

Studies of SiPM @ Padova

Plans & Objectives

- **Characterization of Silicon Photo Multipliers of different manufacturers and geometries:**
 - Currents
 - Gain & Efficiency
 - Dark Rate
 - Time resolution
 - Long term stability
 - ...
- **Search for a well defined criteria to identify the working point.**

All the above mentioned parameters depends on bias voltage and temperature: we will search (if exist) a working point what gives the best performances.
- **Comparison of performances.**

Caveats

- Very few devices tested
- Problems with PiLas laser
(sent back for reparation)

Devices Available

- **From FBK**

FBK = Fondazione Bruno Kessler, previously known as
IRST = Istituto di Ricerca Scientifica e Tecnologica Trentino.

(1 mm² active area)

- 4 with 625 pixels (px size: 40x40 μm)
- 4 with 400 pixels (px size: 50x50 μm)
- 2 with 100 pixels (px size: 100x100 μm)

- **From Hamamtsu**

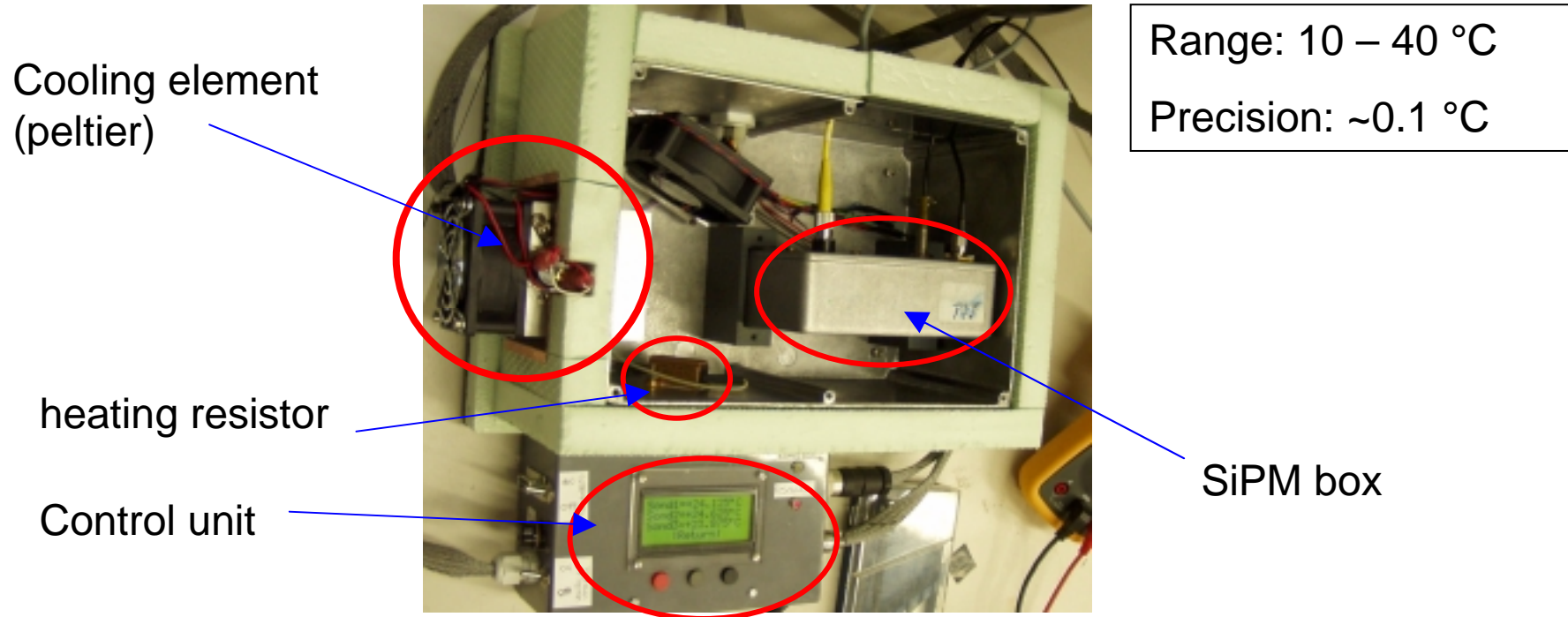
(1 mm² active area)

