

2014.05.01-06.06の仕事報告

My work

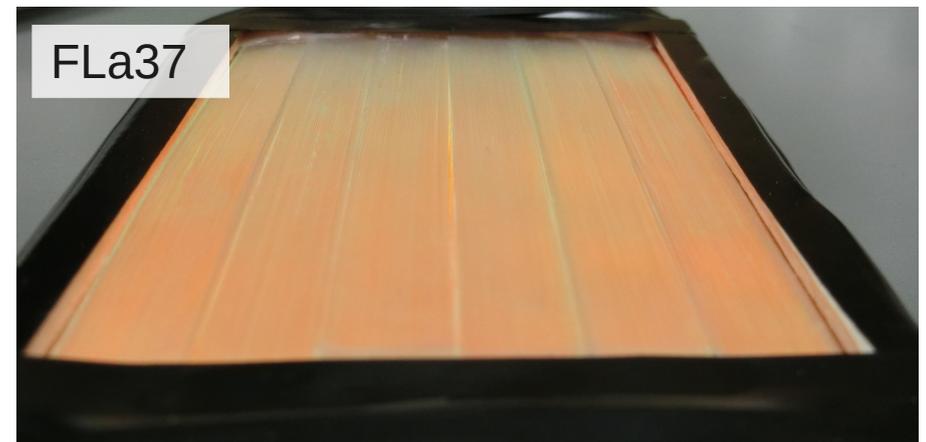
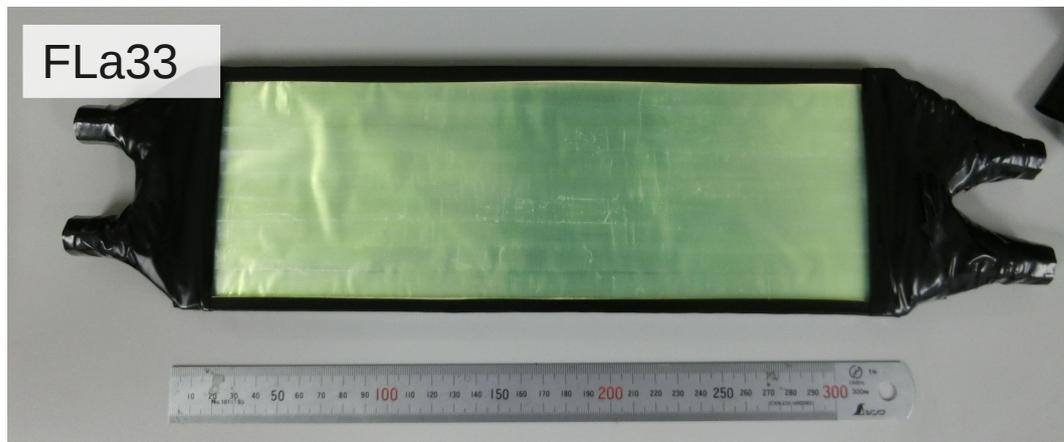
- M-ACC (E36 AC2)
- SFT ... MPPC + EASIROC module
- ^{90}Sr Counter

My Schedule

- Fiber Sheet 作成 ... 5/1-5, 7-11, 12-14, 18-20
- E36 meeting @KEK ... 5/7
- IEEE abstract dead line ... -5/11
- E36 SFT MPPC+EASIROC module @KEK ... 5/13-17
- 学振申込書類提出 ... 5/21-23
- Sr カウンター[30x10]作成 ... 5/1-20
- Sr カウンター[30x10]性能評価測定 ... 5/20, 23
- 日本物理学会秋季大会2014@佐賀 abstract 〆切 ... 5/25
- 春の学校@滋賀 琵琶湖クラブ ... 5/29-31
- TIPP '14 @ Amsterdam in Netherlands ... 6/1-6/6

Fiber Sheet 作成

Sial number		Fla_33	Fla34 + Scinti.	Fla35 + Scinti.	Fla36 + Scinti.	FLa37
Total number of fiber layers		4	4	4	4	4
layer type		BBYY	YYYY	YYYY	YYYY	BYOR
fiber type		Double Clad	Double Clad	Double Clad	Double Clad	Double Clad
area[mm×mm]		289 x 97	100 x 5 (x4)	100 x 5 (x4)	100 x 5 (x4)	63 x 95
connecting cross section [mm Dia]	BY1[mm Dia]	BY1: 8.40	Y1:	Y1:	Y1:	BY1: 7.00
	BY2[mm Dia]	BY2: 8.50				BY2: 6.90
	OR1[mm Dia]	BY3: 8.70				OR1: 6.95
	OR2[mm Dia]	BY4: 8.45				OR2: 6.85
cross section bonding agent		アロンアルファ	アロンアルファ	アロンアルファ	アロンアルファ	アロンアルファ
underground reflector type		アルミホイル	黒シート	黒シート	黒シート	アルミマイラー
製作日		2014/5/9	2014/5/13	2014/5/13	2014/5/20	2014/5/25
備考		30x10, 表面PVALコーティング	10 x 10 sinti用ファイバーライトガイド側面一周モデル			





Home Programs Education Author Info Activities Logistics Committee

Welcome!

