



Instrumentation  
Technologies

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# Single Pass Position Measurements

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Libera **WORKSHOP**  
2007

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# Outline

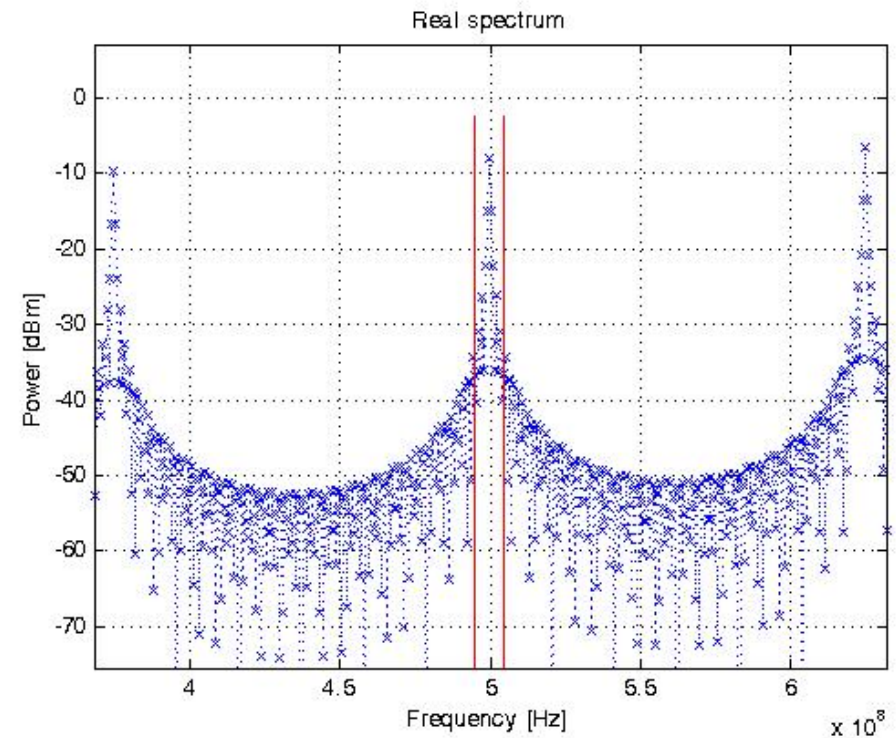
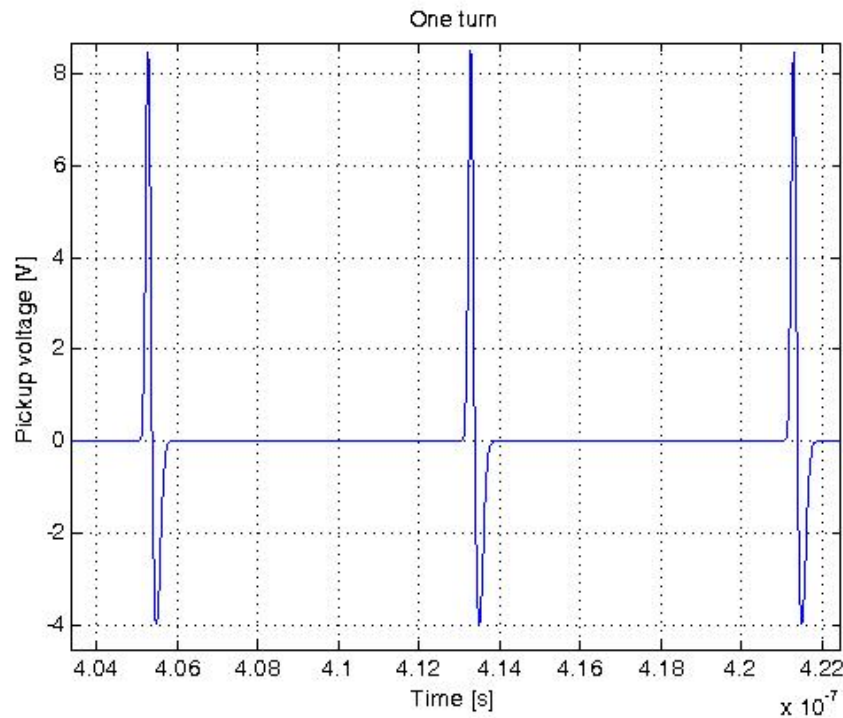
- **General single pass measurement concepts**
- **Single pass pickup review**
- **Single pass measuring concepts for FELs**
- **Requirements and preliminary results**
- **LANSCÉ BPPM system**



