

Radiation Hardness Photon Flux/Charge Studies

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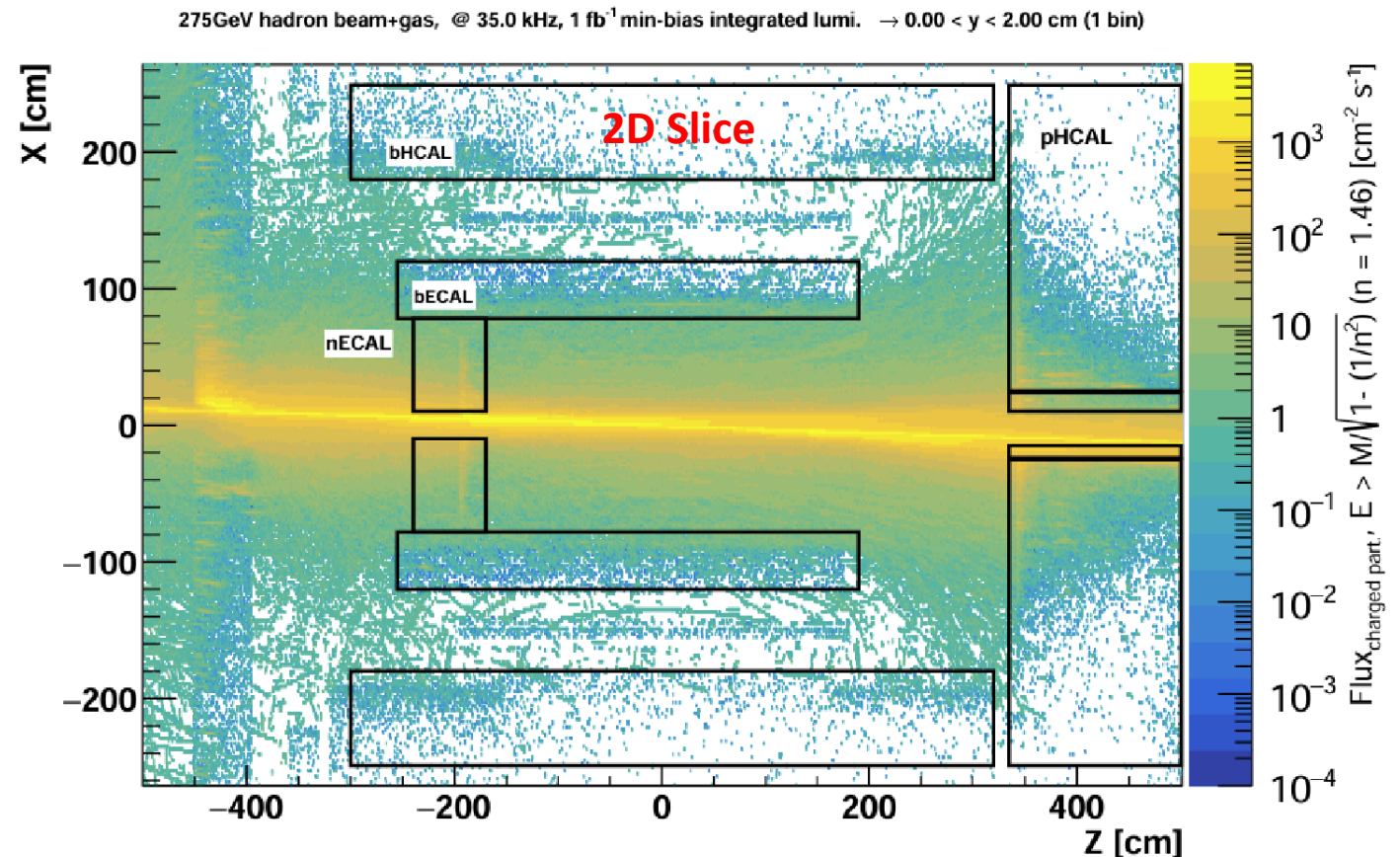
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Radiation Simulations

- Radiation simulations run by Alexander Jentsch, similar to those present on [Radiation Doses - Electron-Proton/Ion Collider Experiment \(bnl.gov\)](#) but with pfRICH specific considerations
- 3D map of Flux of all charged particles that pass Cherenkov cut

$$E > \frac{M}{\sqrt{1 - \left(\frac{1}{n}\right)^2}}$$

- Separate histograms for n of aerogel and HRPPD window as well as particles produced via beam-gas interactions and DIS.