2014 NSS/MIC

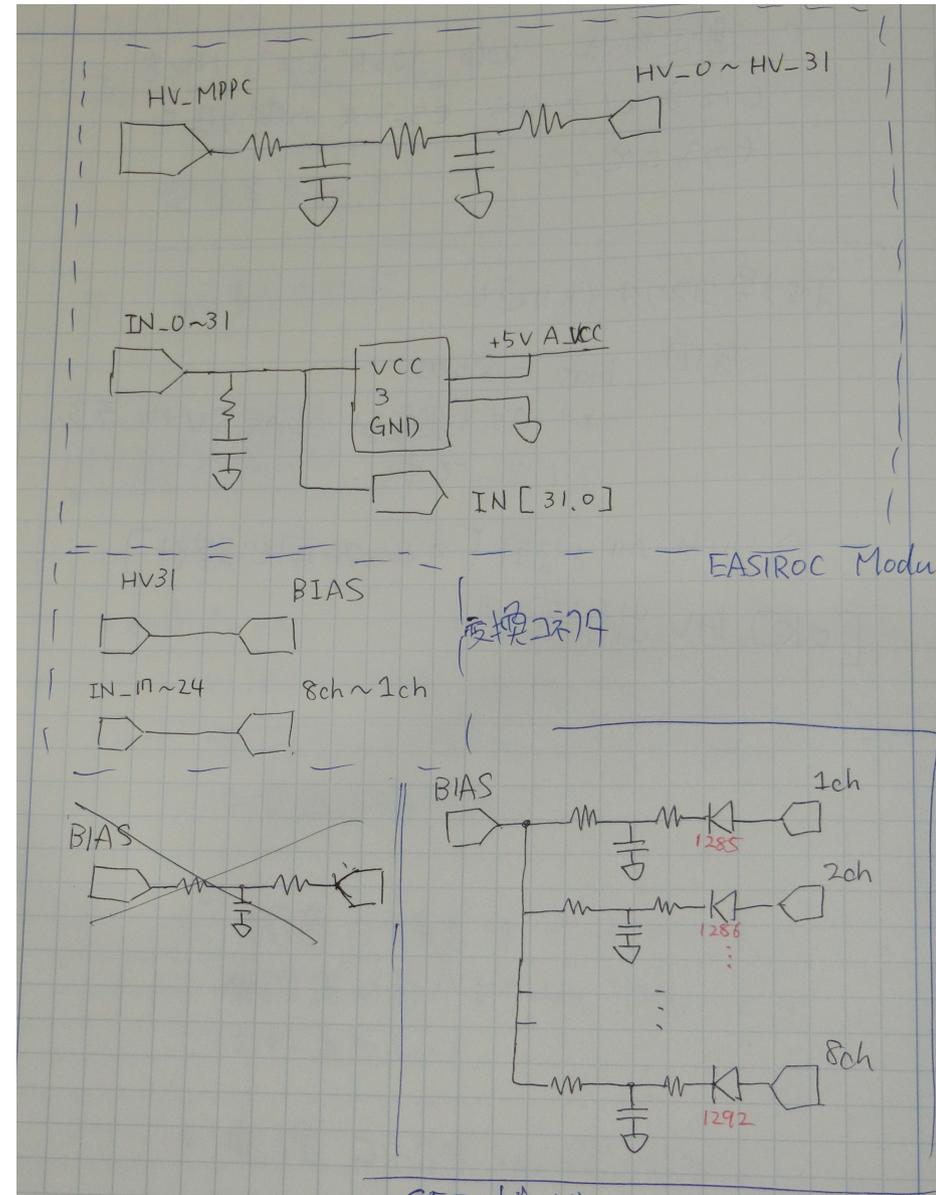
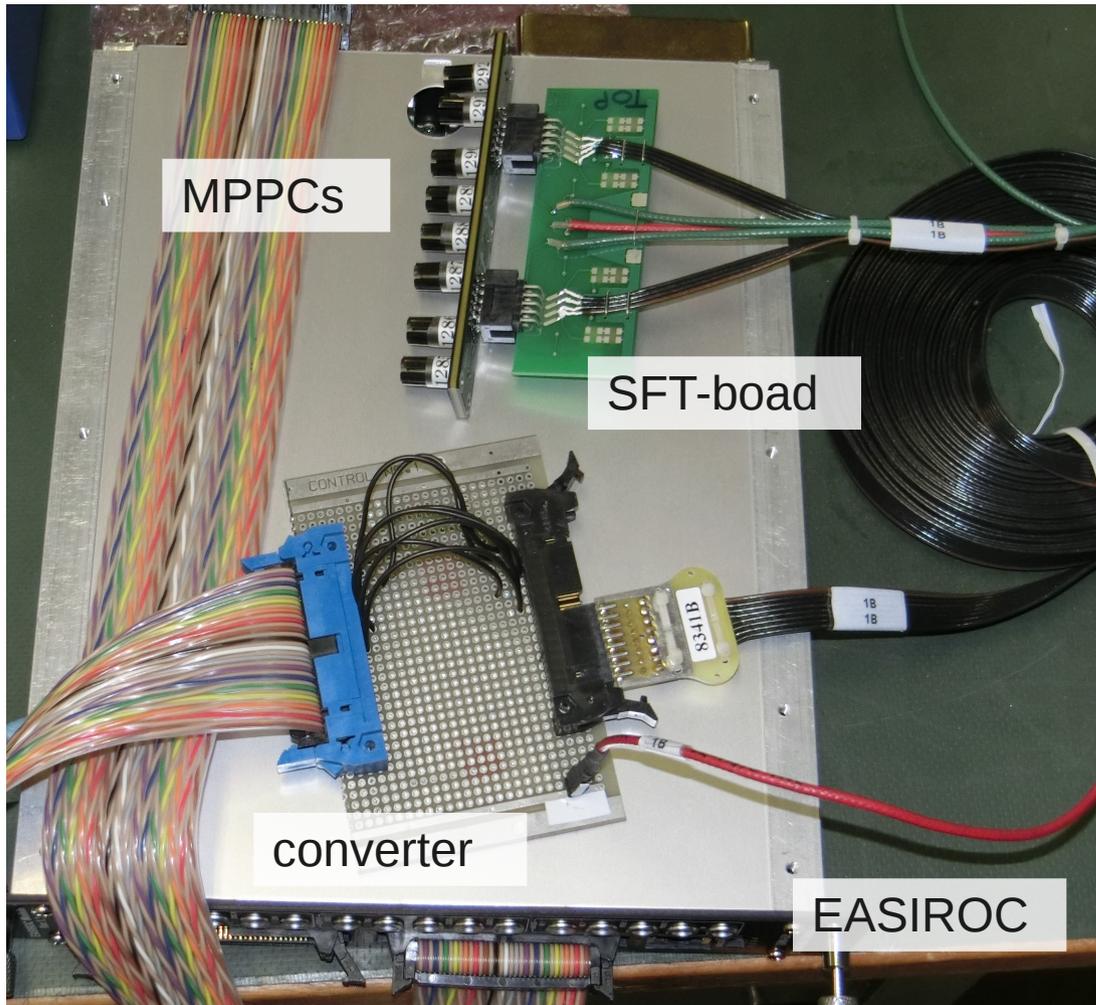
8-15 Nov. 2014

