. Sen, M. Huening, jerry Cay,… Many thanks to all of them!

Please visit the poorly written web site at

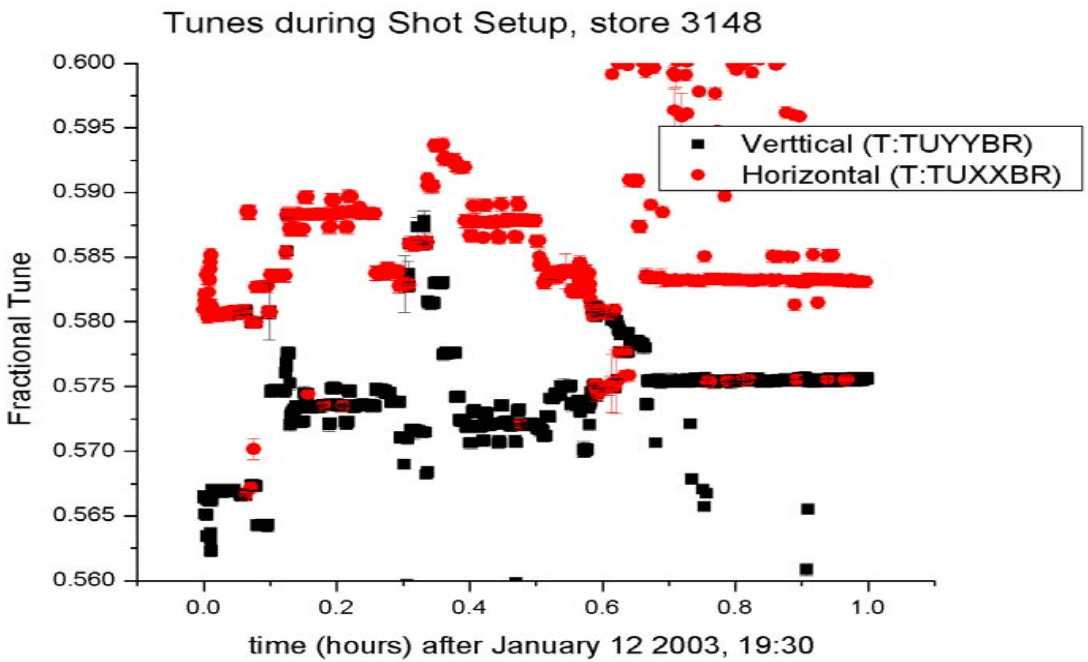
http://www-bd.fnal.gov/tevtune/

21.4 MHz Tune Fitters

An old and, in a few month time scale, a new one!

Based on ancient VaxVMS based fitting package (C39, C42, C44..)

The existing – and running – Tune fitter takes data from two dedicated HP3561a and fits the spectra at a rate ~ 0.5 Hz (uncoalesced)



Old 21.4 MHz Tune Fitter, Limitations & Plans

Limitation & defects:

1. Only proton channel, no pbars. -> we'll try to get Pbars…, from two to 4 concurrent fitters
2. We would like to go a bit faster (1Hz) (Should be possible!)
3. GPIB-based : configuration is hard to control, HP3561a are obsolete, thus difficult to maintain… -> purchase new front-end equipment
4. No chromaticity measurement from the ratio of synchrotron to main line from the fit. -> Tanaji Sen will give me the formula/procedure
5. The fit is sometimes plainly wrong … Hard to fix! Post processing software will take care of this. This software must have quite a bit of intelligence and awareness.. Note: quite often, it is indeed hopeless and it does not matter…

21.4 MHz Tune Fitter, New Front-end Implementation

Wrote an upgrade plan, and we are in the process of implementing it:

1. Purchased an ICS 110BL VME card to digitize at 100.5 kHz the 4 signals coming out of the 21.4 Mhz down-converter. This card is equipped with a daughter board to do antialiasing, signal conditioning. The card can also generate data..
2. Acquire a VME crate with a PC-board to do the DA and the FFT.
3. Select an FFT package and wrote a very small simulation package to learn how to use it. Results (frequency spectrum) are written to test ACNET devices.

