MEG実験液体キセノン検出器の為の光電子増倍管について

東京大学 THE UNIVERSITY OF TOKYO 名取寛顕

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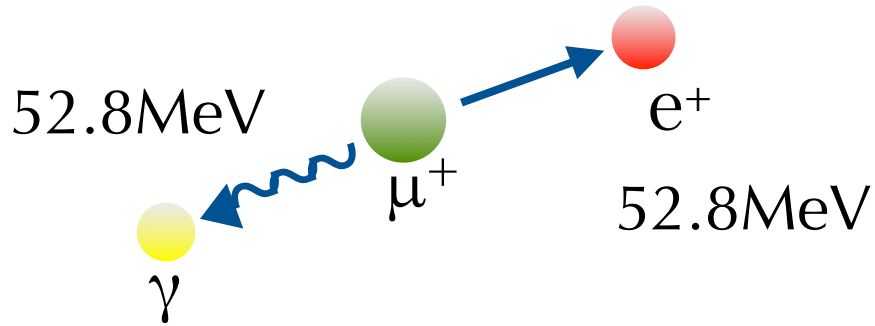
Contents

- Liquid Xe Detector
- PMT R&D
- Summary

$\mu \rightarrow e+\gamma$ decay

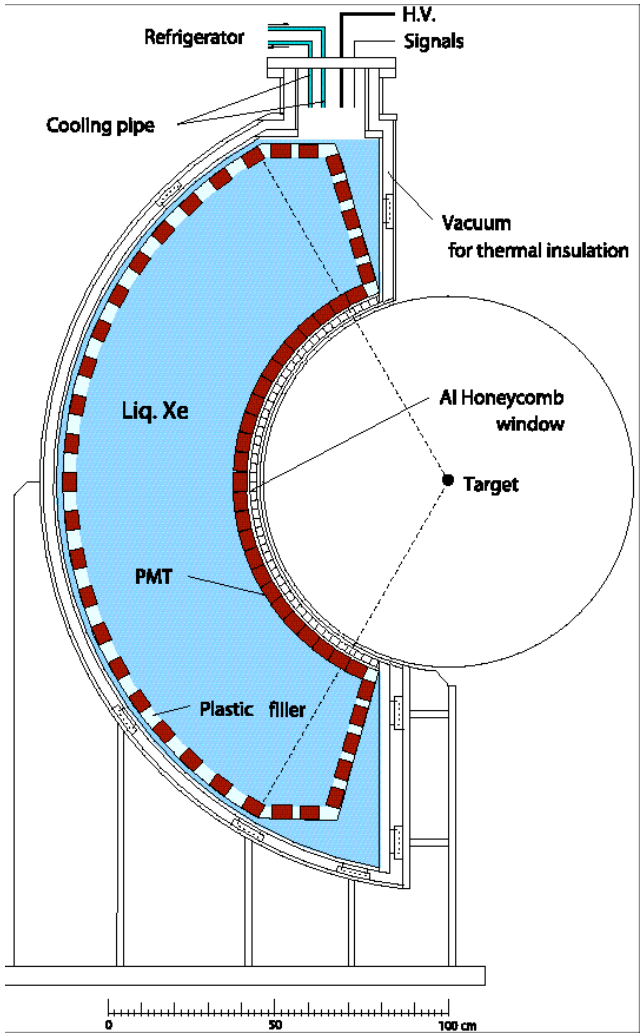


- LFV process
- Forbidden in the SM
- Sensitive to SUSY-GUT, seesaw

$Br < 1.2 \times 10^{-11}$(MEGA)

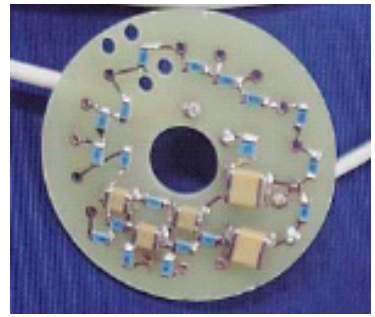
- Physics run: 2006 using most intense μ^+ beam @PSI(10^8 /s)
- Our goal : Br ~ 10^{-14}

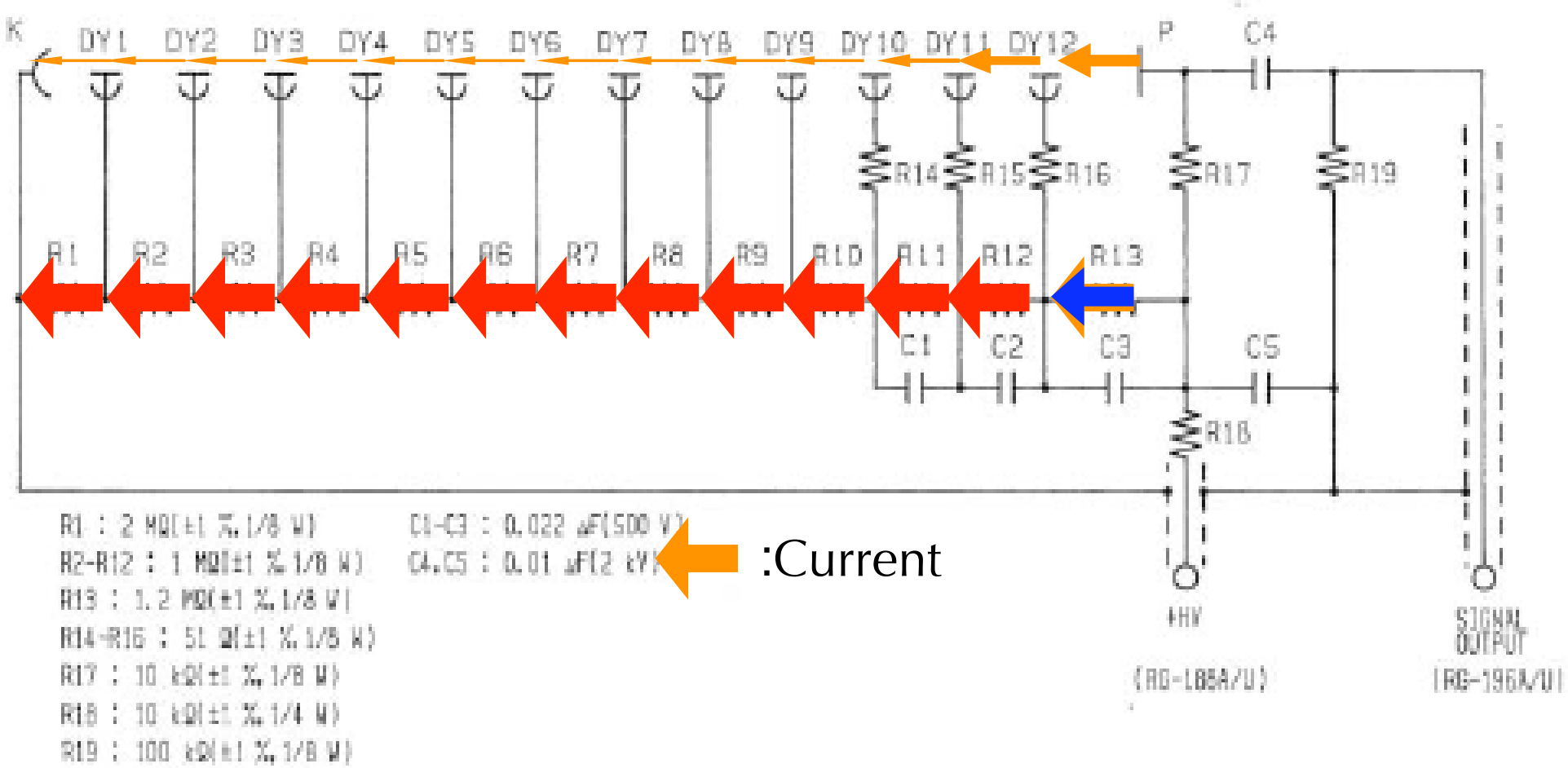
Liquid Xenon Photon Detector



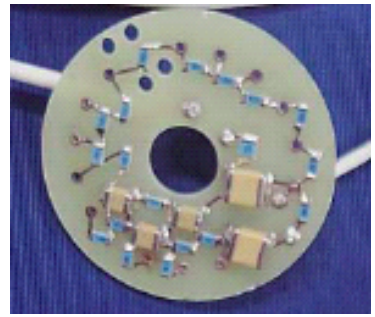
- Liquid Xenon Features
  - High light yield : Good resolution
  - Fast decay time : Reduce pileups
  - Liquid : Uniformity, can be purified
  - Z, density = high
- Special PMT is developed
  - Good performance at 165K
  - Sensitive to VUV
  - Stable under high rate B.G. etc.