IEEE abstract dead line

Presenter

- H. ITO; “Arbitrary Shape of Cherenkov Counter Using WLS Fiber”
“Development of 3D-PET with wavelength shifting fiber”
- S. IIJIMA; “Development of realtime Sr Counter used in low rate radioactive”
- S. KODAMA
“Property Test of Threshold Type Clear Fiber Cherenkov Counter”
- N. KANEKO
“Proposal of a PET positron detector with scintillation fibers”
- D. KUMOGOSHI
“Production and performance measurement of Clear Fiber TOP counter”

E36 SFT MPPC+EASIROC module @KEK



写真のピン配置は間違っている。テストは正しくコネクタして信号を読みだした。

学振申込書類提出

研究テーマ 「任意実験環境における粒子識別装置ACCの開発」

(申請内容ファイル)

2. 現在までの研究状況 (図表を含めてもよいので、わかりやすく記述してください。様式の変更・追加は不可(以下同様))

- ① これまでの研究の背景、問題点、解決策、研究目的、研究方法、特色と独創的な点について当該分野の重要文献を挙げて記述してください。
- ② 申請者のこれまでの研究経過及び得られた結果について、問題点を含め①で記載したことと関連づけて説明してください。
なお、これまでの研究結果を論文あるいは学会等で発表している場合には、申請者が担当した部分を明らかにして、それらの内容を記述してください。

