

# ET Enterprises

## Capabilities and Product Developments



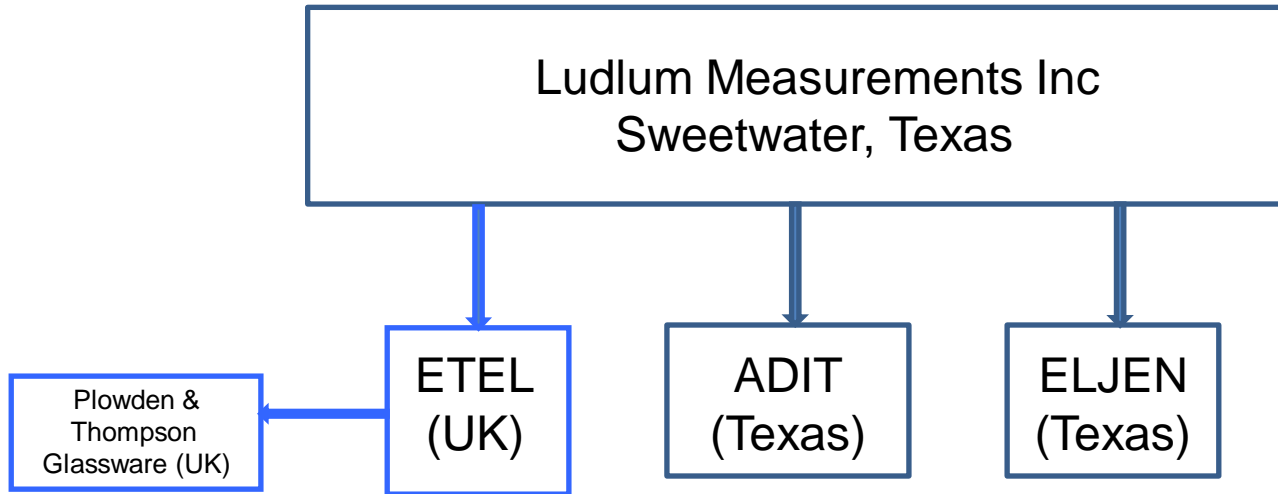
# LIGHT



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- ETEL is based in the UK close to London Heathrow Airport (SME of 100 people)
- Specialise in the design and manufacture of photomultipliers and electronics
- 50 year history in photomultipliers and electronics for industrial, scientific, and medical applications



## ET Enterprises, UK

- Pmts for specialist applications
- 19 mm to 280 mm diameter
- 110 to 900 nm sensitivity options
- Low dark noise for photon counting
- Good SER p/v
- QE to 35%
- Ultra-low background glass options
- 200 to + 175 deg. C capability
- Rugged pmts for space and oil well logging

Flexible dual site manufacturing for high volumes



## ADIT, USA

- Pmts for radiation monitoring and homeland security
- Pmts for:
  - plastic scintillators
  - Inorganic scintillators
  - Photon counting
  - PET
- 13 mm to 135 mm diameter



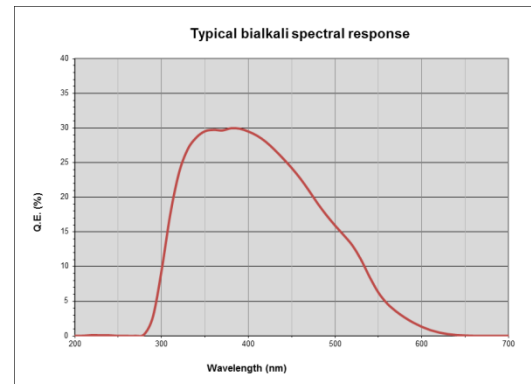
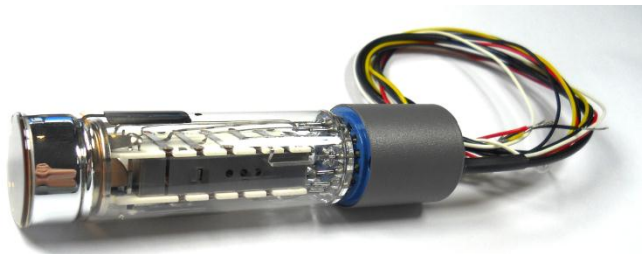
# General photomultiplier products

Flat windowed pmts for industrial scintillation and photon counting applications

Hemispherical pmts mainly for HEP applications including down to Liq. N<sub>2</sub> temperature

