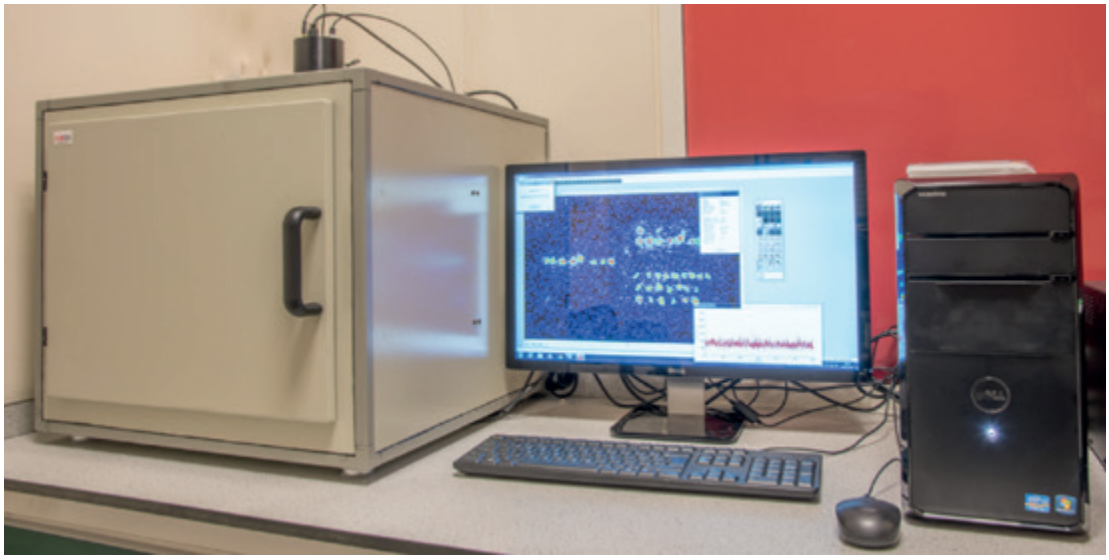
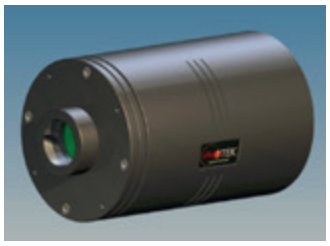
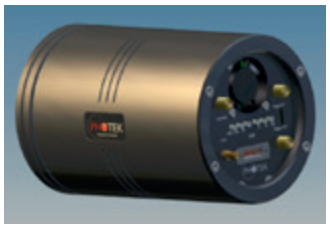
# HRPCS5 Photon Counting System

The High Resolution Photon Counting System (HRPCS), now in it's 5th generation, is a true single photon counting camera which offers the ability to capture and integrate ultra low light level images in realtime. The HRPCS camera is a parallel readout device and is capable of detecting multiple photons at the exactly the sametime.







## Features

- Extreme sensitivity with single photon counting capabilities
- Ultra low noise allows long integration times
- Automatic centre of gravity detection ensures high resolution in photon counting mode
- Binary slice mode allows fast data acquisition
- Bright field mode for focussing

## Applications

- Bio and chemiluminescence
- Measurement of Aequorin, Luciferase & ATP
- Simultaneous fluorescence and luminescence imaging
- Analysis of microtitre plates
- Autoradiography
- X-ray photon counting

## Principle of Operation

The HRPCS5 camera uses a 2nd generation image intensifier as the primary method of photon amplification and a secondary CCD camera for electronic readout. Incident photons pass through the input window and hit the photocathode. Photoelectrons are released from the photocathode and are accelerated by a potential field to the microchannel plate. The photoelectron is amplified by approximately $10^5$ by the stack of two MCPs. The actual gain of the detector can be adjusted by varying the voltage across the MCPs. The cloud of electrons emitted from the MCP is further accelerated into a phosphor screen which converts the electrons back to photons.

