

CYGNO simulation of saturation

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CYGNO simulation meeting

Samples

- Data ^{55}Fe in LIME (April 2021):
 - z from GEM scan: 6, 11, 16, 21, 26, 31, 36, 41, 46 cm
 - HV GEM1 scan: 350, 386, 406, 420, 431, 440 V (GEM2 and GEM3 @440V)
 - runs from 4119-4190 available on cloud: cygnus/Data/LAB/
- Digitized Monte Carlo:
 - available on cloud in bucket cygno-sim/digitized/
 - naming of files should be self-explaining

Files on cloud can be downloaded from minio <https://minio.cloud.infn.it/minio/>
o accessed with Giovanni's scripts: https://github.com/gmazzitelli/cygno_repo/

Simulation of GEM gain + light production

- Single GEM gain for HV @450V from portugues group measurement
- Extraction x Collection efficiency of electrons in GEM1 and GEM2 from F&K measurements
- Light yield: 0.07 photons/electrons
- ORCA Fusion:
 - 2304 x 2304 pixels
 - Camera aperture 0.95
 - Sensor size 14.976 mm
 - Sensor calibration → 1 photon = 2 sensor counts
- Active area: 35 cm x 35 cm
- Distance from the GEM: 20 cm
- Diffusion parameters from <https://arxiv.org/pdf/2007.00608.pdf>
 - σ_{T0} : 350 μm , σ_T : 0.11 mm/sqrt(cm)
 - σ_{L0} : 260 μm , σ_L : 0.099 mm/sqrt(cm)
- Geometry factor of light collection: $\Omega=1/(4(d+1)*a)^2$
 - d = ratio between image size (350 mm) and sensor size (14.976 mm)
 - a = camera aperture (0.95)

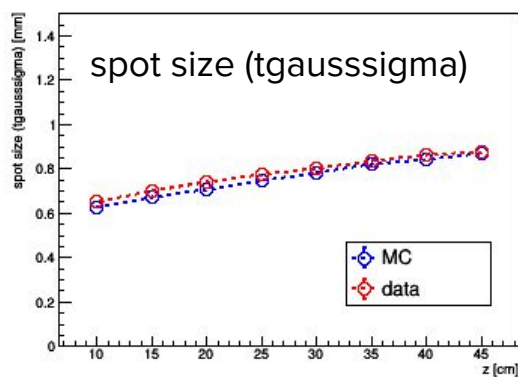
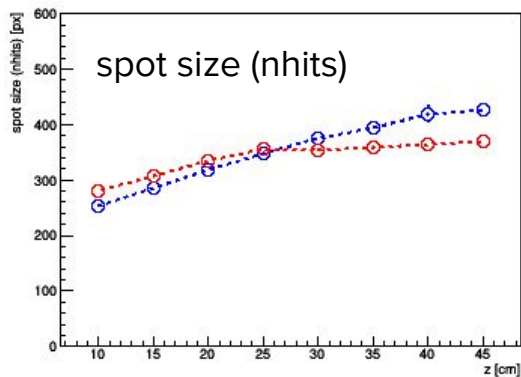
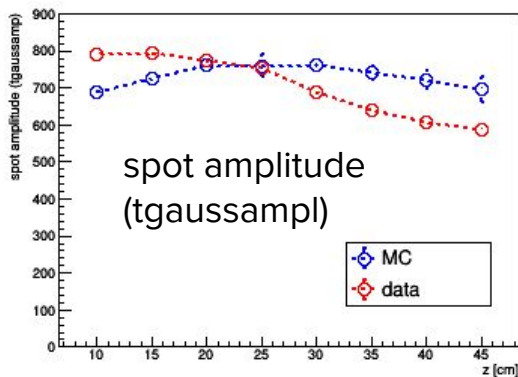
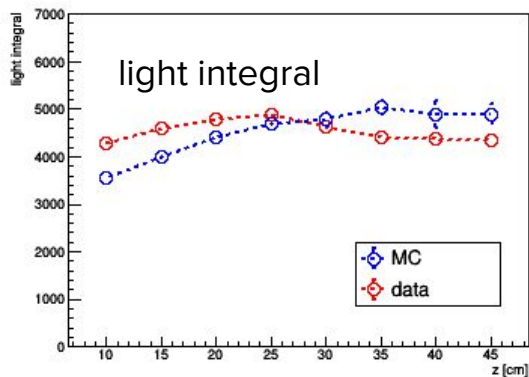
Comparison with ^{55}Fe data

