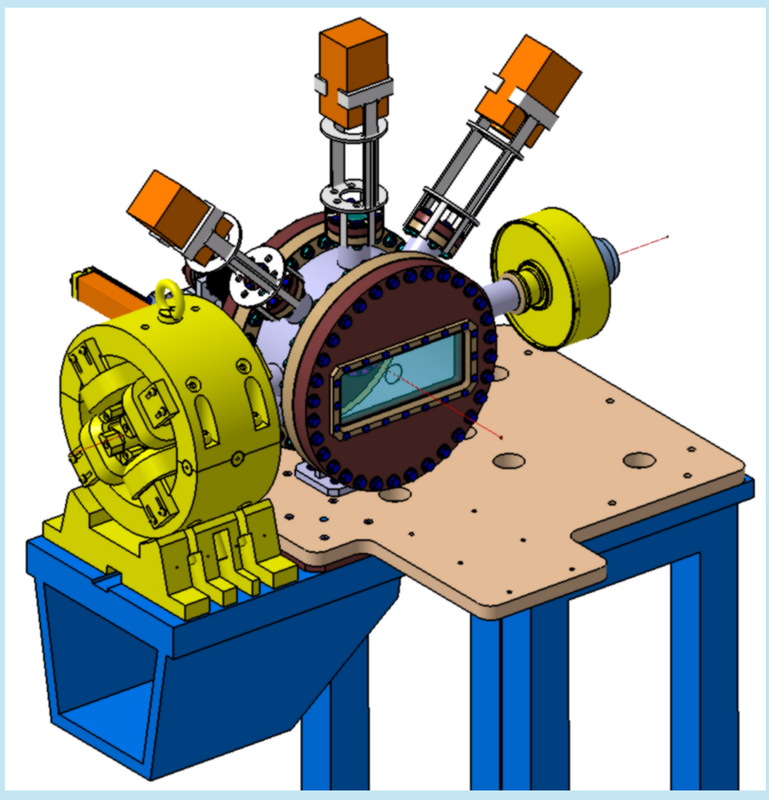
Study of Short Bunches at the Free Electron Laser CLIO

Nicolas Delerue[1], Stéphane Jenzer, Vitalii Khodnevych[23]
LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France.
Jean-Paul Berthet, Francois Glotin, Jean-Michel Ortega, Rui Prazeres
CLIO/ELISE/LCP, Univ. Paris-Sud, CNRS, Université Paris-Saclay, Orsay, France.
[1]delerue@lal.in2p3.fr [2]hodnevuc@lal.in2p3.fr
[3]also at National Taras Shevchenko University of Kyiv, Kyiv, Ukraine

Intro

CLIO is a Free Electron Laser based on a thermoionic electron gun. As part of the accelerator studies we want to measure and optimize the bunch length at the exit of the acceleration cavity (AC) at CLIO. This will be done using Coherent Smith-Purcell Radiation (CSPR) and Coherent Transition Radiation (CTR) .