- 2 with 1600 pixels (px size: 25x25 μm)
- 2 with 400 pixels (px size: 50x50 μm)
- 2 with 100 pixels (px size: 100x100 μm)

We learned that SiPM
are very sensitive to temperature

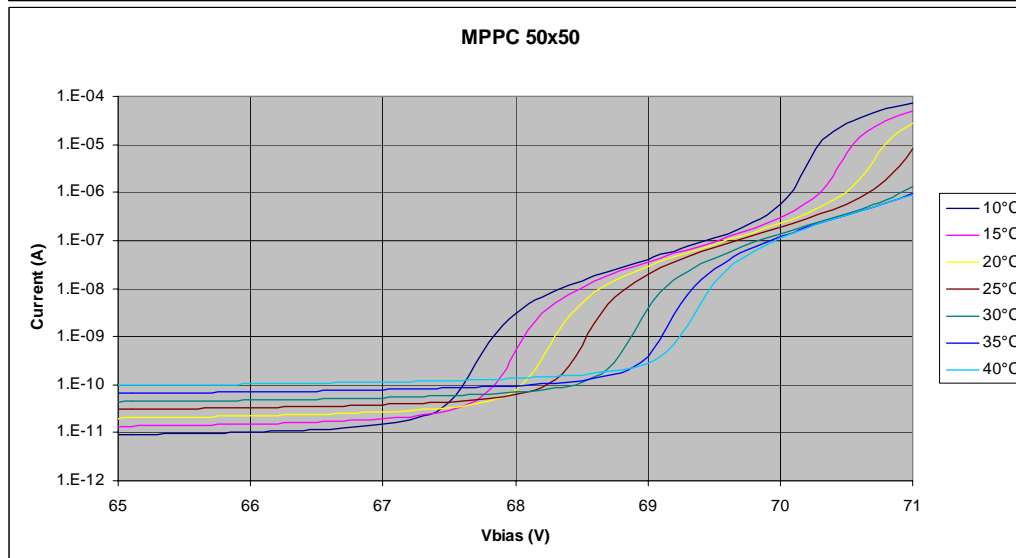
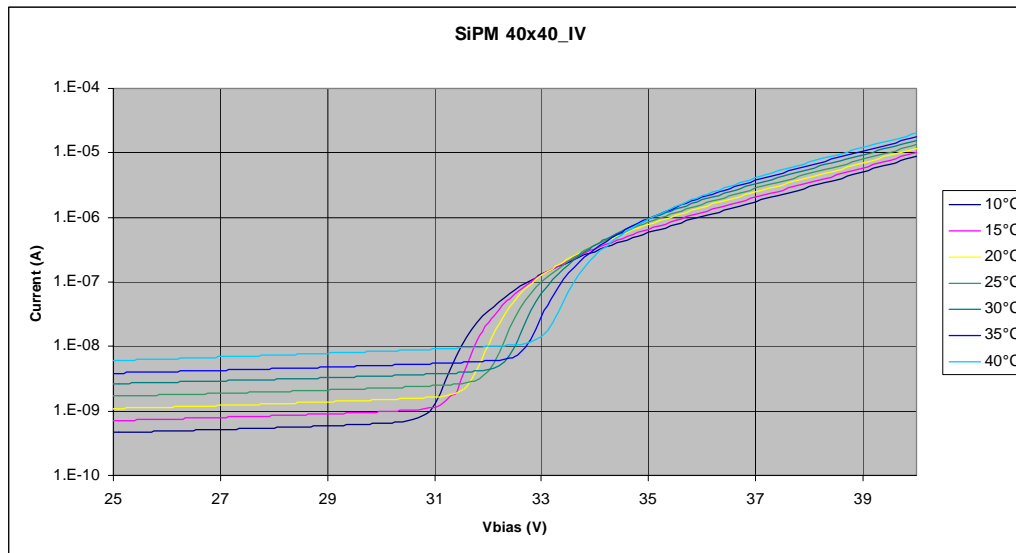


Measurements must be performed in a
thermostatic chamber.