- Config file parameters in digitization code to reproduce LIME data (April 21)
 - Distance from GEM scan: 10, 15, 20, 25, 30, 35, 40, 45 cm
 - GEM1_HV scan: 350, 386, 406, 420, 431, 440 V
 - GEM2_HV = 440 V
 - GEM3_HV = 440 V
 - $A = 1$ (free parameter of the model, to be fixed)
 - $\beta = 1e-5$
 - $\text{absorption}_l = 1 \text{ m}$
 - noise from pedestal run 4159
- Data and MC reconstructed and analyzed with the same code
 - reconstruction code by Emanuele, “autumn21” unstable branch
- all plots at: https://www.roma1.infn.it/~dimperig/CYGNO/reco/dataMC_55Fe/

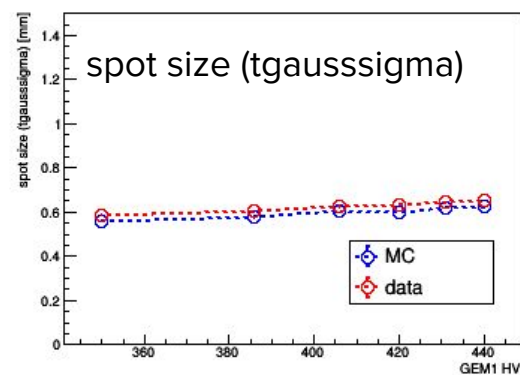
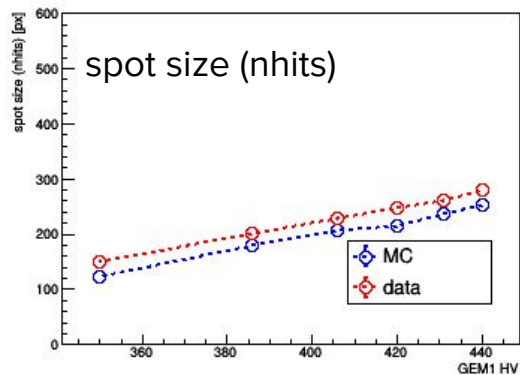
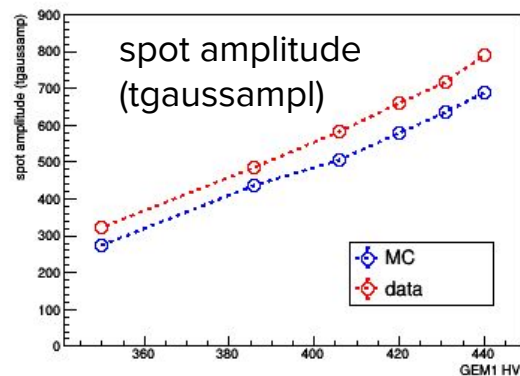
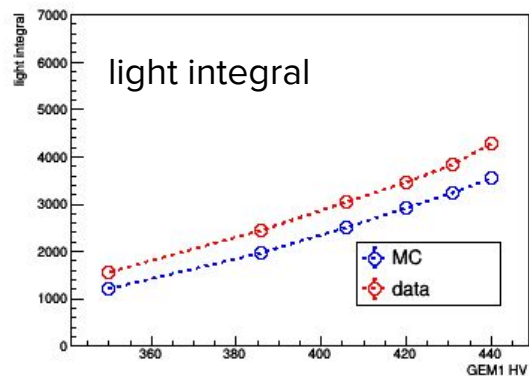
Selection