# General Concepts, 1

## 1) CW position measurement:

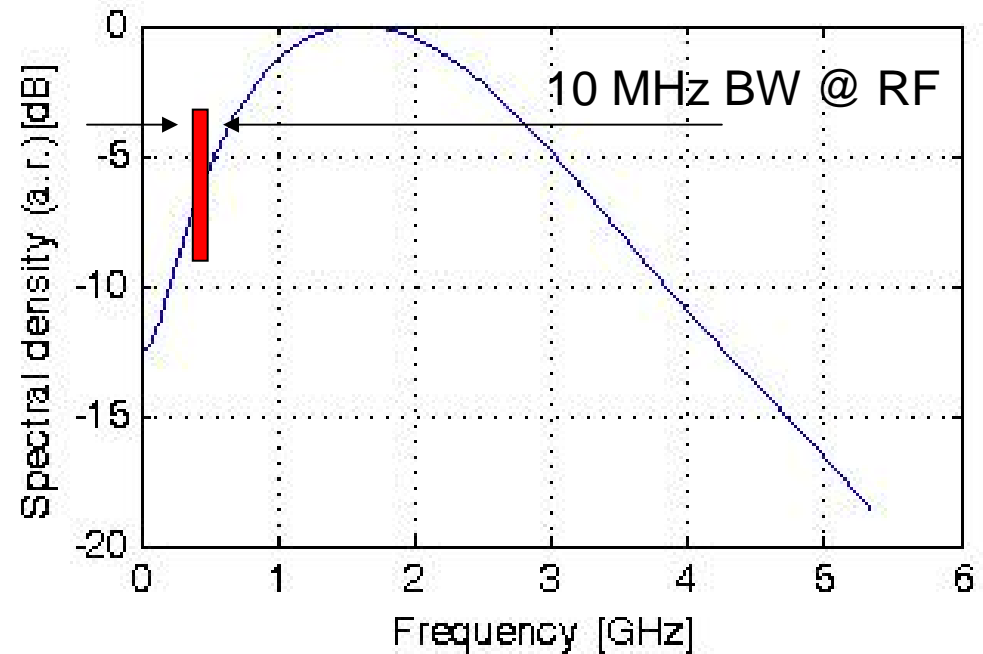
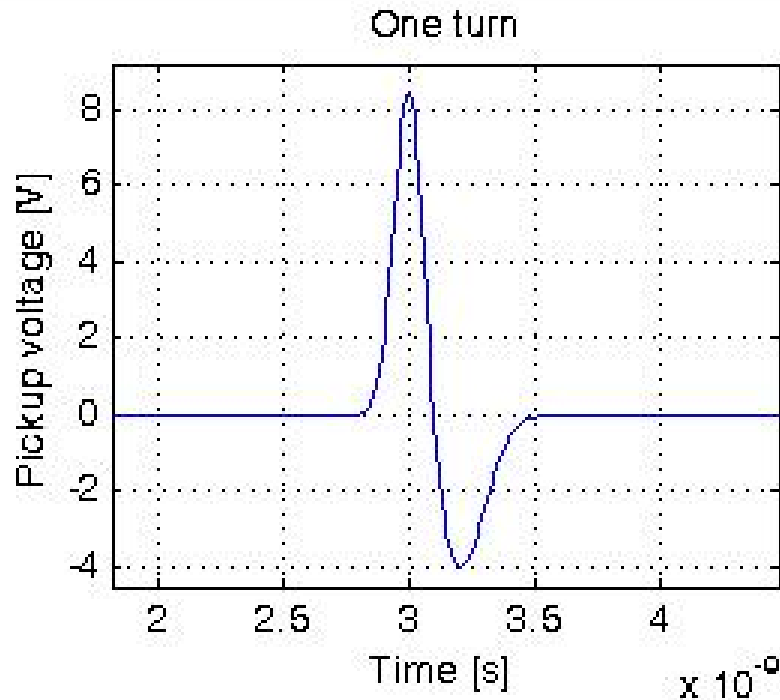
- circular machines
- fast repetition rates (100 kHz – 600 MHz)