Pmts available with quantum efficiencies up to 35% peak

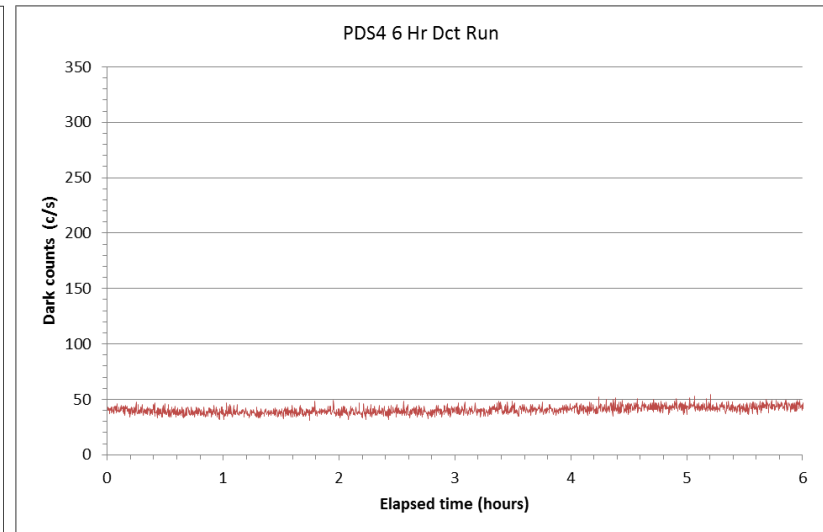
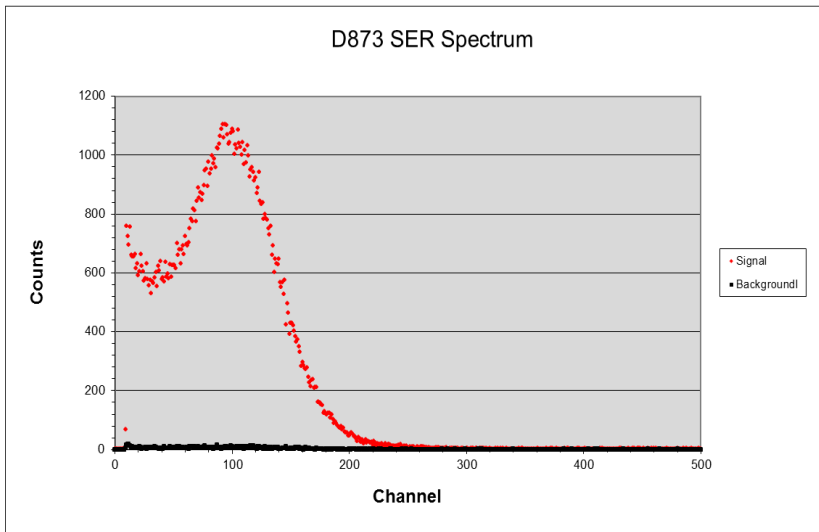
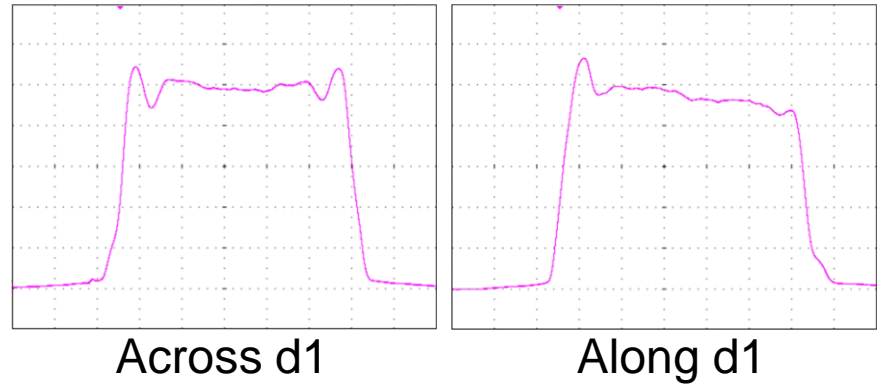
Low power consumption high performance power supplies and electronics (7 mW)



