Contribution ID: **42** Type: **not specified**

Study of the excess noise and optimum operating conditions for LGAD detectors in high precision X-γ ray spectroscopy

Thursday, 19 June 2025 11:20 (20 minutes)

Radiation and particle detection systems based on low-gain avalanche diodes (LGAD) are promising technologies for a broad range of applications spanning from timing detectors of minimum ionizing particles in High-Energy Physics (HEP) experiments to soft X-ray detectors in synchrotron, FEL and X-ray fluorescence analysis instruments. LGADs are expected to improve the performance of the detection systems with respect to the standard Diode detector's structures due to the charge signal multiplication gain (Ms) originating from the impact ionization process in the narrow high electric field region near the output electrode. However, the advantage of the increase in the charge signal amplitude is hindered by the concurrent rise of the excess noise associated with the charge multiplication statistics itself, which negatively affects the energy resolution in spectroscopic acquisitions. In this study, all the noise components of LGAD-based X-γ ray detection systems are precisely determined for a broad range of multiplication gain values and different shaper peaking times. The dependence of the electronic noise associated with the LGAD dark current is studied as a function of Ms and temperature. The white and 1/f series noise contributions decrease as Ms increase, reducing the optimum peaking time, reaching 0.1 us at Ms = 13 with the equivalent noise charge of 11 el. measured at room temperature. An expression for the equivalent noise charge at the optimum peaking time is proposed. The conditions, in terms of multiplication gain and shaping time to achieve the maximum energy resolution with LGAD-based X-γ ray detection system, are experimentally and theoretically determined.

Primary authors: MELE, Filippo (Istituto Nazionale di Fisica Nucleare); Dr GIACOMINI, Gabriele (Brookhaven National Laboratory); BERTUCCIO, Giuseppe (Istituto Nazionale di Fisica Nucleare); EREMEEV, Iurii (Politecnico di Milano); Dr CHEN, Wei (Brookhaven National Laboratory)

Presenter: EREMEEV, Iurii (Politecnico di Milano)

Session Classification: Detectors and Detection Techniques