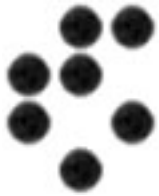
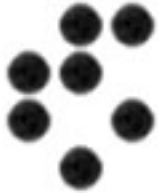


Beam test of Burle 85011-501 64 channel MCP PMT

Peter Križan (for Andrej Gorišek and Samo Korpar)

University of Ljubljana and J. Stefan Institute

Contents



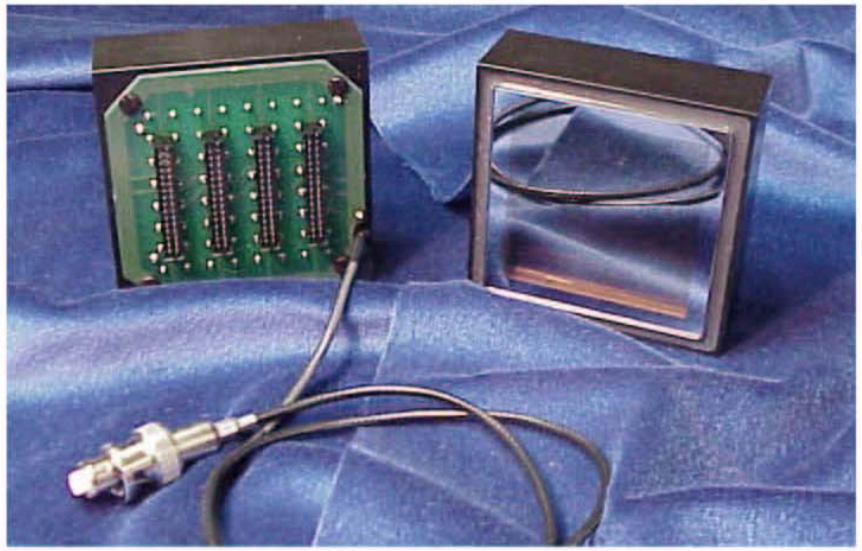
Burle 85011-501 MCP PMT

Test set-up

Beam test results

Further plans

The 85011 assembly is based on a new photomultiplier tube that uses microchannel plates (MCP) for electron multiplication, the PLANACON™. This 2" square head-on MCP-PMT is very low profile, less than one inch thick including the voltage divider network. The sixty-four anodes provide 6mm position resolution when used as a discrete pixel device. Improved resolution can be obtained using the charge-sharing technique with an alternate voltage divider network. The dual MCP multiplier provides excellent time response, good gain, and extremely high pulse linearity. Response uniformity over the full 2" square active area is exceptional, typically 1:1.5. The assembly comes with terminated anode and high voltage cables for ease of use. Applications include specialized medical imaging, ring imaging Cherenkov counters, fluorescence microscopy, and high-speed applications such as LIDAR.



GENERAL

Parameter		Value	Unit
Spectral Response		165 to 660	nm
Wavelength of Maximum Response		410	nm
Photocathode Material		Bialkali	--
Window	Material	Quartz	--
	Thickness	0.080	in
Multiplier	Structure	MCP (25µm pore, 40:1 L:D)	--
	Number of Stages	2	--
Anodes	Number	64 (8 x 8)	
	Size / Pitch	0.234 / 0.254	in
Voltage Divider Resistance		12	MΩ

Maximum Ratings (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	2400	Vdc
Average Anode Current, sum of all anodes		3	µA
Ambient Temperature		- 40 to + 70	C

