A 32 x 32 Doped Silicon based matrix read by HEMT/SiGe Cryo-electronics

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Abstract

- **Since a decade, CEA have started a long term program to achieve the collective realization of a large (32 x 32 pixels) microcalorimeters camera for X-ray Astrophysics. This camera is based on silicon doped sensors with composite Tantalum absorber readout thanks to HEMT/SiGe based Cryo-electronics. The goal of this development is to achieve a spectral resolution of about 2 eV @ 6 keV in a thermal budget of ~1 µW @ 50 mK for over than 4000 pixels.**

- **After some delays in production, we present the design of our first 32x32 sensors matrix. We also present the steps of the development plan of first measurements onto our matrix.**

Goals

Scientific Goals:

Spatial X-ray observation

- **Large Field of View ⇒ a lot of relatively big pixels**
- **Homogeneity of FoV ⇒ All pixels/readout should be similar**

Technical choices:

- **All-Silicon collective design**
- **Cryo-Electronics (@2.5-4 K) based on HEMTs and SiGe ASICs.**
- **34 : 1 ”classic” Multiplexing**
- **First electronics stage @ 2.5-4 K and polarization resistance @ 300 mK ⇒ Ultra-Low consumption @ 50 mK**

Pixel :

- **500 µm x 500 µm ~2 eV @ 6 keV**
- **High Z absorber: Superconducting hybrid Tantalum absorber**
- **Sensor M.I.S. Si:P:B**

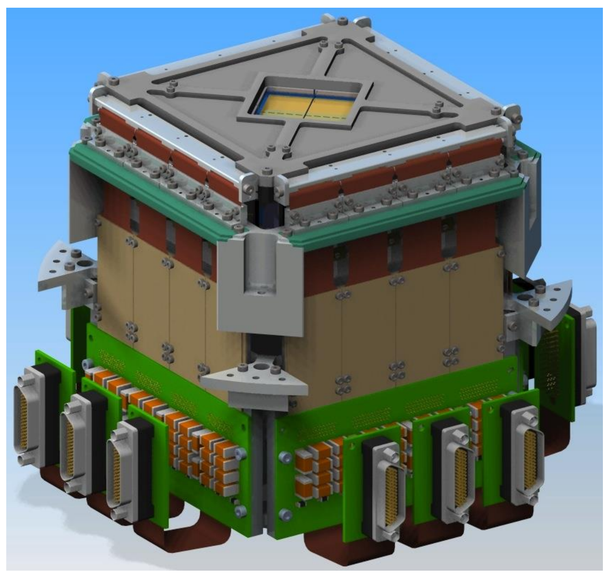
Thermal decoupling :

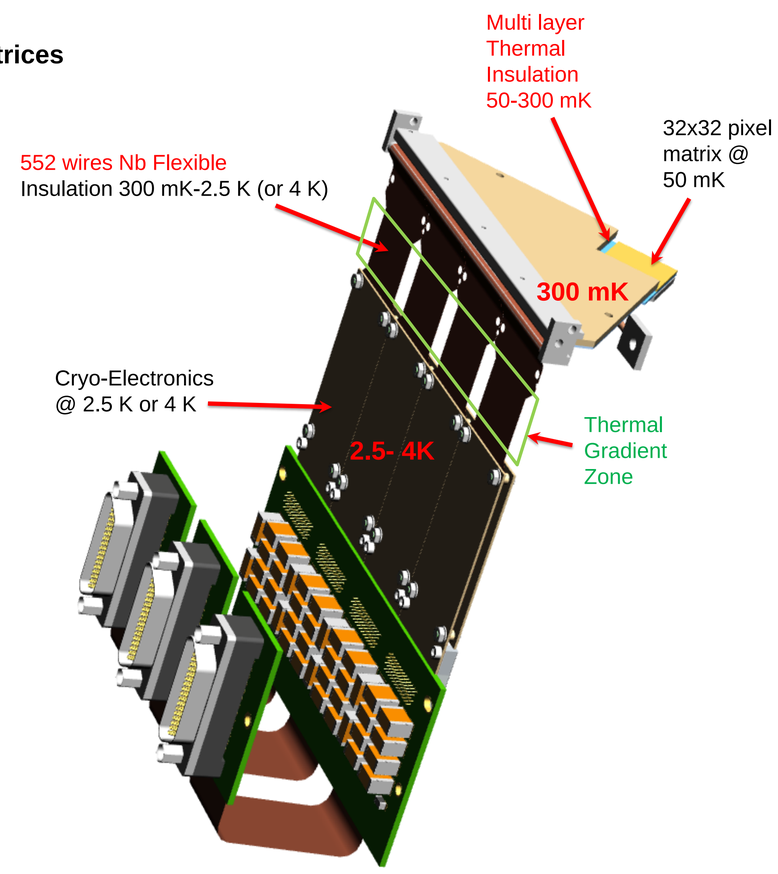
- **Multilayers between 50 mK and 300 mK**
- **Superconducting Nb flexible between 300 mK and 2.5 - 4 K**

