Polarization Related Beam Experiments for the AGS

H. Huang

December 5, 2008
APEX Workshop 2008

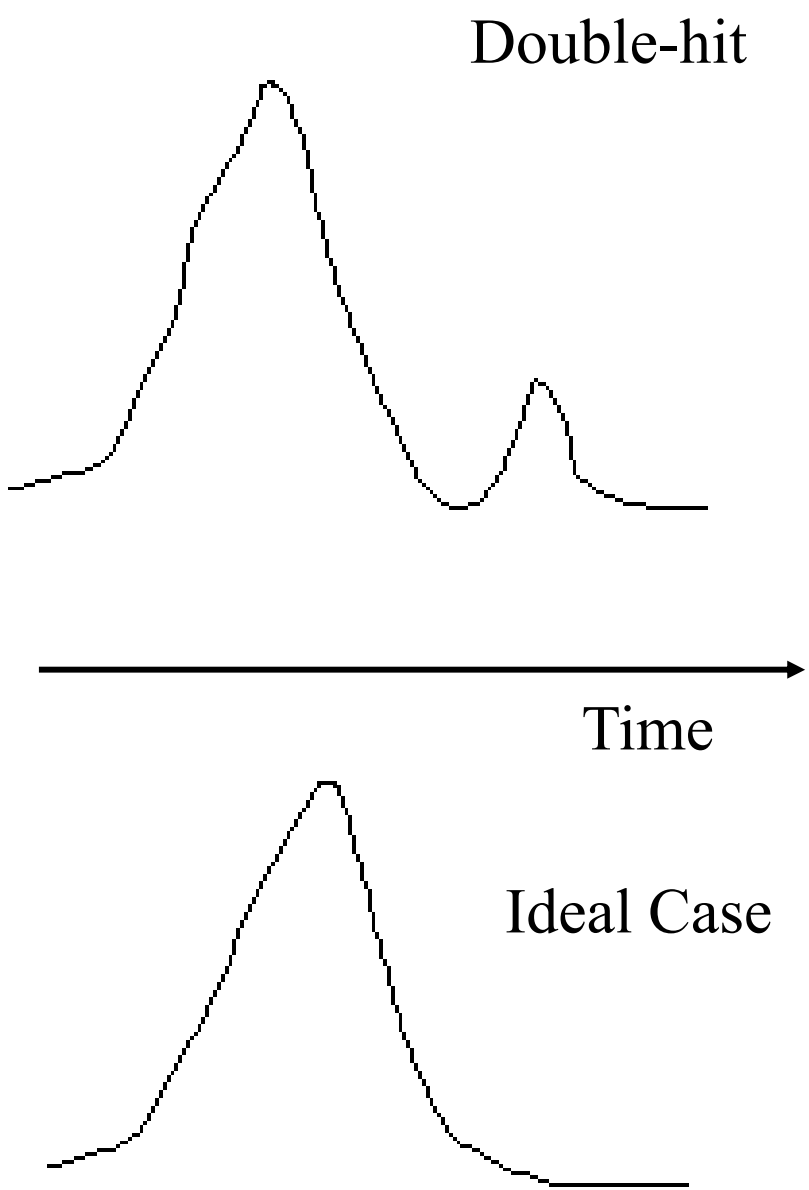
AGS PP Related Beam Expts. Listed in Run-8

- New CNI polarimeter detector test. (Boris)-> Did not happen, moving to RHIC now
- Rate dependence of polarimeter. (Haixin)->Didn't happen due to tight schedule
- Polarizations for each bunch with higher accuracy. (Haixin)-> Didn't happen due to tight schedule
- Manipulating β_x at snake entrances to reduce horizontal depolarizing resonance strength. Measure horizontal polarization profile with various settings. (Kevin) -> Some beam test last run, spinned off from this list.
- Spin echo experiment at low energy in the AGS. (Mei) Didn't happen, won't happen (hardware removed)

