Electron Beam Characteristics And Beam Diagnostics

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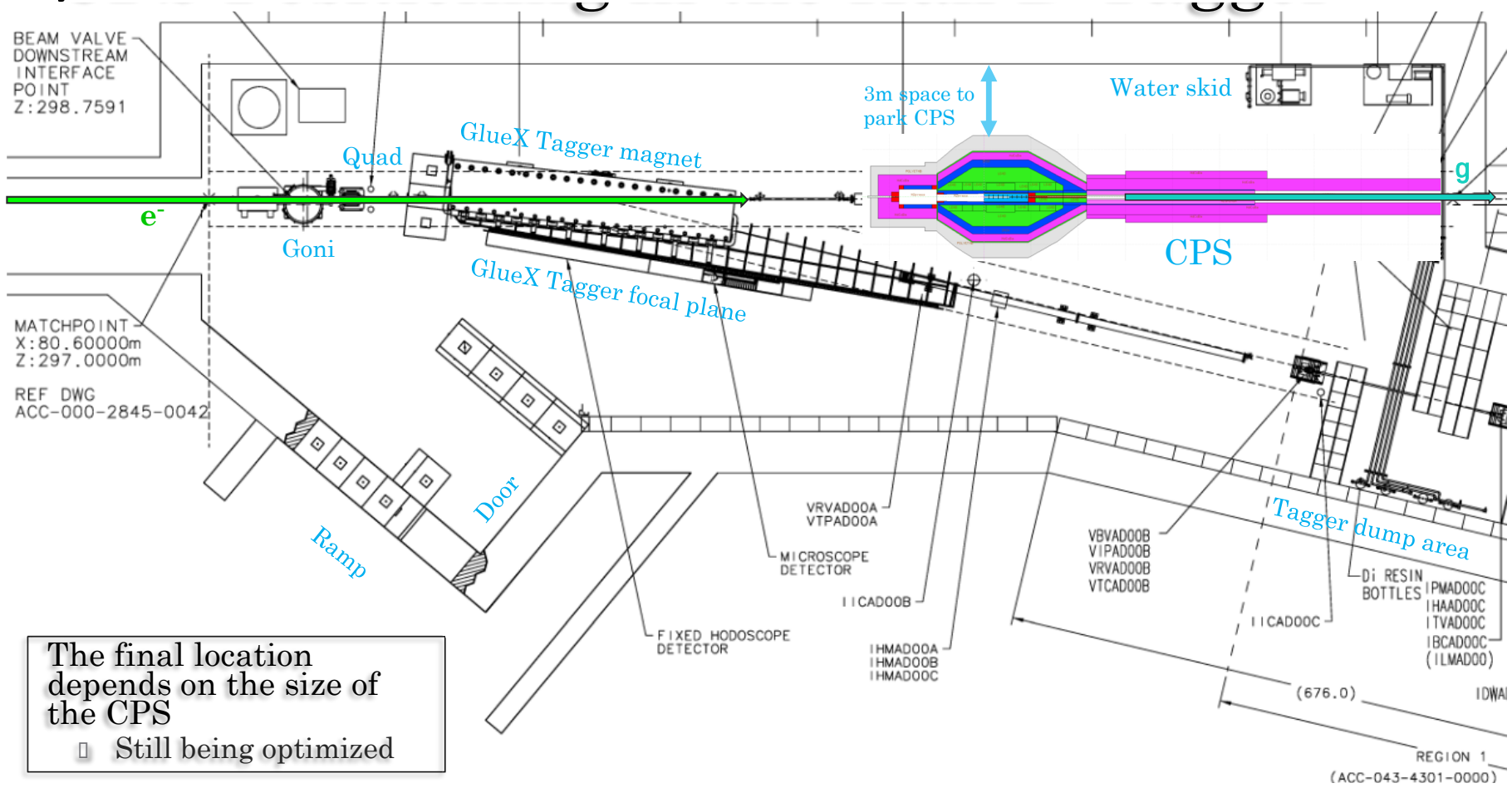
Outline