Devices Characterization

Current vs Vbias & Temperature



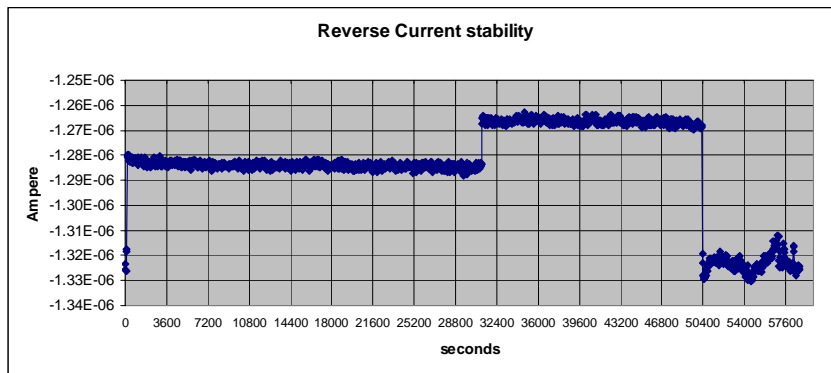
SiPM (FBK)
vs MPPC (Hamamtsu):

- Lower breakdown voltage
- Higher reverse current
- Less sensitive to temperature

Devices Characterization

Reverse Current Stability

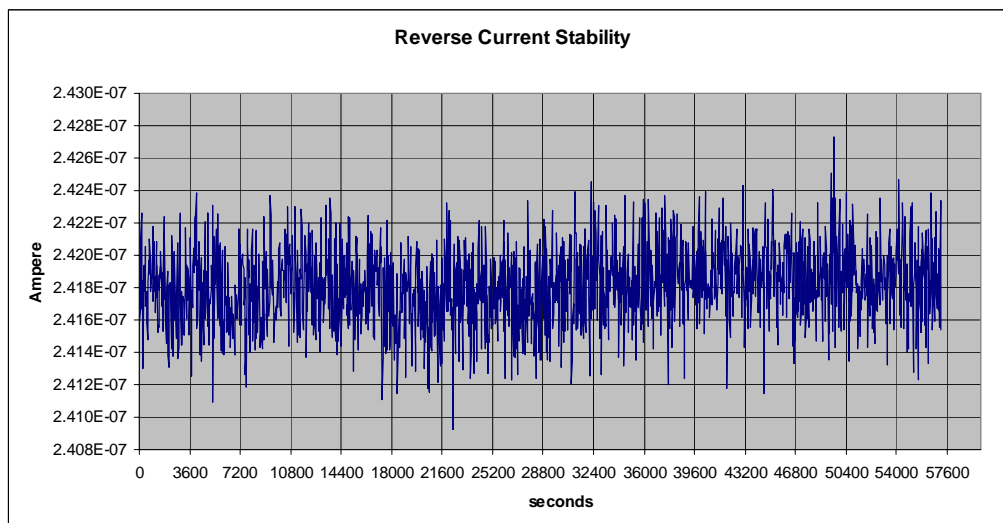
1.



2.



