Proposal for building a light-sensitive array based on Digital SiPM from PHILIPS for the Aerogel-RICH HMPID system.

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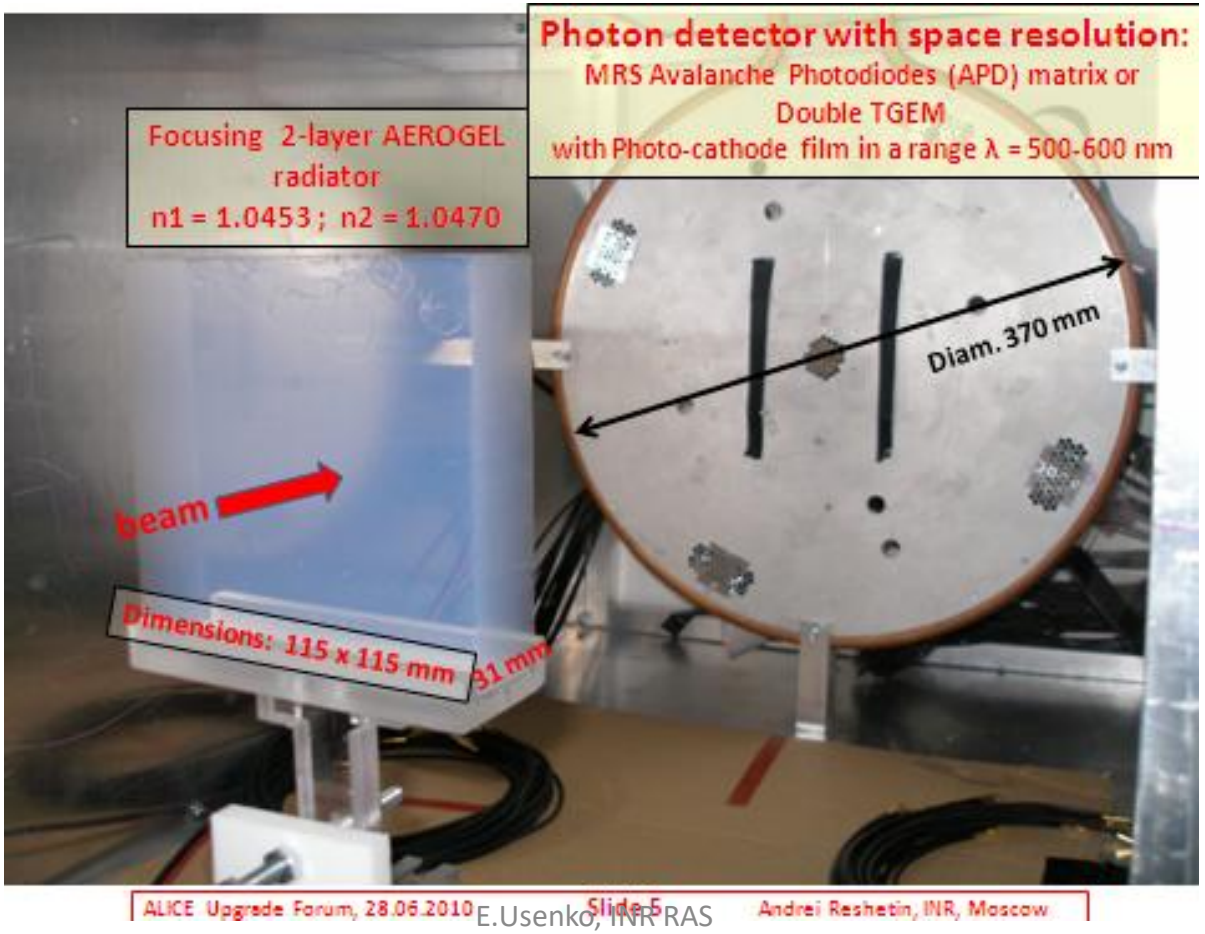
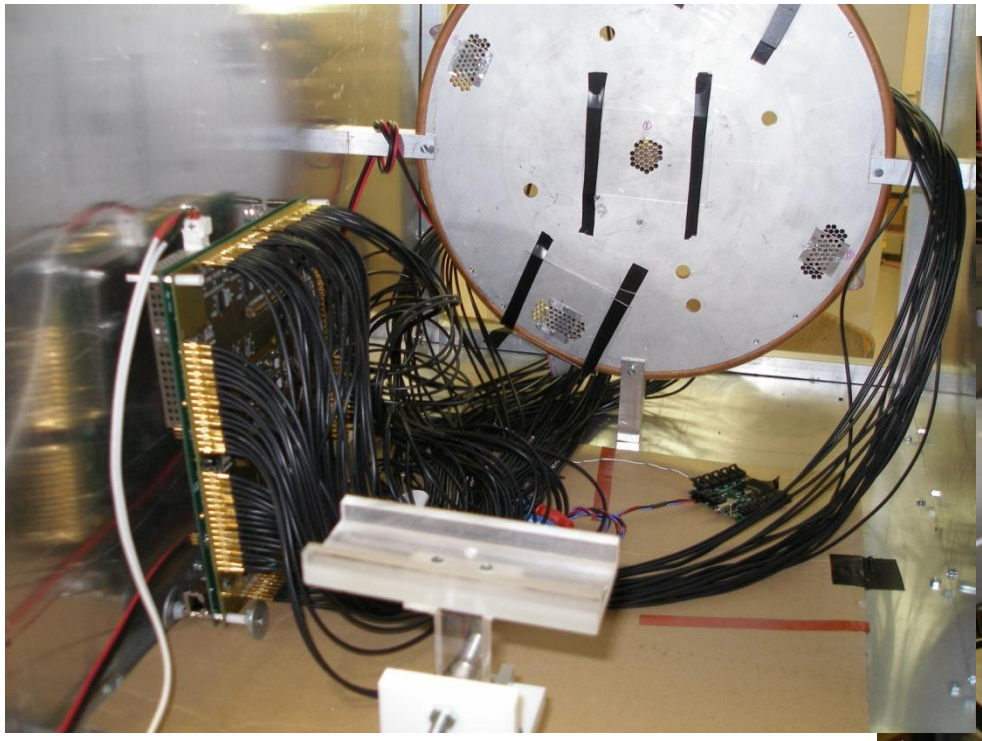
Introduction.

