



# INFORME D'ACREDITACIÓ DEL PROGRAMA DE DOCTORAT (IAPD) FASE ESPECÍFICA *Fotònica*

Traçabilitat de les versions del document		
Versió	Data	Modificacions
1	31/05/2021	Autoinforme d'acreditació V1 enviat a GPAQ per a la seva revisió
2	18/06/2021	Autoinforme d'acreditació V2 que incorpora revisió del GPAQ
3	07/07/2021	Autoinforme d'acreditació V3 que incorpora aportacions rebudes durant l'exposició pública i és la versió definitiva per enviar a AQU que ha aprovat l'òrgan col·legiat que estableixi el SGIQ
4	[Data]	Si s'escau, autoinforme que incorpora els requeriments obligatoris d'AQU, un cop acreditat el programa

*S'indiquen les versions mínimes que recomanem que contingui la taula*

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# 1. Context

## Dades identificadores

<b>Universitat</b>	Universitat Politècnica de Catalunya
<b>Nom del programa de doctorat</b>	Fotònica
<b>Codi RUCT</b>	5600740
<b>Enllaç web</b>	<a href="https://doctorat.upc.edu/ca/programes/fotonica">https://doctorat.upc.edu/ca/programes/fotonica</a>
<b>Coordinació del programa</b>	David Artigas Garcia
<b>Dades de contacte</b>	93 553 41 36, david.artigas@icfo.eu

<b>Responsables de l'elaboració de l'IAPD</b>	David Artigas (coordinador, professor del programa), Robert Sewell (Head of acadèmic affairs, professor del programa) , Laia Miralles (Cap de recursos Humans i Educació, PAS Personal d'Administració i Serveis), Mery Gil (Administradora del programa de doctorat, PAS (Personal d'Administració i Serveis) Arturo Villegas, (president ICONS, estudiant)
<b>Òrgan responsable d'aprovació</b>	Comissió acadèmica del programa
<b>Data d'aprovació de l'informe</b>	06/07/2021

## Presentació del Programa de Doctorat

Photonics has been identified by the European Commission (EC) as Key Enabling Technology for Europe, recognizing its importance. Today, the European photonics industry, made up mainly of small and medium companies, is growing rapidly and thriving: it is estimated that 5,000 companies have created more than 300,000 highly skilled job positions in this sector with an annual turnover of over 60 billion 'euros. With an annual growth rate of 6.2% over the period 2005-2017, the European photonics industry is growing four times faster than European GDP, and is expected to reach 8% by the end of 2021. According to the EC, in order to maintain this capacity, it will be necessary to promote cutting-edge research in the field and train a critical mass of professionals and researchers with the necessary skills. The PhD program in Photonics therefore captures this need and transforms it into its mission.

The UPC Doctoral Program in Photonics is promoted by ICFO- the Institute of Photonic Sciences, located in the Mediterranean Technology Park, in the metropolitan area of Barcelona. ICFO is a CERCA Research Center. It was founded by the Generalitat de Catalunya and the Universitat Politècnica de Catalunya (UPC), which are members of its board of trustees together with the Cellex and Mir-Puig foundations, philanthropic organizations that have played a key role in its advancement. The institute currently hosts more than 450 researchers, organized into 24 groups and 60 state-of-the-art research laboratories. The lines of research cover several areas in which photonics play a key role, with emphasis on basic and applied topics relevant to medicine and biology, advanced imaging techniques, information technologies, a range of environmental applications, tunable and ultrafast lasers, quantum science and technology,

photovoltaics and the properties and applications of nanomaterials such as graphene, among others. In addition to three Severo Ochoa grants of excellence, researchers at ICFO have secured 15 ICREA chairs and 40 European Research Council (ERC) grants. During these years, 31 articles have been published in the journal Science, 25 in Nature and more than 185 articles in other journals of the Nature group, all of them with the highest impact factor. Altogether, more than 3,200 publications have been published, obtaining nearly 140,000 citations. ICFO is proactive in fostering business activities, creating spin-off companies, and collaborations and links between industry and its researchers. To date, ICFO has helped create 10 new companies and has a patents portfolio licensed to companies around the world, so that in 2020 it was the 9th institution that registers more European patents in Spain, at the same level than SEAT, and only surpassed at Catalan level by the UPC and the pharmaceutical company Esteve.

The Photonics Program was established in 2007 to channel the growing expertise, research results and prestige into its own training program. Since then, the program has grown to reach more than 145 registered PhD students in the 2020-21 academic year, with more than 170 theses already defended within the program, 91 of them within the Real Decreto 99/2011. The results of the program during these years are valued as highly positive. The program has had a strong evolution and the ability to incorporate improvements in order to respond to the needs of the field and the students, adjusting procedures and protocols when a need has been identified. Broadly speaking, during this period the program has gone from an initial phase of creation and consolidation in which the actions were mainly focused on defining processes, consolidating the program as a reference for doctoral education, to a phase of expansion in which the high quality of the program at the level of education and student support has been enhanced. In this sense, special attention has been paid to selection procedures, the expansion of the educational offer, support, accompaniment services and personal growth, while ensuring future employability of the PhD student. Finally, with the guidance of the Academic Committee of the Doctorate Program (CAPD, from its initials in Spanish), work has been done to consolidate all the processes of the program to guarantee transparency and good practices. All these have made it possible to reach the current situation of a highly consolidated program with processes based on student promotions, participation of selection and monitoring committees, homogenized processes, support and mentoring that guarantee the quality and efficiency of the program.

One of the areas of ICFO's triple mission is training the next generation of scientists; in this context, PhD students are considered one of the main assets of ICFO. The Institute in general and the Photonics program in particular have established themselves worldwide as a reference program for young researchers in the field of photonics, thus responding to the EC's mandate to train a critical mass of professionals and researchers with competencies in Key Enabling Technologies. The present Accreditation Report (Informe de Acreditación) therefore identifies the achievements and areas for continuous improvement that will be required in the future to maintain these excellent results and to consolidate the reputation of the program.

## Agents que han participat en l'elaboració de l'informe d'acreditació (Comitè d'Avaluació Interna)

Nom i Cognoms	Càrrec	Col·lectiu
David Artigas Garcia	Coordinador del programa	Professor UPC
Robert Sewell	Cap d'estudis de l'ICFO i mentor del programa	Professor ICFO
Laia Miralles	Cap de recursos Humans i Educació	PAS (Personal d'Administració i Serveis)
Mery Gil	Administradora del programa de doctorat	PAS (Personal d'Administració i Serveis)
Arturo Villegas	President de l'associació de doctorands ICONS	Estudiant

## Procés d'elaboració de l'informe d'acreditació

The writing of this Accreditation Report has been led by the Internal Evaluation Committee (CAI from its initials in Spanish) described above. Prof. Dr. David Artigas has been the Coordinator of the Doctoral Program since 2009. He holds the position of Head of Academic Liaison at ICFO, and is a Professor in the Department of Signal Theory and Communications at the UPC. Laia Miralles Puig, BSc in Psychology and Ms Human Resources Management is the Head of Human Resources and Education (RHE) at ICFO since 2003. Mery Gil has training in Relational Marketing and is the Administrative Manager of the Program within RHE unit; she is therefore the one who has the most direct and constant contact with the PhD students. Prof. Dr. Robert Sewell is the Head of Academic Affairs at ICFO and a member of CAPD; He holds a PhD in Physics from Imperial College London and his duties include organizing the educational program for PhD students, the selection process and mentoring of all PhD students, (figure described in the report). Therefore, he has a transverse and broad view of the PhD student community within the program. Finally, PhD student Arturo Villegas is the president of the student organization ICONS, a local branch of the international organizations OSA, EPS and SPIE. His contact with PhD students from other countries gives him a unique perspective and added value to the CAI.

The diversity of this writing team is clear. With this composition, a diverse point of view on the different aspects that are raised in the writing process are taken into account, ranging from purely academic aspects to administrative aspects. Finally, the context and current trends and recommendations of expert voices in the training of young researchers (ESR) in the ERA (European Research Area) are also considered.

The process of preparing this report consisted of the following phases:

- Initial phase of reviewing the next reports: Verification (2013), Follow-up (January 2018) and Modification (submitted May 2021). 06/04-16/04/2021
- Analysis phase, which is detailed in the following sub-phases:
  - o Collection of data on all the indicators necessary to describe and analyse the evolution of the different aspects of the program. We restrict most of the analysis to students enrolled in RD 99/2011 if possible. 12/04-17/05/2021
  - o Collection of data and on the opinion of the various group of interest in the program. The data was obtained throughout the duration of the program through surveys, formal and informal meetings with students, student association, and professor as well as meetings within the CAPD. 12/04-17/05/2021
- Benchmarking phase: comparison of the situation of the program with respect to the current trends described in reports of expert in the field as well as good practices of other doctoral programs both nationally and internationally.
- Report writing and reviewing phase, which has been detailed in the following sub-phases:
  - o CAPD meeting to explain the Accreditation process. Appointment of the CAI (12/05/2021).
  - o Writing phase by the different members of the CAI. (12/05/2021 to 28/05/2021)
  - o Review phase of the entire report by all CAI members. (19/05/2021 to 30/05/2021)
  - o Report Submission to the CAPD and the GPAQ for final review and proposals for document improvement. (31/05/2021)
  - o Implementation of the proposals for document improvement, final preparation of the report. (07/06/2021 to 22/06/2021)
  - o Public exhibition of the report, (23/06/2021 to 1/07/2021).
  - o Implementation of the proposals after the public exhibition.
  - o Final approval of the Accreditation Report by the CAPD (06/07/2021)

The report was prepared by a diverse and experienced team, which takes into account the views of all groups of interest as well as the recommendations of experts in the field and good practices from other programs.

