Energy Calibration with ML

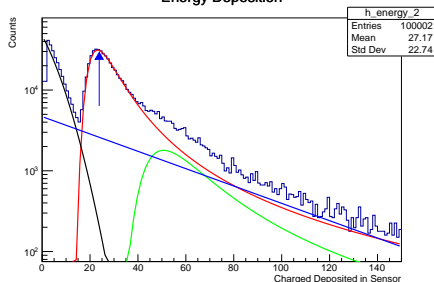Jason Bryslawskyj

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Energy Calibration

- Sensors in EmCal calibrated by looking for minimum ionizing particles (MIPs)
- Charge deposited by MIPs follows Landau distributions:

$$\text{Signal} = \text{Landau}_0(\mu_0, \sigma_0) + \text{Landau}_1(\mu_0, \sigma_0)$$

- Shown as Red, Green
- Background is composed of a Gaussian pedestal (Black)
  + high Energy particles (exp,blue), which are signal for analysis, but BG for calibration
- Regression complicated by zero-supression, which cuts a square notch in a random location between 0 and 10
- Challenge: Fit 200,000 sensors, all with differently shaped signal and background
- Find Most Probable Value (μ) of MIP Landau (Blue Arrow)

Example of charge disposited in single sensor

Energy Deposition

h_energy_2	
Entries	100002
Mean	27.17
Std Dev	22.74

Counts

Charged Deposited in Sensor

Feature Selection

- Naively fitting using regression with entire underlying functional form fails
- Due to the large number of fit parameters
- Can fit after seeding using features discribing histograms shape
- Find following features:
- Local Minima (Green) and Maxima (Blue)
- Locations where $\frac{dy}{dx} = 0$ (Red)
- Locations where $\frac{d^2y}{dx^2} = 0$ (Black)

Example of charge disposited in single sensor