This proposal based on R&D of prototype FARICH which provided 2009-2012 years on CERN PS test beam for ALICE experiment.



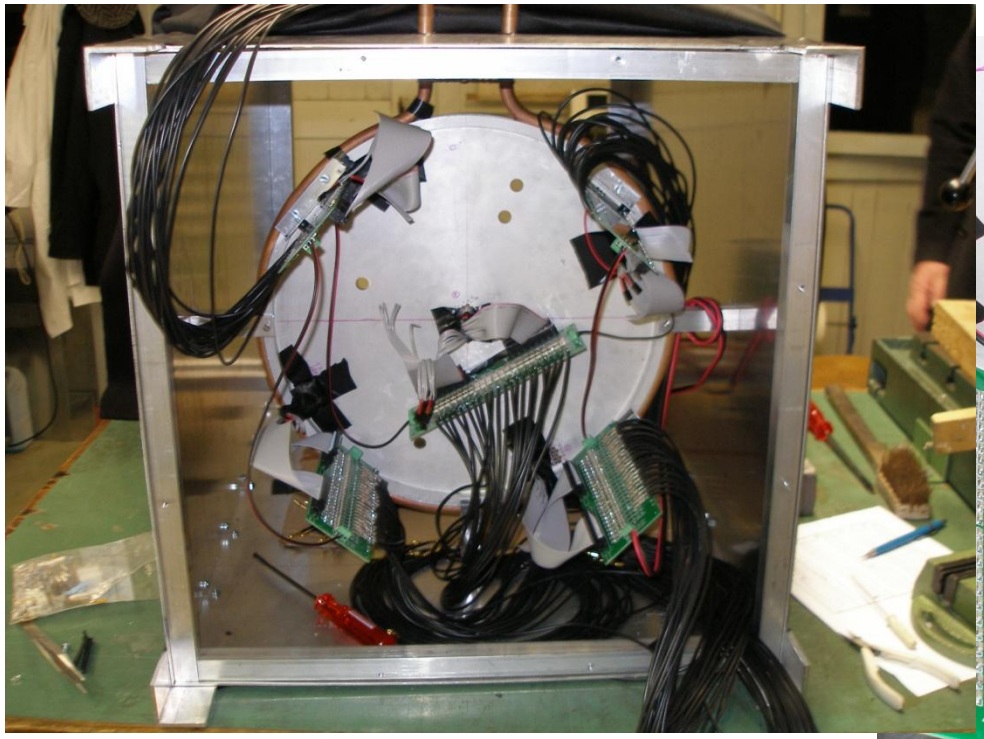
The first phase of FARICH-Prototype test on the CERN PS T10.

