Construction of a Fast Photon Beam Position Monitor for the KLF beamline

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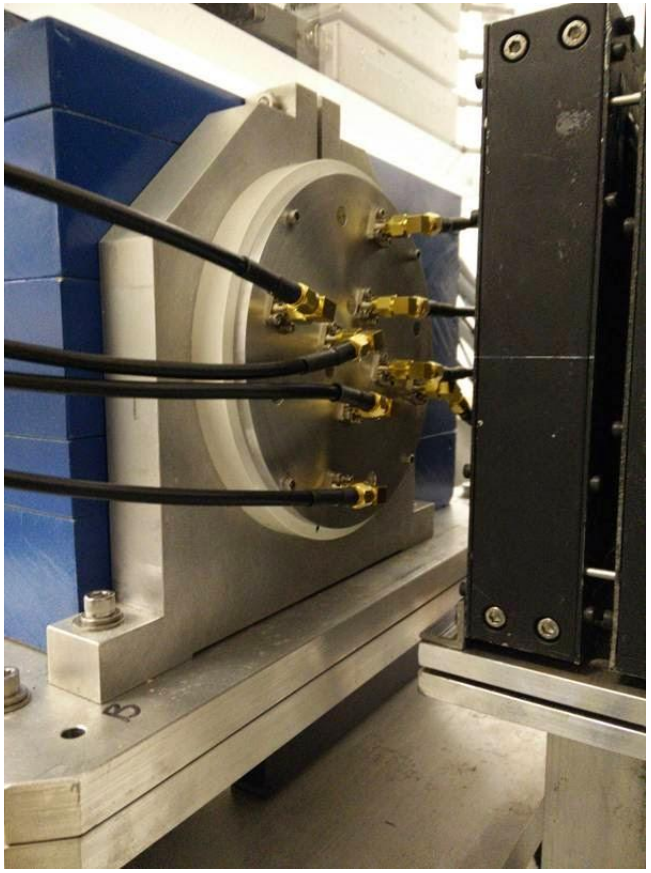
Design overview

- Tungsten pin-cushion detector
  - original design developed at SLAC in 1970's, **Miller and Walz, NIM 117 (1974) 33-37.**
  - adapted by GlueX for use as Hall D polarized photon beam "active collimator".
  - current device not suitable for KLF beamline, ***but***
  - **a new device** based on the same operating principles and similar geometry would serve the needs of KLF.



Design requirements

- Be target radius

  $r_{clearance} \geqq$ 30 mm

- Be target photon beam intensity

  $I_{KLF} \leqq 10^4 \times I_{GluexII}$

based on early CPS model design, Nuclear Inst. and Methods in Physics Research, A 957 (2020) 163429

