

SDHCAL Test Beam data analysis

Kieffer Robert IPN Lyon
CALICE meeting Casablanca
September 2010



kieffer@ipnl.in2p3.fr

Outline

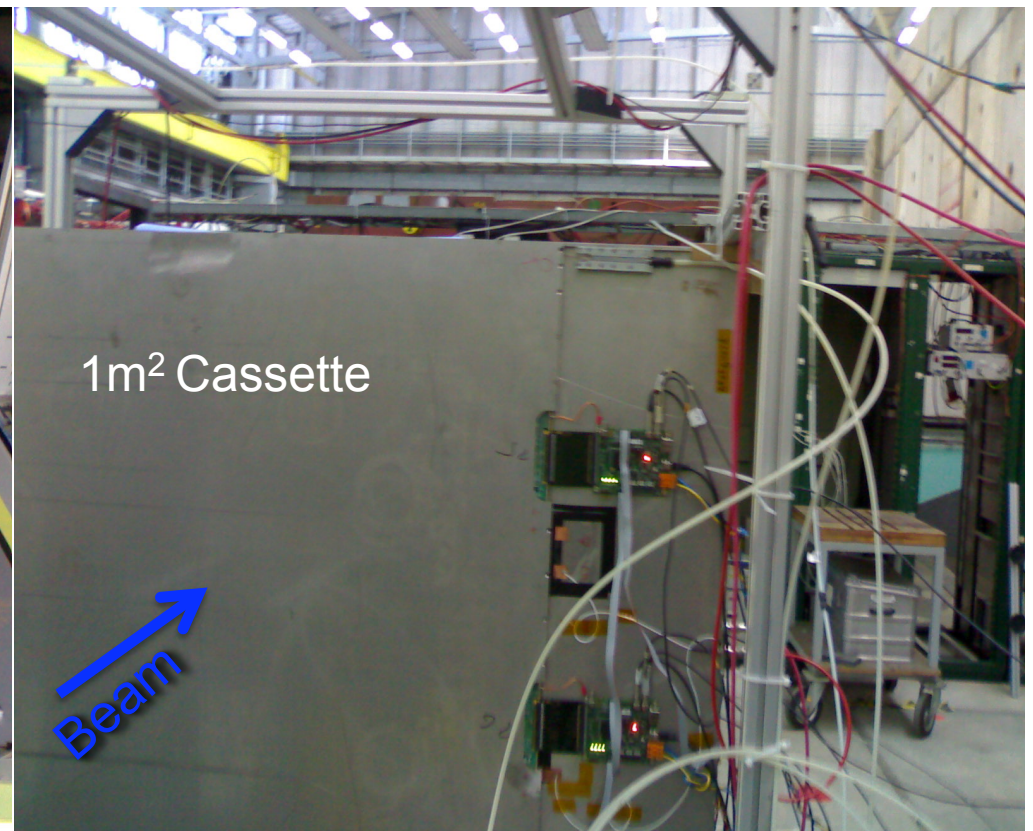
- ✓ Test Beam May 2010: Large detectors study
- ✓ Test Beam June 2010: Power Pulsing into B field
- ✓ Conclusions

First test beam with HARDOC2

May 2010: 12 days PS T9 (1-12GeV)

Aim: Large prototype homogeneity studies (1m^2)

Recorded events: 378 kEvents



Data time structure

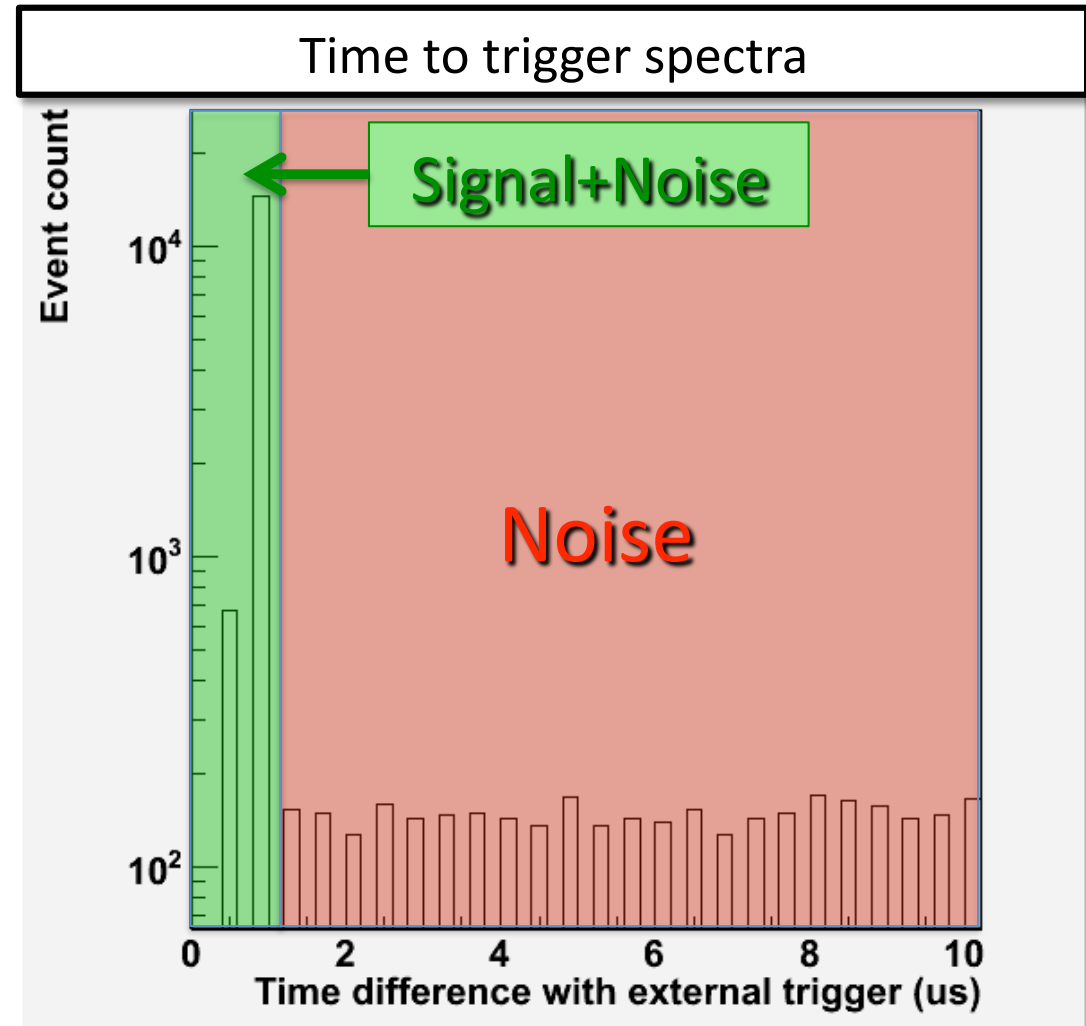
Clock period: 400ns

Time selection for triggered events:

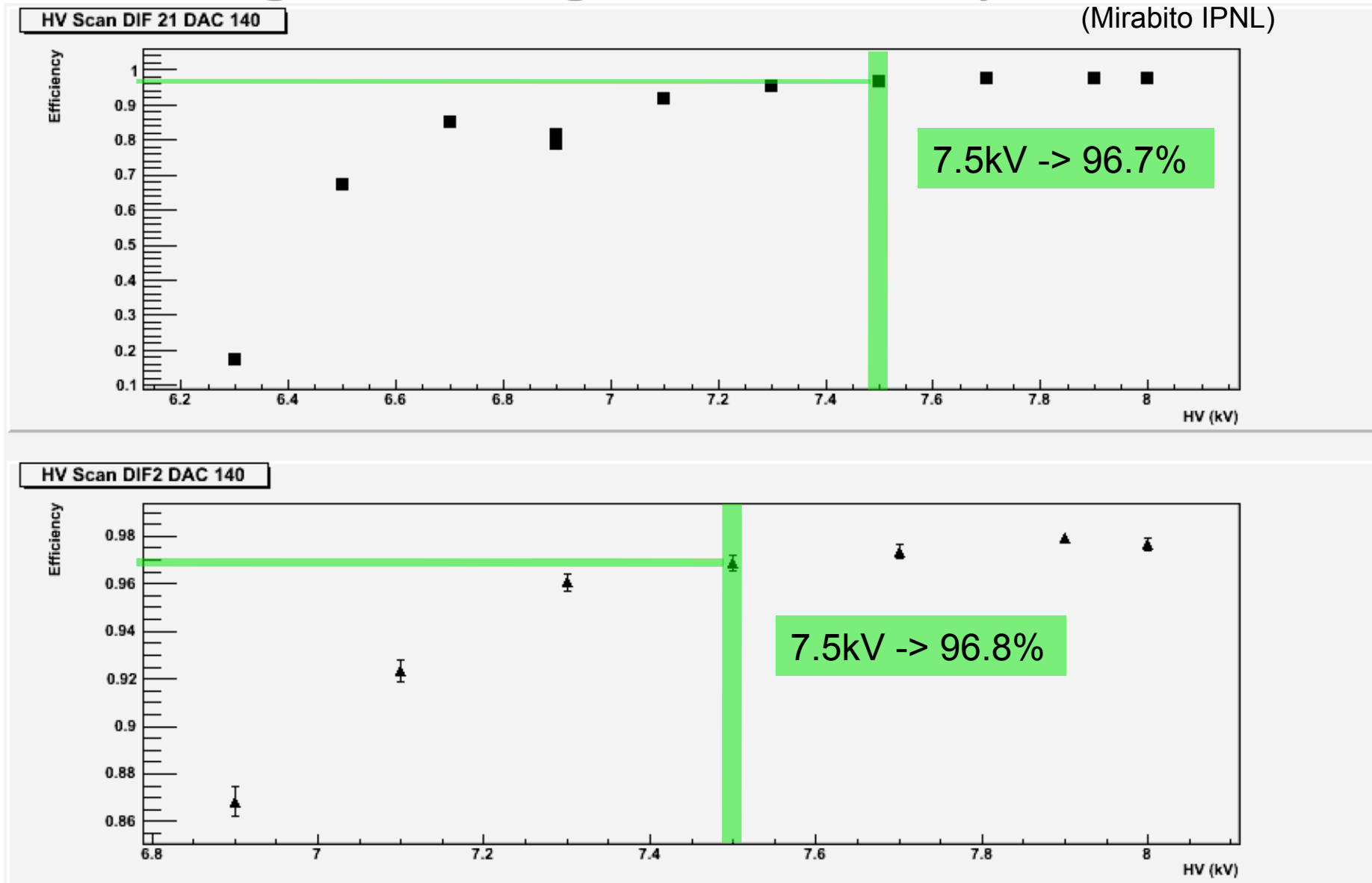
$$0 < \text{EvTime} < 1.2 \mu\text{s}$$

Noise contamination ratio:

1%

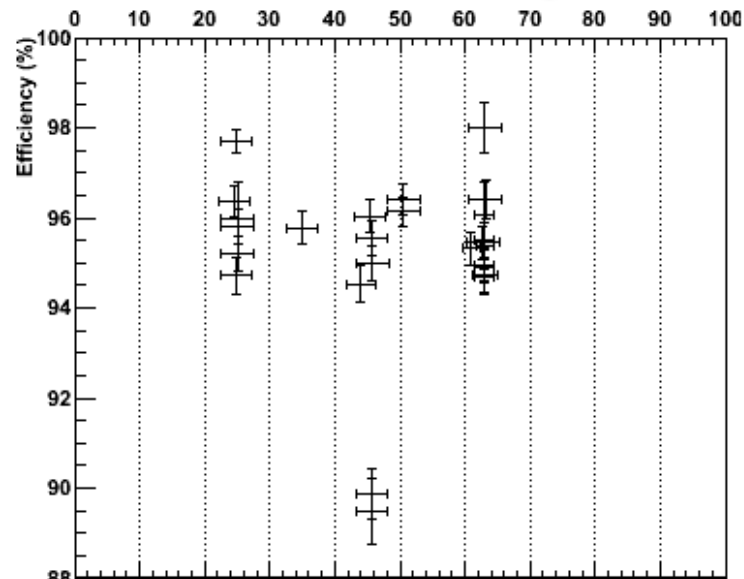


High Voltage Efficiency Scan

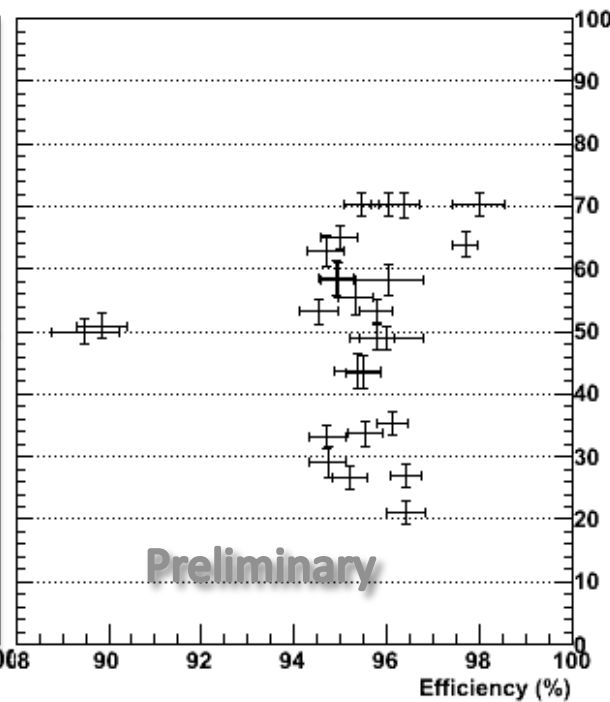
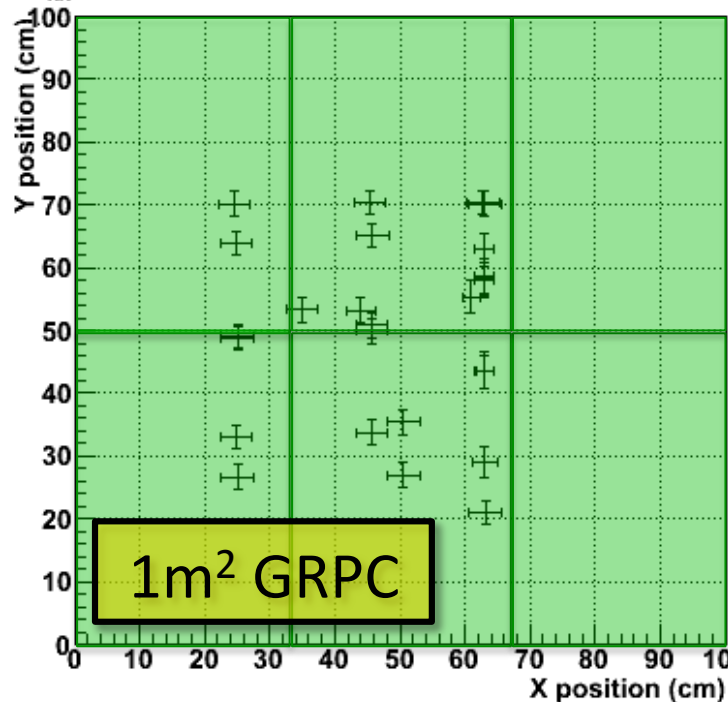


Efficiency behaves **has expected**, like for previous chambers.

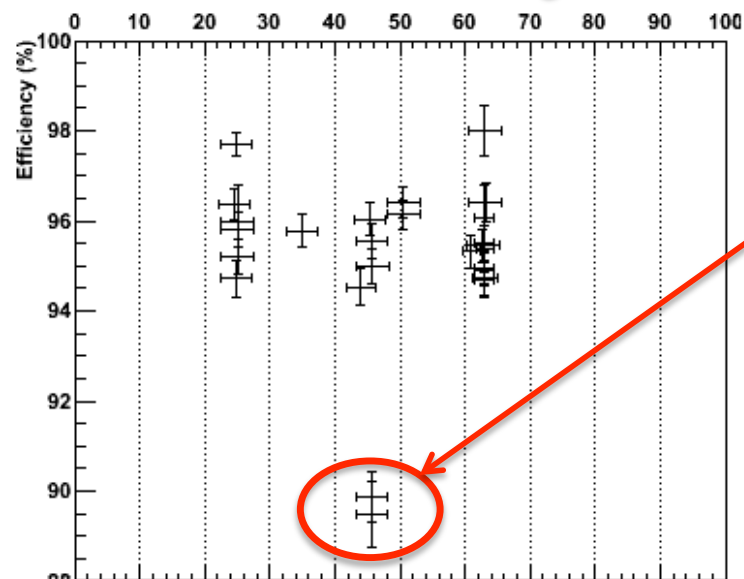
Efficiency Homogeneity Study



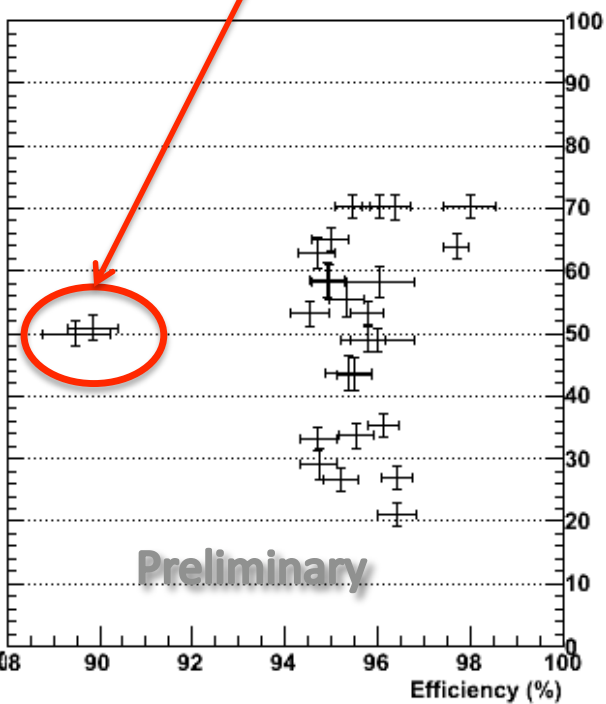
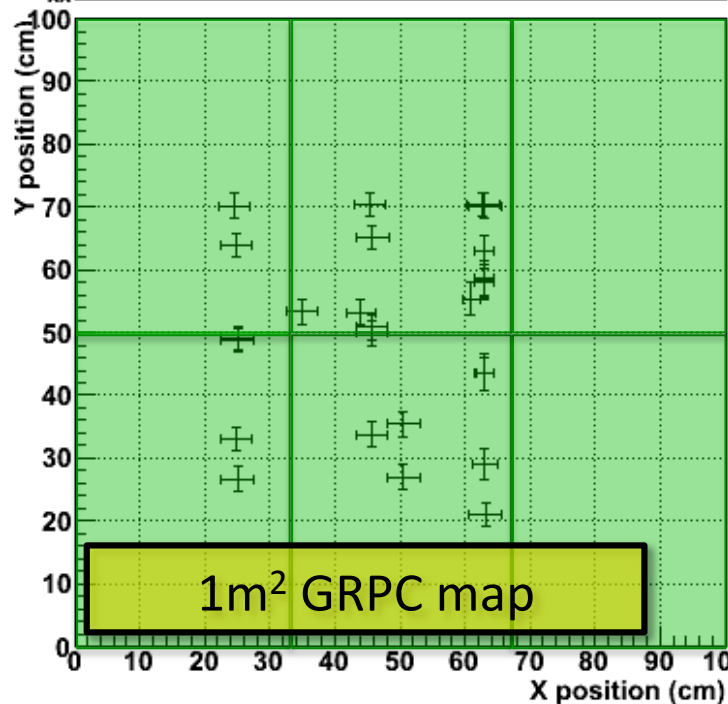
- HV: 7.5 kV
- Threshold: 100 fC (144 DAQ)
- Position scan area **limited by the movable table.**
- Efficiency obtained using **Time selection.**



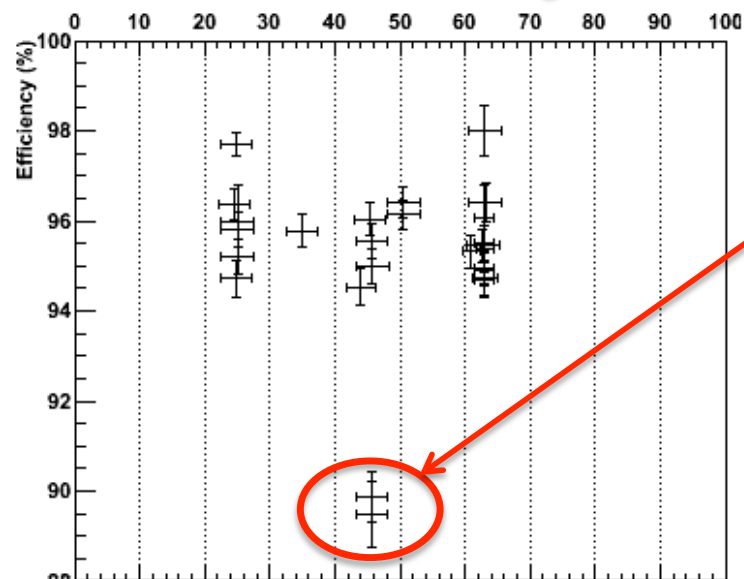
Efficiency Homogeneity Study



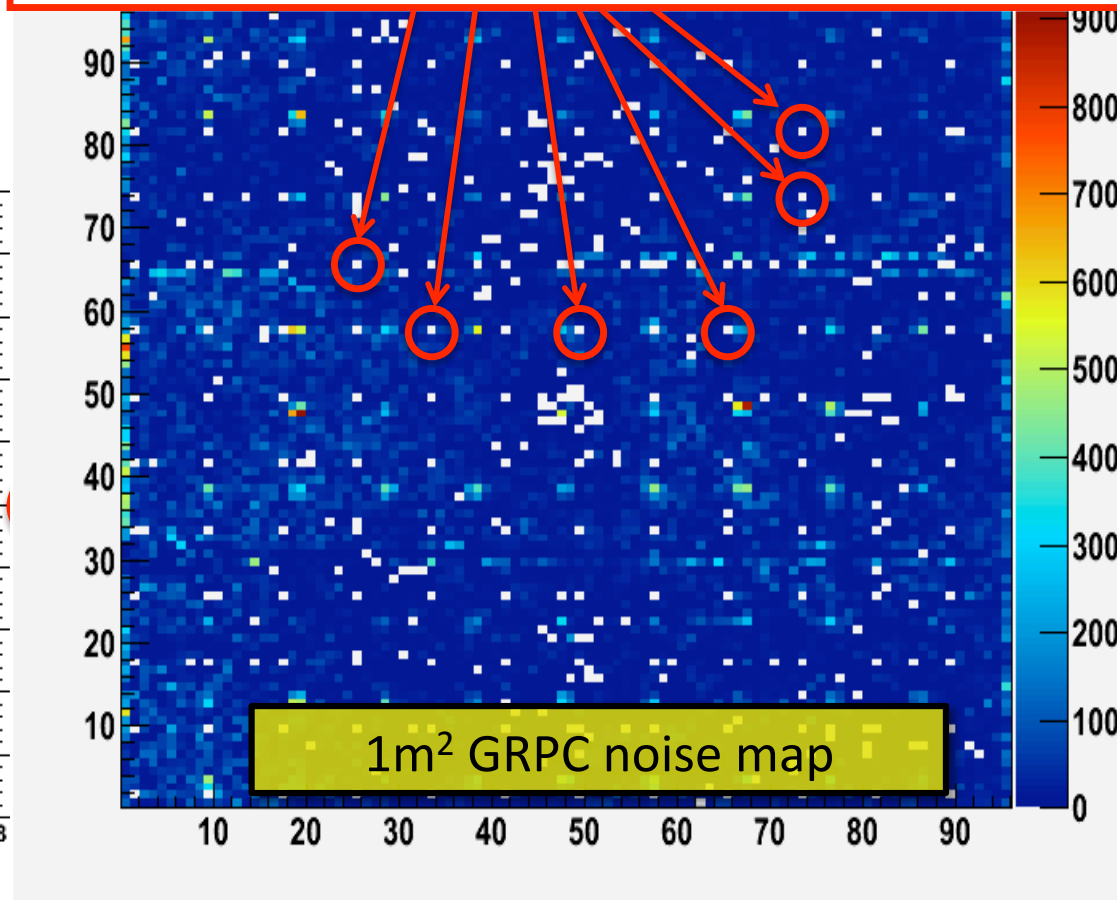
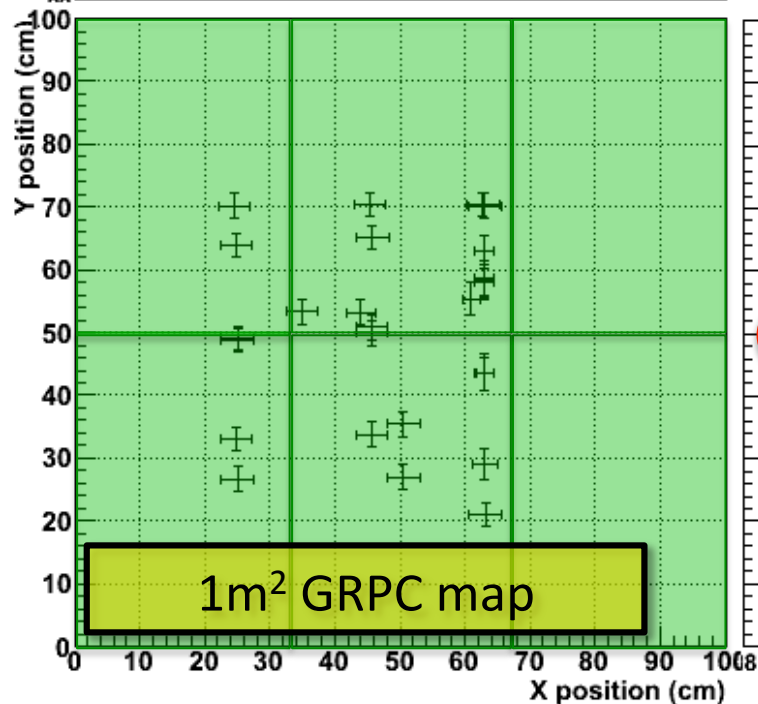
On pad accidentally set off on each ASIC => Could explain these efficiency losses.



