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BioQantSense

# Twinning for excellence of the Serbian Research Center for quantum biophotonics

Work Package 2

## Knowledge and skill transfer/exchange

Deliverable 2.2

# Mid term report on visits at CNR


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# Summary

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# 1 Introduction

The D2.2 deliverable reports on the management and scientific mutual exchange visits that have been implemented between IPB and CNR-INO during the first part of the BioQantSense project (M1-M18).

Number, typology and duration of all exchange visits foreseen in the project as well as the potential purposes were tentatively defined in D4.2 at M3. The visits were progressively numbered according to the expected temporal order and those of the original plan reported here are #2, #3, #6, #8, #10, #11 and #12 of the Table 1 of D4.2. The dates of some visits were then changed as needed.

The Table 1 resumes management/scientific visits involving IPB and CNR-INO staff effectively carried out. Some changes from the initial plan defined in D4.2 occurred:

1) The 2nd long-term scientific visit expected by IPB staff at CNR and performed in June 2023 (M9) was missing by mistake in the scheduled programme. It was added as Visit #6bis.
2) The short-term scientific visit #12 scheduled for January 24 has been switched to several online interactions and VC meetings to continuously develop and monitor the work performed at IPB. Briefly, they consist of two Zoom meetings in December 2023 and one zoom meeting in February 2024.

| Visit | Type | Where | Duration | When | Project Month | effective date | involved people | Objectives |
|---|---|---|---|---|---|---|---|---|
| 2 | Scientific | CNR (from IPB) | Short-term visit | February-March | M5 | 6-10 March 2023 | Dejan Pantelic | Finalization of plan for scientific training |
| 3 | Scientific | CNR (from IPB) | Short-term visit | February - March | M5 | 6-10 March 2023 | Branislav Salatic | 1st Training on materials and processes for MOEMS manufacturing |
| 6 | Management | CNR (from IPB) | Mid-term visit | May 2023 | M8 | 21-23 June 2023 | Dusica Vukcevic Stojiljkovic, Marina Lekic | Managing EU-funded projects |
| 6bis | Scientific | CNR (from IPB) | Long-term visit | June 2023 | M9 | 13-27 June 2023 | Svetlana Savic Sevic, Aleksander Kovacevic | Sharing knowledge on photocurable materials and laser-based fabrication |
| 8 | Scientific | IPB (from CNR) | Mid-term visit | September 2023 | M11 | 27 August - 1 September/6 September 2023 | Sara Nocentini, Caterina Dallari | Participation to project workshop and Photonica conference (28.08-01.09.2023); sharing knowledge on photocurable |
| 10 | Management | IPB | Mid-term visit | September 2023 | M11 | 18-21 March 2024 | Giulia Adembri, Donata Fornaciari (remotely) | Innovation and transfer - Partner & Funds search and aspects of cooperation with |
| 11 | Scientific | CNR (from IPB) | Long-term visit | November 2023 | M14 | 5-18 November 2023 | Danica Pavlovic | 2nd Training on materials and processes for MOEMS manufacturing |
| 12 | Scientific | CNR | Short-term visit | January 2024 | M16 | three remote meetings Dec2023-Feb2024 | Caterina Credi, Sara Nocentini, Caterina Dallari, Dejan Pantelic, Aleksander Kovacevic, Svetlana Savic Sevic | Updates and discussion on past training and plan for future training |

*Table 1 Extract from the table 1 reported in the D4.2 section 2 reporting scientific/management visits planned for IPB staff to CNR for the first part of the BioQantSense project (till M18) updated with the effective dates and involved staff.*

# 2 Scientific visits

The Scientific visits effectively performed among IPB and CNR-INO staff is reported in Table 2. As mentioned above, the long-term visit 6 bis was added to the list because was missing by mistake and the short-term visit 12 was switched to remote working.

| Visit | Type | Where | Duration | When | Project Month | effective date | involved people | Objectives |
|---|---|---|---|---|---|---|---|---|
| 2 | Scientific | CNR (from IPB) | Short-term visit | February-March | M5 | 6-10 March 2023 | Dejan Pantelic | Finalization of plan for scientific training |
| 3 | Scientific | CNR (from IPB) | Short-term visit | February - March | M5 | 6-10 March 2023 | Branislav Salatic | 1st Training on materials and processes for MOEMS manufacturing |
| 6bis | Scientific | CNR (from IPB) | Long-term visit | June 2023 | M9 | 13-27 June 2023 | Svetlana Savic Sevic, Aleksander Kovacevic | Sharing knowledge on photocurable materials and laser-based fabrication |
| 8 | Scientific | IPB (from CNR) | Mid-term visit | September 2023 | M11 | 27 August - 1 September/6 September 2023 | Sara Nocentini, Caterina Dallari | Participation to project workshop and Photonica conference (28.08-01.09.2023); sharing knowledge on photocurable |
| 11 | Scientific | CNR (from IPB) | Long-term visit | November 2023 | M14 | 5-18 November 2023 | Danica Pavlovic | 2nd Training on materials and processes for MOEMS manufacturing |
| 12 | Scientific | CNR | Short-term visit | January 2024 | M16 | three remote meetings Dec2023-Feb2024 | Caterina Credi, Sara Nocentini, Caterina Dallari, Dejan Pantelic, Aleksander Kovacevic, Svetlana Savic Sevic | Updates and discussion on past training and plan for future training |

*Table 2 Extract from the table 3 reported in the D4.2 section 2.1.2 reporting visits planned for IPB scientific staff to CNR for the first part of the BioQantSense project (till M18)*

As a general overview on scientific visits, during the first-year, short-term visit #2, IPB members have been first acquainted with the current research at CNR-INO through laboratory visits, short seminar and discussions. Then, the long-term visits #6bis, #8, and #11 have been focused on practical training through demonstration of experimental procedures, processes and protocols, aimed at transferring skills and expertise to be installed at IPB and propaedeutic to the exploratory project of WP5.

## 2.1 Visit #2

### 2.1.1 Program

The 1st short-term visit, referred to as Visit #2, was held at CNR-INO headquarter, hosted at the European Laboratory for non-linear spectroscopy (LENS), in the Sesto Fiorentino Area, Florence from the 6$^{th}$ of March till the 10$^{th}$ of March 2023. The visit was attended by two senior IPB Researchers: Dejan Pantelic and Branislav Salatic. CNR attendees were Caterina Credi (CNR-INO), Sara Nocentini (INRIM, associated to CNR-INO), Francesco Riboli (CNR-INO), Riccardo Cicchi (CNR-INO), Daniele Martella (INRIM) and Caterina Dallari (UniFi).

### 2.1.2 Summary

The Visit 2 was focused on introducing IPB senior researchers to the main CNR-INO research activities and technologies with two main goals:

1) To highlight the CNR-INO expertise and skills to be transferred to Serbian partners to raise their scientific excellence towards the European standard.

2) To schedule a potential plan of experimental activities for the scientific training foreseen along the project.

To this end, IPB senior researchers have been introduced to the main scientific activities at CNR with particular focus on the laser-based micro and nanofabrication processes with advanced materials for applications in microfluidics, MOEMS and microrobotics. Fruitful discussions have been addressed to analyse IPB research level in these research areas and to understand the strategy to be implemented to strengthen their expertise. Whenever possible, preliminary practical demonstration of experimental procedures, processes and protocols have briefly been conducted according to the agenda in Figure 1:

**Monday 6 – Sesto Fiorentino - 10.00 - 16.00**

- 10.15-10.30 Welcome at the CNR-INO c/o LENS in Sesto Fiorentino
- 10.30-12.00: Preliminary meeting and discussion on scientific activities
- 12.00-13.00 Visit to the laboratories
  - Lab 9: discussion on „Physical unclonable functions" set-up and connection with the research line on butterfly wings; discussion on natural-derived dyes, discussion on gelatin
  - Lab 43: Introduction to super resolution microscopy, confocal microscole
  - Lab 31: Introducion to light-sheet microscopy and tissue clearing
  - Lab 31a: Introducation to the chemical lab
- 13.00-14.00 lunch break
- 14.00-16.00 Lab 89: visit and Optical Imaging session of IPB samples prepared by thermal effect of laser on gelatin

**Tuesday 7 - Sesto Fiorentino - 10.00-16.00**

- 10.00-12.00 Seminar held by Dejan Pantelic "What to do with a butterfly"
- 12.00-13.30 lunch break
- 14.00-16.00 Characterization of IPB samples (gelatin, chitosan and pullulan):
  - FTIR
  - MicroRaman

