Experimental set-up at E.S.R.F.

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Experimental set-up

- Hardware
  - Kickers
  - Bpms
- Software
  - Data acquisition
  - processing

Horizontal beam kicker

- We use an injection kicker:

Pulse length	1 μs
Repetition rate	10 Hz
Deflection angle	> 2 mrad
β_x	5 m
Max. amplitude	10 mm *

* Limited by beam lifetime

- Will impose 1/3 (at most) filling pattern for all measurements
- Sets the repetition rate for all others parts
- No power limitation
- Flat top

Vertical beam kickers

- Tune monitor shaker

Pulse length	1 μs
Repetition rate	Up to 100 Hz
Deflection angle	.1 mrad
β_z	35 m
Max. amplitude	3.5 mm

- New dedicated kicker

Pulse length	1 μs
Repetition rate	10 Hz
Deflection angle	.6 mrad
β_z	35 m
Max. amplitude	7 mm *

* Limited by beam lifetime

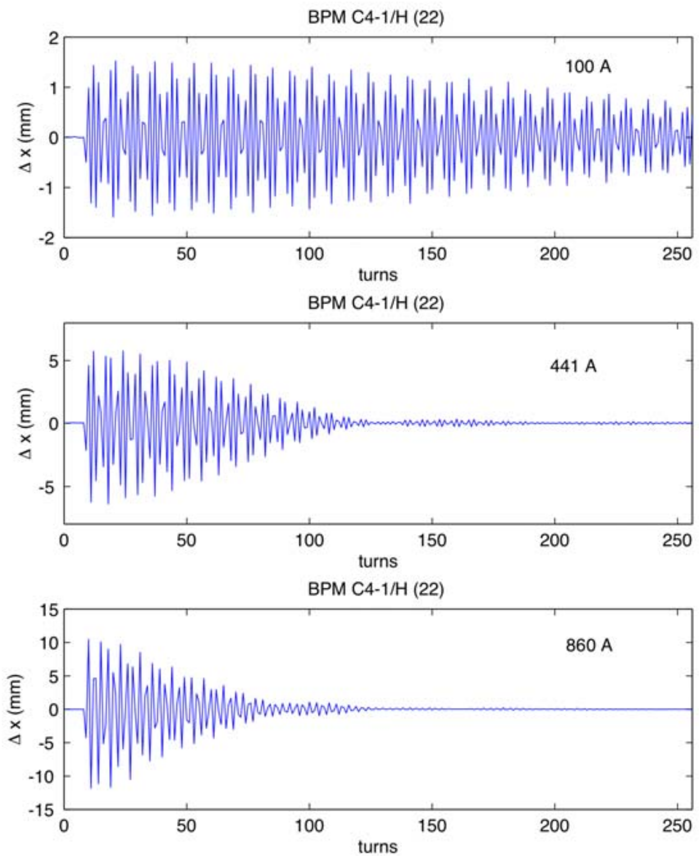
Longitudinal kicker

- Phase shifter at the output of the RF master source
- Very large kicks are possible
- No calibration
  - Needs to be calibrated with beam

Standard BPM system

- "Pseudo" turn-by-turn BPM system:
  - Multiplexed system: the 4 electrodes are read on different kicks
  - Data are averaged over many kicks (typically 32 to 256)
- Good linearity thanks to the processing
- Good resolution: ≈ 1 μm
- Large number of BPMs read simultaneously
- Slow system: ≈ 90s / point
  - Needs a sufficient lifetime

