Prototype Experiment for Upgrades in the BGOegg Gamma Spectrometer at ELPH

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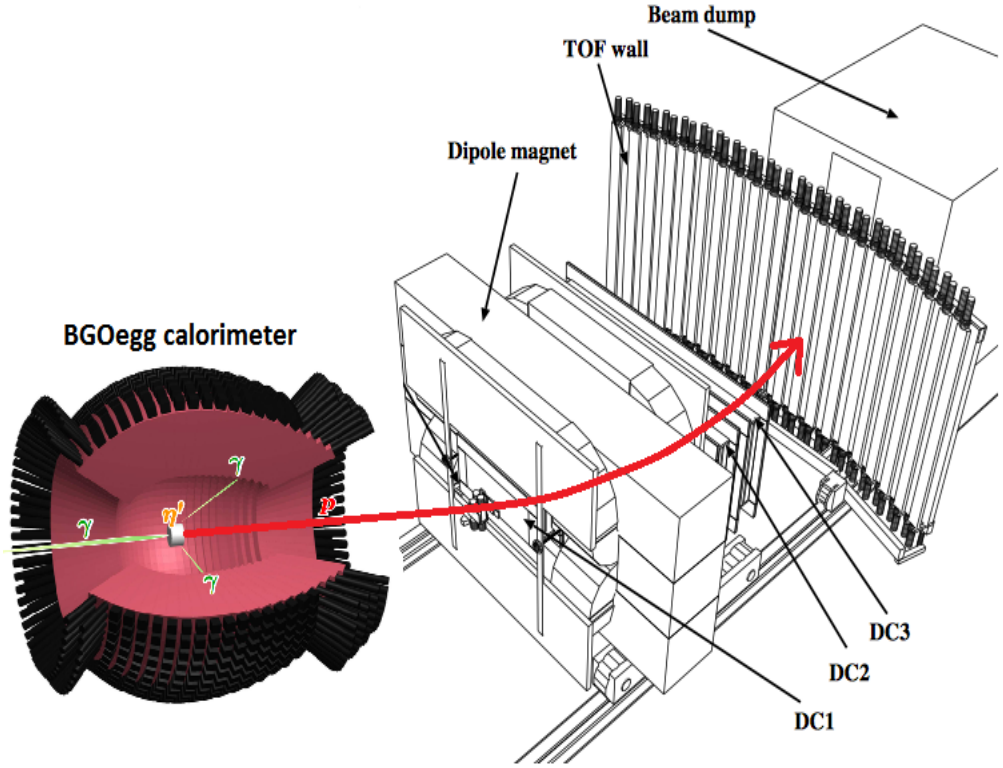
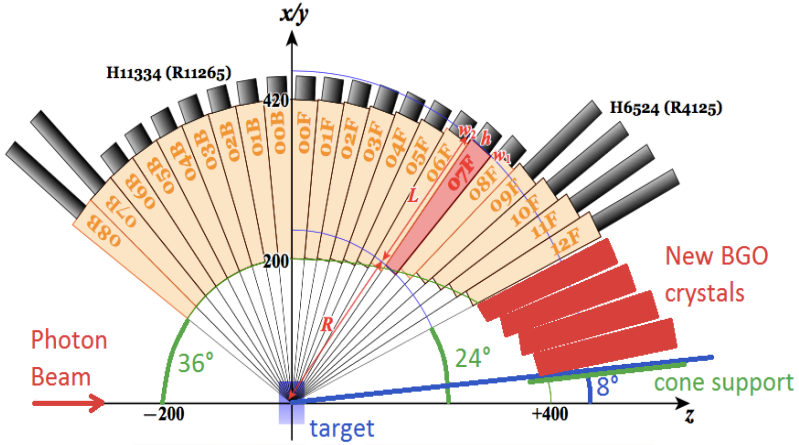
for the BGOegg collaboration

