LIFETIME MEASUREMENT EXPERIMENTS

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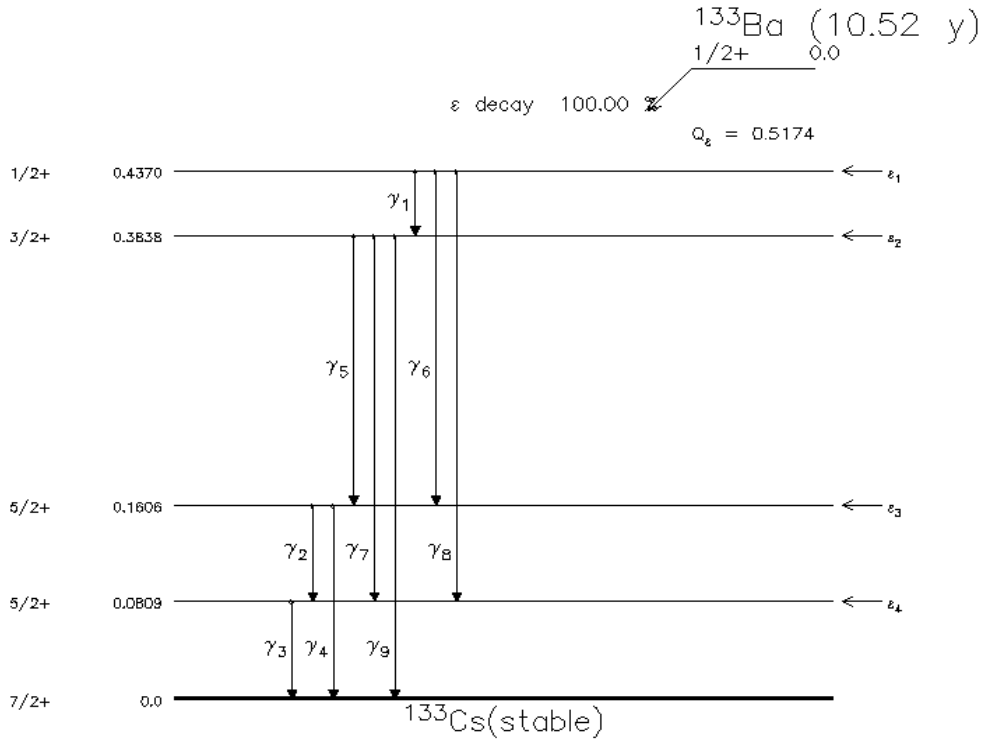
MOTIVATION

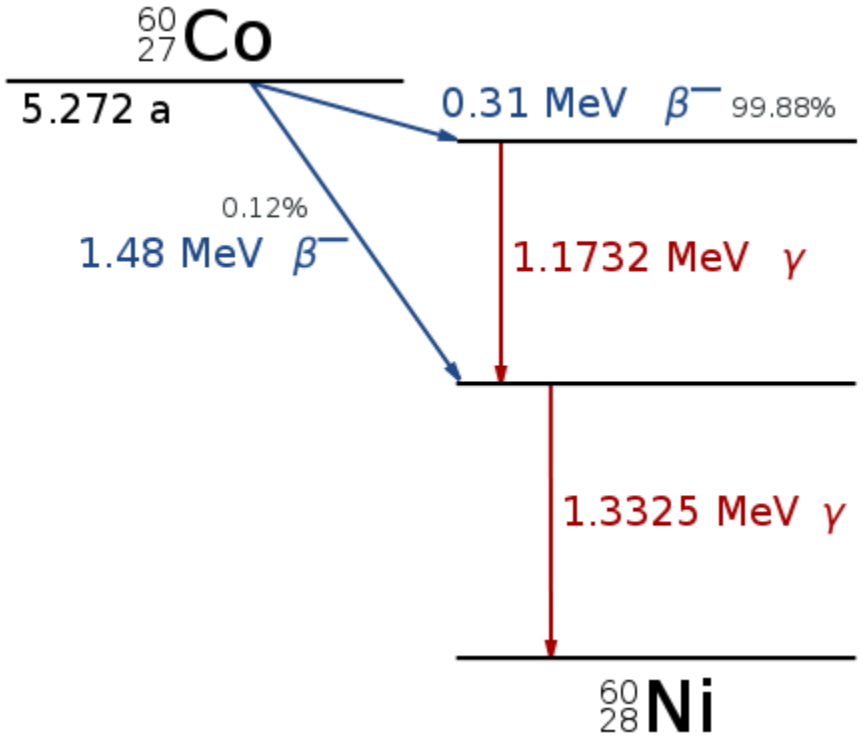
A series Experiments are conducted to design the a System that will measure the Lifetime of Nuclear Excited States in the range of few nanoseconds.

The ultimate goal of the project is to find out the possibility of change of Lifetime of a Nuclear excited state depending on its Physical or Chemical Surroundings.

Today's presented Experiment has measured the Lifetime of 81kev state of Cs-133 gamma source.

