

# 進捗報告

2015.02.28 – 2015.03.06

## DOI-PET/WLSF

日本医学物理学会CyPos提出完了  
GSO+Y-11: ReAnalysis  
GAGG+R-3: Setup

## M-ACC

LEPS II Detector Meeting 準備  
日本物理学会発表準備

## SrCounter

PoS(TIPP2014)242 Accept

# 日本医学物理学会CyPos登録完了

**O-003**  
H. ITO (Chiba Univ.)

The 109th Meeting of Japan Society of Medical Physics  
Date: 16 - 19 April 2015  
Venue: Pacifico Yokohama

## Readout of high resolution DOI for whole-body 3D-PET detector using wavelength shifting fibers

Hirashi ITO<sup>1)</sup>, Soeun Han<sup>1,2)</sup>, Naemi Kaneko<sup>1)</sup>, Hideyuki Kawai<sup>1)</sup>, Satoshi Kodama<sup>1)</sup>, Atsushi Kobayashi<sup>1)</sup>

<sup>1)</sup>Physics Department, Graduate School of Science, Chiba University, Japan.  
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### Conflict of Interest Disclosure

None of the authors have any potential or actual conflict of interest with the following companies:

- 2014年度研究助成金、公募型選任人、小笠原国立大学先端先端研
- 特別出版、千葉大学、平成27年1月12日、掲載(2014-0530)

研究報告書

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### PET, Positron Emission Tomography

**Hardware**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

**DOI (Depth of Interaction)**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

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### Recent Study Features

**WLSF Structure**

- The only whole Crystal array
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

**Key**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

**Adv.**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
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### New Data Results

**Material**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

**High Performance**

- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)
- 1.5m x 1.5m x 1.5m (1.5m x 1.5m x 1.5m)

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### Primary Experiment

#### 1. WLSF readout test

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### Primary Experiment

#### 2. Position Reconstruction by LED test

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#### 2. Position Reconstruction by LED test

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### Result of Experiment

1.  $GW = WLSF + NaI$  test
  - $Np > 1.2$
  - Less yield for positioning
2. reconstruction test by LED
  - Achieved resolution of  $FWHM 1.2$  mm
  - resolution  $\approx$  fiber strip width
  - Require yield of 4 p.e. for the enough

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### Application

If it is used the WLSF + NaI, the resolution is better than FWHM 1.2 mm.

If it is used the WLSF, the resolution is better than FWHM 1.2 mm.

Lower cost and higher yield for the enough.

## GSO+Y-11: ReAnalysis

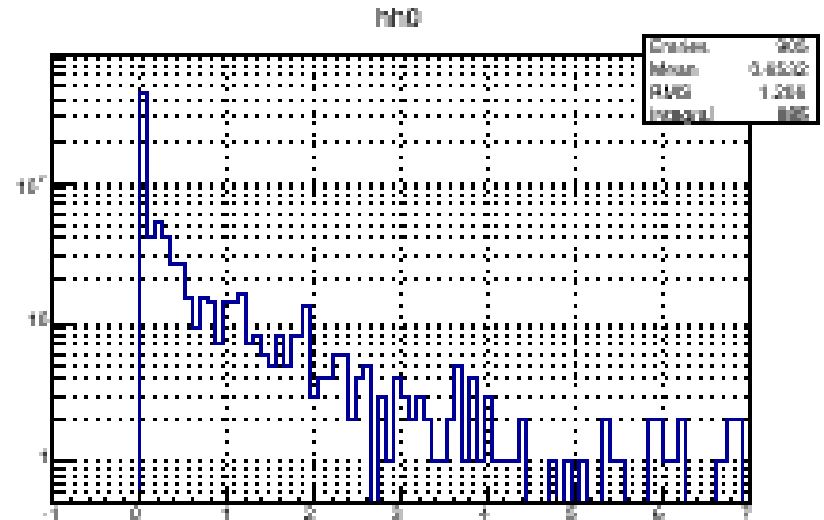
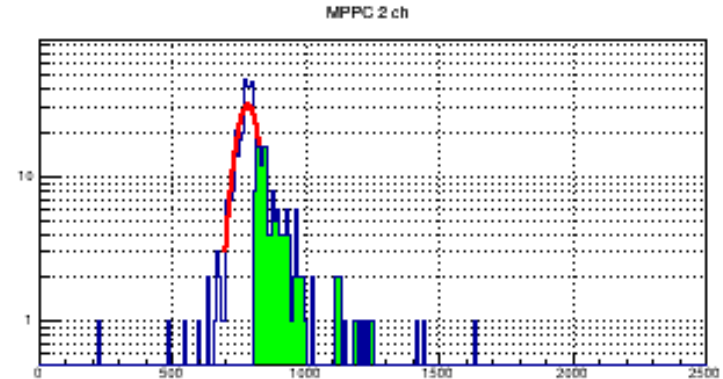
modification