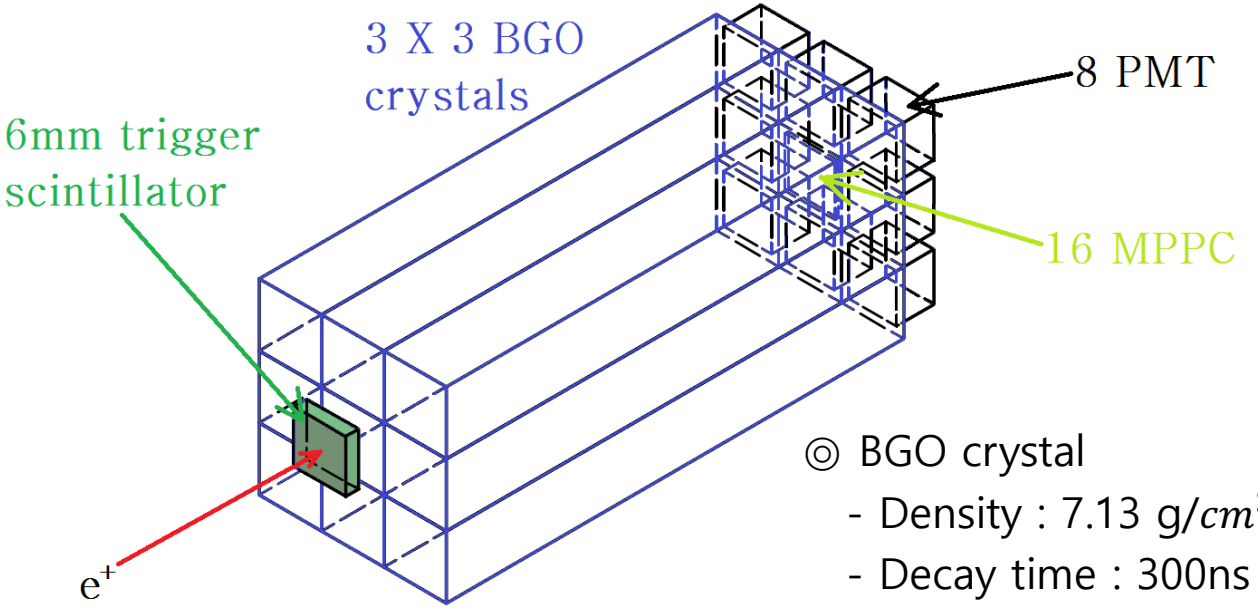
BGOegg Upgrade

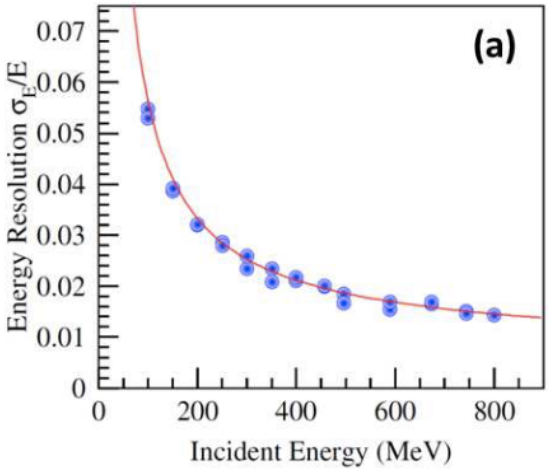




- Recoil proton momentum will be measured using a dipole magnet at LEPS, as well as BGOegg updates with 120 additional crystals

Prototype test for BGOegg Upgrade





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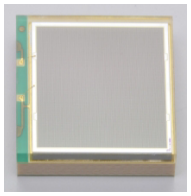
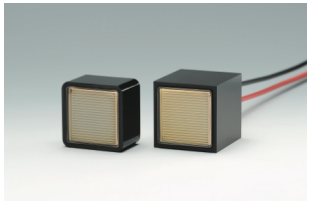
◎ BGO crystal
- Density : 7.13 g/cm^3
- Decay time : 300ns