- Data:
 - center of the sensor: `abs(sc_xmean-1152)<250 && abs(sc_ymean-1152)<250`
 - light threshold: `sc_integral>600 && sc_integral<20000`
 - round spot: `sc_tgausssigma/sc_lgausssigma >0.6`
 - sc length: `sc_length<100`
- Monte Carlo:
 - center of the sensor: `abs(sc_xmean-1152)<250 && abs(sc_ymean-1152)<250`
 - light threshold: `sc_integral>600 && sc_integral<20000`
 - checked that for MC fake rate ~ 0 and efficiency 1

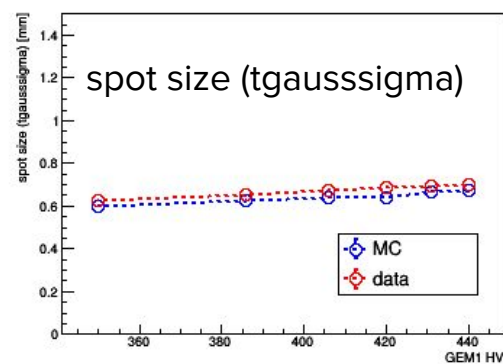
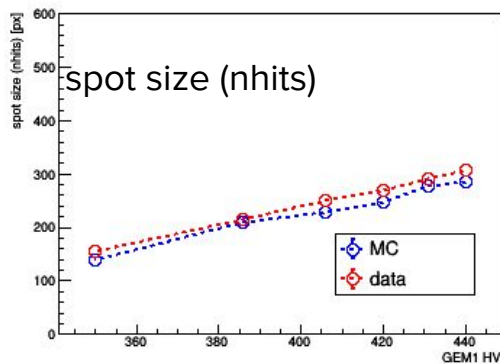
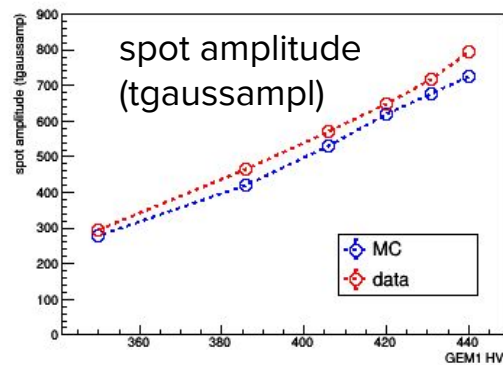
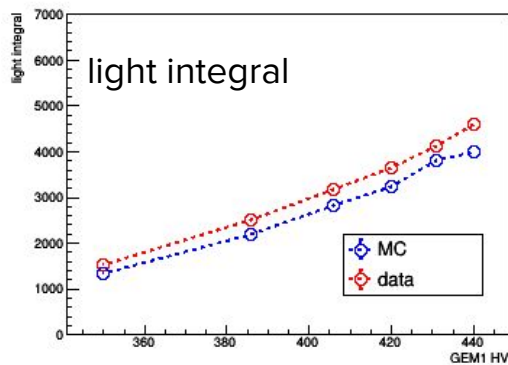
z scan, HV = 440 V



