European XFEL

SRF Gun Cavity R&D at DESY.

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Abstract

SRF Gun Cavity is an ongoing accelerator R&D project at DESY, being developed since several years. Currently several SRF Gun cavity prototypes were simulated, built and tested in our Lab and elsewhere. Lately the 1.6 cells Pb thin film cathode niobium cavity (fig.1) was tested in a vertical cryostat with a different cathode plug configurations (fig.2). Cathode plug design was improved, as well as SRF Gun Cavity cleaning procedures.

Goal of this R&D is to prove feasibility of all-superconducting electron source, delivering low emittance beams for FLASH / XFEL like facilities. We began this R&D several years ago aiming for 1 mA current with 1 nC bunches at 1 MHz repetition rate, but:

- LCLS showed in 2009 that SASE process can take place with charge, as low as 20 pC.
- Experiments listed in the Scientific Case, which inspires the CW operating LCLS II project at SLAC, will nominally use photons generated by 100 pC bunches at 100 kHz repetition rate.

Both, led us to a revision and less demanding SRF-injector parameters in our project. We assume currently that generated electron current will be ≤ 10 μA

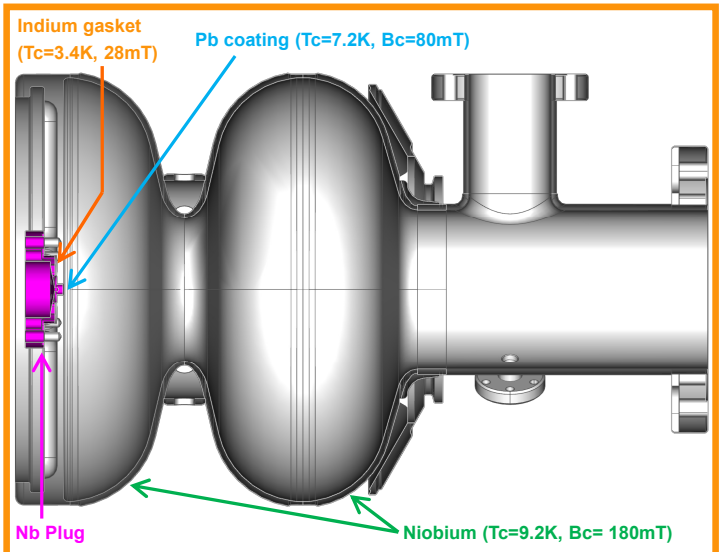

Figure 1: SRF Gun Cavity with a Plug.

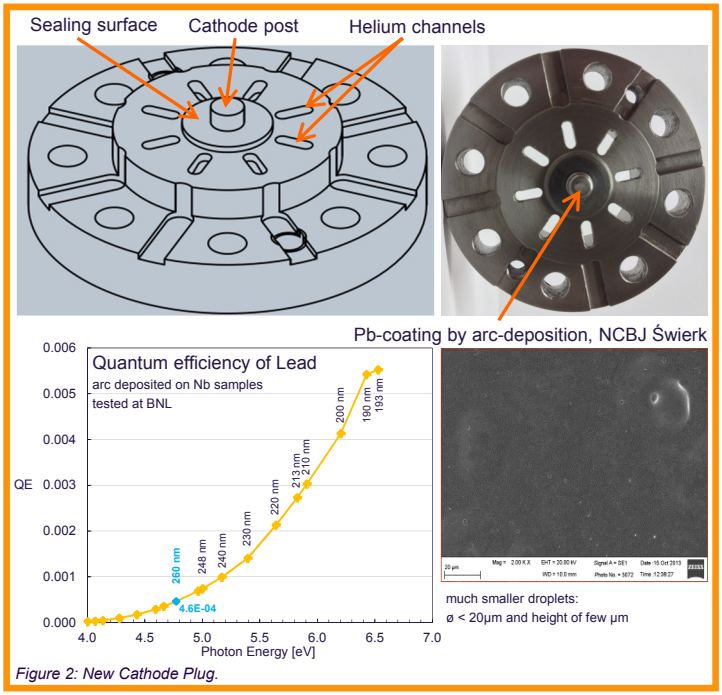

Figure 2: New Cathode Plug.

