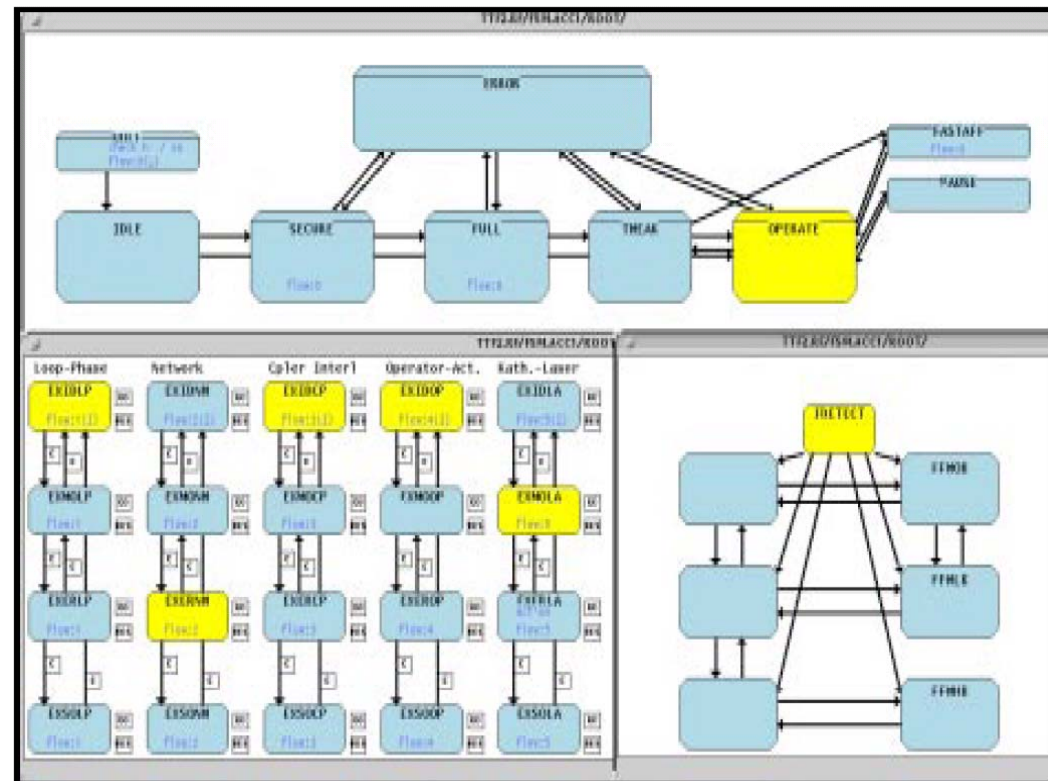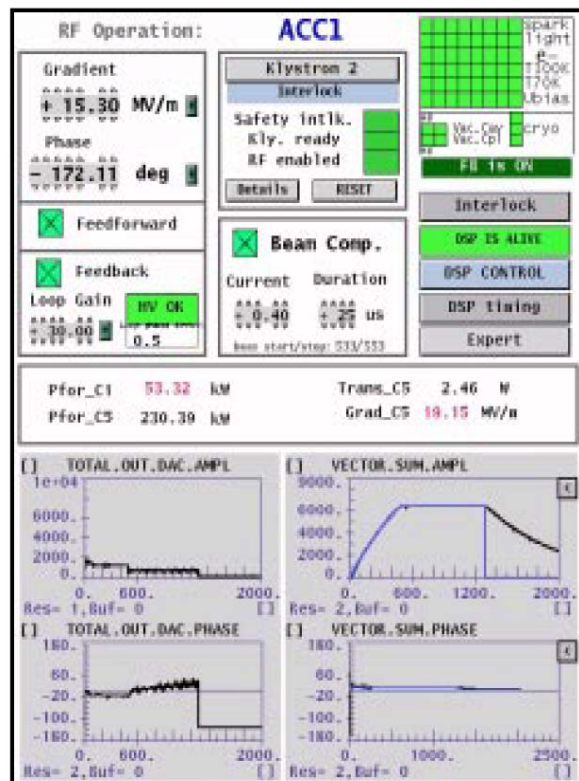# Status of R&D at DESY

