Purchase Contract

entered into pursuant to Section 2079 et seq. of Act No. 89/2012 Coll., the Civil Code (hereinafter the "**Civil Code**")

I. CONTRACTUAL PARTIES:

1. **Buyer:**

Fyzikální ústav AV ČR, v. v. i.
(Institute of Physics of the Czech Academy of Sciences, public research institution)
with its registered office at Na Slovance 2, ZIP 182 21 Praha 8
represented by: RNDr. Michael Prouza, Ph.D. - Director
Registered in the register of public research institutions of the Ministry of Education, Youth and Sports of the Czech Republic
Id. No.: 68378271
(hereinafter the "**Buyer**")

and

2. **MB Cognitio**
with its registered office at Mokslininku g. 2A, LT08412 Vilnius, Lithuania
represented by: Tadas Kildušis
Id. No.: 303407506

(Hereinafter the "**Seller**"; the Buyer and the Seller are hereinafter jointly referred to as the "**Parties**" and each of them individually as a "**Party**").

enter, on the present day, month and year, into this Purchase Contract (hereinafter the "**Contract**").

II. INTRODUCTORY PROVISIONS:

The Seller has been selected as the winner of a public procurement procedure announced by the Buyer for the public contract called "**Laser system for material processing with in-situ visualization**" (hereinafter the "**Procurement Procedure**").

The public contract is funded from the Operational Programme Research, Development and Education managed by the Czech Ministry of Education, Youth and Sports.

III. SUBJECT-MATTER OF THE CONTRACT:

The Seller shall in return for the purchase price stipulated below deliver to the Buyer a laser system for material processing with in-situ visualization specified herein (including transport to the place of delivery and other related services – e.g. on-site installation, commissioning and training, service support) (hereafter the "**Device**") and the Buyer shall take over the Device, all in accordance with the terms and conditions hereof. The Device and related services shall comply with the Annex No 1 hereto Technical Specification and Annex No 2 hereto Seller´s bid.

The final design of the Device may differ from the conceptual design included in Annex No 2 Seller´s bid. In case the final design is different from the conceptual design, the Device in its final design must provide equivalent functionality as presented in the conceptual design. If the modification of the design causes the change of behaviour of the Device or its usage with respect to the conceptual design, the modification must be approved in written by the Buyer. The Buyer shall not refuse its consent without stipulating technically justified grounds for the refusal.

IV. OWNERSHIP TITLE:

The ownership right to the Device passes to the Buyer upon execution of the acceptance protocol (as defined below).

V. PURCHASE PRICE AND PAYMENT TERMS

1. The purchase price for the Device is **79 999 EUR** without value added tax (hereinafter the "**Purchase Price**").
2. The value added tax shall be paid according to the applicable law or international agreements.
3. The Purchase Price is the maximum price for performing this Contract that cannot be exceeded. The Purchase Price includes all costs related to the performance of the Contract, including the cost of transport of the Device to the place of delivery, customs (if applicable), licenses and fees, etc. The Purchase Price is fixed and shall not be changed regardless of the changes of subsuplier prices or changes in the foreign exchange rates.
4. The Purchase Price for the Device shall be paid on the basis of a tax document – invoice, to the account of the Seller specified in the invoice. The Seller is entitled to issue the invoice after execution of the acceptance protocol. Copy of the acceptance protocol must be attached to the invoice. The invoice shall have only the electronic form and shall be submitted to the email address: efaktury@fzu.cz.
5. The invoiced amount is due in thirty (30) days of the date of delivery of the invoice to the Buyer. If the invoice stipulates different due period such period is deemed irrelevant and the period stipulated herein applies. Payment of the invoiced amount means the date of its remitting to the Seller's account. In conformity with the applicable tax regulations of the Czech Republic, the tax documents – invoices issued by the Seller hereunder shall include the following details:
   - the business name/designation and registered office of the Buyer
   - the tax identification number of the Buyer
   - the business name/designation and registered office of the Seller
   - the registration number of the tax document
   - the subject matter of the delivery
   - the date of issue of the tax document
   - the date of the supply or the date of acceptance of the consideration, whichever is earlier, if it differs from the date of issue of the tax document
   - the price
   - the registration number of the Contract, which the Buyer shall communicate to the Seller at his request before the invoice is issued

- declaration that the performance of the Contract was executed for the purposes of the project "HiLASE Centre of Excellence", reg. number: CZ.02.1.01/0.0/0.0/15_006/0000674

and must also comply with any double taxation treaties applicable to the given case.

6. The Buyer's invoicing details are set out in Art. I hereof.

VI. TIME OF PERFORMANCE OF THE CONTRACT:

1. The Seller shall deliver the Device to the place of delivery and carry out all related services (installation, commissioning, training etc.) within 15 weeks from the signature of this Contract.
2. The Buyer is entitled to extend the above delivery term by up to 4 weeks if it is unable to provide cooperation needed for due take over and acceptance of the Device (e.g. in case of non-readiness of respective premises).

VII. PLACE OF DELIVERY

The place of delivery is HiLASE research centre, Za Radnicí 828, ZIP 252 41, Dolní Břežany, the Czech Republic.

VIII. ACCEPTANCE OF THE DEVICE

1. The Device shall be accepted in the place of delivery on the basis of an acceptance protocol if the Device complies with this Contract and after the following activities are completed by the Seller:
   - On-site installation and commissioning
   - On-site training and software features demonstration after installation

   The acceptance protocol shall contain the following information:
   - identification of the Seller
   - identification of the Device
   - the list of defects and deficiencies of the Device, if there are any, and the deadlines for their removal, if the Buyer decides to accept the Device despite having defects
   - the signature of the Buyer and the date of acceptance

   (hereinafter the "**Acceptance protocol**").
2. The Buyer may but is not obliged to accept the Device with defects or deficiencies, particularly if the defects or deficiencies do not prevent the Buyer from using the Device for intended use. Should the Buyer accept the Device with defects or deficiencies, the Parties shall list these in the Acceptance protocol, including the manner and deadline for their removal. Should the Parties not agree on the deadline for the removal of defects or deficiencies in the Acceptance protocol, then these must be removed within 30 days from the date of the acceptance.

IX. WARRANTY

1. The Seller hereby provides the warranty for the Device:

   a) for mechanical and electronic components for the period stipulated in Annex No 2 hereto and

b) for optical components for the period of 90 days.

2. The warranty period shall commence on the date of the execution of the Acceptance protocol. However, if the Device is taken over with defects or deficiencies, the warranty period shall commence on the date of the removal of the last defect or deficiency by the Seller.

3. The Buyer shall raise a claim for removal of a defect of the Device without undue delay after detecting the defect, but not later than on the last day of the warranty period, by means of a written notice to the Seller's email address for claims notification set out herein (hereinafter the „**Warranty claim**"). Warranty Claim sent by the Buyer on the last day of the warranty period shall be deemed to have been made in time.

4. In the Warranty claim the Buyer shall describe the defect and the manner in which the defect is to be removed. The Buyer is entitled to:

   - request the removal of defects by delivery of a substitute Device or its part, or
   - request that the defects are repaired, or
   - request an appropriate discount on the Purchase Price.

   The choice among the above specified claims shall be made by the Buyer. However, the Buyer is not entitled to request delivery of the substitute Device or its part in case of removable defects unless one defect occurs more than twice.

5. The Seller agrees to remove the defects of the Device free of charge.

6. Defects must be removed within the period of 30 days from the date, on which the Warranty Claim was notified to the Seller unless the Buyer and the Seller agree on another term. The Buyer shall agree on longer term if the Seller proves that the period of 30 days is unfeasible for reasons not given on the side of the Seller (e.g. the subsupliers´ delivery terms).

7. The Seller shall remove defects of the Device within periods stated in the Contract also in the instances when the Seller is of the opinion that it is not liable for such defects. In case the Seller will not accept the defect and the Buyer will not agree with such conclusion, the validity of the Warranty Claim shall be ascertained by an expert, which is to be selected by the Buyer but on which the Seller also must agree. In the event the expert declares the Warranty Claim as justified, the Seller shall bear the costs of the expert's assessment. If the Warranty Claim is raised unjustly (according to expert's assessment), the Buyer shall reimburse the Seller all reasonably incurred costs associated with removing the defect.

