

# Spring 2019 Nonlinearity calibration



**Calorimetry Group Meeting**  
**31/Oct/2019**

# Nonlinearity Calibration

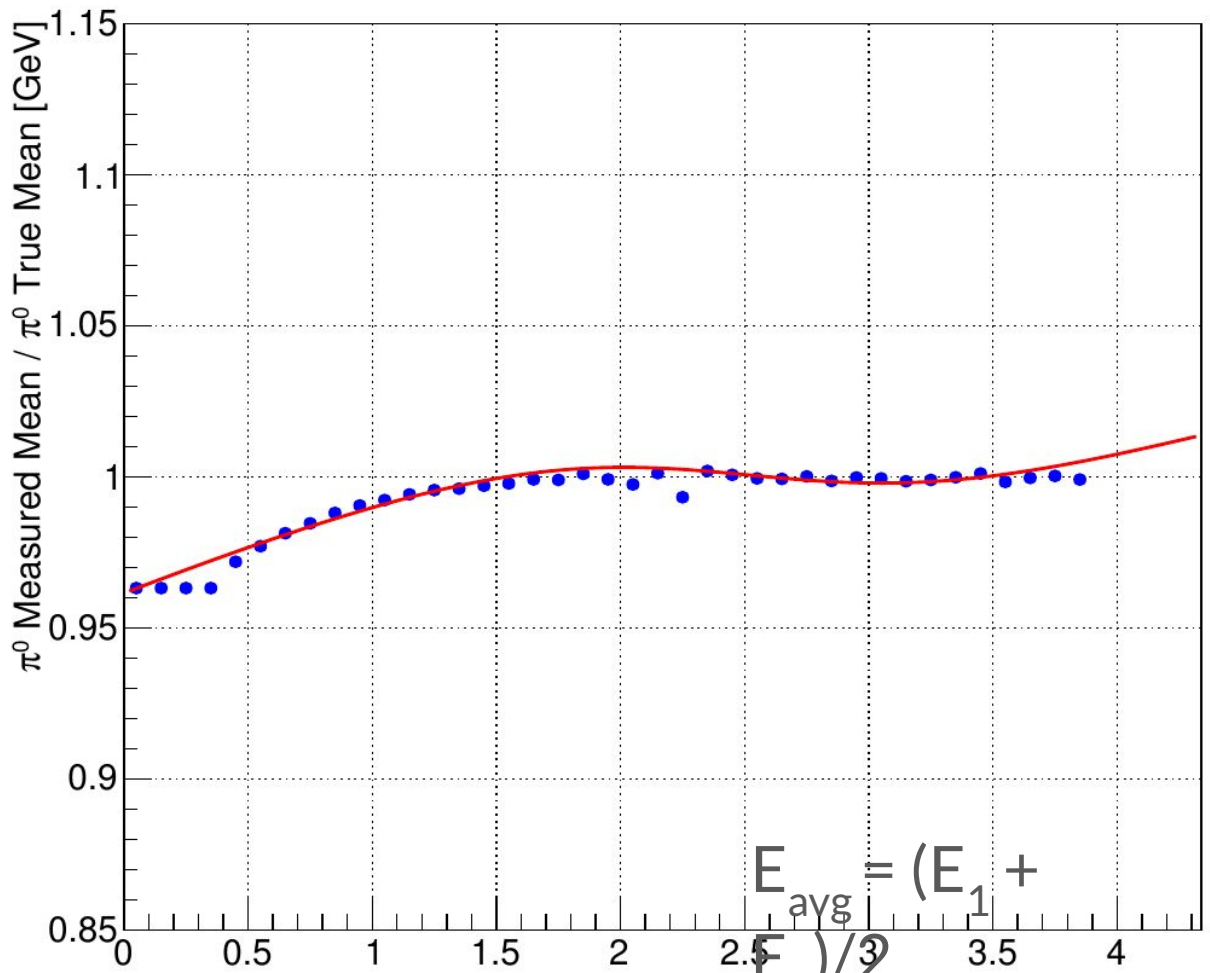
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- Even after gain calibration, there exist a nonlinearity in measuring Energy of the photons in the BCAL
- This is due to many factors but mostly due to SiPM saturation
- Elton back in early 2018 implemented a correction for the SiPM saturation
- However it did not completely remove the nonlinearity in the measurement of energy

