



Activité “semiconducteurs”

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- Tests et caractérisation $I(V)$, $C(V)$, diaphonie, laser 1060 nm, ...
- Intégration & Font End
- Design (R&D simples) & simulation
- Industrialisation
 - HPK
 - OnSemi

Détecteurs : MPPC / SiPM / ...

- Caractérisation de 10^3 MPPC au LLR (T2K near detector)

Régulation 1/10°

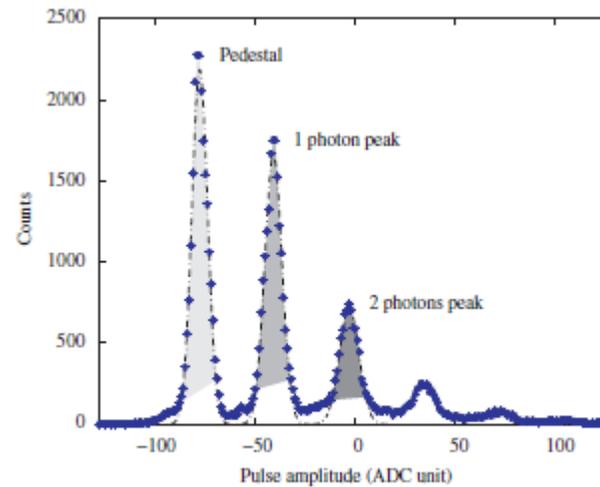
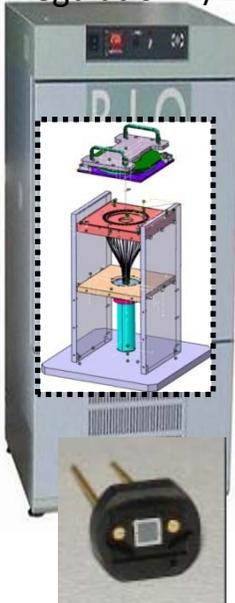


Fig. 7. A typical LED amplitude spectrum of one MPPC.