## 2. Valoració de l'assoliment dels estàndards

### ESTÀNDARD 1: QUALITAT DEL PROGRAMA FORMATIU

El disseny del programa (línies de recerca, perfil de competències i activitats formatives) està actualitzat segons els requisits de la disciplina i respon al nivell formatiu requerit en el MECES.

En aquest apartat, el programa pot analitzar el perfil d'ingrés, la distribució d'estudiants per línies de recerca i la resta d'indicadors i dades estadístiques corresponents a la supervisió i a les activitats formatives tot considerant la perspectiva de gènere, i implantar accions de millora quan es detectin manques d'equitat en la igualtat entre doctorands i doctorandes.

**1.1** El programa disposa de mecanismes per garantir que el perfil d'ingrés dels doctorands és adequat i el seu nombre és coherent amb les característiques i la distribució de les línies de recerca del programa i el nombre de places ofertes.

The Internal Quality Assurance System (SGIQ from the initials in Spanish) of the Doctoral School has the process [PF.02 Access](#), admission and enrolment, recently evaluated favourably by AQU, which guarantees the adequate admission of PhD students. This process has been implemented and improved by setting up a selection process to the Photonics program designed on the principles of good practice established in the European Charter for Researchers and based on the recommendations of the OTM-R (Open Transparent and Merit-Based Recruitment) of the EC. In this context, in 2015, ICFO obtained the seal of excellence awarded by the EC for good practices in this framework and an improvement plan was established that has allowed the gradual implementation of successive improvements in related processes.

To begin with, it is important to highlight the institution's high capacity for raising competitive funds at an institutional level. In the last 5 years, ICFO has obtained 4 MSCA-COFUND projects (one of these in collaboration with the BIST centres). Also, ICFO groups are highly successful in obtaining competitive funds for their projects part of which is used to cover contract costs of PhD contracts. As an example, in the last 5 years, 20 projects including funds for a PhD position has been funded by the Plan Nacional, several MSCA-ITN actions of the European Union has been granted securing funding for 9 PhD positions, and 40 ERC grants has been secured. In total, 75% of our PhD students are financed from competitive funds. Finally, PhD candidates willing to undertake their studies in our program has also been highly successful in being awarded competitive external nominal fellowships such as INPhINIT "LaCaixa" Fellowship Program, Predoctoral Grants from the Ministry of Economy and Competitiveness, as well as from the Generalitat - AGAUR. This allows that all students who join the program has fully-funded full-time contract for the entire period of their studies. This availability of fellowships allows their distribution among the research groups according to their supervision capacity, showing a good balance between lines of research, as shown in the following table:

	Nanophotonics	Nonlinear Optics	Quantum Optics	Biomedical Photonics
# of presently registered PhD students	53	17	50	21
PhD student average per group	5.3	4.25	6.25	5.25

The principles of fairness, openness and transparency are considered at all times during the selection process. All detailed information on the access process can be found on the [program's website](#), while information on the scholarship offer can be found at <http://jobs.icfo.eu>. Specifically, the web contains detailed information about available vacancies, the different phases of the selection process, and admission to the program. ICFO ensures broad dissemination of information on available sites both locally and internationally, through multiple actions to disseminate information on PhD opportunities at ICFO. The aim is attract talented students worldwide interested in carrying out doctoral studies in the various fields of photonics, thus giving the opportunity to anyone from around the world, regardless of their origin, gender or condition, to access to the PhD in Photonics, and providing a net source of talent into the local research community.

Photonics is a multidisciplinary discipline, resulting in a range of research groups working in various branches of the photonic sciences. The program needs students with diverse access profiles, so it is important to specify the competencies that students will require based on the research projects they are joining. In this sense, in the recent Modification process, the admission profile was adapted to make it

broadened and, in particular, to make possible the admission of students from biomedical disciplines, defining appropriate Training Complements for that profile (improvement proposal "Enhance training complements" 1407.M.9.2021). The table below shows the admission profile of currently registered PhD students:

Optics and Photonics	Physics	Chemistry and Material Sciences	Engineering	Biomedical/ Multidisciplinary
26	85	13	10	8

As a result of the fundraising success and the higher capacity to host and supervise PhD students (as discussed in section 4.2), the number of new PhD students has notably increased in the last years, showing a trend that we expect will be maintained. This created a discrepancy between the official offer and the actual offer of the program. To correct this discrepancy, we proposed the improvement proposal "Increase vacancies offered by the program" (1041.M.8.2017), which implies the Modification of the Verification document to increase the number of new PhD position from 20 to 35.

	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Offered PhD Positions	20	20	20	20	20	20	20
Demand (*)	350	350	400	555	627	463	503
Registered Students	17	33	26	31	27	34	39
Female	7 (41%)	7 (21%)	8 (31 %)	10 (32%)	8 (30%)	12 (35%)	10 (25%)
Male	10 (59%)	26 (79%)	18 (69%)	21 (68%)	19 (70%)	22 (65%)	29 (75%)
% Fellowships (**)	100%	100%	100%	100%	100%	100%	100%
Total PhD Students per Academic year	17	50	74	105	124	136	152
Total Foreign Students	8 (47%)	34 (68%)	48 (65%)	68 (65%)	89 (71%)	97 (71%)	104 (68%)
Students with a Ms from other Universities	8 (47%)	35 (70%)	49 (66%)	72 (69%)	90 (73%)	105 (77%)	117 (77%)

Only EEES students has been considered in this table, Source: [Llibre de Dades](#)  
 (\*) Application to the PhD fellowships through <http://jobs.icfo.eu>.  
 (\*\*) UPC has not all the information on the Fellowship, showing disagreement with the percentage shown here.

A second consequence of the offer increase has been the need to improve the selection process (Improvement proposal "New selection process" 1041.M.3.2017). Therefore, following process PF.02 Access, admission and registration of the Doctoral School SGIQ, and in accordance with the recommendations of good practice set out in the European Charter for Researchers and the principles of OTM-R (Open Transparent and Merit-Based Recruitment) of the EC, a new selection procedure has been designed (which has also been included in the Modification process) based on the following phases:

1. Pre-selection of candidates by the Admissions Body. The aim is to determine the admissibility and suitability of the candidate profile to the different areas of the doctoral program.
2. Creation of an external selection committee (including members outside the ICFO) that will rank the candidates for fellowship offers, based on the curriculum and personal interviews<sup>2</sup>.
3. The professors of the program with a PhD position within the group examine the external committee selection, identify candidates that fits for their project and proceed to interview them, in order to confirm potential match with one or more host groups & supervisors.
4. Finally, the candidates who pass the interview with the professor, and by order in the ranking, choose a supervisor from among the professors that confirm a potential hosting offer, until the available positions are filled.
5. Admission to the program is granted, and a fellowship is awarded, assigning as supervisor the chosen professor.

This selection process ensures a transparent and merit-based selection, with clearly defined admission criteria. Together with the high demand, the selection process ensures 100% suitability of the candidates

<sup>2</sup> In the modification report, reference is made to the presentation of a research project in the interviews. This refers to a evaluation exercise based on work done during the master or bachelor degrees, and not to the PhD research plan, as it appears to have been interpreted by the evaluation committee of the modification report.



to the research project. Finally, control over the number of places offered is ensured, allowing that all students enjoys a fellowship, resources and all necessary conditions to carry out a satisfactorily thesis.

It is worth to point out, the effort being made to promote the recruitment of women and other under-represented groups into the PhD program. ICFO carries out a significant number of actions aimed at increasing awareness, establishing protocols, and making visible a diverse range of role models in Science. In the selection process, all evaluators and selection committee members are advised on best practices, including unconscious bias issues prior to evaluating and/or interviewing the candidates. In addition, ICFO recently launched the [María Yzuel Fellowship Awards](#), the actions of the [SPIE@ICFO Chair for Diversity in Photonic Sciences](#), and scholarships for young doctoral female students through the ENLIGHTEN program. In this way, we have gradually increase the % enrolment of women in the PhD program to its current level of 31%, an achievement that is above the standard in the field, and notably above the percentage of comparable local and international programs.

## 1.2 El programa disposa de mecanismes adequats de supervisió dels doctorands i, si escau, de les activitats formatives.

The SGIQ of the Doctoral School has the [process PF.04](#) Supervision, monitoring and evaluation of the PhD student, recently evaluated favourably by AQU, which regulates and guarantees the supervision, monitoring and evaluation of the PhD student. The photonics PhD program has implemented this mechanism with some improvements, as we describe below.

PhD students access the program with a thesis supervisor assigned, who also acts as a tutor. The PhD students join the research group and a research project is assigned from day one. All PhD students have a salary fellowship that covers the entire period of their studies. Therefore, all current phd students are registered full-time. The part-time option is also available, however the program counts only a few cases of students switching to part-time enrolment, for example if the PhD student obtains a job offer before defending the thesis. This set of characteristics constitute ideal conditions that are necessary for an effective supervision and a good academic evolution of the PhD student.

The thesis supervisor is the first contact point for the PhD student, and is responsible for monitoring the students' research project, providing them with academic support and guidance, as well as coordinating their research and training tasks, and providing advice on career development. The PhD students and their respective supervisors sign the [Commitment Agreement](#), which establishes the principles of mutual collaboration, obligations, dedication, confidentiality aspects concerning the intellectual/industrial property. The program also ensures an adequate proportion of students per supervisor at all times, with co-supervision support from experienced researchers where required. Therefore, 30% of PhD students are assigned a Postdoctoral Researcher as co-supervisors, a percentage that increases in the largest groups of the program. In this way, the task of PhD student supervision and monitoring is distributed and the volume of load per supervisor is reasonable; and postdocoral researchers gain valuable experience with experienced guidance from the corresponding Group Leader, supporting their career development.