PP Related Beam Expts. For the Coming Run

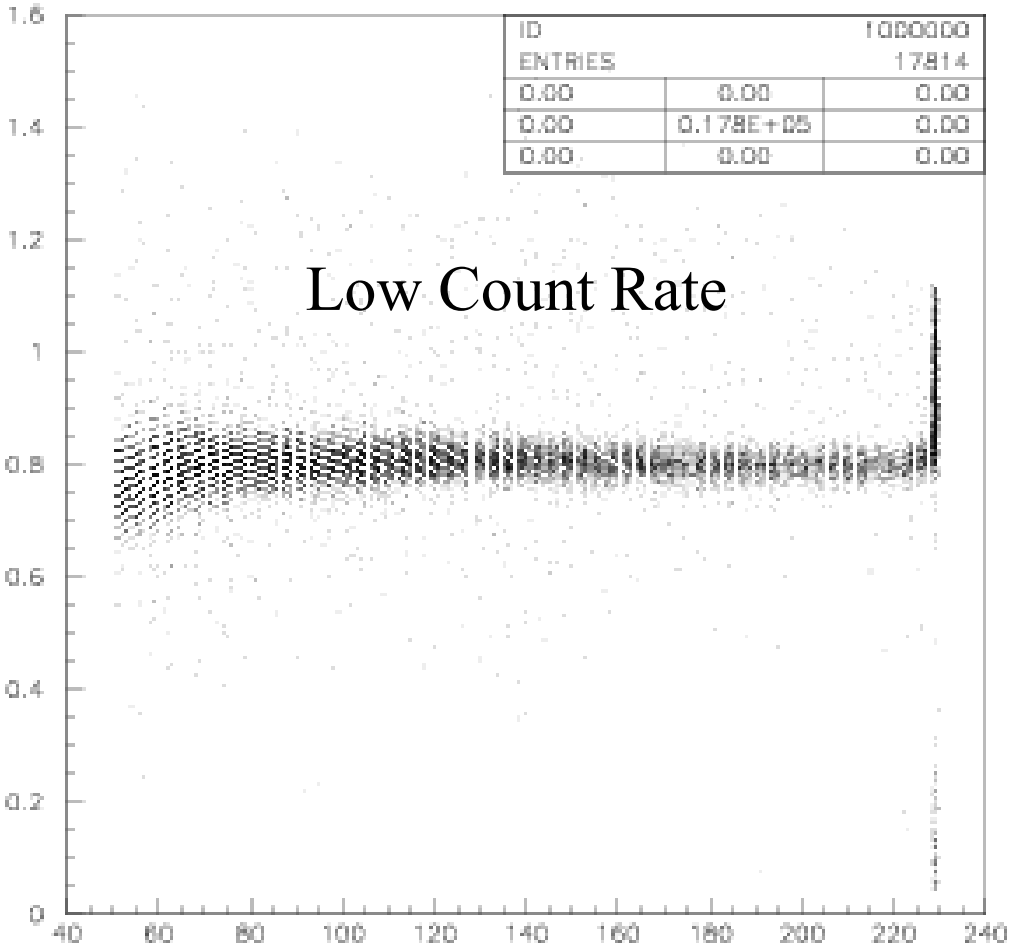
- Rate dependence of polarimeter.
- Polarizations for each bunch with higher accuracy.
- Ramp measurements have been used as tool of documentation to see how well we preserve polarization through ramp. It will be used more often (early on in the run) as diagnostic tool.
- Overcome horizontal resonances with tune jumps.
  - Test the tune jump at $G\gamma=7.5$
  - Test tune jump with tunemeter kicker on at later half of the ramp.