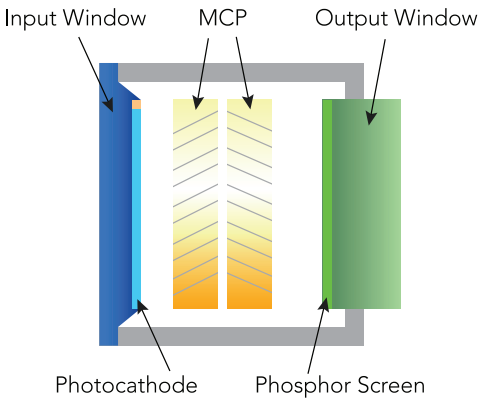
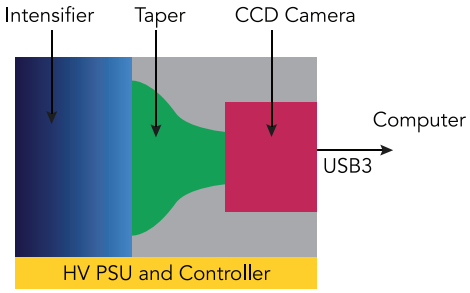



Image Intensifier




HRPCS Block Diagram

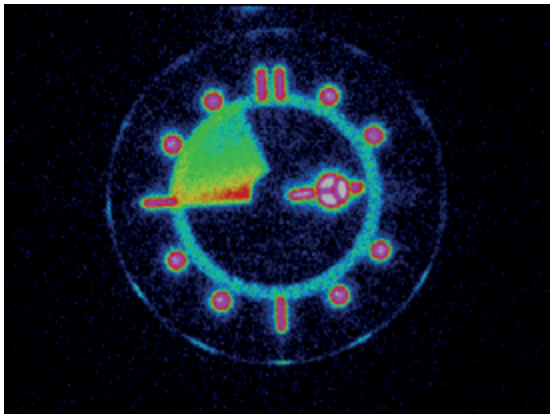
A CCD camera is the coupled to the output of the image intensifier using either a reducing fibre optic taper or relay lens. A high voltage power supply, gate unit and camera control board complete the HRPCS camera. Transfer of data from the camera to PC computer is via a high speed USB3 link.

## Software

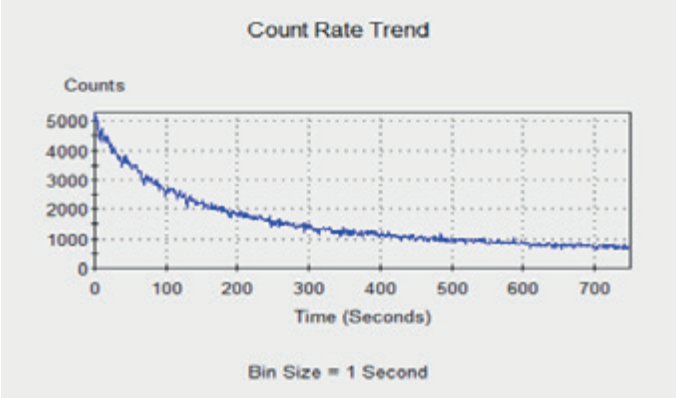
- HRPCS systems are provided with Photek Image32 software. This provides tools for both data acquisition and analysis.
- A live display shows integrated data in real time.
- A count rate trend graph shows how count rate changes over time.
- X, Y and time infotmation can optionally be saved to disk and tools are provided to analyse this data.
- A sophisticated scripting language in incorporated allowing users to customise the data acquisition and analysis processes.
- Drivers compatible with LabView 8.0 and above can also be provided.