The Research Plan and the Activities Document (DAD) are the follow up mechanisms established by the academic regulations and the SGIQ of the Doctoral School. The PhD student starts working in the Research Plan from the registration in the program, and in the first month, he writes a research plan for his first year. Before the end of the first year, a complete Research Plan for the remaining thesis duration is presented in a report and in a public session in front of a specific committee made up of internal and external professors. After the presentation, the PhD student incorporates the committee advices to his research plan. In parallel, the student updates their CV with information about all their research and training activities, to be incorporated into the DAD. Annually, the coordinator and the mentor, by delegation of the CAPD, jointly evaluates the research plan and the DAD. In the event that the thesis duration is over 3 years and the student requests a first extension, more details are requested into the research plan, specifying tasks and calendar until the writing and delivery of the thesis. If the student requires a second extension, personalized follow-up is done with regular meetings. The aim is to guarantee the completion of the thesis within the maximum period of 5 years. Recently, the Doctoral School has launched the online platform [Atenea PhD](#), which includes the research plan and the DAD in electronic format. This platform is starting to be used within the program, simplifying the supervision of PhD Student by the CAPD.

The improvement proposal within the Follow-up Process, "Creation of the Mentor position" (1041.M.4.2017) resulted from the need to improve supervision. The Mentor is a scientist with previous experience in the field who is part of the doctoral committee. His mission is to reinforce the responsibilities of the CAPD and acts as source of confidential advice and feedback to the student, and a mediator in any



conflict or misunderstanding between PhD Students and supervisors, or in any other situation in which help is needed by the student. To reinforce this task, the figure of the mentor has recently been promoted to the rank of Head of Academic Affairs at ICFO, and provided with additional training and support. In addition, it performs / organizes the following supervision tasks:

- Annual meeting with all PhD students: This is a forum that takes place at the end of each academic year for feedback from the student community, open discussion, and proposals for improvements and concern common to all PhD students.
- Regular follow-up meetings of each student with the “mentor”.
- Meetings on demand with PhD students at different academic key moments: enrolment in the PhD program, defence of the Research Plan, thesis writing, request for extensions, etc.
- Regular meetings with the ICFO student chapter, ICONS, to encourage their activities and the collaboration atmosphere among PhD students.
- Reinforce and inform on the opportunity that students have to express their concerns as well as the channels to do so.
- Ad-hoc meetings with individual students on demand to provide support, advice and assistance with conflict resolution as necessary.

With all the information gathered, the coordinator, the mentor, the head of human resources and the administrator of the program meet every week to analyse the evolution of the program and monitor all PhD students, identifying those who may need any mentoring action. A report from the mentor is presented at each CAPD meeting, summarizing the actions and analysing the most important cases.

In the field of training, we offer an extensive program that is periodically reviewed and expanded taking into account the internal evaluation processes as well as official recommendations and international trends such as the [Principles for Innovative Doctoral Training](#), among others. Thus, there are currently a large number of scientific [colloquia and seminars](#) organized by ICFO where internationally renowned researchers explain their projects. Lectures are offered to broaden the training of students in particular sub-fields, such as theory and biophotonics. Technical training is provided in topics related to scientific computing and experimental techniques. In addition, a series of training activities in transversal skills are offered within the [Plus+ training package](#), including communication, patents, entrepreneurship, writing scientific articles, project management, scientific dissemination or languages. This training provides the personal and professional skills needed to become future leaders in academia and industry, enabling different training itineraries based on the particular interests of each student. Interdisciplinarity is also encouraged through activities that promote the exchange of knowledge between students from various research groups. A training program in [Resilience & Well-being](#) is offered to help students maintain high-performance in a competitive environment. Finally, career guidance activities are carried out to facilitate the transition of students to their new occupations once the doctoral thesis has been defended, engaging in particular the extensive [ICFO Alumni](#) community. All these activities are collected by the student in his DAD and are evaluated annually by the mentor and the coordinator of the program.

### 1.3 El programa recull les modificacions que s'han introduït en el títol.

After the Follow-up Process, we detected the need to initiate a Modification Process of the degree in three aspects:

1. Increase in the number of places in the program from 20 to 35 students. This modification is a consequence of the Follow-up improvement proposal 1041.M.8.2017.
2. Modification of the compulsory courses. The compulsory nature of specialized courses was changed, as it was detected that they did not fulfil their initial function. This modification is a consequence of the Follow-up improvement proposal, 1041.M.1.2017.
3. Improving the selection process to include the principles and recommendations of the Open Transparent and Merit-Based Recruitment EC. This modification is a consequence of the Follow-up improvement proposal 1041.M.3.2017.

Finally, the Modification was used to include improvements in other points not detected during the Follow-up Process:

4. Adapt the training complements to the needs of the program, specifically to students within biomedical photonics area. New improvement proposal 1407.M.9.2021.
5. The list of Professors within the program has been updated, justifying the capacity of the program to increase from 20 to 35 students in access.

Apart from the previous modifications, the information and data that had become obsolete in the Verifica report have also been updated.

Evidences: [Verification report](#) and [Follow-Up](#) report. The Modification report will be made available to the CAE once evaluated.

#### 1.4 L'aplicació de les diferents normatives es realitza de manera adequada i té un impacte positiu sobre els resultats dels programes de doctorat.

Aquest apartat es va avaluar a la fase transversal, durant la visita a l'Escola de Doctorat, duta a terme el 4/7/2018

## ESTÀNDARD 4: ADEQUACIÓ DEL PROFESSORAT

**El professorat és suficient i adequat, d'acord amb les característiques del programa de doctorat, l'àmbit científic i el nombre d'estudiants.**

#### 4.1 El professorat té una activitat de recerca acreditada.

The doctoral program in photonics has 27 permanent professors: 4 are professors at the UPC, 13 are ICREA professors at ICFO and 10 are ICFO staff. In addition, ICFO has more than 120 postdoctoral researchers, who can carry out co-supervision tasks, but are not considered within the core of professors that support the program. Comparing the number of professors reported in the Verifica (28) and in the Follow-up report (29), there have been some changes, but the number has remained quite constant, updating the situation in the recent Modification process. There are currently 24 groups led by each of the program professors (in 3 cases with 2 professors per group). These groups have typically 4 - 6 postdoctoral researchers and are grouped in the 4 research lines established in the verification and modification processes: Quantum Optics, Nanophotonics, Biomedical Photonics and Nonlinear Optics.

ICFO professors do not belong to the public system, so they are not subject to the six years evaluation (sexenio). Thus, as an equivalent parameter, we supply the number of JCR articles published in the last 6 years (in the case of the 4 professors from UPC, the number of sexenios is also indicated). We also provide the number of previous and present thesis supervised within the program (for newly incorporated professors, previous directed theses are indicated), the number of competitive projects where the professor is the PI, and the h-index referenced to the Web of Science (WoS). Finally, in the "additional information" section, other indicators are highlighted, such as relevant awards or scholarships.

Surname, Name	Research Line	Published articles, WoS (2015-20)	previous + present supervised thesis	IP in live Competitive Projects	Index h (WoS)	Additional Information.
Acín Dal Maschio, Antonio	Quantum Optics	77	23+11	3	59	Prof. ICREA, ERC SGA, ERC CGA
Artigas Garcia, David	Nonlinear Optics	9 4 sexenios +1 sexenio transferència	2+2	1	24	Catedrático. Coordinador del PD.
Bachtold, Adrian	Nanophotonics	19	5+3	5	44	Prof. ICFO ERC SGA, ERC AGA
Biegert, Jens	Nonlinear Optics	36	9+9	2	39	Professor ICREA ERC AGA
Chang, Darrick	Quantum Optics	44	2+4	7	38	Prof. ICFO ERC SGA

De Riedmatten, Hugues	Quantum Optics	27	7+7	6	43	Prof. ICREA, ERC SGA
Durduran, Turgut	Biomedical Photonics	49	11+6	10	43	Professor ICREA
Ebrahim-Zadeh, Majid	Nonlinear Optics	55	12+2	2	37	Professor ICREA
Efetov, Dimitri K	Nanophotonics	26	+5	5	21	Professor ICFO des de Gener 2017 ERC SGA
García De Abajo, Javier	Nanophotonics	121	8+3	4	87	Professor ICREA ERC AGA
Garcia de Arquer, F. Pelayo	Nanophotonics	83	(2 tesis fora del programa)		45	Professor ICFO from January 2021
García Parajo, María	Biomedical Photonics	37	5+6	5	45	Professor ICREA ERC AGA
Konstantatos, Gerasimos	Nanophotonics	60	4+7	6	45	Prof. ICREA, ERC CGA
Koppens, Frank	Nanophotonics	66	7+11	7	55	Prof. ICREA ERC SGA ERC CGA
Krieg, Michael	Biomedical Photonics	13	+4	5	23	Professor ICFO from January 2017 ERC SGA
Lewenstein, Maciej	Quantum Optics	148	21+15	5	99	Prof. ICREA, ERC AGA
Loza Alvarez, Pablo	Biomedical Photonics	42	8+2	7	24	Staff ICFO Head of the Microscopy Unit
Martorell Pena, Jordi	Nanophotonics	29 (5 sexenios)	9+4	4	25	Titular de Universitat
Mitchell, Morgan	Quantum Optics	37	14+9	7	40	Prof. ICREA, ERC SGA
Papadakis, Georgia	Nanophotonics	11	(1 tesis fora del programa)		7	Professor ICFO from January 2021
Perez Torres, Juan	Quantum Optics	25 (5 sexenios)	7+3	2	38	Catedrático. ICREA Academia
Pruneri, Valerio	Nanophotonics	54	14+10	11	47	Prof. ICREA, Corning Inc. Chair
Sewell, Robert	Quantum Optics	6	2+2	2	14	Professor ICFO, mentor del PD.
Tarruell, Leticia	Quantum Optics	11	2+4	6	19	Professor ICFO ERC CGA
Torner Sabata, Lluís	Nonlinear Optics	37 (5 sexenios)	5+1	3	63	Catedrático Director de l'ICFO
Van Hulst, Niek	Nanophotonics	38	11+7	5	66	Prof. ICREA, ERC AGA
Wieser, Stefan	Biomedical Photonics	12	1+3	1	12	Staff ICFO from January 2017

Only theses supervised at ICFO. ERC awards: SGA (starting grant award), CGA (consolidator grant award), AGA (Advanced grant award). This information can partially found at: <https://www.icfo.eu/lang/research/groups/>

It should be noted that the required number of articles published in 6 years to obtain a sexenio is 5. Therefore, the 100% of professors far exceed this criterion and would have a "live sexenio" (including the 4 UPC professors). Also, note that all professors, except the two incorporated this year, are PI in competitive project (in most of the cases, more than one) and have very high h-index, indicating the high level of scientific quality of our Professors.

