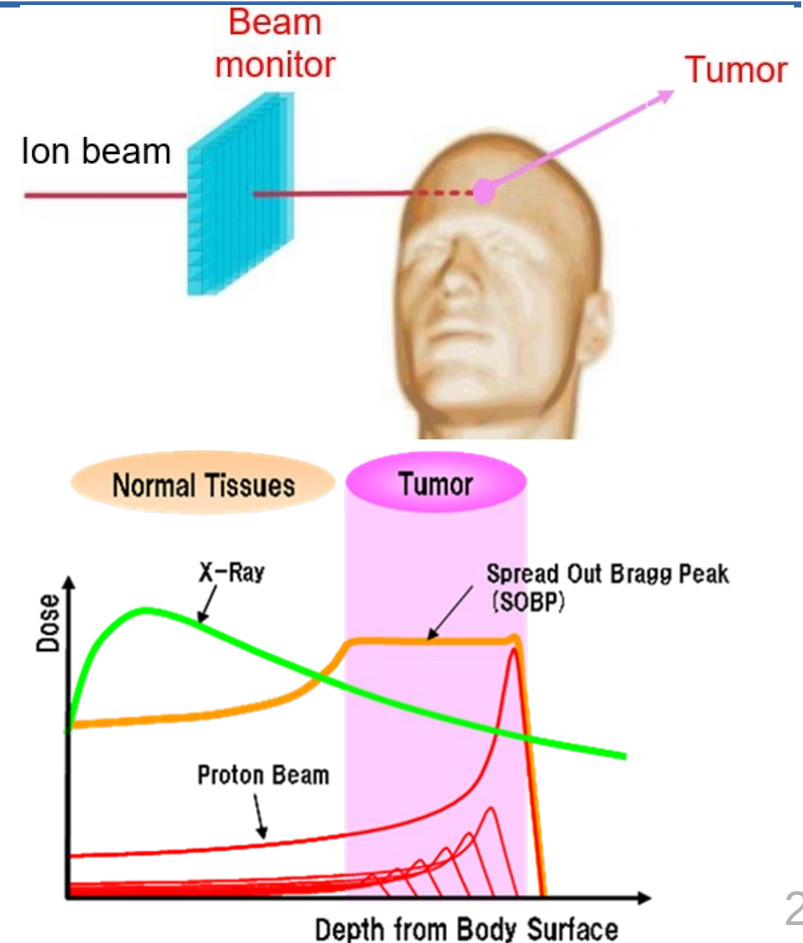


Amplificateurs faible bruit et large bande pour les SiPMs et les Diamants

Christophe Hoarau
Service électronique LPSC

Hadronthérapie

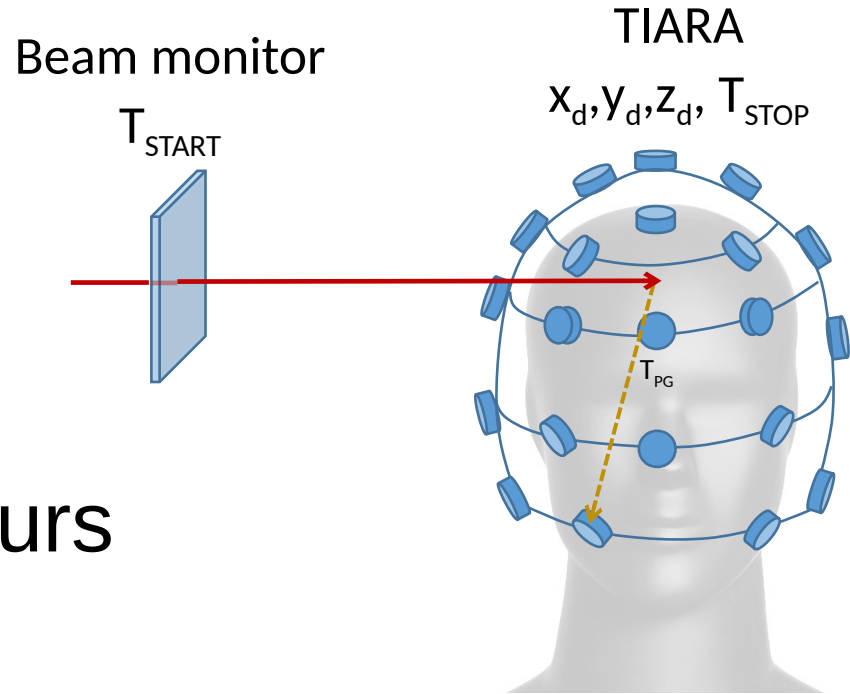
- Physique nucléaire pour les applications médicales
- Radiothérapie (faisceau proton, ion C)
- Localisation de la radiation (pic de Bragg)