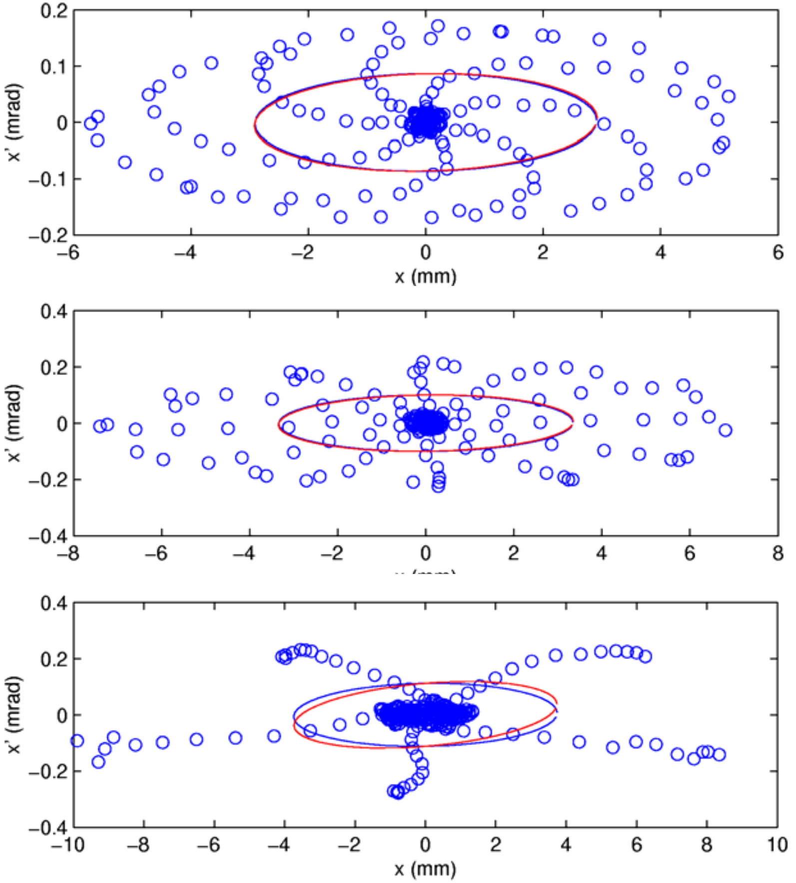
Turn-by-turn BPM readings



Decoherence due to

- Chromaticity:
  work with 0 chromaticity
- Head-tail damping:
  work at low intensity
- Tune shift with amplitude
  unavoidable