#### 4.2 El professorat és suficient i té la dedicació adequada per desenvolupar les seves funcions.

Analysing the table above, the average number of PhD students per professor is just over 5. We also observe that in specific theoretical groups, a single professor may supervise 11 PhD students, however in these cases co-supervision of students by Postdoctoral researchers within the group is required. These numbers may seem a very large figure for a University typical PhD program, however, three factors must be considered:

1. All the professors from the program, except the four at the UPC, have full-time dedication to research. Because they do not teach, his potential for supervising doctoral theses is twice that of a university professor. In fact, we can say that thesis supervision is the main task of ICFO professors.
2. In addition to the permanent professor, ICFO has more than 120 postdoctoral researchers (see sections "research fellows" and "postdoctoral fellows" at <http://www.icfo.eu/icfonian-people>). They usually help as co-supervisors.
3. High degree of support in management tasks by the ICFO administrative units, which relieves supervisors and students from management tasks.

Taking into account these three aspects, the situation of the photonics PD would be comparable to that of a doctoral program with an average of 2-3 students per professor. In addition, the photonics program has almost one postdoctoral researcher for each PhD student, who supports the student in the more technical aspects of their thesis. The postdoc is appointed co-supervisor in those cases where a stable and sustained relationship with the student is maintained over time. Thus, among all PhD students in the EEES program, including graduates and current student, 30% had a postdoc as co-supervisor. This system is similar to that in Anglo-Saxon countries, where PhD students have as a reference a postdoc that closely supervise them, as well as a senior and experienced professor who guides him through all the process, and acts as the lead supervisor. As a result, according to the [PhD School survey](#), 73% of students in the program meet once or more times per week with their supervisors, and >94% at least once every two weeks. Thus, we can consider that the number of professors of the program is adequate.

Regarding the degree of satisfaction of PhD students with their supervisors, the UPC survey indicates a score of 3.7 out of 5 at the [PhD School survey](#). Although still good, this value is below the UPC average (4.2). This topic come up in different forums and meetings with students. An initial diagnosis indicated that in some groups a better communication between student and supervisor was advisable. There are also indications that this situation is more pronounced among international students, who are the vast majority in our program. This is a situation shared with other large doctoral programs at the UPC and other research centres. To deal with this situation, an Improvement Proposal "Consolidation of Supervision Mechanisms" (1407.M.10.2021) was launched, which includes conducting specific surveys, [courses for supervisors](#) (already in place), and implementing conflict resolution protocols. Given the relevance of this Improvement Proposal, it will be maintained over time, adding new actions when necessary and will be reviewed in each Follow-up and Accreditation Process of the program.

#### 4.3 El programa de doctorat compta amb les accions adients per fomentar la direcció de tesis.

This section was evaluated during the transversal evaluation of the Doctoral School in 4/7/2018, where the actions to promote thesis supervision carried out by the University and the PhD School were positively evaluated. However, below we discuss the unique features of ICFO and the professors of the program.

As a centre dedicated exclusively to research and training of the next-generation of researchers, training of PhD students is the key to ICFO's strategy and mission, as the thesis supervision is in the best interests of both professors and institute. Thus, the main mission of ICFO is to train young researchers through the PhD in Photonics. In order to achieve a proactive promotion of thesis direction, ICFO has its own fellowship program, which make possible the capture of good students and allows them to complete their thesis full-time without any other concerns than purely scientific problems.

ICFO's scientific performance is evaluated annually by its board of trustees, with thesis supervision being one of the most important parameters in the evaluation. Likewise, the ICFO faculty undergoes a periodic

evaluation that determines their continuity in the institute, and again, one of the parameters considered in their evaluation is the number and quality of the supervised PhD theses. The CAPD also monitors the supervision tasks performed by postdoctoral researchers to ensure that a postdoc's dedication to a PhD student is recognized in the form of co-supervision.

#### 4.4 El grau de participació de professorat estranger i doctors internacionals en les comissions de seguiment i tribunals de tesi és adequat a l'àmbit científic del programa.

18 out of the 27 professors in the PhD program are originally from abroad, and of the 9 nationals, 3 have completed their PhD at a foreign university. All the professors of the program have carried out postdoctoral stays of more than one year in foreign research centres or universities. The CAPD encourages appointing International professors as the two external members of the defence thesis committee. The following table shows the participation of international professors in the thesis defences process.

Academic year	Defended Theses	International Experts (# experts / total members)	
		Thesis Committee	External Revision
2019-2020	23	35/69	35/46
2018-2019	27	40/81	38/54
2017-2018	24	40/72	39/48
2016-2017	20	27/60	27/40
2015-2016	13	18/39	18/26
TOTAL	107	160/321 (50%)	157/214 (73%)
The complete list with the thesis defence committees can be found <a href="#">here</a> .			

Given these results, the professor internationalization is evident, and is naturally promoted through the international talent selection process promoted by ICFO at all levels, from PhD students to group leaders.

## ESTÀNDARD 5: EFICÀCIA DELS SISTEMES DE SUPORT A L'APRENENTATGE

Els recursos materials i serveis necessaris per al desenvolupament de les activitats previstes en el programa de doctorat i per a la formació del doctorand són suficients i adequats al nombre de doctorands i a les característiques del programa.

#### 5.1 Els recursos materials disponibles són adequats al nombre de doctorands i a les característiques del programa de doctorat.

The [process PS.01](#), Material resources and services, within the SGIQ of the Doctoral School recently evaluated favourably by AQU, guarantees the proper management of resources. This process mainly affects University common facilities, such as areas of study, libraries, common computer services, etc. Here we want to highlight the added value that ICFO provides to the PhD program in Photonics.

Located at the PMT-Mediterranean Technology Park, in Castelldefels, ICFO is housed in two buildings of 14,000 m<sup>2</sup> and 6,500 m<sup>2</sup>, the latter recently built.<sup>3</sup> They consist of common research services, spaces and offices for all research staff as well as administration staff, numerous meeting rooms, an auditorium, a specific library and 60 state-of-the-art research laboratories, which with the new building they will be expanded to 20 more. It also has its own catering service, leisure areas and lecture halls for conferences, seminars and scientific meetings.

<sup>3</sup> In the AQU final modification report, the external evaluation commission refers to the new facilities on the Besós campus. These facilities are general to the UPC, not specific to the Photonics PhD program.

From the arrival day, PhD students have a personal space in an office shared with a maximum of four officemates, PhD students or Postdocs. PhD students have a personal desktop computer, fully equipped with the software required for their research project, access to the Internet and to the ICFO server to ensure the secure storage of their documents and data, as well as a corporate email account. As a result, the [PhD School](#) surveys to PhD students show a high level of satisfaction, in the areas of computer resources and services, well above the University average.

Degree of satisfaction with:	Photonics	Sciences	UPC
Resources (furniture, laboratory equipment, material) that I have at my disposal:	4.6	4.2	3.8
The computer services (computer, software, etc.) that I have at my disposal:	4.5	4.1	3.8
Source: PhD School the surveys <a href="#">link</a>			

In addition, PhD students have access to research laboratories to carry out their projects since the beginning of their studies and after passing the occupational safety and risks training courses offered by specialized personnel. These courses place special emphasis on the specific safety measures of each laboratory depending on the risks involved. The high capacity to raise competitive funds by group leaders ensures that these laboratories are fully equipped and have the necessary equipment for the development of the PhD student research project.

ICFO research facilities fulfil the highest standards, equipped with the required equipment and technical staff to support PhD students in their research. In addition, they are responsible for the PhD Student training to become an independent user. The available facilities can be found at the [ICFO website](#) and are summarized here:

- The Nanofabrication Laboratory (NFL): is the main service and is intended for the manufacture and characterization of micro- and nanostructured photonic devices. The laboratory has state-of-the-art tools and techniques in a clean controlled atmosphere. With the inauguration of the new building, this laboratory will double its service capacity and space.
- The Characterization and Post Processing Laboratory: intended to support the processing and characterization of materials. It offers services in dicing and polishing machines, wet electroplating benches, wire bonders, solar simulators, fluorimeters, spectrometers, etc.
- The Super-resolution Light Microscopy and Nanoscopy Laboratory is equipped with state-of-the-art microscopy techniques that allow observing from the superresolution to mesoscopic scales.
- The Basic Chemistry and Biology Laboratory is equipped with high standard equipment to prepare chemical samples and biological cultures.
- Advanced Engineering Laboratory: Includes mechanical workshop, electronic workshop, technical office and 3D printing service, equipped with state-of-the-art tools and equipment.

In addition, PhD students have access to [industrial laboratories](#) created in partnership with companies to carry out projects of common interest. The CORNING Surfaces Laboratory, LEICA Nanoscopy Imaging Centre and The NIKON Centre of Excellence in STORM are currently operational.

