INVESTIGATE THE BIPO DECAY WITH FADC 500MHZ

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ABSTRACT: *Investigation of BIPO decay to measure the purity of ^{208}Tl and ^{214}Bi in the ββ source foils plays an important role in SuperNEMO international colaboration project. In this article, we report the successful results in the measurement of both long and short life of BiPo events with FADC 500Mhz. Especially, a very low of BiPo events from Yunohara powder is correctly detected and measured.*

Key word: *BiPo decay, double beta decay, Yunohana.g ta*

1. INTRODUCTION

Today's experiments in searching for neutrino lessdouble β decay (0v2β), as well as projects of next-generation experiments (SuperNEMO), have run into a serious problem in monitoring the radioactive purity of structural materials. The required sensitivity of the experimental data is so high that the traditional low-background semiconductor detectors are not sensitive enough to detect the radioactive contamination of structural materials by the uranium and thorium series of natural radioactivity. In the SuperNEMO experiment the content of ^{208}Tl and ^{214}Bi are *the main background source* in the search for 0v2β decay [1]. Observing the so-called BiPo process (a sequence of decays of radioactive bismuth and polonium isotopes followed by an emission of charged particles) allows one to reach such a sensitivity. This process is part of the chain of radioactive decays of natural-radioactivity uranium and thorium. The energies of the electrons and α particles produced in these decays are sufficient enough for them to be registered adequately in plastic scintillator detectors; the mean lifetimes of the intermediate isotopes are no longer than several hundred microseconds, which permits the sequential registration of decays. In this article, we had success in the measruing both two long and short life of BiPo events from Yunohana powder by using two scintillator detectors and FADC 500Mhz. Also in this case, a very low of BiPo events from Yunohara powder is correctly detected and measured.

2. MATERIAL AND INSTRUMENTS [2]

2.1. Material

Purpose of the BiPo decay experiment is to measure the contamination in ^{208}Tl and ^{214}Bi of the ββ source foils which are used for double beta decay experiment. And material to make BiPo detector is called Yunohana powder which contains BiPo decay. In this study Yunohana is placed as sandwich of two photomultipliers (PMTs)

2.2. Instruments

Two scintillator detectors (6cm×6cm×1cm), advanced TCA-crate, trigger module, SpW network, Spacecube, Pc and FADC 500MHZ are used for this study.

3. EXPERIMENT [2]

The decay chain of BiPo processes is showed in Fig. 1.

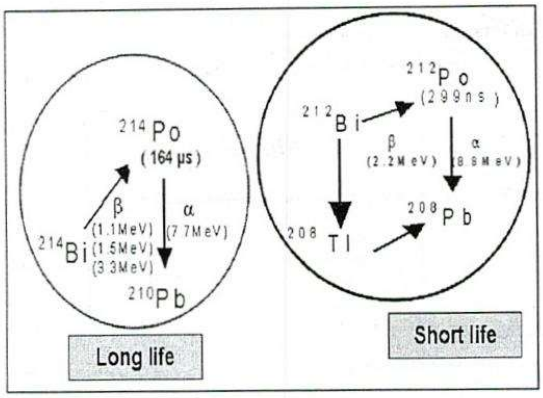

Fig. 1. BiPo processes for ^{214}Bi and ^{208}Tl

In this work, the measurement of BiPo decay includes the detection of the β particle in one PMT and the other for the delayed α particle