PGTI : Principe

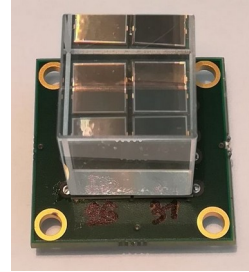
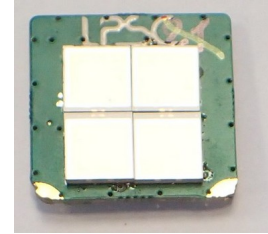
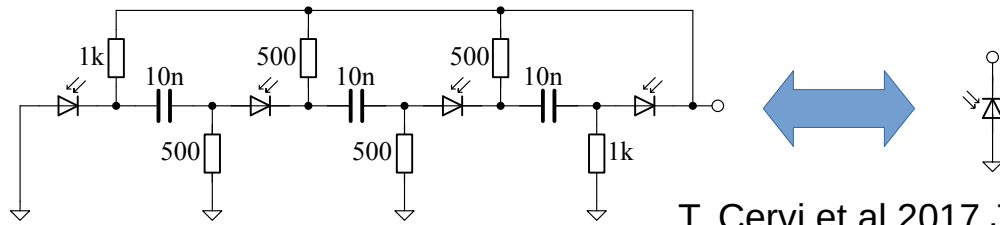
$T_{STOP} - T_{START}$:

- T_{START} : 1 Moniteur faisceau proton
- T_{STOP} : 8 (/32) Détecteurs gamma-prompt



T_{STOP} Détecteur & Amplificateur

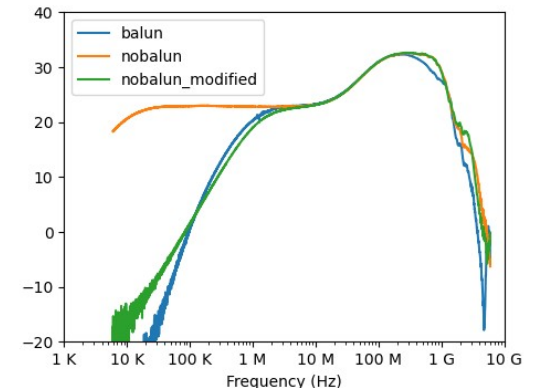
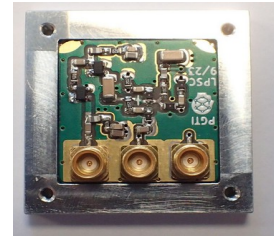
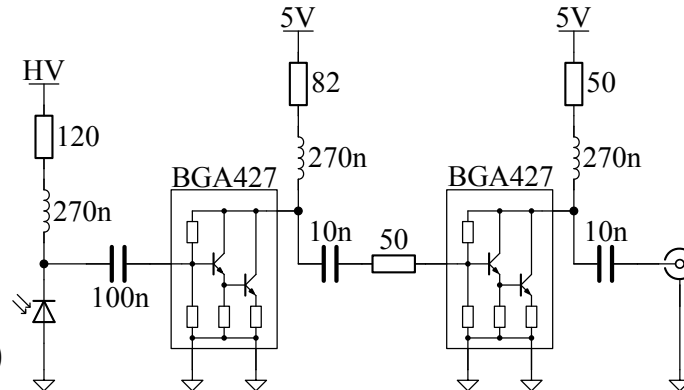
- Détecteurs 4x SiPM – Scintillateur :