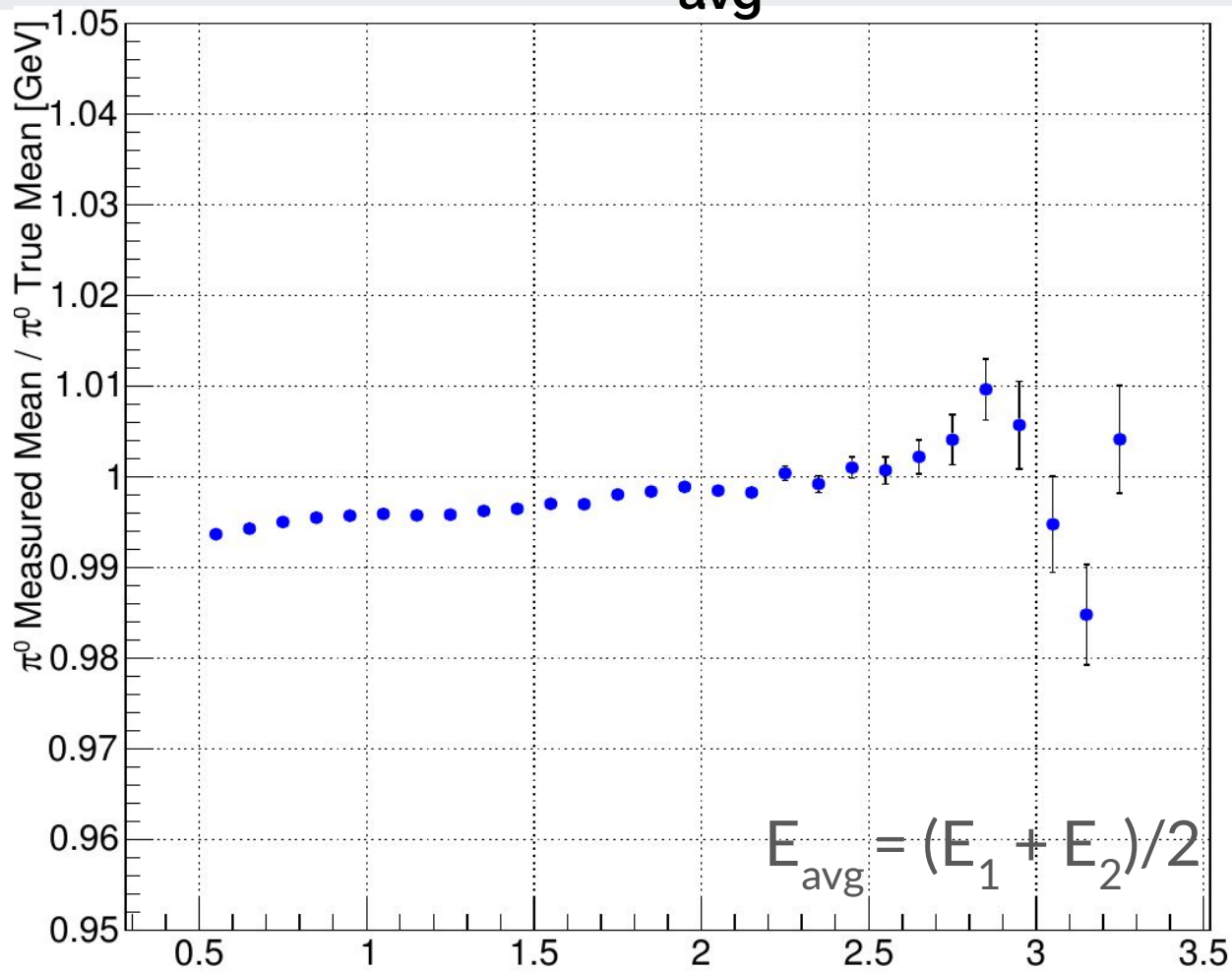
# Procedure

- Once when the gains are calibrated, We look into symmetric  $\pi^0$  decays (where both the photons have same energy ( $|E_{\text{photon1}} - E_{\text{photon2}}| \leq 100 \text{ MeV}$ ))
- We then look into the  $\pi^0$  mass as a function of average energy ( $E_{\text{avg}} = (E_1 + E_2)/2$ )