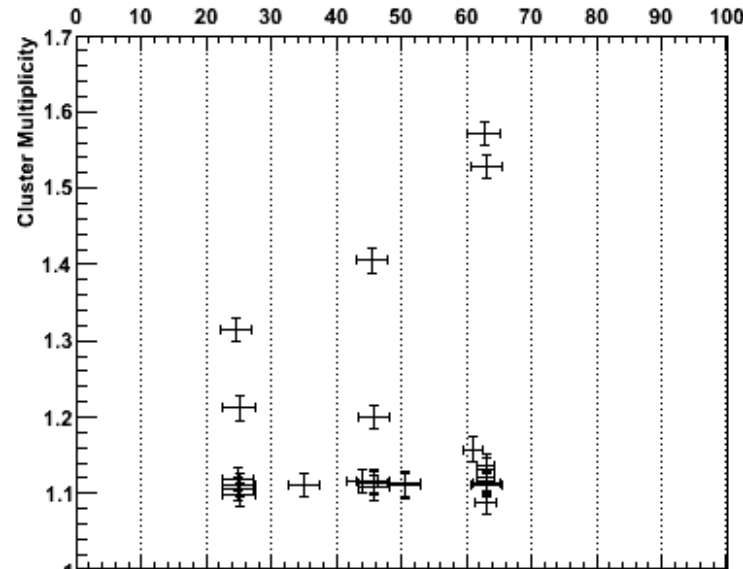
Efficiency Homogeneity Study



On pad accidentally set off on each ASIC => Could explain these efficiency losses.



Multiplicity Homogeneity Study

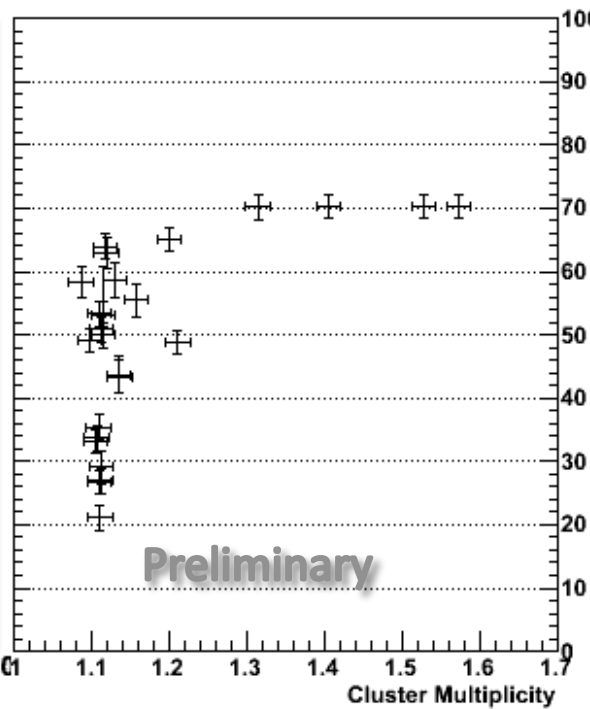
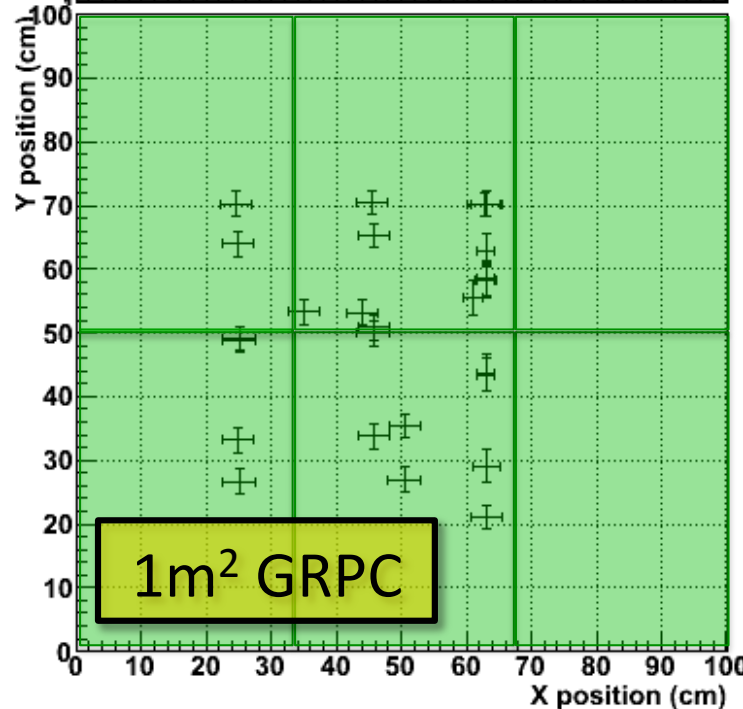


Values from 1 to 1.6 are found.

Variation could be due to **beam position** with respect to **pads**.

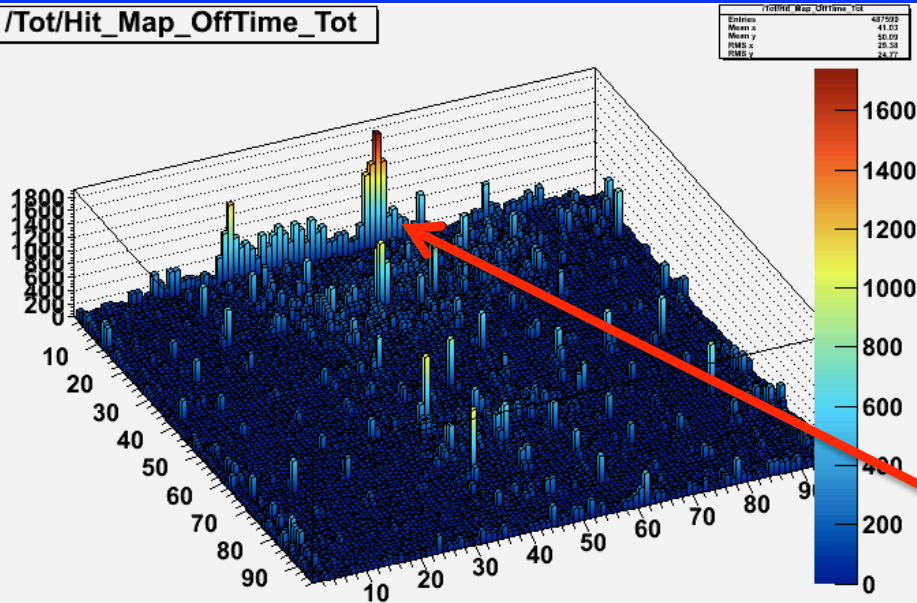
We only have **time selection** here.

