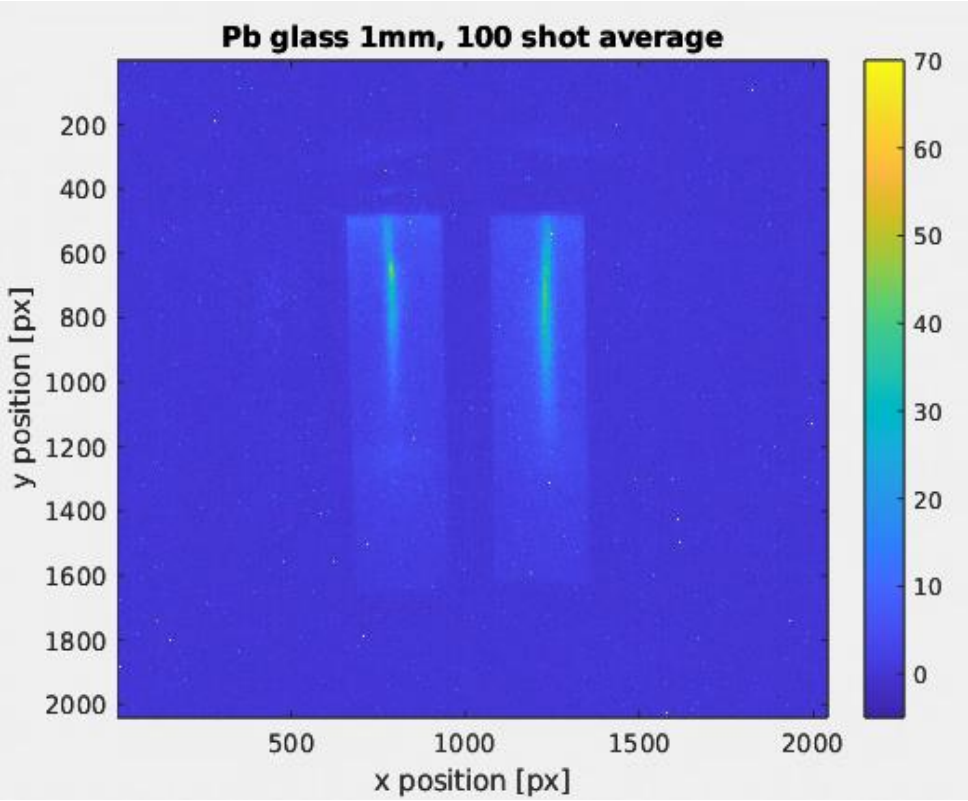
# E320 data analysis meeting

Sheldon Rego

9/24/24

# Overview

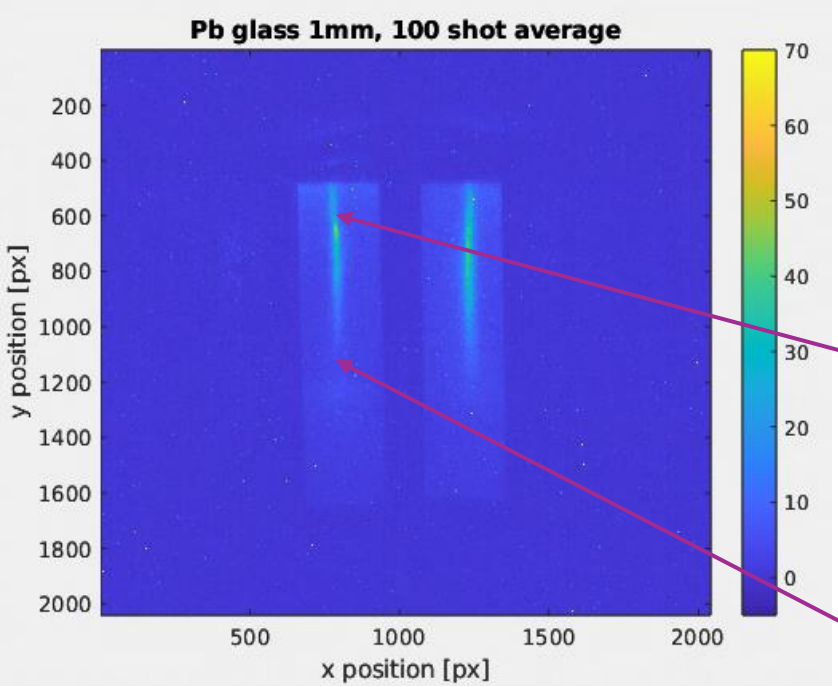
- Analyzed LYSO screen images taken during May 2024 E320 run
- Subtracted the average of 100 background images taken at the end
- Subtracted a polyfit on the left/right sides of the LYSO screen
- Calibrated the conversion from y axis to y axis in mm and to energy in GeV
- Converted counts/pixel to counts/mm and to counts/GeV
- Calibrated count to positron number with GEANT4 simulations

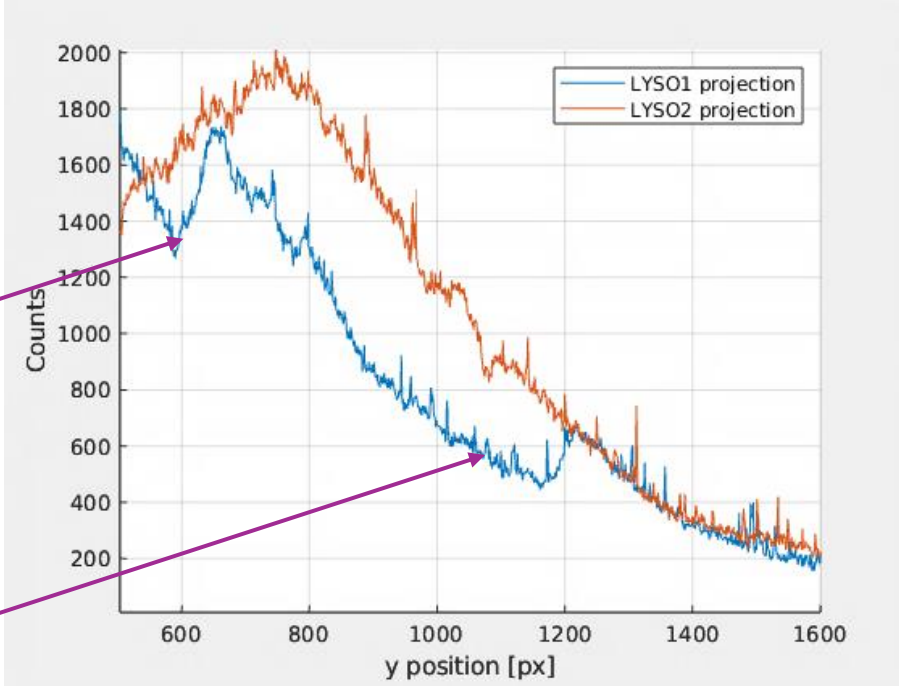



dipole = 24 GeV, quads = 6 GeV

# LYSO1 defect

Positrons appear to be consistently under-detected on certain pixels of LYSO1 – only LYSO2 is used for the rest of the analysis,



