Backward Hadronic Calorimeter

SiPM noise update

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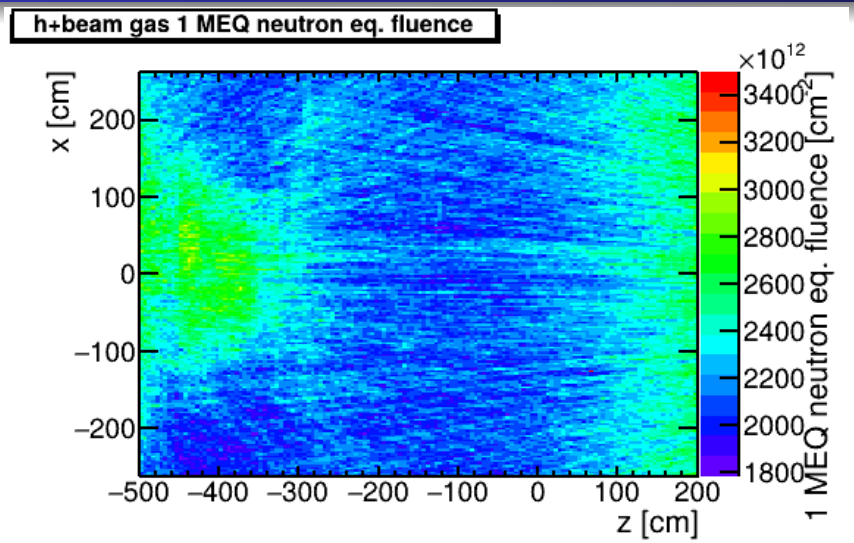
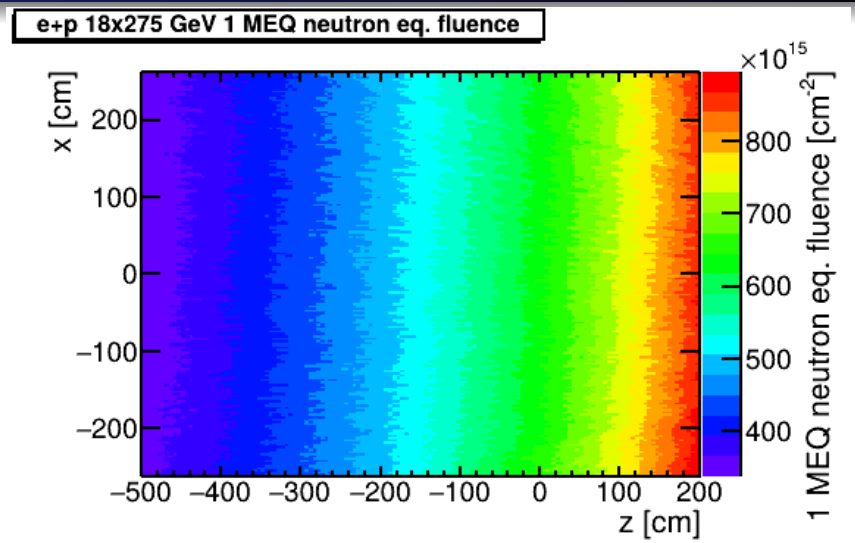
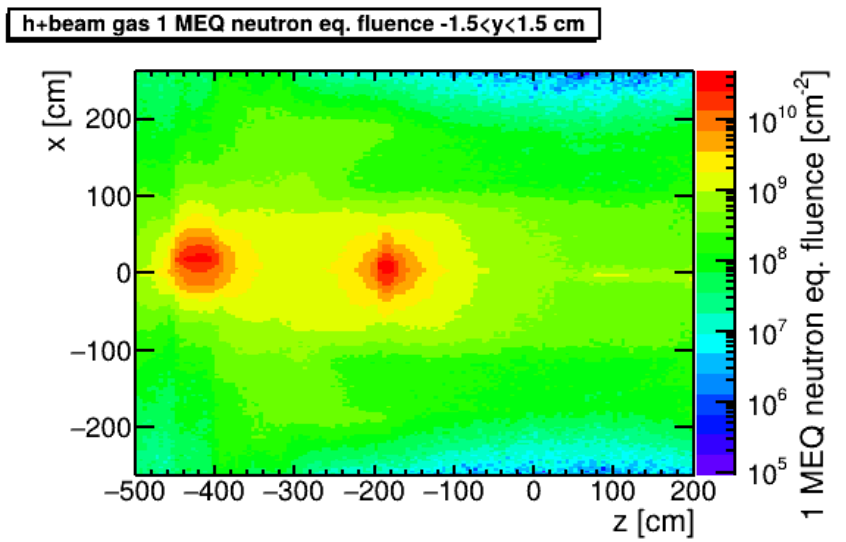
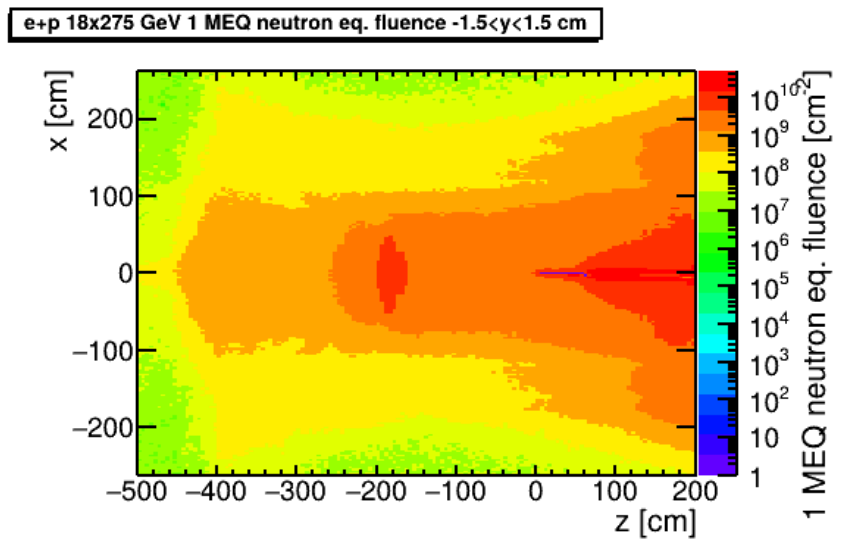
Outline