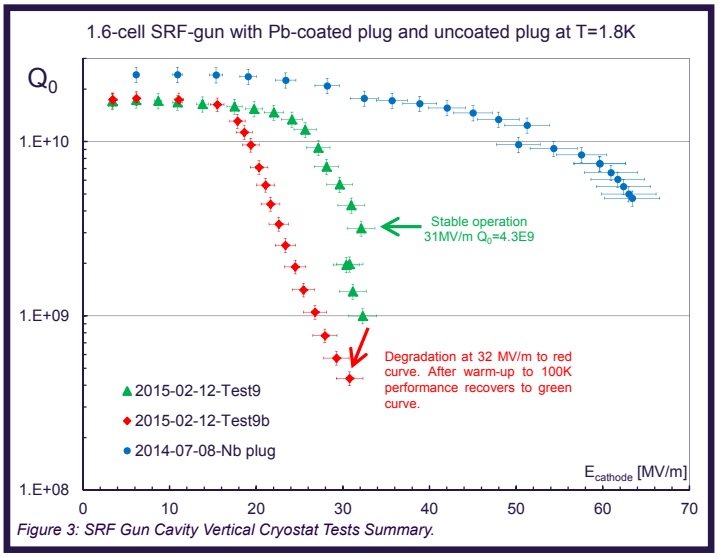

Figure 3: SRF Gun Cavity Vertical Cryostat Tests Summary.

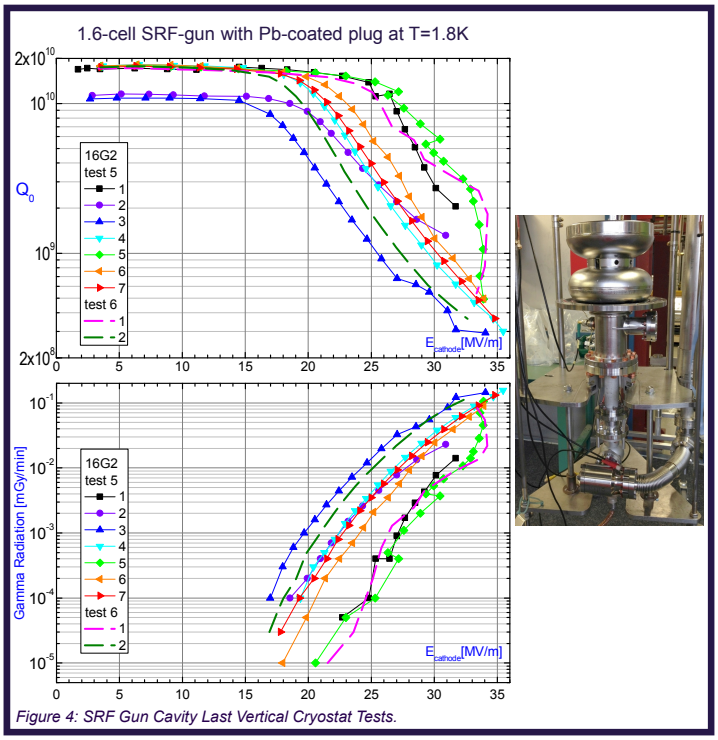

Figure 4: SRF Gun Cavity Last Vertical Cryostat Tests.

Summary

- SRF Gun development is an ongoing accelerator R&D program at DESY since 2006. Several SRF cavity options were simulated, and two 1.6-cell were built at DESY and JLab (fig.1).
- Recently, the 1.6-cell niobium cavity was tested in a vertical cryostat with improved plug (cooling and coating, fig.2), reaching 63 MV/m with Nb-plug and 32 MV/m with Pb-coated plug (fig.3).
- The vertical tests of the prototype cavity 16G2 showed that stabile operation with Pb-coated cathode is possible for $E_{cathode}$ of 25 .. 30 MV/m.
- Not yet is clear why the degradation happened and what prevents operation at higher gradients.
- We plan to investigate other emitting materials (for example 40 nm thin layer of GaN).
- Long term operation with laser will be very useful to learn more about durability of the coating and stability of the cavity performance. Here we need help from other labs.

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