Cryocoolers as Enabling Technology for Higher Brightness Photoguns

G.E. Lawler, J. Parsons, A. Fukasawa, N. Majernik, Y. Sakai, J.B. Rosenzweig, UCLA, Los Angeles, CA

The next generation of electron particle accelerators will likely focus on increasing a figure of merit known as beam brightness. Several important concepts propose to increase brightness by cryogenic operation of the photogun used to produce electron beams. The most relevant concepts are the Ultra-compact xray free electron laser (UC-XFEL) and Cool Copper Collider (C3), an electron-positron collider. Large cooling infrastructure is not conducive to the university-scale research and development of proofs of principles for these concepts. Cryocoolers have made the design of a small-scale cryogenic test accelerator possible. We present the continuing development of a beamline to demonstrate the feasibility of a cryogenic radiofrequency (RF) photogun with photoemission-based cathode. The main issues considered for our targeted 45K operation are RF pulse heating in the cavity, temperature stability across necessary structures, and minimizing cool down time. Considerations will further be given towards schemes for manipulation of the cathode at low temperatures. Results from the first cryocooler commissioning tests and low temperature measurements will also be presented.