Product-Manual

Laser Shutter

Item-Number(s): 1108321, 1108322, 1108324, 1108325

LAVISION

WE COUNT ON PHOTONS

Product-Manual for DaVis 8.2

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Contents

1 Safety Precautions

Before working with your LaVision system we recommend to read the following safety precautions. Observing these instructions helps to avoid danger, to reduce repair costs and downtimes and to increase the reliability and life of your LaVision system.

1.1 Laser Safety

If a laser[1] is integrated in your system it is important that every person working with it has fully read and understood these safety precautions **and** the laser manual of the specific laser.
Lasers included in LaVision systems may belong to CLASS 4 laser devices, which are capable of emitting levels of both visible and invisible radiation that can cause damage to the eyes and skin. It is absolutely necessary that protective eyewear with a sufficiently high optical density is worn at any time when operating the laser. The goggles must protect against all wavelengths that can be emitted, including harmonics. See your Laser´s manual for further details.

Class 4 laser beams are by definition a safety and fire hazard. The use of controls, adjustments or performance of procedures other than those specified in the LaVision manual and laser manual may result in hazardous radiation exposure.

AVOID EYE AND SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION. FOLLOW THE INSTRUCTIONS YOU CAN FIND IN THE CORRESPONDING LASER MANUAL FOR PROPER INSTALLATION AND SAFE OPERATION. USE PROTECTIVE EYE WEAR ALL THE TIME WHEN OPERATING THE LASER.

Important instructions for safe laser handling:

- Before operating the laser contact your laser safety officer.

[1] In the following ‘laser’ means any kind of laser, in particular Nd:YAG- and dye laser as well as Optical Parametric Oscillators at any wave-length and output-energy.

- Read and understand the instruction manual of the particular type of laser. Take special care with respect to laser emission, high voltage and hazardous gases if in use.
- Declare a controlled access area for laser operation. Limit access to trained people. Never operate the laser in a room where laser light can escape through windows or doors. If possible, cover beam paths to avoid obstacles getting into the beam.
- Provide adequate and proper laser safety-goggles to **all** persons present who may be exposed to laser light. The selection of the goggles depends on the energy and the wavelength of the laser beam as well as the operation conditions. Check the Laser´s manual for a detailed description.
- While working with lasers do not wear reflective jewelry like watches and rings, as these might cause accidental hazardous reflections.
- Avoid looking at the output beam, even diffuse reflections can be dangerous.
- Operate the laser at the lowest beam intensity possible.
- Avoid blocking the output beam or reflections with any part of the body. Use beam dumps to avoid reflections from the target.
- Wear clothes and gloves which cover arms and hands to avoid skin damage when handling in the optical path. Especially UV-radiation can cause skin cancer.

1.2 Seizures Warning

WARNING: HEALTH HAZARD! STROBE LIGHTING COULD TRIGGER SEIZURES
Some people (about 1 in 4000) may have seizures or blackouts triggered by flashing lights or patterns. This may occur when viewing stroboscopic lights or objects illuminated by such devices, even if a seizure has never been previously experienced. Anyone who has had a seizure, loss of awareness, or other symptoms linked to an epileptic condition should consult a doctor before operating systems which include flashing lights, strobe lights, or a pulsed or modulated laser.

Stop operating the system immediately and consult a doctor if you have one of the following symptoms:

- convulsions, eye or muscle twitching, loss of awareness, altered vision, involuntary movements, disorientation

To reduce the likelyhood of a seizure when operating a system:

- Do not look directly at flashing light sources or on illuminated objects, e.g. into a strobe light or a flashing LED panel.
- Operate the system in a well-lit room.
- Take frequent breaks in normally illuminated areas.

1.3 Camera / Image Intensifier Safety

The camera integrated in your system is based on a CCD (Charge Coupled Device) or CMOS (Complementary Metal-Oxide Semiconductor) sensor with high resolution and high sensitivity. Optionally your system is equipped with a built-in or external image intensifier.

A LASER BEAM FOCUSED ON THE CHIP OR INTENSIFIER, EITHER DIRECTLY OR BY REFLECTION, CAN CAUSE PERMANENT DAMAGE TO THE CHIP OR INTENSIFIER. ANY LASER POWERFUL ENOUGH TO PRODUCE LOCALIZED HEATING AT THE SURFACE OF THE CHIP OR INTENSIFIER WILL CAUSE DAMAGE EVEN WHEN THE CAMERA OR INTENSIFIER POWER IS OFF. A CHIP OR INTENSIFIER DAMAGED BY LASER LIGHT IS NOT COVERED BY ITS WARRANTY.

Important instructions for safe camera handling:

- Fully read and understand the instruction manual of the specific type of camera.
- Put the protection cap on the camera lens whenever you do not take images, especially when the laser beam is adjusted. Switching off the camera / image intensifier does not protect the chip from damage by laser light.
- Use full resolution of the sensor and always read out the complete chip to have control of the intensity on all areas of the sensor.
- Make sure that no parts of the image are saturated, i.e. the intensity is below maximum gray level ($<$ 4095 counts for a 12 bit camera, $<$ 65535 counts for a 16 bit camera, ...).

- Start measurements with the lowest laser power and a small aperture of the camera lens.
- Increase laser power step by step and check the intensity on the corresponding image. Make sure that the sensor does not run into saturation.
- Bright parts in the experiment, like reflections on walls or big particles, will limit the maximum laser power. Modify the optical arrangement of your setup in order to remove bright reflections from the camera image.

2 Hardware

The LAVISION Laser Shutter guarantees the stable operation of a frequency converted laser, especially if you are using the 3^{rd} (= 355 nm) and 4^{th} (= 266 nm) harmonic[1]. The nonlinear crystals of a harmonic generation unit inside a laser need stable temperature conditions for generating an intensity-stable laser beam. To achieve these conditions the laser (flash lamps and Q-switch) must be operated **continuously** at its specific frequency. To avoid laser light at your experimental set-up while not recording images you can place the Laser Shutter directly at your emission aperture of your laser system. This allows continuous operation of the laser without any dangerous presence of laser light for the camera system. If using a dye laser you will in addition increase the lifetime of the laser dye. The Laser Shutter is computer controlled and will only be opened during data acquisition or system adjustment.