## Time Resolved Imaging

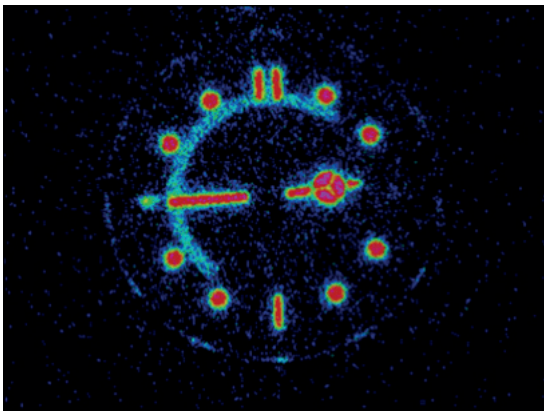
The following example uses a luminous watch face to demonstrate the time resolved imaging capabilities of the HRPCS5 camera.



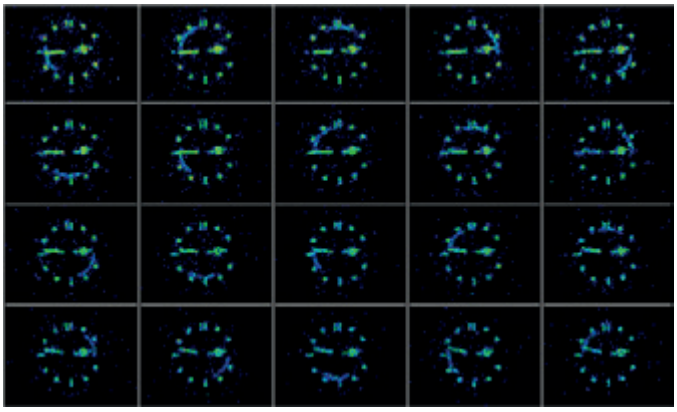
The above image shows a 700 second integration of the luminous hands of a watch.



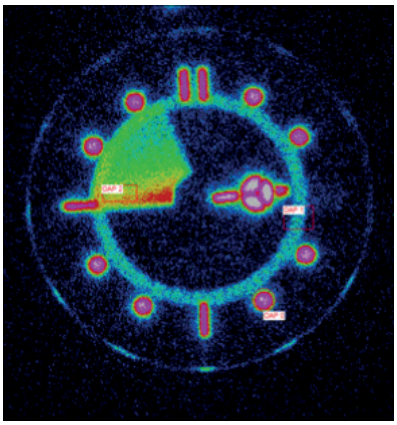

During image integration a graph shows how the global count rate is changing with time.



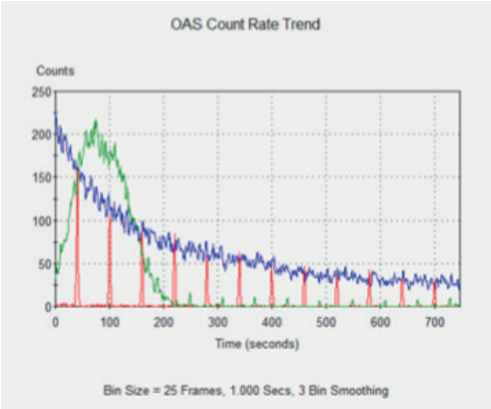
Post integration analysis software allows images to be reconstructed from recorded data. In this example the first 30 seconds of data have been reconstructed to form an image.



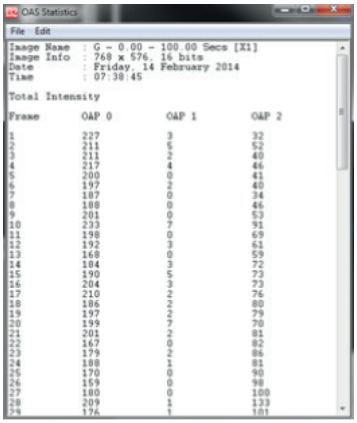
The above example creates a timme lapse sequence. In this case each image corresponds to a period of 10 seconds. Data may be presented as a matrix image (above) or saved as an AVI file.