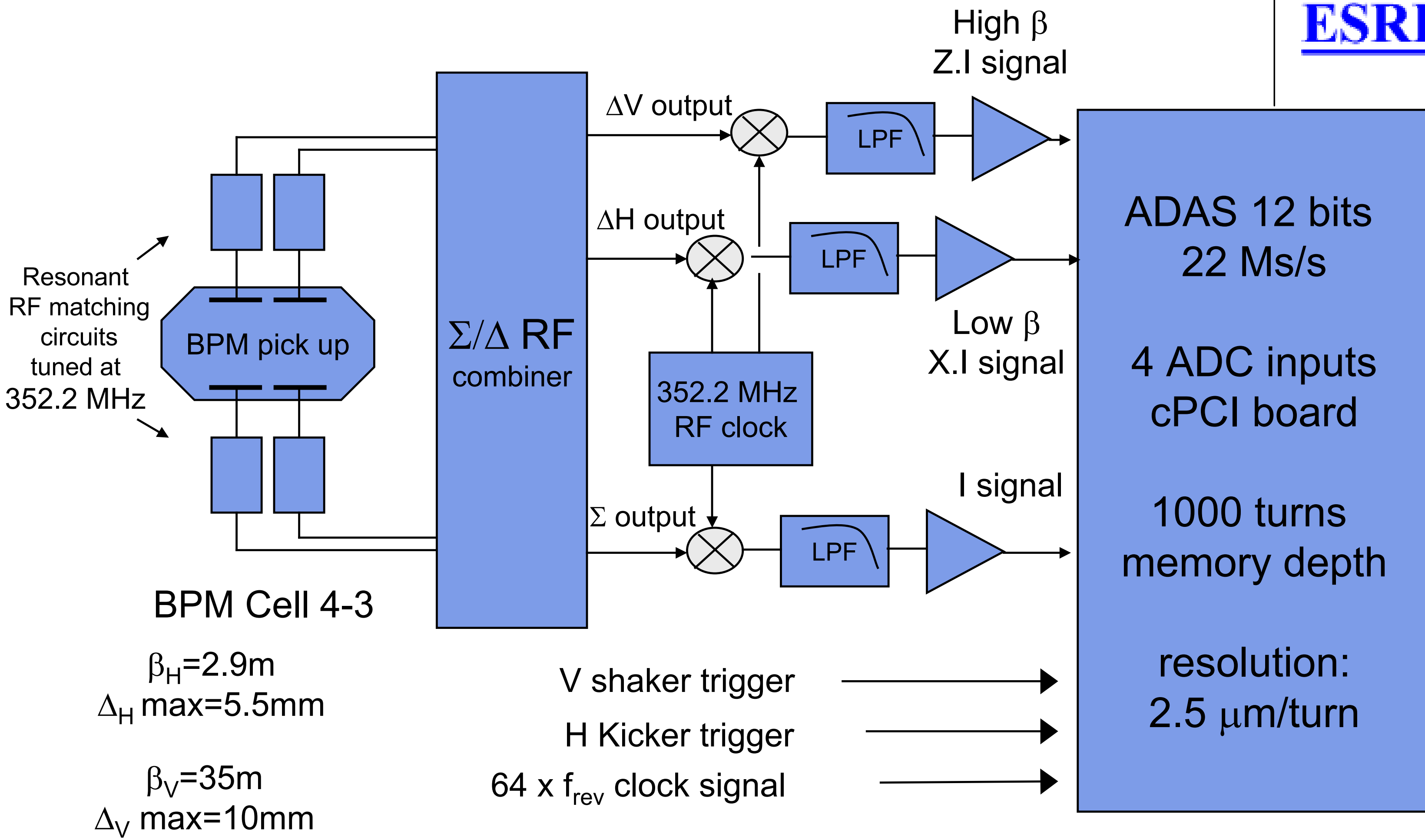
Phase-space plots



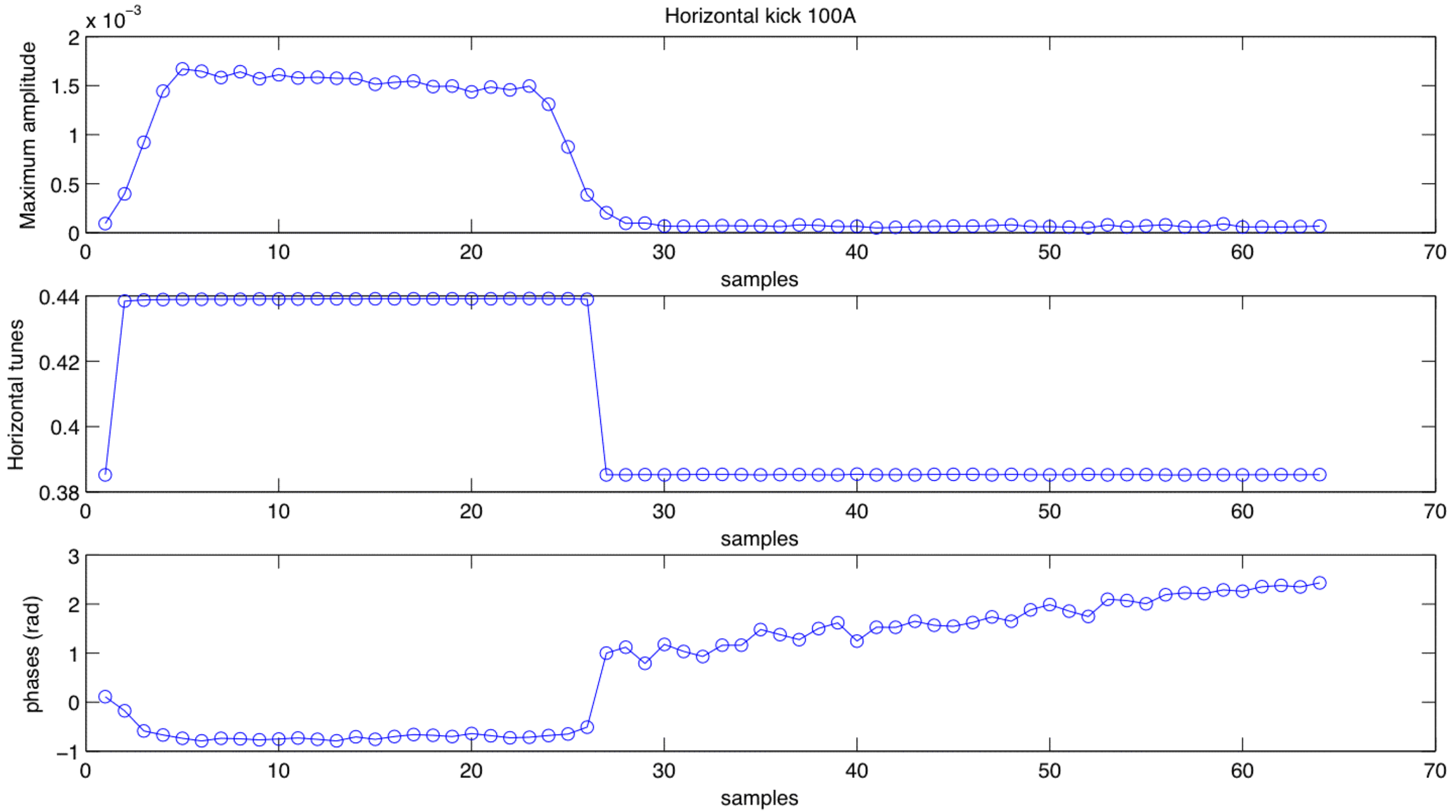
Dedicated BPM system

- Goal
  - Much faster reading
  - A true single-shot system will allow to go closer to the limit of the aperture (no lifetime concern)
- Solution
  - Analog combination of electrodes
    - Calibration, drifts are not critical
    - The rather bad linearity is not penalizing for frequency analysis
  - A single block is enough
    - Location in high β_z and low β_x to make the best use of the linear region

