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High-quality GeV-scale electron bunches with the Resonant Multi-Pulse Ionization Injection

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Laser Wake Field accelerated electrons need to possess a good beam-quality to comply with FEL requirements, or to be post-accelerated in a further LWFA stage towards multi-GeV energies scale.
Controlling electron injection and laser pulse evolution are therefore two of the crucial tasks for high-quality e-bunch production. A new bunch self-injection scheme, the Resonant Multi Pulse Ionization Injection (RMPII), is able to generate electron bunches with extremely low normalized emittances (as low as 0.08 mm mrad) and very low energy spread (below 0.3% of slice rms energy spread), with peak current of about 1kA.
The new scheme employs a single Ti:Sa laser system whose main fraction is time shaped as a train of resonant pulses that drive a large-amplitude plasma wave. A minor fraction is frequency doubled and acts as an ionizing pulse that extracts electrons in a controlled way. Further, in order to achieve multi-GeV energies, a stable pulse(s) propagation should be achieved. A detailed comparison between the pulse evolution in standard single-pulse and multi-pulse setup will be given. Finally, FEL simulations with GeV-scale electron bunches generated via the RMPII scheme will be presented.

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