Figure 2.1: The LAVISION standard laser shutter with trigger distribution unit.

ATTENTION:

The LAVISION Laser Shutter is not a laser safety device! Only use this Laser Shutter for experimental reasons and not for safety applications. Even if the Laser Shutter is closed you will have emis-

[1] Of course the laser shutter can be used with any other laser source. Please specify the laser wavelength you are using so that the correct mirror can be installed.

sion of scattered laser light out of the input and output aperture! Please contact your laser safety officer for details concerning your local safety regulations.

2.1 The Components of the Laser Shutter

The lavision Laser Shutter is available with and without variable attenuator. The switching mirror inside the Laser Shutter which blocks the laser light is available in two different coatings. One coating is highly reflective for 532 nm and 355 nm. The other coating is highly reflective for 532 nm and 266 nm. Chose the right coating for your laser system! The wavelength of the coating is declared on the label of the Laser Shutter.
The trigger distribution unit includes the Laser Shutter interface board. Optionally this trigger distribution unit may also contain other boards depending on the system you purchased.
Figure 2.2 shows the standard laser shutter set with its components.

Figure 2.2: The LAVISION standard Laser Shutter, trigger distribution unit and cable.

Figure 2.3 shows the Laser Shutter with variable attenuator and its components.
Additionally to the shutter function, this Laser Shutter has a variable attenuator. The degree of attenuation for the laser light at 532 nm can be adjusted continuously with the slider on the Laser Shutter sidewall. The transmittance for 532 nm ranges from 0.1 % to 90 %.

Figure 2.3: The LAVISION Laser Shutter with variable attenuator, trigger distribution unit and cable.

The laser light at 355 nm or 266 nm [2] will pass almost unattenuated through the attenuator (when shutter is open).

2.2 Hardware installation of the Laser Shutter

2.2.1 Mechanical setup

The lavision Laser Shutter can be arranged on its rubber pedestals or mounted on its M6 threads underside. The arrangement of the threads allows an assembly of the Laser Shutter on flat rail carriers in each orientation.

[2] Which of these two wavelengths will pass through the laser shutter almost unattenuated depends on the installed mirror. Please specify the laser wavelength you are using so that the correct mirror can be installed.

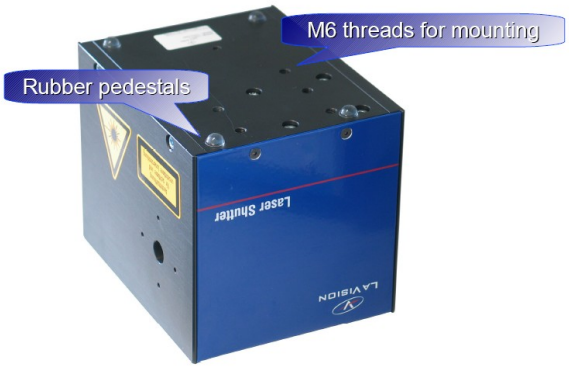


Figure 2.4: The LAVISION Laser Shutter can stand alone on its rubber pedestals or mounted on M6 threads

2.2.2 The Laser Shutter Interface Board

Figure 2.5: The front panel of the Laser Shutter interface board

For controlling the Laser Shutter the interface board in the trigger distribution unit will be used. Figure 2.5 shows the front panel. On the top of the front panel you can find a LED which indicates the status of the laser shutter. A red light indicates that the laser shutter is closed and a green light that it is open. The switch below has three possible positions: a) upper position: the shutter is always open, b) center position: the shutter is controlled by the external trigger pulses and c) lower position: the shutter is always closed.
The external trigger input “Ext.Trig.” is a standard male BNC connector. For triggering the Laser Shutter you will need a standard TTL pulse as input signal.

2.2.3 Wiring connection

The Laser Shutter is connected to the trigger distribution unit with the 6-pole Lemo cable. To trigger the Laser Shutter the trigger distribution unit needs a connection to the PTU. Use the provided PTU-Camera cable (1003344). Connect the BNC-connector: “LaserShutter” to the BNC-connector: “Ext.Trig.” of the trigger distribution unit and plug in the DSub25 connector of the PTU Camera cable (1003344) to the PTU Camera port.
The PTU will now give a trigger signal to the trigger distribution unit every time the laser is in “on” mode in DAVIS and images are recorded or every time the laser is switched into “adjustment mode” in DAVIS. Connect the power cable to the trigger distribution unit. Be sure that this unit is switched off!

3 DaVis Hardware Setup

The LaVision Laser Shutter device must be added in the DaVis software. Start DaVis and go to the Setup dialog. In the device tree on the left hand side click on the adequate “PTU Light Source” which you want to use in combination with the Laser Shutter (see figure 3.1 No.1). The settings of the Light Source is shown. Check the box “Q-switch trigger always (Laser shutter)”(No.2). This setting will set the Q-switch trigger on. The Laser will now operate continuously and is only shuttered by the Laser Shutter. Additional Caution concerning the laser safety is requested.
Now press the “add” button (No.3) to add new devices. A new window: “Add device(s) to ’PTU-controlled Light Source’ ” pops up. Chose “Laser Shutter” from this list and press OK. (The content of this list is dependent on the selected Light Source and may differ from the list shown here.)

