

Managing the Emittance: Transverse and Longitudinal

V. Schoefer

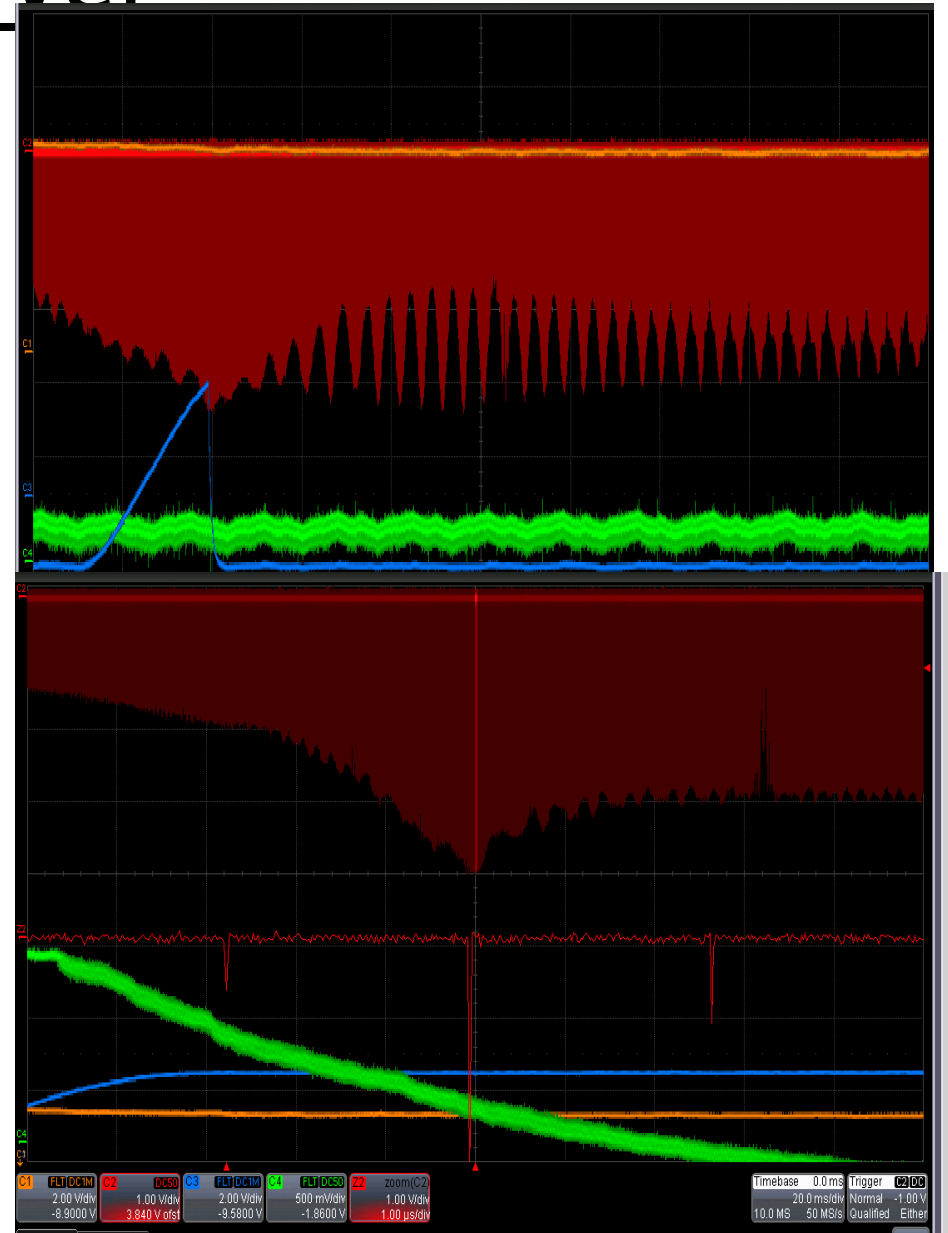
RHIC Retreat 2013

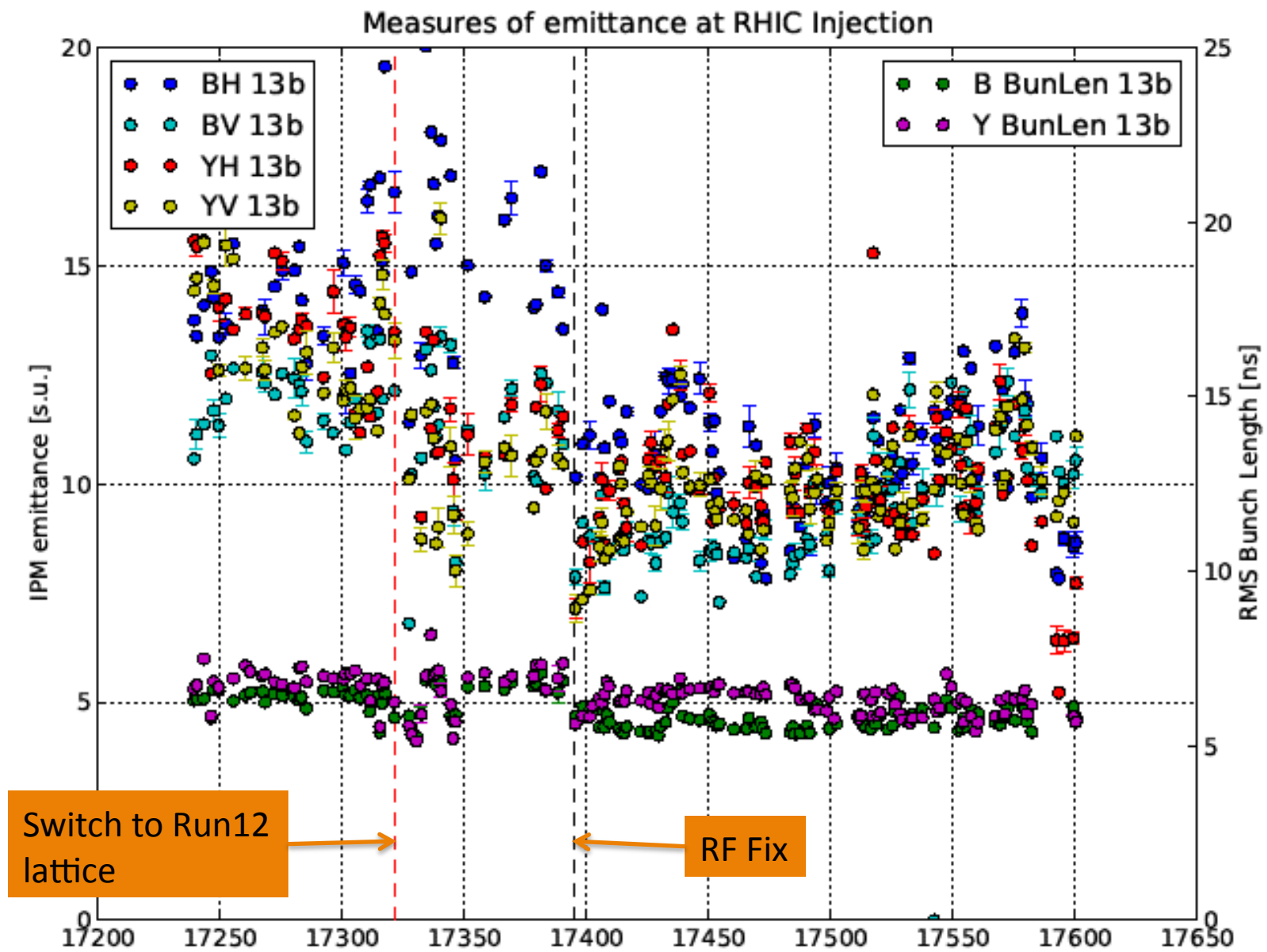
Agenda

- Part I: Some specific cases
 - AGS RF phase rollover fix, effects on the emittances
 - Conjectures about longitudinal emittance and ramp losses in RHIC