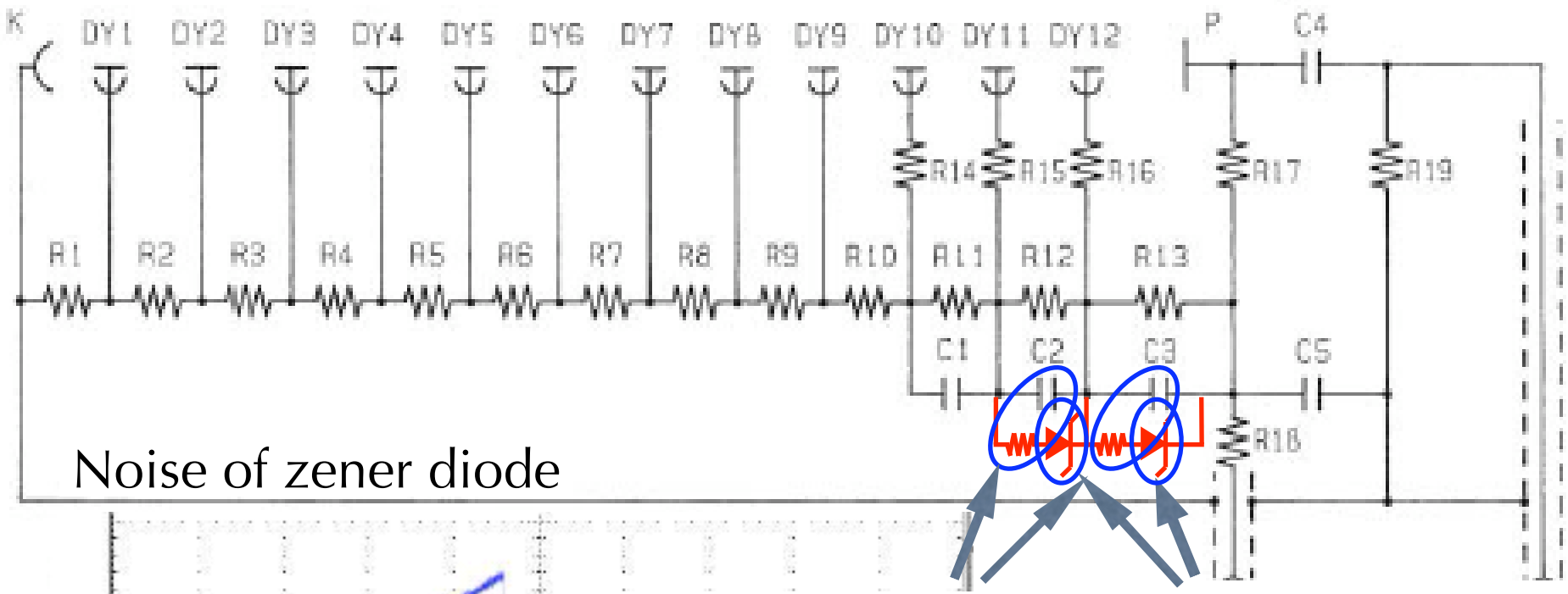
Gain & Base Circuit



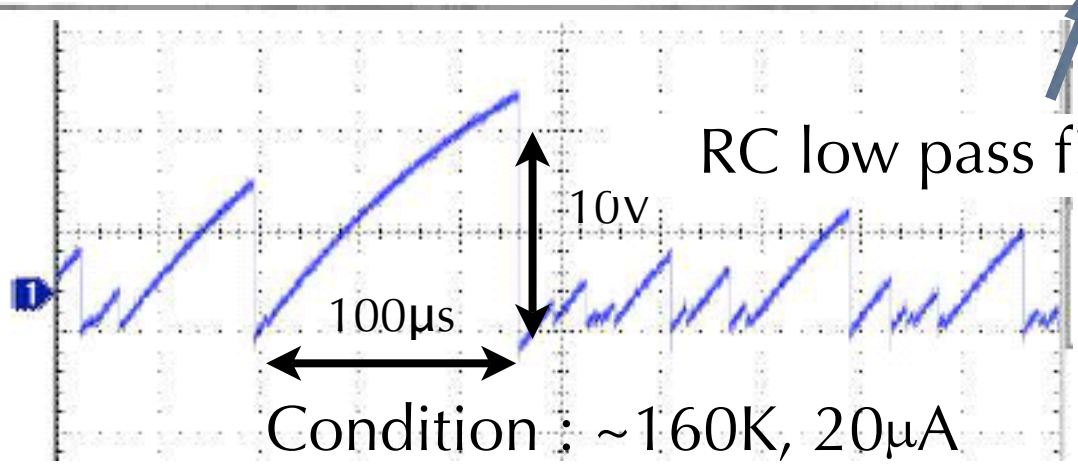


Zener diode & filtering





Noise of zener diode

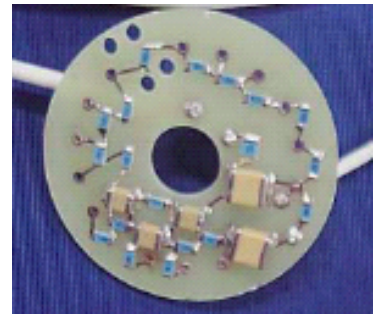


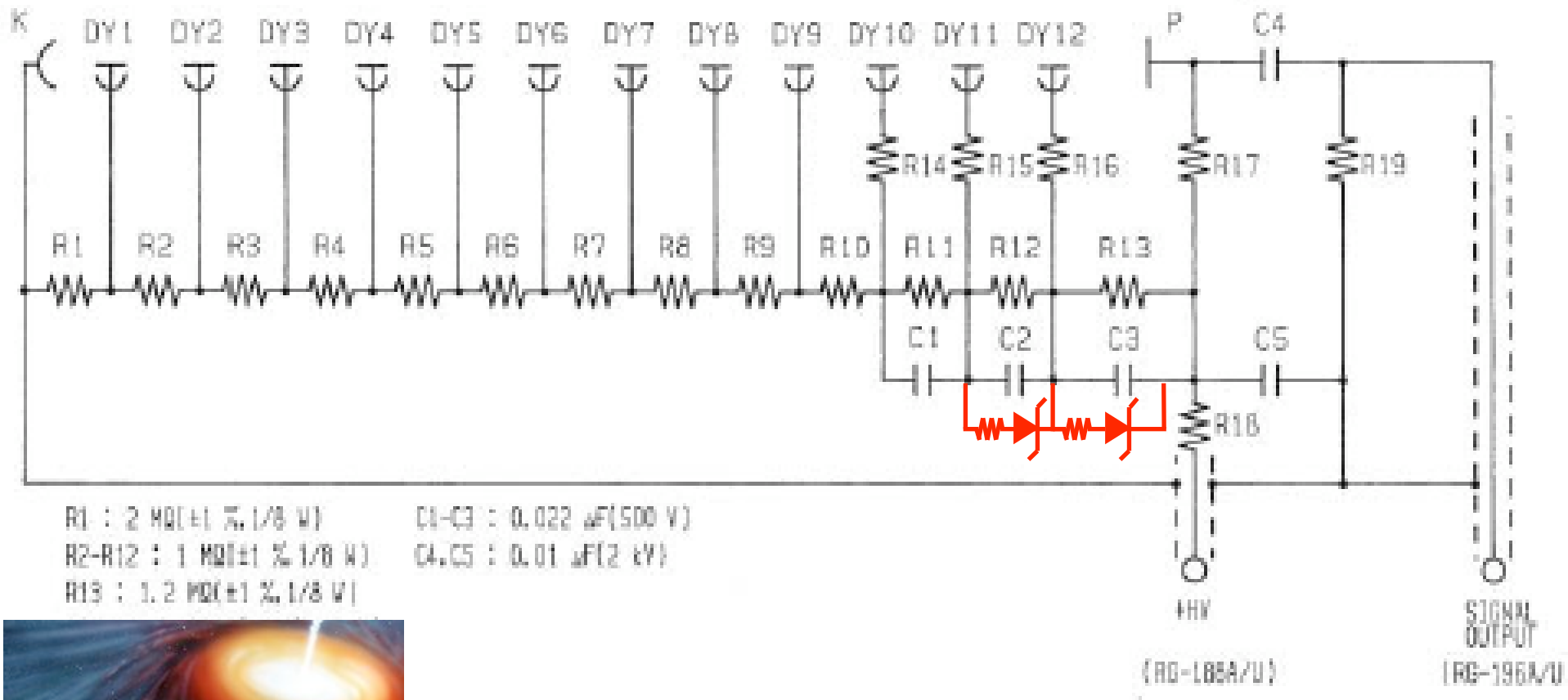
Condition : ~160K, 20µA

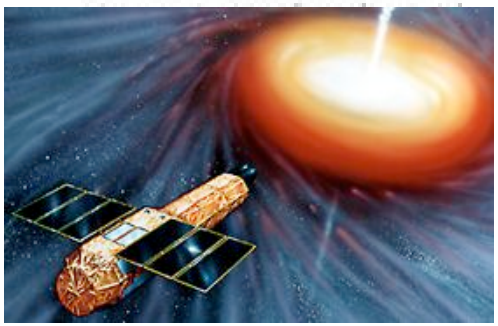
RC low pass filter

Zener diode
(Constant voltage source)

