Enhancing source detection for threat localisation
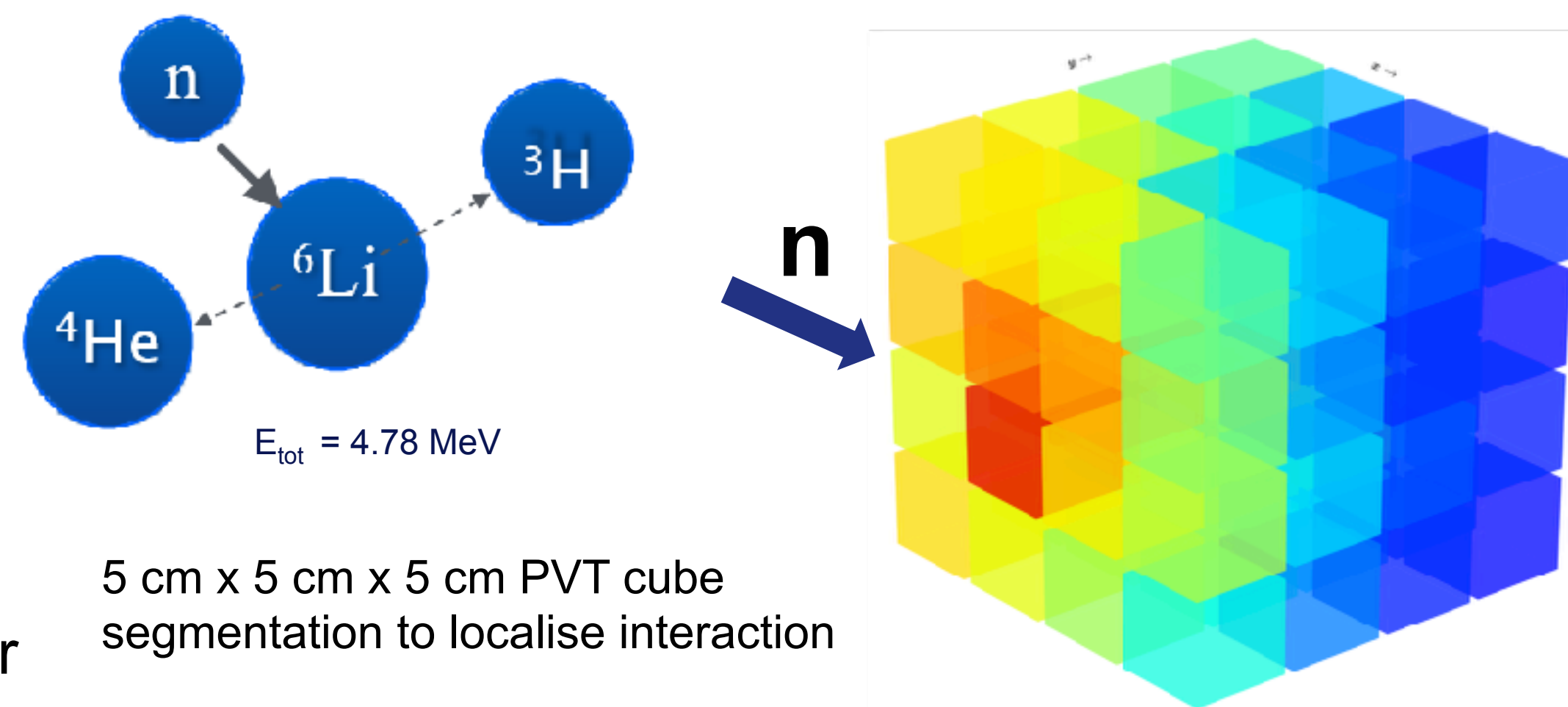
S. Bonomally, S. Ihantola and A.Vacheret

