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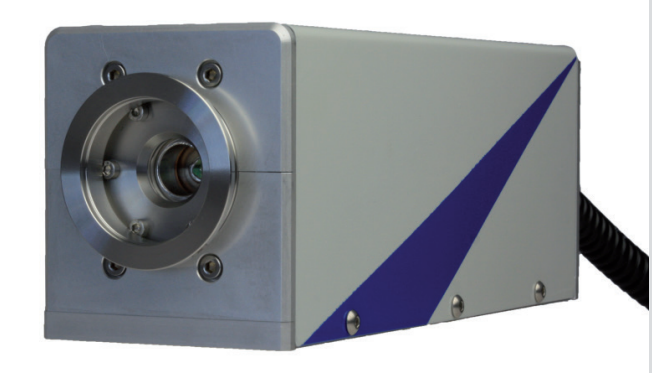
E-Lux™

Brilliant
Vacuum Ultraviolet (VUV) Light Sources

Key Features

- Exceptional brilliance
- Highly stable light output
- Small and well defined focal light spot
- Pulse and cw operation
- High repetition rates
- Long lamp life
- “Cold” emission, no heating-up of samples
- High efficiency, low energy consumption
- No X-ray hazard
- Compact design for mobile applications
- Air-cooling
- Fully computer-controlled & easy handling



Innovative Technology - The vacuum ultraviolet (VUV) light sources *E-Lux*™ use an innovative and advantageous concept of VUV light generation: Pure rare gases or rare gas mixtures at elevated pressures are excited by low energy electron beams. Electrons penetrating a thin, but stable and inert membrane are stopped within the gas on a very short distance creating a small and highly brilliant VUV light emitting plasma. Its brilliance and flexible performance makes the *E-Lux*™ to a powerful solution for any photophysical and photochemical application.

Applications

- Photoionization source for ion mobility and mass spectrometry
- Photophysical & photochemical studies
- Planning of synchrotron experiments in the lab

Potential applications:

- Surface treatment & analysis
- Medical applications

Models

Model*	*E-Lux*™ 116**	*E-Lux*™ 121**	*E-Lux*™ 126	*E-Lux*™ 147	*E-Lux*™ 172
Central emission wavelength (nm)	116	121.56	126	147	172
FWHM *** (nm)	< 1	< 3 * 10^{-3}	10	10	10
Photon energy (eV)	10.7	10.2	9.8	8.4	7.2

* For tailor-made lamps with other emission wavelengths, please contact us.
** For detailed information, please contact us.
*** Full-Width-at-Half-Maximum.

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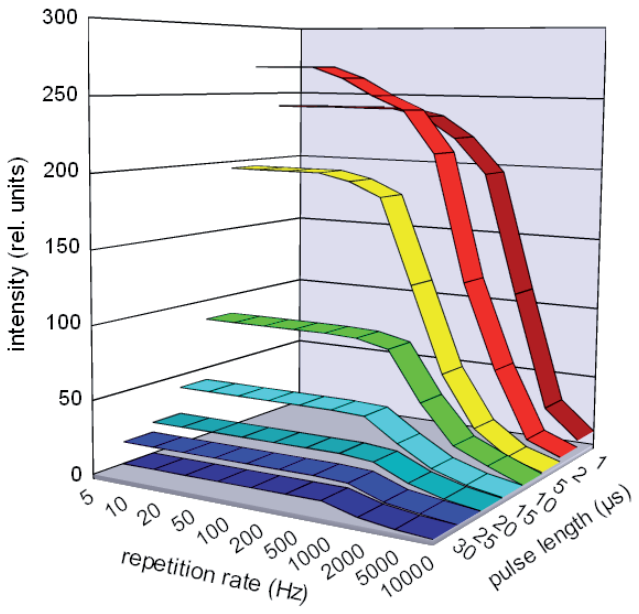
High Brilliance & Flexibility