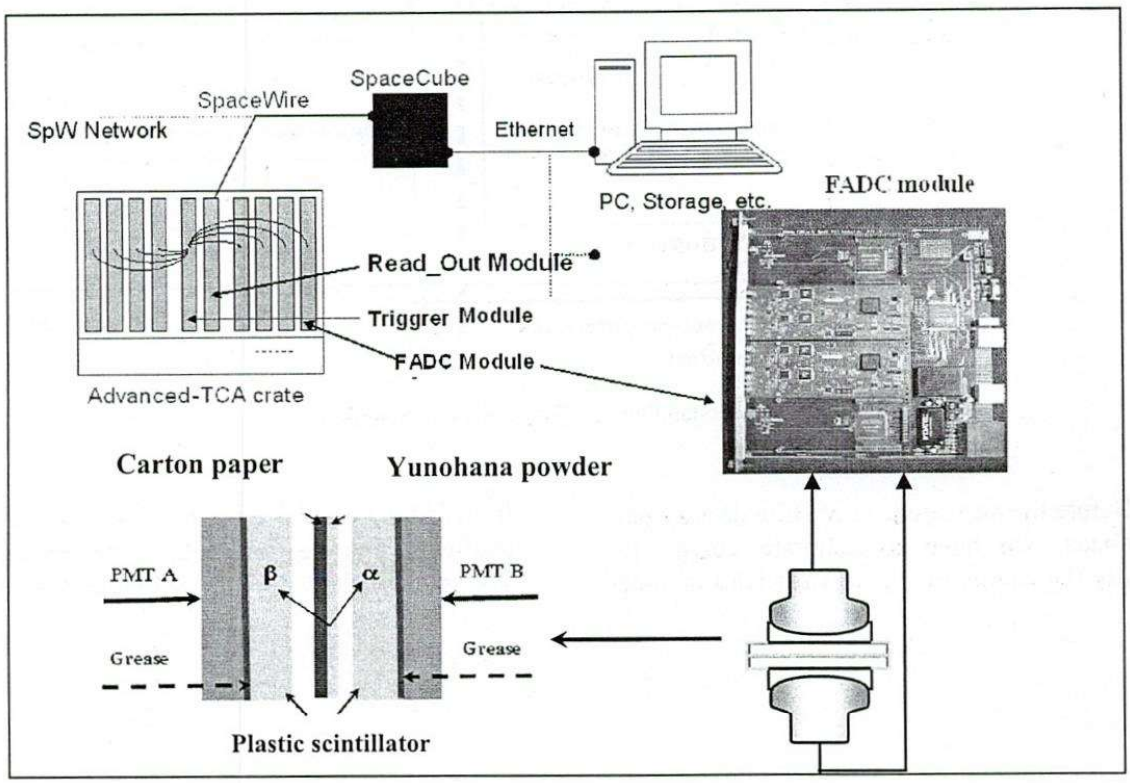

Fig. 2. Set up FADC 500 Mhz for the experiment

For this pupose, the carton paper is placed behind the Yunohana source foil to absorb all of the α particle to PMT A. It means that the Yunohana only faces to PMT B. Therefore, the PMT A gets the signal of the β particles only. A true BiPo event is only in case PMT B detects the α particles and PMT A detects the β particles in different time. If two hits in time are observed in the two PMTs, this is not a BiPo event.