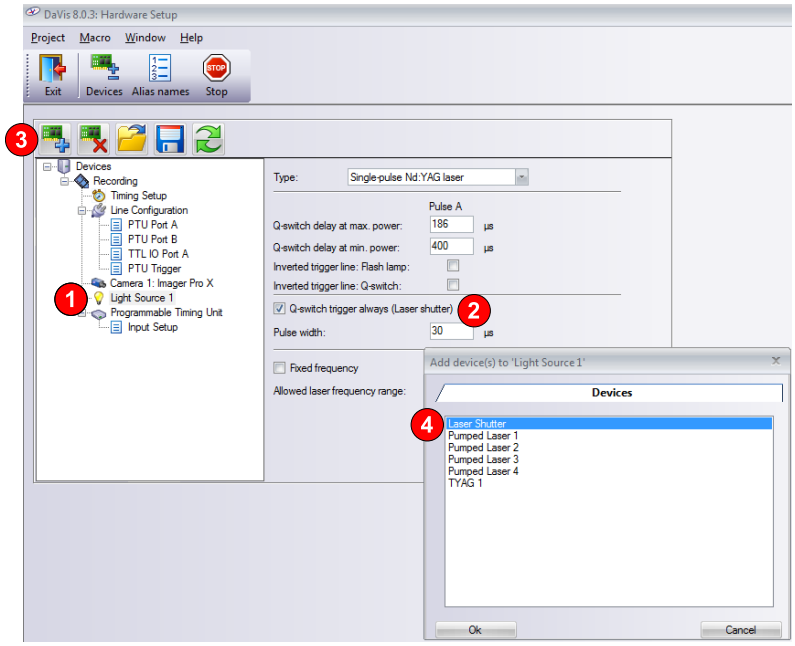


Figure 3.1: Add the Laser Shutter in the Setup menu

Now click on “Devices” in the device tree on the left hand side (figure 3.2 No.5) and initialize the devices (No.6). The Laser Shutter is now registered in the device list on the right hand side and stated as “OK”.

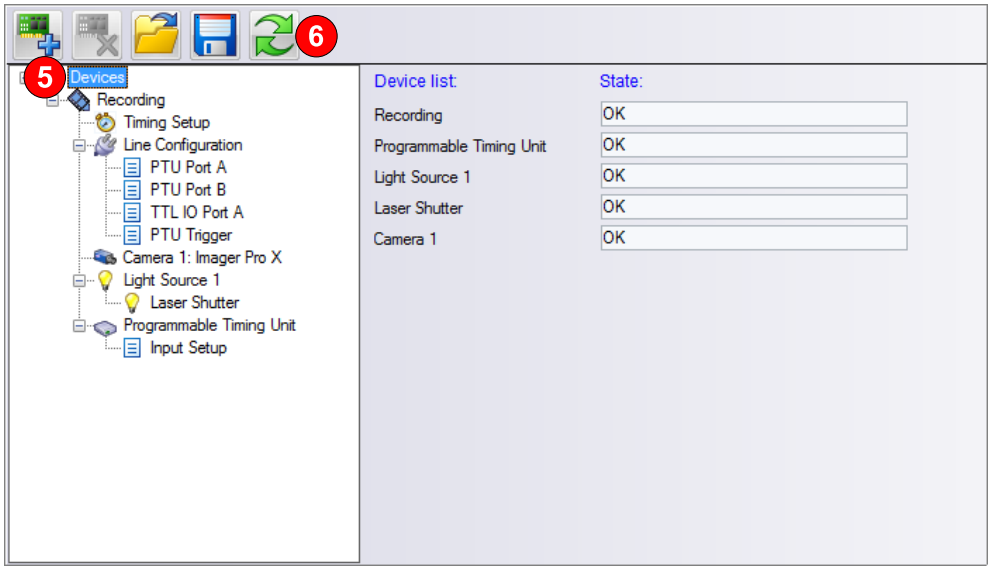


Figure 3.2: Initialize the new device

Go to the Laser Shutter entry in the device tree (figure 3.3 No.7) and enter the right settings (No.8). The Laser Shutter must “open on TTL high”. The delay between the trigger for the Laser Shutter and the trigger for recording can be entered in the field “Delays”. A Delay of 50 to 100 ms for opening and closing is recommended.

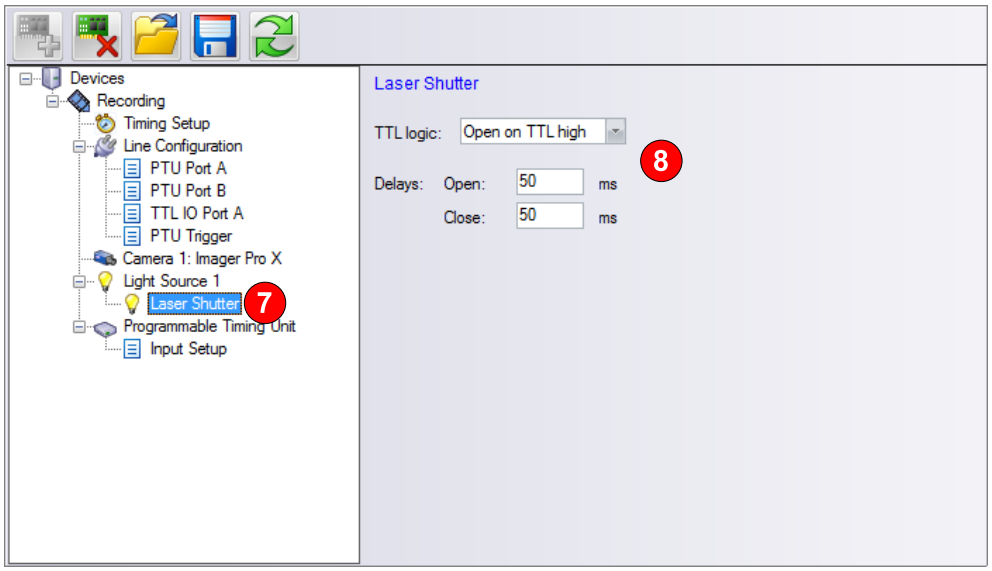


Figure 3.3: Adjust the settings of the Laser Shutter

The new PTU Camera cable 1003831 must be selected in DAVIS. Open the “Line configuration” entry in the device tree on the left hand side (figure

3.4 No.9) and go to “PTU port A”. Choose the right Laser cable adapter (1003831 Laser) (No.10) and press “Initialize” again. The Laser Shutter is now setup.