Zener diode & filtering

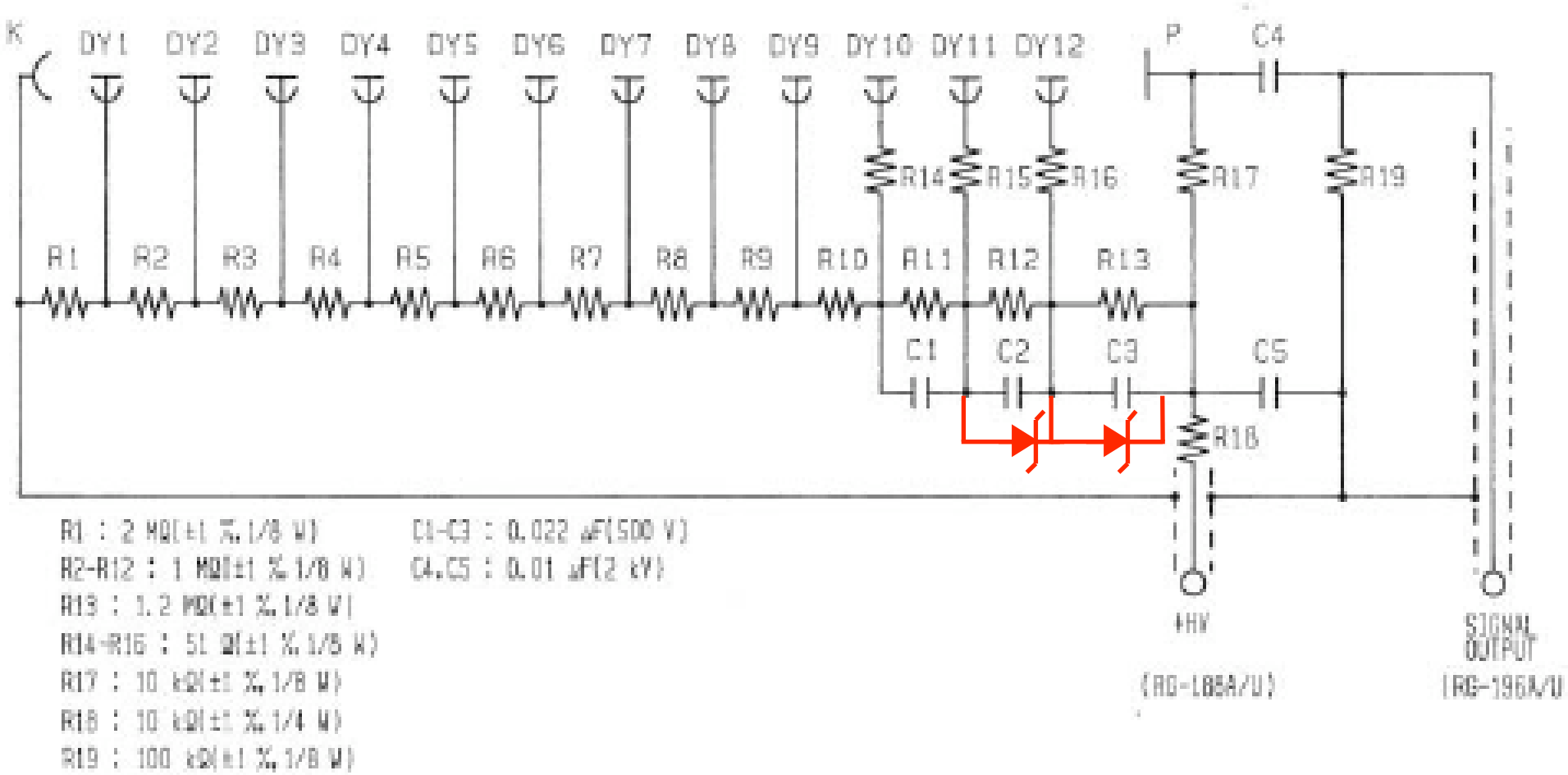




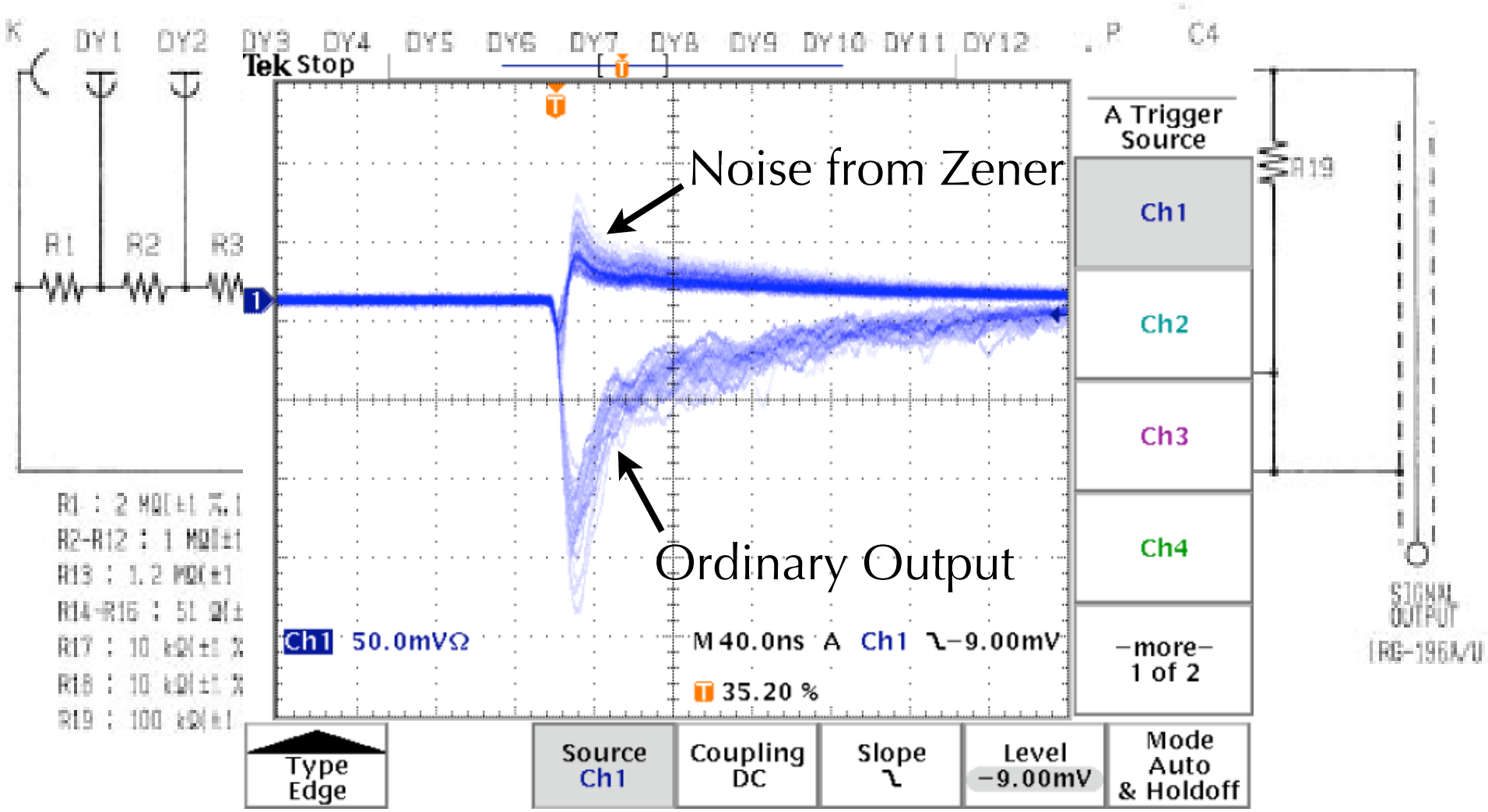


For filtering : Bigger resistance
For gain stability : Smaller resistance

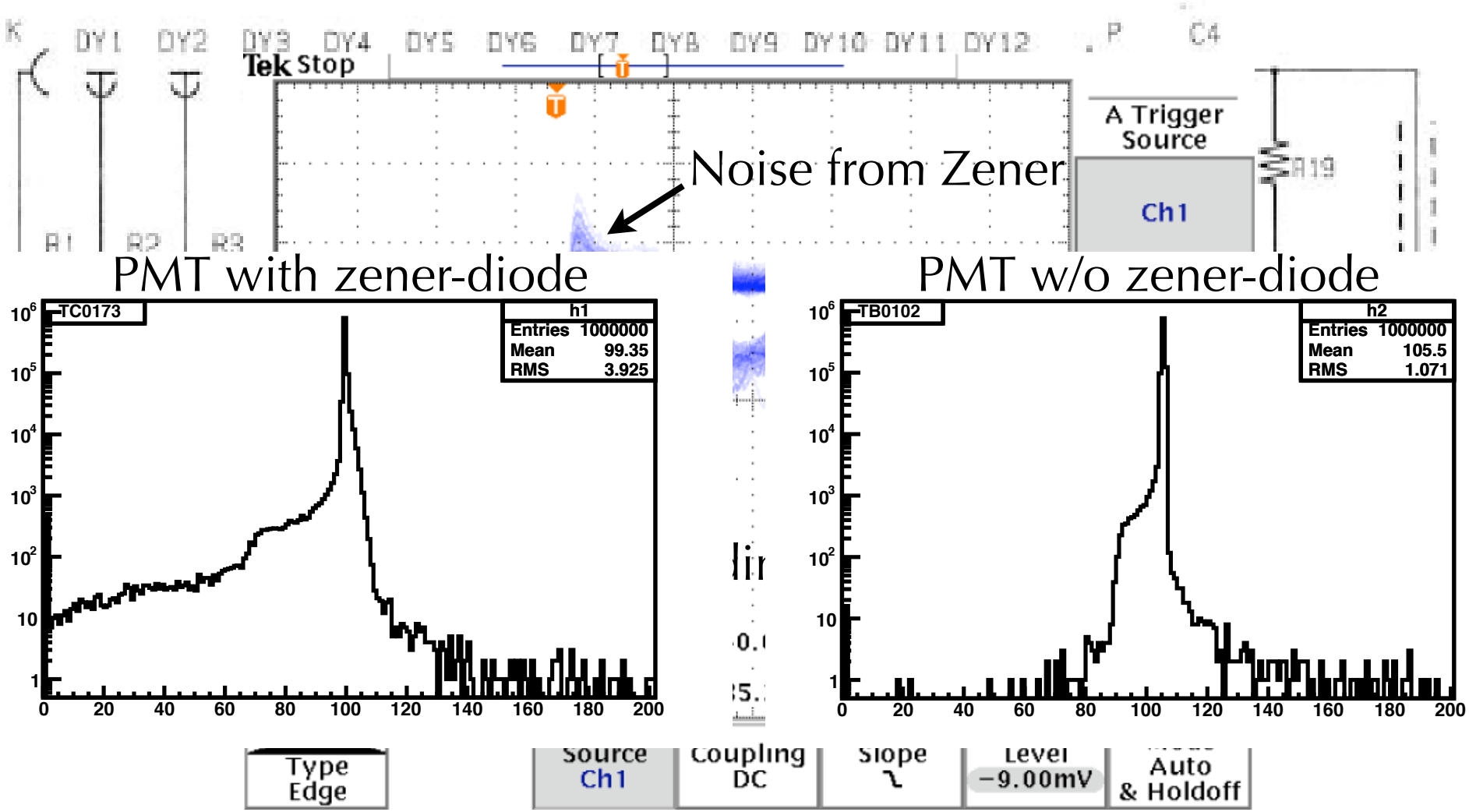
Output of PMT with zener-diode

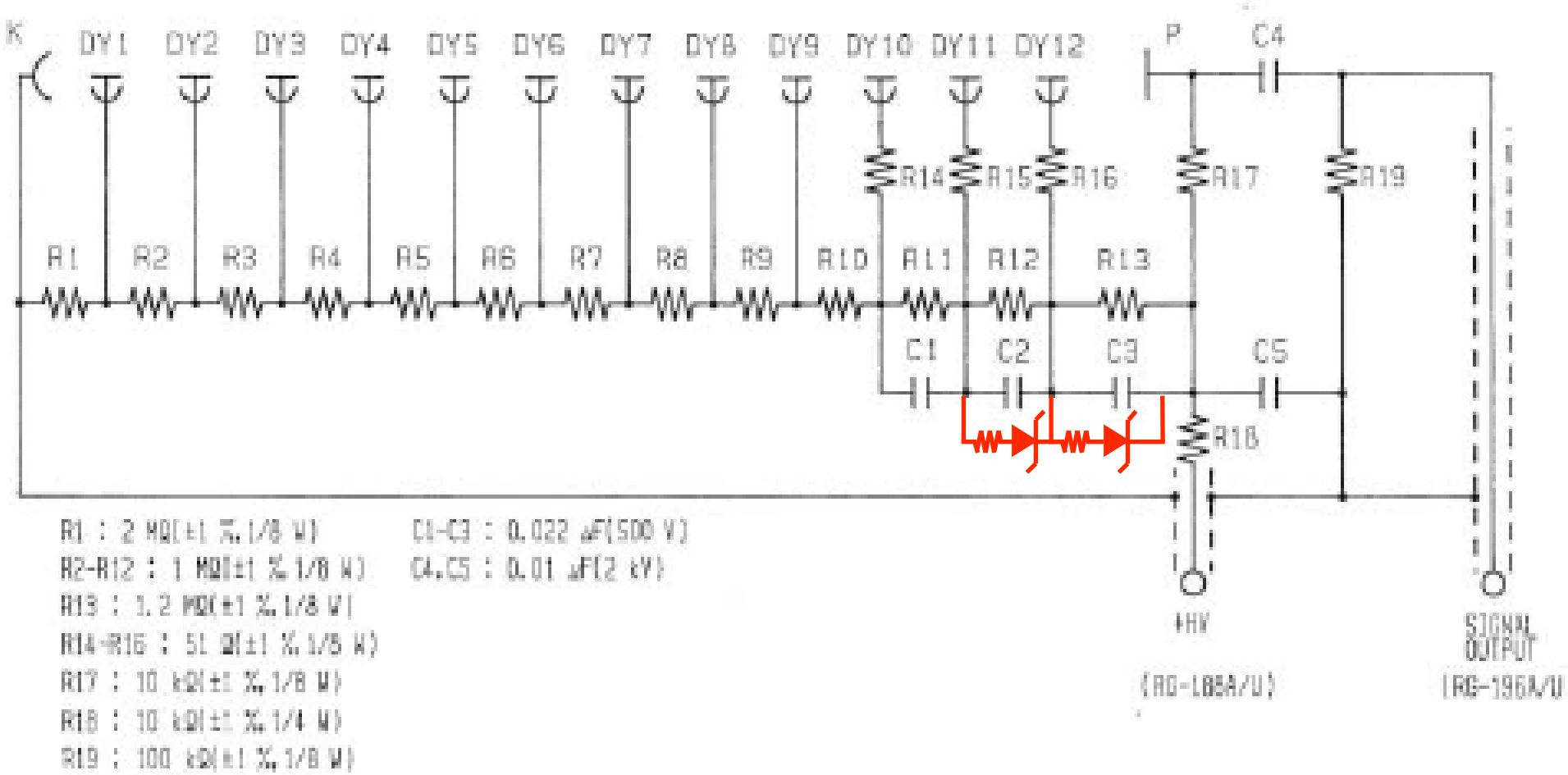


Output of PMT with zener-diode



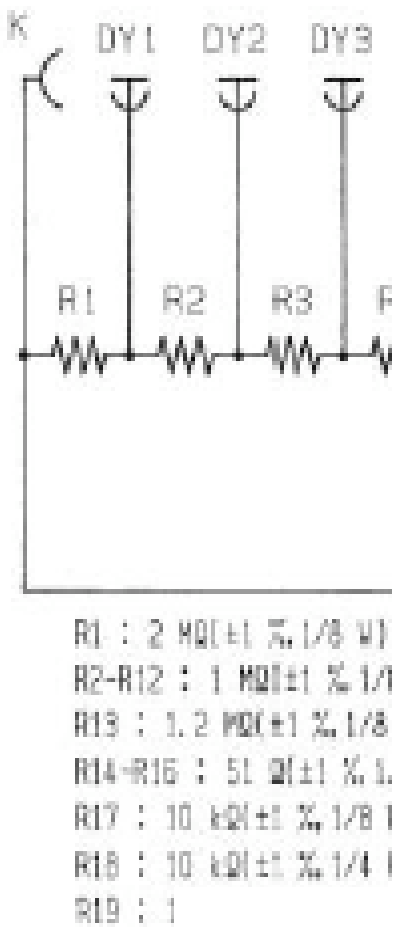
