-RayCi-

Laser Beam Profiling Solutions

Laser Beam Profiling Software

CINOGY
TECHNOLOGIES

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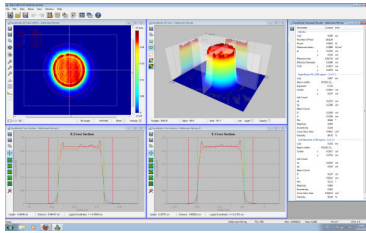
Beam Profiler Software RayCi
- Product Description -

CINOGY Technologies beam profilers are available with the specifically designed analysis software, RayCi, which supports XP / Vista / Windows 7 / 8 operating systems. It is available as 32 Bit / 64 Bit version and can control several beam profiler cameras on a single computer simultaneously.

ISO 11145
ISO 11146
ISO 11670
ISO 11554
ISO 13694
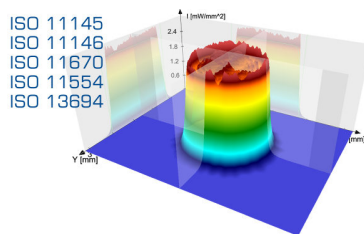
| |
| --- |
| XP / Vista / Windows 7 / 8 |
| Pentium IV / AMD Processor (Dual / Quad Core) |
| 512MB graphic, Open GL V1.4 (NVIDIA) |
| 2GB RAM |
| 500MB free memory |
| PCI / PCIe slot |
| USB ports |
| CD / DVD-ROM drive |
| Internet access for update request |

Due to its clearly designed menu structure, RayCi shows self-explanatory functions, which help the user to access quickly standard settings. Incomparable visualization modes, extensive analytical capabilities as well as new developed correction algorithms ensure the highest accuracy in laser beam analysis.

A wide range of beam width techniques e.g. 2nd Moment, Knife Edge, Moving Slit, Plateau and Gauss-Fit can be applied to determine quick and reliable standard beam parameters. The unique measurement tool enables the continuous monitoring of beam parameters, beam position and power density distribution. Moreover a new beam quality M^2 tool enables accurate beam quality analysis.

The extraordinary graphical and analytical tool of RayCi can be used for live data (LiveMode) and stored data (SaveMode) simultaneously, while each mode has its own individual functions. This makes RayCi the most advanced analysis software on the market. Helpful features like AOI Tracking, AOI Optimization, Zoom Functions, Look-Up Tables, etc. simplify the laser beam analysis.

RayCi is equipped with flexible data and image output capabilities. This permits the user to store data and images in the format that is compatible with their needs. A clearly arranged and printable protocol view displays the measurement parameters as well as the most important laser beam analysis results.

CINOGY'S laser beam profiler can easily be integrated in different automation systems and processes. The supplied Software Development Kit (SDK) based on a XML-rpc interface. The user can write programs in a number of platforms, such as Python, Visual Basic, LabVIEW, etc. which will remote-control the beam profiler.
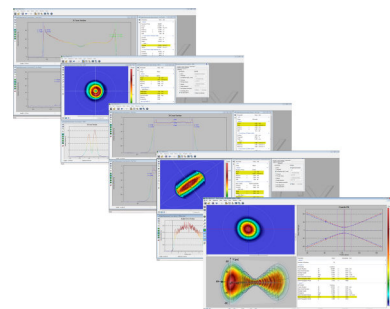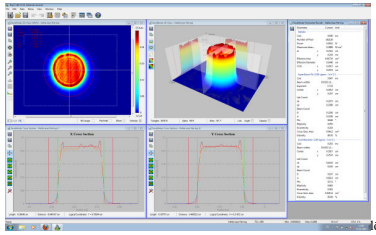
Beam Profiler Software RayCi
## - Visualization Options -

RayCi's incomparable illustration capabilities ensure the optimal visualization of measurement results during beam profiling. Several visualization windows allow the monitoring and analyses of live data and previously stored data simultaneously. Thanks to its clearly designed menu structure and the self-explanatory functions RayCi can easily be operated by any user.