# Outline

Section 1: Positron signal

- Experiment
- Simulation
- Calibration

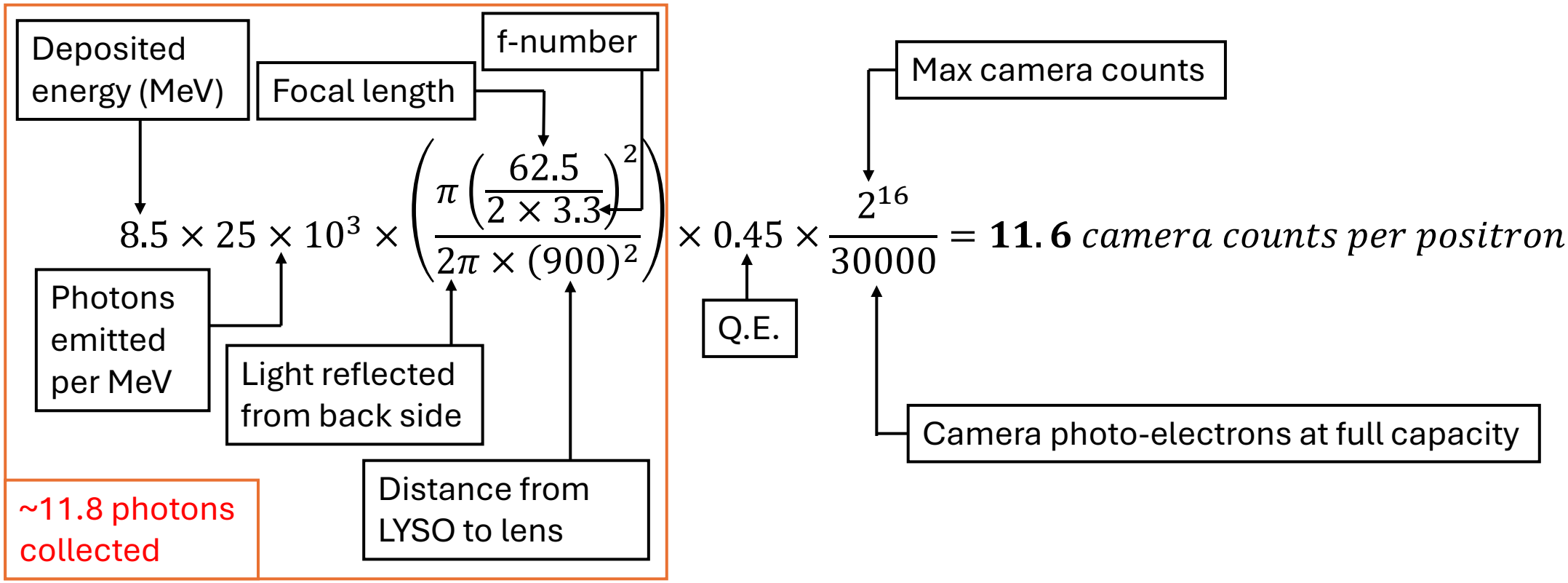
Section 2: Background subtraction

- Constant background
- Screen-induced background
- Shot averaging

# Section 1: Positron signal

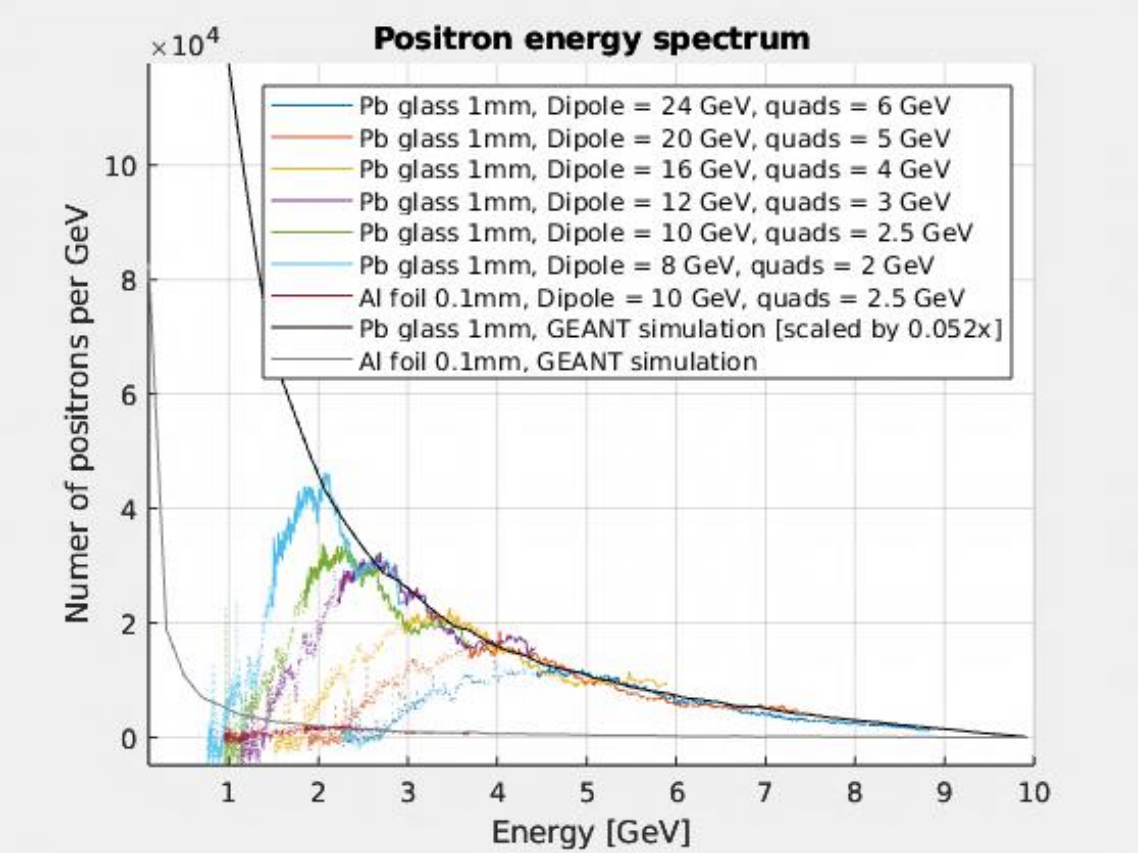
# Positron count to camera count estimation

