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Superior imaging intensified CCD cameras



XXRapidFrame

Multiframing ICCD camera

Up to 8 channels

Up to 100 billion frames per second

Based on 4 Picos or 4 Quik E ICCD camera technology

UV enhanced system



2014
PRISM
AWARDS
FINALIST

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XXRapidFrame **multi-channel ICCD camera**

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General structure of the XXRapidFrame

The multi-channel framing camera consists of a single optical input and a mirror based image splitter. The custom designed splitting optics divides the incoming light homogeneously into the individual channels. The intensified CCD channels are fully remote controllable by state-of-the-art electronics. This allows highly accurate timing control to capture ultra high speed phenomena.

The multi-channel framing camera is able to record up to optional eight images with a interframing delay down to 10ps (based on 4 Picos technology). This enables successive image sequences taken with a corresponding frame rate of up to 100 billion frames per second.

Ideal optical design for framing cameras

The customized optical design offers up to eight separate channels without compromising resolution, shading, or parallax. The mirror based image splitter ensures spectral independent intensity division. The UV enhanced image splitter enables measurements in ultraviolet spectral range down to 200nm.

Individual controllable ICCD channels

The XXRapidFrame is available based on the 4 Picos or on the 4 Quik E ICCD camera technology with the shortest gating time down to 0.2ns or 1.2ns, respectively. Each of the channels is equipped with a high resolution image intensifier and a high resolution CCD sensor.

Ultra high speed imaging

The ultra high shutter speed and the minimum interframing time of 0.01ns (based on 4 Picos technology) enables photographs of ultra high speed phenomena such as lightning emergence. Hence, the multi-channel framing camera XXRapidFrame offers the ultimate performance to scientists and engineers across all disciplines.



Standard features and benefits

- Up to eight intensified CCD channels
- Respective channel parameter based on 4 Picos or 4 Quik E ICCD technology
- Ultra fast shutter speed down to 0.2ns (4 Picos) or 1.2ns (4 Quik E)
- Optical shutter repetition rate 100kHz continuous, 3.3MHz burst mode
- Highly accurate timing control with step size of 10ps (4 Picos) or 100ps (4 Quik E)
- High resolution image intensifiers with optical system resolution of >60lp/mm
- Extreme low jitter: <10ps (4 Picos) and <20ps (4 Quik E)
- Spectral sensitivity from UV to red
- Perfectly spectral flat mirror image splitter
- Customized optical design ensures images free from ghosting, shading, distortion or parallax
- Brilliant sensitivity providing single photon detection
- High dynamic range (12bit resolution)
- High resolution CCD sensor with 1360 x 1024 pixel
- Comprehensive trigger options: TTL, high voltage or via optical fiber
- USB 3.0 output
- 4 Spec Software for camera control, image readout, handling and storage
- Compact and light system design

Optional features

- Optical shutter repetition rate 2MHz continuous, 3.3MHz burst mode, only available for system based on 4 Picos technology, down to 0.4ns shutter speed
- Double frame readout in full resolution with a interframing delay per channel of 500ns
- UV enhanced mirror image splitter down to 200nm
- Multi spectral imagery enables multi spectral images
- Highest dynamic range (14 bit resolution)

