

New development of a profile grid electronics to measure the spatial and temporal resolution of ion beam



CEA/GSI Meeting

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6.12.2011

Content

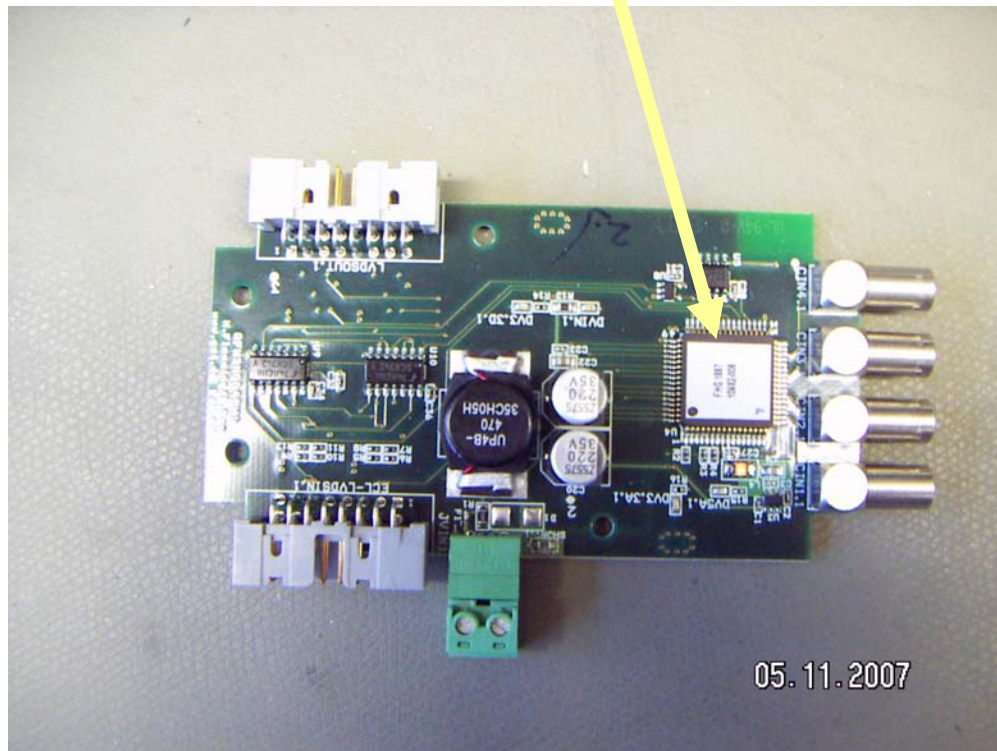
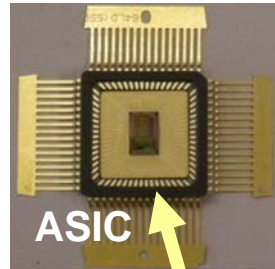
- QFW-ASIC by Dr. H. Flemming, EE
- Currently Prototype - Hardware Architecture
- Next prototype of PG-Electronics
- Discussion

SEM-Grid (**S**econdary **E**lectron **e**Mission Grid)

QFW (**C**urrent to **F**requency **C**onverter, **CFC**)