Waldemar Koprek
on behalf of LLRF team

R&D activities at DESY

- Automatization
- Klystron linearization
- Piezo control
- Controller of sc cavities
- RF-gun controller
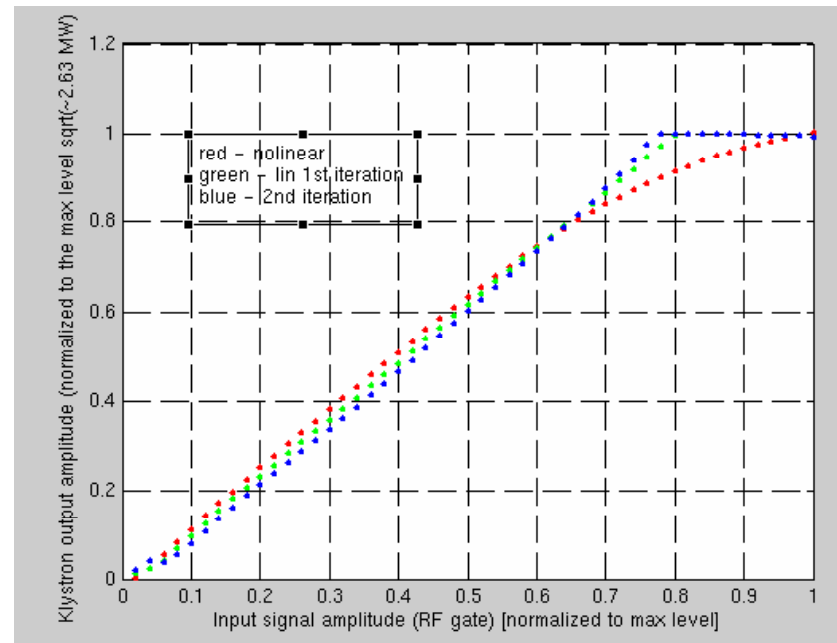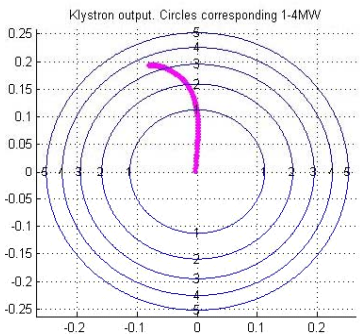