Electron Beam Characteristics And Beam Diagnostics

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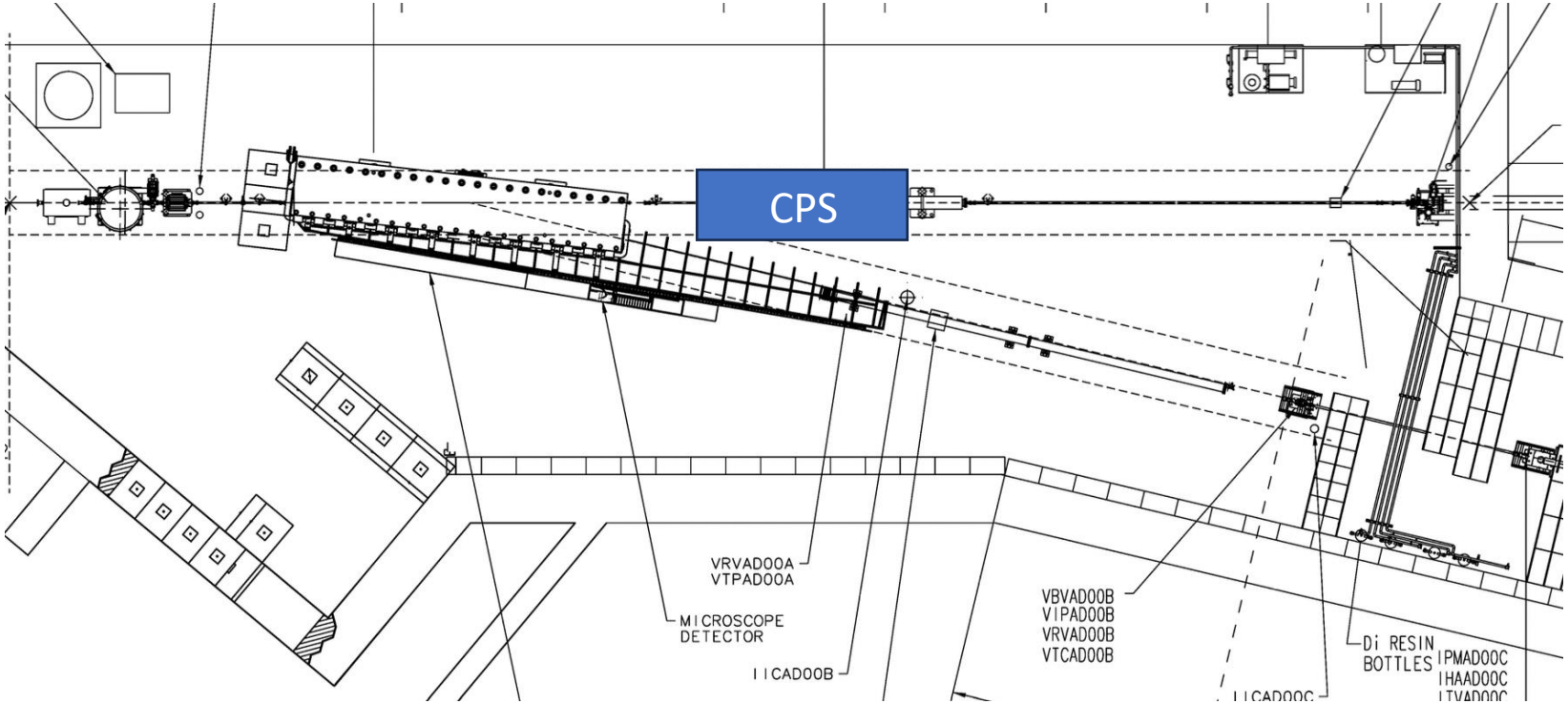
KLF ERR dry run, 7/17/23

Outline

- Layout of the CPS in Hall D
- Parameters of the CPS and Hall D
- Control systems for KLF
- Optics Requirements for KLF
- Conclusions

Layout of the CPS and the Hall D line



Not to scale

- Current baseline is to have the CPS 10m from the radiator

CPS and Hall D Parameters

- The KLF experiments will hit electrons into a compact photon source
- This will require a control system to keep the beam centered and background radiation from getting too high
- The beam also needs to hit the CPS in such a way that it doesn’t heat up the CPS too much
  - Can be achieved via rastering the beam
  - Can also be achieved via altering the beam optics to change the spot size
- We are pursuing an optics based system

Control system for KLF (Beam Position)

- Current slow lock method used in GlueX should be sufficient, though a new Beam Position Monitor (BPM) would need to be placed closer to the face of the CPS to get the best results.
- BPM would need to be upstream of the CPS enough to avoid radiation giving false readings, which could effect final placement of CPS.

