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Microstructured Targets for Enhanced X-Ray and Particle Emission – Fabrication and Characterization

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Intense electromagnetic fields generated by tightly focused, energetic and short laser pulses are amenable to accelerate charged particles across just a few hundred micrometers to MeV energies. Laser driven electron and ion acceleration is a very effective approach to generate high number particle bunches with short duration and excellent emittance, though typically a broad energy spectrum and large divergence. Such compact laser driven accelerators benefit from recent developments of tabletop high intensity laser systems with an increased repetition rate. Currently 10Hz operation is feasible, future systems with 1kHz and more are envisioned. Typical nuclear scattering experiments at traditional accelerator facilities usually work with a single target which can be used for an entire experimental campaign or, e.g. for stripper foils, is only to be exchanged from time to time. In contrast targets for high power laser matter interaction are for single use only. In order to benefit from the increased repetition rate of the driver, it is vital to develop efficient targetry techniques that are amenable to high number production, automated characterization and robotic handling of individual components. Targets are inherently small to prohibit excess waste production and mitigate material cost. Still they can be of complex geometrical shape, e.g. to positively influence the particle beam divergence or enhance the conversion efficiency from laser light into particle and X-Ray emission.
This presentation will outline different fabrication and characterization techniques at TUD target laboratory to the audience, specifically exemplified by micro structured silicon targets – also known as “black silicon”.

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