◎ Positron beam
- Energy range : 100 ~ 800MeV



◎ S13360-6025PE
- V_{op} ≅ 57V = V_{br} + 5V



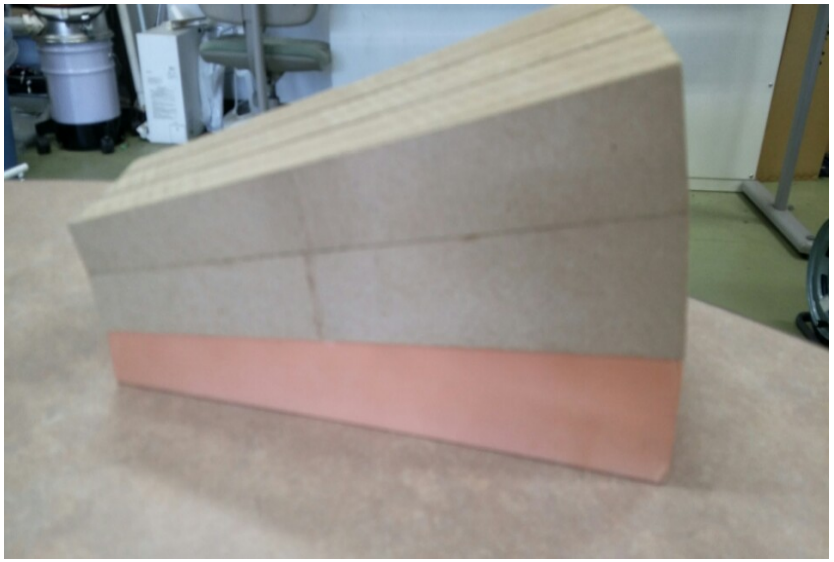
◎ PMT
- H11334(R11265)
- Effective area : 23 X 23mm

BGO crystal Assembly

$$\begin{cases} h = R\left\{ (\sin\theta_2 - \sin\theta_1)^2 \cos^2\dfrac{\Delta\phi}{2} + (\cos\theta_2 - \cos\theta_1)^2 \right\}^{1/2} \\ w_1 = 2R\sin\theta_1 \sin\dfrac{\Delta\phi}{2}, \quad \text{and} \\ w_2 = 2R\sin\theta_2 \sin\dfrac{\Delta\phi}{2}. \end{cases}$$

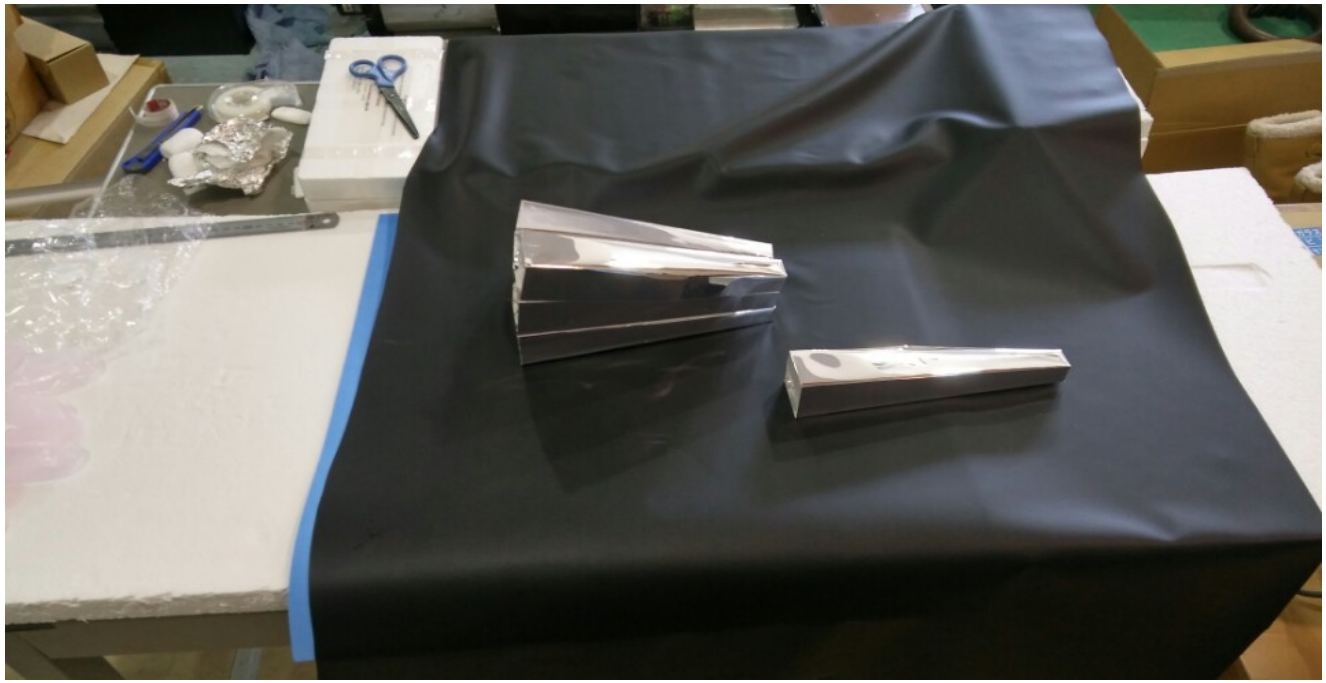
$$\begin{cases} \theta_1 = \dfrac{\pi}{2} - \tan^{-1}\left\{ b\tan\dfrac{(i+1)\Delta\phi}{b} \right\}, \\ \theta_2 = \dfrac{\pi}{2} - \tan^{-1}\left\{ b\tan\dfrac{i\Delta\phi}{b} \right\}, \quad \text{and} \\ r = \dfrac{200\ \text{mm}}{\sqrt{\left(\dfrac{1}{2}\cos\dfrac{\theta_1+\theta_2}{2}\right)^2 + \left(\sin\dfrac{\theta_1+\theta_2}{2}\right)^2}} \end{cases}$$