ADC Distribution

- (1) Pedestal Mean:  
Gaussian Fitting  
~800 ADC Channel
- (2) The Mean  $M_{ped} = 0$  p.e.
- (3)  $ADC < M_{ped} := 0$  p.e.

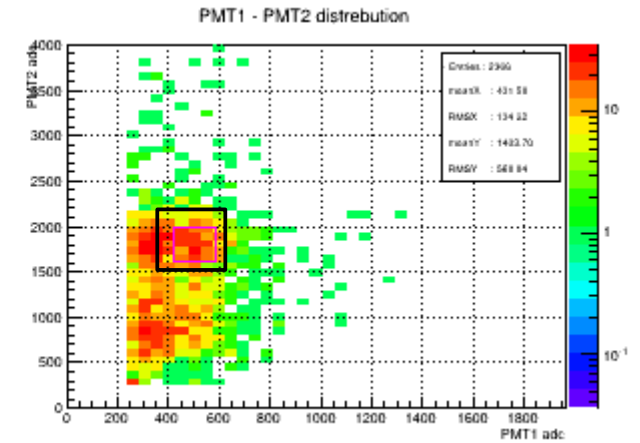
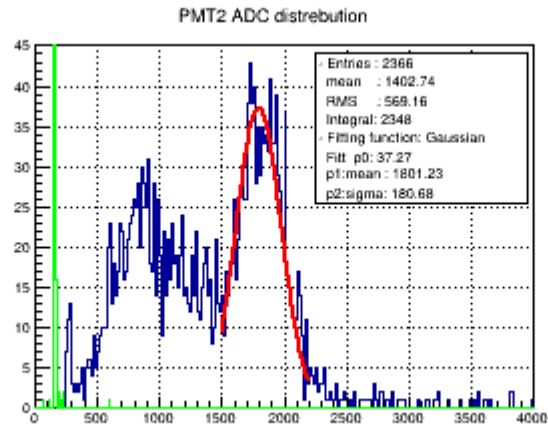
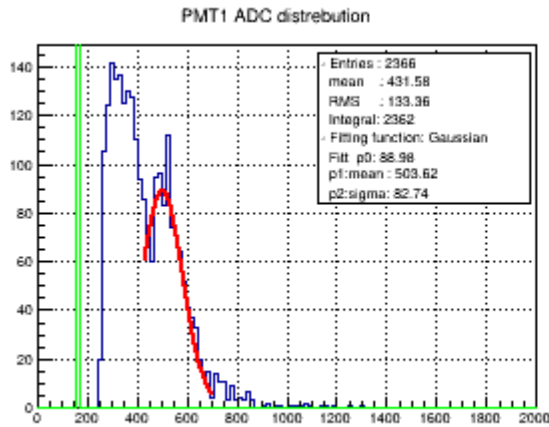
p.e. Distribution