Radiation - neutrons



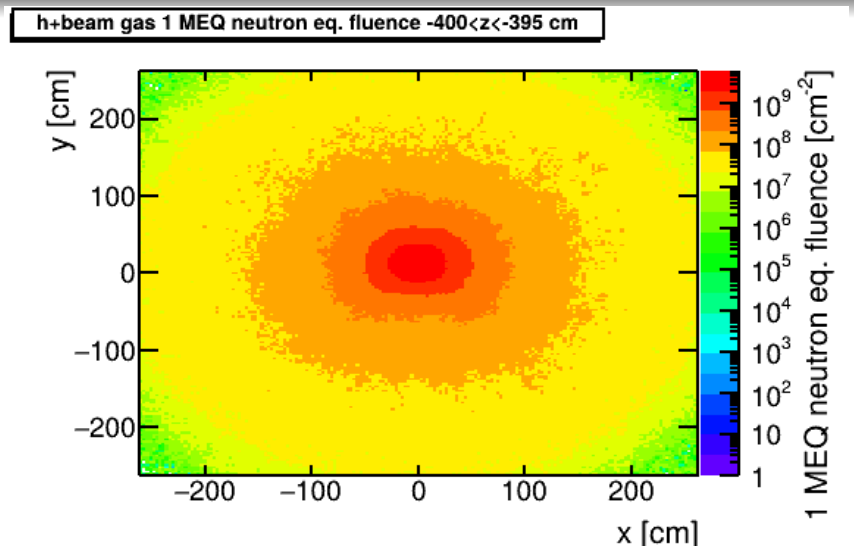


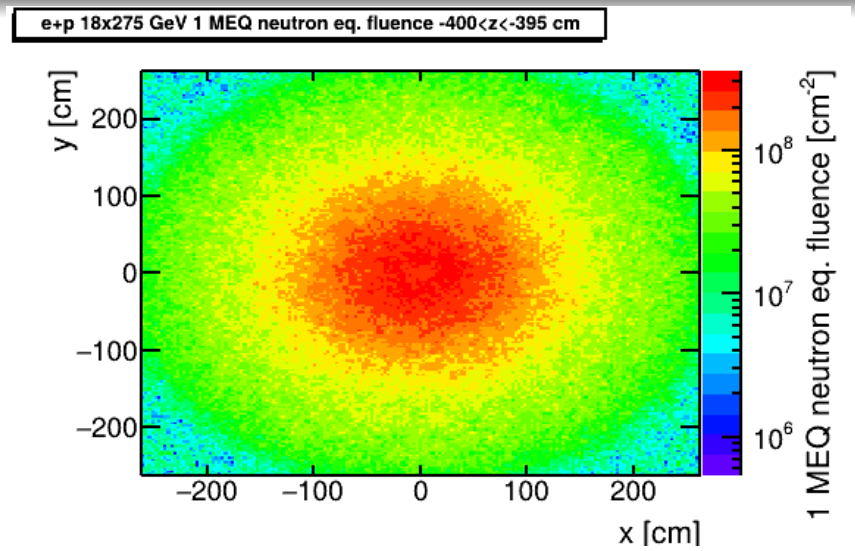


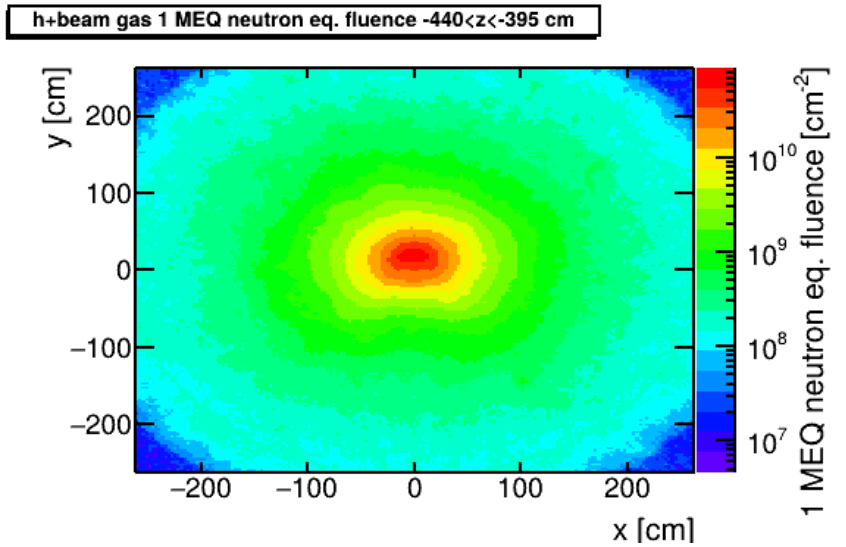


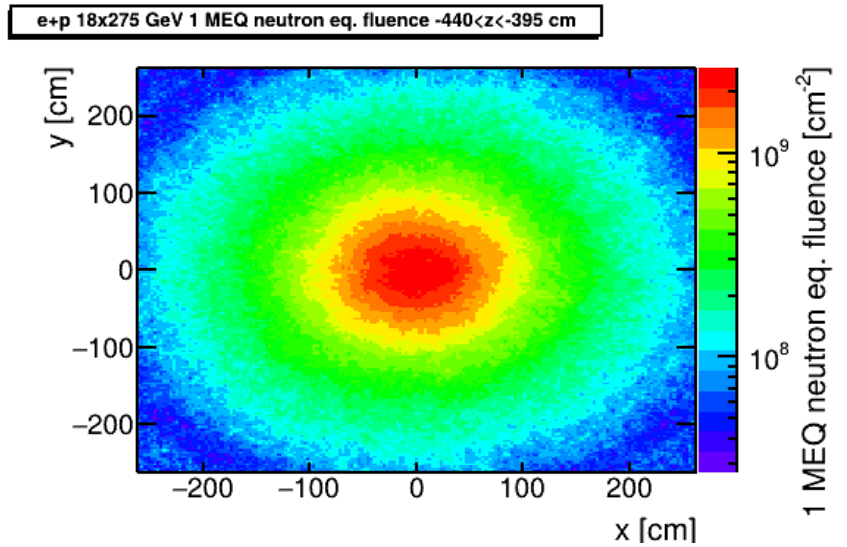
- Neutron fluence taken from updated files:
  `https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses`
- Slices and integrated distributions correspond to 100 fb^{-1}
- Some areas close to the beam are exceeding 10^{10} cm^{-2}
  - may affect SiPMs dark current

