Bunch Length Measurements Using Coherent Smith-Purcell Radiation With Several Gratings at CLIO

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Coherent Smith-Purcell Radiation

Coherent Smith-Purcell Radiation is a radiative phenomena that occurs when a bunch of charged particles passes above a grating. The spectrum of the coherent emission depends on the longitudinal profile of the bunch [1].

Exponential decay fit

$\phi_B = 8.09$

By fitting the signal as function of the beam-grating separation we are able to see the predicted exponential decay (top image). Furthermore one free parameter of the fit gives us the detectors tilt (bottom image).

References

Références

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[2] R. Chaput et al. "Optimization of the FEL CLIO Accelerator". In : *Conf. Proc.* (1994).

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Experimental setup

(above) Layout of the CLIO accelerator, position of the experimental setup and indication of the relative phases that can be modified to change the bunch length. Image taken from [4] and adapted from [2]. ϕ_2 in this figure will later be referred to as ϕ_B. (right) Picture of the detectors around the experimental chamber.

Spectrum, form factor and profile reconstruction

The radiation spectrum provides information on the bunch length. From the spectrum the form factor can be calculated and the the profile reconstructed using the method given in [3].

Comparison with Astra

Simulations [4] predict that when the booster phase is changed, the tail of the bunch will become larger first (left image around $\phi_B \simeq 300°$). So we introduced new variables to characterize the bunch and see this evolution. There is a good agreement between the predictions and the observations.

Multiple gratings and backgrounds

The form factors for two gratings installed on different days follow a similar and compatible trend.

Very preliminary: Background measurement (middle) et background deducted from comparing the data with simulations. The trend is similar.

A new experimental chamber will be installed soon allowing consecutive measurements of signal with several gratings and background.