PG- GROUP

Exploiting commercial CMOS technologies for:

- detection of Minimum Ionizing Particles for High Energy Physics experiments
- direct detection of X-rays for medical applications

People:

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Felloship: L. Bissi[2,1]

Students

INFN
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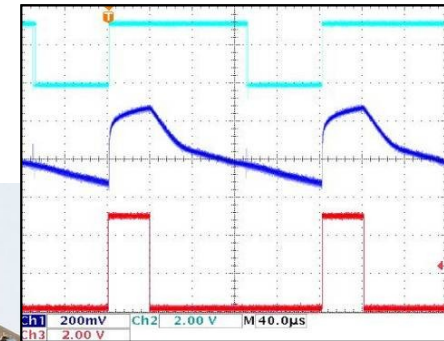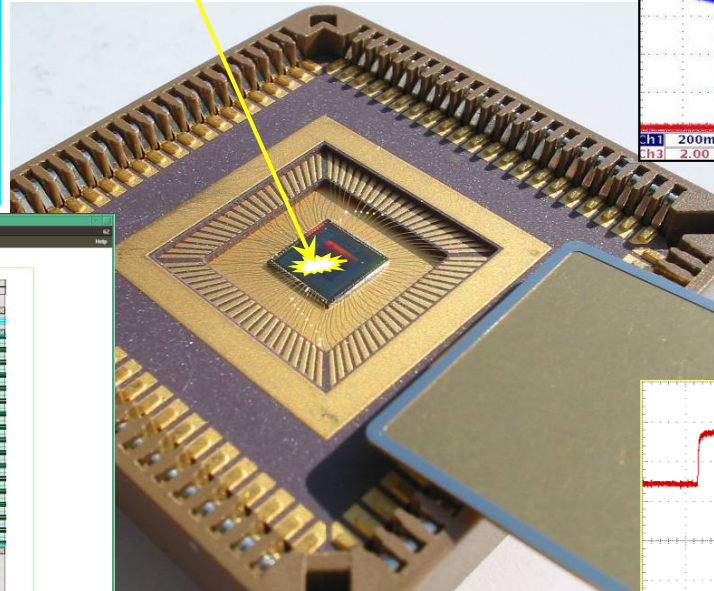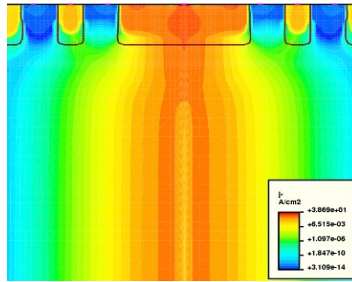(1) Istituto Nazionale di Fisica Nucleare
Sezione di Perugia

(2) Dipartimento di Ingegneria Elettronica e dell'Informazione
Università degli Studi di Perugia

Activity (1)

Radiation **A**ctive **P**ixel **S**ensors

Geant 4→ Synopsys Advanced TCAD ->Cadence

Visible Light

$\Delta V = 360$ mV

α particle
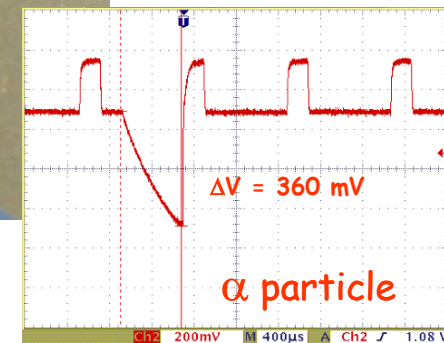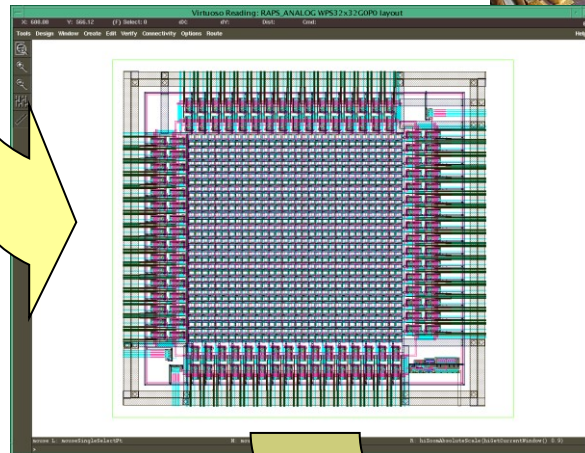
Activity (2)