In those cases where the activities cannot be carried out at ICFO, such as clinical trials, agreements are available with other institutions, in this case with hospitals; 12 clinical research institutes are part of the ICFO-led [Barcelona Medical Photonics Network](#). Similarly, the PhD student can collaborate with integrated initiatives that bring together research infrastructures of which ICFO is a partner, such as Laserlab-Europe, the Systems Microscopy Network of Excellence, or the NanoPhotonics for Energy Efficiency Network of Excellence.

Finally, as the [PhD School](#) surveys show, the use of the UPC library is not widespread among our PhD students, with the exception of the access to journals in electronic format. This is largely due to the library available at ICFO, with our own support staff, a bibliographic collection, which guaranteed access to the most relevant scientific publications, complementing the PhD student's access to UPC libraries.

## 5.2 Els serveis a l'abast dels doctorands suporten adequadament el procés d'aprenentatge i faciliten la incorporació al mercat laboral.

This section was evaluated during the transversal evaluation of the Doctoral School in 4/7/2018. However, below we discuss the benefit that ICFO brings to the program.

The ICFO administration team is made up of highly specialized staff in different areas who provide specific,



high quality and close help to PhD students in the Photonics program. The most relevant units are the Human Resources and Education Unit, which manages the doctoral program, and is in charge of the immigrations permits, recruitment and fellowships; and the Academic Affairs unit, which manages academic activities and the [Plus+ training program](#). The Knowledge and Technology Transfer Unit provides services in the field of intellectual property, patents, entrepreneurship and the creation of spin-offs. The Project Unit provides service in the field of competitive project management. The Corporate Communications unit in the field of design and communication. The Finance unit in the field of financial, travel and expenditure management. Finally, the Occupational Safety and Biosafety unit in the field of safety, both in laboratories and Health. The aim is to provide a wide range of administrative service, high quality advice and support at all levels with the aim that PhD students devote all their efforts to research and learning. These services are valued very positively by both students ([PhD School surveys](#)) and professors:

Degree of satisfaction with:	Photonics	Sciences	UPC
La informació, l'orientació i el suport que rebo en el procés d'admissió, acollida i matrícula:	4.3	4	3.9
La informació i l'atenció que rebo dels serveis administratius al departament, institut o centre:	4.4	4	4

Source: [PhD School surveys](#)

These services had important external recognition, such as:

- “HR Excellence in Research” quality seal awarded by the European Commission to ICFO in 2015, a recognition given to institutions that promote a favourable work environment and are committed to implementing fair and transparent selection and evaluation processes.
- OHSAS 18001 certification for the implementation of a Health and Safety management system that goes beyond the standards dictated by the European Union; Atlante Award given by Fomento del Trabajo; Second prize of the Antonio Baró prize, awarded by MC Mutual.

It is worth to note the role of the [ICFO Alumni Program](#), a key piece in promoting job offers among recent graduate PhD students and former ICFO members. The management platform allows to enhance networking and works on the of visibility and promotion of the program, ensuring:

- The possibility to contact former ICFO PhD students who now hold positions in both academia and industry around the world.
- Career guidance talks given within the training program offered by former PhD students who have followed different professional path.
- To have more information about the current and future employability of the program PhD students and the characteristics of possible jobs, which allows us to promote new actions when necessary.
- An Alumni Platform linking current students to the Alumni program worldwide, and providing news and updates, including job postings and offers.

Finally, the Technology and Knowledge Transfer ([KTT](#)) unit carries out a series of activities that facilitate the incorporation of PhD students into the labour market. These activities include:

- Entrepreneurial actions, in which KTT detects opportunities for the creation of spin-offs and business incubators.
- [Corporate Liaison Day](#), in which companies in the sector are invited and where PhD students have the opportunity to interact with the industrial network and present their research.
- [CARLA](#), a project funded by the European Union and led by ICFO in which the industry and some of the most important European academic institutions in the field of photonics are creating inclusive pan-European photonics career camps. These are aimed at PhD students and early-stage researchers in which a better knowledge of the market, professional opportunity and contacts with the industry are provided, thus offering a clear Roadmap for better employability.



## ESTÀNDARD 6: QUALITAT DELS RESULTATS

Les tesis doctorals, les activitats formatives i l'avaluació són coherents amb el perfil de formació. Els resultats quantitatius dels indicadors acadèmics i d'inserció laboral són adequats.

**6.1** Els resultats d'aprenentatge assolits es corresponen amb els objectius formatius pretesos i amb el nivell establert al [Marc català de qualificacions per a l'educació superior \(MCQES\)](#) per als programes de doctorat.

All the PhD graduates in the program have completed their thesis in the diverse areas of photonic sciences, in coherence with the group that hosts them and the research lines of the program, as can be seen at the [program website](#) in the section of thesis / repository of defended theses.

Students in the program must conduct a research plan during the first year of the thesis, with a public defence in front a committee where one of the members is external to the program. This research plan is reviewed annually by the Student and the supervisor and is evaluated, ensuring that the PhD student is able to design a research project and conduct a critical analysis of their progress. In the last years of his project, the PhD student must show that he is able to carry out his research autonomously.

Although no minimum number of publications is defined, all ICFO PhD students complete their dissertation with several publications in excellent journals. As discussed in the next section, most publications are published in top journals, demonstrating that they are able to make an original and significant contribution to scientific advancement and are recognized by the international scientific community. In addition, all of them participate in conferences, presenting oral presentations and posters. ICFO does not promote publishing in any specific journals. Researchers knows best the most suited outlet for their results.

All PhD students in the program must take a compulsory course on transversal training within the [Plus+ program](#), comprising courses and activities in social responsibility and scientific integrity, scientific writing and presentation courses. Practical sessions within the [ICONS seminars](#) complement these courses. The PhD students themselves organize the seminars, which are presented by PhD students to the entire audience of the Institute. This experience also extends internationally by organizing student conferences, which different international scientific societies, such as the OSA or the SPIE promote.

The thesis defence is the culmination of doctoral studies, where PhD students must show the achievement of the skills according to the MCQES. At the time of the defence, the members of the PhD Defence Committee receive a guideline with recommendations for conducting the evaluation at the highest international level.

As a result of all the process, graduates from the PhD program in Photonics acquire a frontier knowledge in photonics through theoretical and experimental research.

**6.2** El nombre de tesis doctorals defensades, la seva durada i els resultats científics que se'n deriven són adequats i coherents amb el perfil formatiu pretès.

The SGIQ of the Doctoral School recently evaluated favourably by AQU, includes the [process PT.04](#) that facilitate the collection and analysis of results. The information in the following two tables shows the results of the program, broken down by year, and discerning between EEES (1<sup>st</sup> table) and pre-EEES (second table) PhD students

EEES	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Thesis Defences	0	1	0	3	21	27	23
Male	-	1	0	3	14	19	16
Female	-	0	0	0	7	8	7
Average Thesis Duration (in Years)	-	1.8	-	3.5	3.9	3.9	4.3
Dropouts	-	0%	2%	0%	4.8%	2.4%	2.9%
% Thesis with Cum Laude	-	100%		100%	95,2%	88,9%	87%
%Thesis with International mention	-	0%	-	0%	4,8%	29,6%	4,3%

Pre-EEES	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Thesis Defences	4	4	4	2	2	1	0
Male	13	14	12	11	15	2	-
Female	17	18	16	13	17	3	-
Average Thesis Duration (in Years)	3.7	4.6	4.6	4.2	2.9(*)	1.2(*)	-
Dropouts	5.6%	5.8%	1.5%	2%	0%	0%	-
% Thesis with Cum Laude	73%	94%	75%	84.6%	94.1%	100%	-
% Thesis with International mention	5.9%	0%	6.3%	15.4%	0%	0%	-
Source: Quadre de comandament d'indicadors de l'Escola de doctorat: <a href="#">link</a> (*) Students adapted from previous Real Decretos to the 99/2011, are considered within the pre-EEES students, resulting in anomalous short durations.							

This result shows an increase in the number of theses defended, in line with the increase in students. There is an appreciable decrease in the duration of the doctorate if we compare pre-EEES and EEES PhD students, which is a result of the mentoring and individual follow-up of PhD students who request an extension (the low values in pre-EEES students in courses 2016-17 and 2017-18, are fictitious, due to students adapted to decree 99/2011). As a result, the dropout rate is remarkably low. In addition, the number of women defending the thesis has increased, in line with the access increase of women, without finding significant differences between women and men in the PhD duration for EEES students.

Regarding the thesis results, the university cannot provide data on the production of PhD students in the Photonics program, due to the lack of access of ICFO professors to the DRAC system of scientific production at the UPC. Similarly, no information of PhD students who carried out research stays abroad is available. To correct this deficiency, the improvement proposal "Consolidate Data Management Project" (1407.M.11.2021) aims to obtain the production associated with each thesis defended, as well as the PhD Student research stays. In addition, during the Follow-up process we launch the improvement proposal "Improve the number with theses with the international mention" (1041.M.7.2017).

However, the ICFO's library service has conducted a study using the Web of Science of articles published in JCR journals (conferences not included) by our EEES graduates. The following table shows the publications by year for the 91 graduated PhD students (counting the 13 theses defended until May 15, 2021) and the total number of co-authors who are PhD students.

PhD Graduated EEES only	2013	2014	2015	2016	2017	2018	2019	2020
Published JCR articles	14	30	39	56	75	91	64	53
PhD Co-authors	17	33	41	60	91	103	75	60
The list of publications by year can be found <a href="#">here</a>								

These 91 PhD students have published a total of 443 articles in JCR journals (average 4.9 per student) in the period shown, and they appear as first author in 201 of these publications (average 2.2 per student). Of these journal articles, 38 are co-authored by more than one PhD student, indicating that the vast majority of published articles correspond to a single thesis. On average, across the program, a graduate student finishes the thesis with 5.3 publications. For comparison purposes, the number of papers/thesis in Scandinavian universities is 4.5 (see Fig.1b).