# General Concepts, 2

## 2) Single pass position measurement:

- linear machines, transfer lines
- slow pulse repetition rates (10 Hz – 5 MHz)



# Single Pass Pickup Review, 1

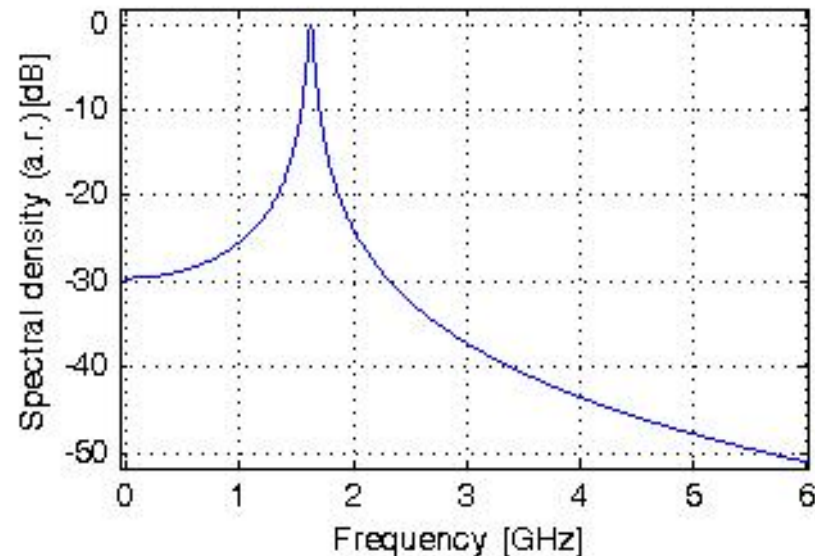
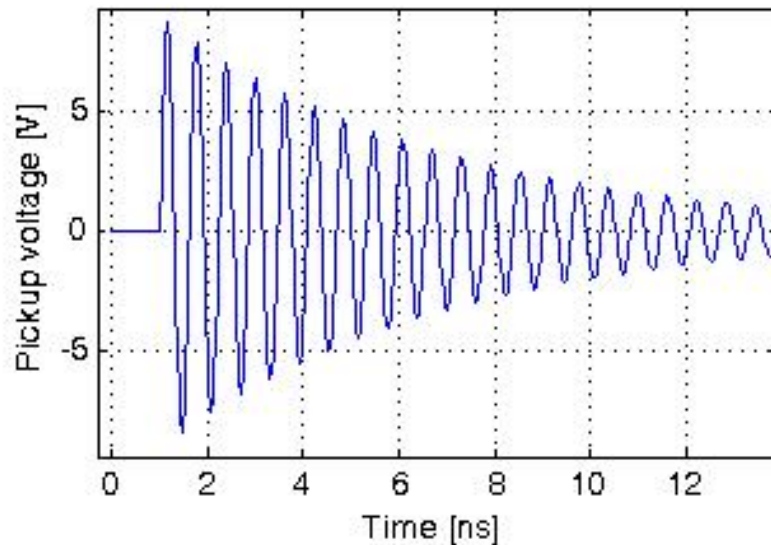
## 1) Resonant stripline BPMs:

(XFEL)

