

GEP Target Studies in GEANT4

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SBS Weekly Meeting

Nov. 29, 2017

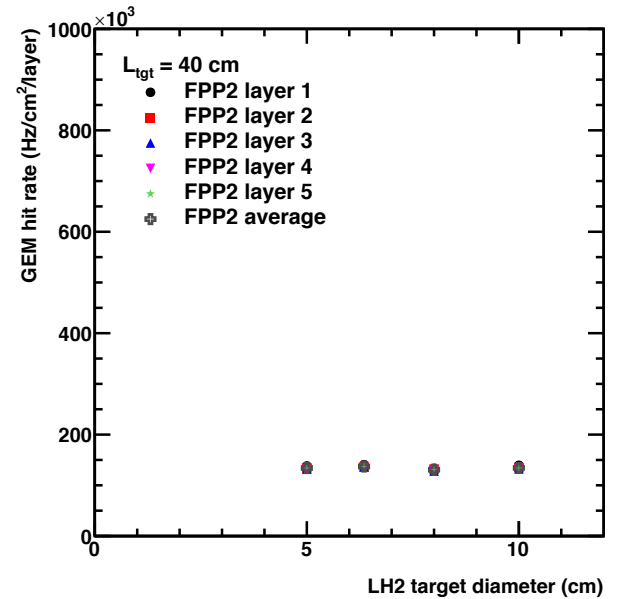
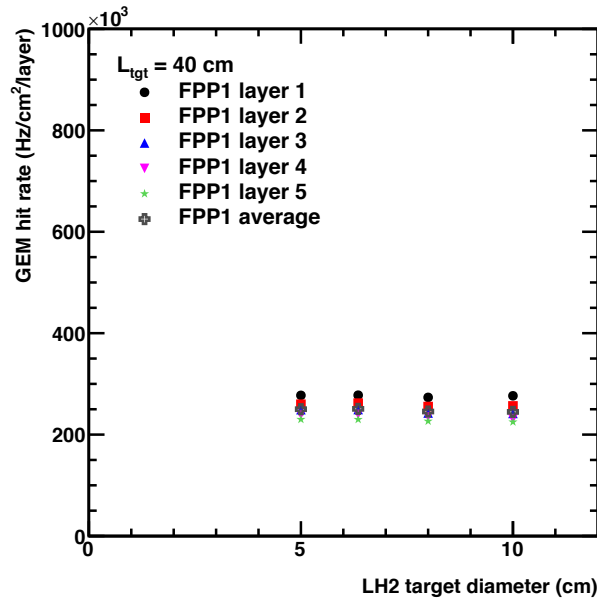
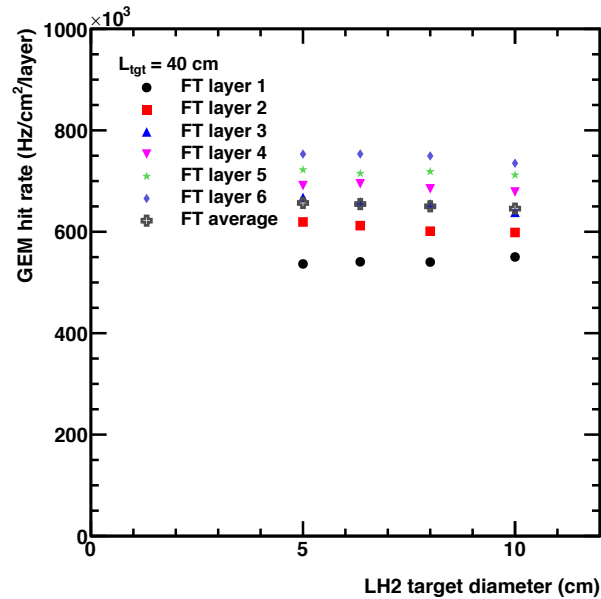
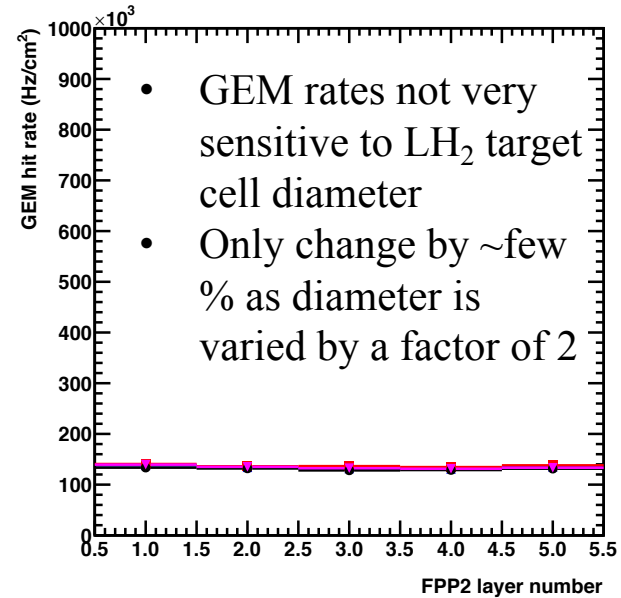
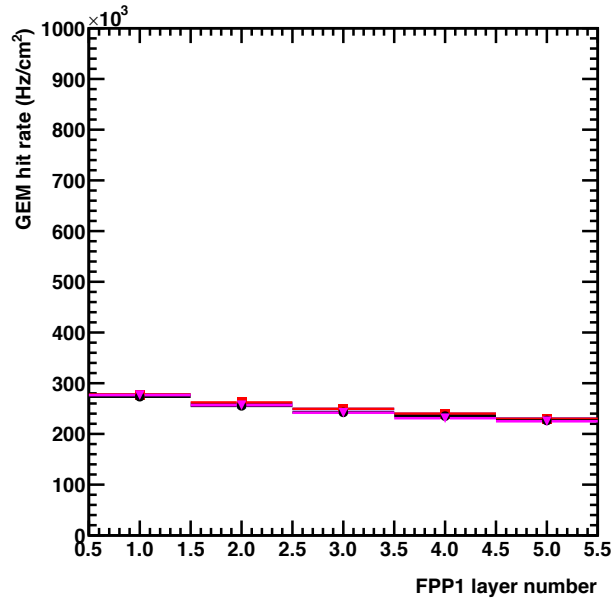
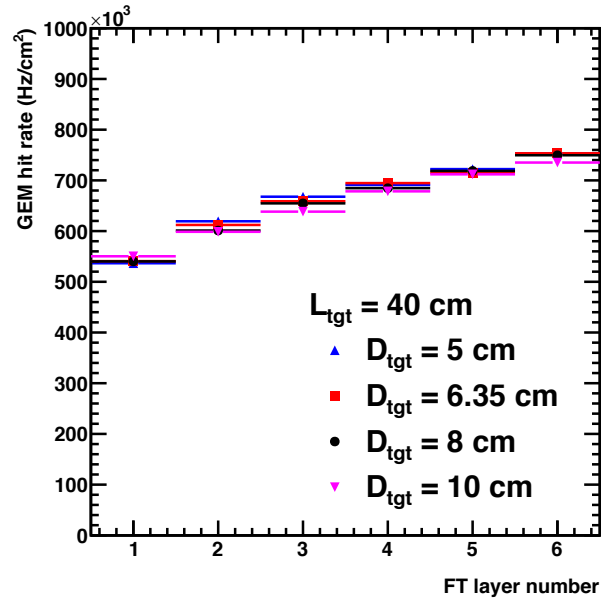
Motivation