13 years of experience in radiation damage due to the collaboration with the AMS experiment and private companies
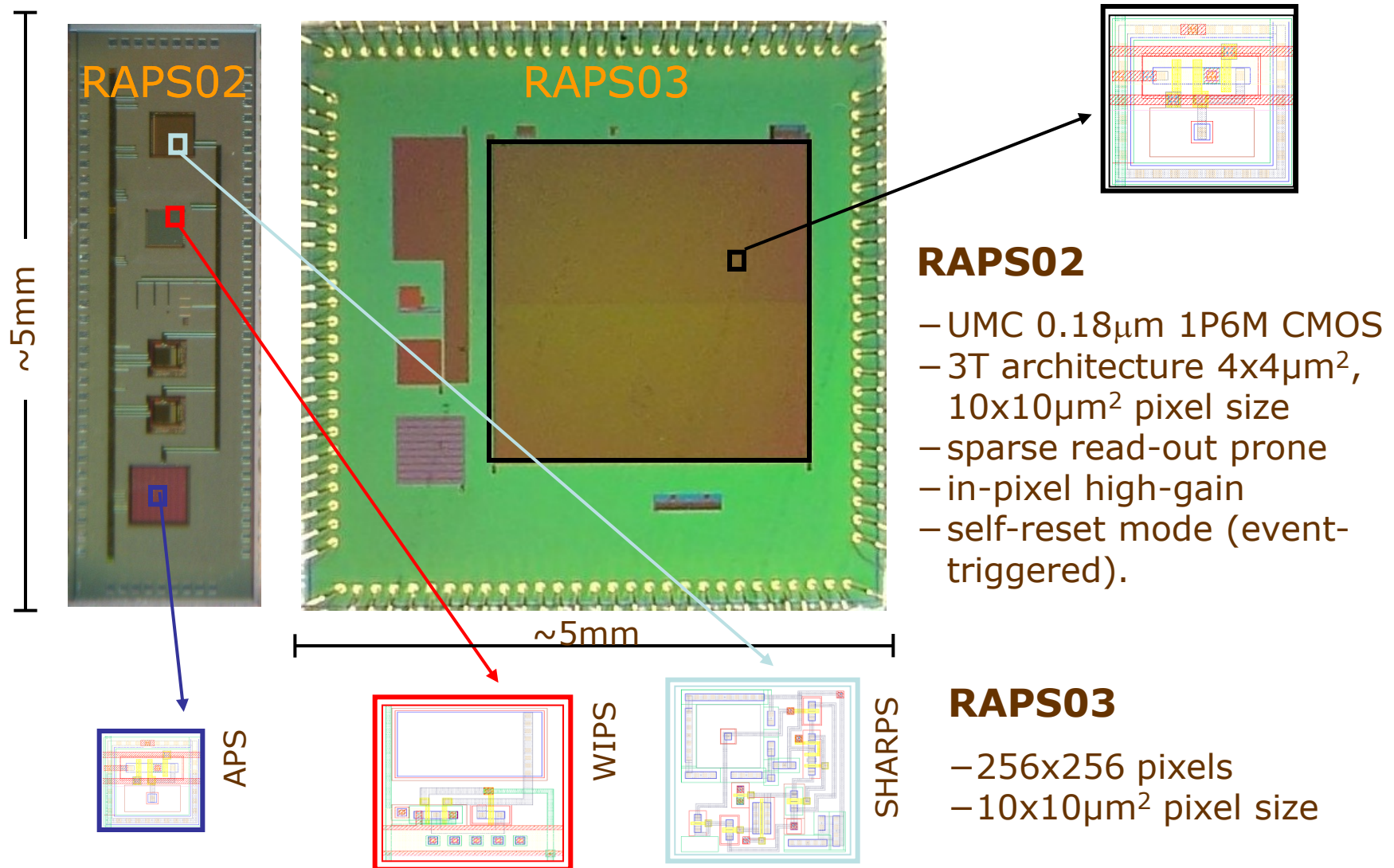
Projects (custom design)

