

***Multi-Anode PMT / HPD
and
their Applications***

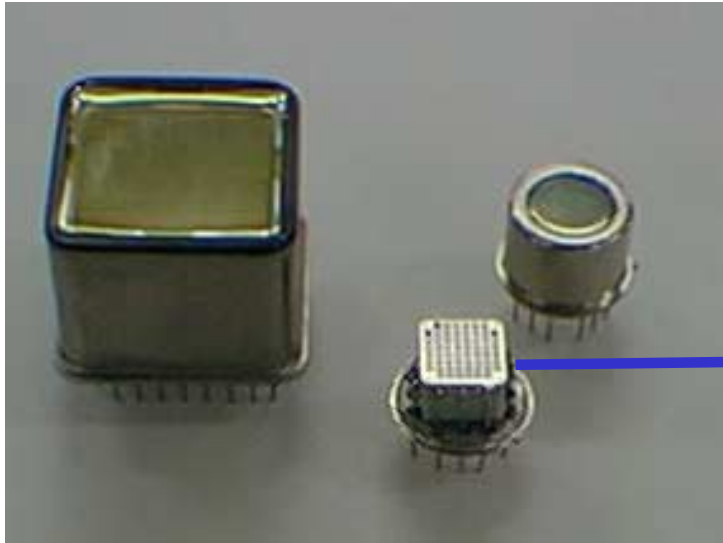
Hamamatsu Photonics K.K.

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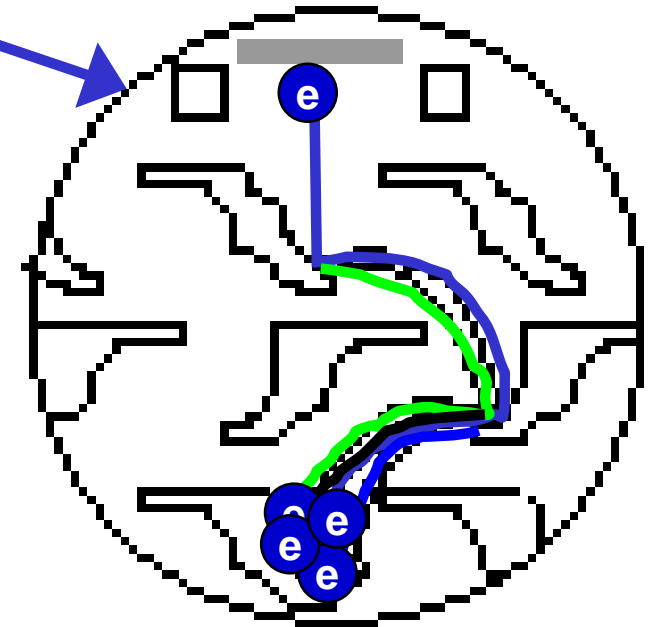
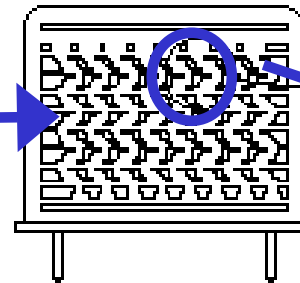
- Metal Package PMT & Flat Panel PMT
- MA PMT Readout Module
- Multi-channel HPD (under development)

Metal Channel Dynode & Metal Package PMT



Metal Channel Dynodes

- Computer Electron Trajectory Design
- Micro machine technology

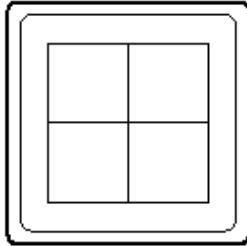


Features

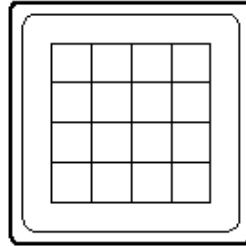
- Downsizing
- Excellent Time Response
- Good Linearity
- Multi anode capability

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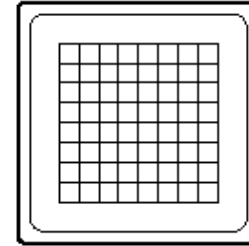
Various Anode Patterns



