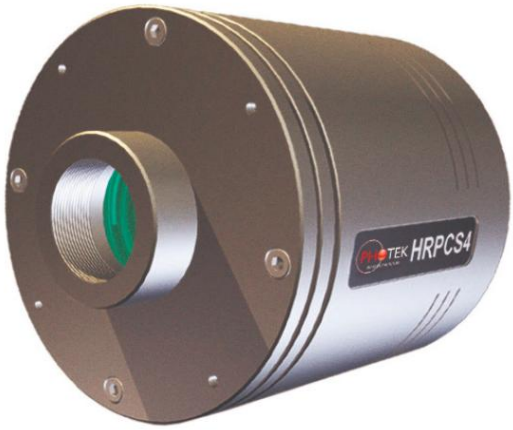
HRPCS4 Camera

Features

- Extreme sensitivity with single photon counting capabilities
- Automatic centre of gravity detection ensures high resolution in photon counting mode
- Binary slice mode allows fast data acquisition
- Bright field mode for focussing
- 18mm 25mm and 40mm intensifier options
- Variety of photocathode's
- X-ray input option
- Vacuum imaging detector option
- Cooled housing option



Applications

- Bio and chemiliminescence
- Measurement of Aequorin , Luciferase & ATP
- Simultaneous fluorescence and luminescence imaging
- Analysis of micro titre plates
- Multiple wavelength imaging
- Contact imaging of samples
- Astronomy
- Autoradiography
- X-ray photon counting

General Description

The High Resolution Photon Counting System (HRPCS), now in is 4th generation is a true single photon counting system which offers the ability to capture and integrate an image in real time. Unlike our IPD camera systems, the HRPCS camera is effectively a parallel readout device and is capable of detecting multiple photons at the exactly the same time (but not at the same position). Time response is system limited to the readout rate of the CCD camera.

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Principle of Operation

The HRPCS4 camera uses a 2nd generation image intensifier as the primary method of photon amplification and a 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 micro-channel plate.
- The photoelectron is amplified by approximately 105 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 P43 phosphor screen which converts the electrons back to photons.
- A CCD camera is the coupled to the output of the image intensifier using either a reducing fibre optic taper or relay lens.

Cameras

Photek offer a choice of 3 CCD camera manufactured by Basler and represent a balance between readout speed and resolution. All cameras are provided with the Firewire otherwise known as IEEE1394 interface.

Camera	Resolution	Frame rate	CDD Pixel Size	Sensor Size
Basler A602f	656 x 491	100pfs	9.9um	½" CMOS
Basler A312f	782 x 582	53fps	8.3um	½" CCD
Basler A102f	1392 x 1040	15fps	6.4um	2/3" CCD

Control Electronics

All of our HRPCS cameras are provided with the HRPCS4 camera controller which is incorporated into the camera. This interface controls the image intensifier and synchronisation for the CCD camera and is programmed by simple protocols transmitted over a RS232 interface.

Modes of Operation

The HRPCS camera has 3 basic modes of operation: Photon Counting, Binary Slice and Bright Field.

- The photon counting mode work by finding the centre of gravity of each detected scintillation and incrementing tine pixel in the image buffer by 1. This results in a direct relationship between input photons and counts in the image.
- The binary slice mode applies t threshold to the acquired image and adds the binary result into the image buffer. In theory this results in reduced resolution but generally provides higher quality images in a shorter time.
- In the bright field mode the gain of the image intensifier is reduced to a point when the sample is easily recognisable. This makes it much easier to focus the system and provide a reference image.

Software

HRPCS4 systems are provided with Photek IFS32 software. This provides tools for both data acquisition and analysis.

- A live display shows integrated data in real time.
- Count rate trend graph shows how count rate changes over time
- XY time information can optionally be saved to disk and tools are provided to analyse this data.
- A sophisticated scripting language based around GTK-LUA has been incorporated allowing users to customise the data acquisition and analysis processes.
- Drivers compatible with LabView 8.0 and above can also be provided.

HRPCS4 System Highlights

- Photon events are amplified by the image intensifier and can clearly be discriminated for

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CCD camera noise. The only source of noise is from the photocathode of the image intensifier and this can be reduced by cooling if necessary.

- Simultaneous events can be measured at the same time (but not at the same position).
- The use of electronic ND filers allows the camera to operate with higher input light levels.
- Long Integration time with real-time image display during integration is possible. This means it is not necessary to define an integration time prior to the start of the experiment. Also, data acquisition may be stopped at any time either when enough data has been acquired or if it is clear that an experiment is not providing the expected results.
- The intensifier gain can be reduce to a point where a “bright field” image may be acquire. This is very useful when focussing the camera.

Applications

There are a number of application areas for the HRPCS system ranging from luminescence and fluorescence, measurement of micro titre plates, to detection of x-rays and particles, astronomical imaging and missile warning.

- The HRPCS camera is ideal for detecting ultra low level signals from engineered cells using Aequorin or Luciferase. It is not uncommon for integration to last for many hours or even days. Flash responses either from thermal or chemical stimulation can be recorded. For plant scientists it is possible to watch plant growth and to monitor circadium rhythms.
- The HRPCS detector is normally provided with a fibre optic input window and this allows direct contact imaging of a sample (which significantly increases the light collection efficiency) or coupling of scintillators for applications such as such as x-ray imaging and beta autoradiograph.
- When supplied with a fused silica input window and solar blind photocathode the HRPCS camera is a useful tool to aid the development of missile warning systems.
- Open faced micro channel place versions of the camera are available for ion and electron imaging applications.

IPD System / HRPCS System Feature Comparison

Feature	IPD System	HRPCS System
Single Photon Counting	✓	✓
Live Display	✓	✓
Coincident event	×	✓
Count rate trend Graph	✓	✓
High count rate point source	✓	×
Frame rate	-	100fps max
Bright Field Mode	×	✓
Time tag resolution	10ns	10ms
Real time analogue outputs	✓	×
Electronic ND Filter	×	✓
External Triggering	×	✓
Interface	USB-2	IEE1394/ RS232
Geometric Distortion	Dependant on anode	Minimal

Camera Specifications

Size	18mm, 25mm and 40mm diameter
Input windows	Fibre Optic
Photocathode	Solar Blind, Bialkali, LNS20 and S20
Anode	P43 phosphor screen

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Performance Specifications

Spectral Response

Solar Blind	180- 300nm
Bialkali	180 - 500nm
LN S20	180 - 700nm
S20	180 - 900nm

Dark Noise

Solar Blind	<2cps/cm2
Bialkali	<10cps/cm2
LNS20	<50cps/cm2
S20	<2000cps/cm2
	<20cps/cm2 when cooled to -30C

Resolution

Basler A602f	656 x 491 pixels
Basler A312f	782 X 582 pixels
Basler A102f	1292 x 1040 pixels

Count Rate

Flat field count rates linear to 500,000 cps
Point source count rate 100cps max (limited by CCD camera readout rate)

Optional Accessories

- Cooled housing and PTC6 temperature controller
- DB2 Dark Box
- Peltier temperature controlled stage and PTC6 temperature controller
- LED Illumination

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