- (4) New ROOT file  
→ Skimming
- (5) 平均光電子数が見積もれる  
※ペDESTALが太い



## GSO+Y-11: ReAnalysis

## Data Tagging



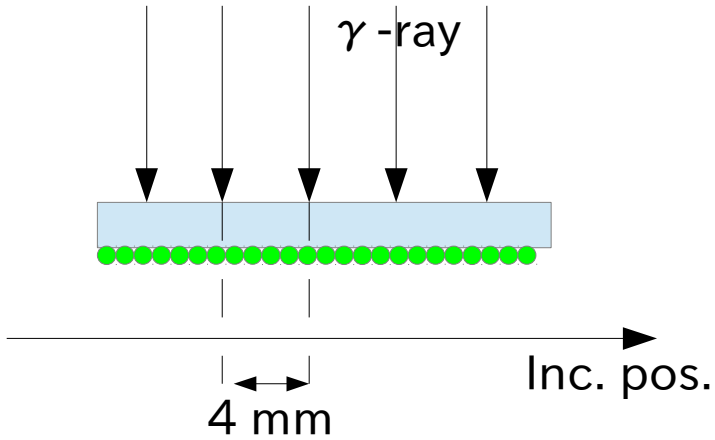
データカット

トリガーカウンター2個が同時に光電効果した事象をpickup

カット範囲はMean  $\pm$   $\sigma$

# GSO+Y-11: ReAnalysis

## Incident - Reconstruction Positions



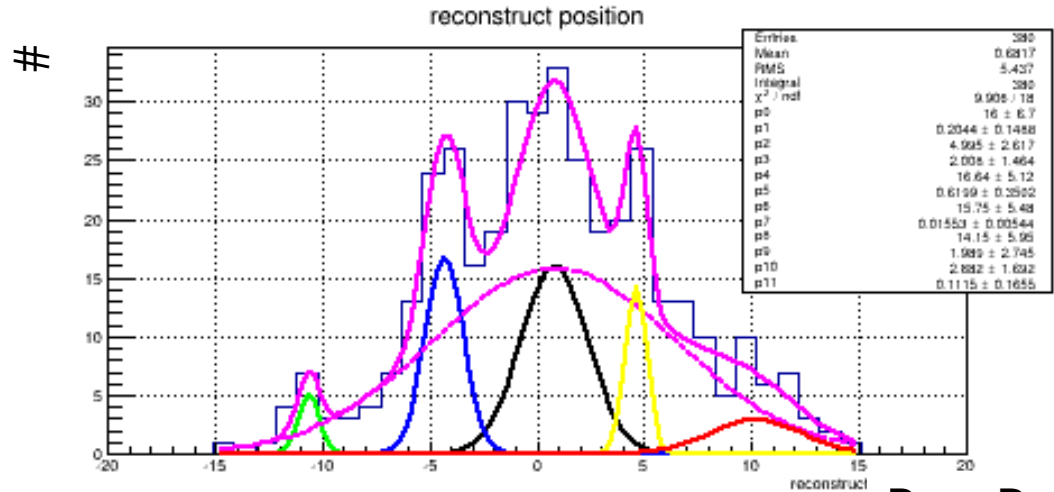
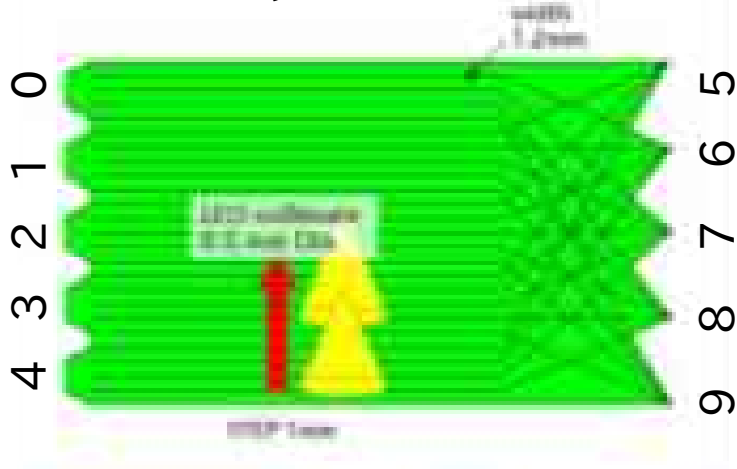
$$\text{Rec. Pos.} = X1 + X2$$

