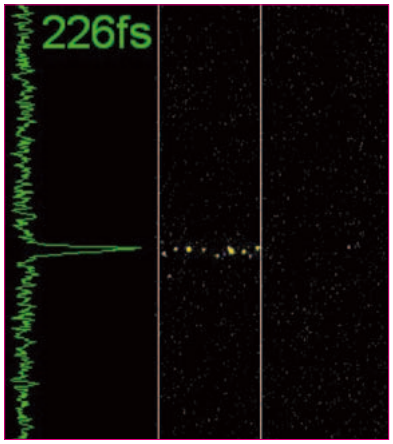
FESCA-200 Femtosecond streak camera C6138 series

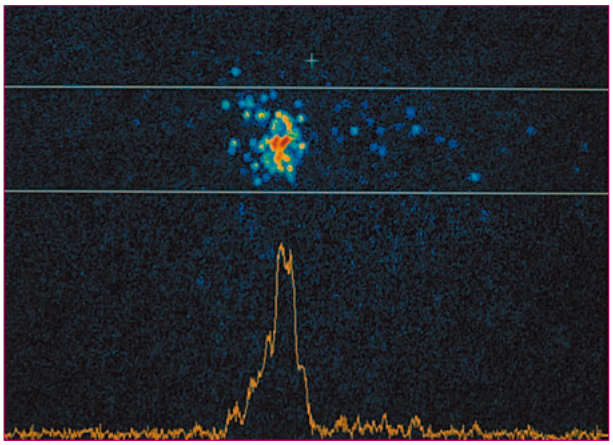
The FESCA-200 is an ultra fast streak camera with a temporal resolution of 200 femtoseconds (typ.). It is designed for use with single-shot or slow-repetitive phenomena. It can analyze the process of energy relaxation and the dynamics of chemical reaction in the femtosecond region in combination with femtosecond pulse laser.

Features

- **Single-shot 200 fs (typ.) temporal resolution**
- **Simultaneous measurement of light intensity on both the temporal and spatial axis**
- **Dedicated readout system**



▲Streak image and intensity profile of light pulses from Ti:Sapphire laser measured with the FESCA-200



▲This streak image, taken with the FESCA-200, was used to measure Cherenkov radiation. LINAC was used to generate an electronic pulse, which, in contact with the air, produced the Cherenkov radiation.
Photo courtesy of Dr. Mitsuru Uesaka, Associate Professor, Nuclear Engineering Research Laboratory, Faculty of Engineering, University of Tokyo.

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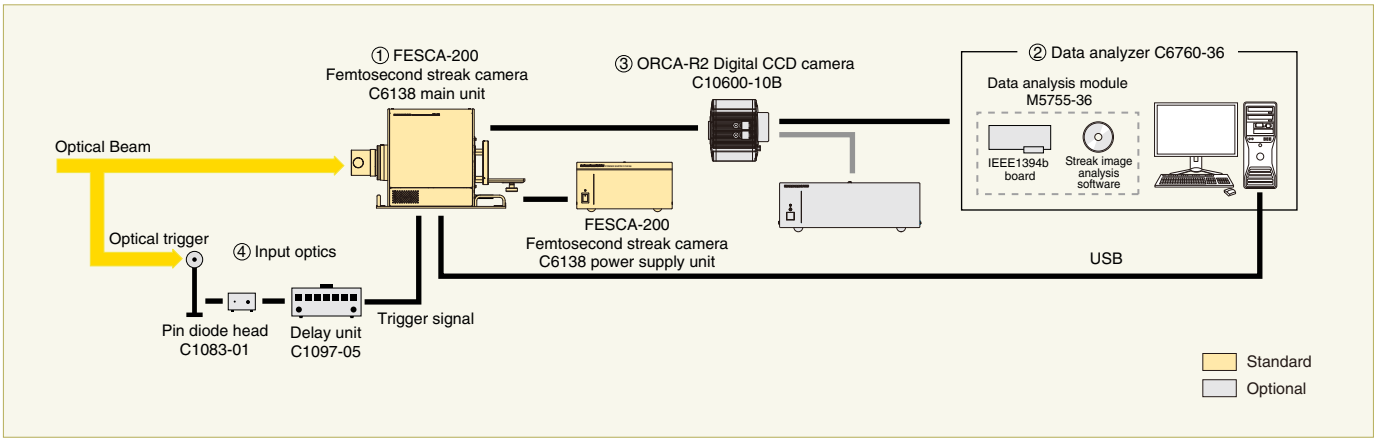
Applications