①【背景】我々は任意実験環境(限られた狭い空間、強磁場中、特殊な形状、限られた物質質量など)で動作可能な粒子識別装置としてエアロゲルチェレンコフカウンター(AC)を開発している。研究はs, cクォークを含んだハドロン物理実験が注目されておりK中間子の同定が重要である。さらに最近の大強度ビームによる高統計実験ではトリガー頻度を限定する必要がある。これが可能な粒子識別装置はしきい値型ACにおいて他にない。シリカエアロゲルは固体でありながら低密度・低屈折率をもち、製作時にシリカと空気の配合率を変えることで1.002-1.3 [1]の領域で任意に屈折率を決定できることからKEK Belle [2], J-PARC E36 [3], LEPS [4], ELPH FOREST など多くの実験の粒子識別に採用されている。

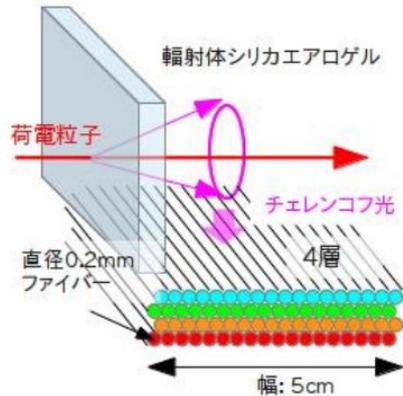


図1. チェレンコフ光ファイバーライトガイドのイメージ

(4) 年次計画

DC1申請者は1~3年目、DC2申請者は1~2年目について、年次毎に記載してください。元の枠に収まっていれば、年次毎の配分は変更して構いません。

【1年目】

E36実験 ACおよびAC2開発はM2で開発と検出器インストールを完了し、2014年度に検出器全体の性能評価を完了し2015年4月から検出器物理測定を開始する。D1は物理データを解析し $K^+ \rightarrow e^+ \nu_e$ と $K^+ \rightarrow \mu^+ \nu_\mu$ の崩壊モードの比 R_K の精密測定から、レプトン普遍性、SUSYレプトンフレーバーの破れ、MSSMの寄与など最初のデータ取得における物理結果を学位論文にまとめる。