Pedestal distribution

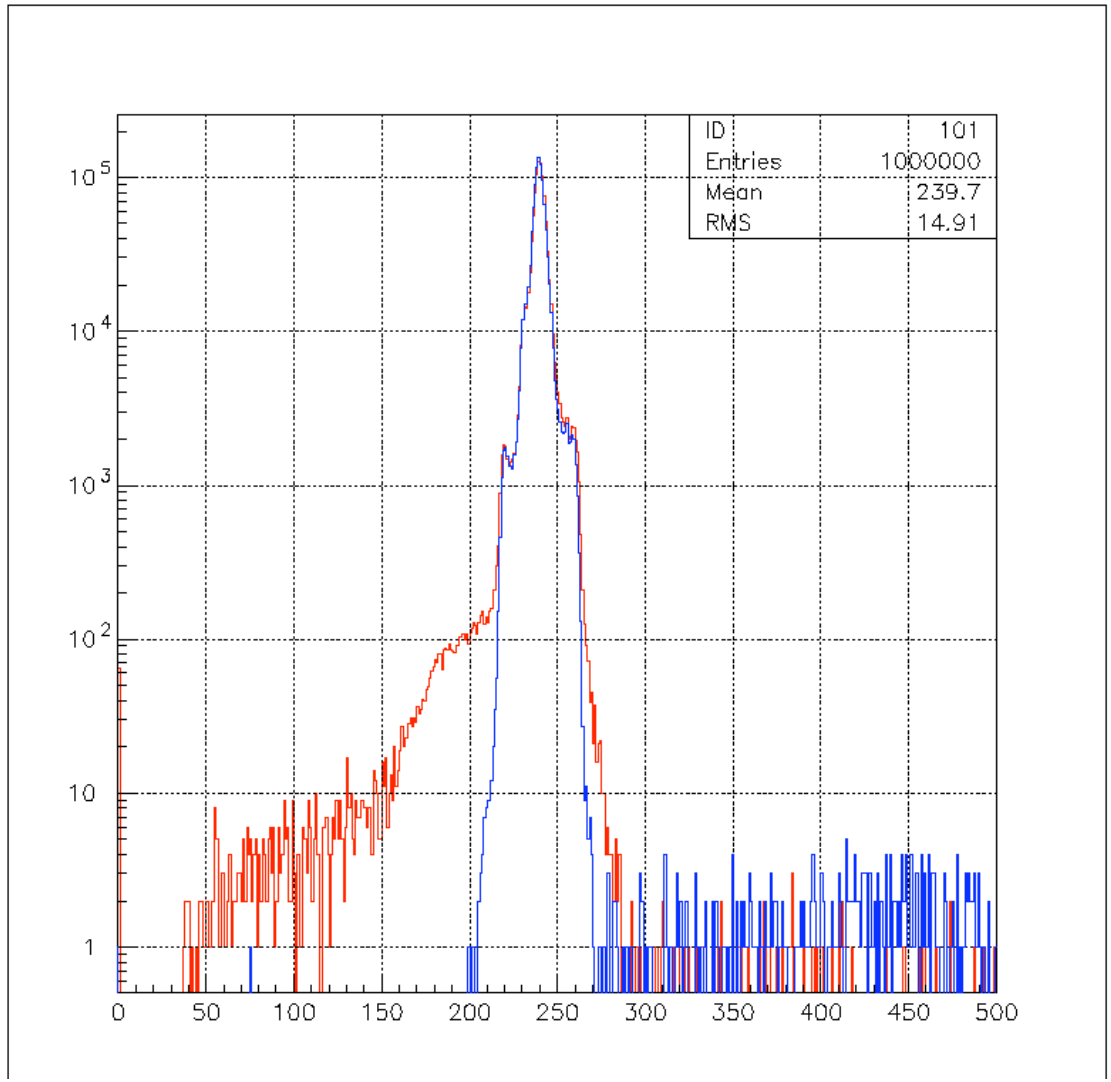


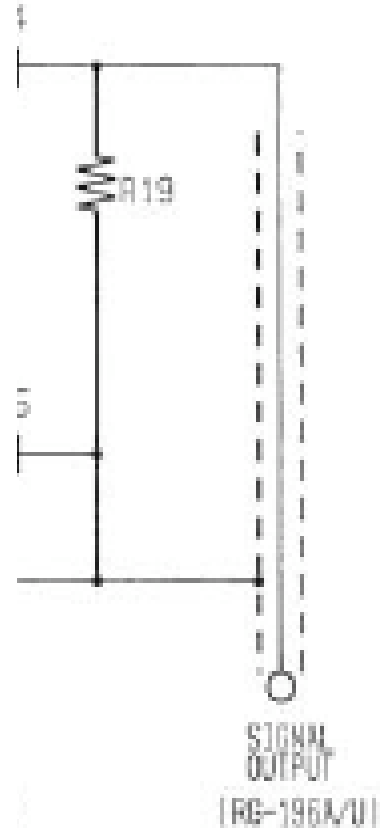

K
DY1
DY2
DY3
DY4
DY5
DY6
DY7
DY8
DY9
DY10
DY11
DY12
P
C4
R14
R15
R16
R17
R19
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
C1
C2
C3
C5
R18
+HV
(RG-58A/U)
SIGNAL OUTPUT
(RG-196A/U)
R1 : 2 MΩ(±1 %, 1/8 W)
R2-R12 : 1 MΩ(±1 %, 1/8 W)
R13 : 1.2 MΩ(±1 %, 1/8 W)
R14-R16 : 51 Ω(±1 %, 1/5 W)