NIMA 837-2016-109



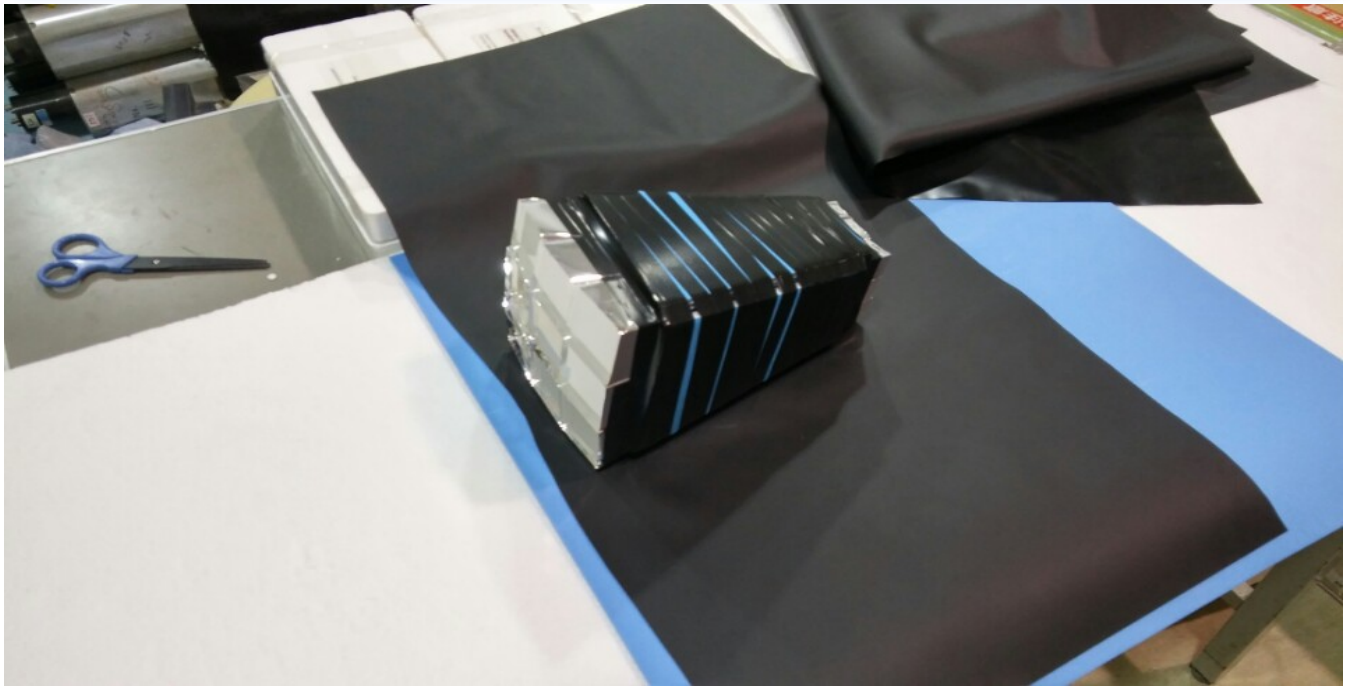
- Calculate dimensions for each crystals using those equation (reference : nima837-2016-109)
- Making BGO crystal assembly using dummy woods

