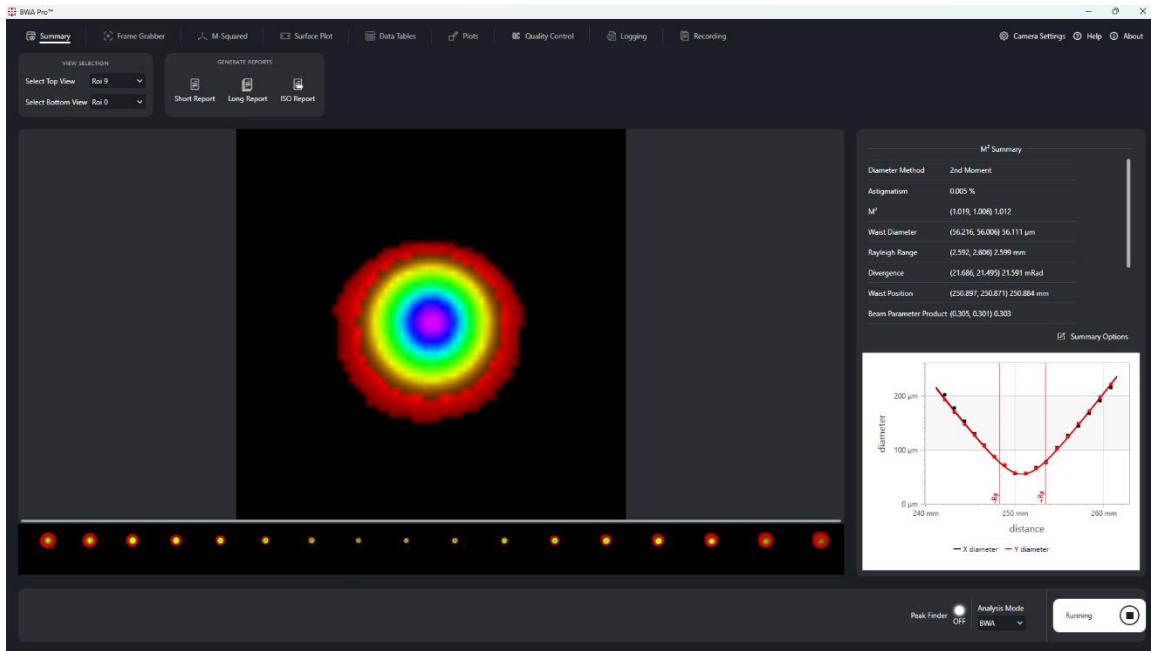




The Haas LTI BWA-CAM® (**Beam Waist Analyzer CAM**era) is a precision laser diagnostic system designed for real-time beam profiling. The BWA-CAM is a completely passive optical system. The BWA-CAM utilizes a specialized user-adjustable Fabry-Perot cavity positioned in front of a CMOS sensor. The adjustable Fabry-Perot cavity creates time delayed spatial slices of the focused laser beam. The adjustment range of the Fabry-Perot cavity is from touching to 9mm. This allows the BWA-CAM to accommodate Rayleigh lengths of up to 36mm in a single measurement. This allows for rapid measurement of the beam waist like shown in figure 1 for a wide range of focal lengths.

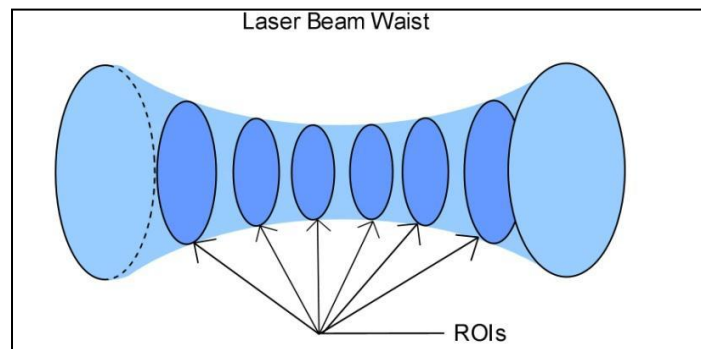


Figure 1: Time Delayed Spatial Slices (**R**egion **O**f Interest)

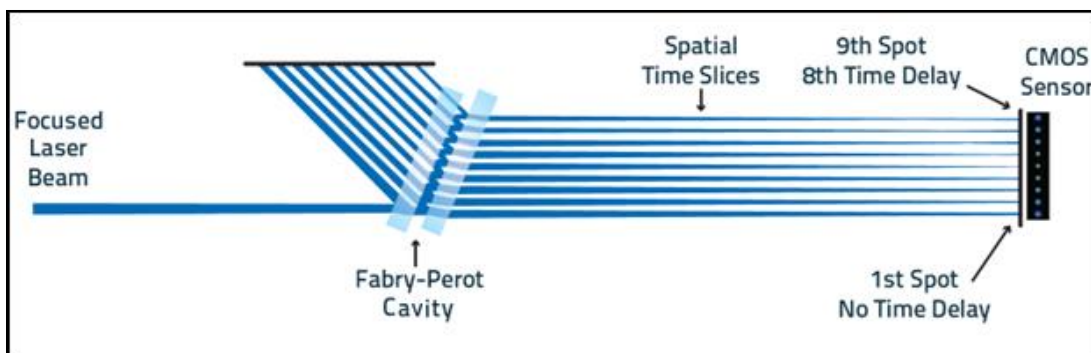


Figure 2: Schematic of the BWA-CAM Adjustable Fabry-Perot Cavity

The system captures multiple time-delayed slices of the beam, each being a spatial cross-section along the waist, which are then imaged and analyzed for accurate M^2 value calculation as shown in figure 2. The BWA-CAM operates at over 5 frames per second, resulting in M^2 factor measurements in about 200 milliseconds. Adjustments can be made to ensure the exact beam waist is contained within the regions of interest generated by the camera and software.

The BWA-CAM supports a wide range of wavelengths (325 nm to 1200 nm) and power levels. Depending on the laser configuration and attenuation modules used it can measure laser sources from sub-milliwatt to over 30 kW. It performs real-time M^2 measurements without any moving optics or scanning components, making it valuable for single-pulse lasers or high-power continuous wave systems. The system also enables thermal lensing detection, allowing users to monitor and quantify focus shifts caused by heat buildup in optical components.

The BWA-CAM is highly configurable, supporting single or multi-camera setups to accommodate different resolution and measurement range requirements. It includes built-in optical density (OD) attenuation ranging from -4.0 to -7.0, with external options available for higher power lasers. The system can measure minimum spot sizes as small as 28 μm .

Software plays a pivotal role in the BWA-CAM's functionality. The control software offers auto-tracking of the region of interest, ISO-compliant report generation, and real-time logging for offline analysis. It also supports external interlock control, enhancing safety and integration with existing laser systems. The BWA-CAM system provides key spatial metrics such as beam waist size and location, divergence, circularity, astigmatism, and centroid, essential for maintaining consistent part quality in laser-based manufacturing.

Built to comply with ISO 11146 and ISO 13694 standards, the BWA-CAM is CE-certified and utilizes an efficient, power-over-ethernet, GigE interface. Its compact, modular design allows for easy mechanical integration into diverse optical setups, and its robust construction ensures reliable performance even in demanding scientific or industrial environments.