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CHIBA UNIVERSITY

Study and Search for Main Reason of Lung Cancers Based on Cherenkov Radiation in Environmental Radiation
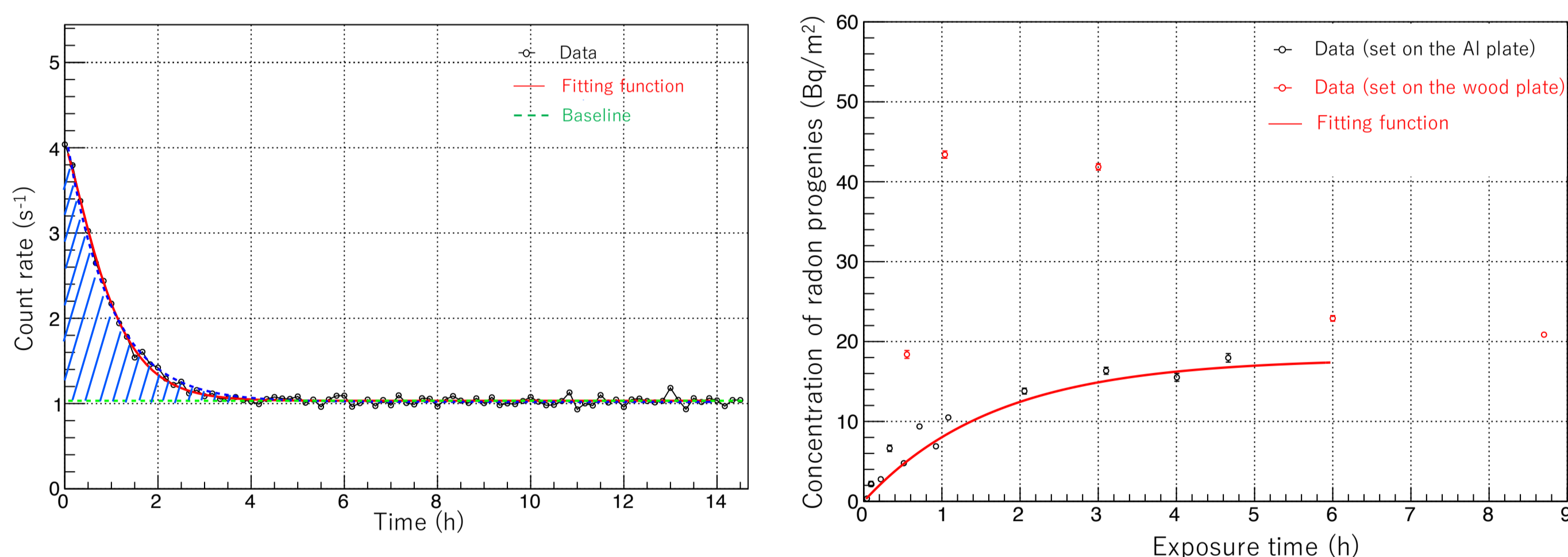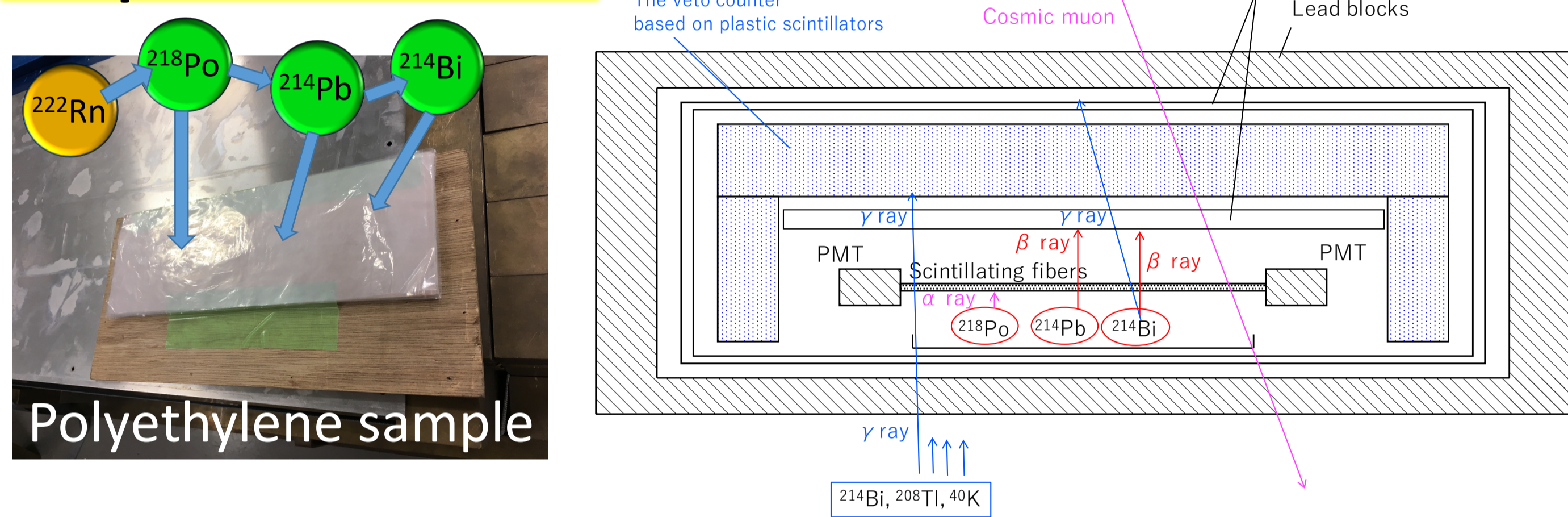
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Abstract—The surface concentration of ^{214}Bi on the sample was measured. The behavior