- Position resolution

  $\Delta x = \Delta y \leqq 1$ mm

- Dynamic range

  $I_{min} \leqq 10^{-4} I_{max}$

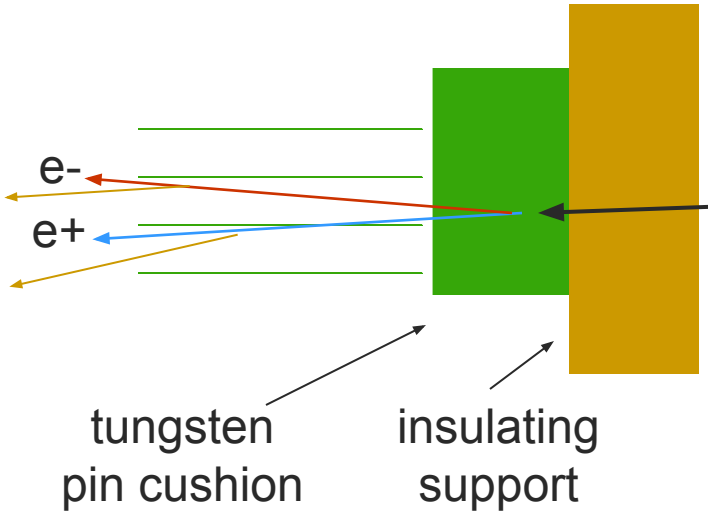
- Response time

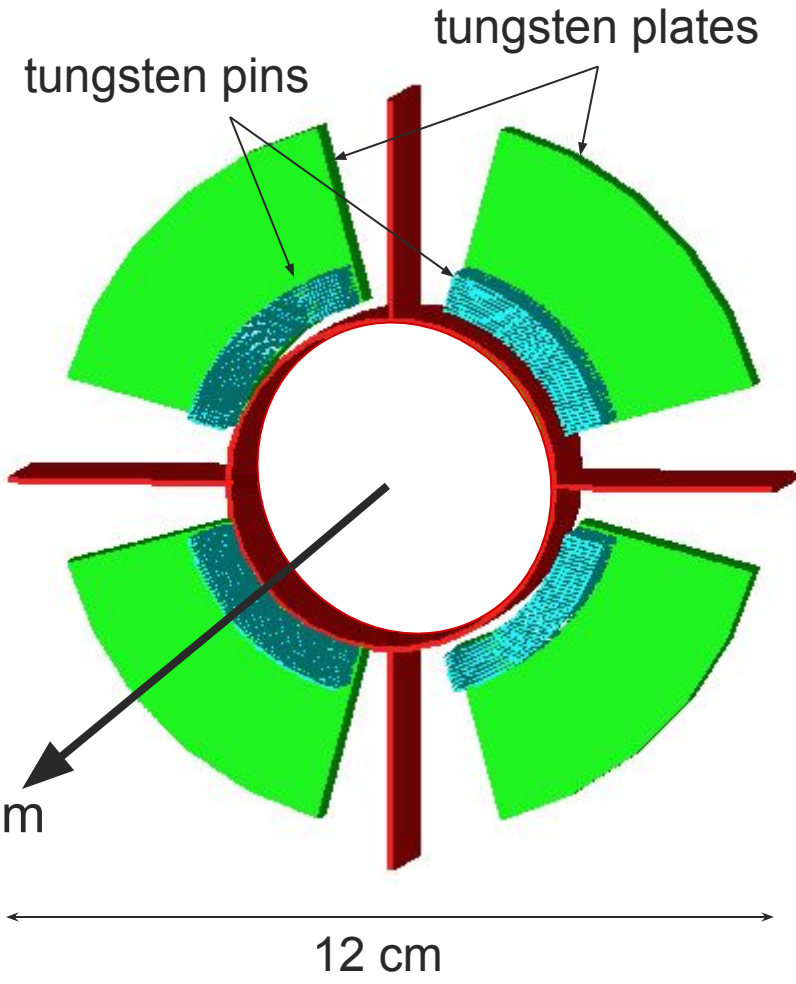
  $\tau \leqq$ 1 ms