   -> All this has been prototype by Marcus Huening
4. J. You has the ICS card and is studying it..
5. Visited the A1 service building with Brian Fellenz, check for room, network, and so forth. Need to coordinate with Tan as well!

21.4 MHz Tune Fitter, New Front-end Implementation, II

6. Accel. Controls purchased 3 + 1 Linux box for "computational servers". This is the same equipment CD uses for RunII farms.

Java software has been installed, DAE starts to run…

(Linux/PC solutions suggested by Jim P., myself and others, because the hardware is cheaper, and Linux is as well supported as Sun stuff, particularly if we run C++ applications.)

Same Linux boxes can be used for any CPU demanding "OAC", written in either C, C++, or Java..

➔ We purchased what we wanted for FY2004, I think.. May be we need a few more Linux boxes (few thousands..)

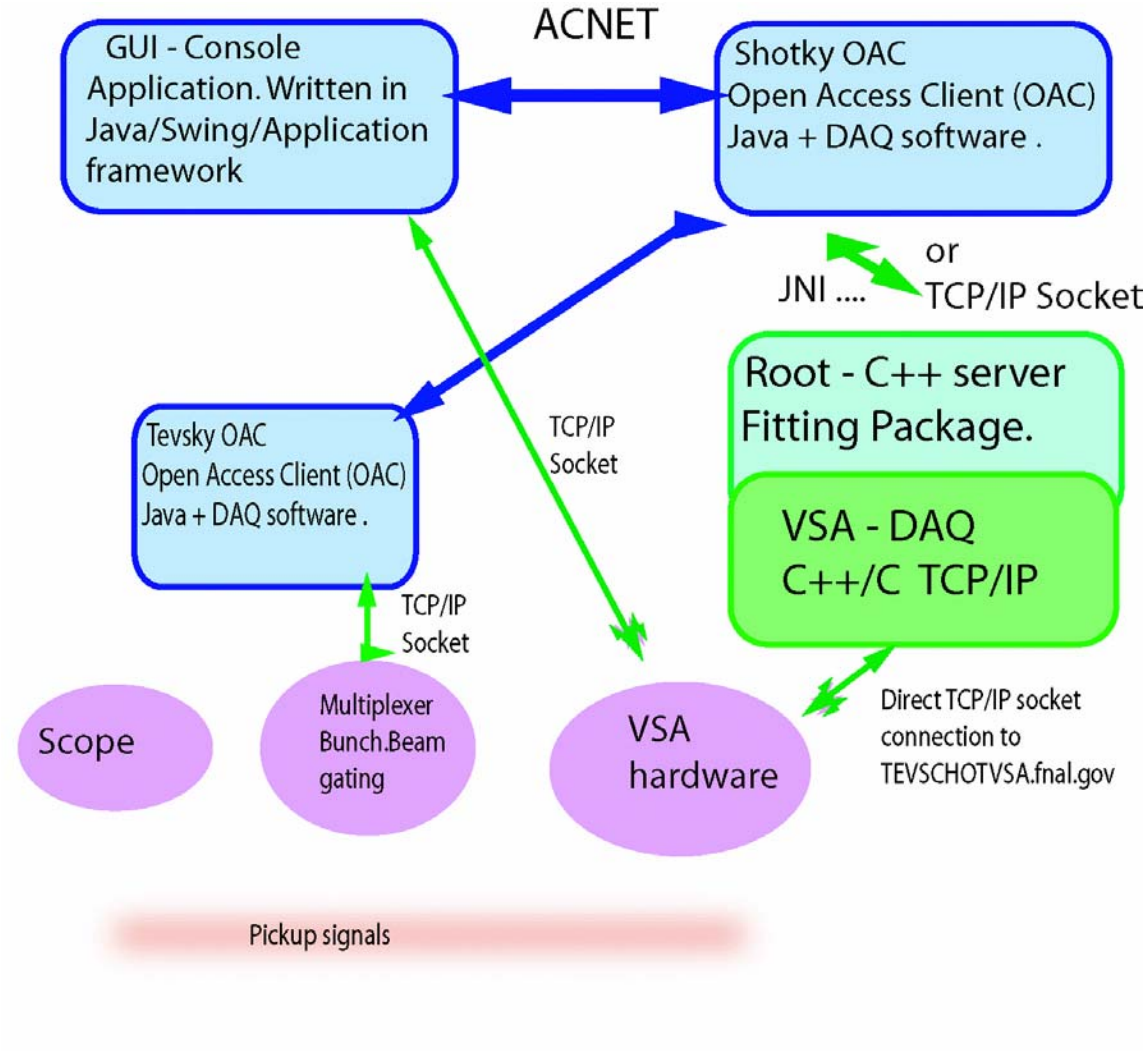
1.7 GHz Tune Fitter.