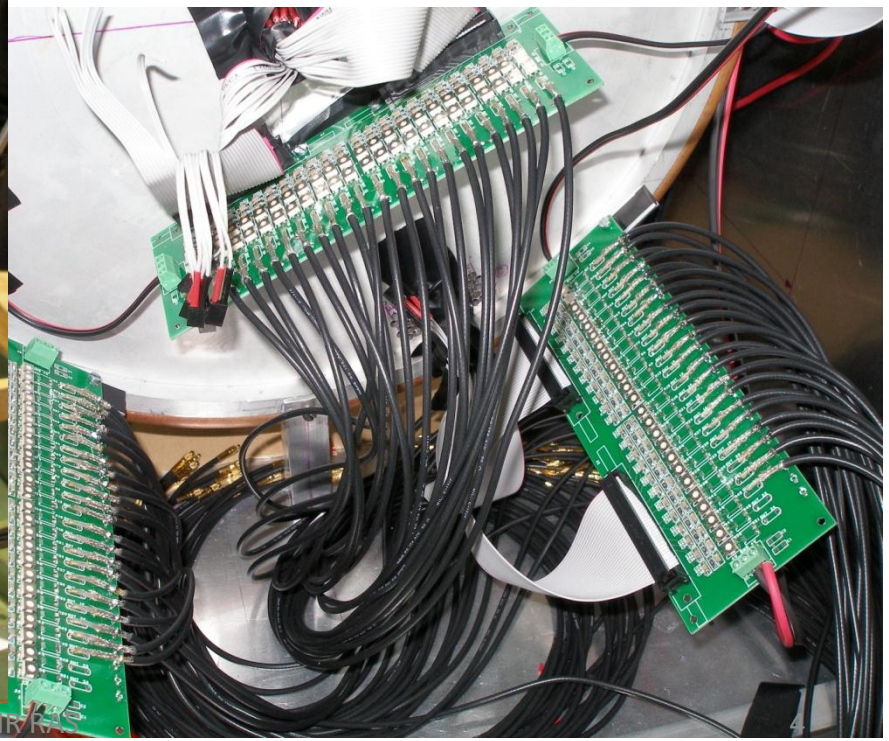
- First prototype of light sensitive array for Cherenkov rings was design by analog SiPM 1x1mm and consists of 108 single analog SiPM combined to four groups for 27 channels.
- Light sensitive array as a first prototype was consisting of four segments by total numbers of 27x4=108 SiPMs 1mm^2 size by one.



The first phase of FARICH-Prototype test on the CERN PS T10.