BGO crystal Assembly



- Using a ESR(Enhanced Specular Reflector) covering surface of the BGO crystal except backward

BGO crystal Assembly

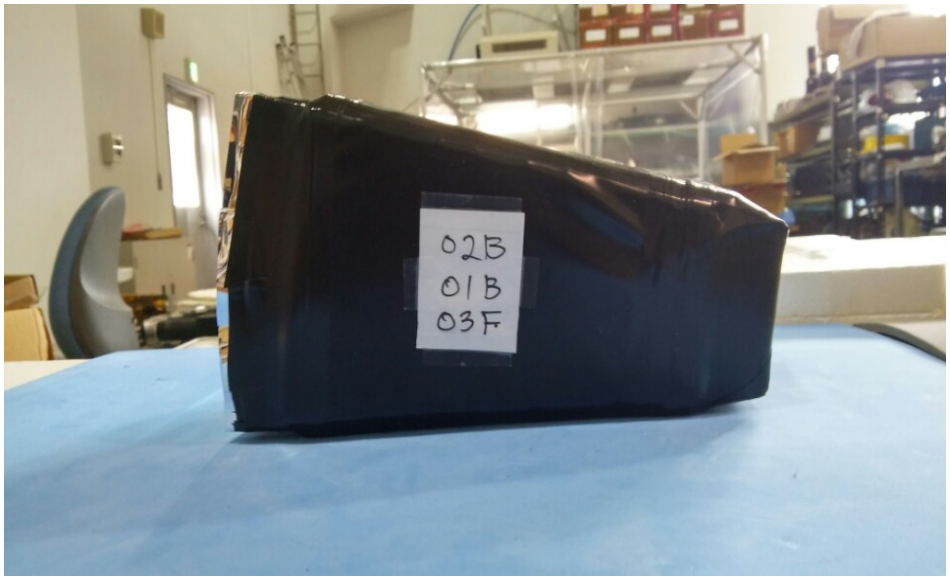


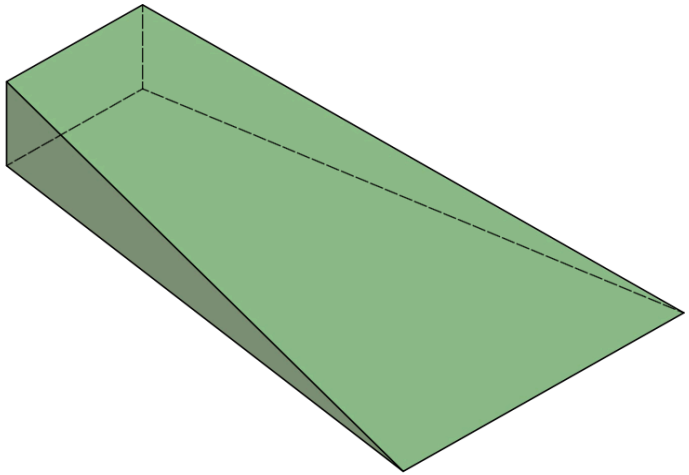
- After the making assembly, for eliminate gaps of the each crystals, we tight to use black tape covered styrofoam board.

