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Generation of a Sub-Picosecond Sheet Electron Beam Using a 100 fs Laser

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The biggest benefit of DC photoelectron-gun driven by the sub-picosecond laser is that such type of guns can be operated with the current density much higher than the Child's low limitation. We demonstrated 0.3 nC bunch generation by irradiating a 100 fs Ti:sapphire laser focused to 0.1 square-cm area onto a tangsten photocathode installed in a diode type 40 kV DC gun. The drawback is the strong Coulomb repulsive force by which electrons may suffer the emittance degradation in the vicinity of the cathode. To reduce the repulsive force at the cathode surface, we are trying to generate a "sheet-like"photoelectron bunch. In our experiments, electron bunches are generated by irradiating the laser pulse shaped in an ellipse onto the photocathode. The ellipticity is set in the range of 0.03-0.05 while the most of sheet-beam experiments were conducted with the ellipticity about 0.1. The smaller the ellipcity, the longer the circumference; this may reduce the radial electric field on the electron bunch side-wall. Moreover the electron bunch shape is rather a "line"than a "sheet" due to the short duration of the drive laser pulse. We conducted a preliminaly experiment and observed that the elliptical photo-electron bunch had much larger divergence angle in the minor axis direction. In the presentation, experimental results, the numerical simulation on the particle motion and the design of the sheet-photo-electron DC gun will be discussed.

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