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High average power laser drivers for particle acceleration

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High peak power lasers have been successfully used to accelerate particles, for example producing a 8 GeV record for electron acceleration with a PetaWatt laser. However laser repetition rate is quite limited, to 1 Hz maximum and this prevents use of lasers in applications requiring significantly higher repetition rate. To be able to build the next generation of laser-based machines such as Eupraxia, we will need a new generation of lasers combining a high peak power and a high average power. We will present designs and development results of a new generation of Titanium Sapphire lasers being able to operate between 100 Hz and 500 Hz repetition rate. We will present results of development of a new generation of Nd:YAG pump lasers as well as results obtained to improve the thermal management of Titanium Sapphire crystals. We will also review the challenges of high average power pulse compression and derive the requirements for the development of the relevant compression gratings sustaining in the same time high peak power and high average power.

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