Status and Plans of ULTIMATE Sensor Development at IPHC

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▷ more information on IPHC Web site: **http://www.iphc.cnrs.fr/-CMOS-ILC-.html**

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ULTIMATE Design: Progress and Plans

- **Sensor design :**
  - present status in sink with schedule
  - will incorporate MIMOSA-22AHR Summer beam test results (see M-22AHR slide)
  - expected to be completed by mid-Octobre
  - post-simulations until $\sim$ mid-Novembre

- **Fabrication :**
  - wait for final MIMOSA-22AHR (Septembre) beam test results as well as latch-up test results
    $\Rrightarrow$ expected to be ready by early Novembre
  - start mid-Octobre preparing documents for design review
  - foresee design review $\sim$ mid-Novembre
  - sensor submission shortly after if no major change decided

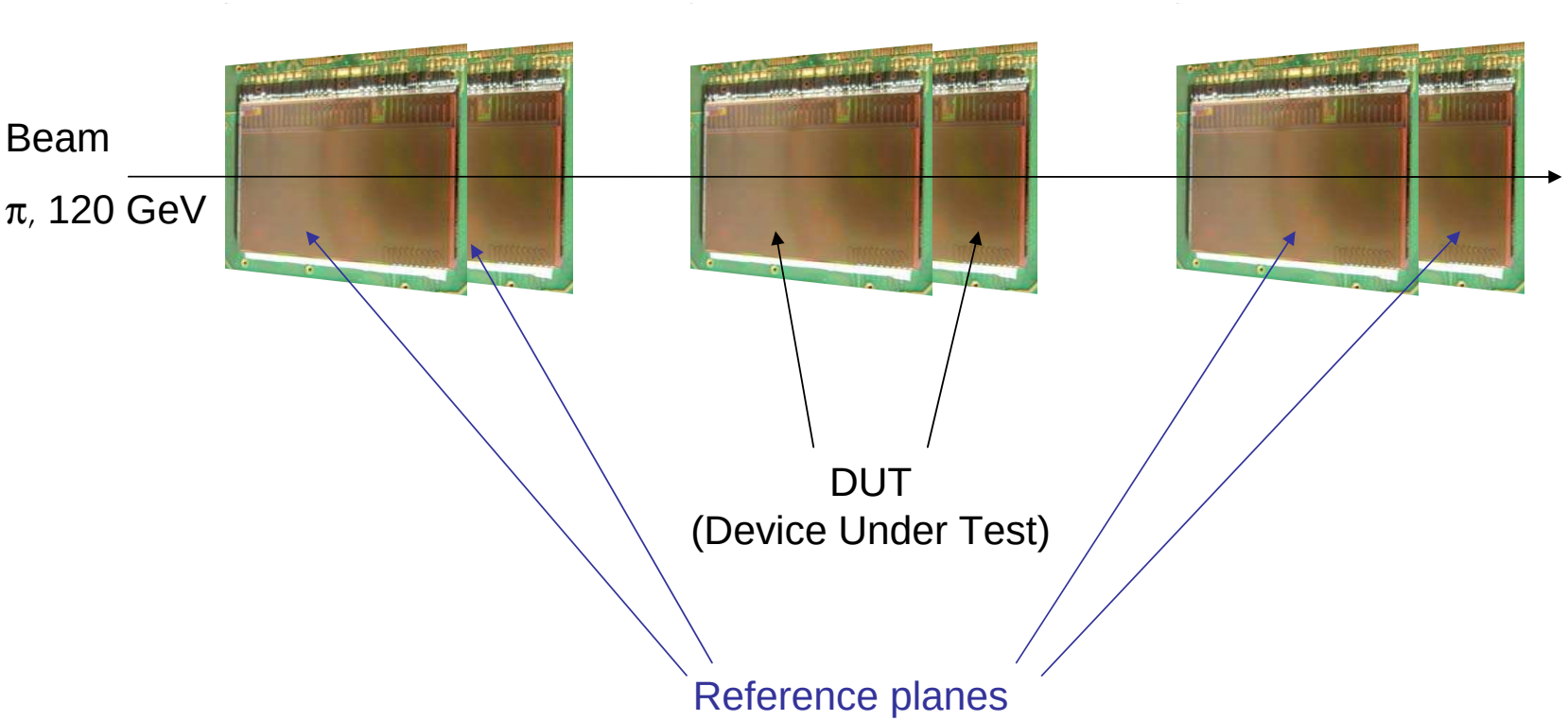
MIMOSA-26AHR : First Beam Test Results

- **Data collected at the CERN-SPS in June with:**
  - standard epitaxial layer
  - high-resistivity epitaxial layer: 10 μm, & 15 μm and 20 μm thick