- 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



The final location depends on the size of the CPS

- Still being optimized

- Current baseline is to have the CPS 10.5 m from the position of the diamond radiator

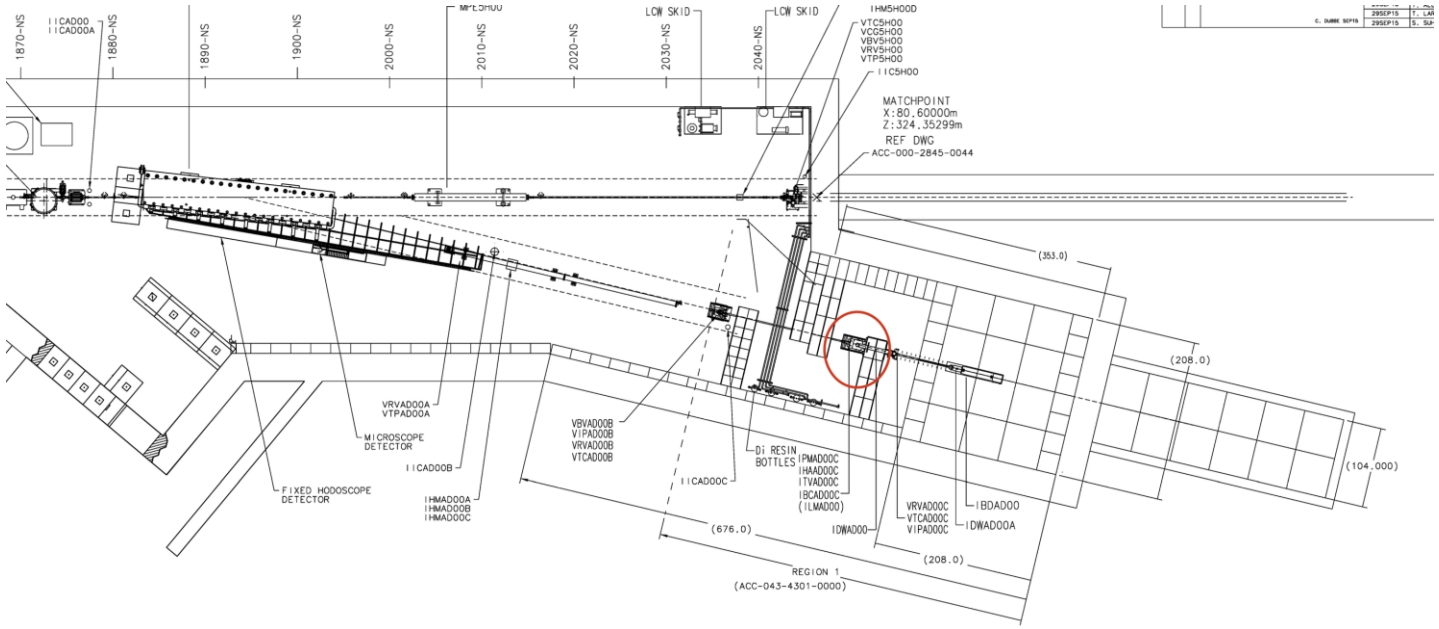
CPS and Hall D Parameters

- The KLF experiments will send 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 enter 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.
  - Due to the higher peak current in relation to the average current in the KLF system there will likely need to be attenuation added to the lines attached to the BPMs to prevent signal saturation
- Would also require a beam current monitor as well as either a viewer or a harp scanner.

