# 5D Calorimetry

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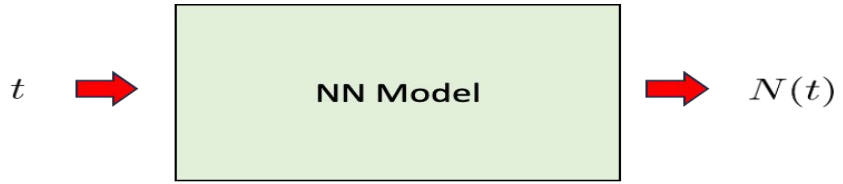
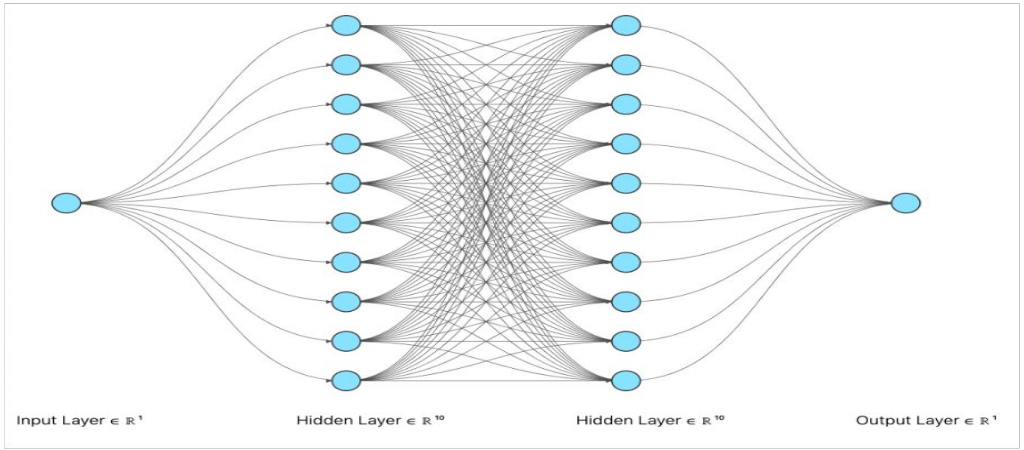
# Work in Progress

- Using fully connected Neural network for finding the fit for time distribution
- Finding best fit for Time distribution based on the known distributions
- Correction the energy for the isolated slow neutrons in the shower.

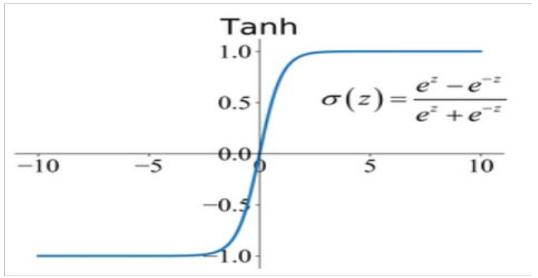
# Fully Connected Neural Network




$N(t)$= No. of events




activation function = $Tanh$



# Implementations details

- Framework :pytorch
- Number of epochs :30,000
- Time: 29 sec ( I ran it on google colab on A100 gpu)
- Optimizer : SGD (stochastic gradient descent)
- Trained with 20% noise to avoid overfitting with mean = 0 and standard deviation = 0.2

# Neural Network results (Pi - events)

- Selecting pi- events which meet the criteria
- Cuts on the cell Level and pion level

Celltime != 0 and Cell Reco Energy  > 0.01

Reco energy for pion < 50 Gev

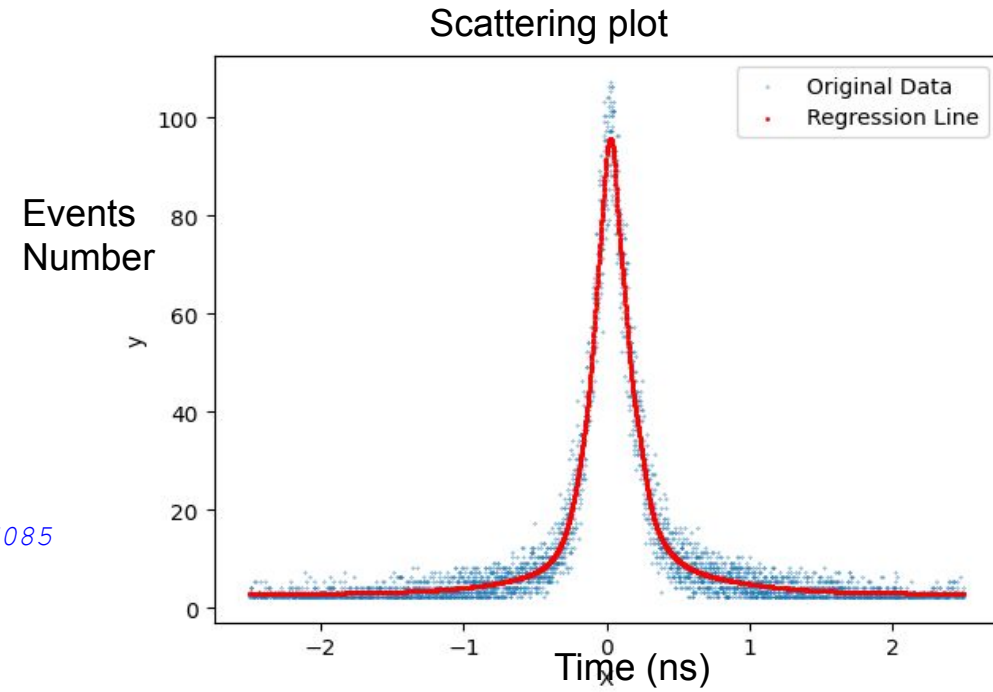
Time interval for training (-2.5, 2.5)