Assume positron deposits 8.5 MeV on second LYSO screen (Felipe's simulation) w/ 2x2x4 $mm^3$ pixel. Calibration factor :



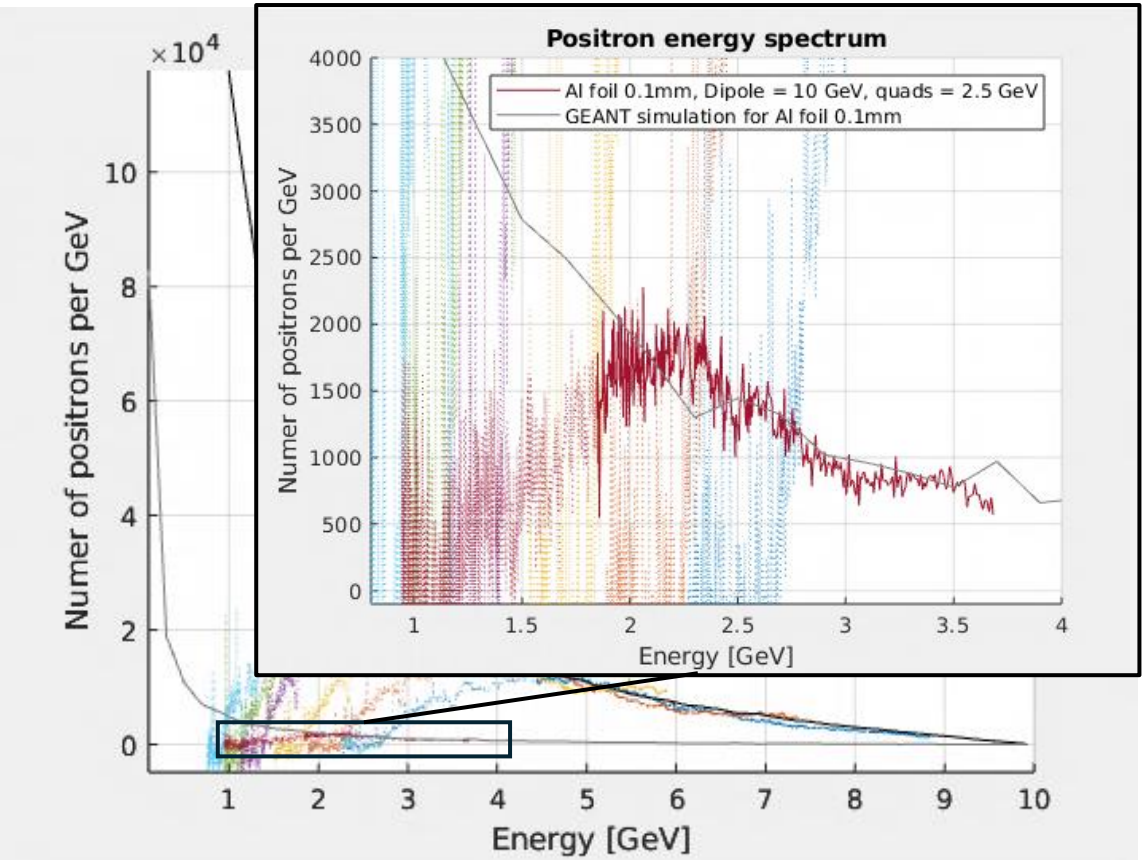
# Experiment vs Robert's GEANT4 simulation

- Positron spectrum for 1mm lead glass and 0.1mm Al foil compared to simulation
- Dotted lines represent approximate vertical cutoff for dipole exit window
- Good match for general shape
- Pb glass simulation result scaled linearly



# Experiment vs Robert's GEANT4 simulation

- Positron spectrum for 1mm lead glass and 0.1mm Al foil compared to simulation
- Dotted lines represent approximate vertical cutoff for dipole exit window
- Good match for general shape
- Al foil data calibrated with simulation in 2.5 GeV to 3.5 GeV range: **14.2** counts per positron

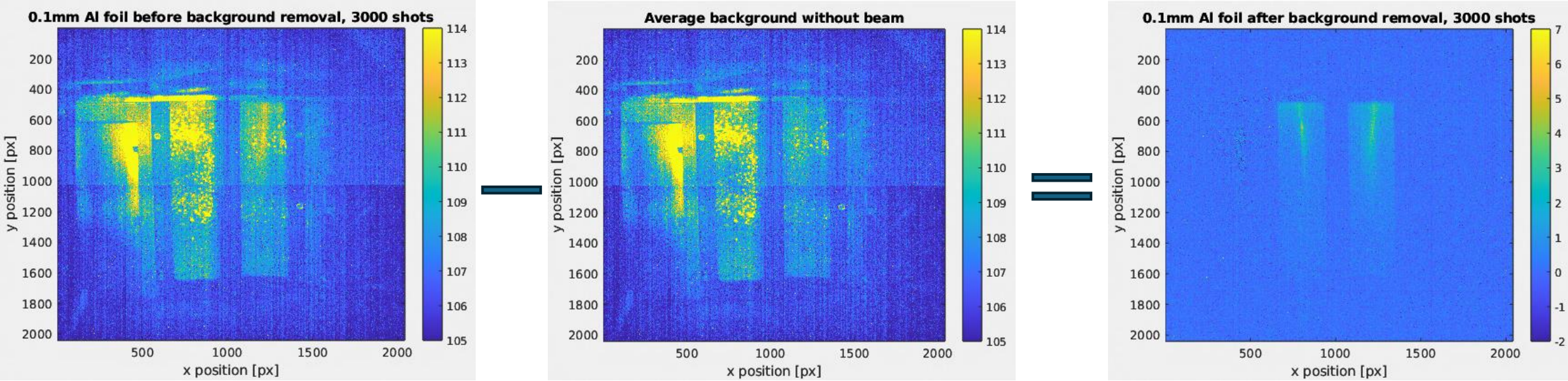


# Section 2: Background subtraction

# Background subtraction

Three kinds of background:

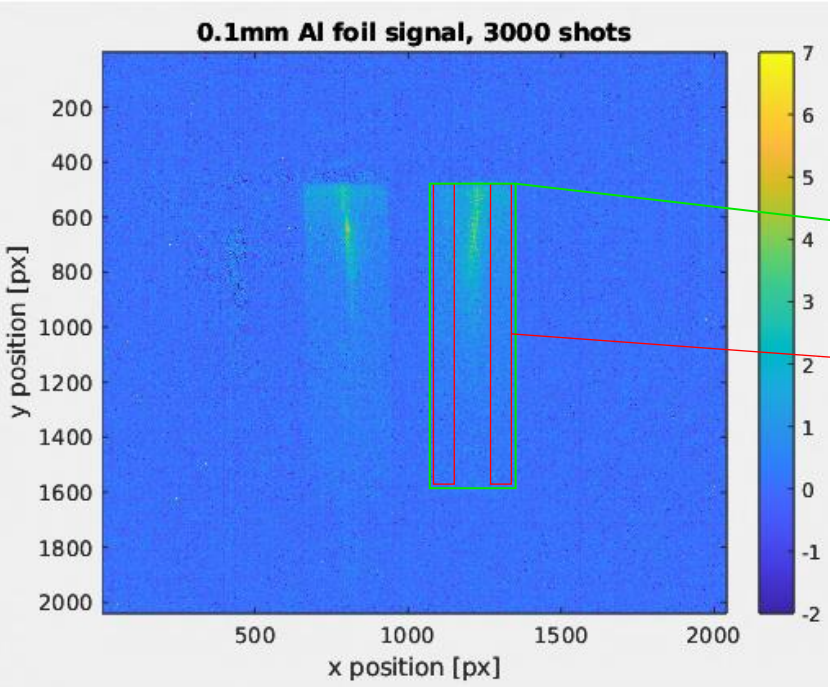
1. Constant background: subtract image recorded without beam

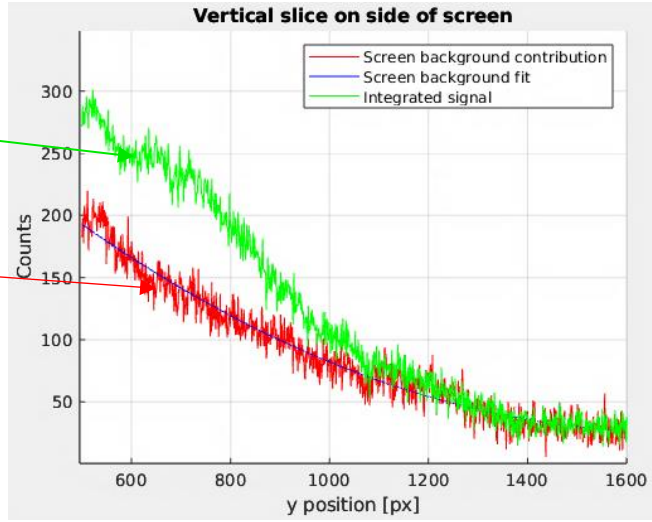


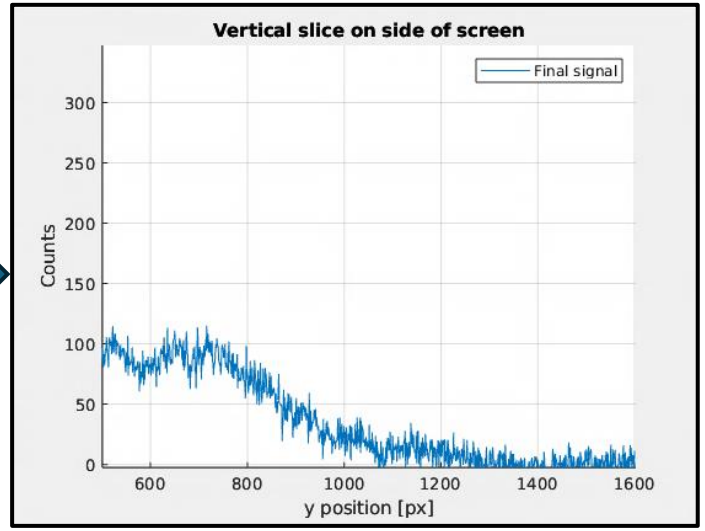
# Background subtraction

Three kinds of background:

2. LYSO Screen background (while beam is present): polynomial fit section of screen where there is no signal, then subtract from signal



