

REPORT on the PIANOFORTE-funded training course  
**BioMod<sup>R</sup> - "Models" in biomedical physics and radiation protection  
research: from *in vitro* cell systems to population studies**  
*organized and hosted by the University of Pavia, Pavia, Italy*  
19 – 23 June 2023

The 1<sup>st</sup> edition of the **BioMod<sup>R</sup>** course was intended to propose to participants an excursus on different models adopted to study biological phenomena, with a focus on ionizing radiation effects and radiation protection research, starting from standard *in vitro* cell cultures, organoids and 3D tissue replicas, organ-on a chip systems, *in vivo* models, finally extending the conception of "model" to a population of subjects/patients for clinical or epidemiological studies.

#### **PARTICIPANTS, LECTURERS and PRACTICAL ASPECTS for the ORGANIZATION**

The course has attracted a large number of applicants (26), among which we selected, based on the provided documentation (CV, motivation letter and reference letter) and rules anticipated in the call for application (priority to PhD students), 12 participants from a varied list of Countries (Spain, Belgium, Greece, Sweden, 2 x Hungary, Czech Republic, Croatia, Netherlands, France, Poland, Portugal). The course had no fee and these 12 participants (the target number of the course) were offered accommodation in a Guesthouse close to the Physics Department, UniPv, where the course took place.

In addition to these participants, and considering the obvious limitations in space and cost to organize practical hands-on sessions (see later), we decided to accept for the course 3 extra participants not requiring free accommodation (2 from Italy and 1 from Singapore). Moreover, 3 local PhD students also attended the course, which was integrated in the course offer of the Pavia PhD programme in Physics, for a total of 18 participants. All participants were invited to the course social dinner, which took place on Wednesday. They were also provided information on ongoing events in Pavia for the week of the course.

Participants' background was as follows: 12 had a biology/biomedical background; 6 a more specific physics/medical physics background. All of them (with the exception of an Italian M.Sc. student and a senior researcher from Singapore) are currently enrolled in a PhD programme, in almost all cases their PhD projects includes radiobiology and radiation protection research.

Lecturers were UniPv staff (**Lonati** and **Guardamagna**, Physics Dept., and **Conti**, Engineering Dept.) and external: **Regalbuto** (Biomedical Sciences Institute of the Italian Ministry of the Defence, Italy); **Conde** (MICRONIT, The Netherlands); **Gadan** (Comisión Nacional de Energía Atómica, Argentina); **Fumagalli**, **Moro** and **Micotti** (Research Institute Mario Negri, Italy); **Citterio** (Piacenza Hospital, Italy); **Eidemüller** (BfS, Germany). In their selection we paid attention to the varied nature of their institutions, including research institutes (with clinical

or military focus), national commissions, as well as a private company, and also to the inclusion of techniques/approaches not yet commonly implemented in radiation research, for a further translation of new ideas to this field.



BioMod<sup>R</sup> - group picture. Link to UniPv website news (Italian): <http://news.unipv.it/?p=84824>

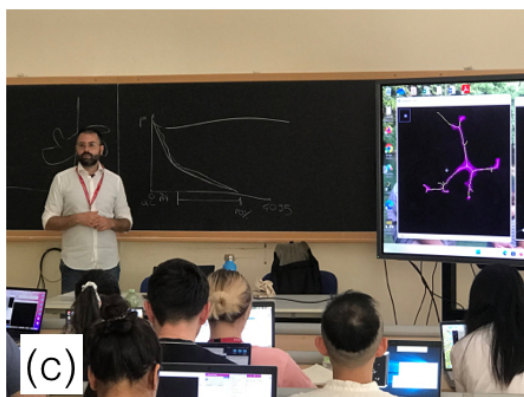
## **COURSE CONTENTS and HANDS-ON SESSIONS**

The course detailed programme is included at the end of this section. In addition to theoretical lectures, we wanted to offer to the course participants hands-on sessions on possibly all topics covered in the course.