Areas of interest (circular, rectangular, freehand, polygon) may be drawn over the original image.



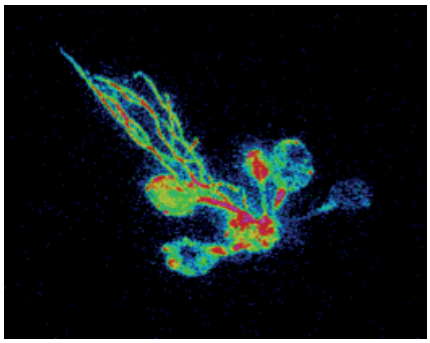

A graph showing the count rate in each defined area can be generated. Up to 16 areas can be displayed on the graph.

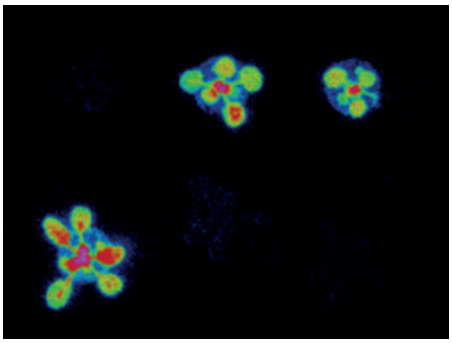


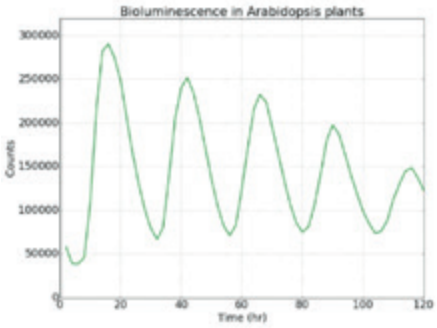

Tabular data showing the number of photons detected in each area can also be generated.

# Application Data

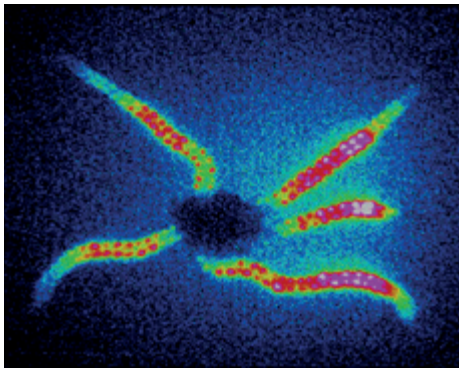
TOC1:LUCIFERASE bioluminescence from 12 day old Arabidopsis seedlings. Antony Dodd – University of Bristol



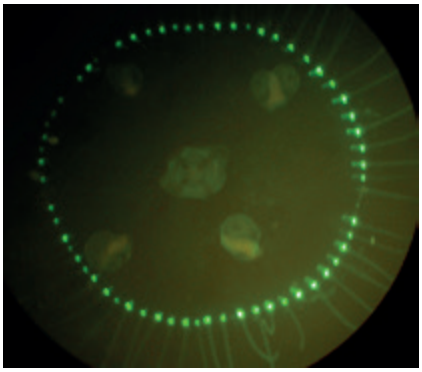




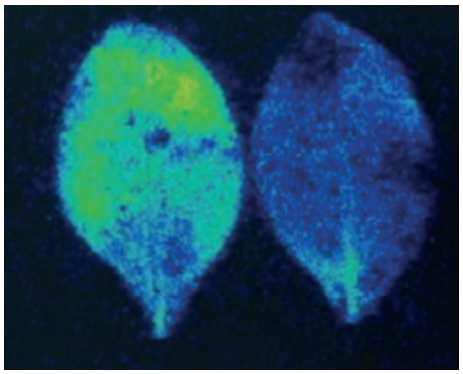

Images courtesy of A K Campbell – University of Wales, College of Medicine and School of Pharmacy