Next test beam => Make tracking



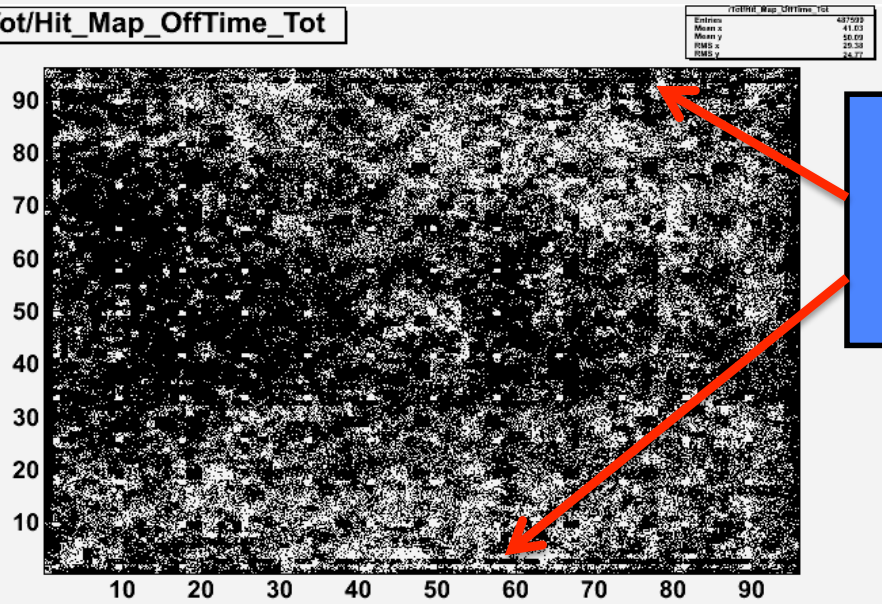
Noise Study

/Tot/Hit_Map_OffTime_Tot

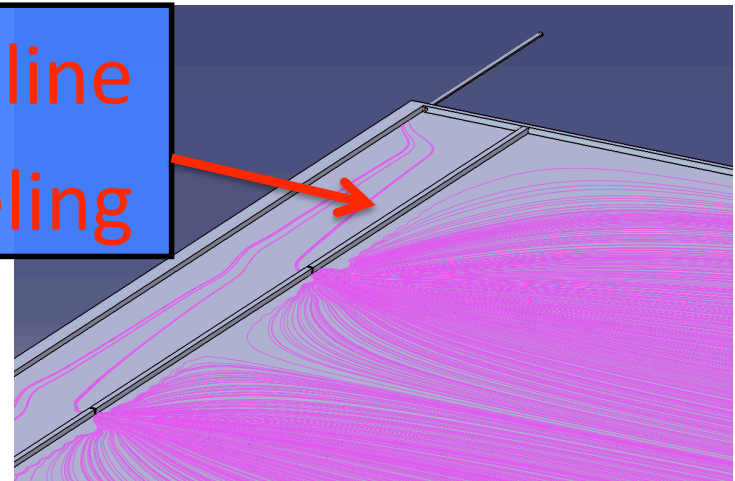


HV supply

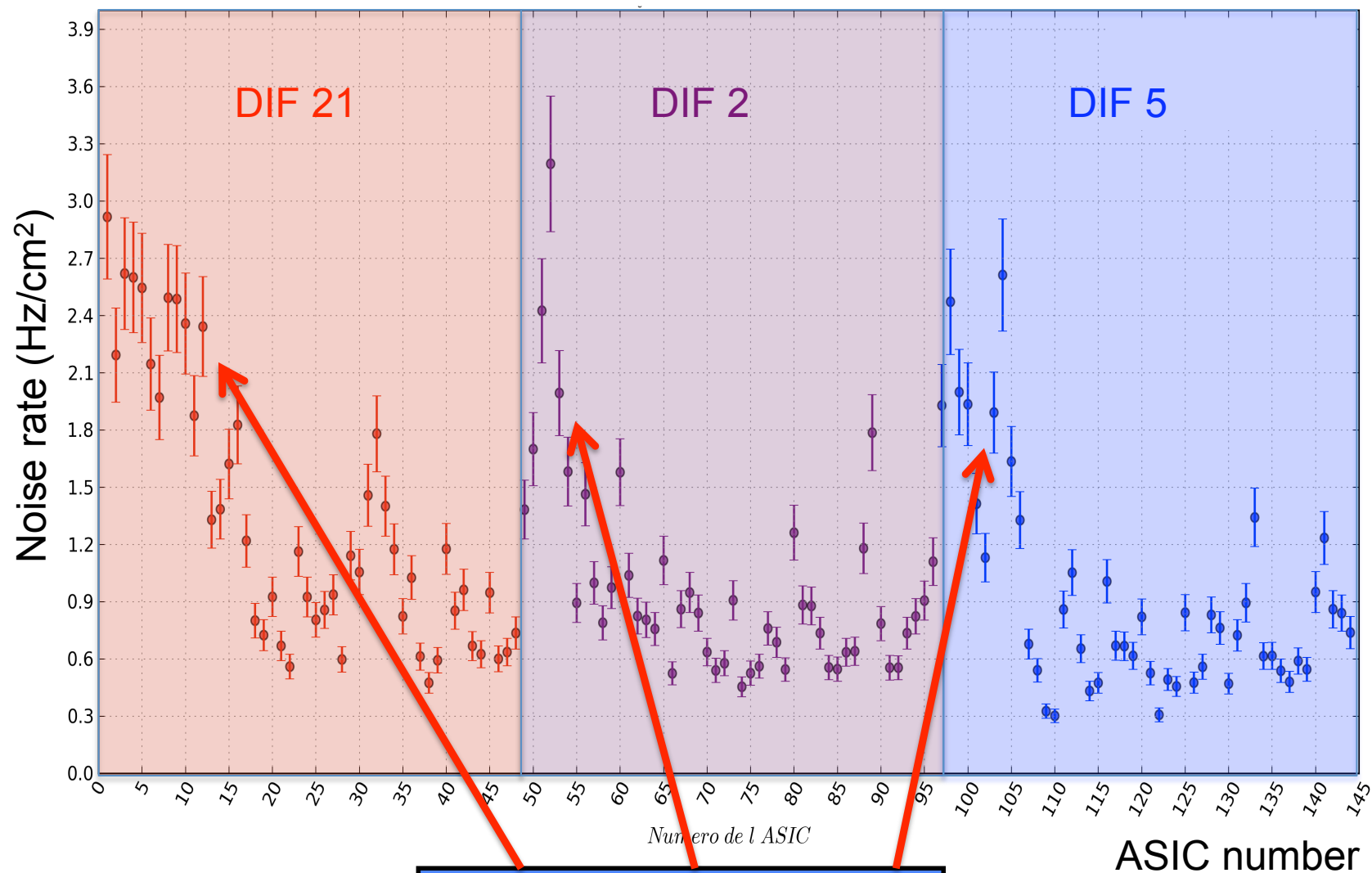
/Tot/Hit_Map_OffTime_Tot



Fishing line
Channeling



Noise Study



HV supply side

Power Pulsing Test Beam

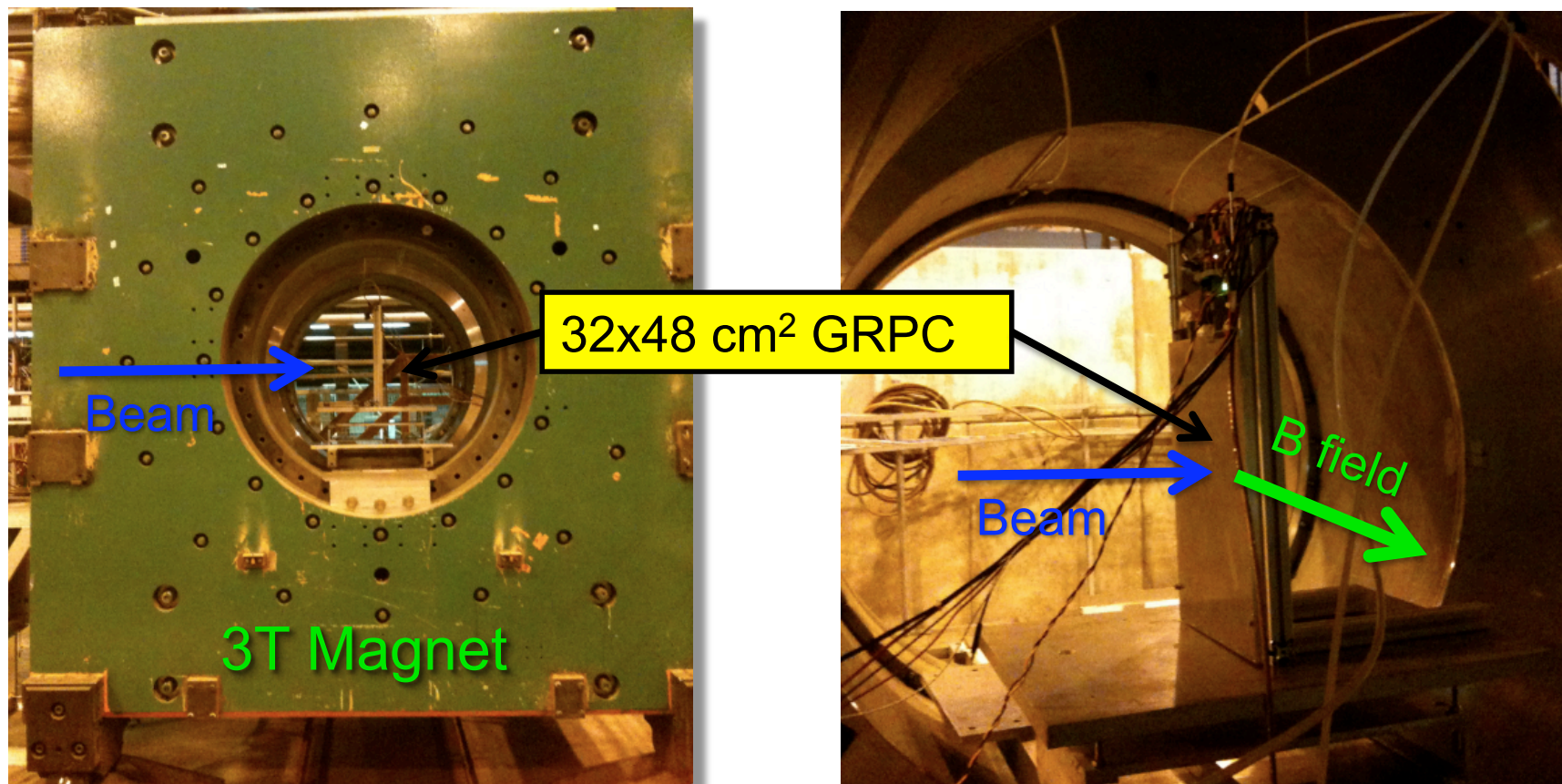
June 2010: 10 days, SPS H2, parasitik operation

Beam conditions: 80GeV @ High Rate

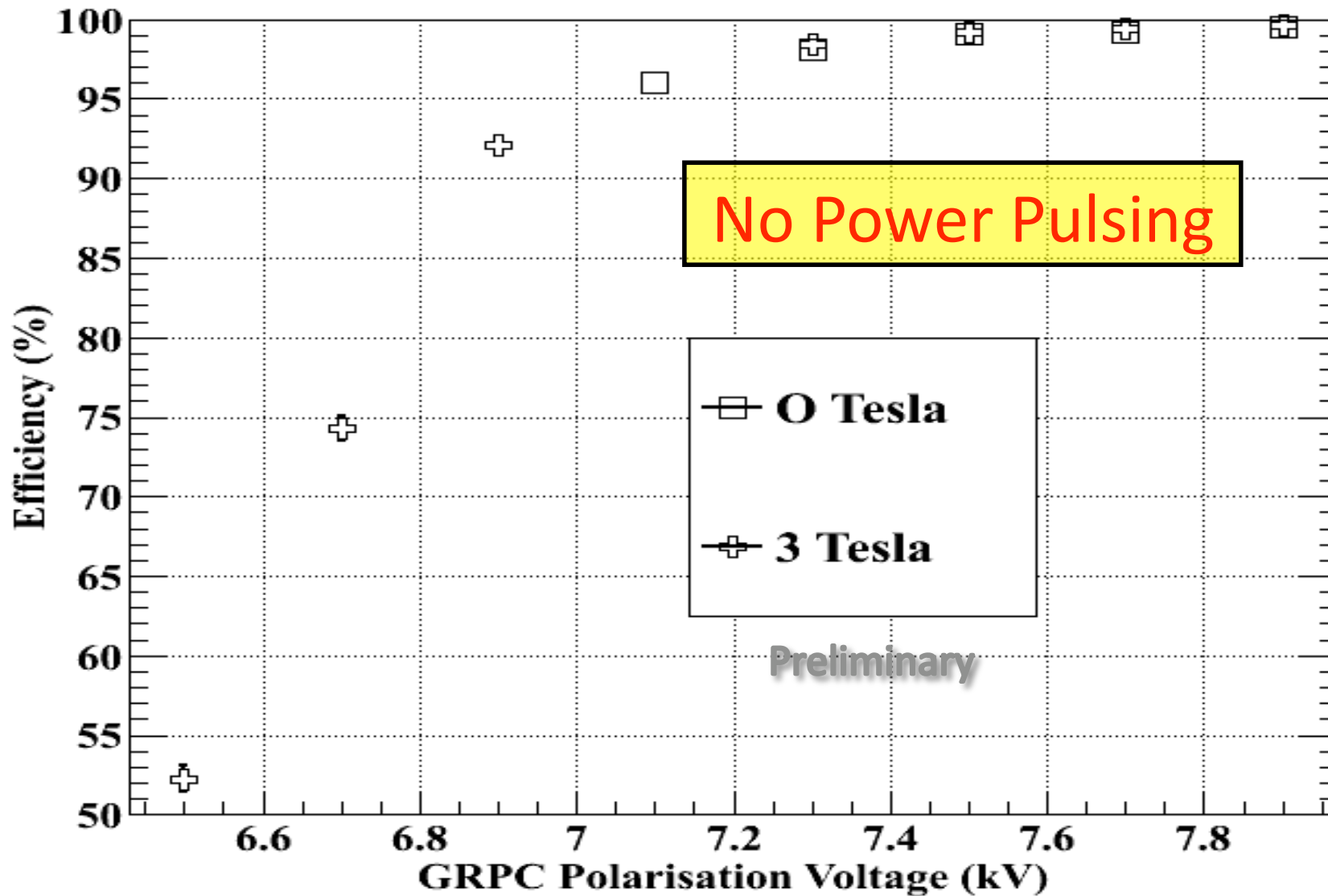
Aim: PowerPulsing tests using B field.