- I am only working on the “back-end”, the OAC and the Application. Goals:
  - Like from any other instruments that can generates data continuously, we should fit the 1.7 GHZ Vsa data continuously during the store -> advanced “Front-end” or an a “background process” or a “computational” OAC.
  - And a new application to drive the OAC

  -> We are part of the VAX-migration effort, since Vax Console applications (T122,.. W101) have already been written and are maintained. The OAC is the new thing.. Note: it relies on an other OAC to control the bunch gating (tevsky)

Software Architecture..

Yes, it is a bit too complicated!.
Too many arrows
In particular..



Status, 1.7 GHz software..

(or the software I am aware off..)

W101 keeps getting better and better…
New (Java/C++) software 90 to 95 % coded up
Being commissioned:

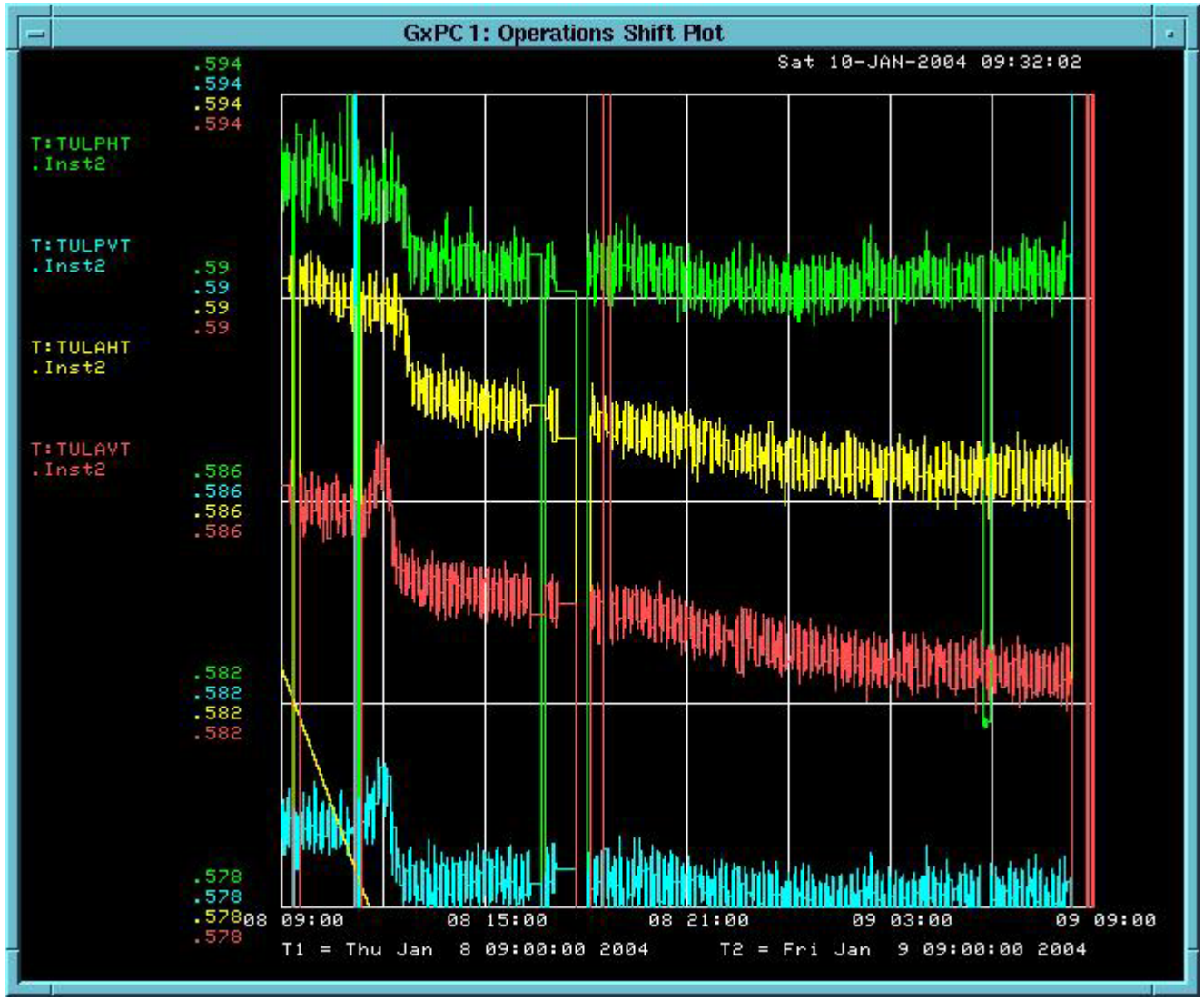
a. New GUI running on the “W” or “Z” Java appix page.
b. OAC is running… most of the time during store.
c. Need to support multiple users of the VSA (see presentation by Andreas)