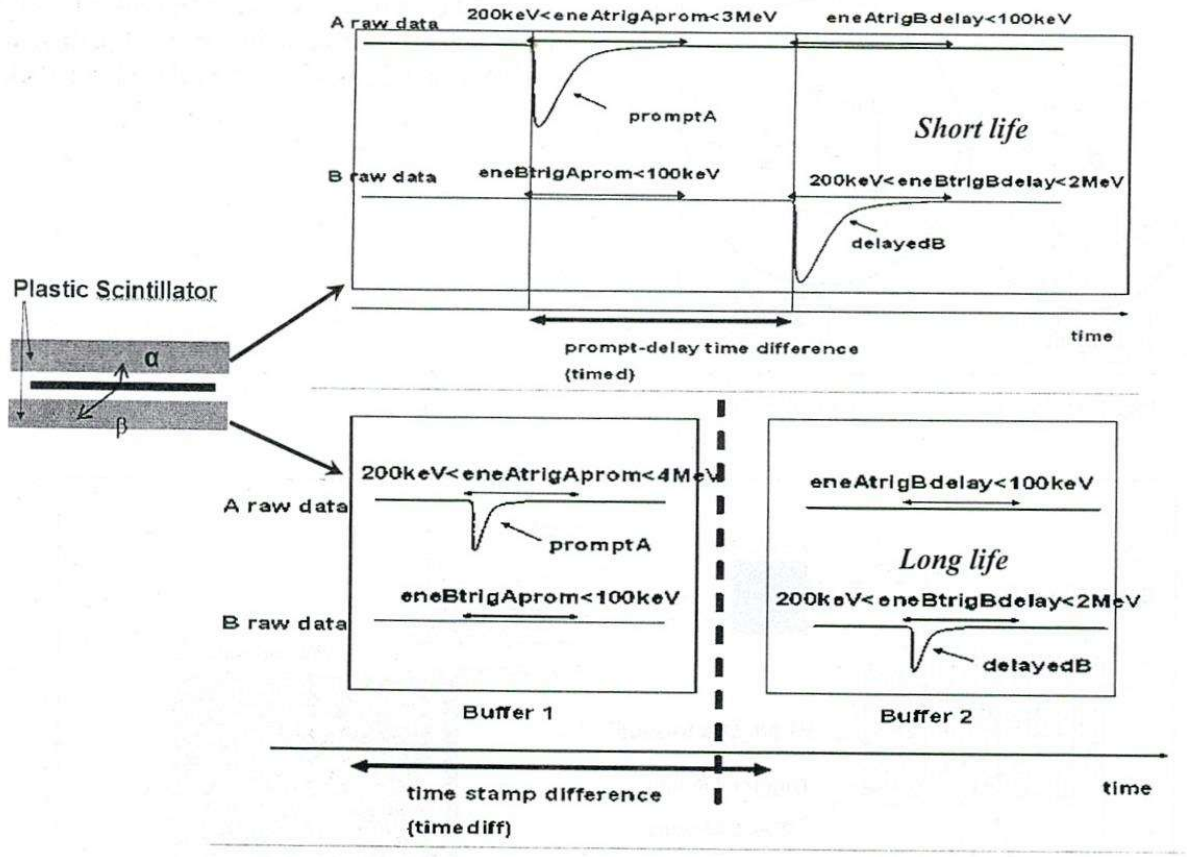

Fig. 3. Understanding of signal collected processing

Before the measurement of BiPo decay from Yunohana, we have to calibrate energy to identify the energy of β and α particles emitted from BiPo decay. And The ^{207}Bi isotope with relatively high electron yield of 92.26% (Q_β = 976 keV) and half-life of 31.55 years was used.

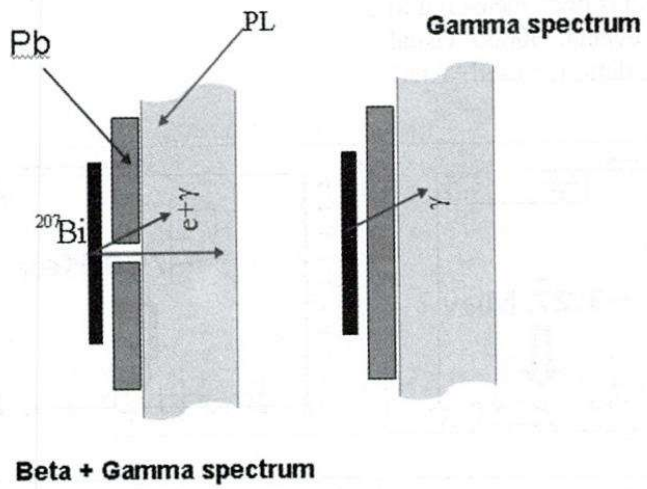

Fig. 4. Scheme of the detector-source arrnangement: (a) Measuring of both gamma and beta rays; (b) measuring of gamma rays only.