PowerPulsed events: 42 kEvents

Non-PowerPulsed events: 74 kEvents

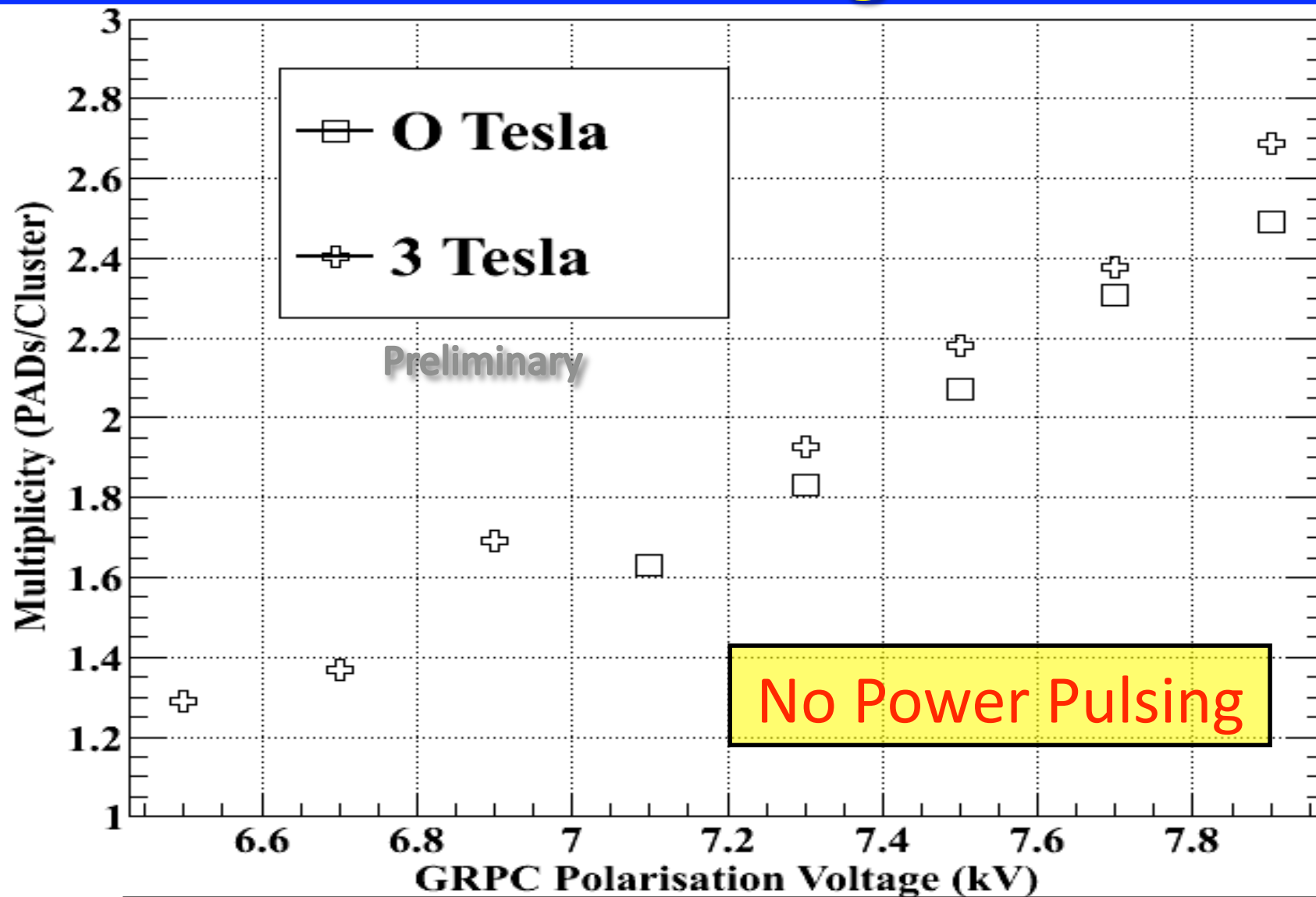


First tests using B field



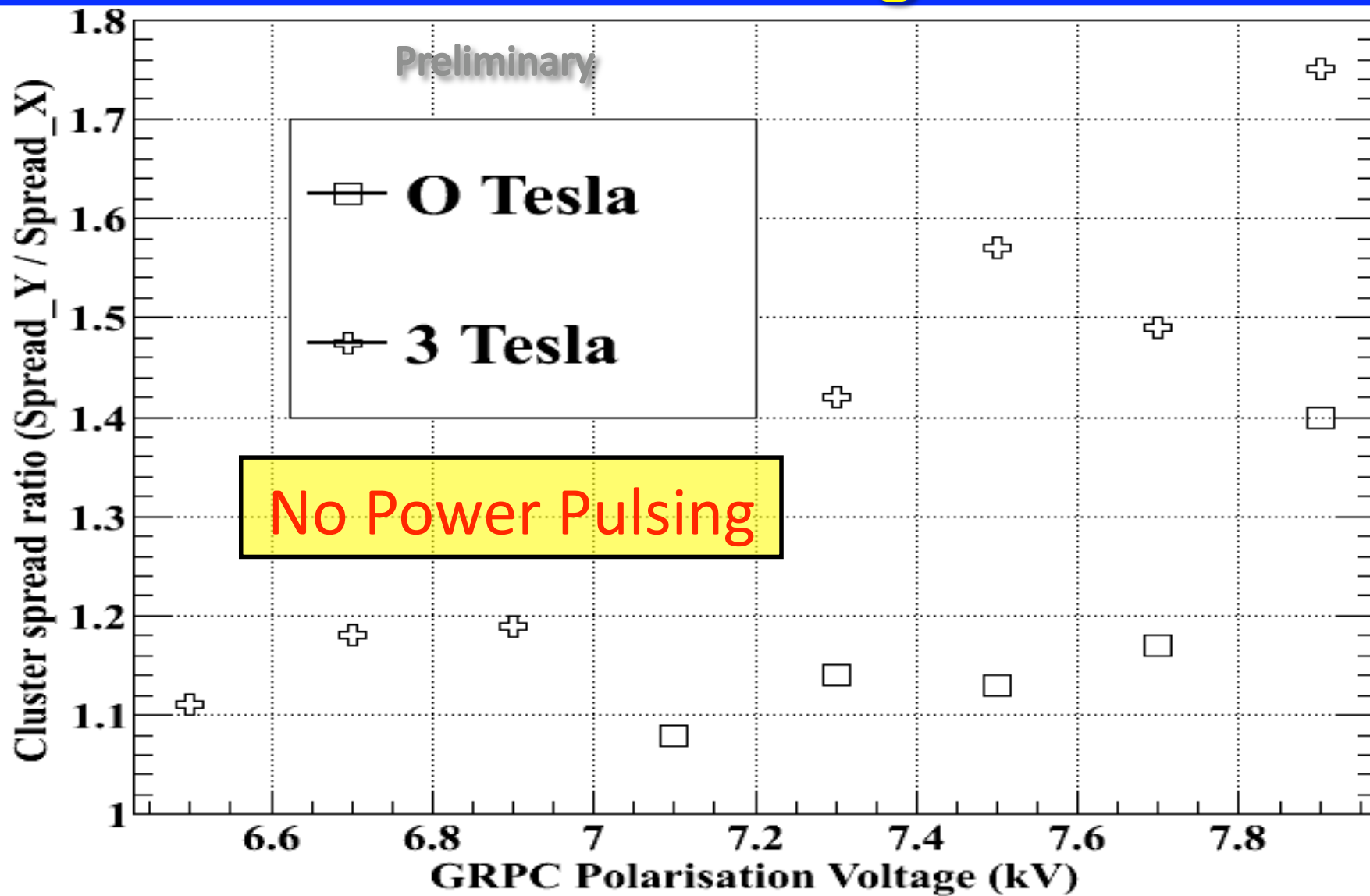
B field has **no impact** on **efficiency**.

First tests using B field



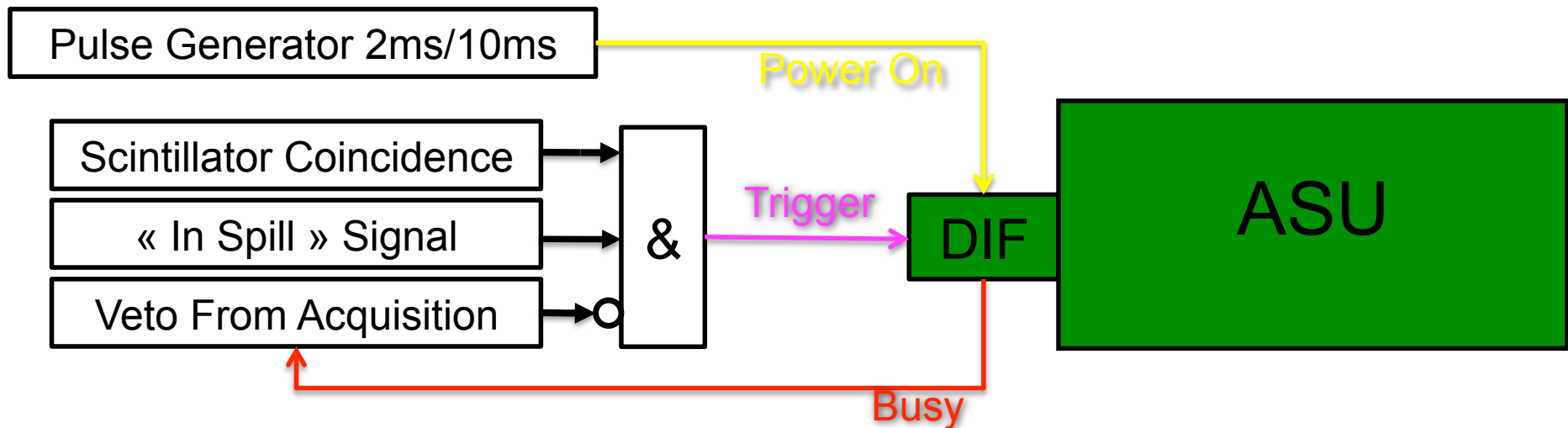
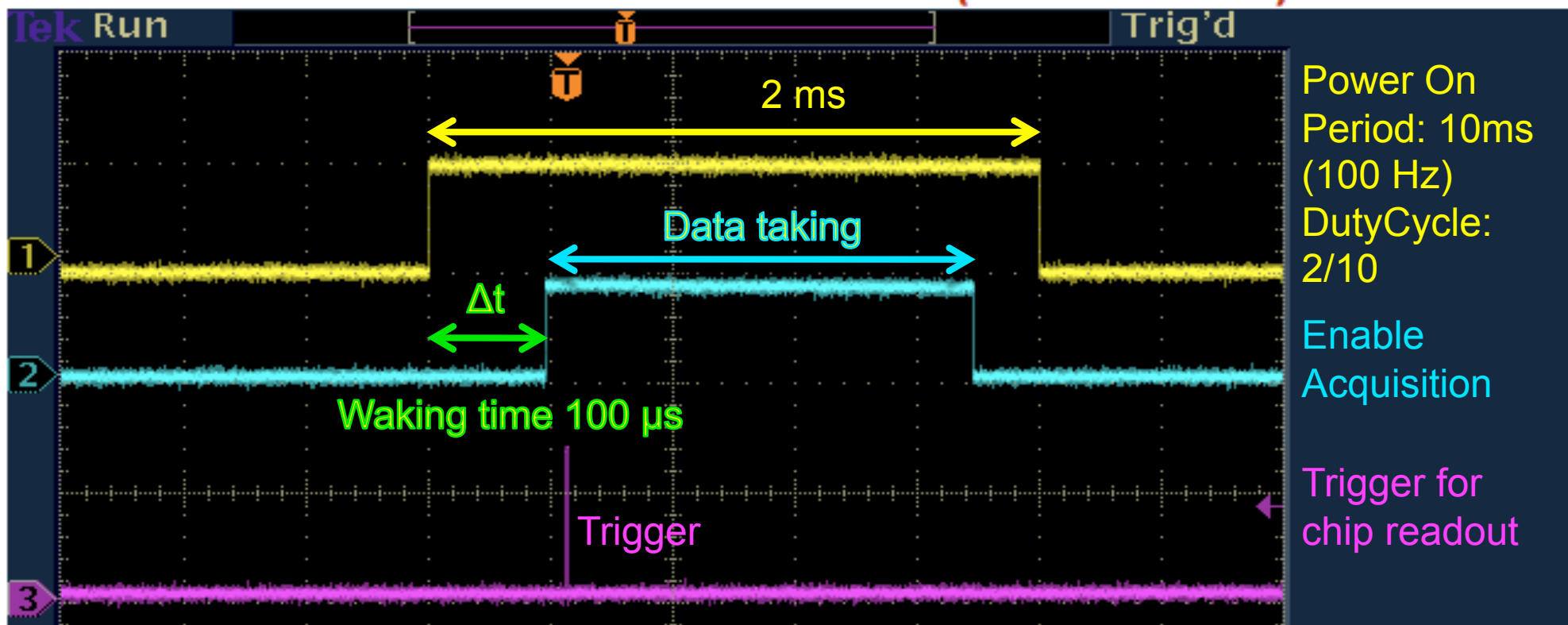
B field increase a bit the multiplicity.

