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Scintillator Beam Diagnostic for CRYRING@ESR Behaviour under Extreme Conditions

CRYRING@ESR facility from FAIR requires the usage of dedicated beam diagnostics systems compatible with ultra-high vacuum (UHV) conditions (up to 10-12 mbar), mechanical strength, high temperature resistance and good tolerance for radiation. [1,2]
An elegant, yet simple approach consists of using scintillator crystals (YAP:Ce) installed inside UHV that are coupled through a quartz window to an external photomultiplier. [3,4].
Radiation hardness tests were performed at IFIN-HH, Romania, using an electrostatic 3 MV TandetronTM to produce MeV gold ions, while the total fluence was delivered in several steps in the range of 1010-1013 ions/cm2.[5]
Remarkably the preliminary results showed a two-step damage process of the scintillator: an abrupt decay of the YAP:Ce efficiency corresponding to a fluence of 4*1012 ions/cm2; nevertheless, increasing the ion fluence up to 1,5*1013 ions/cm2 the photon yield continued to decline at a slower rate. One day after the last irradiation scintillators recovered to 70% of the initial yield, most probably due to a self-annealing effect that may reduce the stress levels in the irradiated region. Further ex-situ X-ray diffraction measurements are required to reveal physical processes that occur at the atomic level for the recovery of YAP:Ce lattice.

The second stage of this work includes measurements that were carried out at CRYRING@ESR synchrotron to characterize one of the detectors already installed in the real experimental conditions. Influence of stray light in various operating regimes was assessed by replacing the ion beams with a 241Am source. First indications that we obtained in this study foreshadow the performance of the YAP:Ce beam monitor during the ion beam experiments that are envisaged for the 2023 CRYING@ESR campaign.

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