Radiation - neutrons



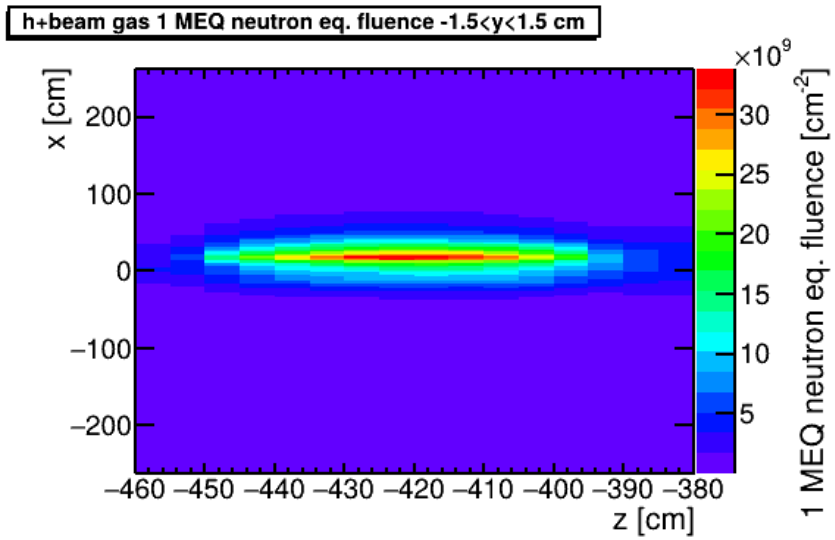


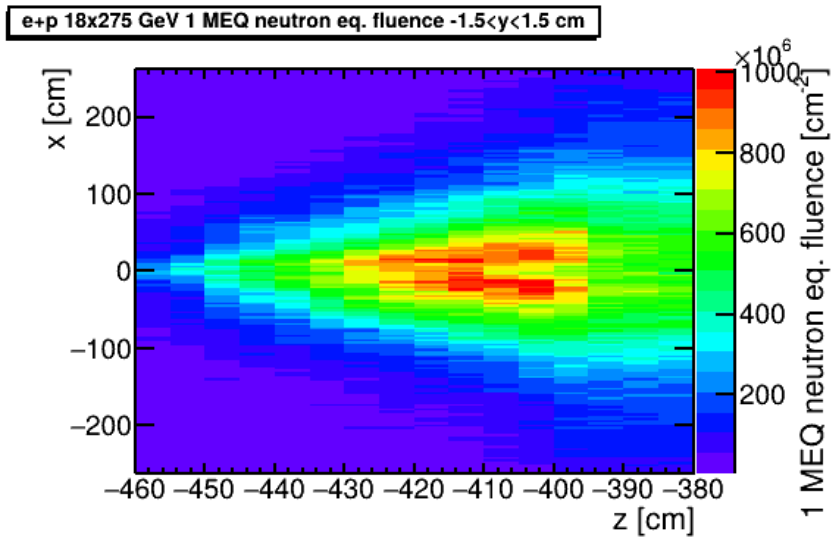




- Neutron fluence taken from updated files:
  `https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses`
- Slices and integrated distributions correspond to 100 fb^{-1}
- Total fluence for nHCal is integrated within $-440 < z < -395\,\mathrm{cm}$