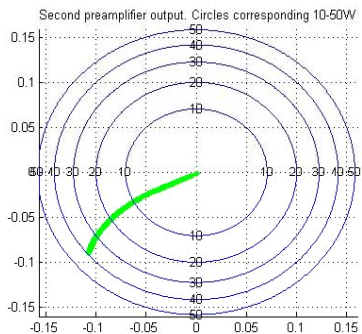- New IF for field detection
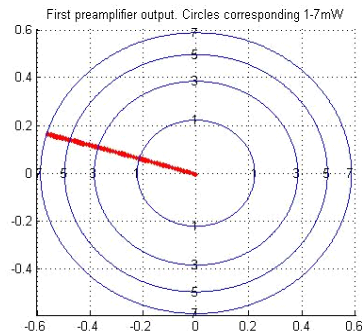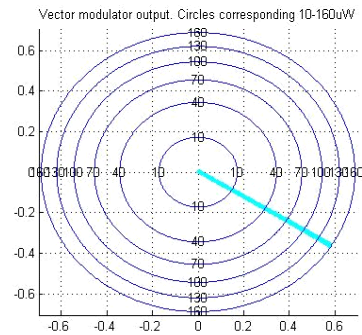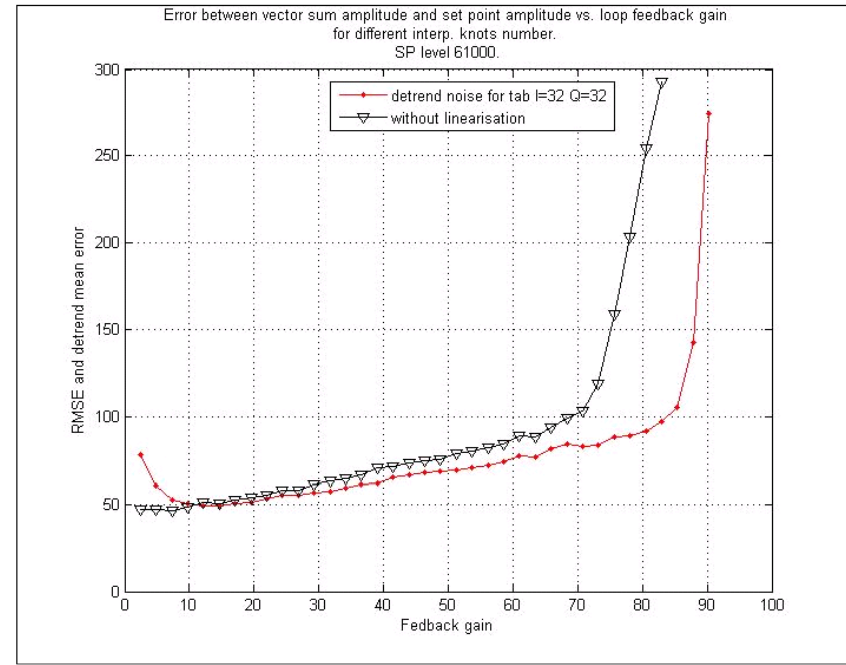- Software for ATCA LLRF control system