- Part II: Why was figuring out Part I so hard?
- Part III: Absolute transverse emittances

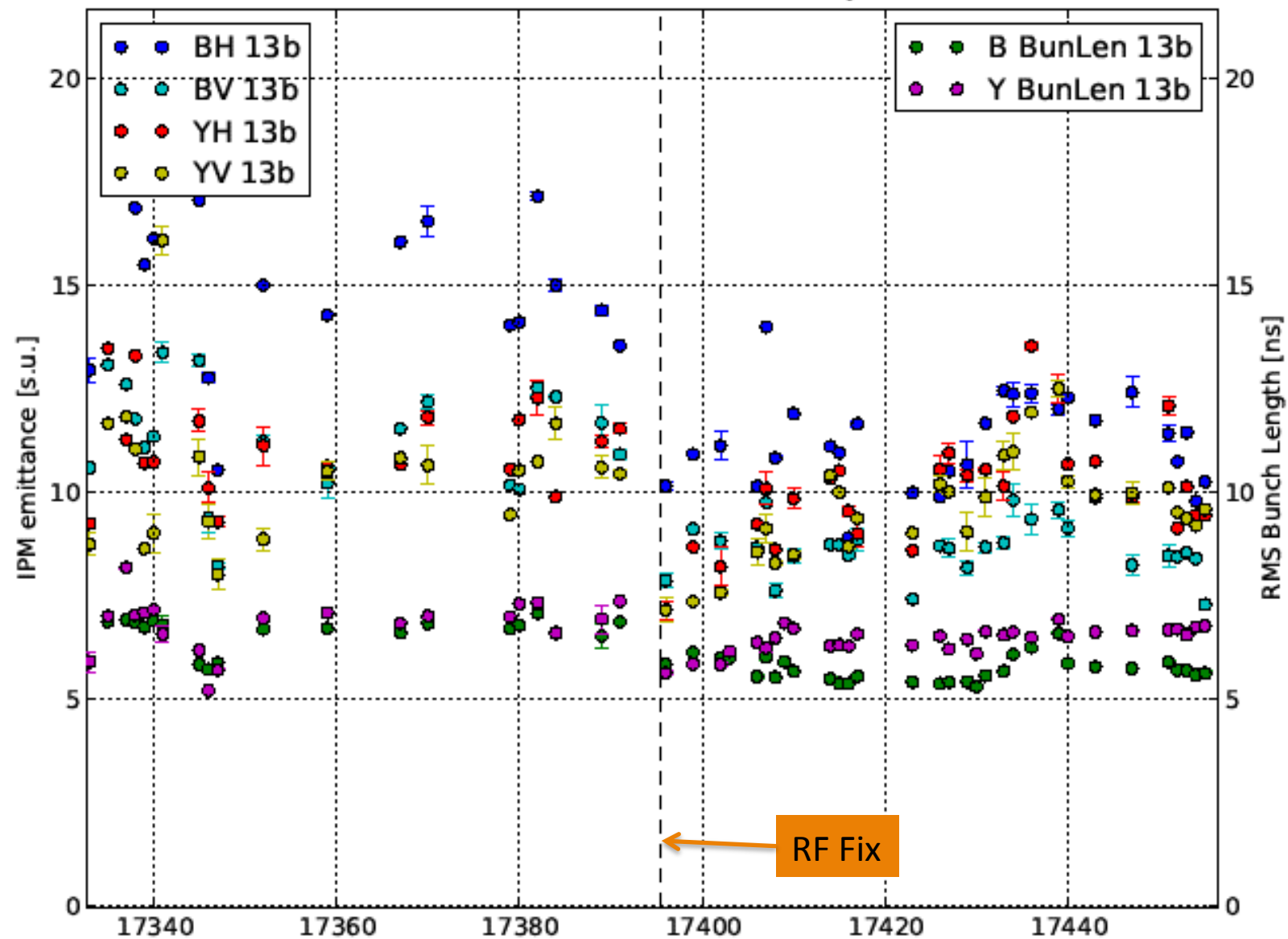
AGS RF Phase Roll-over

- LLRF setup problem causing large synchrotron oscillations at AGS transition
- Fixed between physics fills 17391, 17396, 4/17
- Long. emittance drops from 1.1 to 0.8 eV-s
- What about transverse?