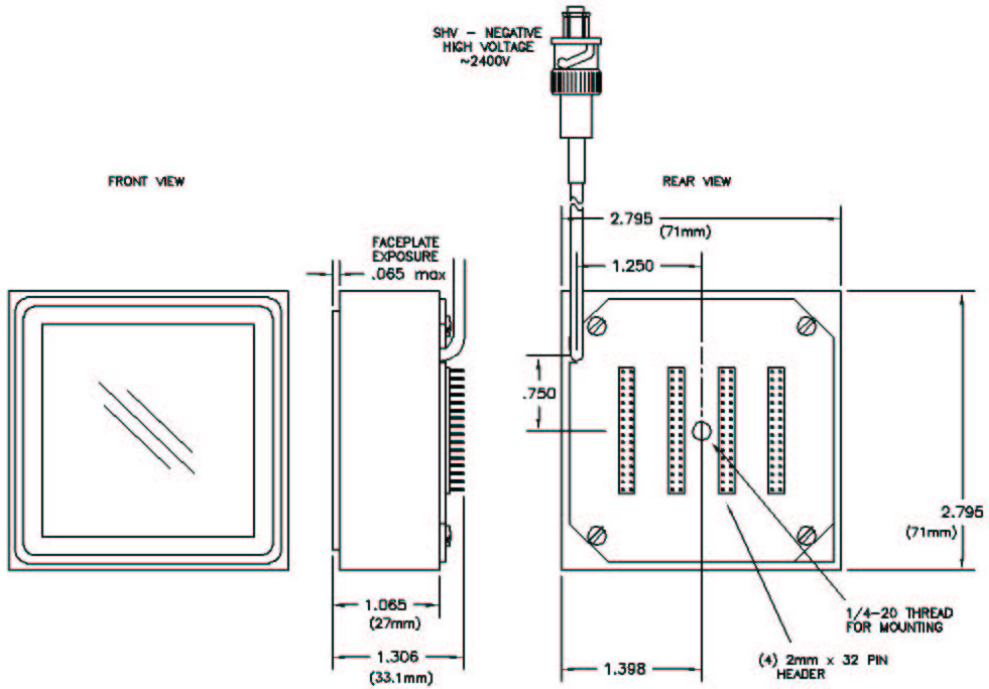
Parameter		Min.	Typ.	Max.	Unit
Cathode Sensitivity	Luminous	40	55	--	μA/Lm
	Blue (with CS-5-58 filter)	5.5	7.5	--	μA/lm-b
Anode Sensitivity	Luminous		35	--	A/lm
Modal Gain		0.3×10^6	0.6×10^6	--	--
Anode Dark Current, Sum of all pixels		--	0.5	5	nA
Time Response	Anode Pulse Rise Time	--	0.3	--	ns
	Anode Pulse Width (FWHM)	--	1.8	--	ns
Pulse Linearity at 5% Deviation		--	300	--	mA
Single Electron Response	Peak-to-Valley	--	2:1	--	
	Resolution (FWHM)	--	150	--	%
Anode Uniformity		--	1:1.25	1:1.5	
Pulse Height Resolution, 2" NaI(Tl) crystal, ^{137}Cs, 1700V (FWHM)		--	10.0	--	%

Note: Measured with the condition shown in Table 1 except where noted.

Table 1 VOLTAGE DISTRIBUTION RATIO AND SUPPLY VOLTAGE (-2300 Volts)

Electrodes	K	MCP_{in}	MCP_{out}	P
Ratio	1	10	1	

Supply Voltage : 1000Vdc, K : Cathode P : Anode

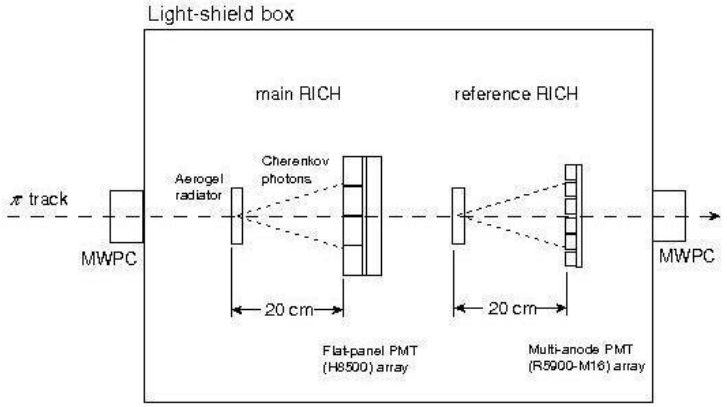


Beam test set-up

Beam test Nov. 2002 set-up

RICH1: array of Hamamatsu H8500 (flat pannel PMTs)

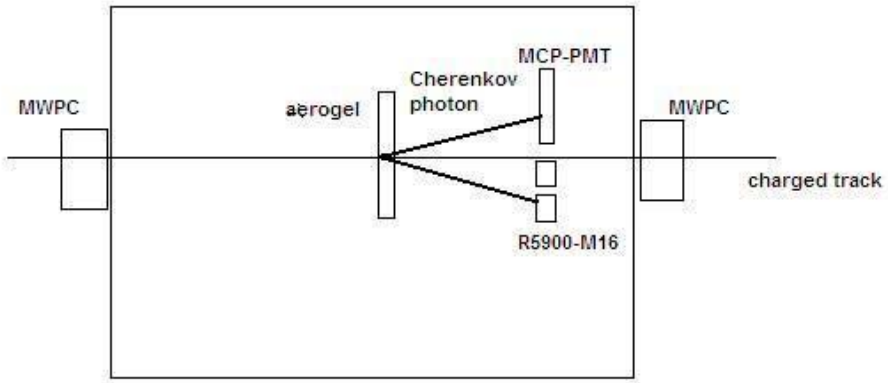
RICH2: reference, R5900-M16



Beam test March 2004:

RICH1: same

RICH2: Burle 85011 MCP PMT (+Hamamatsu R5900-M16 as reference)