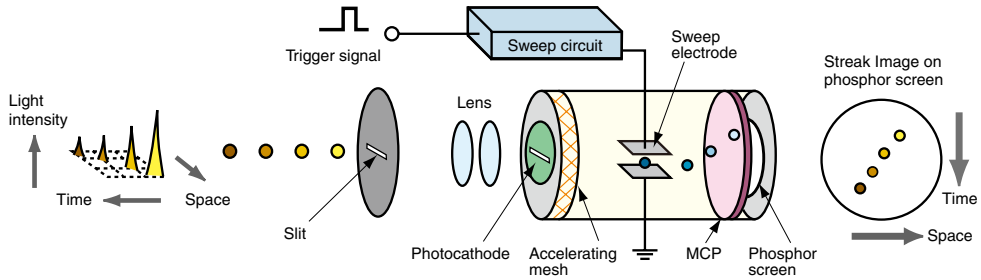
- **Research of the process of energy relaxation of quantum well semiconductors**
- **Research of the dynamics of chemical reactions in the femtosecond region**
- **Research of the dynamics of ultra fast laser diodes, ultra fast optical logic devices, etc.**
- **Diagnosis of femtosecond lasers**

System configuration



Operating principle

The light pulse to be measured is projected onto the slit and is focused by the lens into an optical image on the photocathode of the streak tube. Changing the temporal and spatial offset slightly each time, four light pulses, each with a different light intensity, are introduced through the slit and conducted to the photocathode.
Here, the photons are converted into a number of electrons proportional to the intensity of the incident light. The four light pulses are converted sequentially to electrons which are then accelerated and conducted towards the photocathode.
As the group of electrons created from the four light pulses passes between a pair of sweep electrodes, a high-voltage is applied (see above), resulting in a high-speed sweep (the electrons are swept in the direction from top to bottom). The electrons are deflected at different times, and at slightly different angles in the perpendicular direction, and are then conducted to the MCP (micro-channel plate). As the electrons pass the MCP, they are multiplied several thousands of times and are then bombarded against the phosphor screen, where they are converted back into light.
The fluorescence image corresponding to the first incident light pulse is positioned at the top of the phosphor screen, followed by the others, with images proceeding in descending order; in other words, the axis in the perpendicular direction on the phosphor screen serves as the temporal axis. The brightness of the various fluorescence images are proportional to the intensities of the corresponding incident light pulses. The positions in the horizontal direction on the phosphor screen correspond to the positions of the incident light in the horizontal direction.



Operating Principle of the Streak Tube

Specifications

① FESCA-200 Femtosecond streak camera C6138-11, -12

• Main unit

Temporal resolution		200 fs (better than 300 fs) typ. (at the fastest sweep range)
Effective phosphor screen size	Time axis	Approx. 10 mm
	Spatial axis	Approx. 9 mm
Sweep time/full screen (10 mm)		20 ps, 50 ps, 100 ps, 200 ps, 500 ps, 1 ns
Trigger jitter		Less than ±20 ps
Trigger delay		Approx. 30 ns (at the fastest sweep range)
Maximum sweep repetition frequency		100 Hz
Trigger input	Maximum input voltage	±5 V / 50 Ω
	Maximum input repetition frequency	150 MHz
	Trigger level	-4 V to +4 V
Power supply		AC 100 V to AC 240 V, 50 Hz/60 Hz
Operating temperature		0 °C to +40 °C
Operating humidity		Less than 70 % (with no condensation)

• Streak tube

Photocathode/Material of Windows		Multi-alkali / Kovar glass
Effective photocathode size		Max. 3 mm (H)
Spectral response	C6138-11	280 nm to 850 nm
	C6138-12	300 nm to 1050 nm
Phosphor screen size		ϕ 18 mm
Phosphor screen		P-43
Image magnification		1 : 3

• Image intensifier

Effective photocathode size	ϕ 18 mm
Photocathode	GaAsP
Light gain	More than 2500
Phosphor screen	P-43
Effective phosphor screen size	ϕ 18 mm

② Data analyzer C6760-36

• Data analysis module M5755-36

Image Input board	IEEE1394b
I/F	PCI
Data acquisition	Monitoring, Analog integration, Photon counting
External device control	Streak camera, Spectrometer etc.
Profile analysis	Realtime monitoring, FWHM, Peak count etc.
Calibration	Dark current, Shading, Time axis, Wavelength axis, Jitter
File format (image)	Binary (16 bit), TIFF, ASCII
File format (profile)	TEXT
Data processing	Windows PC