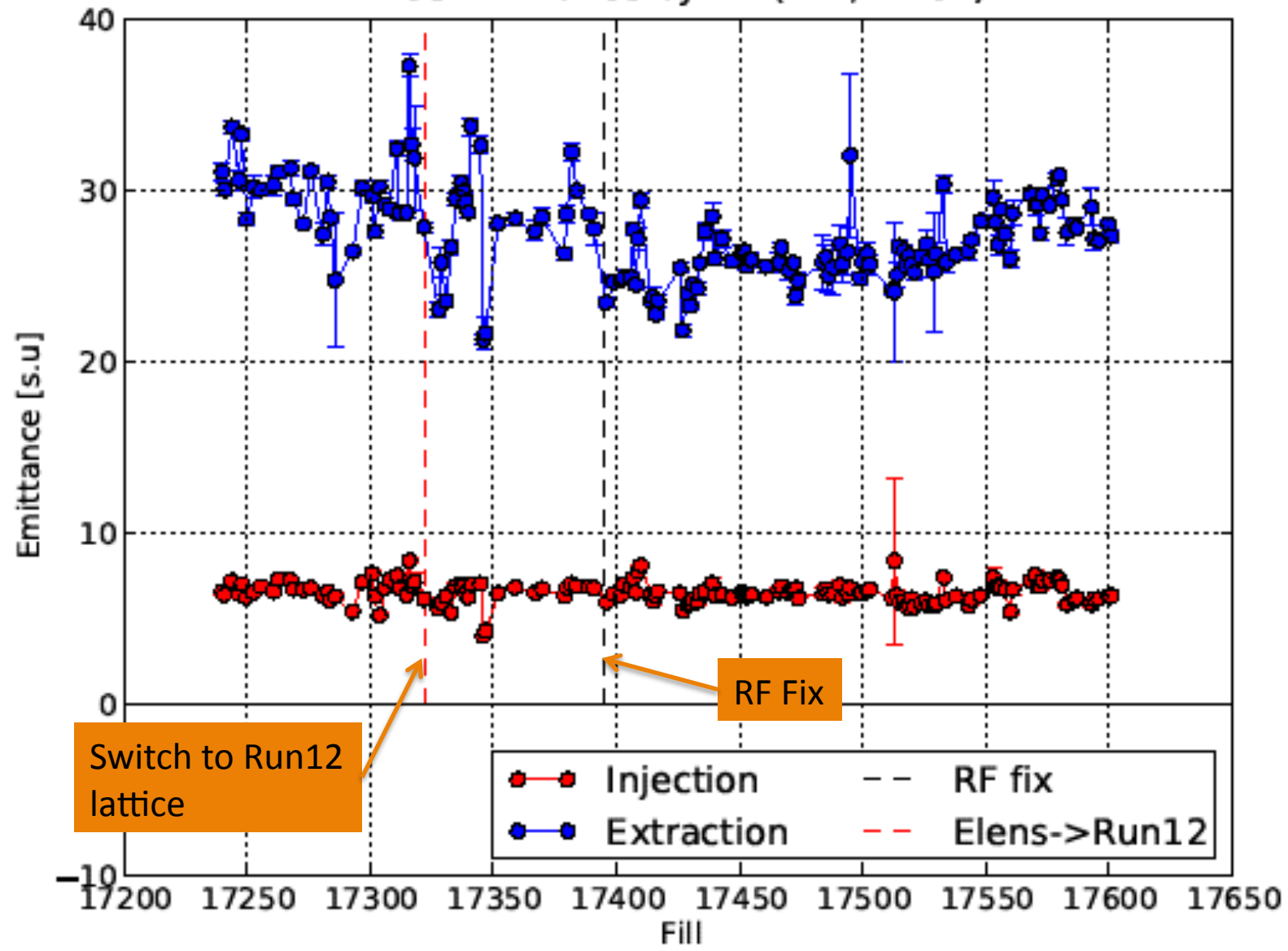




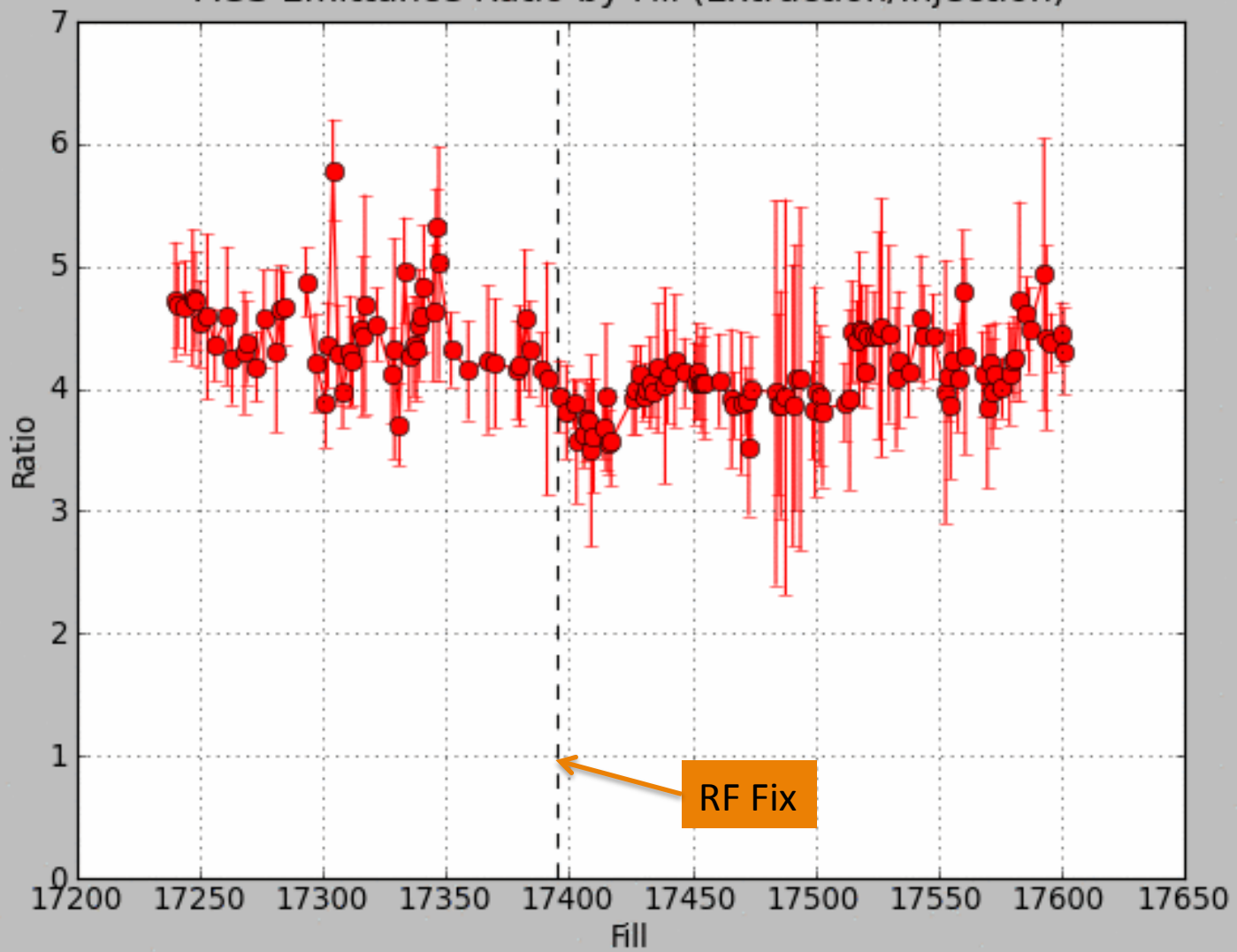
Measures of emittance at RHIC Injection

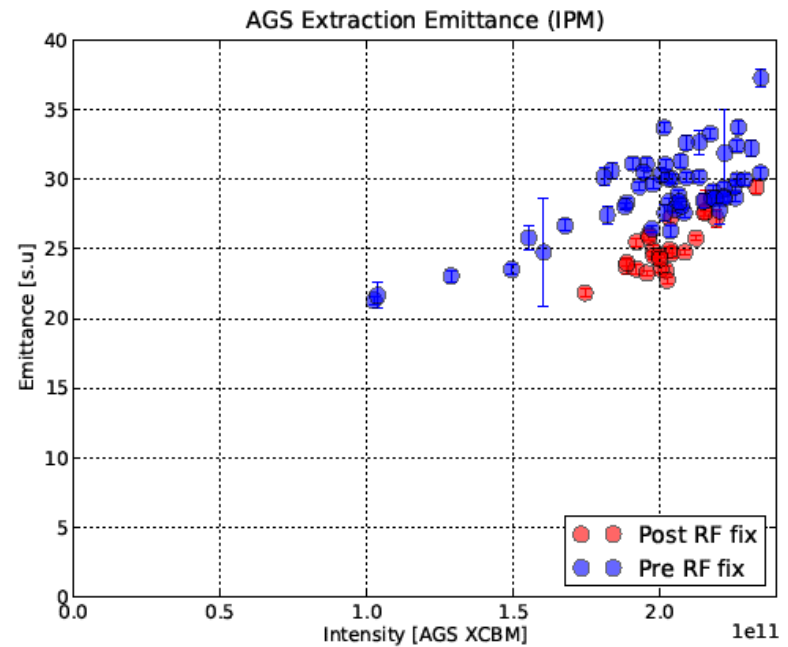
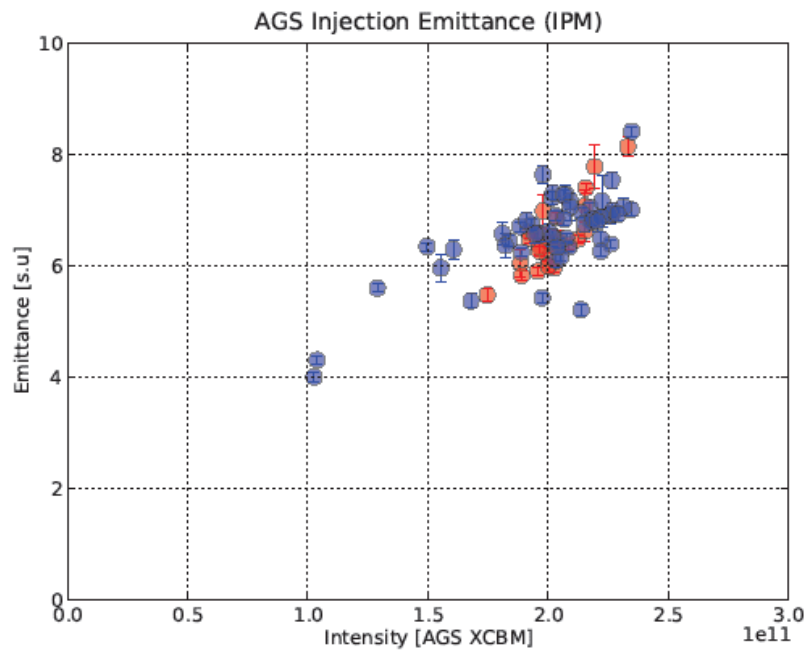


AGS Emittance by Fill (IPM, RF on)



AGS Emittance Ratio by Fill (Extraction/Injection)





The improvement definitely happens in the AGS (injection unchanged by the fix, extraction clearly improves)

Maybe some RHIC style dedicated scope diagnostics for the AGS WCM (injection oscillations, bunch length at transition) would be helpful.

Longitudinal Emittance and BBB Damping

RMS Bunch Length just prior to rebucketing

	Blue [ns]	Yellow [ns]
Run 12	5.5	5.8
Run 13	5.8	5.9

Longitudinal emittance (at store) is basically the same with the BBB damper

BUT, we are clearly able to accelerate more intensity through the ‘bucket squeeze’

This gives the Run 12 story that the permit pulls were always small losses out at the tails more weight. The BBB damping + lower Landau voltage (maybe) reduces the beam out at the tails and removes the losses.

Could also be that the bunches were doing coherent BBB oscillations at bucket squeeze time in Run 12.

Analysis would now consist of more detailed look at specific bunch profiles.

Part II

‘Managing’ the emittance

Can we make it easier to

catch emittance problems early?

compare to previous performance?

make the most of measurements we already

have to improve/maintain emittance fill to fill?

'Run level' comfort displays

Borrow an idea from the polarimetry group:
Web-based display of fill-by-fill plots of interest

