



EUROPEAN UNION  
European Structural and Investing Funds  
Operational Programme Research,  
Development and Education



MINISTRY OF EDUCATION,  
YOUTH AND SPORTS

## PURCHASE CONTRACT

This purchase contract ("**Contract**") was concluded pursuant to section 2079 *et seq.* of the act no. 89/2012 Coll., Civil Code ("**Civil Code**"), on the day, month and year stated below by and between:

- (1) **Institute of Physics of the Czech Academy of Sciences, a public research institution**,  
with its registered office at: Na Slovance 2, Praha 8, PSČ: 182 21,  
registration no.: 68378271,  
represented by: RNDr. Michael Prouza, Ph.D., director  
("**Buyer**"); and
- (2) **MIT, spol. s r.o.**  
with its registered office at: Klánova 71/56, 147 00 Praha 4,  
registration no.: 46348395,  
represented by: Martin Moser, managing director ("**Seller**").

(The Buyer and the Seller are hereinafter jointly referred to as "**Parties**" and individually as "**Party**".)

### WHEREAS

- (A) The Buyer is a public contracting authority and the beneficiary of public grants for projects within the Operational Programme Research, Development and Education.
- (B) For the successful realization of projects it is necessary to purchase the Object of Purchase (as defined below) in accordance with the act no. 134/2016 Coll., on public procurement, and Rules for the Selection of Suppliers within the Operational Programme Research, Development and Education.
- (C) The Seller wishes to provide the Objects of Purchase to the Buyer for consideration.
- (D) The Seller's bid for the public procurement entitled "*Closed loop deformable mirror system for L3 to the Gammatron beamlines TP20\_053*", whose purpose was to procure the Object of Purchase ("**Public Procurement**"), was selected by the Buyer as the most suitable.

### IT WAS AGREED AS FOLLOWS:

#### 1. BASIC PROVISIONS

- 1.1 Under this Contract the Seller shall hand over to the Buyer two systems (one of type DFM 1 and one of type DFM 2) (including all accessories) that are described in Annex 1



(*Technical Specification*) to this Contract in the quality described therein (together as “**Objects of Purchase**” and each separately as “**Object of Purchase**”) and shall transfer to the Buyer ownership right to the Object of Purchase, and the Buyer shall take over the Object of Purchase and shall pay the Seller the Purchase Price (as defined below), all under the terms and conditions stipulated in this Contract.

1.2 Under this Contract the Seller shall also:

- a) prepare manufacturing drawings of the Object of Purchase as further described in Annex 1 (*Technical Specification*);
- b) provide all materials needed for the manufacturing of the Object of Purchase;
- c) manufacture, inspect, clean, test and assembly the Object of Purchase in the extent specified in Annex 1 (*Technical Specification*);
- d) transport the Object of Purchase to the place of delivery;
- e) install and test the Object of Purchase at the place of delivery in accordance with Annex 1 (*Technical Specification*);
- f) carry out training of Buyer’s staff in the extent specified in Annex 1 (*Technical Specification*);
- g) to elaborate and hand over to the Buyer operational and maintenance manuals of the Object of Purchase in the extent specified in Annex 1 (*Technical Specification*) or other documents which are necessary for the proper takeover and use of the Object of Purchase in Czech or English language;
- h) carry out other activities specified in Annex 1 (*Technical Specification*); and
- i) cooperate with the Buyer during the performance of this Contract  
**(“Related Activities”)**.

## 2. **OPTION**

The Buyer is entitled within 12 months from the conclusion of this Contract to ask the Seller to deliver up to one additional closed loop deformable mirror system (type DFM2). In such a case all provisions of this Contract shall also apply to such additional purchase (phasing of the delivery, delivery periods – starting from the date of receiving the notice from the Buyer about activation of the option, payment conditions, warranty conditions, penalties, etc.). The price for such additional purchase is stipulated in Annex 2 (*Price Table*) to this Contract.



### 3. **SPARE MEMBRANE**

As part of the delivery of the Object of Purchase, the Seller shall also deliver to the Buyer a spare membrane for the deformable mirror, adjusted to DFM 1 (and to DFM 2 respectively) and coated in the same batch as the main substrate. The price for the spare membrane is stipulated in Annex 2 (Price Table) to this Contract.

The Buyer is entitled within 12 months from the conclusion of this Contract to ask the Seller to deliver up to one additional spare membrane for closed loop deformable mirror systems (type DFM2). In such a case all relevant provisions of this Contract shall also apply to such additional purchase similarly. The price for such additional purchase is stipulated in Annex 2 (Price Table) to this Contract.

### 4. **THE PLACE OF DELIVERY**

4.1 The place of delivery is at the address: Fyzikální ústav AV ČR v.v.i/ELI beamlines, Průmyslová 836, 252 41 Dolní Břežany, Czech Republic.

4.2 While performing tasks under this Contract at Buyer's premises, the Seller shall observe "Entry conditions for outsources" as was published on the Buyer official website along with other procurement documentation.

### 5. **THE TIME OF DELIVERY**

5.1 The Seller shall deliver the Object of Purchase and shall carry out all Related Activities within 40 weeks from the effectiveness of this Contract. The Buyer is entitled to postpone the time of delivery by 12 weeks, if the premises at the place of delivery are not due to construction reasons prepared for the acceptance of the Object of Purchase.

5.2 The Buyer shall extend the time of delivery at the request of the Seller, if the Seller is not able to fulfill this Contract due to circumstances that the Seller had no control over and such circumstances were hard to anticipate and are hard to overcome (e.g. covid-19 measures and/or impacts). In order for the Buyer to extend the time of delivery, the Seller must prove to the Buyer that such circumstances happened, unless these are generally known or publicly available. The time of delivery shall be extended by the period corresponding to the time that is necessary for obstacles to disappear or to be overcome by the Seller. However, this does not affect the right of the Buyer to withdraw from this Contract in accordance with the Article 15.

### 6. **THE OWNERSHIP RIGHT**

The ownership right to the Object of Purchase shall be transferred to the Buyer upon the signature of the acceptance protocol by both Parties.



## 7. PRICE AND PAYMENT TERMS

- 7.1 The total purchase price for the Object of Purchase is stipulated in Annex 2 (Price Table) (“**Purchase Price**”) without value added tax (“**VAT**”). VAT will be paid in accordance with the applicable legal regulations.
- 7.2 The Purchase Price cannot be exceeded and includes all costs and expenses of the Seller related to the performance of this Contract. The Purchase Price includes, among others, all expenses related to the handover and acceptance of the Object of Purchase and execution of Related Activities, costs of copyright, insurance, customs, warranty service and any other costs and expenses connected with the performance of this Contract.
- 7.3 The Purchase Price for the Object of Purchase shall be paid in euro on the basis of a tax document – invoice, to the account of the Seller designated in the invoice. The Purchase Price shall be paid in the following manner:
- a) 20 % of the Purchase Price shall be paid after the signature of this Contract;
  - b) 20 % of the Purchase Price shall be paid after the Buyer approves manufacturing drawings (as defined in Annex 1); and
  - c) 60 % of the Purchase Price shall be paid after the signature of the acceptance protocol. The copy of the acceptance protocol must be attached to the invoice. If the Object of Purchase is accepted with deficiencies, then the Buyer shall pay 50 % of the Purchase Price instead and the remaining 10 % of the Purchase Price shall be paid after the last deficiency has been removed.
- 7.4 The Buyer shall realize payments on the basis of duly issued invoices within 30 days from their receipt (maturity period). The invoice shall be considered to be paid for on the day when the invoiced amount is deducted from the Buyer’s account on behalf of the Seller’s account. To avoid any doubts Parties declare that if on the invoice is stated a maturity period that is shorter than 30 days, then such maturity period may be disregarded by the Buyer.
- 7.5 The invoice issued by the Seller as a tax document must contain all information required by the applicable laws of the Czech Republic. Invoices issued by the Seller in accordance with this Contract shall contain in particular following information:
- a) name and registered office of the Buyer,
  - b) tax identification number of the Buyer,
  - c) name and registered office of the Seller,
  - d) tax identification number of the Seller,
  - e) registration number of the tax document,
  - f) scope of the performance (including the reference to this Contract),