T. Cervi et al 2017 JINST 12 C03007
Lukas Nies, et al, arXiv:1811.02680

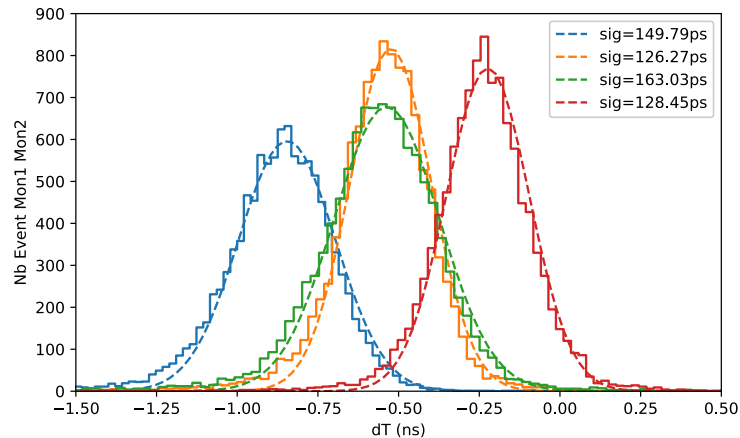
- Pré-Amplificateur 2 étages

- 33 dB
- 80 – 980 MHz

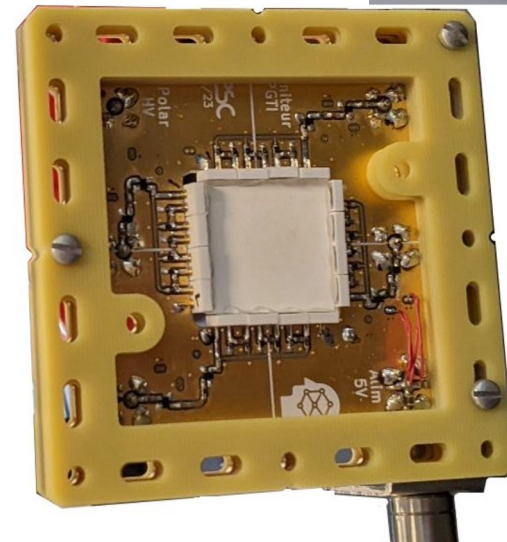
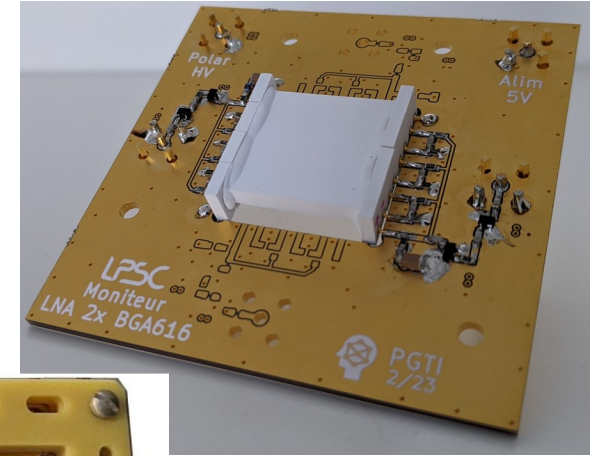


