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Cavities for high-energy pulse applications

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The demand for a huge number (i.e. up to millions) of channels for a fiber laser based particle accelerator originates from the energy limitation of a single fiber emission rather than average-power capabilities of rare-earth-doped fibers. Therefore, it is possible to reduce the required number of channels by 2-3 orders of magnitude by operating the fiber amplifiers at a higher repetition rate and average power (fiber's favorite operation regime) followed by a pulse stacking element in order to enhance the pulse energy. Passive enhancement cavities appear as an excellent choice in such a high-performance system, as the pulses of a high-repetition-rate laser (e.g. 10 MHz) can be coherently overlapped and the resulting high-energy pulse can be dumped out of the cavity at a repetition rate much lower (e.g. 15 kHz) via a fast switching element. Thus, in case of an ideal switching element the pulse energy is increased by simultaneous reduction of the repetition frequency at a constant average power.
We will discuss the important components of this concept such as the cavity (stack) and the switching element (dump) and, finally, present a system design that employs (only) 516 fibers to reach the final ICAN parameters. In addition a risk analysis and a budget estimation is provided.

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