DECAY SCHEMES FOR Ba-133 and Co-60





TIMING METHOD

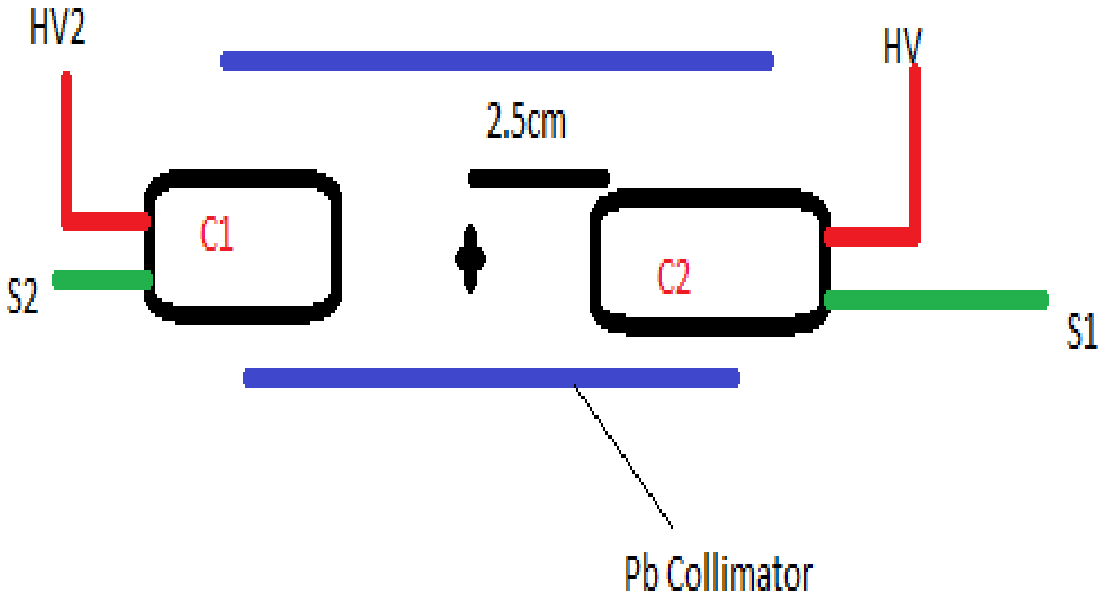
Timing is achieved by using a Start-Stop TDC whose full scale is set to 500ns

The gate Signal which is made by the coincidence of two signals from the two Detectors is set as the Common Start Signal.

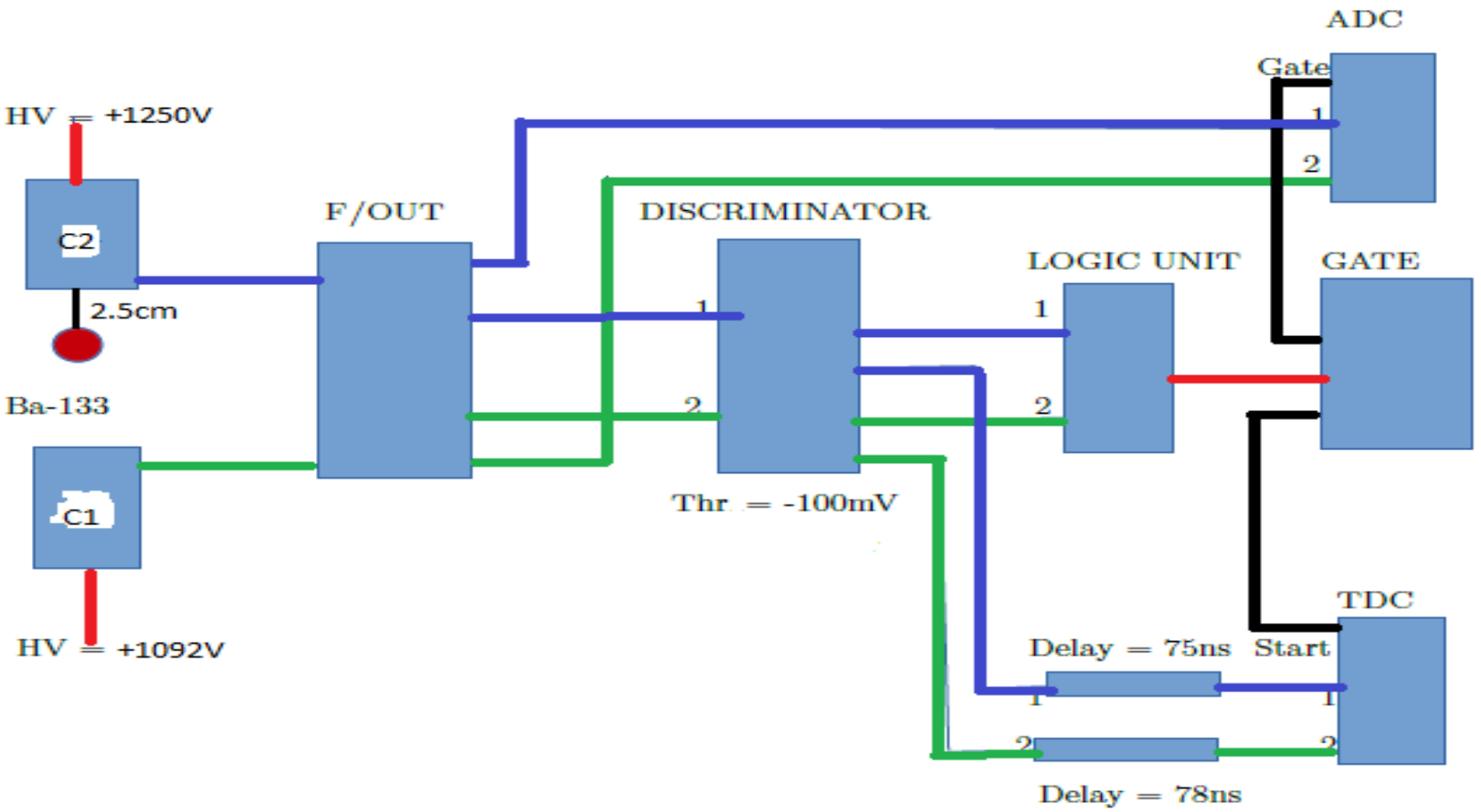
Individual Signals from the two Detectors are set as STOP1 and STOP2.