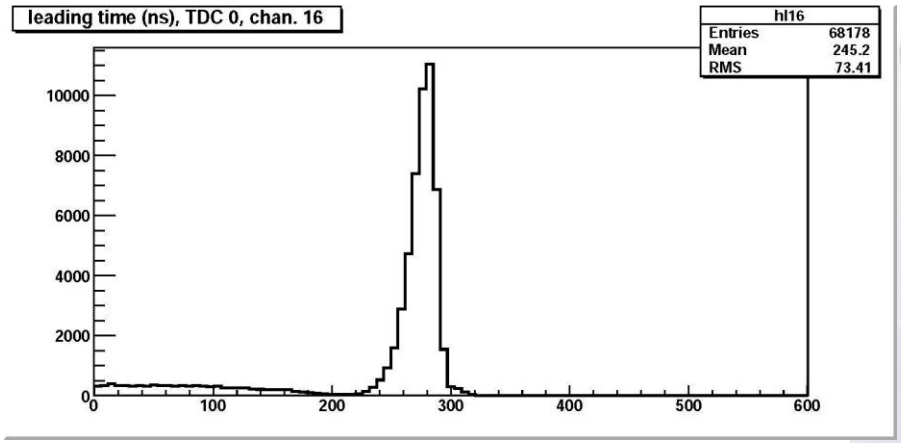
- Interconnection included SiPM biasing,
- Cabling to front-end electronics.