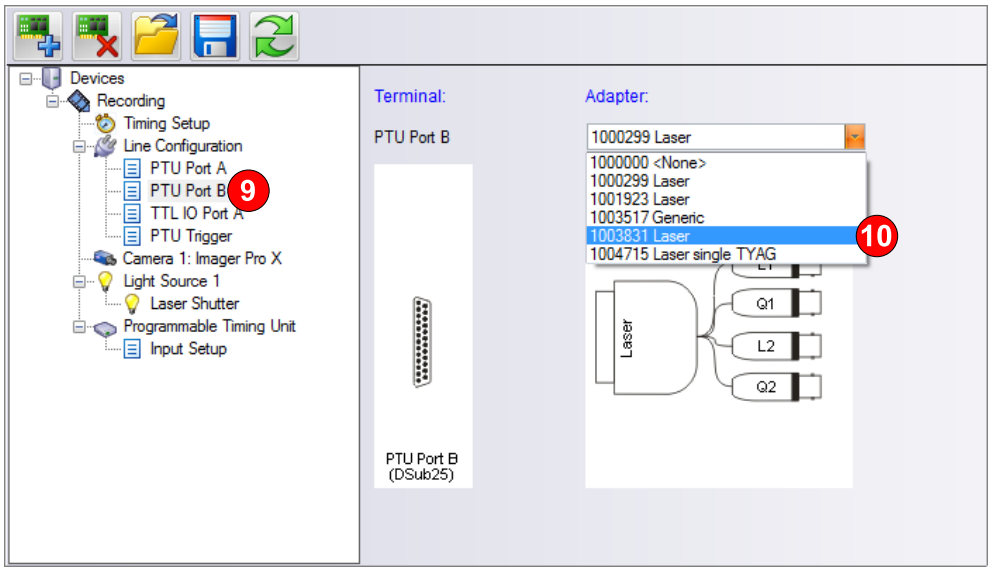


Figure 3.4: Adjust the settings of the Laser Shutter

When starting a recording go to the “Laser Control” dialog in the device manager. Figure 3.5 No.11 shows the settings for the Laser Control. Table 4.1 shows the Laser Shutter status and the Trigger signal when using a Laser Shutter

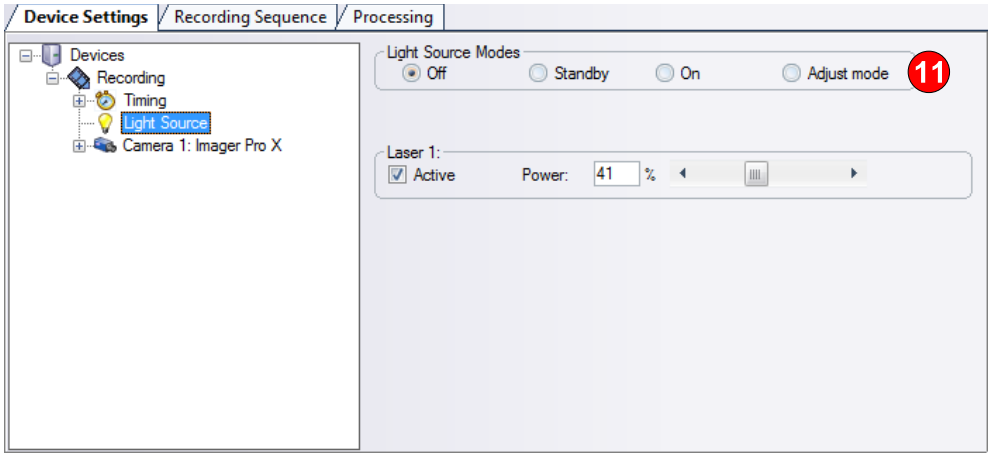


Figure 3.5: Settings of the Laser Control

Table 3.1: Effect of the different laser modes in the Laser Control dialog on the laser shutter and trigger pulses

check box	Laser Shutter status	triggering of flashlamp and q-switch
Off	always closed	no triggering
Standby	always closed	continuous triggering
On	only open during taking single images or grabbing	continuous triggering
Adjust mode	always open	continuous triggering

4 Specifications and dimensions

Table 4.1: The LAVISION Laser Shutter models and specifications.

article no.	Laser Shutter	shutters	attenuates	not attenuated
1108321	w/o attenuator	532 and 355 nm	NA	NA
1108322	with attenuator	532 and 355 nm	532 nm	355 nm
1108324	w/o attenuator	532 and 266 nm	NA	NA
1108325	with attenuator	532 and 266 nm	532 nm	266 nm