$$X1 = \left\{ \frac{\sum Q_i d1}{\sum Q_i} \right\}$$

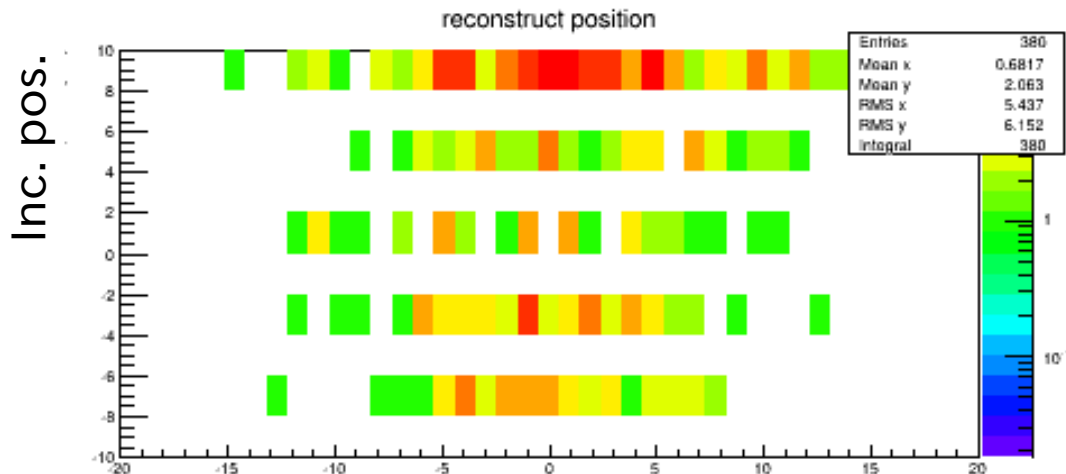
$$X2 = \left\{ \frac{\sum Q_j d2}{\sum Q_j} \right\}$$