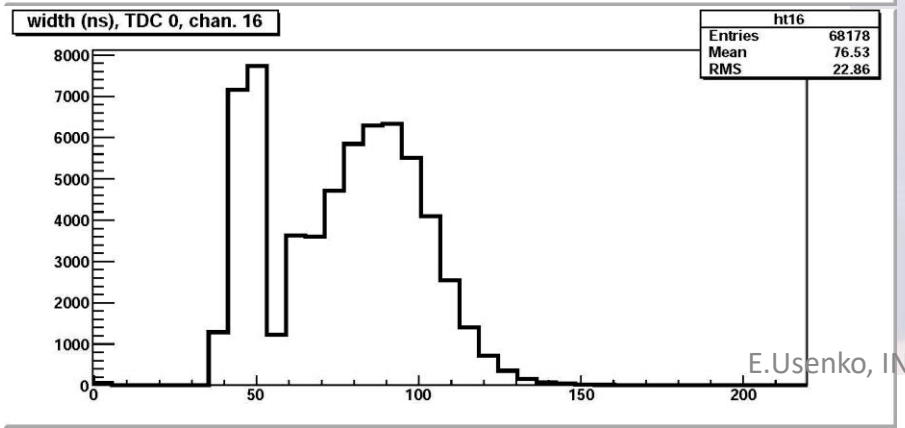


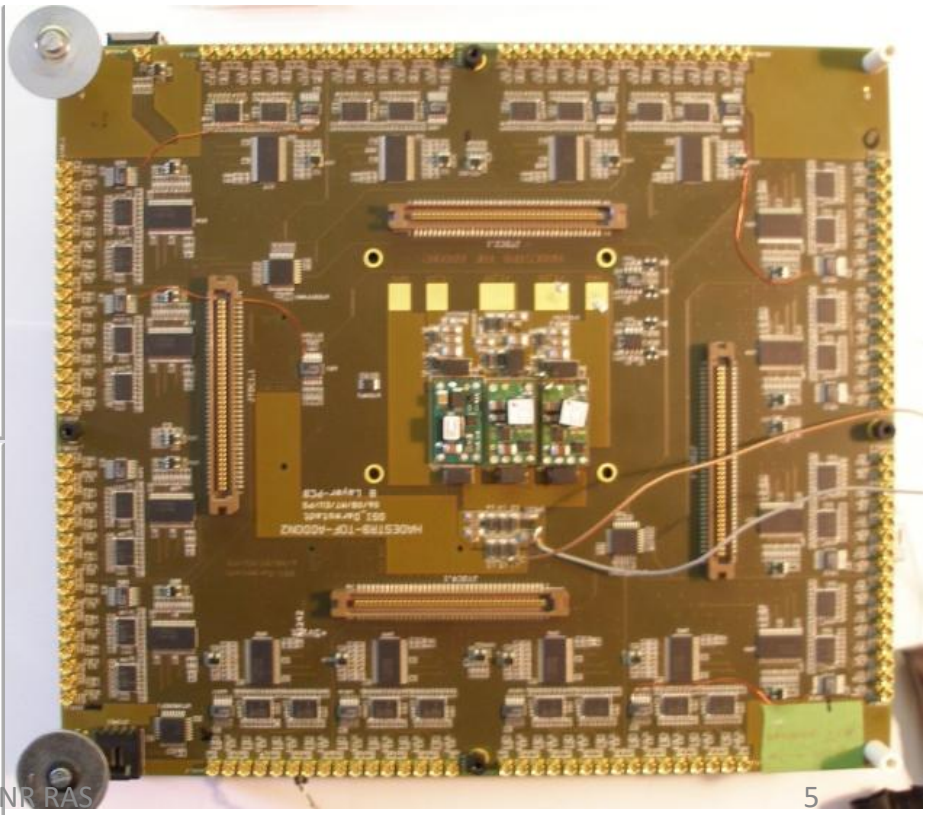


The first phase of FARICH-Prototype test on the CERN PS T10.

- 128-channel TRB2 based DAQ and front-end electronics especially modified for low threshold application – APD signals by ~ 1mV amplitudes for 50 Ohm load.
- Digitizing by TDC, 100ps/bin.



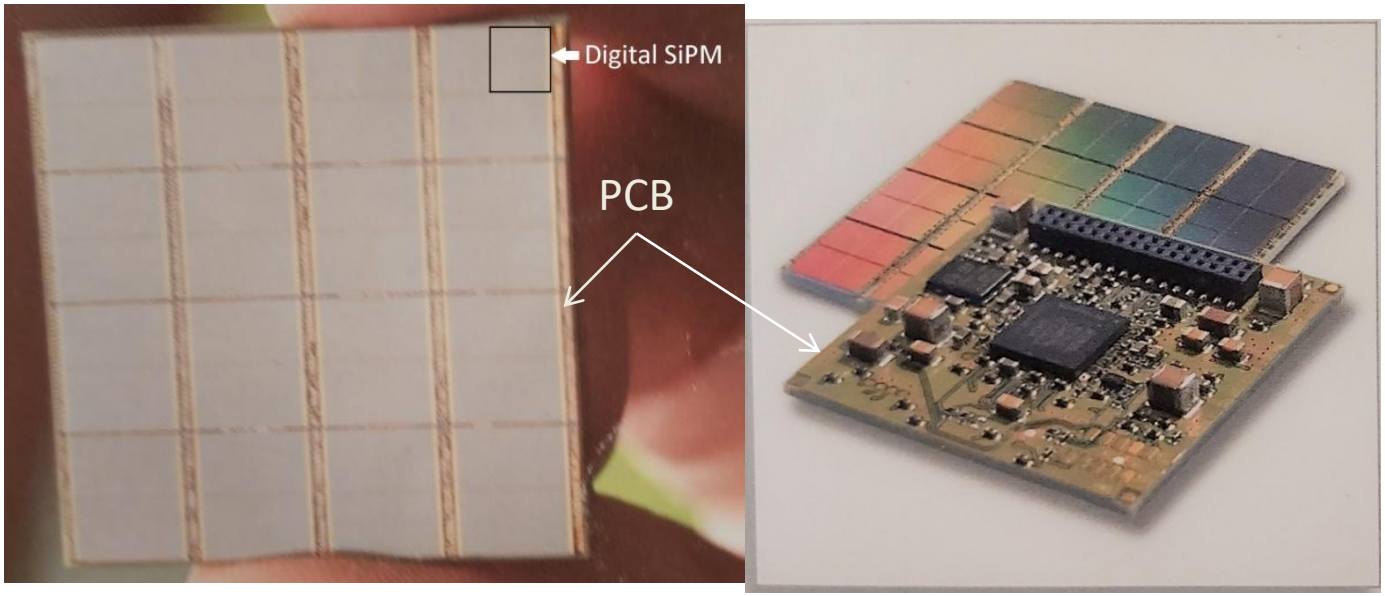




The first phase of FARICH-Prototype test on the CERN PS T10. Conclusion.