- g) the date of the issue of the tax document,
- h) the date of the fulfilment of the Contract,
- i) Purchase Price,
- j) registration number of this Contract, which the Buyer shall communicate to the Seller based on Seller's request prior to the issuance of the invoice,
- k) declaration that the performance of the Contract is for the purposes of a specific project (the number and the title of the project shall be communicated to the Seller based on Seller's request prior to the issuance of the invoice).

7.6 In case that the invoice shall not contain the above mentioned information, the Buyer is entitled to return it to the Seller during its maturity period and this shall not be considered as a default. The new maturity period shall begin from the receipt of the supplemented or corrected invoice to the Buyer.

7.7 The Buyer prefers electronic invoicing on the following email address: [efakturny@fzu.cz](mailto:efakturny@fzu.cz)

## 8. **COPYRIGHT OF THE BUYER**

For the purposes of design and manufacture, the Buyer already provided (during the award procedure) sketches/conceptual designs of the Object of Purchase ("**Buyer's Drawings**"). The Seller acknowledges that Buyer's Drawings are protected by the act no. 121/2000 Coll., on Copyright and Rights Related to Copyright and on Amendment to Certain Acts ("**Copyright Act**") as an author's work. The Seller may use Buyer's Drawings only and solely for the purposes of the fulfilment of this Contract, i.e. for the manufacture and assembly of the Object of Purchase for the Buyer.

## 9. **DESIGN AND MANUFACTURE OF THE OBJECT OF PURCHASE**

9.1 The Seller, as a professional business entity, must verify whether the Buyer's Drawings have any deficiencies. The Seller must ensure that the Object of Purchase complies with all the requirements stipulated in this Contract and is fully functional. If any part of the Buyer's Drawings or any other requirement of the Buyer related to the Object of Purchase is not suitable or appropriate and there exists a more convenient solution for the Buyer, the Seller shall propose and realize such solution without any effect on the Purchase Price, if the Buyer consents to it.

9.2 The Parties acknowledge that the Seller has to create and prepare its own final technical designs and manufacturing drawings in accordance with Annex 1 (*Technical Specification*) to this Contract and other documents necessary for the manufacture and assembly of the Object of Purchase ("**Seller's Drawings**").

9.3 The Seller's Drawings must comply with this Contract and shall be approved by the Buyer prior to the manufacture and assembly of the Object of Purchase. The Buyer shall approve the Seller's Drawings within 3 weeks from the day on which Seller's Drawings were



received, if these comply with all the requirements stipulated in this Contract. If the Buyer suggests modifications to Seller's Drawings, the Seller shall incorporate such modifications or shall explain why it refuses to do so. By approving the Seller's Drawings, the Buyer does not accept any responsibility for the design flaws or deficiencies. The Seller (as a professional business entity and expert in this field) is solely responsible for fulfilling all the requirements stipulated in this Contract and its annexes.

- 9.4 The Seller shall hand over to the Buyer all Seller's Drawings.
- 9.5 The Seller's Drawings shall be prepared to such extent that the Buyer can reasonable verify that the technical requirements of this Contract are fulfilled or can be expected to be fulfilled.

## 10. **COPYRIGHT OF THE SELLER**

- 10.1 The Seller grants to the Buyer a right to use Seller's Drawings in the original or modified version, in connection with other work or independently ("**License**").
- 10.2 License is granted
- a) free of charge;
  - b) for all manners of use within the meaning of the Section 12(4) of the Copyright Act, as amended;
  - c) without any time restriction;
  - d) for the whole world (i.e. without any geographical restriction); and
  - e) under the condition that the Buyer is entitled not to use the License.
- 10.3 The Seller hereby represents and warrants to the Buyer that:
- a) is entitled to use and enforce all author's rights to Seller's Drawings, in particular if the Seller's Drawings were created by employees or by more than one author, and, therefore, the Seller received all consents and permissions from authors and ensured that the Buyer may use the Seller's Drawing properly and without any interference;
  - b) all rewards to the authors of Seller's Drawings were provided;
  - c) did not grant license to Seller's Drawings to any other person in the extent that could disturb the License of the Buyer; and
  - d) is entitled to grant License to the Buyer in the extent specified in this Contract.



## 11. **SELLER'S DUTIES**

- 11.1 The Seller shall ensure that the Object of Purchase and Related Activities are in compliance with this Contract including all its annexes and applicable legal (e.g. safety), technical and quality norms.
- 11.2 During the performance of this Contract the Seller proceeds independently. If the Seller receives instructions from the Buyer, the Seller shall follow such instructions unless these are against the law or in contradiction to this Contract. If the Seller finds out or should have found out if professional care was exercised that the instructions are for any reason inappropriate or illegal or in contradiction to this Contract, then the Seller must notify the Buyer.
- 11.3 All things necessary for the performance of this Contract shall procure the Seller, unless this Contract stipulates otherwise.
- 11.4 The Seller is aware that the Buyer does not have at its disposal premises for the storage of packaging and, therefore, shall not store packaging of the Object of Purchase. The absence of original packaging cannot be an excuse for refusal of elimination of defects or deficiencies of the Object of Purchase.

## 12. **HANDOVER AND ACCEPTANCE OF THE OBJECT OF PURCHASE**

- 12.1 Prior to the acceptance of the Object of Purchase, all Related Activities must be executed.
- 12.2 The acceptance of the Object of Purchase shall be realized on the basis of a acceptance protocol in accordance with Annex 1. The acceptance protocol must at least contain:
- a) identification of the Parties;
  - b) the description of the Object of Purchase;
  - c) list of defects, if there are any.
- 12.3 If the Seller fails to duly carry out all Related Activities or if the Object of Purchase does not meet requirements of this Contract, the Buyer is entitled to refuse the acceptance of the Object of Purchase. In such a case the Seller shall remedy the deficiencies within ten (10) working days, unless Parties agree otherwise. The Buyer is entitled (but not obliged) to accept the Object of Purchase despite the above mentioned deficiencies, in particular if such deficiencies do not prevent the Buyer in the proper operation of the Object of Purchase. In such a case the Seller and the Buyer shall list the deficiencies in the acceptance protocol, including the manner and the date of their removal (remedy). If the Parties do not reach agreement in the acceptance protocol regarding the date of the removal, the Seller shall remove the deficiencies within ten (10) working days.