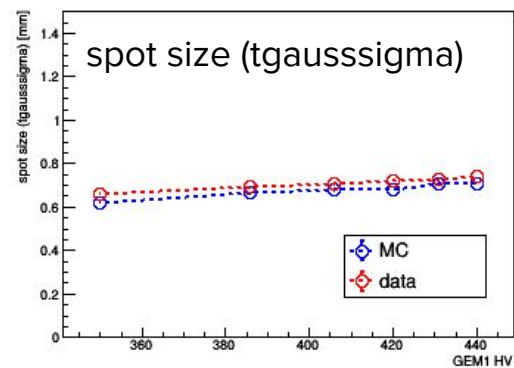
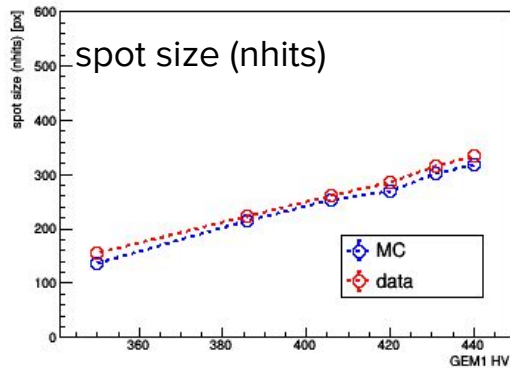
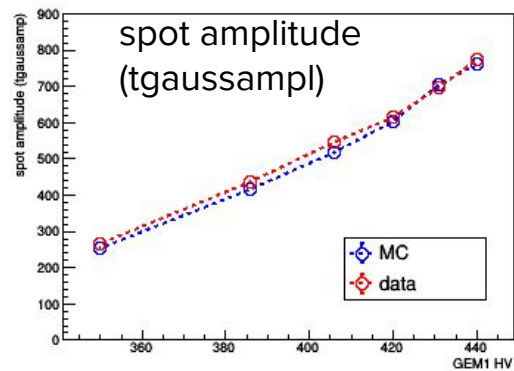
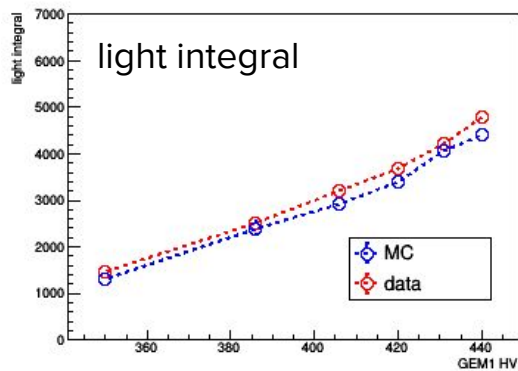
HV scan, $z = 10$ cm



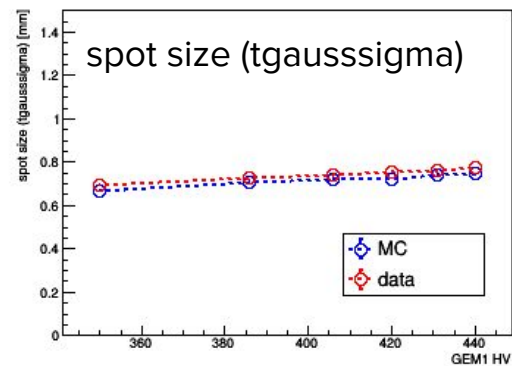
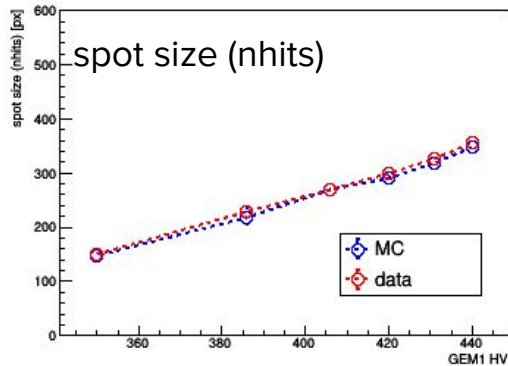
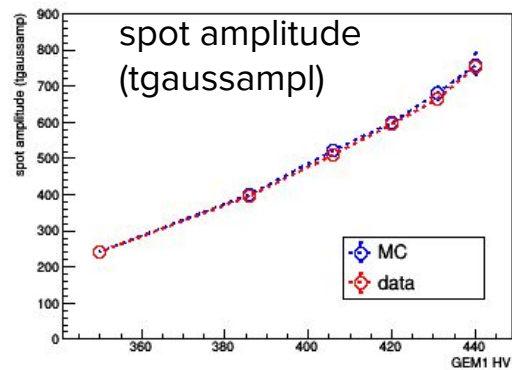
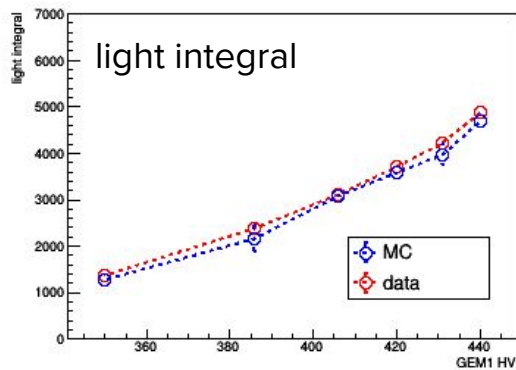
HV scan, $z = 15$ cm