Max beam diameter at input (mm): 12

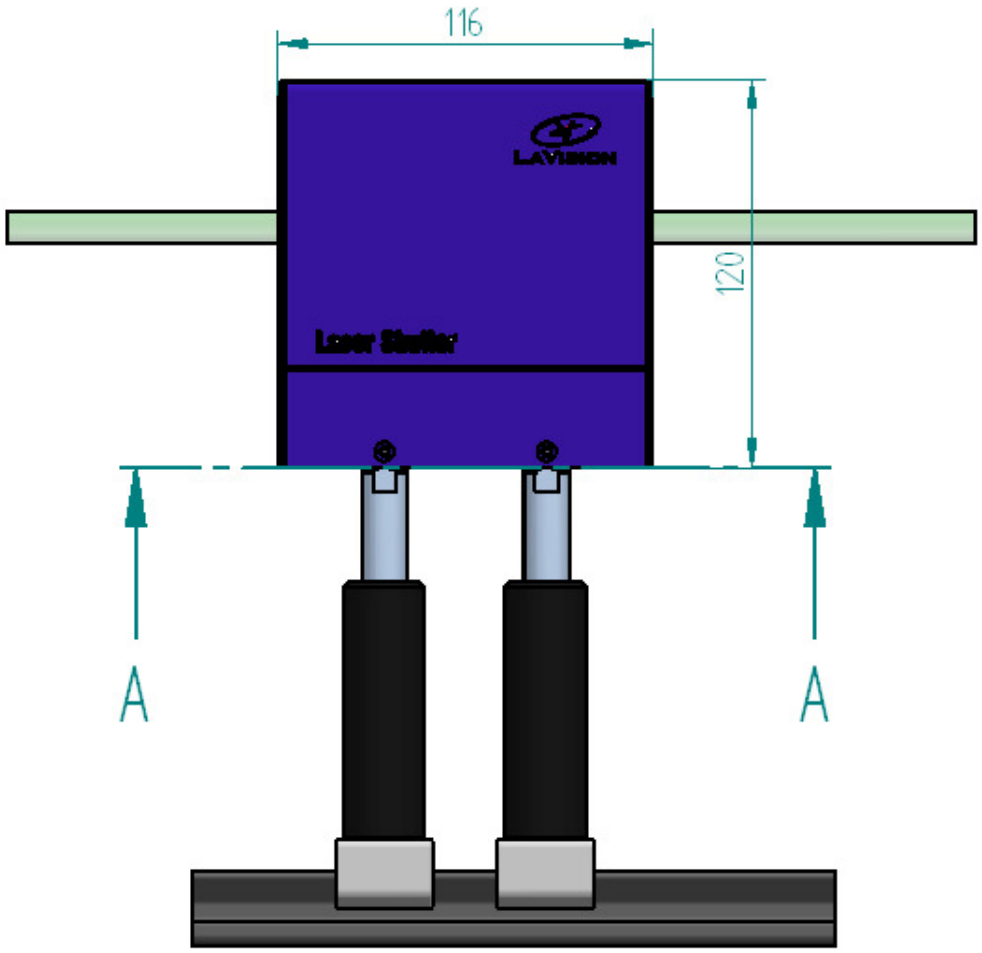


Figure 4.1: Front View

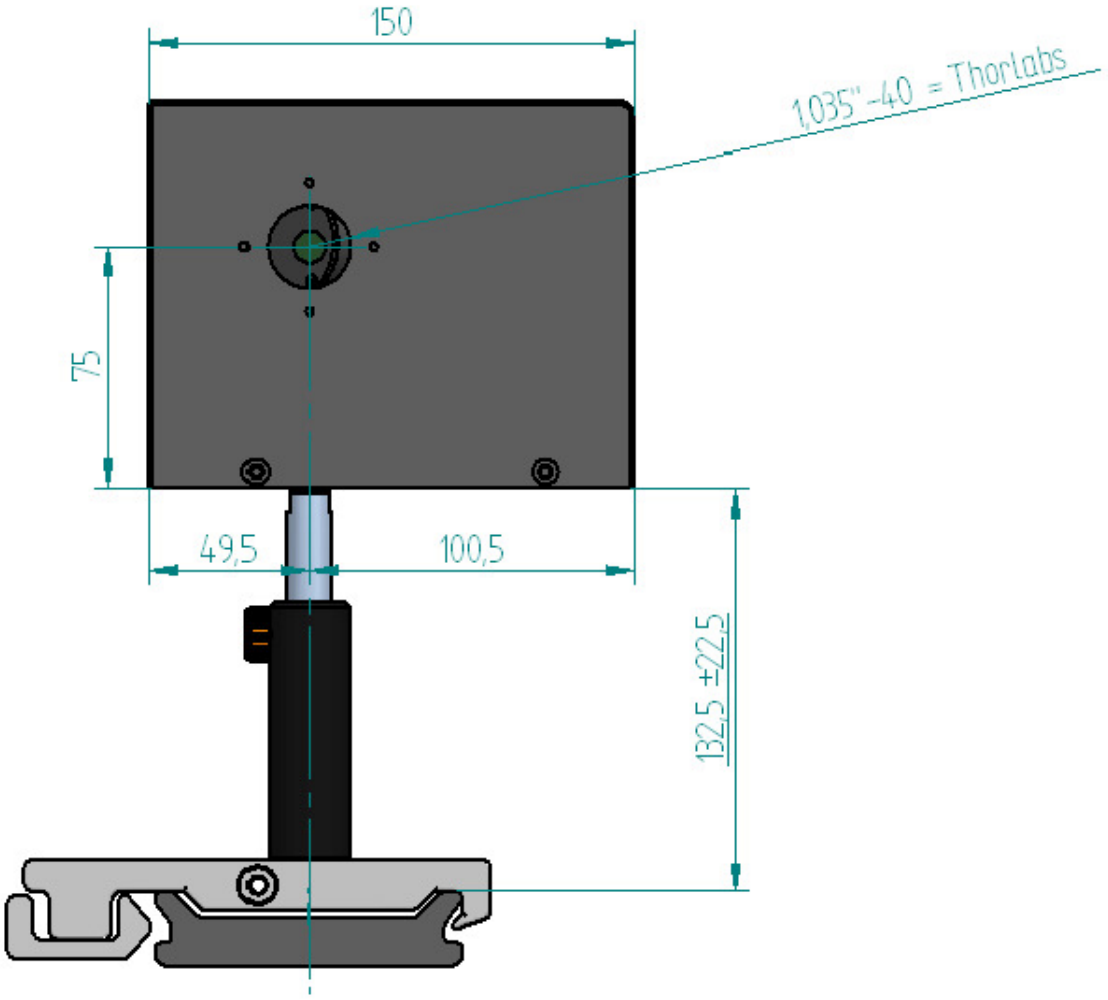


Figure 4.2: Left Side View

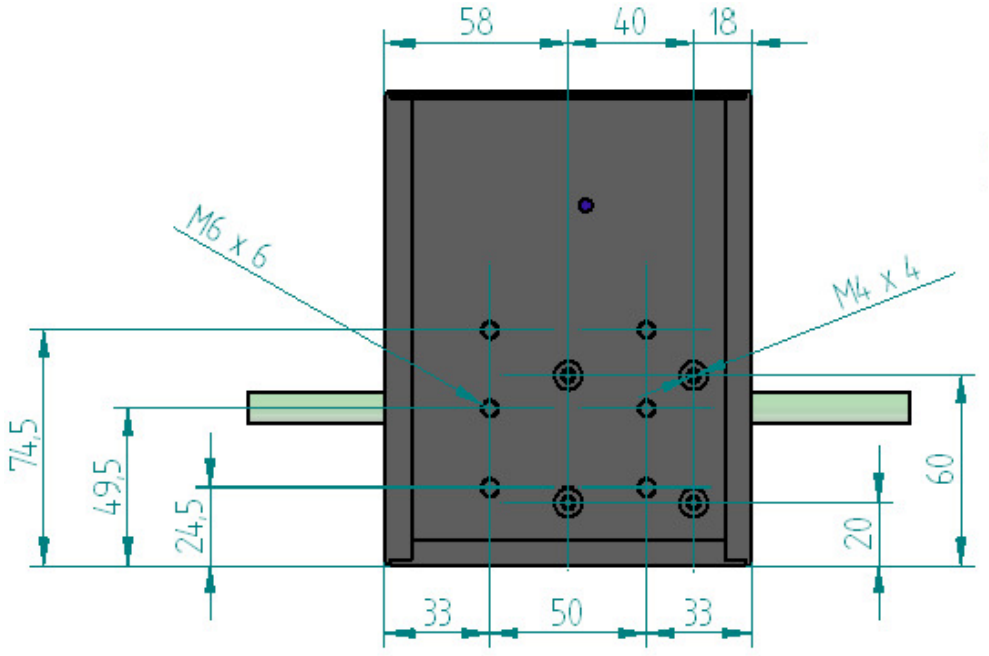


Figure 4.3: Cut A-A

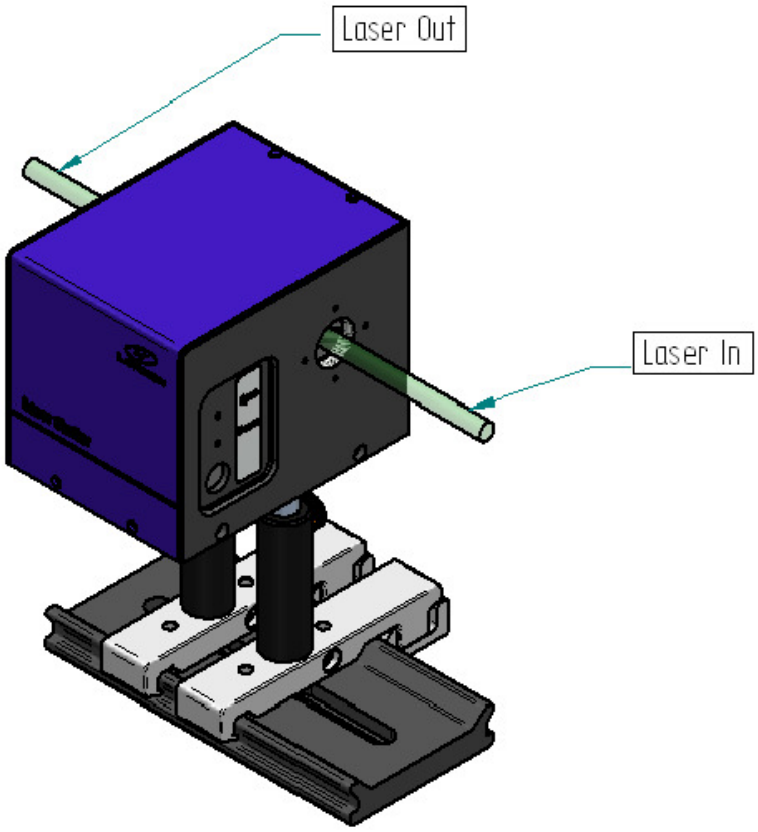


Figure 4.4: 3D View

5 Customer Service

If you have a technical problem or questions regarding hardware or software which is not adequately addressed in the documentation please contact your local representative or LaVision service directly.
In order to speed up your request please include following information:

- The order number of your system (see section 5.1).
- The number of the used dongle (see section 5.1).
- A short description of the problem.
- Your customer settings file (see section 5.2).
- A `log.txt` if you have a reproducible software problem (see section 5.3).
- An information on the used operating system and service pack.

You can contact service at LaVision GmbH by:
email: service@lavision.de
phone +49 551 9004 229
Alternatively you may submit your problem using the service request interface on the LaVision homepage under the URL `www.lavision.com`.

5.1 Order and Dongle Number

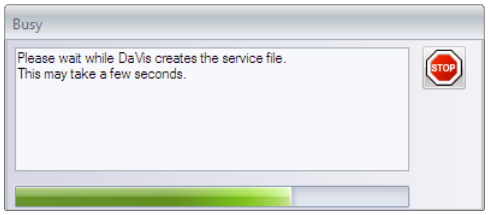