8. The Parties shall execute a record on the removal of the defect, in which they shall confirm that the defect was removed. The warranty period of the Device shall extend by the time that expires from the date of exercising the Warranty Claim until a defect is removed if the defect prevented the Buyer from using the Device for intended use.

9. In case the Seller fails to remove the defect within the time period set out in the Contract, or within other period as may be agreed by the Parties, or in case the Seller refuses to remedy the defect, the

Buyer shall be entitled to have the defect removed at its own cost by a third party, and the Seller shall be obliged to compensate the Buyer for all reasonably incurred costs associated with removing the defect within 30 days of the Buyer's request to do so. Under the condition that the repair was professionally done, the scope and length of the warranty remains unaffected by the defect removal by the third party.

10. The warranty shall not cover defects caused by unprofessional handling, non-compliance with the manufacturers' written rules of operation and maintenance of equipment, or those of which the Seller advised the Buyer in writing. The warranty shall also not apply to defects caused by intentional conduct.

11. This email address info@directmachining.com serves as a defect notification address.

X. CONTRACTUAL PENALTIES

1. In the event that the Seller is in delay with due delivery of the Device to the place of delivery (including related services) within the term set forth in Art. VI. hereof, the Seller shall pay to the Buyer the contractual penalty in the amount of 0.05% of the Purchase Price without VAT for each, even commenced day of delay.
2. Total amount of the contractual penalty for delay with the delivery of the Device shall not exceed 5 % of the Purchase Price.
3. In the case where the Seller fails to remove defects within the periods stipulated in the Contract, the Seller shall pay to the Buyer a contractual penalty in the amount of 10 EUR for each defect and for each day of delay.
4. If the Buyer fails to pay the Purchase Price within the deadlines set out in this Contract, the Buyer shall pay the Seller interest on delay in the amount set forth by the applicable law for each day of delay.
5. The obliged Party must pay any contractual penalties/ interests to the entitled Party not later than within 15 calendar days of the date of receipt of the relevant claim from the entitled party.

XI. TERMINATION OF THE CONTRACT, VIS MAJOR

1. This Contract may be terminated by agreement of the Parties or by withdrawal from the Contract on the grounds stipulated by law or by the Contract.
2. The Buyer is entitled to withdraw from the Contract without any penalty if any of the following events occur:
   a) the Seller has materially breached the obligations imposed on it by the Contract, especially i) by being in delay with the due performance hereunder for more than 3 months, or ii) the Device is defective and such defect is not removed within 3 months from notifying the Seller of such fact;
   b) insolvency proceedings are initiated against the Seller's assets,
   c) should it become apparent that the Seller provided information or documents in the Seller's bid, which are not true and which could have influenced the conclusions of the Procurement

Procedure leading to the conclusion of this Contract.

3. The Seller is entitled to withdraw from the Contract in the event of material breach of the Contract by the Buyer, especially by delay with due payment of the Purchase Price longer than 3 months.

Vis major circumstances

4. Circumstances constituting vis major shall be constituted by such circumstances / obstacles which arose independently of the will of the obliged Party, and which prevent fulfilment of that Party's obligation, provided that it could not be reasonably expected that the obliged Party could overcome or avert this obstacle or its consequences, and furthermore that such Party could foresee such obstacle when it entered into the respective covenants. Vis major shall not be constituted by obstacles that arose only after the obliged Party was in default with fulfilment of its obligations, or which arose in connection with its economic situation.

   Any particular effects or impacts on the Seller or his performance under this Contract of the Covid-19 epidemic that meet the conditions above will be considered as a vis major cases despite the fact of the existence of the epidemic on the date of the signature of this Contract.

5. Should a situation occur, which a Party could reasonably consider to constitute vis major, and which could affect fulfilment of its obligations hereunder, such Party shall as soon as possible notify the other Party and attempt to continue in its performance hereunder in a reasonable degree. Simultaneously, such Party shall inform the other of any and all its proposals, including alternative modes of performance, however, without consent of the other Party, it shall not proceed to effect such alternative performance.

6. If a situation constituting vis major occurs, the deadlines imposed hereunder shall be extended by the period of the documented duration of the said vis major. The obliged Party shall properly document to the other Party the start and the finish of the vis major period.

XII. REPRESENTATIVES OF THE PARTIES

1. The Buyer has appointed the following authorised representative for communication with the Seller in relation to this Contract:

   Ing. Jiří Beránek, email: beranekj@fzu.cz, Phone: +420 314 00 77 35

2. The Seller has appointed the following authorised representative for communication with the Buyer in relation to this Contract:

   Tadas Kildušis, email: tadas.kild@directmachining.com, Phone: +370 61497699

XIII. CHOICE OF LAW

1. This Contract and all the legal relationships arising out of it shall be governed by the laws of the Czech Republic.
2. Any disputes arising out of this Contract or legal relationships connected with the Contract shall be

resolved by the Parties amicably. In the event that a dispute cannot be resolved amicably within sixty (60) days, the dispute shall be resolved by the competent court in the Czech Republic based on application of any of the Parties.

XIV. FINAL PROVISIONS

1. The Contract with all annexes represents the entire and complete agreement between the Buyer and the Seller.
2. The Seller shall not be entitled to assign any rights or obligations arising in connection herewith to a third party. The Buyer is entitled to set off any even yet undue of its financial claims towards the Seller against any financial claim of the Seller (e.g. the claim for the Purchase Price payment).
3. In the event that any of the provisions of this contract shall later be shown or determined to be invalid, putative, ineffective or unenforceable, then such invalidity, putativeness, ineffectiveness or unenforceability shall not cause invalidity, putativeness, ineffectiveness or unenforceability of the Contract as a whole. In such event the Parties undertake without undue delay to subsequently clarify any such provision or to replace after mutual agreement such invalid, putative, ineffective or unenforceable provision of the Contract by a new provision, that in the extent permitted by the laws and regulations of the Czech Republic, relates as closely as possible to the intentions of the Parties to the Contract at the time of entering hereto.
4. This Contract is subject to mandatory publication according to the applicable Czech law.
5. This Contract becomes valid as of the day of its execution by the authorised persons of both Parties.
6. This Contract may be changed or supplemented solely in writing.
7. The following Annexes form an integral part of the Contract:

   Annex No. 1: Technical Specification and

   Annex No 2: Seller´s Bid

   In case of any discrepancies between this Contract and its annexes, the provisions of this Contract shall prevail. In case of any discrepancies between the Annexes the technically more advanced solution or the option more favourable for the Buyer shall prevail.
8. The Parties, manifesting their consent with the entire the Contract, affix their signatures below.

In
Seller:

_____

Name: Tadas Kildušis

Position: CEO

In
Buyer:

_____

Name: RNDr. Michael Prouza, Ph.D.

Position: Director

Annex 1 Technical Specification

Technical Specification - Laser System for Material Processing with in-situ visualization

Description of the device

Device specified by this document is a system that is able to guide the laser beam in convenient way to the sample stage that is able to carry and precisely move the sample with respect to the laser beam in such a way that laser processing of materials can be carried out with ease. Moreover, the device integrates means for in-situ visualization of the material processing and means for controlling the state or parameters of the beam (shutter, means for adjusting laser power, focusing optics and power meters). Controlling and visualization subsystems that are used during experiment are integrated in software so that the user has a full control of them from the computer station.

System will be used with Light Conversion laser Pharos PH1-SP-1mJ. Compatibility is addressed in R 0 and R 3.1 – R 3.5. Arrangement dimensions and mass limits for the design of the system are specified in the Requirements 1.1 – 1.3, 2.1 – 2.11 together with the drawings in Fig. 1 and 2 in the Drawings and Layouts section.

Laser is not a part of this system.

Computer is not a part of this system.

