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Short_Oral_17: Characterization of Vacuum HV Micro discharges at the HVPTF Facility Through X-ray Bremsstrahlung Spectroscopy

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The development of MITICA, the prototype for a neutral beam injector for ITER, drives the interest in investigating HV insulation in vacuum. The High Voltage Padova Test Facility (HVPTF) is an experimental device which has the double aim of studying the physical phenomena underlying the voltage holding in vacuum and testing technical solutions to increase the breakdown threshold. HVPTF features a vacuum chamber containing two stainless steel electrodes separated by an adjustable gap of few centimeters. Electrodes are available in different shapes and can achieve an HV difference up to 800 kV. Both the current and the voltage of the electrodes are sampled at a 100 Hz rate along with the vacuum pressure and the gas composition. Two scintillating crystals, a LYSO and a LaBr3, are installed to detect the hard X-ray bremsstrahlung radiation produced by the interaction of the free charges accelerated by the HV difference on the electrode surfaces. Both scintillators are coupled to photomultipliers and have small active volumes and fast electronics, resulting in very fast signals (40-100 ns); this minimizes the pile-up effect and enhances time resolution, allowing for the measurement of X-ray emission spectra to up to 500 keV with a time-width of few hundreds of μs.
The electrodes are subject to a conditioning process through which the breakdown voltage is gradually increased until the system reaches a saturation value. Between major breakdown discharges a series of current micro-discharges are observed, during which the number of bremsstrahlung photons drops almost to zero. A global increase in gas emission is measured in correspondence of such events, likely due to degassing induced by the discharges.
The aim of this contribution is to expand the knowledge around the micro-discharge dynamics focusing on the bremsstrahlung spectra obtained through the scintillators. Different micro-discharge types will be characterized and put in relation with the different electrodes and the conditioning phase.

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