nFacet 3D neutron imager
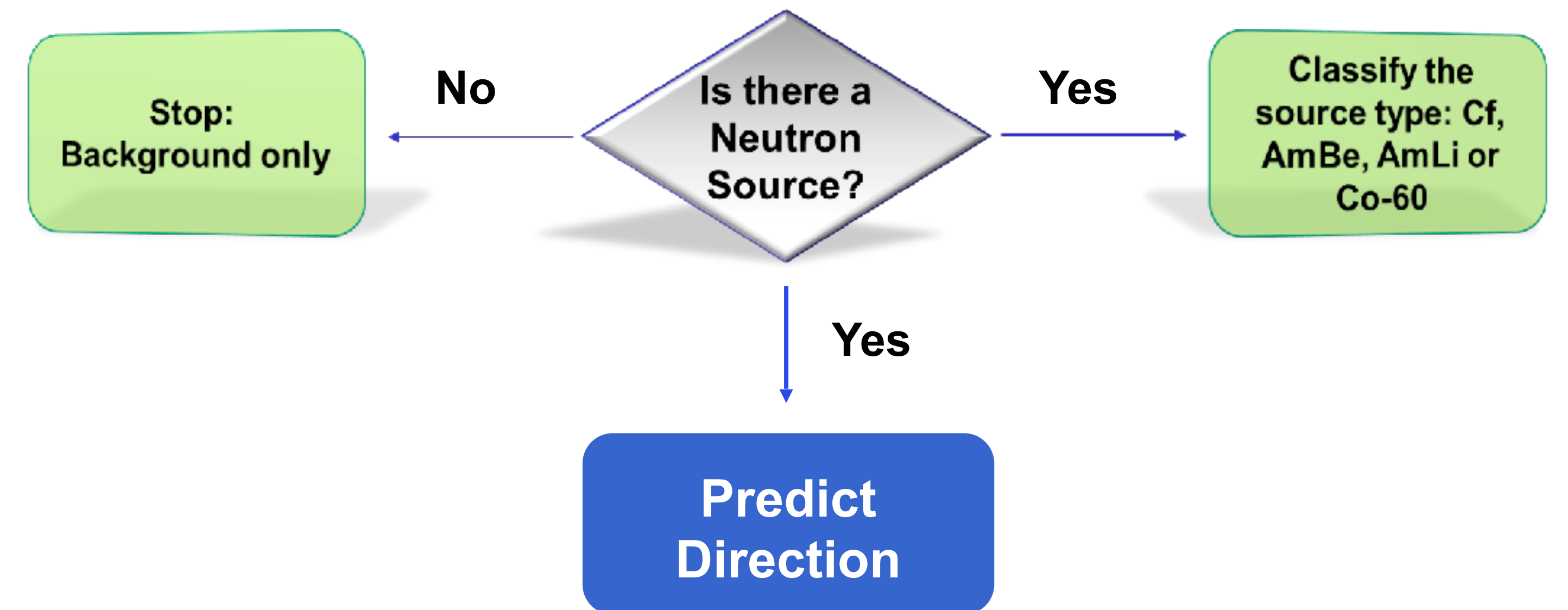

$E_{tot} = 4.78\ MeV$

Composite dual scintillator detector elements

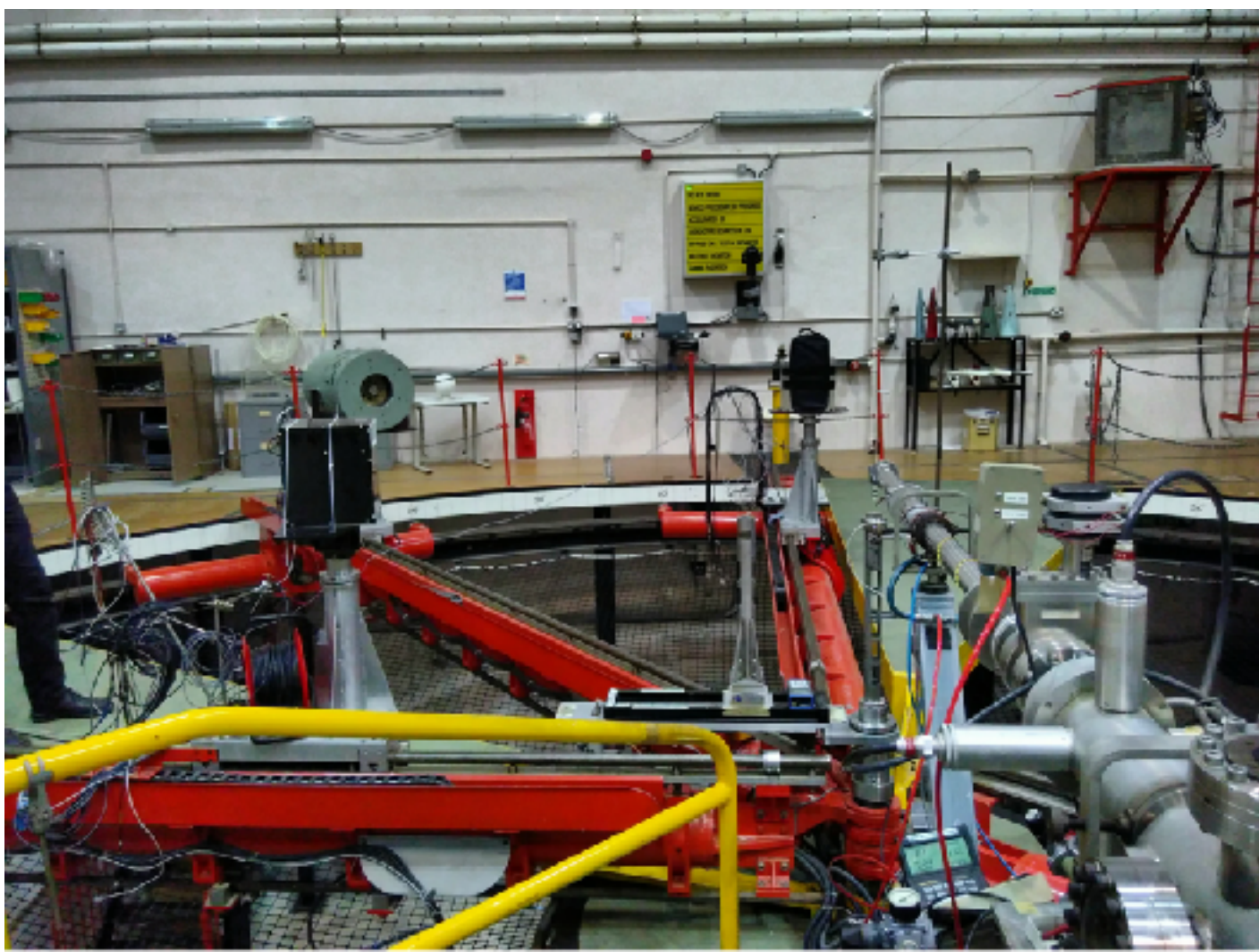5 cm x 5 cm x 5 cm PVT cube segmentation to localise interaction

Layer of LiF:ZnS(Ag) for neutron detection in each detector cell

Threat Management

Stop: Background only — **No** ← Is there a Neutron Source? → **Yes** → Classify the source type: Cf, AmBe, AmLi or Co-60

