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High harmonics and sub-attosecond pulses in the relativistic regime TEODORA BAEVA, Institute for theoretical Physics, University of Duesseldorf, SERGEY GORDIENKO, Landau Institute of theoretical Physics, Moscow, Russia, ALEXANDER PUKHOV, Institute for theoretical Physics, University of Duesseldorf — The theory of relativistic spikes explaining the high harmonics generation due to the interaction of a short ultra-relativistic laser pulse with overdense plasma in the relativistic regime is presented. The main analytical results based on microscopic analysis of the plasma as well as PIC simulations are discussed. This theory predicts universal spectrum of the high harmonics, which includes the power-law part $I_n \propto n^{-8/3}$ for $n < \sqrt{8\alpha}\gamma_{max}^3$, followed by exponential decay. Here γ_{max} is the largest relativistic γ-factor of the plasma surface and α is the second derivative of the surface velocity at this moment. The high harmonic roll-over at γ_{max}^3 is parametrically larger than the $4\gamma_{max}^2$ predicted by the oscillating mirror model based on the Doppler effect. These predictions of relativistic spikes were confirmed experimentally. The cornerstone of the theory is the new physical phenomenon: spikes in the relativistic γ-factor of the plasma surface. These spikes define the high order harmonic spectrum and lead to a train of sub-attosecond pulses in the reflected radiation. The theory of relativistic spikes proposes a way to extract a single attosecond pulse out of the pulse train generated by a multi-cycle driver by means of the mechanism of Relativistic Plasma Control (RPC).

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