**Wednesday 8 – Sesto Fiorentino – 10.00-16.00**

- 10.00-13.00 Demonstration of microfluidic devices fabrication and sealing:
  - 3D printing of molds
  - Protocol for polydimethylsiloxane (PDMS) preparation and curing
  - PDMS pouring on molds
  - PDMS pouring on IPB pullulan-based molds

**Wednesday 8 – Sesto Fiorentino – 10.00-16.00**

- 10.00-13.00 Demonstration of microfluidic devices fabrication and sealing:
  - 3D printing of molds
  - Protocol for polydimethylsiloxane (PDMS) preparation and curing
  - PDMS pouring on molds
  - PDMS pouring on IPB pullulan-based molds
- 13.30-14.15 lunch break
- 14.15-16.00 Demonstration of microfluidic devices fabrication and sealing
  - PDMS peeling off from the replica
  - Plasma treatment and sealing to glass slide

**Thursday 9 – Sesto Fiorentino – 10.00-14.00**

- 10.00-11.00 Visit to the Clean-room:
  - Introduction to the spin coater
  - Discussion on the 2-photons direct laser writing system
- 11.00-14.00 Preliminary characterization of IPB samples
  - Differential Scanning calorimetry (DSC)
  - Dynamo mechanical analysis (DMA) of gelatin samples

**Friday 10 – Sesto Fiorentino – 10.00-17.00**

- 10.00-12.00 Final discussion
- 10.00-12.00 Final discussion
  - Activity planning for IPB researcher back in Belgrade
  - Activity planning for 1st long-term visit:
- 12.00-12.30 Final conclusions of the visit

*Figure 1 Agenda of scientific visit at CNR-INO held on 6-10.03.2023*

Initial discussion on integrated photonics and spectroscopy have been also part of meetings. Briefly:

- Discussion on Brillouin microscopy with Dr. Riccardo Cicchi
- Discussion on the synthesis of photoresponsive-polymers with Dr. Daniele Martella
- Discussion on bio-inspired physically unclonable functions (PUFs) with Dr. Francesco Riboli

In addition, during these open discussions and during the visits to the laboratories, IPB researchers had the possibility to be informed on small and medium laboratory instruments or optical set-up parts that IPB could purchase within the project to improve IPB laboratories

efficiency and quality related to the experimental fabrication and characterization procedures.

### 2.1.3 Material

Besides seminars, open discussions and laboratory visits occurred in visit#2, preliminary practical demonstrations were also implemented on two topics:

*a) Demonstration of microfluidic devices fabrication and sealing*

A well-established protocol optimized by CNR-INO researchers for polymeric devices fabrication was presented to IPB researchers. The method that is widely described in J. Phys. Photonics 2 (2020) 024008 and Bioengineering (2023), 10, 676, is based on the replica molding of 3D printed stamps with commercial polydimethylsiloxane (PDMS), a thermoset elastomeric material widely used for microfluidic applications due to its biocompatibility, optical transparency, and high replica fidelity.

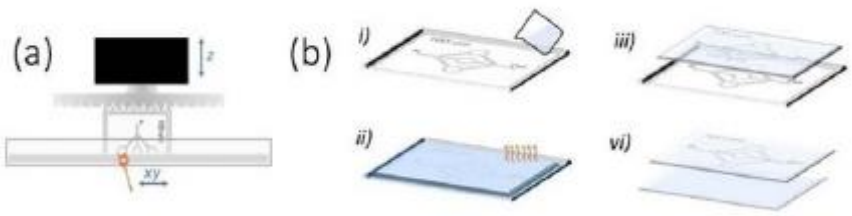


*Figure 2. Scheme representing the method implemented for the fabrication of PDMS device by replica molding of 3D printed negative stamps. (a) laser-based fabrication of plastic molds; (b) REM-fabrication of PDMS devices: (i)pouring the PDMS prepolymer mixture in the mold, (ii) thermal curing of PDMS, (iii) peeling off the mold and (iv) sealing with a flat layer of cured PDMS [J. Phys. Photonics 2 (2020) 024008]*

As a demonstration, microstructured PDMS devices were prepared by replica molding of the negative stamps fabricated with the single-photon laser-based 3D printer in Florence. Then, to demonstrate the versatility of the method, the same protocol of PDMS replica was applied to negative stamps, fabricated with the Direct Laser Writing (DLW) at IPB in Belgrade with natural-derived formulation composed by gelatine, chitosan and pullulan doped with organic dyes. This protocol can be easily transferred to IPB laboratories and could represent a powerful strategy for the rapid prototyping of microfluidic devices to be engineered in the 3rd year of BioQantSense, within the exploratory research project.

*b) Introduction to materials characterization*

The negative stamps that were realized in Belgrade by DLW-structuring of natural-derived materials, were used to introduce to IPB Researchers characterization techniques that are used at CNR. The intent was also to help IPB partners identifying a first list of equipment that they could purchase with the project. The following characterization techniques were implemented:

- Optical microscopy to characterize the dimension of the DLW-fabricated structures.

- UV-vis measurements to study the absorbance of the formulations obtained by doping with organic edible dyes.
- Raman measurements and FTIR measurements to check for chemical differences among samples.
- Thermomechanical analysis with differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA)


*Figure 3. Some images of Visit #2.*

## 2.2 Visit #6bis

### 2.2.1 Program

The 1st long-term visit, referred to as Visit 6bis, was at CNR-INO Unit hosted at the European Laboratory for non-linear spectroscopy (LENS), in the Sesto Fiorentino Area, Florence from the 13th till the 27th of June 2023. The visit was attended by two IPB Researchers: Svetlana Savic-Sevic and Aleksander Kovacevic. For CNR attendees were Caterina Credi (CNR-INO), Sara Nocentini (INRIM, associated to CNR-INO), Daniele Martella (INRIM) and Caterina Dallari (UniFi).

### 2.2.2 Summary

The visit #6bis was focused on the scientific activities defined in Visit #2 and then refined with a remote meeting organized on the 25th of May 2023 to optimize the working days of the visit. The general scientific topic was laser-based micro- and nanofabrication processes with advanced materials for applications in microfluidics, MOEMS and microrobotics. The aim of the visit was to continue transferring protocols and procedures to IPB researchers so that they can successfully replicate the experiments at IPB. All addressed scientific topics were considered propaedeutic for the successful achievement of the exploratory project. At the

same time, open discussions on the main issues that IPB researchers face in their current experiments, were held on the scientific topics mentioned above. To this end, different training activities have been organized as listed in the chronological plan reported in Figure 4:

**Wednesday 14–Sesto Fiorentino - 10.00 -16.00**

- 10.15-10.30 Welcome at the CNR-INO c/o LENS in Sesto Fiorentino
- 10.30-12.00: Preliminary meeting on scientific activities
  - Discussion on IPB samples fabricated with fs-laser and continous laser with different materials (gelatin, pullulan, DLW commercial photoresists)
  - Discussion on PDMS replica protocols implemented by IPB and related issues
  - Discussion on problems with Fs-laser structuring of the photoresist (focusing, identifying the interface, not enough power, working area)
  - Discussion on gelatin structuring by continuous laser
- 12.00-13.00 Visit to the laboratories
- 13.00-14.00 Lunch break
- 14.00-15.00 Video Call with Pavle Andjus (FBUB) and Dejan Pantelic (IPB) to define the first design of the microfluidic chip
- 15.00-16.00 Fabrication of the microfluidic prototype: negative mold
  - Designing of the 3D model by software Solidworks (TM)
  - 3D printing by stereolithography of the negative mold of the prototype with a commercial photoresist.

**Thursday 15 -Sesto Fiorentino - 10.00-17.00**

- 10.00-12.00 Fabrication of the microfluidic prototype: PDMS preparation
  - Development of 3D printed molds and post-curing treatment
  - Polydimethylsiloxane (PDMS) preparation procedure and thermal curing protocols
  - PDMS pouring on 3D printed molds
  - PDMS pouring on pullulan, gelatin and dental composite negative molds from IPB
- 12.00-13.00 Preliminary test on to check the photocuring behavior of the dental composite with stereolithography
- 13.00-14.00 Lunch break
- 14.00-15.00 Introduction to the 2 photon direct laser writing (DLW)
  - Overview of the instrument
  - Overview of the controlling software
  - Designing an array of 3D grids to be fabricated embedded in the PDMS device
- 15.00-16.00 1st slot of optical characterization of negative and positive samples fabricated with fs-laser and continuous from IPB.