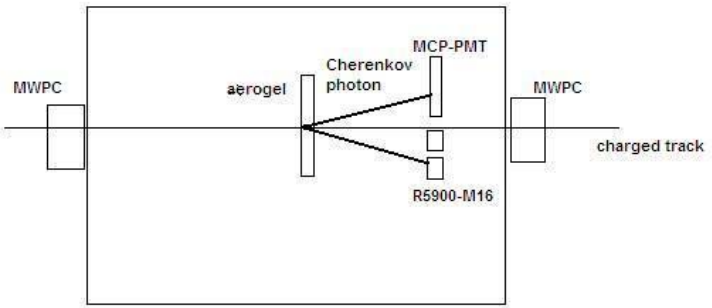


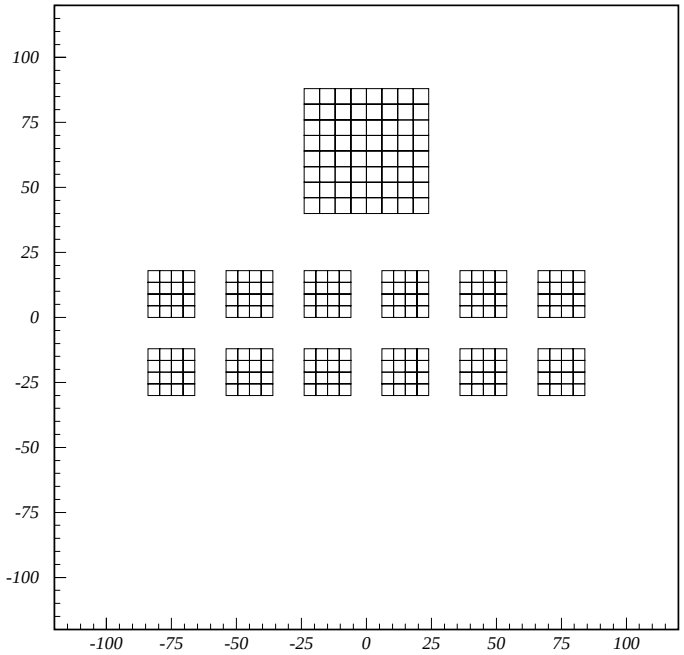
Beam test set-up

RICH2:

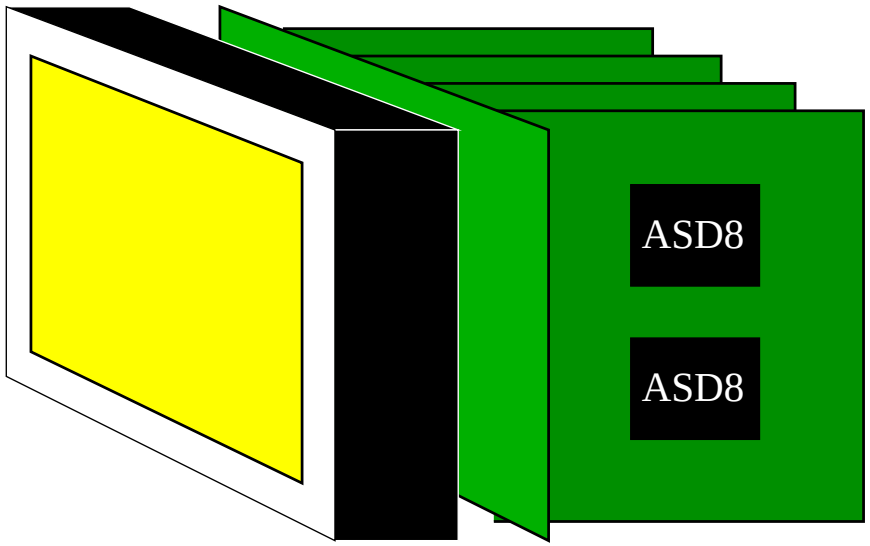
Burle 85011 MCP PMT

R5900-M16 as reference





Beam test set-up: read-out



PMT with ASD08 boards, all inside the light tight box

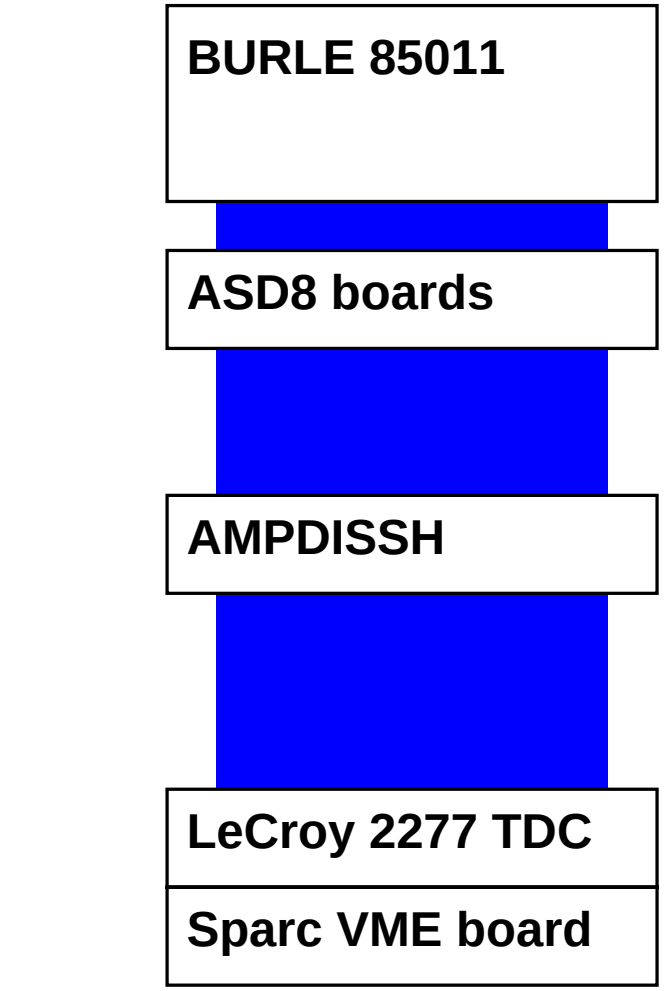
Signals are lower than from R5900-M16 PMTs