2D-View
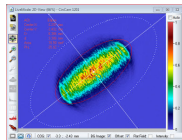
|	
Options:	3D-View, Histogram, Cross Sections, Beam Results, Saturation
Illustrations:	2D Data, Beam Width, Cuts, Centroid, Coordinate System
Features:	LUT, Adjustable LUT, Auto Contrast, Auto / Manual AOI, Zooming, Summing
Calibration /Correction:	Background, Baseline, Flat Field, Linearity, Power

3D-View
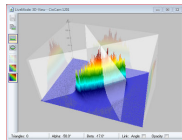
Options:	Data Style, Opacities
Illustrations:	3D Data, Beam Width, Cuts, Fits, Coordinate System
Features:	Rotating, Zooming, Linking 3D-Views

### Cross Sections
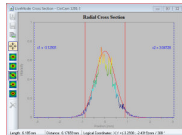
Options:	Type (X, Y, Radial, Circular, Arbitrary)
Illustrations:	Cross Section Data, Beam Width, Fits, Coordinates
Features:	Tracking, Zooming, Analysis (1D Beam Width, Edge Steepness)

Power Profile
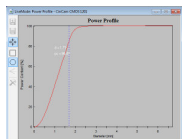
Options:	Virtually Aperture
Illustrations:	Power Content versus Beam Diameter (Position of Virtually Aperture)
Features:	Zooming, Analysis Areas (Square / Circular / Numerical Aperture)

Histogram
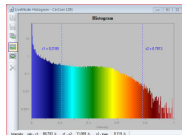
Options:	Linear, Logarithmic
Illustration:	Frequency Distribution of Data
Features:	Zooming, Cursor

Beam Results
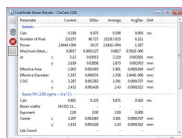
Option:	Data Recording
Illustrations:	AOI, Centroid, Statistics, 1D / 2D Beam Width, Beam Parameter
Feature:	Data Export
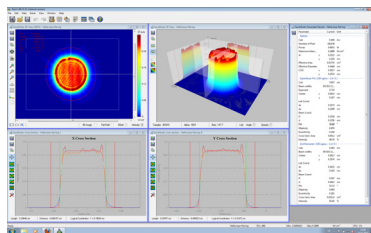
Beam Profiler Software RayCi
- Measurement Options -

RayCi's extraordinary analytical tools enable the monitoring of beam parameters, beam position, power density distribution and beam caustic to ISO standard. Several measurement windows allow the monitoring and analyses of live data and previously stored data simultane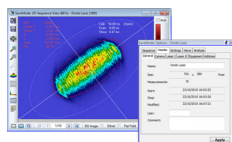ously. Thanks to its clearly designed menu structure and the self-explanatory functions RayCi can easily be operated by any user.

Single Measurement/ Time Series

Charts:	2D-View, 3D-View, Histogram, Cross Sections, Beam Results
Features:	LUT, Adjustable LUT Dynamic, Auto Contrast, Auto / Manual AOI
Data:	Arithmetic's, Image Transformations, Filter, Optimization Function
Output:	Data, Export, Image, Protocol
ISO:	ISO 11145 / ISO 11146 -1 / 2 / ISO 13694

Divergence Measurement
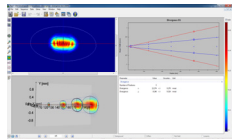
Charts:	2D-View, 3D-View, Fit, Results
Features:	Data Selection, Zooming, Optimization Function, Coordinates
Data:	Fit, 3D-Fit, Measurement Planes
Output:	Data, Export, Protocol

Beam Quality M^2 Measurement
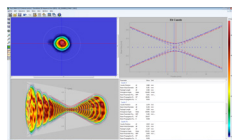
Charts:	2D-View, 3D-View, Caustic Fit, Results
Features:	Data Selection, Zooming, Optimization Function, Coordinates
Data:	Caustic X / Y Fit, Caustic Fit, 3D-Caustic Fit, Measurement Planes
Output:	Data, Export, Protocol
ISO:	ISO 11145 / ISO 11146 -1 / 2

Beam Stability Measurement
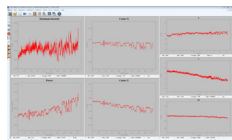
Charts:	Power, Peak, Centroid X / Y, Beam Width
Features:	Flexible Time Interval, Statistical Data, Zooming, Linking
Output:	Data, Export, Protocol
ISO:	ISO 11554