T_{START} Moniteur Faisceau

- Détecteurs SiPM-Plastique
- Mesure CAL : Jitter ~100ps

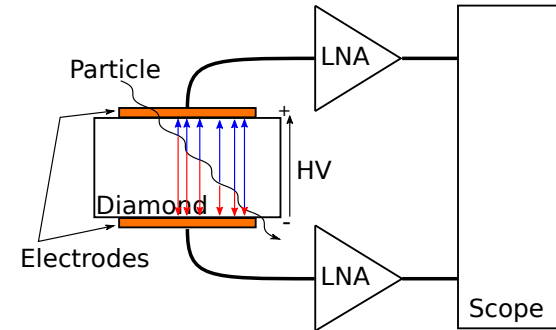
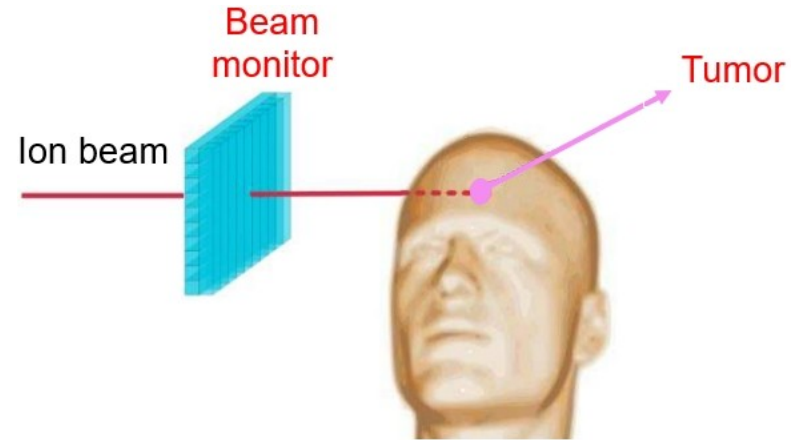


- Diamètre de faisceau
20 mm → 25 mm



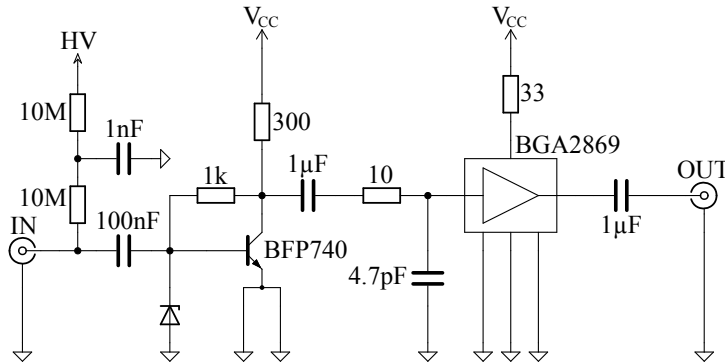
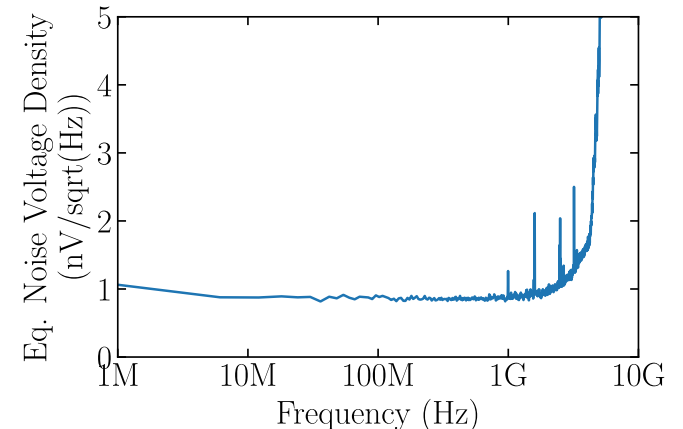
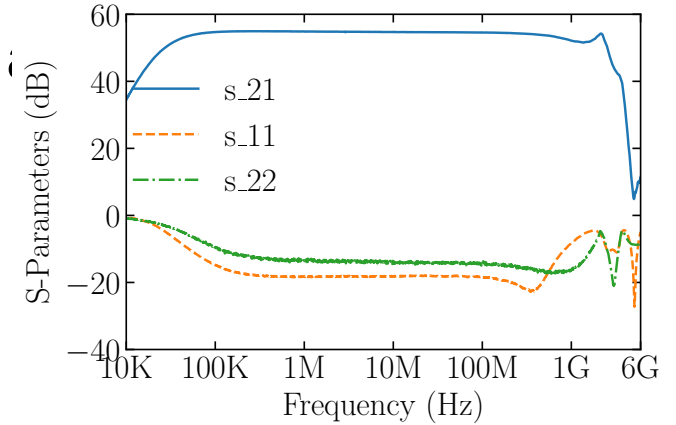
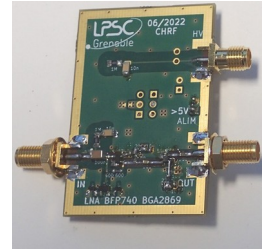
Hodoscope

