

Design of a Diamond Camera for TCV

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The design of diagnostics for next-generation fusion devices must address a number of technological and scientific issues, including the capability to operate in the harsh environment expected inside the vacuum vessel. Recent studies have suggested the use of diamond photodetectors within diagnostic systems positioned in close proximity to the plasma as replacements for other semiconductors, in particular Si diodes, thanks to their higher resilience to radiation damage and high temperatures, their high signal-to-noise ratios, and their extremely fast response.

Thin, single-crystal CVD diamond detectors are being developed at the Laboratory of Industrial Engineering of the University of Rome “Tor Vergata” for several applications, including fusion plasma diagnostics. An initial installation of two photodetectors on JET [1], followed by a subsequent deployment on FTU [2, 3], has shown that these detectors are highly suitable for the investigation of fast plasma phenomena, owing to their strong sensitivity in the spectral range up to 3 keV combined with their excellent time resolution.

In this work, we present the design of a Diamond Camera to be integrated on the TCV tokamak. The prototype, developed within a collaboration between ENEA and the University of Rome “Tor Vergata”, consists of an array of 15 detectors to be installed in one of the upper lateral ports of the device. The design allows the placement of filters in front of the detectors to select specific spectral ranges along chosen LoS, as well as the possibility to rotate the entire diagnostic system by 90°, thereby enabling access to complementary measurement geometries (toroidal or poloidal). Signals from the Diamond Camera will be processed using an 8-channel, low-noise current amplifier developed by CAEN and FEMTO single-channel transimpedance amplifiers. The acquired data will be benchmarked against measurements from other diagnostics available on the machine to exploit the capability of diamond photodetectors to provide complementary information on the observed plasma phenomena. This could provide an indication of the minimum number of photodiodes effectively required in a fully diamond-based tomographic system for reliable plasma reconstruction.

[1] M. Angelone et al. (2008) *Nuclear Instruments and Methods in Physics Research A* 595 616

[2] F. Bombarda et al. (2021) *Nuclear Fusion* 61

[3] S. Cesaroni et al. (2021) *Fusion Engineering and Design* 166, 112323