R17 : 10 kΩ(±1 %, 1/8 W)
R18 : 10 kΩ(±1 %, 1/4 W)
R19 : 100 kΩ(±1 %, 1/8 W)
C1-C3 : 0.022 μF(500 V)
C4,C5 : 0.01 μF(2 kV)

zener only

zener + resistance





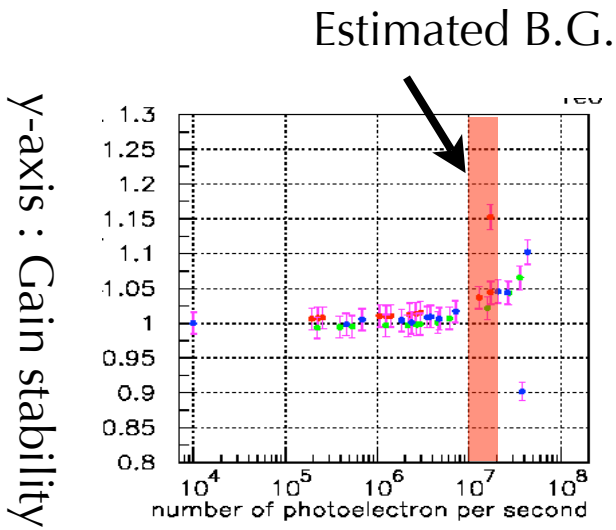


Resistance & Noise test : R = 200k, 100k, 51k, 1k, 51[Ω]

R=51[Ω]: Noise observed

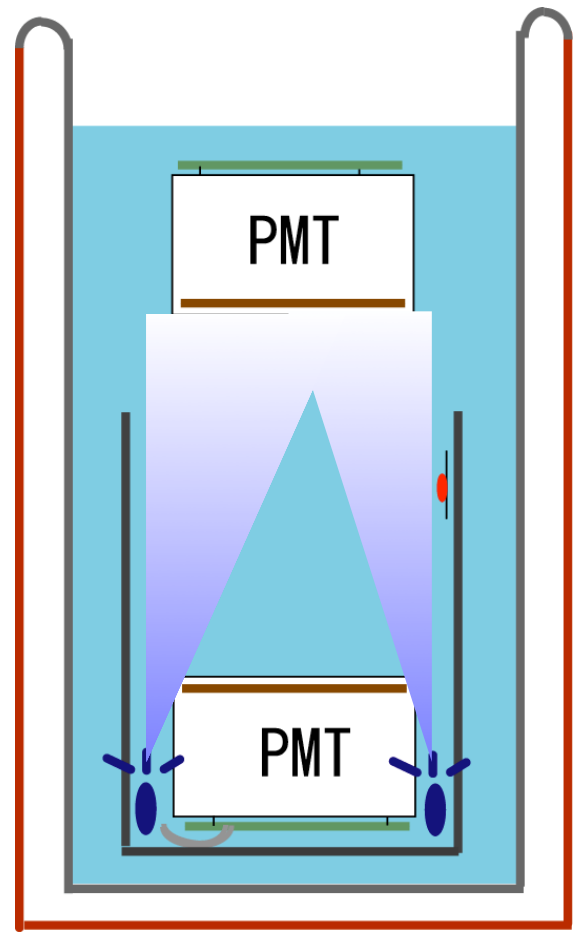
R = 200k, 100k, 51k, 1k[Ω]: No noise observed

