A REAL-TIME PROFILE MONITOR FOR NUCLEAR PHYSICS RESEARCH AND MEDICAL ION BEAMS

D. S. Levin[1], P. S. Friedman[2], T. Ginter[3], N. Ristow[1], C. Ferretti[1]

[1] University of Michigan, Randall Laboratory, Ann Arbor, MI
[2] Integrated Sensors, LLC, 201 Thornton Dr, Palm Beach Gardens, FL
[3] Michigan State University, Dept of Physics, East Lansing, MI

We have developed a high-performance Scintillator Ion Beam Monitor that provides real-time analysis across a wide range of isotopes, energies, and intensities. It is has attracted attention at facilities where fast beam imaging and tuning are at a premium. It uses a low-noise machine-vision camera and thin scintillator targets that can be moved into/out of the beam without breaking vacuum. Two proprietary scintillators are used: 1) a semicrystalline polymer film tested over a thickness range of ~1 to 190 μm. It produces, per unit thickness, much stronger signals than common PVT based plastic scintillators, and can be transmissive for fast beams. 2) An opaque sheet of thickness 100-400 μm consisting of inorganic crystal grains in a polymer hybrid matrix. It generates an order of magnitude larger signal per unit thickness than a single crystal CsI(Tl) reference. Importantly it produces a sharp beam image, with minimal secondary reflections and little to no observable halo. Both scintillator types are non-hygroscopic and are radiation damage resistant with no observed signal loss with ~10 kGy total dose. The SBM was staged at the FRIB (East Lansing, Michigan) reaccelerated 3 MeV/u ion beam, demonstrating real-time beam profile and rate analysis spanning more than five orders-of-magnitude including visualization of single ion signals with ~10 μm spatial resolution. This instrument is also a development platform for a transmissive and fast 20 KHz real-time monitor intended for FLASH radiotherapy. The monitor was also staged in an 8 MeV electron beam at the Notre Dame Radiation Laboratory at FLASH compatible dose rates of ~1 Gy per 2 ns pulse. This work is funded by the DOE Office of Science, Office of Nuclear Physics.

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[1] University of Michigan, Randall Laboratory, Ann Arbor, MI
[2] Integrated Sensors, LLC, 201 Thornton Dr, Palm Beach Gardens, FL