$d1 = 6.0 \text{ mm}, d2 = 1.2 \text{ mm}$

$i=0-4 \text{ ch}, j=5-9 \text{ ch}$

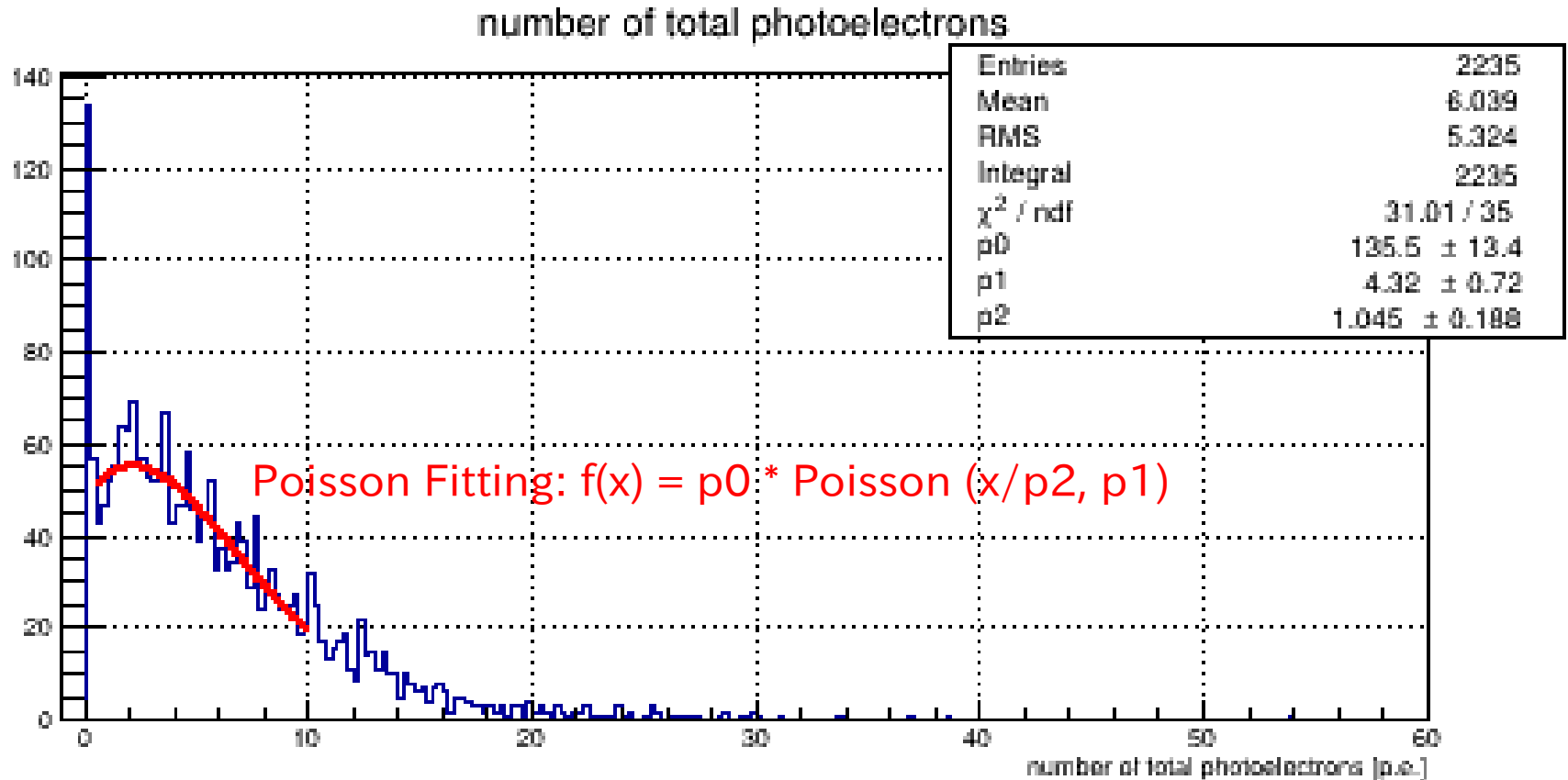


Rec. Pos.



Rec. Pos.

## GSO+Y-11: ReAnalysis



- MPPC 10個の合計平均光電子数は4 p.e. ?
- 比較するためにはバックグラウンドを引くべきだろ?
- 光電子数ピークが2p.e.ずつというのは  
キャリブレーション合ってる?

## GAGG+R-3: Setup

- [ ] Setup作成 (3/1 – 3/14)
  - [OK] R-3 for connecting PMT (3/5)
    - 1, 2, 3, 4 layers
  - [OK] R-3 for connecting 10 MPPCs (3/5)
    - 1 layer
  - [ ] 固定具(木工)実験ジオメトリ作成 (3/8 – 3/10)
  - [ ] 回路 & DAQ
  - [ ] MPPCs ReCalibration (3/12 – 3/14)
- [ ] 実験1: GAGG + R-3 @PMT, Layer vs. p.e.
- [ ] 実験2: GAGG + R-3 @ MPPCs, Inc. vs. Rec. Pos. (x-axis)
- [ ] 実験3: GAGG + R-3 @ MPPCs, Inc. vs. Rec. Pos. (z-axis)

## スケジュール

2015年 3月

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

LEPS 英語発表練習 (3/8)

Setup作成 (3/1-3/14)

LEPS (3/11)

MPPC Calib. (3/12-3/14)

exp1 (3/15-3/18)

物理学会発表練習 (3/19-3/21)

物理学会 (3/23)

exp2 (3/25-3/28)

千葉大入学手続き (3/26-3/28)

一旦まとめ:ポスター (3/29-3/31)

2014年 4月

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

ANTIMMA Summary 〆切 (4/1)

医物学会 (4/16)

ANIMMA (4/22-4/26)