→Need additional amplification

→Take the ASD08 amplifier, shaper and discriminator chip (same as in the HERA-B RICH)

→Feed the output signals to the read-out chain

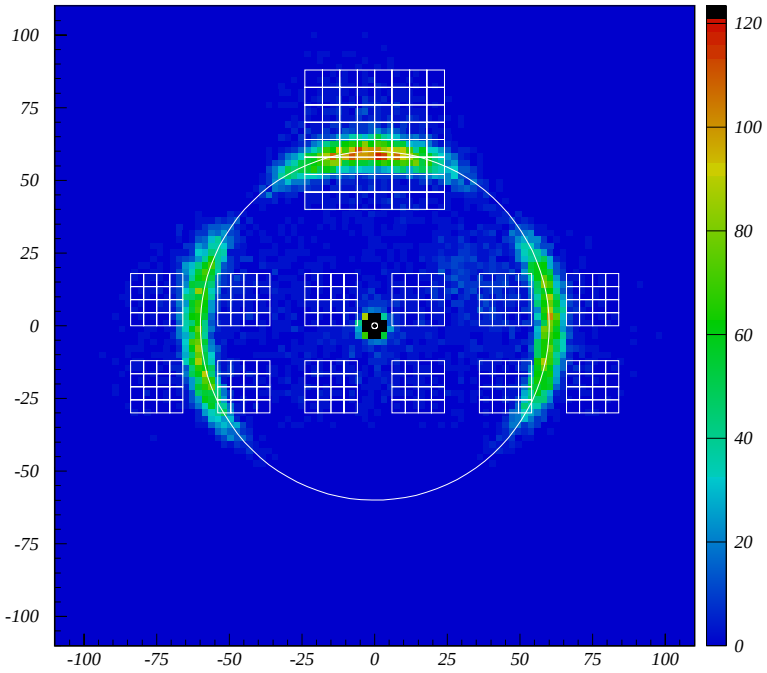
Beam test set-up: read-out



→Feed the output signals from the ASD08 amplifier to the usual PMT read-out chain (outside the light tight box)