F. Moreau et al. / NIM A 613 (2010) 46–53

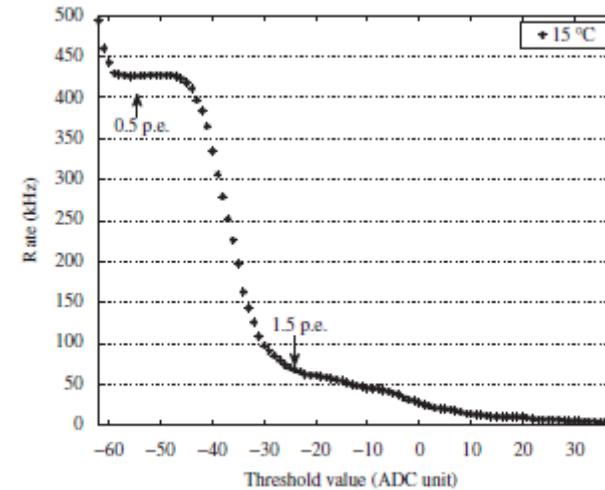


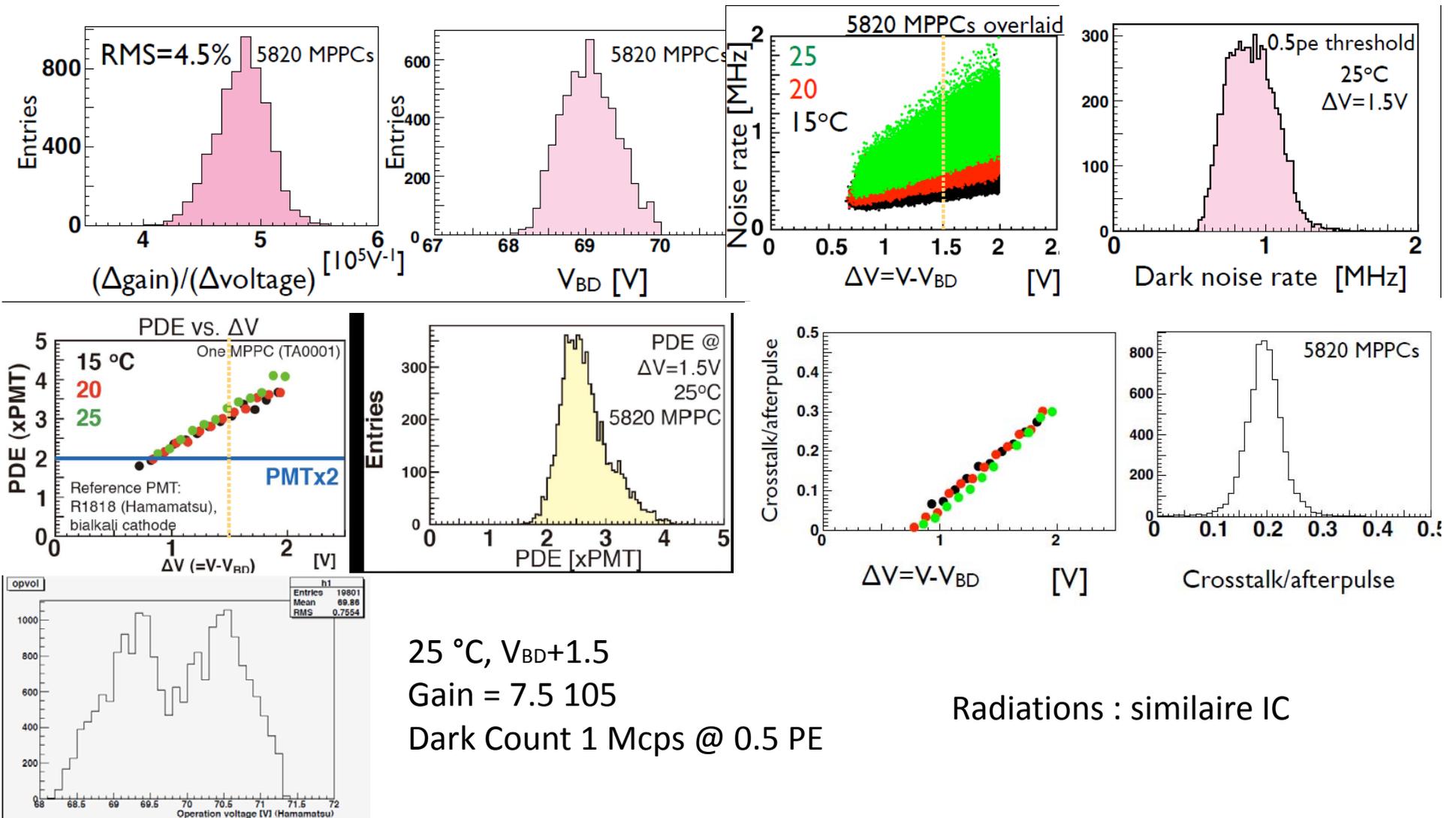
Fig. 8. A typical dark noise rate (DNR) of a MPPC at 15°C.