*Average of predicted X: 0.052579454680150635*

*Average of true X: 0.05260613537995921*

*Standard Deviation of predicted X: 0.6735857762177085*

*Standard Deviation true X: 0.671975397651194*



# Best Fit Using known distributions

Candidate distributions :

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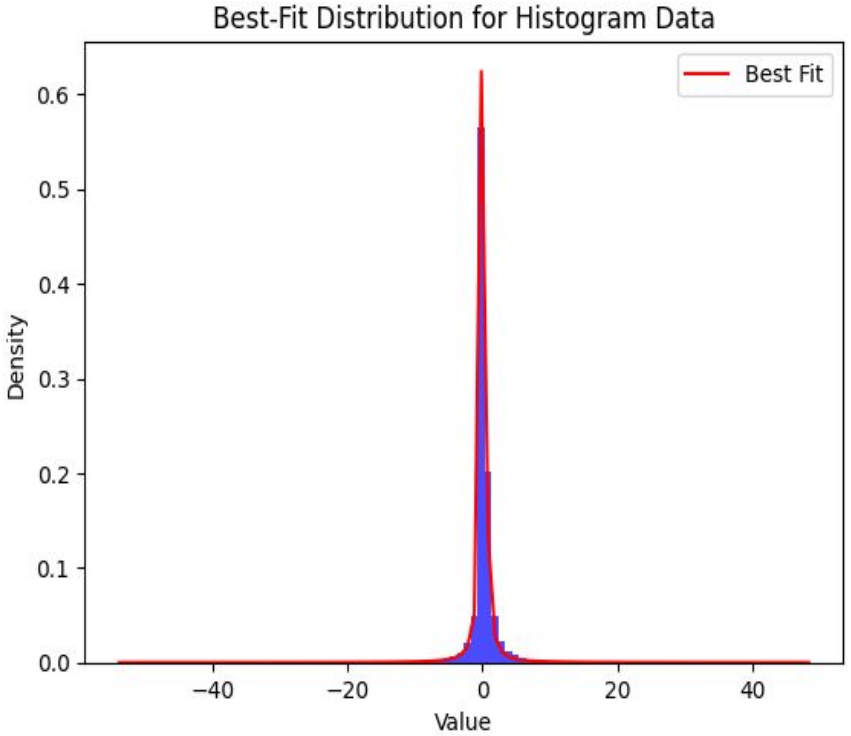
Normal distribution
Exponential distribution
Log-normal distribution
Weibull distribution
Cauchy distribution
Beta  distribution
```

**Best-Fit Distribution: cauchy**

**Best-Fit Parameters: (0.07882458870596636, 0.2788260703638121)**



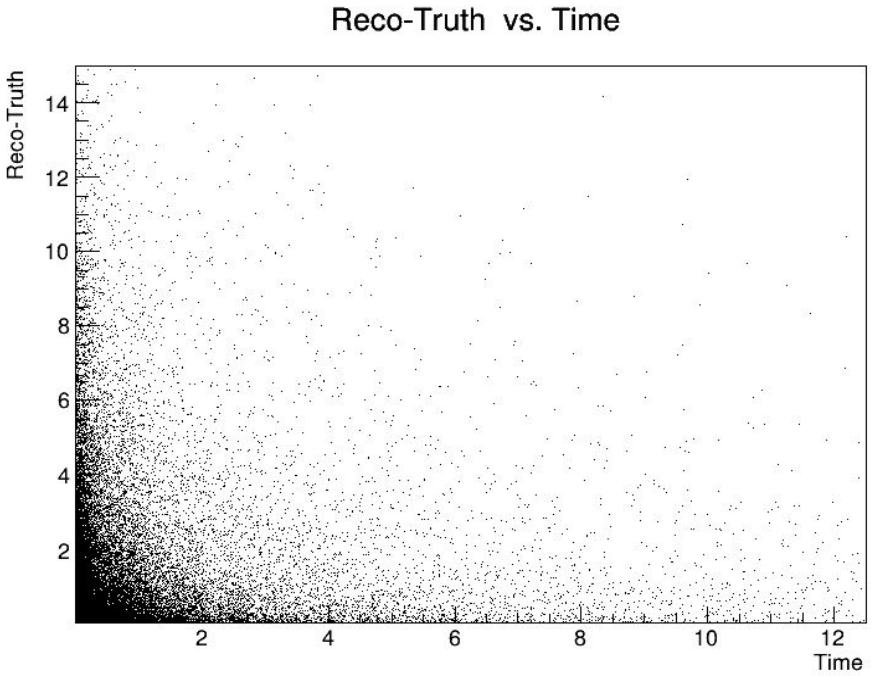
# Reoc_Truth in bins of Times

Cuts:

Cell level:

cellTime != 0
cell reco E> 0.001GeV
Pion level:

recoE<50 GeV
Truth E < 50 GeV



# Propose Idea

Training Neural Network for different Time distribution based on the energy level Cuts to discover correlation between Energy level and Time distribution.