Plenty of polishing-up work need to be done, as shown in a few slides and plenty of detailed analysis to do!

Status, 1.7 GHz software..a week ago..

Notes:

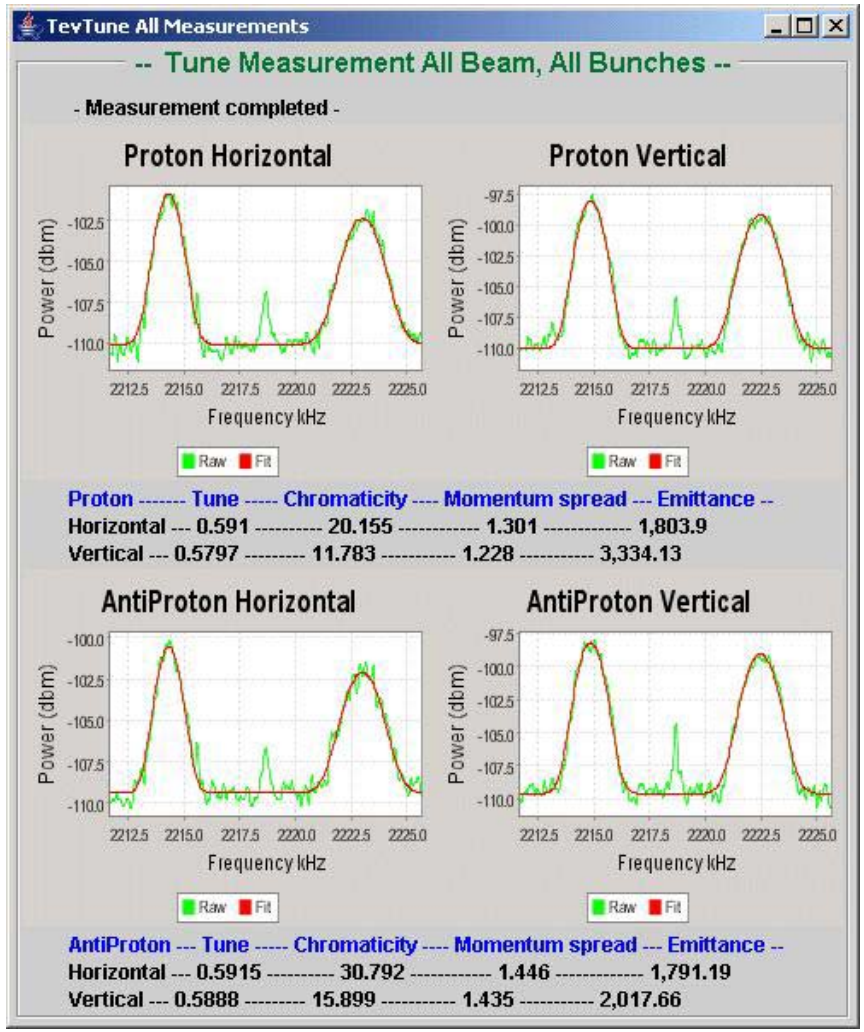
1. The bump early in the software is due to changes made to the base tune circuit, and matches (semi-quantitatively) with what Ops typed in the T55 page..
2. However, the tune value are off by ~ 0.001, due to an inaccuracy in the internal frequency scale. It has been readjusted last Sunday..
3. Yet, the tunes are still off with respect to the 21.4 MHz. This will need more work..