BGO crystal Assembly

- Finally, we covered all surface (except backward surface) to use black sheet with marker

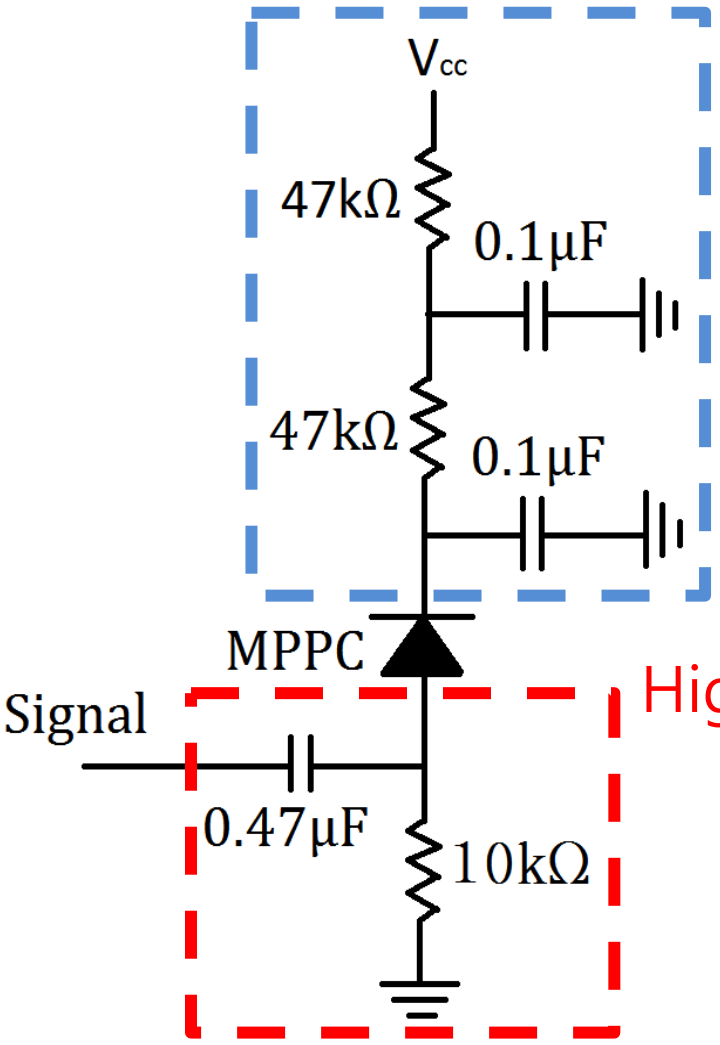
Support Structure





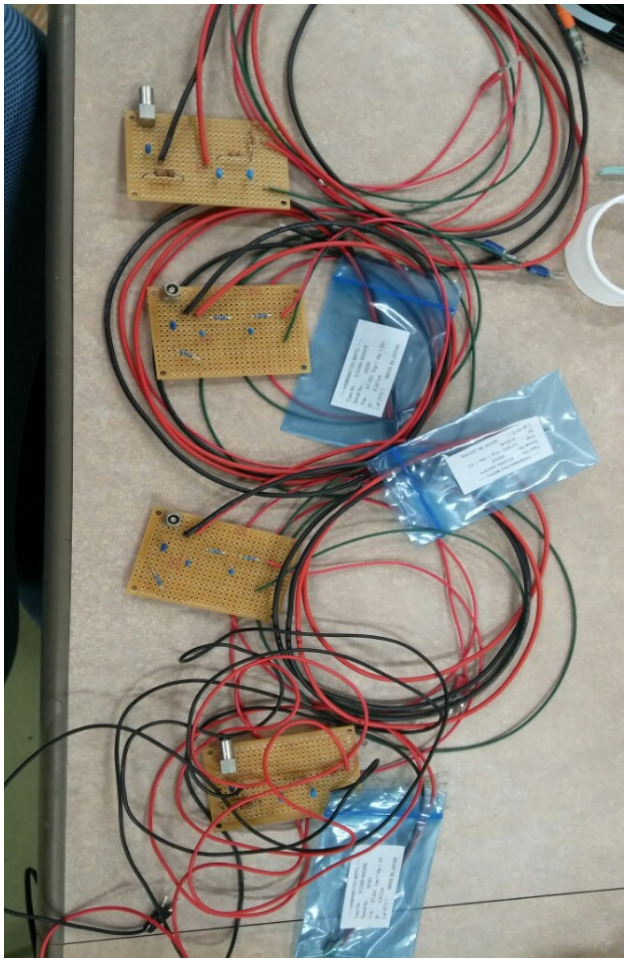
- To make a middle position crystal horizontally, we need some support structure