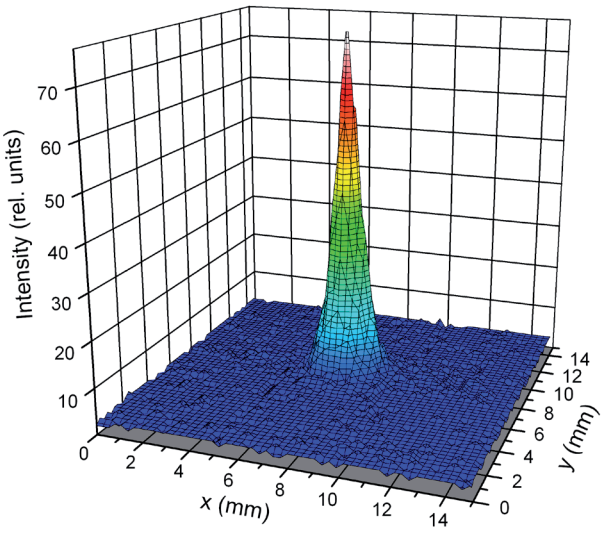
Brilliance & Beam Quality

The *E-Lux*™ vacuum ultraviolet (VUV) light sources open up new dimensions in brilliance: A total photon flux of up to $2 \cdot 10^{16}$ photons/s (cw operation) and a small emission volume of less than 1 mm^3 makes the *E-Lux*™ to an ideal VUV radiation source for demanding applications. The brilliance is even increased by a factor of 100 when working in pulse mode. The user interface allows for an easy adjustment of the emitted light intensity. This feature gives you the opportunity to always select optimal experimental conditions.

A small emission area of only 1 mm in diameter is easy to refocus onto a target area with high precision, which is a major prerequisite for many applications. A large accessible emission angle offers high photon fluxes and gives you maximum flexibility in using your own optics. For refocusing you can also use the *E-Lux*™ EEM Optical Module which is available as optional accessory and can be easily mounted to the *E-Lux*™ as well as to your setup by means of standard vacuum flanges.



Light intensity for different settings of repetition rate and pulse length (E-Lux™ 126).



Intensity distribution at the target site using the E-Lux™ EEM Optical Module with a focal length of f = 120 mm (E-Lux™ 126).

Pulse and CW Operation

The *E-Lux*™ can be operated in full cw as well as in pulse mode. Within pulse mode the user can choose between single pulses and repetition rates of up to 10 kHz. Depending on the repetition rate, pulse lengths can be set between 1 to 100 µs and 1 ms to cw. The computer-controlled power supply allows for internal as well as for external pulsing (lock-in, pulse-probe etc.).

Efficiency

The *E-Lux*™ comes with an outstanding conversion efficiency of beam power into light of up to 40 %. The result is a compact design with high performance, but low energy consumption. Because there is no need of water cooling, the VUV light source is also ideal for mobile applications.

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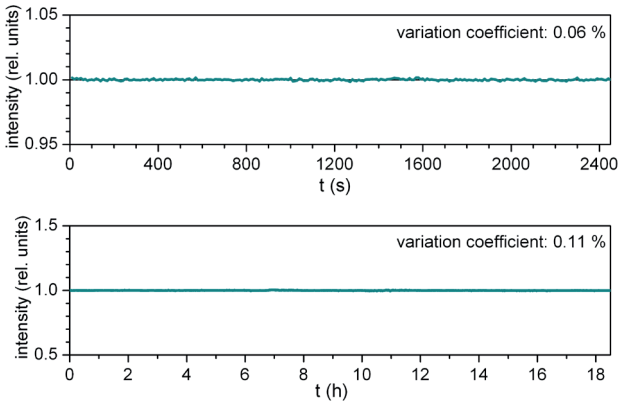
Stable & Reliable Operation