→To the AMPDISSH boards, convert to the standard ECL logic signals

Beam test results

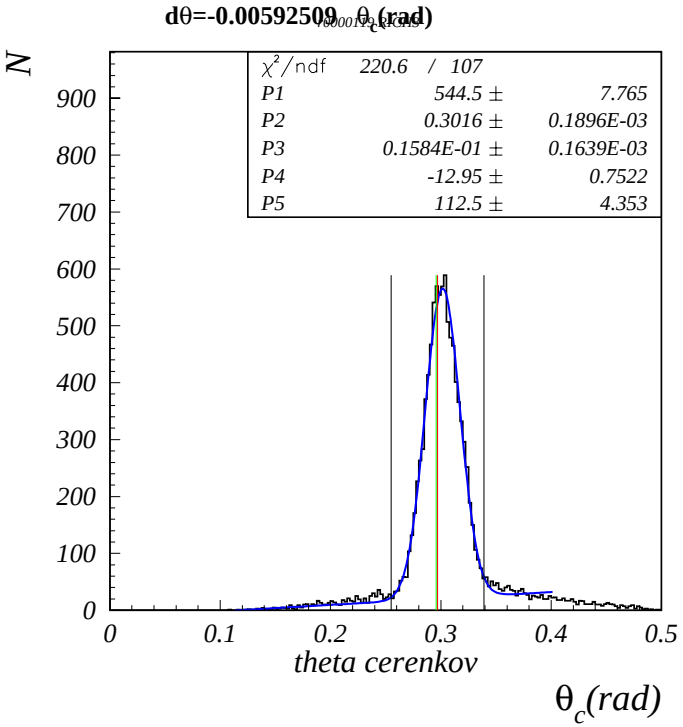


ring on PMT plane

Accumulated hits on both photon detectors

- corrected for beam particle position and direction

Resolution for single photons

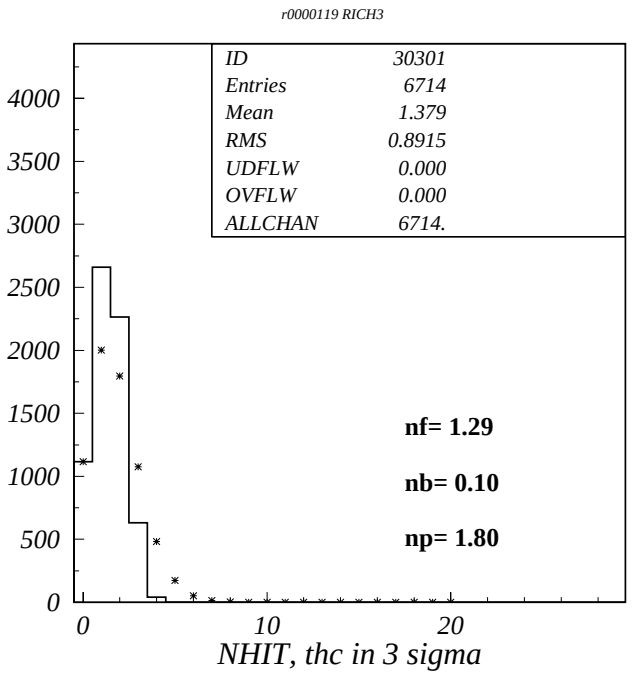


σ=15.3mrad in rough agreement with expectations

(R5900-M16 has 14.3mrad for this particular run (4cm rad.) with slightly smaller pads, 4.5mm instead of 5.5mm)

- will come back to it

Number of photons



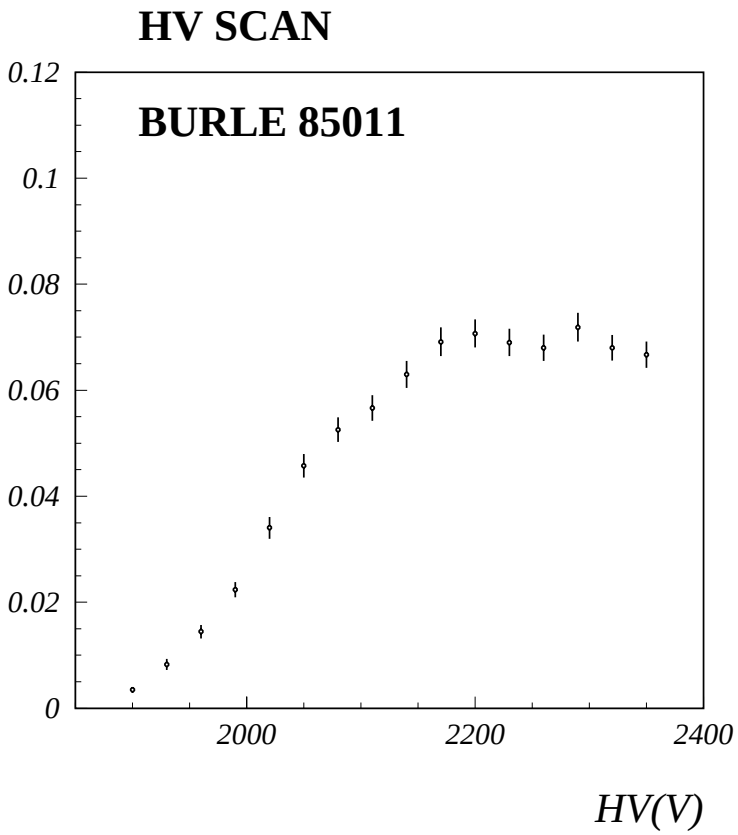
N=1.29

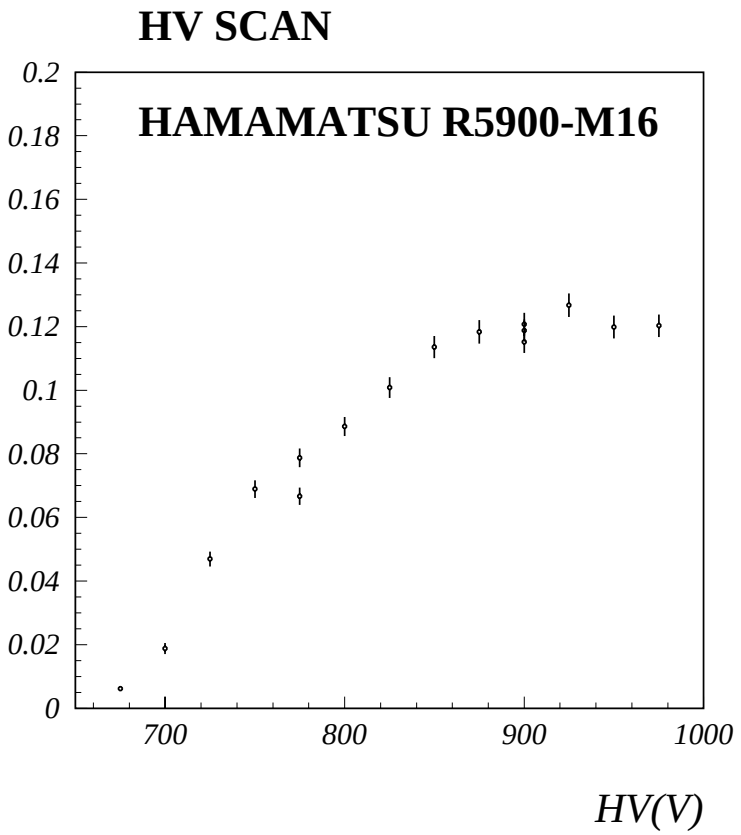
Extrapolate to full ring, full active area: 9.7

