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Flux Concentrator Optimization for Future Positron Sources

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State-of-the-art future lepton colliders, such as SuperKEKB, CLIC, FCC-ee or ILC require high quality positron sources. Positrons are created after the collision of electrons on a tungsten target and then focused to match the emittance of the injector chains within an Adiabatic Matching Device. This contains a Flux concentrator (FC), a magnet that produces the positrons yield. The FC is a tapered solenoid powered with fast pulses (microsecond) of high current (kiloamperes) at high repetition rates (hundreds Hz). The current pulse produces a strong magnetic field (3-8 T) at the magnet entrance that rapidly decays (over few cm) to zero. This paper describes the finite element model of the FC and the transient electromagnetic simulation capable of describing experimental data in terms of current, field and voltage. The computed field map is transferred into particle tracking code to compute the positron yield. The coil configuration is optimized to minimise the voltage and Lorentz forces and to maximise the yield. Three optimized designs are intended to be tested at the KEK test bench.

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