Rate dependence test



x-axis : Quantity of B.G. light

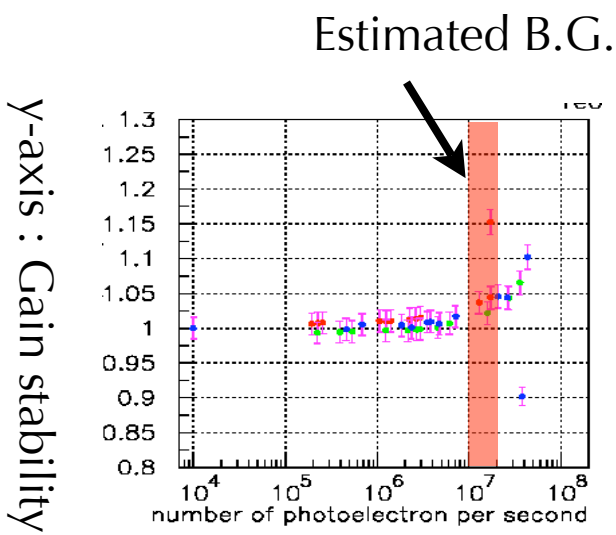
w/o zener diode

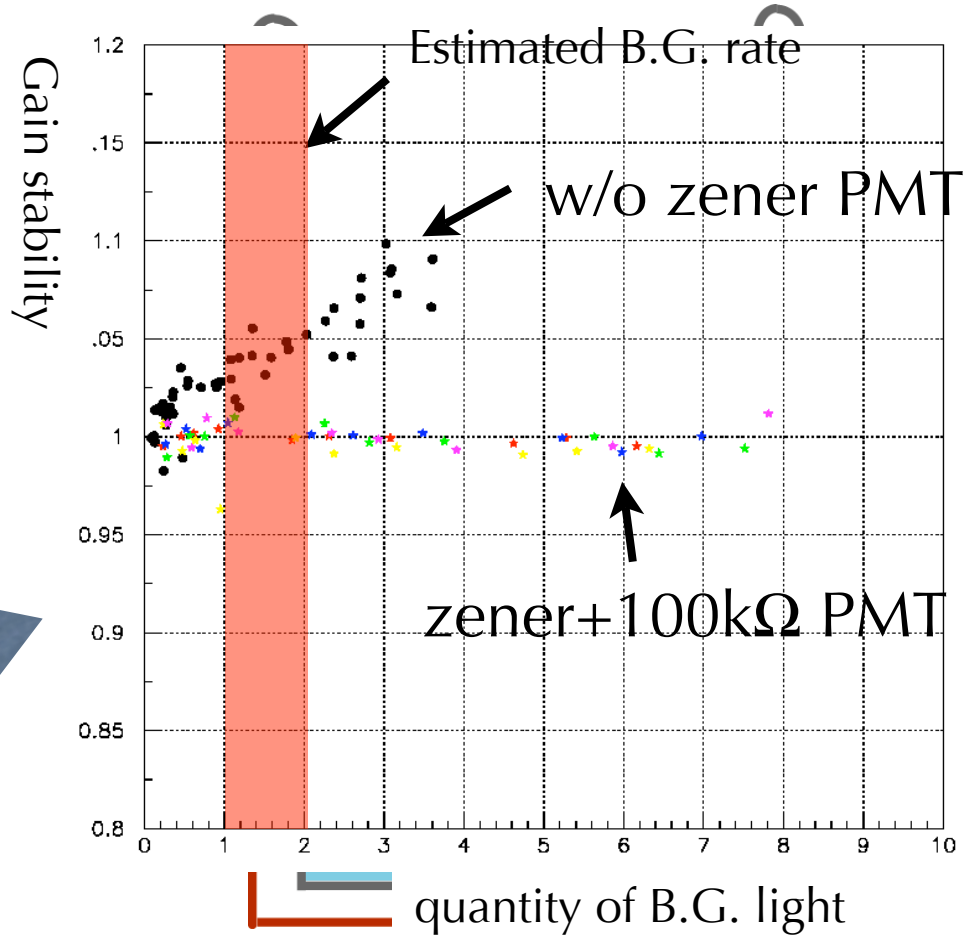


Rate dependence test

- Added zener diode

→No gain fluctuation





x-axis : Quantity of B.G. light

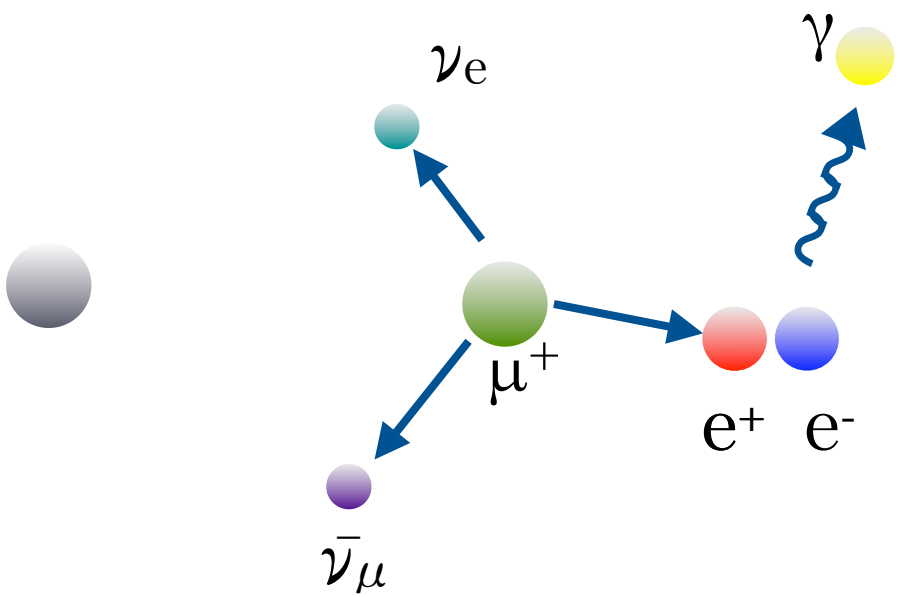
w/o zener diode

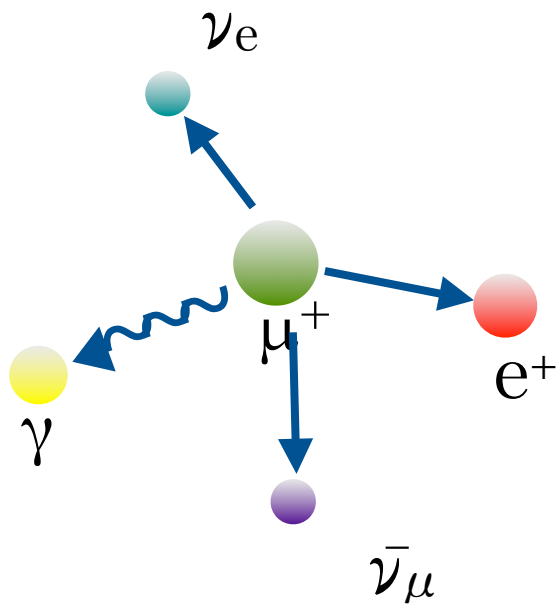
zener diode+100kΩ

Summary

- With Zener-diode + 100kΩ Resistance
  - Good gain stability
  - No effect of Zener-diode's Noise
- PMT design is Completed

Expected Backgrounds





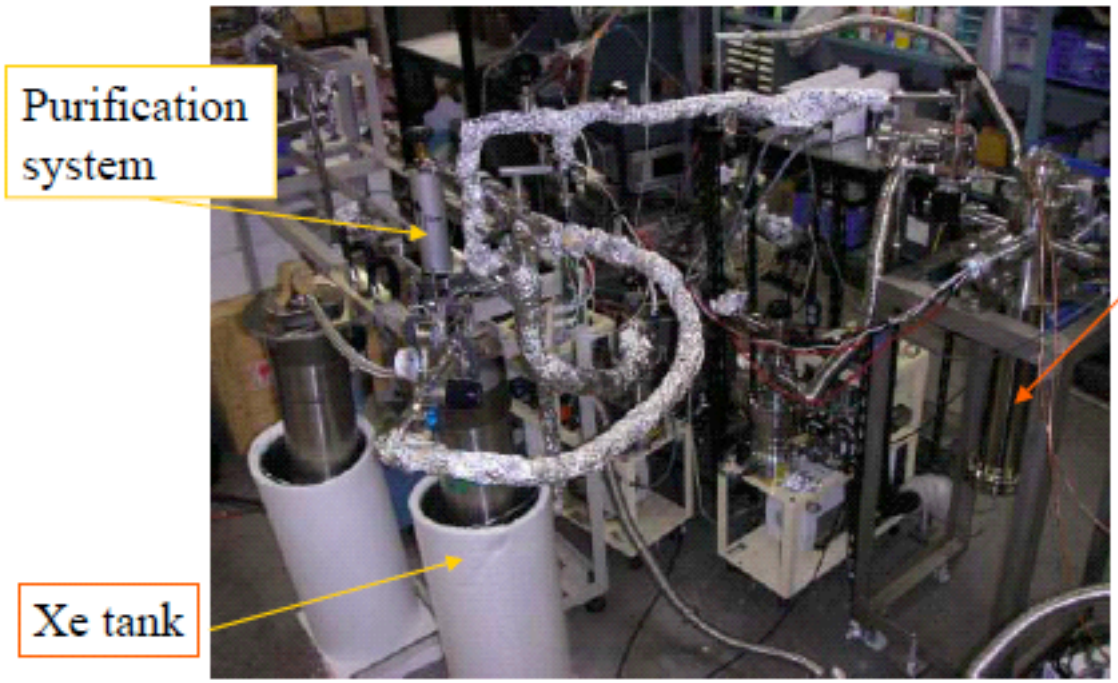
Neutron
From Beam

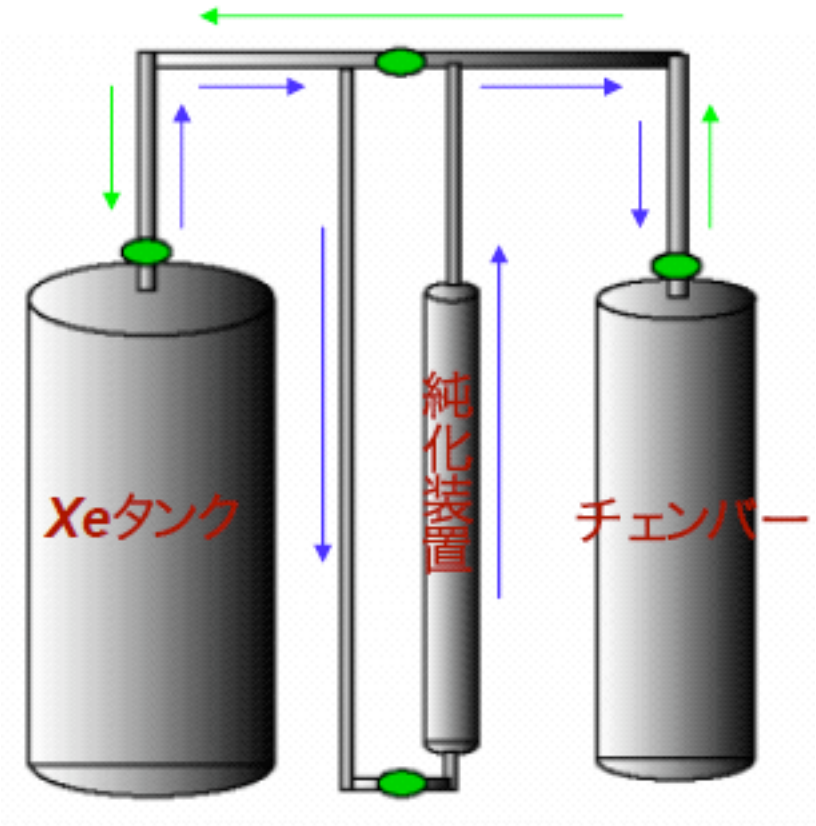
Michel decay
→ Pair annihilation

Radiative decay

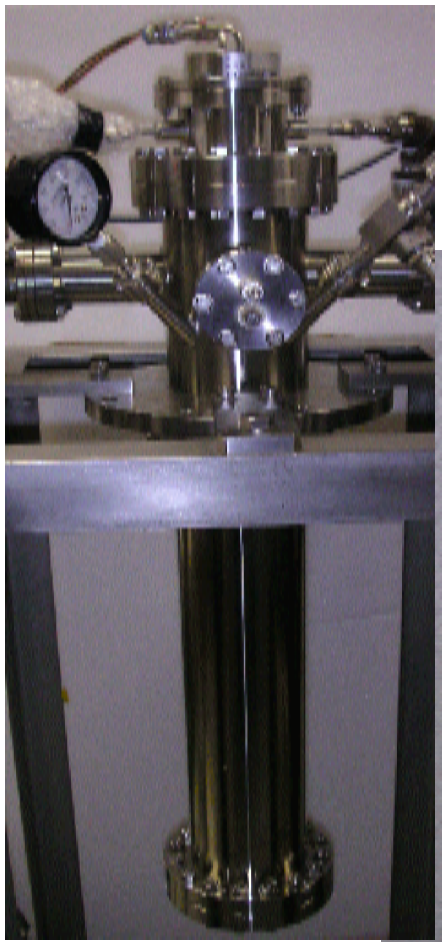
- Under high rate B.G.