Note:

The purpose of Fig. 2 is to illustrate possible arrangement and the solution proposed by the bidder may be different in arrangement and in components that are present with the following exception: **In case that any statement in Requirements 1.1 – 14.1 explicitly references Fig. 2 it is obligatory to follow this statement using the information given in Fig. 2 in the solution.**

Contents :

Drawings and Layouts
R0 Compatibility
R1 Weight and Dimensions
R2 Arrangement and properties of the LSMP
R3 Requirements on optical components
R4 Stage (X, Y)
R5 Stage (Z)
R6 Focusing optics
R7 In-situ visualization system (camera, filter, beam splitter, white light source)
R8 Requirements on control of individual elements of the system
R9 Beam path
R10 Accessories
R11 Software
R12 Delivery and Installation
R13 Warranty and Service
R14 Training

Drawings and Layouts

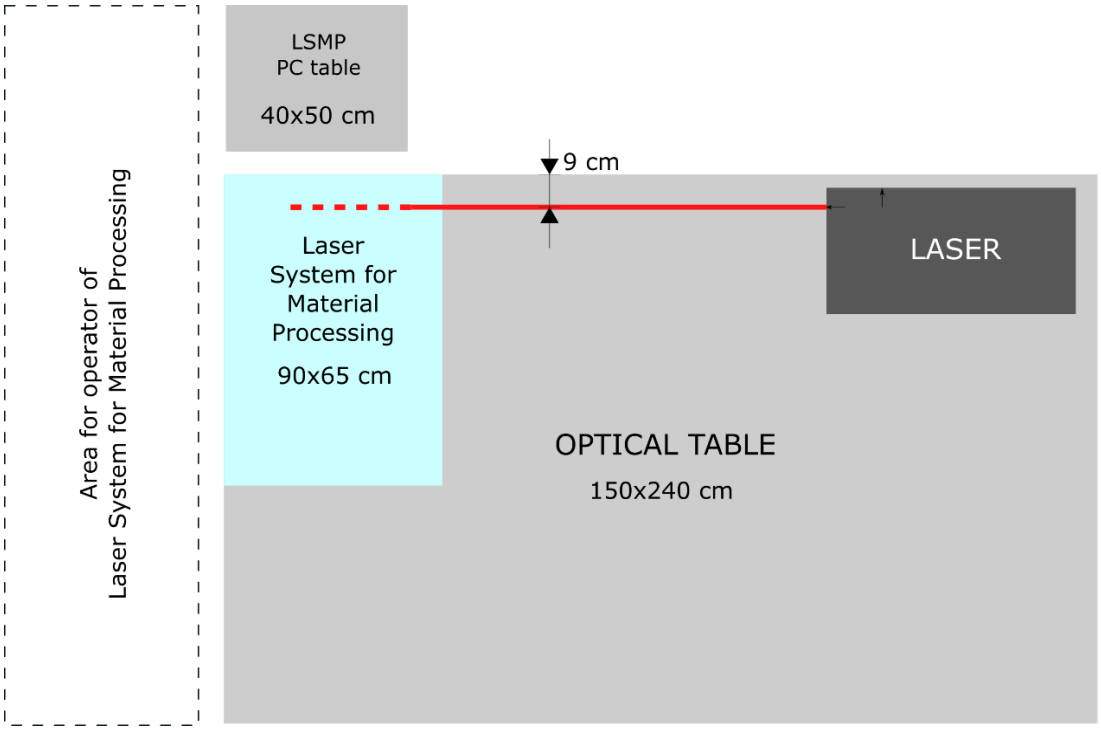


Fig. 1. Layout of the optical table with marked position of the Laser Material Processing System (LMPS) and location of the beam from the source laser.

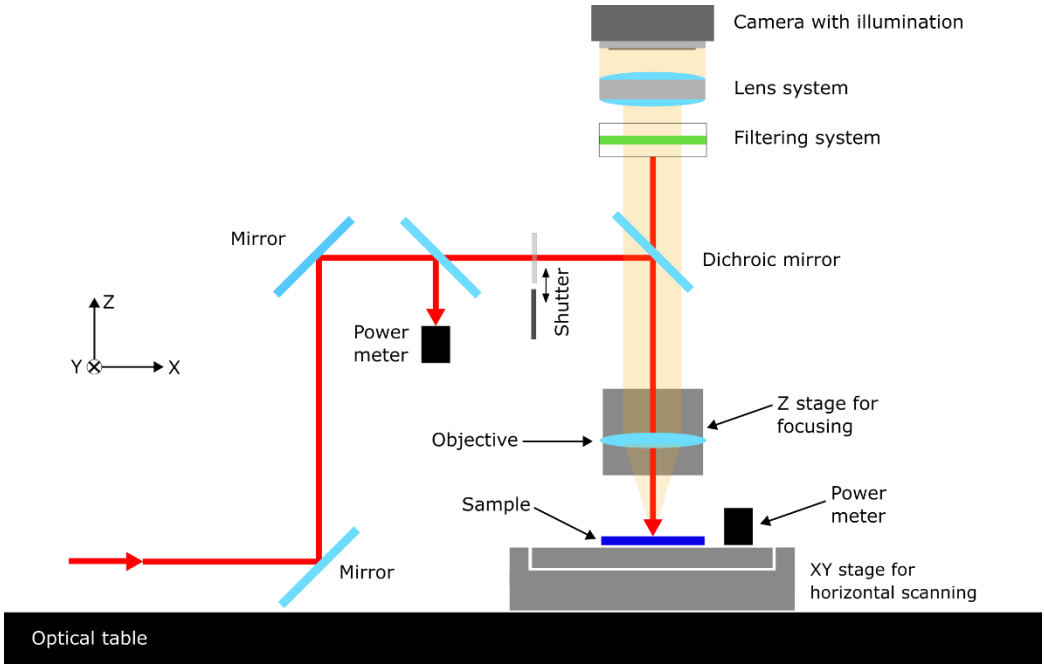


Fig. 2. Drawing shows one of the possible implementations of the LSMP. Setup proposed by the bidder may not correspond to the drawing, However, must comply with the requirements specified in this document**. NOTE: Not all the components specified by requirements of this technical specifications may be included in this drawing!**

Compatibility

R 0.1	System proposed by the bidder must be compatible with the Pharos laser type PH1-SP-1mJ. Main requirements on the optics are mentioned in section R 3.1 – R 3.5 (Requirements on optical components). In case further information is needed, the bidder should refer to the Pharos laser datasheet (**Annex A**) of this technical specification.	

Weight and Dimensions

R 1.1	Maximum area occupied by the system on the optical table:	90 x 65 cm	
R 1.2	Maximum height from the system on the optical table:	75 cm	
R 1.3	Maximum weight of the system on the optical table:	200 kg	

Arrangement and properties of the LSMP

R 2.1	Location of the LSMP and the computer dedicated to its control is given by the layout in Fig. 1. Design proposed by the bidder must respect this arrangement and allow direct access to the system from the area of operator as indicated in Fig. 1.	
R 2.2	Location of the laser with respect to the optical table and LSMP system is specified in the Fig. 1. Beam height is 10 cm ± 3 cm above the optical table. Design of the system must respect the location and the height of the beam.	
R 2.3	XY stage provides positioning of the sample in the horizontal plane, i.e. parallel to the plane of the optical table.	
R 2.4	XY stage for horizontal positioning of the sample is located on the optical table or it can be placed on a removable granite pedestal to increase height of the sample if convenient for the system.	
R 2.5.a	Optical path of the laser beam in the system is such that the focused beam is oriented perpendicularly to the horizontal plane of the stage and impinges the sample from the top as in Fig. 2.	
R 2.5.b	Visualization system provides undistorted top-view visualization of the sample area where the material processing is taking place.	
R 2.6	Shutter is located in the optical path of the laser. Its location is such that its state (open/closed) does not limit or affect the imaging of the sample by the visualization system (see Fig. 2).	
R 2.7	Fixed power meter with fixed beam splitter for reference measurement of the beam power are located before the shutter (with respect to the incoming beam, see Fig. 2) so that reference measurement of the power in the laser beam is available independently of the state of the shutter. Power meter must be compatible with wavelengths 515 nm and 1030 nm, power up to 3W.	
R 2.8	System allows direct control of the laser power from the software (USB or RS232 ports) or contains the computer-controlled attenuator that is	

	placed before the means providing reference measurement of the beam power (with respect to the incoming beam, see Fig. 2).	
R 2.9	Removable power meter for measurement of the total beam power impinging on the sample is provided. This power meter is placed on the XY stage by the operator for a short-term measurement (Fig. 2). Power meter must be compatible with wavelengths 515 nm and 1030 nm, measured power up to 3W.	
R 2.10	Stage is equipped with the means for attaching flat samples by vacuum chuck (thickness of the samples < 5 mm). Vacuum pump is the part of delivery.	
R 2.11	Design proposed by the bidder must have the possibility to be user-upgraded for the use of UV laser beam (replacement or insertion of optical and opto mechanical elements and their adjustment.) System must not require a factory upgrade in this case.	