### 13. **WARRANTY**

- 13.1 The Seller shall provide a warranty of quality of the Object of Purchase for the period of 12 months. If on the warranty list or other document is the warranty period of longer duration, then this longer warranty period shall have priority over the period stated in this Contract.
- 13.2 The warranty period shall begin on the day of the signature of the acceptance protocol by both Parties. If the acceptance protocol lists any deficiencies, the warranty period shall be extended by the period, during which the Seller remedied the last deficiency.
- 13.3 The Seller shall remove defects and deficiencies that occur during the warranty period free of charge and in the terms stipulated in this Contract.
- 13.4 If the Buyer ascertains a defect or deficiency of the Object of Purchase during the warranty period, the Buyer shall notify such defect or deficiency without undue delay to the Seller. Defects and deficiencies may be notified on the last day of warranty period, at the latest.
- 13.5 The Buyer notifies defects and deficiencies in writing via e-mail. The Seller shall accept notifications of defects on the following e-mail address: **servis@mit-laser.cz**. The Seller shall confirm within 24 hours from the receipt of the notification.
- 13.6 In the notification the Buyer shall describe the defect or deficiency and the manner of removal of the defect. The Buyer has the right to:
- a) ask for the removal of the defect by the delivery of new Object of Purchase or its individual parts, or
  - b) ask for the removal of the defect by repair, or
  - c) ask for the reasonable reduction of the Purchase Price.
- The choice among the above mentioned rights belongs to the Buyer, however the Buyer shall take into account recommendation of the Seller.
- 13.7 The Seller shall remove the defect within 4 weeks from its notification, unless Parties due to the nature of the defect agree otherwise.
- 13.8 Parties shall execute a protocol on the removal of the defect, which shall contain the description of the defect and the confirmation that the defect was removed. The warranty period shall be extended by a period of time that elapses between the notification of the defect until its removal.
- 13.9 In case that the Seller does not remove the defect within stipulated time or if the Seller refuses to remove the defect, then the Buyer is entitled to remove the defect at his own costs and the Seller shall reimburse these costs within 10 days after the Buyer's request to do so.
- 13.10 The warranty does not cover defects caused by





- a) unprofessional manipulation;
- b) failure to follow Seller's instructions for the operation and maintenance of the Object of Purchase (abnormal use, accident, neglect, lack of supervision or mishandling, consequences of a fall, shock or abnormal vibration level, the consequences of handling or abnormal installation, default or failure of network electric environment out of the contract specifications);
- c) any attempt maintenance, adjustment, troubleshooting of the Buyer without the prior approval of the Seller;
- d) any failure due to equipment not delivered under this Contract or due to changes in the equipment or its software; or
- e) use of supplies not approved by Seller.

#### 14. **PENALTIES**

- 14.1 If the Seller fails to deliver the Object of Purchase or fails to carry out Related Activities in time stipulated in Article 5.1 of this Contract (i.e. the acceptance protocol cannot be signed in time stipulated in Article 5.1), the Seller shall pay to the Buyer a contractual penalty in the amount of 0,1% of the Purchase Price for every (even commenced) day of delay.
- 14.2 If the Seller is in delay with the removal of the defect, the Seller shall pay to the Buyer a contractual penalty in the amount of 0,05% of the Purchase Price for every (even commenced) day of delay.
- 14.3 The Seller shall pay contractual penalties within fifteen (15) days from the day, on which the Buyer enumerated its claims. The payment of contractual penalties shall not affect the right of the Buyer to damages even to the extent to which such damages exceeds the contractual penalty.
- 14.4 The total amount that the Seller shall be obliged to pay on contractual penalties shall not exceed 10% of the Purchase Price.
- 14.5 The Buyer is entitled to unilaterally set off claims arising from the contractual penalties against the claim of the Seller for the payment of the Purchase Price.

#### 15. **RIGHT OF WITHDRAWAL**

- 15.1 The Buyer is entitled to withdraw from this Contract without any penalties, if any of the following circumstances occur:
  - a) the Seller shall be in delay with the fulfilment of this Contract and such delay lasts more than 4 weeks;



- b) The Object of Purchase shall not fulfil the requirements stipulated in this Contract, in particular in Annex 1 (*Technical Specification*) and such defects or deficiencies cannot be remedied (in such a case this Contract may be withdrawn partially only in relation to a defective Object of Purchase);
- c) the insolvency proceeding is initiated against the Seller; or
- d) the Buyer ascertains that the Seller provided in its bid for the Public Procurement information or documents that do not correspond to the reality and that had or could have had impact on the result of the tendering procedure, which preceded the conclusion of this Contract.

## 16. **SPECIAL PROVISIONS**

By signing this Contract, the Seller becomes a person that must cooperate during the finance control within the meaning of Section 2 letter e) of the act no. 320/2001 Coll., on finance control in the public administration, and shall provide to the Directing Body of the Operational Programme Research, Development and Education or other control bodies access to all parts of the bid, Contract or other documents that are related to the legal relationship formed by this Contract. This duty also covers documents that are subject to the protection in accordance with other acts (business secrets, secret information, etc.) provided that control bodies fulfil requirements stipulated by these acts. The Seller shall secure that all its subcontractors are also obliged to cooperate with control bodies in the above stipulated extent. The possibility of effective control must be preserved until the year 2035.

## 17. **REPRESENTATIVES OF THE PARTIES**

17.1 The Seller appoints following representatives for the communication with the Buyer:

In technical matters:

Name: Thomas Meier

E-mail: meier@mit-laser.cz

Tel.: +420 777 708 931

In contractual matters:

Name: Martin Moser

E-mail: moser@mit-laser.cz

Tel.: +420 777 708 930

17.2 The Buyer appoints following representatives for the communication with the Seller:

In technical matters:



EUROPEAN UNION  
European Structural and Investing Funds  
Operational Programme Research,  
Development and Education



Name: CHAULAGAIN Uddhab

E-mail: Uddhab.Chaulagain@eli-beams.eu

The appointed representative of the Buyer is entitled to communicate with the Seller regarding all technical aspects of this Contract including issuing all the approvals foreseen by this Contract and signing the acceptance protocol or other protocols foreseen by this Contract. The appointed representative of the Buyer is not entitled to change or supplement this Contract.

## 18. SOCIAL, ECOLOGICAL AND INNOVATIVE ASPECTS

18.1 The Buyer aims to conclude contracts with the suppliers that take into account and implement the principles of social responsibility, ecological sustainability and innovation. Therefore, the Seller shall ensure that

18.1.1 this Contract shall be fulfilled only by persons that are employed in accordance with the applicable legal regulations (no illegal or child workers);

18.1.2 while performing this Contract, all applicable health and safety regulations and rules at work place are observed;

18.1.3 all persons performing this Contract are employed under fair and non-discriminatory working conditions;

18.1.4 if presented with different manners of fulfilling this Contract, the Seller shall select the solution/process that is in accordance with the principles governing nature conservation and nature protection, ecological sustainability and ecological waste management; and

18.1.5 if presented with different manners of fulfilling this Contract, the Seller shall select the solution/process that is the most innovative.

## 19. FINAL PROVISIONS

19.1 This Contract is governed by the laws of the Czech Republic, especially by the Civil Code.

19.2 The terms and conditions of this Contract represent the whole agreement between the Parties regarding the subject matter of this Contract and any prior or oral agreements have been either consolidated into this Contract or are disregarded by the Parties.

19.3 Parties acknowledge that this Contract shall be published in the Register of Contracts in accordance with the Act no. 340/2015 Coll., on the Register of Contracts.

19.4 All disputes arising out of this Contract or out of legal relations connected with this Contract shall be preferable settled by a mutual negotiation. In case that the dispute is not settled within sixty (60) days, such dispute shall be decided by courts of the Czech Republic in the procedure initiated by one of the Parties.