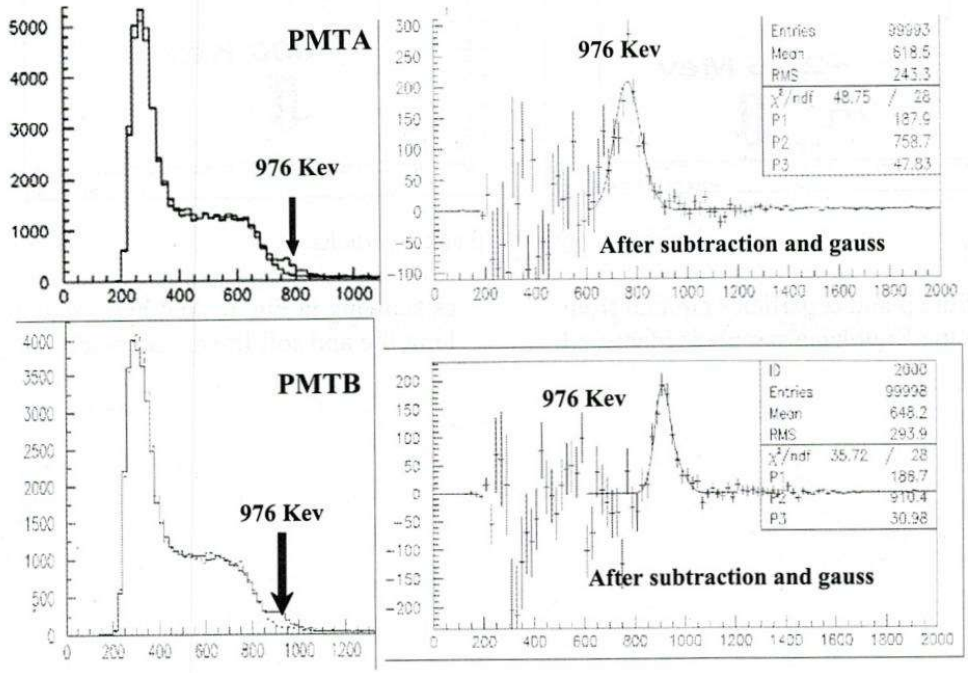

Fig. 5. Energy calibration for ^{207}Bi

4. RESULTS AND DICUSSION

The Yunohana sample has been measured in 9 hours with number of events: 30000 visual scaler: 30302. After taking data, we used "Ana" program (Nomachi's group) and "Paw" (Cern) software for the analysis Bipo events.

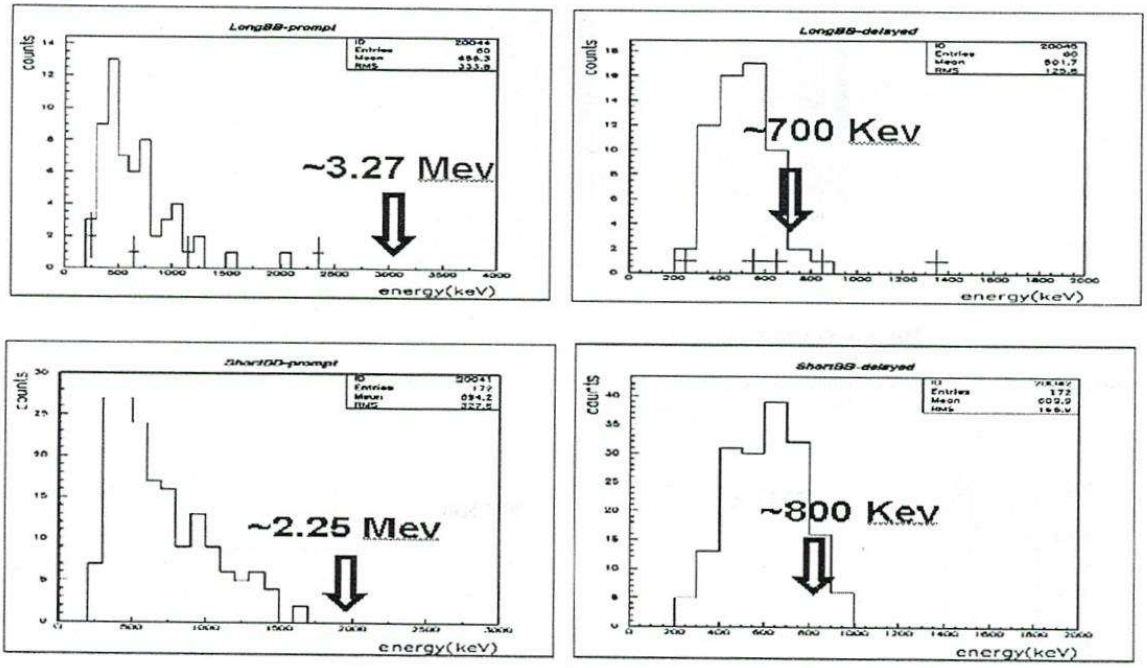

Fig. 6. Energy of the β and α particles

The energy of the β and α particles emitted from BiPo decay in the Yunohana sample is identified as showing in Fig. 6. And haft - time for both long life and soft life are obtained as fig 7