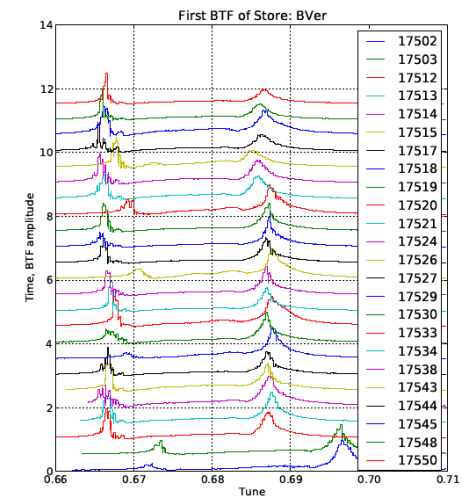
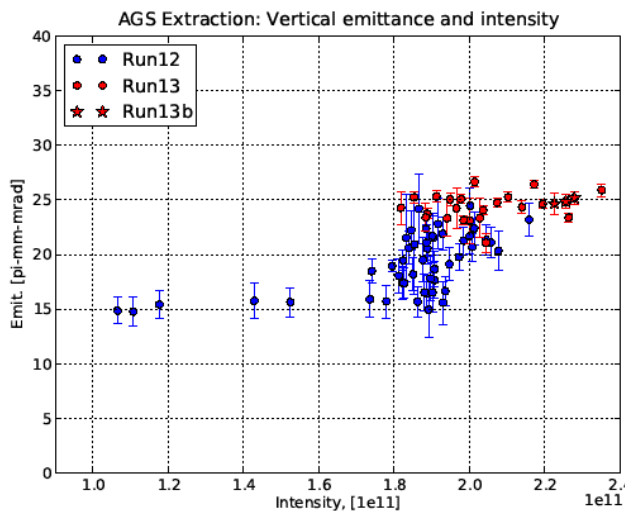
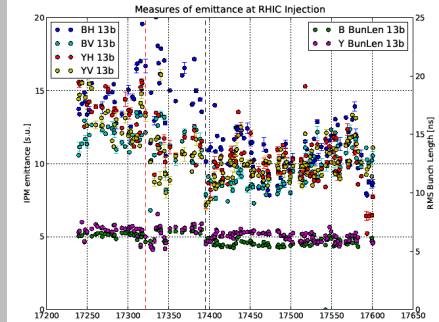
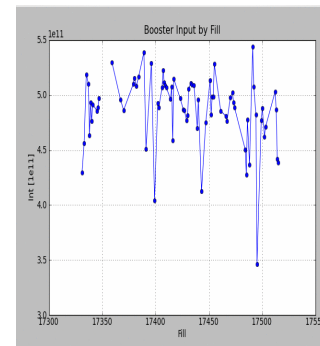
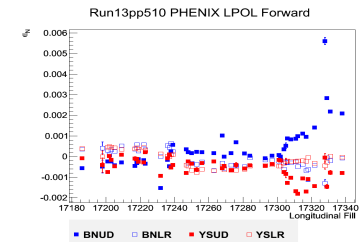
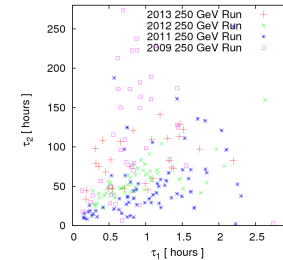
Automate creation and posting of plots that
are routinely useful (but typically don't get
made until we have a problem)

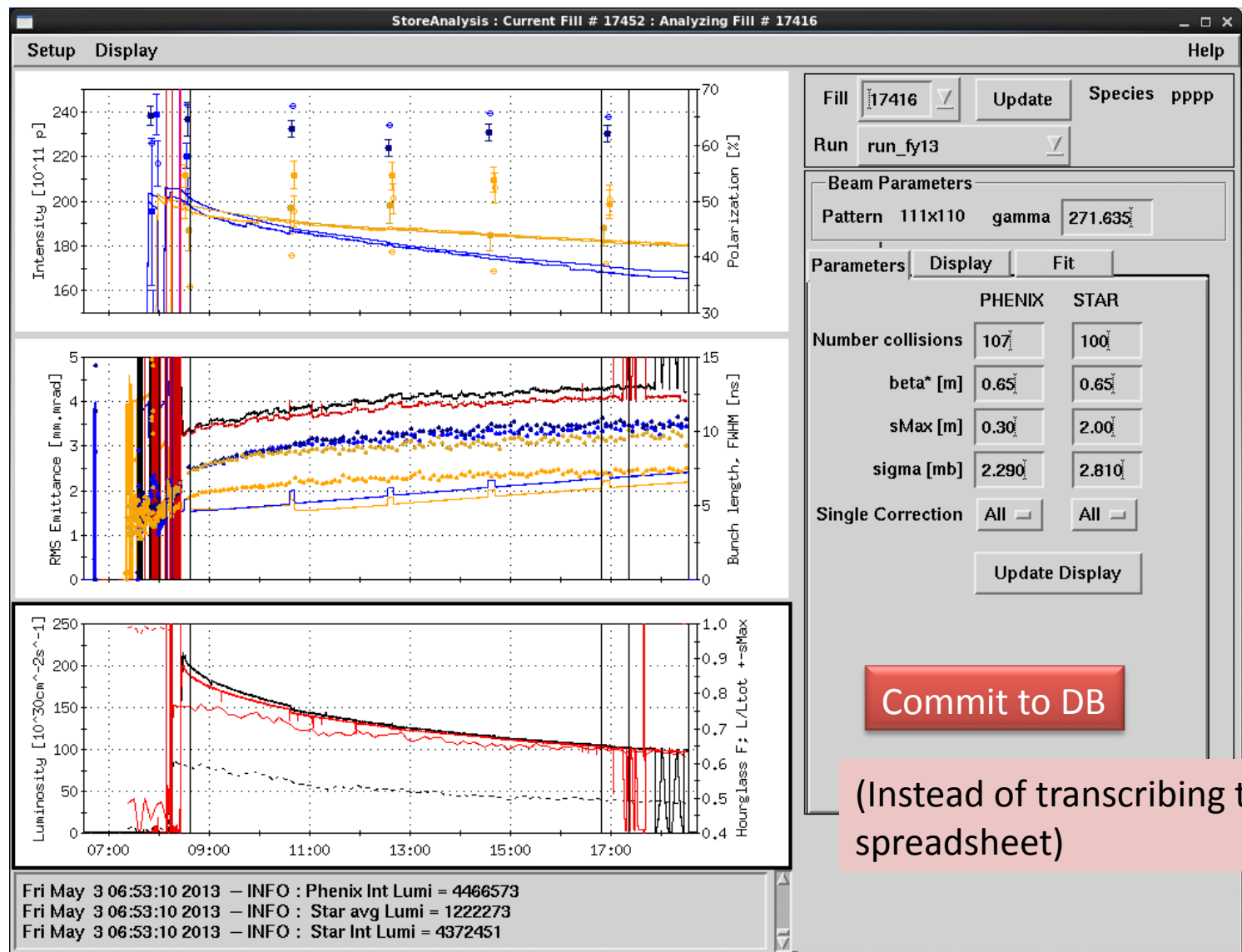
Include background data from previous
comparable runs.