Pointing Stability Measurement
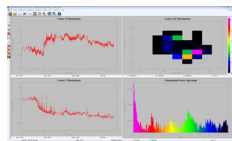
Charts:	Centroid Fluctuation X /Y, Centroid Position Analysis, Power Spectrum
Features:	Flexible Time Interval, Statistical Data, Zooming, Linking
Output:	Data, Export, Protocol
ISO:	ISO 11670
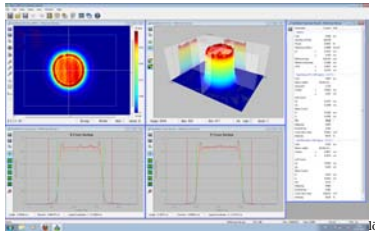
Beam Profiler Software RayCi
- Single Measurement -
- Time Series -

RayCi features a unique laser beam measurement technique – the measurement of time series. It allows beam profile acquisition and evaluation not only as single measurement but also as a sequence of consecutive measurements with a selectable interval. Thereby RayCi enables a continuous monitoring and analysis of laser beam parameters and their temporal behavior automatically.
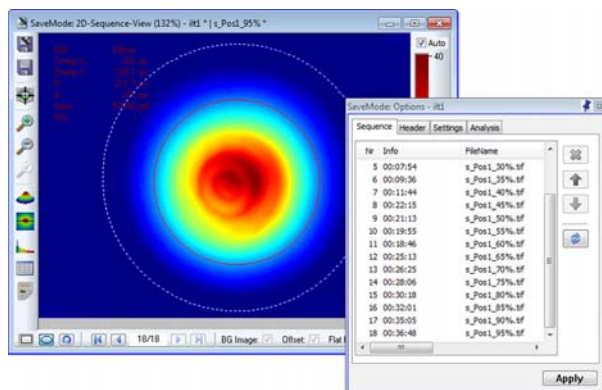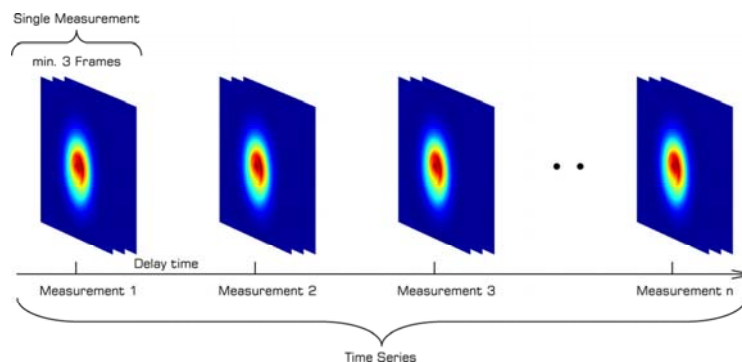
Examination

Each measured laser beam profile, acquired either as single measurement or as time series, is completely analyzable by the full range of RayCi's sophisticated analytical methods, e.g., beam width techniques, arithmetic operations, filters, image transformations, and optimization features and can be visualized as 2D, 3D, Cross-Section and Histogram.

Option Window

List of all individual measurements of the time series.
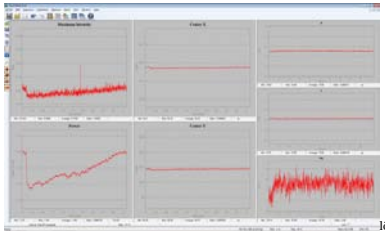
Beam Profiler Software RayCi
- Beam Stability -

For high-precision laser beam applications is it important to know the temporal behavior of the laser beam parameters. Thus, RayCi continuously measure, analyze and monitor standard laser beam parameter according to ISO standard. This unique stability tool is indispensable for today's laser beam applications. The enhancement of product quality, process reliability and efficiency are just a few of the many benefits of this measurement option.
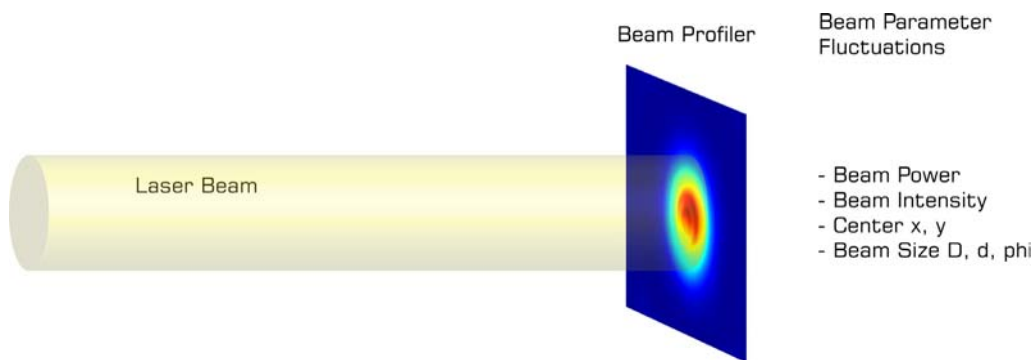
CHARTS:

Power
Depicts the values of the power (δPower) versus time.
Minimum, maximum, average and standard deviation values are shown.

Peak
Depicts the values of the peak (δPeak) versus time.
Minimum, maximum, average and standard deviation values are shown.

Centroid X / Y
Depicts centroid x and centroid y positions of the laser beam versus time.
Minimum, maximum, average and standard deviation values are shown.

Beam Width (D, d, Phi)
Depicts the values of the beam width versus time.
Minimum, maximum, average and standard deviation values are shown.
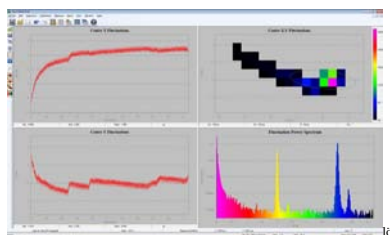
Beam Profiler Software RayCi
- Pointing Stability -

The pointing stability is one of the essential parameter of today's laser applications. The laser process is highly sensitive to several internal and external effects. The consequences are beam position fluctuations, which can cause significant problems. For such reasons a quantitative measure of the beam pointing stability is of importance. RayCi continuously measures the beam pointing stability according to ISO 11670 calculated by the centroid.
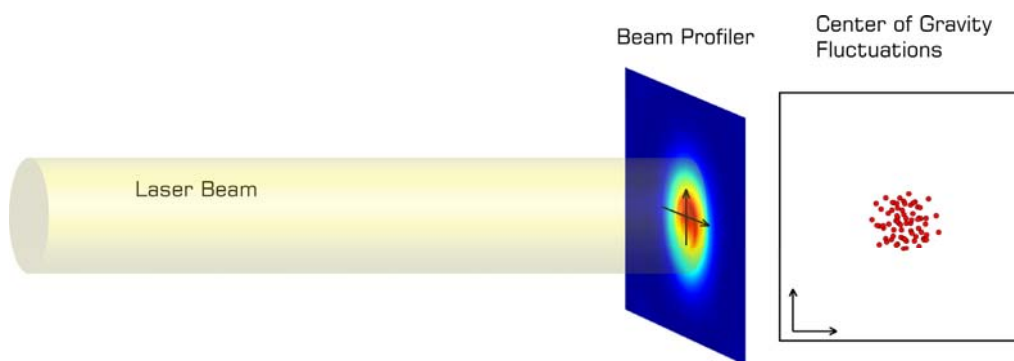
CHARTS:

X-Fluctuation
Depicts the centroid fluctuation in x-direction (δX).
Minimum, maximum and standard deviation values are shown.

Y-Fluctuation
Depicts the centroid fluctuation in y-direction (δY).
Minimum, maximum and standard deviation values are shown.

Centroid Position Analysis
Monitors the centroid fluctuations in x- and y- directions. The frequency of occurrence is displayed in different colors. Additionally, RayCi calculates the 2nd moments of this distribution as ellipse. The respective characteristics of the ellipse are listed.

Power Spectrum
Depicts the frequency spectrum of the centroid fluctuations.
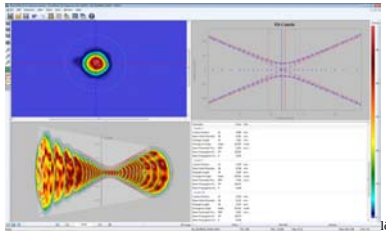
Beam Profiler Software RayCi
- Beam Quality M² -