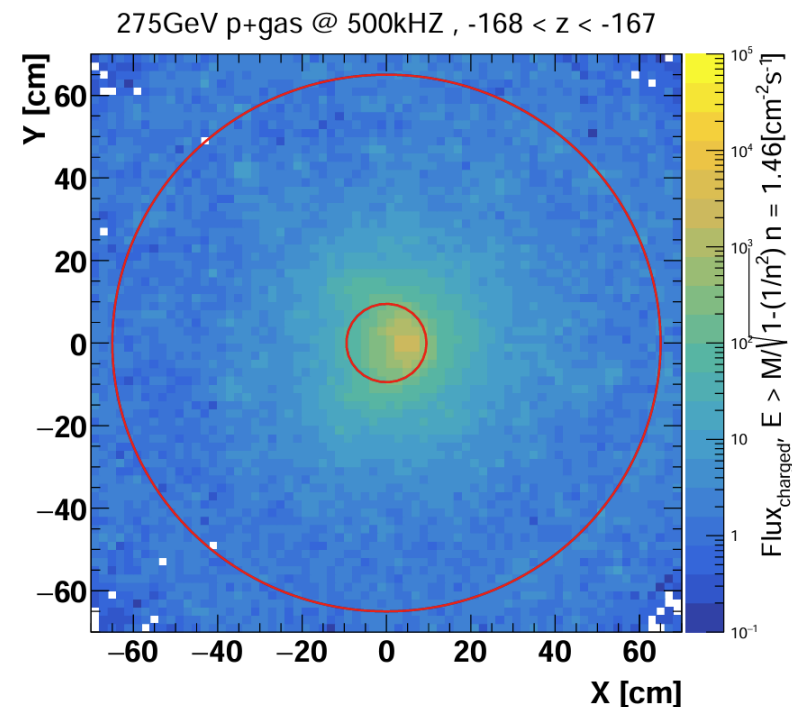
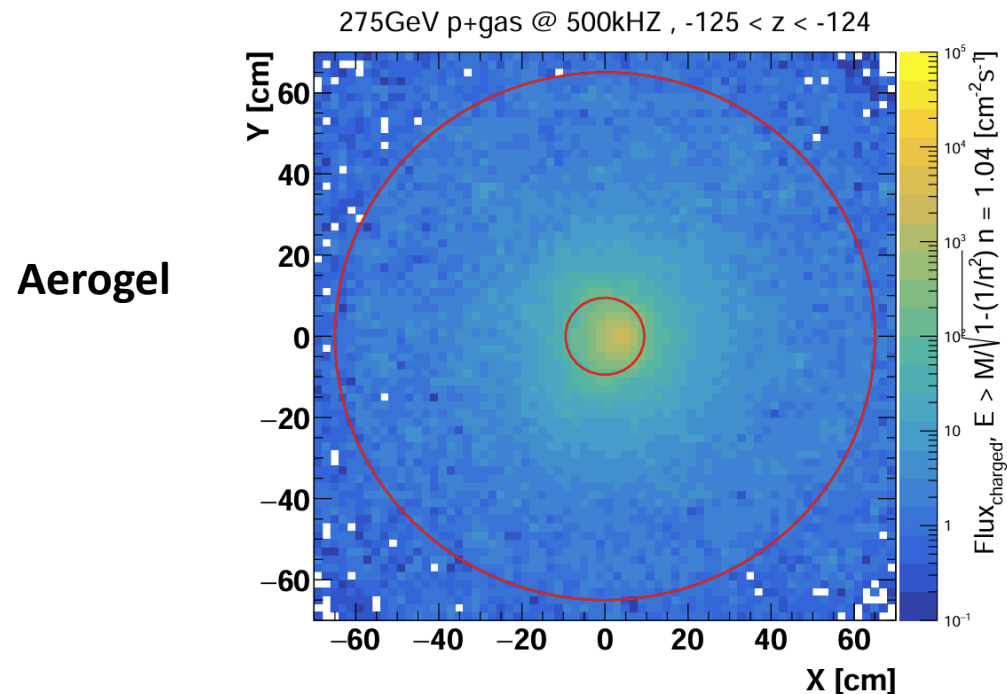