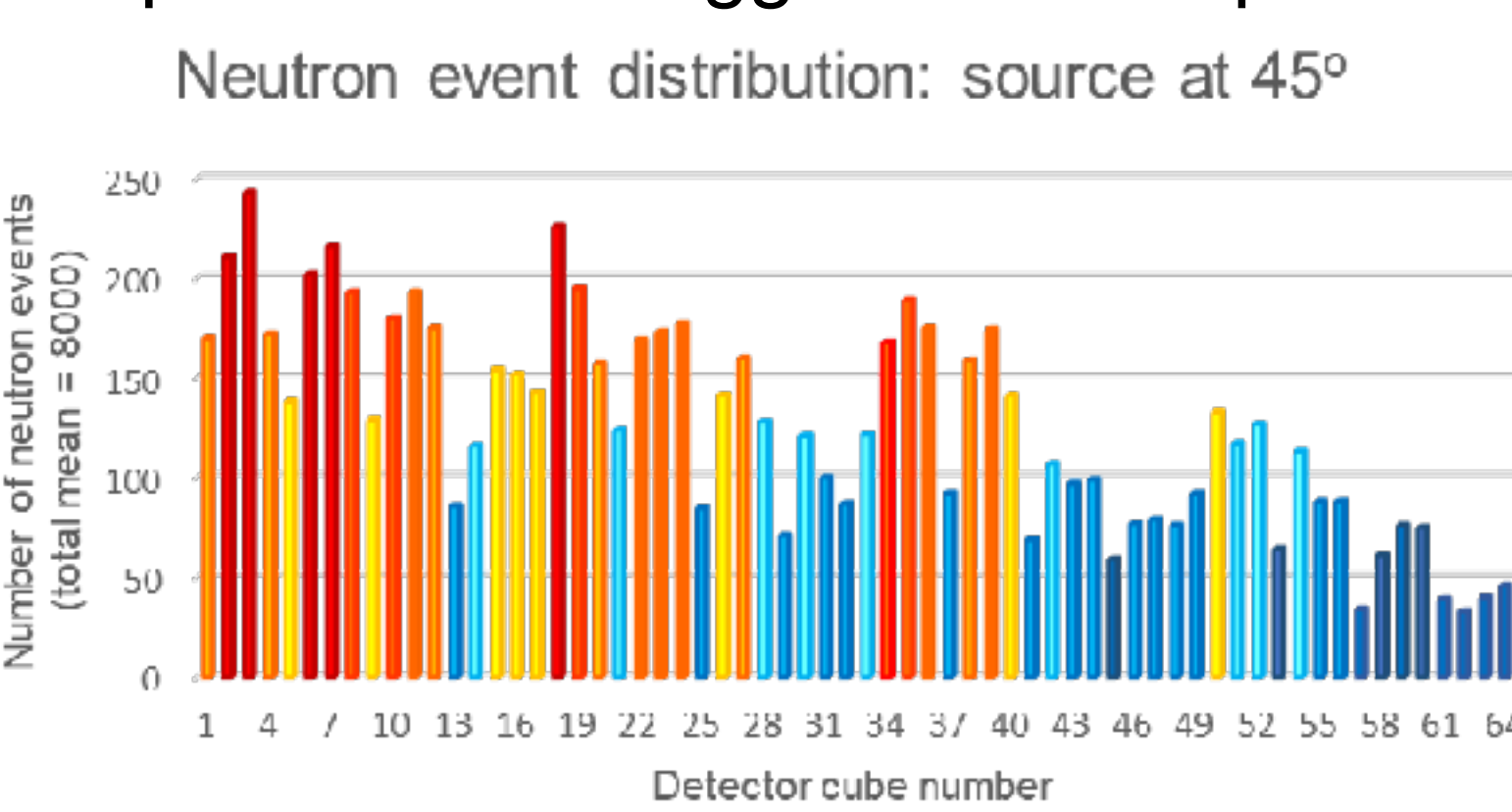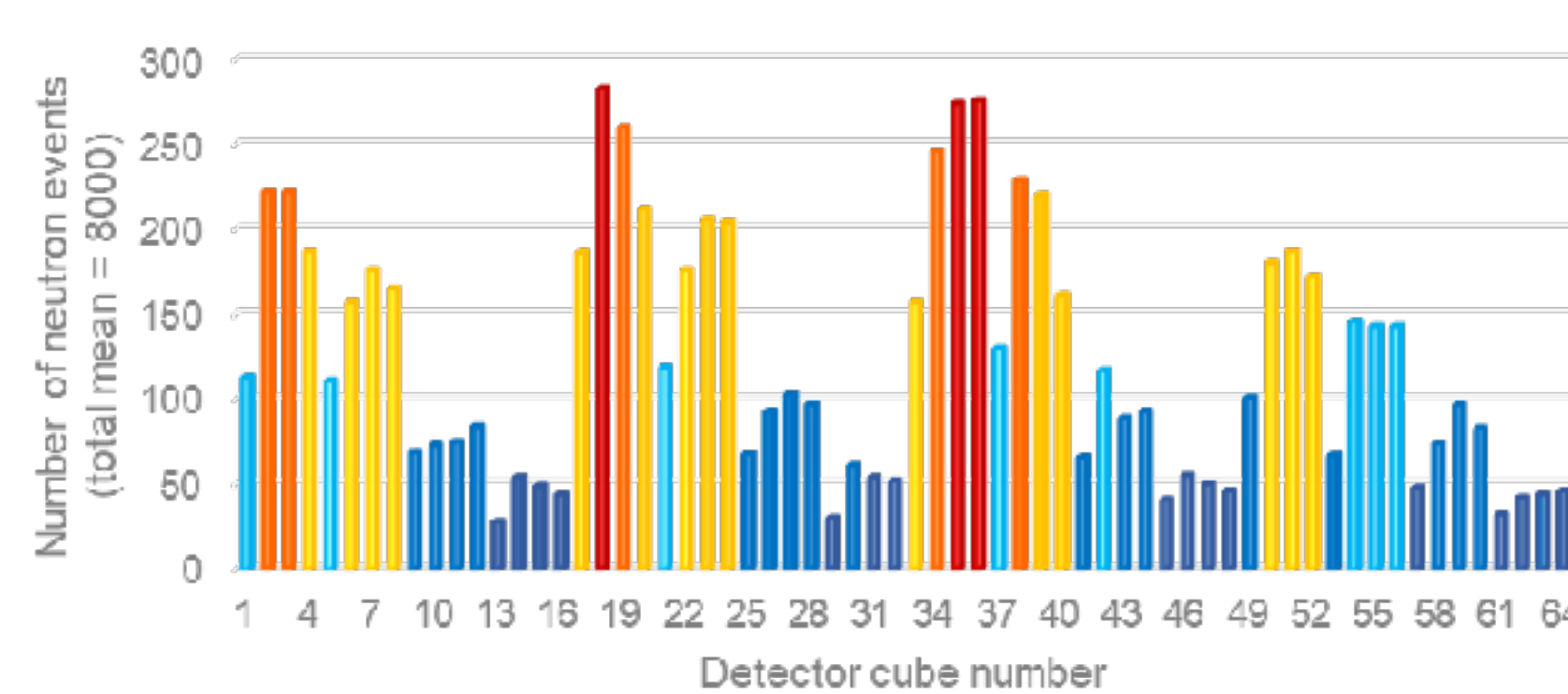**Yes** → Predict Direction