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- 19.5 The Seller is not entitled to set off any of its claims or his debtor's claims against the Buyer's claims. The Seller is not entitled to transfer its claims against Buyer that arose on the basis or in connection with this Contract on third parties. The Seller is not entitled to transfer rights and duties from this Contract or its part on third parties.
- 19.6 All modifications and supplements of this Contract must be in writing.
- 19.7 If any of provisions of this Contract are invalid or ineffective, the Parties are bound to change this Contract in such a way that the invalid or ineffective provision is replaced by a new provision that is valid and effective and to the maximum possible extent correspond to the original invalid or ineffective provision.
- 19.8 This Contract is executed in four (4) counterparts and every Party shall receive two (2) counterparts.
- 19.9 An integral part of this Contract is Annex 1 (*Technical Specification*) including all its annexes and Annex 2 (*Price Table*). If Annex 1 (*Technical Specification*) uses the term "Contracting Authority", it means Buyer and if it uses the term "Supplier", it means Seller. In case of any discrepancies between the text in the body of this Contract and the text in Annex 1 (*Technical Specification*), the text in the body of this Contract shall prevail.
- 19.10 This Contract shall be valid on the date of the signature of both Parties and effective on the day, on which it is published in the Register of Contracts.

**IN WITNESS WHEREOF** attach Parties their handwritten signatures:

**Buyer**

Signature: \_\_\_\_\_

Name: RNDr. Michael Prouza, Ph.D.,

Position: director

Date:

**Seller**

Signature: \_\_\_\_\_

Name:

Position:

Date:



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## **ANNEX 1**

### **TECHNICAL SPECIFICATION**

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|   |   |  |            |
|---|---|--|------------|
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|   | <b>Position</b>   | <b>Name</b>  |            |
| <b>Responsible person</b>   | Chief Optical Designer of Laser Team<br>Associate Scientist   | Daniel Krammer,<br>Uddhab Chaulagain                                   |            |
| <b>Prepared by</b>  | Associate Scientist<br>Senior Researcher<br>Chief Optical Designer of Laser Team<br>Senior Consultant | Uddhab Chaulagain<br>Tae Moon Jeong<br>Daniel Kramer<br>Stefan Borneis |            |

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|---------------------------|-------------------------------|--|-------------------------|
| 021729/A.001              | 4.9.2020                      | 4.9.2020                               | Amélie Grudinová        |
| 021729/A.002              | 9.9.2020                      | 9.9.2020                               | Amélie Grudinová        |
| 021729/A.004              | 15.10.2020                    | 15.10.2020                             | Amélie Grudinová        |
| 021729/A.005              | 21.4.2021                     | 21.4.2021                              | Amélie Grudinová        |
| 021729/A.006              | 4.5.2021                      | 4.5.2021                               | Amélie Grudinová        |

| <b>Reviewed By</b>     |   |   |                  |
|------------------------|---|---|------------------|
| <i>Name (Reviewer)</i> | <i>Position</i>   | <i>Date</i>                               | <i>Signature</i> |
| Jaroslav Nejd          | X RAY Team Leader                                       | <a href="#">Informed via mail and AWC</a> |                  |
| Ladislav Půst          | Manager installation of technology                      | <a href="#">Informed via mail and AWC</a> |                  |
| Martin Laub            | Chief Engineer  | <a href="#">Informed via mail and AWC</a> |                  |
| Veronika Olšovcová     | Safety Team Manager                                     | <a href="#">Informed via mail and AWC</a> |                  |
| Jack A. Naylor         | Team Leader of the Laser Beamlines Control System Group | <a href="#">Informed via mail and AWC</a> |                  |
| Plötzeneder Birgit     | Control System Team Leader                              | <a href="#">Informed via mail and AWC</a> |                  |
| Pavel Bakule           | Team Leader L3 BT                                       | <a href="#">Informed via mail and AWC</a> |                  |
| Daniel Kramer          | Team Leader Scientific_OD                               | <a href="#">Informed via mail and AWC</a> |                  |
| Viktor Fedosov         | Head of Quality and Risk Management                     | <a href="#">Informed via mail and AWC</a> |                  |

| <b>Approved by</b>     |   |  |                  |
|------------------------|---|--|------------------|
| <i>Name (Approver)</i> | <i>Position</i>   | <i>Date</i>                                | <i>Signature</i> |
| Sergei Bulanov         | Head of Department of Radiation Physics and Electron Acceleration | <a href="#">2021-05-06 Approved via TC</a> |                  |

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# 1. Introduction

## 1.1. Purpose

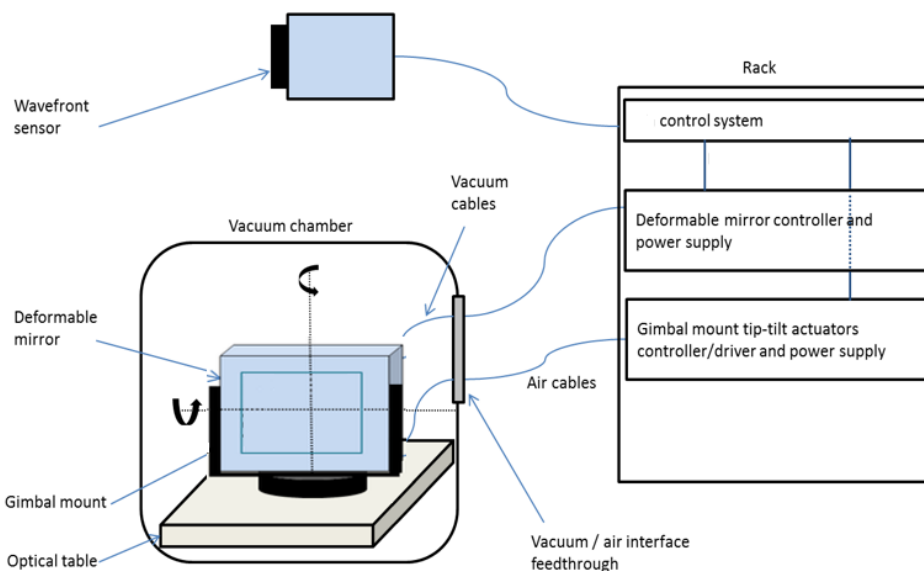
This Requirements Specification Document (RSD) lists the technical requirements and constraints of the “Closed loop deformable mirror system for the Gammatron station in the E2 hall. This leads to the identification of interfaces with the ELI Beamlines science based technology. This RSD also acts as the parent document for the technical requirements that need to be addressed in lower level design description documents.

## 1.2. Scope

This RSD contains all of the top level technical requirements: functional, performance and design, packaging and delivery, safety, and quality requirements for the following products: “Closed loop deformable mirror systems for L3 to E2” (*further “CL-DFM system”*).

The CL-DFM systems are integral parts of the following standalone systems: “E2 (RA2) Gammatron beamline”. These products are registered in the PBS software under the following PBS code: E.E2.BETA.BT.DFM.1.

The main laser parameters of L3 are 30 J, 30 fs, 10 Hz at 810 nm. The **CL-DFM system** comprises the deformable mirror (DFM), the motorized tip/tilt gimbal mount for the DFM, the software to operate the full closed-loop system including the gimbal mount, the power supply, the controller, the cables and an adequate wavefront sensor as schematically shown in fig. 1.