Updates

- Have now included electron-beam+gas contribution
- Assumptions:
 - 26 weeks of 24hr running
 - Luminosity of $1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
 - Photons Produced per Cherenkov inducing particle (factors in quantum eff.)
 - Window: 100
 - Aerogel: 10
 - HRPPD Gain of 10^5

Flux Studies – Proton Beam Gas

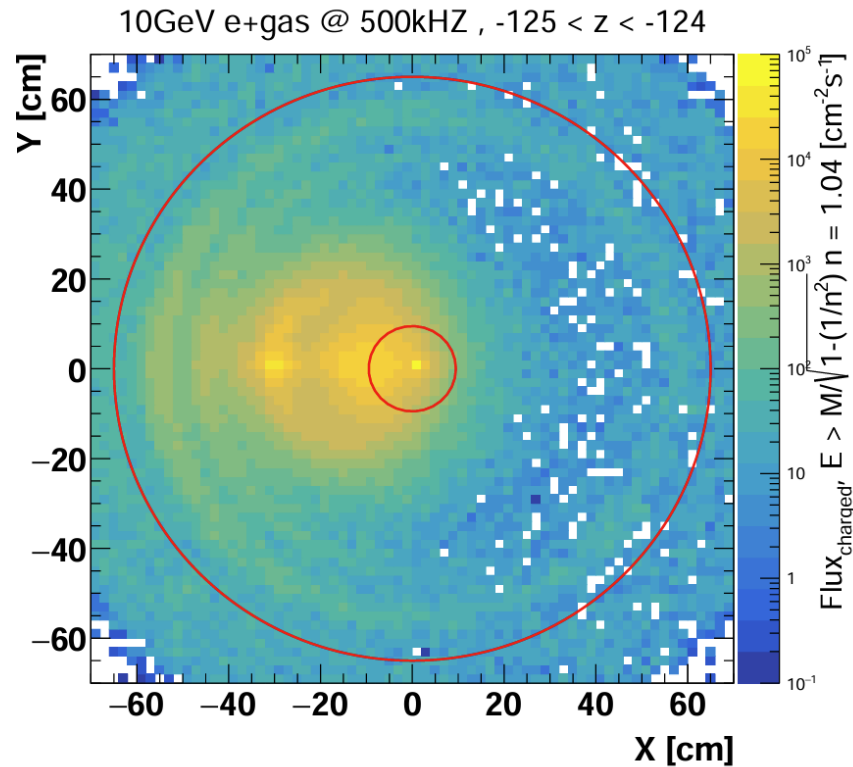
- Contributions due to beam-gas interactions and DIS were simulated separately
- Take slice for particles passing window Cherenkov cut at $z = -168$, and for those passing aerogel cut at $z = -125$ to get total flux of particles producing Cherenkov



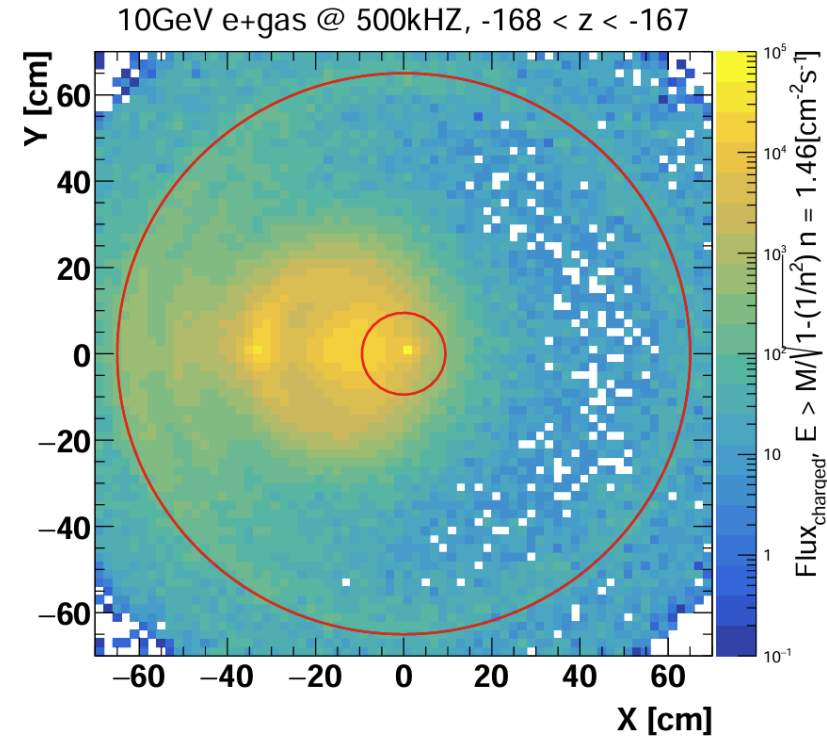
Flux Studies – Electron Beam Gas

- Now, largest contribution
- Causes largest dose to be offset from the beam-pipe