Emission Characteristics

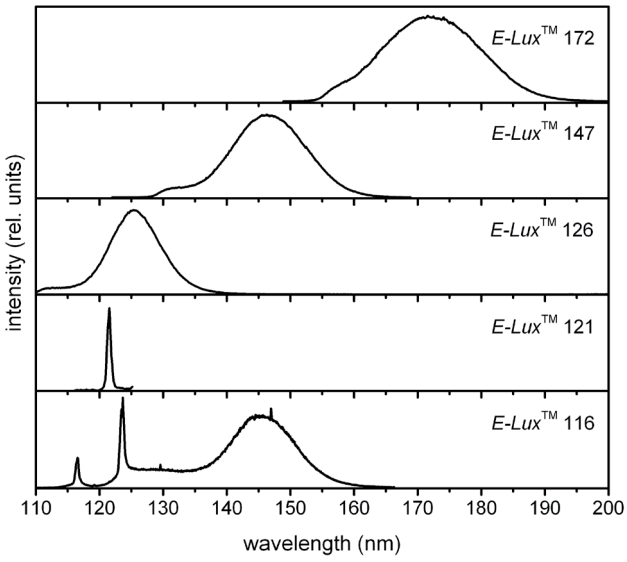
Customers can choose between five different lamp types with central emission wavelengths ranging from 116 to 172 nm (7.2 to 10.7 eV). With the exception of the *E-Lux*™ 121 (emission from the H_2 Lyman-α band), the VUV radiation is comprised of the excimer emission of rare gases or rare gas mixtures. This leads to a broadband emission with a bandwidth of around 10 nm. The range of photon energies of the VUV radiation supplied by the different *E-Lux*™ models corresponds to the ionization potentials (IPs) of many organic compounds (typically between 7 to 12 eV) as well as to the dissociation energies of selected molecular bonds. This and the outstanding performance of the *E-Lux*™ VUV lamps make them ideal for single-photon ionization (SPI) in combination with mass or ion mobility spectrometry. However the *E-Lux*™ VUV lamps will also find application in the fields of fundamental photophysical research or material science.

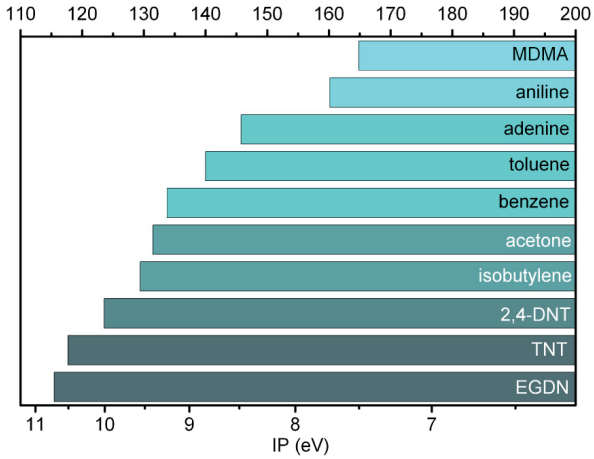
Stable Light Output

Light output remains stable over the entire lamp life of 1000 h. The innovative operating principle of electron-beam induced light emission prevents well-known stability problems of other commercial VUV lamps, such as electrode burn-off. Moreover, there is no need of readjustment of the optical axis due to arc point shift, leading to highly stable light emission over space and time.



Stability of light intensity for short and long operation times (E-Lux™ 126).





Top: Emission spectra of the different E-Lux™ models (concerning the E-Lux™ 116, please contact us).
Bottom: Ionisation potentials (IPs) of selected analytes.

Instant On/Off

Ignition or termination problems of other commercial VUV lamps are overcome, since light emission follows directly the fast and easy to modulate electron beam.

"Cold" Radiation

An inherent feature of the *E-Lux*™ is the emission of "cold" VUV radiation. This is of a great advantage for measurements of samples that are sensitive to heat.

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Applications

Applications - Overview

- Photoionization source for ion mobility and mass spectrometry applications (SPI-GC/MS, APPI-LC/MS etc.)
- Photophysical & photochemical studies
- Planning of synchrotron experiments in the lab

Potential applications:

- Surface treatment (curing and matting of polymers, optical chemical vapor deposition, surface cleaning or etching)
- Surface metrology (spectroscopic reflectometry & ellipsometry)
- Medical applications (tissue engineering & biomaterial science)