**Figure 1:** Schematic of the CL-DFM system: deformable mirror, motorized tip/tilt gimbal mount, wavefront sensor, cables (vacuum and air), power supplies, controllers, the closed loop driving software and the tip/tilt gimbal mount adjustment software.

## 1.3. Terms, Definitions and Abbreviations

For the purpose of this document, the following abbreviated terms are applied:

| <b>Abbreviation</b> | <b>Meaning</b>  |
|---------------------|---|
| A                   | Analysis (as a verification method)   |
| AMU                 | Atomic Mass Unit  |
| AOI                 | Angle Of Incidence  |
| CA                  | Contracting Authority (Institute of Physics AV CR, v. v. i.)  |
| C <sub>Ap</sub>     | Clear Aperture  |
| CL-DFM              | Deformable Mirror running in closed loop to minimize wavefront errors   |
| Critical Component  | Component critical for proper operation of system regarding Operator Safety, Machine Safety and System Funcnality |
| DFM                 | Deformable Mirror   |
| DFM1                | Deformable Mirror with AOI = 5 degrees  |
| DFM2                | Deformable Mirror with AOI = 45 degrees   |
| ELI                 | Extreme Light Infrastructure  |
| EMP                 | Electromagnetic Pulse   |
| GDD                 | Group Delay Dispersion  |
| H x V               | Horizontal x Vertical   |
| I                   | Inspection (as a verification method)   |
| L3                  | Laser 3   |
| LIDT                | Laser Induced Damage Threshold  |
| NCR                 | Nonconformity Report  |
| OS                  | Operating System  |
| QR                  | Quality Report  |
| R                   | Review (as a verification method)   |
| RA1                 | Research activity 1   |
| RGA                 | Residual Gas Analysis   |
| RH                  | Relative humidity   |
| RMS                 | Root Mean Square  |
| RSD                 | Requirements Specification Document   |
| SDK                 | Software Development Kit  |
| SW                  | Software  |
| T                   | Test (as a verification method)   |
| UHV                 | Ultra-High Vacuum   |

## 1.4. Reference Documents

| Number of doc. | Title of Document/File  |
|----------------|---|
| RD-01          | 00272188/A DIR20 ELI name convention and addressing for electrical components_V01.pdf |
| RD-02          | 00115311_C_alignment marks system.pdf   |

## 1.5. References to standards

If this document includes references to standards or standardized/ standardizing technical documents the CA allows/permits also another equal solution to be offered. If a supplier offers another equal solution the CA shall not reject its bid, once the supplier by appropriate means in the bid proves that the offered supplies, services or works meet in an equivalent manner the requirements including references to standards or technical documents.

## 2. General Requirements

The CL-DFM system is an integral part of the Gammatron beamline enabling precompensation of intrinsic or alignment optical errors that would degrade the focusing power of the laser system. The inclusion of CL-DFM system would allow to manipulate or tailor the focal spot intensity profile.

Functional, performance and design requirements for the **CL-DFM system** are summarized within the reference tables below:

- **RT-01** – Clear and active aperture of each deformable mirror;
- **RT-02** – Deformable mirror with control electronics;
- **RT-03** – Adaptive optics SW loop;
- **RT-04** – Wavefront sensor.

REQ-031349/A

The Supplier shall supply **one CL-DFM system of type DFM1 and one CL-DFM system of type DFM 2** (in accordance with the requirements given in the reference table **RT-01 – RT04**).

REQ-030790/A

The Supplier shall provide the manufacturing drawings for the **DFM** in conformity with the Table **RT-01** and **RT-02** for approval by the CA.

REQ-030791/A

The clear aperture of each **DFM** shall correspond to the Table **RT-01**.

REQ-030792/A

The parameters of the **DFM** shall correspond to the Table **RT-02** below.

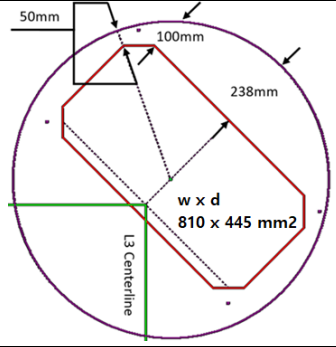
REQ-030972/A

All installations shall follow the electrical installation directive (see **RD-01**).

**Table RT-01:** The parameters of Minimum Clear Aperture (CAp) and Minimum Active Aperture (AAp)

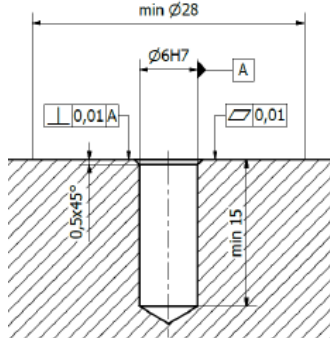
| # | Mirror | Angle of incidence (AOI) | Minimum Clear Aperture (CAp) H X V at which Coated membrane shall meet all specifications | Active Aperture (AAp) H X V where actuator pattern shall be optimized |
|---|--------|--------------------------|---|---|
| 1 | DFM1   | 5°                       | 250 mm x 250 mm   | 230 mm x 230 mm   |
| 2 | DFM2   | 45°                      | 354 mm x 250 mm   | 325 mm x 230 mm   |

**Table RT-02:** The parameters of the DFM and its gimbal mount

| # | Parameter  | Required value   | Comment   |
|---|--|--|---|
| 1 | Laser beam size at 0.1 % intensity and @ AOI=0°      | 230 mm x 230 mm  | SQUARE  |
| 2 | Maximal physical dimensions [width x height x depth] | 810 mm x 700 mm x 445 mm   |   |
| 3 | Position of the connectors                           | Back plane   | Side connectors are possible if the full assembly is compatible with the max. physical dimensions. Which side to be agreed with CA during the final design phase of the gimbal mounted DFM. |
| 4 | LIDT at s and p-polarization                         | $\geq 400 \text{ mJ/cm}^2$ , 100,000-on-1 @ 1 kHz, $\tau < 35 \text{ fs}$ in high vacuum             | beam normal fluence, providing LIDT witness samples per coating run is part of the contract   |
| 5 | Scratch-dig per MIL-PRF-13830A rev.H                 | 20-10  | –   |
| 6 | Central wavelength                                   | (810±5) nm   | –   |
| 7 | Minimum bandwidth $\Delta\lambda$                    | $\pm 40 \text{ nm}$ , $770 \leq \Delta\lambda \leq 850 \text{ nm}$ with central wavelength at 810 nm | –   |
| 8 | Angle of incidence AOI                               | As specified in <b>Table RT-01</b>   | –   |