Aerogel



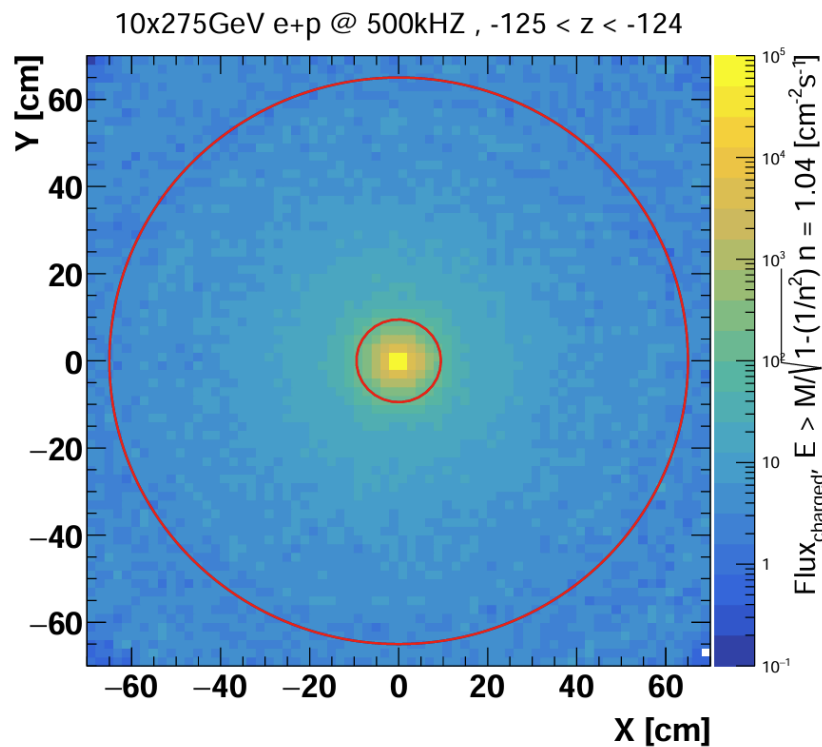
Window



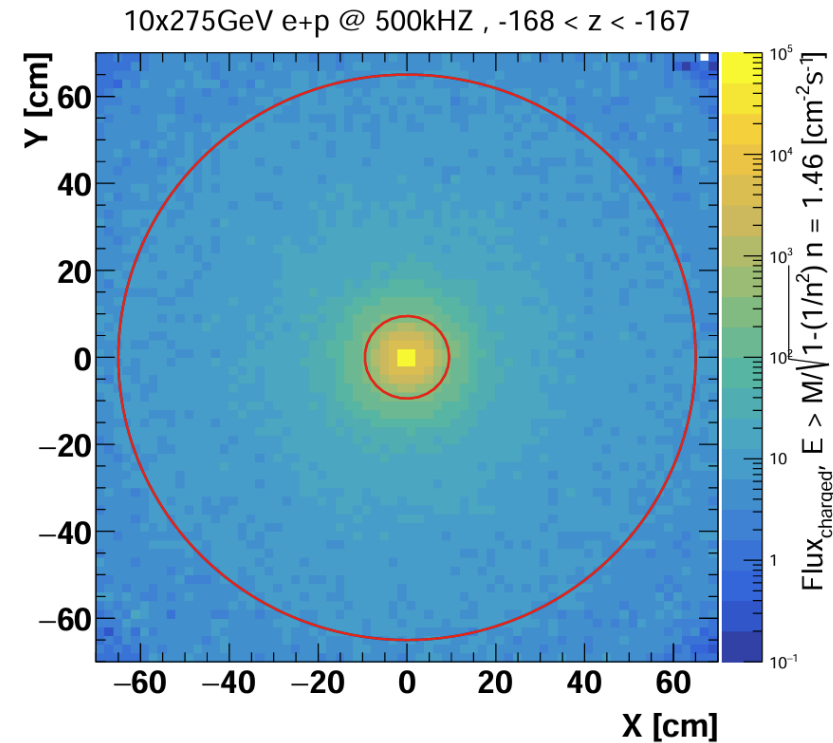
Flux Studies - DIS

- Repeat study for particles resulting from DIS
- Add together all contributions: aerogel/window DIS/Beam-Gas (next slide)