- We fit the nonlinear function with 10 parameters to fit the nonlinearity. 
$$[0] - [1]e^{-[2]x+[3]} - \frac{[4]}{[5] + [6]e^{-[7]x+[8]}}$$
- Because of the kinematic we run out of statistics in the higher energy ( $E_{\text{photon}} > 2.5 \text{ GeV}$ )

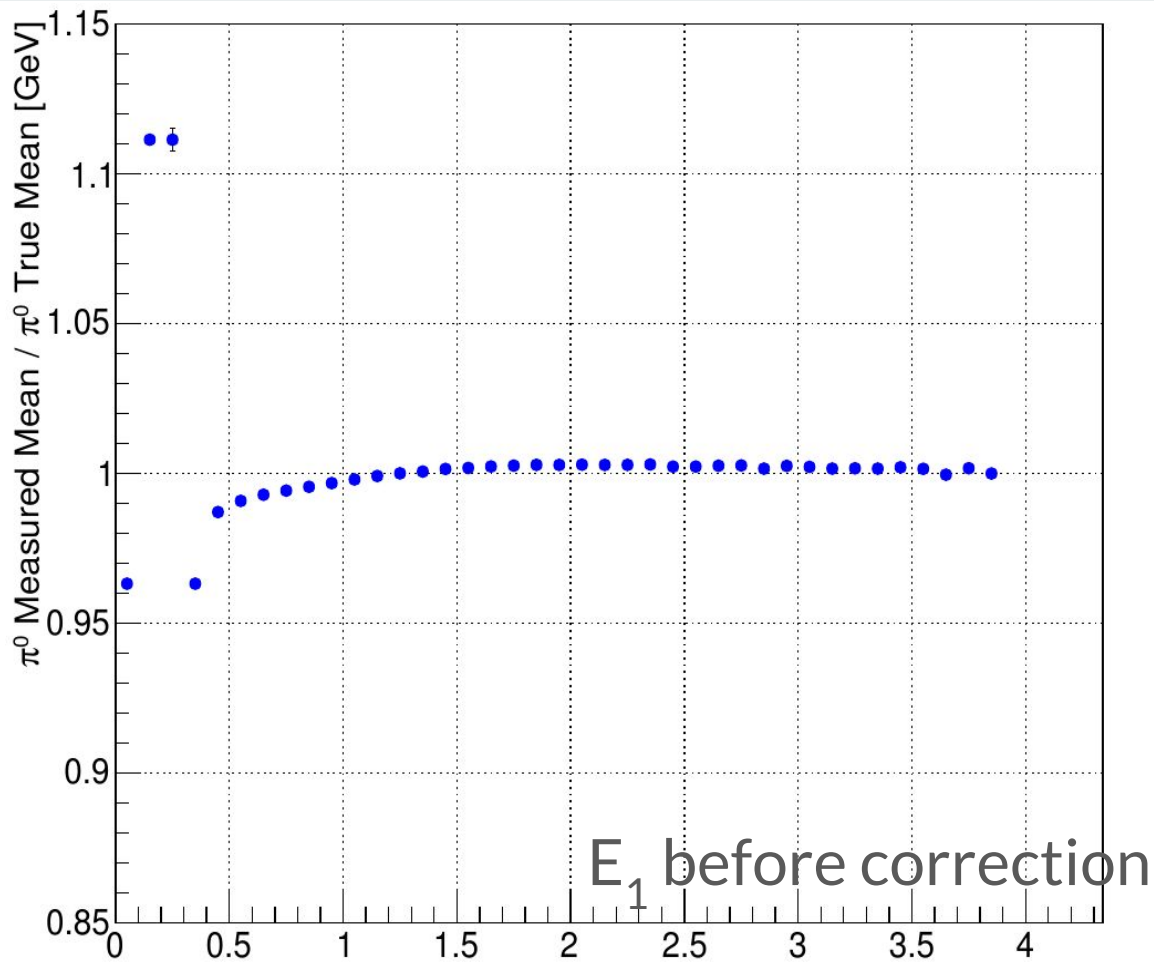
# $\pi^0$ mass as a function of $E_{\text{avg}}$ before correction ( $E > 0.4$ GeV)



