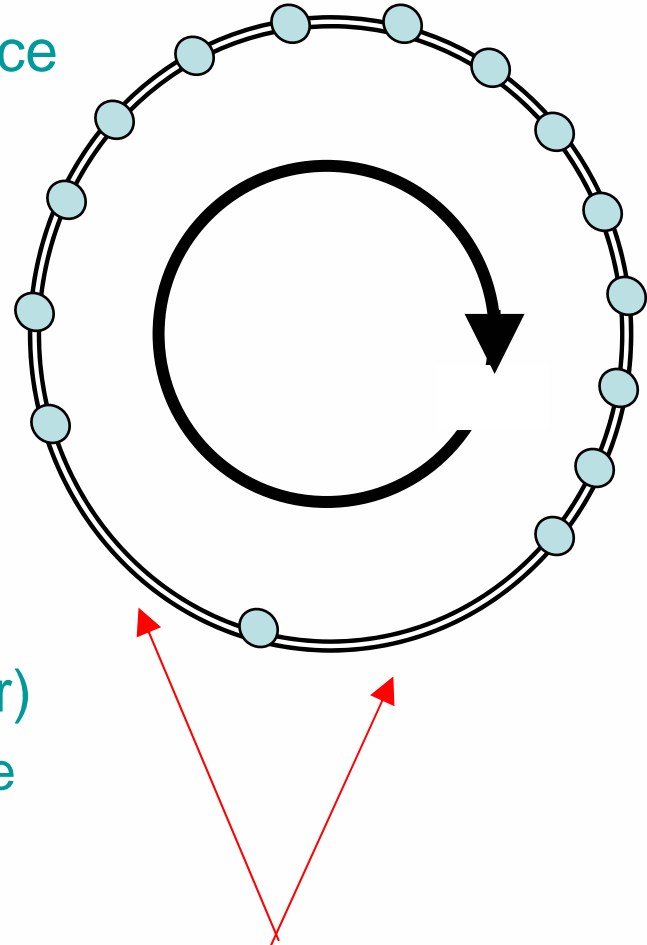- **Bunches**
  - Can fill up to 328 bunches space 2 ns apart

- **Fill patterns**
  - Multibunch mode
    - Train of 276 filled with a gap
    - Train of 276 filled with an isolated (camshaft) bunch
  - 2-bunch mode (4 weeks a year)
    - 2-bunches spaced on opposite sides of the ring