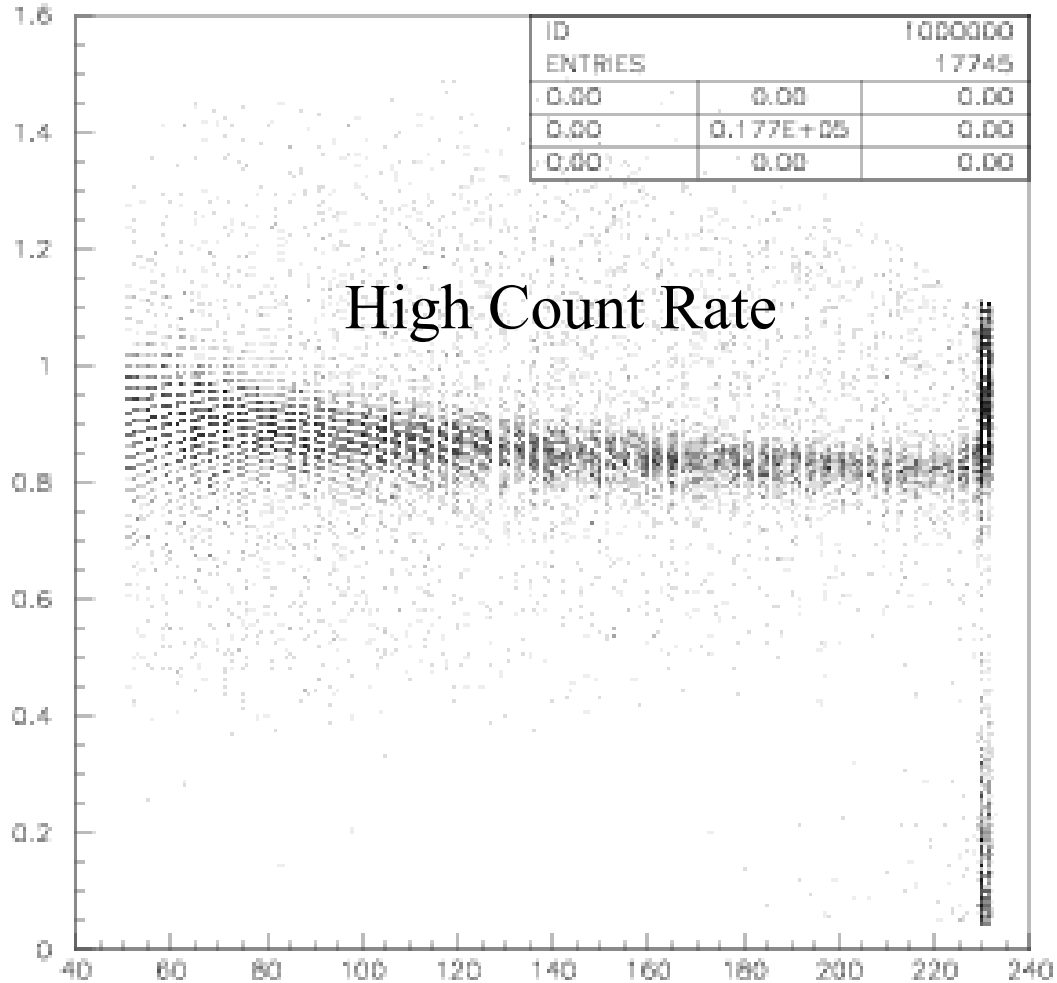
Double-hit in Si Detectors



- The waveform is digitized, the ToF and energy of each event is recorded.
- Double hit (two events in one detector strip for each bunch crossing) is always a concern for high rate. It can change the measured asymmetries.
- Double-hit can be detected by comparing the pulse amplitude and integration.

I/A Ratio vs. Amplitude (Energy)





- Initial test in run6 for $2*10^{11}$ intensity with 250μm and 600μm targets, respectively.
- The ratio is constant for low rate, but not for the high rate.
- Two possible problems with high count rate: double hit and baseline calculation.

AGS CNI Polarimeter Rate Dependence

- The past data already shown that 600μm Carbon target can cause rate problem with intensity higher than $1.5*10^{11}$.
- This study is aimed to further quantify the effect.
- Measure polarization for the same beam using targets with different width.
- Measure polarization with two targets for various intensities (intensity scan).
- We have currently targets with three widths: 600μm, 250μm and 125μm.