System and camera

Camera:

- **4 Independent quadrants of 2 sides buttable 32 x 32 pixel matrices**

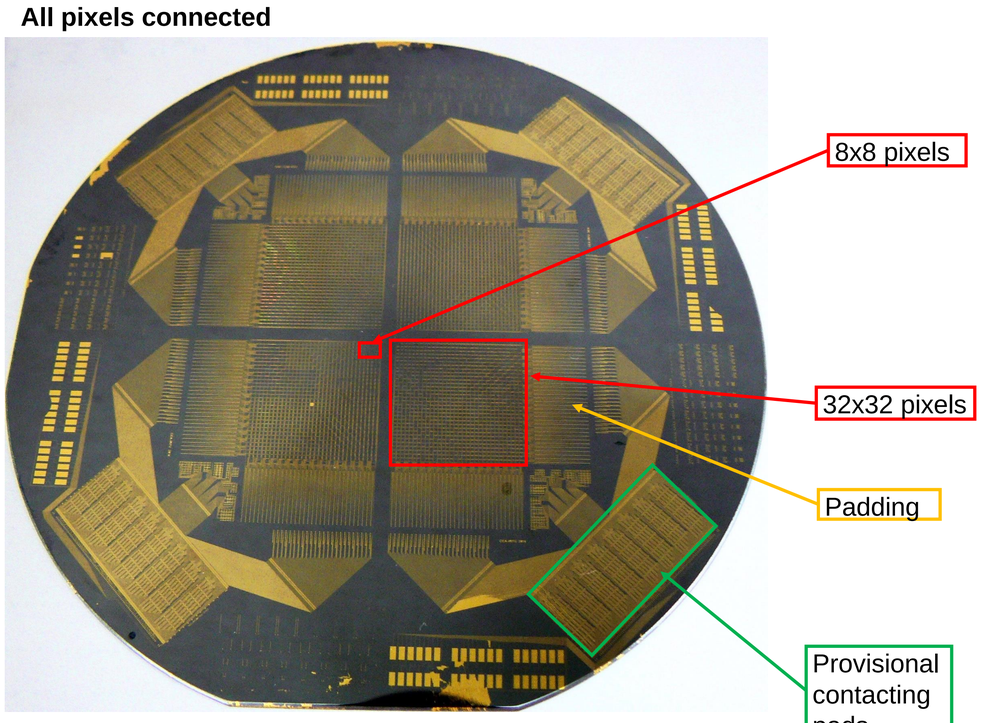




Production of 15 4-inch-wafers

Validation wafer extracted before last step of production before DRIE

All pixels connected



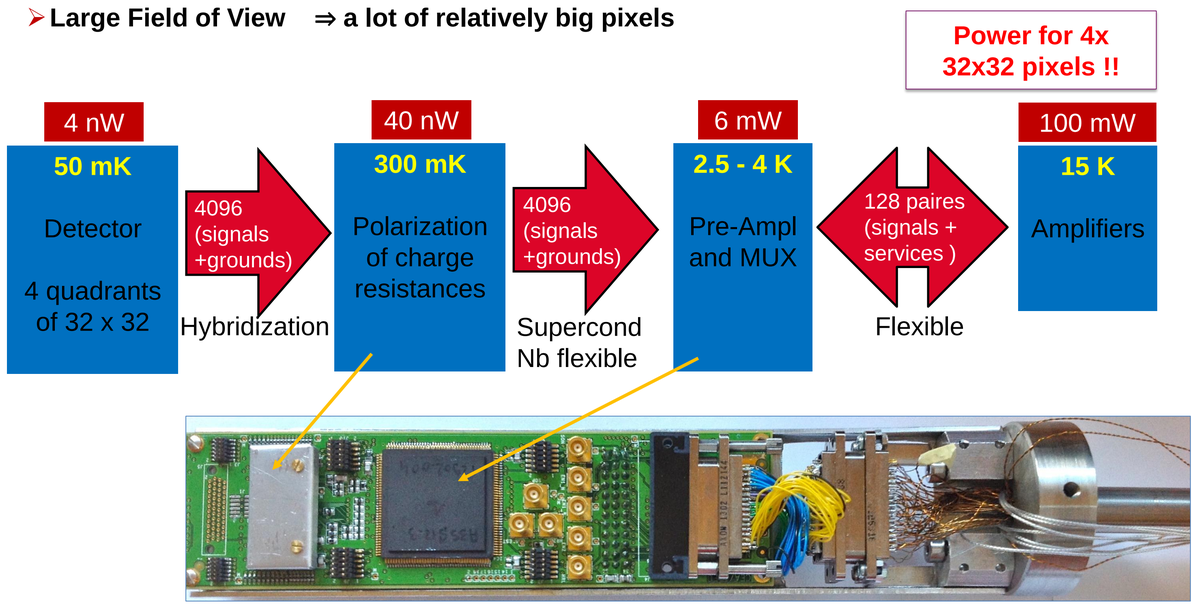
Last step: Back etching DRIE to make pixels free

And hybridization of sensors with composite Ta

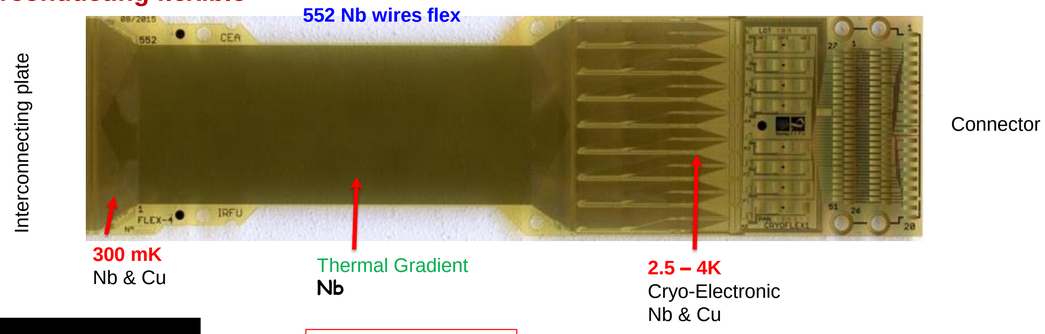
Thermal parameters

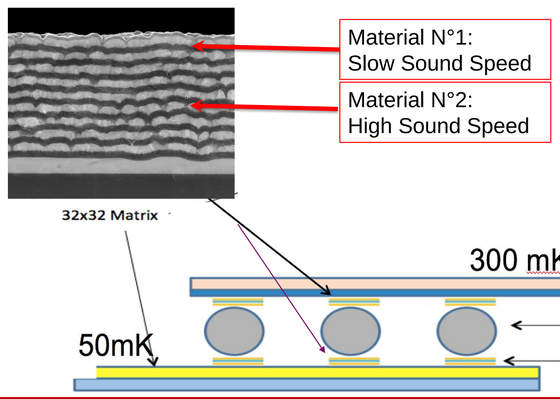
Very low dissipated power satisfying satellite power budget

- **Large Field of View ⇒ a lot of relatively big pixels**



Superconducting flexible





Multi layers super thermal insulation

Alternation of two maximally acoustically-mismatched materials

Optic Analogy ⇒ Total Reflexion Condition

Aknowledgements and references

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- **References:**

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