First tests using B field

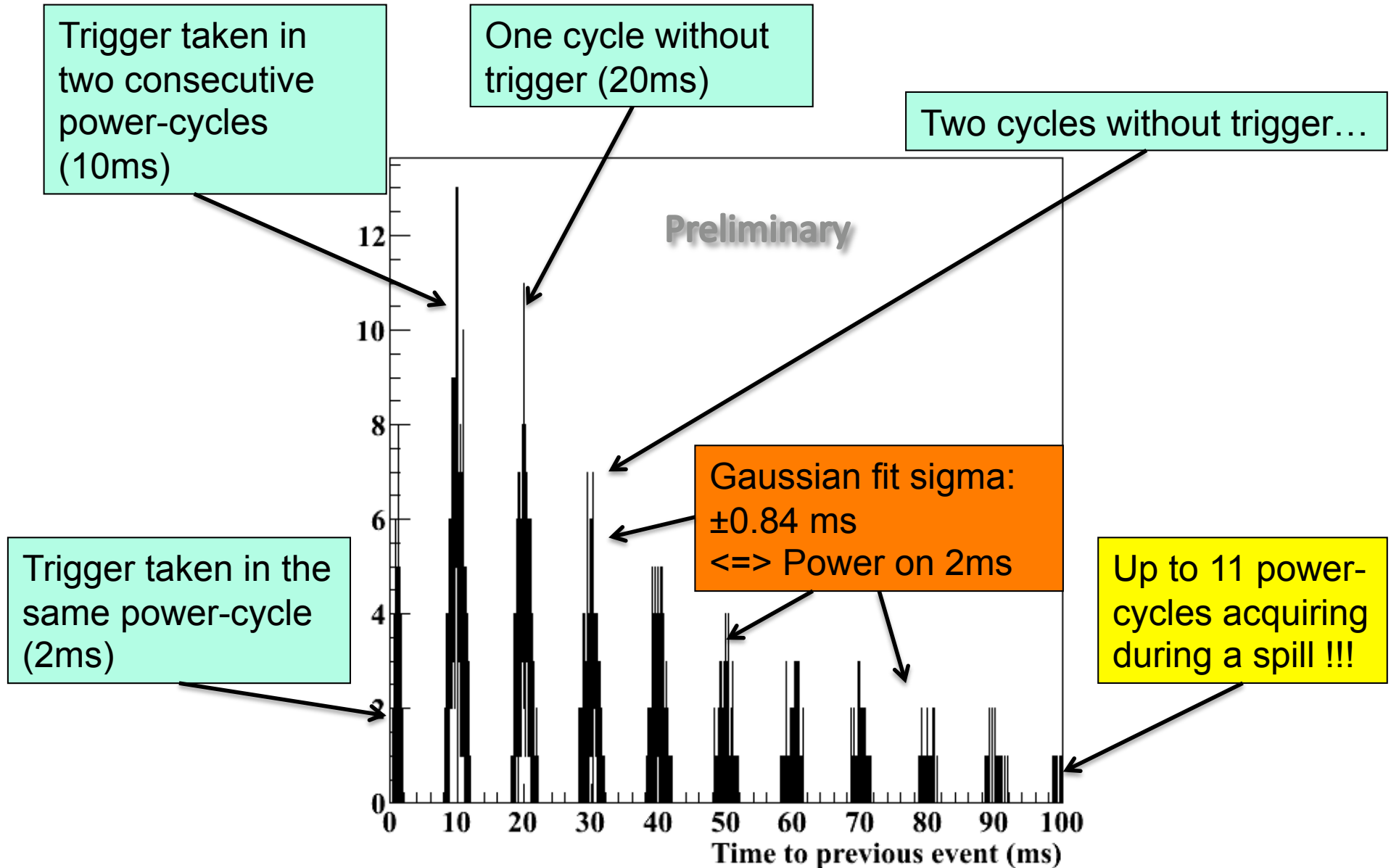


Is B field having an effect on cluster shape?

