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Features of Electron Bunch Formation in Radiofrequency Photoinjectors

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Radiofrequency (RF) photoinjectors are widely utilized to generate bright electron bunches for light sources. In RF photoinjectors, pico- and subpicosecond laser pulses meet the photocathode surface, resulting in photoemission. Although there are well-recommended models and approaches to describe photoemission in RF photoinjectors, some dark spots in understanding and theory-to-experiment inconsistencies still exist.

The brighter the electron bunch to be generated, the more detailed consideration of photoemission is needed. Electron bunch formation at the photocathode and its vicinity seems to be an especially crucial and sophisticated phenomenon. As laser pulses perturb the photocathode medium, a nonequilibrium conduction electron concentration, which evolution is described via the drift-diffusion equation, occurs. Electron concentration at the photocathode-vacuum contact not only defines photocurrent (longitudinal electron bunch profile), but also is defined by the one through the boundary condition in the respective drift-diffusion problem. Thus, photoemission is a self-consistent process worth investigating and describing with due attention. Also, it is of essence to account electron bunch not only influences the photocathode and its charge dynamics, but also on itself through space-charge forces, resulting in saturated photoemission.

In this research, recent results on developing a self-consistent model to describe bunch formation in RF photoinjectors are presented and briefly discussed.

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