Highlights

Ultra high speed gating
down to 0.2ns flat top

Highly accurate timing
control down to 10ps

Spectral flat mirror
based image splitter

UV enhanced custom
image splitting optics

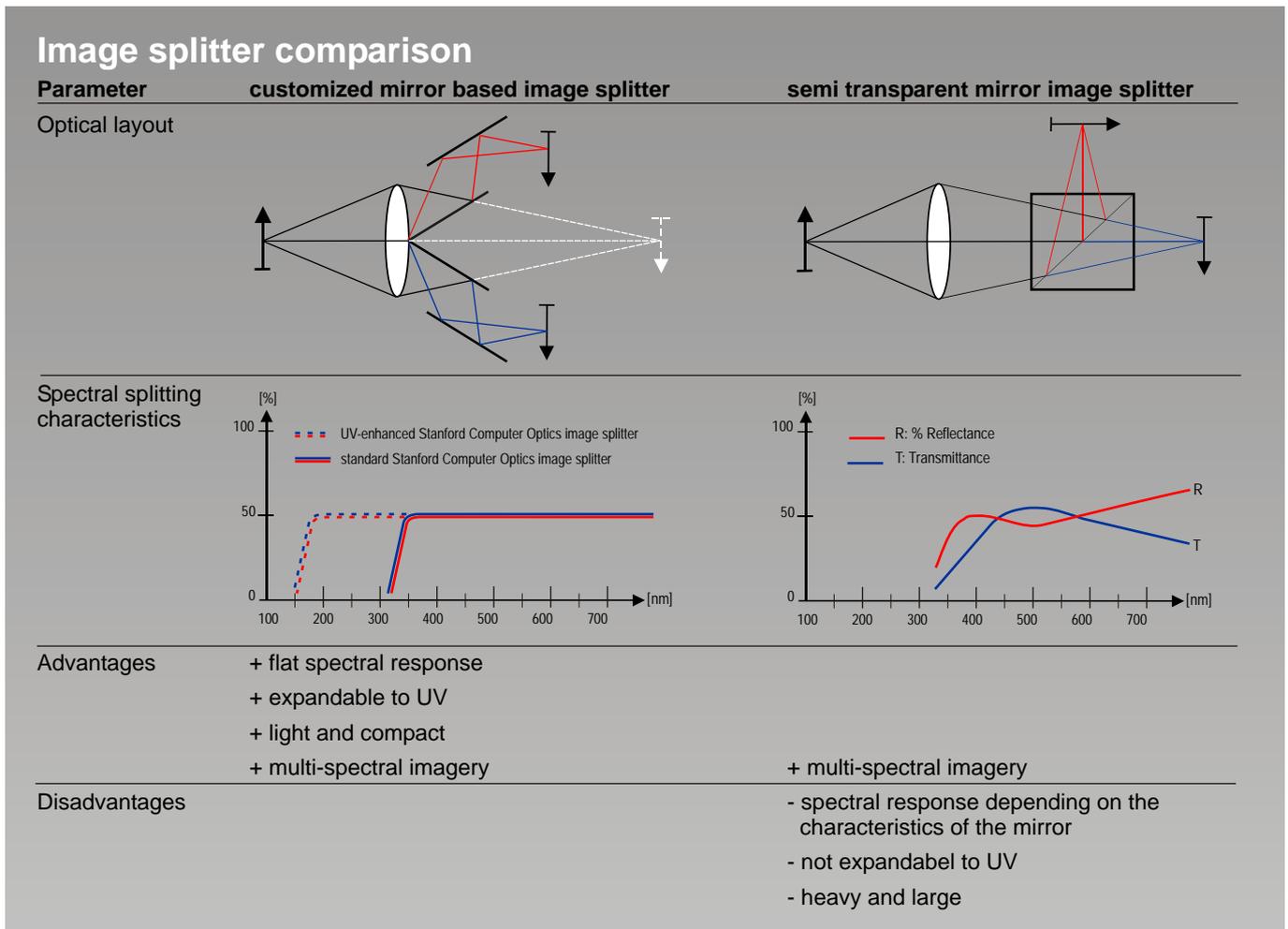
Ultra high resolution
image intensifiers

Images cover and backside: Consecutive image series of a high-voltage discharge development taken with a XXRapidFrame framing camera. The individual channels are based on the 4 Quik E ICCD camera providing shortest gating times of 1.2ns. The image series is taken with inter-channel delay of 15ns

Mirror based image splitter

Best performance mirror based image splitter without compromising resolution and imaging quality.

Stanford Computer Optics developed and designed the mirror based image splitter to provide the best optical resolution and imaging quality with the multi-channel ICCD camera, XXRapidFrame. This customized image splitter does provide spectral flat response over the UV, VIS and IR and splits the incoming light equally between the attached channels. Hence, the mirror based image splitter has numerous advantages in comparison to competing solutions.



UV enhanced image splitter

The standard mirror based image splitter enables measurements down to 350nm. Even if the downstream ICCD cameras are sensitive in the UV the light below 350nm just does not pass the image splitter. The UV enhanced mirror based image splitter

enables in combination with the adequate photo-cathode measurements down to 200nm. It consist of a customized, in-house developed lens system including 6 lenses made of UV capable material like MgF2 and adequate mirror coatings.



Individual channel settings

The individual channels are equipped with technology based on the 4 Picos or 4 Quik E ICCD camera.

The 4 Picos and 4 Quik E provide highly accurate timing control with 0.2ns and 1.2ns minimum gating time, furthermore, the gating and delay time can be controlled with a step size of 0.01ns and 0.1ns, respectively.

Both ICCD cameras cover the spectral range from 180nm up to 900nm with the respective image intensifier. The customized design of the optical coupling lens guarantees in both cameras high sensitivity, high resolution, distortion free and vignetting free images. The CCD sensor can be chosen independently from the time setting.

All multi-channel framing cameras with four or less channels are equipped with fully functional, independent usable ICCD cameras. All intensified CCD channels within multi channel framing cameras with six and more channels are not removable from the housing.