Requirements on optical components

R 3.1	System must be equipped with holders for 1“ optical components.	
R 3.2	Optics must be suitable femtosecond pulses (pulse duration ≥ 150 fs).	
R 3.3	Optics must be suitable for the wavelengths 1030 and 515 nm.	
R 3.4	Optics must be suitable for the pulse energy up to 2 mJ.	
R 3.5	Optics must be suitable for the repetition rate up to 1 MHz	

Stage X,Y

R 4.1	Accuracy (X axis):	≤ ±2.0 µm	
R 4.2	Accuracy (Y axis):	≤ ±2.0 µm	
R 4.3	Range (X axis):	> 120 mm	
R 4.4	Range (Y axis):	> 50 mm	
R 4.5	Bidirectional repeatability (X axis):	≤ ±0.35 µm	
R 4.6	Bidirectional repeatability (Y axis):	≤ ±0.35 µm	
R 4.7	Minimum step in each direction:	< 0.15 µm	
R 4.8	Maximum velocity in each direction:	≥ 50 mm/s	
R 4.9	Maximum load (X axis):	≥ 100 N centered load capacity	
R 4.10	Maximum load (Y axis):	≥ 100 N centered load capacity	

Stage Z

R 5.1	Accuracy:	< ±3,00 µm	
R 5.2	Range:	≥ 100 mm	
R 5.3	Bidirectional repeatability:	< ±2.00 µm	
R 5.4	Minimum step:	< 1 um	
R 5.5	Maximum velocity:	> 30 mm/s	
R 5.6	Maximum load:	≥ 200 N	

Focusing optics

R 6.1	Objective holder allows exchange of objectives.	
R 6.2	Holder attached to Z axis to allow change of working distance (focusing).	
R 6.3	Two apochromatic infinity corrected objectives compatible with VIS and near IR with magnifications 10x and 20x.	

In-situ visualization system

R 7.1	Type of illumination:	White light LED	
R 7.2		Through-the-lens illumination	
R 7.3	Filters:	Dielectric reflective system of filters	
R 7.4		User exchange of the filters allowed.	
R 7.5		At least filtering for 515 nm, 1030 nm must be provided.	
R 7.6	Camera:	Sensor: CMOS, linear	
R 7.7		Provides live image of the sample	
R 7.8		Resolution ≥ 1,3 Mpix	
R 7.9		Frame rate > 50 fps	

Requirements on control of individual elements of the system

R 8.1	Stage X,Y:	Fully computer controlled movement.	
R 8.2		Controller with interpolated XY motion for line and arc trajectories.	
R 8.3		Automatic procedure for zero or “home” position of positioning system based on end switch or position mark readout.	
R 8.4	Stage Z:	Fully computer controlled movement.	
		Automatic procedure for zero or “home” position of positioning system based on end switch or position mark readout.	
R 8.5	Light source:	Computer controlled Switch On/OFF.	
R 8.6	Camera:	Live image and image from camera provided.	
R 8.7	Shutter:	Computer controlled state Open/Closed.	
R 8.8	Laser power control:	Computer controlled power attenuator or direct control of laser settings.	
R 8.9		Must provide linear decrease of laser power until from 100% to 15% of the power. (step ≤ 2 %)	
R 8.10	Power meters:	Real-time readout from both power meters available in the software.	
R 8.11	Synchronization:	Systems is able to process external input signal and use it as a trigger for further actions.	
R 8.12		Position based laser-triggering option, to space laser pulses evenly along the curved trajectory, including the acceleration and deceleration part.	

Beam path

R 9.1	Beam paths must be covered by solid covers where this is not in conflict with moving parts and design.	

Accessories

R 10.1	Sources and other accessories must be compatible with the 230 V/50 Hz power supply.	
R 10.2	Power supplies, controllers and other accessories must be located in one or more racks. These racks can be places in locations specified by R 10.3-R 10.5.	
R 10.3	Rack that is placed in the operators table must be maximum 45 x 65 x 45 cm (width x height x depth). Maximum weight 60 kg.	
R 10.4	Rack that is placed under the optical table must have maximum height 45 cm.	
R 10.5	Rack that is placed next to the optical table or next to the operators table must have maximum 50 x 50 cm (width x depth).	

Software

R 11.1	Compatible with Win 10, 64 bit.	
R 11.2	Graphical user interface	
R 11.3	Possibility to predefine and save user defined sequences of actions in the provided software that can be later executed automatically, or possibility to predefine and save such a set of instructions using text editor. In latter case, documentation with examples must be provided.	
R 11.4	All features in R 8.1 – R 8.12 integrated in at maximum two parallel-running windows.	
R 11.5	Supports multiple user profiles.	
R 11.6	Wizard for definition of patterns by point-by-point input, data file input or graphical definition.	
R 11.7	Pattern input from at least DWG, DXF, STL formats supported.	
R 11.8	Import of G-code supported.	
R 11.9	Definition of user selected stage positions and buttons for easy access of these positions.	
R 11.10	Possibility to save/load user settings.	
R 11.11	Updates provided at least 12 months for free.	

Delivery and Installation

R 12.1	Delivery no later than 15 weeks contract conclusion.	
R 12.2	On–Site installation and commissioning of the system must be provided.	

Warranty and service

R 13.1	Warranty as stipulated by the contract for mechanical and electronic components.	
R 13.2	Warranty 90 days for optical components.	
R 13.3	Service support with response time ≤ 2 working days via phone/skype/email.	

Training

R 14.1	On-site training and software features demonstration after installation.	

Annex A: Pharos laser datasheet

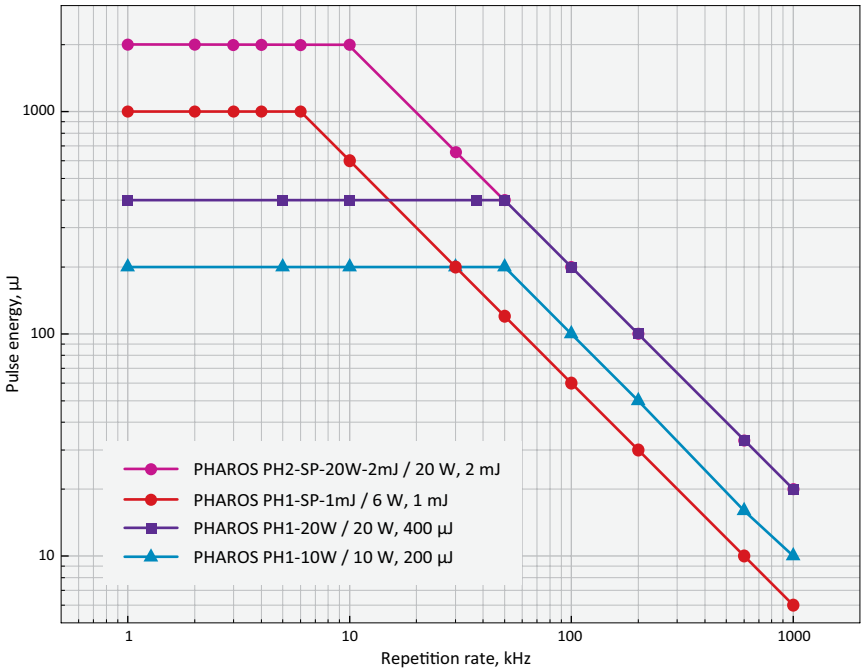
PHAROS

High Power and Energy Femtosecond Lasers

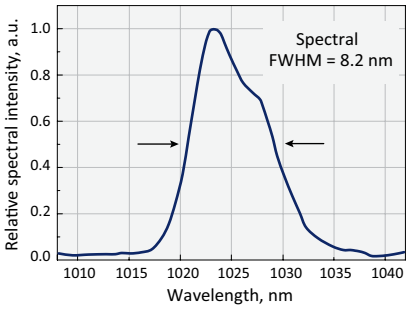
FEATURES

- 190 fs – 20 ps tunable pulse duration
- 2 mJ maximum pulse energy
- 20 W output power
- 1 kHz – 1 MHz tunable base repetition rate
- Pulse picker for pulse-on-demand operation
- Rugged industrial grade mechanical design
- Automated harmonics generators (515 nm, 343 nm, 257 nm, 206 nm)
- Optional CEP stabilization
- Possibility to lock oscillator to external clock

