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Cryogenic characterization of new Silicon Photomultipliers produced at FBK and their use in DarkSide-20k experiment

DarkSide-20k is an innovative experiment whose scientific purpose is the direct detection of dark matter in the form of WIMPs. Its design allows to reach a sensitivity of 9x10ˆ(-48) cmˆ2 of WIMP-nucleon spin-independent cross section for particles with a mass of 1 TeV/cˆ2. The detector will be a two-phase (liquid-gas) Argon Time Projection Chamber. To detect Argon scintillation light DS-20k will rely on the new technology of Silicon Photomultipliers (SiPM), interesting for the extremely high gain and resolution. The top and the bottom of the TPC will be instrumented with about 15 mˆ2 of SiPMs arranged in 6000 tiles. The SiPMs will be required to work at cryogenic temperatures. This challenging environmental condition modifies in non-trivial ways parameters of the devices that have to be absolutely under control for any experimental purpose. In this poster we will show the characterization at cryogenic temperatures of three new prototypes produced by FBK: Standard Field NUV-HD, Low Field NUV-HD and Low Quenching Resistance RGB-HD. In particular we will focus on the measurement of: dark count rate (DCR), after-pulse (AP) probability, direct and delayed cross-talk (CT) probabilities, break-down voltage, gain and photo detection efficiency (PDE). Pictures and sketches of the experimental setup, with a brief description, will also be produced. Future R&D studies envisioned for SiPMs are described together with the experimental considerations to push on some particular features.

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