- **Preliminary analysis results with standard, 10 μm & 15 μm HR epitaxial layers:**
  - detection efficiency, fake hit rate and single point resolution vs discri. threshold value at T_{room}
  - sensors signals analysed up to now: standard epi, high-res epi with 10 and 15 μm thickness
  - impact of $1 \cdot 10^{13} n_{eq}/cm^2$ on detection performances at $T_{op} \sim 0^{\circ}C$

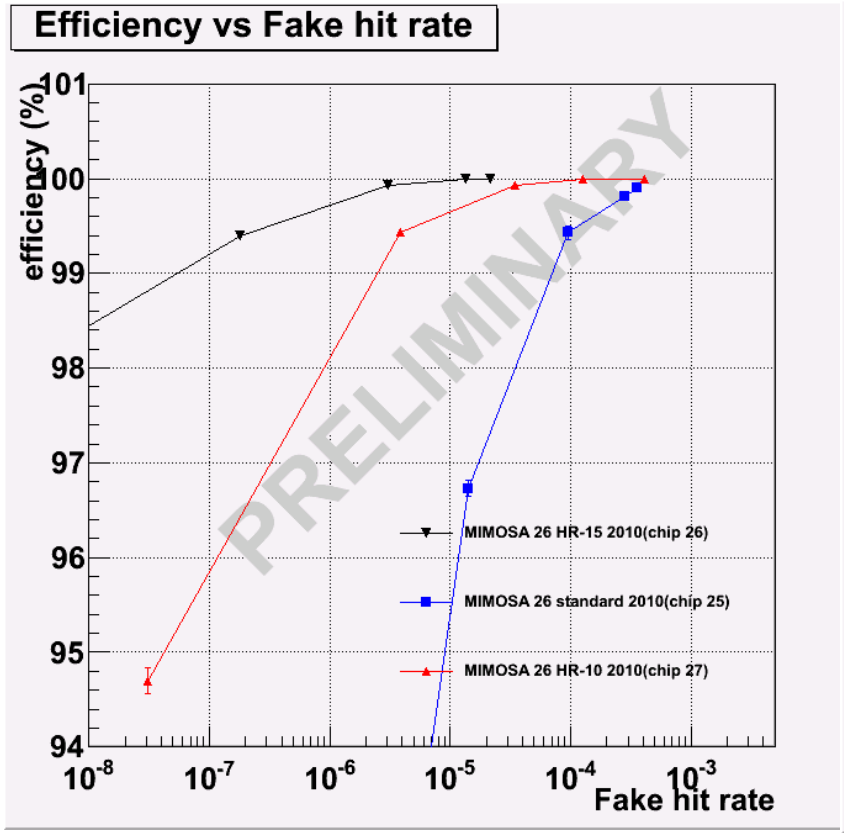
- **Results are very preliminary, and several runs are not yet analysed, i.e. :**
  - High-Resistivity with 20 μm thick epitaxy
  - T dependence of detection performances
  - radiation tolerance : $3 \cdot 10^{12} n_{eq}/cm^2$, 150 kRad, etc.
  - others: lower Vdd, etc.