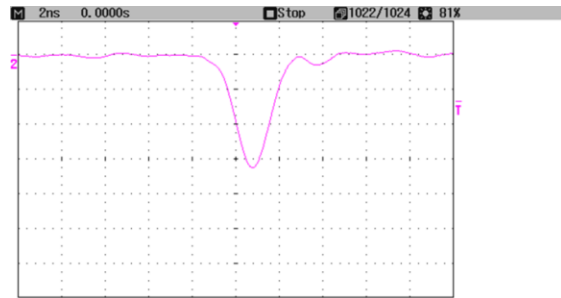
# Compact 1" diameter pmt (D873)



Nominal pmt gain: 50 A/lm ( $10^7$ )

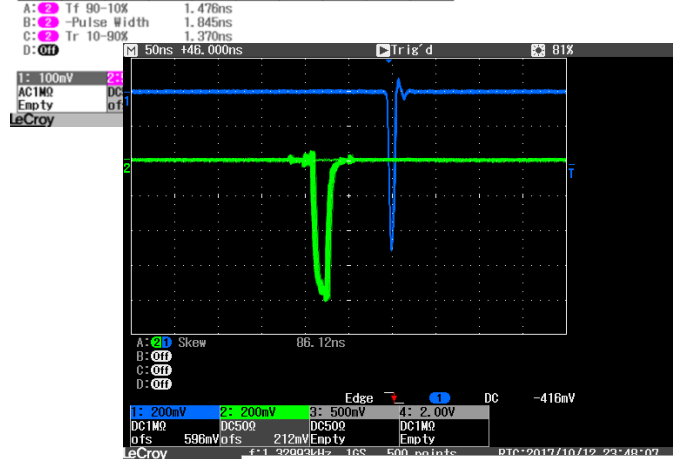


# Compact 1" diameter pmt (D873)



Trace uniformity

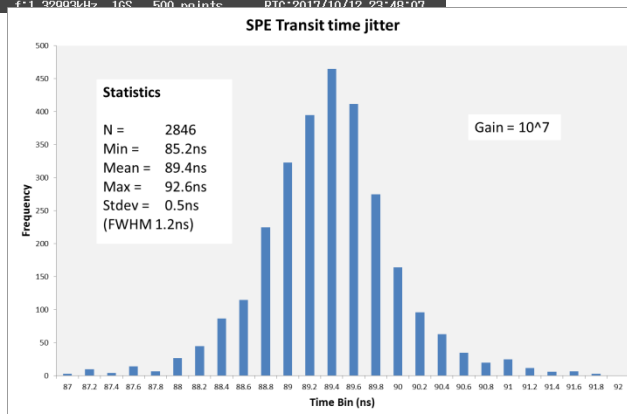
Low dark rate – typ.  
100 cps



Good pulsed linearity  
typ. –5% at 70mA.

High gain – typ. 1050V 5E6 Gain

SER (p/v) – typ. 2.5



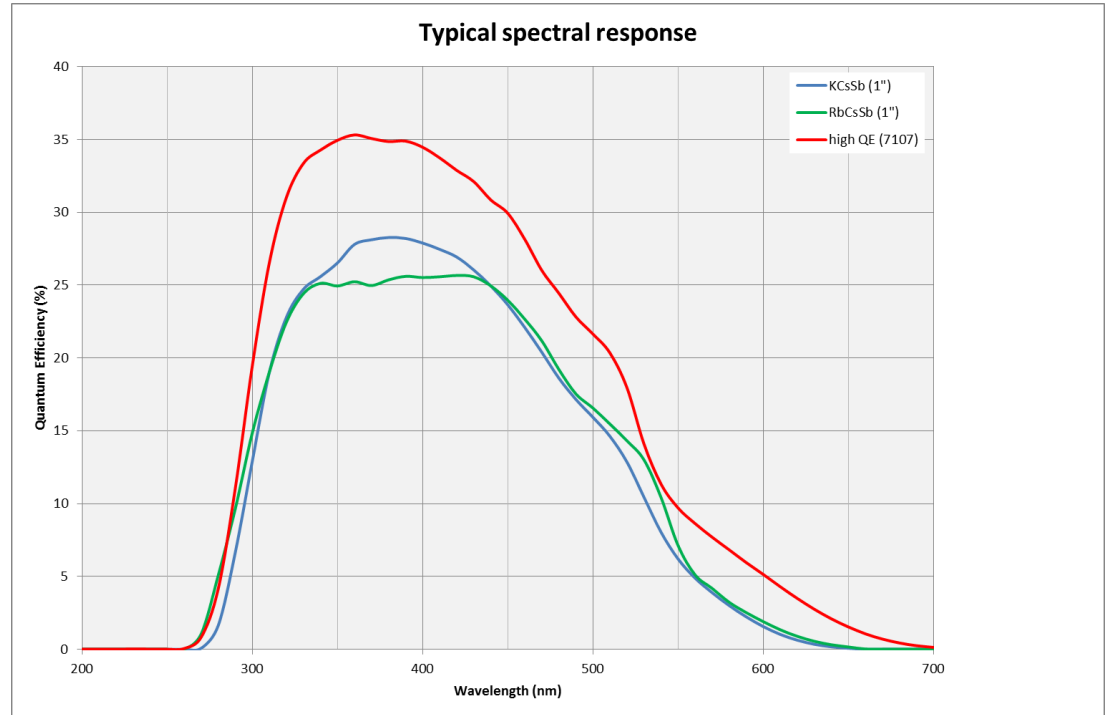
Fast timing  
Spe tts (FWHM) – typ. 1.2ns