- **Bunch Purification (Cleaning)**
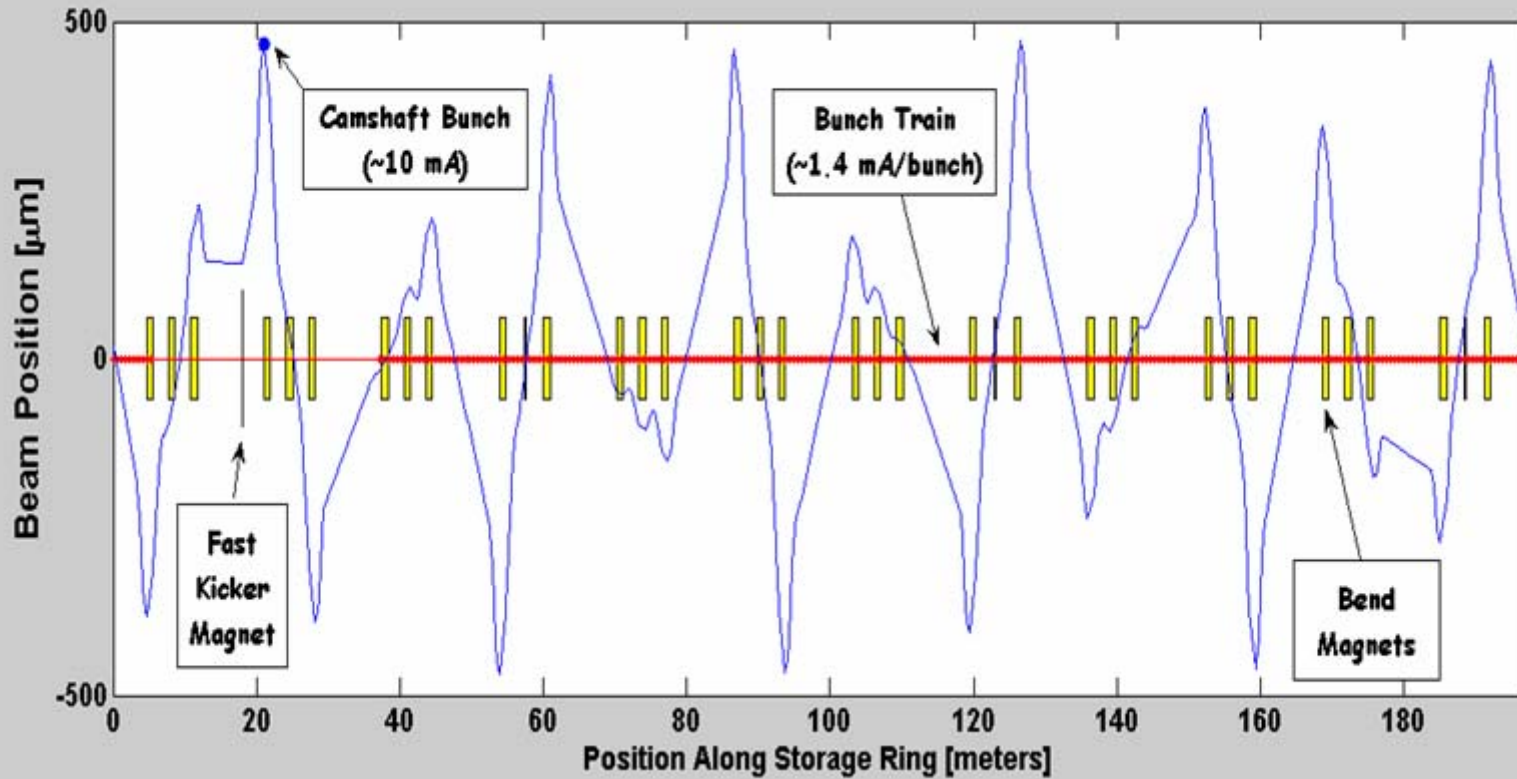 - Removing current in the unwanted bunches

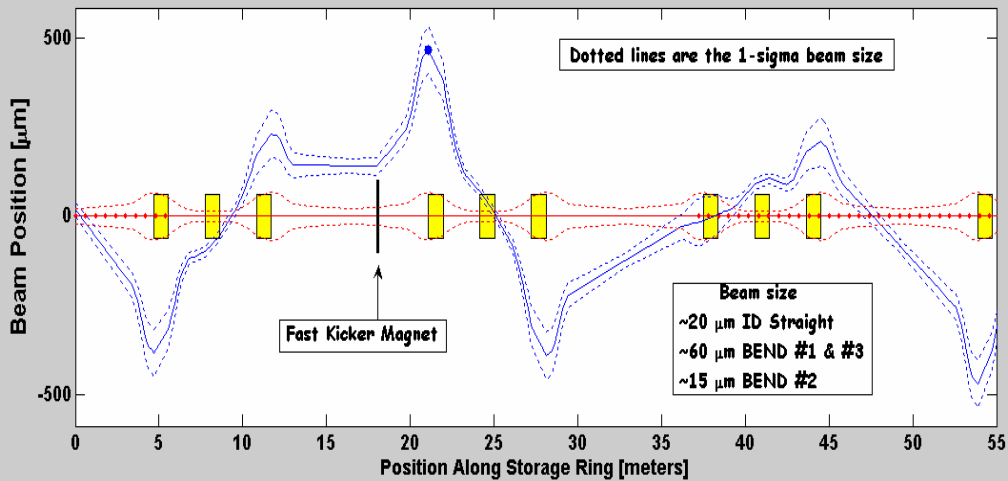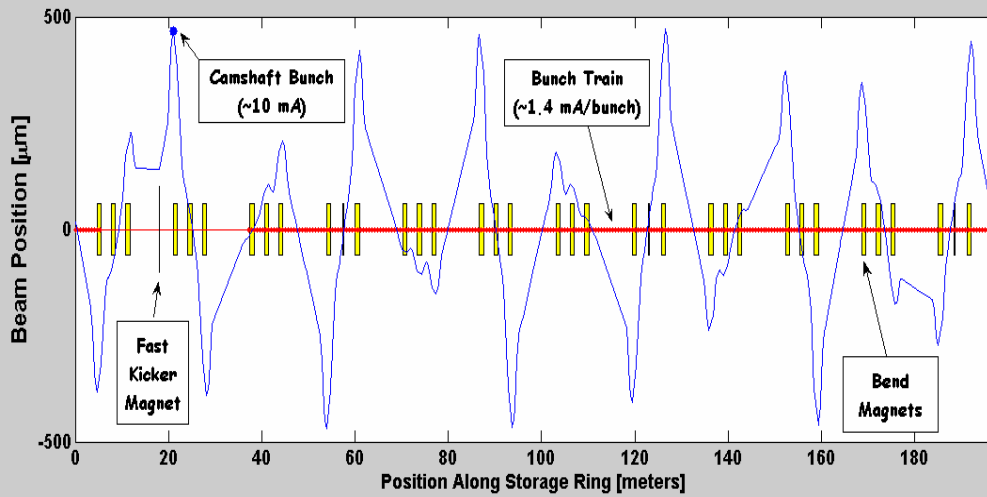# A New Operational Mode: Flexible Bunch Frequencies