projections based on known performance of the GlueX active collimator

KLF active collimator design

- measures current due to knock-ons in EM showers

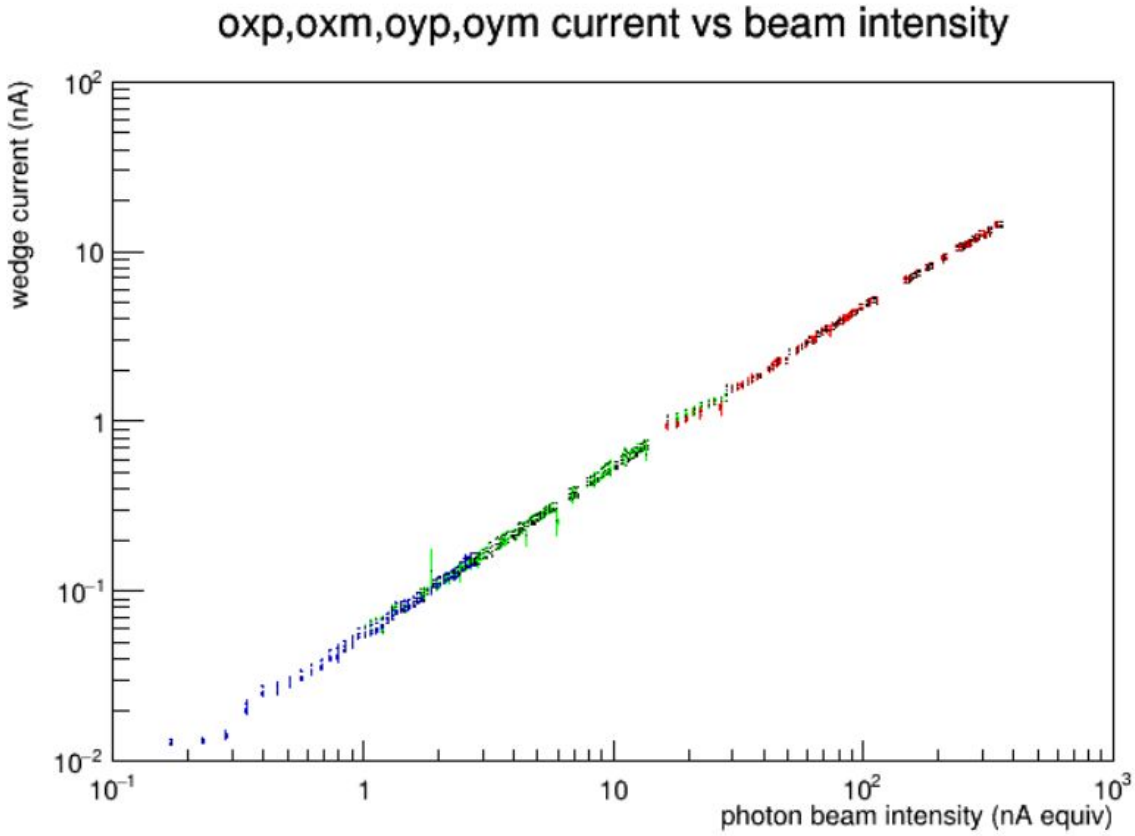




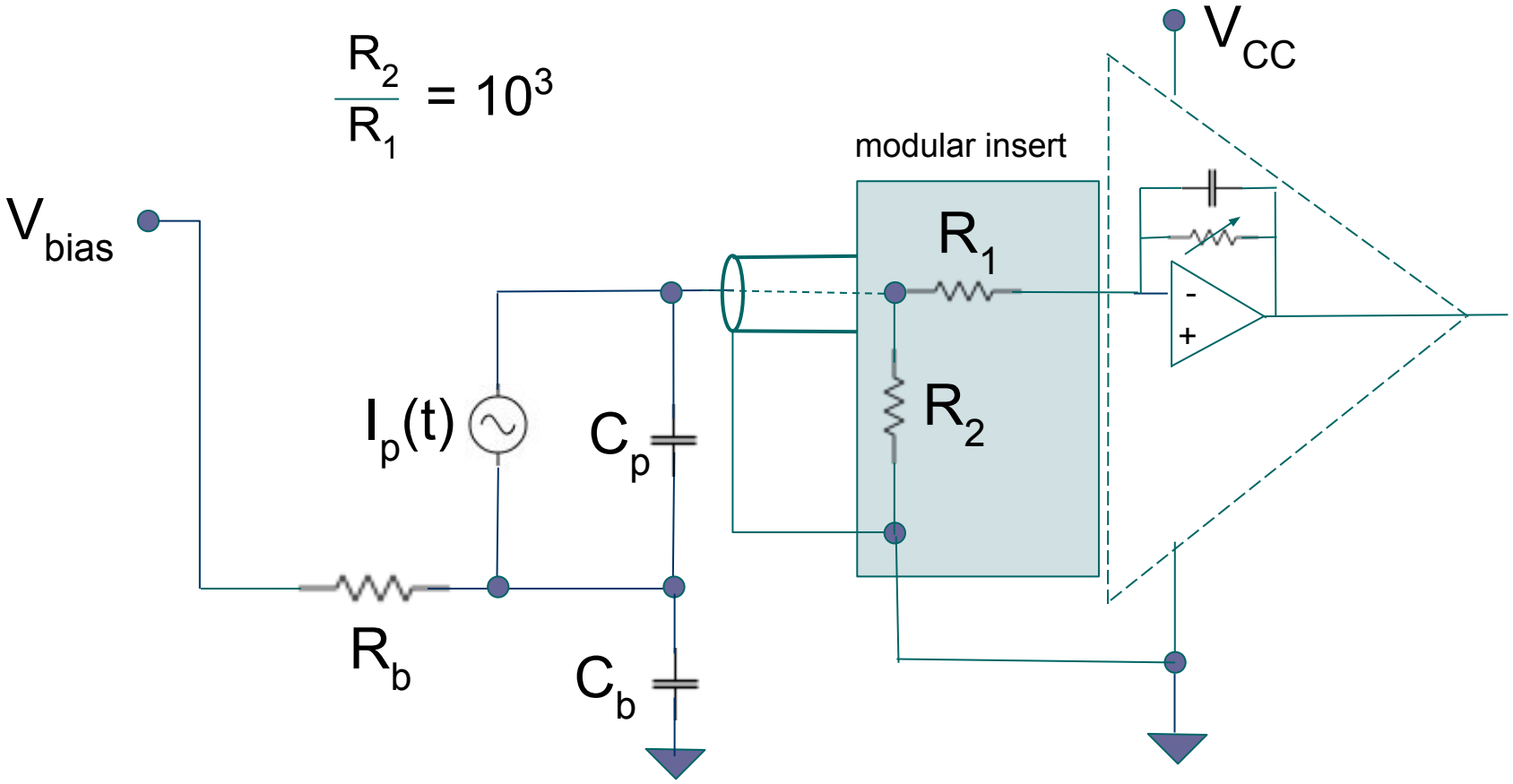
Can it scale by 10^4 intensity?