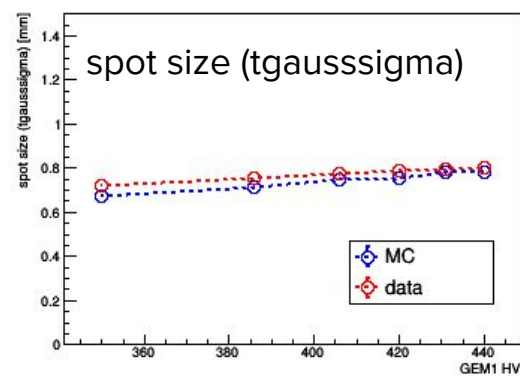
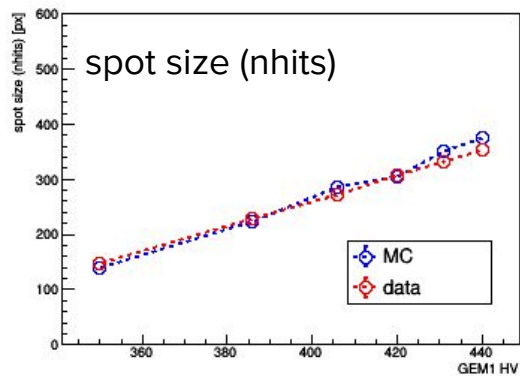
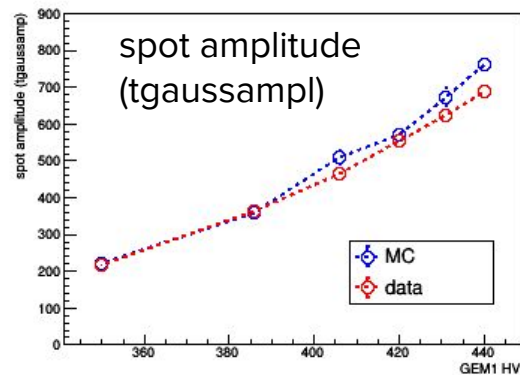
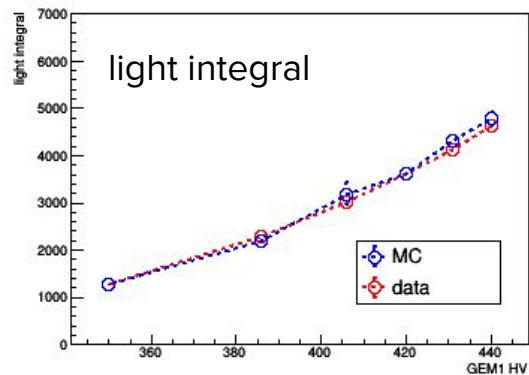
HV scan, $z = 20$ cm