Aerogel

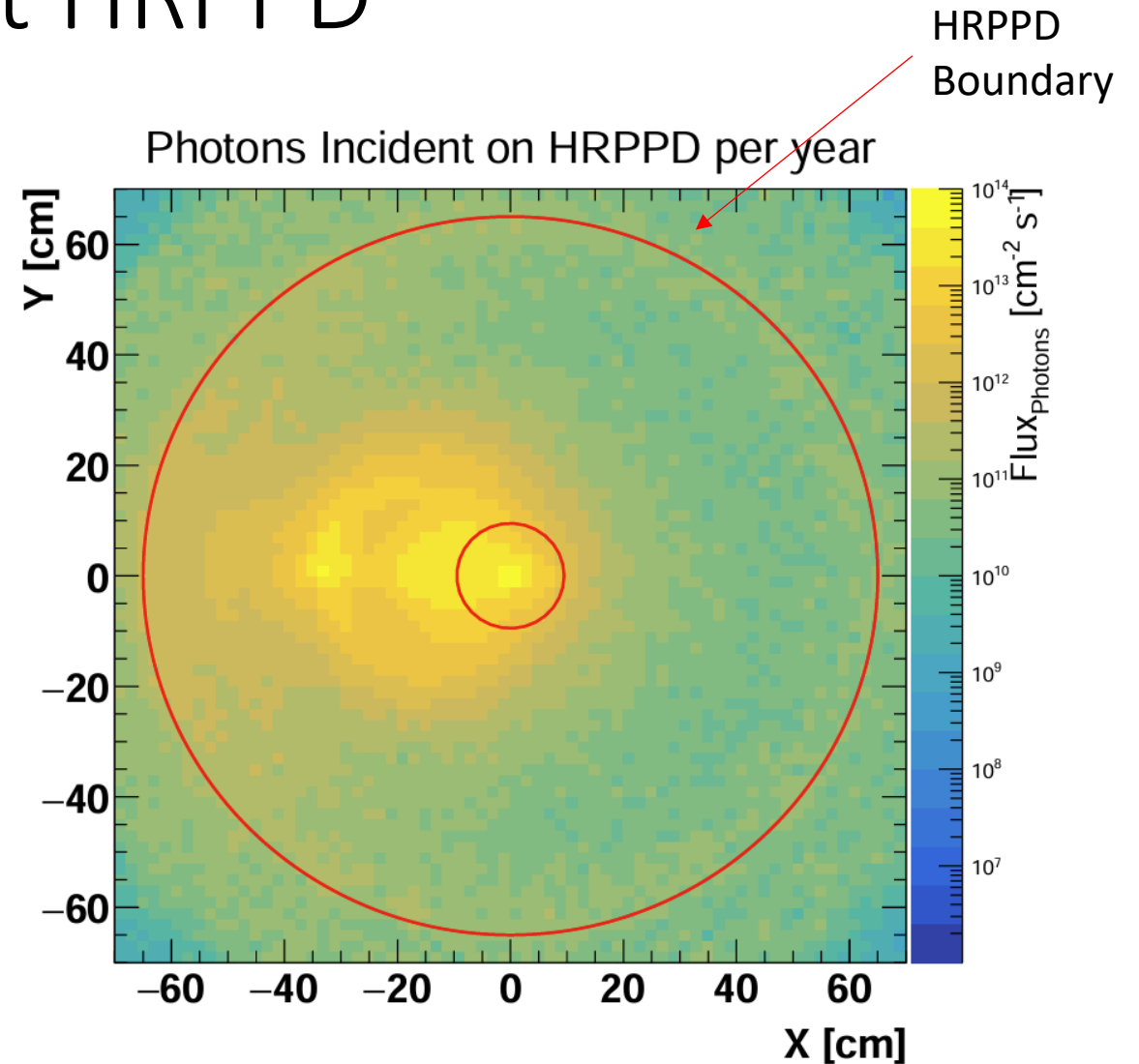


Window



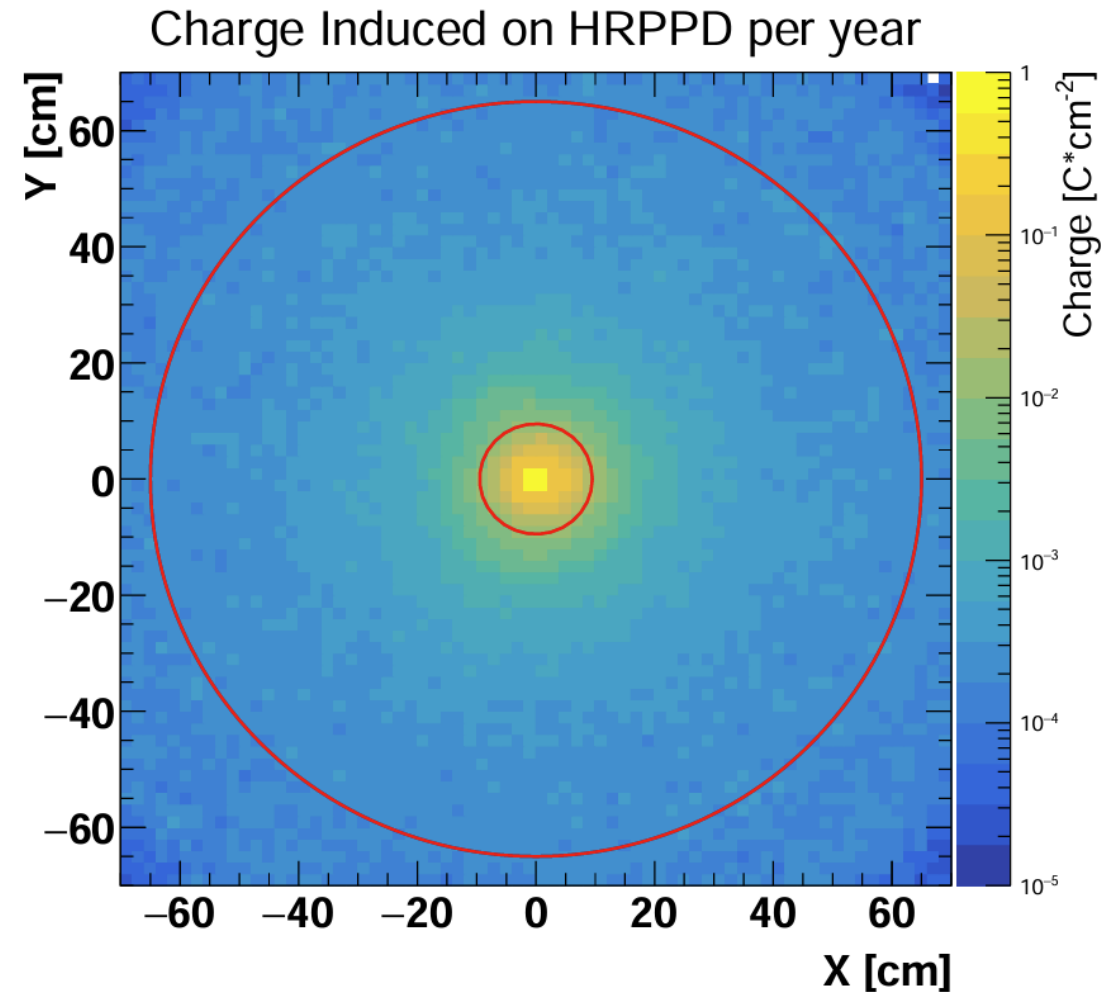
Total Flux of photons at HRPPD

- Scale total per second flux by 26 weeks in seconds
- Add together both contributions, and scale to 100 photons/particle at window at 10 photons/particle at aerogel
- Assuming all photons travel straight ahead (naïve assumption for now)
- Total photons incident on HRPPD in one year of running