Regarding the type of publications, the [ICFO 2019 annual report](#) (page 9) specifies that 80% of the institute's research papers belong to the Q1, a percentage that could be extrapolated to articles published by PhD students. Looking in detail the journals where our students publish, we find 6 papers in Science, 7 in Nature, 37 articles in journals of the Nature group (Nature, Nature Photonics, Nature Physics, ...), 45 Physical Review Letters, 9 Physical Review X, 19 Nano Letters, 14 ACS Photonics, 8 Optics, 5 PNAS, 3 Cell reports, 3 Molecular Cell, etc. All of them belonging to the top 10% in their category. On the other hand, all PhD students have presented papers at conferences, so we can say that the theses defended in the photonics program are highly productive compared to a typical thesis within the field and topic of the program.

### 6.3 Els doctorands, les doctorandes, les persones titulades i el professorat estan satisfets amb la formació que proporciona el programa de doctorat i amb els seus resultats.

The SGIQ of the Doctoral School, recently evaluated favourably by AQU includes [process PT.03](#) to collect the satisfaction of the stakeholders, making possible the continuous improvement of the program.

The participation of PhD students in the photonics program was very low in the first two editions of the surveys, so that a campaign was made to encourage participation in the last surveys, obtaining a participation of the 40% of the registered PhD students.

Degree of satisfaction with the doctoral program:	Photonics	Sciences	UPC
Survey 2013-2014	-	4	3.8
Survey 2018-2019	-	4	3.7
Survey 2019-2020	4	3.9	3.8
Source: Quadre de comandament d'indicadors per programa <a href="#">link</a>			

In general, PhD students are very satisfied with the possibilities offered by the PhD program and its organization. In particular, the support at the time of reception and the attention and guidance by the administrative services showed a very high level of satisfaction (see table in section 5.2). However, in terms of the degree of satisfaction of the PhD students with the program, the survey of the PhD School reaches a value of 3.96 out of 5, just above the UPC average, which is 3.85. In contrast, compared with programs of similar size, the satisfaction with our program is clearly superior. Analysing the surveys in more detail, we see that our potential weaknesses are in three aspects related to the student's perception of the program's ability to resolve conflicts between supervisors and students, and the ability to transmit information to the PhD student:

Degree of satisfaction with:	Photonics	Sciences	UPC
The help and guidance of the program or a member of the CAPD to resolve a problem or in case of conflict:	3.3	3.5	3.7
The information I receive from the decisions of the CAPD:	3.4	3.5	3.6
Public information on the doctoral program (website and other resources):	3.3	3.4	3.5
The usefulness of the courses or seminars that have been done in the doctoral program	3.6	3.4	3.4
Source: PhD School the surveys <a href="#">link</a>			

In all three cases the Photonics program is rated at slightly below the average across Science and the UPC as a whole. The statistical significance of this difference is not reported.

In the case of the program's ability to resolve conflicts, we have identified several factors that may contribute to the students' perception, as we discussed in Section 4.2. To give more relevance, power and influence to the mentor in conflict resolution, ICFO management has recently decided to appoint the figure of the mentor to Head of Academic Affairs at ICFO, a figure that is just below the Director in the organizational of the institute, which is part of the improvement proposal 1407.M.10.2021. The mentor has been provided with additional training and support in his role. We identify the need to better communicated mentoring and conflict resolution channels and protocols to PhD students.

In addition, the program wants to provide the PhD student with tools to overcome stressful situations associated with cutting-edge research through the improvement proposal "Continuous enhancement of the career and personal development opportunities" (1407.M.13.202) that include training courses in Research Ethics, Integrity and Open Science, and a program on Resilience and Well-Being.

Dissatisfaction with the public information seems to be related to reported difficulties to find information on the ICFO intranet, and the salary diversity of the fellowship/contract of the different PhD students, a problem that was raised at the moment of the surveys. Regarding the first point, we have significantly improved access to information on relevant academic policies and procedures, PhD student positions, and information about academic committees on the intranet. Regarding the second point, there was dissatisfaction among students with Spanish-sourced scholarships (FI, FPI, FPU, or ICFO's own scholarships) with lower salaries than European-origin scholarships (ITN, COFUND). Although these differences in salaries were unrelated to the program, was not clearly communicated to the PhD students. However, we note that the minimum fellowship provided to ICFO PhD is above that provided by national scholarship, with the difference provided by internal funds. This minimum level has been increased to minimize this discrepancy between national and EU fellowship levels. The topic was discussed at an annual meeting, improving the information the student receives concerning the selection processes and allocation of these fellowships.

On the other hand, the PhD School survey shows a degree of satisfaction with the courses and seminars offered by our program that is above the average of the PhD programs in the field of sciences and those of the University in general.

The answer to the PhD graduates surveys had a very low participation, with only 5 answers, adding the

surveys conducted in 2017 and 2020. The degree of satisfaction they show is very high, but statistically not significant due to the low participation.

Degree of satisfaction with:	Photonics	Sciences	UPC
Satisfaction with the PhD studies (1-7)	6.33	5.63	5.33
Source: Quadre de comandament d'indicadors per programa <a href="#">link</a>			

Looking at the ICFO Alumni program, almost all former PhD students have actively joined it (143 of the little more than 170 former students), a good indicator that their degree of satisfaction with the program is high. We want to take advantage of the strong relationship of ICFO-Alumni with PhD graduates to collect their degree of satisfaction with the program conducting specific surveys (improvement proposal 1407.M.12.2021).

Finally, we do not have information on the faculty satisfaction with the program. This is an issue we are working on and is also part of the 1407.M.10.2021 improvement proposal. However, the faculty of the program hold periodic meetings (at minimum 3 per year), where the PhD program is a recurring standing item, keeping professors informed of developments in the PhD program, gathering their suggestions, and noting their high degree of satisfaction.

In conclusion, we can say that the degree of satisfaction of the different actors in the program is high, despite the normal difficulties that appear in any program, especially when the number of students in the program is high and the demand for high quality research is great.

#### 6.4 Els valors dels indicadors d'inserció laboral són adequats per a les característiques del programa doctorat.

Every three years UPC conducts a job surveys on PhD graduate promotions. For the period covered by the EEES studies, there are two surveys carried out, corresponding to the years 2017 and 2020, with the following aggregate results:

(2017, 2020)	UPC	Sciences	Photonics (5 responses)
Employment rate	95,9%	96,2%	100%
Adequacy rate	57,7%	66%	80%
Source: Quadre de comandament d'indicadors per programa <a href="#">link</a>			

Again, at the University level and considering all the PhD programs on science, the number of responses is significant, but not at the Photonic PhD program level: although the results obtained are good, there were only 5 total responses in the two editions. However, we can use the data from the ICFO Alumni program to obtain information on the current situation of 143 graduates out of a little more than 170 graduates who have defended the thesis in the program since its creation in 2007. Although we do not have disaggregated information between EEES and pre-EEES students, these data may allow us to estimate the adequacy of the job position to the PhD studies. Performing the analysis by job sectors and geographical areas, we obtain the following results:

	Spain	Europe	N. America	S. America	Asia	Oceania	Africa	Total
University	2	22	7	3	5	1	2	42
Research Ins,	15	17	5	1	1	-	-	39
Industry	23	24	4	1	4	1	-	57
Public Sector	2	3	1	-	-	-	-	6
Freelance	2	2	-	-	-	-	-	4
Total	44	68	17	5	10	2	2	148

A file with the status of our graduated PhD students can be found [here](#).

We see that just over half of our doctorates (55%) have found job in research institutes or at the University, which is the natural job position for the characteristics of our PhD program. We consider a positive situation that 38.5% of the PhD students found job in the industry, an indication that they are valued by this sector. Also, note that most of them find work abroad, distributed between Europe (46%) and the rest of the world (26%), and made up of foreign PhD students returning to their country and Spanish PhD students seeking

international experience. Of the 44 PhD students (31%) who find work in Spain, mainly in the Barcelona area, 23 are of foreign origin, demonstrating the program's ability to attract and retain international talent, which has a positive impact on our local society. Notably, 6 graduates are currently employed in ICFO Spin-Off companies.

Analysing the results by activity in the workplace (table below), we see that 62% are engaged in research tasks for which a PhD degree is explicitly required. In addition, other activities also require a doctorate degree, as is the case of entrepreneurs who have created their spin-off company as a result of the thesis. Project developers and project managers also use the transversal skills acquired during the PhD, or even in consulting companies, the skills in data analysis are highly appreciated.

	Spain	Europe	N. America	S. America	Asia	Oceania	Africa	Total
Research	18	46	14	3	8	1	2	92
Business Develop.	3	2			1	-	-	6
Consulting	5	5	1	1			-	12
Technology Transfer	3	1		-	-	-	-	4
Project development.	6	4	2					12
Management	3	3		-	-	-	-	6
Others	6	7		1	1	1		16
Total	44	68	17	5	10	2	2	148

An Excel file with the status of our graduated PhD students can be found [here](#).

Finally, it is worth to note that several of our graduates have been subsequently employed at the most prestigious universities in the world, including Harvard, Princeton, Stanford, Yale, Berkeley, MIT, Oxford, Cambridge, and ETH Zurich to name a few. Others have found positions in research institutes such as Los Alamos National Laboratory, Max Planck Institutes, Curie Institute and in companies like IBM, HP, Huawei, Trumpf or Corning. Others work in the European Commission as research project managers and editorial staff member of journals such as Nature. We note that 15% of our graduates have become University Professors or Group Leaders at research institutes, a large % given the youth of the program, and a significant fraction (15%) of those who continue in research have managed to win the most prestigious postdoctoral fellowships within Spain (e.g., Ramon y Cajal, La Caixa Junior Leader) and the EU (e.g. MSCA Individual Fellowships).