東京のTest Facility

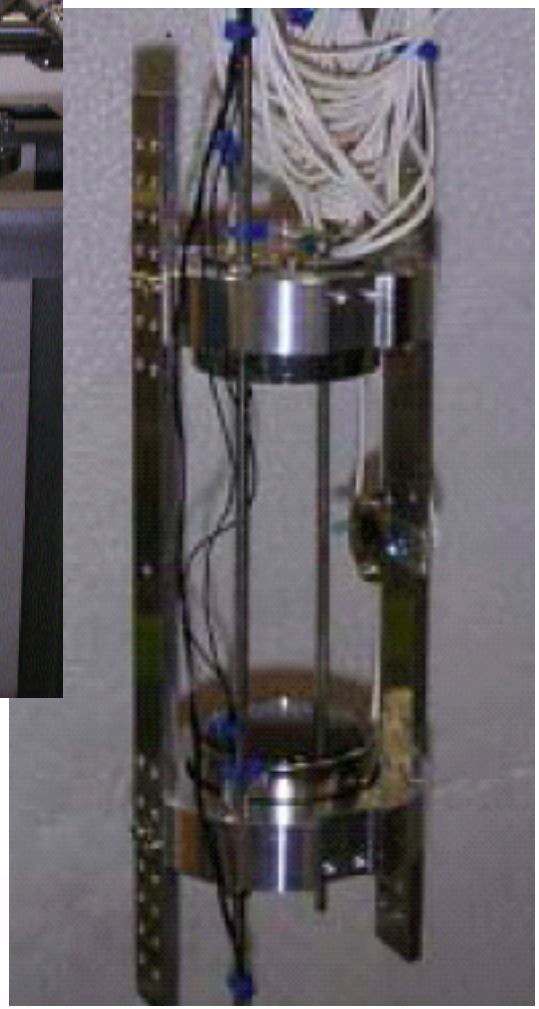


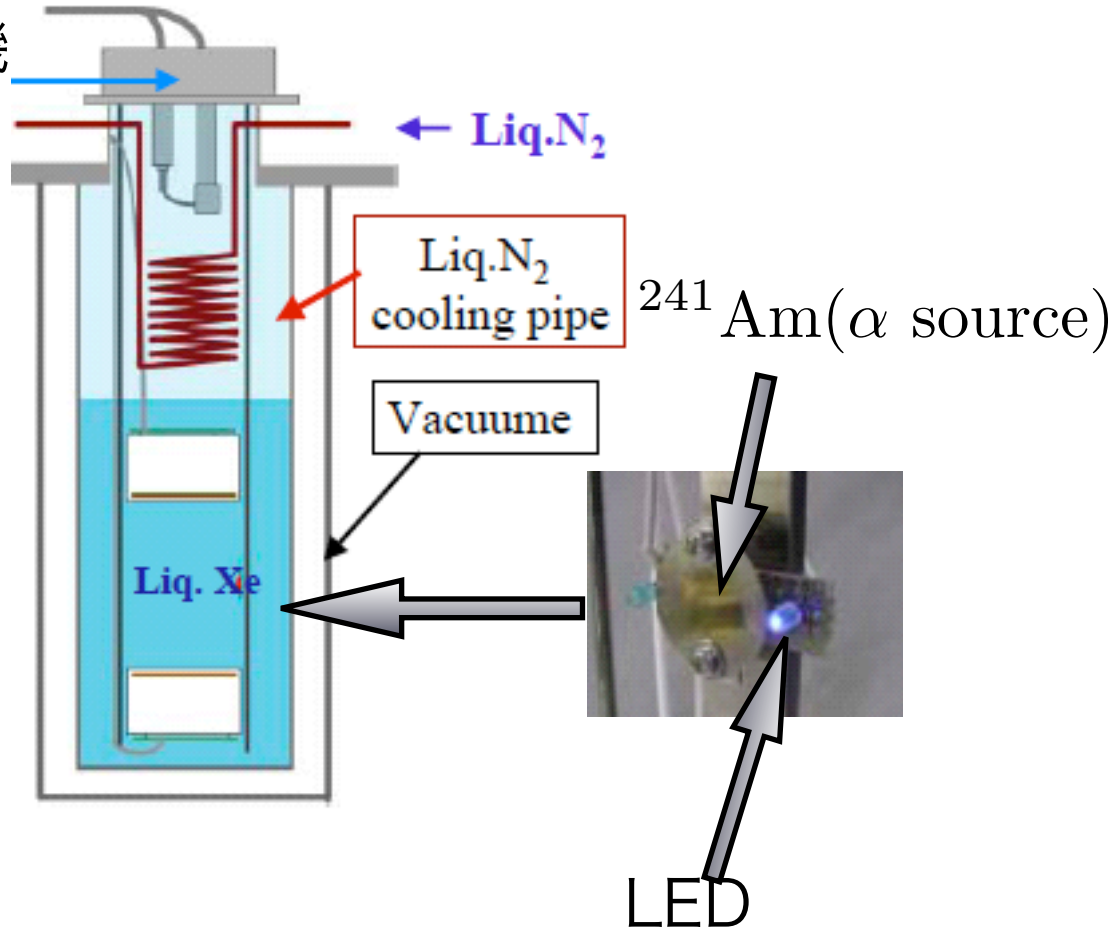


chamber

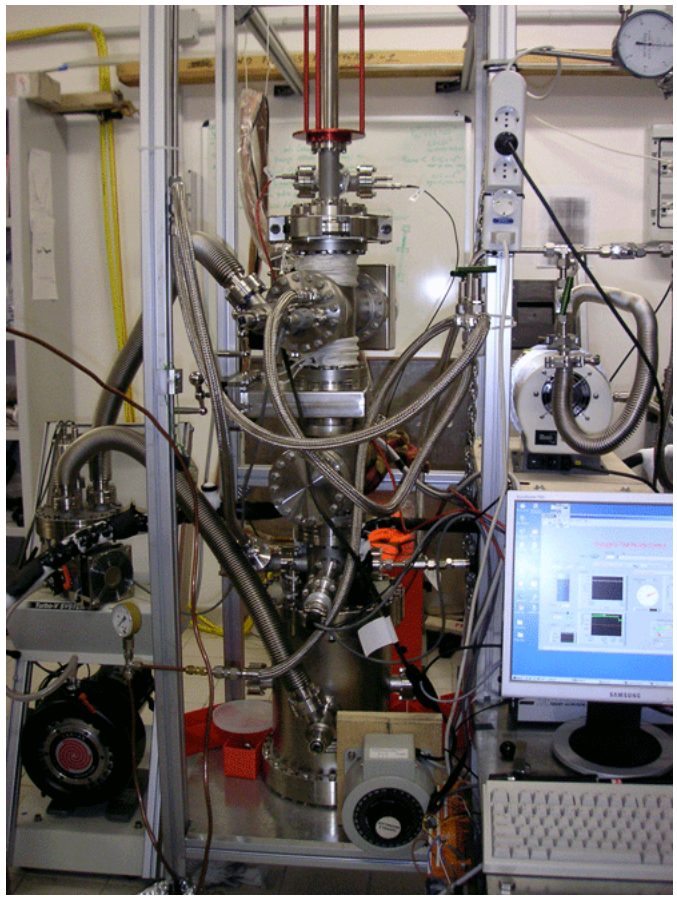


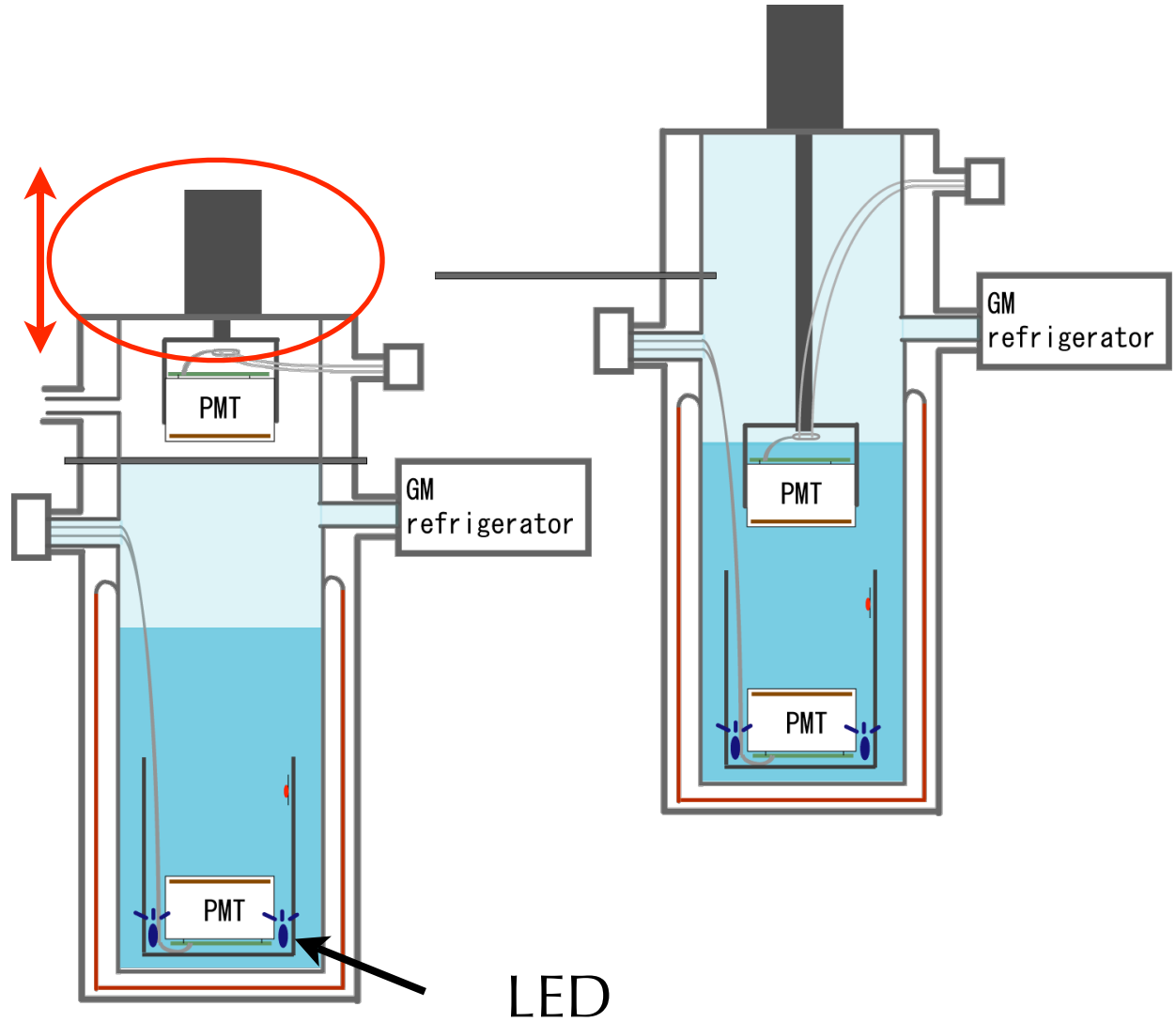
パルス管冷凍機



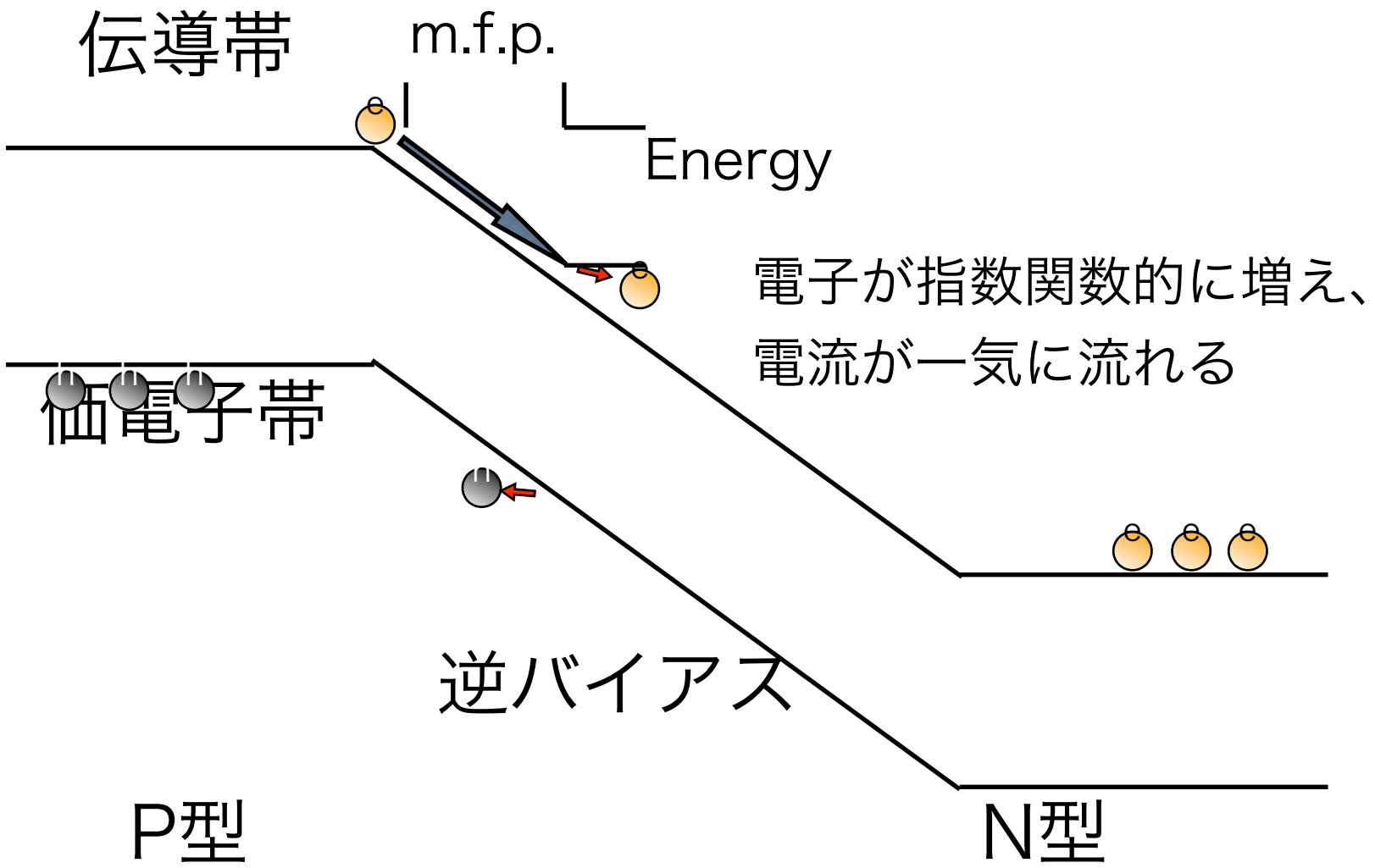