To be able to find information on the delivered hardware components and customer details in the database your order number is required. This number can be found in the **DaVis/Help/About** menu or on the original DaVis installation CD (see Fig. 5.1).
In the **About DaVis** dialog you find the order number in the 3rd line. The five digits behind the leading X are the order number followed by the DaVis version and the release date.
The dongle number is required to exclude license problems. This number is is written on the hardware key. The number of the used dongle can also be found using the **DaVis/Help/About** menu and on the DaVis CD.

Figure 5.1: Order no. in DaVis/Help and on installation CD.

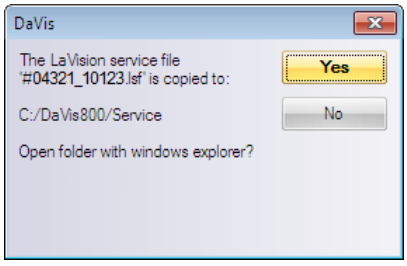
Please include the order number and the dongle number in your service requests.

5.2 Customer Settings

To be able to reproduce your problem it could be essential to know the exact hardware setup and software parameter in DaVis. All currently used parameter can be extracted using the **DaVis/Help/Create service file for LaVision Support** menu.



After you have selected this the system will write back all values for the relevant variables to an lsf-file. This procedure will take a while indicated by a **Busy** dialog. The lsf-file will also contain the current settings of the hardware setup, acquisition setup and processing operation lists.