EXPERIMENT SET UP

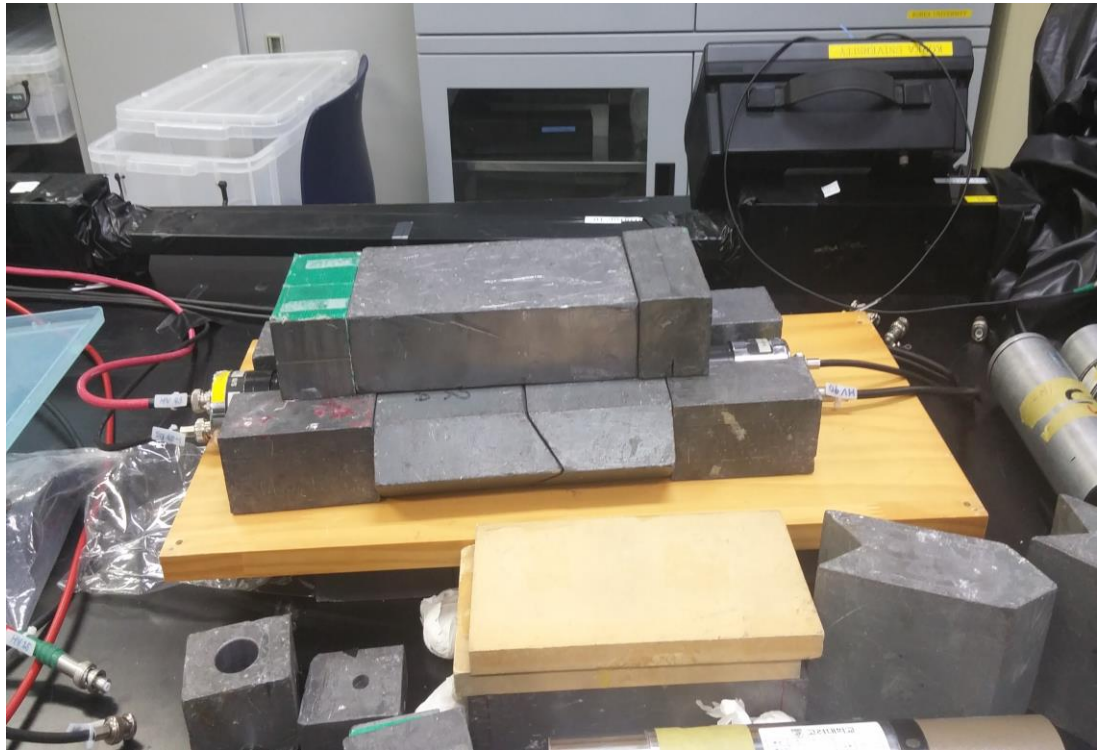
Two Cylindrical NaI(TI) Detectors are set such that they face each other with the source between them