| #  | Parameter  | Required value   | Comment   |
|----|--|--|---|
| 9  | GDD  for s and p polarization  | $\leq 50 \text{ fs}^2$   | Over bandwidth $\Delta\lambda$ and AOI  |
| 10 | Minimum reflectivity @ s- and p-polarization                                     | 99.8 % for s and 99.6 % for p-polarisation   | Over bandwidth $\Delta\lambda$ and AOI  |
| 11 | Operating environment  | High vacuum $\leq 2\text{e-}6$ mbar  | No crazing of coating in vacuum for at least 1 year   |
| 12 | System chemical cleanliness  | Very low outgassing equivalent to UHV applications. See #13.   | Water is not critical, hydrocarbons and silicone oils are critical  |
| 13 | Vacuum compatibility – RGA scan result after 12h pumping at $< 5\text{e-}6$ mbar | <ul style="list-style-type: none"> <li>The amplitude of the 43 AMU peak shall be <math>\leq 1/10</math> of the 44 AMU peak;</li> <li>The amplitude of all peaks <math>&gt; 44</math> AMU shall be no higher than <math>1/100</math> of the 44 AMU peak, with 1.1 % of 44 amu peak of isotope <math>^{13}\text{C}</math> in <math>\text{CO}_2</math> subtracted from 45 amu peak</li> </ul> | The RGA shall be conducted up to AMU 200 of the fully assembled and functional DFM in a cleanliness compliant vacuum vessel at $1\text{E-}6$ mbar.  |
| 14 | Acceptable vacuum grease for actuators   | UHV compatible ultra low-outgassing grease grade   | The Supplier shall present the vacuum grease to the CA for approval. The CA shall approve it, if the Supplier demonstrates that all the requirements are met.   |
| 15 | Actuator technology  | mechanical   | –   |
| 16 | Material for connectors and cables   | UHV compatible plugs, connectors and cable ties shall be made of PEEK. All cables shall use polyimide insulation.  | Any other non-metallic materials require approval by the CA. The CA shall approve such other materials, if the supplier demonstrates that the alternative materials have equivalent or better properties. |
| 17 | Maximum power-off change   | $< 10 \text{ nm RMS}$ over 1h  | Surface shape to be identical to the powered state. Temperature drift subtracted  |
| 18 | EMP tolerance  | Up to 1 kV/m, full resistance to electromagnetic interferences   | In the power off mode   |
| 19 | Number of actuators  | $\geq 50$ pcs for DFM1 and DFM2 and to be optimized for the specified beam footprint on the AAp mirror surface.  | –   |
| 20 | Actuator pattern   | Optimized for the first 21 Legendre polynomials  | Simulation results to be provided by the Supplier and   |

| #  | Parameter  | Required value   | Comment   |
|----|--|--|---|
|    |  |  | discussed with CA before the start of manufacturing   |
| 21 | Electrode pattern  | Customizable even after delivery.  | Ability to change the electrode pattern without having to buy a new membrane.   |
| 22 | Baseline surface sag (flattening)                          | Flat with RMS $\leq 30$ nm, best effort $\leq 25$ nm   | Over AAp  |
| 23 | Correction range for 45 deg astigmatism                    | $\geq \pm 15$ $\mu\text{m}$  | Relative residual to flat sag $< 25$ nm RMS   |
| 24 | Correction range for horizontal and vertical defocus       | $\geq \pm 15$ $\mu\text{m}$  | Relative residual to flat sag $< 25$ nm RMS   |
| 25 | Correction range for coma                                  | $\geq 5$ $\mu\text{m}$   | Relative residual to flat sag $< 25$ nm RMS   |
| 26 | Capability to taylor the focal spot intensity distribution | Any desired shape compatible with REQ # 20, 22, 23, 24 and 25  | –   |
| 27 | Length of vacuum cables                                    | $\geq 2$ m   | –   |
| 28 | Length of air side cables                                  | $\geq 10$ m  | –   |
| 29 | Vacuum feedthroughs  | D-SUB type   | UHV connector types (e.g. from PEEK) and Pins pattern to be agreed with CA depending on the configuration proposed by the Supplier  |
| 30 | Mechanical mounting interface                              | Three point stiff clamping   | Concept and final design has to be discussed with and approved by CA.   |
| 31 | Particulate cleanliness                                    | All components to be cleaned and assembled in clean room ISO5 according to ČSN EN ISO 14644 or better. Components shall be cleaned with best effort to meet a particle cleanliness level of 100 and a guaranteed particle level of 130 per MIL-STD-1246C superseded by IEST-STD-CC1246D for particles with size $\geq 5$ $\mu\text{m}$ | or equivalent, e.g. EN ISO 14644; Control rack to be cleaned for clean room ISO7 compliant operation. Documented particle level cleanliness validation shall be conducted by the Supplier by swiping with a nitrocellulose paper and counting particles $\geq 5$ $\mu\text{m}$ diameter under a microscope or by surface rinsing followed by particle counting. |

| #  | Parameter   | Required value  | Comment  |
|----|---|---|--|
| 32 | Surface roughness – metallic parts for high vacuum installation   | Must allow cleaning to ISO5 clean room standard according to ČSN EN ISO 14644 and to meet the outgassing requirement validated by the RGA measurement of #13      | or equivalent, e.g. EN ISO 14644. Best effort Ra<0.5µm   |
| 33 | Tip and tilt resolution of DFM gimbal mount   | 15 µrad   | A non-gimbal design mount, requires the approval of the CA. The CA commits to have a joint effort design phase to optimize the tip/tilt mount.       |
| 34 | Rotation axis of gimbal mount   | Aligned with middle of membrane surface   | –  |
| 35 | Travel range for tip/tilt   | ± 15 mrad   | –  |
| 36 | Gimbal mount to breadboard connection   | Clamping shall be compatible with a 50 mm x 50 mm tapped hole grid with up to M12 threads   | Design to be approved by CA.   |
| 37 | First Eigenfrequency of the full assembly: DFM mounted into the gimbal with cables connected.                 | 70 – 90 Hz, <b>best effort</b> to achieve ≥ 80 Hz   | Shall not have Eigen modes at 50 Hz and multiples of 50 Hz as well as at 110 Hz. CA may support the optimization.                                    |
| 38 | Beam height   | 350 mm  | Beam center above the breadboard   |
| 39 | Gimbal shall be equipped with 2 tapped holes for lifting eyes and 3 holes for laser tracker reference targets | Laser tracker reference holes shall have 6 mm diam. with a required depth of min. 15 mm and a flat contact surface of min. 28 mm diam. around the reference holes | Laser tracker reference holes (according to <b>RD-02</b> ):<br> |

## 2.1. Adaptive closed-loop software/controller and wavefront sensor

REQ-030973/A

All necessary operations to use the DFM to its full capacity (including startup, configuration, data readout and shutdown) shall be performable via the SDK to allow remote control. No HMIs, GUIs, touch panels, push buttons, laptops, displays or similar are permitted to be required in order to use the DFM to its full capacity.

*NOTE: A "power-on" button or similar is permitted, provided that regular operation of the system does not require use of it, i.e. the*

*system would normally be powered on all the time, except for maintenance.*

REQ-030974/A

In case an operation with the SDK incurs an error, or there is any other fault on the DFM, error information shall be provided via the SDK. The supplier shall provide a list of the possible errors (for example specified as error codes), their descriptions and suggested remedial measures in the documentation.

REQ-030975/A

All configurable parameters shall be accessible via the SDK; and shall be permanently retained and restored automatically in the event of a power cycle. It shall be possible to read back the full configuration from the unit.

REQ-030976/A

Using the SDK, it shall be impossible to send any command or set any parameter to a value that is outside of the achievable range or to a mode that could cause damage to the DFM.

REQ-030977/A

All result parameters shall be made available over the SDK at the specified minimum processing rate. All physical parameters shall be accurately calibrated and unless more accurately specified as tolerance parameters, within <10% error of the real physical value when in an operational regime.

REQ-030793/A

The parameters of the Adaptive optics **SW** loop shall correspond to the requirements given in the reference Table **RT-03** below.

REQ-030794/A

The parameters of the **wavefront sensor** shall correspond to the requirements given in the reference Table **RT-04** below.