**Friday 16–Sesto Fiorentino–10.00-17.00**

- 10.00-13.00 1st Training on Liquid Crystal Elastomers (LCEs) (Daniele Martella)
  - Brief Overview on LCEs
  - Introduction to LCEs preparation
  - Introduction the LCEs samples characterization by polarized optical microscope (POM)
- 13.30-14.15 Lunch break
- 14.15-17.00 DLW printing test of arrays of polymeric scaffolds with a 3D grid shape: Designing and printing
  - Training on finding the interface
  - Training on sample preparation and instrument initialization
  - Training on printing parameters (laser speed, laser power, hatching and slicing distance).

**Monday 19 – Sesto Fiorentino – 10.00-17.00**

- 10.00-13.00 Fabrication of the microfluidic prototype: PDMS replica peeling
  - Accomplishment of PDMS thermal curing and replica peeling from molds from IPB and from CNR (the ones prepared by stereolithography)
  - 2nd training on PDMS preparation (done by IPB researcher with CNR supervision)
  - Sealing of PDMS positive replica with glass
  - 3D printing of new negative molds with larger areas
- 13.30-14.30 Lunch break
- 14.30-15.30 DLW printing test of arrays of polymeric scaffolds with a 3D grid shape: Development and characterization
  - 3D grid arrays were removed from sample holder, developed with proper solvent and characterized by optical microscope
  - Checking the DLW printing resolution as a function of printing parameter
- 15.30-17.00 2nd Training on LCEs
  - How to prepare glass cells for LCE alignment and infiltration before DLW writing.

**Tuesday 20 – Sesto Fiorentino – 10.00-17.00**

- 10.00-12.00 Capillary tests on open-channel samples fabricated at IPB
  - Plasma treatment of positive samples (channels in gelatin, pullulan and dental composites)
  - Plasma treatment of PDMS replicas from negative samples (channels in gelatin, pullulan and dental composites)
  - Dropping of dye-doped solution and optical characterization
- 12.00-13.00 2nd DLW printing test of 3D grid arrays
  - Printing of 3D grid array with optimized parameters
- 13.00-14.30 Lunch break
- 14.30-15.30 Preparation of highly refractive substrate
  - Introduction to Au sputtering device
  - 50 nm Au sputtering on bare and plasma-treated glass slides (100 µm thickness, 3 mm and 5 mm diameters)
  - 50 nm Au sputtering on bare and plasma-treated PDMS
  - Au-coated samples incubation in saline buffer used for cell culture
- 15.30-17.00 3rd DLW printing test: Embedding the arrays in the PDMS channel
  - Plasma treatment of PDMS channel
  - Infiltration of IPL DLW commercial resist in the PDMS
  - Sample mounting in the DLW
  - Identifying the correct interface
  - Printing using the identified proper parameters

**Wednesday 21 – Sesto Fiorentino – 10.00-17.00**

- 10.00-11.00 Fabrication of the microfluidic prototype
  - PDMS preparation, pouring and curing
  - Novel PDMS replica peeling
- 11.00-12.00 Preparation of highly refractive substrate
  - Optical characterization of the Au-coated samples after overnight incubation
- 10.00-13.00 4th DLW printing test: embedding the arrays in the PDMS channel
  - Identification of the correct interface
  - Setting of the proper printing parameters
- 13.00-14.30 Lunch break
- 14.30-17.00 Capillary tests on IPB samples in closed configuration
  - Plasma treatment of IPB open-channel samples (channels in gelatin and pullulan)
  - Sealing positive IPB channels with PDMS layer
  - Dropping of dye-doped solution and optical characterization.

**Thursday 22 – Sesto Fiorentino – 10.00-17.00**

- 10:00-13:00 Capillary tests on IPB samples in closed configuration
  - Plasma treatment of IPB open-channel samples (channels in gelatin and pullulan)
  - Sealing positive IPB channels with PDMS layer
  - Dropping of dye-doped solution and optical characterization
- 13.00-14.30 Lunch break
- 14.30-17.00 Optical imaging and characterization of the DLW microstructures.

**Friday 23 – Sesto Fiorentino – 10.00-17.00**

- 09.30-15.30
  - Meeting with the Management stuff from IPB and CNR within the Visit n°6 (check that report for further details)
  - Reorganization of the data and images acquired during the permanence of IPB researchers
- 15.30-17.00 5th DLW printing test: Biomimetic hierarchical structures
  - DLW printing of butterfly wing model.

**Monday 26 – Sesto Fiorentino – 10.00-17.00**

- 10.00-13.00 6th DLWprinting test: Biomimetic hierarchical structures
  - Development of printed structures
  - Optical characterization of printed structures
- 13.00-14.00 Lunch break
- 14.00-15.30 3rd Training on LCEs
  - Cell preparation for LCEs alignment and infiltration (performed by IPB researcher with supervision)
  - POM characterization of cells.

15.30-17.00 Final conclusions of the visit

*Figure 4 Agenda of scientific visit at CNR-INO held on 13-27.06.2023*

Briefly, these activities could be divided in two main categories:

1) Training activities for the long-term goal of BioQantSense project to develop a Lab-On-Chip device for cell culturing. The following subtopics have been included:

   - Micro-fabrication processes with laser-based 3D printing process (T2.7 and T2.8)

   - Standard procedure for replica molding with polydimethylsiloxane (T2.8)

   - Nanofabrication processes with two-photon laser-based writing process (T2.7 and T2.8)

   - Formulation of stimuli-responsive liquid crystal elastomer (LCE) (T2.6 and T2.7)

   - Preparation and characterization of highly reflective biocompatible substrates;

2) Training activities and discussion on samples prepared by IPB with natural-derived materials. The following subtopics have been included:

   - Capillary tests on open-channel and closed-channel nanometric samples

- Plasma treatment and macroscopic wettability tests

- Optical characterization

- DLW printing of biomimetic butterfly's wing model

A brief description of the methodology adopted for each activity, together with results and comments are in the following section. More details could be found in the resume documents shared by partners.

### 2.2.3 Material and details

1) Training activities for the long-term goal of BioQantSense project to develop a Lab-On-Chip device for cell culturing:

- Activities related to T2.7 and T2.8.

During the remote meeting of 25th May, 2023, CNR and IPB partners defined a first prototype for the microfluidic device to be realized for cell culturing and further coupling with the quantum microscope for cell imaging. As shown in the rendering in Figure 5 (a), the device is constituted by *i)* a bottom layer with a central round-shaped chamber, and two rectangular-shaped microchannels for cell medium flow; *ii)* a round-shaped reflective substrates to be inserted into the chamber and *iii)* a top layer with three holes, two lateral holes for fluid loading and a central one to be coupled with the cell chamber. This open-channel configuration should decrease the number of interfaces to be crossed by the probing laser source of the quantum microscope before interaction with the cell samples. On the other hand, the highly reflective substrates place within the cell reservoir should also avoid any light interaction (losses due to material absorption in the Mid infrared) of the probing beam with the substrate.

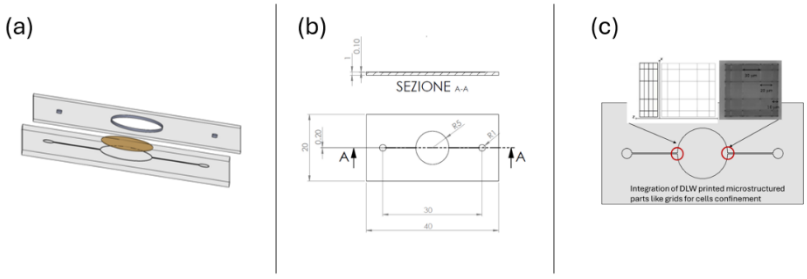


*Figure 5 (a) Rendering of the first prototype of microfluidic devices for cell culture and cell imaging. (b) 2D model of the prototypes. (c) Example of integration of DLW-nanostructures in the microfluidic device.*

To realize the prototype *i),* practical laboratory procedures (presented in Visit#2) were implemented by combining micro-fabrication processes with laser-based 3D printing process and standard procedure for replica molding of PDMS.