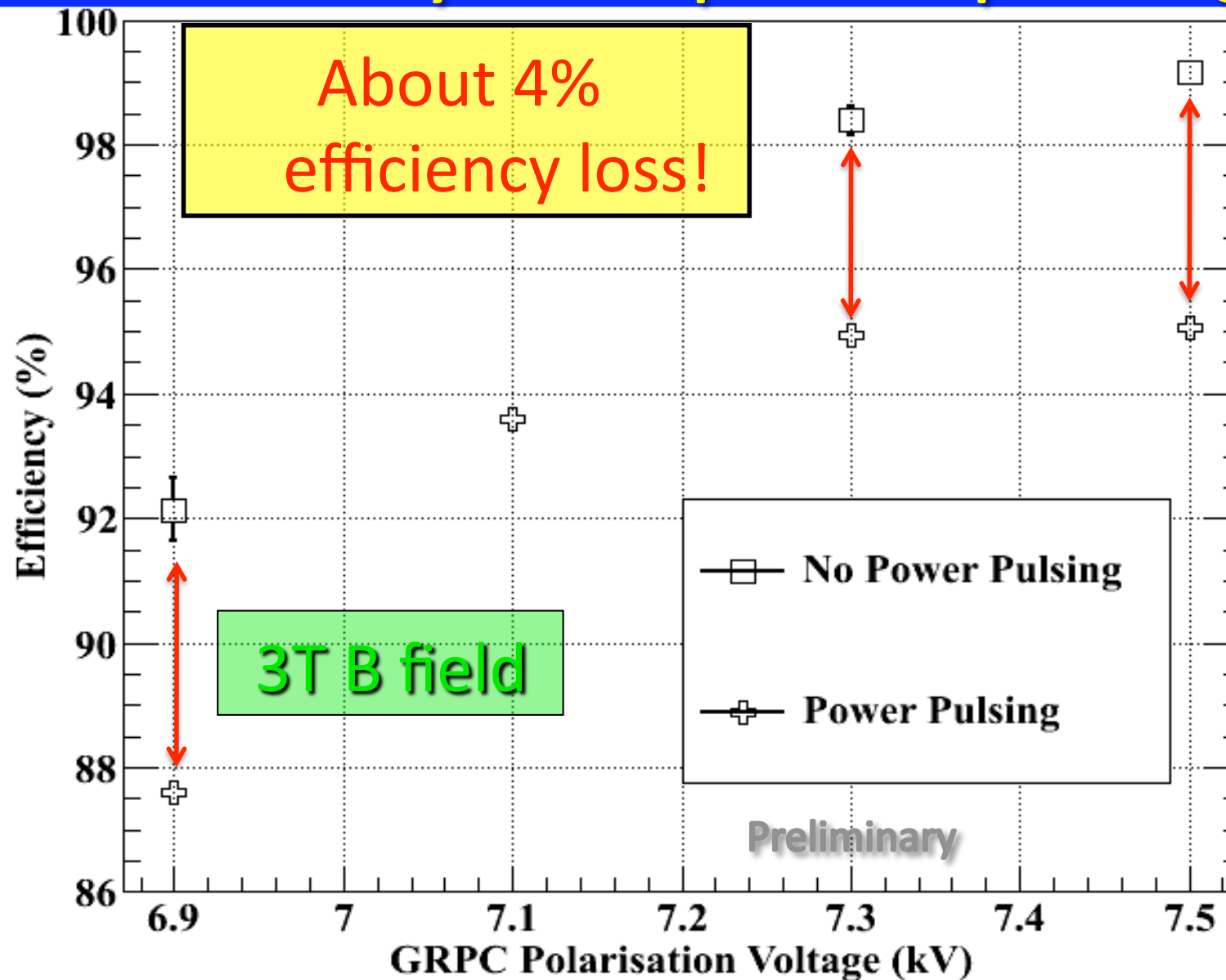
Principle of power pulsing



Timing of power pulsing

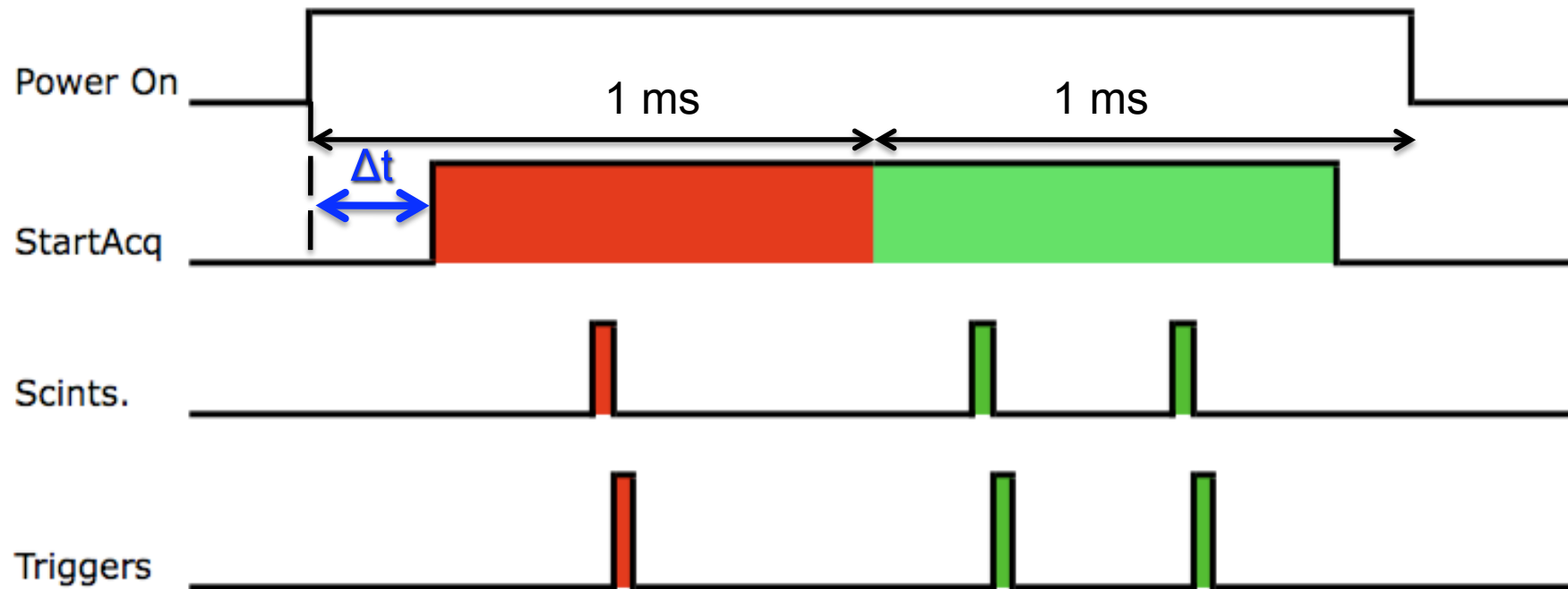


Efficiency with power pulsing

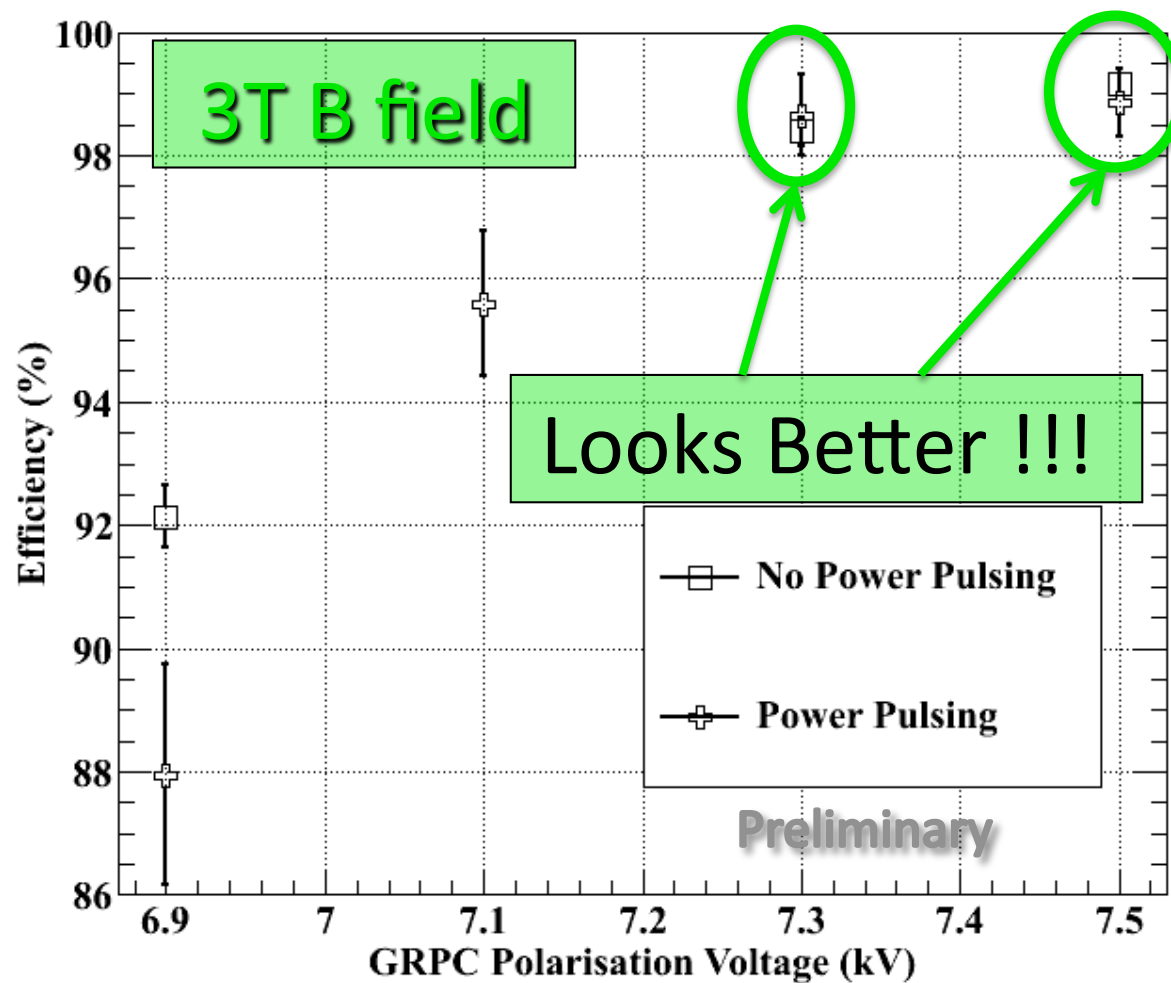


Understanding efficiency loss

- Can't change the **internal delay** ($\Delta t = 100 \mu\text{s}$) during test beam (DIF's Firmware).
- I applied a time selection to keep only event taken during the **second part** (1 ms) of the 2 ms power-on time.

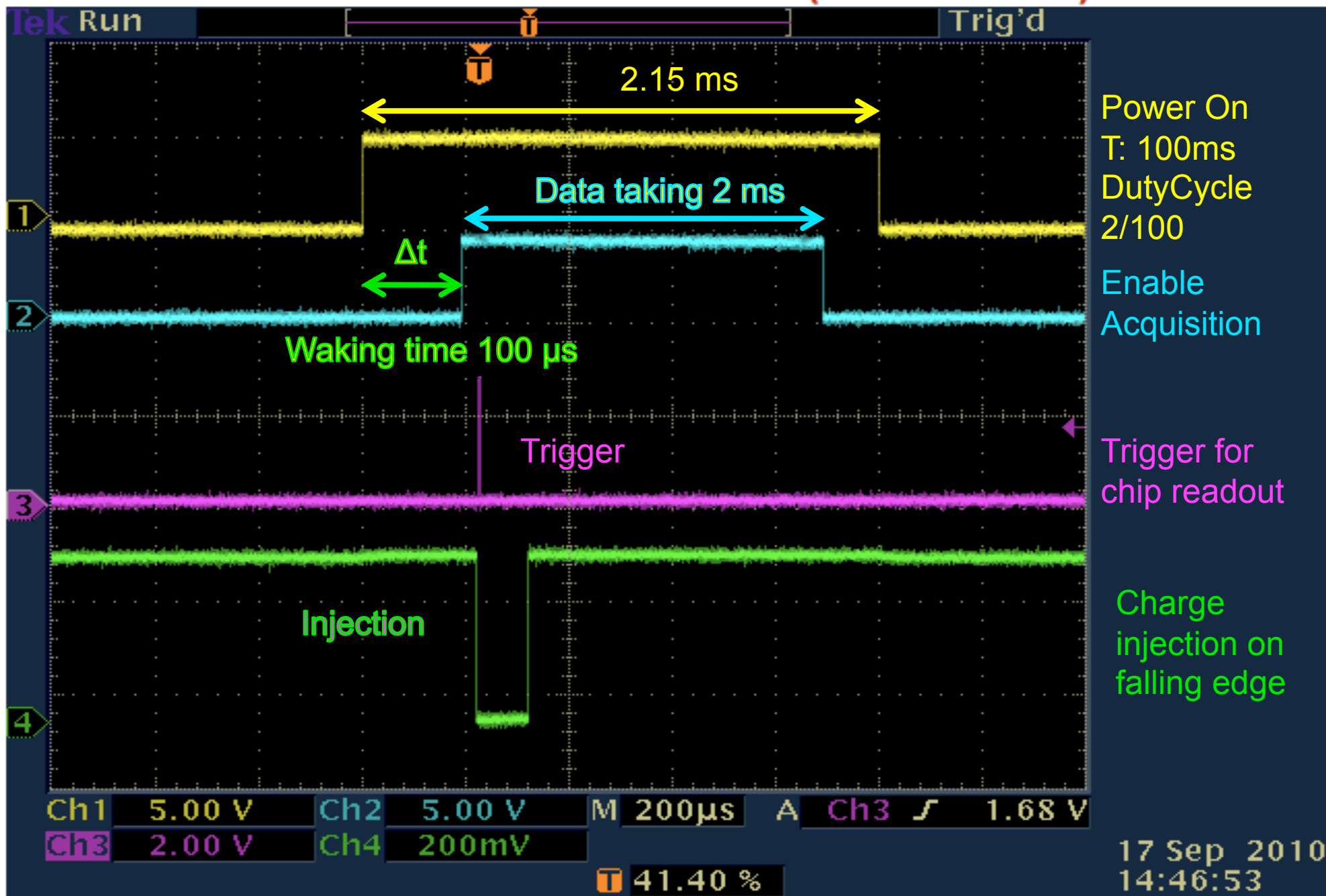


Understanding efficiency loss

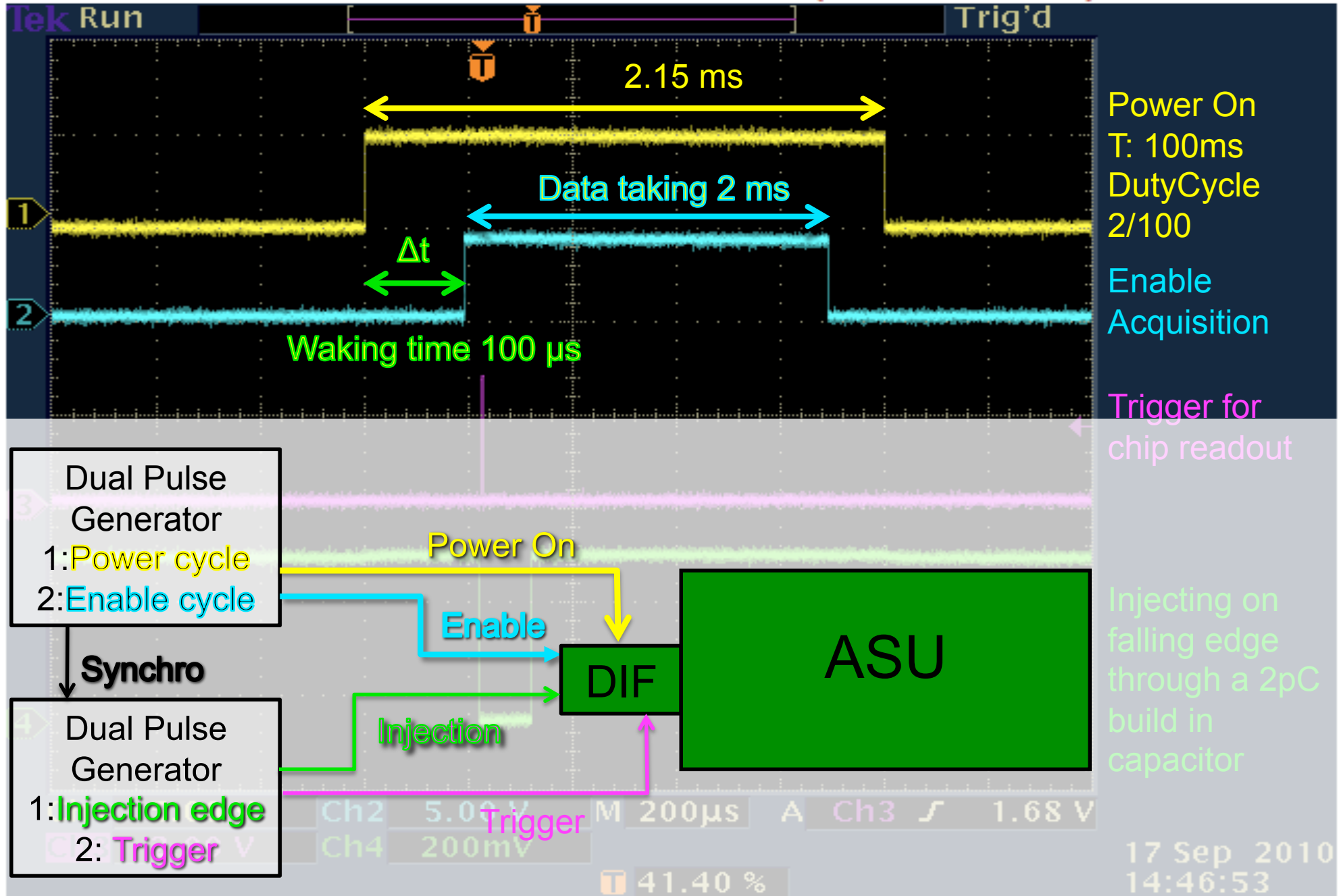


More than 100 μ s seems to be needed to be in a steady way, but **at most 1ms**.