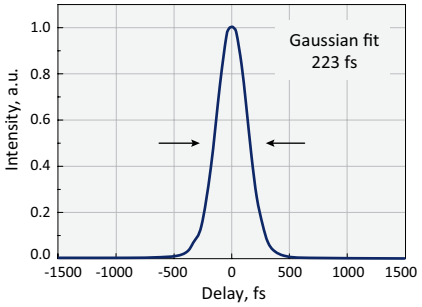
PHAROS is a femtosecond laser system combining millijoule pulse energies and high average powers. PHAROS features a mechanical and optical design optimized for industrial applications such as precise material processing. Compact size, an integrated thermal stabilization system, and sealed design allow PHAROS integration into machining workstations. Laser diodes pumping Yb medium significantly reduces maintenance costs and provides a long laser lifetime. Software tunability of PHAROS allows the system to cover applications normally requiring different classes of laser. Tunable parameters include pulse duration (190 fs – 20 ps), repetition rate (single pulse to 1 MHz), pulse energy (up to 2 mJ) and average power (up to 20 W). Its power level is sufficient for most material processing applications at high machining speeds. The built-in pulse picker allows convenient control of the laser output in pulse-on-demand mode. PHAROS compact and robust optomechanical design features stable laser operation across varying environments.



Pulse energy vs base repetition rate for PHAROS



Typical spectrum of PHAROS

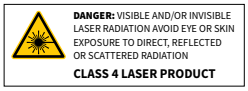


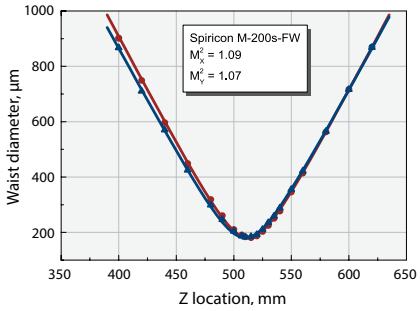
Typical pulse duration of PHAROS

SPECIFICATIONS

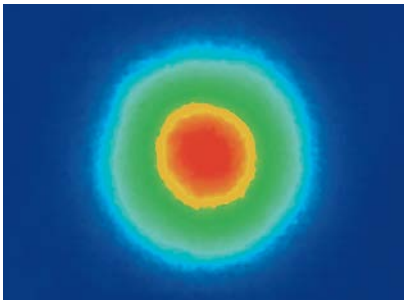
Model [1]	PH1-10W	PH1-15W	PH1-20W	PH1-SP-1mJ	NEW PH2-SP-20W-2mJ
OUTPUT CHARACTERISTIC					
Max. average power	10 W	15 W	20 W	6 W	20 W
Pulse duration (assuming Gaussian pulse shape)	< 290 fs			< 190 fs	
Pulse duration adjustment range	290 fs – 10 ps (20 ps on request)			190 fs – 10 ps (20 ps on request)	
Max. pulse energy	> 0.4 mJ			> 1 mJ	> 2 mJ
Base repetition rate [2]	1 kHz – 1 MHz				
Pulse selection	Single-shot, Pulse-on-Demand, any base repetition rate division				
Centre wavelength	1028 nm ± 5 nm			1033 nm ± 5 nm	
Polarization	Linear, horizontal				
Beam quality	TEM_{00} ; M^2 < 1.2			TEM_{00} ; M^2 < 1.3	
Output pulse-to-pulse stability [3]	< 0.5 % rms over 24 hours				
Output power stability	< 0.5 % rms over 100 h				
Beam pointing stability	< 20 µrad/°C				
Pre-pulse contrast	< 1 : 1000				
Post-pulse contrast	< 1 : 200				
OPTIONAL EXTENSIONS					
Oscillator output	Optional. Please contact *sales@lightcon.com* for more details or customized solutions				
Typical output	1 – 6 W, 50 – 250 fs, ~1035 nm, ~ 76 MHz, simultaneously available				
Harmonics generator	Integrated, optional *(see page 8)*				
Output wavelength	515 nm, 343 nm, 257 nm, 206 nm				
Optical parametric amplifier	Integrated, optional *(see page 15)*				
Tuning range	640 – 4500 nm				
BiBurst mode	Tunable GHz and MHz burst with burst-in-burst capability, optional *(see page 9)*				
GHz-mode (P)					
Intra burst pulse separation [4]	~ 200 ± 40 ps			~ 500 ± 40 ps	
Max no. of pulses [5]	1 . . 25			1 . . 10	
MHz-mode (N)					
Intra burst pulse separation	~ 16 ns				
Max no. of pulses	1 . . 9, (7 with FEC)				
PHYSICAL DIMENSIONS					
Laser head [6]	670 (L) × 360 (W) × 212 (H) mm				730 (L) × 419 (W) × 233 (H) mm
Rack for power supply & chiller	642 (L) × 553 (W) × 673 (H) mm				PS integrated in the laser head
ENVIRONMENTAL & UTILITY REQUIREMENTS					
Operating temperature	15 – 30 °C (air conditioning recommended)				
Relative humidity	< 80 % (non condensing)				
Electric	110 V AC, 50 – 60 Hz, 20 A or 220 V AC, 50 – 60 Hz, 10 A				
Rated power	2000 W				1000 W
Power consumption	600 W				

[1] *More models are available on request.*
[2] *Some particular repetition rates are software denied due to system design.*
[3] *Under stable environmental conditions.*
[4] *Custom spacing on request.*
[5] *Maximum number of pulses in a burst is dependent on the laser repetition rate. Custom number of pulses on request.*
[6] *Dimensions might increase for non-standard laser specifications.*