Janos Kirz, Greg Portmann and S. Kwiatkowski
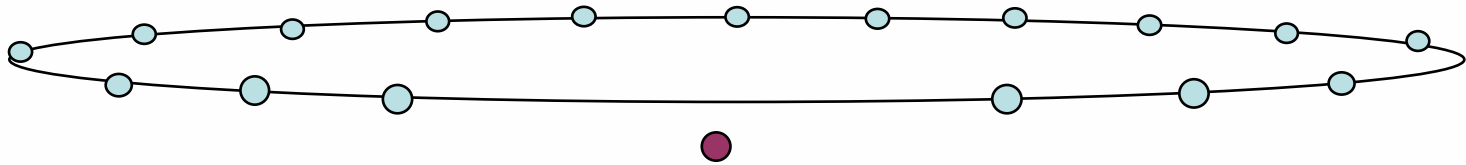
**By vertically kicking only the camshaft bunch,
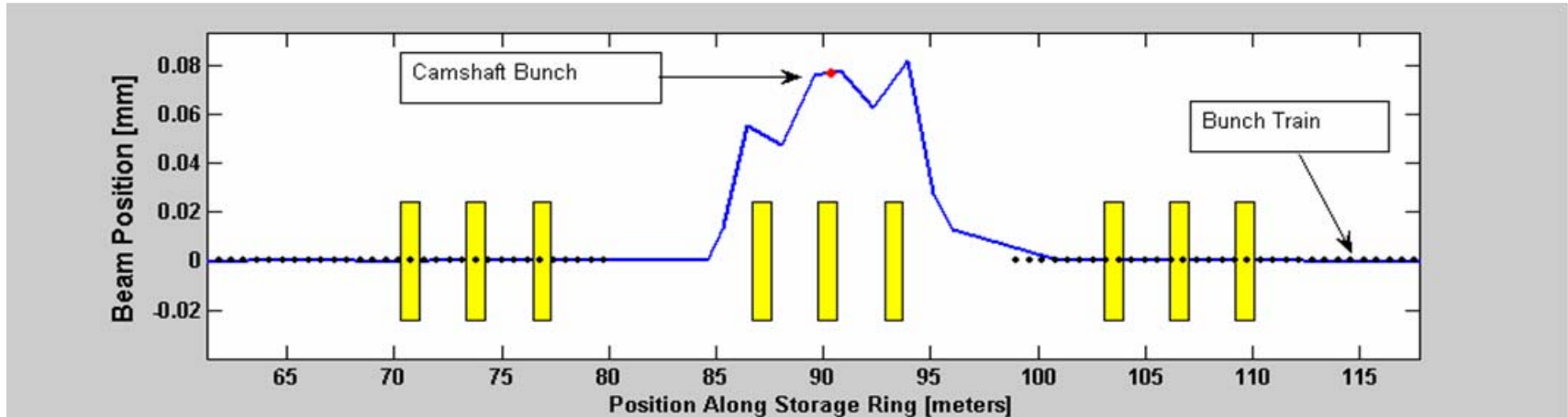a pseudo single bunch operation could be obtained.**