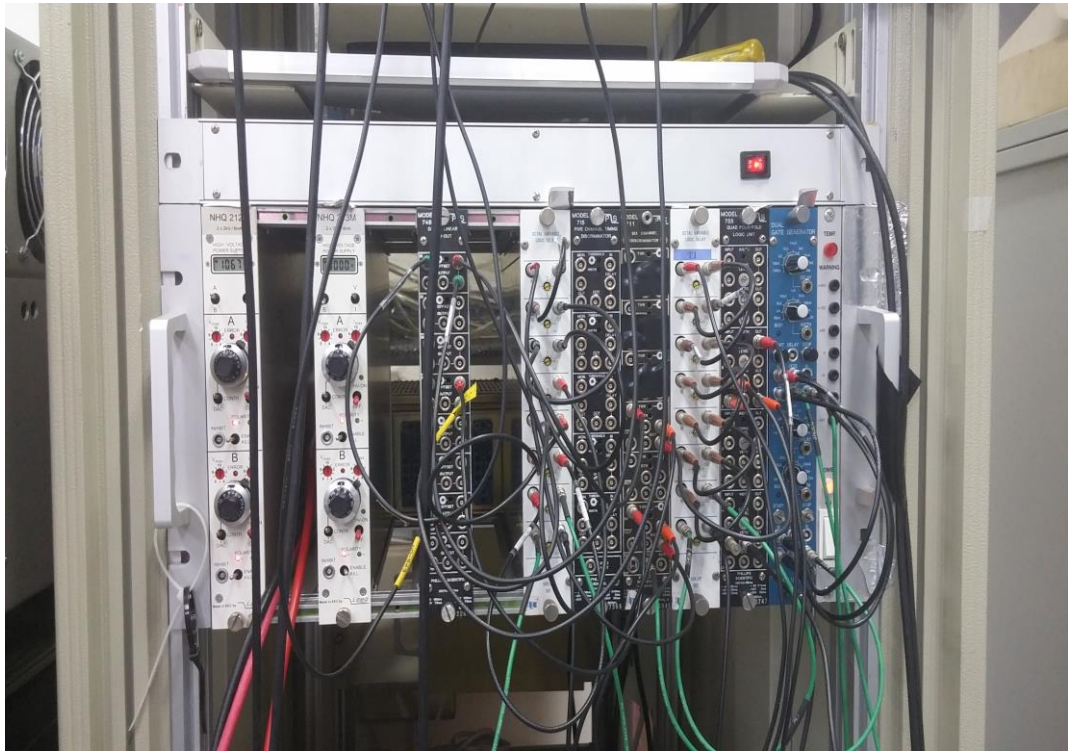


DATA PICK UP ELECTRONICS



SET UP AND PICK UP CIRCUIT





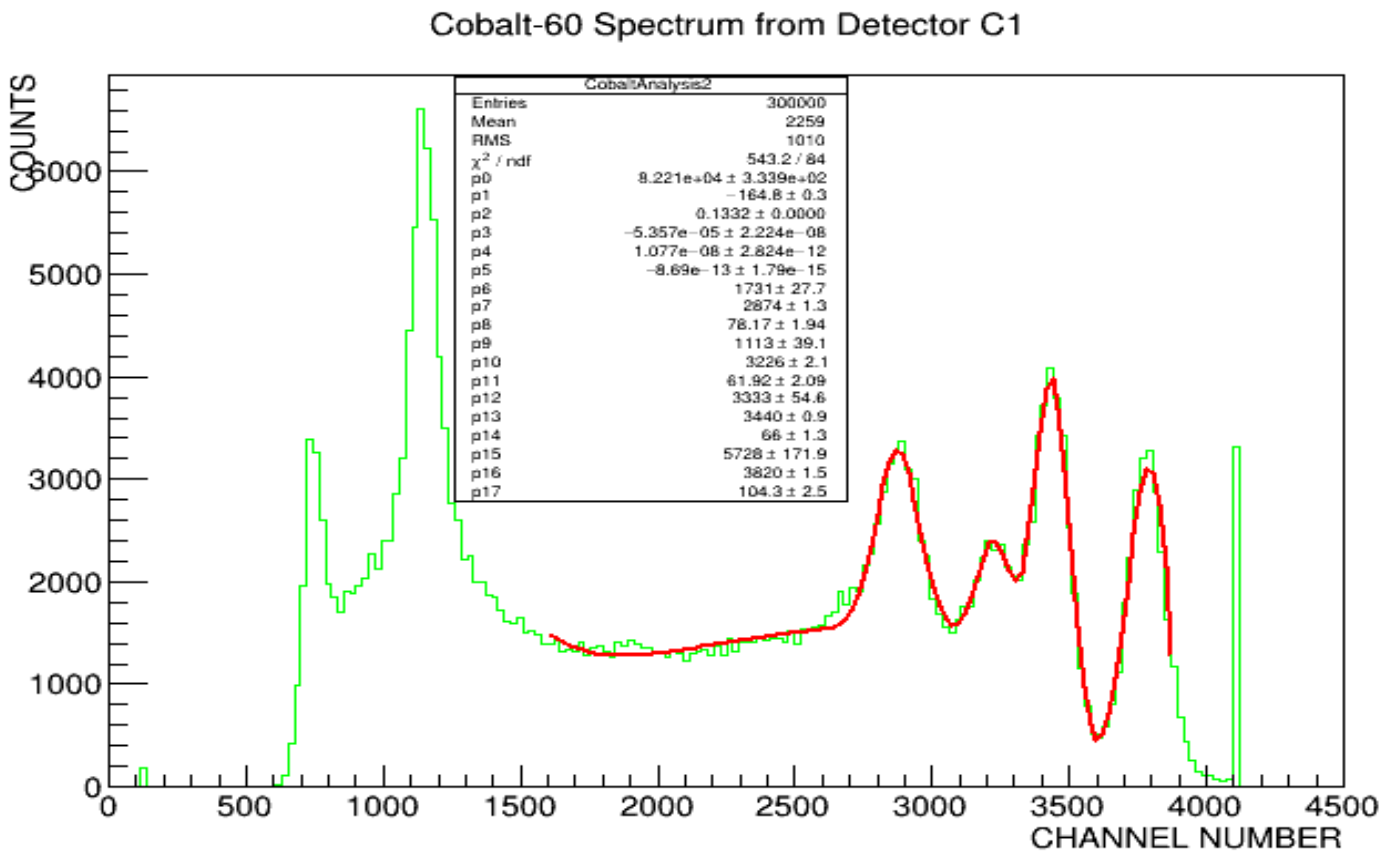
PROCEDURE

The Detectors are first gain-matched so as to measure coincident events

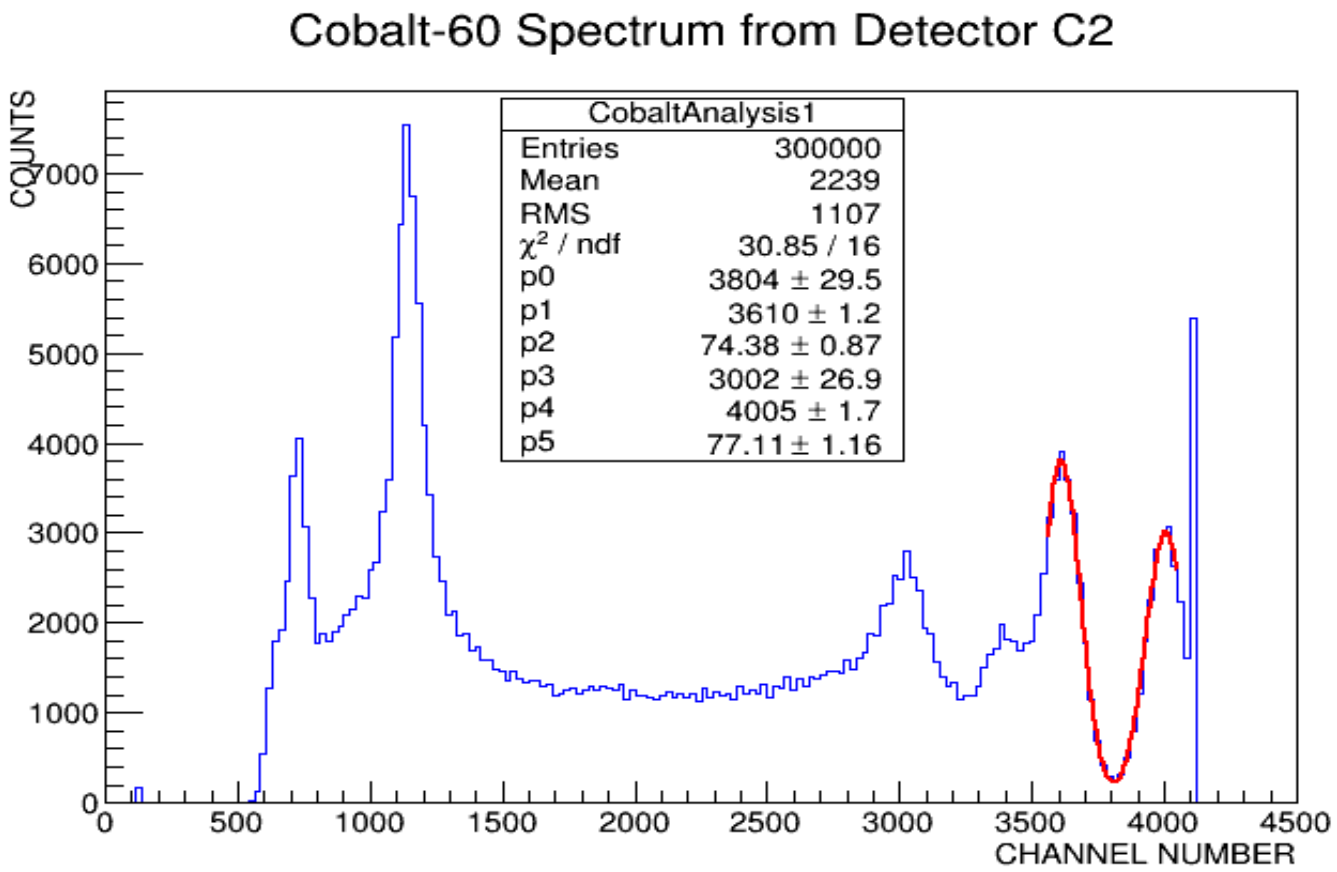
Three sets of Data were taken, Data without Source for Background measurement, With Co-60 Source and finally with Ba-133 source.

Co-60 Data are used to determine the width of the Prompt peak while Ba-133 Data are used to determine the Lifetime of the state of interest.