**$f_0 = 1625$  MHz**

**BW = 54 MHz**

$$x = k \frac{V_c - V_a}{V_c + V_a}$$



# Single Pass Pickup Review, 2

## 2) Cavity BPMs: (Fermi FEL)

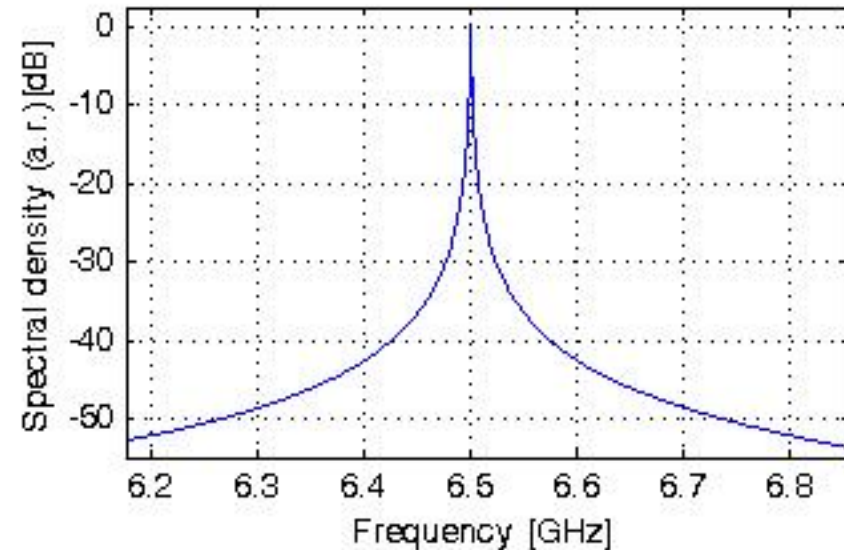
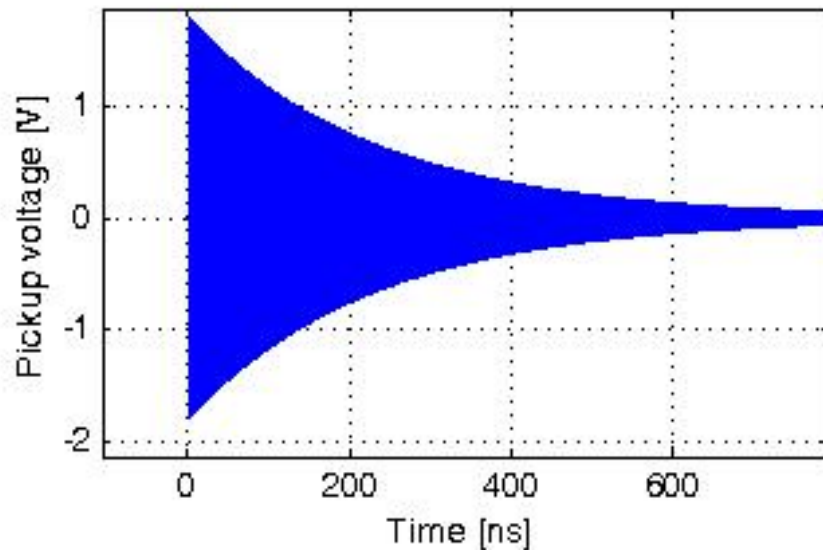
**fo** = 6500 MHz

