

ASPERA Technology Forum

Welcome

Munich
21-22.10.2010

HAMAMATSU
PHOTON IS OUR BUSINESS

1. Hamamatsu / Main company structure

Hamamatsu Photonics K.K.

The collage includes:

- Solid State Division:** Various electronic components like diodes and transistors.
- Electron Tube Division:** A collection of vacuum tubes and glass envelopes.
- Laser Group:** A photograph of a laser beam and a close-up of a laser component.
- Systems Division:** A computer monitor displaying a software interface.
- Research Laboratories:** A photograph of laboratory equipment.

World Map:

- Europe:** Labeled "Subsidiaries".
- Japan:** Labeled "Headquarters".
- USA:** Labeled "(Subsidiaries)".
- Southeast Asia:** Labeled "(Representatives)".

Text at the bottom:

Established : Sept.29.1953
Net Sales : (FY 2009) Yen 90B (€800M)
Employees : 4,000 (Group) (As of Sept.2010)

2. ETD/ production capability

Toyooka Factory

R&D / Metal Channel PMT/
Various Photocathodes



2. ETD/ production capability

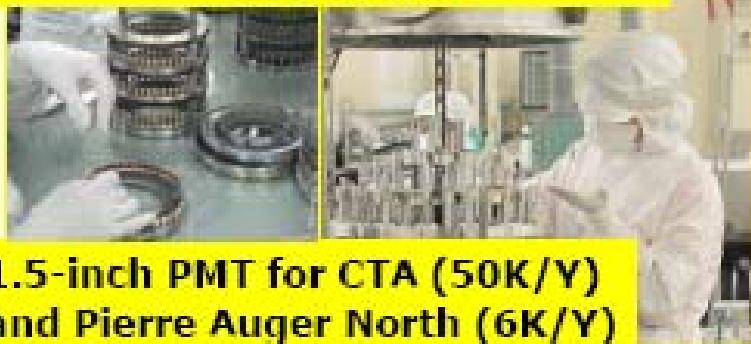
Takaoka Factory

PMT for Gamma Camera
Old Mass Production Types

PMT Factory
& Office



Production Quantity: 300K/Year
Employees: 145 for PMT
150 in total



BHP/China Factory

PMT for PET
New Mass Production Types

Production Quantity: 200K/Year
Employees: 160 for PMT
270 in total



2. ETD/ PMTs and development for astro particle projects

PMT for Gamma-ray Telescope

R8619MOD (1.5-inch, CC window, Bialkali)

Gain=4E+04 min., Rise=2.5ns, TTS=1.4ns

QE=35% at 400nm, AP/NOISE=0.04%

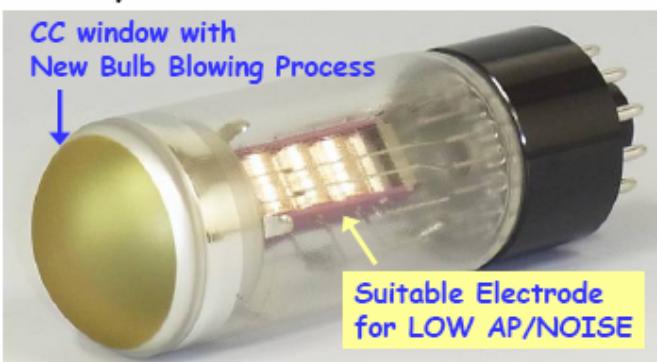
< Features >

High QE
LOW AP/NOISE

< Potential >

CTA: 150,000 pcs
PAN: 18,000 pcs

PAN: Pierre Auger North



Prototype was successfully made. We are studying adequate process for Mass-Production right now.

PMT for Deep Sea Neutrino EXP.

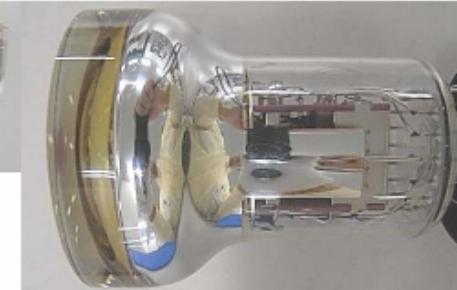
R6233MOD (3-inch, CC window, Bialkali)

Gain=1E+06, Rise=7ns, TTS=5ns

QE=27% at 400nm

CC window which fits for 17" Glass Sphere

< Features >
High QE
LOW Cost



< Potential >
KM3NeT: 200,000 pcs

Prototype will be available in Dec.2010.

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2. ETD/ PMTs and development for astro particle projects

PMT for Neutrino EXP.

R11780 (12-inch, Hemi-Spherical, Bialkali)
Gain=1E+07, Rise=4ns, TTS=3ns
Large Size, High Pressure-resistance

< Features >
High QE
Large Size for LOW Cost

< Potential >
MEMPHYS: 100,000 pcs
LENA: 100,000 pcs

Few samples are available.



Prototype was made and basic characteristics is being checked.

PMT for Dark Matter EXP.