Gains $\sigma = 1.8\%$

T2K : Tests de production

Application of MPPC to T2K near detectors, M. Yokoyama, NDIP08, June 18 2008

- Total : 60 000 SiPM (Hamamatsu) : très bonne uniformité

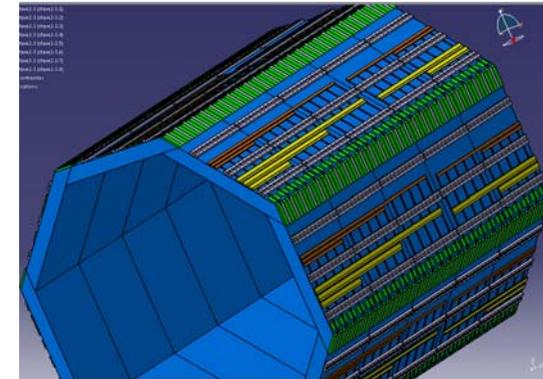
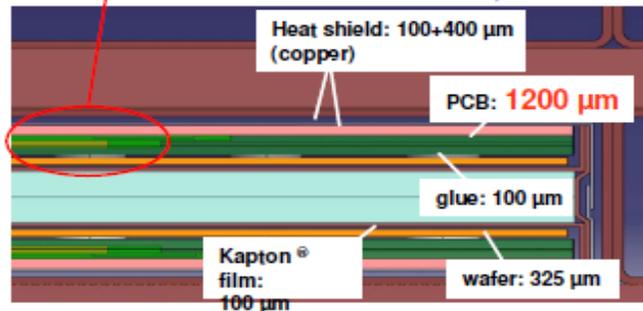
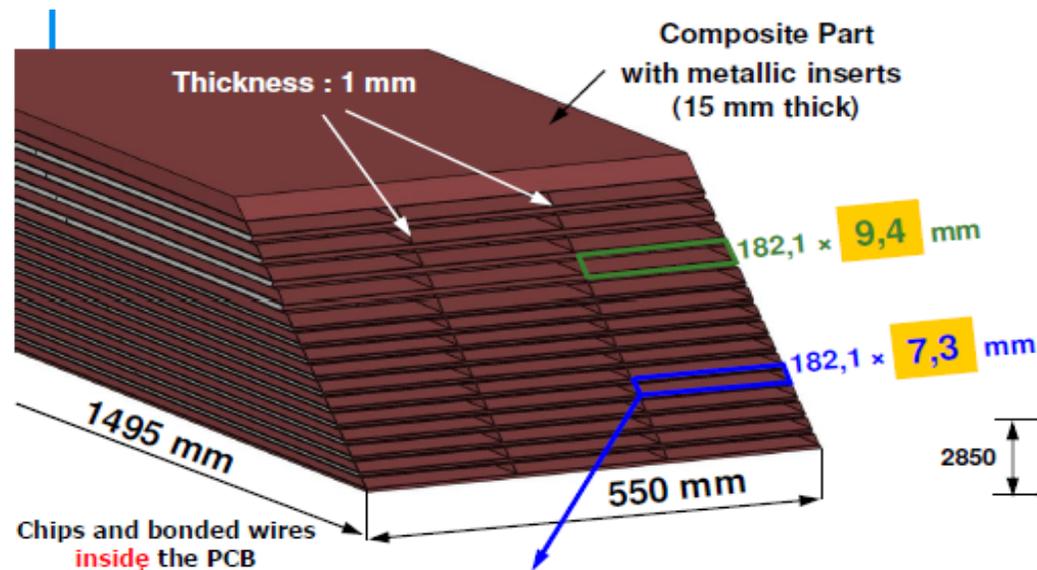