Control System for KLF (other instruments)



- There is a set of dump instruments that contains a BPM, a viewer, a harp scanner and a beam current monitor that should fit within the space allocated for the CPS

Control System for KLF (Ion Chambers)

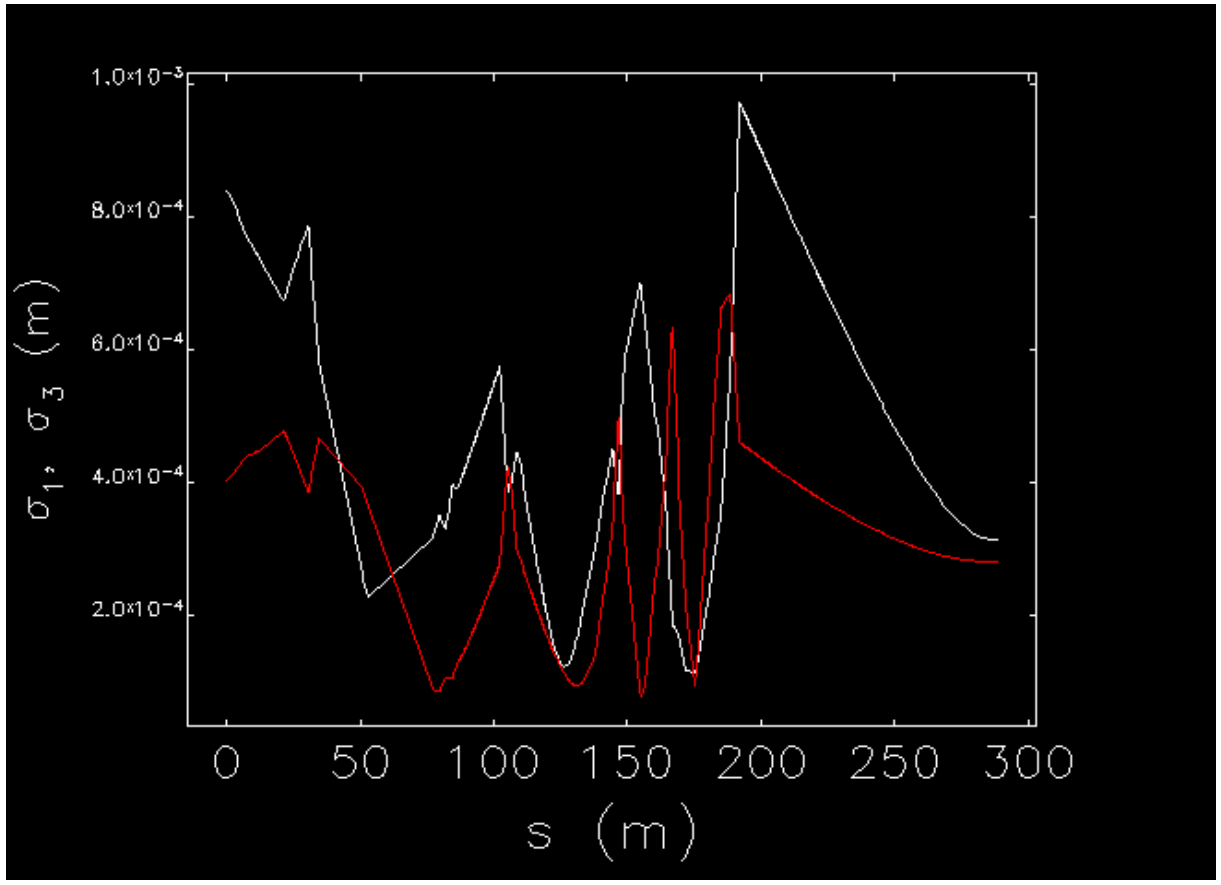
- A fast shutdown system will need to be added to protect the machine.
- Ion chambers like those used in other halls would be the most likely candidate.
  - Currently there's an ion chamber at the Goniometer which could be repurposed

