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Direct detection of particle radiation with perovskite sensors

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In the past decade, organometal halide perovskites (OMHP) semiconductors have been studied as sensors for ionization radiation and X-ray detectors, beside the well known success as photovoltaic devices. Properties such as simple single crystal growth from low-cost solution processes, high stopping power, defect-tolerance, large mobility-lifetime product and tunable bandgap make OMHP very promising materials for novel detectors.

In the first part of the talk an overview of usage of perovskite for radiation detection of charge particles (α and β particles) and electromagnetic radiation (X-rays and γ -rays) will be presented.

In the second part, the results of PEROV INFN project [1] will be shown: OHMP based single crystal devices have been developed and tested with electrons from the Beam Test Facility at INFN Frascati National Laboratories, close to the minimum ionizing energy deposition. The crystal sensor can reach the single particle sensitivity with a bias voltage as low as 5 V. It also shows a good linearity of the response as a function of the number of electrons with a dynamic range of approximately 104.

Efforts towards the application of OMHP sensors as X-ray detectors will also be also discussed.

[1] Testa et al, Direct detection of minimum ionizing charged particles in perovskite single crystal detector with single particle sensitivity, accepted by Nanoscale, <https://doi.org/10.1039/D4NR01556H> (2024)

Primary authors: PAOLONI, Alessandro (Istituto Nazionale di Fisica Nucleare); DE SANTIS, Antonio (Istituto Nazionale di Fisica Nucleare); ROVELLI, Chiara Ilaria (Istituto Nazionale di Fisica Nucleare); MATTEOCCHI, Fabio (Istituto Nazionale di Fisica Nucleare); TINTI, Gemma Maria (Istituto Nazionale di Fisica Nucleare); FELICI, Giulietto (Istituto Nazionale di Fisica Nucleare); PAPALINO, Giuseppe (LNF); VIOLA, Ilenia; Prof. LO PRESTI, Leonardo (Università degli Studi di Milano); TESTA, Marianna (Istituto Nazionale di Fisica Nucleare); AUF DER MAUR, Matthias (Istituto Nazionale di Fisica Nucleare); RIZZATO, Silvia (Istituto Nazionale di Fisica Nucleare); MORGANTI, Silvio (Istituto Nazionale di Fisica Nucleare); CHUBINIDZE, Zaza

Presenter: TINTI, Gemma Maria (Istituto Nazionale di Fisica Nucleare)

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