The knowledge of the laser beam quality is one of the essential characteristic for today's laser material processes. The beam quality factor M2 indicates the focusing ability of the laser. The best possible beam quality M2 = 1.0 is achieved for a Gaussian TEM00 beam. The closer M2 is to 1.0 the better the beam can be focused. M2 is measured according to ISO 11146-1 / 2 by focusing the beam and measuring several beam profiles along the beam caustic.
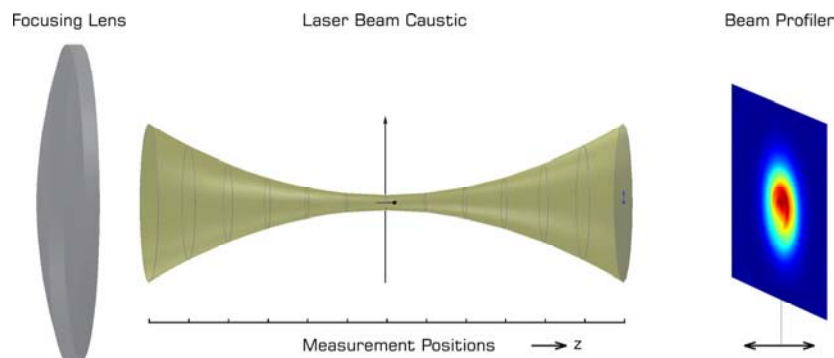
CHARTS:

2D-View
Displays the currently beam profile measured along the beam caustic.
The user can click any individual beam profile to observe the beam propagation.

2D-Caustic Fit
This view presents the beam widths at all measured z-positions. RayCi extrapolates a hyperbola fit to these data meaning the caustic x fit, caustic y fit and caustic fit. The beam waist position and the Rayleigh length are shown automatically.

3D-Caustic Fit
The unique 3D tool displays the individual beam profiles at each measured z-position.
Additionally, the caustic x fit, caustic y fit and 3D-caustic fit are illustrated.

Results
Displays the calculated results such as beam waist diameter (do), Rayleigh length (zR), divergence angle (θ), M2, K, ect. by using ISO 11146-1 or ISO 11146-2 standards.

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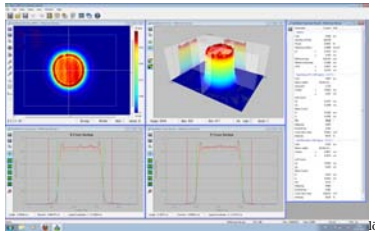
Beam Profiler Software RayCi
- Beam Width Methods -

The exact knowledge of beam parameters is essential for the success of laser processes. RayCi provides a wide range of beam width techniques according to ISO 11146 to calculate quick and reliable standard beam parameters. The beam parameter results depend on the selected beam width technique. For every laser beam shape, intensity profile and mode structure RayCi offers the respective technique. The calculated beam width is depicted in the 2D-View (circular), 3D-View (circular cylinder, gauss distribution curve), and Cross Section (lines, gauss distribution curve).

|		Threshold	2nd Moments	Fit Gauss	Fit Super-Gauss	Plateau	Simple Geometry	Area	Knife Edge 90/10	Moving Slit 86/14
Beam Parameters	Exponent			•	•					
	Centroid X / Y		•	•	•	•	•	•		
	Beam Width X / Y (Labor Coordinates)		•	•	•				•	•
	Divergence X / Y (Labor Coordinates)		•	•	•				•	•
	Beam Width Major / Minor (Beam Coordinates)		•	•	•	•	•	•	•	•
	Divergence Major / Minor (Beam Coordinates)		•	•	•	•	•	•	•	•
	Azimuth Angle		•	•	•	•	•	•	•	•
	Ellipticity		•	•	•	•	•	•	•	•
	Eccentricity		•	•	•	•	•	•	•	•
	Cross-Sectional Area		•	•	•	•	•	•		
	Intensity		•	•	•	•	•	•		
	Goodness if Fit index (GFI)			•	•	•				
	Correlation			•	•	•				
	Uniformity	•				•				
	Roughness					•				
	Slope					•				
	Top Hat Factor (F)					•				
	Effective Power	•								
	Power Ratio	•								
	Effective Area	•								
	Mean Intensity	•								
	Flatness	•								
	Edge Steepness	•								
Settings	Threshold Value (90%, 50%, 10%, 1/e, 1/e^2)	•		•	•					
	Sigma Environment (1.41s, 2s (D4 Sigma), 2.82s, 3s)		•	•						
	Intensity Fraction (63.21, 86.47, 98.17, 98.89)					•	•	•		
	Ellipse (Beam shape)		•	•	•	•	•			
	Rectangle (Beam shape)					•	•			
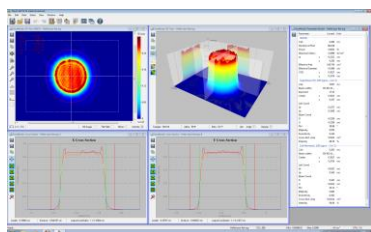
Beam Profiler Software RayCi
- Version Overview -