Luminous brittle star Amphipholis squamata

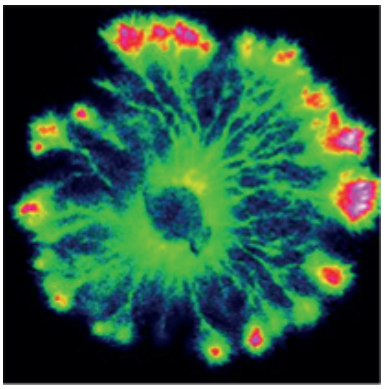


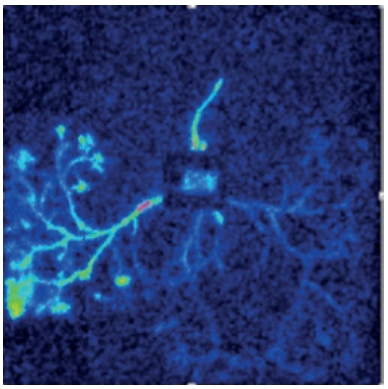
GFP fluorescence in the jelly fish, excited by blue light

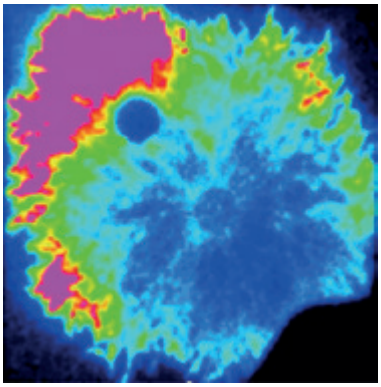


Effect of cooling roots on leaf free $Ca^2$

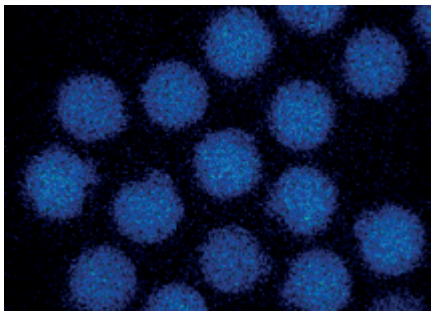
Photon Counting Scintillation Imaging, Research into Fungal Networks. Mark Fricker – Oxford University



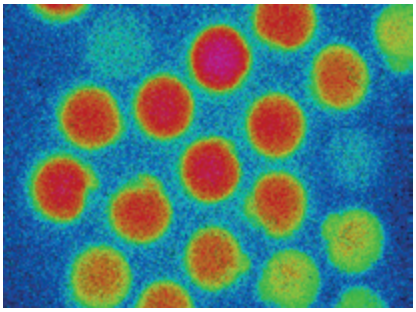




Chemiluminscence and fluorescence imaging of live cells. K.Swann – Cardiff University School of Medicine

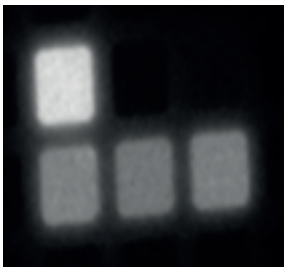


Chemiluminescence of luciferase



Fluorescence of $Ca^{2+}$ dye

Accumulated photons emitted from mouse eggs for a 10 minute window during an experiment that lasted several hours. The chemiluminescent light is from a luciferase fusion protein (PLCz-luciferase) that is expressed in the eggs and shown on the left hand side. The right hand image is the fluorescent light emitted during epifluorescent illumination (490nm excitation) of a $Ca^{2+}$ sensitive fluorescent dye loaded into the same eggs.



