Joint DESY and University of Hamburg Accelerator Physics Seminar

Tuesday June 8, 2004

(16:00 in Room 459/30b)

Modeling of the Secondary Electron Emission in RF Photocathode Guns

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Abstract

During the last couple of decades, photocathode RF guns have been proved to be successful for providing very high quality electron beams for VUV or X-ray FELs. Beam dynamics simulations in the RF gun show that the electron beam quality is strongly dependent on the beam dynamics in the vicinity of the cathode. Therefore, the injection process plays a significant role in the beam performance. Several codes are available to simulate the beam dynamics in the gun. They are able to track the beam with the space charge force, but detailed emission processes are still missing at those codes. In photocathode RF guns, the electron beams have a high charge density. Especially during emission from the cathode, the electrons have almost zero velocity and thus see a very high longitudinal space charge force. Due to the backward space charge force, some part of the electrons emitted from the cathode might hit back the cathode to generate secondary electrons. On the other hand, a high electric field in the gun cavity produces a large amount of dark current. If the electrons, field–emitted from the cathode or from another surface inside the cavity, hit the cathode, additional secondary electrons can be produced. To make simulations for a detailed understanding of measurements of the electron beam and dark current in the RF gun, a model of the secondary electron emission is necessary. In this talk, a simple model is discussed with an application to the beam dynamics at high RF phases. Detailed simulations have been done in comparison with corespondent measurements at PITZ. The primary electrons which are directly emitted from the cathode and the secondary electrons which are produced by the primaries at the cathode could be clearly distinguished in the simulations. Measurement setups used for this study are also briefly introduced.

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