A shopping list for your beam profiler

Choosing the best profiler for a laser is a complex process. There is no one profiler available that works with all lasers because of all the factors involved. Here we'd like to help you begin figuring out what to focus on when doing laser profiler shopping (window or otherwise).

First of all, keep in mind that there are two main types of profilers used today:

1. Array/camera based profilers and (array is a general term for camera-types of technology where pixels are used to capture an image.)
2. Mechanical scanning apertures and knife edges profilers.

The main four things you'll need to know about your laser are:

1. The wavelength
2. The beam size
3. The power and
4. Whether the laser is continuous wave (CW) or pulsed

Here is a table with examples of some of the ways these factors affect the laser profilers needed:

Laser characteristic	**Which profiler fits**	**Notes**
Wavelength Criteria		
Wavelengths of 250nm-1100nm	Silicon detector camera and scanning slit based profilers.	These are the most cost-effective profilers. They include CCD or CMOS cameras and silicon detector-equipped scanning aperture systems.
UV Wavelengths of <190nm-250nm	CCD and CMOS cameras are best but they can be damaged at these wavelengths. Conversion plates and imagers will be necessary for more than occasional use. Pyroelectric, imagers and scanning slit, systems can operate deep into the UV without risk of damage.	
Wavelengths from 1100nm-1700nm	Up to 1300nm, regular silicon cameras will work. After that, either pyroelectric/InGaAs arrays or germanium/pyroelectric scanning slit systems are necessary. At lower resolution, Phosphor coated arrays are also available	Pyroelectric and InGaAs are 5-10 times the price of silicon detectors. Scanning slit systems are lower in price. Phosphor coated arrays are the least expensive with resolution of ~50μm
Wavelengths >1700nm	Pyroelectric imagers and scanning slit systems, can operate into the far infrared.	

Beam Size Criteria		
Beam diameter of ≥ 1mm	Silicon, InGaAs, Phosphor coated and Pyroelectric arrays are suitable. Scanning slit systems are available with apertures up to 25mm.	Beam should cover about 10x10 pixels. Pyrocam pixels are 100μm.
Beam diameter of ≥250μm	Silicon and InGaAs array pixels and scanning slit systems	InGaAs pixels size is ~30μm.
Beam diameter of ≥50μm	Silicon cameras, with smaller pixel sizes and scanning slit systems	The pixels on silicon arrays are down to ~4μm
Beam diameter of 4μm - 50μm	Scanning slit profilers only	
Power and Energy Criteria*		
Powers >100mW up to ~300W	Direct Measurement: Pyroelectric detector equipped scanning slit profiler Using beam splitters/attenuators: array profilers	The amount of power being measured will affect whether or not attenuation or beam splitting is needed. It will also determine the detector type. Of course, as we've seen, CCD and CMOS cameras will always need attenuation. Scanning slit profilers can measure beams directly without attenuation.
High power lasers >300W up to thousands of watts	Spinning or scanned wire techniques or beam splitters with scanning slits	
Pulsed lasers at a repetition rate of less than 1Hz-2kHz	Camera array profilers	
Continuous wave lasers or pulsed lasers with repetition rates above 2kHz	Camera array profilers or Scanning slits	This depends on the repetition rate, beam size, the length of the pulses, power levels and pulse energy thresholds.

* All of the above technologies can be used at most power/energy levels but will require varying amounts of beam attenuation before exposing the detection system to the laser beam.

More questions

How, where and for what purpose will your profiler be used?

The scanning slit system does not need much or any attenuation which makes it easier to use, especially with continuous wave (CW) or high frequency pulsed lasers. It can measure focused and unfocused beams one after the other and it can also measure very small beams directly. This could make it the profiler of choice on a factory floor since it creates ease of use. It is also good for measuring a laser at various points along its propagation, like in the case of the M2, or focusing an optical system.

The camera array profilers are suited for both CW and pulsed lasers and reveal true beam profile structure (which is important for tuning lasers) since it shows a two dimensional view of the beam. The spatial resolution of a camera based system is best for performing more complex beam analysis such as TopHat, Gaussian Fit, Orientation, Ellipticity, etc.

Read the full article Beam Profiling: A Primer by Allen M. Cary, Photon Inc., San Jose CA

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