30% QE peak with std.  
photocathode

# High QE cathodes - 1" diameter pmt (7107)



- High QE version of 9107.
- Available as a standard product.
- Suitable for photon counting.



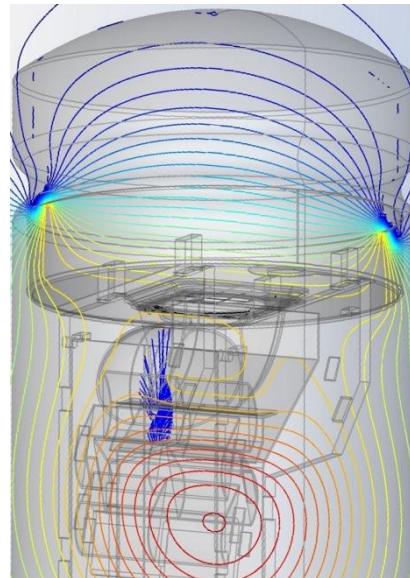
- High QE pmts currently available in 1" – 3" diameter



# 1.5" Diameter pmt (D573FL)



HQE photocathode



Simulation of ion-optic feedback

## Sample performance measurements

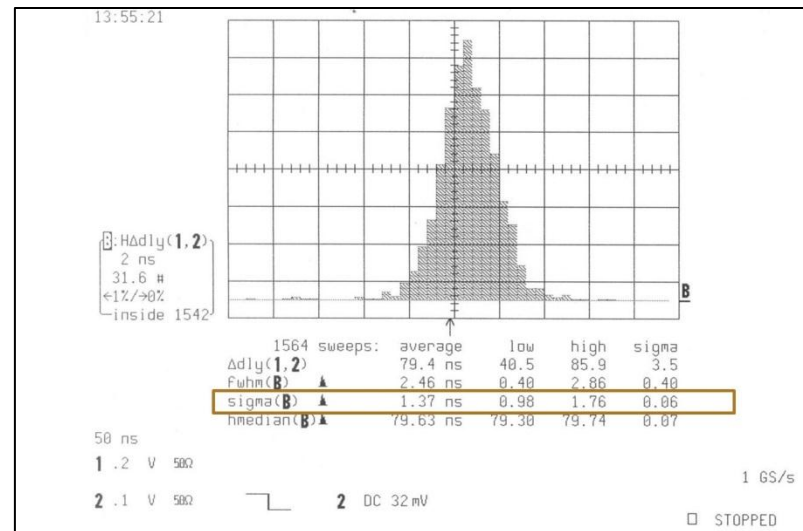
Peak QE (typ)	35%
2E4 gain	1000V
SER p/v	3.0
spe tts (FWHM)	1.5 ns
dark rate	1.5kcps



CAD model of low After-pulse upgrade



# Compact 3inch pmts (for HEP)



- short, fast timing, large area, high gain, low afterpulse, and low cost pmt.
- Evolution of pmt design:

D783 – special window

D793 – blown window optimum collection and timing

9320 - larger area small timing loss.