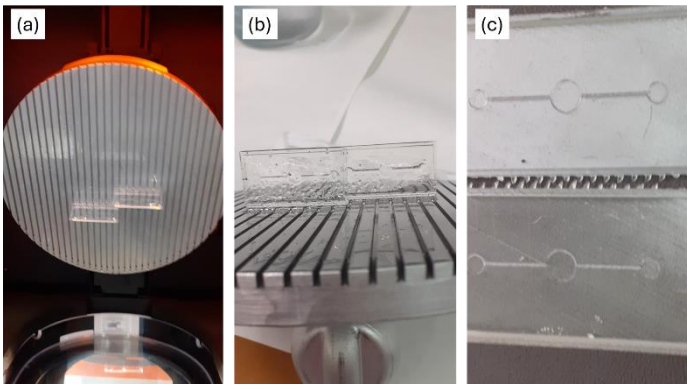


*Figure 6 (a) and (b) 3D printed negative molds attached to the working platform at the end of the printing process. (c) Pictures of 3D printed transparent molds after the removal of uncured material.*

Briefly, negative stamps of the fluidic prototypes were 3D printed with a single-photon laser-based machine with a transparent photocurable resin (Figure 6) and then replicated by pouring PDMS and thermally curing. After one night, the PDMS microstructured positive layer was released from the 3D printed mold and coupled with a flat PDMS layer (part *iii)*) punched to create the three holes corresponding to the inlet/outlet and to the central chamber.

The round-shaped high reflective substrates *ii)* to be inserted into the cell culture chamber as required for quantum microscope coupling, were prepared by simple sputtering of gold. Both glass and PDMS, with and without plasma treatment, were considered as potential substrates to be gold-coated. 50 µm of gold were deposited on the surfaces and then immerged overnight in a buffer mimicking the cell medium. To check the efficiency of gold deposition, optical microscope images were acquired before and after buffer immersion to observe eventual gold delamination phenomena. Experimental results demonstrated that best gold layer stability was obtained with cleaned glasses without plasma treatment.

- Activities related to T2.6 and T2.7

As a step forward, we started to investigate the possibility to embed light-active fluidic parts in the PDMS microfluidic devices (Figure 5 (c)). To this end, IPB partners were introduced to practical training on nanofabrication processes with two-photon laser-based writing (2P-DLW) process and preparation of stimuli-responsive liquid crystal elastomer (LCE).

The experiment was focused on the DLW-fabrication of 3D grid-like nanostructures in the PDMS microfluidic channels reported above. These structures could work as grid for cell confinement or cell support. To train Serbian researchers on 2P-DLW, an array of grids was first realized with a commercial photocurable resin (IPL) (design reported in Figure 7 (a)). The following protocol was implemented:

- Plasma treatment of PDMS channel (to improve adhesion of the DLW-strucures)
- Infiltration of IPL DLW commercial resist in the PDMS
- Sample mounting in the DLW
- Designing the 3D model to be printed
- Identifying the correct interface
- Printing using the identified proper parameters (laser exposure, laser power)

Proper printing conditions enabled to realized self-standing structures, adhering to the PDMS and with high printing resolution (Figure 7 (b) and (c)).

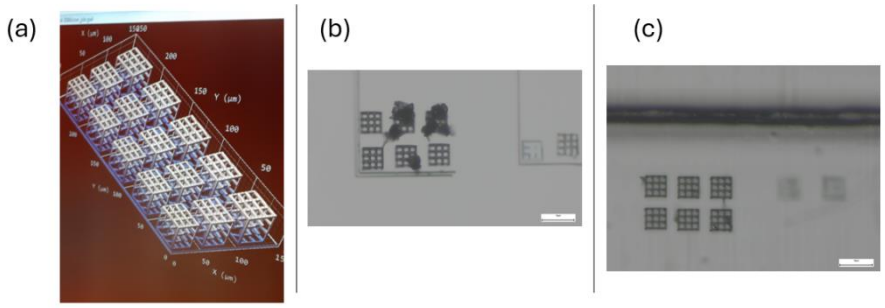


*Figure 7 (a) 3D rendering model of the array of grids designed with the DLW-proprietary software; (b) and (c) optical microscope images of grids printed with different writing parameters.*

Finally, aiming at realizing stimuli-responsive parts (such as valves, filters) IPB researchers were introduced to the LCEs technology. After an overview on responsive materials, the following protocol was implemented by IPB researchers under UNIFI and INRiM researcher supervision:

- Cell preparation for LCEs alignment and infiltration
- Polarized Optical Microscope (POM) characterization of liquid crystalline cells

2) Training activities and discussion on samples prepared by IPB with natural-derived materials.

As previously mentioned, during the visit, IPB researchers took advantage of CNR equipment to start characterizing their samples and to discuss issues they have at IPB. More in details, parallel experiments were focused on:

i) Improving the stability of microfluidic devices fabricated by fs-laser based local melting of formulation constituted by natural-derived materials (gelatine, pullulan and chitosan). To increase the thermal sensibility of the formulations, these were further doped with edible organic dye adsorbing at the wavelength of irradiation used for selective melting. Negative and positive microfluidic devices were prepared at IPB with two designs reported in Fig. 5 and sent to CNR for characterization.

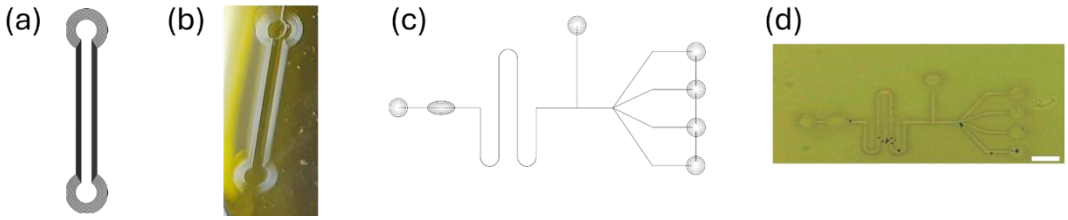


*Figure 8 Virtual models (a) and c) and pictures (b and d) of the two networks of channels realized at IPB by fs-laser nanostructuring of natural-derived formulations sensitized with organic dyes.*

Optical microscope images were acquired to characterize the width and depth of channels that showed a V-shaped cross-section with some clogged parts (Figure 9). This was ascribed to the fabrication process involving scanning a laser whose irradiance has

a gaussian profile and to the spatial confined thermal fusion of the materials. In addition, the samples surfaces were rough and not homogeneous due to the presence of melted and re-deposited materials.

Capillary tests were performed on positive devices and on PDMS stamps, replicated from the negative devices. Samples were tested by pouring a drop of coloured liquid after plasma treatment of the surfaces to increase their wettability and recording videos to observe if capillary effects occurred. For all the samples, no capillar flux was observed due to clogged channels and swelling phenomena (typical of physical hydrogels such as gelatine) that destroyed the samples. Small capillary effect was observed for PDMS channel replicated by pullulan negative stamps.

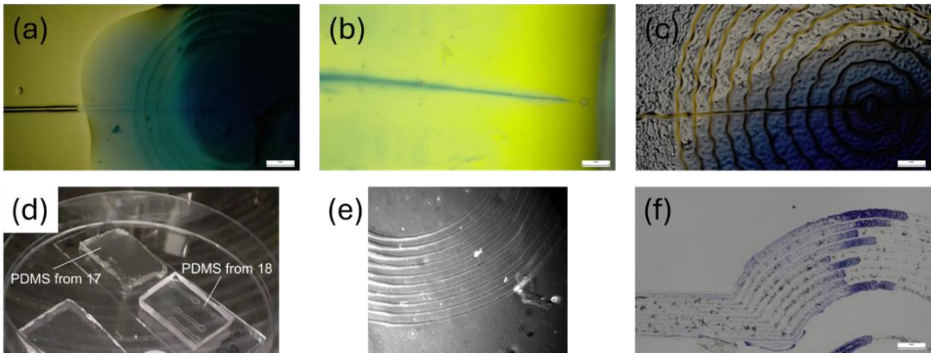


*Figure 9 OM images of gelatin (a and b) and pullulan (c) samples channels used for capillary tests. Picture (d) of the PDMS replica of negative devices. OM images (e and f) of PDMS replicated from pullulan and tested for spontaneous capillarity.*

Based on the experimental results, CNR researchers gave some suggestions on how to decrease the swelling effect by chemically crosslinking the materials, and how to improve the geometries of nanofabricated devices by tuning the laser melting parameters (speed and power).

ii) DLW printing of biomimetic butterfly's wing. This 3D model was used to demonstrate 2-photons DLW nanofabrication procedure.

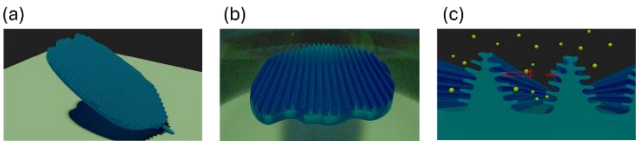


*Figure 10 3D rendering of the bioinspired hierarchical nanostructures characterizing the butterfly wings that has been replicated by 2-photons DLW.*

*Figure 11 Some pictures of the 2nd long-term visit.*

## 2.3 Visit #11

### 2.3.1 Program

The 2nd long-term visit, referred to as Visit #11, was held at CNR-INO headquarter hosted at the European Laboratory for non-linear spectroscopy (LENS), in the Sesto Fiorentino Area, Florence from the 5th till the 18th of November 2023. The visit was attended by one IPB Researcher: Danica Pavlovic. CNR attendees were Caterina Credi (CNR-INO), Caterina Dallari (UniFI) and Sara Nocentini (INRIM, associated to CNR-INO).