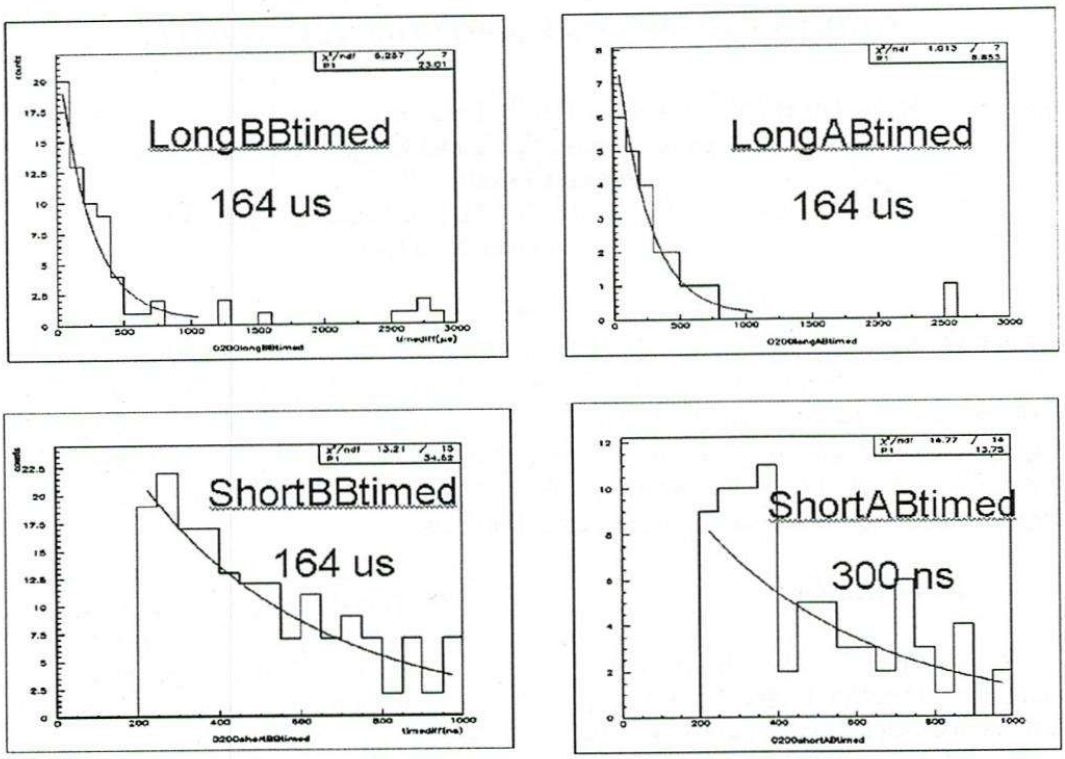

Fig. 7. Time results for both long and short time

5. CONCLUSION

By using FADC we can observe both long and haft life in BiPo source that is limited by experiment using NIM & CAMAC instrument [3]. However, there are also some present problems for FADC:

- Data size is too large
- Event selection can not be done until data are copied to CPU memory

Despite of the draw-backs mentioned above, FADC is the most suitable choice thank to many advantages this method can be used for good investigation of the BiPo decay.

6. ACKNOWLEDGMENT

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NGHIÊN CỨU PHÂN RÃ BIPO VỚI FADC 500MHZ

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TÓM TẮT: *Ngày nay việc nghiên cứu phân rã BIPO nhằm xác định sự tinh khiết không nhiễm bẩn ^{208}Tl và ^{214}Bi của những phôi nguồn phát ββ đóng vai trò cực kì quan trọng trong dự án quốc tế SuperNEMO. Trong bài báo này chúng tôi đã thành công trong việc xác định chính xác cả hai chu kỳ sống ngắn và dài của những sự kiện phân rã BiPo với thiết bị điện tử FADC 500MHZ. Trong đó tốc độ rất thấp của những sự kiện BiPo trong bột Yunohara đã được phát hiện và ghi nhận một cách chính xác.*

Từ khóa: *Phân rã BiPo, phân rã double beta, Yunohana*

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