Natural extension of FDAView

Run coordinator 'dashboard'

Would need a steward





Fill Summary Pages

Again web-based

Brings together different forms of data

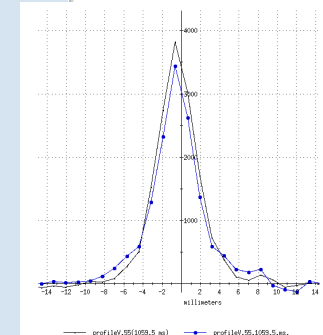
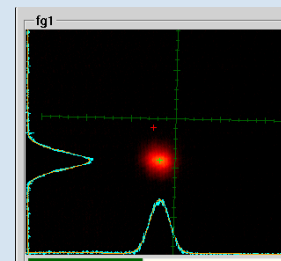
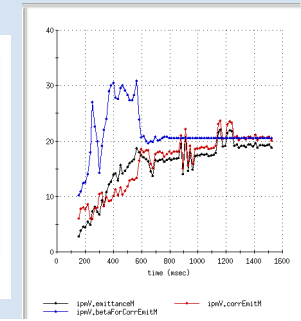
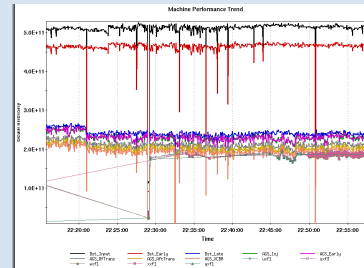
e.g LogView cannot really show the profiles and the calculated sigma

Could include data from a designated reference or 'golden' fill.

Operator 'dashboard'
(see LHC commissioning page)

Asking a LOT of (fewer) operators in less and less time.
We should get them some tools

Fill #12345



Operator parameters:
RB cell temp
AGS Bfield correction

Midas ADO

The screenshot shows a window titled "OpsStorageServer/Ramp" with a menu bar (Page, PPM, Device, Data, Tools, Buffer) and a Help button. The main area is divided into three sections: "Describe ramp mode:", "Ramp Switches:", and "Other Settings:".

Describe ramp mode:

Low Energy?	No
Gamma Transition?	No
Valid Ramp List	pp13e-v4,pp13b-v
PP?	Yes
Cogging Mode	atStore
Blue fractional tune	OverHalf
Yellow fractional tune	OverHalf

Ramp Switches:

Energy Ramp	pp13b-v2
Use Storage Ramp?	On
Storage Ramp	pp13b-rot1
Ramping Cavities	9MHz
Rebucket Cavities	28MHz
Landau Cavities	197MHz

Other Settings:

Using Roman Pots?	No
Energy Wiggles?	Off
Storage Wiggles?	Off
OD Data Store?	Off
Idle AtR with Up.tape?	Yes
Auto-Idle AtR?	Yes
Check GammaTs?	Yes
Popup between ramps?	Off

Energy Ramp Feedback

	Blue	Yellow
Orbit	On	On
Tune	On	On
Chrom	Off	Off
IPM	On	On
Tunemeter	BBQ	BBQ
Transition Dipole		Off

Golden Fill: 17456

At the bottom, there is a status bar with a "Nudge: 0" indicator and a "236" value. A log window at the very bottom shows the following messages:

```
Wed Jul 24 15:21:35 2013: copying parameter values to buffer.  
Wed Jul 24 15:21:36 2013: Get and Async requests complete.
```

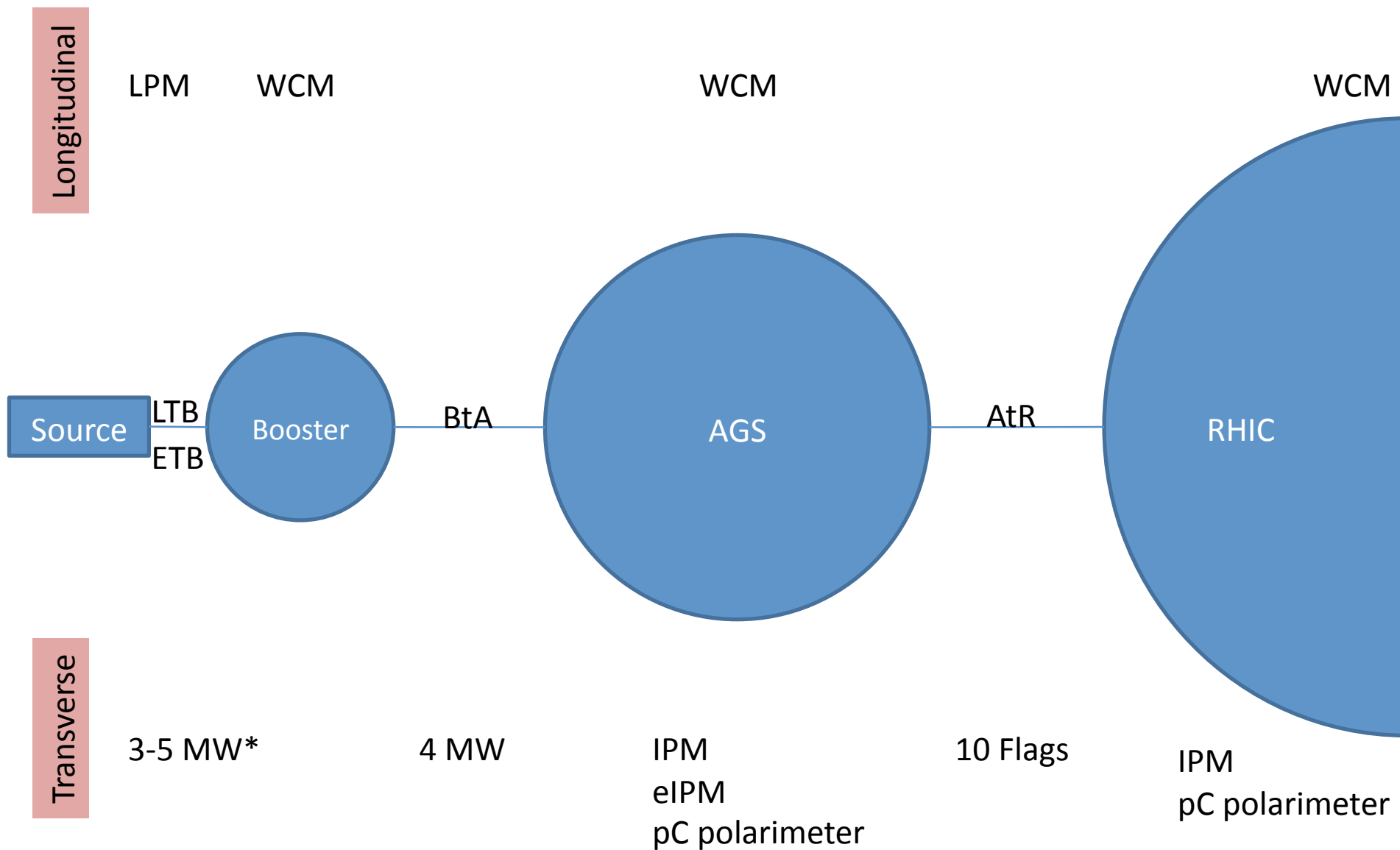
Run coordinator 'sets' the golden fill

Applications (LogView, injpscompare, Gpm, agslpm, etc.) can display as a reference data associated with that fill