### 2.3.2 Summary

The long-term Visit #11 was focused on preparing biological samples on different substrates/scaffolds to be delivered to project partner FSU in Jena to test the feasibility of acquiring images of biological samples with the set-up for quantum imaging with undetected photons that FSU partners are using to train the IPB researchers on quantum holography. The experiment was crucial to understand the feasibility of materials from Visit#6bis to be implemented for the fabrication of devices in the exploratory project. To plan the experimental activities for samples preparation in Florence, a VC meeting including all the BioQantSense partners was held the 18th of October. During this meeting the following things were discussed:

- Explanation of the experiment: briefly, the idea was to seed cells on different types of materials (mainly including the materials for microfluidic devices from Visit#6bis) and to enrich cells with lipids. The mechanical stimulus deriving from different materials employed for substrates, as well as the varied lipid content, should induce morphological and phase changes among samples that could be observed with amplitude and phase images by the quantum holography set-up.
- Definition of the substrates for cells seeding to be prepared at IPB with natural-derived materials. This is a crucial step because it is directly linked to the selection of suitable materials for the lab-on-chip devices of the exploratory project.

- Explanation of FSU set-ups: this discussion was crucial to define the geometry of the cells samples to be prepared as a function of the sample holder, the wavelength of irradiation and the detection configuration of the system.

Following the guidelines identified with the VC call, during the Visit#11, 16 different samples were prepared by implementing practical laboratory experiments already available at CNR and used to train IPB researcher. These protocols included: spin-coating and preparation of PDMS micrometric coatings onto glass; gold-sputtering; cells culturing and confocal microscope characterization. The experimental work was divided according to the following:

*Week 1 – (6$^{th}$- 10$^{th}$ November 2023): Establishment of sampling protocol*

- Preparation of PDMS-coated substrates
- Characterization of the substrates
- Preparation of gold sputtered glasses
- Growth of fibroblast cells on the different substrates
- Cholesterol addition Confocal characterization of seeded cells
- Decision on final arrangement and closing of samples

*Week 2 - (13$^{th}$ – 17$^{th}$ November 2023): Samples preparation for Jena*

- Seeding of cells on substrates to be shipped
- Cholesterol addition
- Fixation of cells
- Closing of samples – two groups: experimental and control
- Samples shipment

More detailed description of the materials and methodology adopted, together with results and comments are reported in the following section.

### 2.3.3 Material

In this section, technical aspects and main results on biological samples preparation are reported. As mentioned before, the aim of the visit was to implement cells culture on substrates potentially used for microfluidics for holographic characterization in Jena. In particular, the idea was to target cholesterol within fibroblast with quantum holography. Indeed, this biological target is of great interest considering that cholesterol quantification is currently used to diagnose rare children disease such as Neimann-Pick.

*Motivation:*

To date, a few biological samples have been characterized by quantum holography with undetected photons. In this context, cholesterol was selected because it has a strong absorbance at 2.6 µm, thus potentially matching the wavelength of the signal photon from the set-up in Jena. Cells with different cholesterol content can result in different samples absorption. Furthermore, CNR researcher has already developed a protocol to enrich the fibroblasts in culture with cholesterol at different concentration.

*Samples preparation:*

During the 1st week of work, the protocol for cells seeding and enrichment was optimized. Figure 9 reports the general scheme of the samples with the main functional components and the main steps implemented.

- Step 1: four types of substrates were prepared to test their potential influence on fibroblasts. Considering the microfluidic application, the selected materials were: standard 100 µm glass cover slip, PDMS, Gelatin and a commercial dental composite. PDMS samples were prepared at CNR by spin-coating (7000 rpm for 3 minutes) on standard glass slides while gelatin and dental composite samples were prepared at IPB before the visit occurred. The thickness of the layers coating the glass was measured.
- Step 2: Cells were plated, seeded on the substrates and left in culture in controlled conditions for 24 hours (following the protocols already optimized at CNR).
- Step 3: 0.6 mg/ml cholesterol aqueous solution was added to the different samples and left for 3 hours (following the protocols already optimized at CNR). Samples without cholesterol were also prepared as reference (Figure 12).

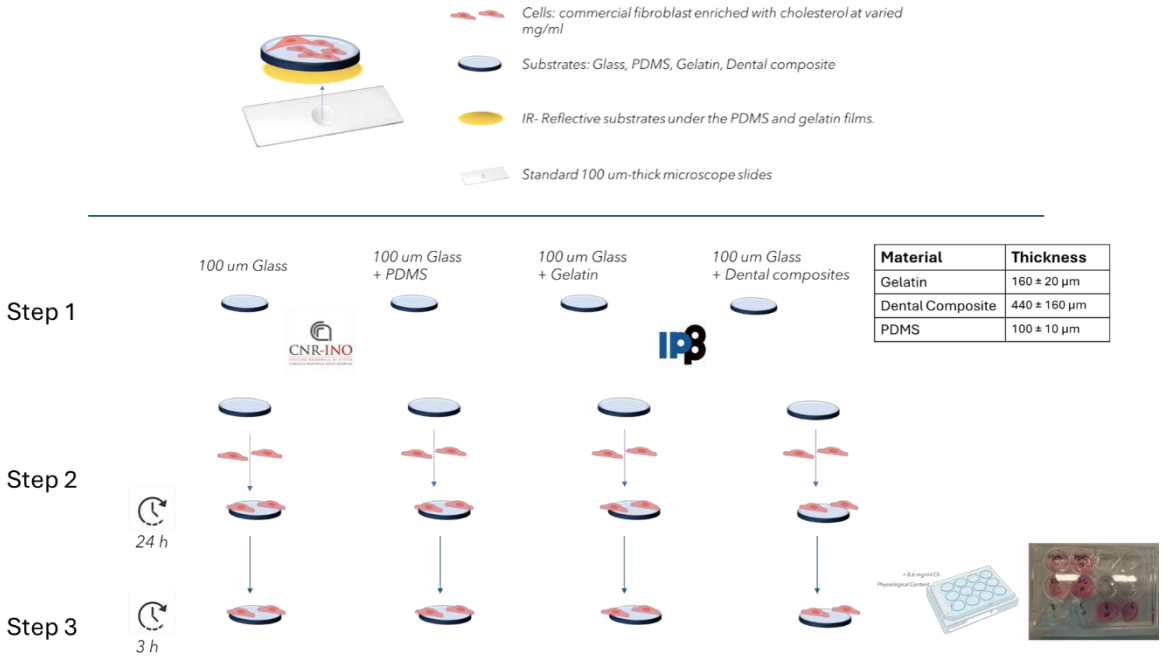


*Figure 12 Overall Scheme of the biological samples prepared for Jena testing and the steps implemented for fibroblast seeding and cholesterol enrichment.*

To check that fibroblasts were still alive and remained attached to the substrates, confocal microscope images were acquired after staining cells membrane with a red-fluorescent protein commonly used to label the membranes. Cells imaging was possible with the bare glass and the PDMS-coated glass because no cells were found on gelatine samples (due to gelatine swelling) as well as on dental composite (probably due to the surface tension of the material). Confocal microscope images showed that cells remained alive and attached to the substrates (Figure 123). An accentuated round-shape morphology was appreciated for cholesterol enriched cells. This interesting result could be verified thorough analyses of images obtained by quantum microscope.

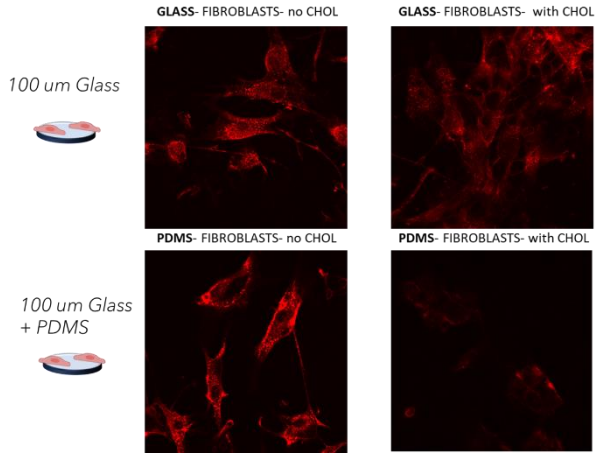


*Figure 13 Confocal images of WGA-labelled fibroblasts growth on bare glass and PDMS-coated glass.*

*Samples closing for FSU imaging:*

During the 2nd week of work, the optimized protocol for cells seeding and enrichment was repeated. In addition, samples were prepared for safe shipping to Jena and to be easily adapted to the sample holder of the two set-ups exploitable for first sample imaging. A general scheme of the working configuration of the two set-ups together with the main technical details are reported in Figure 14. During sample preparation and design of the experiment with cells, it was crucial to consider the strong back scattering of idler photons in the working configuration of the systems.