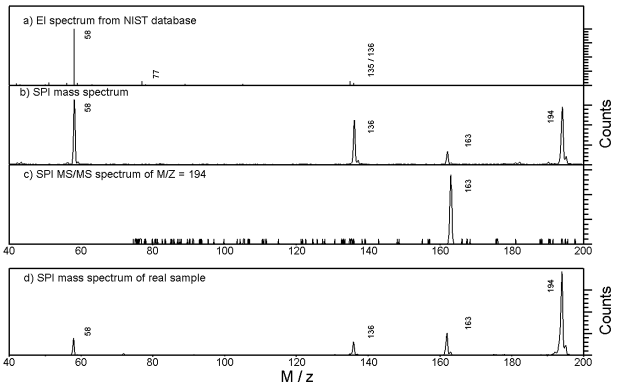
Photoionization

Single-photon ionization (SPI) represents an approved „soft“ ionization technique in mass spectrometry. Due to the low excess energy of the VUV-radiation ionization occurs without fragmentation.

Using the *E-Lux*™ as ionization source, a wide range of organic compounds, including polar and non-polar substances, can be ionized without fragmentation.

Typical matrix compounds (O_2, N_2, H_2O, CO_2 ...) are not ionized, so a selective detection of target analytes is possible. Moreover, even nonaromatic compounds like cyclohexane are accessible to ionization. Ionization of such analytes cannot be achieved by resonance-enhanced multiphoton ionization (REMPI) using UV-lasers.

Mass / Ion mobility spectrometry



Mass spectrometric detection of the synthetic drug MDMA:

a) MS spectrum of MDMA using electron impact ionization (taken from NIST database). Only small, non-specific fragments are observed.

b) MS spectrum of MDMA-HCl measured with an Ion Trap Mass Spectrometer (ITMS) using the E-Lux™ as ion source. Due to the soft ionization, the molecular ion (M/Z = 194) is detected and can be used for further identification in MS/MS-experiments (cf. spectrum c).

d) SPI mass spectrum of a real sample taken from a former illegal drug laboratory. Although neither sample preparation nor chromatographic separation steps have been performed, the molecular ion is the dominant peak and a fast on-site identification of MDMA is possible.

According to its high brilliance, the VUV light of the *E-Lux*™ can be refocused on a few mm² spot in the ionization chamber of a mass spectrometer. The *E-Lux*™ is being applied successfully as ion source in mass spectrometry (MS), for example for the detection of toxic industrial compounds (TICs), drugs and drug precursors.

Ion mobility spectrometry (IMS) is another very interesting field of application. In contrast to radioactive ion sources, the *E-Lux*™ provides direct ionization of the target analytes. This means that no reactant ion peak (RIP) is observed. This is of great benefit for the detection of substances, whose signals interfere with the RIP in radioactive IMS, like for example benzene or toluene.

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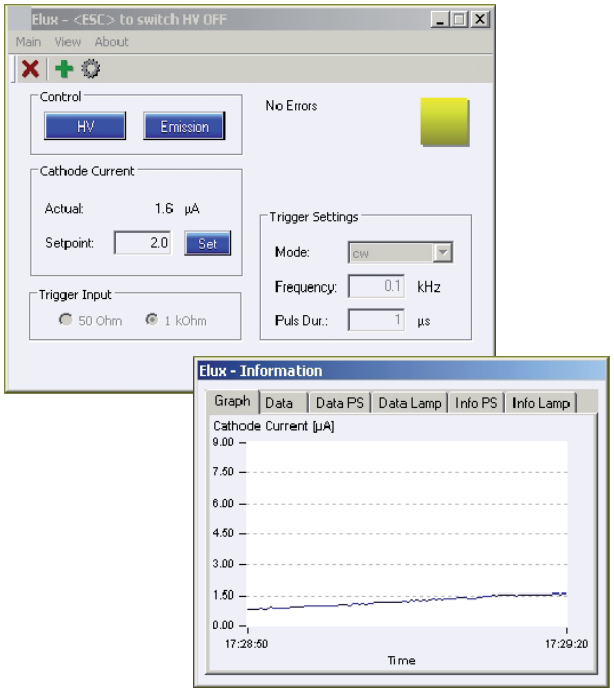
Software & Power Supply

E-Lux™ Software



User-Friendly Operation

The *E-Lux*™ software allows for an user-friendly and safe operation of the *E-Lux*™ VUV lamp system. Following parameters can be set by the user:

- beam intensity,
- operation mode,
- pulse duration,
- repetition rate,
- trigger settings.