of radon progenies in the air is discussed by a research for the progenies attaching on the sample after the radon decay. Thus, understanding the behavior of progenies in the air makes to clear the causal relation between the radon concentration and lung cancers.
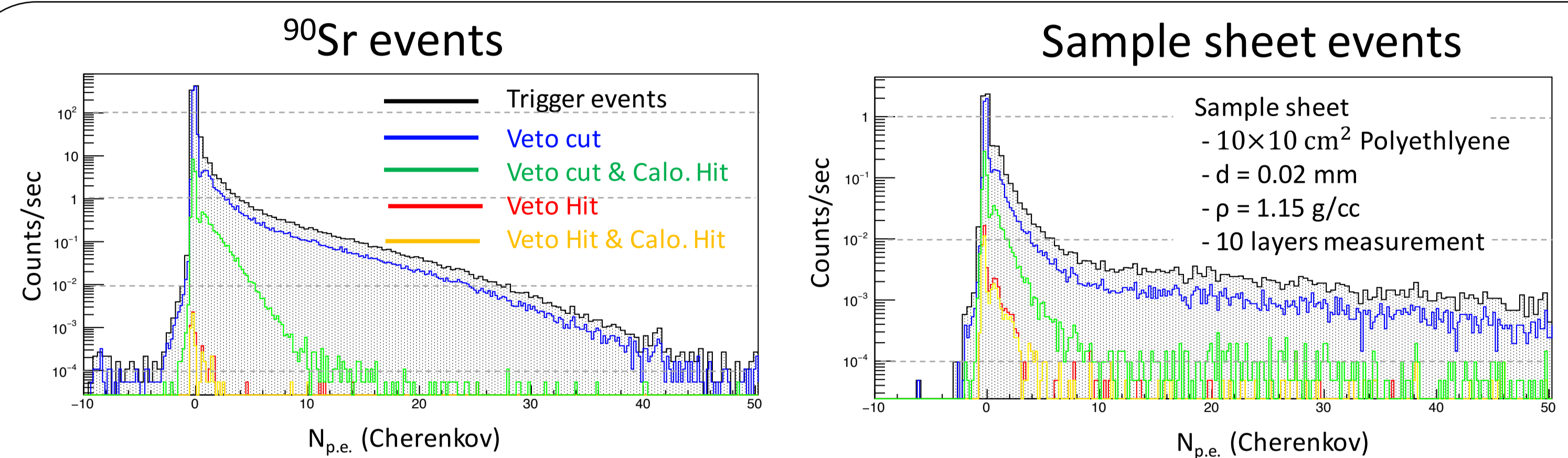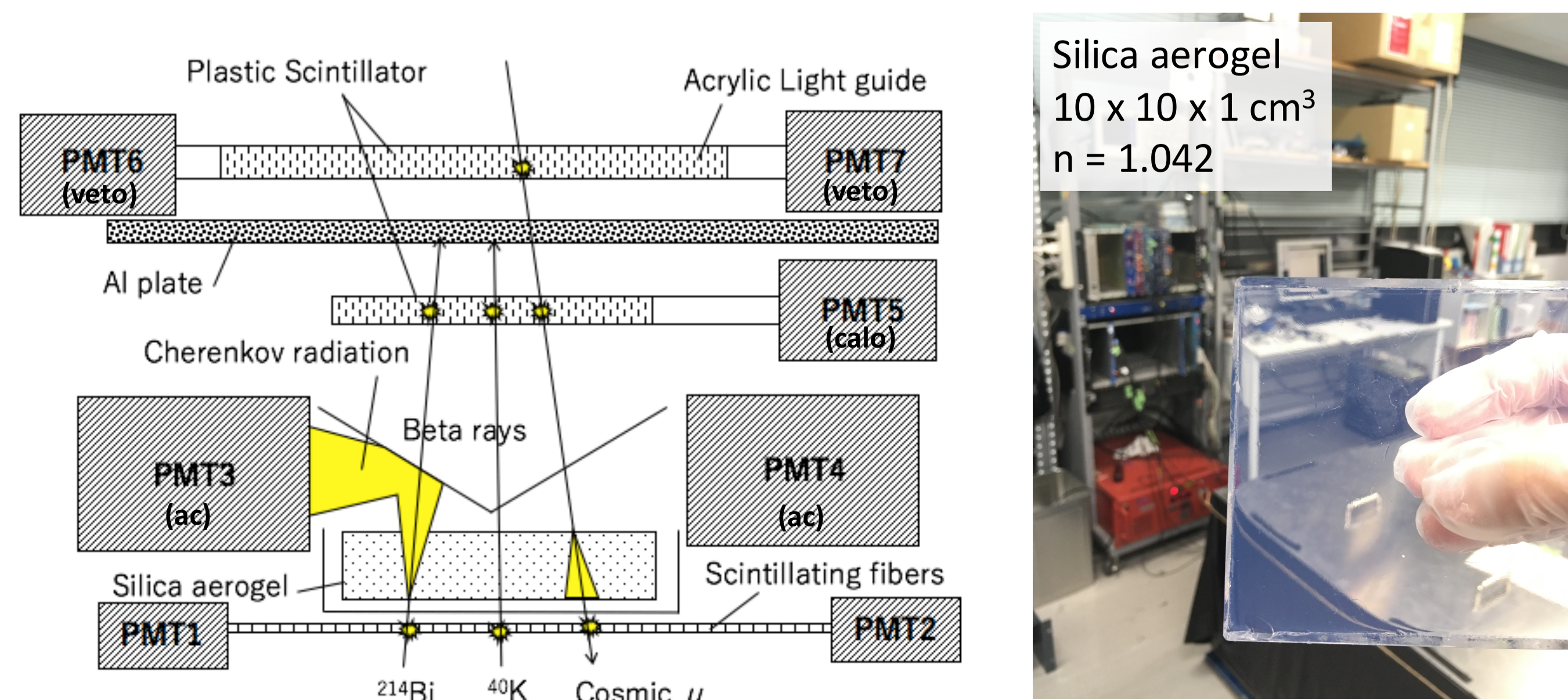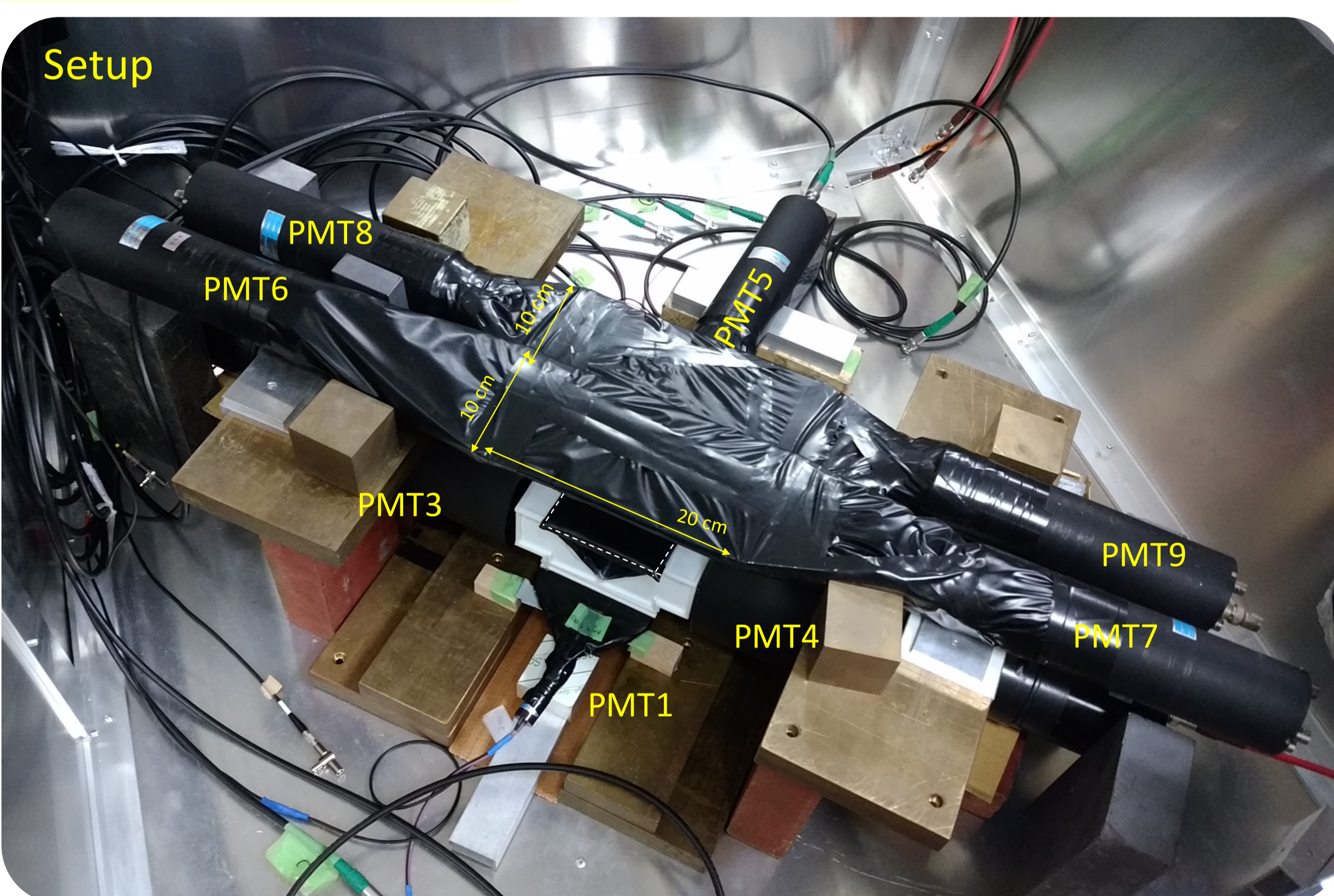
Introduction