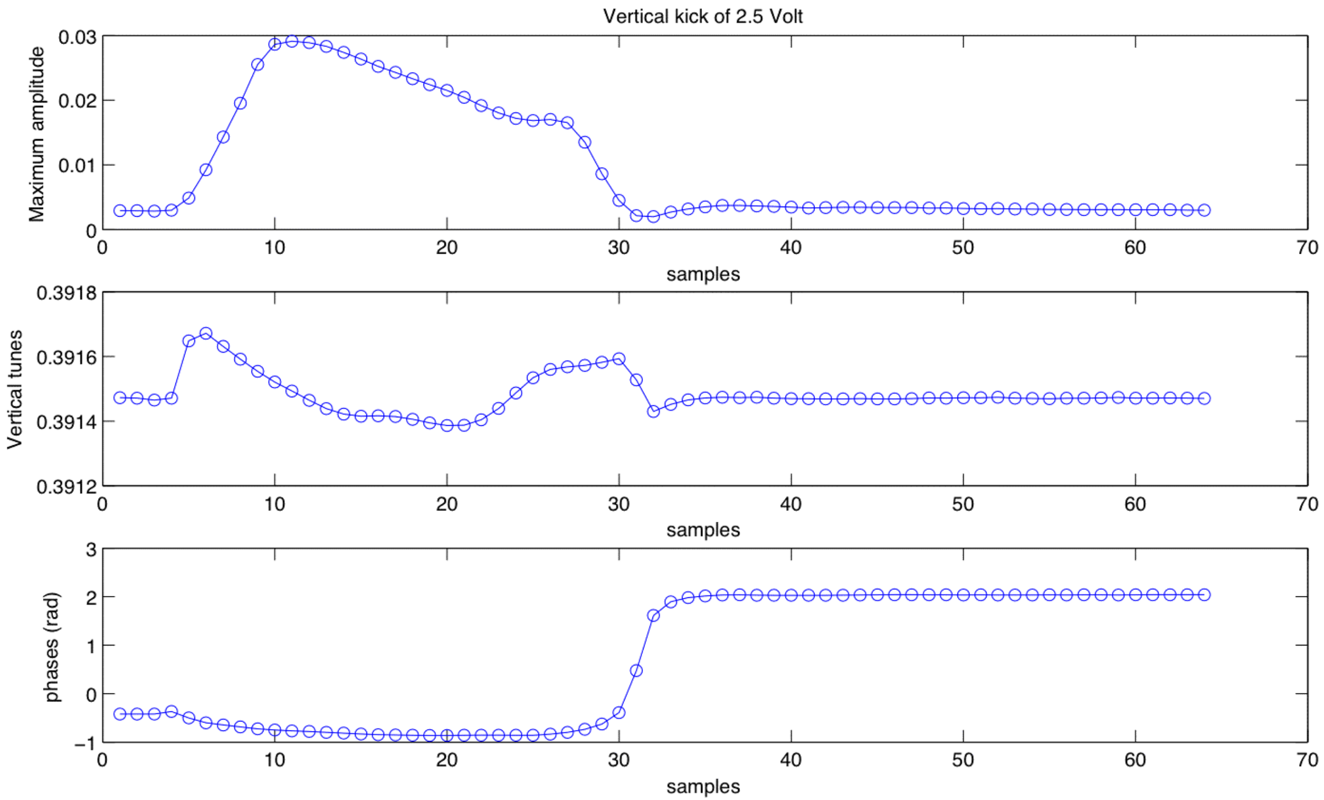
Dedicated BPM system



“ADAS” BPM horizontal



“ADAS” BPM vertical (shaker)



Future BPM

- Processing based on FPGA
  - Excellent compensation of non-linearities
  - High speed
- Wide linear range: 8 buttons
- A few dedicated BPM blocks
  - Blocks are installed
  - Processing currently being developed

BPM comparison

Standard BPM

- Resolution 1 μm
- Calibrated
- Linear in 10x10 mm^2
- 90 s / measurement
- 214 available blocks
  - Averaging
  - Possibility to process all BPMs together