^{90}Sr カウンター M2で試作による性能評価を行い実用化する予定であるのでD1では需要があれば大量生産プロジェクトを立ち上げる。

PET検出器 GSOプレートの層にファイバーシートを縦横で挟む。位置分解能を3mm以下の試作器を製作し性能評価する

私はD1もしくはD2の期間にE36で学位論文を提出し博士号取得を目指す。その後PDとなってFORESTに参加する。

【2年目以降】

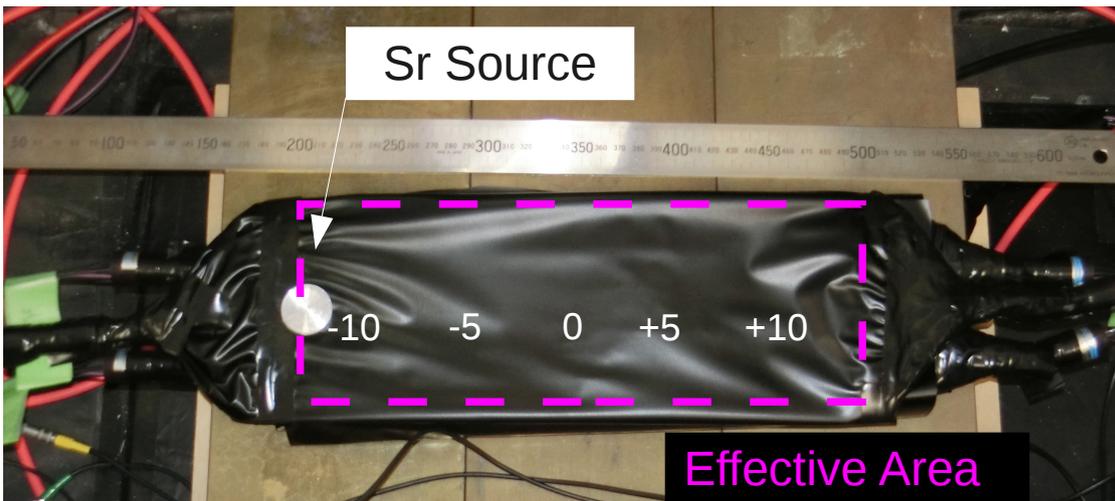
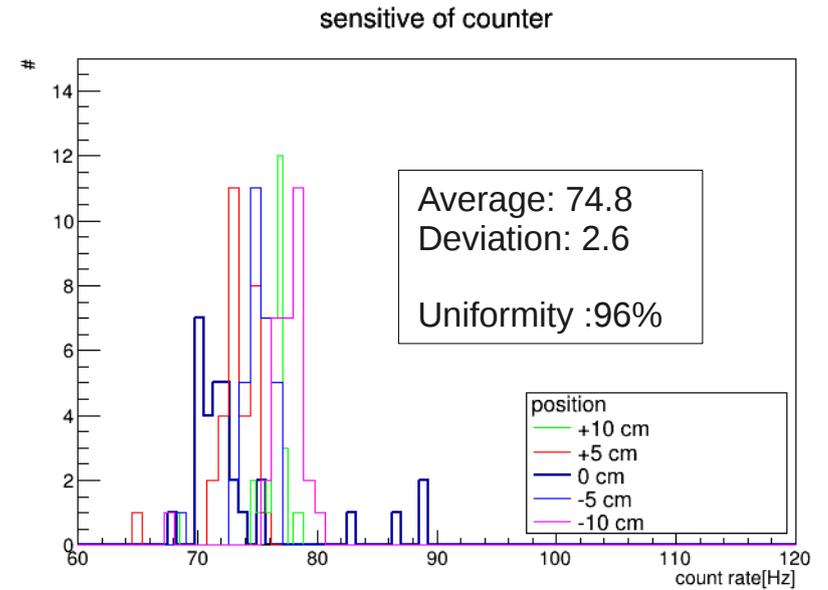
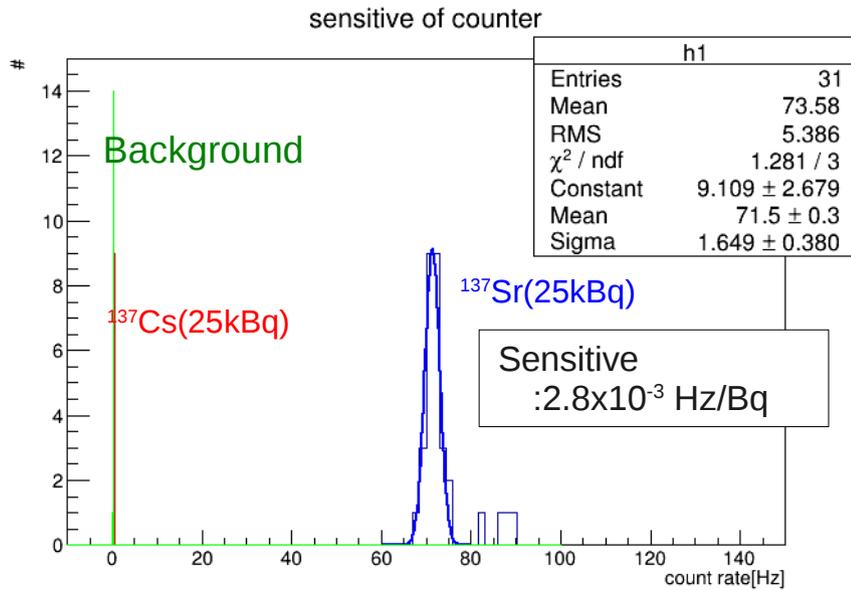
FOREST ACは2015年度末までには導入完了している予定である。D2で物理測定とデータ解析を行い、ACを入れたことによる測定精度の向上を調べる。光生成による $\sigma(600)$ や $N^*(1670)$ などのエキソティック粒子の探索について学術論文を投稿する。

任意環境における動作可能な粒子識別装置ACの開発研究を完了させる。狭い領域、任意形状、強磁場中環境の定量的な限界値を調べ、学術論文を投稿する。

(備考)LEPS II ACは千葉大が提供するが実験実施のスケジュールはまだ、未定である。D2以降検出器開発およびデータ収集・解析にも積極的に参加したい。

PET検出器 機会があれば全身用PETの製作と性能評価するプロジェクトを立ち上げ普及に励む。

Sr カウンター[30x10]性能評価測定



Prototype	
Effective area :	30 x 10 cm ²
⁹⁰ Sr sensitivity :	2.8 x 10 ⁻³ Hz/Bq
¹³⁷ Cs sensitivity:	6 x 10 ⁻⁶ Hz/Bq
BG noise ratio	0.28 Hz
Sr/Cs ratio:	500
Position uniformity :	96%