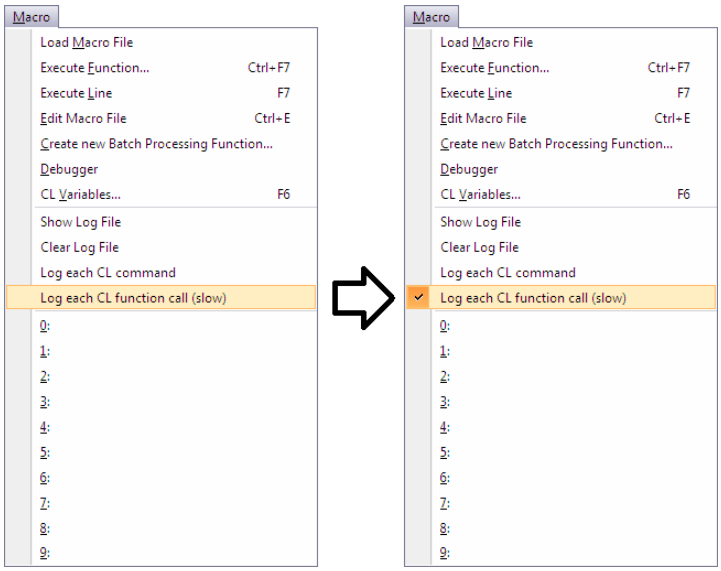
The lsf-file will be written automatically to a d̃avis/service subdirectory. The name contains the order number and dongle number that is extracted

from your software (`#ordernumber_donglenumber.lsf`). Send this lsf-file as attachment to the description of you problem by email to service@lavision.de.

5.3 Log.txt

If you have a reproducible software problem in DaVis please generate a log-file. This file contains all functions you have called and all error messages that have been displayed after you have activated the log. Please proceed as follows:

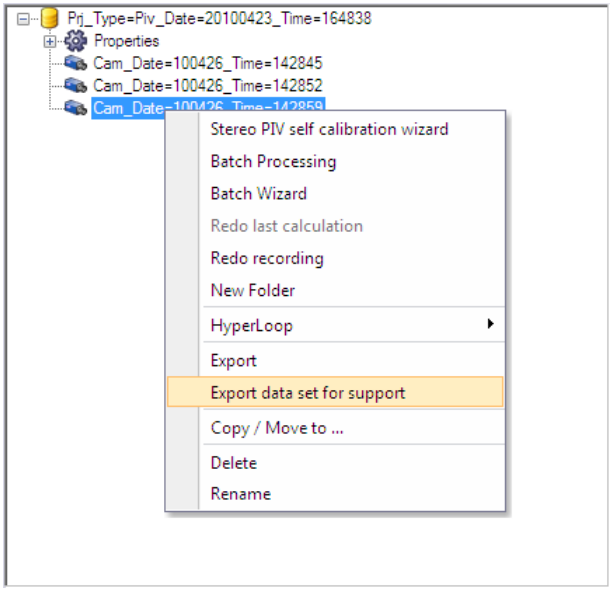
- Start DaVis and use the **Macro/Clear Log file** menu.
- Enable the **Log each CL function call (slow)** entry in the Macro menu. This feature is active if you see a flag left next to the entry. Every time you click on this entry its status is changed.



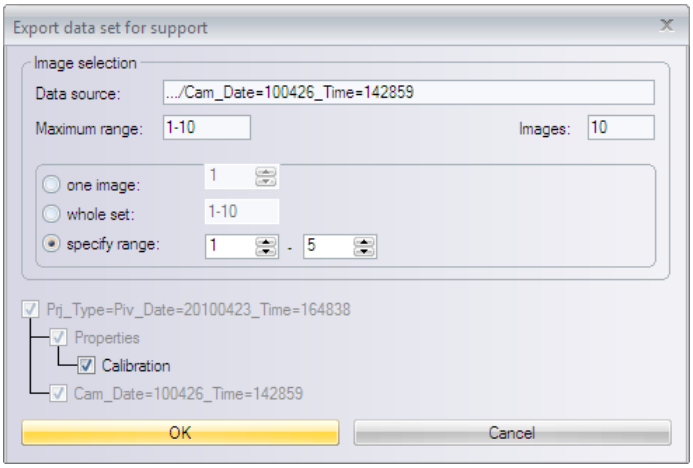
- Try to reproduce your problem, e.g. until an error message is displayed.
- A `log.txt` file has been generated in the DaVis main directory. Send this text file attached to your email.
- Disable the **Macro/Log each CL function call (slow)**. This function is deactivated if you don't see a flag next to the entry.

5.4 Export data set for support

Some problems can only be reproduced on images that contain particular information or artifacts. For error analysis it can be necessary to provide exemplary data that needs to be extracted from the corresponding project. Depending on the project type, number of used cameras and error the corresponding calibration and derivative data can be required as well.



A convenient way to extract the data from the project is the **Extract data set for support** option that can be selected via right mouse click on the corresponding data set in the Project Manager.