2001 – 2004: Radiation Active Pixel Sensors (RAPS) *Partners*: Univ. of Perugia, Univ. of Parma e INFN di Perugia

2005 – 2008: Self-resetting High-gain Active Radiation Pixel Sensor (SHARPS) *Partners*: Univ. of Perugia, Univ. of Parma e INFN di Perugia

2009 – 2011: VERTICAL SCALE INTEGRATION – PIXEL CMOS (VIPIX) *Partners*: SLIM5 – PI, PV, BG, BO, TO / DIGIMAPS – RM3 / SHARPS PG-PR
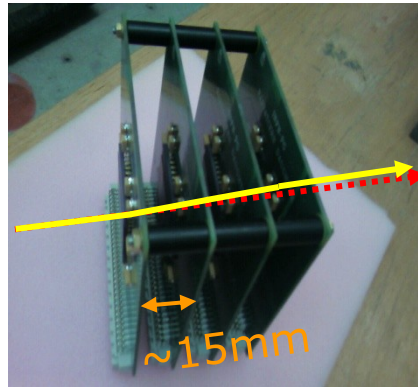
2009 – 2011: To_ASIC *Partners*: (INFN-Sez. di Catania, INFN-Sez. di Cagliari, INFN-Sez. di Perugia, Univ. of Perugia, Univ. of Parma)
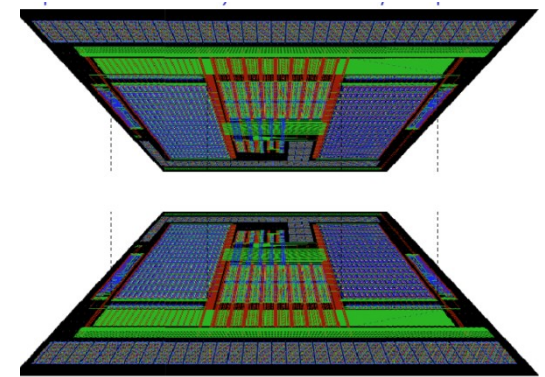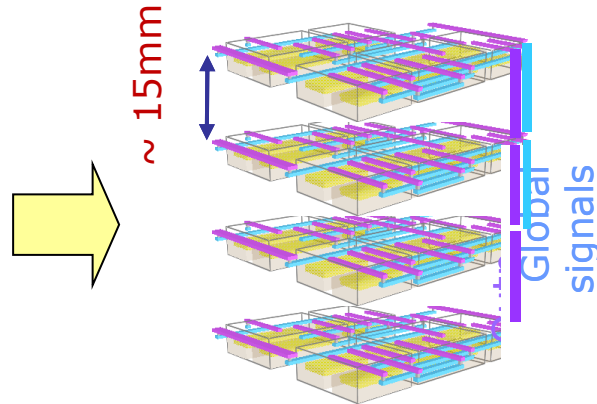
Background .....

RAPS02

RAPS03

~5mm

~5mm

APS

WIPS

SHARPS

RAPS02

- UMC 0.18μm 1P6M CMOS
- 3T architecture 4x4μm^2, 10x10μm^2 pixel size
- sparse read-out prone
- in-pixel high-gain
- self-reset mode (event-triggered).