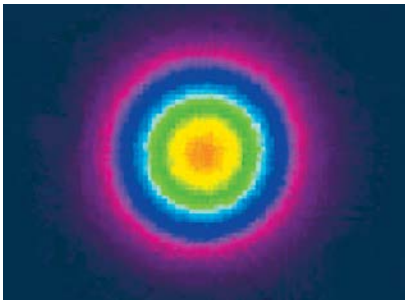




Typical M^2 measurement data of PHAROS

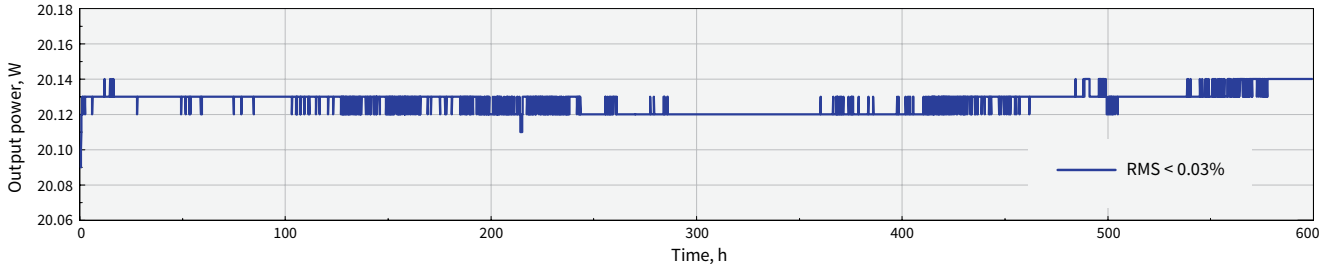


Typical near-field beam profile of PHAROS at 200 kHz

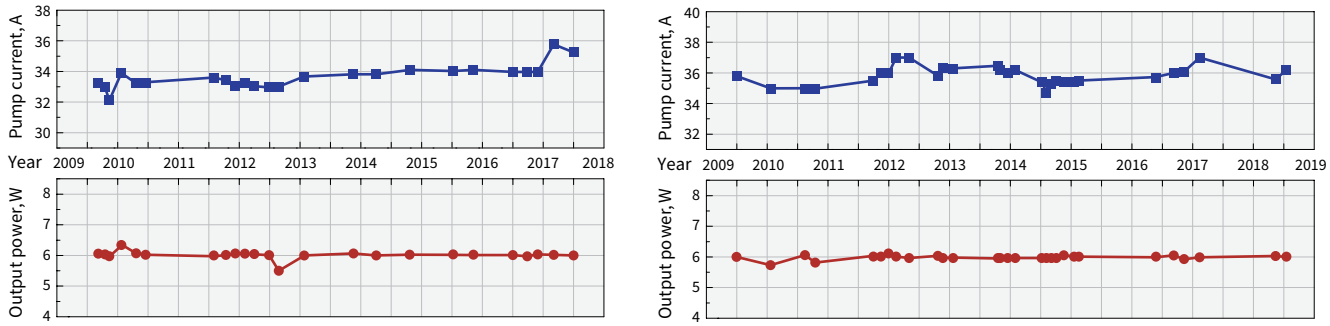


Typical far-field beam profile of PHAROS at 200 kHz

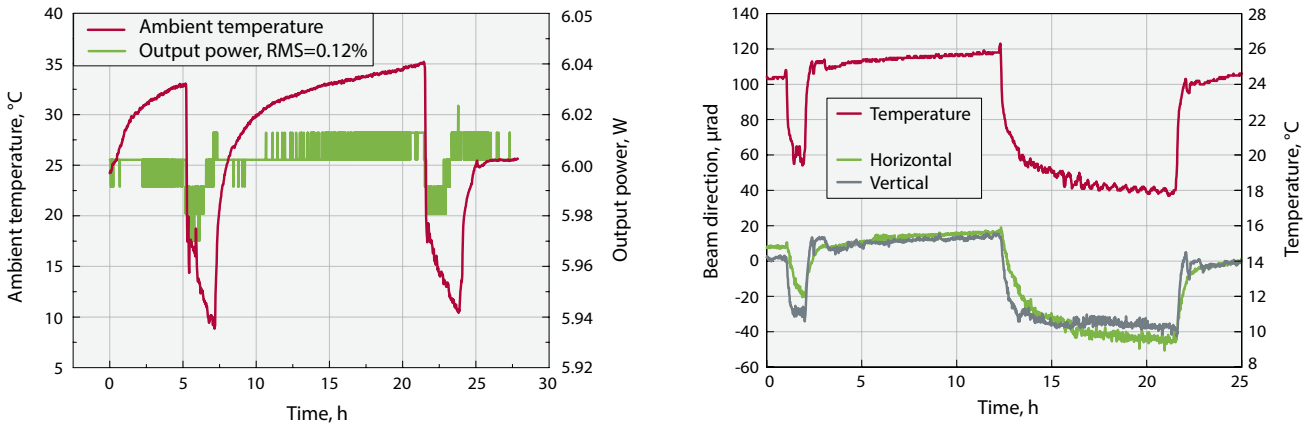
STABILITY MEASUREMENTS



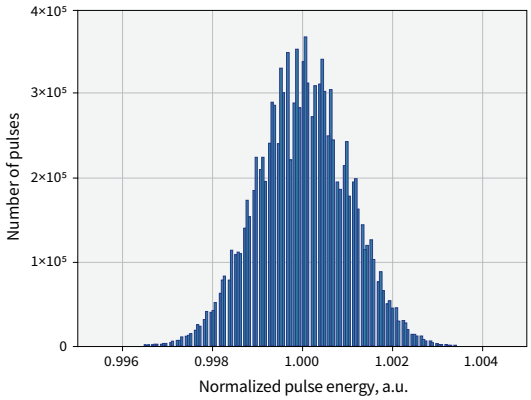
Long term stability graph of PHAROS



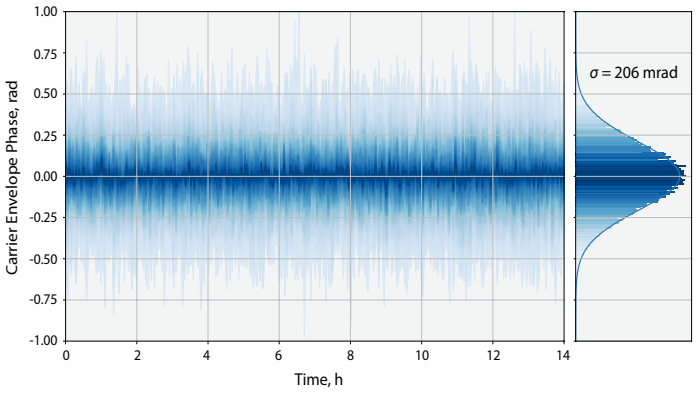
Output power of industrial PHAROS lasers operating 24/7 and current of pump diodes during the years



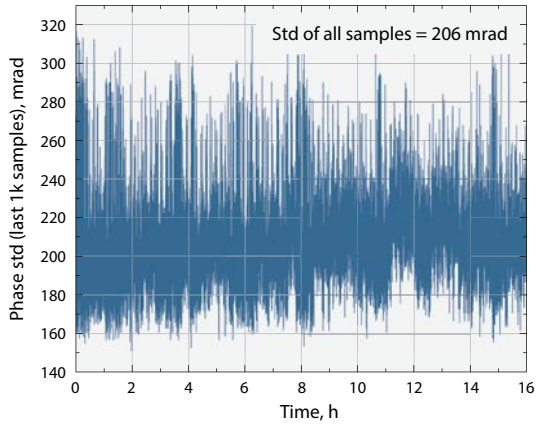
PHAROS output power with power lock enabled under unstable environment



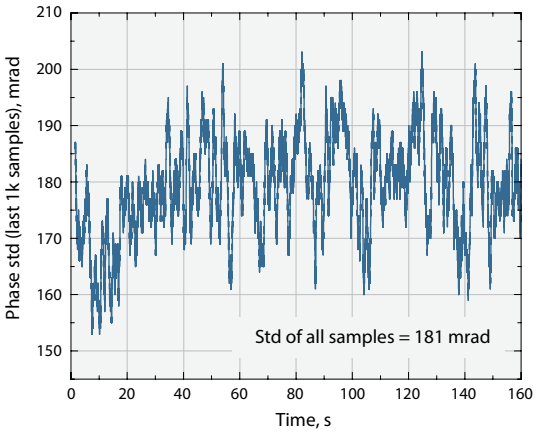
Short term pulse-to-pulse energy stability of PHAROS lasers. 1.2×10^7 pulses (1 min at 200 kHz), STD < 0.11%, peak-to-peak < 1%



Carrier-envelope phase (CEP) over the long period with active phase stabilization system



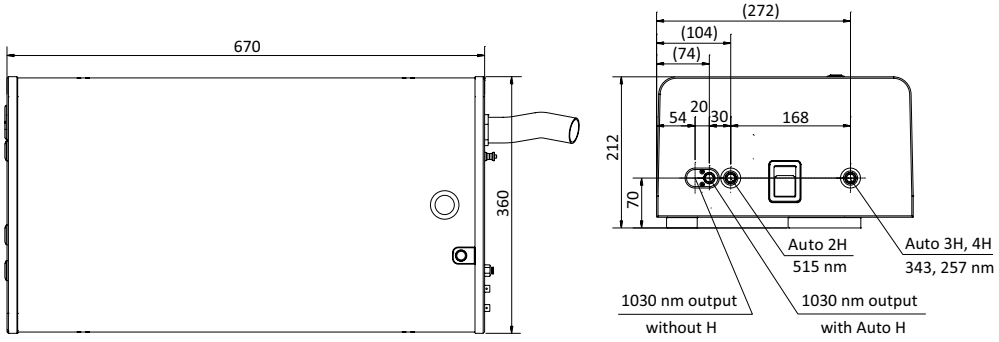
CEP stability over a long time scale



CEP stability over a short time scale

PHAROS CEP stability when laser is isolated from all noticeable noise sources – vibrations, acoustics, air circulation and electrical noise. System can achieve < 300 mrad std of CEP stability over a long time scale (> 8 hours) and < 200 mrad over a short time scale (< 5 min)

OUTLINE DRAWINGS



PHAROS PH1 laser outline drawing

Annex 2 Seller´s Bid

A) Warranty period

The warranty period for mechanical and electronic components of the Device is 24 months.