In order to have more accurate data, within improvement proposal "Expand mentoring program for career transition" (1407.M.12.2021), and with the help of ICFO Alumni (see section 5.2), we aim to conduct appropriate surveys for our graduates. However, everything seems to indicate that the 80% of the adequacy rate obtained in the UPC surveys corresponds to a value quite close to reality or it may even be low. This improvement proposal also includes a career guidance program to assist PhD students in the transition to working life.

### 3. Pla de Millora

Fruit de l'anàlisi i reflexió del desenvolupament del programa de doctorat, cal proposar un Pla de Millora.

#### Relació de propostes de millora

##### List of improving proposals from the "Follow-up process"

- 1041.M.1.2017 Modification of compulsory courses, Finished.
- 1041.M.2.2017 Courses on transversal skills at the start of the PhD studies. Finished
- 1041.M.3.2017 New selection process. Finished
- 1041.M.4.2017 Creation of the Mentor position. Finished
- 1041.M.5.2017 Consolidation of mechanisms to obtain the opinion of students. Finished
- 1041.M.6.2017 Improve the different websites that provide information on the PhD program. In progress
- 1041.M.7.2017 Improve the number with theses with the international mention. in progress
- 1041.M.8.2017 Increase vacancies offered by the program. Finished

##### List of improving proposals from the "Accreditation process"

- 1407.M.9.2021 Enhance training complements. Finished.
- 1407.M.10.2021 Consolidate supervision mechanisms. In progress.
- 1407.M.11.2021 Consolidate Data Management Project. Not started.
- 1407.M.12.2021 Expand mentoring program for career transition. Not started.
- 1407.M.13.2021 Continuous enhancement of the career and personal development opportunities.

1041.M.1.2017	<b>Modification of compulsory courses</b>	
	<b>Càrrec:</b>	Coordinador del programa, Mentor
	<b>Origen:</b>	seguiment
	<b>Estàndard:</b>	Estàndard 1: Qualitat del programa formatiu
	<b>Diagnòstic:</b>	Compulsory classes of the program aimed to broaden the student's vision, exposing them to the different lines of research within ICFO. The established system resulted in classes that did not provide any training that could not be learned by other mechanisms (internet courses, studying books, etc.). This created discontent among both faculty and PhD students.
	<b>Implica modificació de la memòria verificada?:</b>	Si
	<b>Objectius a assolir:</b>	To ensure that the PhD students are exposed to the research carried out within the program, so that at they have more global vision of photonics.
	<b>Accions proposades:</b>	Conduct seminars organized by students, given by students and aimed at students. They are scheduled to take place once per week or every two weeks, where two students explain their research. After the presentation, there is a round of technical questions and another round where the students themselves make a constructive critique of the presentation, highlighting the strengths and points to be improved. The courses on theoretical optics and on biology will be maintained with optional character. Depending on the demand, the possibility to organize optional course in other areas will be considered.
	<b>Indicadors i valors esperats:</b>	Greater satisfaction with PhD courses. Greater adaptability to real training needs.
	<b>Abast:</b>	Programa de doctorat en Fotònica
	<b>Prioritat:</b>	mitja
	<b>Termini:</b>	30/11/2019
	<b>Estat:</b>	Finalitzada



	<p><b>Actuacions realitzades:</b> The proposed actions were carried out during the years 2017-18. After analysing the results and seeing that they were mostly satisfactory, we introduced these changes in the Modification Process and were accepted.</p> <p><b>Resultats obtinguts:</b> The question in the surveys on the satisfaction regarding the "courses or seminars I have done in the doctoral program in relation to the research of the thesis" gets a 3.6, above the average of 3.4 in the field of science. Courses has ceased to be a subject of complaint in the regular meetings with PhD students.</p>
<b>1041.M.2.2017</b>	<p><b>Courses on transversal skills at the start of the PhD studies.</b></p> <p><b>Càrrec:</b> Coordinador del programa, Mentor</p> <p><b>Origen:</b> seguiment</p> <p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> The PhD program offered optional transversal courses at any time during his or her doctorate. This resulted into two problems: 1.- Some courses were very popular, while others that the academic committee found important, basically entrepreneurship, were not very successful. 2.- Some students followed the course at inappropriate times. For example, the technical writing course was followed at the end of the thesis, while during the PhD they need to write articles.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> 1.- Expose the student to a minimum number of courses. 2.- Courses are taught at the beginning of the doctorate. 3.- Take advantage of the opportunity to create the feeling of pertaining to a cohort, knowing and supporting each other during the duration of the PhD.</p> <p><b>Accions proposades:</b> Organization of a 2 days annual stay outside ICFO facilities (in a camp house or similar) for all students starting their PhD. During the stay, they will attend the courses in transversal skill determined by the academic commission of the program.</p> <p><b>Indicadors i valors esperats:</b> An improvement on section B1 of the surveys, in the question "The usefulness of the courses or seminars I have done in the doctoral program in relation to the research of the thesis". More satisfaction with the courses.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> mitja</p> <p><b>Termini:</b> 30/11/2019</p> <p><b>Estat:</b> Finalitzada</p> <p><b>Actuacions realitzades:</b> The stays have been carried out every year since 2017, except the present year, which was done at the Institute in a reduced and hybrid face-to-face and online because of the covid situation.</p> <p><b>Resultats obtinguts:</b> The annual meeting with PhD students shows that the stay and the courses have become an activity they really enjoy. Transversal training is imparted more efficiently. Results in section B1 of the surveys score a 3.6, above the 3.4 in the field of science.</p>
<b>1041.M.3.2017</b>	<p><b>New selection process</b></p> <p><b>Càrrec:</b> Coordinador</p> <p><b>Origen:</b> seguiment</p> <p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> ICFO has significantly increased resources for doctoral scholarships, particularly from COFUND calls. These calls require a transparent selection process. On the other hand, ICFO decided to follow the recommendations of good practice established in the European Charter for Researchers as well as the principles of OTM-R (Open Transparent and Merit-Based Recruitment) of the EC, so that a transparent selection is guaranteed and based on the merit of all the scientist hired by the Institute, which includes the PhD students.</p>



	<p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Ensure a transparent selection process based on PhD student merit.</p> <p><b>Accions proposades:</b> Adapt the process taking into account: A first phase of eligibility verification. A second pre-selection phase that is carried out by an internal selection committee that assesses the basic skills of the candidates as well as adaptation to the profile of the program. A third phase of interviews with the potential Thesis supervisor and with an external selection committee.</p> <p><b>Indicadors i valors esperats:</b> An improvement in the selection process</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> alta</p> <p><b>Termini:</b> 30/11/2018</p> <p><b>Estat:</b> Finalitzada</p> <p><b>Actuacions realitzades:</b> The selection procedure is routinely performed following this method.</p> <p><b>Resultats obtinguts:</b> The results are satisfactory. Both the participants in the process and the future thesis supervisors value the new selection process very positively. The interview with the candidates conducted by the external selection committee is very useful in cases of doubt about the suitability of the candidate.</p>
1041.M.4.2017	<p><b>Creation of the Mentor position</b></p> <p><b>Càrrec:</b> Coordinador del programa, Direcció de ICFO.</p> <p><b>Origen:</b> seguiment</p> <p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> The relationship established between the PhD students and the Coordinator of the Doctoral program is distant, first because he is chosen from among the most senior faculty, second because most of the work he does in the program is mainly bureaucratic. As a result, many of the problems did not reach the coordinator, and when they did, it was too late. Therefore, a figure closer to the student who could detect as soon as possible PhD student conflicts or personal difficulty was needed.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Create the figure of the mentor, becoming a reference close to the student to turn to in case of difficulty.</p> <p><b>Accions proposades:</b> Appoint a mentor with the following characteristics: young researcher, with international experience (most of the students of the program are foreign), with emotional intelligence. The Mentor will form part of the academic committee of the program.</p> <p><b>Indicadors i valors esperats:</b> A better satisfaction with the PhD program</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> alta</p> <p><b>Termini:</b> 30/11/2018</p> <p><b>Estat:</b> Finalitzada</p>

	<p><b>Actuacions realitzades:</b> Dr. Robert Sewell has been appointed mentor. The mentor has begun to hold regular meetings with all the students and to organize courses and other activities of the doctorate. The mentor holds weekly meetings with the coordinator, the head of the human resources and education section and the administrative manager of the program.</p> <p><b>Resultats obtinguts:</b> The creation of the figure of the mentor, and the weekly meetings, has allowed us to make a more individualized follow-up of each PhD student, a better evaluation of his evolution, the detection of cases with difficulties and propose efficient solutions.</p>
<b>1041.M.5.2017</b>	<p><b>Consolidation of mechanisms to obtain the opinion of students</b></p> <p><b>Càrrec:</b> Coordinador del programa, mentor</p> <p><b>Origen:</b> seguiment</p> <p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> The student surveys have little participation and yet, being the questions fixed by the PhD school, it gives little information about what the students' concerns are and what their proposed solutions are.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Improve participation in the University surveys. Obtain direct information from students, complementing the surveys carried out by the University.</p> <p><b>Accions proposades:</b> <ol style="list-style-type: none"> <li>1. Establish an annual meeting at the end of the academic year with all PhD students.</li> <li>2. Regular meetings with the ICFO student association, ICONS.</li> <li>3. Periodically inform students of the channels they have to provide their opinion.</li> </ol> </p> <p><b>Indicadors i valors esperats:</b> Increased participation in surveys. Obtain more direct information.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> mitja</p> <p><b>Termini:</b> 30/11/2019</p> <p><b>Estat:</b> Finalitzada</p> <p><b>Actuacions realitzades:</b> A meeting has been held each academic year with all PhD students. Participation in university surveys has been encouraged. ICON students have a representative on the Program Academic Committee.</p> <p><b>Resultats obtinguts:</b> A 40% turnout was achieved in the surveys. Meetings with PhD students made possible to improve the collection of information.</p>
<b>1041.M.6.2017</b>	<p><b>Improve the different websites that provide information on the PhD program</b></p> <p><b>Càrrec:</b> Head of the human resource and education unit</p> <p><b>Origen:</b> seguiment</p> <p><b>Estàndard:</b> Estàndard 2: Pertinència de la informació pública</p> <p><b>Diagnòstic:</b> The follow-up Process (procés de seguiment) has shown that some links on the doctoral school website do not lead to the expected page and that some content is difficult to access and is incorrect.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Better interconnection between the different web pages, ensuring that the information is unique and correct.</p>