Automated Accelerator Operation

High degree automation of accelerator operation

Klystron linearization

• How close to saturation can we operate? (10%? 3%?)

• Klystron linearization implemented in Simcon 3.1

     -measurements of nonlinearities in high power chain

     - first results of operation

Piezo control

$$\Delta\omega = -\frac{1}{2\pi}\left(\frac{d\phi_{probe}}{dt} - 2\omega_{1/2}\frac{|U_{for}|}{|U_{probe}|}\sin\left(\phi_{for} - \phi_{probe}\right) \right)$$

Fine amplitude corrector
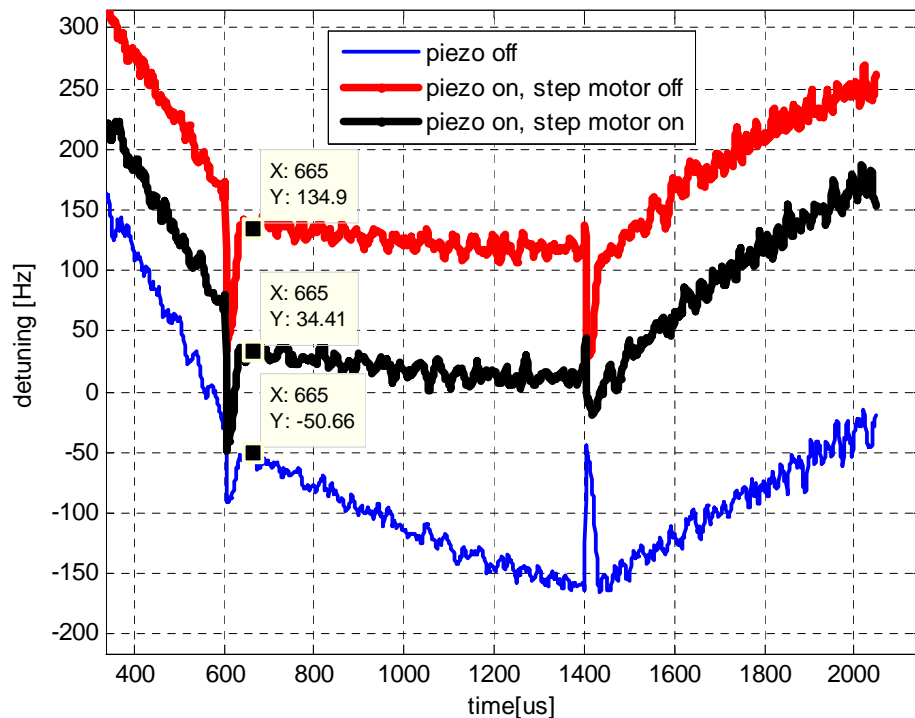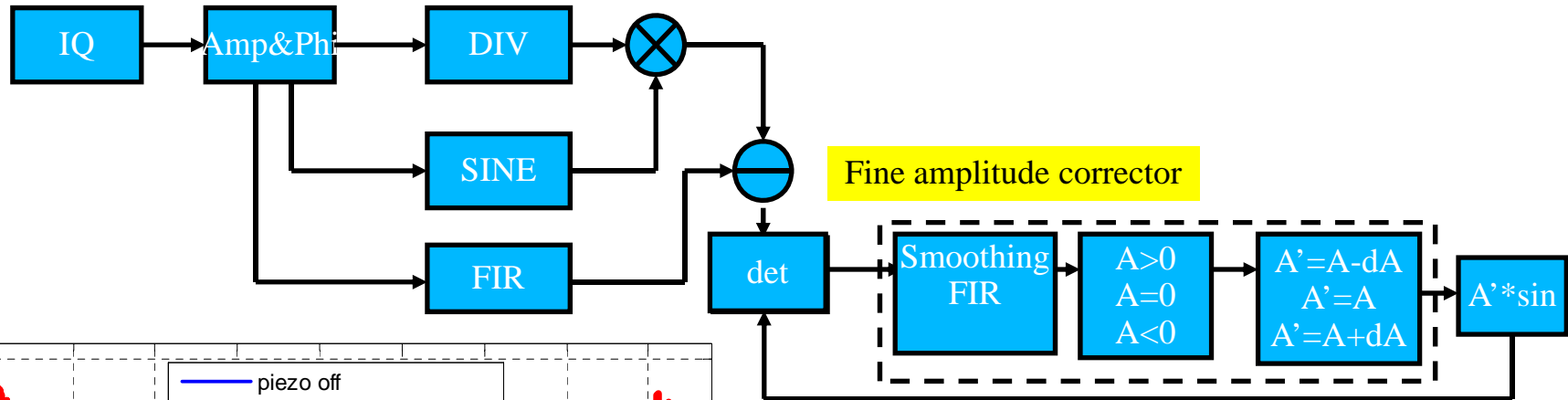
Detuning calculated from cav1 ACC6 in MTS (matlab script)