③ ORCA®-R2 Digital CCD camera C10600-10B

Effective number of pixels		1344(H) × 1024(V)
Cell size		6.45 μm (H) × 6.45 μm (V)
Frame rate	Normal scan	8.5 Hz (binning : 1 × 1)
		15.6 Hz (binning : 2 × 2)
	Fast scan	16.2 Hz (binning : 1 × 1)
		28.4 Hz (binning : 2 × 2)
Readout noise (rms) typ.	Normal scan	6 electrons
	Fast scan	10 electrons
Dynamic range typ.		3000 : 1 (Normal scan / binning : 1×1)
Cooling method / temperature	Forced-air cooled	- 35 ˚C
	Water cooled	- 40 ˚C (Water temperature : +20 ˚C)
Dark current		0.0005 electrons/pixel/s (- 40 ˚C)
Dual A/D converter		12 bit or 16 bit
Exposure time		10 μs to 4200 s

④ Input optics

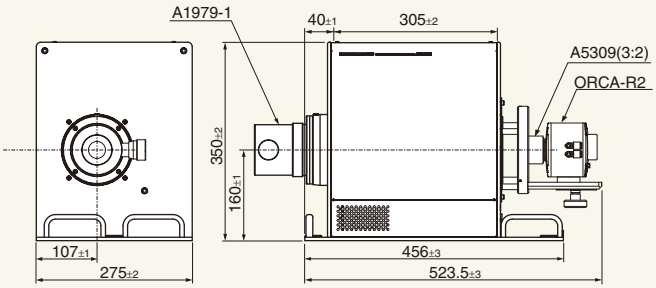
Type number	Input optics A1976-01	Mirror optics A6856
Spectral transmittance	200 nm to 1600 nm	200 nm to 1600 nm
Image magnification	1 : 1	1 : 1
Effective F number	5.0	4.0

< Others >

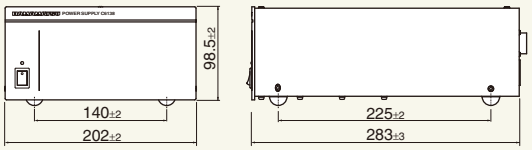
- **Pin diode head C1083-01**
- **Delay unit C1097-05**

Dimensional outlines (Unit: mm)

● C6138 main unit (Approx. 26 kg)



● C6138 power supply unit (Approx. 2.6 kg)



● The temporal resolution of FESCA-200

The temporal resolution of FESCA-200 can be limited depending on wavelength or input light intensity. (See Figure 1, 2)
The photoelectron from photocathode spread spatially along as the wavelength become shorter. Therefore, the temporal resolution is limited by wavelength.
The photoelectron can be spread spatially, each photoelectron bound back while traveling inside streak tube if a number of photoelectron is increased. Thus, the temporal resolution can be limited.

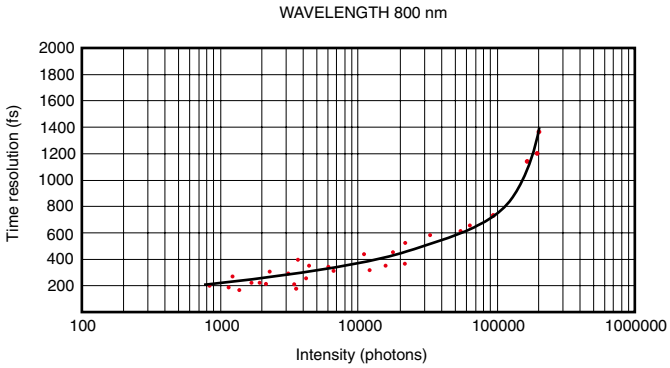


Figure 1

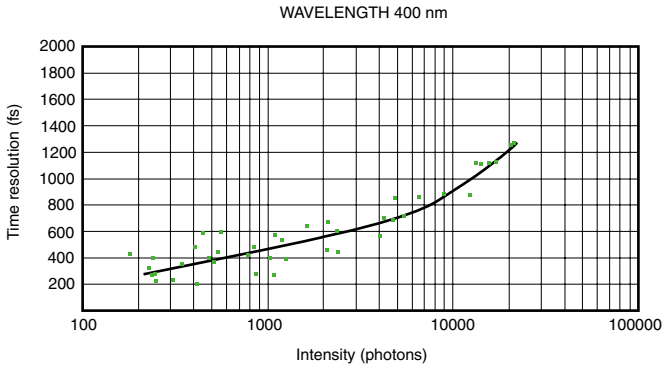


Figure 2

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Cat. No. SHSS0003E04
AUG/2015 HPK
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