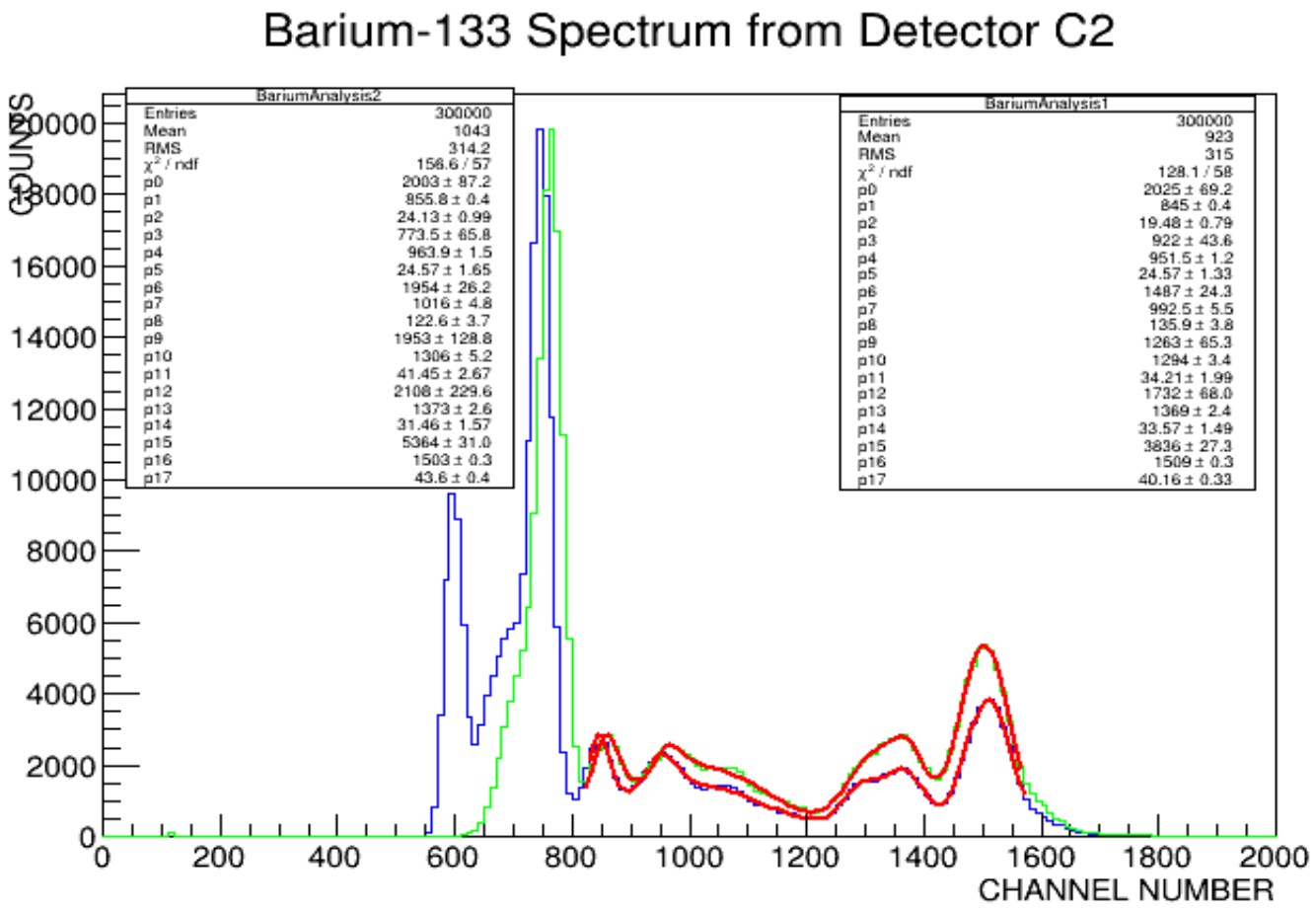
ENERGY SPECTRUM FOR Co-60 Source



ENERGY SPECTRUM



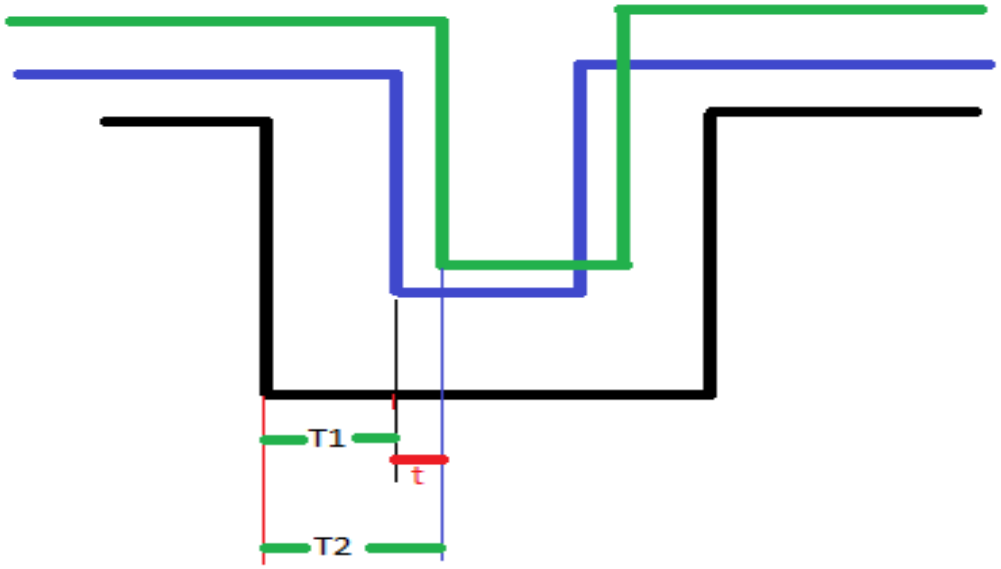
ENERGY SPECTRA FROM Ba-133



TIME MEASUREMENT

Time measurement is done between two specific Signals

Since there are several Gamma Rays from the Source, Energy conditions must be set.



SETTING ENERGY CONDITIONS

Energy conditions are set by first, Determining the Centroids of the Peaks of Interest.

Then, the Width Resolution for each peak is Determined