Controller of sc cavities

SIMCON 3.1 at:

1. FLASH-ACC1 – 8 cavities (permanently)
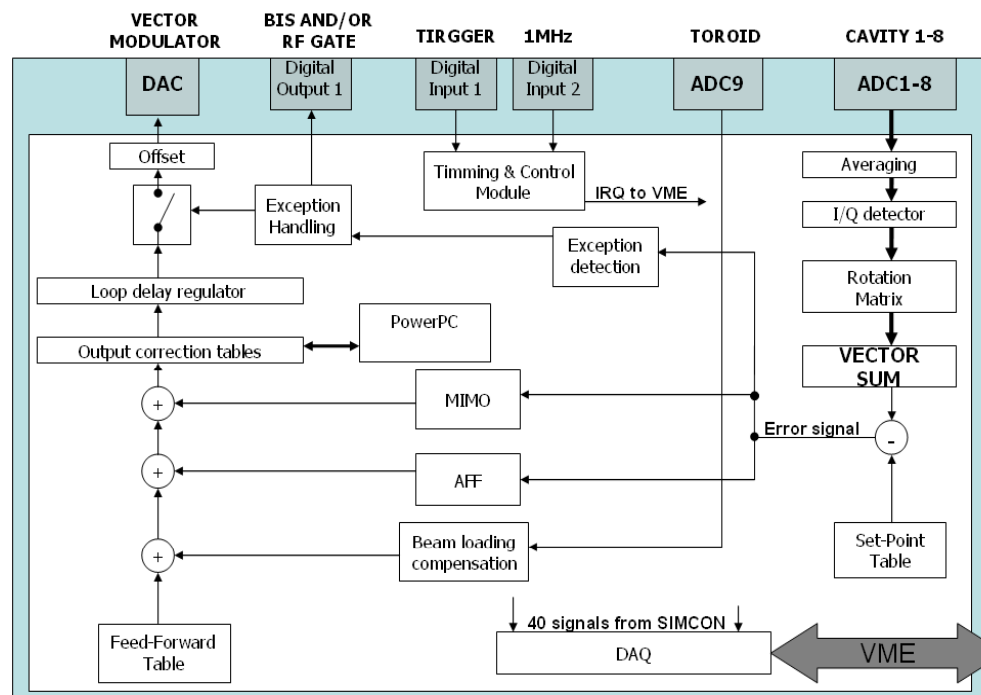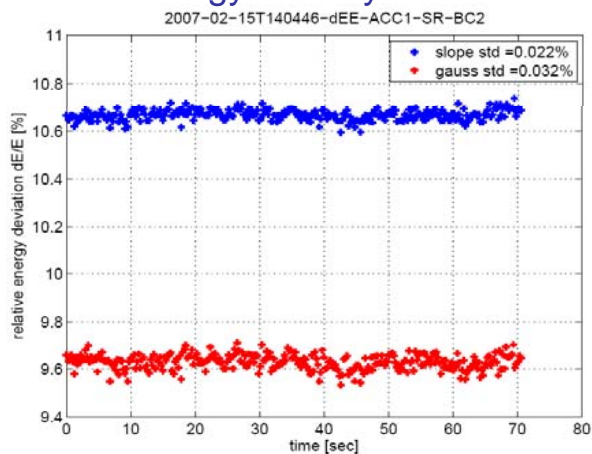2. FLASH-ACC2/3 with 2 boards – test of 16 cavities
3. MTS – 8 cavities (permanently)
4. CHECHIA – permament installation in April 07
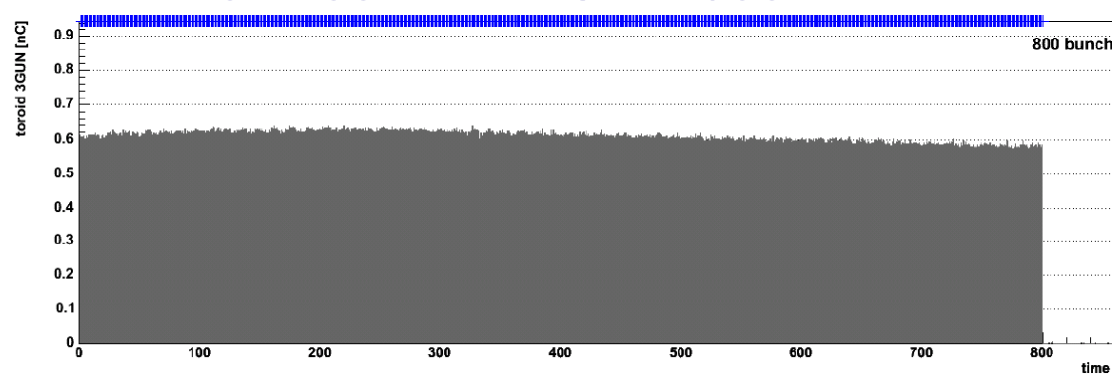5. FNAL at CC1
6. FNAL at Meson Hall