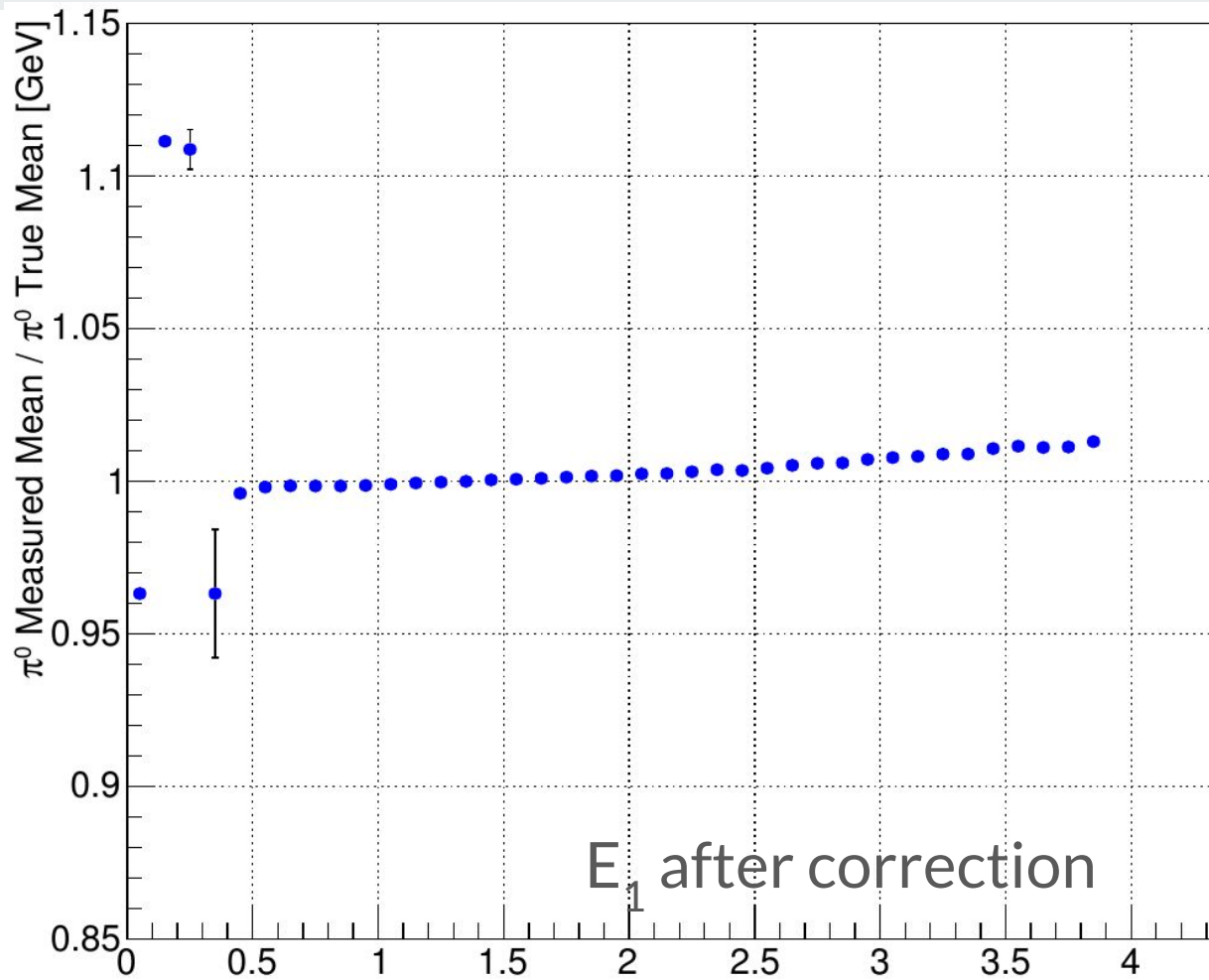
# $\pi^0$ mass as a function of $E_{\text{avg}}$ after correction