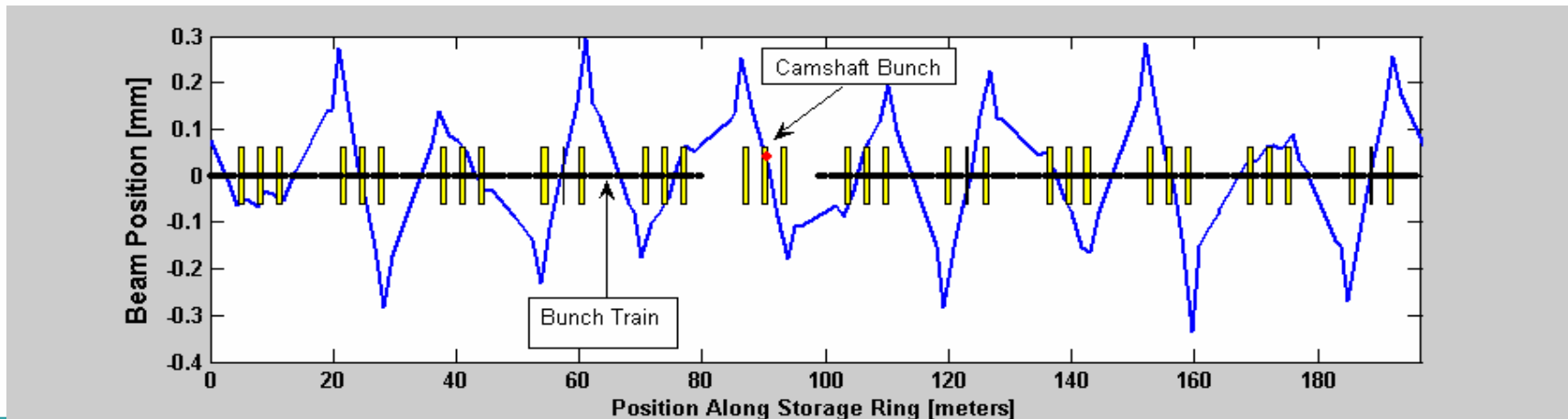**Global Orbit Displacement Using One Kicker Magnet**
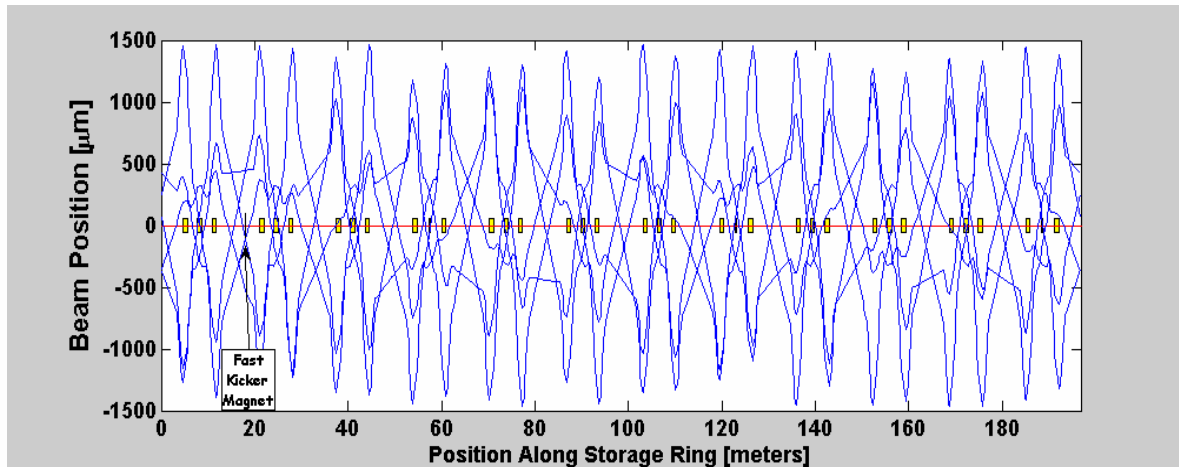
First 3 Sectors.