- Moniteur faisceau XY
- Chambre d'ionisation solide diamant
 - faible bruit
 - bonne résistance aux radiations
 - rapide
- Diamant métallisé en strip :
 - Une face : strip verticals
 - Une face : strip horizontals



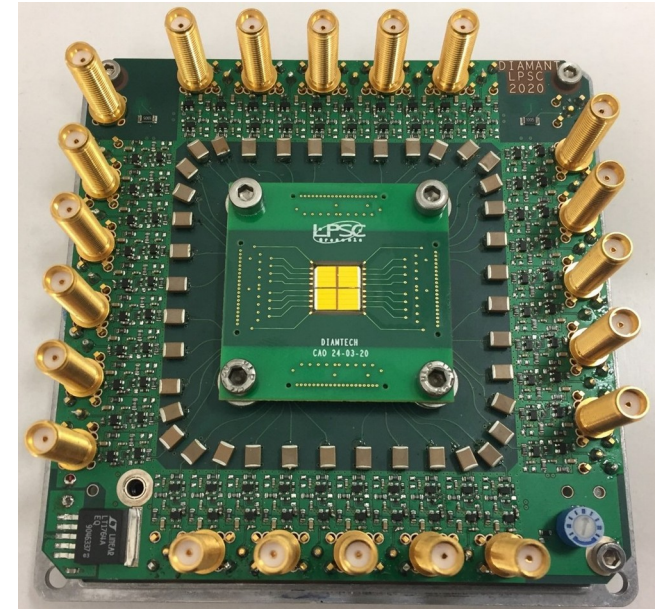
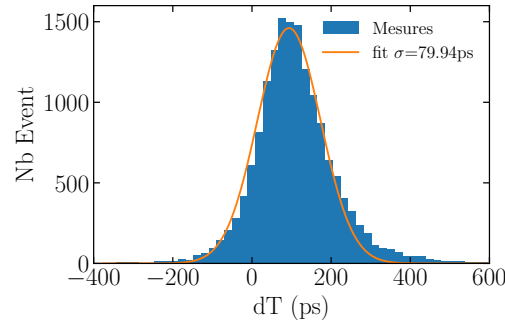
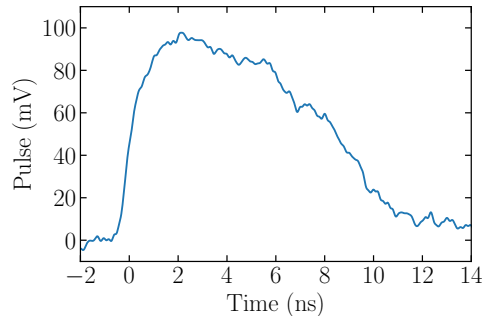
Amplificateur

- Montage à émetteur commun d'un transistor hétérojonction (SiGe:C) NPN RF BFP740, et second étage à MMIC BGA2869
- Grand gain 56 dB
- Faible bruit $NF=0,85$ dB
- C. Hoarau, et al., JINST 16 (2021)