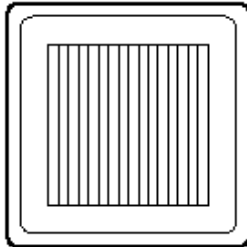
R5900U-00-M4



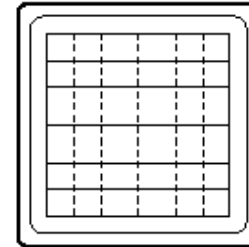
R5900U-00-M16



R5900U-00-M64



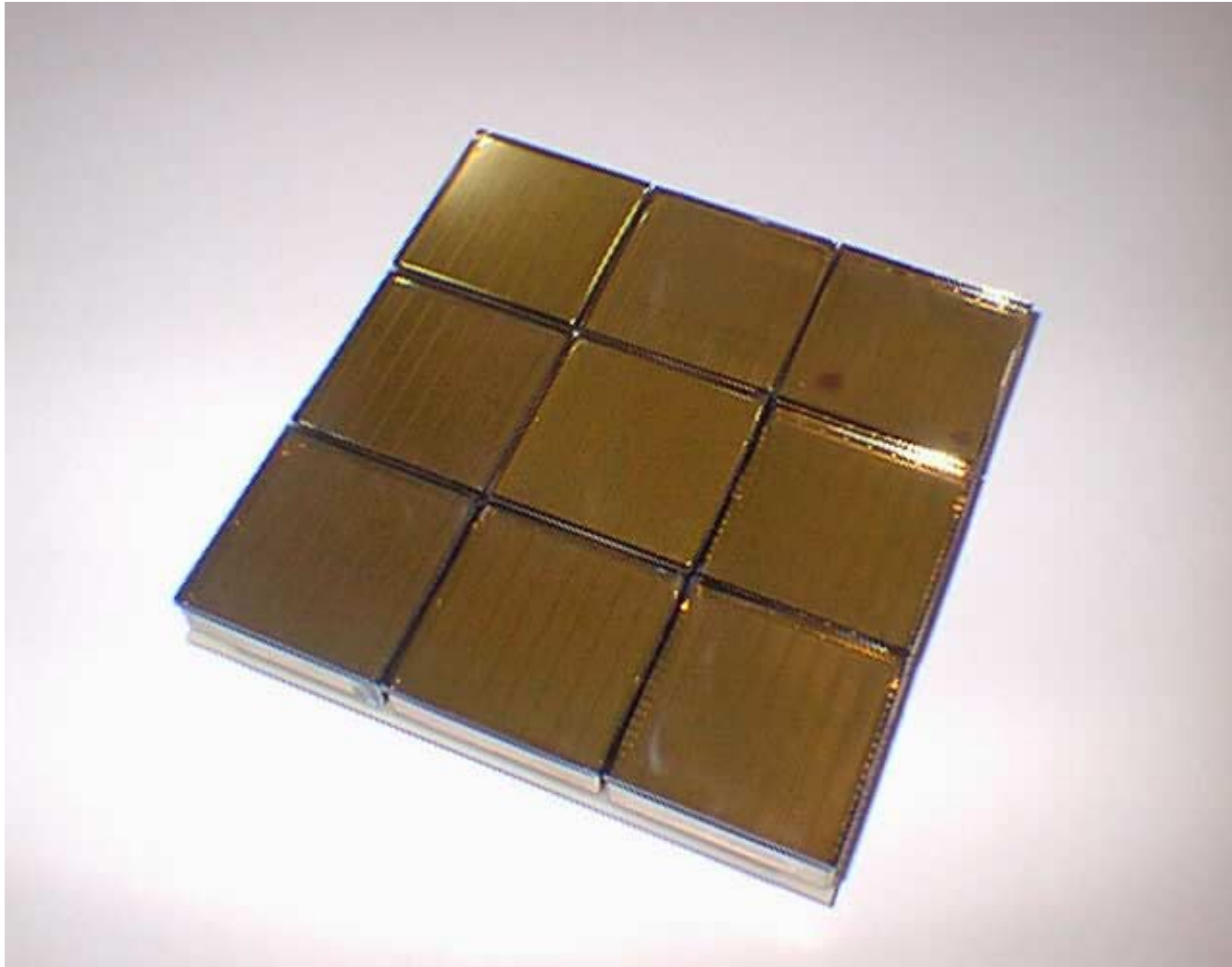
R5900U-00-L16



R5900U-00-C12

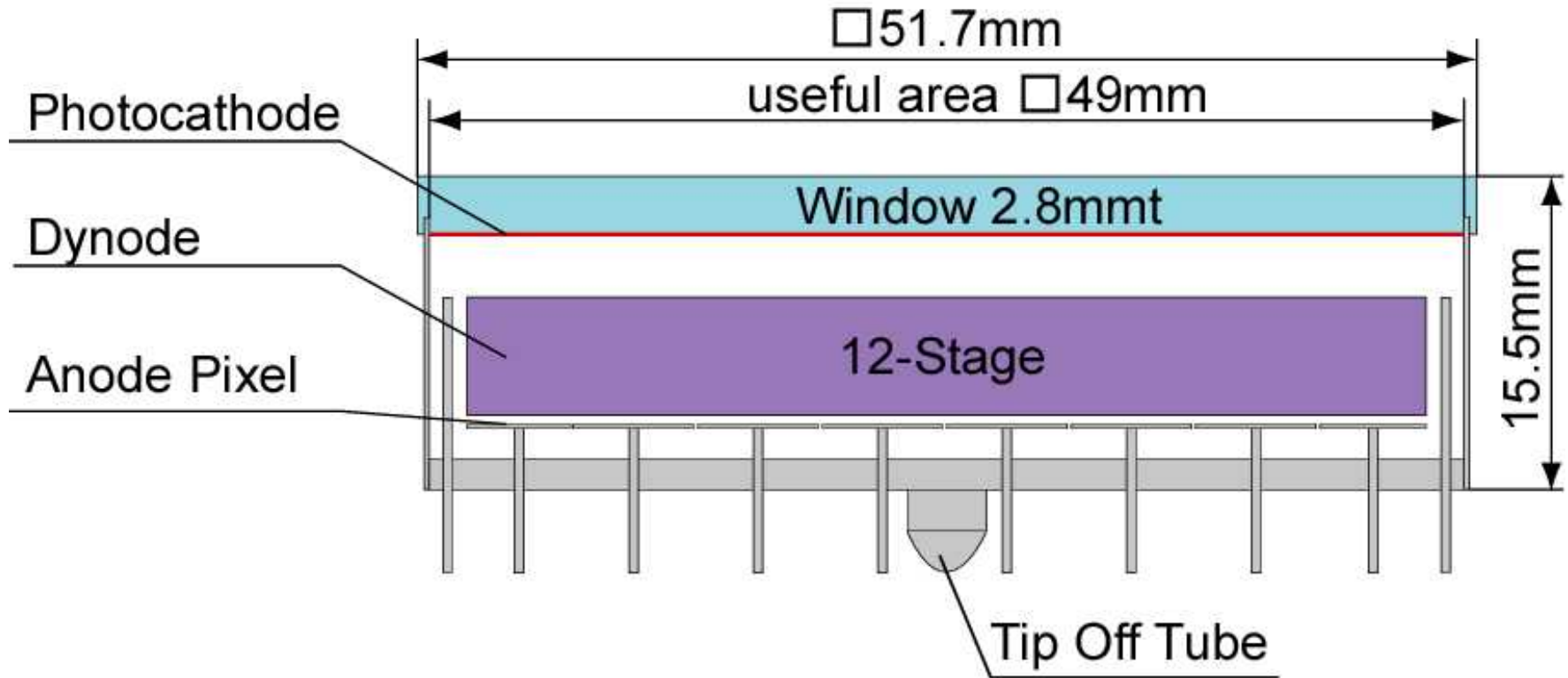
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Flat Panel PMT



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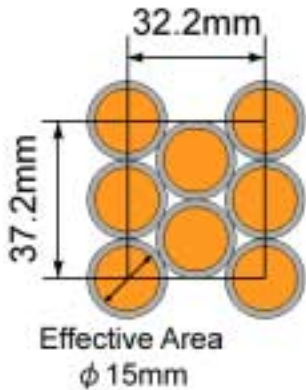
Cross Section of Flat Panel PMT



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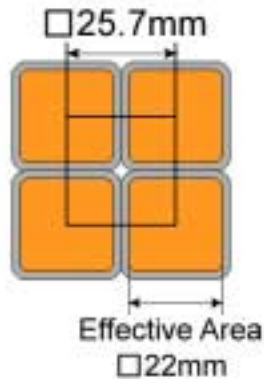
Comparison of Effective Area Ratio

R1450

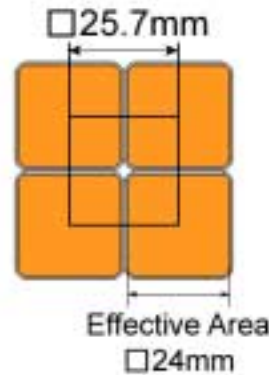


Effective Area Ratio
59%

R7600-C8,C12 R8520MOD-C12

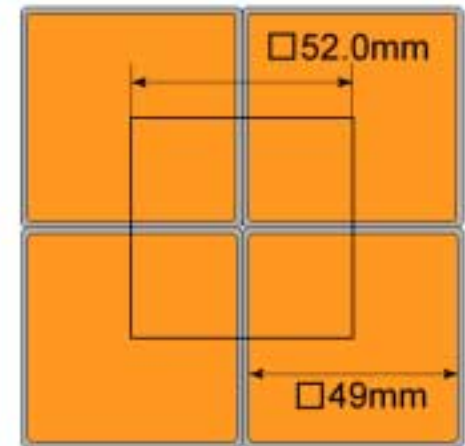


Effective Area Ratio
73%



Effective Area Ratio
87%

64ch Flat Panel PMT
(Development product)