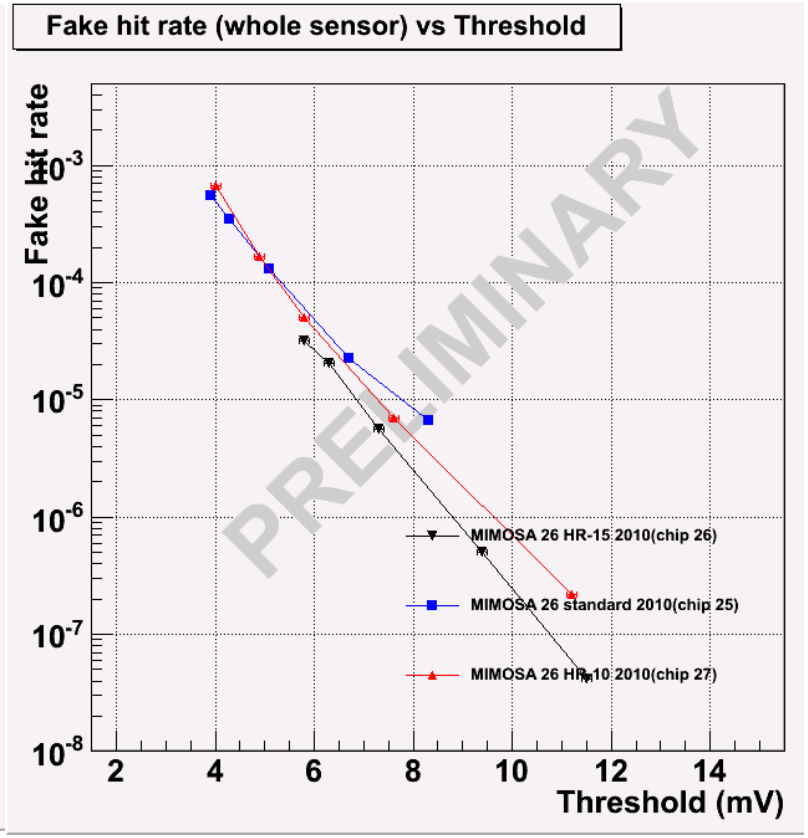
Experimental Setup



MIMOSA-26AHR: Detection Efficiency & Fake Rate

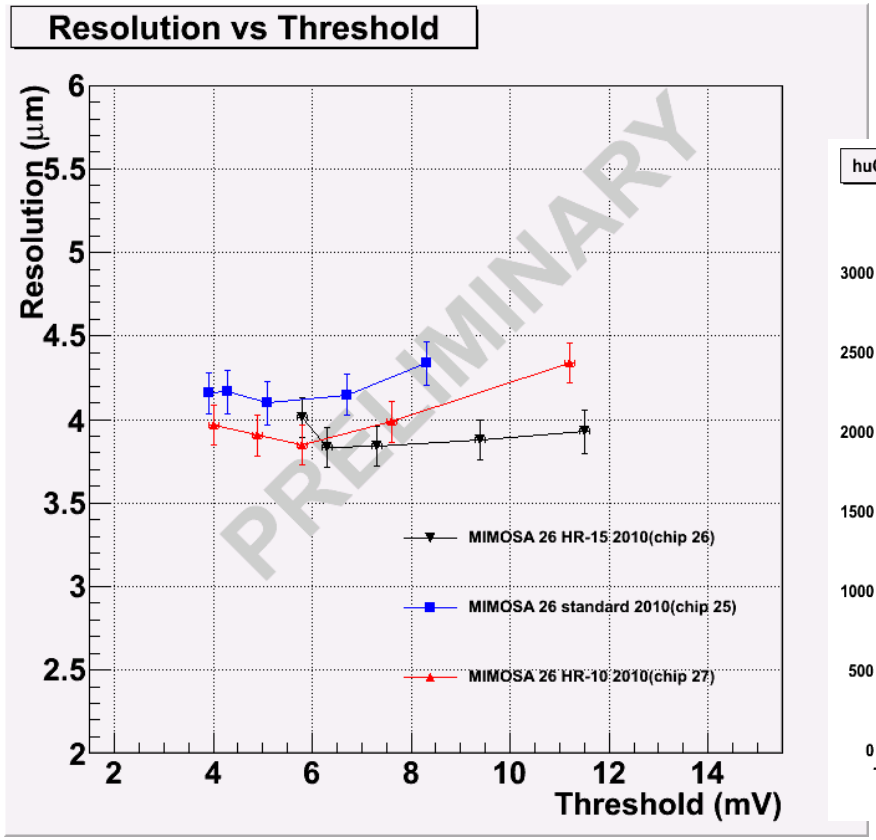
A few preliminary results on non-irradiated chips : Efficiency, fake hit rate