Extrapolate to full ring, real active are: 4.9

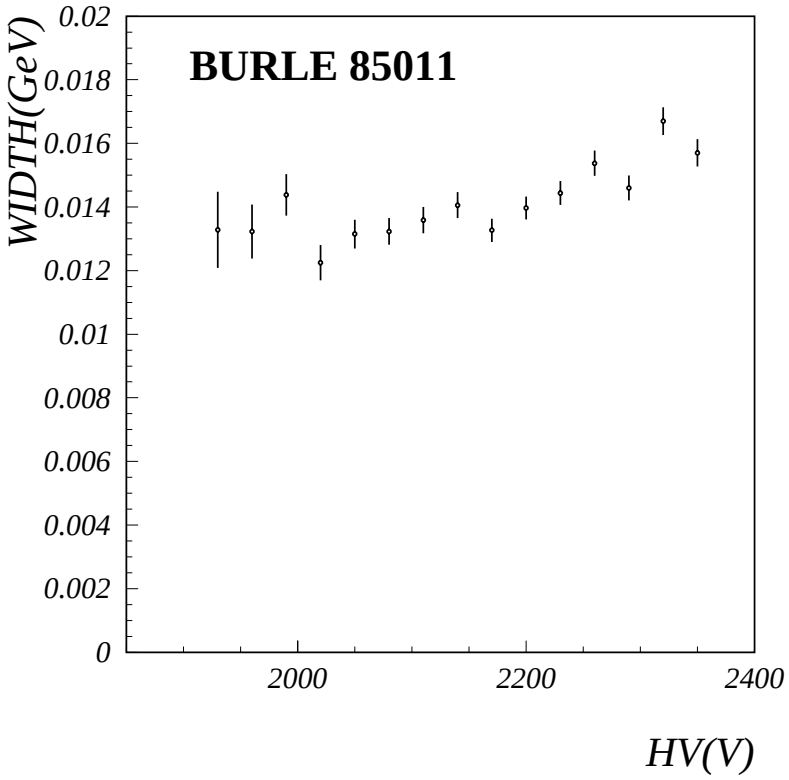
N.B. Numbers for the reference R5900-M16: 16.2 and 5.8.