Possible Operational Modes

Local Bump using Multiple Kick Magnets – Variable Single Bunch Frequency

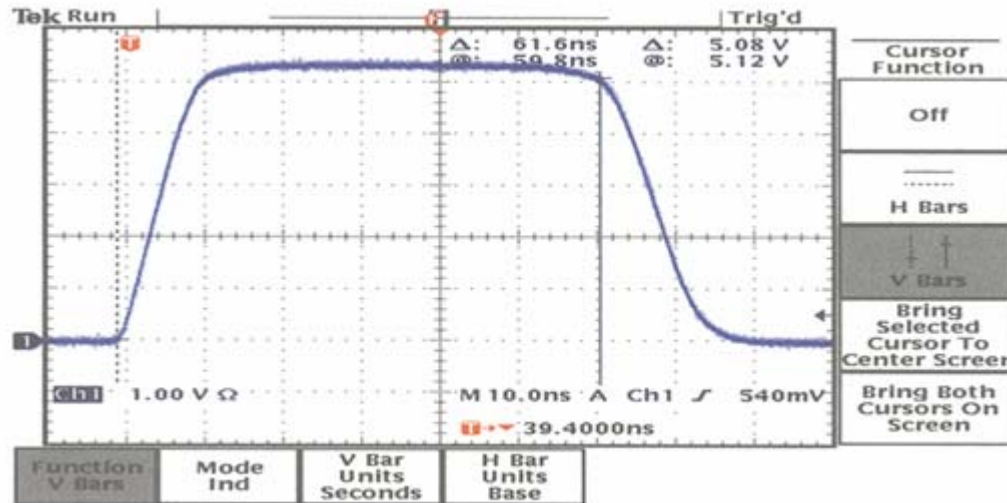## Single Kick Magnets – 1.5 MHz Single Bunch Frequency (30 µradian kick)

Advantages of sampling different phases and increasing the amplitude

Kick Every Fifth Turn.

- **Constructed and tested a fast pulser for a magnet**

- **Plan to install a magnet in the storage ring in the next year**

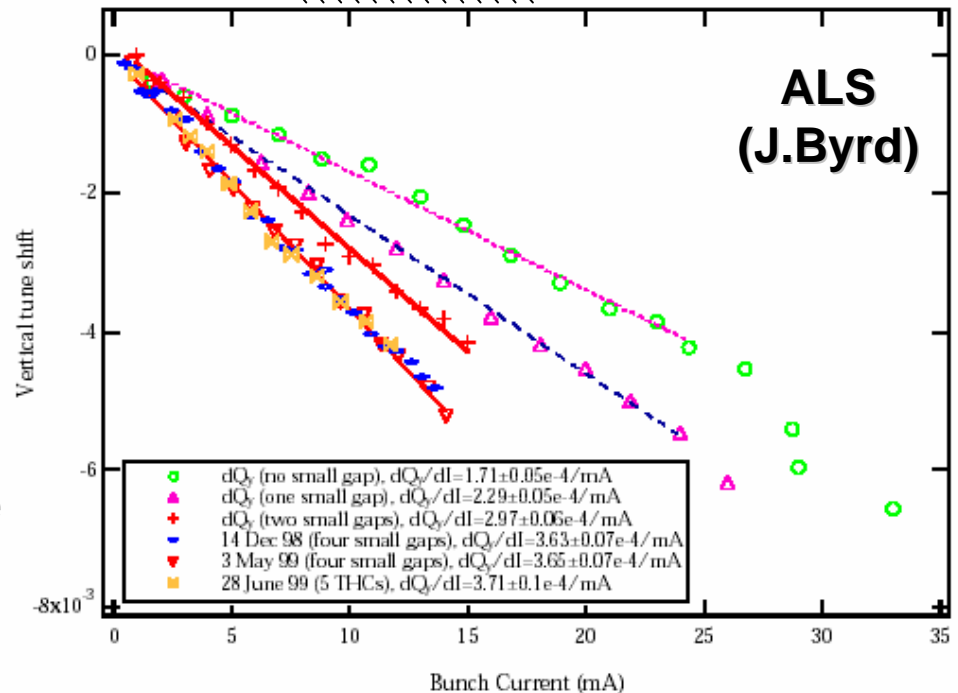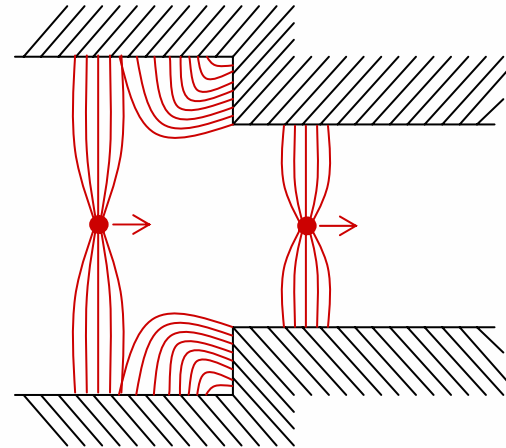 - **Test the impact on the beam and on the experiments**