Time settings

XXRapidFrame parameter	based on 4 Picos*	based on 4 Picos MHz	based on 4 Quik E*
Shortest gating time	0.2ns ... 80s	0.4ns ... 80s	1.2ns ... 80s
Shortest interframing time	10ps ... 80s	10ps ... 80s	100ps ... 80s
Timing control step size (gating and delay time)	10ps	10ps	100ps
Jitter	<10ps	<10ps	<20ps
Double frame interframing time (two frames one channel)	500ns	500ns	500ns
Minimal dead time between multiple exposures	300ns	300ns	
Trigger propagation delay	internal gate pulse: 67-72ns		
External trigger options	TTL, high voltage (100V) or optical fiber connector		

* More detailed information: www.stanfordcomputeroptics.com/products.html

CCD sensor options (independent from time settings)

Parameter	High resolution CCD sensor (standard)	Standard resolution CCD sensor (optional)
Resolution (pixel)	1360 x 1024	780 x 580
Pixel size (µm)	4.7 x 4.7	8.3 x 8.3 (higher full well capacity)
Max. frame rate (full, 2x2, ROI)	8.8 / 14.8 / 20.7 fps	14.1 / 25.3 / 27.1 fps
Binning options	full frame, 2x2 (binning), ROI (region of interest)	
Dynamic range	12 or 14 bit	
Video gain (dB)	full and ROI: 0..20db; 2x2: 0..25db	
Chip readout	Correlated double sampling, dark current corrected	
Camera interface	USB 3.0	

Image intensifier options

Variety of high resolution image intensifiers

The image intensifiers are the key component of each intensified CCD channel of the XXRapidFrame. All of the image intensifier provide excellent, high resolution images. Further demands and requirements of the different applications can be met by the large variety of image intensifier options.

Diameter

The 18mm image intensifier provides higher shutter speed and higher specific resolution than the 25mm image intensifier. This makes the 18mm image intensifier to the standard and best suitable to most applications of the multi-channel ICCD camera XXRapidFrame. For the best spatial resolution with the drawback of slower shutter speeds the 25mm image intensifier is the preferred choice.

Photocathode

The photocathode material defines the sensitivity and the spectral characteristics of the image intensifiers. The different materials cover the spectral range from 200nm up to 1300nm. However, the overall spectral sensitivity of the XXRapidFrame is as well limited by the image splitter (see page 4).

Multi channel plate (MCP)

The single stage MCP features excellent signal gain and fits most applications of the ultra high speed framing camera. The V-stacked double MCP provides

higher signal gain and is especially used for low light environments. The increased electron multiplication provide single photon detection with increased signal to noise ratio and reduced ion feedback noise.

Phosphor screen

The P43 phosphor screen provides highest efficiency and excellent resolution and is hence the standard option for multi-channel ICCD framing cameras. The P46 phosphor screen provides fast decaying phosphorescence and enables double frames with each channel down to a interframing time of 500ns.