Calibration data

Data sets taken at NPL at fixed angle and positions

Input : neutron trigger value acquired during fixed time duration

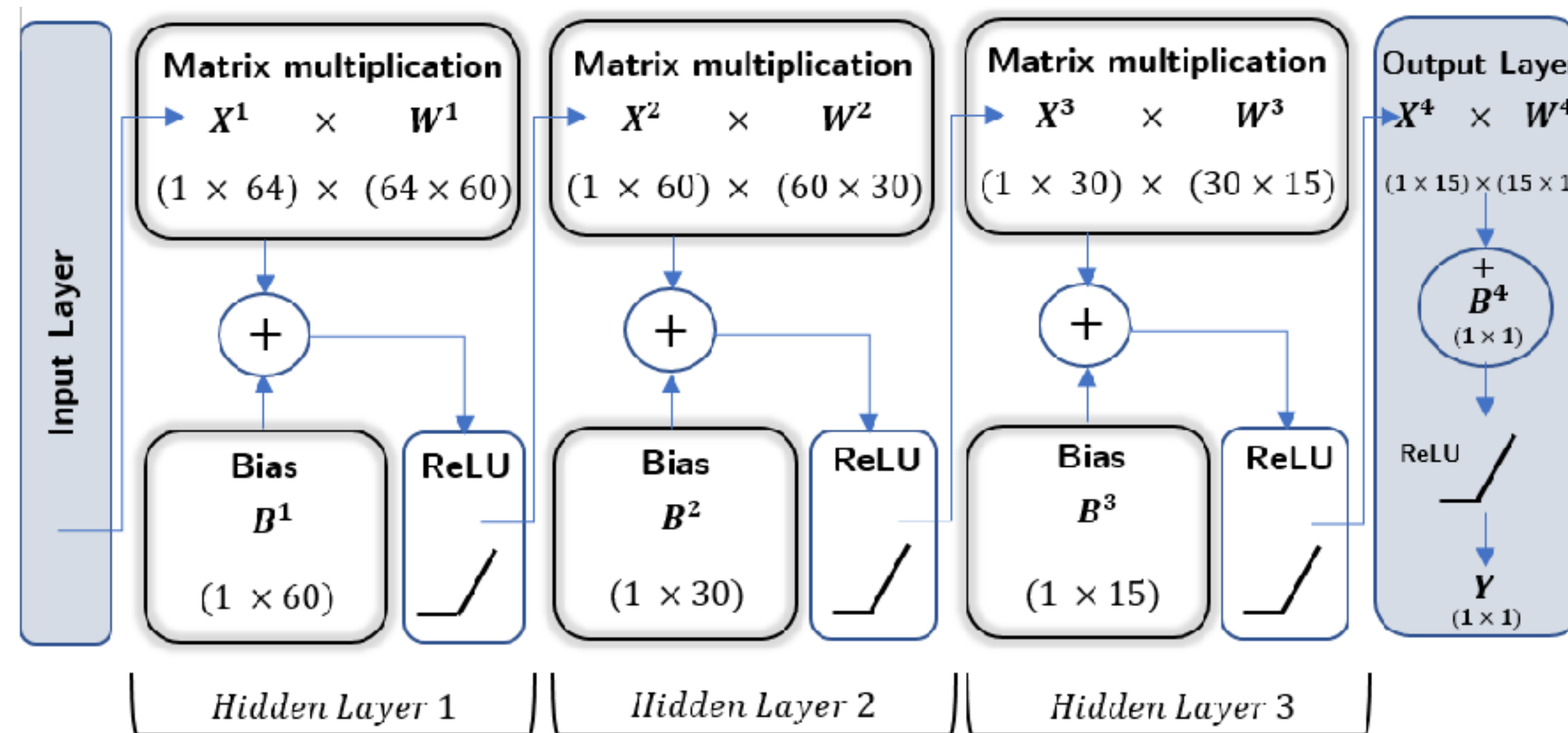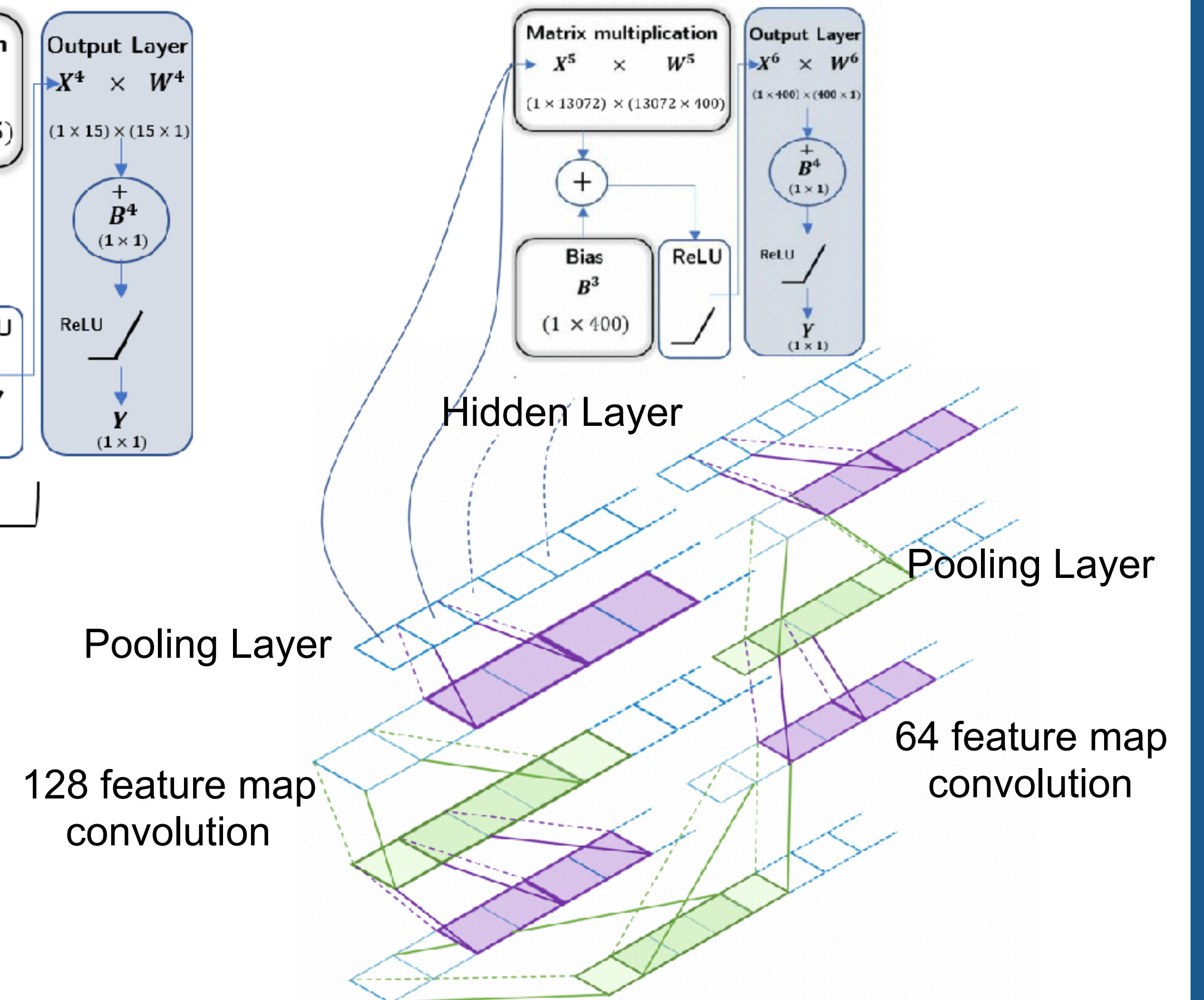Neutron event distribution: source at 45°