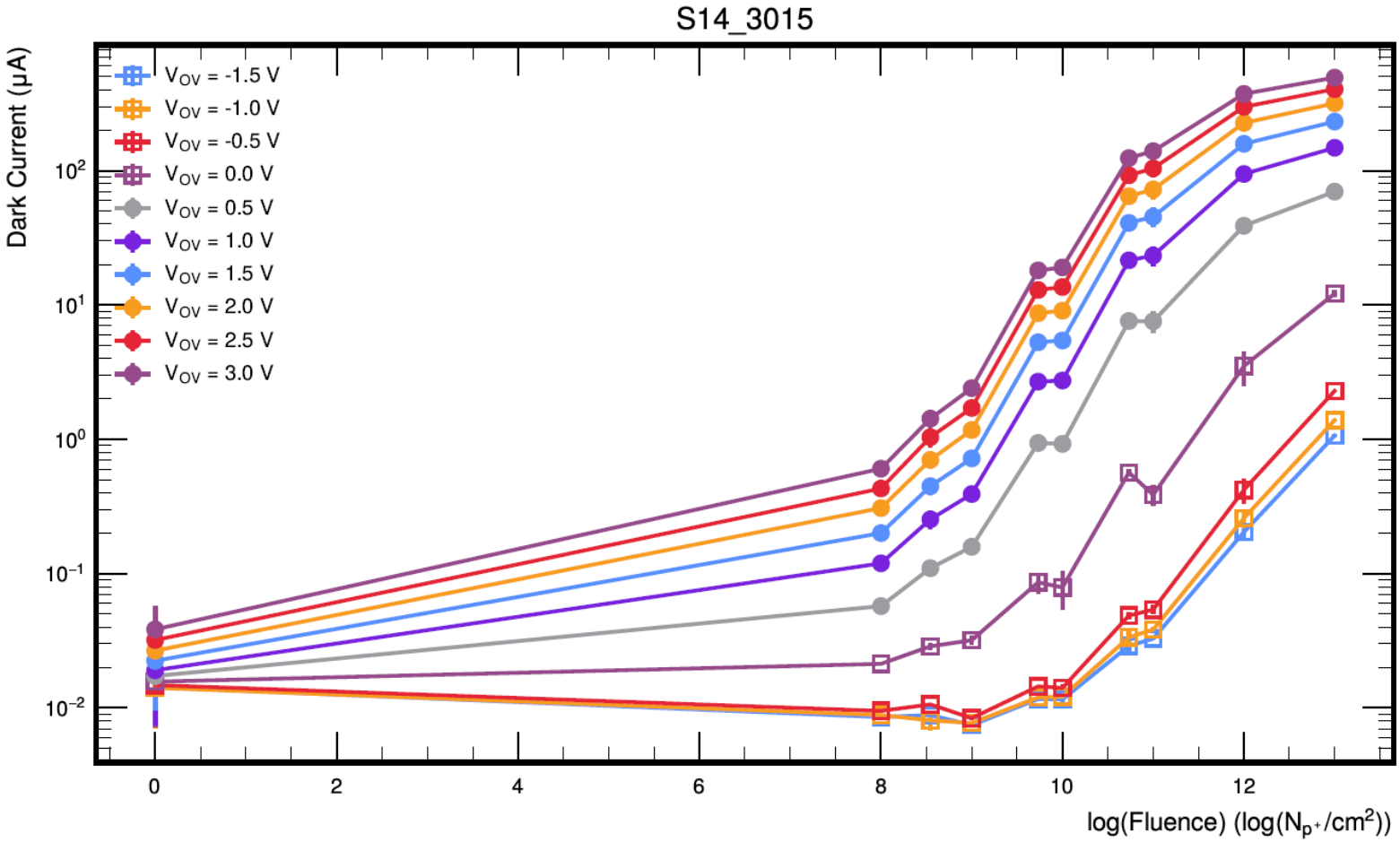
Radiation neutron fluence vs. layer





- Zoom in to see fluence vs. layer
- $e + p$ gives max. fluence of $10^9\ \mathrm{cm}^{-2}$ in 2-4th layers
  - quickly drops to $10^8\ \mathrm{cm}^{-2}$ 70 cm away from beam
- h+beam gas gives max. fluence of $3.3 \cdot 10^{10}\ \mathrm{cm}^{-2}$ in 7th layer (-425 cm)
  - quickly drops to $10^9\ \mathrm{cm}^{-2}$ 50 cm away from beam
- h+beam gas penetrates deeper than $e + p$

Dark current



- Taken from `https://indico.bnl.gov/event/24087/#17-further-rad-hard-studies-an`
- Dark current starts to increase above $10^{10}\ \mathrm{cm}^{-2}$

Rates

bkg. type	hit rate in detector [kHz]	max single channel hit rate [kHz]
DIS	$\sim 10^3$	1.23324
Synchrotron rad.	$\sim 2 \cdot 10^1$	-
e+gas	403.899	6.6448
h+gas	$\sim 7 \cdot 10^2$	0.303781

Table 8.49: Maximum expected background rates for backward HCal. The assumed threshold is 170 keV.

- Taken from `https://wiki.bnl.gov/EPIC/index.php?title=Background`
- Included in pre-TDR
- Threshold very similar to our assumption

Signal characteristics