This cleaning technique exploits the tune shift on current

Vacuum chamber wakes create current dependent (de)focusing fields that change the betatron tunes

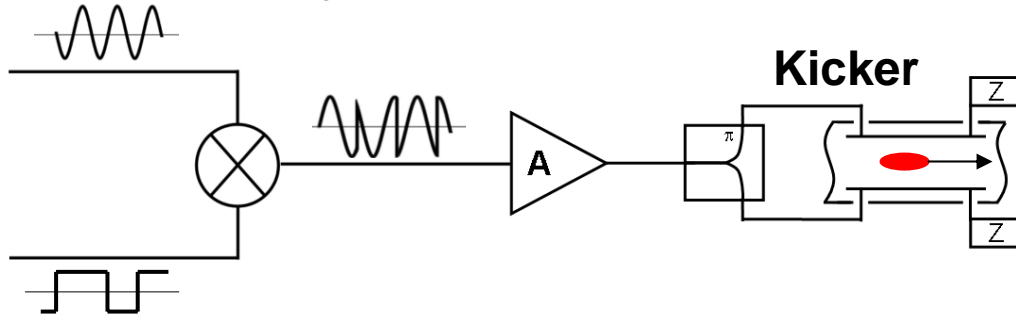**Low current bunches present a tune significantly different from the high current ones ~ 10 kHz.**

**By exciting the beam at the low current bunches tune, these will undergo to bigger oscillation than the large current ones.
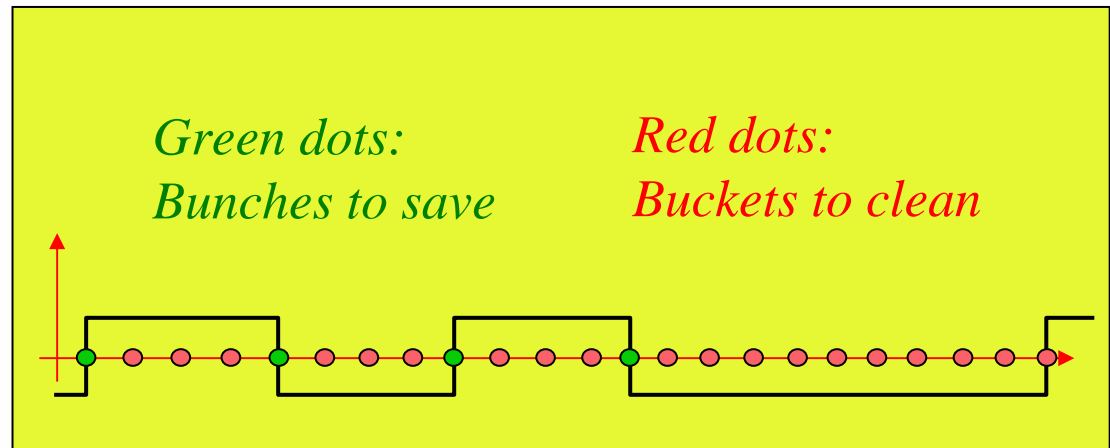By inserting a scraper is possible to perform the cleaning.**
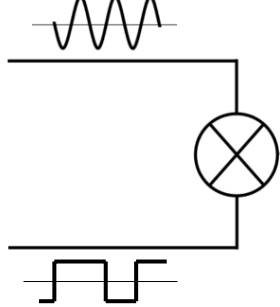