25 °C, $V_{\text{BD}} + 1.5$
 Gain = 7.5 10⁵
 Dark Count 1 Mcps @ 0.5 PE

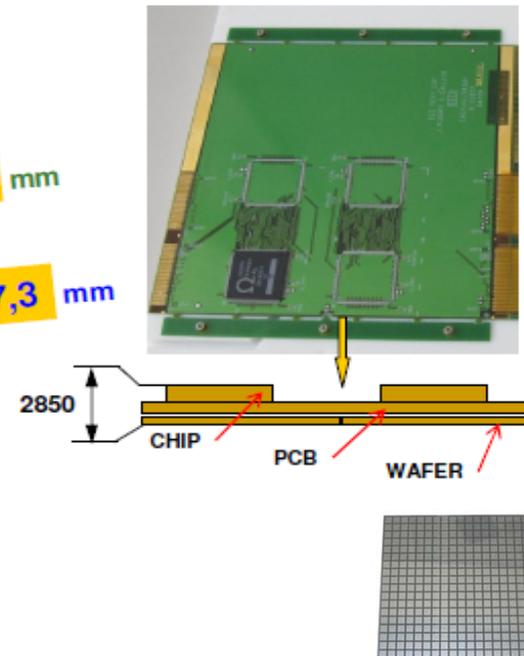
Radiations : similaire IC

ILD

- Si-W ECAL : 80 000 000 chn



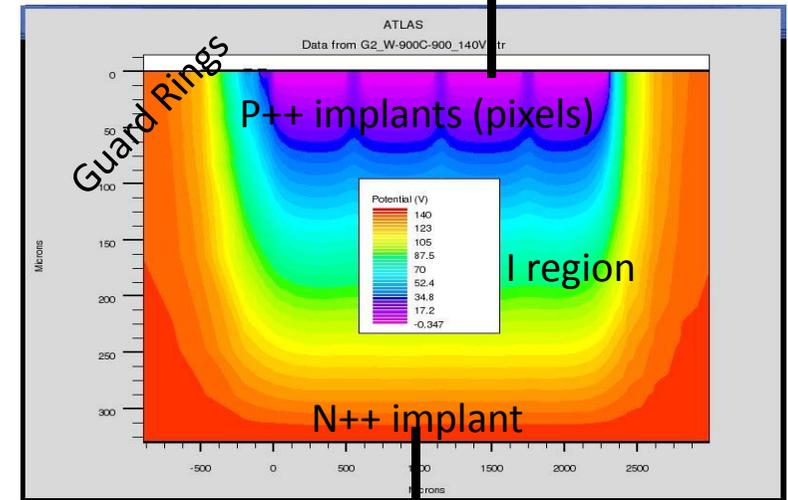
FEV7 CIP at the present time



Sensor Design

- Large : 9 cm x 9 cm
- Glued on PCB
- Guard rings are not biased
- Production of 200 000 pcs
- New versions should optimize
 - Width of the dead zone at the edges
 - Crosstalk level between GR & pixels (Square Events)
- Assumption that the simplest design allow to control the cost
 - Few thousands of m² needed for ILD
 - Financial viability would be insured for costs of about a few € /cm²
 - HPK, OnSemi, (China ?)

To DC coupled electronics



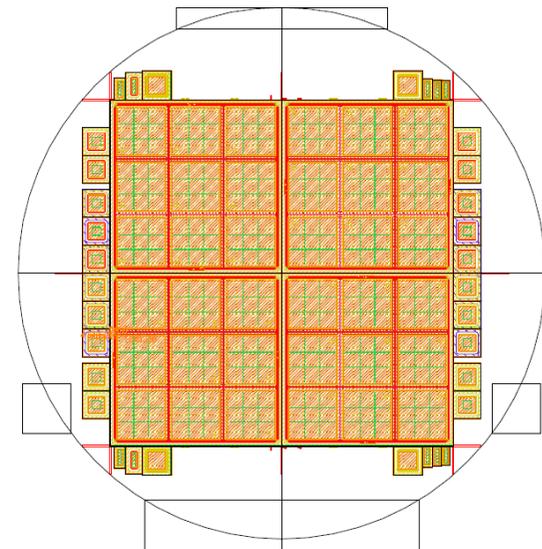
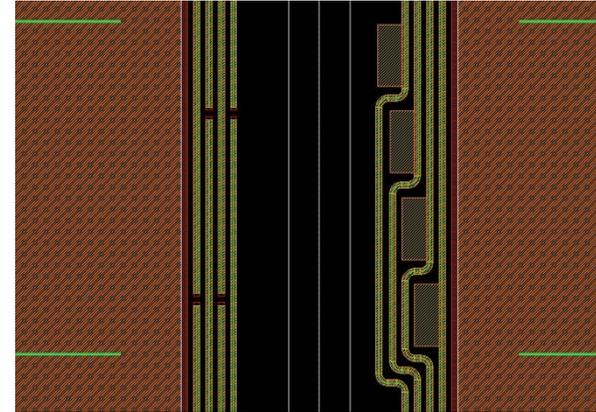
Vbias = + 150 V



