

PhD GRANTS 2024

PhD project title: Dynamical manipulation of relativistic electron-bunches circulating in storage rings during spatio-temporal instabilities

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PhD project summary (max. 20 lines):

Relativistic electron-bunches (i.e. bunch composed of electrons with velocities near the light velocity) are used worldwide as light sources, to produce intense and broadband synchrotron radiation (from THz frequencies to hard X-rays). In these systems, complex phenomena as instabilities appear commonly, in particular due to the interaction of the electrons with their own radiation. Usually this phenomena impose limitations on this type of sources, but sometimes they can also be used as advantages.

In our group, a part of our activities concern the investigation of such complex phenomena in so-called *storage rings*, which are one of most used facilities to produce synchrotron radiation. In these storage rings, when a high number of electrons are used, *micro-structures* appears spontaneously inside an electron-bunch, and permits the emission of a very strong THz radiation, but often with very high fluctuations (and thus not directly usable as a THz source for synchrotron radiation users).

The subject of this thesis concerns the manipulation of the electron-bunch dynamics during this instability, to produce intense or/and regular THz emission. On this subject, important first results were recently obtained, in the frame of a collaboration between the PhLAM laboratory and the Synchrotron SOLEIL [1-2]. The general objectif of this thesis is to develop and explore these type of methods to obtain new properties of the emitted synchrotron radiation. Work will be based on numerical simulations and experiment with our collaborators on this subject (Synchrotron SOLEIL in France, KARA storage ring and Metrology Light Source in Germany).

[1] C. Evain, C.Szwaj, E. Roussel, J. Rodriguez, M. Le Parquier, M.-A. Tordeux, F. Ribeiro, M. Labat, N. Hubert, J.-B.Brubach, P. Roy & S. Bielawski, *Nature Physics* 15, 635 (2019).²

[2] C. Evain , F. Kaoudoune, E. Roussel , C. Szwaj , M.-A. Tordeux, F. Ribeiro, M. Labat, N. Hubert, J.-B. Brubach, P. Roy and S. Bielawski, *Phys. Rev. Acc. and Beams*, **26**, 090701 (2023)