# Bayesian optimization of ultrashort, 100 MeV-scale, 1 kHz rep. rate laser-plasma electron accelerator at Eli-Alps: First results

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The advent of dispersion-controlled chirped mirrors [1] technology has enabled the operation of laser wakefield accelerators (LWFA) at kHz repetition rates. Many facilities across the globe are operating kHz and multi-kHz femtosecond (fs) lasers. A few tens of mJ and sub-10 fs laser facility at ELI-ALPS is one such station where LWFAs are being driven in the bubble regime [2] which has the capabilities to produce a few 10s of MeV quasi-monoenergetic electron bunches at a kHz repetition rate. A plethora of physical effects inside the accelerator which directly depends on laser and plasma parameters governs the electron acceleration mechanism. The generation and optimization of such accelerated, high-quality electron pulses demand high-precision balancing and control of input parameters. A very dynamic laser-plasma coupling and wake structure evolution pose challenges in the experiments and simulations. Machine learning-driven Bayesian optimization [3] of laser-plasma parameters is a technique for the efficient generation of high-quality electron beams. In order to optimize beam charge, divergence, the electron mean and peak energies, the electron pulse width of ionization injected electron bunches - parameters like spectral and spatial phase of the laser, the longitudinal position of the laser focus, plasma parameters like gas density, the dopant concentration, and its localization were optimized and the electron pulses of peak energies of $\geq$ 100 MeV (fig.1), few mrad divergence and total charges upto 200 pC are obtained in the simulations.

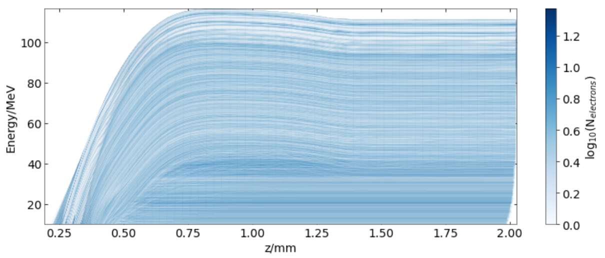


Figure 1: Plot of the electron energy evolution in space.

The first experimental and proof of principle fbPIC simulation results will be presented.

## References

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