Electron-bunch dynamics during the micro-bunching instability: third-generation & low-emittance configuration

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The Coherent Synchrotron Radiation (CSR) instability (or microbunching instability) is a general process that occurs in accelerators-based light sources, when the electron bunch peak current is sufficiently high. Due to the interaction of the electrons with their own radiation, micro-structures spontaneously appear in the longitudinal profile of the bunch, usually with a bursting behavior.

We will present (mainly) studies from a collaboration between Synchrotron SOLEIL and the PhLAM laboratory, on the dynamics of an electron bunch during this instability. We will first focus on the comparison between numerical results (using the Vlasov-Fokker-Planck equation), and ultrafast measurements (using the so-called time-stretch electro-optic sampling technique) in the context of the present configuration of Synchrotron SOLEIL. The second part will be dedicated to numerical studies of the bunch dynamics in the context of the low-emittance configuration of the future upgrade of Synchrotron SOLEIL.