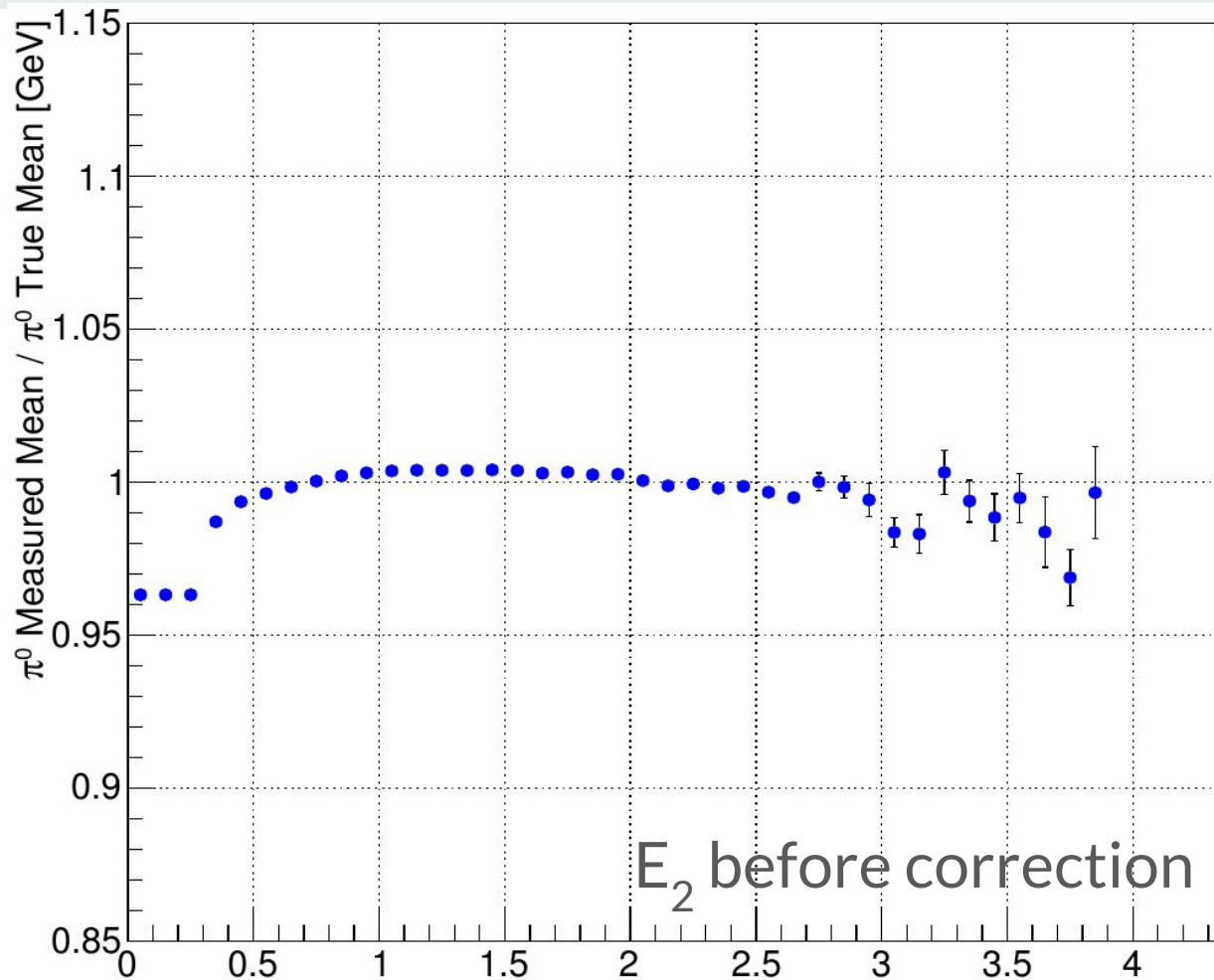
# $\pi^0$ mass as a function of $E_1$ before correction