Part III

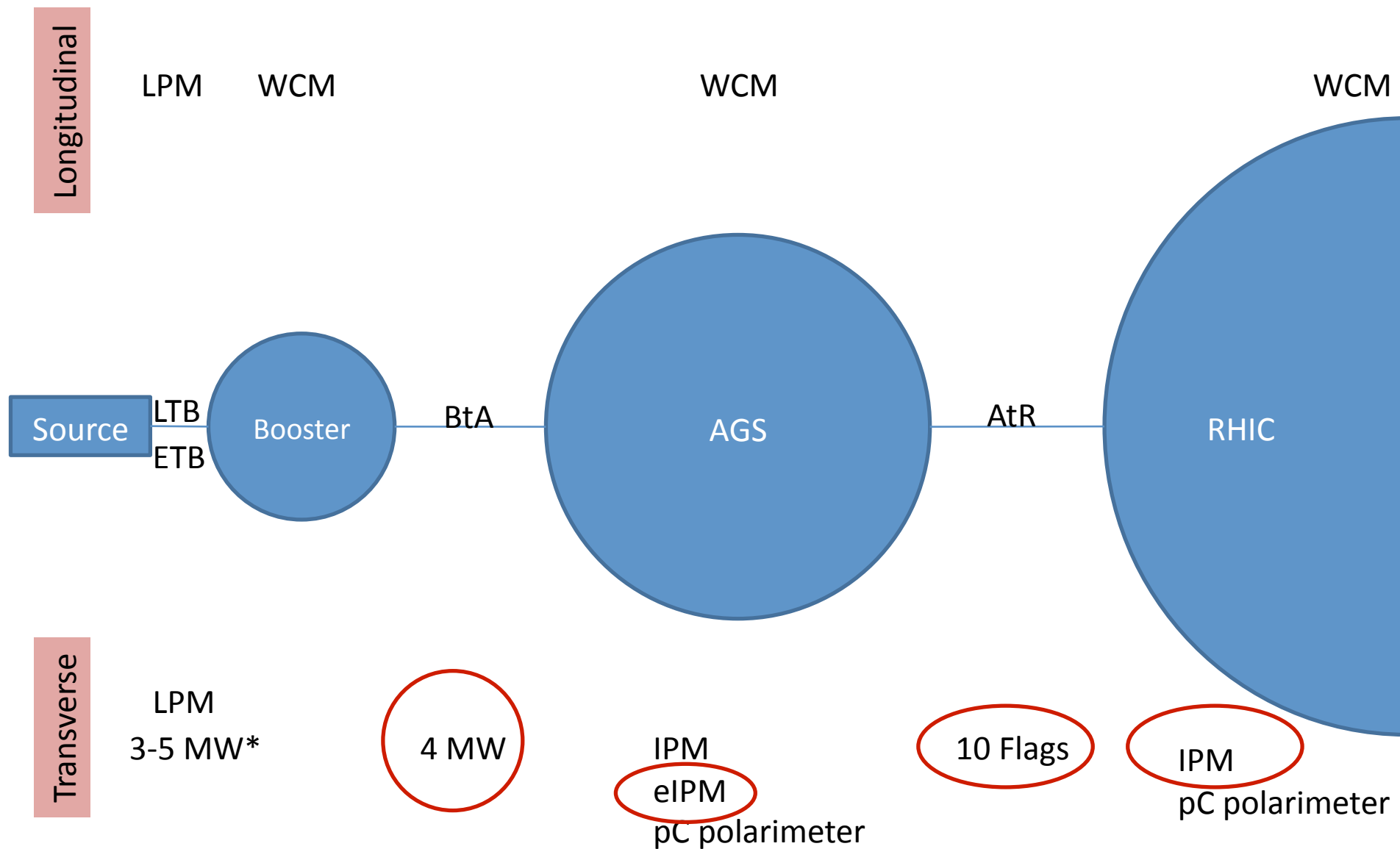
Efforts I think might be useful in learning what the emittance actually is