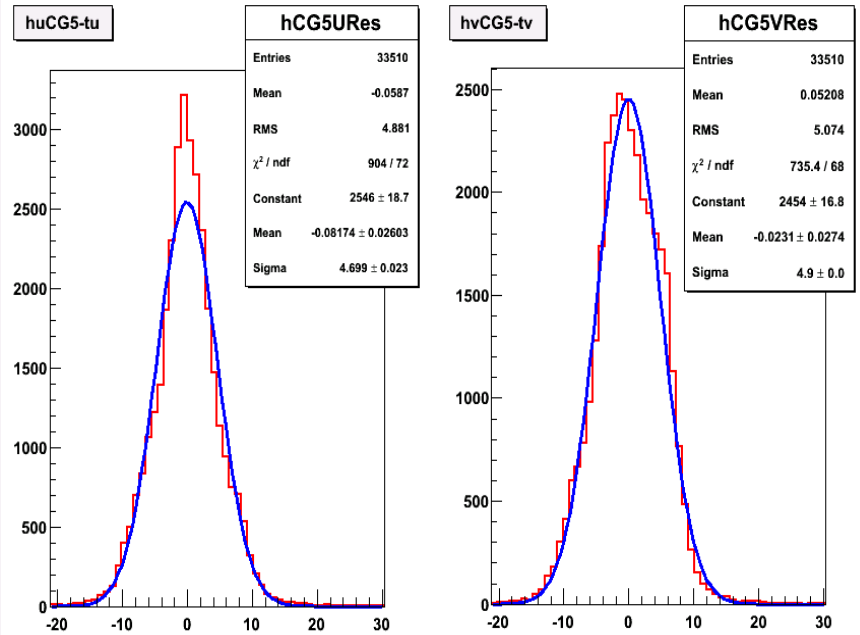


MIMOSA-26AHR: Single Point resolution

A few preliminary results on non-irradiated chips : Resolution



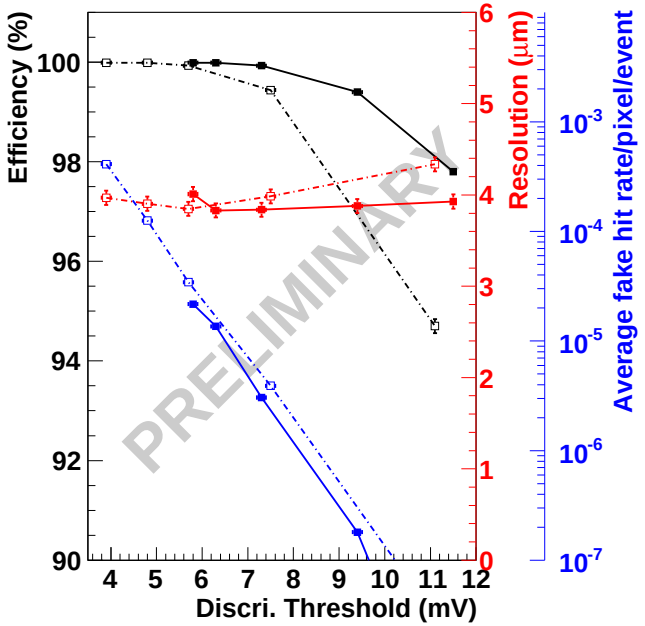
Residus, chip HR-15, 5 S/N threshold



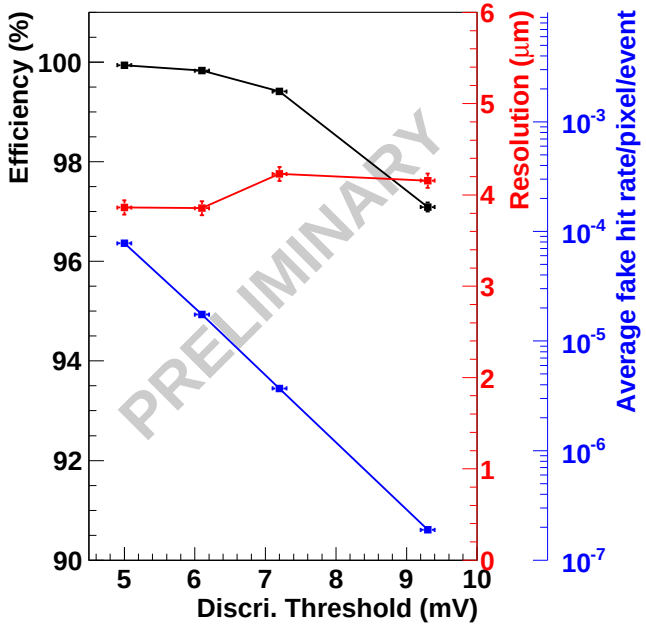
MIMOSA-26AHR : NI Radiation Tolerance

▷▷▷ Impact of 1·10^{13}n$_{eq}$/cm^2 on detection performances at T$_{op}$ $\sim$ 0°C