- Inform design of G_{Ep} cryotarget.
- Study GEM background rates as a function of target cell diameter and thickness
- For now, only cylindrical targets were considered
- Vary target diameter within a plausible range
- Vary target thickness within a plausible range consistent with physics goals.

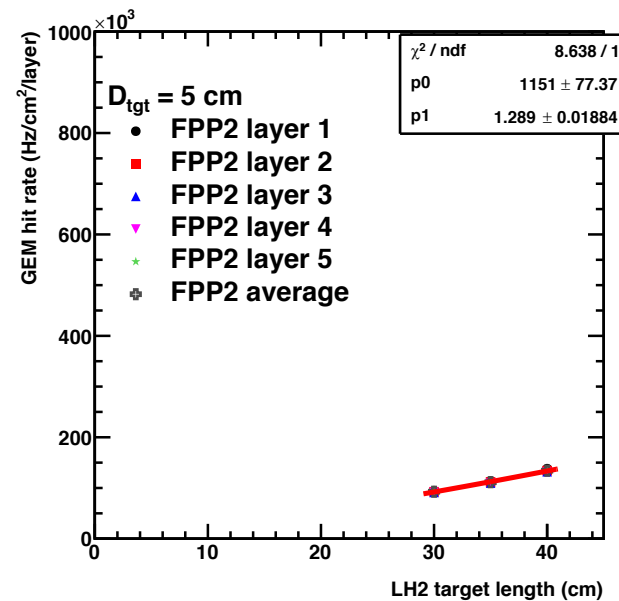
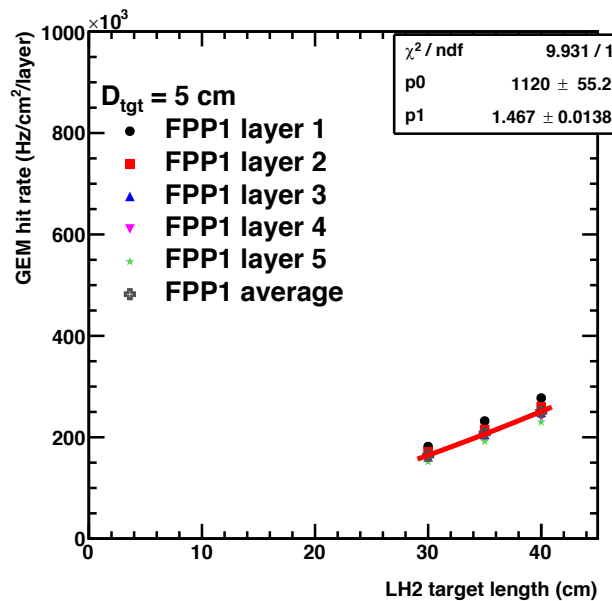
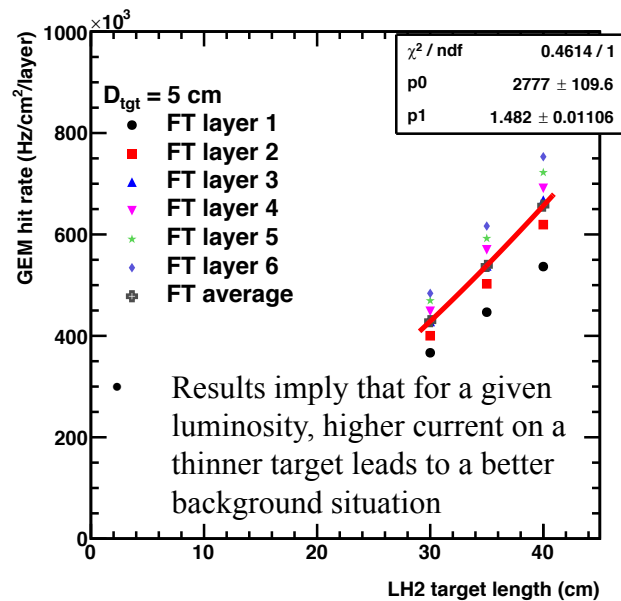
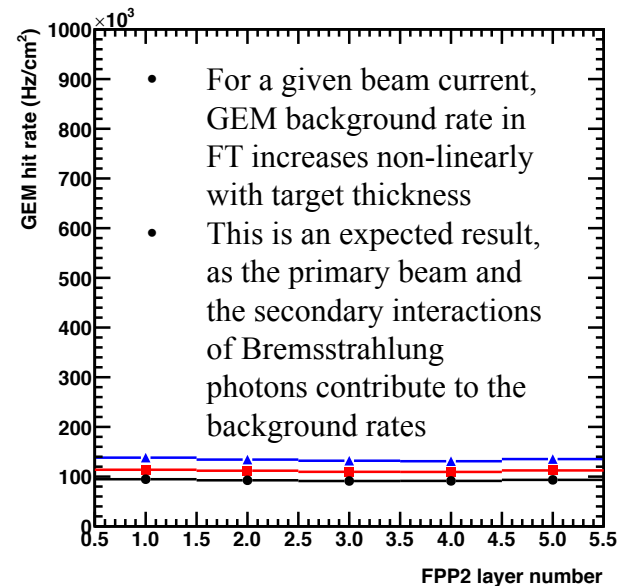
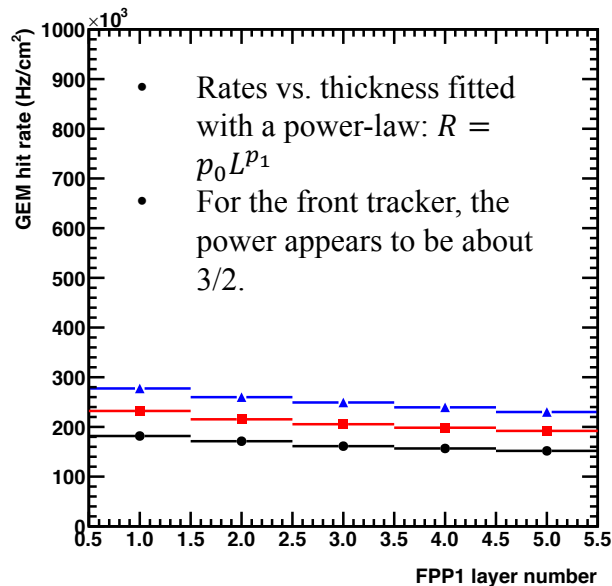
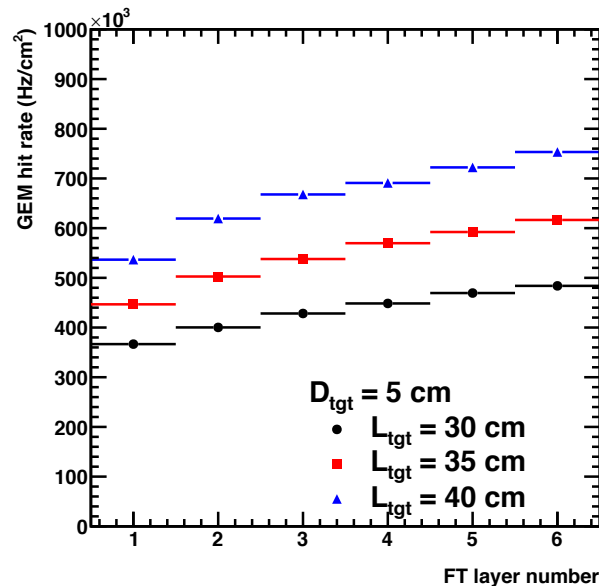
Simulations