Beam Profile Instrumentation



*MW = multiwire

Beam Profile Instrumentation



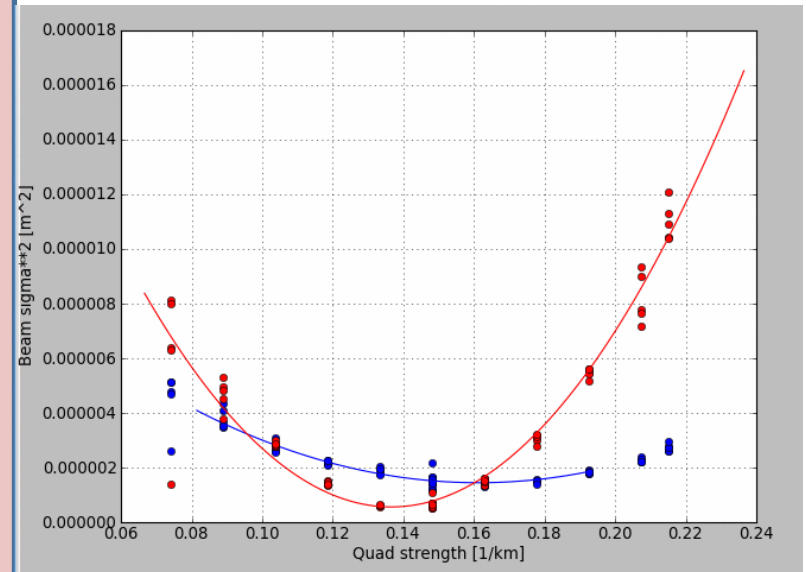
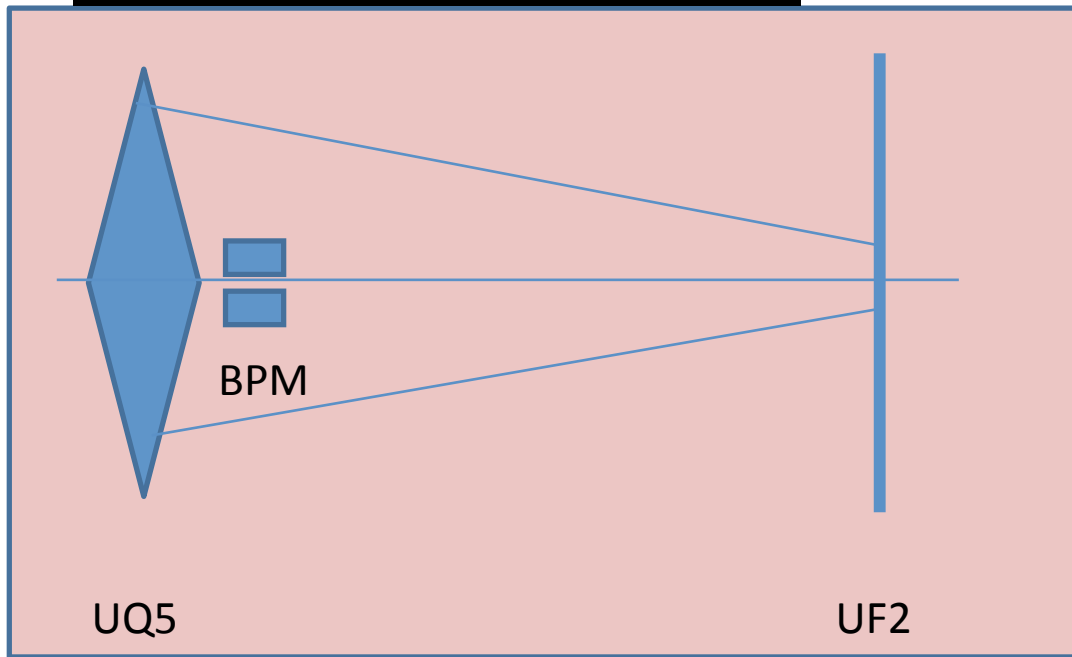
Absolute Transverse Emittance?

- Transfer line MW/flags and AGS eIPM, RHIC IPM
 - Best shot at directly measuring the profile AND the optics

AtR Flags

- Two options (both being pursued)
 - ‘Three flag’ method
 - Great progress resurrecting this method late in Run 13 (Julia Huang, Michiko, Nick Tsoupas et al)
 - Three flags means more data to constrain the problem
 - Doesn’t require changing the lattice
 - Requires careful setup of three flags and model inputs
 - Quad scan

Quad scan in AtR

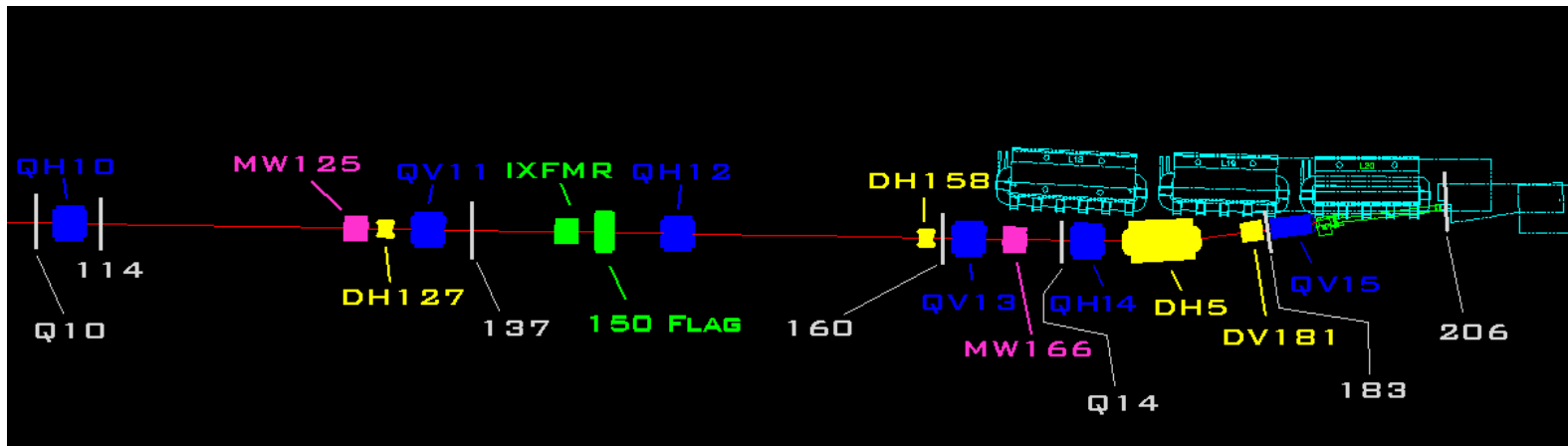


UF2 is at a beam waist location in BOTH planes (adjacent to stripping foil)
Beam sigma variation with quad strength gives emittance and optics (betas AND alphas)
BPM adjacent to quad also allows dispersion and its slope to be measured.
Maybe the only place in the complex to get all six linear matching parameters

But requires careful BBA beforehand

BtA Multiwires

- 'Multi-flag' option not really available, too many elements between measurements
- Quad scans still an option (but one plane at a time)



AGS eIPM

- Doesn't have the space charge problem suffered by the ion-collecting IPMs
- Can do TBT injection profiles (!)
- In any case where we upgrade/install/move a profile monitor, we should consider ease of optical measurement at the same time
- Options for optics measurements at the eIPM
 - Windings on the permanent magnet (used as a guide field for the electron)
 - Install an AGS steering dipole adjacent to IPM (as we did recently for the ion IPMs)
 - Install a thin quad in the same location

Things I did not talk about

- Laser profile monitor in LTB
 - (covered elsewhere in retreat)
- Heavy ion longitudinal emittance growth mysteries in the Booster
 - No really new information since Final Jeopardy (K. Smith-Trebek, Retreat 2012)
- Recent successes in optics measurements at, and calibrations of RHIC IPM
 - Optics covered elsewhere in retreat
 - Calibration a standing effort