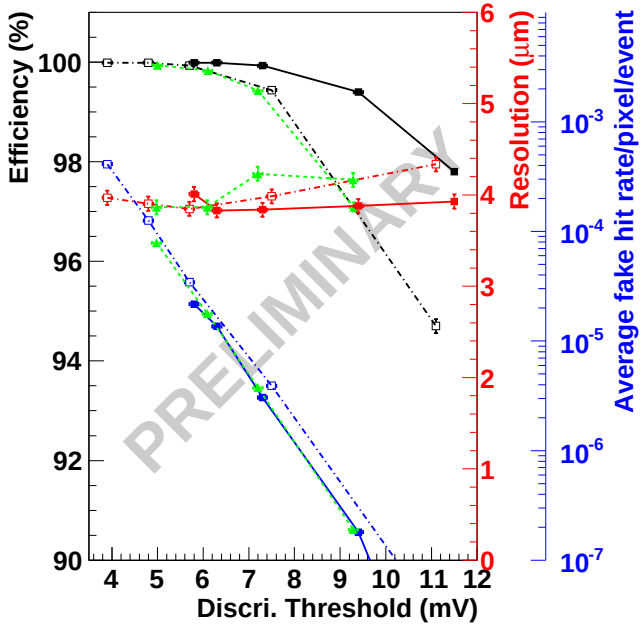
Mi26 HR-15 and HR-10 Efficiency, Fake rate and Resolution



Mi26 HR-15 Efficiency, Fake rate and Resolution
for a chip irradiated with a 1.10^{13}N$_{eq}$ dose at T$_{op}$ ~ 0° C



Mi26 HR-15 and HR-10 Efficiency, Fake rate and Resolution



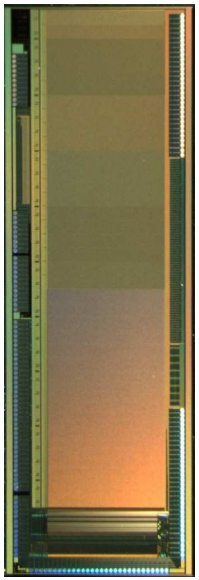
- **Preliminary conclusions:**
  - ⁂ det. eff. $\sim$ 100 % for very low fake rate: HR-15 ▷ plateau until fake rate of few 10^{-6}
  - ⁂ single point resolution $\lesssim$ 4 μm
  - ⁂ det.eff. of HR-15 still $\sim$ 100 % after exposure to 1·10^{13}n$_{eq}$/cm^2

⇒ **Striking evidence for performance improvment with HR epitaxy (in particular 15 μm thick)**

High Resistivity Sensitive Volume: Recent News

- **Goals of the submission (reminder):**
  - ⁂ validation of High-Res substrate against latch-up
  - ⁂ higher depletion voltage (SNR, rad. tol.): 0.7 V $\longmapsto$ $\lesssim$ 2 V
  - ⁂ larger pitch (power dissipation, speed) for STAR-PIXEL : 18.4 μm $\longmapsto$ 20.7 μm $\Rrightarrow$ validate
  - ⁂ higher in-pixel amplification (SNR, rad. tol.) $\Rrightarrow$ less sensitivity to FPN
- **Engineering run submitted April 14th shared with IRFU $\Rrightarrow$ back from foundry since Tuesday July 13th**
  - ▷ delay generated by High-Res unavailability

Generic name	X(mm)	Y(mm)	Description
TopLatchUp-AHR	2.07	2.35	Test structure: Anti-latchup digital cells
Memory	3.01	3.08	Test structure: Anti-latchup memory cells
MIMOSA-18AHR	5.70	6.50	Pixels with 10, 12 and 25 μm pitch
MIMOSA-22AHR	3.70	13.00	M-22 copy, 18.4 & 20.7 μm pitch, 128 col. with discri. ▷▷



  - ▷▷▷ 3 epitaxial layer thicknesses: 10, 15 and 20 μm
- **Essential input for ULTIMATE design optimisation:**
  - ⁂ lab tests have started $\Rrightarrow$ MIMOSA-22AHR alive with reasonable prelim. signals
  - ⁂ beam tests in August & Sept. (new) $\Rrightarrow$ adapt ULTIMATE submission schedule to data analysis timing