Further parameters, like the voltages applied in the electron ray tube, are controlled automatically. A damage of the system due to improper settings is therefore excluded. All lamp parameters are monitored in a separate information window.
The operation software requires a PC or laptop (2 GHz / 2 GB RAM) with Windows XP® and an USB 2.0 interface.

E-Lux™ EPU Power Supply

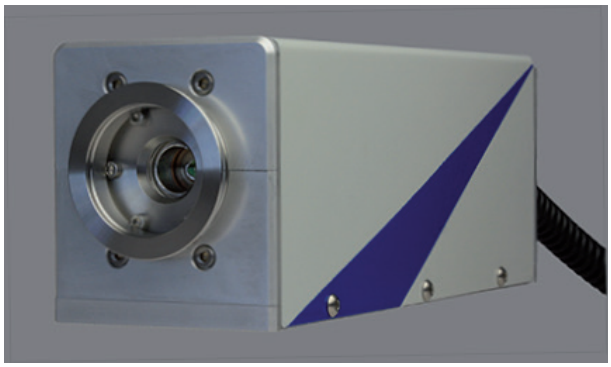
The *E-Lux*™ VUV lamp systems are designed for a stable light output and a variety of operation modes that can be exactly selected to the users needs. The *E-Lux*™ EPU power supply fulfills all requirements for a safe and reliable operation and is prerequisite to operate the *E-Lux*™ VUV lamps.

Parameter	Specifactions
Current	2 A
Voltage	90 - 220 V
Communication Interface	USB 2.0
Dimensions	Standard 19“ rack unit
Weight	10.5 kg

