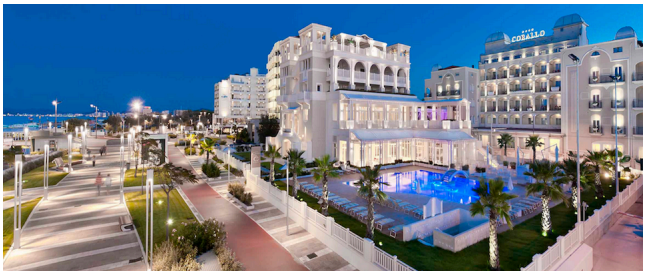

Contribution ID: **83** Type: **poster**

The Synchronous Detection Technique for Accurate Monitoring of High-Energy Pulsed X-rays

Tuesday, 6 June 2023 18:19 (1 minute)

At high energy, the smaller inelastic nucleon-Carbon cross-section implies that diamond has a radiation hardness an order of magnitude higher than that of silicon. The production of high-quality diamond samples grown using the chemical vapor deposition technique paved the way for the use of synthetic diamonds in the fabrication of detectors for both charged particles and photons. Importantly, laser processing technology for the fabrication of three-dimensional (3D) contacts in diamond has been proposed to produce highly efficient detectors, even with ultra-low active volumes. However, 3D contact structures made with laser treatments unavoidably induce structural defects in the bulk of the material, thus affecting detector response due to trap-related charge transport mechanisms. Remarkably, low-quality diamond-based detectors show a strong sub-linear response with the radiation dose-rate, as usually observed for synthetic diamonds grown with the high-pressure and high-temperature technique. When pulsed radiation is concerned, the experimental results illustrated in this work demonstrate that adequate synchronous signal conditioning can strongly mitigate the trap-mediated contribution, thereby improving the performance of the overall detection system. Very significantly, the results open the way of using low-quality diamond samples for the fabrication of accurate detectors also in the field of microdosimetry.

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Session Classification: PS: Poster Session