Performance of QFW(CFC)-ASIC

QFW test module PCB with ASIC by Dr. H. Flemming/GSI



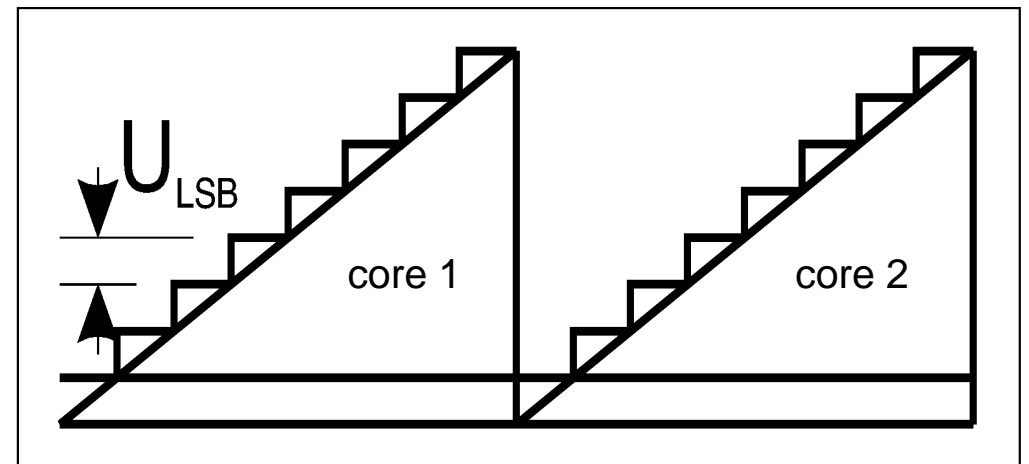
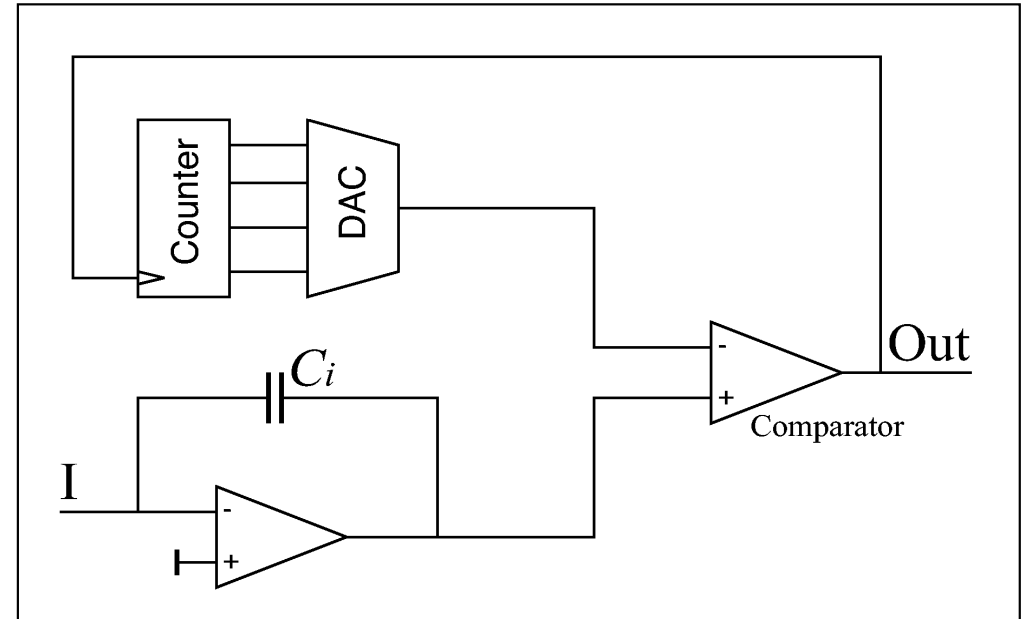
- ASIC provides 2 ranges (0.25/2.5 pC/pulse)
- Large dynamic range (100)300 fA ...130 (180) μ A
- Power supply 5V and 3.3V (ASIC), (test module needs 5.2-7V)
- 4 analogue inputs/ASIC (module has 4 LEMO coaxial input jacks)
- 4 on-chip counters, 16bit
- Output frequency max. 40 MHz
- QFW has digital interface (serial or parallel; module only serial port in operation)
- Module with additional drivers (LVDS and ECL compatible)
- Offset correction via parallel interface
- Price: <50 €/ASIC