Multi spectral imagery

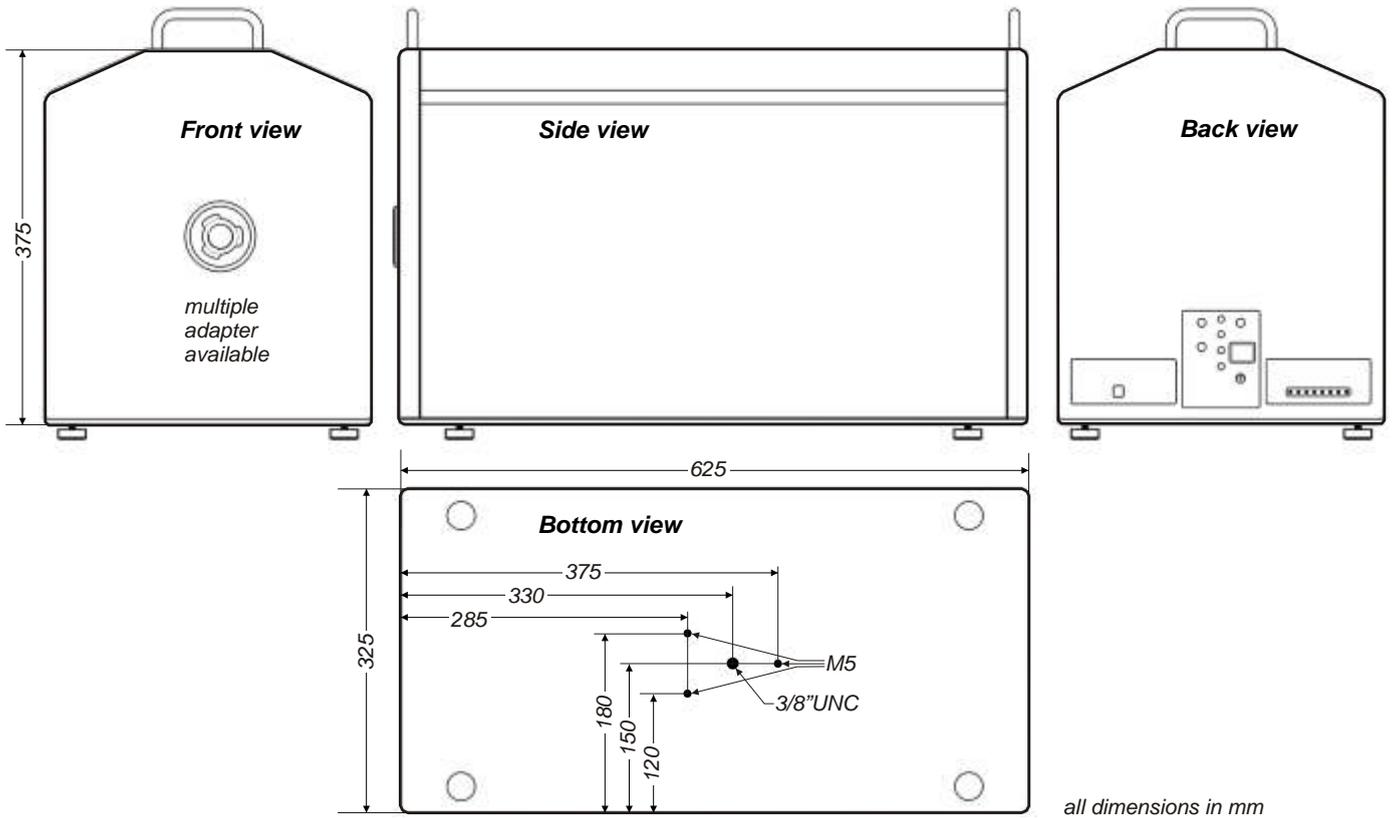
The multi-channel XXRapidFrame can be equipped with different types of image intensifiers at the individual channels. This enables for instance the simultaneously recording of multi-spectral images. Furthermore, the separate channels can be equipped with individual spectral filters for defined spectral range selection.

Image intensifier specifications (with XXRapidFrame)

Parameter	standard	optional
Diameter (imaging area)	18mm (14.4 x 10.8mm)	/
Photocathode	high QE UV	high QE blue, high QE red
Multi Channel Plate	single stage	dual stage
Phosphor screen	P43	P46 (fast decay for double frames)
Gain control	high precision, remote control with 10bit resolution	
Input field of view	6 x 4.5mm	
CCD sensor coupling	customized 6 element F/0.8 relay lens No distortion! No shading! No vignetting! No pin cushion! No honey-comb pattern!	



Technical drawing



Mechanical and environmental data

XXRapidFrame

Parameter	4 channels	8 channels
Camera weight (all in one)	35kg / 77.2lb	43kg / 94.8lb
Camera dimensions without lens	625 x 325 x 375mm (l x w x h)	
Camera mount	3/8" and M5 mounting holes	
Operating humidity	25..95%, non condensing	
Operating temperature	0°C - 50°C / 32°F - 122°F	
Performance specification	10°C - 40°C / 50°F - 104°F	
Operating limits	-10°C - 50°C / 14°F - 122°F	
Shock and vibration	60g accel. shock, 7g Vibration (11 - 200Hz) excludes MCP in direct frontal impact	
Voltage	90..260VAC	



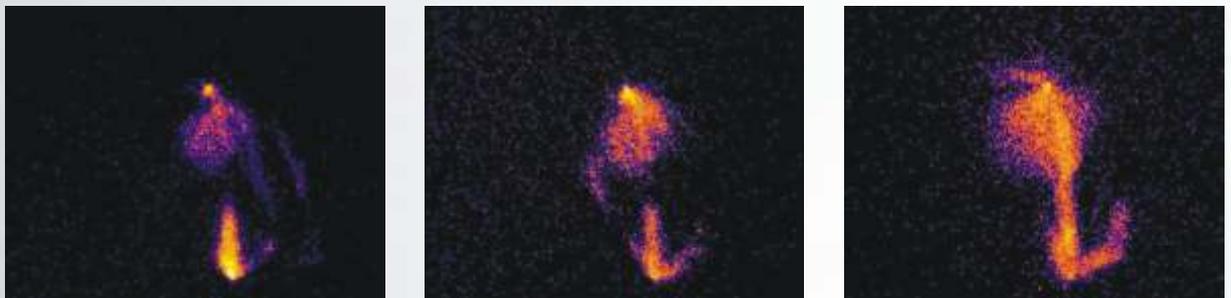
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