Control System for KLF (Ion Chambers)

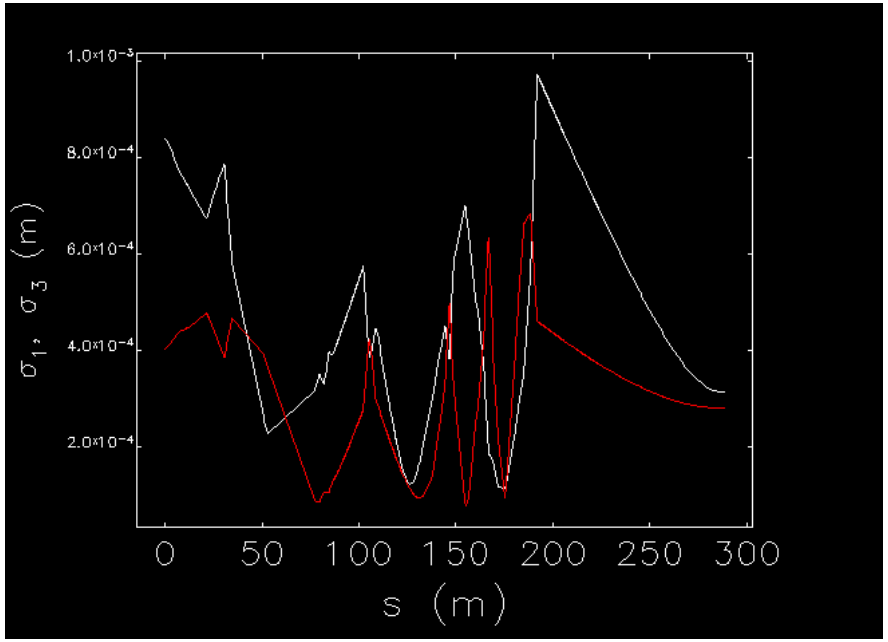
- A fast shutdown system will need to be added to protect the machine.
- Ion chambers like those used in other halls would be the most likely candidate.

KLF Optics Requirements

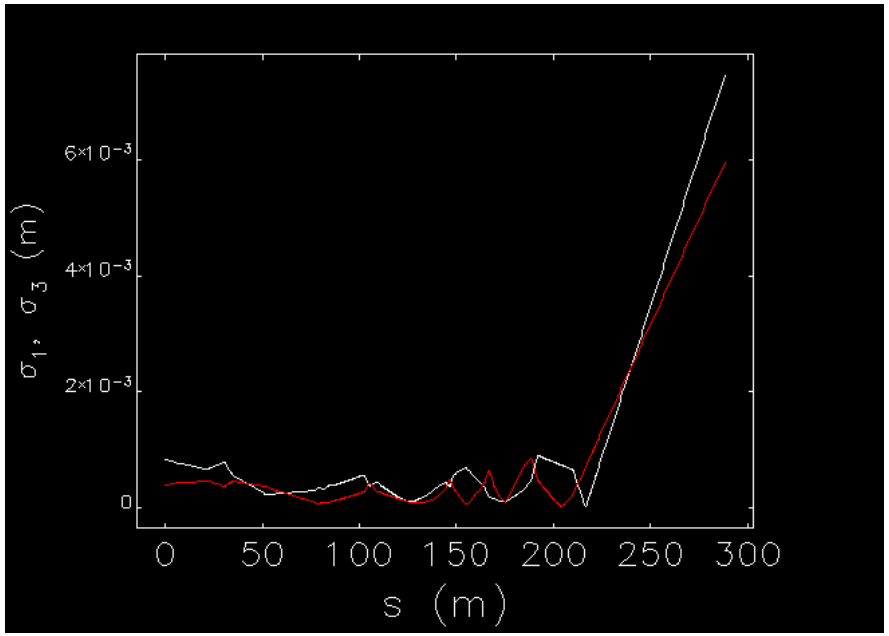
- The current design has $\boldsymbol{\sigma}x = \boldsymbol{\sigma}y \cong 1mm$ at the face of the CPS
- The collimator near the target has $\boldsymbol{\sigma}x = \boldsymbol{\sigma}y$ of the virtual electron beam no bigger than 1cm
- Currently using the CPS at 10m from the radiator, the closer the CPS is to the last quadrupole, the easier.
- We will be using the existing quadrupole MQPAD00, which is after the radiator but before the tagger dipole