総括発表 (4/29)

## LEPS II Detector Meeting 準備

## スライド作成

## 構成内容

1. Introductino: LEPS II ACPlan
2. Index
3. MPPC array type AC desing
4. ELPH Beam test
  - Setup
  - Analysis
  - Result ←
5. Discussion
  - その1
  - その2

まだ完成していない。



## 発表練習

1. 日本後で言いたいことを書く
2. 英語に直す
3. 日本後で自分ツッコミで質疑応答を考える
4. 英語になおす。

[まだ] LEPSのサーバにアップロード  
 [ ] 河合さんにOKをもらう  
 本番3/11





## Development of real time $^{90}\text{Sr}$ Counter applying Cherenkov light detection

H. Ito\*, S. Iijima, S. Han, H. Kawai, S. Kodama, D. Kumogoshi, K. Mase, M. Tabata

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Radioisotopes have been emitted around Japan due to a nuclear accident at the Fukushima daiichi nuclear power station in March 2011. A problem is the contaminated water including the atomic nucleus which relatively has a long half-life time such as  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$  generated from  $^{235}\text{U}$  used for nuclear fuel. Internal exposures by  $^{90}\text{Sr}$  are more dangerous than  $^{137}\text{Cs}$ 's because it has a long biological half-life (49years). Therefore, real-time  $^{90}\text{Sr}$  counter has been required. It is relatively easy to identify a nucleus emitting gamma ray, but it is more difficult to identify a nucleus emitting pure beta ray such as  $^{90}\text{Sr}$ . Typically, measurement of a radioactivity absolute value of  $^{90}\text{Sr}$  takes a month at least to give a result. At first, we aim to identify  $^{90}\text{Sr}/^{137}\text{Cs}$  by threshold type Cherenkov detection. It needs radiator which has less than 1.0492 of refractive index for identification of  $\beta$ -ray with maximum energy of 2.28 MeV from  $^{90}\text{Sr}$  and 1.17 MeV from  $^{137}\text{Cs}$ . Recently, The material satisfying this condition does not exist except the silica aerogel. We produced a prototype counter and evaluated performance. The sensitivity is observed  $(5.49 \pm 0.06) \times 10^{-3}$  Hz/Bq and  $(1.12 \pm 0.66) \times 10^{-5}$  Hz/Bq of  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ , respectively. And the counter achieved  $(2.0 \pm 1.2) \times 10^{-3}$  of sensitivity ratio between  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$ .

POS(TIPP2014)242

*Technology and Instrumentation in Particle Physics 2014,  
2-6 June, 2014  
Amsterdam, the Netherlands*

\*Speaker.

## ANIMMA ポスター発表準備

- TIPPの内容とIEEEの内容をあわせ、プラス修論の内容を加える。
- 林栄精器のPackage後の写真をつくる。
- パンフレット作成(一般用/技術者用)
- ポスター作成
- IEEE Transactionの準備: 英文を作成する。

## スケジュール

2015年 3月

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
LEPS 英語発表練習			11	12	13	14
8	9	10	11	12	13	14
Setup作成			LEPS	MPPC Calib.		
15	16	17	18	19	20	21
exp1			物理学会発表練習の日			
22	23	24	25	26	27	28
物理学会			exp2	千葉大入学手続き		
29	30	31				
一旦まとめ:ポスター						

2014年 4月

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
		ANIMMA Summary	SrCounterポスター作成			
6	7	8	9	10	11	12
SrCounterポスター作成、論文作成			医物学会スライド作成、学振書類作成			
13	14	15	16	17	18	19
医物学会発表練習			医物学会	ANIMMA発表練習		
20	21	22	23	24	25	26
ANIMMA						
27	28	29	30			
		昭和の日				

## 来週の仕事

3/8 – 3/11

DOI-PET/WLSF Setup作成の完了  
LEPS II Detector Meeting 発表練習

3/12 – 3/15

MPPC Calibration

HV-Gain

@ PreAmp Gain 150, time Coeff. 50