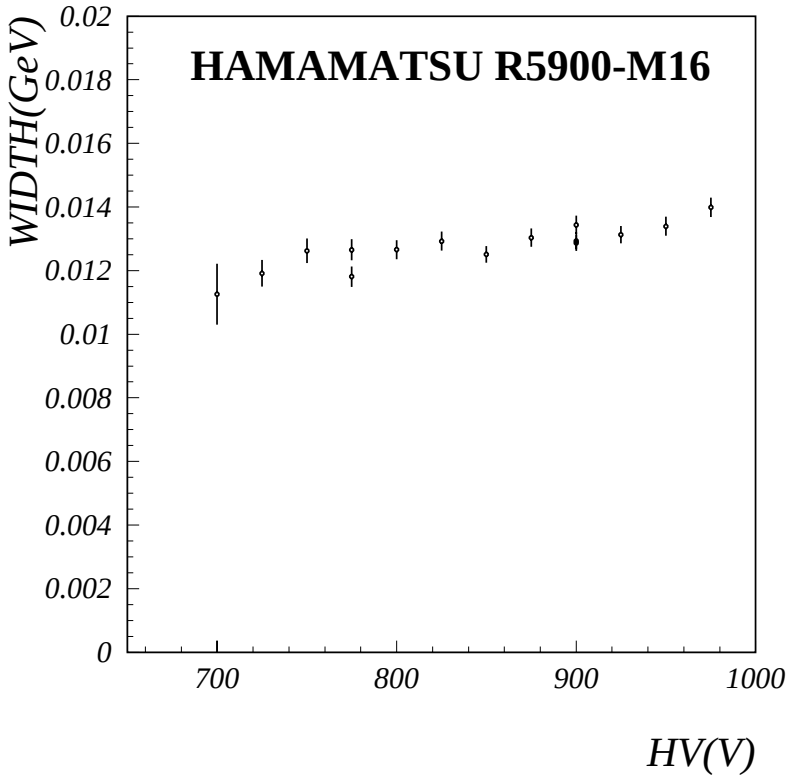
HV scan: yield





HV scan: width



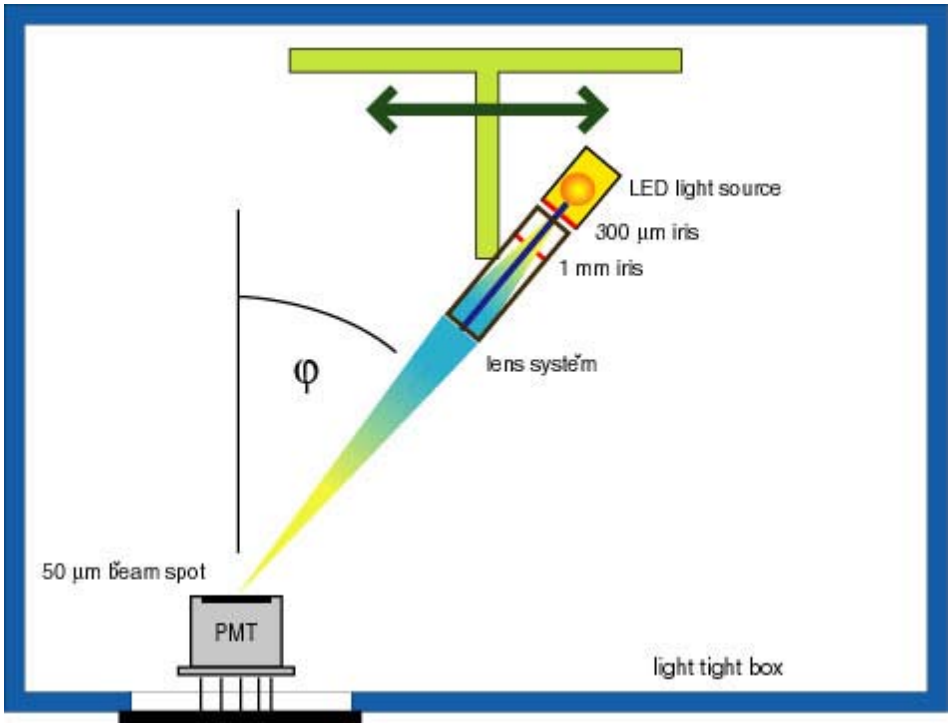


Width increases with HV: cross-talk?

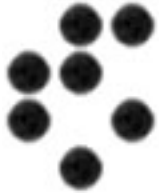
Further tests - plans

Understand cross-talk, clustering

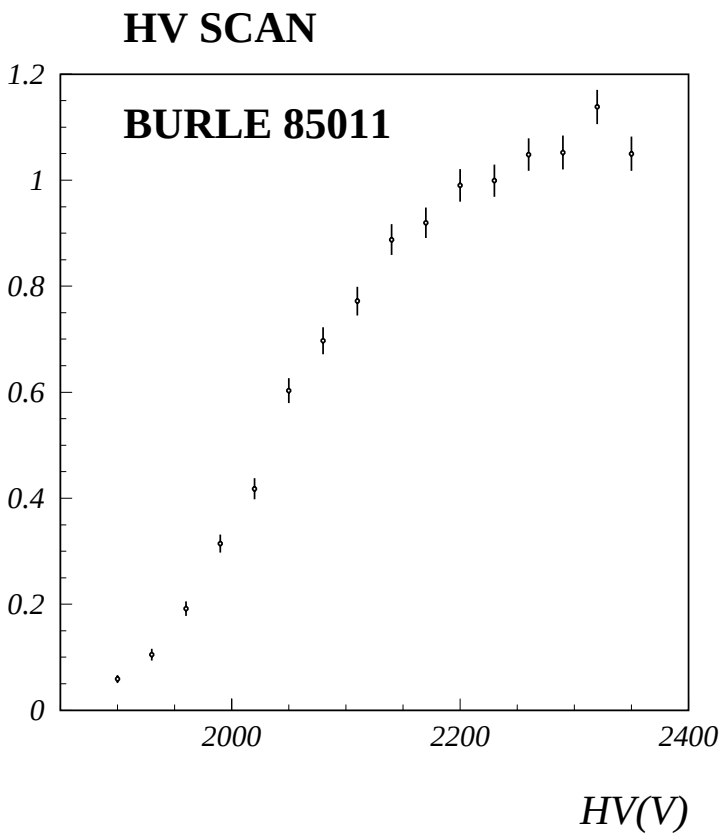
Study uniformity of the sensitivity over the surface