- Single SiPM could be use for build array only for low number of channels.
- Parasitic interconnect capacitance and coupled transmittion lines reduce detector quality more than array size.
- The price of of Front-end electronics and DAQ is higher than the detector itself and further increases with the size of the array increase.

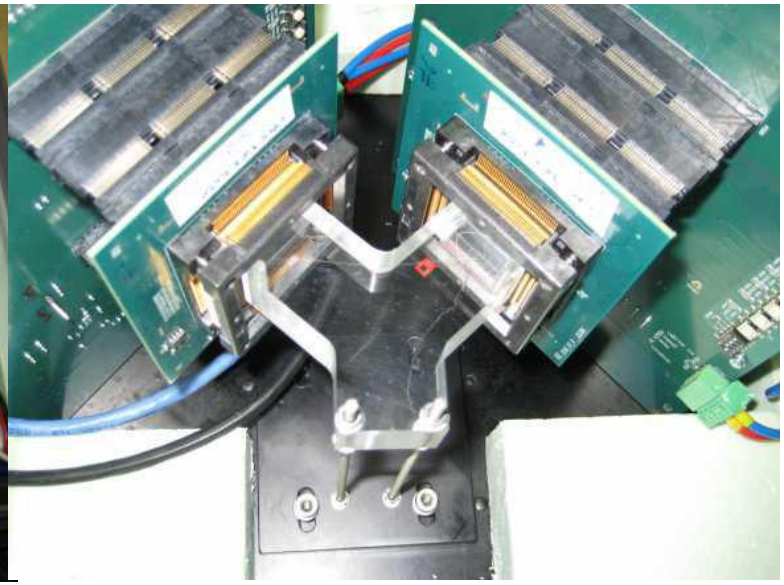
Digital SiPM from Philips.



Digital SiPM array cluster based on 32x32mm PCB:

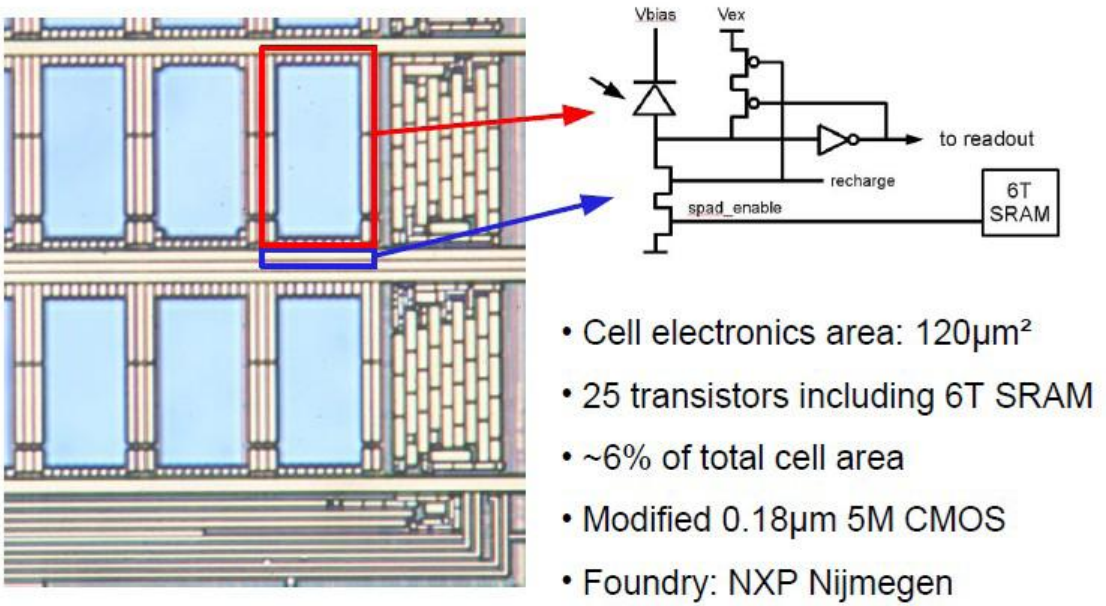
- On top side is mounted 8x8 DSiPMs,
- On bottom side – interface electronics cluster.
- Integrated readout electronics is the key element to superior detector performance