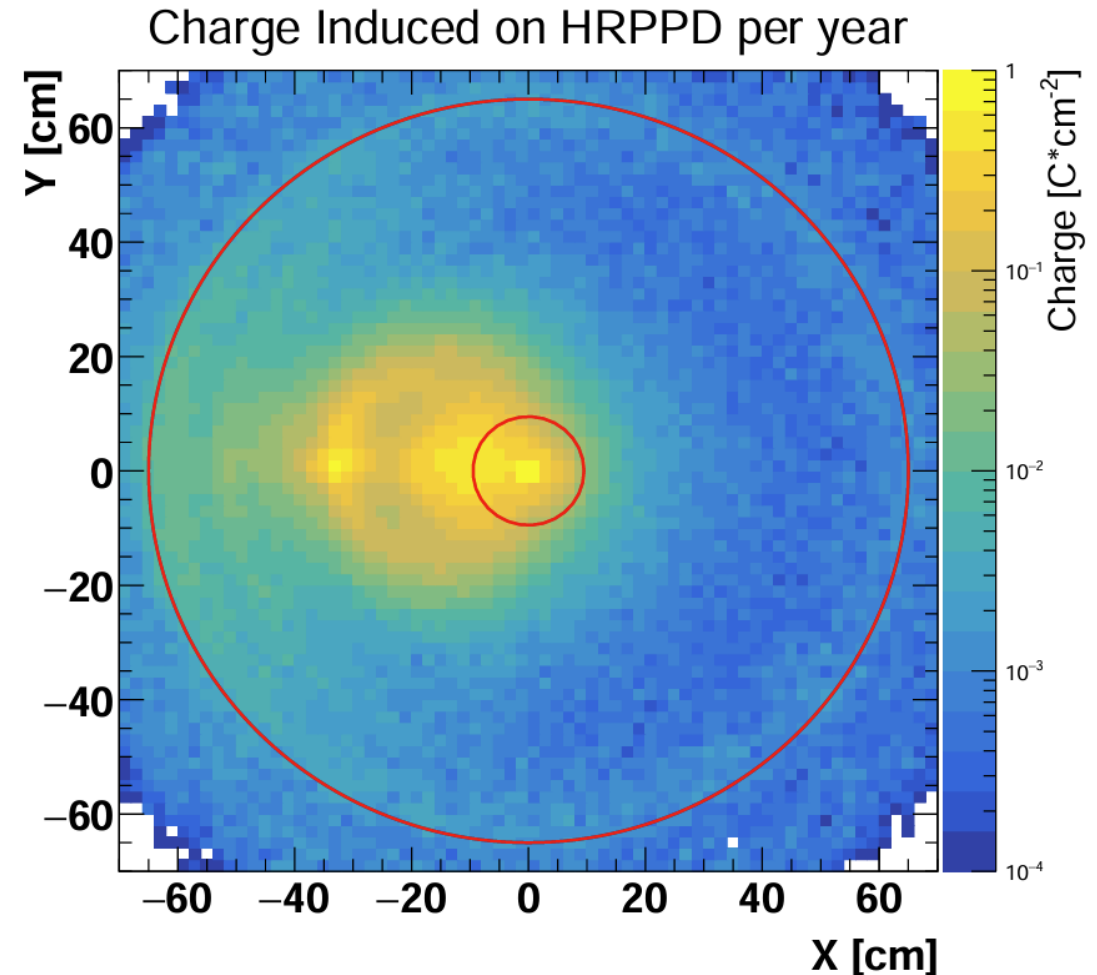
Total Charge induced on HRPPD (Previous Estimate)

- Scale total flux by HRPPD Gain
 - assuming 10^5
- Then scale by charge of electron for total charge induced in a year
- Within pfRICH radius:
 - Max Value: 0.011 C/cm^2



Total Charge induced on HRPPD (Including electron-beam + gas contribution)

- Scale total flux by HRPPD Gain
 - assuming 10^5
- Then scale by charge of electron for total charge induced in a year
- Within pfRICH radius:
 - Max Value: 0.8119 C/cm^2



Conclusions

- Electron-Beam + gas is by far the largest contribution to Cherenkov background.
- After 10 years of running, would accumulate charge of approximately 8 C/cm^2 at gain of 10^5
 - 26 weeks of 24hr running
 - Luminosity of $1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
 - Photons Produced per Cherenkov inducing particle (factors in quantum eff.)
 - Window: 100
 - Aerogel: 10
 - HRPPD Gain of 10^5
- Still within benchmark of 10 C/cm^2
- Don't believe it will affect results, but had some questions about changes in binning to ask Alex, will update as anything changes.