Gabriel’s thesis outline DRAFT

February 2019

Rev 00 with comments from J. Grames

1. Introduction and Motivation
2. Electrostatic design for the 200kV CEBAF gun upgrade
   1. Redesign of nominal T-shape electrode to include triple junction shield for robust operation at 200kV . Gabriel’s published paper #1: "Electrostatic design and conditioning of a triple point junction shield for a -200 kV DC high voltage photogun," Review of Scientific Instruments 89, 104703 (2018).
   2. Design philosophy: Minimize profile for best vacuum, optimize shape to minimize gradient at triple point junction and at crown for no field emission and no plug arcing, optimize shape to minimize impact on beam dynamics in the anode-cathode gap.
   3. Consider latency effects, whereby we observe the beam orbit from the gun changes a small amount after the gun HV has either a) tripped off or b) been generally off e.g. by ramping? See NOTES at the end.
   4. Study anode-cathode gap and perhaps anode geometry to compensate for radial field asymmetry. This will also be a function of laser spot position on the cathode and will involve feedback process between CST and GPT studying beam deflection and emittance.
   5. Measure beam deflection vs laser position across photocathode by using BPMS and correctors. Do this for the ‘large mushroom’ electrode in CEBAF, and for the “T-shape” electrode in UITF both at 130kV for normalized comparison.
   6. Measure beam emittance for each electrode at 5 positions on the cathode and compare to GPT predictions, in particular using a quad rather than a solenoid, or perhaps using both and benchmarking both methods considering solenoid rotation on transverse beam. This would be an important step to understand, implement, and disseminate solenoid emittance method considering rotation.
   7. Later, repeat for the optimized smaller mushroom electrode, likely in UITF, for 130kV and 200kV to benchmark optimized electrode before installing in CEBAF.
3. 200kV gun high voltage conditioning (not sure if should be a chapter on its own, or part of Ch 1)
   1. Methodology & background
   2. Results
4. Electrostatic and Magnetostatic design of the 200 kV Wien filter.
   1. Review physics, function and idiosyncrasies of the our Wien filters
   2. Review Jay Benesh’s upgrade designs, evaluate (how?) what we built and its issues
   3. Based on the above, propose design changes if needed
   4. Beam tests at UITF, backed with GPT simulations. See NOTE at the end.
5. Particle tracking code estimates of CEBAF front end with 200kV gun upgrade and either the conventional Wien filter design, or Jay’s upgrade, or Gabriel’s improved design.
   1. Perform CEBAF beam-based measurements to benchmark Wien filter improved design if different from conventional, or Jay’s upgrade designs.
6. Conclusions

NOTES from Joe Grames:

* At CEBAF this data would be in the archiver, where you could look for cases where HVPS was obviously tripped or ramped off, and remained so for different periods of time. Also, depending on how useful and/or how far you want to go back, there should be data for different configurations such as tee+pure alumina, or more recently tee+shed+doped alumina, etc. My recollection is that we did NOT suffer from this with the conventional cylindrical ceramic, but maybe we did…? Understanding and eliminating and/or mitigating this would be notable, and for folks like us who operate for a program pretty great to solve.
  + Comment from Carlos: Is there sufficient time for this? Could this be a project for a summer student instead? And of course, the results may prove relevant to include in Gabriel’s thesis. For example, does the doped alumina insulator helped to minimize or cancel the latency effect?
* By reviewing the design, perhaps we can all then agree what is the most efficient path forward e.g. to prioritize whether to “sleuth” problems w/ present design or maybe put forward a modified design with specs we agree are sensible. One of the deciding points will be whether we can upgrade the two Wien filters at CEBAF now (default plan) or whether we built brand new (that is a longer job).