Effective Area Ratio
89%

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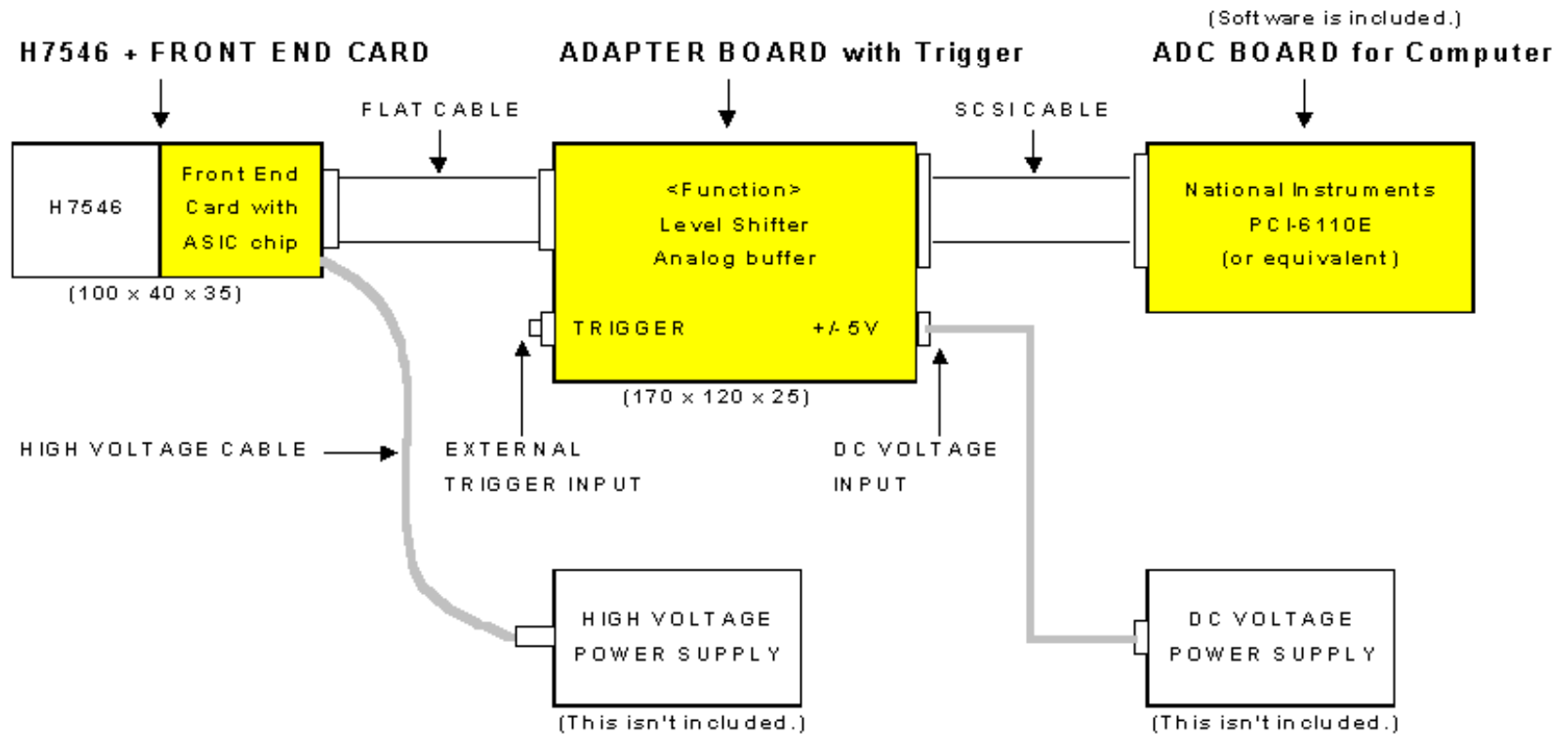
Readout Module for 64ch-PMT



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Block Diagram of Readout Module

() : Dimensional Outline / unit : mm

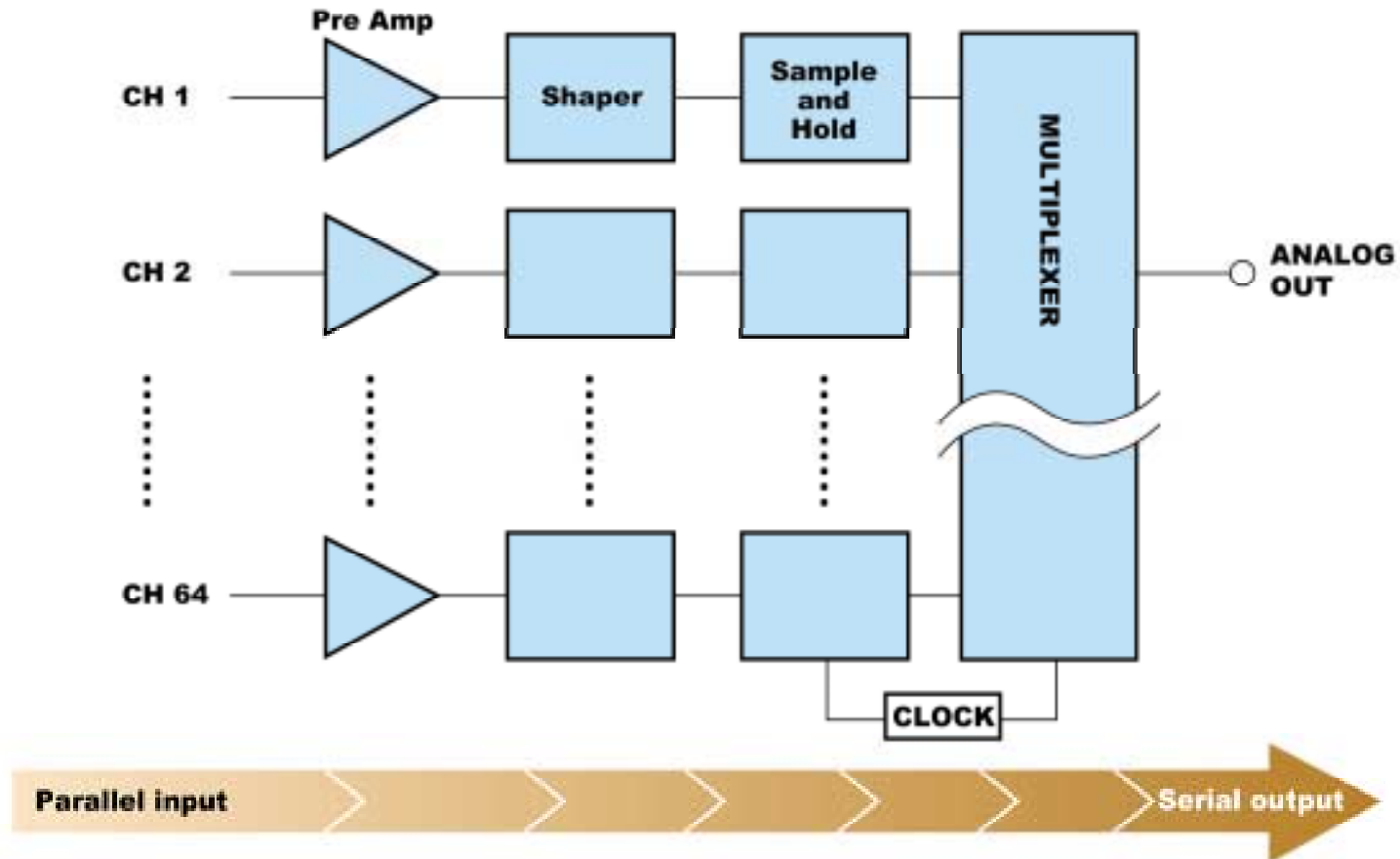


Peaking Time = 1 u sec
 Readout Time = 50 u sec / 64 ch
 Sampling Rate = 20 kHz for all 64 ch

*LabVIEW is a trade mark of National Instrument
 in the US and other countries.