"ADAS" BPM

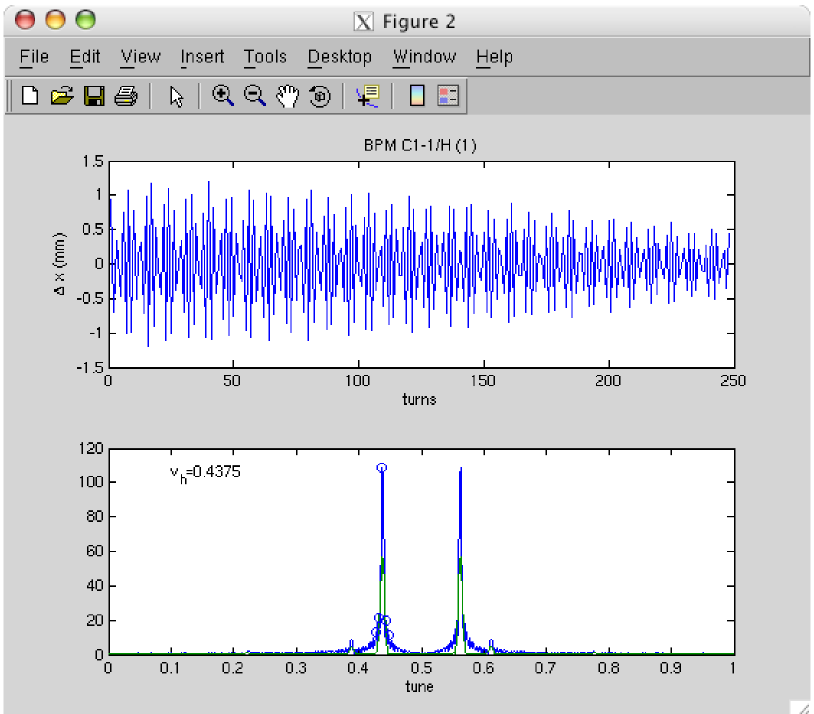
- Resolution 2.5 μm
- No calibration
- Limited linearity
- 1 s / measurement
- Single block
- 20 samples / turn
  - Averaging
  - Evolution along the bunch train

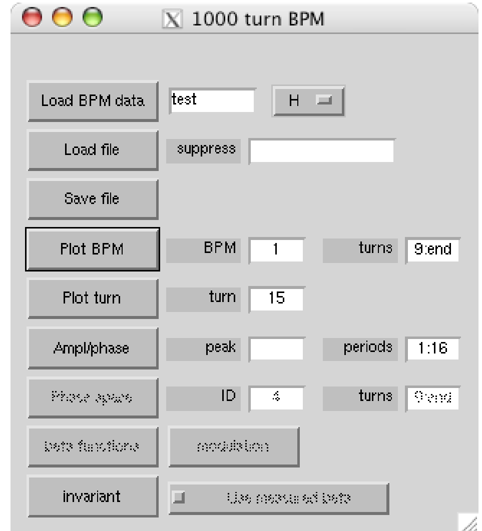
Software

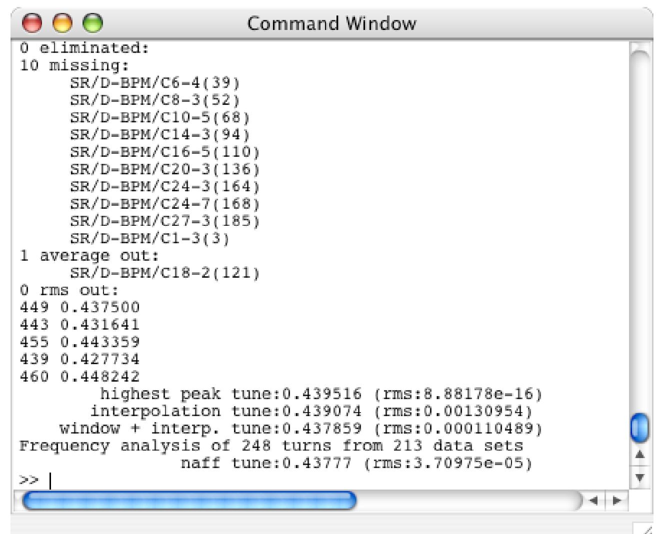
Matlab used for

- Acquisition sequence
  - K_x, K_z setting
  - BPM acquisition
  - Data storage
- Processing of BPM data
  - Detection of “dead” BPMs
  - Detection of the non-empty bunches
  - Averaging of selected samples
- Frequency analysis
  - FFT
  - NAFF

Matlab processing







Conclusions

- System built without major hardware or software investment
- Present limitations:
  - Still no real “single shot” measurement
    (for triggering reasons)
  - The measurement speed is limited by the control system
    (5 s / point)
- Many open possibilities:
  - 3 plane system (H, V, Long.)
  - Large number of available BPMs
    (a clever processing may compensate for the decoherence)

Thanks to…

- Diagnostics group
  - E. Plouviez
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