Injection with power pulsing

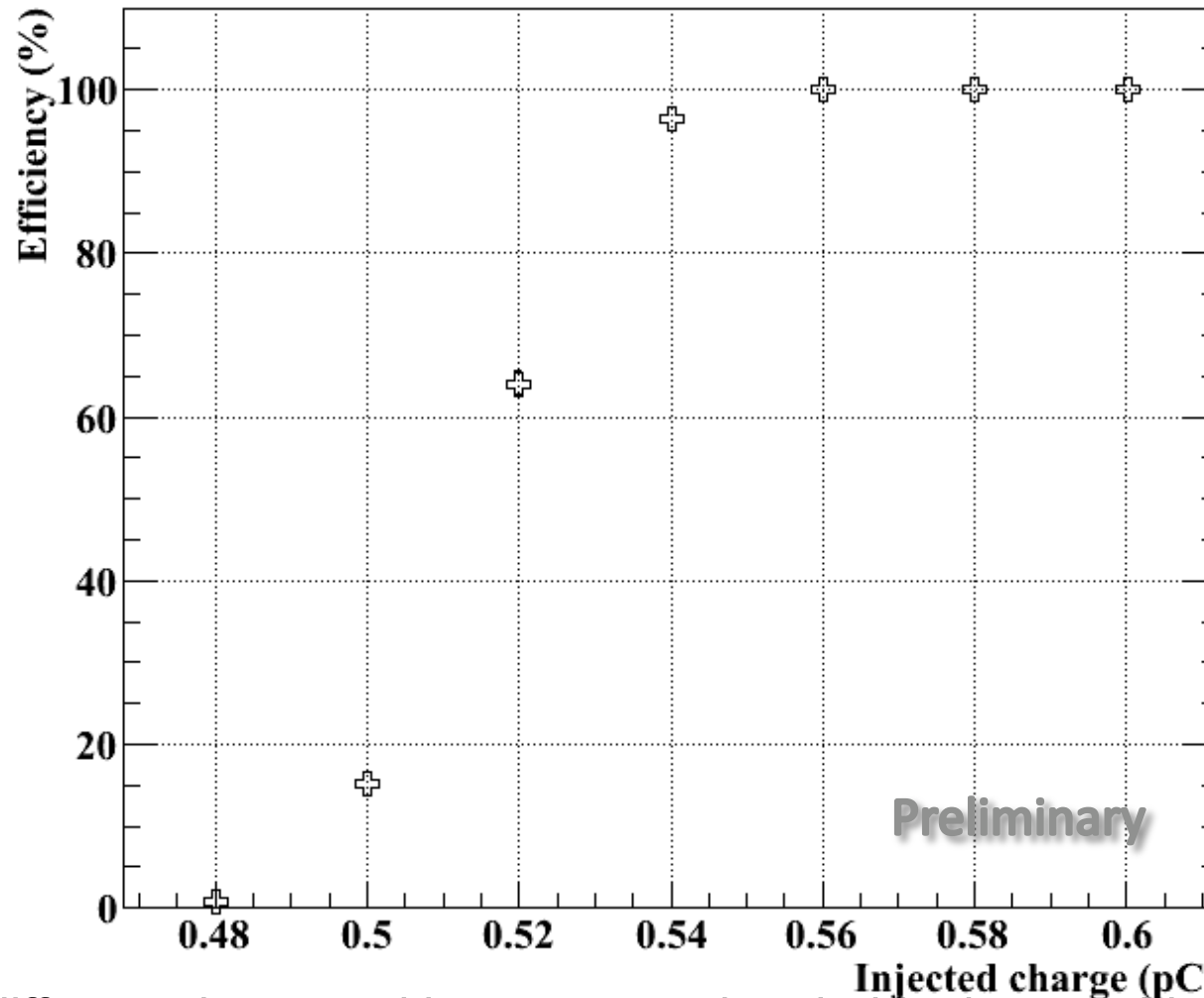


Injection with power pulsing



Injection with power pulsing

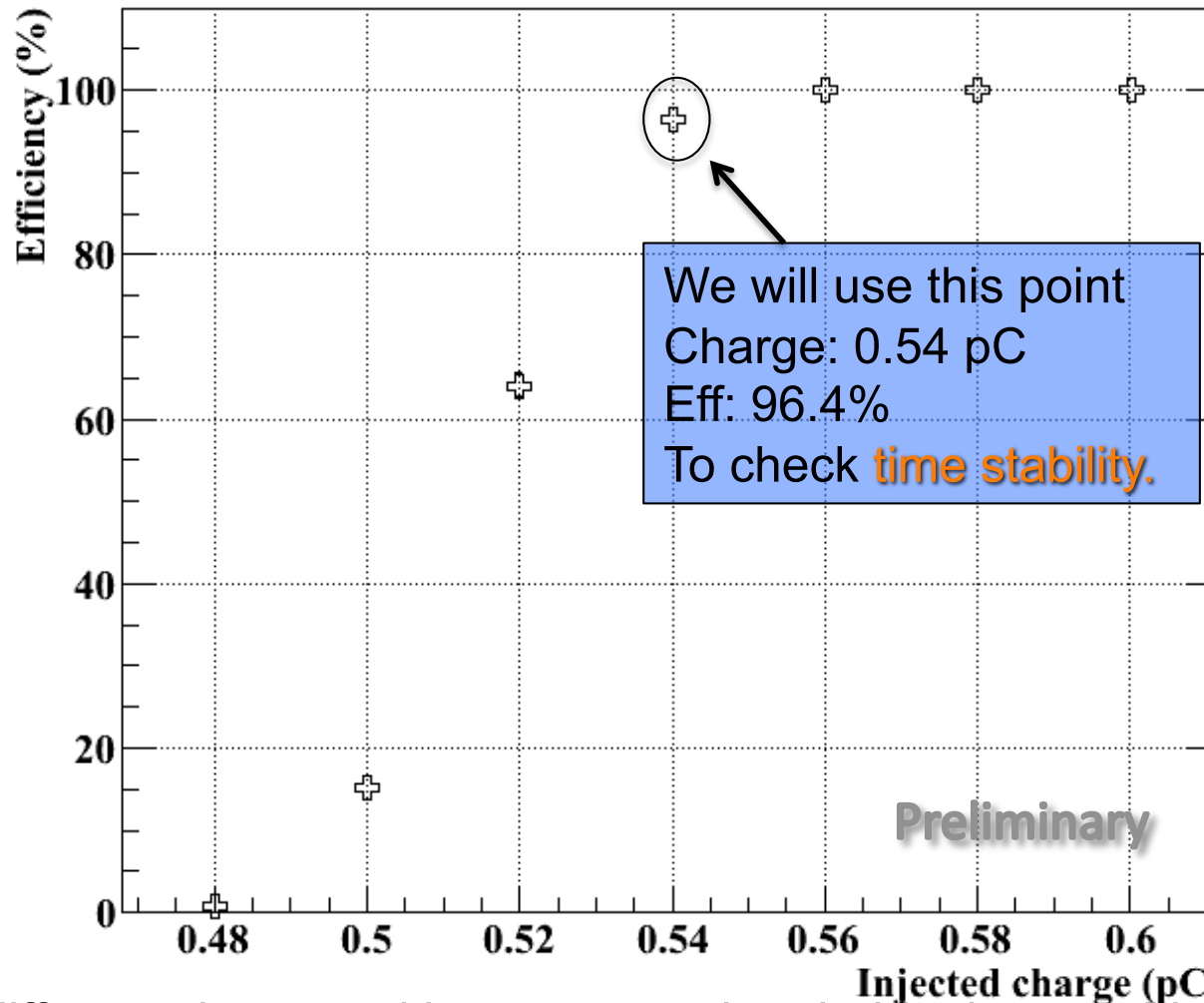
ASIC Threshold_0 (DAC=140 Gain=128)



Injecting different charges with a constant threshold, give roughly a DAC/Charge value for HARDROC 2B. => **140 DAC \approx 0.53 pC** (on Threshold_0)

Injection with power pulsing

ASIC Threshold_0 (DAC=140 Gain=128)

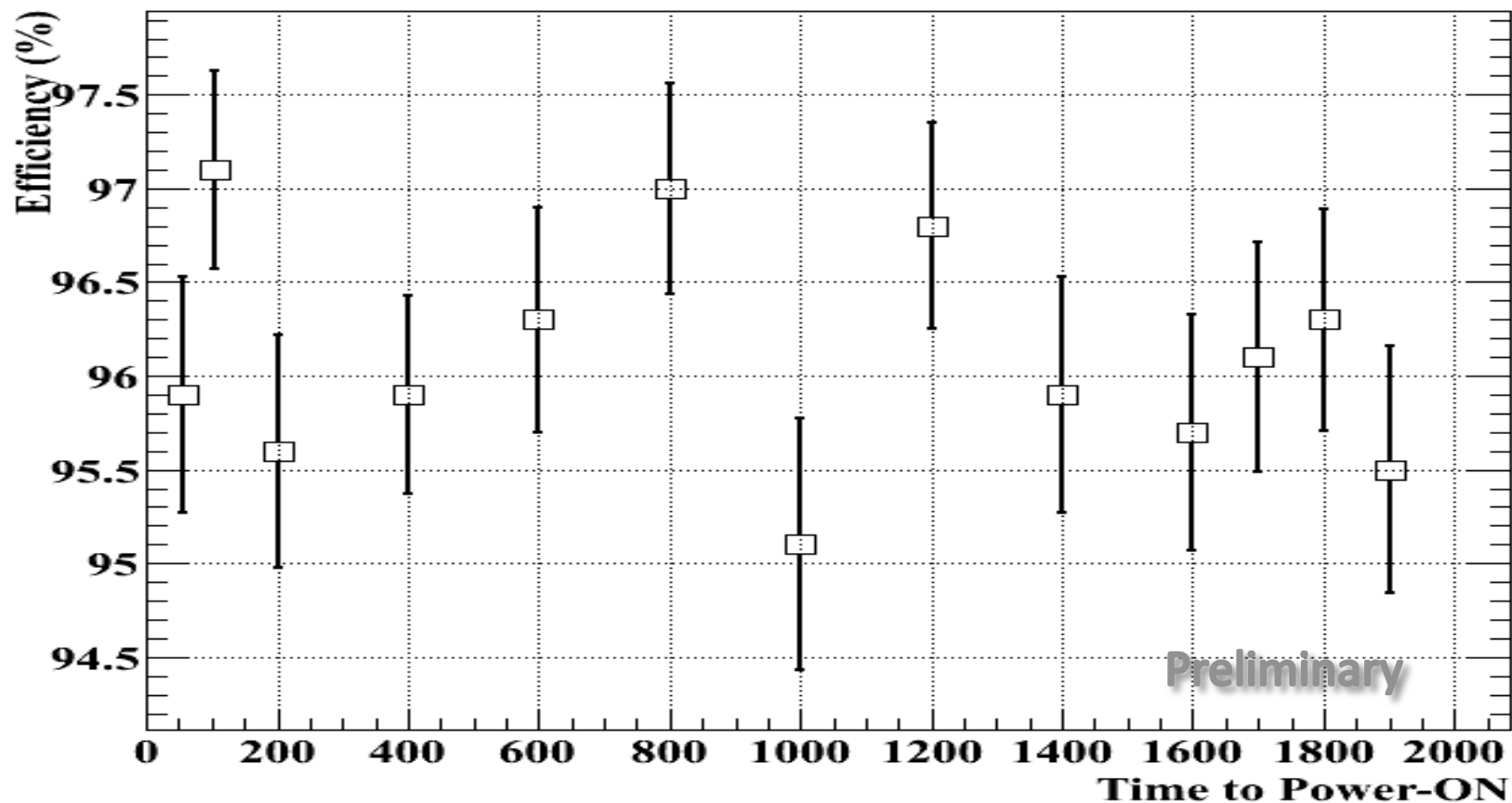


Injecting different charges with a constant threshold, give roughly a DAC/Charge value for HARDROC 2B. => **140 DAC \approx 0.53 pC** (on Threshold_0)

Injection with power pulsing

Suspecting threshold stability, we injected charges with different delays from Power-ON edge. Efficiency is quite constant during the 2ms power cycle. Work is still ongoing to understand efficiency loss recorded on beam data.

ASIC Threshold_0 (DAC=140 Gain=128 Charge=0.54pC)



Summary & Outlook

Large chambers:

- First step in homogeneity study on large chamber give promising results.
- Next coming test beam we hope to do tracking to make detailed homogeneity studies (next week SPS H4).

Power Pulsed acquisition:

- Validity of power-pulsed electronics on B field demonstrated.
- Huge gain in power consumption could effectively be reached: 2Amps -> 0.7Amps (2/100 ms PowerCycle) on 48 HARDROC slab.
- We have to dig a bit more to optimise waking up timing.