RAPS03

- 256x256 pixels
- 10x10μm^2 pixel size

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…. we're working on

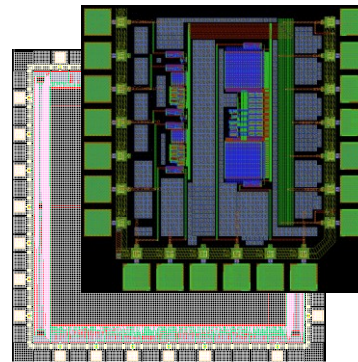1) What we have ….   …… and what we would like to have!
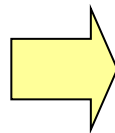

UMC 180nm

~ 15mm

Global signals
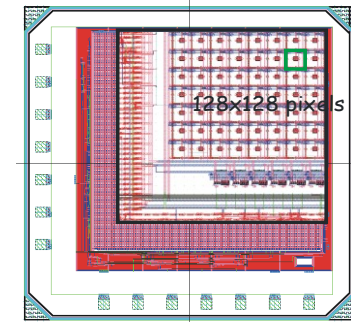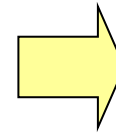
Chartered 130nm

2) looking forward deep submicron technology
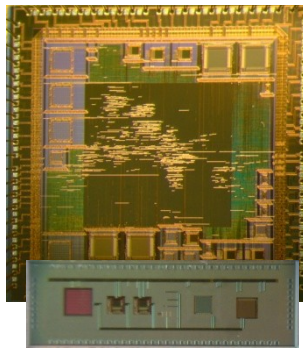
UMC 180nm   Chartered 130nm   UMC 90nm

128×128 pixels

Facilities (1)

Software Equipment

- Cadence Combined IC and Systems Package, Calibre, MultiSim, Synopsys Advanced TCAD, ISE- Foundation (Xilinx)

Technological Facilities

- Optical bench

  – different laser heads
  – laser spot characterization: photon rate, intensity, focusing capability (~ 1-2μm, single pixel hit)

  – advanced movement and DAQ capabilities: micropositioning

  – GUI: calibration, remote data acquisition , analysis (single pixel response, surface mapping, cross-talk
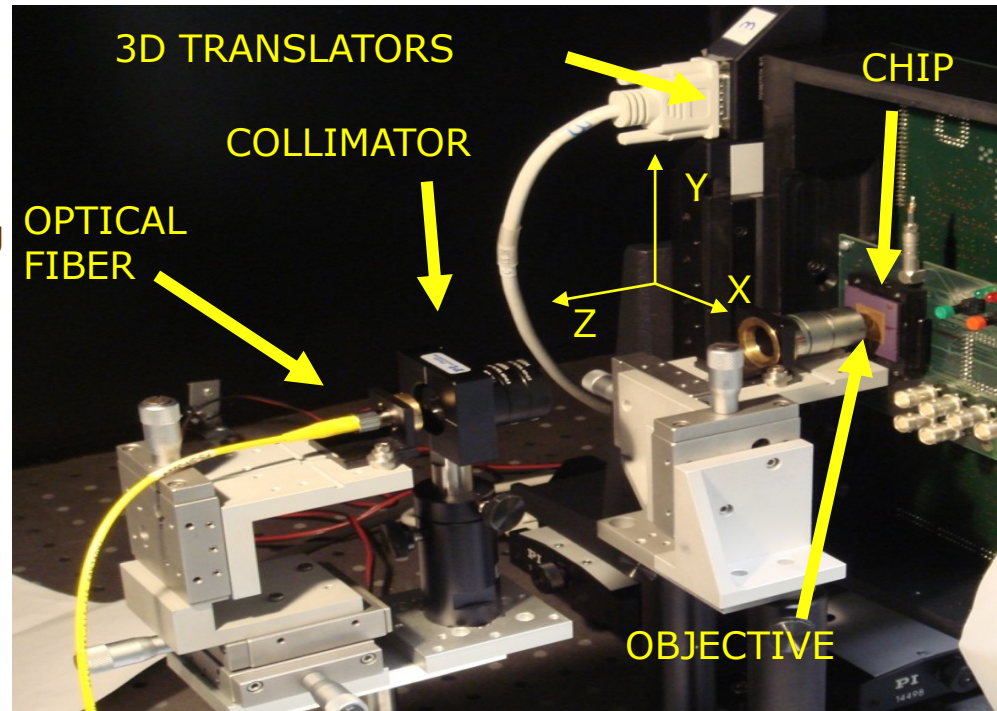
Facilities (2)