B) Technical quality of the Device

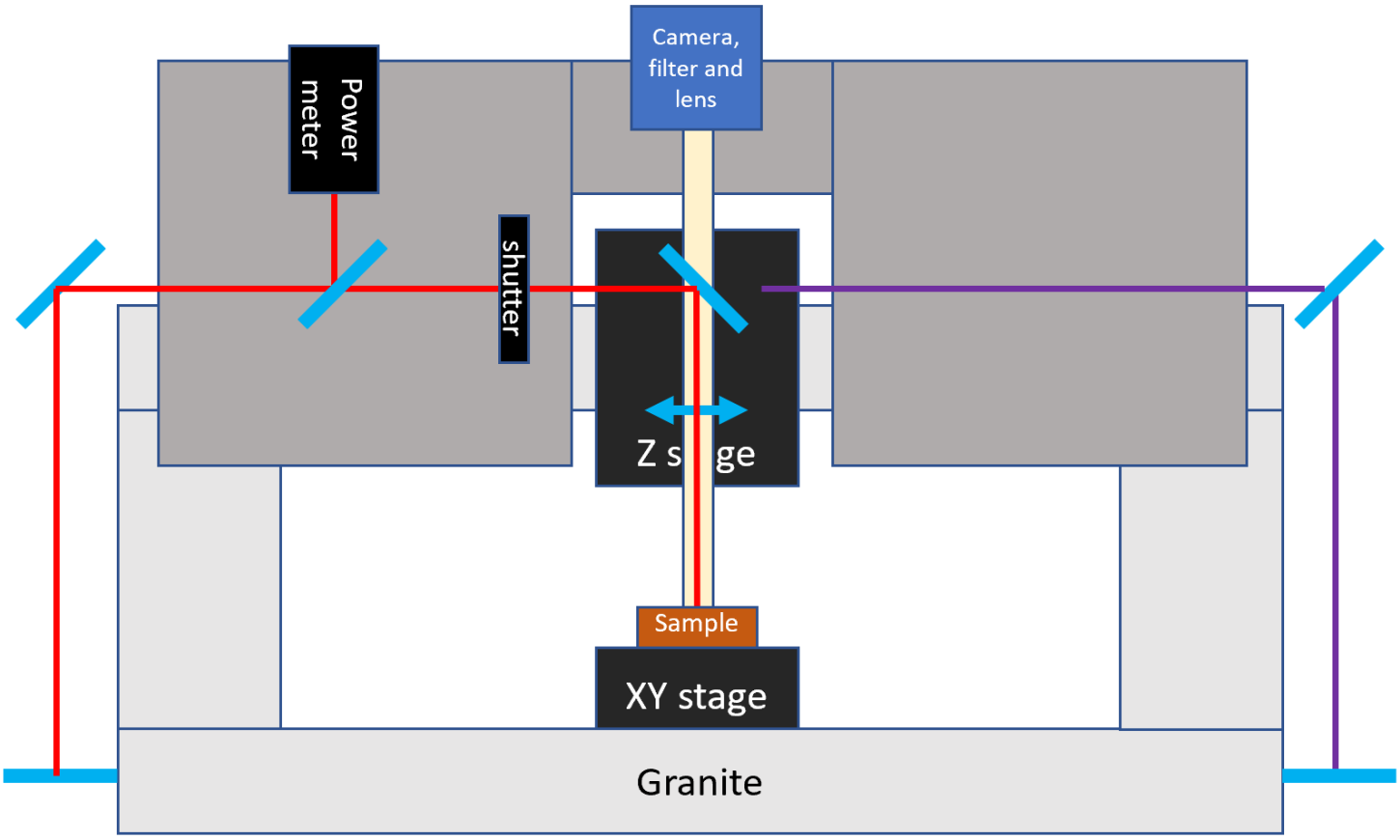
Q 1.1	Control of the Pharos Laser integrated in the software.	YES
Q 1.2	Closed loop control of the power attenuation based on the readout from power meters integrated.	YES
Q 1.3	System has the second beam path for UV wavelengths without optics.	YES
	OR	
	System has single beam path and allows user to replace elements in the optical path of laser to be suitable for UV operation.	NO
Q 1.4	Camera with sensor pixel size ≤ 2,7 µm	NO
Q 1.5	Two licenses for the supplied software.	NO

C) Conceptual design of the Device

Conceptual Design

Public Contract Name:

„Laser system for material processing with in-situ visualization”



Specification of the system

No.	Requirement	Parameter	System Parameter
	COMPATIBILITY		
R 0.1	System proposed by the bidder must be compatible with the Pharos laser type PH1-SP-1mJ. Main requirements on the optics are mentioned in section R 3.1 – R 3.5 (Requirements on optical components). In case further information is needed, the bidder should refer to the Pharos laser datasheet (Annex A) of this technical specification.	N/A	System is comaptible with Pharos lasers.
	WEIGHT AND DIMENSIONS		
R 1.1	Maximum area occupied by the system on the optical table:	90 x 65 cm	System footprint no more 90x65 cm. Final footprint will be defined in design phase.
R 1.2	Maximum height from the system on the optical table:	75 cm	System height no more than 75 cm. Final height will be defined in design phase.
R 1.3	Maximum weight of the system on the optical table:	200 kg	System weight no more than 200 kg. Final weight will be defined in design phase.
	ARRANGEMENT AND PROPERTIES OF THE LSMP		
R 2.1	Location of the LSMP and the computer dedicated to its control is given by the layout in Fig. 1. Design proposed by the bidder must respect this arrangement and allow direct access to the system from the area of operator as indicated in Fig. 1.		System is accessible for the operator from the longer side (Figure 1).
R 2.2	Location of the laser with respect to the optical table and LSMP system is specified in the Fig. 1. Beam height is 10 cm ± 3 cm above the optical table. Design of the system must respect the location and the height of the beam.		Laser beam can be delivered from the laser position specified in the requirements. Laser position and beam delivery direction can be changed freely.
R 2.3	XY stage provides positioning of the sample in the horizontal plane, i.e. parallel to the plane of the optical table.		XY stages move sample parallel to the optical table.
R 2.4	XY stage for horizontal positioning of the sample is located on the optical table or it can be placed on a removable granite pedestal to increase height of the sample if convenient for the system.		XY stage is positionioned on a granite base.

R 2.5.a	Optical path of the laser beam in the system is such that the focused beam is oriented perpendicularly to the horizontal plane of the stage and impinges the sample from the top as in Fig. 2.		Focused beam incidents sample along the Z axis.
R 2.5.b	Visualization system provides undistorted top-view visualization of the sample area where the material processing is taking place.		Visualization system provides undisorted top-view vizualization of the sample where processing is taking place (coaxial with laser beam).
R 2.6	Shutter is located in the optical path of the laser. Its location is such that its state (open/closed) does not limit or affect the imaging of the sample by the visualization system (see Fig. 2).		Shutter is located in the beam path before the camera, and does not affect camera view. Model: Thorlabs SH1/M + SC10
R 2.7	Fixed power meter with fixed beam splitter for reference measurement of the beam power are located before the shutter (with respect to the incoming beam, see Fig. 2) so that reference measurement of the power in the laser beam is available independently of the state of the shutter. Power meter must be compatible with wavelengths 515 nm and 1030 nm, power up to 3W.		Fixed power meter is located before shutter. Maximum measured power: 6W Compatible with wavelengths: 515/1030 nm Model: Gentec UP-17P-6S-W5-D0 + U-LINK PC interface.
R 2.8	System allows direct control of the laser power from the software (USB or RS232 ports) or contains the computer-controlled attenuator that is placed before the means providing reference measurement of the beam power (with respect to the incoming beam, see Fig. 2).		System controls laser power directly from the software.
R 2.9	Removable power meter for measurement of the total beam power impinging on the sample is provided. This power meter is placed on the XY stage by the operator for a short-term measurement (Fig. 2). Power meter must be compatible with wavelengths 515 nm and 1030 nm, measured power up to 3W.		Removable power meter is provided with the system and can be connected to the system software. Maximum measured power: 6W Compatible with wavelengths: 515/1030 nm Model: Gentec UP-17P-6S-W5-D0 + U-LINK PC interface.
R 2.10	Stage is equipped with the means for attaching flat samples by vacuum chuck (thickness of the samples < 5 mm). Vacuum pump is the part of delivery.		Stage is equiped with vacuum chuck and connected vacuum pump.