KLF Optics Possibilities

GlueX Baseline Optics

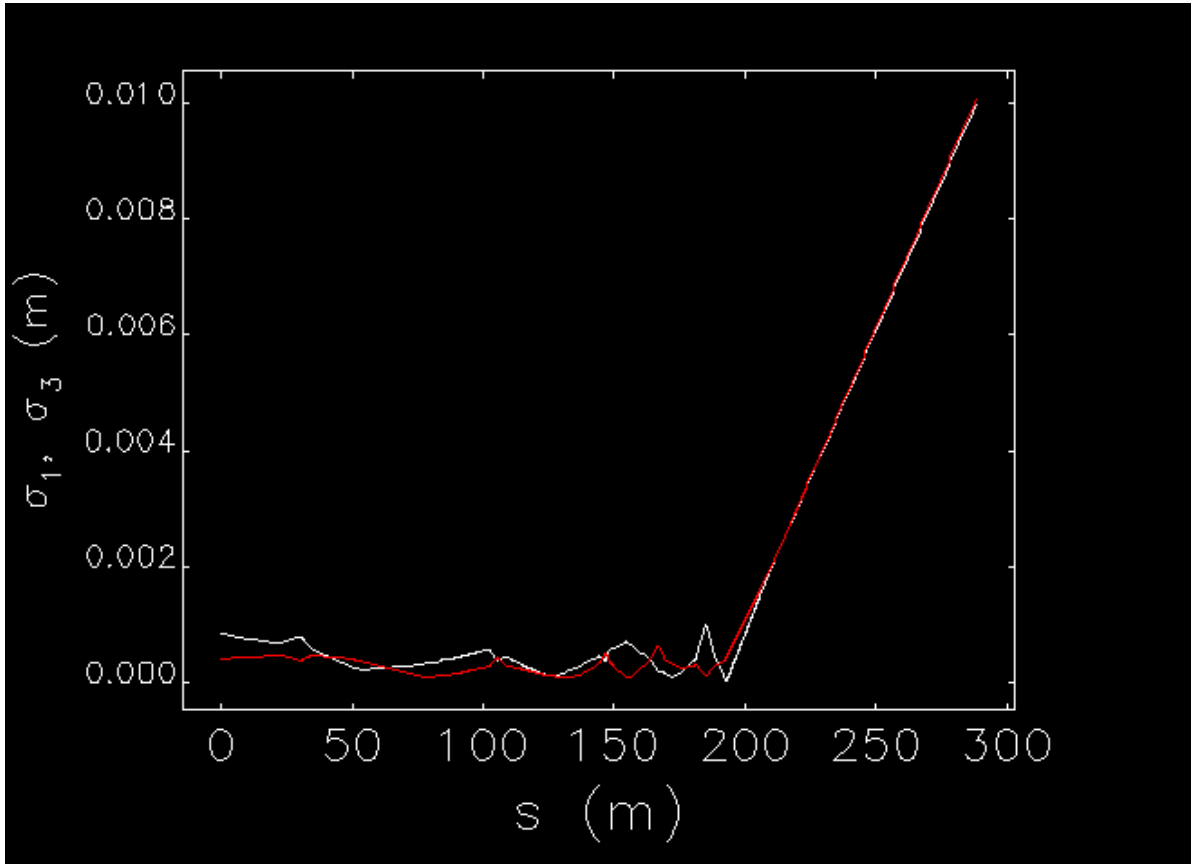


1mm CPS Face Optics



- 1mm face optics has σx = 1.098 mm σy = 1.072 mm
- In these plots σ1 = σx, and σ3 = σy

KLF Other Optics Possibilities



- If 1mm is too intense it is possible to get to a 3mm σx , σy using the full 1cm σx , σy at the collimator
- Further optimization is possible, and will have to be done as the position of the CPS and any other desired beam parameters are finalized

KLF Optics Tolerances

- Currently with GlueX the convergence can wander, when we correct it, the process is stopped when it's "good enough."
  - These tolerances will need to be determined for KLF
- Calculations shown here use design emittances, those can increase as the machine runs, measurements from the end of the run showed a 20-40% increase in the west arc.
  - Spot size scales with the square root of emittance so while not huge, it is important to be aware of.

Conclusions

- We have a set of parameters for Hall D and the proposed KLF facility
- A control system should be simple to put in based on current CEBAF technology and equipment
- We have a few different options for the optics properties of the beam depending on the progression of the design.
- We will need to determine the operational tolerances for the control and optical properties of the beam.