- Lung cancer patient increases to 8-13% per every rising 100 Bq/m^3 radon[1].
- Annual radioactive dose is 1.15 mSv by ^{222}Rn (45 Bq/m^3 in the air) inhalation [2].
- Radon inhalation is a strong candidate of the reason of lung cancer in the nature [3, 4].
- However, a reason why the radon contributes to the lung cancer have been not understood.
- This study focuses to radon progenies (^{218}Po, ^{214}Pb, and ^{214}Bi) in the air.
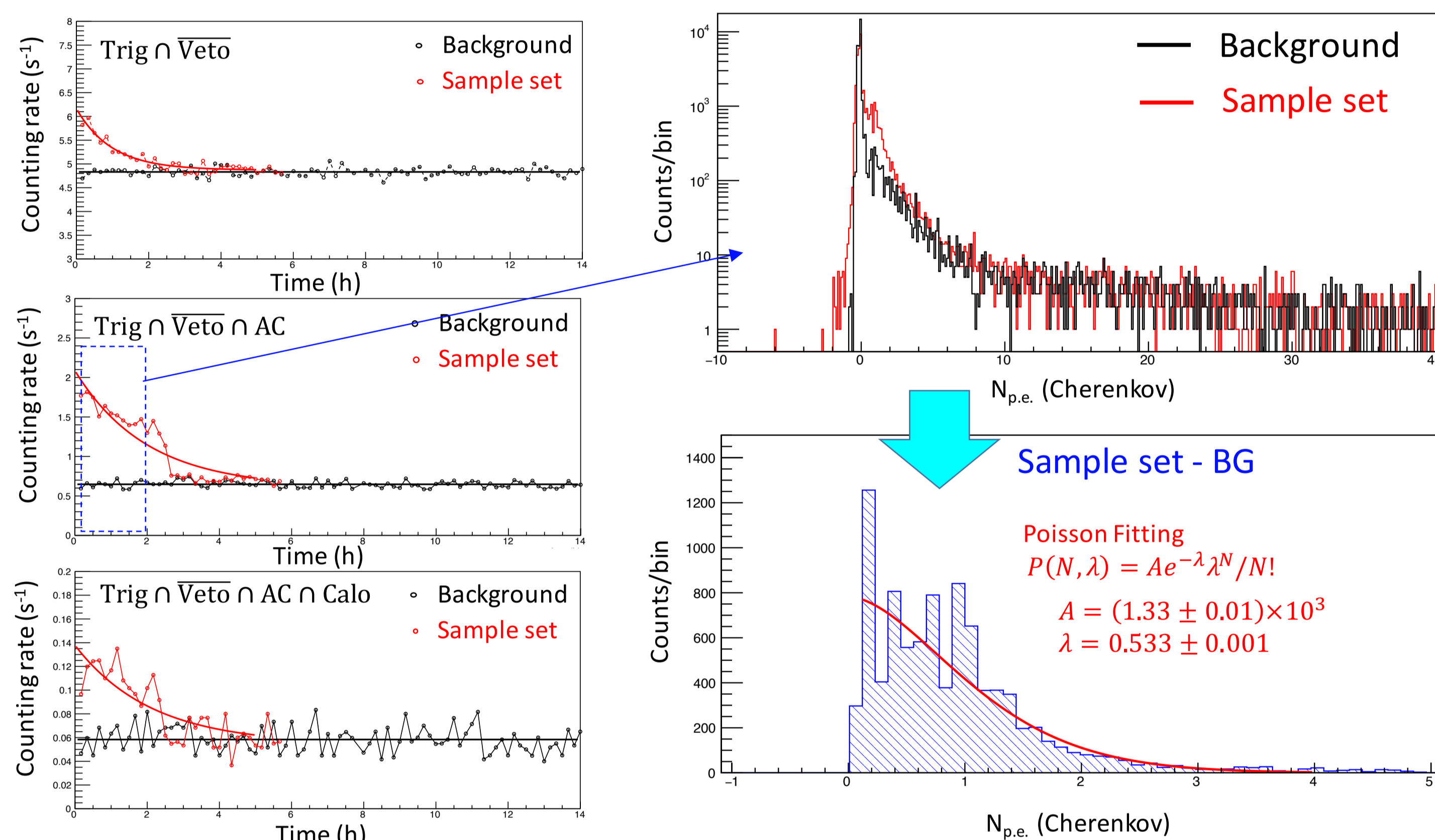
Experiment 1