In particular:

- During day 1, a radiation biology lab session was organized and hosted by the Radiation Biophysics and Radiobiology Laboratory of the Physics Department (<http://radbiophys.unipv.eu/>). Participants (in particular those who had no previous experience because of their main Physics background) performed *in vitro* work with cell cultures (more in detail, they were guided in a staining protocol for flow-cytometry), and example measurements with the flow-cytometer and at the fluorescence microscope;
- During day 2, in the morning: participants visited the 3D@UniPv Lab (<https://3d.unipv.it/>) facility and were shown a demonstration with a bioprinter; in the afternoon, they assembled a small microfluidic device for disease diagnosis;

- During day 3, two image analysis hand-on sessions were organized, the first with Image-J (for fluorescence microscopy images) and the second with ITK-SNAP (for MRI images obtained from in vivo models);
- During day 3, in the morning: participants were guided in a group exercise to analyse and find mistakes and pitfalls in clinical trial papers that were first published and then withdrawn by the journals; in the afternoon, they were asked to solve mathematical exercises dealing with radiation risk estimation.



**BioMod<sup>R</sup> – pictures of hands-on sessions:**

**(a) Radiobiology Lab Session; (b) microfluidics hands-on; (c) Image-J training; (d) clinical trial paper analysis session**

Day	Topic	Title	Time	Lecturer
<b>Mon</b> <b>19/6</b>	Welcome	<i>BioMod<sup>R</sup> – presentation of the course</i>	09:30-10:15	<u>G. Baiocco</u>
	In vitro - LEC	<i>In vitro cell systems – an overview</i>	10:15-13:00	<u>E. Regalbuto</u>
	In vitro - LAB	<i>In vitro lab techniques for radiation biology</i>	14:15-18:00	<u>I. Guardamagna,</u> <u>L. Lonati</u>
<b>Tue</b> <b>20/6</b>	Towards In Vivo (3D@UniPv Lab)	<i>3D tissue models and bioprinting</i>	9:30-13:00	<u>M. Conti</u>
	Towards In Vivo LEC + hands-on	<i>Microfluidics applications and Organ-on-a-chip systems</i>	14:15-18:00	<u>A.J. Conde,</u> <u>M.A. Gadan</u>
<b>Wed</b> <b>21/6</b>	In Vivo – LEC + hands-on	<i>Optical microscopy in clinically relevant models of diseases</i>	09:30-13:00	<u>S. Fumagalli</u>
	In Vivo – LEC + hands-on	<i>Magnetic Resonance Imaging in Experimental Models</i>	14:15-18:00	<u>F.Moro</u> <u>E. Micotti</u>
<b>Thu</b> <b>22/6</b>	Population studies	<i>Clinical trials</i>	09:30-13:00	<u>C. Citterio</u>
	Population studies	<i>Radiation epidemiology and radiation risk modelling</i>	14:15-18:00	<u>M. Eidemüller</u>
<b>Fri</b> <b>23/6</b>	Self-preparation for the test		9:30-11:30	
	Final test		11:45-13:30	

BioMod<sup>R</sup> - detailed course programme.

## **FINAL EXAM and PARTICIPANTS' EVALUATION FORM**

During the last day of the course a multiple-choice questionnaire was administered to participants, with questions on all course topics prepared by the lecturers. Teaching material for self-preparation was shared with the participants prior to each lecture. The correction of the exam revealed a high-score for all participants, who were given a certificate of attendance and completion of the exam.

After the final exam, participants were asked to fill an online anonymous evaluation form, whose results are reported in the following.

