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A Micromegas neutron detector as Beam Loss Monitor for the ESS Linac

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The high beam intensity of linear accelerators such as the ESS linac implies that even a loss of a small fraction of the beam could result in significant irradiation and destruction of accelerator equipment. The Beam Loss Monitor (BLM) systems must be capable of detecting the smallest possible fraction of beam loss, approaching 0.01 W/m loss, preventing activation of machine components and allowing hands-on maintenance. The monitoring of a loss is usually done by detecting the secondary radiation that is produced by the impact of the lost particles on the accelerator materials. However, especially at the first stages of the accelerators (proton energies <100 MeV), typical BLMs based on charged particle detection (i.e. Ionization Chambers) are not appropriate because the expected particle fields will be dominated by neutrons and photons. Another issue is the photon background due to the RF cavities, which is mainly due to field emission from the electrons from the cavity walls, resulting in bremsstrahlung photons.

The idea for the new BLM system (ESS-nBLM) is to use Micromegas detectors specially designed to be sensitive to fast neutrons and insensitive to low energy photons (X and gammas). In addition, the detectors will be insensitive to thermal neutrons, since part of them will not be directly correlated to beam losses. The appropriate configuration of the Micromegas operating conditions will allow excellent timing, intrinsic photon background suppression and individual neutron counting, extending thus the dynamic range to very low particle fluxes. The performance of several prototypes have been studied over the last year in several irradiation facilities, while one detector was tested with real beam losses at CERN Linac4. The concept of the nBLM system, as well as the performance of the detectors, will be presented here.

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