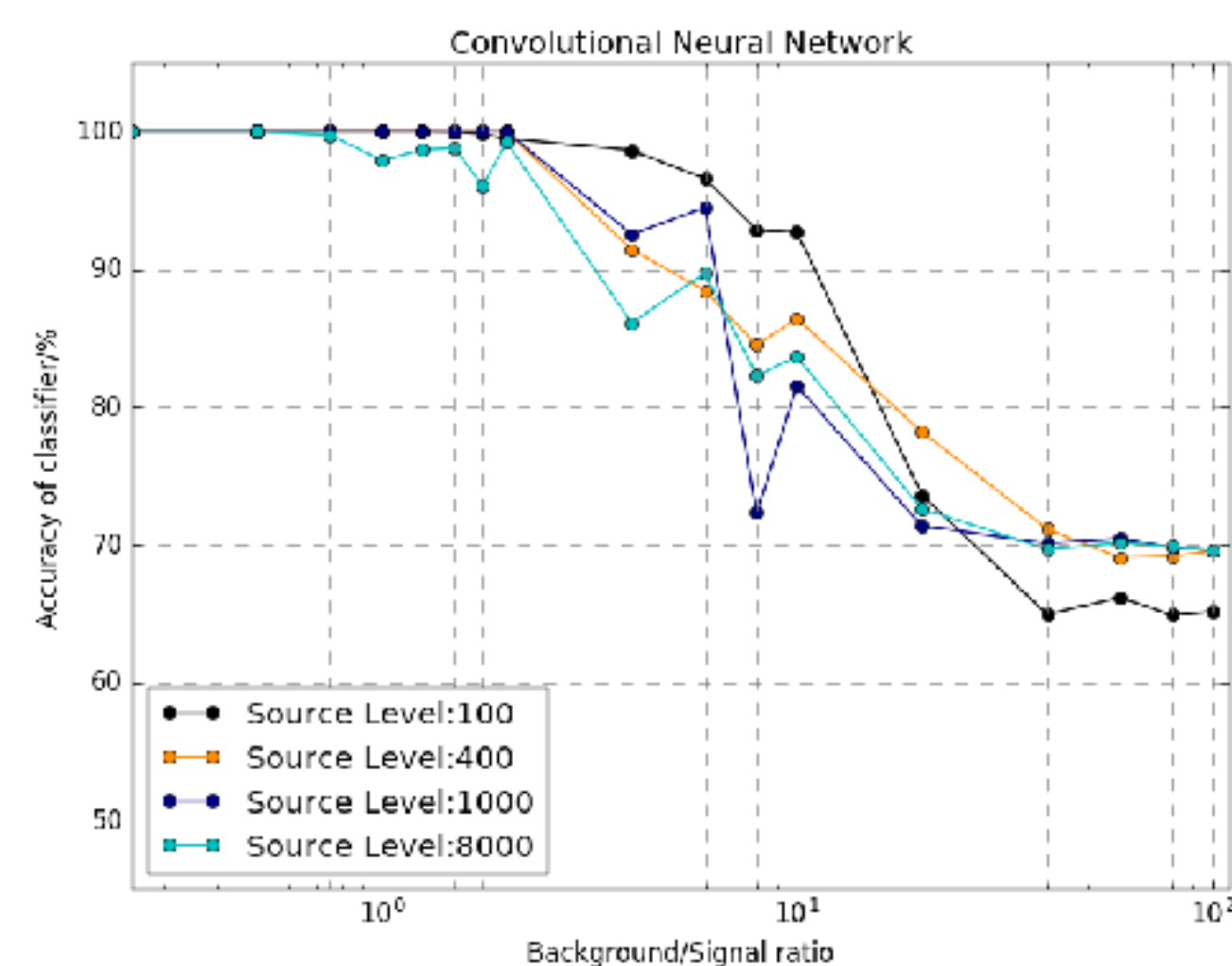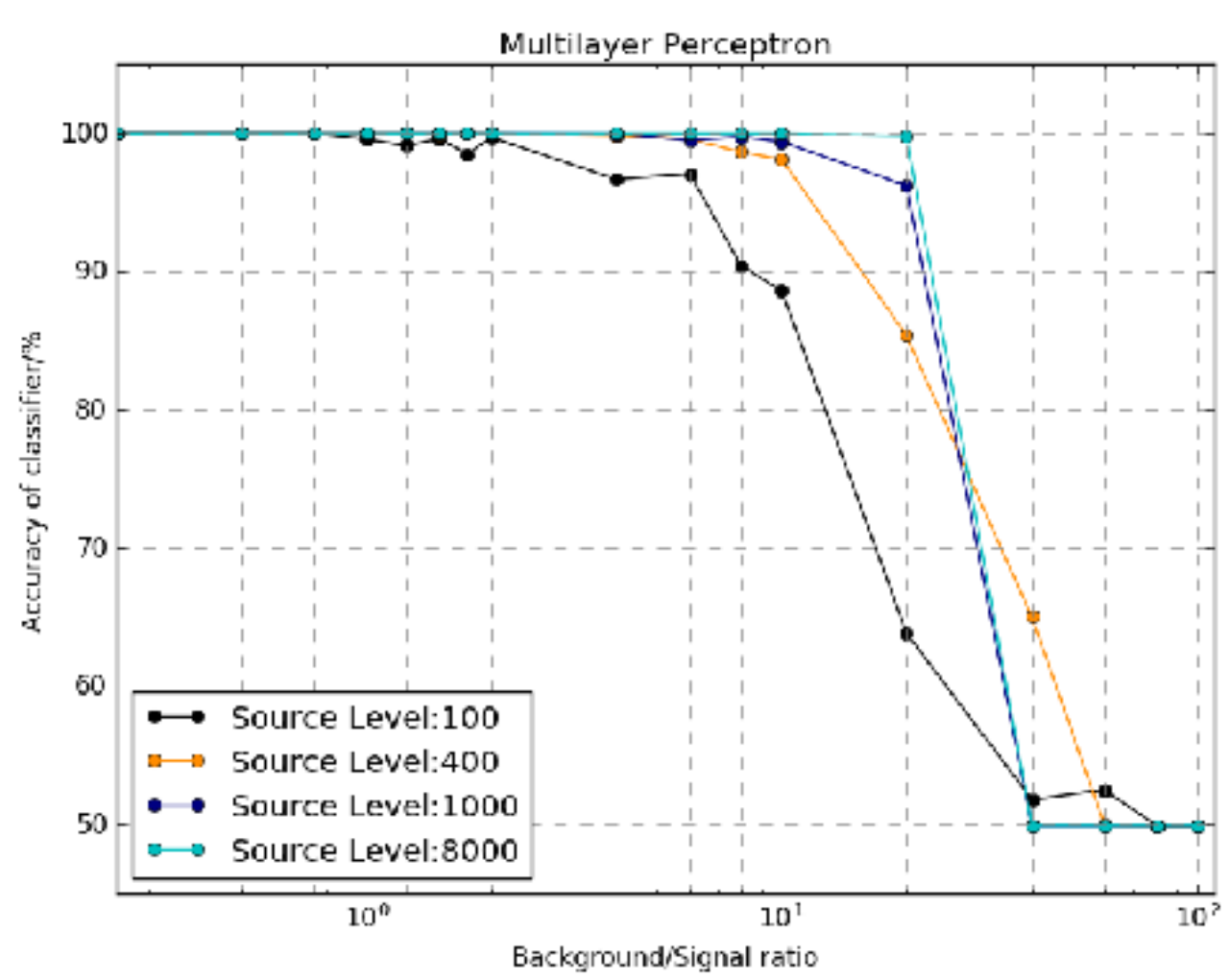Neutron event distribution: source at 0°
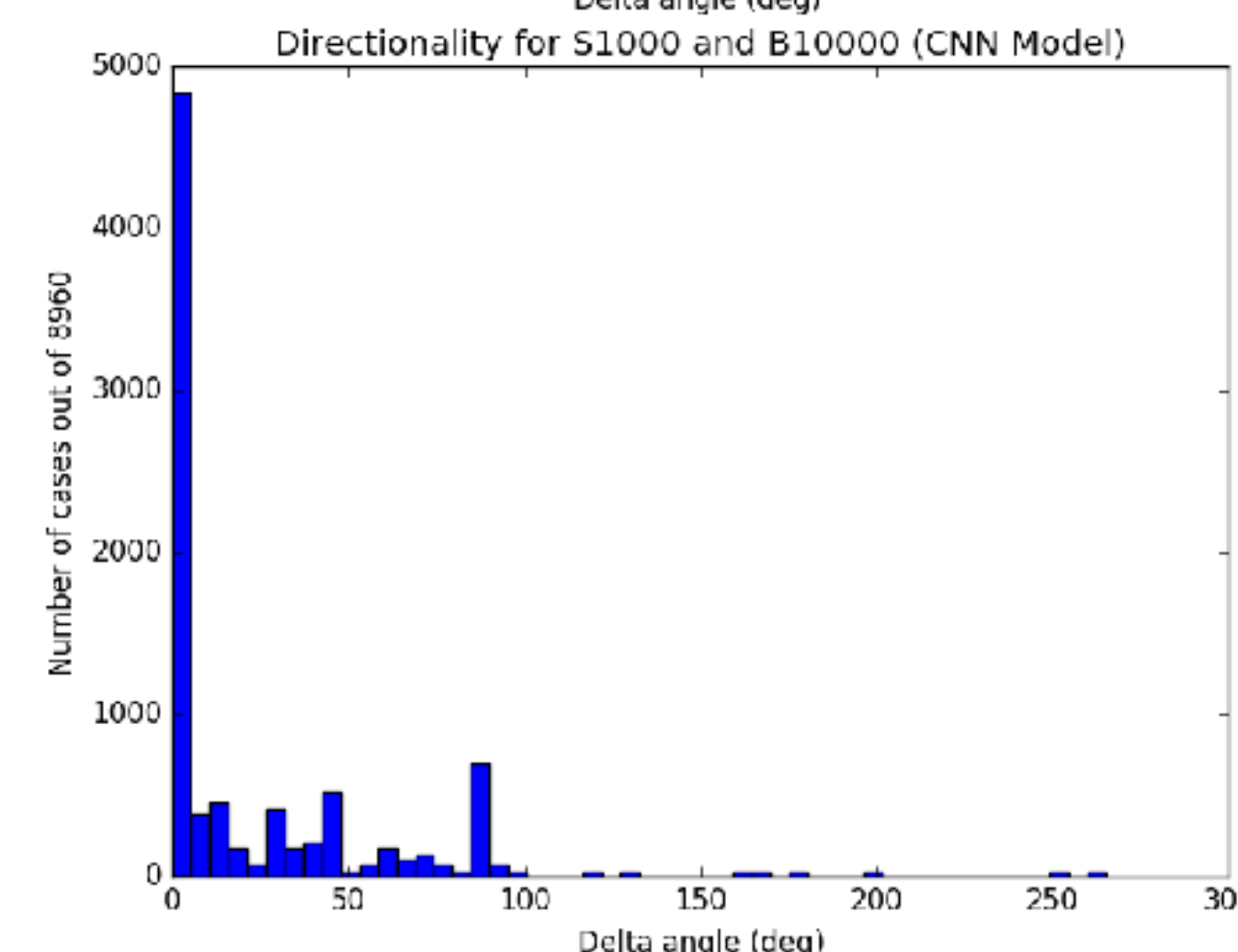
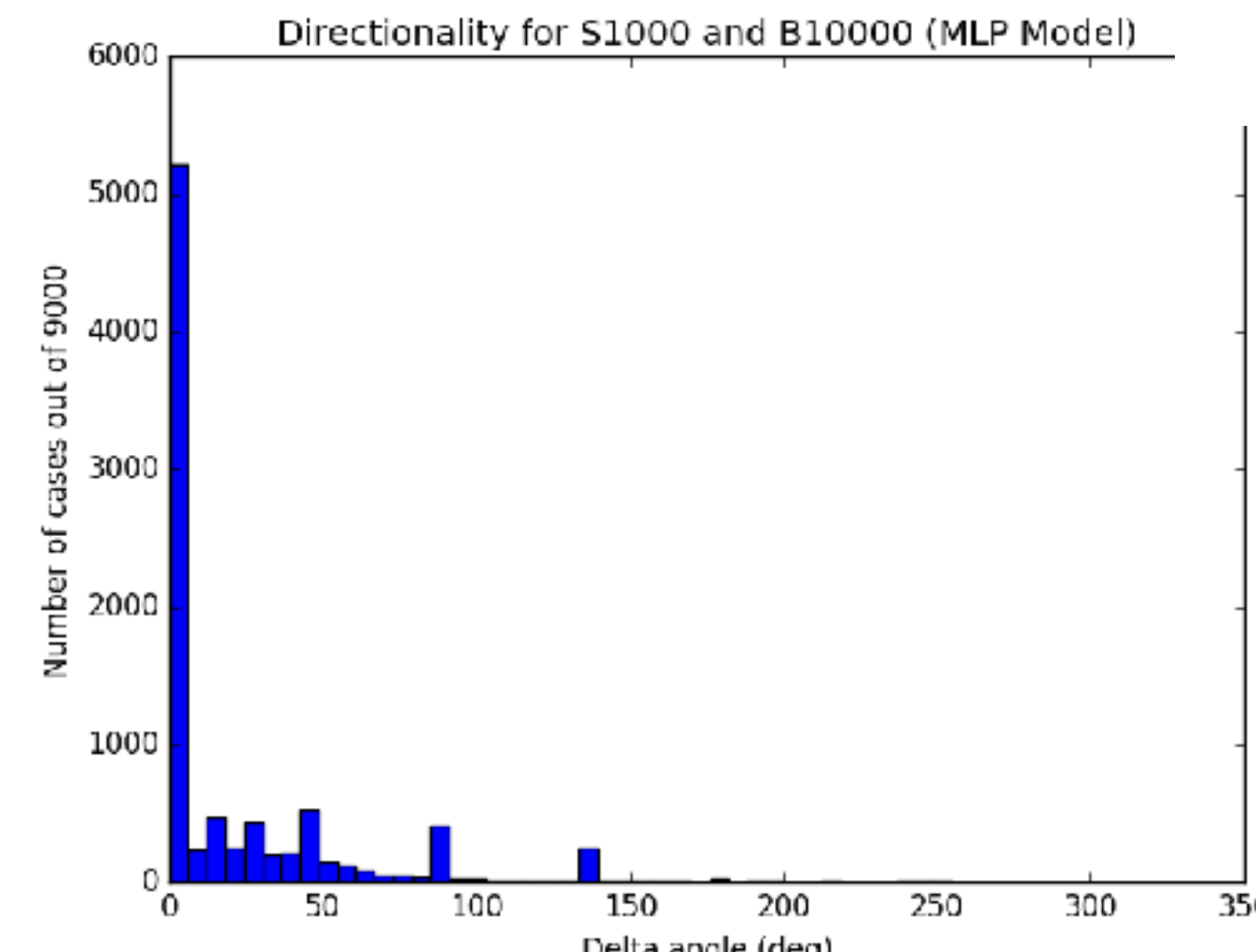## Machine Learning Algorithms
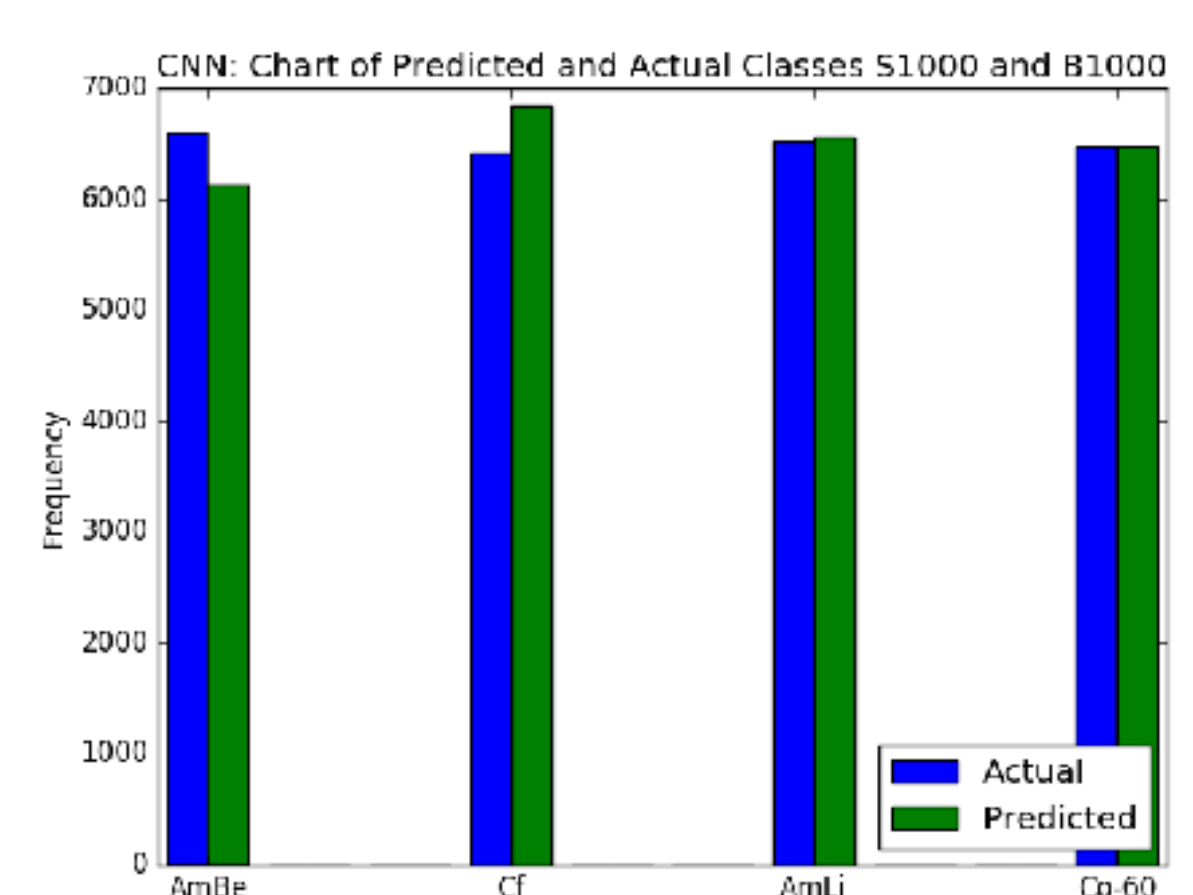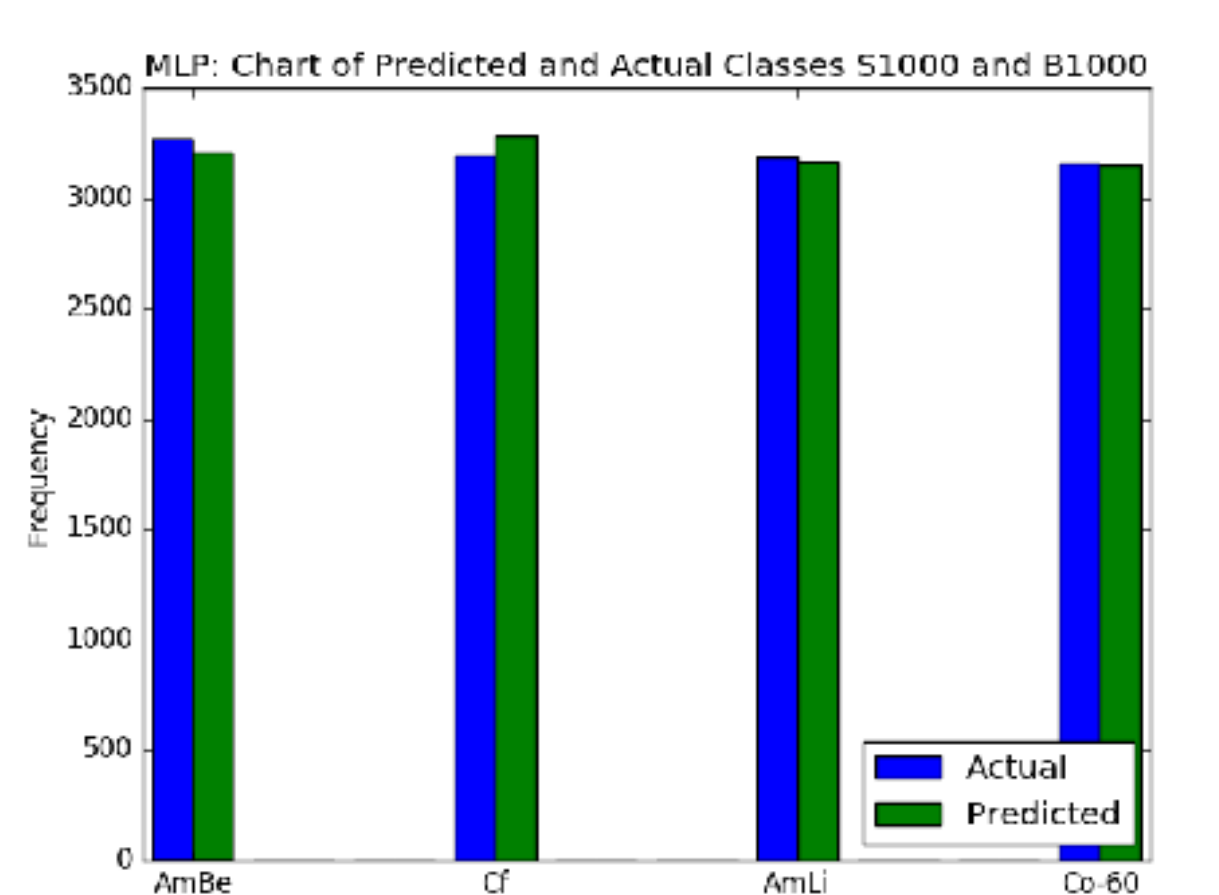
Multilayer Perceptron (MLP)

Convolutional neural net (CNN)

Detection and Classification

Multilayer Perceptron

Convolutional Neural Network

Receiver operating characteristic curve MLP for 5100

Receiver operating characteristic curve CNN for 5100

MLP: Chart of Predicted and Actual Classes S1000 and B1000

CNN: Chart of Predicted and Actual Classes S1000 and B1000

Direction estimation

Directionality for S1000 and B10000 (MLP Model)

Directionality for S1000 and B10000 (CNN Model)

Dataset Visualisation

Principal Component Analysis (PCA)

Distributed Stochastic Neighbour Embedding (tSNE)

Ongoing Work

✓PCA and t-SNE visualisation tools to pinpoint the source location in **real-time.**

✓Benchmarking against classical **statistical methods**

✓Development of a **program** to detect, classify and locate neutron sources based on a series of inputs from a given time of exposure