Low vs. lower emittance lattices

L. Emery, M. Borland 9/18/02

Insertion Device Source Parameters	"Low" Emittance Lattice	"Lower" Emittance Lattice
Horizontal Emittance	3.5 nm-rad	2.5 nm-rad
Effective Horizontal Emittance $\sigma_X * \sigma_{X'}$	3.9 nm-rad	3.1 nm-rad
Peak On-Axis Brightness **(x 1e19) ph/s/mm^2/mrad^2/.1%BW**	3.1 @ 1.0% Coupling	4.1 @ 1.4% Coupling*
Lifetime @ 1% Coupling (measured)	9.4 Hours	8.3 Hours
Horizontal Beam Size σ_X	253 microns	274 microns
Contribution from Energy Spread	117 microns	162 microns
Horizontal Angular Divergence $\sigma_{X'}$	15.6 μrad	11.3 μrad

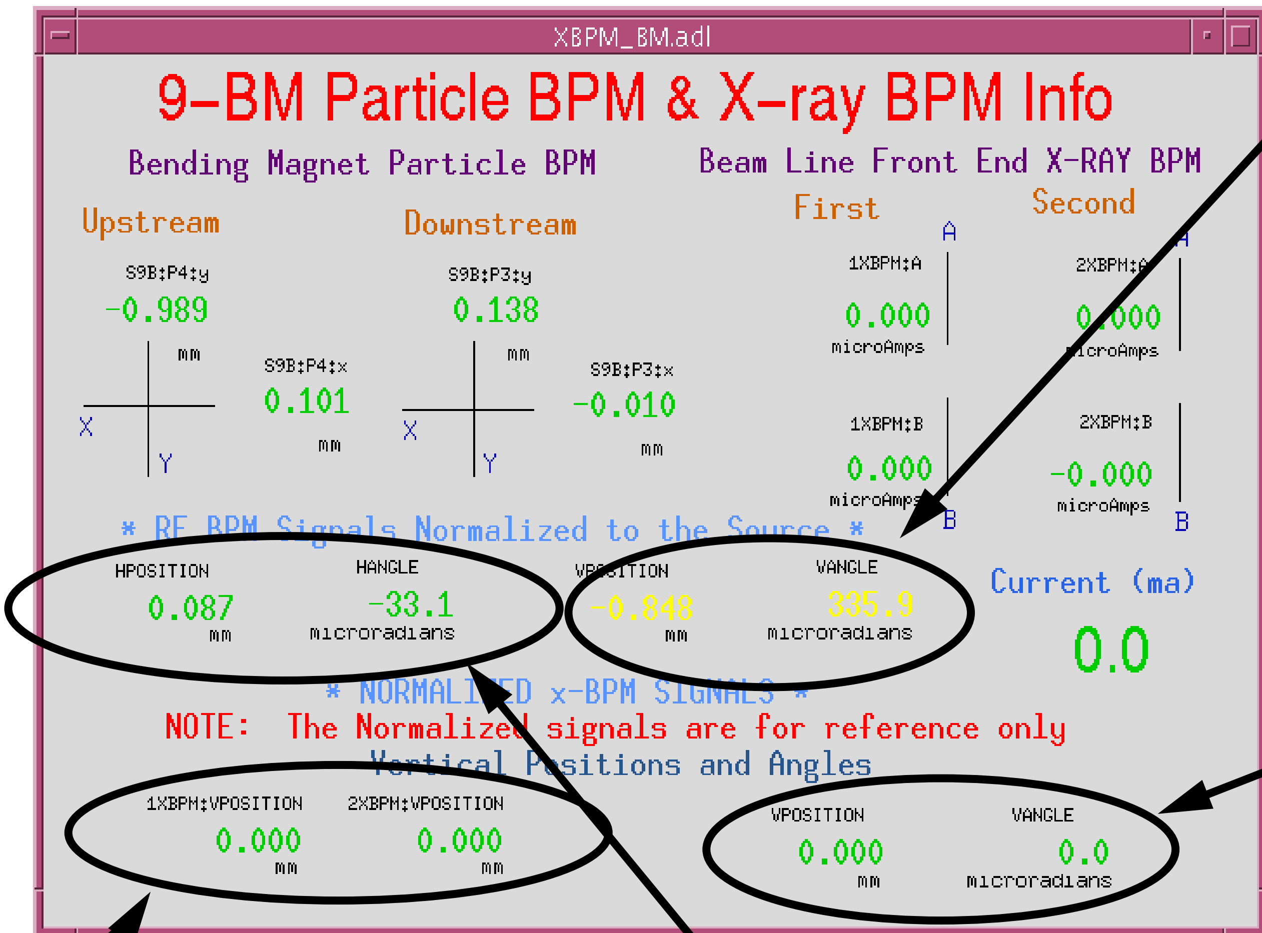
*: 1.4% coupling gives same vertical beam size in low vs. lower emittance lattice