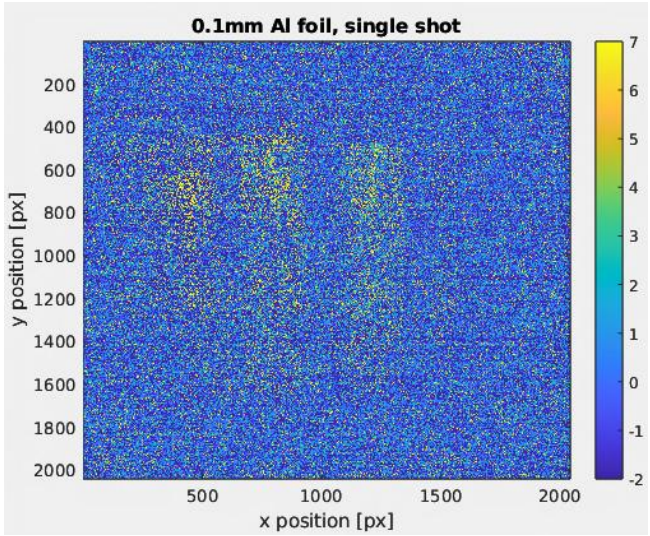



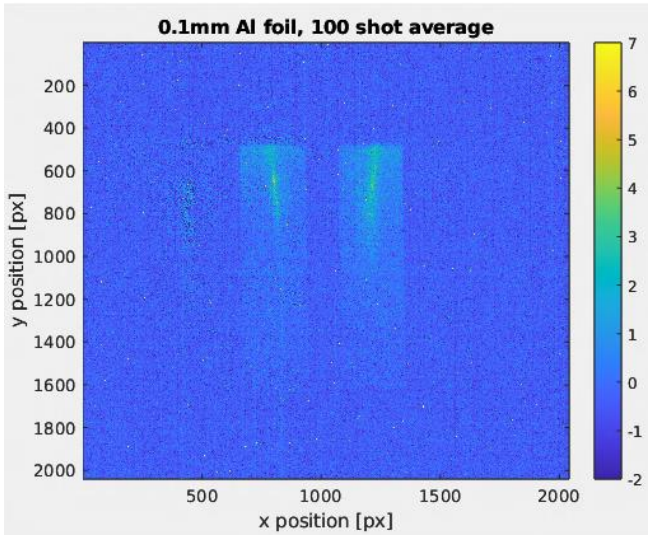



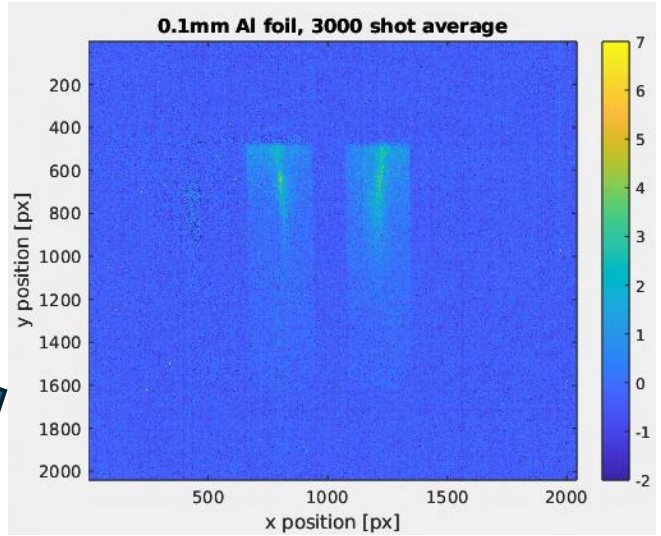
# Background subtraction

Three kinds of background:

3. Random noise: reduce by averaging over shots

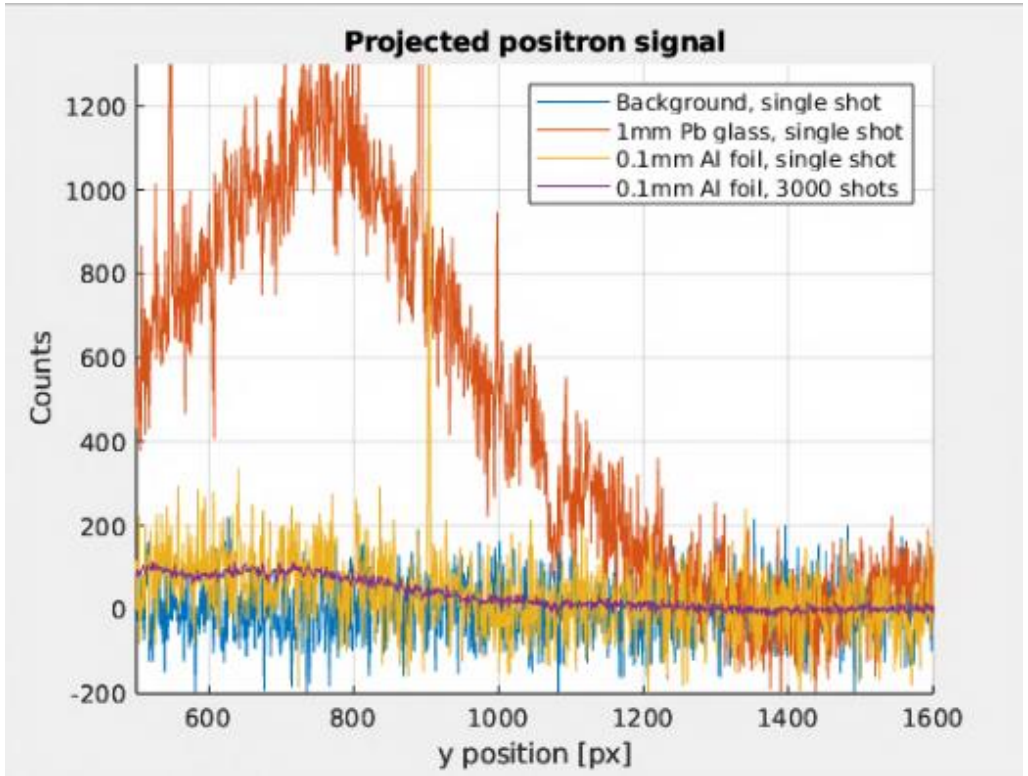


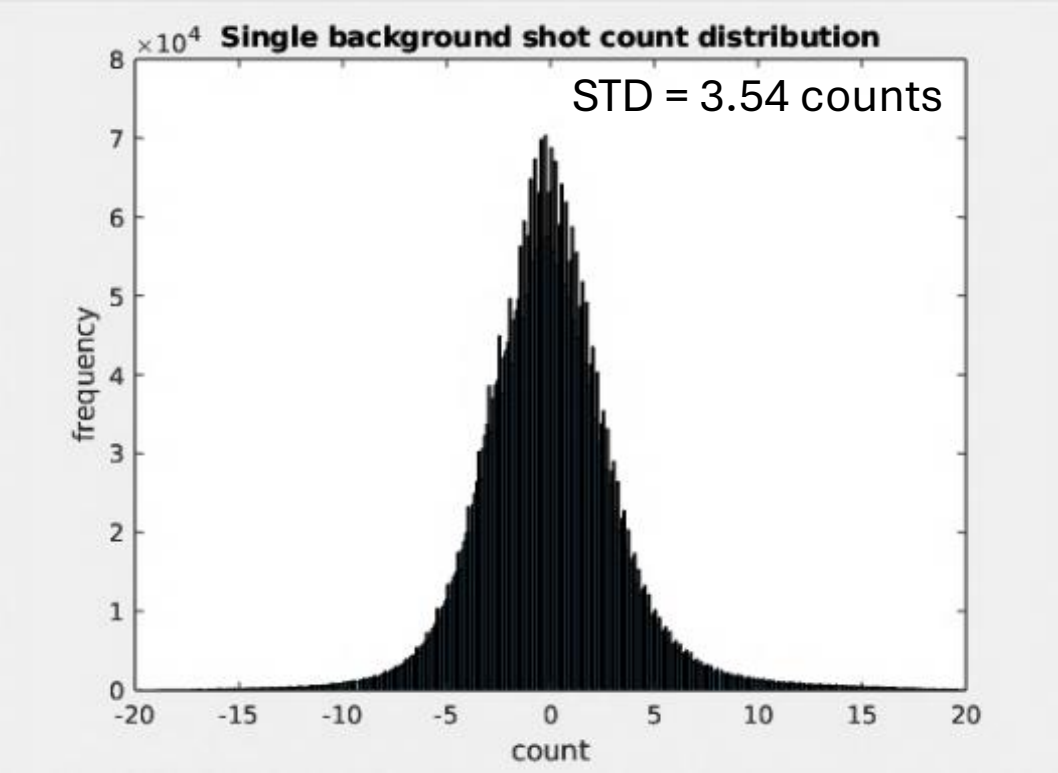



# Background subtraction

Aluminum foil signal is faintly visible even with a single shot after all other background subtractions

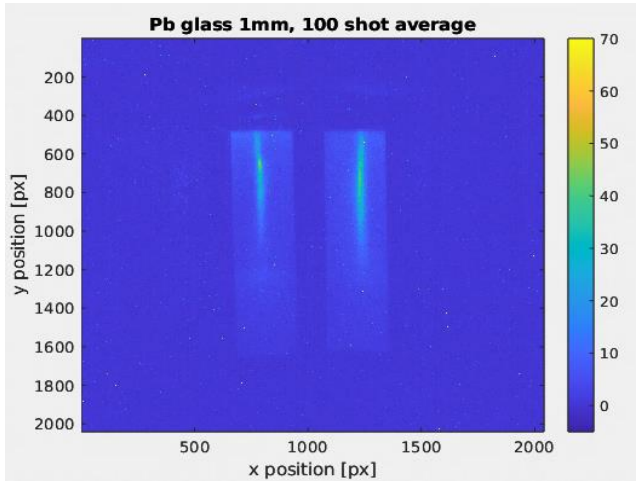


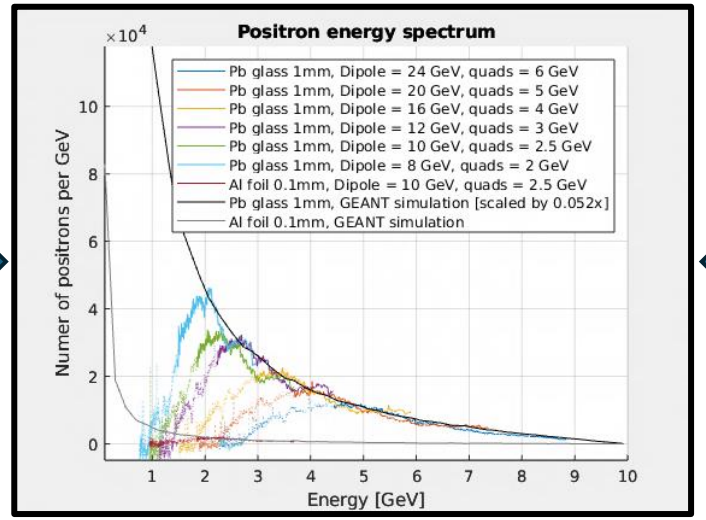
# Summary

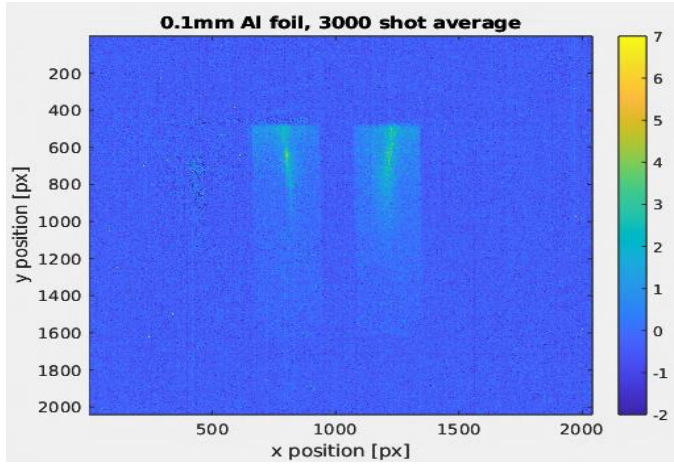
May 2024 setup sensitivity:

- Estimate:11.6 counts per positron
- Experimental Calibration: 14.2 counts per positron