15.02.2007 – FLASH
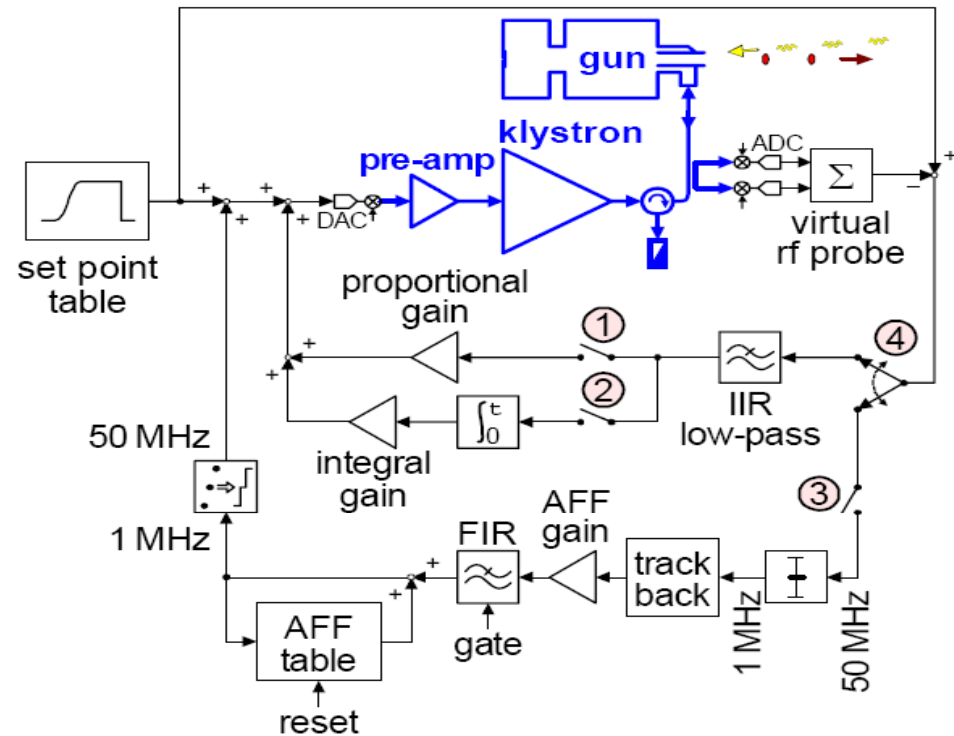Bunch energy stability meas. In BC2

17.02.2007 – FLASH – 800 bunches

RF-gun controller

SIMCON 3.1 at:

- RF-Gun at FLASH – permanently
- RF-Gun in Zeuthen – permanently
- BESSY gun tested in Zeuthen with probe
- RF-gun in PSI – plan for 07

Phase stability of beam in RF-gun at FLASH

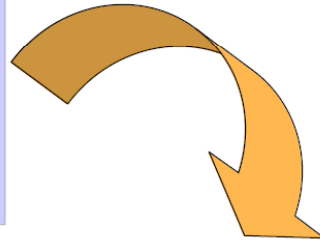| rf control	phase change over time	phase r.m.s. bunch to bunch	phase r.m.s. pulse to pulse
rf drive only	2.2°/400 µs	0.73°	0.50°
PI control	0.7°/400 µs	0.18°	0.17°
AFF(1) PI(9)	0.3°/400 µs	0.10°	0.13°
AFF and P	as above	as above	as above
AFF and PI	unstable	unstable	unstable