Insertion Device Source Parameters	**“Low” Emittance Lattice**	**“Lower” Emittance Lattice**
Vertical Beam Size σ_y @ 1% Coupling	11.7 microns	8.5 microns
Vertical Angular Divergence $\sigma_{y'}$ @ 1% Coupling	3.0 μrad	2.9 μrad
Effect of gap closing on Horizontal emittance:	- 6 %	+- 3%

Bending Magnet Source Parameters (displaced / non-displaced)	**“Low” Emittance Lattice**	**“Lower” Emittance Lattice**
Horizontal Emittance	3.5 nm-rad	2.5 nm-rad
Effective Horizontal Emittance $\sigma_x * \sigma_{x'}$	6.7 / 6.8 nm-rad	5.1 / 5.0 nm-rad
Horizontal Beam Size σ_x	106.9 / 107.5 microns	91.4 / 88.4 microns
Horizontal Angular Divergence $\sigma_{x'}$	62.3 / 63.7 μrad	56.1 / 56.5 μrad
Vertical Beam Size σ_y @ 1% Coupling	26.9 / 27.1 microns	25.4 / 25.5 microns
Vertical Angular Divergence $\sigma_{y'}$ @ 1% Coupling	1.6 / 1.7 μrad	1.1 / 1.2 μrad

Bending Magnet Legacy PV's, or,

What I hate / don't hate about the legacy process variables / medm screens - G. Decker



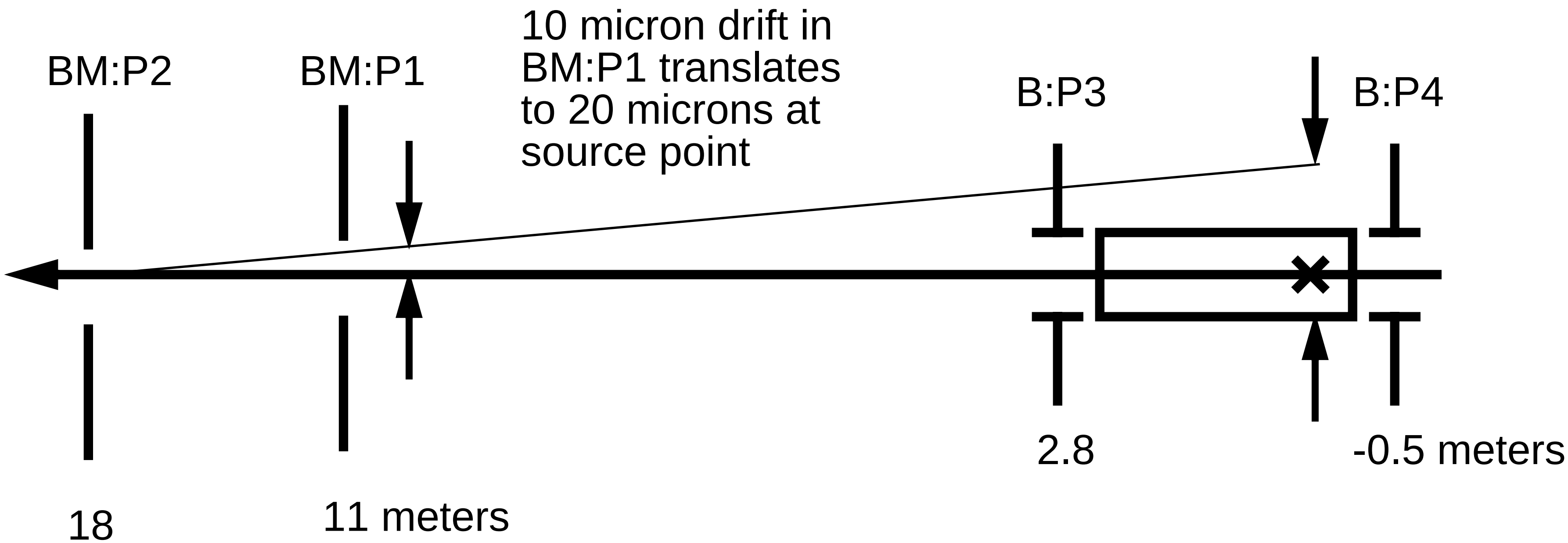
VAngle, VPosition derived from broadband (monopulse) RF beam position monitors.
These readbacks suffer from the rogue microwave disease - resulting in hypersensitivity to small fill pattern variations, viz. what happens every two minutes during top-up. The numbers are yellow to siginify suspect data. If you don't do top-up and only observe for short periods of time, like less than an hour, these are ok for beam position. Other than that, they are crap. The problem is with the vacuum chamber internal geometry, not the electronics.