Original design worked in SLAC (pulsed) e- beam!

- unit gain, like an ion chamber
- large dynamic range 10^6 used by GlueX
- will insert x1000 attenuators before preamplifiers for KLF



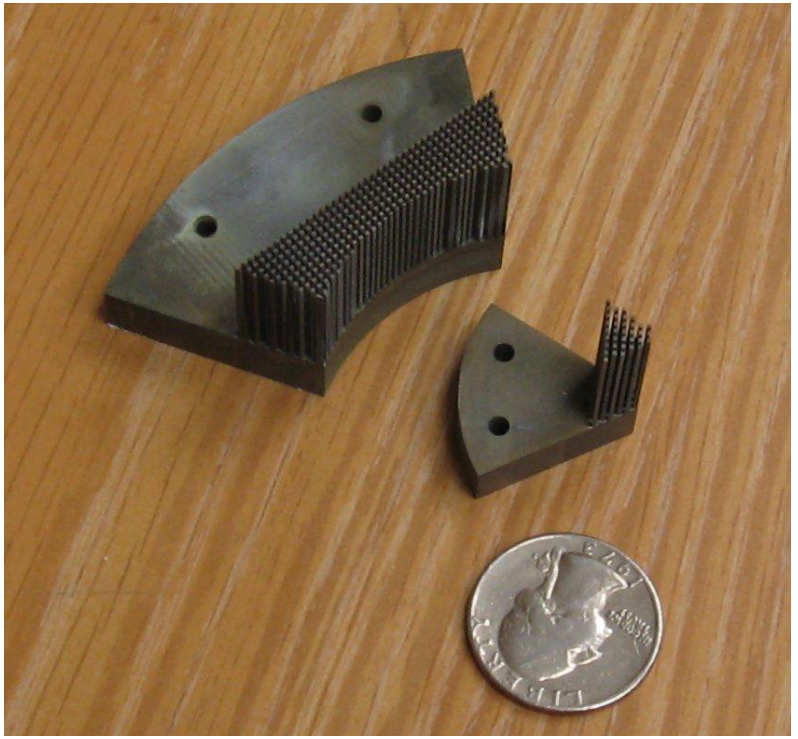
Necessary changes to the readout



Tungsten pin construction

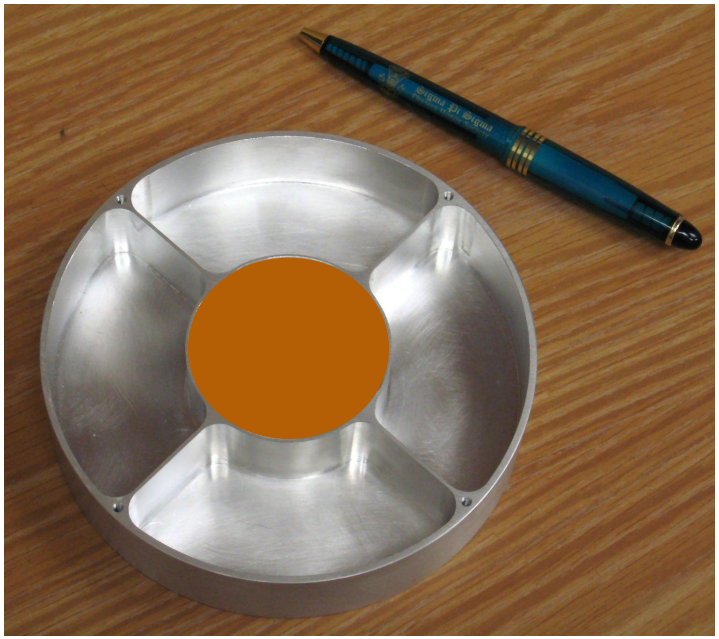
Pin cushions fabricated using electrical discharge machining (EDM)