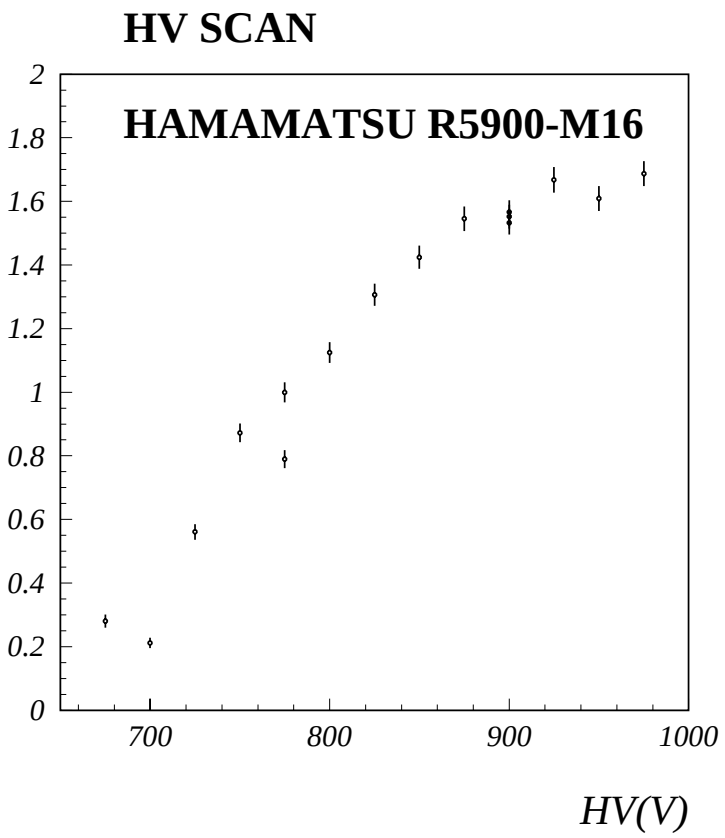


Backup slides



HV scan: yield from peak area

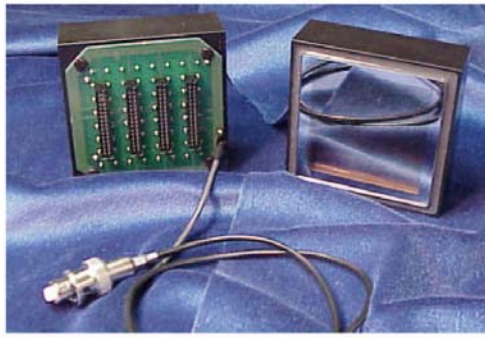




BURLE

PLANACON™ PHOTOMULTIPLIER TUBE ASSEMBLY 85011-501

TENTATIVE DATA
November 2002



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GENERAL

Parameter		Value	Unit
Spectral Response		165 to 660	nm
Wavelength of Maximum Response		410	nm
Photocathode Material		Bialkali	--
Window	Material	Quartz	--
	Thickness	0.080	in
Multiplier	Structure	MCP (25µm pore, 40:1 L:D)	--
	Number of Stages	2	--
Anodes	Number	64 (8 x 8)	
	Size / Pitch	0.234 / 0.254	in
Voltage Divider Resistance		12	MΩ

Maximum Ratings (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	2400	Vdc
Average Anode Current, sum of all anodes		3	µA
Ambient Temperature		- 40 to + 70	C

FOR ADDITIONAL INFORMATION, TELEPHONE IF IN THE U.S.A. OR CANADA 1-800-366-2875, AND ELSEWHERE, 1-717-295 REQUEST TO 1-717-290-1263. BURLE INDUSTRIES, INC., 1000 New Holland Avenue, Lancaster, Pennsylvania 17601-5688 U.S.A.

Characteristics (at 25 °C)

Parameter		Min.	Typ.	Max.	Unit
Cathode Sensitivity	Luminous	40	55	--	µA/Lm
	Blue (with CS-5-58 filter)	5.5	7.5	--	µA/lm-b
Anode Sensitivity	Luminous		35	--	A/lm
Modal Gain		0.3×10^6	0.6×10^6	--	--
Anode Dark Current, Sum of all pixels		--	0.5	5	nA
Time Response	Anode Pulse Rise Time	--	0.3	--	ns
	Anode Pulse Width (FWHM)	--	1.8	--	ns
Pulse Linearity at 5% Deviation		--	300	--	mA
Single Electron Response	Peak-to-Valley	--	2:1	--	
	Resolution (FWHM)	--	150	--	%
Anode Uniformity		--	1:1.25	1:1.5	
Pulse Height Resolution, 2" NaI(Tl) crystal, ^{137}Cs, 1700V (FWHM)		--	10.0	--	%

Note: Measured with the condition shown in Table 1 except where noted.

Table 1 VOLTAGE DISTRIBUTION RATIO AND SUPPLY VOLTAGE (-2300 Volts)

Electrodes	K	MCP_{in}	MCP_{out}	P
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