**Table RT-03:** The parameters of the Adaptive Loop (AL) software

| # | Parameter                               | Minimum required value  | Comment  |
|---|---|---|--|
| 1 | Operating system                        | Tested (compatible) with Microsoft Windows 10                     | Additional support for NI Real Time OS (ETS Pharlap or NI Linux RT) should be provided if possible |
| 2 | NI LabVIEW SDK                          | SDK provided and tested with LabVIEW 2016                         | Provided in a form that is re-compileable by the client on demand                                  |
| 3 | Closed loop capability processing speed | $\geq 1$ Hz   | With CPU performance LESS or equal 8000 points when using CPU Mark Test of the Passmark software   |
|   | External hardware trigger               | DFM system shall have an input and output for external triggering | –  |
| 4 | Fitting polynomials                     | Legendre, Zernike   | –  |



| #  | Parameter                             | Minimum required value  | Comment |
|----|---------------------------------------|---|---------|
| 5  | Full control of the actuator voltages | Yes   | –       |
| 6  | Load/Save voltage configuration       | Yes   | –       |
| 7  | Transfer function measurement         | Automatic and Manual  | –       |
| 8  | Calibration verification              | Yes   | –       |
| 9  | Convergence wavefront                 | to a flat phase or an arbitrary phase profile, including phase profiles generated by Zernike/Legendre polynomials | –       |
| 10 | DFM safety functions                  | tools to automatically remove inconsistent measurements and preventing incoherent voltage application             | –       |
| 11 | DFM wavefront averaging               | Customizable  | –       |
| 12 | DFM parameters customization          | Number of modes/polynomials, gain, stop point, number of iterations   | –       |
| 13 | DFM display options                   | Measured phase, error signal, correction, applied voltages. Temporal evolutions. Mirror mode                      | –       |
| 14 | DFM iteration rate                    | $\geq 1$ Hz   | –       |
| 15 | Number of DFM iterations              | Arbitrary including single iteration  | –       |
| 16 | DFM data saving                       | All settings, measurements and applied functions shall be saved during the loop.                                  | –       |
| 17 | basic access and raw data extraction  | for both, the deformable mirror and the wavefront sensor.   | –       |
| 18 | Software to operate gimbal mount      | Adjustment of tip/tilt with counting of steps   | –       |

**Table RT-04:** The parameters of the Wavefront sensor

| # | Parameter                               | Required value   | Comment   |
|---|---|--|---|
| 1 | Operating system                        | Tested (compatible) with Microsoft Windows 10          | Additional support for NI Real Time OS (ETS Pharlap or NI Linux RT) should be provided if possible          |
| 2 | Phase and intensity sampling resolution | $\geq 160 \times 120$ (>19 000 points)                 | Will be required for the high resolution beam diagnostics and to stay compatible with existing diagnostics. |
| 3 | Spatial resolution                      | 30 $\mu\text{m}$ or less                               | –   |
| 4 | Phase resolution                        | < 2 nm RMS   | –   |
| 5 | Phase accuracy                          | < 15 nm RMS  | –   |
| 6 | Connection                              | GigE interface compliant with the GigE Vision Standard | –   |
| 7 | NI LabVIEW SDK                          | SDK provided and tested with LabVIEW 2016              | Provided in a form that is re-compilable by the client on demand  |

|    |   |   |   |
|----|---|---|---|
| 8  | Full resolution processing speed  | ≥ 5 Hz  | – |
| 9  | Wavelength range  | 400 - 1100 nm   | – |
| 10 | Wavefront processing – Far Field  | Strehl ratio, focal spot, encircled energy  | – |
| 11 | Wavefront processing – fitting  | Legendre, Zernike polynomials, radii of curvature, RMS and peak-to-valley wavefront error, wavefront gradient   | – |
| 12 | Vacuum compatibility – RGA scan result after 12h pumping at < 5e-6 mbar | The amplitude of the 43 AMU peak shall be ≤ 1/10 of the 44 AMU peak;<br><br>The amplitude of all peaks > 44 AMU shall be no higher than 1/100 of the 44 AMU peak, with 1.1 % of 44 amu peak of isotope 13C in CO2 subtracted from 45 amu peak | – |

### 3. Serviceability and Spare Parts

REQ-030978/A

The availability of all components (or of equivalent components that can replace original components) that may need replacing over the lifetime of the system will be guaranteed for at least 10 years.

REQ-030979/A

The supplier shall identify critical components of the system and provides information about the parts, typical lifetimes, cost, leadtimes and information about the time, equipment and conditions required to replace in case of failure.

### 4. Environmental Requirements

REQ-030795/A

The Supplier shall provide the cleaning method to clean the mirror surface without degrading its properties and to avoid contamination of clean space.

*NOTE: The cleaning methods may use high gas flow (dry air, CO2) and specialized chemical cleaning liquids (i.e. methanol, isopropyl alcohol, deionized water).*

### 5. Packaging and Delivery Requirements

REQ-030796/A

All the components of the **CL-DFM system** that would stay inside the Vacuum chamber shall be cleaned and packaged in a clean room ISO

6, preferably ISO 5 according to ČSN EN ISO 14644 (or equivalent, e.g. EN ISO 14644).

*NOTE: Regarding the referred to standard/s or technical documents the CA allows/permits also another equal solution to be offered.*

REQ-030797/A

The **DFM** and all its vacuum components shall be placed in an appropriate clean packaging with sufficient padding and placed in a box suitable for air transport and with tip/tilt and shock sensor. The innermost wrapping has to be compatible with class 5 clean room handling.

REQ-030798/A

The transportation to the final destination of the **CL-DFM system** shall be conducted by the Supplier.

*NOTE: The Supplier is fully responsible for the delivery of undamaged **CL-DFM system**.*

REQ-030799/A

The installation of the **CL-DFM system** shall be conducted by the Supplier. The CA will provide all the necessary cooperation.

## 6. Training Requirements

REQ-030800/A

The Supplier shall provide onsite training for at least 3 days (7 hours per day) for up to 10 persons.

## 7. Safety Requirements

### 7.1. General Safety Requirements

REQ-030801/A

The Supplier shall supply a Declaration of Conformity or any other equivalent document legally recognized and accepted in the Czech Republic for each product type if the appropriate legislation determines the Supplier's obligation to have a Declaration of Conformity (or the equivalent document) for the purposes of a product sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.

### 7.2. Machine Safety Requirements

REQ-030980/A

The system shall provide an option that movement of the actuators can be reliably disabled from a remote control system (provided by

the CA). The purpose of this is to be able to prevent movement of the DFM during certain operational modes of the laser (such as high power mode) to protect the machine.