VAngle, VPosition, derived from x-ray bpm's, _extrapolated_ back to the source point. VAngle is ok, but VPosition will enhance every little burp made by either x-bpm due to the extrapolation. I hate that.

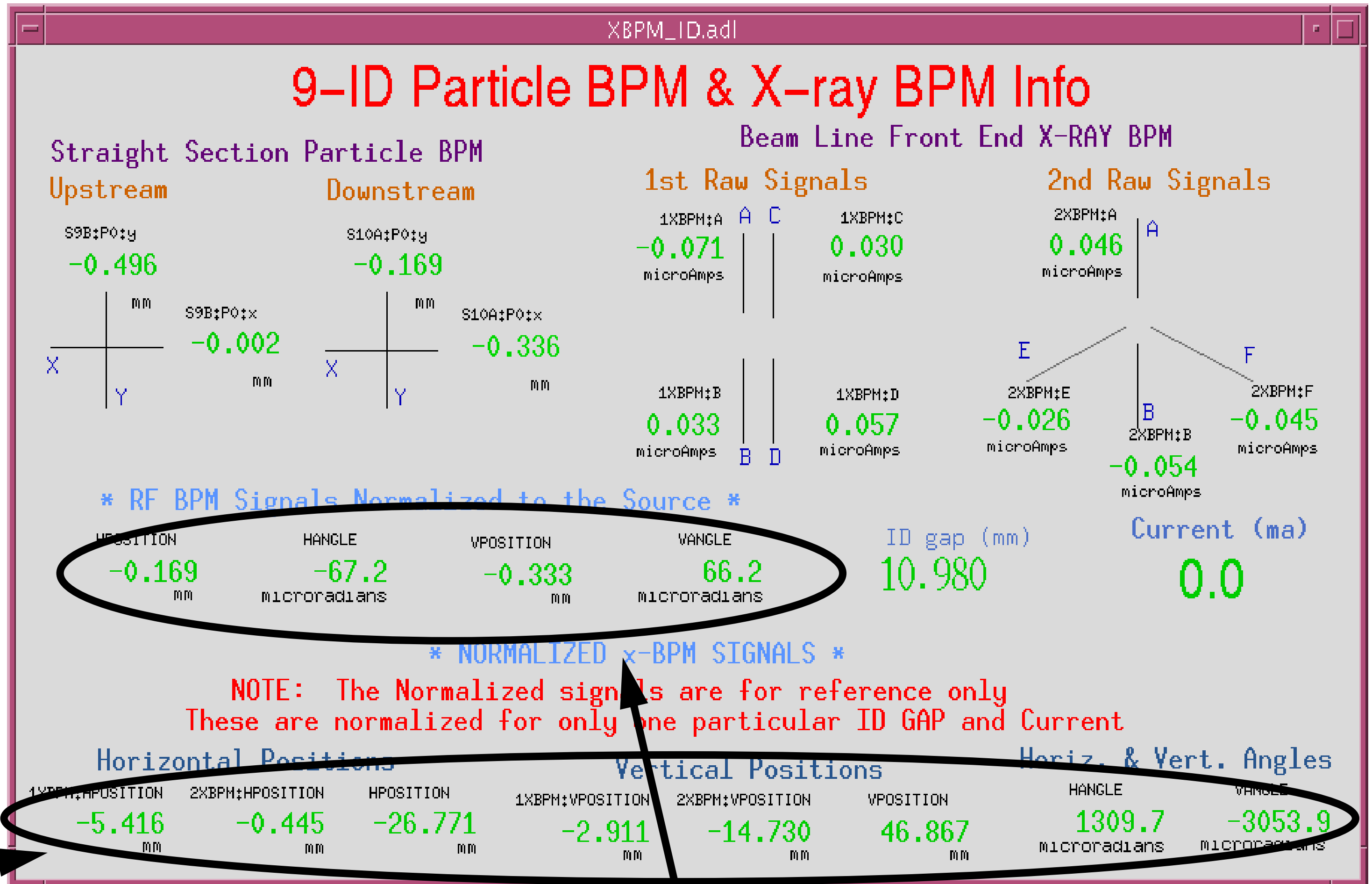
Front-end x-ray beam position monitor raw read-backs. Our most reliable diagnostic. Unfortunately, these PV names are archaic and better ones should be used.