The Resolution is in turn used to estimate the range for which the peak of interest can appear on Left and Right side of the Centroid

This Range is set as a Condition for Determining Time Spectrum.

ENERGY RANGES

For Cobalt Source, the Resolutions were found to be about 4.5% for both peaks

Then, the ranges were determined to be;

3285<ADC[5]<3595 and

3824<ADC[11]<4186

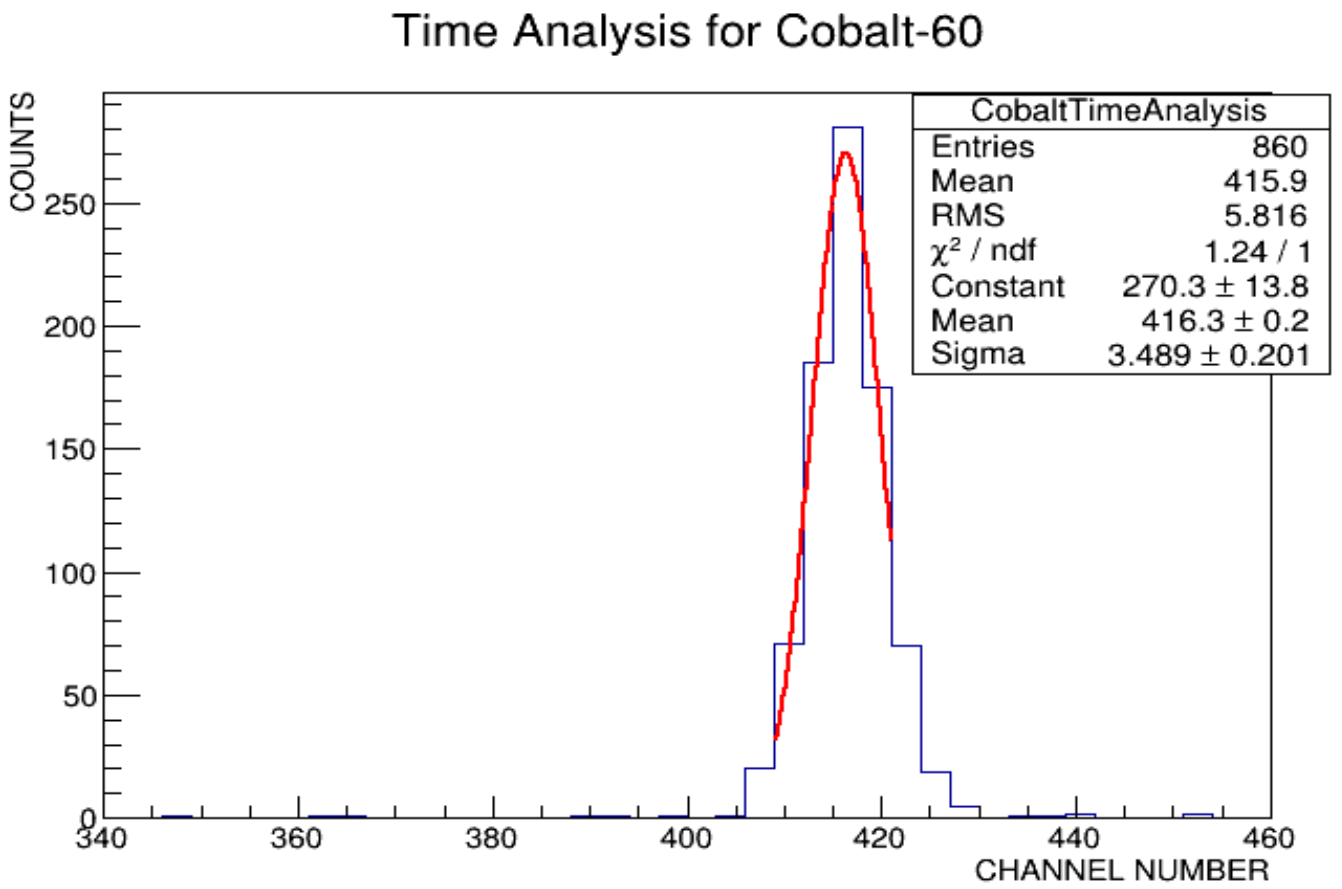
For Ba-133, the Resolutions were about 6.2% for 380Kev peak and 6.6% for 81kev peak