Analysis of luminescent markers in microtitre plate

## Outline Specification

| | |
|---|---|
| Image Intensifier | MCP218 |
| Input Window | Fibre Optic |
| Photocathode | Bialkali |
| MCP | 2 Stage MCP in chevron configuration |
| Phosphor | P46 |
| Output | Fibre Optic |

| | |
|---|---|
| Spectral Range | 340nm to 700nm |
| Peak QE | >15% @ 450nm |
| Dark Noise | <30cps |

| | |
|---|---|
| Gain | Fully adjustable<br>Maximum gain is used for photon counting |

| | |
|---|---|
| Power Supply | WP830-18 |
| Gate Unit | GM10-50 (Integrated Version) |
| Controller | HRPCS5 |

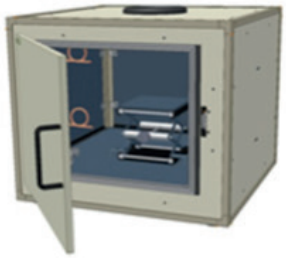
| | |
|---|---|
| Taper Ratio | 2:1 |

| | | |
|---|---|---|
| CCD Camera | IDS uEye 3240 | |
| Resolution | 1248 x 1024 | 640 x 512 Window |
| Frame Rate | 60 fps | 100 fps |

| | |
|---|---|
| Lens Mount | C Mount |
| FOV | 10.6mm x 13.6mm |

| | |
|---|---|
| Power | +12V |
| Interface | USB3 |

## Accessories



**DB2 Dark Box.** This is a light tight dark box and is fitted with an internal height adjustable lab jack for accurate positioning of samples. Large working area of 500mm x 500mm.

**LB3 Light Box.** These light boxes are available with Red, Green, Blue and White LEDs or combinations of colours. Up to 3 light boxes may be fitted in a DB2 Dark box. LED intensity is computer controllable.

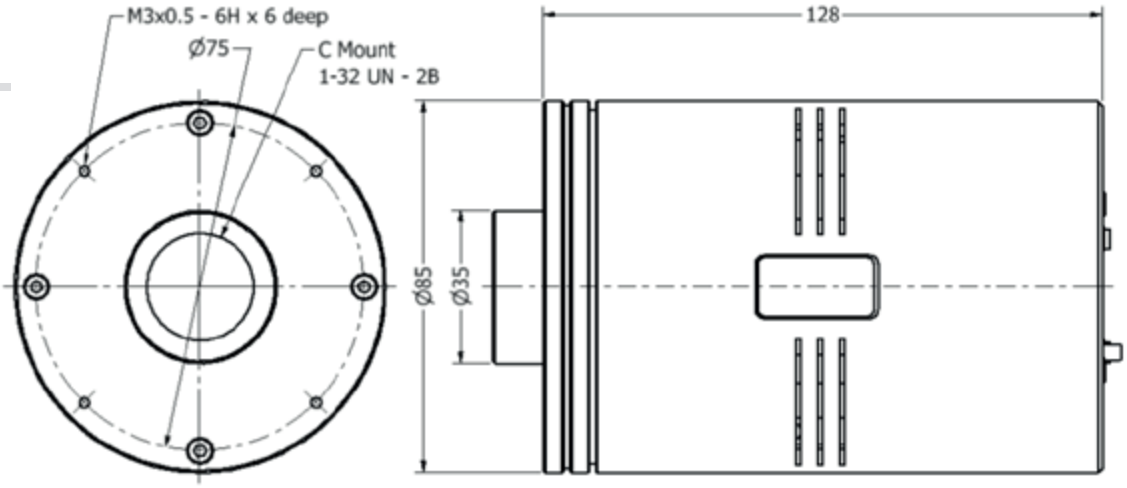
**The PTC-6 Peltier Controller** and cooled stage provide a means of accurately controlling the temperature of sample stage.

**The TCS2 Sample Stage** can be temperature controller within the range -20C to +50C.

**Recommended Computer**
Intel i5 processor, 8GB Ram, 24" Monitor, USB3 Interface, Windows 7 x 64

## Mechanical

Photek reserve there right to modify and improve the design of the camera at any time.

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