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$$N_{Sr} = aSxt + ct$$

$$N_{Cs} = bkSxt + ct$$

$$N_{Sr} > N_{Cs} + 2.58\sqrt{N_{Cs}}$$

Reliability of 99% or more

N_{Sr} : Number of counts for Sr

N_{Cs} : Number of counts for Cs

a : Sr sensitivity [Hz/Bq]

b : Cs sensitivity [Hz/Bq]

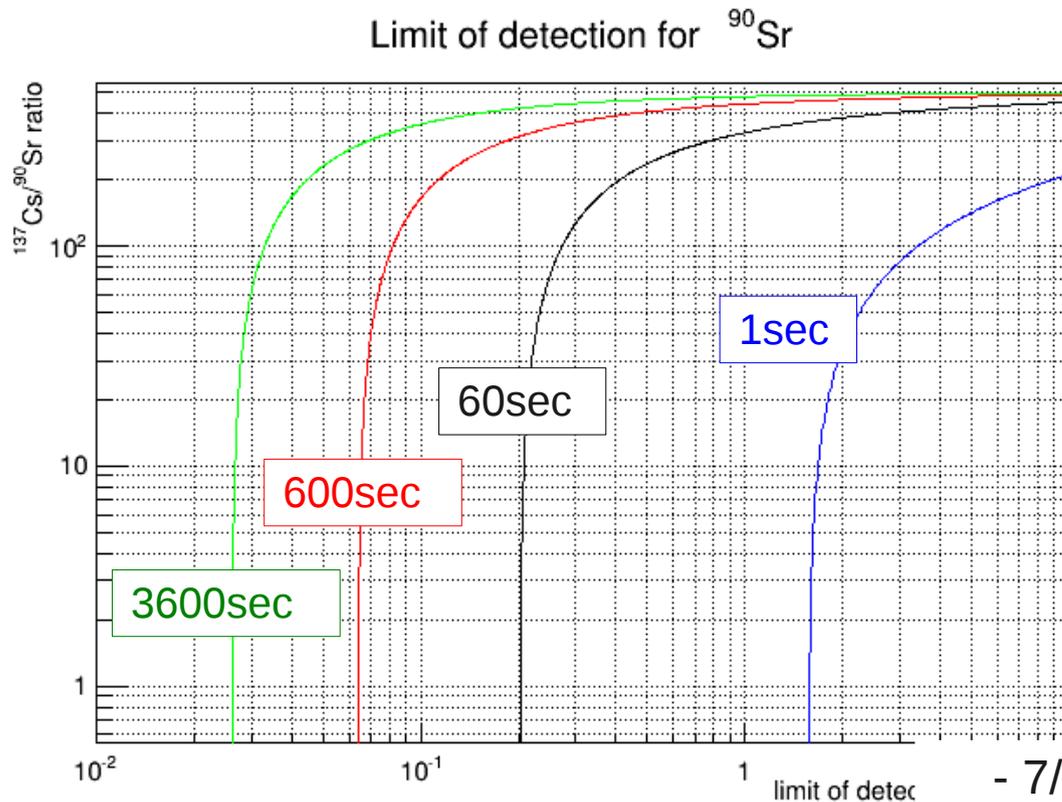
c : Noise ratio [Hz]

S : Effective area [cm²]

k : Sr/Cs ratio

t : time of measurement [sec]

x : limit of detection [Bq/cm²]



Limit of detection : ~ 0.3 [Bq/cm²]

Monitoring time : 60 sec

Allowable ratio of Cs/Sr : 100

Limit of detection : ~ 0.08 [Bq/cm²]

Monitoring time : 600 sec

Allowable ratio of Cs/Sr : 100

Sr カウンター[30x10]性能評価測定

New reference value: 10 Bq/kg of ^{90}Sr in foods

by Ministry of Health, Labour and Welfare in Japan.

Beta-ray is stopped with water depth of a few cm.



Limit 30 Bq/kg	...	60 sec
Limit 8 Bq/kg	...	600 sec

The limit of detection satisfies the reference value with monitoring of 10 minutes.

春の学校2014@滋賀 琵琶湖クラブ



IceCube PMT responses to Double light pulse events

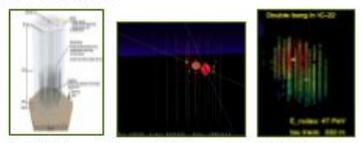
Shunsuke Ueyama
Department of Physics, Faculty of Science, Chiba University
IceCube Collaboration

Introduction

IceCube₁ is a neutrino telescope at the South Pole. IceCube is focused on seeing high energy neutrinos, which can help us understand a variety of astronomical phenomena such as gamma ray bursts, supernovae, neutrino oscillations, and the origin of cosmic rays.