*NOTE: Suggested and recommended implementation is a "Machine Protection Enable" input. An externally provided closed contact (suitable for 24V DC signals) shall be required at all times for the DFM to operate. Opening these external contacts shall cause the DFM to stop moving within < 100ms of the open-circuit event and disable the power on the motors. In this case, it shall be impossible to operate the system even if a command is given using an operators GUI / the SDK. The preferred connector types for this interface are DSUB-9 female or M12 female. Alternative implementations of this protective function may be provided or developed together within the infrastructure of the CA; but are subject to approval from the CA.*

REQ-030981/A

The DFM shall have internal detection and protection against, or be inherently resistant to sustaining damage from the following modes:

1. Sudden loss of external power on any supply
2. Sudden loss of any external control signal or interface
3. Overvoltage or overcurrent of internal power supplies
4. Random failure of electronic controller

## 8. Quality Control

### 8.1. Quality Reports (QRs)

REQ-030802/A

The Supplier shall perform tests of the **CL-DFM system** and provide corresponding specific quality reports (I - VII):

- I. Measured reflectivity curve at s and p polarization at a measured humidity level and in dry air or N<sub>2</sub> at RH < 3% or in vacuum on 1" – 2" diameter ride-along coating run witness sample. The substrate of the witness shall be manufactured from an equivalent material and with the same surface finish as the DFM membrane;
- II. LIDT test protocol of one witness sample of the actual coating run;
- III. Interferometric or high-resolution wavefront measurement of clear aperture after flattening normal to the surface. Use angle interferometry has to be discussed with CA if required by the coating. If stitching is needed, procedure must be approved by the CA. Minimum resolution is 1 mm of the full usable aperture

- of table RT-01, which is 354 x 250 mm<sup>2</sup> for the AOI=45deg DFM
- IV. Table summarizing RMS residuals and RMS slope errors of first 15 Legendre polynomials;
  - V. Measured GDD curve over the bandwidth centred at 810 nm at s and p polarization at a measured humidity level with scaling to vacuum, preferably a measurement at  $\leq 2\%$  RHM or vacuum OR providing a 1 or 2" witness sample that the CA may measure the GDD;
  - VI. Report listing materials used in the vacuum components (i.e. cable insulation, grease, glues, metals, plastics...);
  - VII. RGA test protocol
- NOTE: The RGA test shall be performed by the CA.*

## 8.2. Documentation and Data Control

REQ-030803/A

The Supplier shall provide Instructions for use (Product User Manual) as part of the delivered Product. The Manual shall include the instructions and descriptions regarding the following procedures:

- transport, handling and storage;
- installation and cleaning;
- safe operation and maintenance procedures.

REQ-030804/A

The Supplier shall provide a Declaration of Conformity (or the equivalent document) with technical requirements defined by the product RSD and ensure completeness of the products.

REQ-030805/A

The Supplier shall supply the following relevant manufacturing documents:

- all approved by the CA manufacturing drawings, 3D models and design supporting documentation;

*NOTE: The manufacturing documents may be supplied in electronic form in relevant data formats described in the REQ-030806/A.*

REQ-030806/A

The Supplier shall use following data formats:

- \*.dat (Zygo binary file format for interferograms)
- \*.JPG, \*.PDF/A, \*.HTML, \*.ppt, \*.pptx
- CAD 2D: \*.dwg
- CAD 3D: \*.stp; \*.ste; \*.step or other 3D CAD formats agreed with the CA
- text processors \*.doc, \*.docx, OpenDocument Format
- spreadsheet processors \*.xls, \*.xlsx, OpenDocument Format

REQ-030807/A

The Supplier shall establish and maintain a nonconformity control system compatible with ČSN EN ISO 9001 (or equivalent, e.g. EN ISO 9001).

REQ-030982/A

The supplier shall provide list of spare parts for Critical Components of this system including their:

- Estimated Lifetime
- Cost per Unit
- Lead time

### 8.3. Specific Quality Requirements

REQ-030808/A

In case of a warranty repair of the **CL-DFM system** by the Supplier, the Supplier shall redo necessary parts of the verification procedure (see chapter 8). The results of this process shall be provided to the CA.

## 9. Verification Requirements for the Supplier

### 9.1. Phasing of the Delivery

This chapter is intended to briefly summarize basic milestones of the contract delivery. These milestones represent gates (checkpoints) where the quality of the delivery shall be evaluated.

Delivery shall not proceed past these gates unless their satisfactory accomplishment is approved by the CA.

Delivery lifecycle shall contain at least the following phases (quality gates):

- **Qualification of Design;**
- **Manufacturing;**
- **Acceptance.**

#### 9.1.1. Qualification of Design

Summary of what has to be provided by the Supplier in terms of documentation (QRs and manufacturing drawings) before starting the manufacturing. The goal is to verify the **manufacturing drawings and design supporting documentation**.

Output of this phase is **Qualified Design**.

REQ-030811/A

Before the ending of Qualified Design phase the Supplier shall provide structure and content of quality reports (see REQ-030802/A) that shall be approved by the CA.

REQ-030812/A

Before the ending of Qualified Design phase the CA shall approve (if all the requirements are met):

- final manufacturing drawings provided by the Supplier (see REQ-030805/A);
- exact layout of the actuators based on the Supplier's analysis (see Table **RT-01**, item 20);
- detailed procedures related to the testing during the manufacturing phase (see chapter 8.3.2);
- common nonconformity control system (see REQ-030807/A).

### 9.1.2. Manufacturing

The goal is to demonstrate that the manufactured products meet the specified technical requirements (RSD) of the CA.

This quality gate concerns primarily:

- **Inspection of manufactured and assembled product;**
- **Testing at the Supplier's site (factory testing);**
- **Packaging and shipping;**

Output of this phase is the **Verified Final Product**.

REQ-030813/A

The results of the Manufacturing phase of verification shall be recorded by the Supplier in the corresponding **QRs** (or in other factory/quality reports, if not specified in the chapter 7.1) and provided to the CA for approval. The approval shall be given, if all the relevant requirements are met.

*NOTE: The results of all the tests shall be given strictly in units which are used to define the requirements in the chapter 2.*

### 9.1.3. Acceptance

The Acceptance phase shall demonstrate following:

- Final delivered **CL-DFM system** has been successfully installed and verified and this process has been documented in an appropriate way through QRs (see REQ-030802/A);
- All detected nonconformities have been solved in accordance with REQ-030807/A;
- Final **CL-DFM system** is free of fabrication errors.

In case of successful acceptance phase the CA shall provide to the Supplier signed acceptance protocol. In case of unsuccessful acceptance stage the CA shall provide to the Supplier the Nonconformity Report (NCR) and process in accordance with REQ-030807/A shall be applied.

REQ-030815/A

Verification process shall be carried out by the Supplier and it is successfully completed when the final **CL-DFM system** complies with

all specifications and the results of this process is documented in an appropriate way through QRs (see REQ-030802/A).

*NOTE: Acceptance will be carried out by the CA (or if required, representatives/contractors appointed by the CA) on the final delivered and at ELI installed **CL-DFM system**.*





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**ANNEX 2**  
**PRICE TABLE**

## Closed loop deformable mirror system

| # | Item                              | Unit | Quantity | Price without VAT per unit     | Total price without VAT |
|---|-----------------------------------|------|----------|--------------------------------|-------------------------|
| 1 | System DFM 1                      | pc   | 1        | 160 108,00 €                   | 160 108,00 €            |
| 2 | System DFM 2                      | pc   | 1        | 233 546,00 €                   | 233 546,00 €            |
| 3 | System DFM 2 (option)             | pc   | 1        | 203 546,00 €                   | 203 546,00 €            |
| 4 | Spare membrane for DFM 1          | pc   | 1        | 39 500,00 €                    | 39 500,00 €             |
| 5 | Spare membrane for DFM 2          | pc   | 1        | 45 200,00 €                    | 45 200,00 €             |
| 6 | Spare membrane for DFM 2 (option) | pc   | 1        | 45 200,00 €                    | 45 200,00 €             |
|   |                                   |      |          | <b>Total Price without VAT</b> | <b>727 100,00 €</b>     |