HAngle, HPosition derived from broadband (monopulse) RF beam position monitors
The best available, however they are susceptible to bunch pattern dependence, i.e. every 52 minutes in top-up mode (1+22 Singlets) an artificial step occurs in the readings. Orbit correction fits a smooth curve through many bpm's (eleven per betatron wavelength), so the beam isn't doing this - really. I promise.

Extrapolation vs. Interpolation for defining source angle



Insertion Device BPM Legacy PV's



Insertion Device X-ray Beam Position Monitors: Very high resolution, very pathological systematic effects. Non-linear outside +- 0.5 mm, Feedforward required to compensate for gap dependent effects, useless for gaps larger than approx. 30 mm. My extrapolation comments also apply for the Position pv's.

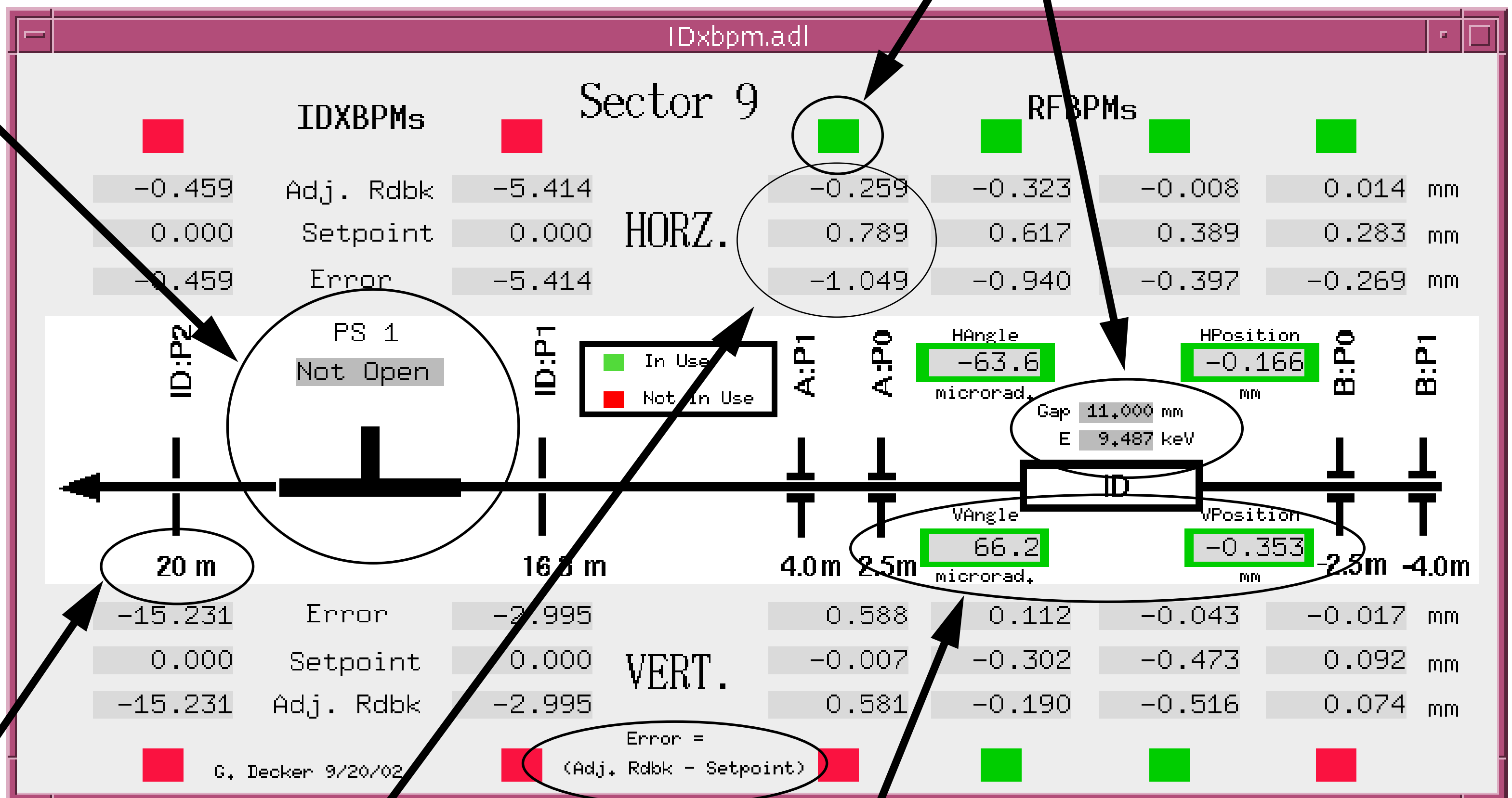
Source parameters derived from narrowband rf beam position monitors (P0's). These are actually pretty good. These have a 20 second time constant, and are downstream of the intensity-dependence offset compensation feedforward. That's good.

By Popular Demand, the following screen for insertion device beamlines meets most requirements that I have heard:

InUse status
(by orbit control algorithm)

Insertion Device Gap Status

Shutter Icon that moves when the shutter opens and closes!



Process variables that are actually used by the orbit correction algorithm! (Background turns red if the device is hopelessly broken)

Source position and angle pv's that I won't complain about defending! (Background turns yellow if something is fishy).