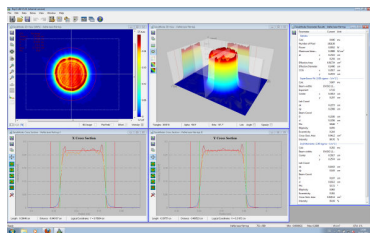|	Lite	Standard	Professional
System			
XP, Vista, Windows 7, Windows 8	32Bit / 64Bit	32Bit / 64Bit	32Bit / 64Bit
Beam Profiler			
Multi-Use (Several Beam Profilers simultaneously)	○	○	●
Support for USB / FireWire / GigE / CameraLink Beam Profiler	● / ● / ● / ○	● / ● / ● / ●	● / ● / ● / ●
CW Mode / Pulse Mode (Software Trigger)	● / ●	● / ●	● / ●
Live Mode (live data) and Save Mode (stored data) can be used simultaneously	●	●	●
Automatic Update Support / Email Support	○ / ●	● / ●	● / ●
Visualization Windows			
2D-View (2D Profile, AOI Features, Beam Width, Cuts, Coordinate System)	●	●	●
3D-View (3D Profile, Coordinate System, Rotation, Cuts, Fit)	○	●	●
Cross Section (X/Y-Cut, Radial-Cut, Circular-Cut, Arbitrary-Cut, Beam Width, Cursor)	● (X, Y)	● (All)	● (All)
Number of Cross-Section Windows	1	2	2
Cross Section Analysis (1D Beam Width, Sinc² Fit, Edge Steepness)	○	●	●
Power Profile (Power Content Virtually Aperture)	○	●	●
Histogram (Probability Density Distribution, Cursor)	○	●	●
Beam Results (Highlighting, Separating, Pass / Fail Criteria)	● / ● / ○	● / ● / ●	● / ● / ●
AOI Parameter (Center xy, Diameter, Area, Intensity)	●	●	●
Centroid Position	●	●	●
Power Profile Position	○	●	●
Statistics (Number of Pixel, Power, Peak)	●	●	●
Beam Parameter (Beam Width, Centroid, Uniformity, etc.)	●	●	●
Beam Profiler Dynamic (Saturation, Intensity, Power)	●	●	●
Measurement Windows (ISO 11146, ISO 13694, ISO 11670)			
Single Measurement (2D / 3D-View, Histogram, Cross Section, Beam Results)	●	●	●
Time Series (2D / 3D-View, Histogram, Cross Section, Beam Results)	○	●	●
Divergence Measurement (2D / 3D-View, Fit, Divergence Parameter)	○	●	●
Beam Quality M² Tool (2D / 3D-View, Caustic Fit, 3D Caustic Fit, Caustic Parameter)	○	○	●
Beam Stability (Peak, Power, Centroid X/Y, Beam Width: d, D, Phi)	○	●	●
Pointing Stability (Centroid Fluctuation X/Y, Centroid Position Analysis, Spectrum)	○	●	●
Standard Features			
LUT / Adjustable LUT Dynamic / Auto Contrast	● / ● / ●	● / ● / ●	● / ● / ●
AOI Adjustment (Centroid, Peak, Beam Width)	●	●	●
Centroid Calculation (Data, Threshold Level, Highest Pixel)	○	●	●
Spatial Units (px, µm, mm, cm, in, m)	●	●	●
Power Units (1, nW, µW, mW, W, kW)	●	●	●
Coordinate System (Default, Standard, User-Defined)	●	●	●
Adjustable Cursors (Peak, Beam Width, Edge Steepness)	○	●	●
Zoom Function (All Visualization and Measurement Windows)	●	●	●
Camera Settings (Exposure Time, Gain, Floating Average, Frame Summing)	●	●	●
Trigger Settings (Polarity, Delay Time, Auto Pulse Finder)	●	●	●