QFW-ASIC working principle

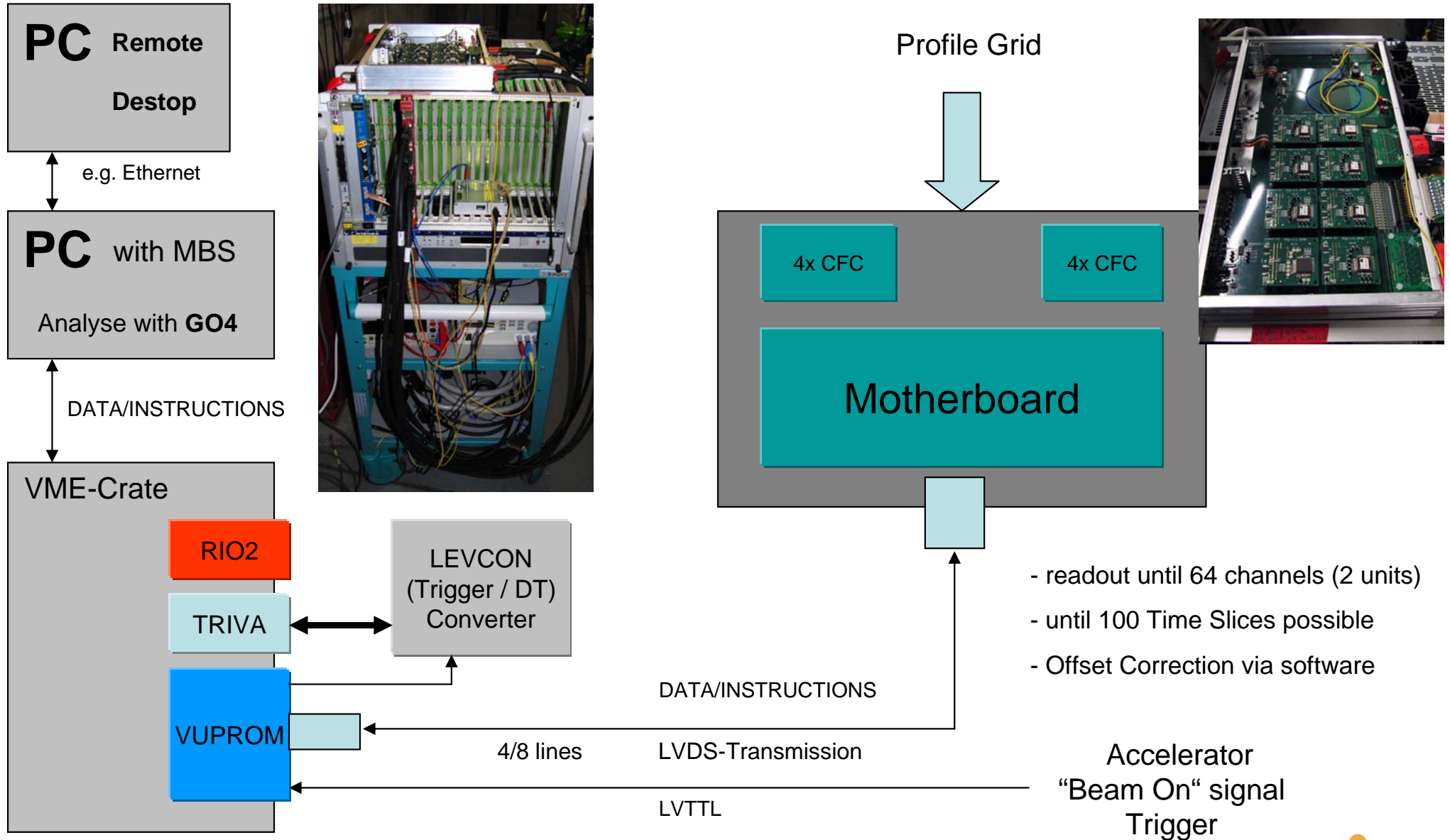
Block diagram of CF converter core

(with 4-bit DAC)

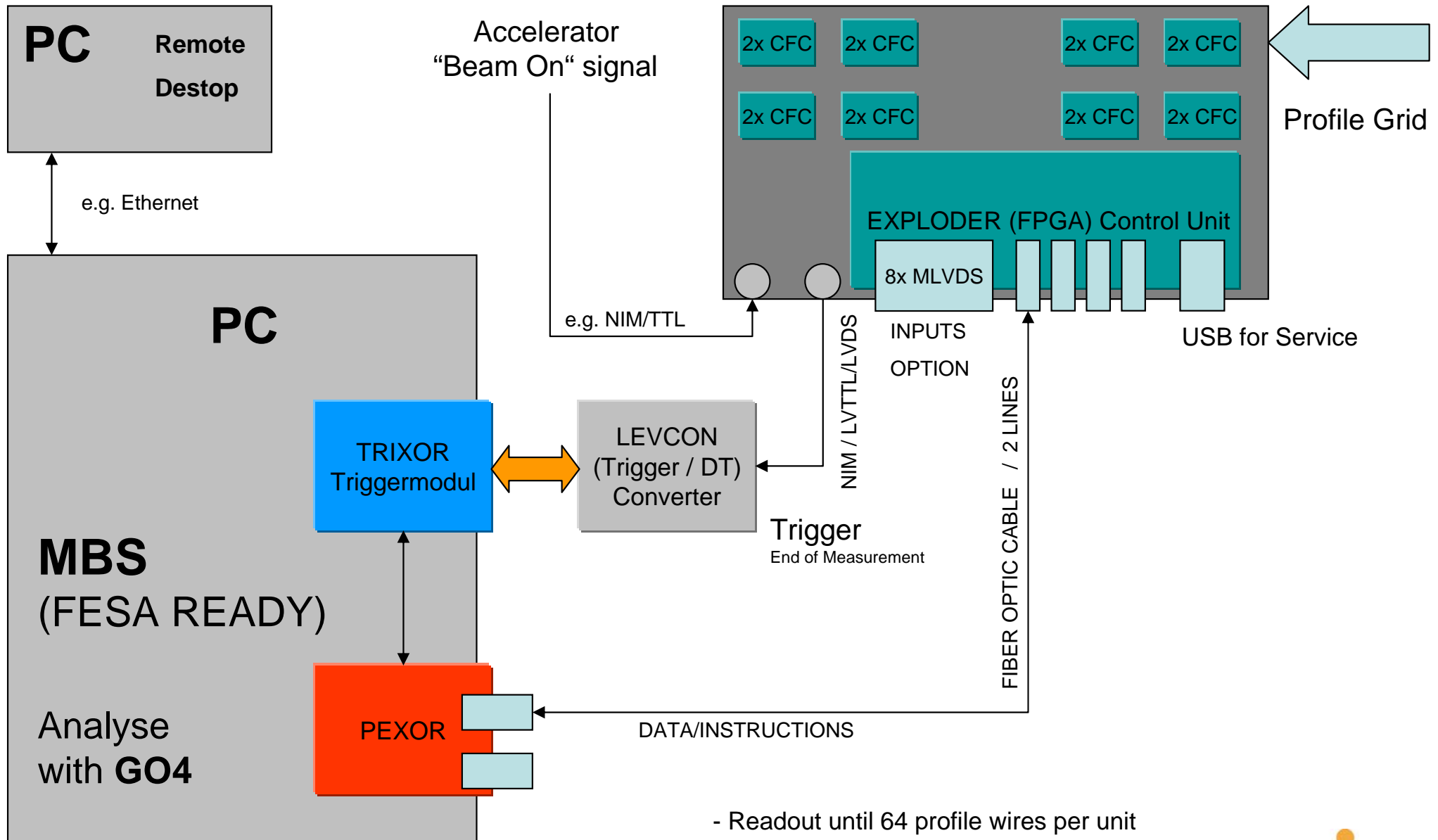
- 2 QF cores per channel
- Input current is integrated in active core #1
- Comparator checks integrator voltage and DAC reference
- If comparator trips the counter advances one step (or LSB value)
- On overflow the integrator of core #1 is reset while core #2 gets activated
- The measured charge per step is defined by $dQ = U_{\text{LSB}} * C_i$
- The output frequency is linearly dependent of the input current:
 $f = I / dQ$