Since neutrinos are weakly interacting particles, they are hard to detect. 51 60 Photo Multiplier tubes (PMTs) were deployed in Antarctic glacier. When we target very large signals which have more than 100GeV, it is important to think about "Coincidence" (signals come to detectors at the almost same time) or "Double bangs". "Double bangs" are produced by very high energy primary tau neutrinos because it has a short life. This phenomenon makes possible the generation of two extensive showers.

In this paper, supposing these situations, we study PMT's response to successive light pulses.



Double pulse behaviors

In this analysis I calculate NPE for 300ns which is enough width to include the double pulse.

In the (1-1) case, The data are stable against NPE, which is expected because two lights shouldn't correlate.

In the (1-2) case, I see strange behavior. The black points are real data which were taken using the double pulse. The red points are the ideal values, which are checked by summing the data with only the pulser (turn off LED and only the LED (turn off pulser)). Around 40ns~120ns, although NPE values decrease a little bit (less than 25%), they are normal. This is because the pulser light becomes a little smaller over time.

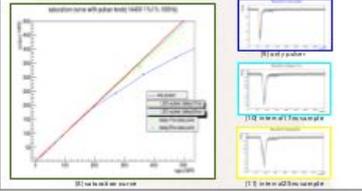
The data around 0ns~40ns are the most important points because the pulser light and LED are overlapping which may cause saturation to occur. If that is true, I can explain these behaviors. The double pulse is regarded as a single large signal.

For further details, I discuss saturations under block.

Saturation curve

I study a PMT saturation curve, for gain of 10⁷. The measured NPE is plotted against the ideal NPE. Although it is natural, each saturation curve is different from the others because the pulse width of LED (50ns) is broader than one of pulser (500ps). The smaller the pulse width is, the earlier saturation can occur. Indeed depending on "only pulser", "LED+pulser(interval 17ns)", or "LED+pulser(interval 25ns)", the width and form differ each other a little.

I tried to apply saturation curve with the data of double pulse. When the interval is 17ns or 25ns, I plot (1-1) and (1-2) data together (8) yellow and aqua points). They are 3%~6% different from the saturation curves. At this time, I am unsure if these differences are due to systematic errors, or some unknown effect. Further work is needed.



Method

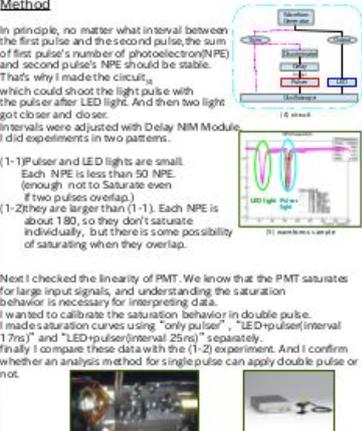
In principle, no matter what interval between the first pulse and the second pulse, the sum of first pulse's number of photoelectron(NPE) and second pulse's NPE should be stable. That's why I made the circuit, which could shoot the light pulse with the pulser after LED light. And then two light got closer and closer.

Intervals were adjusted with Delay NIM Module. I did experiments in two patterns.

(1-1) pulser and LED lights are small. Each NPE is less than 50 NPE (enough not to saturate even if two pulses overlap).

(1-2) they are larger than (1-1). Each NPE is about 180, so they don't saturate individually, but there is some possibility of saturating when they overlap.

Next I checked the linearity of PMT. We know that the PMT saturates for large input signals, and understanding the saturation behavior is necessary for interpreting data. I wanted to calibrate the saturation behavior in double pulse. I made saturation curves using "only pulser", "LED+pulser(interval 17ns)" and "LED+pulser(interval 25ns)" separately. Finally I compare these data with the (1-2) experiment. And I confirm whether an analysis method for single pulse can apply double pulse or not.



Reference

[1] Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment
[2] IC22 LINE Tau Neutrino Search - IceCubeWiki
[3] Diffuse neutrino fluxes and GZK neutrinos with IceCube

Summary

On double pulse, IceCube PMT works correctly when the sum of NPE is below 100, but when it become larger than 350, something happens. Maybe this is because saturation occurs, however they don't have consistence with the saturation curves. So they may have another reason. I'll check systematic errors.



2-6 June 2014, Amsterdam, Netherlands
Sensors, Novel technologies

Development of Multipurpose Aerogel Cherenkov Counter

H. Ito, S. Iijima, S. Han, H. Kawai, S. Kodama, D. Kumogoshi, K. Mase, M. Tabata
Department of Physics, Chiba University, Chiba, Japan

Abstract

We have been developing a multipurpose aerogel Cherenkov counter which is able to identify charged particles at any environments such as a limited space and high magnetic field [1,2]. The device is composed of an aerogel radiator [3], light guide made of 4 kinds of wavelength shifting (WLS) fibers and small photo-device (PMTs or SiPMs). Cherenkov light emitted from the aerogel radiator is collected by the fiber light guide, and transferred to the both ends of the fiber by a total reflection condition. Therefore, this counter enables to identify particles on a large effective area and arbitrary shape with a small photo-devices.