● included   ○ not included

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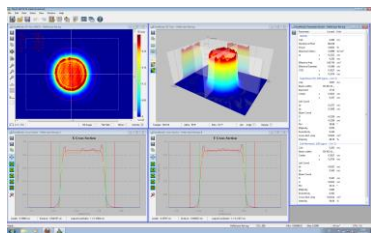
Beam Profiler Software RayCi
- Version Overview -

	Lite	Standard	Professional
Correction and Calibration Tool			
Background Correction (incl. Cold and Hot Pixel)	●	●	●
Baseline Correction	●	●	●
Flat Field Calibration	●	●	●
Linearity Calibration	○	●	●
Power Calibration	●	●	●
2D Beam Width Techniques			
Threshold	●	●	●
2nd Moment	●	●	●
Gauss-Fit	●	●	●
Super-Gauss-Fit	○	●	●
Plateau	○	●	●
Geometry Simple	○	●	●
Geometry Area	○	○	●
Knife-Edge 90/10	●	●	●
Moving Slit 86/14	○	●	●
2D Beam Parameters			
Exponent	○	●	●
Centroid at x, y	●	●	●
Beam width at x, y / Divergence at x, y (Lab Coordinates)	●	●	●
Beam width major, minor / Divergence major, minor (Beam Coordinates)	●	●	●
Azimuth Angle	●	●	●
Ellipticity / Eccentricity	●	●	●
Correlation	●	●	●
Uniformity	●	●	●
Roughness	○	●	●
Slope	○	●	●
Cross-Sectional Area	●	●	●
Intensity	●	●	●
Goodness of Fit Index (GFI)	●	●	●
Top Hat Factor (F)	○	●	●
Effective Power	●	●	●
Power Ratio	●	●	●
Effective Area	●	●	●
Mean Intensity	●	●	●
Flatness	●	●	●
Edge Steepness	●	●	●
Beam Statistics			
Number of Pixel	●	●	●
Power	●	●	●
Peak at x, y	●	●	●

● included   ○ not included

Beam Profiler Software RayCi
- Version Overview -

	Lite	Standard	Professional
Video			
Video capturing	○	●	●
Video playback	○	●	●
Almost all measurements / visualizations can be performed on video files	○	●	●
Work with Live Data / Save Data			
Camera Options (Binning 1x1, 2x2, 4x4, 8x8)	●	●	●
Arithmetic Operations (Add, Subtract, Multiply, Divide, Raise)	●	●	●
Image Transformation (Flip vertical / horizontal, Rotate Left / Right)	●	●	●
Filter (Median, Smoothing, Lowpass, Highpass)	●	●	●
Optimization (Baseline Correction)	○	●	●
Data (Save / Open)			
Single Measurement (TIF / Printable Report)	● / ○	● / ●	● / ●
Time Series (TS / Printable Report)	○ / ○	● / ●	● / ●
Divergence Measurement (DVG / Printable Report)	○ / ○	● / ●	● / ●
Beam Quality (M2 / Printable Report)	○ / ○	○ / ○	● / ●
Beam Stability (BST / Printable Report)	○ / ○	● / ●	● / ●
Pointing Stability (PST / Printable Report)	○ / ○	● / ●	● / ●
Export			
Data (TXT / CSV)	●	●	●
Image (BMP / JPEG / GIF / TIFF / PNG)	●	●	●
Grayscale Image 8Bit (BMP / GIF / TIFF / PNG); 16Bit (PGM)	○	●	●
Video (AVI / TS)	○	●	●
Workspaces / Settings	●	●	●
Import			
Data (CSV)	○	○	●
Grayscale Image (BMP / JPEG / GIF / TIFF / PNG / EMF / WMF / ICO)	○	○	●
Workspaces / Settings	●	●	●
XML-RPC interface that allows full remote control of all RayCi functions			
Control of all camera settings	○	●	●
Capture of data and results	○	●	●
Control of measurement settings	○	●	●
SDK			
Wrapper-Dll for C (LabView)	○	●	●
Wrapper-Dll for .NET	○	●	●
Control of External Devices			
Translation Stage for Beam Quality M^2 - CinSquare	○	○	●
Trigger Device for Advanced Pulse Measurements	○	○	●
Dongle Network Server	○	●	●

● included   ○ not included