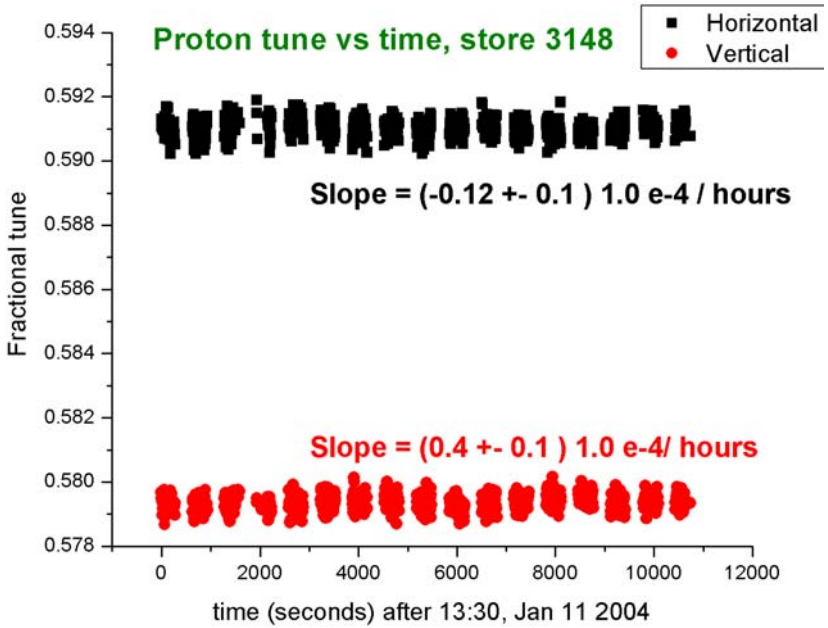
Status, 1.7 GHz software..Fit Quality.

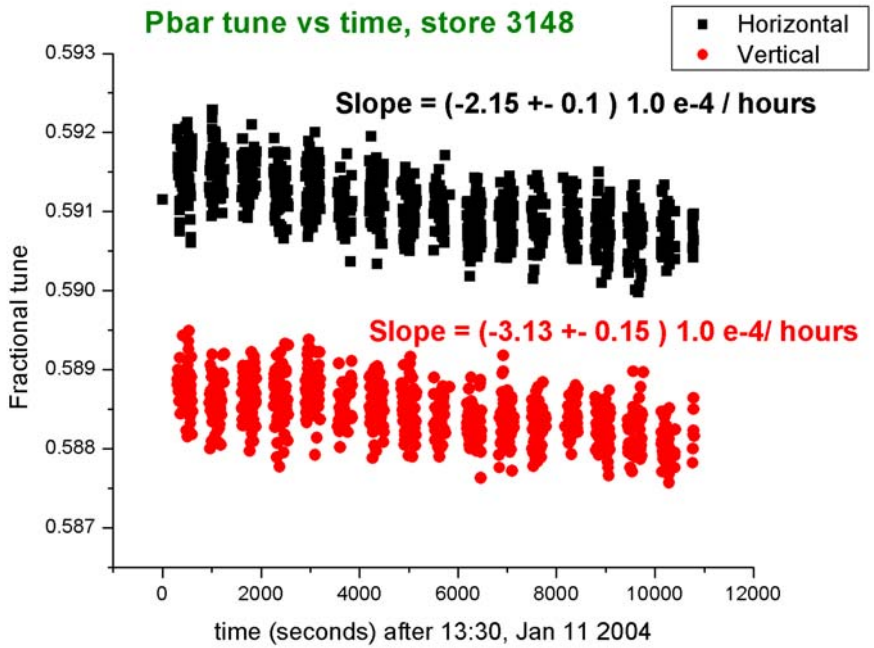
Notes:

1. Fits are O.K. when gating on all bunches.
2. Marginal for Pbar gating on 3 bunches
3. Not quite there gating on a signal bunch..But, remember, we will get 4 times more pbars next year!