Light Guide using WLS fibers

WLS fibers made by Kuraray Co., Ltd. have the following properties: 4 kinds of absorption and emission wavelengths (B-3, Y-11, O-2, and R-3), trapping efficiency of 5.4% by double cladding, attenuation length of about 3 m and 0.2 mm minimal diameter [4]. Cherenkov light emitted from the aerogel radiator is transferred the both ends of the fiber by the total reflection condition. Since the light has continuous spectrum depending on the wavelength, collection efficiency would be improved. Furthermore, the light leaked from a fiber layer would get a chance to be absorbed by another fiber layer.





Fig. 2: The light guide has two sensitive faces with the fibers (left) and two side faces are covered with it (top right). A box has a V-shaped reflector and internal. Total aerogel size is (120 mm x 90 mm) x 60 mm (bottom right).

Performance Measurement

We performed a performance measurement of the prototypes with a test beam line, where a positron produced from gamma ray of a few GeV/c. Two scintillation trigger counters were used at the upstream and downstream ends of the aerogel counter. Cherenkov light emitted from the radiator enter the fiber light guide reflected by the reflector placed at 45 degrees. The efficiency and number of detected photoelectrons were decided from "or" logic with detection events of 4 PMTs. The result and schematic of the setup are shown in figures below.

Fiber Light Guide	effective area/cm ²	P.E.	error	collection eff.
B-3/R-3	60 x 100	1.28	0.03	6.1%
B-3/Y-11	60 x 100	1.14	0.03	6.0%
B-3	60 x 100	1.10	0.03	6.7%
B-3/Y-coating	60 x 100	1.42	0.03	8.0%
B-3/R-3	120 x 100	1.81	0.03	7.4%
reference	60 x 100	1.77	0.03	-

Table 1. The result of prototype counter's performance.

Summary

We have performed production and performance measurements of the prototype counter. The device did not obtain sufficient number of detected photoelectrons; however, it would be increased by using SiPMs, improving the collection efficiency of WLS fibers, and changing combination with the fibers. Furthermore, we have an idea of covering all of the side face on the radiator. Nobody has been performed it; however, the idea is possible by using the device.

References

[1] H. Ito et al., Conference Record on IEEE Nuclear Science Symposium (2013) NP01-94.
[2] M. Kubo et al., Conference Record on IEEE Nuclear Science Symposium (2011) pp. 1103-1106.
[3] M. Tabata et al., Nucl. Instrum. Methods A 668 (2012) 64.
[4] Kuraray Co. Ltd., Kuraray's Scintillation Materials. Product Catalog. Available: <http://kuraraypsf.jp/>

Production of Prototype

A prototype counter has an effective area of 120 mm x 100 mm read by the WLS fibers and PMTs. The aerogel radiator have a refractive index of 1.05 and a total thickness of 60 mm. We observed a collection efficiency of about 8%, the mean number of detected photoelectrons of 1.3 p.e., an uniformity of 90% or more, and timing resolution of 140 ps.

Cherenkov light emitted from the aerogel enters the fiber light guide by being reflected by a V-shaped reflector, and is transferred to 4 ends of the fibers. A cross section of each end of the light guide is 7 mm in diameter, and the connected PMTs have a small photo-cathode of 8 mm in diameter.

TIPP '14 @ Amsterdam in Netherlands

6/1 飛行機 成田 to アムステルダム (through 香港)

出発18:20

6/2 AMS到着AM7:00

Session start

6/3 **ポスター発表**, session

6/4 **オーラル発表**, session

6/5 session, dinner conference @ Heineken Bier

6/6 session close

→ 観光

6/7 飛行機 アムステルダム to 成田 (through 香港)

出発12:00

6/8 成田到着 15:00

2014.05.01-06.06の仕事報告 まとめ

- ファイバーシート作成 … 5個
- E36ミーティング参加
- 実験 … Srカウンター性能評価測定
- 解析 … Srカウンター性能評価測定
M-ACC ビームテスト性能評価測定
- 提出 … IEEE NSS/MIC abstract (x2)
日本物理学会 abstract
学振申し込み
- 発表 … 春の学校：ポスター(M-ACC)
TIPP： 口頭発表(Srカウンター)
ポスター(M-ACC)