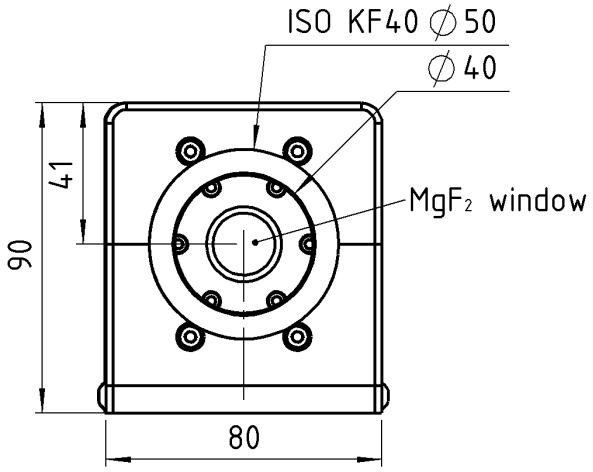
E-Lux™

Dimensional Outlines

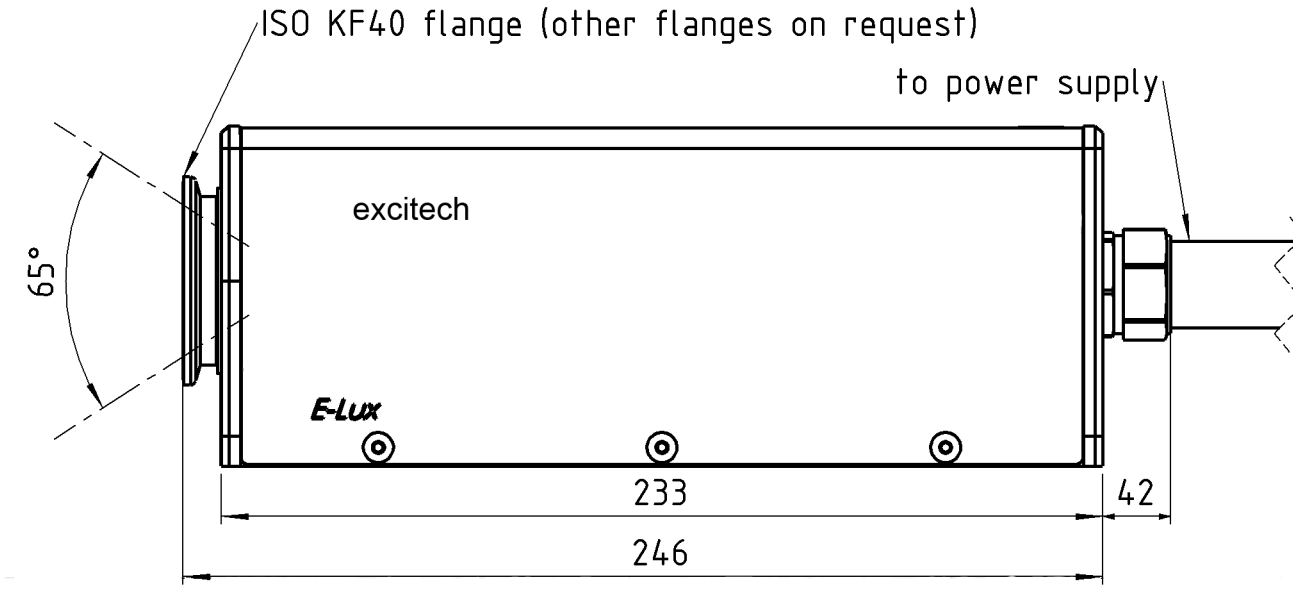
Lamp Unit



Front View (Dimensions in mm)



Side View (Dimensions in mm)



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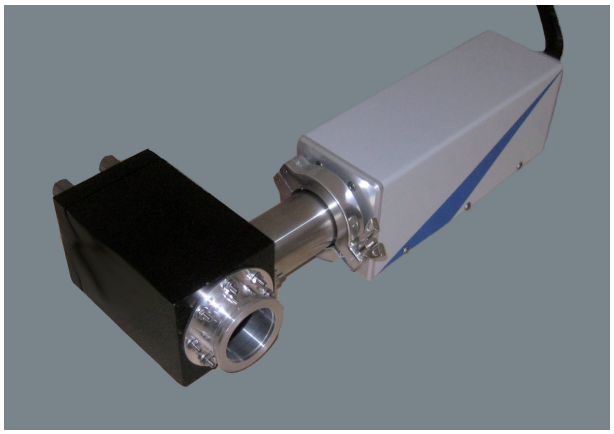
Optional Accessory

E-Lux™ EEM Optical Module



Light Transport

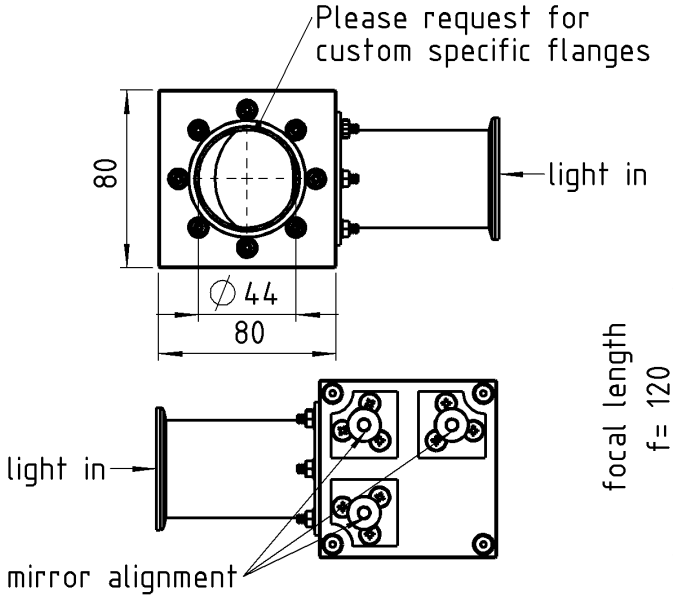
The *E-Lux*™ can be coupled directly to any device offering a suited flange. However the brilliant emission spot inspires the use of a focusing optics to drastically increase the photon density on the target. The *E-Lux*™ EEM Optical Module uses a 90° ellipsoidal mirror with 1:1 imaging ratio. The standard *E-Lux*™ EEM is designed for a focal length of f = 120 mm. Other focal lengths are available on request.