- GEp 12 GeV² configuration, TOSCA field map.
- Generate approximately 5×10^9 primary 11 GeV beam electrons on target for the following target combinations:
 - (L,D) = (30 cm, 5 cm)
 - (L,D) = (35 cm, 5 cm)
 - (L,D) = (40 cm, 5 cm)
 - (L,D) = (40 cm, 6.35 cm)
 - (L,D) = (40 cm, 8 cm)
 - (L,D) = (40 cm, 10 cm)
- Assumed aluminum can thicknesses (these are “typical” for standard Hall A cryotarget):
 - Upstream (entry) endcap: 0.1 mm
 - Downstream (exit) endcap: 0.15 mm
 - Side wall thickness: 0.2 mm
- Raster size 4x4 mm².

GEM Rates vs layer for different diameters at L = 40 cm



GEM rates vs. target thickness, $I_{beam} = 75 \mu A$



Conclusions

- The background rates do not appear to be very sensitive to the target diameter—GEM background rates appear to vary only by a few percent as target diameter is varied by a factor of two. There is also no clear systematic trend for the GEM hit rate vs. D:
 - The first layer of the front tracker has a positive slope of R vs. D
 - Subsequent layers have a negative slope
- GEM background rates scale approximately as $Rate \propto L^{\frac{3}{2}}$ (at least in the front tracker).
- Rates increase faster than linear with L.
- Implies that higher beam current and thinner target is better to achieve a given luminosity, within accelerator and/or budget constraints.
- Insensitivity of background rate to target diameter implies that whatever works best from an engineering perspective, in terms of overall cryotarget performance (cooling requirements, boiling, etc.) will have relatively minor effect on the detector performance in terms of background rates.
- To do: analyze background rates in ECAL/HCAL/CDET wrt target parameters.