- pure tungsten too brittle, pins snap off during fab.
- machinable tungsten OK
- finding the right material is crucial

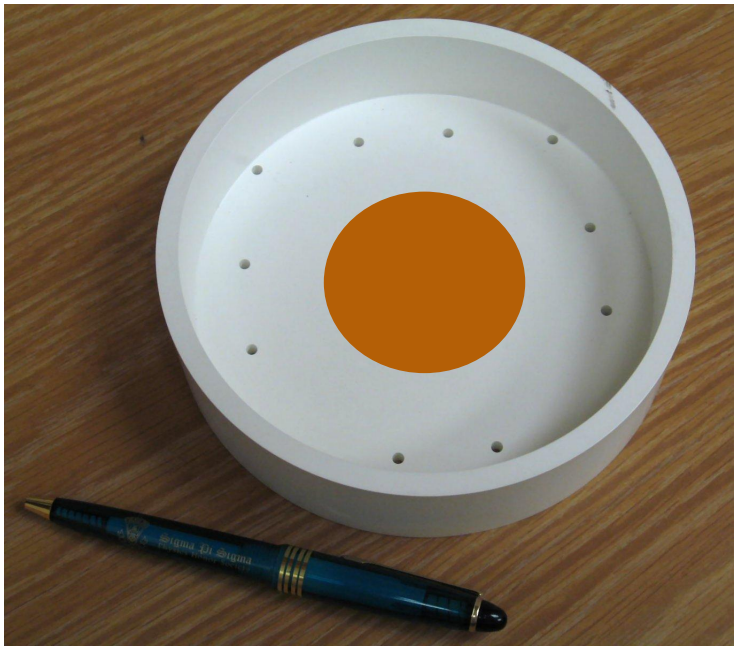


GlueX active collimator housing

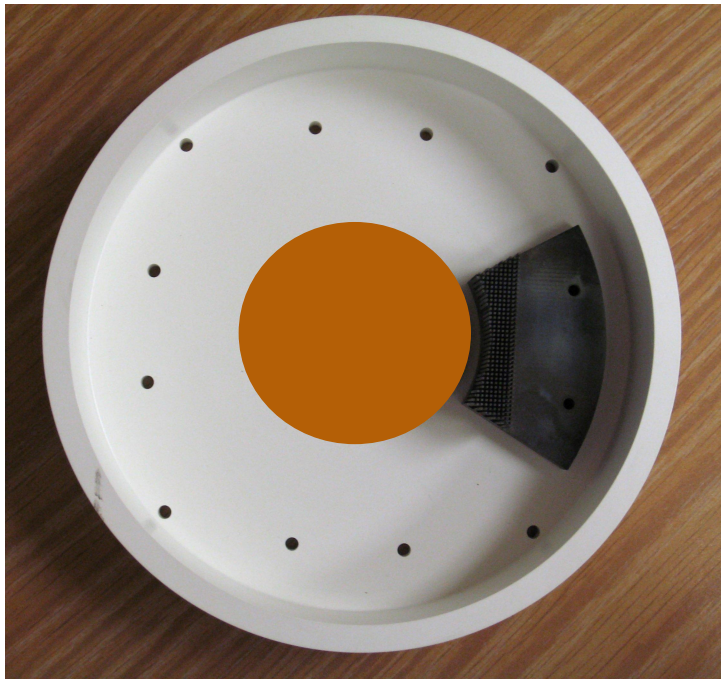
partitioned anode (Al)