New IF for field detection

Now:
IF = 250kHz
SF = 1MHz
TS = 1us
4 samples / IF signal period
prediction needed
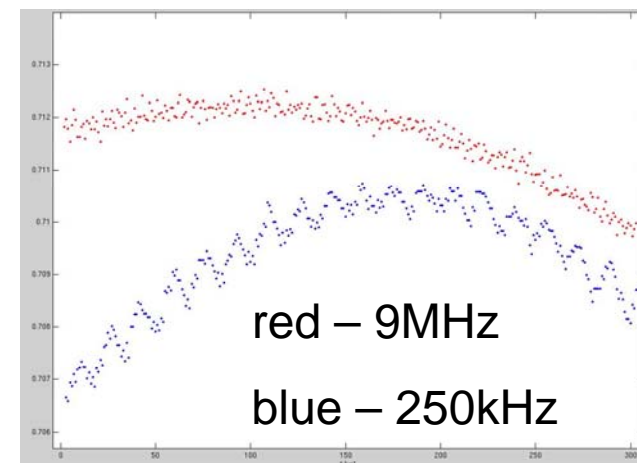
Future:
IF = 81MHz
SF = 36MHz ?
TS = 1us
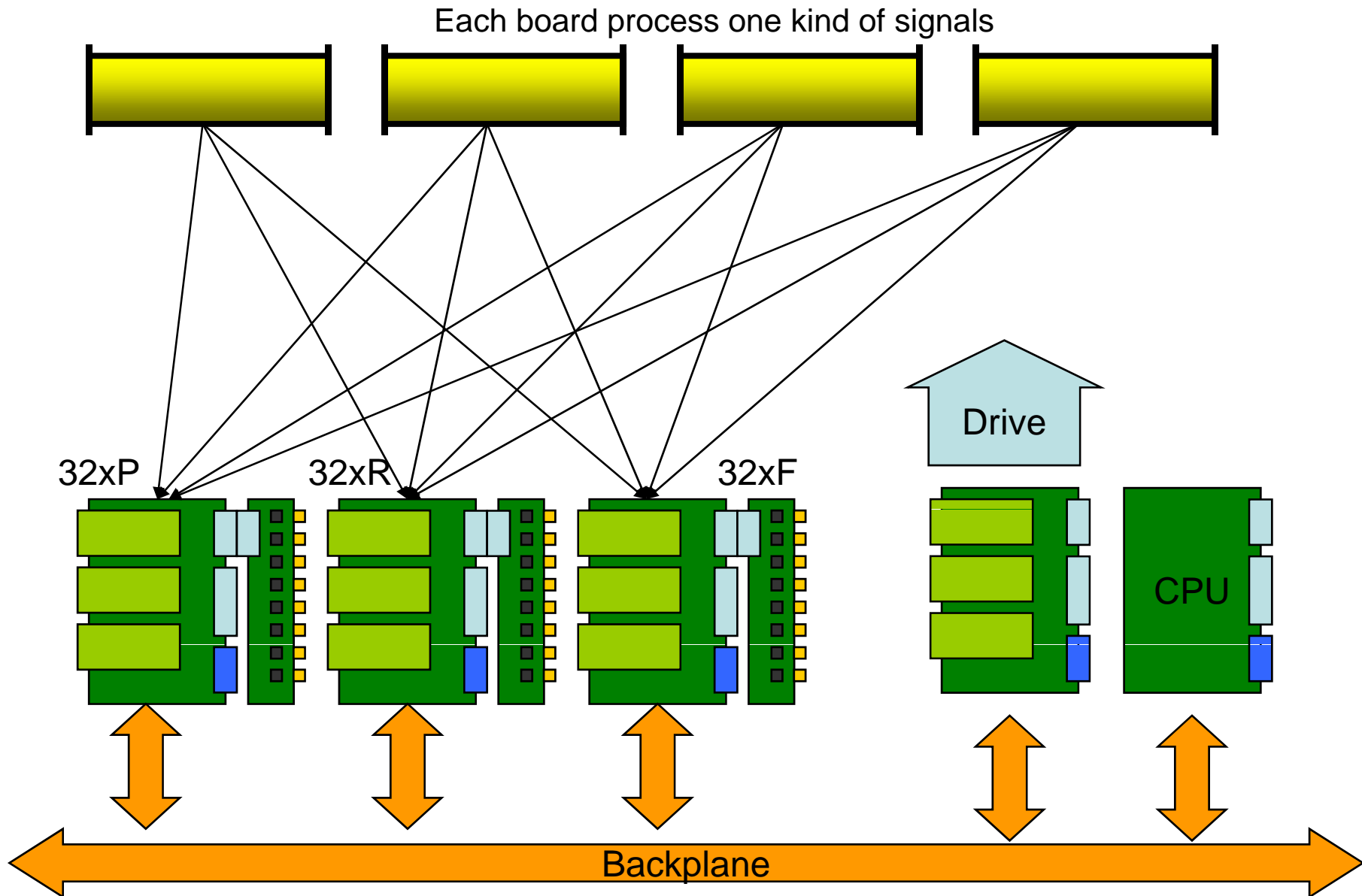many samples per TS
averaging possible (noise reduction)