# $\pi^0$ mass as a function of $E_1$ after correction

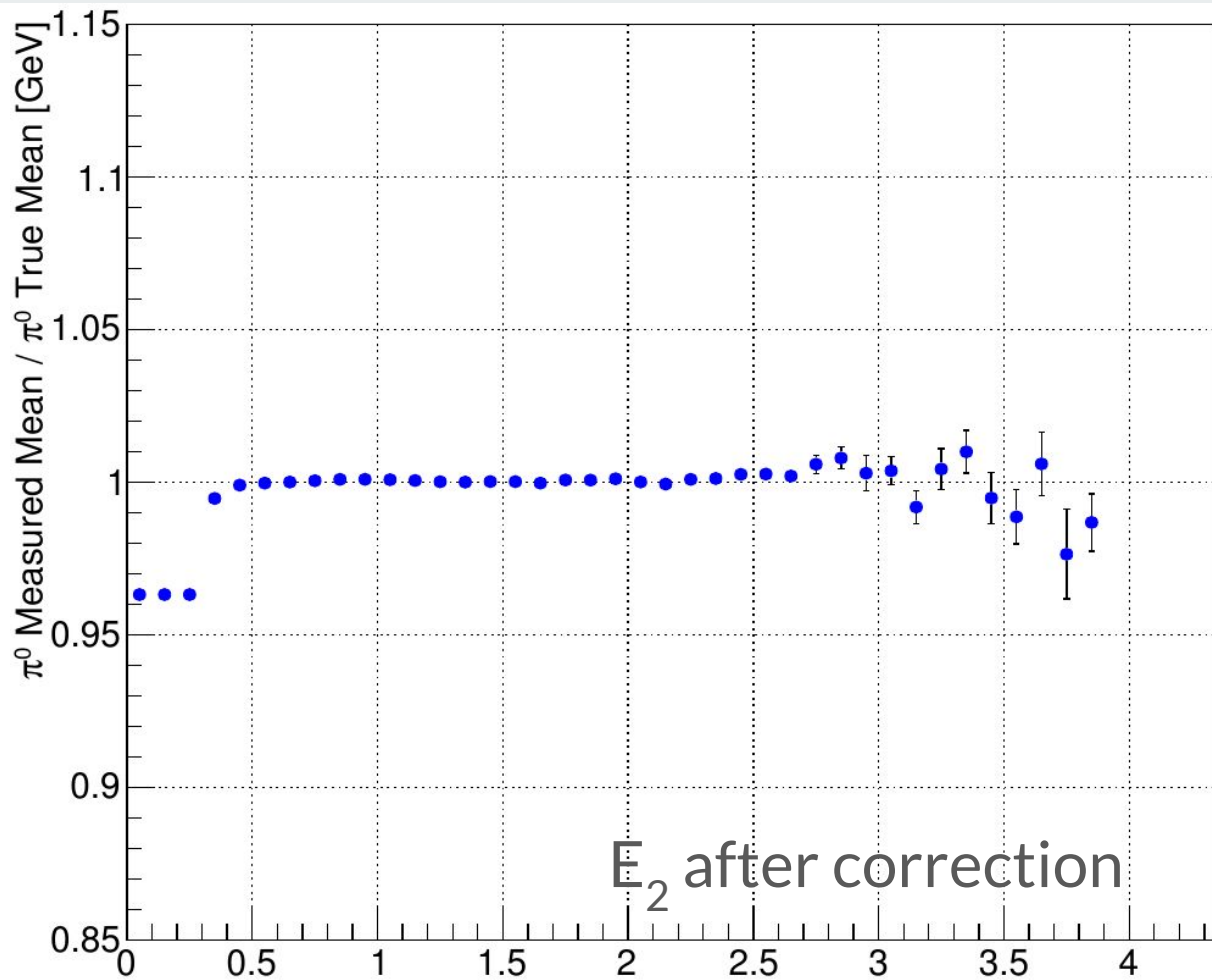


# $\pi^0$ mass as a function of $E_2$ before correction





# $\pi^0$ mass as a function of $E_2$ after correction



# Extrapolation of $E_1$ after correction upto 12GeV