- Taken from `https://indico.bnl.gov/event/19751/#2-lfhcal-tile-sipm-testing` and numbers assumed in eicrecon (take with grain of salt, to be updated)
- ≈ 10 photons for MIP $dE = 0.75\,\mathrm{MeV}$, $\approx 13.3k\,\mathrm{GeV}^{-1}$ photons
- Readout threshold $\approx 3 pixels = 0.1875\,\mathrm{MeV} = 41 ADC$
- Noise: pedestal $10 \pm 2 ADC$ (assumed in EICrecon based on Norbert's studies)

Other updates

- Using StainlessSteel as a non-magnetic steel in simulation
  - But density seems too high! $8.3\,\mathrm{g/cm^3}$. Should we correct?
- Performed geometry optimization for neutron detection efficiency (update soon!)
- Performed sampling fraction study (update soon!)

Listing: Materials.xml

```
<material name="Steel235">
   <D value="7.85" unit="g/cm3"/>
   <fraction n="0.998" ref="Fe"/>
   <fraction n=".002" ref="C"/>
</material>


<material name="StainlessSteel">
   <D type="density" value="8.3" unit="g / cm3"/>
   <fraction n="0.74" ref="Fe"/>
   <fraction n="0.18" ref="Cr"/>
   <fraction n="0.08" ref="Ni"/>
</material>
```

Summary

Conclusions

- Discussed noise, radiation and updates

BACKUP