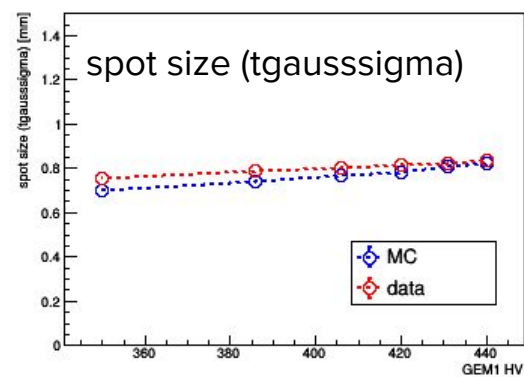
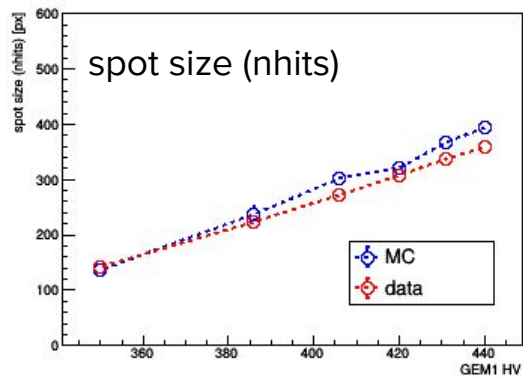
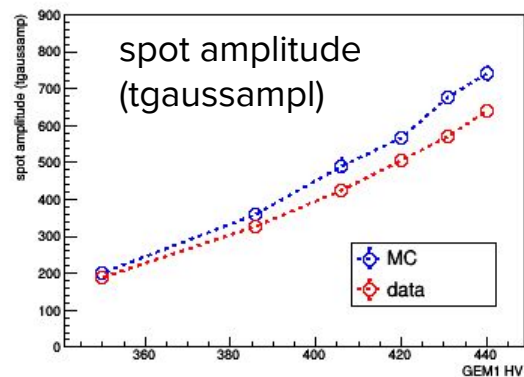
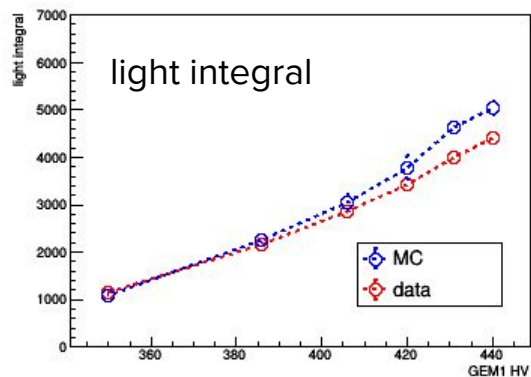
HV scan, $z = 25$ cm



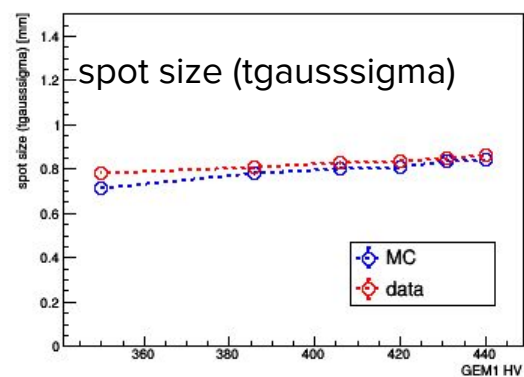
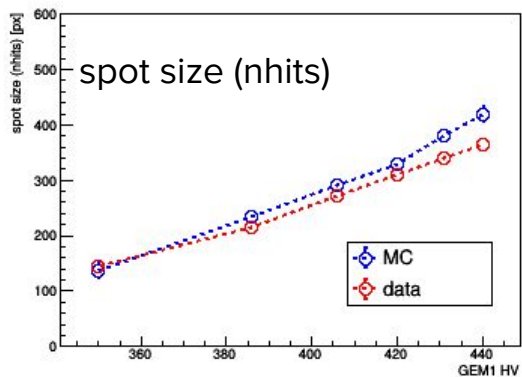
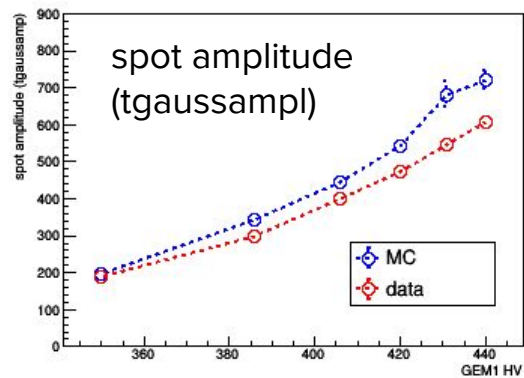
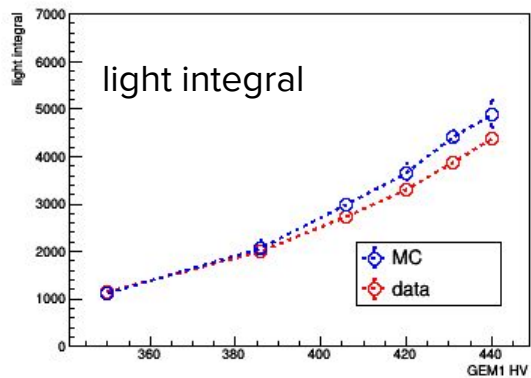
HV scan, $z = 30$ cm