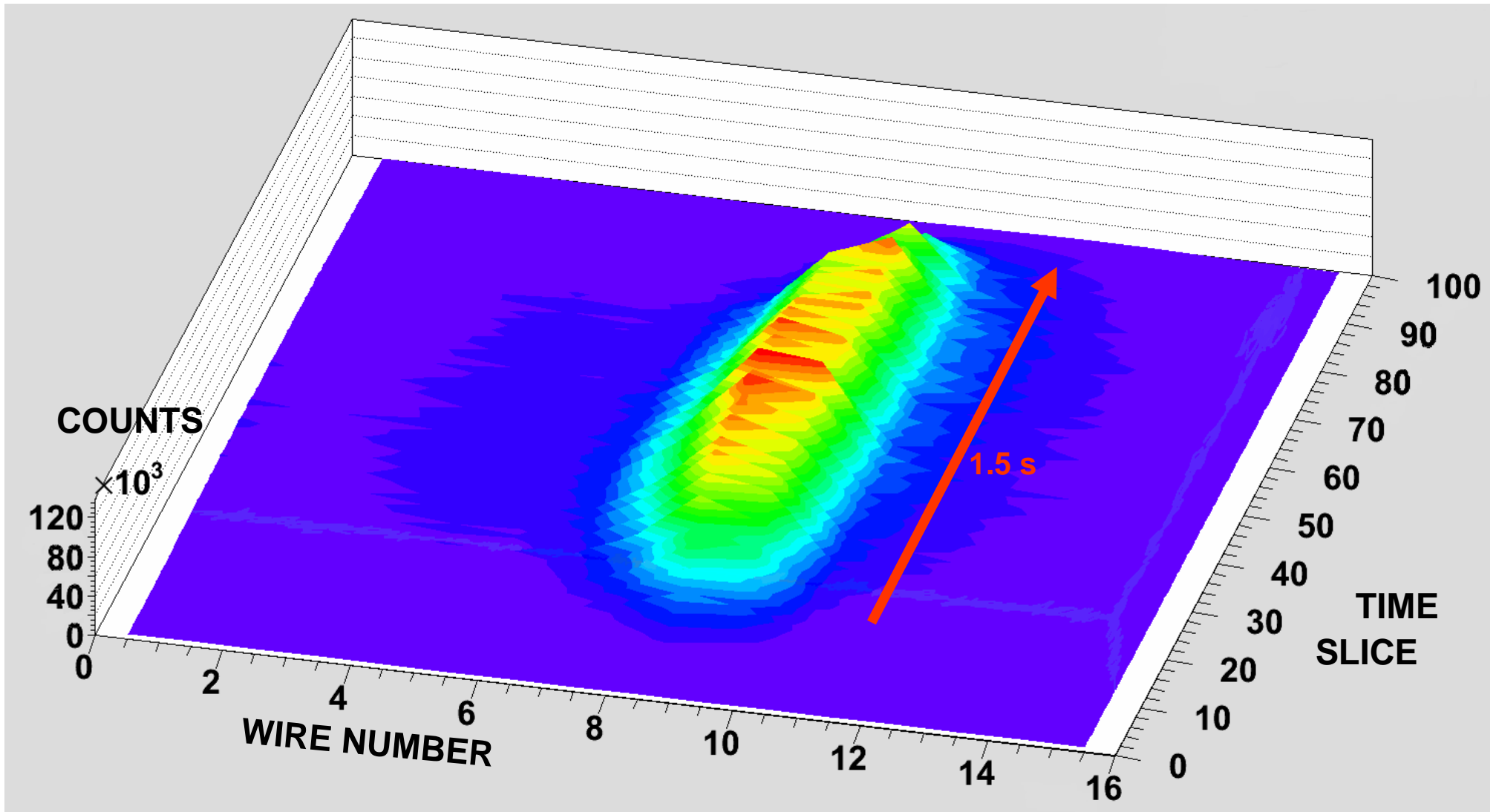
Currently Prototype



Next Step



Measurement with MWPC



$^{40}\text{Ar}^{18}$; @300.0 MeV/u; X-Plane; Time Slice 20ms; MWPC: TH4DG7G; HEPT beamline

Many Thanks

to

Hansjörg Reeg, SD

Frank Becker, SD

Beata Walasek-Höhne, SD

Winfried Barth, BT

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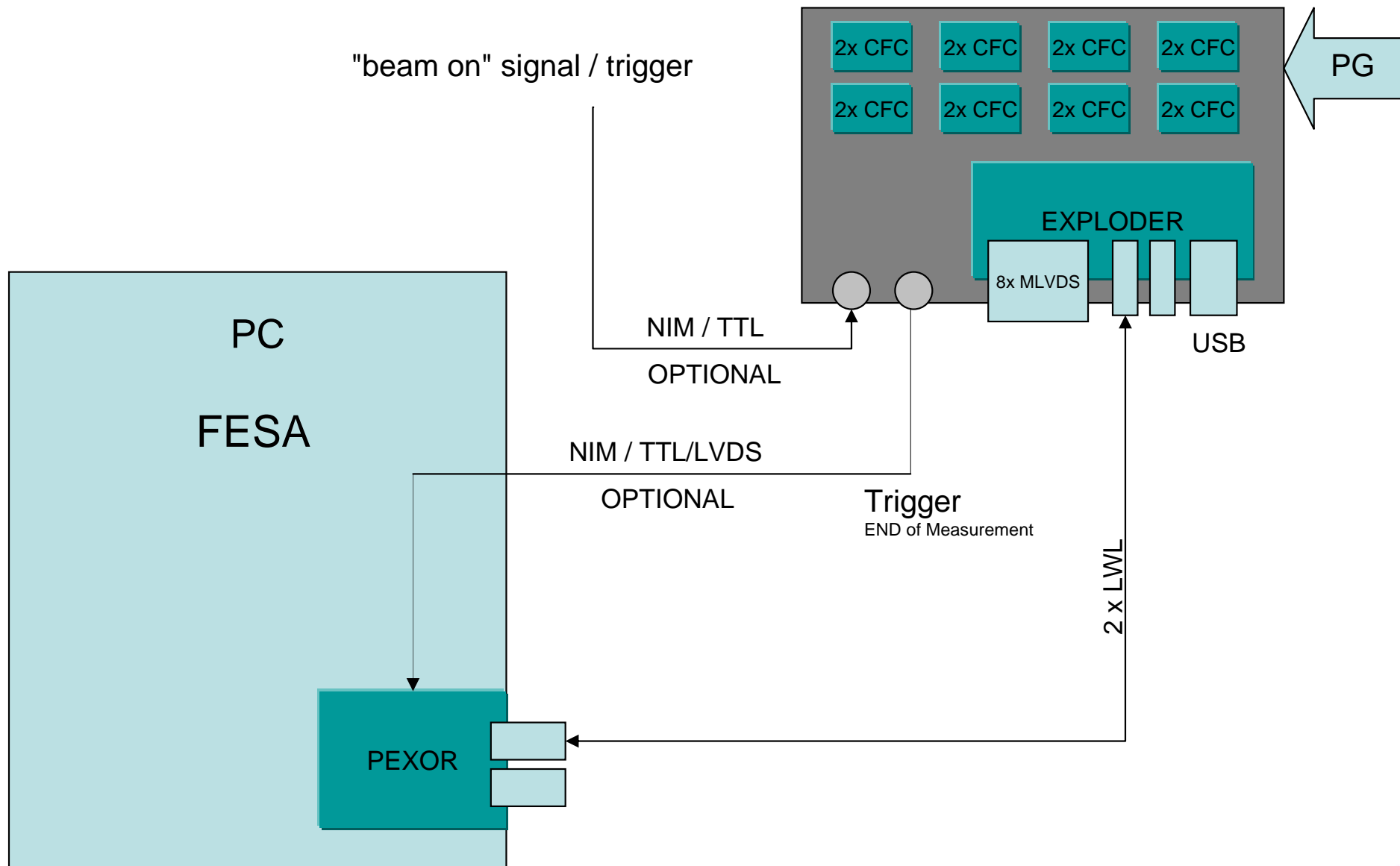
Jörn Adamczewski-Musch, EE

