

Novel detectors and their impact on New Physics

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Micropattern gaseous detectors (MPGD), Micromegas and GEM are widely used by many experiments and future projects: COMPASS, CAST, LHC-B, TOTEM, STAR, NA48, n-TOF, ILC TPC project, T2K TPC, ATLAS SPLC, dEDM. The high radiation resistance and excellent spatial and time resolution make them an invaluable tool to confront future detector challenges at the next generation of colliders. Originally developed for the high-energy physics, MPGD applications have expanded to astrophysics, neutrino physics, neutron detection and medical imaging.

We will present a detailed review on principle and basic performance of Micromegas detector. We will point out new developments that are currently under way:

- An industrial way of fabricating the detector in a single process, called bulk Micromegas allowing to build large, robust and cheap detectors.
- A novel high-precision fabrication technology using etching through copper-kapton-copper, called micro-Bulk, providing the entire Micromegas structure on a single thin foil.
- High accuracy, TPC read-out detectors, with positive ion suppression capability permitting to resolve high particle density events. Its use for low-energy, low-background rare event detection will also be discussed.
- A marriage of micro-pixels and MPGD is currently under development provides single electron detection and unprecedented 3d accuracy.

A particular attention will be devoted on the ability of these detectors to detect low energy ion recoils which is a must in dark matter search in order to determine the direction of WIMP wind.

A new type of radiation detector based on a spherical geometry will also be presented. The detector consists of a large spherical gas volume with a central electrode forming a radial electric field. A small spherical sensor located at the center is acting as a proportional amplification structure. It allows high gas gains to be reached and operates in a wide range of gas pressures. Sub-keV energy threshold with good energy resolution is achieved. This new concept has been proven to operate in a simple and robust way and allows reading large volumes with a single read-out channel.

Such a device would open the way to detect the neutrino-nucleus interaction, which, although a standard process, remains undetected due to the low energy of the neutrino-induced nuclear recoils. Other physics goals of such a device could include supernova detection, low energy neutrino oscillations and study of non-standard properties of the neutrino, among others. Filled with ^3He gas provides a high-resolution massive neutron detector; recent results at ground and underground will be presented.