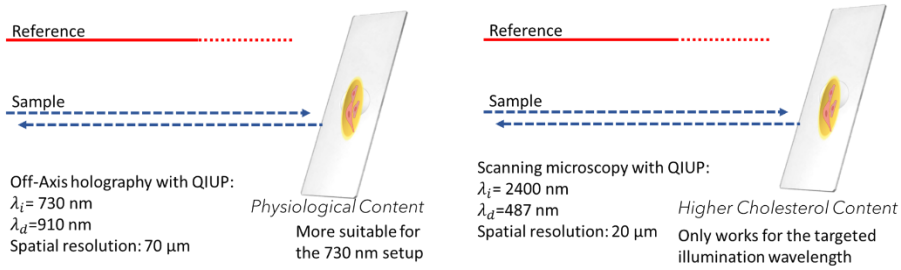


*Figure 14 Overall Schemes and main technical specifics of the set-ups available in Jena for samples imaging.*

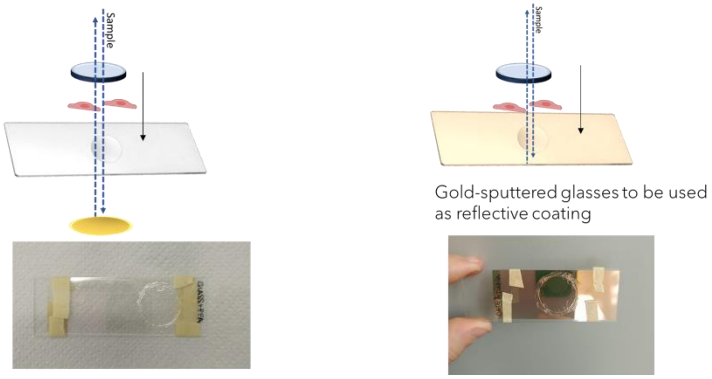


*Figure 15 Scheme and pictures of the two strategies used to easily seal the samples for shipping and for acquiring images.*

Indeed, sample closing for safe shipping was designed i) to decrease the number of interfaces between the source and the sample (to decrease the background signal) and ii) to have a reflective substrate to improve the scattered signal. To address issue i) cells were seeded onto

micrometric layer of varied substrates (previous section). To address issue *ii)* a reflective substrate was coupled with the cells sample. As reported in Figure 15, the reflective substrate could be a standard mirror external to the sample or could be a gold-sputtered standard microscope slide exploited to seal the samples. Before sealing the samples, cells were fixed with standard biochemical protocols. After this treatment, cells samples can be stored in the fridge in dried conditions without losing their morphology. In Figure 16 the samples delivered to Jena are reported.

| **GLASS**: | **PDMS**: |
|---|---|
| Glass + bare glass slide | PDMS + bare glass slide |
| Glass + Au sputtered glass slide | PDMS + Au sputtered glass slide |
| Glass + PFA + bare glass slide | PDMS + PFA + bare glass slide |
| Glass + PFA + Au sputtered glass slide | PDMS + PFA + Au sputtered glass slide |
| Glass + Cells + PFA + bare glass slide | PDMS + Cells + PFA + bare glass slide |
| Glass + Cells + PFA + Au sputtered glass slide | PDMS + Cells + PFA + Au sputtered glass slide |
| Glass + Cells + Cholesterol + PFA + bare glass slide | PDMS + Cells + Cholesterol + PFA + bare glass slide |
| Glass + Cells + PFA + Cholesterol + Au sputtered glass slide | PDMS + Cells + PFA + Cholesterol + Au sputtered glass slide |

*Figure 16 List of samples delivered to Jena.*

# 3 Management visits

The Management exchange visits effectively performed among IPB and CNR staff are reported in Table 3. The main topics addressed in these 2 visits were the management of European projects, good practices and support tools for monitoring project implementation and some approaches for expanding funding opportunities and scientific collaborations.

| Visit | Type | Where | Duration | When | Project Month | effective date | involved people | Objectives |
|---|---|---|---|---|---|---|---|---|
| 6 | Management | CNR (from IPB) | Mid-term visit | May 2023 | M8 | 21-23 June 2023 | Dusica Vukcevic Stojiljkovic, Marina Lekic | Managing EU-funded projects |
| 10 | Management | IPB | Mid-term visit | September 2023 | M11 | 18-21 March 2024 | Giulia Adembri, Donata Fornaciari (remotely) | Innovation and transfer - Partner & Funds search and aspects of cooperation with non-scientific sector |

*Table 3 Management visits planned and performed in M1-M18 among IPB and CNR staff.*

After the visit#6 in Florence at CNR-INO, in addition to the interaction and exchange of documentation via email, two follow-ups via VC calls (oct 2023 and nov 2023) were made to monitor the status of the project and the necessary actions from a management point of view with the scientific coordinator.

The other planned exchange visit in M1-M18, visit #10 at IPB in Belgrade by CNR-INO staff, has been postponed in March 2024, just before the review meeting with the PO and EC Expert held on 21st March.

The *IPB's Department for international cooperation and projects* (IPB Grant Office) was established at the beginning of 2022 and it is still on its path to became strong administrative and expert support to the scientific research teams of IPB working on the EU and international projects. The BioQantSense, being the Twinning Horizon Project, gives the opportunity to IPB staff to learn on the CNR-INO experience in project realization and EU projects Grant Management.

Learning from CNR-INO experiences, IPB is setting the goal of twining some of CNR-INO grant management tools and models to the *IPBs Department for international cooperation and projects*, to became full support to the IPBs researchers.

## 3.1 Visit #6

The 1st Management visit at CNR-INO from IBP staff was held at the National Institute of Optics of CNR (CNR-INO), Arcetri, Florence (21st and 22nd June) and in the European Laboratory for Non-Linear Spectroscopy (LENS), Sesto Fiorentino, Florence (23rd June).

Participants involved:

- IPB staff: Dusica Vukcevic Stojiljkovic (Grant Office), Marina Lekic (BioQantSense Project Manager)
- CNR-INO staff: Donata Fornaciari (Grant Office), Giulia Adembri (Grant Office), Pasqualina Pipino (Grant Office)

### 3.1.1 Program

The topics addressed in the skill transfer were adapted and integrated with respect to the original objective of the visit plan defined in D4.2, based on the specific needs of the IBP management staff who participated.

The resulting program is resumed below:

**Wednesday 21 - Arcetri - 10.15-17.00 – "Biblioteca- Library"**

- Financial management and reporting in projects funded by the European Commission
- Preparation of documentation for audit certificate on an EC funded project
- CNR-INO practices on project management and overview of support tools

**Thursday 22 - Arcetri - 10.00-17.00 – "Biblioteca- Library"**

- General obligations from Consortium and Grant Agreements - How to manage and monitor the budget of a funded project
- BioQantSense project: monitoring of expenses; obligations from Consortium Agreement; obligations from Grant Agreement
- Personnel costs calculation, reporting

**Friday 23 – Sesto Fiorentino - 09.30-15.30 – "European Laboratory for Non Linear Spectroscopy (LENS)"**

- Data Management Plan (D4.3), draft overview and revision
- Project monitoring - deliverables status
- Final conclusions of the visit
- Planning of to do actions

### 3.1.2 Summary

Topics discussed during the visit were about financial administration & auditing preparation for EC funded projects - from understanding the financial aspects of Horizon to successfully dealing with on-the-spot audits. Since the Institute of Physics Belgrade (IPB) has several ongoing EC funded projects, it was extremely useful to discuss these topics with the CNR-INO Grant Management Office representatives, having in mind that CNR is one of the most successful Italian institutions regarding EU project realization.

Special focus was given to the BioQantSense project realization - project financial and administrative management, delivering results and deliverables in time and in accordance with the project proposal, successful project management and coordination.