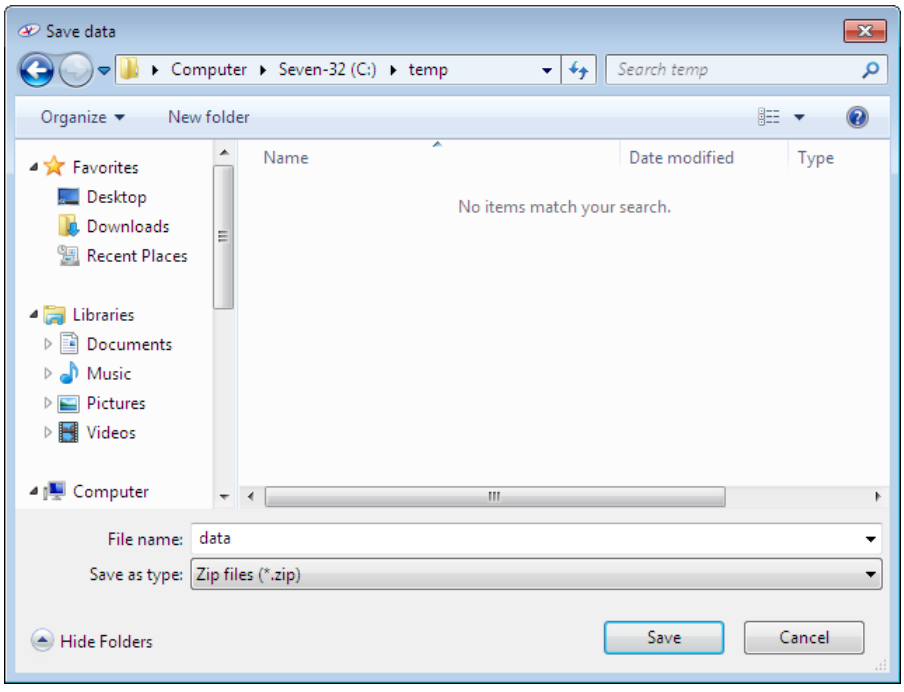
In the **Export data set for support** dialog the **Data source**, the **Maximum range** and the number of **Images** is specified. For the **Image selection** you need to select form following options:

one image: This will extract one image only. You need to select the number of the image.

whole set: This will extract the complete data set. Please note that depending on the number of images the resulting zip-file will be very large.

specify range: This will extract the specified range. You need to select minimum and maximum image number.

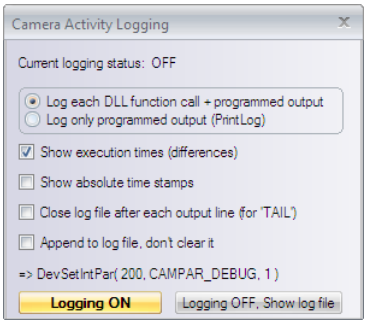
In addition you may activate the **Calibration** option and the corresponding cameras. This will make sure that the calibration for these camera will be included.
Using the **OK** button you need to specify the location and file name for the zip-file that contains the selected data.



Note: Files with a size of more than 20 MB should not be send by email. LAVISION can provide a password protected location on a FTP server for data exchange with read and write access. Please contact `service@lavision.de` for details. For the upload your local user account needs to have enabled FTP functionality. Please check with your system administrator.

5.5 Camera Activity Logging

The camera support libraries (camera DLLs) used by DaVis have a built-in logging function which might be useful for camera activity monitoring and debugging. If you experience problems with camera behavior and contact LaVision support, you may be asked to generate a log file during camera operation and send it by email.
You can use the camera activity logging by choosing the appropriate item in the DaVis **Help** menus. Open the following modal dialog window which serves for starting and stopping the logging function, specifying logging options and viewing the resulting log output. If you create a lsf-service file after camera logging (see 5.2), the camera log data will be included.



In the top line of the dialog the **Current logging status** is displayed. If this is not the 'OFF' status, a number is displayed. Using the following radio buttons you can choose if you want to **Log each CL function call + programmed output**, i.e. the complete communication between DaVis and the camera DLL, or to **Log only programmed output (PrintLog)**.
Programmed output lines are the result of calls to the 'PrintLog' function inside the DLL or, from DaVis, results of a CL function call like DevSetStrPar(DEV_CAMERA_1, CAMPAR_DEBUG, 'output string'). If you choose **Log each DLL function call**, each Get() and Set() function call from DaVis to the DLL is logged together with the value of the parameter passed respectively the result returned by the DLL.
Using the four checkboxes you can specify the output format and writing mode:

Show execution times (differences): If this option is checked, each output line is preceded by the time passed since the preceding output line (microseconds).

Show absolute time stamps : If this option is checked, each output line is additionally preceded by an absolute time counter value (microseconds). This counter can be reset by calling the TimerReset() function inside the DLL

Close log file after each output line (for 'TAIL'): This options must be checked if a TAIL program is used for watching the log file, or if you expect a possible crash of DaVis.
Disadvantage: the logging is much slower (minimum time for an output line about 0.5 millisecond). If this option is unchecked, the log file remains open so you can view it only after switching the logging off.

Append to log file, don't clear it: If this option is unchecked, the output 'CameraLog.txt' is cleared (i.e. deleted) and a new logging is started. If the option is checked, new logging output is appended to the existing file.

On the bottom of the dialog, the syntax of a CL function call is displayed which sets the logging (debugging) to the state displayed in the dialog window.
The **Logging On** button closes the dialog and activates the logging. After this, the activity of all cameras is logged in the 'CameraLog.txt' file. Unless you specify the 3rd option above, the file remains open for writing so you cannot view (read) it.
By clicking the **Logging OFF, Show log file** button you stop camera activity logging (if it was active). The resulting 'CameraLog.txt' file is closed and immediately displayed in a editor (default: ConText).
Logging is automatically activated when DaVis initializes the cameras during startup (or after clicking 'Initialize' in the Hardware Setup dialog). You can see initialization details, some camera properties or possibly error messages in the 'CameraLog.txt'.

5.6 Shipment of defective items

If some items need to be returned to LaVision GmbH for service or repair please contact the LaVision service to obtain a **RMA** (Return Material Authorization) number. Fill out the **Shipment Cover Letter** that is available in **DaVis/Help** directory, in the **Help** folder on the DaVis installation CD or at LaVision service. List all items with SN and a short

description of the problem. Place the Shipment Cover Letter in the box with the item(s) being returned. Return the authorized item(s) per shipping instructions.

Shipping instructions:

- Be sure to obtain a RMA number.
- Include the Shipment Cover Letter.
- Ship only the items that are authorized.
- Use the original boxes to avoid damages during transportation.
- **Remove cooling water from the laser!**
- **Use antistatic bags for computer boards!**
- Ship returned items to:

  LaVision GmbH
  Anna-Vandenhoeck-Ring 19
  D-37081 Goettingen
  Germany

Note: Shipments received by LaVision without a RMA number may be refused.

A List of Figures

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LaVision

We count on Photons

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