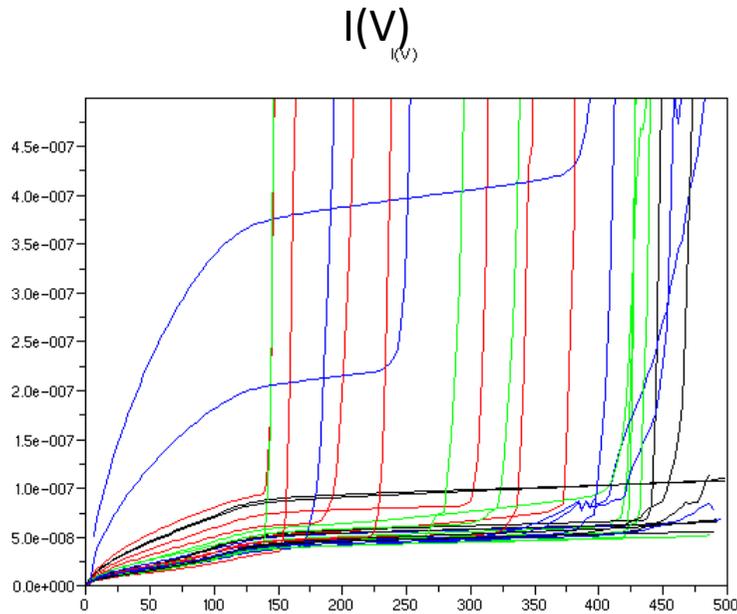
9x9 cm², 324 or 256 pixels

R&D : Split guard ring

- Should avoid the signal propagation along the border of the wafer
- Prototype wafers have been manufactured (layout made at LLR)
 - OnSemi/Institute of Physics (Prague), Cz
 - BhaBha Atomic Research Centre, India
 - Tests are ongoing
 - PhD
 - SILVACO simulations
 - Study of crosstalk



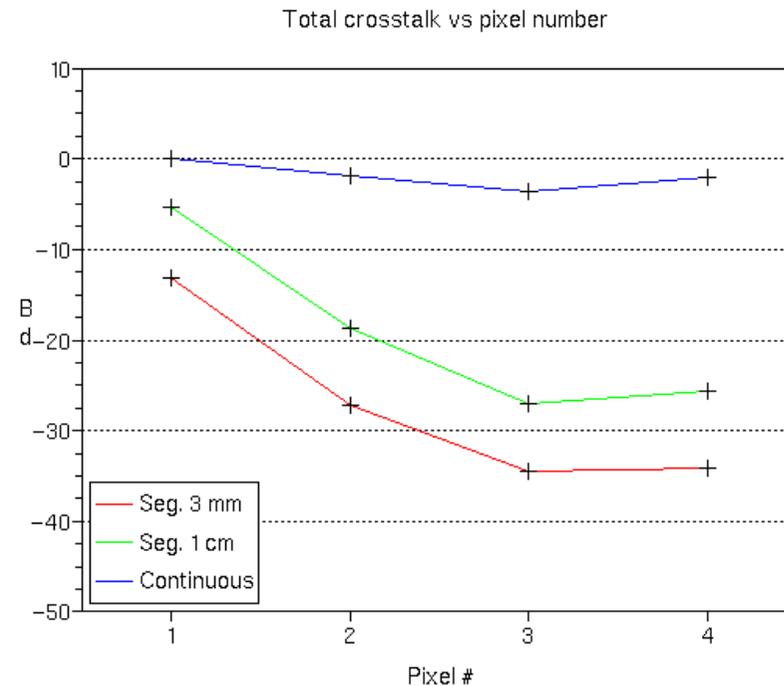
R&D on segmented guard rings



Yield (Breakdown >250V)

- Continuous: 100%
- 1 cm: 85%
- 3 mm: 40%
- Mixed: 70%

Sum of GRs contribution
 Xtalk lowered by a factor 80 (with 3 mm
 segments (measurements made at LPC)



Plateforme CAPTINNOV / Labex P2IO

- Machine à bonder automatique
- Machine test sous pointe automatique
 - Zone test 30 cm x 30 cm
 - Micro-chambre
- Mise en commun de matériel de test
- Budget 340 k€
- Installation @LAL et @IRFU