<b>QUESTION</b>	<b>AVERAGE GRADE (1 – low to 5 - high)</b>
<b>What is your general view about the organization of the course?</b>	4.7
<b>What is your general view about the quality of the course?</b>	4.6
<b>Did the content of the course match your expectations?</b>	4.5
<b>Did you have enough basic knowledge to follow the course?</b>	4.0
<b>How difficult was it to follow the theoretical parts of the course?</b>	2.6
<b>Would you have preferred to hear more lectures?</b>	3.2
<b>Would you have preferred to do more practical work? If yes, on what subject in particular?</b>	7 participants answered NO; YES answers were mainly suggesting the following topics: <ul style="list-style-type: none"> <li>• In vitro assays</li> <li>• Organoids</li> <li>• Bioprinting</li> </ul>
<b>How much knowledge did you acquire from the course?</b>	4.3
<b>Did you miss certain subjects that you think would have been relevant? If yes, what in particular?</b>	12 participants answered NO; YES answers were mainly suggesting the following topics: <ul style="list-style-type: none"> <li>• More basic radiobiology concepts</li> <li>• 3D in vitro cultures</li> <li>• Mathematical modelling and validation technique</li> <li>• CT imaging</li> </ul>

<b>Would you agree: I will benefit from the knowledge acquired during the course and I'll have the chance to include new ideas/experimental models in my research project</b>	4.5
<b>Would you agree: I will benefit from the networking and explore possible opportunities for collaboration in the future</b>	4.8

Participants were equally asked to grade all lectures; results are reported in the following.

<b>LECTURE EVALUATION</b>	<b>AVERAGE GRADE (1 – low to 5 - high)</b>
<b>In vitro cell systems – an overview</b>	4.6
<b>Lab techniques for radiation biology</b>	4.6
<b>3D tissue models and bioprinting</b>	4.5
<b>Microfluidics applications and Organ-on-a-chip systems</b>	4.0
<b>Optical microscopy in clinically relevant models of diseases</b>	4.4
<b>Magnetic Resonance Imaging in Experimental Models</b>	3.8
<b>Clinical Trials</b>	4.2
<b>Radiation epidemiology and radiation risk modelling"</b>	4.2

Free comments/suggestions gathered from the participants in anonymous form were found to depend on their background: few of them asked for a less-intense physics content, while one noticed that the course was more “biology”-weighted. Few participants also suggested shorter lectures and noticed a sometimes too dense lecture schedule, which was a consequence of the planning of the course in 1week.

Free-text comments are reported in the following.

<i>In my opinion it was well prepared course and the lectures where really interesting.</i>
<i>Maybe make it a little less intense on the physics :)</i>
<i>It would be better to introduce the more complicated lectures in the morning sessions rather than at the afternoon ones</i>
<i>Maybe to do the limit of number the slides for lectors</i>
<i>more time dedicated to hands-on</i>

*I would split the radiation hazards lecture (Thursday afternoon) into two separate times, there are many concepts to assimilate in one afternoon*

*I expected a bit more physics. But maybe it was just my misunderstanding about the course. It was definitely more biology weighted.*

*I think that the course is well organized, the wide spectrum of topics is very interesting, I really liked it*

*I think that most of the courses were necessary and very interesting, I would add that maybe some courses went too in detail with irrelevant things (MRI physics is my whole background, and I would have been incapable to follow the course on physics for 4h if I wasn't already knowledgeable on the subject) and some were maybe too abstract, for instance the 3D printing is very interesting, but it's hard to know how I could implement that or how it is relevant to my research.*

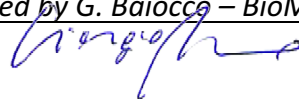
*In general, everything went very well.*

*Explore more the use of in vitro models (3D) with biological assays, correlations or their relevance for dose simulation*

*Some of the concepts require a little easing into. Some of the physics part of the lectures were difficult to follow without a good visualisation of the theories. The imaging software part of it was really cool albeit difficult to follow as i'm not very familiar with the functions and how they work. It was a bit frustrating not understanding what exactly the functions did.*

Overall, a high satisfaction level was assessed both for the course quality and organization. All suggestions will be taken into account for future proposals of course repeats in occasion of future PIANOFORTE CALLS for training courses.

Report prepared by G. Baiocco – BioMod<sup>R</sup> Course Director



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