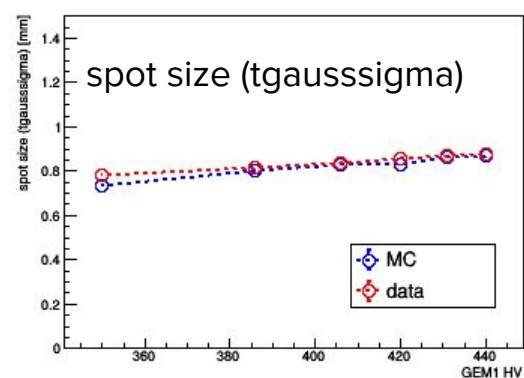
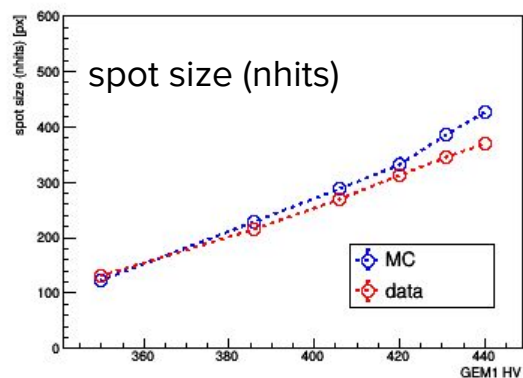
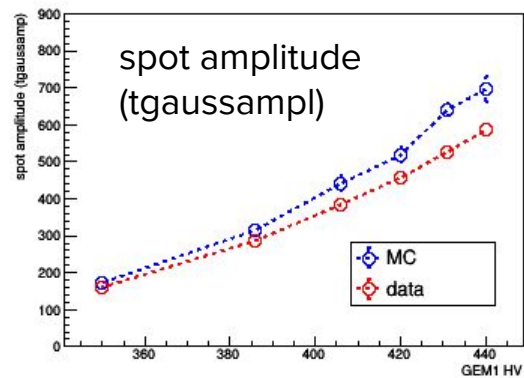
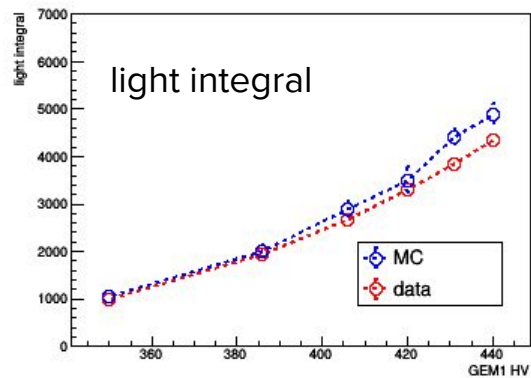
HV scan, $z = 35$ cm



HV scan, $z = 40$ cm



HV scan, $z = 45$ cm



Summary and to-do

- Check also other variables, possibly all the cluster properties saved in the reco files
- Tune simulation parameters in order to improve data-MC agreement
 - for example changing absorption length could improve z-dependence..
- Data-MC comparisons for other LIME datasets available with different sources