Preliminary results on tune drifts. (1.7 GHz)





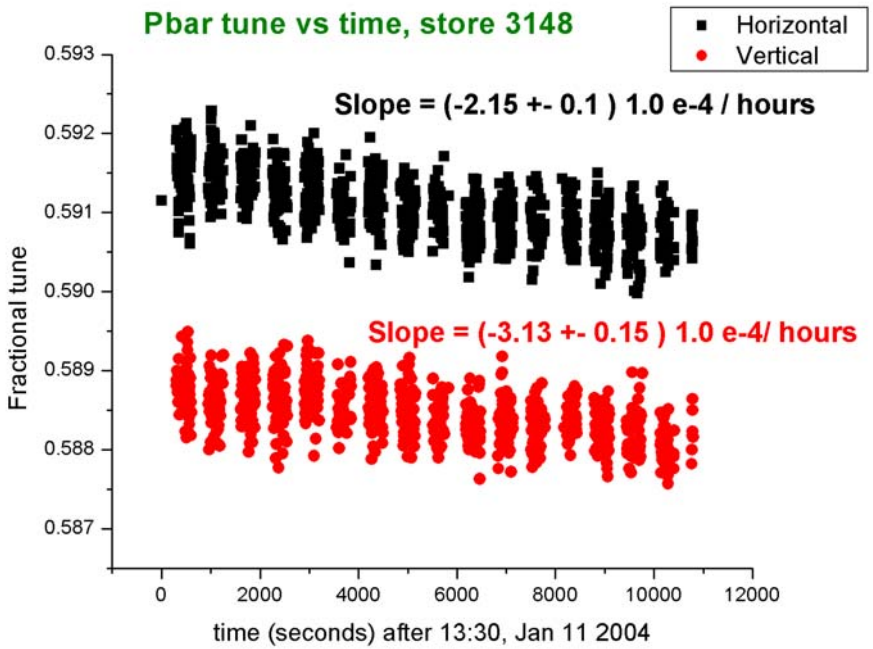
Notes:

Very clear difference between pbar and proton.

Seen on other stores as well…

Proton/pbar Tune split is due to head-on beam-beam tune shifts and differential tune settings.

Prelim. results on tune drifts, theory/meas.



$$\Delta Q = \frac{3}{2\pi} r_p \frac{N_p}{\varepsilon_p}$$

$$\frac{\partial \Delta Q}{\partial t} = \frac{3}{2\pi} r_p \frac{N_{p0}}{\varepsilon_{p0}} (1/\lambda_p + 1/\varepsilon_p \frac{\partial \varepsilon_p}{\partial t})$$

Taking the FW vertical emittance at Remove Halo, and taking the relative growth size from Sync Light, the bunch intensity and bunch lifetimes from SBD (uncorrected), one has:

<Proton lifetime> 201 hours.

<emitt , extrapolated @ 13:30 > = 21.6 pi mmmrad

<Vertical ε growth rate> 53 hours.

<Hor. ε growth rate> 23 hours.

<Tune Shift, Horizontal > = 0.0081

<Tune Shift, Vertical > = 0.0085

<Tune Drift, Horizontal > = 0.00039/hour

<Tune Shift, Vertical > = 0.00020/hour

Status, 1.7 GHz Schottky monitoring

Plenty of beam physics analysis to do…

- Do we understand absolute values of tunes?
- Why is fitted chrom ~ 2 too high ?
- Can we measure emittance ? Emittance growth ?
- Can we measure $\delta P/P$
- Correlation between these 4 fitted quantities? Compare to other measurements ?

And quite a bit of software polishing:

- Adding the capability of taking Ramp and Squeeze measurement up the ramp
- Polishing the GUI (including connection to VSA & Scope)
- Testing other modes of operation