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Ultra-high energy density plasmas using nanostructured plasmas

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As the laser technology continues its spectacular development, ever higher field intensities and power levels become accessible in laboratories. This opens new horizons for laser applications in ultra-bright sources of short wavelength radiation. At the same time, the laser pulse quality – like the
contrast ratio – is greatly improved so that fine structured targets maintain their structure till the main pulse arrival. This opens new and unexpected possibilities for laser-plasma engineering towards new physics.
In the talk, we consider laser pulse interaction with nano- and micro-structured targets like nano-grass or microchannels [1,2] in the intensity range 10 18 -10 20 W/cm 2 . At intensities higher than 10 22
W/cm 2 , the radiation damping force becomes important and can exceed the Lorentz force acting on an electron [2]. The gamma-ray emission is then the major channel of laser energy absorption [3,4].
When a micro-plasma waveguide (MPW) is coupled with a readily available 2J laser, it may serve as a novel compact x-ray source. Electrons are extracted from the walls and form a dense helical bunch inside the channel. These electrons are efficiently accelerated and wiggled by the waveguide modes
in the MPW, which results in a bright, well-collimated emission of hard x rays in the range of 1 ~ 100 keV [5].

References:

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