ALS (J.Byrd)

Sinusoid at Vertical Betatron Frequency

Kicker

Pseudo-square wave

Green dots:
Bunches to save

Red dots:
Buckets to clean

H. Suzuki, *et al*., NIM A **444** (2000) 515-533.

Existing Sinusoidal Generator
300 kHz – 10 mW

Existing Transverse
Feedback (TF) Kicker (Stripline Type)

No scraper required!
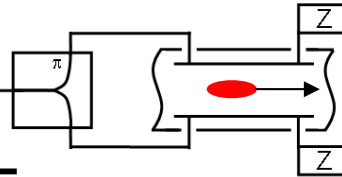
Existing TF Amplifier ~ 150 W 250 MHz BW

New FPGA General Purpose Board ~ 500 MHz BW
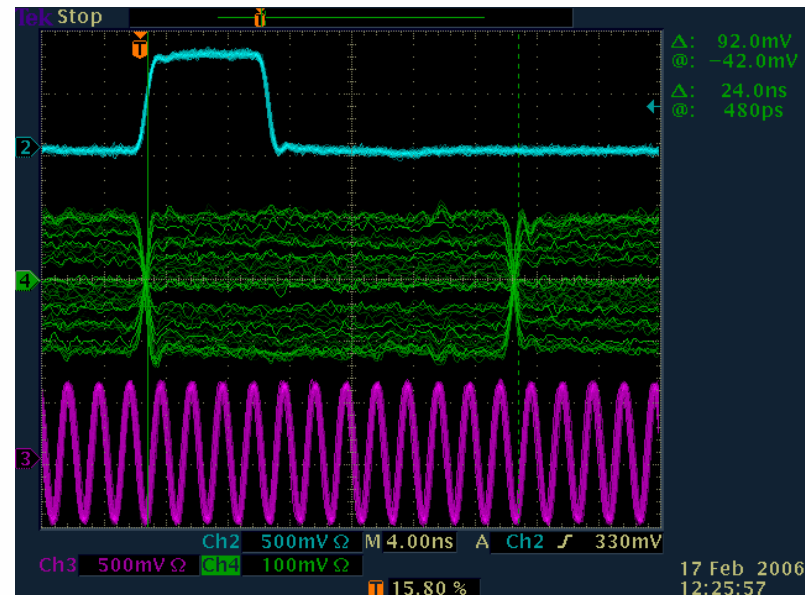
Multi-purpose board (W. Barry, M. Chin, J. Weber):
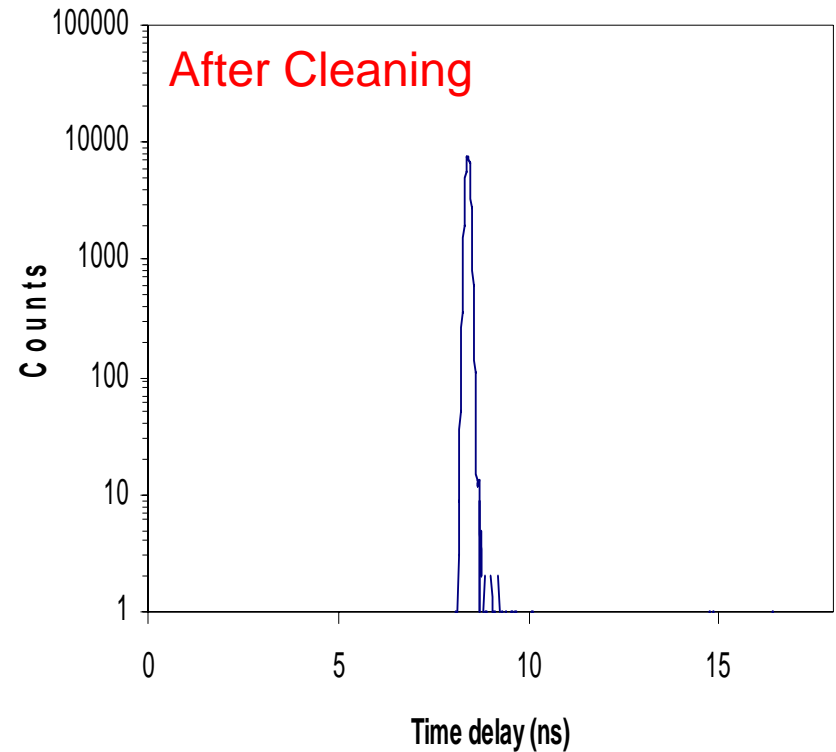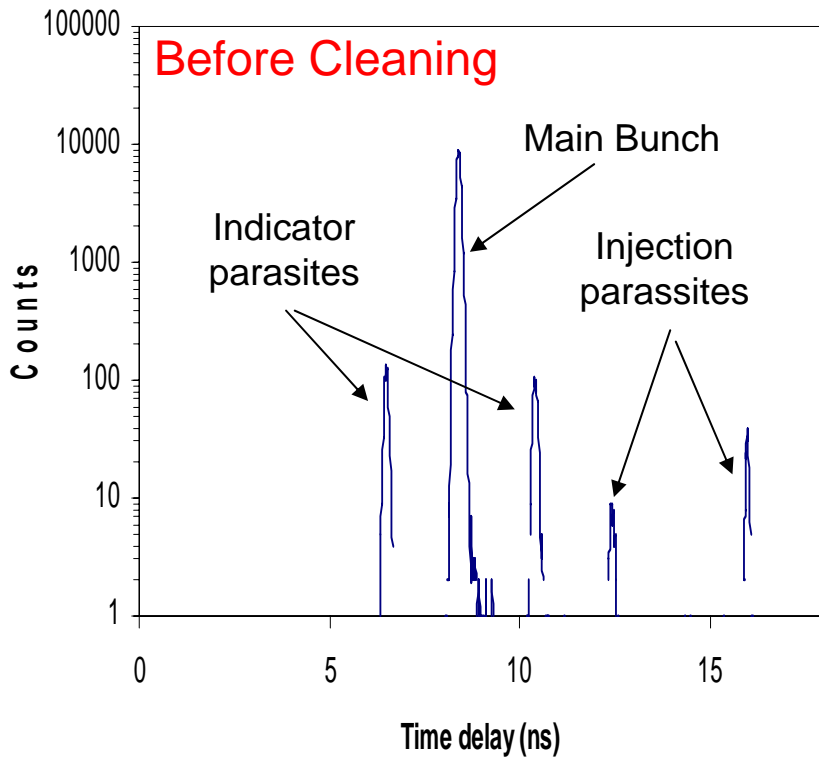- **B-Factory transverse feedback**
- **ALS Control System CPUs**
- **Arbitrary function generator**
- **…**

Very large bandwidth, no timing drift, very reliable, easy to program, …

Existing purity monitor resolution ~ 10^{-3}

**Example of high resolution purity measurement: BL 7.0
(Anton Trensim, Jinghua Guo, Chao-Wen Chiu)**

Comparison between the techniques

	Old Technique	New Technique (NT)	Preference
Purity	Better than 10^{-4}	Better than 10^{-4}	-
Cleaning time	~ 200 s	<60 s Maybe ~ ms	NT
Scraper position	1 mm from the beam	No scraper use required.	NT
Impact on beam lifetime	Severe	None	NT
Transparency to users	Very poor	Seems OK for most 2 bunch users. To be verified with camshaft users.	NT
Top-off compatibility	No	Yes, if fully transparent to users. If not can be used in the booster.	NT
Effective against diffusion	None	Very effective. If not transparent, gating required.	NT
Two bunch run reliability	Sometimes dumps the beam	Impossible to dump the beam.	NT
ALS Operators happiness	Poor	Very high	NT