**BW** = 1.4 MHz

$$x = k \frac{V_{dip}}{V_{mon}}$$

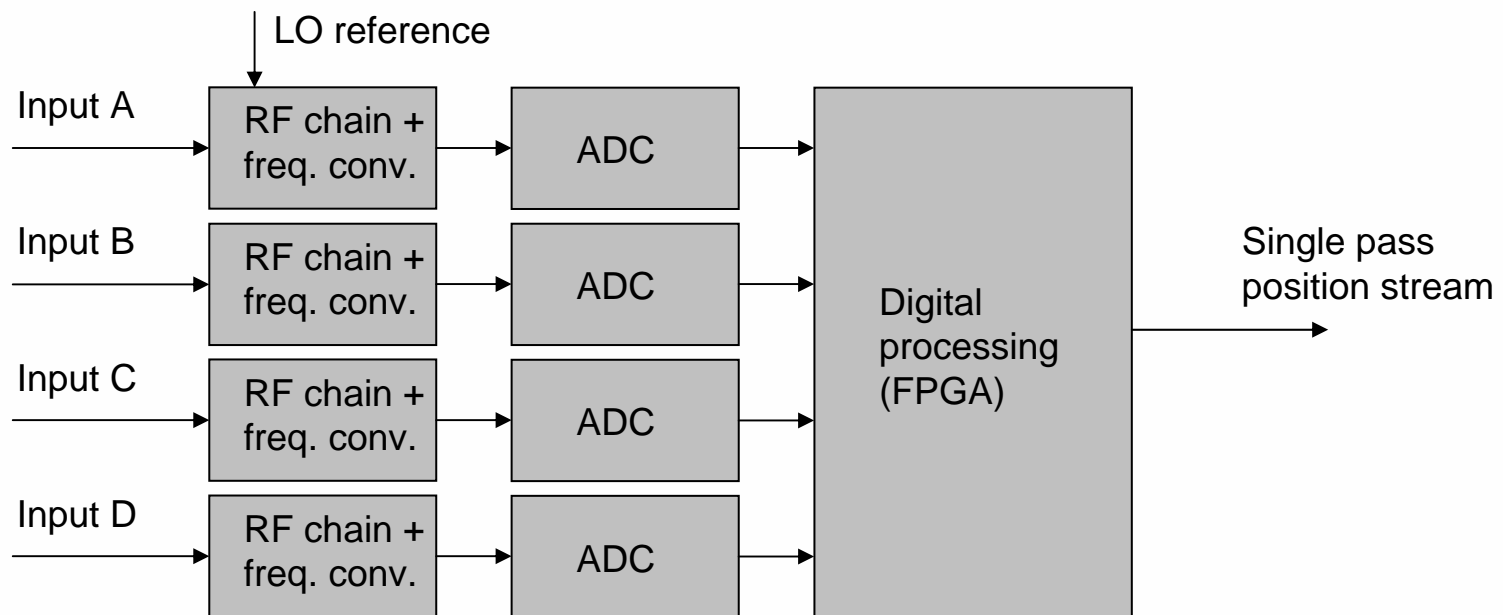
$$V_{dip} \propto qx$$

$$V_{mon} \propto q$$



# Measuring Concepts for FELs, 1

**The pulses are converted to intermediate frequency by means of analog RF chains, then are digitized and processed by the FPGA.**





# Measuring Concepts for FELs, 2

## Features:

- **Low phase noise tunable local oscillators are used to compensate resonant pickup frequency drifts.**
- **Frequency corrections are computed in real time and applied before next pulse arrival.**
- **Temperature drifts in electronics are compensated by means of pilot tone signal.**





# Requirements and Preliminary Results

## Fermi FEL:

**pickup type:** Cavity BPM 6.5 GHz  
**rep. rate:** 10-50 Hz  
**bunch charge:** 100 pC-1nC

**Resolution requirement:**  $< 1 \mu\text{m}$

**Foreseen resolution:** 300 nm

# Requirements and preliminary results

## **XFEL (IBFB):**

**pickup type: resonant stripline BPM 1.6 GHz**

**rep. rate: 5 MHz**

**time resolution: 200 ns**

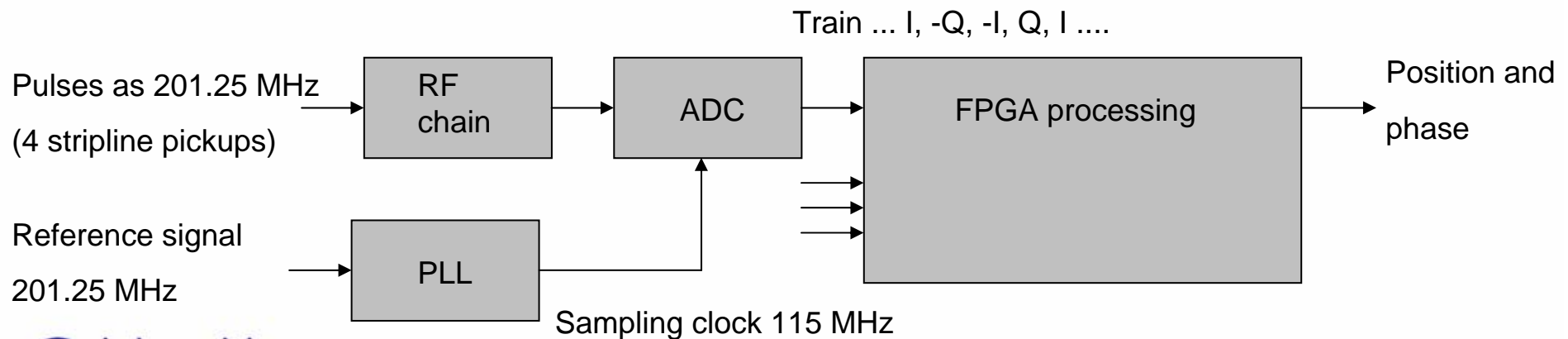
**Resolution requirement:  $< 1 \mu\text{m}$**

**Foreseen resolution: 700 nm**

# LANSCCE LINAC BPPM System, 1

## BPPM (Beam Position and Phase Monitor)

**Repetition rate:** 201.25 MHz  
**External reference:** 201.25 MHz  
**Signal range:** 56 dB  
**Phase repeatability requirement:** 0.25 deg



# LANSCE LINAC BPPM System, 2