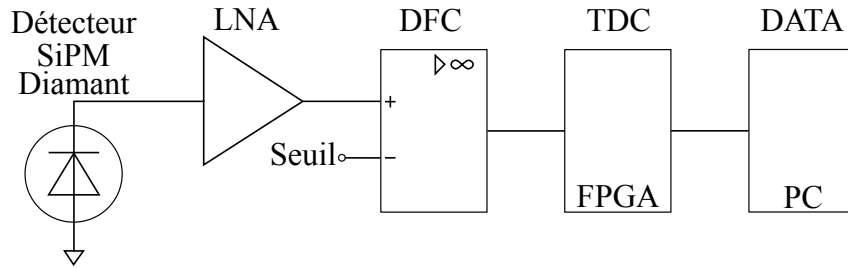


Amplificateur

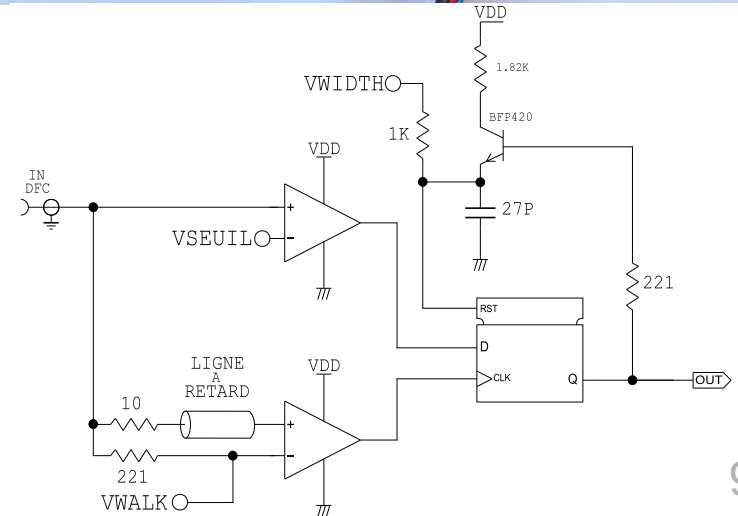
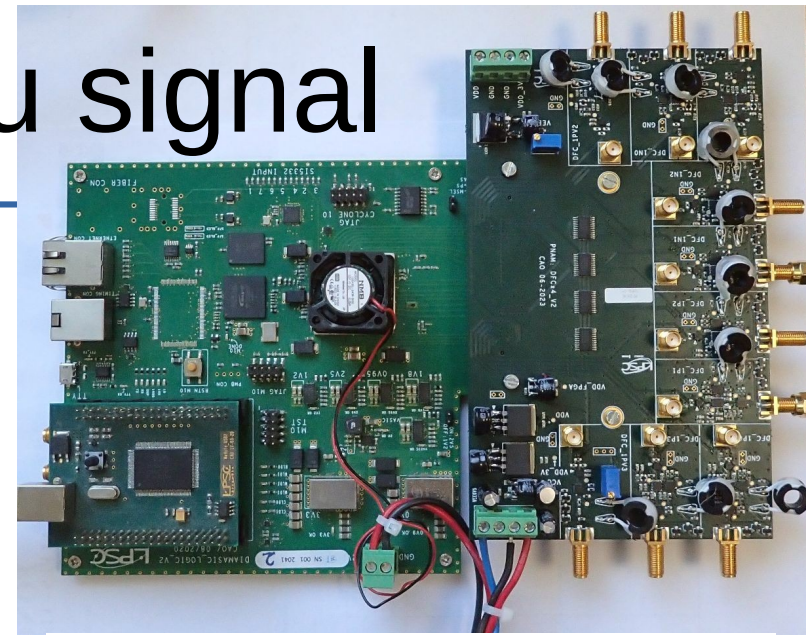
- 40 voies :
 - 2x10 verticales / horizontales
- Coïncidence $\sigma < 100$ ps
- Proton 50 MeV \rightarrow pulse ~ 100 mV



Mise en forme du signal



- Discriminateur à fraction constante $t_m \sim 650\text{ps}$
- TDC (time to digital converter) jitter $\sim 25\text{ps}$
- Interface c++ / QT



Merci