



Contribution ID: 103

Type: **Contributed Oral**

## Development of High Brightness Photoinjector for AWA

*Tuesday, 8 November 2022 13:30 (20 minutes)*

High brightness beams for XFELs and UEM essentially imply a high current and a low emittance. To obtain such beams we propose to raise the accelerating voltage in the gun mitigating repelling Coulomb forces. An ultra-high gradient is achieved utilizing a short-pulse technology. A successful experiment with an X-band photoinjector has been recently carried out at Argonne Wakefield Accelerator (AWA) facility. The carried-out test showed that the 1,5-cell gun was able to inject up to 6 MeV, 100 pC electron bunches at room temperature being fed by 9 ns up to 300 MW pulses. As high as 400 MV/m cathode field was obtained. The gun had ~10<sup>-6</sup> breakdown rate and showed low average dark current. We have been analysing emittance measurements and planning to develop a new gun. This plan includes an idea to fabricate the gun consisted of larger number of cells to increase the energy gain. One of possible solutions is a so-called open structure gun. It was shown that this multi-cell gun can provide excellent field balance and mode selection, easy access of laser to the cathode, easy fine tuning, and efficient pumping. The gun can be based on brazeless technology and can have the removable cathode. Additional appealing opportunity to increase the gradient substantially is to operate the gun at cryogenic temperatures.

### Acknowledgments

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**Session Classification:** WGs 3+5 Joint Session

**Track Classification:** Working Group Parallel Sessions: WG3 Oral: Laser and High-Gradient Structure-Based Acceleration