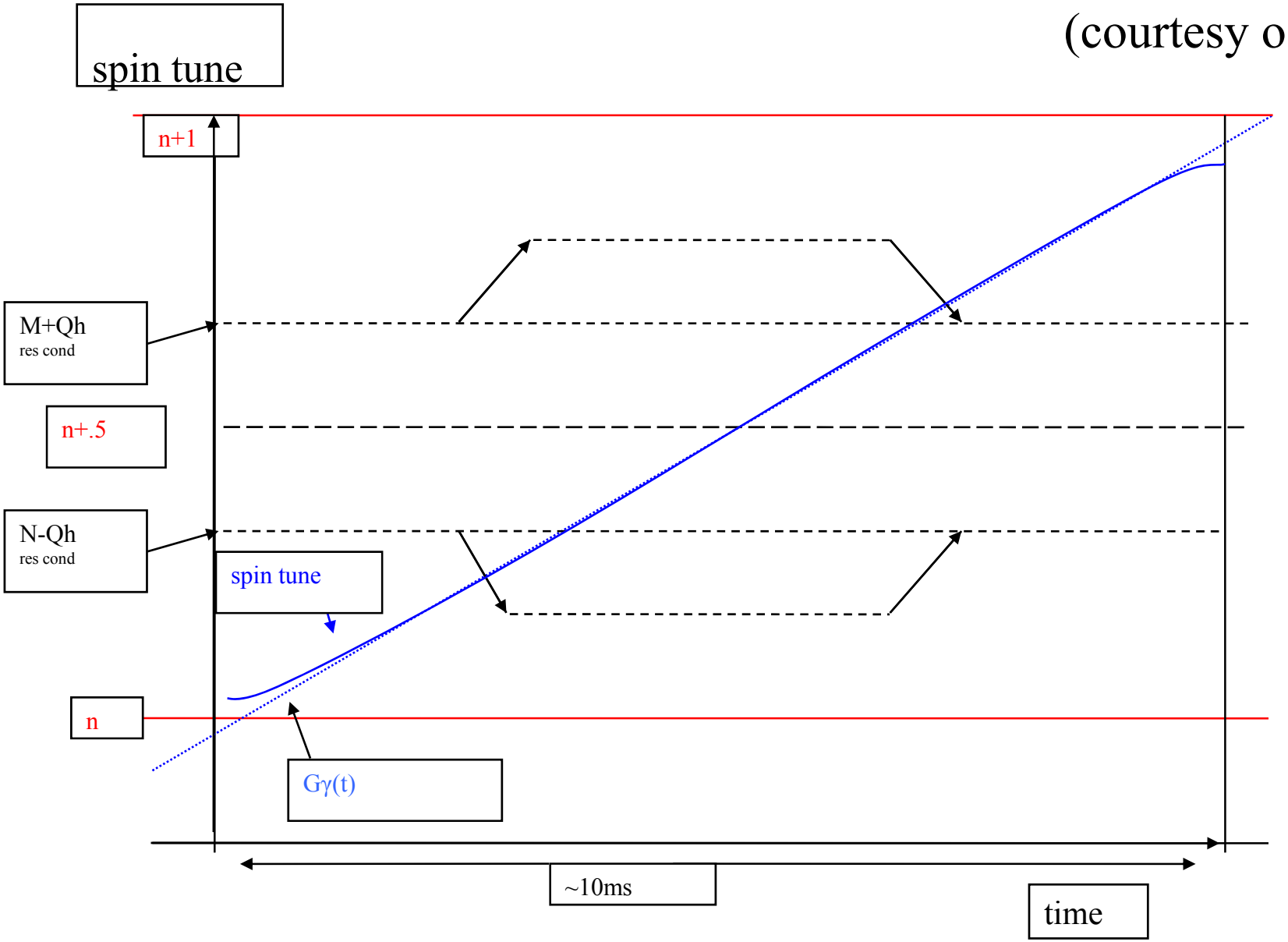
Tune Jump for Horizontal Resonances

- Two fast quads will be installed at I5 and J5 sections.
- Change of ν_x 0.04 in about 100 μs. This increases the crossing speed by about 4 times.
- Operation issue: has to be dead-reckoning of timing. For practical operation, we need to maintain the horizontal tune and radius constant throughout the ramp.
- Benefit on polarization transfer efficiency (horizontal 15π beam):

Crossing speed	P_f/P_i(peak)	P_f/P_i(whole)
regular speed	0.912	0.832
Double speed	0.955	0.912
4X speed	0.977	0.955

Horizontal Tune Jump

(courtesy of Leif)