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Block Diagram of Front End Card



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Test Condition



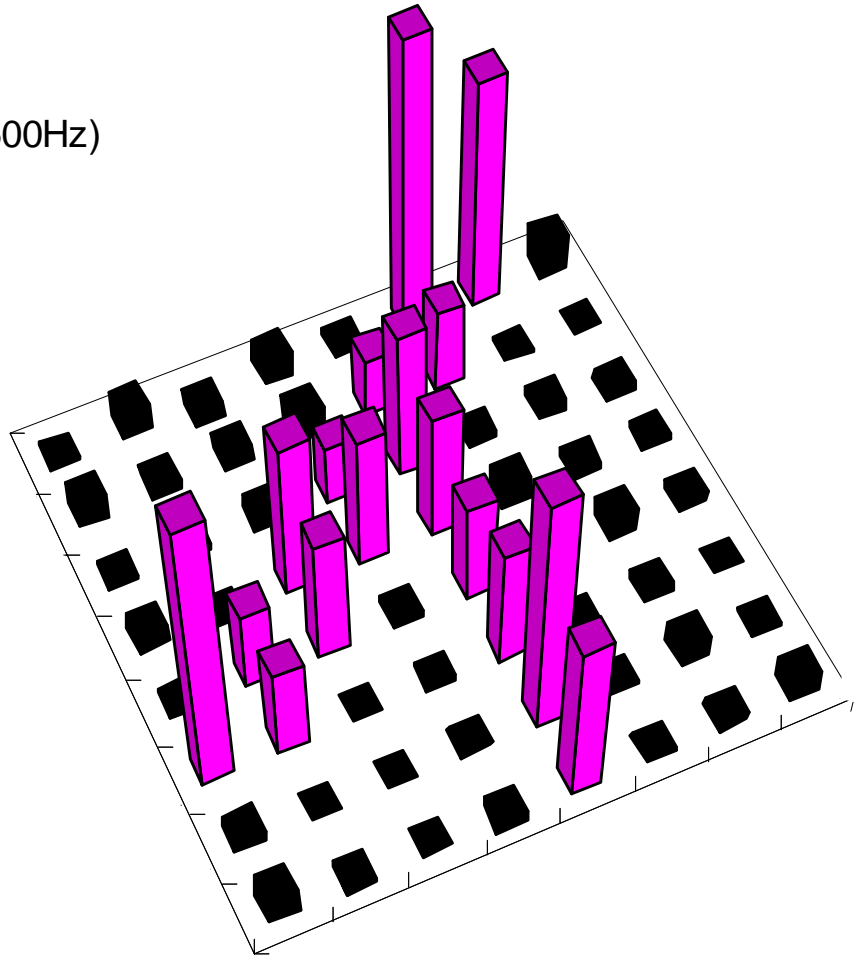
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Output Image of MA-PMT Module

Light Source : green LED
(60ns 500Hz)

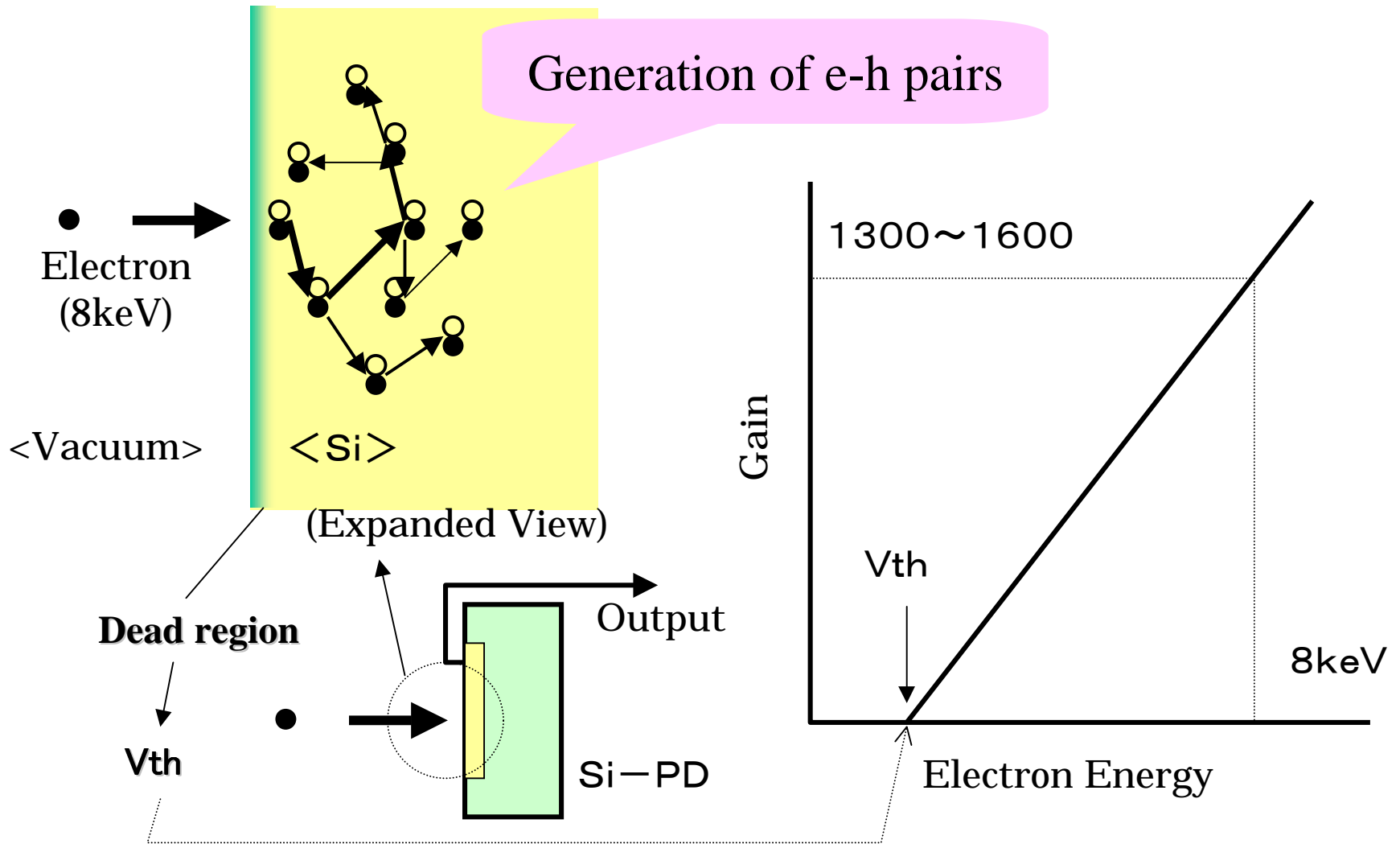
PMT Gain : 2×10^5

Trigger : External



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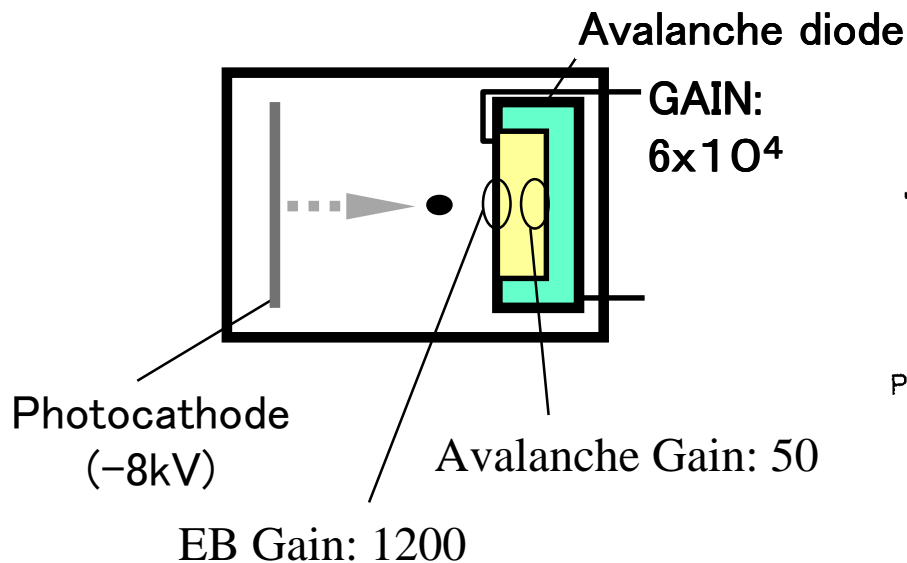
Electron Bombardment Gain



