

# Modeling the ELENA Electron Cooler with COMSOL Multiphysics® Software

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## Abstract

The Extra Low Energy Antiproton ring (ELENA) is a small ring at CERN which will be built to increase substantially the number of usable (or trappable) antiprotons delivered to experiments for studies with antihydrogen and antiprotonic nuclei.

The electron cooler plays a key role in ELENA both for efficient deceleration as well as for preparing extracted beam with parameters defined by the experiments.

COMSOL Multiphysics® software has been used to complement traditional programs such as EGUN and OPERA to completely model the electron cooling device in 3D. We have taken advantage of the different physics-based modules of COMSOL Multiphysics® to optimize the various components of the cooler (magnetic transport system, electron beam generation, recuperation of the electrons in the collector etc.) and then to integrate the different studies into one model of the complete system. In addition COMSOL Multiphysics® has enabled us to make detailed tracking simulations of the passage of the antiproton beam in the highly non-linear magnetic field of the toroid section of our setup.