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Micro-Pattern Gaseous Detector Technologies for Energy, Intensity and Cosmic Frontiers: an overview of the CERN-RD51 Collaboration

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Driven by the availability of modern photolithographic techniques, Micro Pattern Gas Detectors (MPGD) have been introduced in the 20th century by pioneer developments: Microstrip Gas Chambers (MSGC), Gas Electron Multipliers (GEM), Micro-mesh gaseous structure (Micromegas), followed by the thick-GEM (THGEM), resistive GEM (RETGEM), Micro-Pixel Gas Chamber (μ-PIC), and an integrated readout of gaseous detectors using solid-state pixel chips (InGrid). Nowadays, intensive R&D activities in the field of MPGDs and their diversified applications are pursued by the large CERN-RD51 collaboration. The aims are to facilitate the development of advanced gas-avalanche detector concepts and technologies and associated electronic-readout systems, for applications in basic and applied research. MPGD systems now offer robustness, very high rate operation, high precision spatial resolution (sub 100-micron), and protection against discharges. MPGDs became important instruments in current particle-physics experiments and are in development and design stages for future ones. They are significant components of the upgrade plans for ATLAS, CMS, and ALICE at the LHC, exemplifying the beneficial transfer of detector technologies to industry. Beyond their design for experiments at future facilities (e.g. FAIR, EIC, ILC, FCC), MPGDs are considered for rare-event searches, e.g. dark matter, double beta decay and neutrino scattering experiments. Detectors sensitive to x-rays, neutrons and light are finding applications in other diverse areas as material sciences, hadron therapy systems, homeland security etc. Since its early stages, the RD51 collaboration has paid attention to building a proper environment for performing high-quality advanced R&D on MPGDs; it continues to advance the MPGD domain with scientific, technological, and educational initiatives. It is a worldwide open scientific and technological forum on MPGDs, and RD51 has invested resources during ten years in forming expertise, organizing common infrastructure and developing common research tools. Originally created for a five-year term in 2008, RD51 was recently prolonged for a third consecutive five years term beyond 2018 (arXiv: 1806.09955). This talk will highlight recent MPGD technology advances, review RD51 collaboration activities, and address numerous MPGD applications at the Energy, Intensity and Cosmic Frontiers.

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