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Oral_22: Soft-X rays and neutron diagnostics in magnetic confinement and inertial fusion: the SIDE-ON GEM detector and DIAMONDPIX

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In the last years, our group developed new compact detectors not only for soft-X rays diagnostic, but also for gamma photons, charged particles, and neutrons. In the first case, 10×10 cm2 Gas Electron Multiplier (GEM) detectors have been developed and installed on Tokamaks like KSTAR (South Korea) and EAST (China). Recently, these detectors have been equipped with new readout electronics based on GEMINI chips which allow a simultaneous measure of time, charge, and position for each interacting photon. In addition, data transfer is managed through an optical link that can sustain X-rays fluxes until 500 MHz. In the second case, our work concerned solid-state detectors based on the Timepix chip. They are 2D C-MOS hybrid detectors with a 14×14 mm2 area and 256×256 pixels, each pixel having an area of 55×55 µm2. The active material is a few hundred-micron semiconductor layers, typically Si or CdTe. It has also been used for thermal neutron using appropriate converting layers based on B4C or LiF. Two new detectors will be presented and their related applications in magnetic confinement (e.g., DTT, ITER, DEMO) and inertial fusion experiments. The first is a Side-on GEM detector. It has a 10×10 cm2 active area but is equipped with a pad layout of 4 lines of 64 strip pads, each one having an area of 1.5 × 20 mm2. This GEM detector has a 1 cm drift region with two lateral windows, as well as the head-on Mylar window like the previous GEM detectors. With this configuration, this new GEM can work in head-on mode to realize 1D plasma profiles on Tokamaks and in Side-on mode for soft-X rays diagnostic on laser-plasma experiments to realize a spectral reconstruction of X-rays emission. The second novelty is represented by the "Diamondpix". The first prototype was realized through a coupling of a Timepix3 chip with a 10×10 mm2 polycrystalline diamond and used successfully for 2.5 and 14.0 MeV neutrons, the typically observed energies on Tokamaks reactors. In addition, the high time resolution (until 1.6 ns) allows Time-of-Flight (ToF) measurements, which can be used effectively for inertial fusion plasmas. In this case, it has been realized with a 10×10 mm2 single crystal diamond having a thickness of 500 µm. For the coupling to the Timepix3 chip, the innovative technique of Anisotropic Conductive Film (ACF) has been applied after the metallization of the diamond plate on both sides. In the present work, the layout and the first quality tests of this new diamond detector will be presented.

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