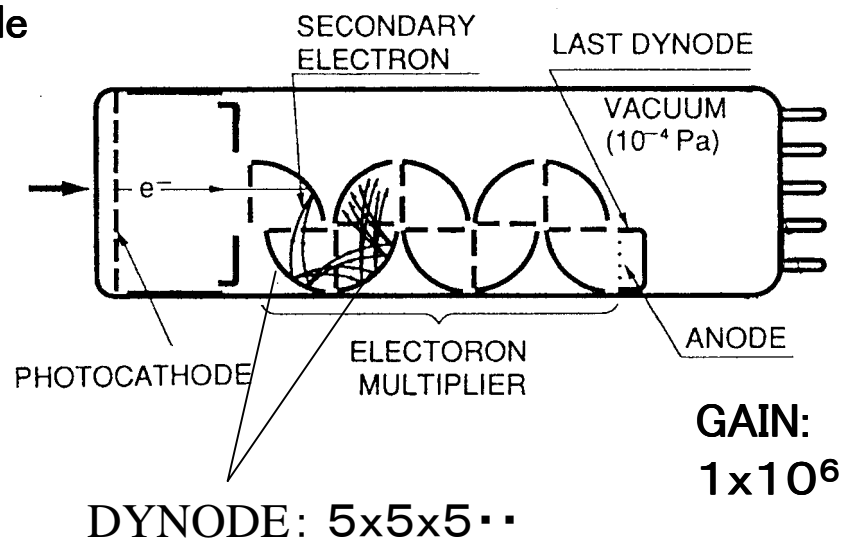
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COMPARISON: HPD and PMT

<Hybrid Photo Detector (HPD)>



<PMT>



S/N determined by First Dynode

HPD: $35 = \sqrt{1200}$

PMT: $2.2 = \sqrt{5}$

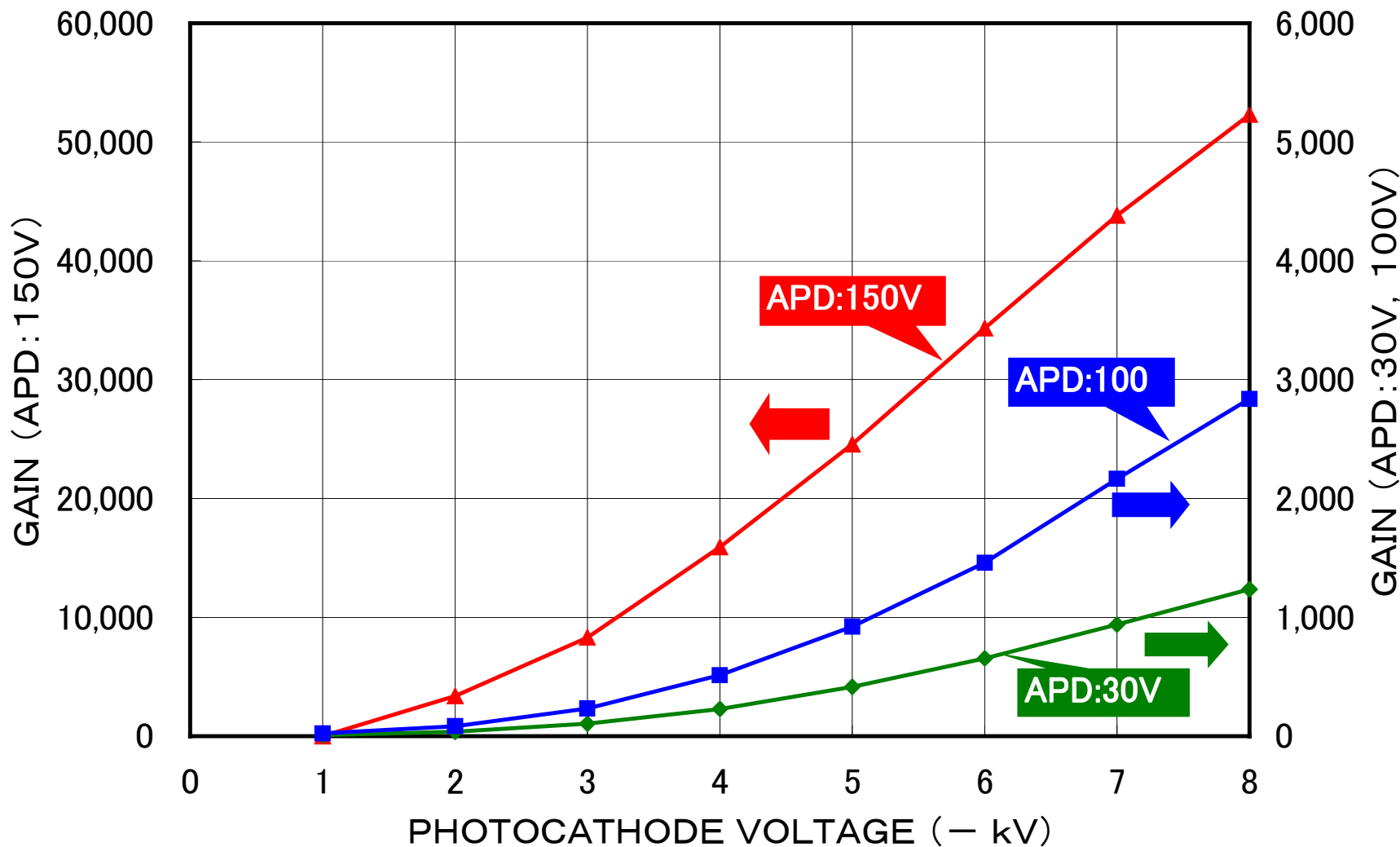
Single channel HPD (R7110)

- Gain 50,000 (Photocathode: -8kV, AD: 150V)
- Rise time: 1.2ns, Fall time: 13ns
- Photocathode: GaAsP (QE45%), S20(10~20%)
- Dimensions: ϕ 20x18 (mm)



