# **Mini-MALTA** for future experiments

106° Congresso SIF





Depleted Monolithic Active Pixel Sensor prototype developed in TowerJazz 180 nm imaging process Hybrid detector



Monolithic detector



Sensor + Amp + Digital

Depleted Monolithic Active Pixel Sensor prototype developed in TowerJazz 180 nm imaging process

Small collection electrode (3  $\mu$ m)



#### Monolithic detector



#### Sensor + Amp + Digital

36.4

Depleted Monolithic Active Pixel Sensor prototype developed in TowerJazz 180 nm imaging process

Small collection electrode (3  $\mu$ m)

→ Small «fill factor»

Hybrid detector



#### Monolithic detector



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#### Monolithic detector



#### Sensor + Amp + Digital



### For future HEP experiments

Designed for outermost layer of the ATLAS Inner Tracker (ITK) pixel detector

time resolution	25 ns
rate	1 MHz/mm <sup>2</sup>
particle flux	2x10 <sup>15</sup> n <sub>eq</sub> /cm <sup>2</sup>
TID (Total Ionizing Dose)	100 Mrad



#### MALTA issues: Random Telegraph Noise

Proposed solution: M3 transistor enlarged



#### MALTA issues: low detection efficiency



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Proposed solution: new implant geometries







NWELL COLLECTION

#### Mini-MALTA characterization

Laboratory measurements:

- Threshold scan
- Noise occupancy
- Signal response using <sup>55</sup>Fe source



#### Threshold scan







#### Noise occupancy



Neutron irradiated chip (2x10<sup>15</sup>  $n_{eq}$ /cm<sup>2</sup>) @ +20°C with <sup>90</sup>Sr

#### Noise occupancy







### Signal response using <sup>55</sup>Fe source



#### Conclusions

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- is cheap
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- threshold and noise
- energetic resolution
- efficiency

proving detector radiation hardness.

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Mini-MALTA is suitable for future High Energy Physics experiments.