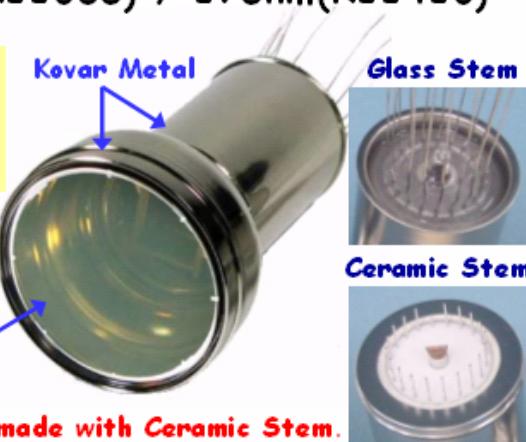
R11065/R11410 (3-inch, LT-Bialkali)
Gain=5E+06, Rise=5.5ns, RI=100 mBq/PMT
QE=30% at 420nm(R11065) / 175nm(R11410)

< Features >
LT-Bialkali for Low Temp.
R11065/Liq.Ar, R11410/Liq.Xe
High QE, LOW RI

< Potential >
DM EXP in Europe: 4,000 pcs

Quart Window
with LT-Bialkali

Further reduction of RI can be made with Ceramic Stem.



2. ETD/ experiment summary

List of Large Scale Experiments												Procurement Plan (pcs)				Date: Oct.05.2010			
ASPERA relation Others	Type	Experiment (Location)	Product Type#	Total QTY	Production	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021			
	Cosmic-Ray Experiment	CTA (N-Hemi & S-Hemi)	R8619 MOD-100 (1.5", High QE)	150.000	Takaoka		1.000		50.000	50.000	50.000								
		PAN (FD) (USA)	R8619 MOD-100 (1.5", High QE)	18.000	Takaoka				6.000	6.000	6.000								
		PAN (SD) (USA)	R5912-03 (8", 8-stage)	4.500	TOYOOKA			2.000	2.500										
	Neutrino (UGL)	LENA (EU-UGL)	R8594 (5" Hemispherical)	124.000	TOYOOKA					20.000	20.000	25.000	30.000	29.000					
	Neutrino (UGL)	Super-NEMO (LSM)	R5912-03 MOD (8", 8-stage, LRI)	11.000	TOYOOKA	500		3.500	3.500	3.500									
	High Energy Neutrino (UGL)	KM3NeT (Mediterranean See)	R6233 MOD (3", CC window)	200.000	BHP			60.000	70.000	70.000									
	Collision Experiment	PANDA (ECAL) (GSI)	R11375 (1" TRIODE)	5.000	TOYOOKA		2.500	2.500											
	Neutrino (UGL)	LBNE (DUSEL PROJECT)	R7081 (10")	140.000	TOYOOKA		500	2.500	2.500	20.000	20.000	20.000	20.000	20.000	14.500				
	Neutrino (UGL)	Hyper-Kamiokande (Kamioka Japan)	20"HPD-ASSY	100.000	TOYOOKA						10.000	20.000	20.000	20.000	20.000	10.000			

PAN : Pierre-Auger North

UGL : Under Ground Laboratory

3. SSD/ MPPC Development for Astro Particale Physics

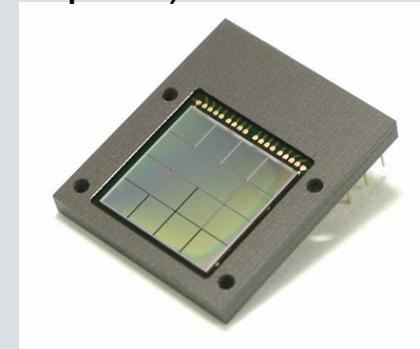
- **Lower dark count**

10Mcps (2007)

5Mcps (2009)

1Mcps (2010 – best case)

} (for 3x3mm, 50um pixel pitch)



- **UV sensitivity (300-400nm)**

PDE 30% -> 45% @350nm(early 2011)

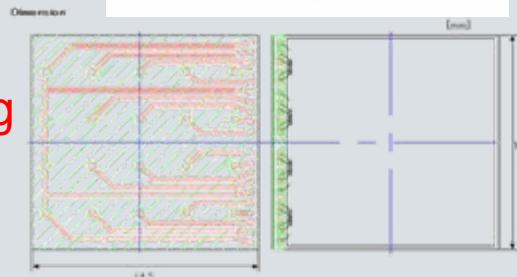
AR control and active area improvement are ongoing

- **High time resolution (jitter)**

200 – 300ps (2009)

lower than 130ps (2010)

} (for 1x1mm, 1 p.e. level)



- **Uniformity improvement and package development**

monolithic array and buttable package

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3. SSD/ APD, MPPC for High Energy Physics

Project	Sensor	Organization	Specification	2011	2012	2013	2014	2015	2016~
S-LHC(ATLAS)	SSD	KEK	97.5x97.5mm etc						
S-LHC(CMS) super-B	SSD DSSD	CERN KEK	6inch full wafer size 90x120mm						
g-II	DSSD	KEK	90x120mm						
S-LHC(CMS)	NonN-PIXEL	CERN	15x60mm						
ILC	PIXEL	ECOLE POLYTECHNIQUE	16x16ch 9cm□						
ILC	PIXEL	Univ of OREGON	hexagonal 1024ch						
Nova	APD	Fermi	32ch APD array						
PANDA	APD	GSI	7x14mm APD						
CMS upgrade	MPPC	CERN	1mm□, (ECAL)						
CMS upgrade	MPPC	CERN	1mm□, (HCAL)						
LBNE	MPPC	Fermi Laboratories	S10362-11-050U						
MICRO-BOONE / Dout	MPPC	MIT							
ILC	MPPC	信州大	1.3mm plastic mold						
CTA	PMT/MPPC	ETH & PSI	3mm□						
JEM-EUSO	PMT/MPPC	INFN ROMA II	3mm□ array						
JEM-EUSO / CTA	PMT/MPPC	MPI	3mm□ array						