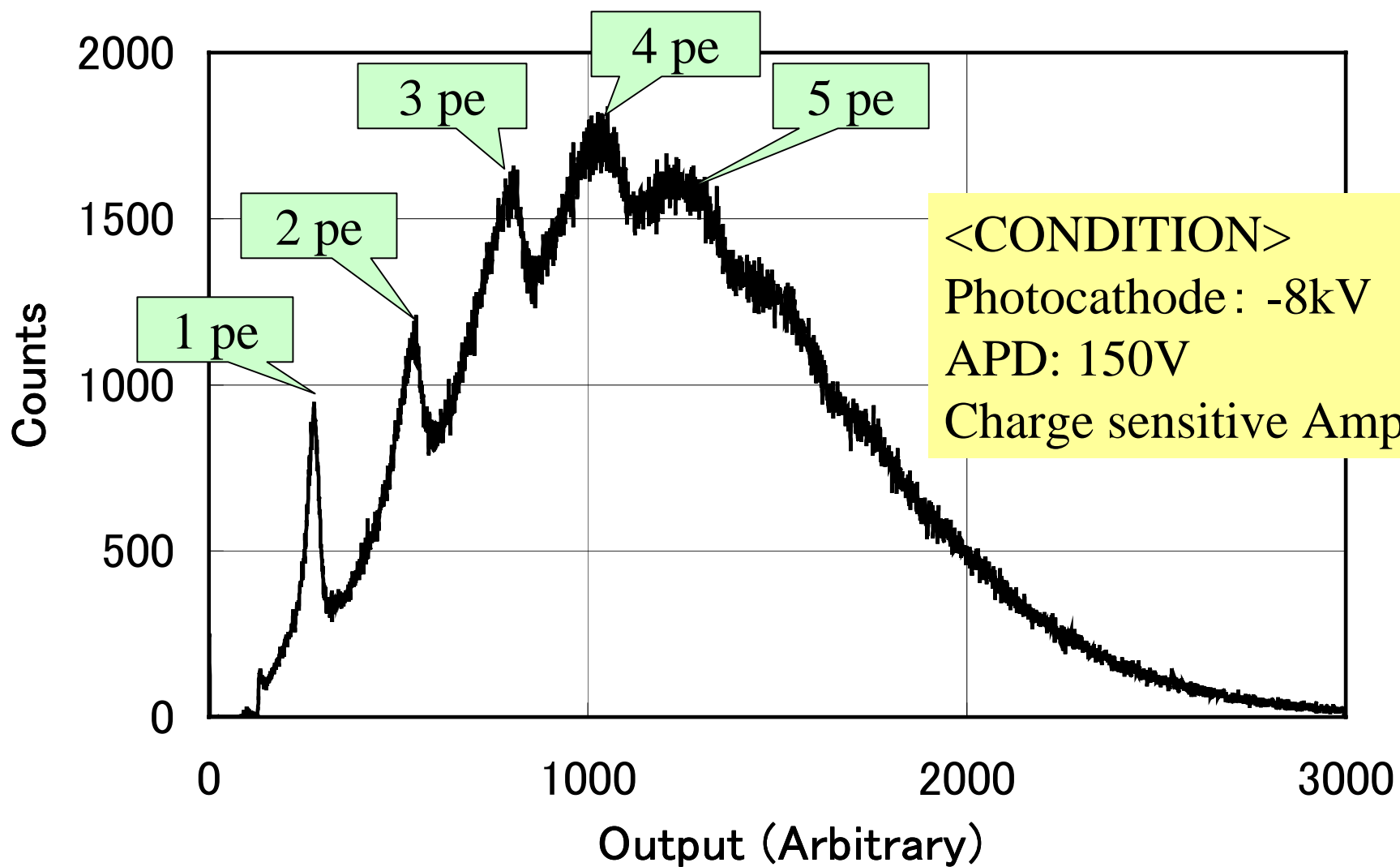
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Gain Characteristics



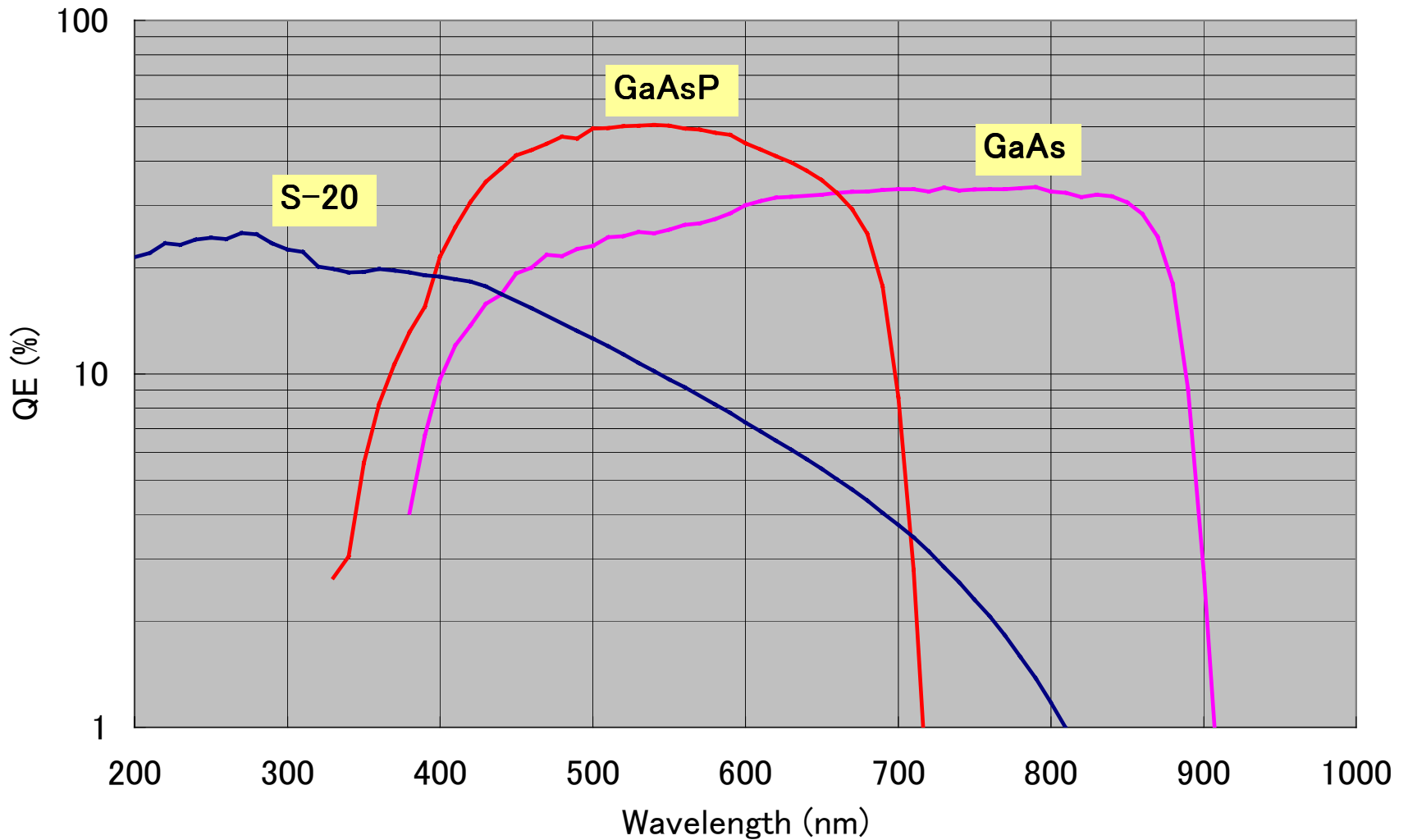
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Pulse Height Distribution