Polyethylene sample

Experiment 2

Setup

PMT8, PMT6, PMT5, PMT3, PMT9, PMT4, PMT7, PMT1

Silica aerogel
10 x 10 x 1 cm^3
n = 1.042

Plastic Scintillator — Acrylic Light guide

PMT6 (veto) — PMT7 (veto)
Al plate
Cherenkov radiation — PMT5 (calo)
PMT3 (ac) — Beta rays — PMT4 (ac)
Silica aerogel — Scintillating fibers
PMT1 — PMT2
^{214}Bi ^{40}K   Cosmic μ

^{90}Sr events

Trigger events, Veto cut, Veto cut & Calo. Hit, Veto Hit, Veto Hit & Calo. Hit

$N_{p.e.}$ (Cherenkov)

Counting rate time spectra

Trig ∩ $\overline{\text{Veto}}$ — Background, Sample set
Trig ∩ $\overline{\text{Veto}}$ ∩ AC — Background, Sample set
Trig ∩ $\overline{\text{Veto}}$ ∩ AC ∩ Calo — Background, Sample set

Sample set

$N_{p.e.}$ (Cherenkov)

Sample set - BG

Poisson Fitting
$$P(N,\lambda) = Ae^{-\lambda}\lambda^N/N!$$
$A = (1.33 \pm 0.01)\times10^3$
$\lambda = 0.533 \pm 0.001$
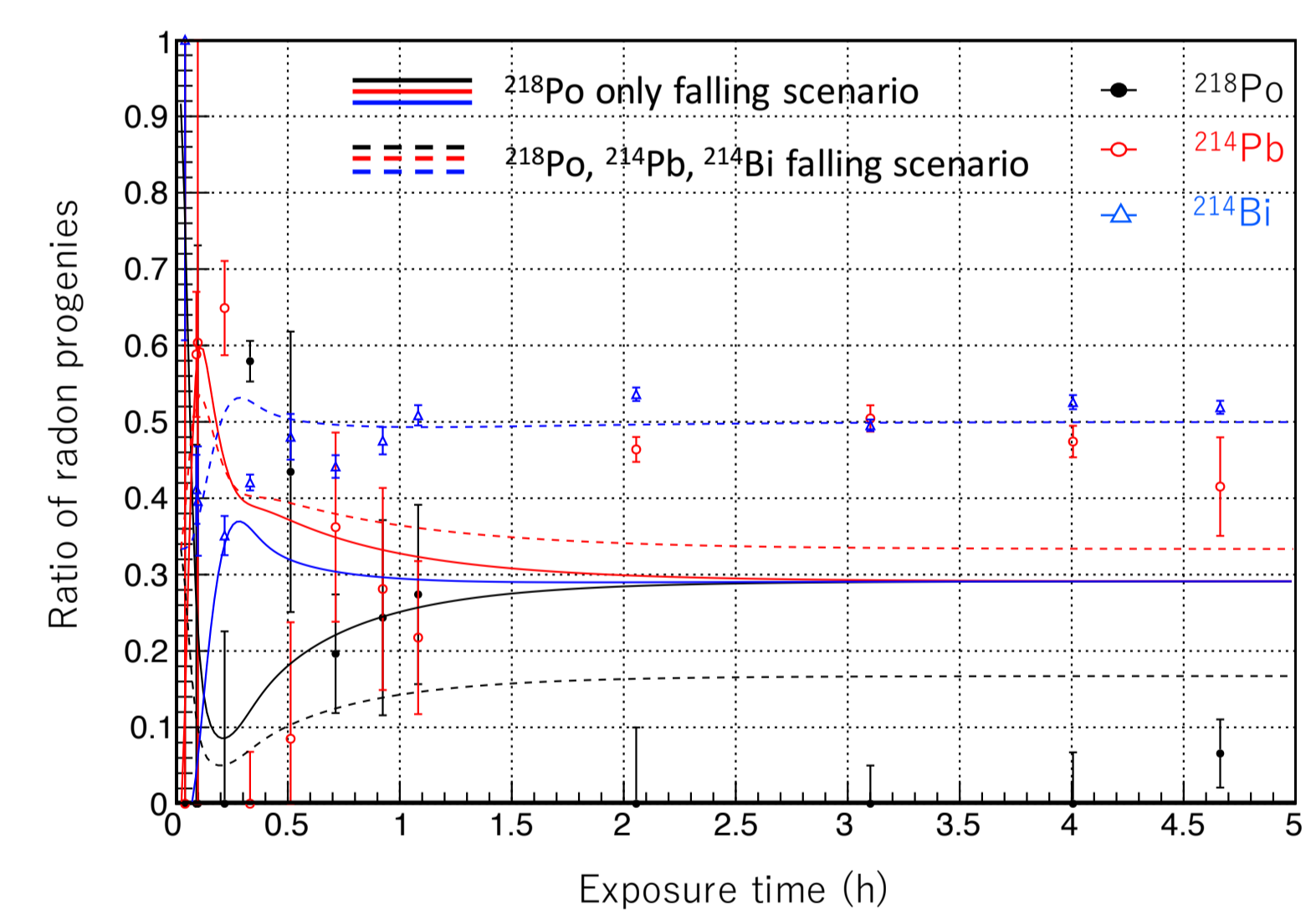
$N_{p.e.}$ (Cherenkov)