R 2.11	Design proposed by the bidder must have the possibility to be user- upgraded for the use of UV laser beam (replacement or insertion of optical and opto mechanical elements and their adjustment.) System must not require a factory upgrade in this case.		Additional beampath is provided in the system without optics.
	OPTICAL COMPONENTS		
R 3.1	System must be equipped with holders for 1“ optical components.		System is equipped with holders for 1“ optical components.
R 3.2	Optics must be suitable femtosecond pulses (pulse duration ≥ 150 fs).		Optics are suitable femtosecond pulses (pulse duration ≥ 150 fs).
R 3.3	Optics must be suitable for the wavelengths 1030 and 515 nm.		Optics are suitable for the wavelengths 1030 and 515 nm.
R 3.4	Optics must be suitable for the pulse energy up to 2 mJ.		Optics are suitable for the pulse energy up to 2 mJ.
R 3.5	Optics must be suitable for the repetition rate up to 1 MHz		Optics are suitable for the repetition rate up to 1 MHz
	STAGE X,Y		Standa 8MTL120XY-LEN1 with ACS motion controllers.
R 4.1	Accuracy (X axis):	≤ ±2.0 µm	≤ ±2.0 µm
R 4.2	Accuracy (Y axis):	≤ ±2.0 µm	≤ ±2.0 µm
R 4.3	Range (X axis):	> 120 mm	121 mm
R 4.4	Range (Y axis):	> 50 mm	120 mm
R 4.5	Bidirectional repeatability (X axis):	≤ ±0.35 µm	≤ ±0.35 µm
R 4.6	Bidirectional repeatability (Y axis):	≤ ±0.35 µm	≤ ±0.35 µm
R 4.7	Minimum step in each direction:	< 0.15 µm	< 0.15 µm
R 4.8	Maximum velocity in each direction:	≥ 50 mm/s	100 mm/s
R 4.9	Maximum load (X axis):	≥ 100 N centered load capacity	20 kg
R 4.10	Maximum load (Y axis):	≥ 100 N centered load capacity	20 kg
	STAGE Z		Standa 8THP200-200-B60-LEN or similar.

R 5.1	Accuracy:	< ±3,00 μm	< ±3,00 μm
R 5.2	Range:	≥ 100 mm	≥ 100 mm
R 5.3	Bidirectional repeatability:	< ±2.00 μm	< ±2.00 μm
R 5.4	Minimum step:	< 1 um	< 1 um
R 5.5	Maximum velocity:	> 30 mm/s	> 30 mm/s
R 5.6	Maximum load:	≥ 200 N	≥ 200 N
	FOCUSING OPTICS		Mitutoyo
R 6.1	Objective holder allows exchange of objectives.		Objective holder allows exchange of objectives.
R 6.2	Holder attached to Z axis to allow change of working distance (focusing).		Holder is attached to Z axis and allows to change working distance.
R 6.3	Two apochromatic infinity corrected objectives compatible with VIS and near IR with magnifications 10x and 20x.		Objectives provided with the system: - Mitutoyo 10x Plan Apochromatic Objective 480 – 1800 nm, 0.26 NA, 30.5 mm WD - Mitutoyo 20x Plan Apochromatic Objective 480 – 1800 nm, 0.4 NA, 20 mm WD
	IN-SITU VISUALIZATION SYSTEM		
R 7.1	Type of illumination:	White light LED	White LED illumination through the lens
R 7.2		Through-the-lens illumination	
R 7.3	Filters:	Dielectric reflective system of filters	Dielectric filters for 515 and 1030 nm.
R 7.4		User exchange of the filters allowed.	
R 7.5		At least filtering for 515 nm, 1030 nm must be provided.	

R 7.6	Camera:	Sensor: CMOS, linear	Basler a2A1920-51gmBAS CMOS sensor
R 7.7		Provides live image of the sample	Provides live image of the sample
R 7.8		Resolution ≥ 1,3 Mpix	Resolution 2.3 MP
R 7.9		Frame rate > 50 fps	Frame rate 51 fps
	CONTROL OF INDIVIDUAL ELEMENTS OF THE SYSTEM		All devices controlled through DMC PRO software.
R 8.1	Stage X,Y:	Fully computer controlled movement.	Yes. Through DMC software and ACS motion controllers.
R 8.2		Controller with interpolated XY motion for line and arc trajectories.	YES
R 8.3		Automatic procedure for zero or “home” position of positioning system based on end switch or position mark readout.	YES., available through DMC software.
R 8.4	Stage Z:	Fully computer controlled movement.	YES Through DMC software and ACS motion controller.
		Automatic procedure for	YES. Available through DMC software.

		zero or “home” position of positioning system based on end switch or position mark readout.	
R 8.5	Light source:	Computer controlled Switch On/OFF.	YES, trhough DMC software.
R 8.6	Camera:	Live image and image from camera provided.	Yes, superpositioned with motion trajectories.
R 8.7	Shutter:	Computer controlled state Open/Closed.	YES
R 8.8	Laser power control:	Computer controlled power attenuator or direct control of laser settings.	Direct control of laser source through DMC software. Ethernet or USB connection to the Pharos laser must be provided.
R 8.9		Must provide linear decrease of laser power until from 100% to 15% of the power. (step ≤ 2 %)	YES
R 8.10	Power meters:	Real-time readout from both power meters available in the software.	YES
R 8.11	Synchronization:	Systems is able to	YES, on ACS motion controllers.

		process external input signal and use it as a trigger for further actions.	
R 8.12		Position based laser-triggering option, to space laser pulses evenly along the curved trajectory, including the acceleration and deceleration part.	YES, with ACS LCM module.
	BEAM PATH		
R 9.1	Beam paths must be covered by solid covers where this is not in conflict with moving parts and design.		YES
	ACCESSORIES		
R 10.1	Sources and other accessories must be compatible with the 230 V/50 Hz power supply.		YES
R 10.2	Power supplies, controllers and other accessories must be located in one or more racks. These racks can be places in locations specified by R 10.3-R 10.5.		All electronics will be placed in the rack.
R 10.3	Rack that is placed in the operators table must be maximum 45 x 65 x 45 cm (width x height x depth). Maximum weight 60 kg.		YES
R 10.4	Rack that is placed under the optical table must have maximum height 45 cm.		YES
R 10.5	Rack that is placed next to the optical table or next to the operators table must have maximum 50 x 50 cm (width x depth).		YES
	SOFTWARE		DMC PRO software with MV Lite module

R 11.1	Compatible with Win 10, 64 bit.		YES
R 11.2	Graphical user interface		YES
R 11.3	Possibility to predefine and save user defined sequences of actions in the provided software that can be later executed automatically, or possibility to predefine and save such a set of instructions using text editor. In latter case, documentation with examples must be provided.		YES
R 11.4	All features in R 8.1 – R 8.12 integrated in at maximum two parallel-running windows.		All control of the system is provided in single software window.
R 11.5	Supports multiple user profiles.		
R 11.6	Wizard for definition of patterns by point-by-point input, data file input or graphical definition.		YES
R 11.7	Pattern input from at least DWG, DXF, STL formats supported.		YES
R 11.8	Import of G-code supported.		YES
R 11.9	Definition of user selected stage positions and buttons for easy access of these positions.		Four predefined position in virtual Joystick.
R 11.10	Possibility to save/load user settings.		YES
R 11.11	Updates provided at least 12 months for free.		YES