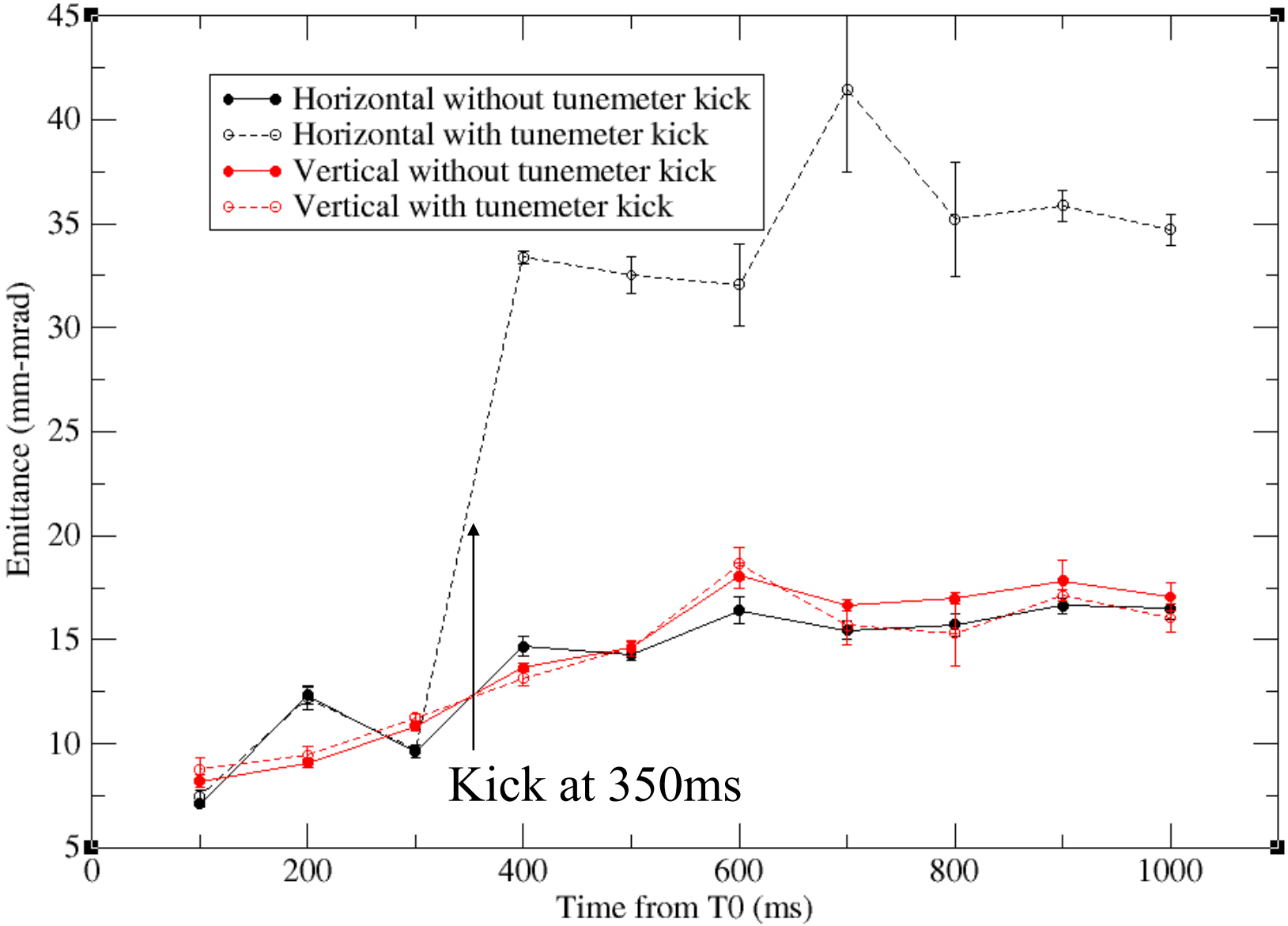


The two resonances between two integers of Gγ will be "paired": the tune is jumped up then down.

Proof of Principle of Horizontal Tune Jump

- The overall effect is about 10+% for the whole ramp with nominal horizontal emittance. A direct way to measure the effect is to measure horizontal polarization profiles for the two cases (with and without jumps). But it is a lengthy measurement.
- Test the effect at a lower energy flattop such as $G\gamma=7.5$. The early part of polarization loss is quite large (~4% from modeling of early horizontal resonances) and the asymmetry is larger (~ five times) which makes a 4% difference measurable.
- The effect can also be enhanced if we can blow up only horizontal emittance. It has been demonstrated that this can be done with tune meter kicker on Mar.4, 2006. However, this probably can not be applied to early part of the ramp due to aperture limitation.
- We can scan some parameters:
  - Shift timing of the tune jump all together.
  - Scan tune jump amplitude (limited range: total of 0.04)

AGS Emittances along the Ramp



Data was taken on March 4, 2006 (Fanglei/Leif). The motion can be limited to horizontal plane only.

How Practical Is the Test?

- There was a series polarization measurements (four of each) with tune meter kick on/off in run6.
- There was a measurable effect: 54.7+-1.2% vs. 48.1+-1.4%. The polarization ratio (off vs. on): 1.14+-0.04
- A quick estimation from simple model with 31 π vs. 15π after 350ms (or $G\gamma$=26.5): 1.08. There could be additional polarization loss from coupling resonances which are not included in the simple model.
- A carefully planned study with enlarged horizontal emittances should be doable.