Third day of the 1st Management visit at CNR-INO was organized at the European Laboratory for Non-Linear Spectroscopy (LENS), Sesto Fiorentino, Florence. Attendees at this meeting were, along with Giulia Adembri and Donata Fornaciari from the CNR-INO Grant Management Office and Marina Lekic and Dusica Vucevic Stojiljkovic from IPB, were BioQantsSense PI Caterina Credi and IPB's project team members, Svetlana Savic-Sevic and Aleksander Kovacevic, who were in the scientific visit to Italian partner at that time (13-27.06.2023, see visit#6bis). During this day, the BioQantSense Data Management Plan (D4.3), draft version, was discussed and revised, and final conclusions of the visit and the future project managemental actions were set. Over the visit, the BioQantSense project monitoring - deliverables status was discussed (first drafts and final versions deadlines, progress of the project and deliverables, etc). Finally, a list of decision taken and of actions have been planned and carried out in the next months (see Table 4).

| Decisions taken and Actions / ToDo Items | | | |
|---|---|---|---|
| | **Description** | **Activity coordinator** | **Deadline** |
| 1. | Develop the template report for exchange visits<br>• number of visits<br>• where<br>• who<br>• when<br>• typology<br>• objective of the visit/what learned<br>• documentation/data typology (report/protocol/dataset/tool) produced during the visit<br>• is it produced some final output? | Dusica Vukcevic Stojiljkovic | 01/07/2023 |
| 2. | Develop the Guide for the potential applicants and active grant holders at the IPB<br>• Rules and Procedures of Horizon Europe<br>• open calls for project submission<br>• travel expenses<br>• internal procedure – grant preparation, grants realization and management<br>• etc | Dusica Vukcevic Stojiljkovic | Draft version – September 2023 |
| 3. | CNR's project management centralized system presentation to be done at the IPB during the visit of the CNR-INO Grant Management Office representatives in September 2023 (visit No. 10)<br>✓ Preparation of the presentation (CNR):<br>• CNR Grant Management Office web site<br>• CNR Grant Management Office data base<br>• CNR Grant Management Office procedure for the grant preparation / application<br>• CNR Grant Management Office – project management<br>• etc<br>Target group / attendees at the presentation: IPB directors and chairs, IPB administrative staff (financial office, public procurement office, HR office, legal office, Department for international cooperation and projects) | Marina Lekic | |
| 4. | D2.1 Implemented measures and processes to improve and strengthen IPB capabilities – draft version to be sent to the partners in August 2023<br>• Description: Report on implemented measures and processes to improve and strengthen IPB capabilities in management, coordination and administration of R&I research projects<br>• Material available to prepare it:<br>  • D1.1, D1.2, D1.3 and D1.4<br>  • implementation of recommendation about the pathway for building a Grant Office and facilities to improve support to researchers in project applications at IPB, especially at european level: long-term plan and first covered steps (IT tools that could be useful for supporting project applications, web pages to inform researchers on the open calls, etc) | Dusica Vukcevic Stojiljkovic | September 2023 |
| 5. | D3.3 Project newsletter | Marina Lekic | September 2023 |

| | | | |
|---|---|---|---|
| | • Description: Includes news about project activities. Also news about major achievement's in the world in the project related research fields. The first issue will be at M12<br>• Material available to prepare it:<br>  • results obtained also through deliverables (kick-off, visits and results, website and plan of communication, social media, brochure, organization of workshops, participation in conferences etc. | | |
| 6. | Communication activities (T3.3 and T3.7)<br>• Publishing posts into the social channels<br>  • facebook IPB and BQS<br>  • linkedin IPB and BQS<br>• Interview on Garden of Physics in IPB at the end of the year 2023 https://www.ipb.ac.rs/en/category/vrt-fizike-en/page/2/ | Marina Lekic | Continuous |

*Table 4 List of decision taken and to do actions at 1st management visit at CNR-INO Florence.*

### 3.1.3 Material

The slides presented and documentation showed during the visit have been put in the shared folder hosted on CNR OneDrive repository dedicated to the BioQantSense project consortium.

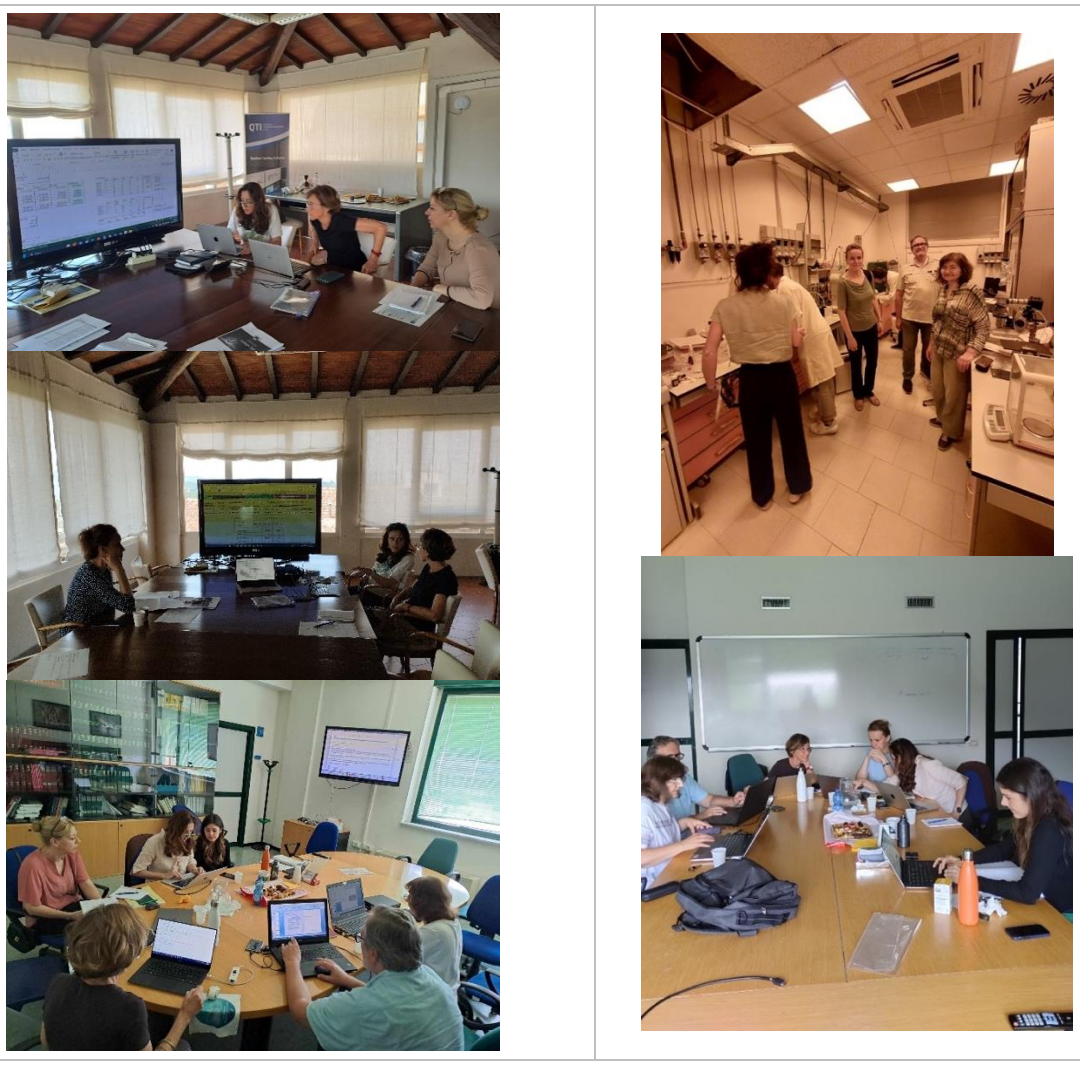

*Figure 17 Some pictures of management visit at CNR-INO held on 21-23.06.2023*

## 3.2 Visit #10

The 2nd Management exchange visit planned was performed at IBP from CNR-INO staff and was carried out on 18-21 March 2024.

Participants involved:

- IPB staff: Dusica Vukcevic Stojiljkovic (IPB's Department for international cooperation and projects), Marina Lekic (IPB Photonics Center Research Associate and BioQantSense Project Manager), IPB director, IPB staff from Innovation Center, Human Resources, Accounting, Legal, IT office and BioQantSense IPB project staff, Aleksandar Krmpot, head of Biophysics Lab at IPB Photonics Center and Mihailo Rabasović, Researcher at Biophysics Lab at IPB Photonics Center.
- CNR-INO staff: Giulia Adembri (Grant Office). Moreover, the responsible for CNR-INO Grant Office Donata Fornaciari remotely connected in the morning session on 19 of March 2024.