dipole = 24 GeV, quads = 6 GeV




dipole = 10 GeV, quads = 2.5 GeV

# Thank you

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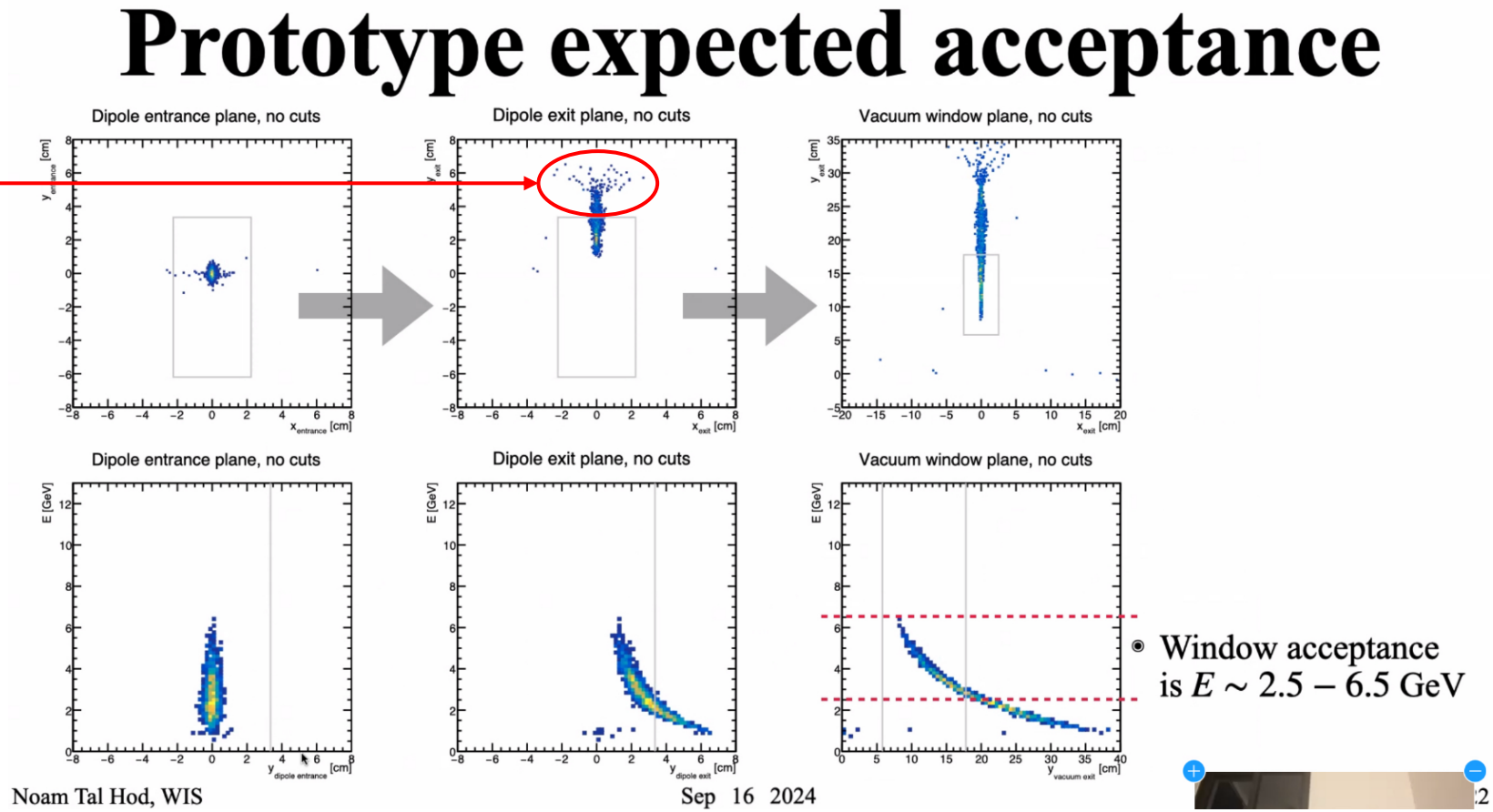
# Backup

# Vertical cutoffs

Some positrons are blocked by the top of the dipole exit plane window



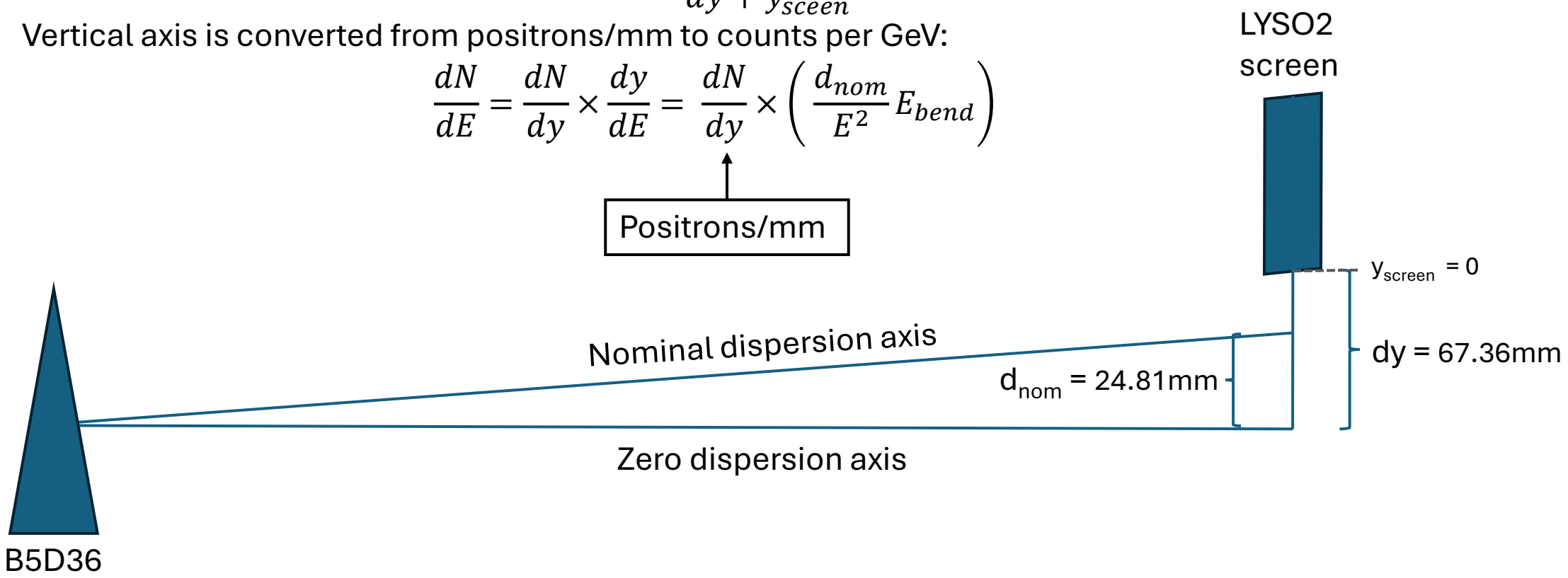
# Energy calibration

- Horizontal axis is converted from px to mm, then from mm to GeV:

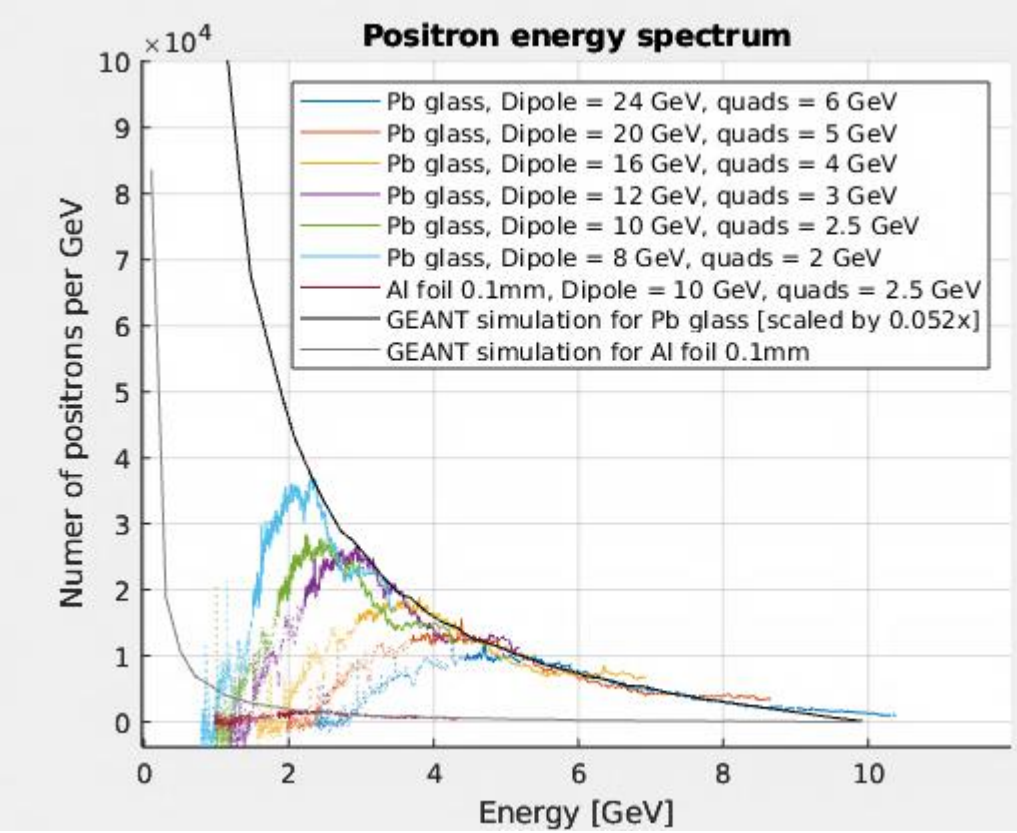
$$E(y_{screen}) = \frac{d_{nom}}{dy + y_{sceen}} E_{bend}$$

- Vertical axis is converted from positrons/mm to counts per GeV:

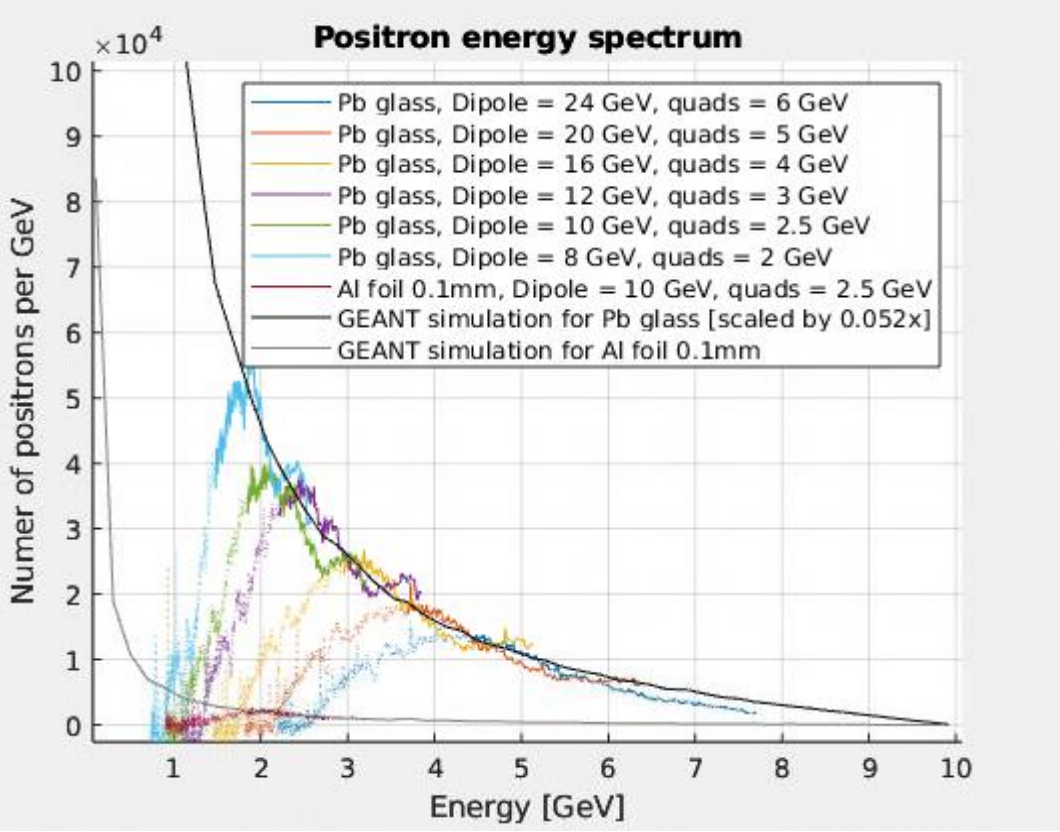
$$\frac{dN}{dE} = \frac{dN}{dy} \times \frac{dy}{dE} = \frac{dN}{dy} \times \left( \frac{d_{nom}}{E^2} E_{bend} \right)$$



# Sensitivity to energy calibration




dy – 1 cm, calibration = 14.10 counts/positron




dy + 1 cm, calibration = 14.09 counts/positron

Regular = 13.6 counts/positron

# Screen-induced backgrounds