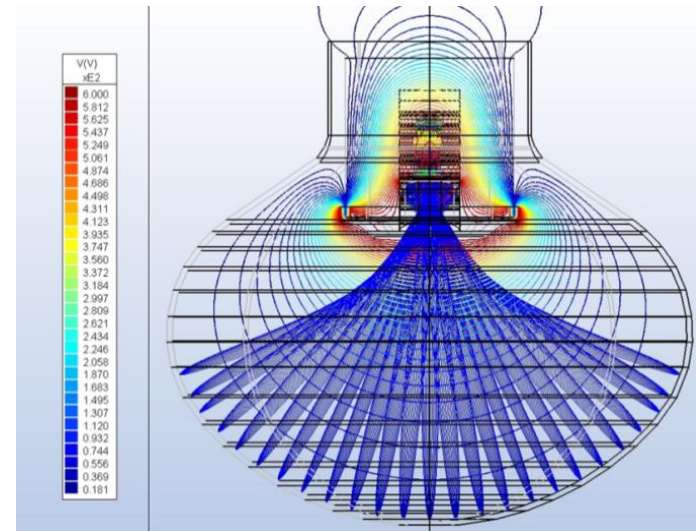
- The special blown bulbs are made in our UK glass facility and can be made in ultra-low background glass.

# Compact 3inch pmts (for O.E.M. applications)

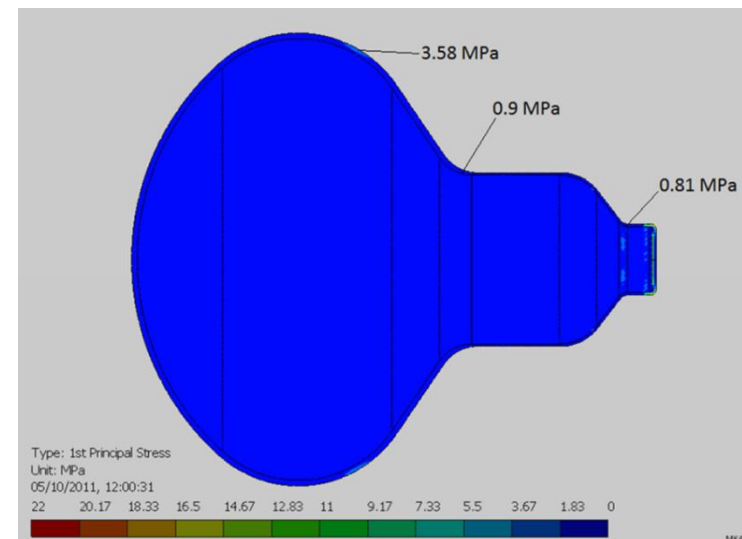


- Flat window variants of the 3" series for scintillator applications
- Compact length
- Low background and ultra-low background glass
- Good resolution
- Available with 8 and 10 dynodes
- Available capped, with flying leads or hard pin

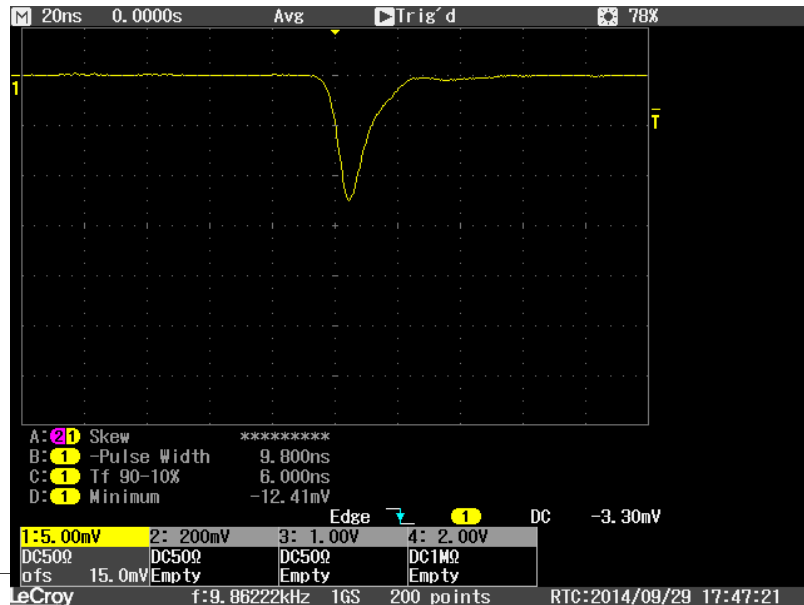
# 11" Hemispherical pmt (D784KFL)



- Pressure resistant, good timing, good energy resolution, low afterpulse, can be available in ultra-low background glass. (2.5 Bq/pmt)
- Designed for long term deployment to 7 bar