The optical module allows for a manual XY-adjustment under the operating conditions of a vacuum. It is equipped with ISO KF-flanges (CF-flanges on request) and is sealed with viton rings. It can be evacuated down to pressures of 4 $\cdot 10^{-8}$ mbar.

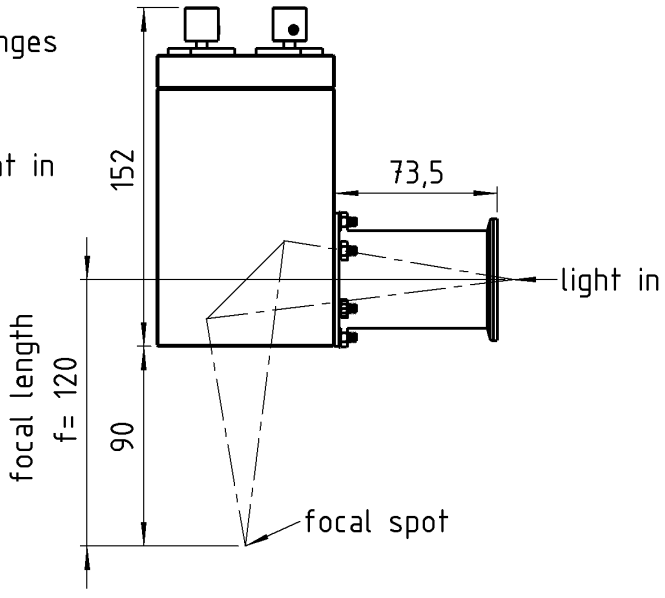
Other configurations of the *E-Lux*™ EEM Optical Module are possible and can be designed and manufactured on request according to customers requirements.

Dimensional Outline (Focal Length: 120 mm; Dimensions in mm)

Front view / Back view



Top view



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Specifications

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Model*		*E-Lux*™ 116	*E-Lux*™ 121	*E-Lux*™ 126	*E-Lux*™ 147	*E-Lux*™ 172
Central emission wavelength (nm)		116	121.56	126	147	172
FWHM (nm)		< 1	< $3 * 10^{-3}$	10	10	10
Photon energy (eV)		10.7	10.2	9.8	8.4	7.2
Spectral photon brilliance, max. (photons / (s sr nm cm²))	cw	$2 * 10^{14}$	$2 * 10^{18}$	$2 * 10^{16}$	$2 * 10^{16}$	$2 * 10^{16}$
	pulsed	$2 * 10^{16}$	$2 * 10^{20}$	$2 * 10^{18}$	$2 * 10^{18}$	$2 * 10^{18}$
Conversion efficiency, max. (%)		0.4	10	40	40	40
Light spot diameter (mm)		1	3	1	1	1
Solid angle (sr)		1				
Aperture diameter (mm)		10				
Pulse length		1 to 100 µs and 1 ms to cw				
Repetition rate		up to 10 kHz				
Guaranteed life (h)		1000				
Window material		MgF_2				
Cooling method		Air				
Operating conditions		Ambient temperature: 5 to 50 °C, ambient humidity: 10 to 80 %				
Weight (kg)		4.2				
Power supply		*E-Lux*™ EPU				
Hardware/software/interface		Standard PC/notebook (min. 2 GHz, 2 GB RAM) needed / *E-Lux*™ Operation Software included / USB 2.0				
Conformance standards		CE, CB-test certificate for IEC 61010-1				
Remarks		Fitted with standard vacuum flanges (ISO KF40) for connecting to vacuum system (leak rate < $1 \cdot 10^{-8}$ mbar l/s). Other flanges on request.				
Optional accessory		*E-Lux*™ EEM Optical Module (standard focal length f = 120 mm or f = 150 mm; other focal lengths on request)				

** For detailed information, please contact us.*

For more information, please contact:

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