END

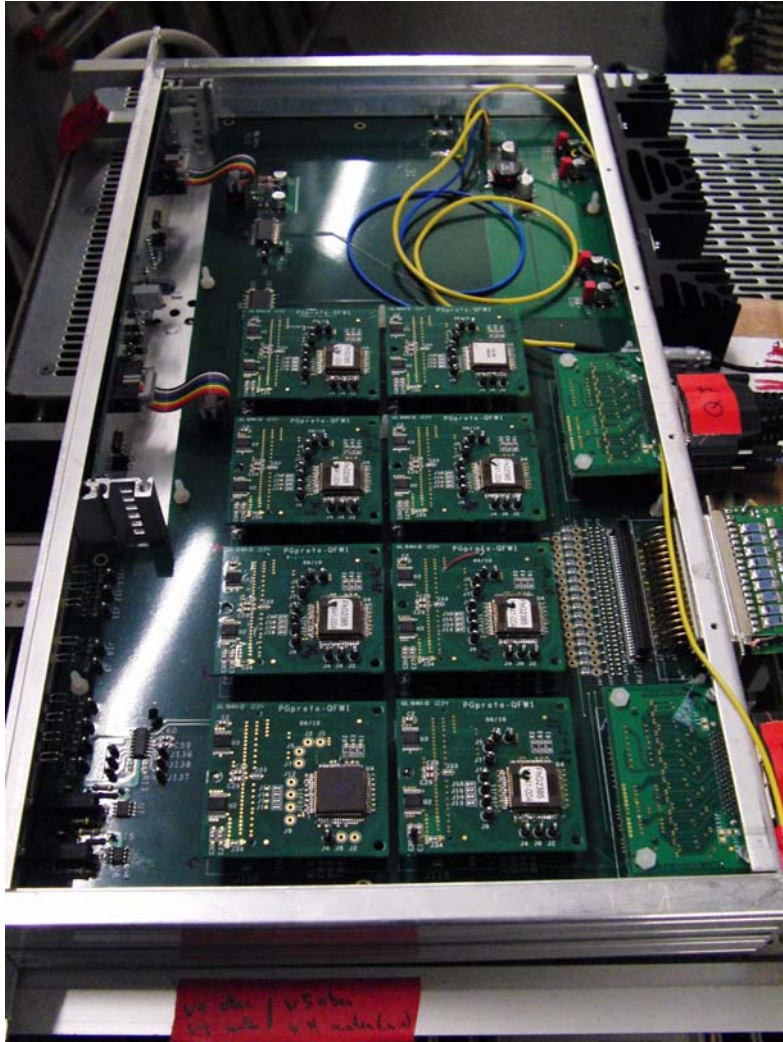


Thanks for your attention !