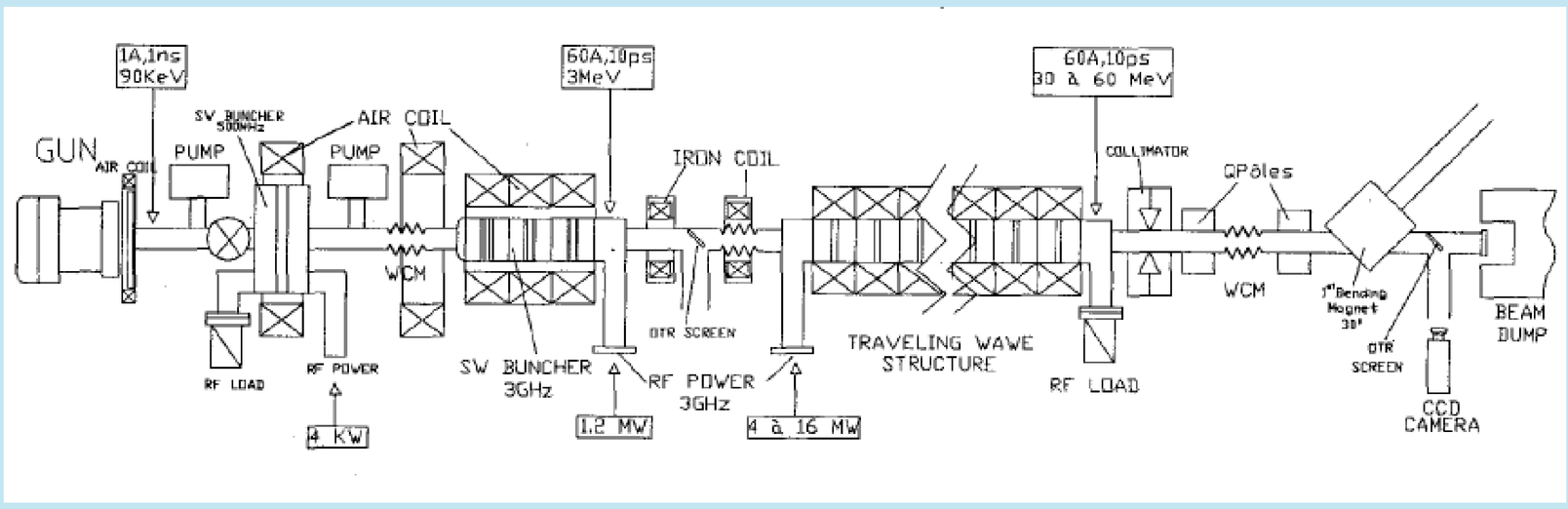
CLIO installation



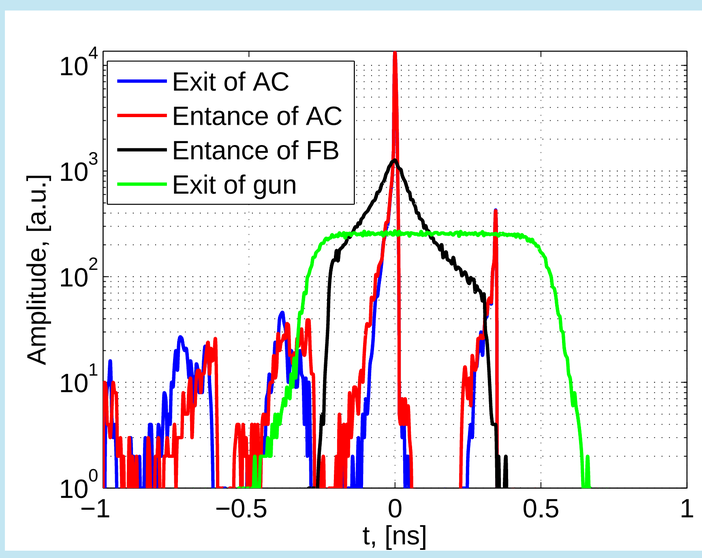
CLIO setup

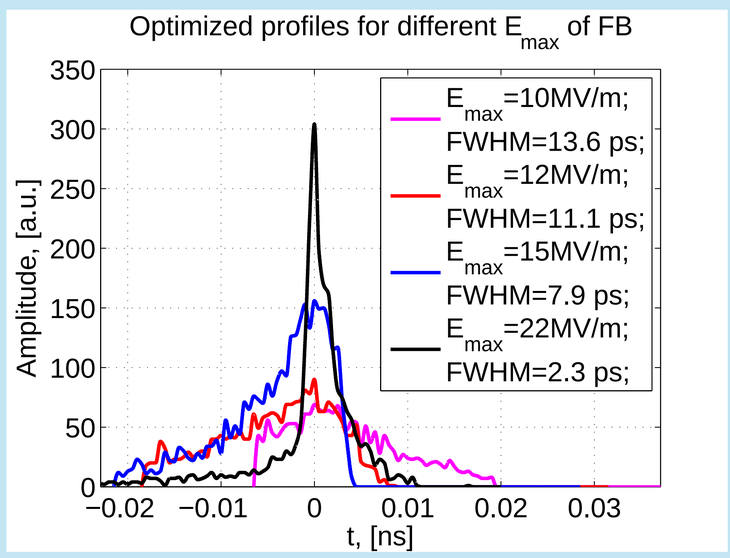
The CLIO accelerator

To predict the spectrums of CTR and CSPR and optimise the CLIO parameters for the experiment, we have performed simulations of of the accelerator using ASTRA.



Layout of the CLIO accelerator (taken from).