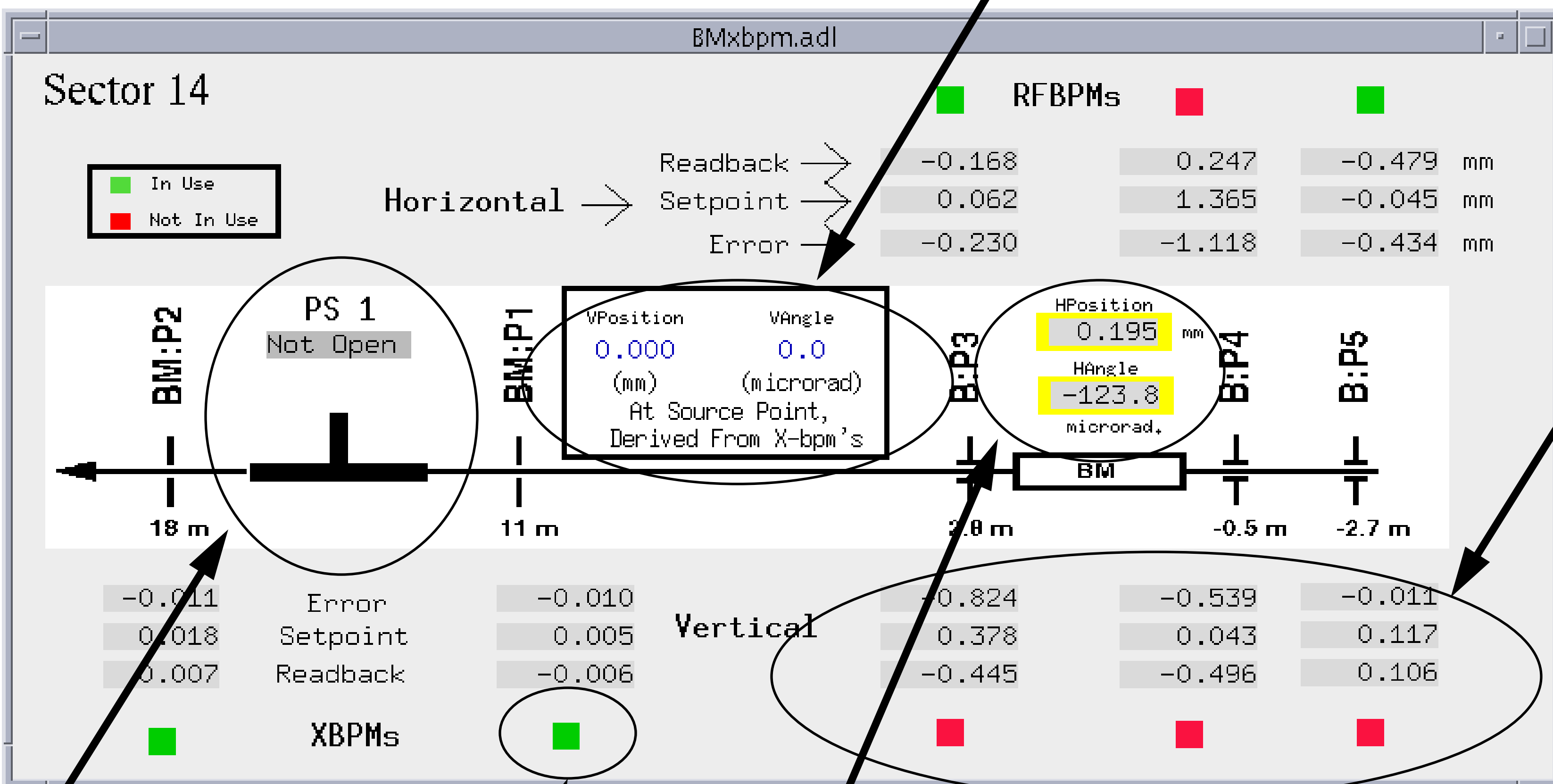
Distance from center of ID straight !

Equation explaining what those three numbers are !

Source code for the above plus other info avaiilable at http://www.aps.anl.gov/asd/diagnostics/xbpmDisplays/index.html

And, in addition, new screens for BM lines are also available:

Vertical Source Point Values
Extrapolated from BM x-bpm's



Flaky vertical
RF bpm
readbacks,
provided for
completeness

Shutter Status

InUse pv's make it
easy to figure out
what's going on here.

Horizontal Source Point Values
Interpolated from RF bpm readbacks
(It's yellow because S14B:P4:x is broken,
but it is a simple matter to use B:P5
for an estimate of angle changes).

Source code for the above plus other info avaiilable at http://www.aps.anl.gov/asd/diagnostics/xbpmDisplays/index.html