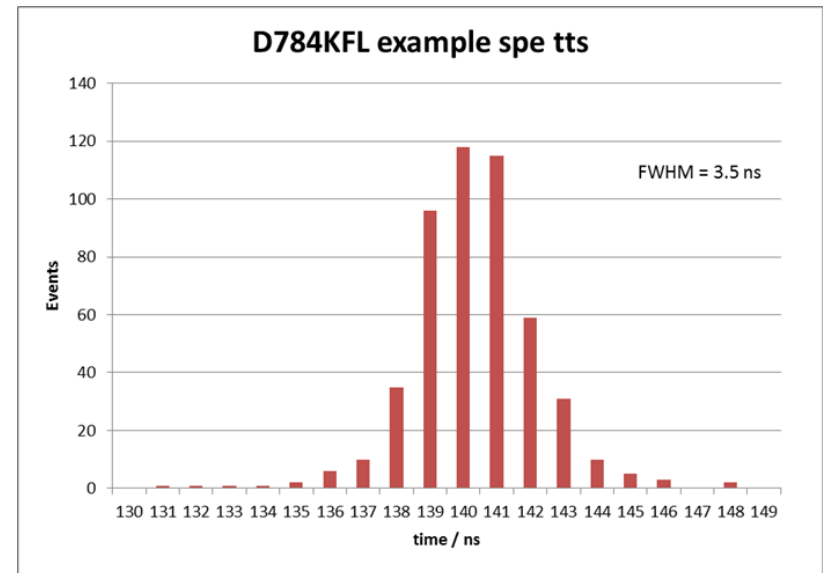
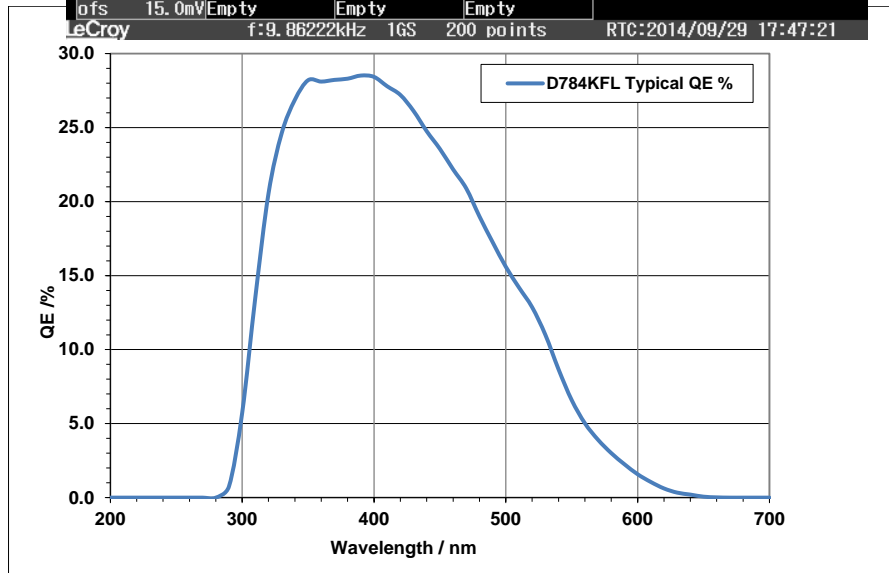


# 11" pmt – Performance summary



## Initial performance measurements

Peak QE	28%
1E7 gain	1300V
SER p/v	3.0
spe tts (FWHM)	3.5 ns
dark rate	6kcps



# Domed and Hemispherical pmt range

Parameter	9116	9117	D750	D793	9320	9372	9354	D784
Diameter (in)	1	1.5	3	3	3.5	5	8	11
No. of stages	6	6	12	10	10	12	12	12
Typical operating gain	10 <sup>4</sup>	10 <sup>4</sup>	10 <sup>7</sup>	5 x 10 <sup>6</sup>	5 x 10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>7</sup>	10 <sup>7</sup>
Typical QE% at peak	27	27	19	30	30	30	30	30
Surface area (cm <sup>2</sup> )	8.5	22	57	57	87	195	425	800
Typical dark cps at 20°C	-	-	500	500	600	1500	4000	6000
Typical SER ratio (p/v)	-	-	2.7	2.7	2.2	2.2	2	2.5
Typical 1e TTJ fwhm(ns)	-	-	2.2	5	5	4.5	4.5	8
Minimum Temperature (°C)	-30	-30	-196	-60	-60	-30	-30	-30
Weight (grams)	15	30	190	130	120	380	700	2100