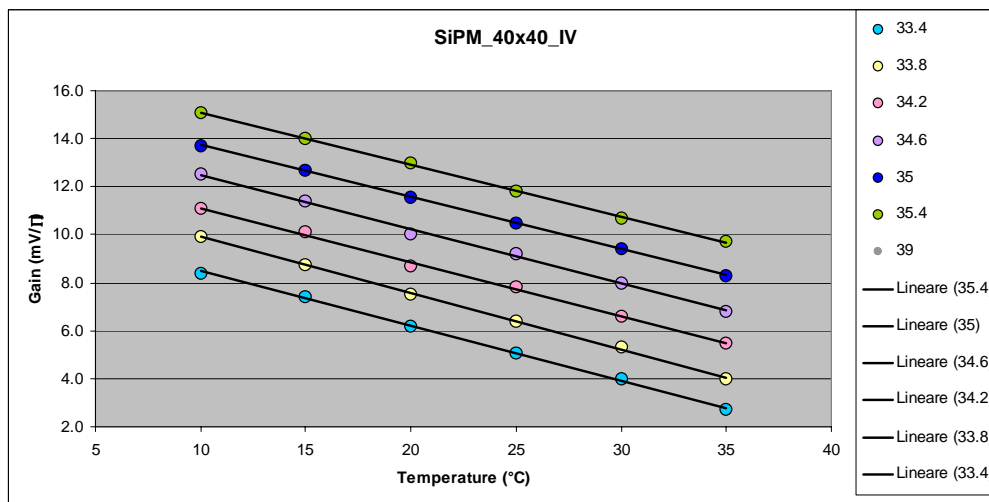
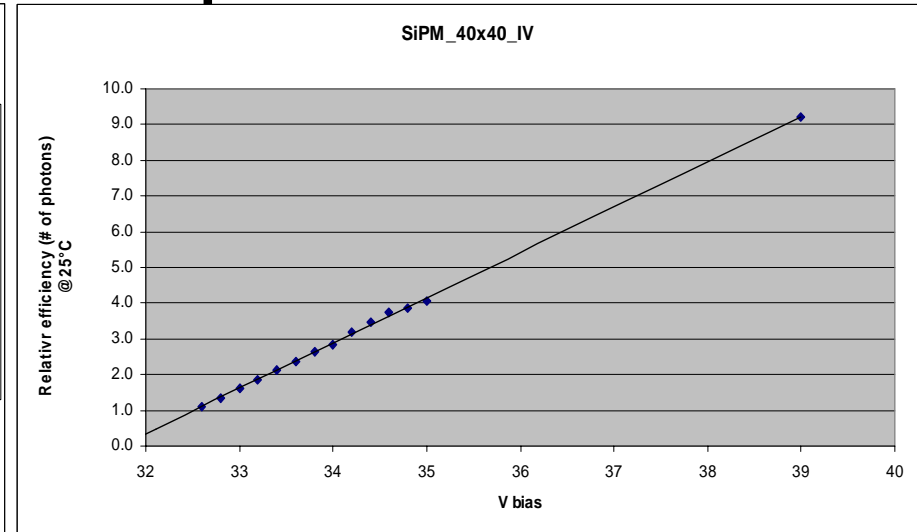
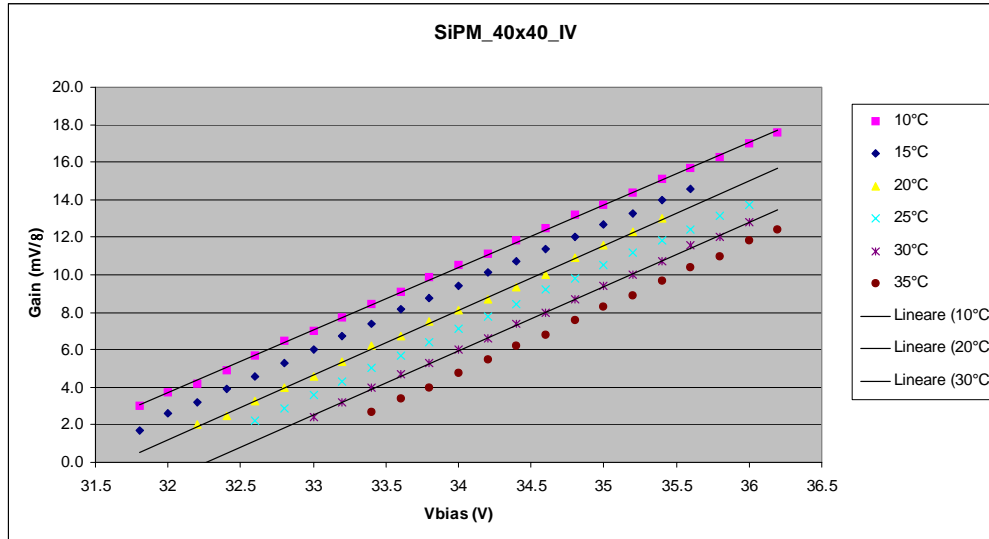
3.