Circuits for the MPPC

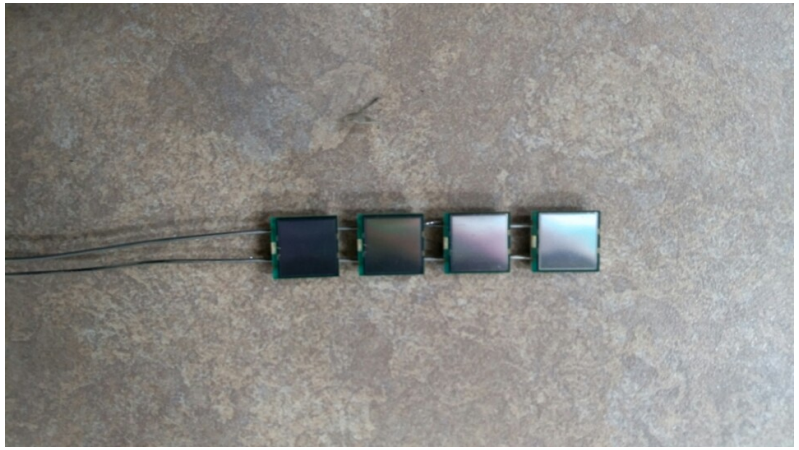


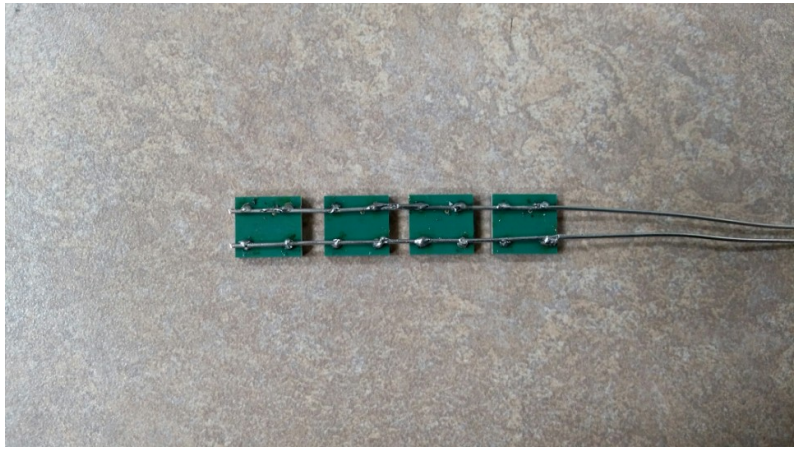
Low pass filter

High pass filter



How to attach the MPPC to the BGO assembly





- We made series connection for using 4 of the MPPC
- Total number of MPPC are 16, we have to make 4 of series connection

Remaining Works

- Making a support structure using CNC machine
- Making a MPPC assembly 3 of them
- Attach PMT and MPPC to BGO crystals
- Making DAQ system
- Cosmic-ray test and gain calibration

Plan for Real Experiment

- I'll go to ELPH at June 2nd again. From June 2nd, We will set up BGO crystal assembly at the positron beamline up to June 4th
- Checking all systems June 5th
- Doing experiment 6 ~ 9
- Clean up the setting 10