PMT test in INFN Pisa





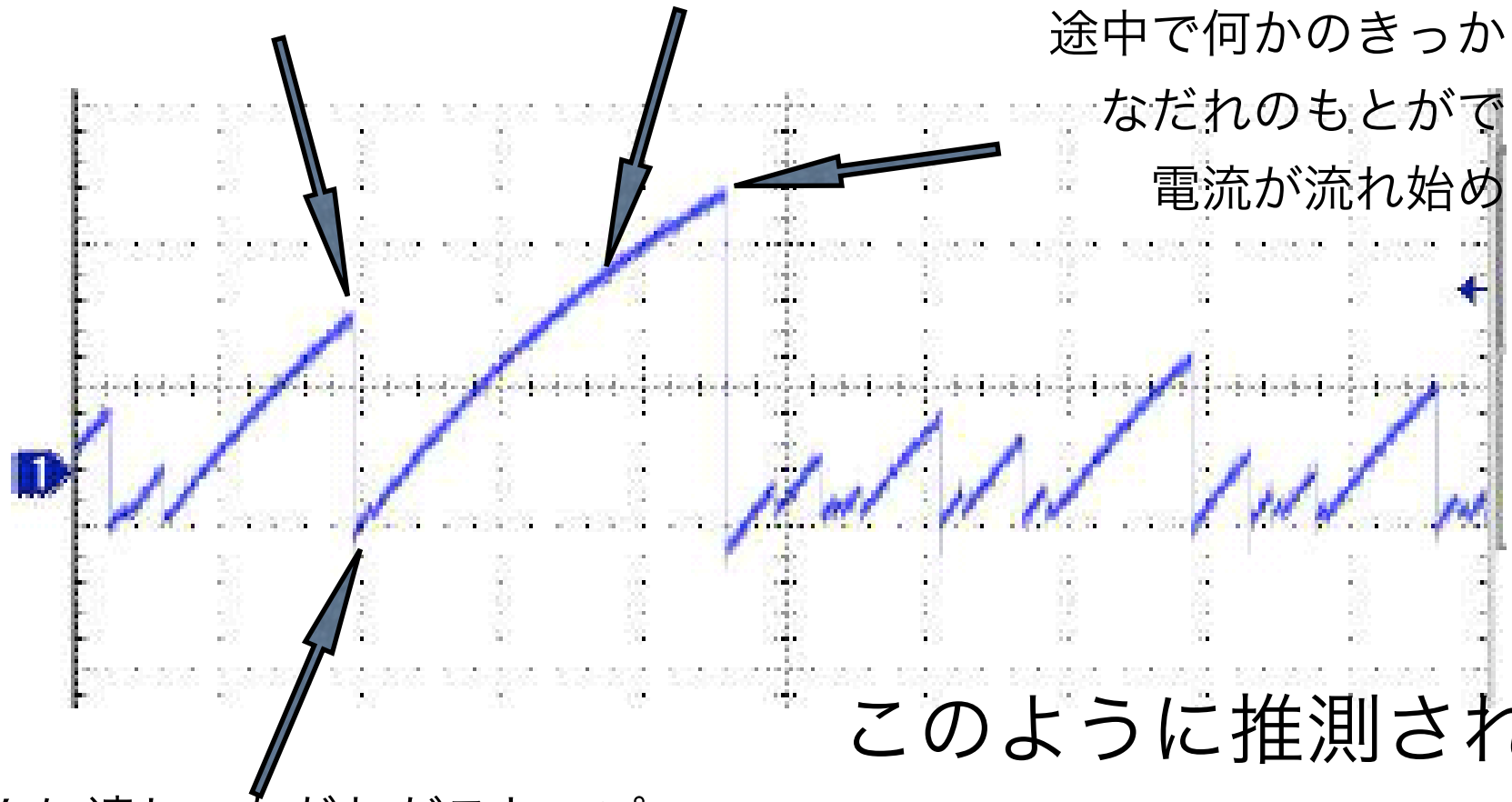
Avalanche 降伏
(なだれ降伏)

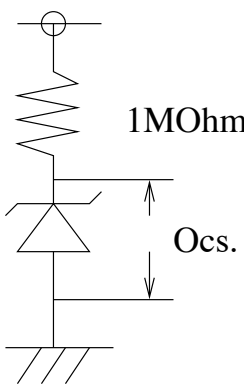


何かのきっかけで、
なだれのもとができる

RCの時定数でイクスポネンシャル電圧上昇

途中で何かのきっかけで、
なだれのもとができて
電流が流れ始める





このように推測される

Vzに達し、なだれがストップ

低温:熱励起少ない？