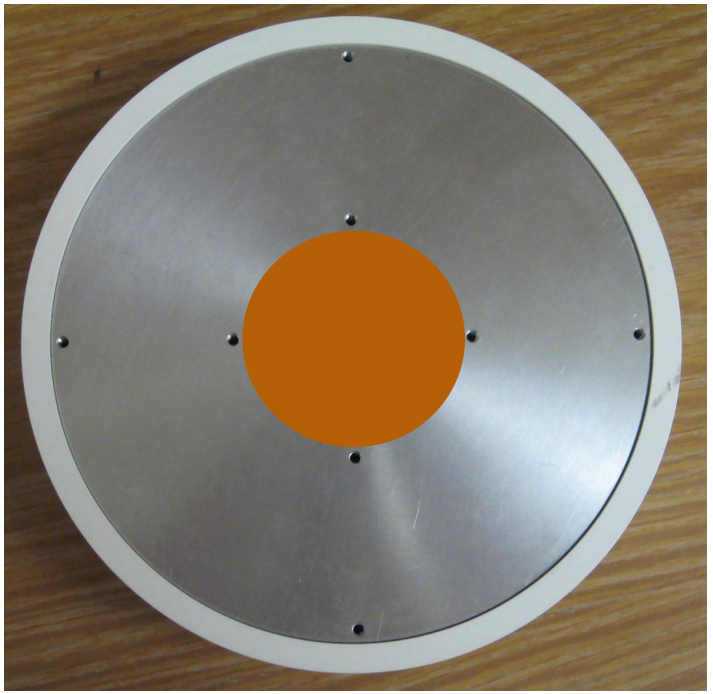


insulating cathode holder (BN)



GlueX active collimator assembly

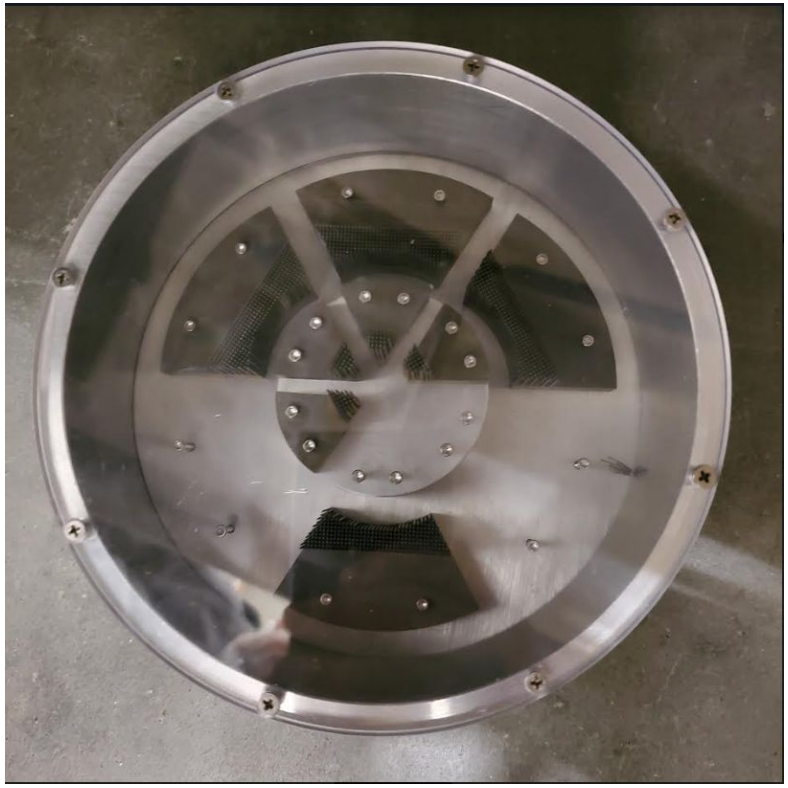




looking upstream w.r.t the beam

Current status

- tungsten “pin cushion” wedges have been found
- no plans to “scavenge” any parts from the existing GlueX active collimator itself
- preamplifiers + digitization electronics from GlueX acol readout will be used (only four instead of 8 channels)



Current status

- some new things remain to be fabricated:
  a. insulator housing (boron nitride)
  b. aluminum EM shield enclosure
  c. aluminum front plate with SMC connectors
  d. longer 75Ω coaxial cables, 4 x 20m(?)
  e. in-line attenuators at preamp inputs
  f. clamp to align and hold in place
- machining, assembly and bench tests to be completed at UConn over second half 2024.