1. Strange current jumps...
2. Reason: fiber's yellow jacket not totally opaque
3. Current much more stable after cure

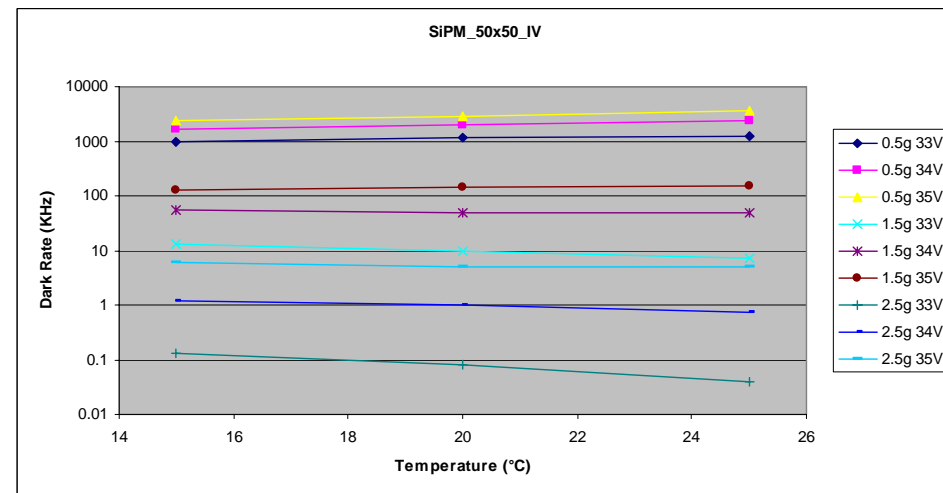
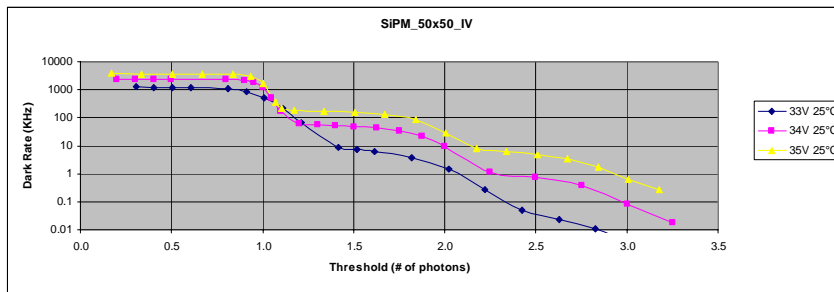
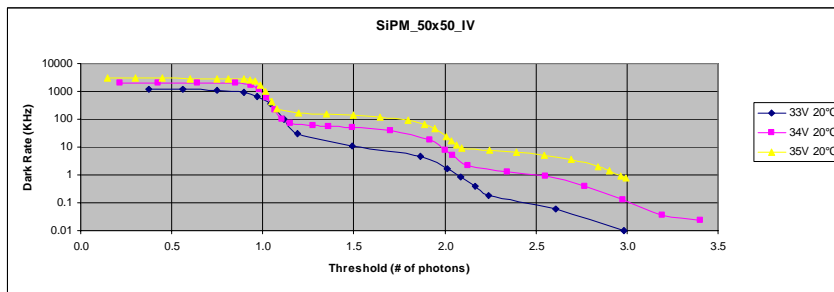
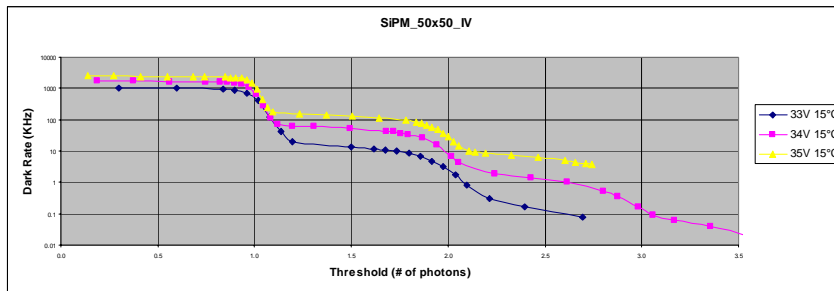
Devices Characterization

Gain vs Vbias & Temperature



Gain & efficiency change linearly with temperature and Vbias ⇒
no criteria to define a precise working point.

Dark Rates



- Almost flat vs temperature
- Dark rate decrease with threshold, more rapidly at lower voltages

Conclusions

A large amount of works still to be done :

- Characterization of all devices
- Further investigation on gain and dark rates
- Absolute efficiency measurements
- Time resolution measurements
- Electronics optimization: studies on amplifiers / discriminators (see Ferrara works)
- Radiation hardness (very important)
- ...