UL Bgd  
1Bq/pmt

## Power supplies and photon counting hardware



Compact High Voltage bases  
(7mW typ. power consumption)

3 kV Benchtop Supplies  
(USB and analogue  
control)

2 kV Modular Supplies

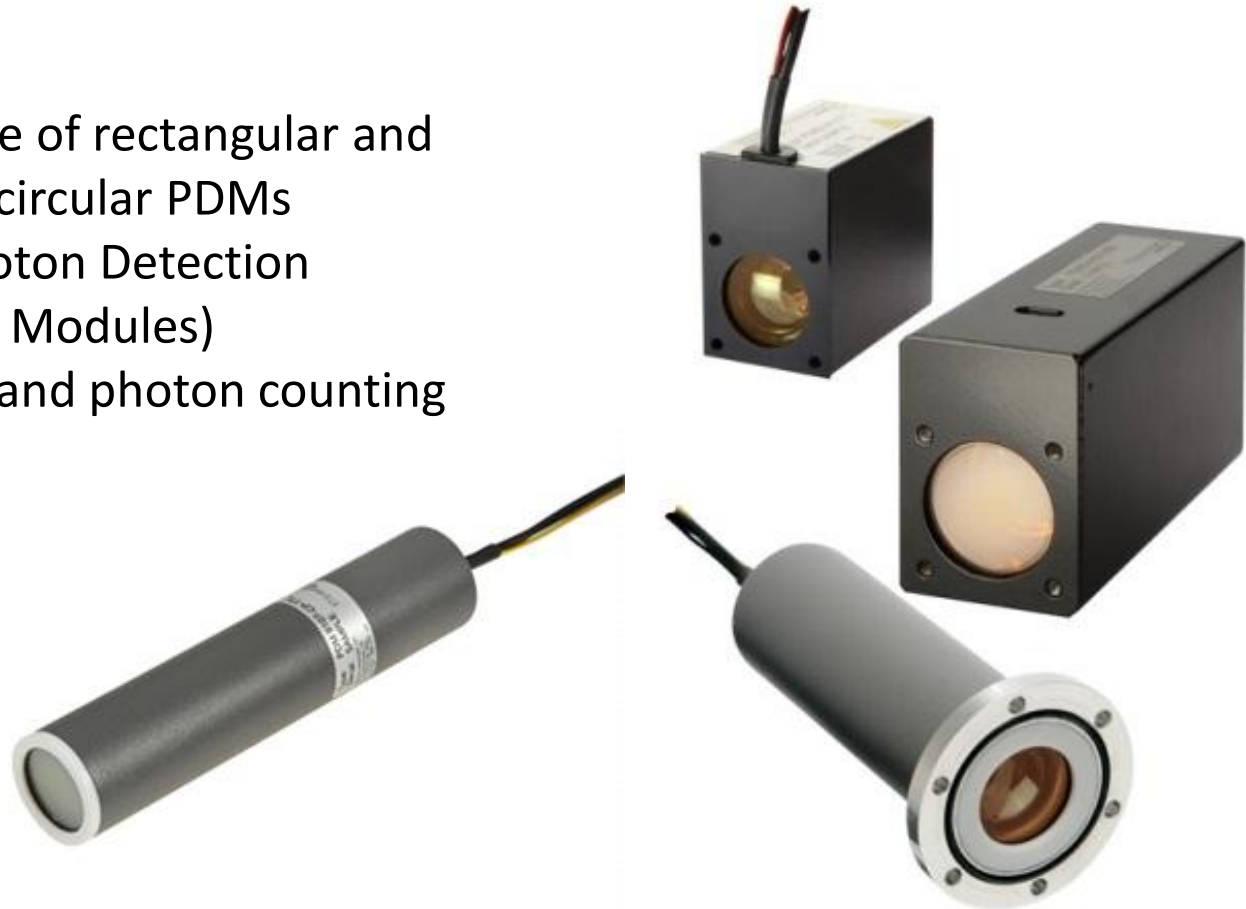
Range of counter timer electronics





## Compact Photodetector Modules

New range of rectangular and  
circular PDMs  
(Photon Detection  
Modules)  
Analogue and photon counting



**Thank you**