Cherenkov Detector: Experimental Setup. CERN PS & SPS beam test.



- PMMA radiator coupled via air gap to two digital SiPMs in coincidence
- Sensors used: DLD8K (technology demonstrator), 8188 diodes each
- Box isolated and temperature-controlled with a TEC to 2-3°C

Digital SiPM from Philips.
SiPM plus readout electronics structure.

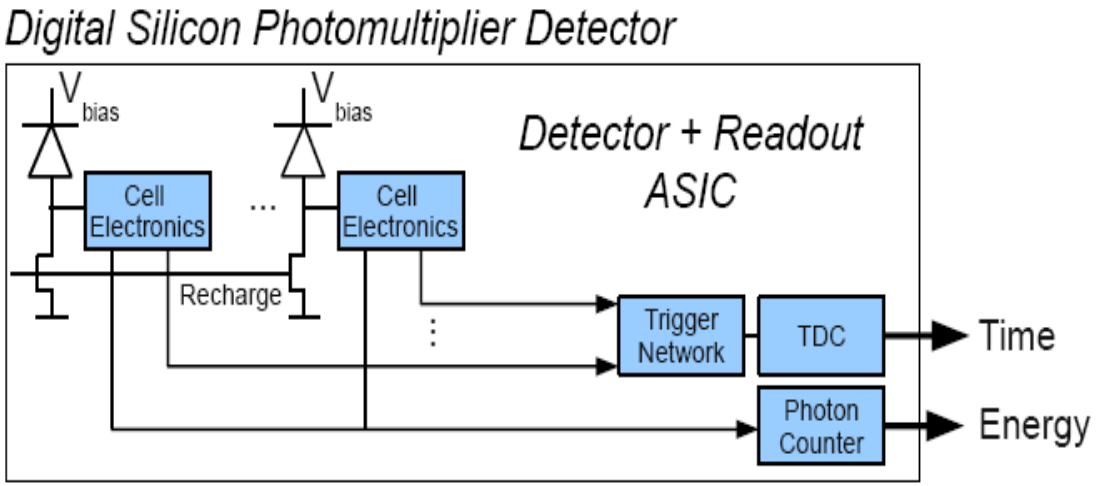


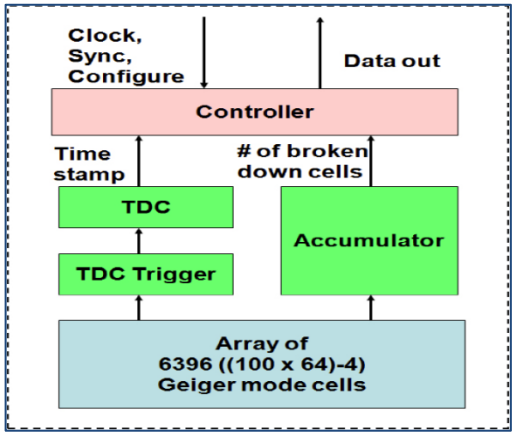
- Cell electronics area: 120μm²
- 25 transistors including 6T SRAM
- ~6% of total cell area
- Modified 0.18μm 5M CMOS
- Foundry: NXP Nijmegen

Digital SiPM is contain of 3200(59,4x64um^2)/6400(59,4x32um^2) cells:

- Digital signal after discriminator for each cell,
- Individual bias adjustment for each cell,
- Fast recovery schematic for cell discharging.