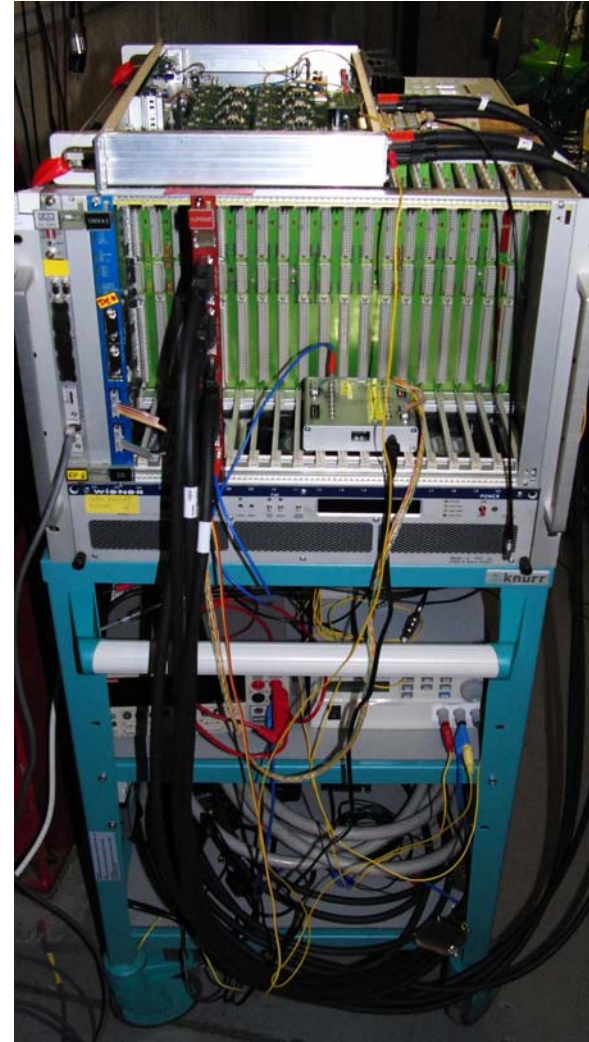
Future PG-Electronics at FAIR



Setup

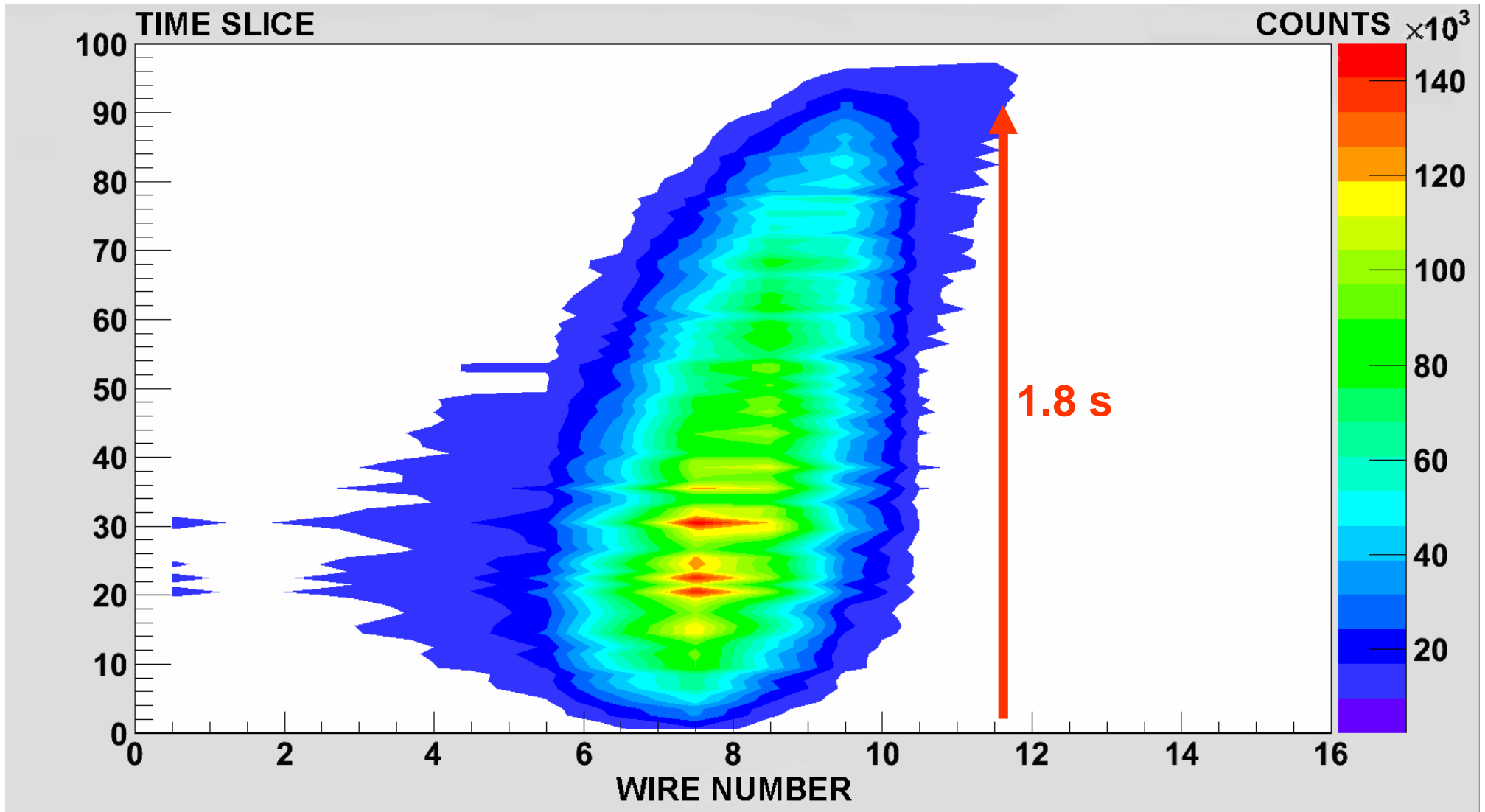


Motherboard with 8 CFC-ASICs



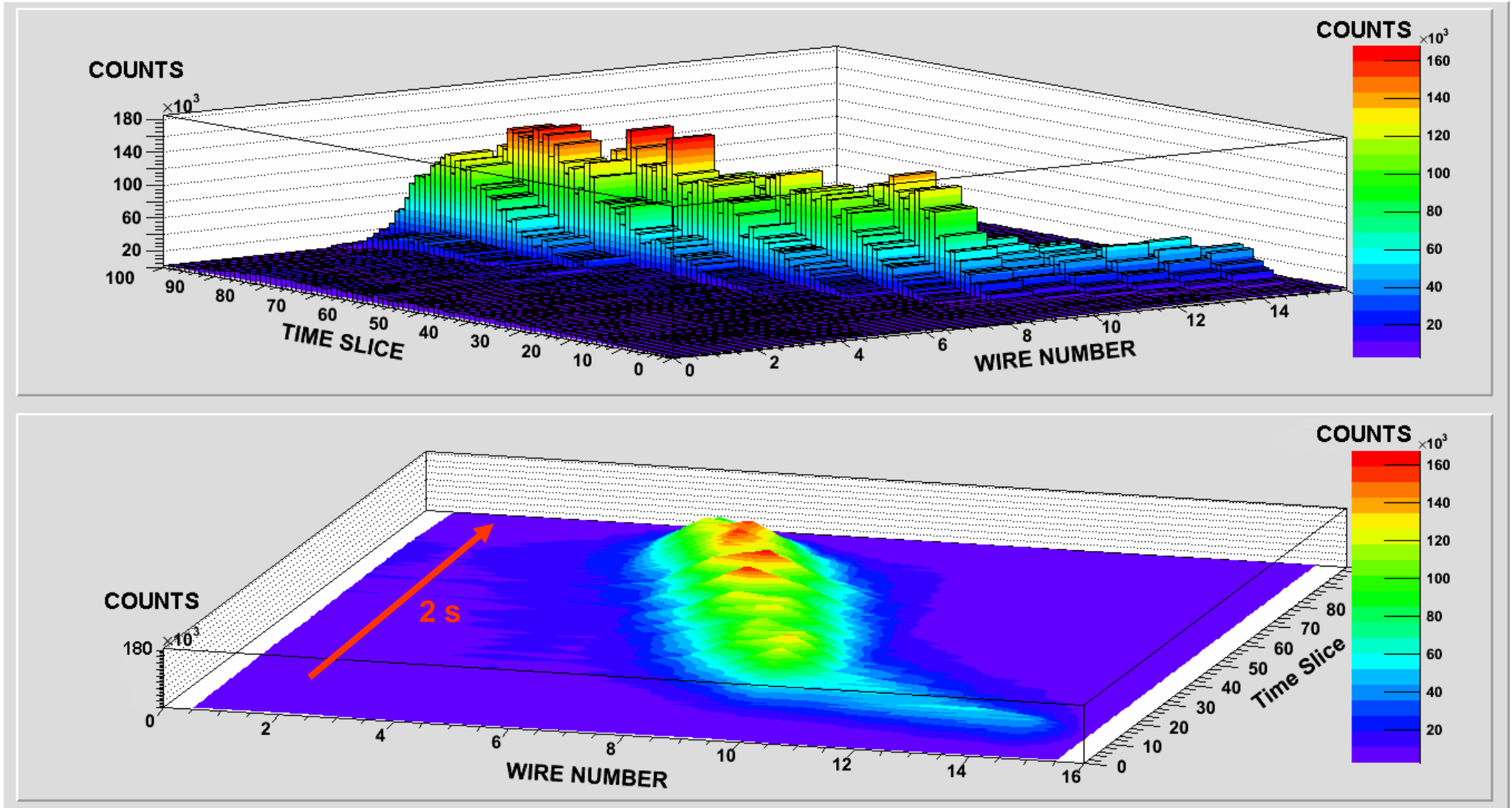
Setup

Results at MWPC



$^{40}\text{AR}^{18}$; @300.0 MeV/u; X-Plane; Time Slice 20ms; TH4DG7G

Measurement with MWPC



$^{40}\text{AR}^{18}$; @300.0 MeV/u; X-Plane; Time Slice 20ms; MWPC: TH4DG7G; HEPT beamline

Excursion: Minimum Current Resolution

Small excursion on the possible achievable minimum current resolution of a QFW:

- QFW is a **Charge to Pulse Converter**.
- In the sensitive range charges are measured with **0.25 pC/pulse**.
- The smallest possible current to be measured depends strongly on the time for the measurement. **$I = Q/t$**
- E.g.:
 $I_{\min,10\mu\text{s}} = 0.25\text{pC}/10\mu\text{s} = 25\text{nA}$
 $I_{\min,100\mu\text{s}} = 0.25\text{pC}/100\mu\text{s} = 2.5\text{nA}$
 $I_{\min,500\mu\text{s}} = 0.25\text{pC}/500\mu\text{s} = 500\text{pA}$