Test Board Design (Servizio Elettronica INFN Perugia)

- PCB design and assembly

- Firmware design capabilities (FPGA and Programmable device)

Facilities (3)

- **Total dose tests**

    Co60 gamma rays
- ENEA Casaccia (Rome-Italy)
- Taek SANAEM (Ankara-Turkey)
- GIF UCL (Louvain-la neuve- Belgium)

    X-rays
- X-ray tube in SERMS (Terni-Italy)

- **SEE test with ions and protons**

    Ions and protons
- INFN LNS Catania (Italy) (ions and protons)
- GSI (Darmstadt- Germany) (ions)
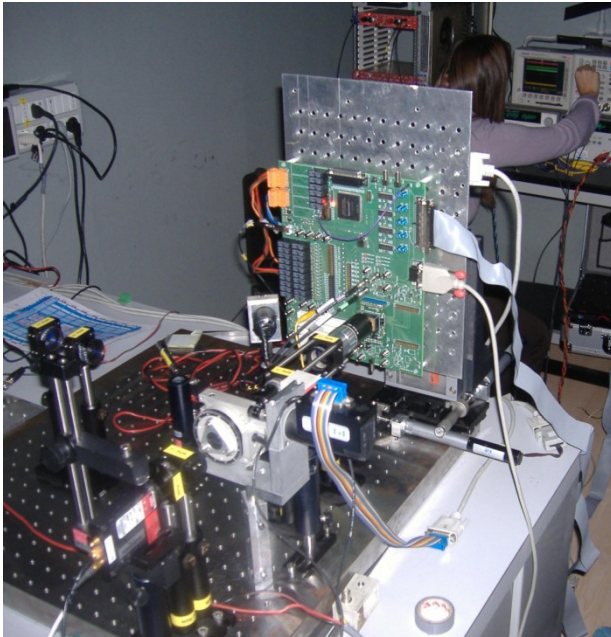- HIF UCL (Louvain-la neuve- Belgium) (ions)
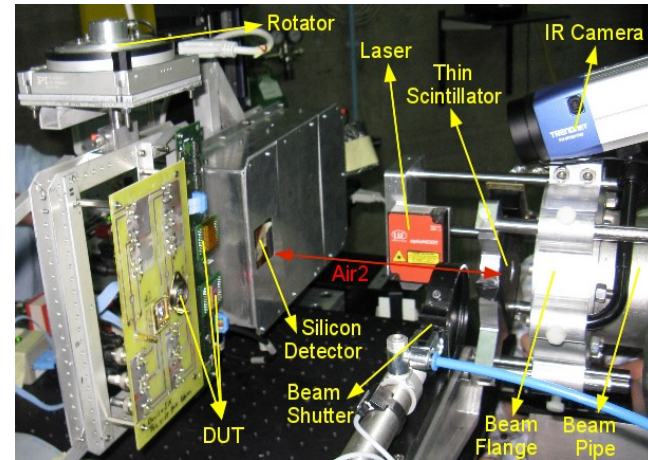
    Laser
- MAPRAD (Perugia) Italy

- **Displacement Damage**
- INFN LNS Catania (Italy) (protons)

Facilities (4)

Laser for SEE testing at MAPRad

SEE testing flux measurement setup at LNS

Cobalt source in Casaccia Rome