### 3.2.1 Program

This exchange visit was mainly focused on in-depth analysis of the practices and tools used at the CNR-INO for the submission, management and reporting of funded projects. Furthermore, some information was provided on the approach of performing scientific collaboration with other bodies and on the practices for exploiting research results. Moreover, the review meeting planned by EC for the 21st of March was prepared and performed.

**Monday, 18 March 14.00-17.30 – Dragan Popovic room**

- Innovation and transfer - Partner & Funds search and aspects of cooperation with non-scientific sector

**Tuesday, 19 March 09.30-17.00 – Dragan Popovic room**

- CNR's project management centralized system presentation including questions and answers
- Suggested improvement to the IPB's Project management office - presentation and discussion
- Visit of Biophysics Lab of IPB Photonics Center

**Wednsday, 20 March 09.30-17.30 – Dragan Popovic room**

- Scientific collaborations and connections to foster the success of funding possibilities and to be more attractive for young researchers
- In-depth analysis of the draft report shared by the expert reviewer in view of the review meeting

**Thursday, 21 March 09.00-12.45 – Dragan Popovic room**

- On-line Review Meeting with PO and Expert

### 3.2.2 Summary

During her three-day stay at the Institute, Giulia Adembri, Project Manager at the National Institute of Optics of CNR and part of Grant Office CNR-INO, shared experiences, practices and procedures from her institution, which has around 180 employees and participates in a large number of international projects.

Giulia Adembri presented CNR-INO approaches mainly to Dusica Vukcevic Stojiljkovic, Marina Lekic and partially to IPB director and staff belonging to various offices of IPB. As first, an introduction on the organizational structure of the CNR, the biggest research public research entity in Italy and the National Institute of Optics, one of the largest among 88 institutes that belong to CNR was necessary (Figure 18).

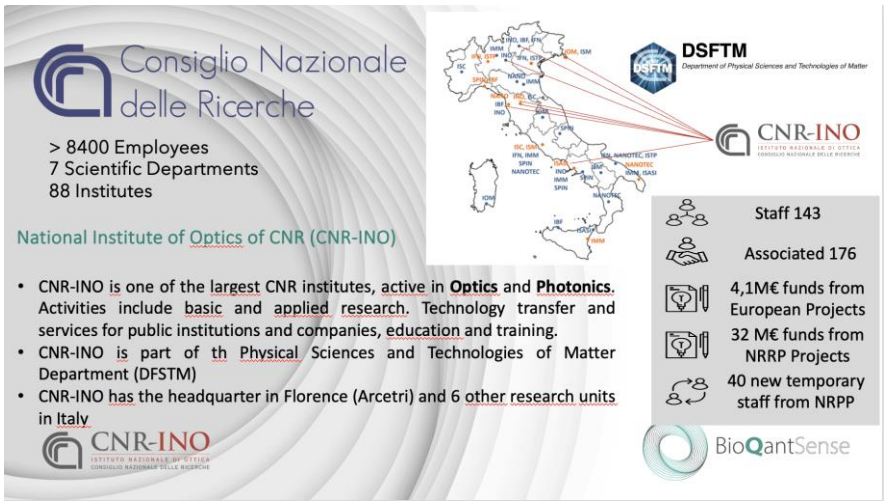


*Figure 18 Organizational structure of the CNR-INO, one of the 88 Institutes of CNR.*

A focus on the collaboration ecosystem of the CNR-INO Unit located in University Campus at Sesto Fiorentino (Florence), where BioQantSense project activities are performed, has been made (Figure 19).


*Figure 19 CNR-INO in Florence, including Arcetri and Sesto Fiorentino Unit.*

An overview on the innovation and transfer activities and initiatives usually performed at CNR-INO have presented, among there: spin-offs generated, joint laboratories with enterprises, networking activities and dedicated events organized to match research results and industrial needs, as the *Vasco Ronchi Colloquia*, short targeted meetings to approach companies and propose innovative technologies (Figure 20).


*Figure 20 Characteristics of CNR-INO Vasco Ronchi Colloquia events*

Facilities and tools to support information and details about funds opportunities performed by CNR Central Grant Office have been showed. This service is provided for all CNR institutes, with a dedicated internal CNR website enabled by SharePoint application of Microsoft Office 365 enterprise package, adopted by CNR by 2023 (Figure 21). CNR Central Grant Office also offers ERC specific support service for supporting the project drafting and for performing an interview simulation for proposal passed the first phase of evaluation.


*Figure 21 CNR Central Grant Office - internal website.*

A mention of financial management of the budget of funded projects at CNR central level was opportune to introduce the management of the budget assigned at CNR institute level for projects approved by funding agencies. CNR-INO developed several own software tools useful to support the monitoring, implementation and claim of costs and resources in project activities. Two main software frameworks are available to Grant Office managers, Administration staff and Principal Investigators with differentiated access and functionalities:

- *FondiGae Platform*, to monitor project budget, purchases and recruited persons)
- *RendicontaProgetti Platform*, to monitor staff resources

*FondiGae Platform* integrates software modules to real time tracking and retrieval of all expenses and completed documental digital flows of purchases and travels, to be facilitated in the claim of costs phase to funding agencies, over than to monitor the project budget and of work plan (Figure 22).


*Figure 22 Screenshots of budget monitoring functionality for BioQantSense project (left) and documental digital flow of a chemicals purchase (right) on it.*

*RendicontaProgetti Platform* is a system linked to the clocking in-out system used by staff access with badge enables (Figure 23):

- to reserve and re-plan person/months for staff involved in each project funded
- control to not exceed the maximum productive annual time of each researcher
- insert daily time spent in each project by staff
- monitor the effective effort performed in each project
- extract timesheets both in integrated form with all projects participated and unique project participation.

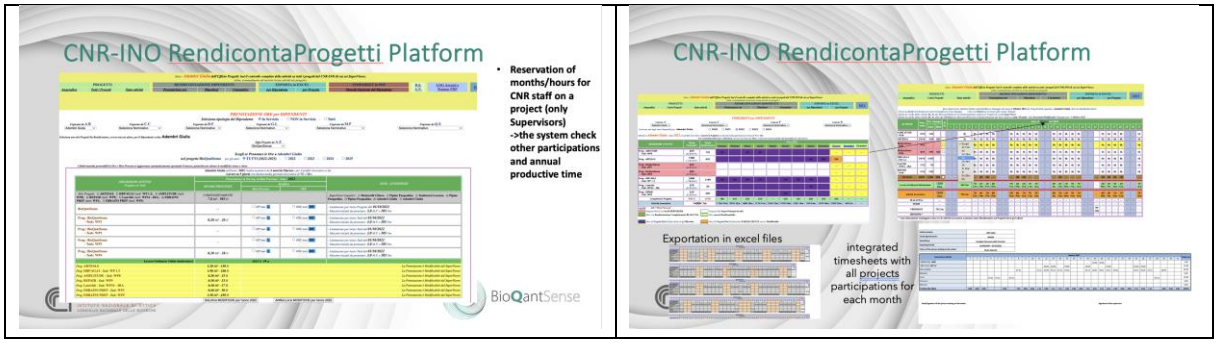


*Figure 23 Screenshots of reservation of person-months functionality (left) and different visualization and formats for timesheets (right) enabled by RendicontaProgetti Platform.*

A good practice at CNR-INO when a new project is funded is to organize an internal kick-off meeting between Grant office, administration and research team (at least the PI) for analyse and plan the implementation of the project according to the submitted proposal. Then a continuos monitoring of the resources and expenses has performed by the specific supervisor from CNR-INO Grant Office assigned to each funded project.

A further software tool developed *Cruscotto Progetti*, for which an optimization is in progress, is also showed. The dashboard Platform goal is to monitor submissions and phases status of project proposals.

Giulia Adembri also performed a visit to the Biophysics Lab at IPB Photonics Center to be informed by his head Aleksandar Krmpot about biophotonics activities already actives in the lab, in order to search for possibilities of expanding collaborations with CNR-INO and LENS.

Since the exchange visit was organized immediately before the online review meeting planned by the PO with the external expert, we also took the opportunity to address together as IPB and CNR-INO some comments anticipated by the reviewer on Wednesday afternoon. The visit ends on Thursday 21$^{st}$, after the participation at the online review meeting.

### 3.2.3 Material

The slides presented and documentation showed during the visit have been put in the shared folder hosted on [CNR OneDrive repository dedicated to the BioQantSense] project consortium.


*Figure 24 Some pictures of management visit at IPB held on 18-21.03.2024.*