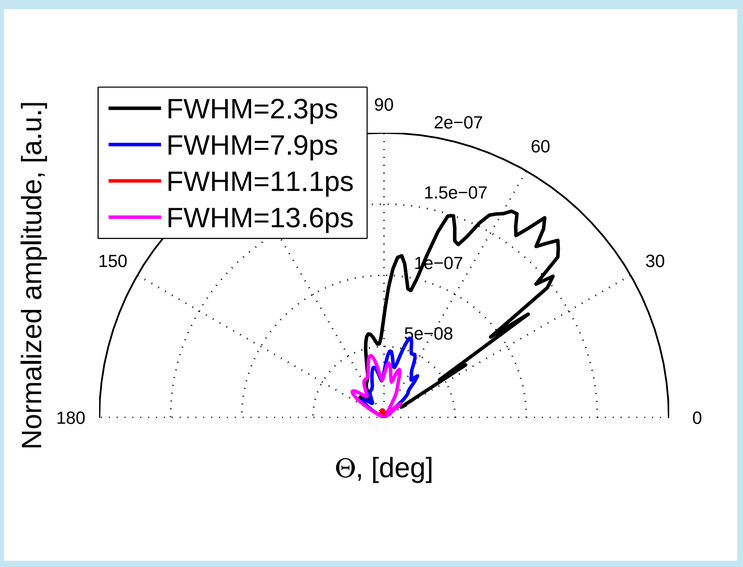


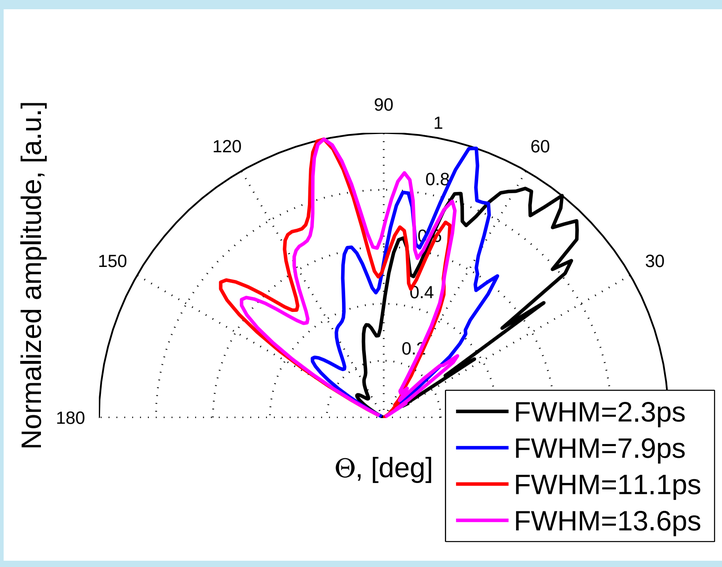


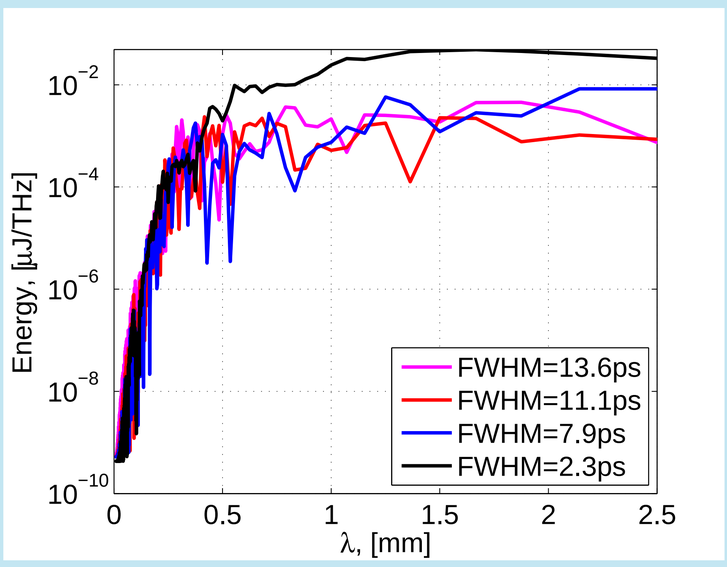
Longitudinal bunch size at exit of gun (FWHM=800 ps), at the entrance of FB (FWHM=92 ps), at the entrance (FWHM=2.35 ps) and at the exit (FWHM=2.29 ps) of the AC at left figure and profile of the bunch at the exit of the acceleration cavity for different maximum fields of fundamental buncher (optimized) at right figure.

Bunch length measurements

Energy distribution of Coherent Smith-Purcell spectrum as a function of the observation angle for different maximum field in the FB at left. The grating used for these simulations is 40 mm × 180 mm with a pitch of 8 mm and a blaze angle of 30°.







CSPR spectrums with original (left) and normalized (center) amplitude. At right CTR spectrums of the different bunch profiles from CLIO simulation.

Unlike the case of CSPR, CTR will give us information to estimate the bunch length. CSPR will be used both to estimate the bunch length and to attempt a more detailed profile reconstruction.