KLF Optics Requirements

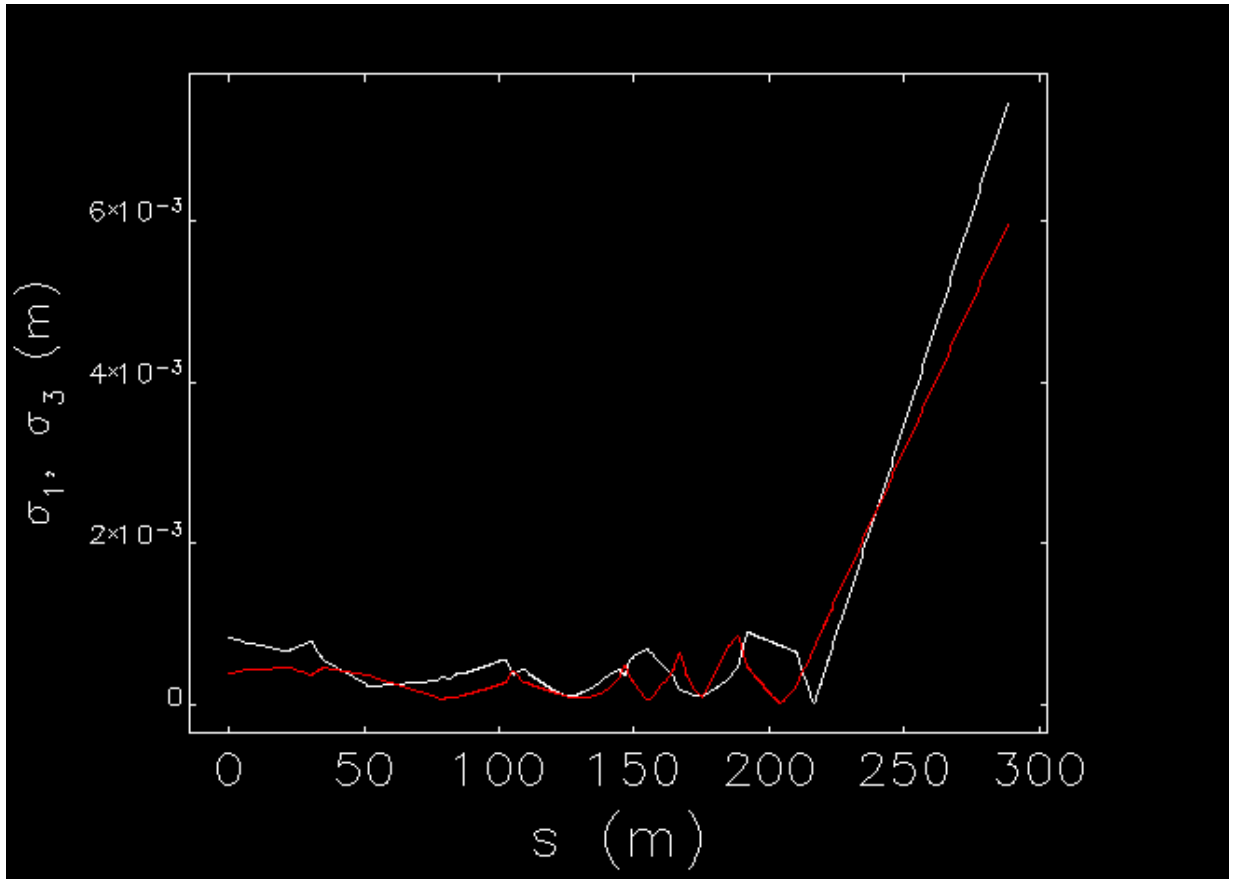
- The current design has $\boldsymbol{\sigma}_x = \boldsymbol{\sigma}_y \cong$ 1mm at the face of the CPS
- The active collimator near the target has $\boldsymbol{\sigma}_x = \boldsymbol{\sigma}_y$ of the virtual electron beam no bigger than 1cm
- Currently using the CPS at 10.5m from the position of the diamond radiator, the closer the CPS is to the last quadrupole, the easier.
- We will be using the existing quadrupole MQPAD00, which is after the diamond radiator but before the tagger dipole

KLF Optics Possibilities

GlueX Baseline Optics



1mm CPS Face Optics



- 1mm face optics has $\boldsymbol{\sigma}_x$ = 1.098 mm $\boldsymbol{\sigma}_y$ = 1.072 mm
- In these plots $\boldsymbol{\sigma}_1 = \boldsymbol{\sigma}_x$, and $\boldsymbol{\sigma}_3 = \boldsymbol{\sigma}_y$
- White lines are the x value, red lines are the y value

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.

Thank You For Your Attention