$$I = \frac{2}{M} \sum_{i=0}^{M-1} x_i \sin(i\alpha)$$

$$Q = \frac{2}{M} \sum_{i=0}^{M-1} x_i \cos(i\alpha)$$

• multi-channel IQ detector implemented in SIMCON controller

• IQ detector tested in ACC1 with IF=9MHz and Fs=54MHz
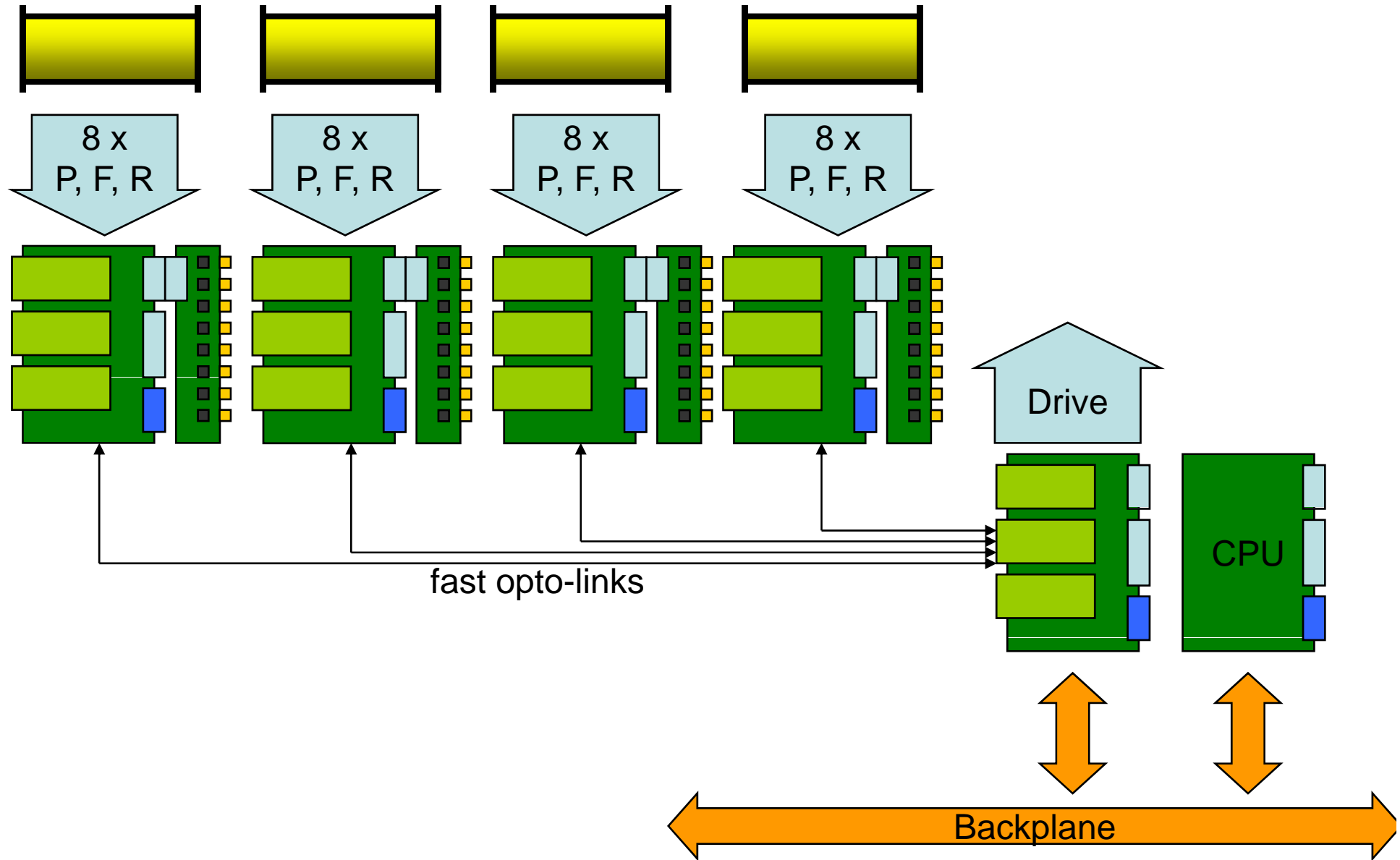
• quality measurement in MTS →

red – 9MHz

blue – 250kHz

ATCA Software - Solution A

Each board process one kind of signals

32xP 32xR 32xF

Drive

CPU

Backplane

ATCA Software - Solution B

Each board process all three kinds of signals

8 x P, F, R

8 x P, F, R

8 x P, F, R

8 x P, F, R

Drive

CPU

fast opto-links

Backplane

ATCA Software – in progress

- IPMI controller
- Communication protocols
  - PCI Express
  - Gb Ethernet
  - Low Latency Communication Links
  - Communication between FPGA and DSP

Thank You