The Ranges were then found to be,

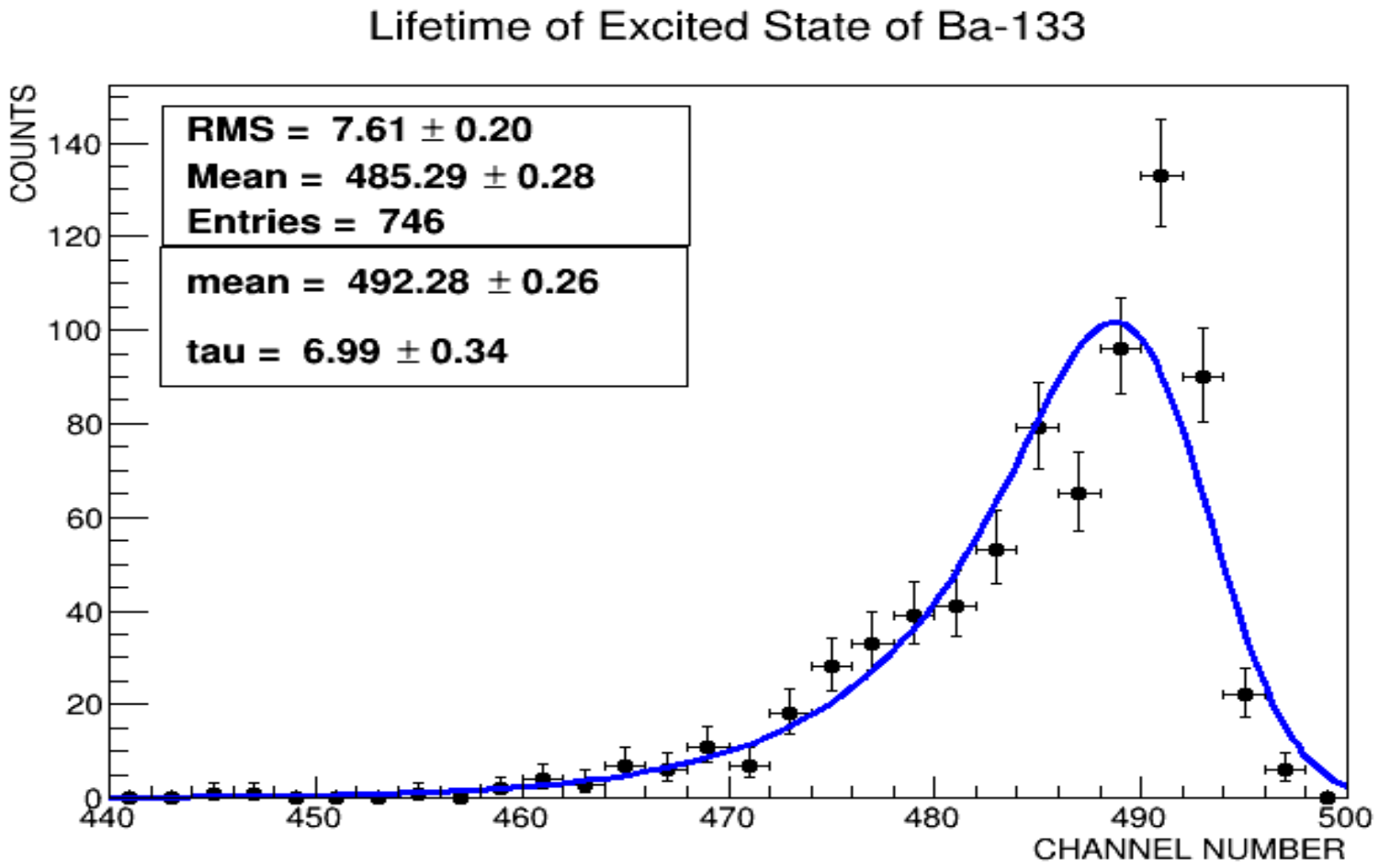
1414<ADC[5]<1603 and

799<ADC[11]<911

TIME SPECTRUM FROM Co-60 source



TIME SPECTRUM FROM Ba-133 Source



PLAN

For the presented Experiment, the statistics is too low to make any solid conclusions.

Therefore, using same setup new experiment will be run for longer time to achieve more events and improve the statistics

New Experiment Setups are to be made using other types of NaI(TI) Detectors, CsI Detectors etc in order to determine which detectors could make an optimum timing system.