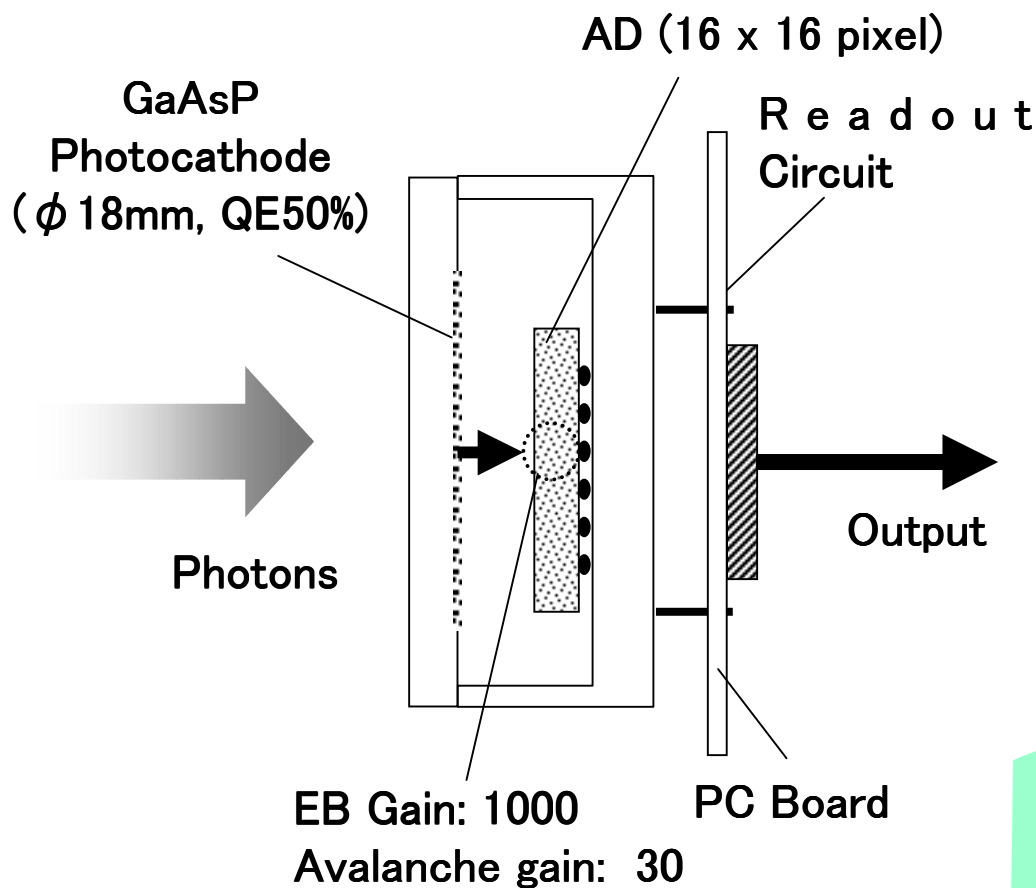
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Highly Sensitive Photocathodes



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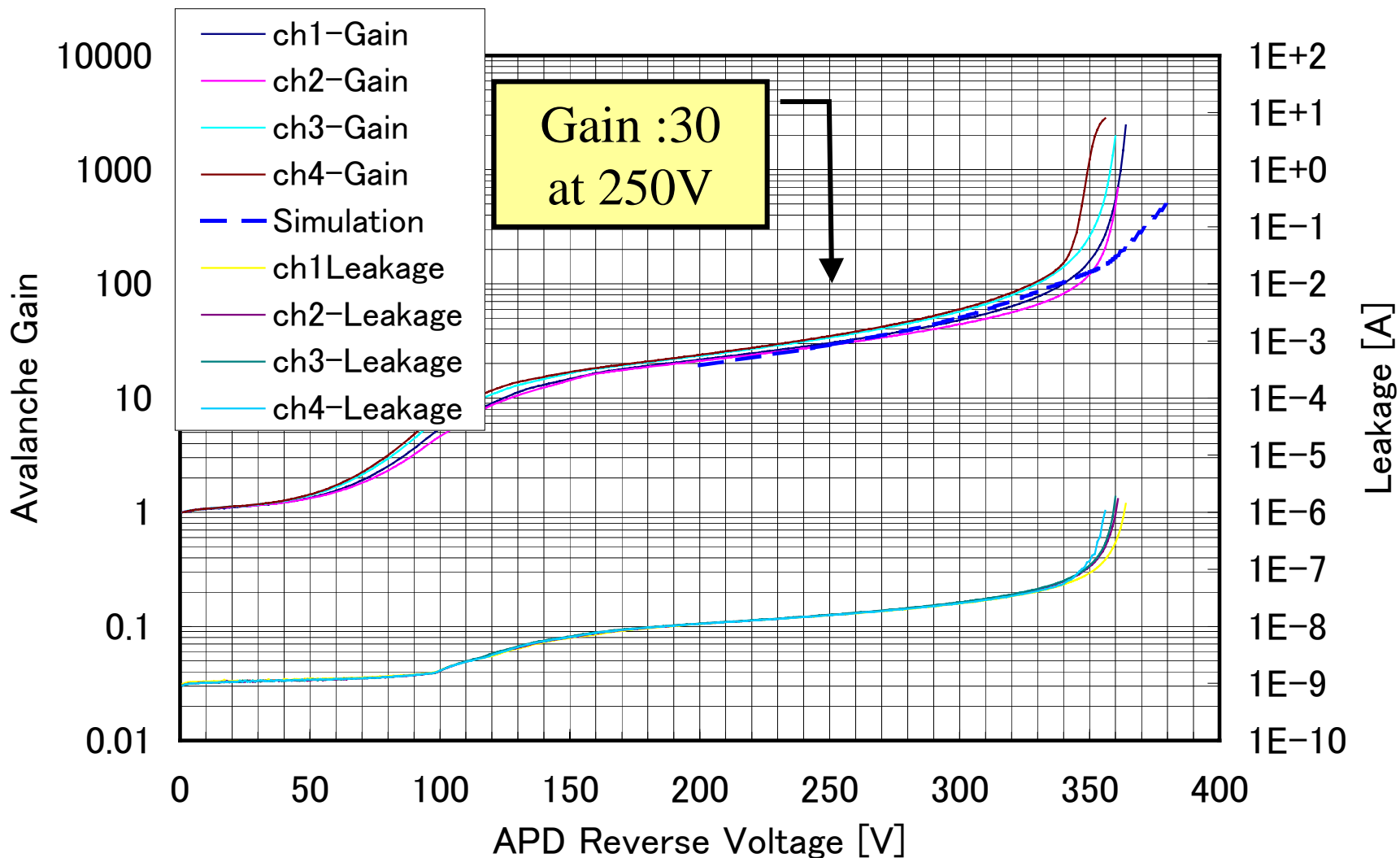
Objective Spec. of Multi-HPD



Photocathode	GaAsP
Effective area	ϕ 18 mm (or 16x16 mm)
Target	Avalanche diode 16x16 pixel 1mm square / pixel
Dead area between pixel	0.05 mm
Capacitance	5pF / pixel
Gain	> 30,000
Response time	< 5 ns rise + fall

