FIELD ASSISTED PHOTOEMISSION DC-PULSED CATHODE FOR 5TH GENERATION LIGHT SOURCES AND ACCELERATORS THEORETICAL STUDY*

Jean-Luc Babigeon, Mohamed El khaldi
Laboratoire de l'Accélérateur Linéaire – 91898 Orsay – France
Nicolas Holtzer PhD, Consultant Engineer
Strasbourg

The scope of that contribution is to present the challenges of the next particle sources for accelerators. It is admitted[1] that emittance near Interaction Point (IP) is strongly dominated by the emittance of the low power source. To minimize the Bremstrahlung effects in the Interaction Point (IP), we also need extremely low emittance bunches, ultra high brillance, very low charges sub fC, near depopulated attosecond electronic bunches. These produced bunches should fit the entrances of Dielectric Laser Accelerators (DLA) and Laser Plasma Accelerators (LPA).

A 20kV DC pulsed sub nanosecond Field Emission Array source with extremely low emittance is considered in order to obtain such results. Firstly, we will describe the DC-pulsed experimental source by blocks. Following that, we will raise more general problems induced by DC-pulsed configuration : thermal transient behaviour of nanostructures, enhancement of plasmons coupling in relation to nanostructured networks, then fast prototyping of cathode geometry will be undertaken using different models. These cathodes are to be fabricated at Orsay.

We present the method of curvilinear coordinate calculus, adapted to major classes of nanostructured tips. We define 3 major classes of 3D analytical profiles to emulate experimental conditions (multi-segment, quadratic and exponential one) and apply curvilinear analytical Maxwell solving to find electrostatic potential around the profile. Our method is concurrent to T-splines for instance, but it is expected to converge faster. Cathode physics will be modelled integrating different phenomenons :photo/thermal/field/emission... Results will be compared to electromagnetic simulations with CST and Astra tools.

To conclude, we shall then evaluate the emittance performances planned for a 20keV cathodic source, and its acceptance to the next stages, with the help of some electrostatic focusing. Numerous experimental and theoretical aspects are to be solved.

1. Dielectric Laser Acceleration
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