Results

- The radioactive surface concentration of Polyethylene sample sheets depending on exposure time in the air was observed at Exp. 1.
- The radon progenies tends to be captured to charged sample strongly.
- The counting rate time spectra was fitted with a function as

$$f(t) = \frac{\lambda_1\lambda_2 x_0^{(1)}}{(\lambda_1-\lambda_2)(\lambda_1-\lambda_3)}\exp(-\lambda_1 t) + \left(\frac{\lambda_1\lambda_2 x_0^{(1)}}{(\lambda_2-\lambda_1)(\lambda_2-\lambda_3)} + \frac{\lambda_2 x_0^{(2)}}{\lambda_3-\lambda_2}\right)\exp(-\lambda_2 t)$$
$$+ \left(\frac{\lambda_1\lambda_2 x_0^{(1)}}{(\lambda_2-\lambda_1)(\lambda_2-\lambda_3)} + \frac{\lambda_2 x_0^{(2)}}{\lambda_3-\lambda_2} + x_0^{(3)}\right)\exp(-\lambda_3 t) + R_{BG}.$$

^{218}Po only falling scenario, ^{218}Po, ^{214}Pb, ^{214}Bi falling scenario
^{218}Po, ^{214}Pb, ^{214}Bi

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Data, Fitting function, Exponential function, Baseline

- ...ity of radioactivity for ^{218}Po, ^{214}Pb,
- ...β rays were observed at Exp. 2.
- ...lling scenario is rejected.
- ...^{218}Po but ^{214}Pb and ^{214}Bi in the air.
- ...after the radon decay.
- ...be considered, and the progenies behavior reason of occurring the lung cancer.
- In short exposure time, Exp. based on Che... make to clear the behavior of the radon pro...

Reference

[1] H. Choi, P. Mazzone, Clev. Cli. J. 81 (9) (2014) 567.
[2] UNSCEAR 2008 report vol. 1.
[3] J. Subramanianand, R. Govindan, J. Clin. Oncol., 25 (2007) 561.
[4] J. Samet, et al., Clin. Cancer. Res. 15 (18) (2009) 5626.