Digital SiPM from Philips.
SiPM plus readout electronics structure.

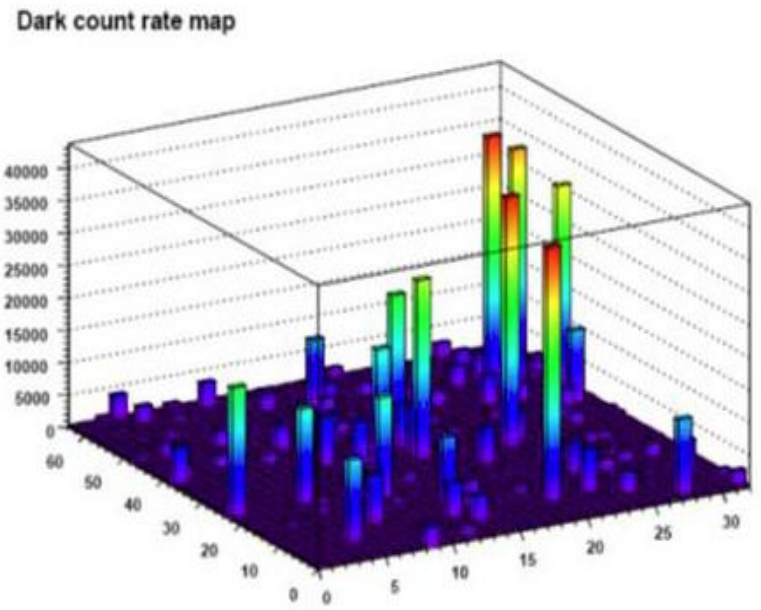


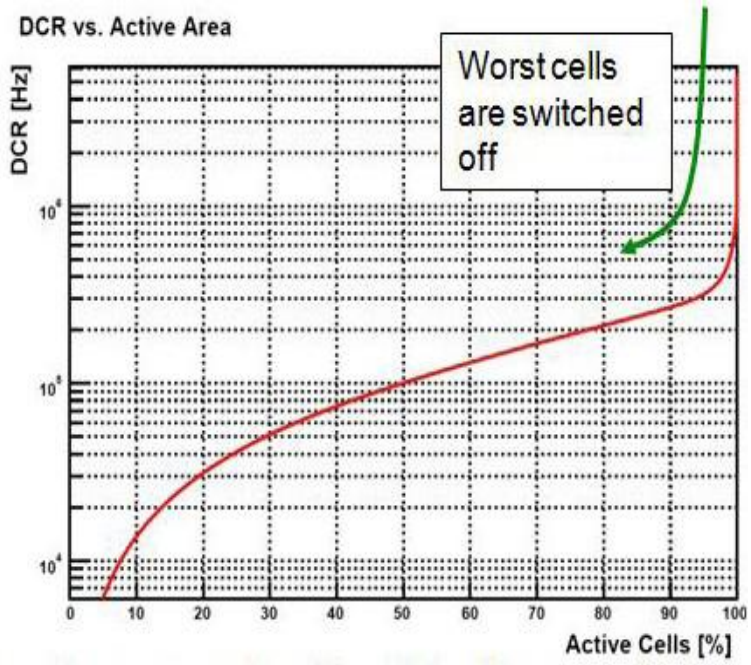


Digital SiPM is contain of 3200/6400 cells:

- All cells outputs are connect by OR-function to one channel TDC (10ps/bin),
- Individual cell noise counting available,

Digital SiPM from Philips. Noise reduction.





Option to physically disable arbitrary.
User selectable cells on the sector.
10-times reduce noise after 10% noisy cells disabled.

Digital SiPM from Philips. What we need to modify?

- *Increase cell size*
- *modify DAQ for reading each cells individually,*

But:

- *Complete redesign*
- *New mask set needed*
- *Volume?*
- *Cost?*
- *Synergies?*