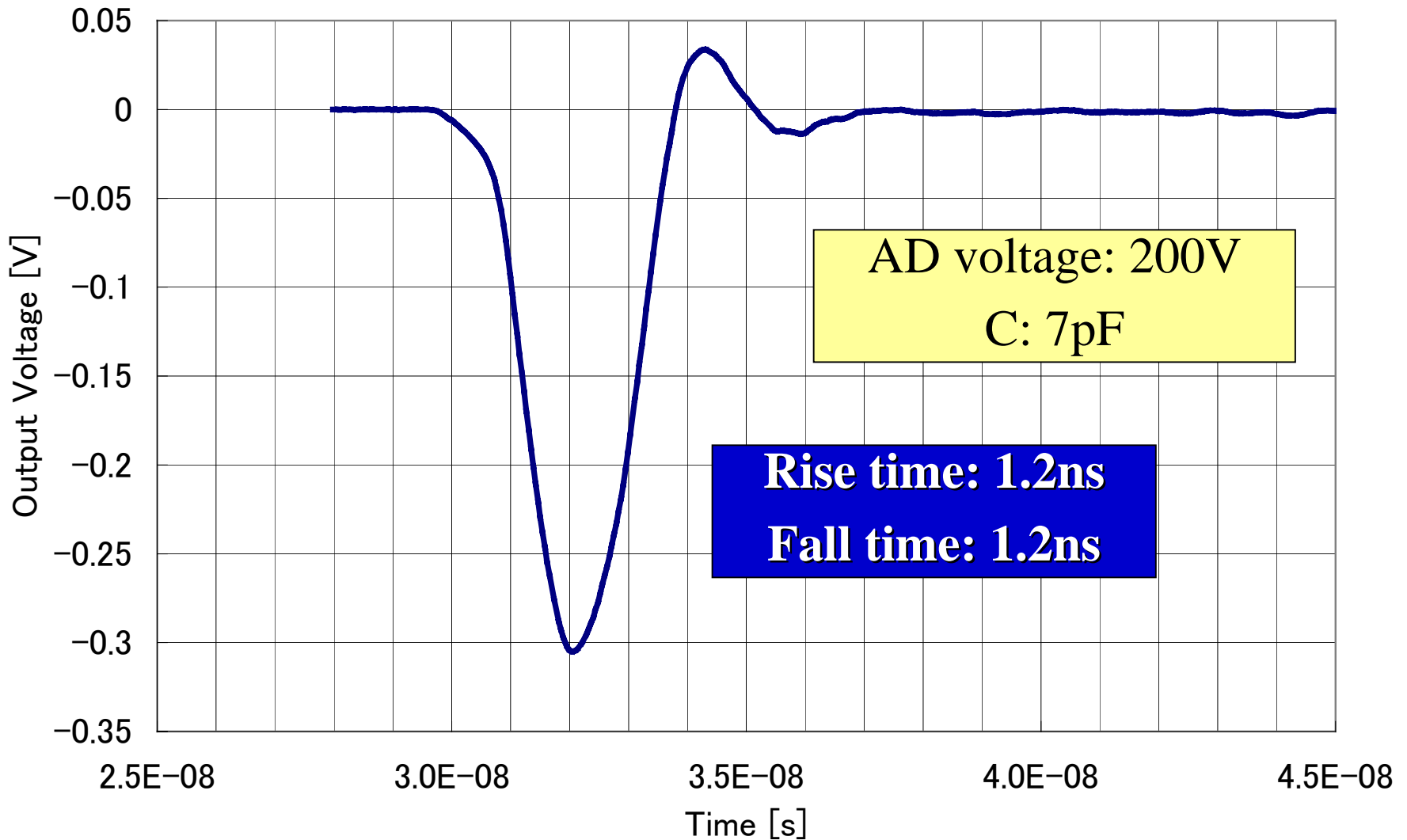
For feasibility study

Gain of AD (Preliminary)



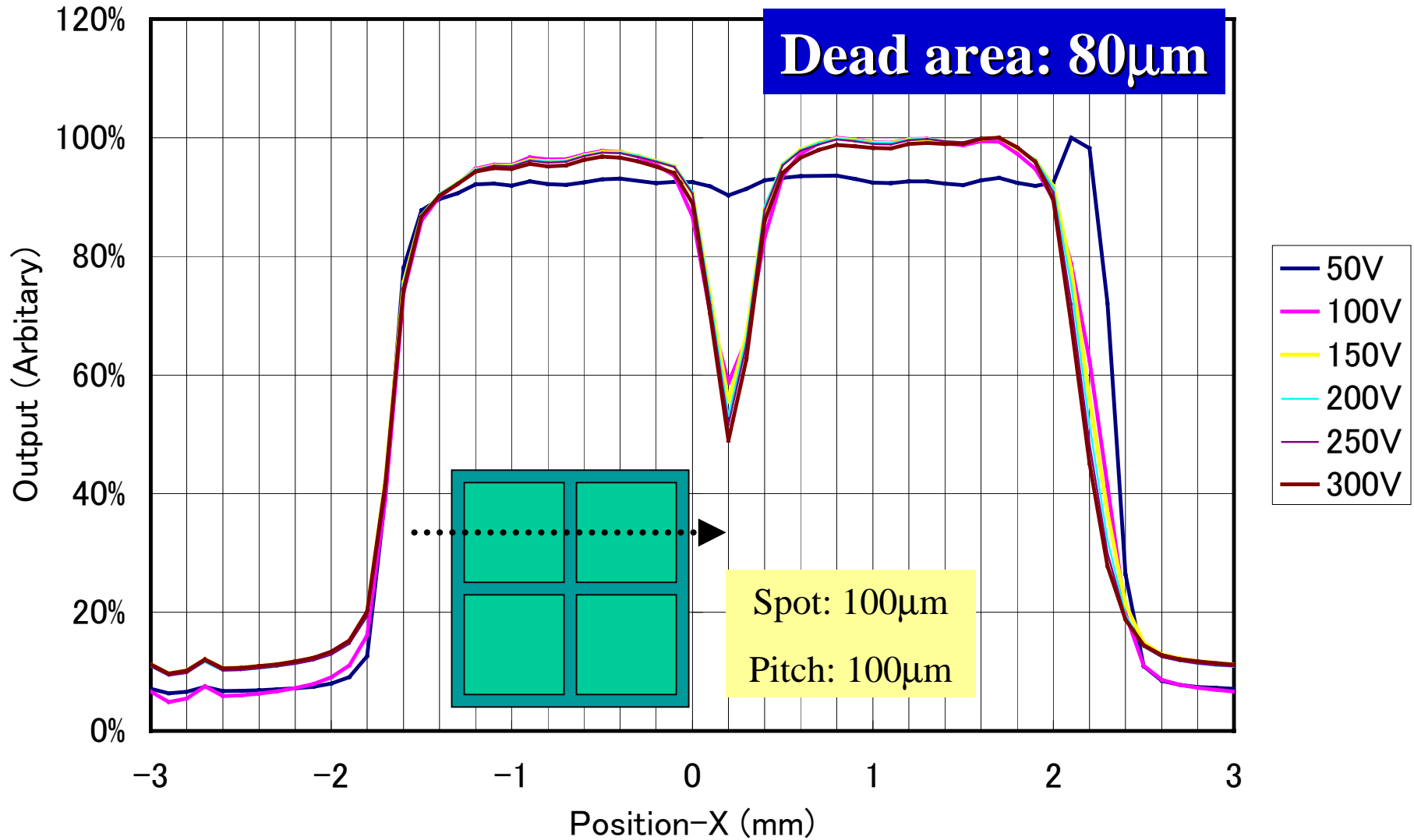
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Response time (Preliminary)



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Uniformity (Preliminary)



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R&D schedule

- Preliminary test of AD: October
- Design: November
- Tube process: Start in February (2002)
- Proto-tube: April (2002)