	<p><b>Accions proposades:</b></p> <ol style="list-style-type: none"> <li>1. Make a thorough analysis of the web pages and make a improvement proposal.</li> <li>2. Complete the information that the University cannot collect due to the lack of interconnection between the ICFO and UPC databases.</li> <li>3. Improve information aimed at PhD students on the ICFO intranet.</li> </ol> <p><b>Indicadors i valors esperats:</b></p> <p>Greater functionality</p> <p><b>Abast:</b></p> <p>Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b></p> <p>mitja</p> <p><b>Termini:</b></p> <p>30/11/2023</p> <p><b>Estat:</b></p> <p>En curs</p> <p><b>Actuacions realitzades:</b></p> <p>The doctoral school completely modified the website for the cross-accreditation procedure (acreditación transversal) passed in 2020. In this process, the content of the program web page was modified, improved and the accuracy ensured. Information on the doctoral program through the ICFO intranet has been improved with the aim of increasing transparency.</p>
1041.M.7.2017	<p><b>Improve the number of theses with the international mention.</b></p> <p><b>Càrrec:</b></p> <p>Coordinador del programa</p> <p><b>Origen:</b></p> <p>seguiment</p> <p><b>Estàndard:</b></p> <p>Estàndard 6: Qualitat dels resultats dels programes formatius</p> <p><b>Diagnòstic:</b></p> <p>A comparative analysis of the statistics of the number of students with international mention shows that the results of our programs are low. However, most of our students meet the requirements to obtain the mention. Specifically, they all write their dissertations in English, the vast majority have international members on their defence committee, and many of them perform stays abroad.</p> <p><b>Implica modificació de la memòria verificada?:</b></p> <p>No</p> <p><b>Objectius a assolir:</b></p> <p>Determine the reasons why the international mention rate is so low.</p> <p><b>Accions proposades:</b></p> <ol style="list-style-type: none"> <li>1.- To promote that the students that fulfil the requirements request the international mention.</li> <li>2.- Inform the students of what the requirements are.</li> <li>3.- Promote stays abroad in such a way that the requirements are met in accordance with the University regulations. Care will be taken to ensure that the stays have a clear academic and research objective. Stays inconsistent with the research plan will not be permitted for the sole purpose of obtaining the international mention.</li> </ol> <p><b>Indicadors i valors esperats:</b></p> <p>Improve the thesis rate with international mention</p> <p><b>Abast:</b></p> <p>Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b></p> <p>baixa</p> <p><b>Termini:</b></p> <p>30/11/2024</p> <p><b>Estat:</b></p> <p>En curs</p> <p><b>Actuacions realitzades:</b></p> <p>Students are encouraged to apply for the international mention if they meet the requirements. Individually inform the students of what the requirements are.</p>
1041.M.8.2017	<p><b>Increase vacancies offered by the program</b></p> <p><b>Càrrec:</b></p> <p>Coordinador del programa</p> <p><b>Origen:</b></p> <p>seguiment</p>

	<p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> The number of students admitted has increased over the years, in line with the success in obtaining grants for doctoral studies and the capacity of the program in terms of equipment and supervisors, which includes the help that post-doctoral researchers currently at ICFO can offer in co-supervising tasks.</p> <p><b>Implica modificació de la memòria verificada?:</b> Sí</p> <p><b>Objectius a assolir:</b> Adjust the number of vacancies offered by the program to the demand, the number of scholarships and the supervision capacity.</p> <p><b>Accions proposades:</b> Carry out the modifying process of the doctoral program.</p> <p><b>Indicadors i valors esperats:</b> An increase in the number of PhD students enrolled</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> alta</p> <p><b>Termini:</b> 30/11/2020</p> <p><b>Estat:</b> Finalitzada</p> <p><b>Actuacions realitzades:</b> The modifying process of the doctoral program has been carried out to increase the access from 20 to 35 vacancies.</p> <p><b>Resultats obtinguts:</b> Have a number of registered PhD students in accordance with the offer. The increase to 35 vacancies has been approved by the modification external committee.</p>
1407.M.9.2021	<p><b>Improve training complements</b></p> <p><b>Càrrec:</b> Coordinador del programa</p> <p><b>Origen:</b> acreditació</p> <p><b>Estàndard:</b> Estàndard 1: Qualitat del programa formatiu</p> <p><b>Diagnòstic:</b> The interdisciplinary nature of photonics includes candidates for master's degrees in photonics, but also candidates in Physics, Electronic, Electrical, Materials and Telecommunications Engineering, Mathematics, Chemistry, Biology, Bioengineering and Biophysics. In recent years the profile of students with a profile other than photonics and physics has been increasing, being a very common situation.</p> <p><b>Implica modificació de la memòria verificada?:</b> Sí</p> <p><b>Objectius a assolir:</b> To clarify which students should follow training complements taking into account the entry profile described, avoid ambiguities and adapt it to the widest range of multidisciplinary admission profiles.</p> <p><b>Accions proposades:</b> The subject of "Photonics Laboratory" is removed as a complement, since in the case of carrying out an experimental thesis the PhD student will already learn the specific techniques during the completion of the project, and in the case of carrying out a theoretical thesis, the subject does not add value to the student training. The linked reference masters are expanded and the subject of "Applied Photonics" is added, from the University Master's Degree in Key Enabling Technologies for the Food Industry and Bioprocesses (KET4FOOD + BIO), which may be useful for those PhD candidates with an entry biology or biomedicine profile.</p> <p><b>Indicadors i valors esperats:</b> A more useful and logical use of the training complements.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> alta</p>

	<p><b>Termini:</b> 23/5/2022</p> <p><b>Estat:</b> Finalitzada</p> <p><b>Actuacions realitzades:</b> The verification document has been modified.</p> <p><b>Resultats obtinguts:</b> An offer of training complements adapted to the profile of the candidates and field of the program.</p>
1407.M.10.2021	<p><b>Consolidate supervision mechanisms</b></p> <p><b>Càrrec:</b> Head of academic affairs</p> <p><b>Origen:</b> acreditació</p> <p><b>Estàndard:</b> Estàndard 4: Adequació del professorat al programa formatiu</p> <p><b>Diagnòstic:</b> Different mechanisms are in place at ICFO to compile feedback and opinion of PhD Students as well as continuously following-up their process and individually providing them mentoring support when needed. While these proved to be very efficient and should be consolidated, in some cases we lack specific quantitative data as well as clear procedures on how to proceed when specific supervising issues are identified.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Ensure that we have complete relevant data on PhD Students opinions and potential conflicts and clear procedures on how to resolve them. Provide</p> <p><b>Accions proposades:</b> <ol style="list-style-type: none"> <li>1.- Provide the mentor with tools, greater power and influence in the resolution of conflicts between PhD student and supervisor by appointing him as a head of academic affairs.</li> <li>2.- Increase the number of PhD students in the Academic Commission of the program.</li> <li>3. Courser for supervisors.</li> <li>4.- Create a specific survey to compile relevant data from PhD students.</li> <li>5.- Collect relevant information from supervisors in the form of a survey or in periodic meetings.</li> <li>6.- Define clear procedures on conflict resolution, have them approved by the PhD committee, and correspondingly inform to all PhD Students.</li> <li>7.- Reinforce and expand other feedback mechanisms already present at ICFO.</li> <li>8.- Encourage the participation of Postdocs as co-supervisors in such a way that the student has a closer supervisor.</li> </ol> </p> <p><b>Indicadors i valors esperats:</b> Improve the level of satisfaction with the supervision and with the program.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> alta</p> <p><b>Termini:</b> 23/5/2026</p> <p><b>Estat:</b> En curs</p> <p><b>Actuacions realitzades:</b> <ol style="list-style-type: none"> <li>1.- The mentor has been appointed Head of Academic Affairs.</li> <li>2.- The BIST Workshop Supervising PhD Students has been offered.</li> <li>3.- The number of PhD student representatives in the Academic Commission of the program has been increased to 3, matching the number of supervisors representatives.</li> </ol> </p>
1407.M.11.2021	<p><b>Consolidate Data Management Project</b></p> <p><b>Càrrec:</b> Head of the human resource and education unit</p> <p><b>Origen:</b> acreditació</p> <p><b>Estàndard:</b> Estàndard 6: Qualitat dels resultats dels programes formatius</p> <p><b>Diagnòstic:</b> The University has a system for collecting the faculty scientific production, obtaining in an automatic way the scientific production for PhD students. ICFO professors do not have access to this system, so the University cannot collect information from the PhD students of the</p>

	<p>photonics program. On the other hand, ICFO has several mechanisms in place to compile data and information. The situation is thus that the data is currently scattered in different platforms and not standardized.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Standardize the data acquisition process, ensuring that Business Intelligence can be used to extract and combine data from different sources allowing the obtention of constantly updated statistics and relevant data indicators. Use the information for continuously tracking our program and correspondingly decide on actions to be taken.</p> <p><b>Accions proposades:</b> 1.- Explore the possibility of collecting information through the Atenea PhD platform at UPC. 2.- Maintain a database of PhD student scientific production with the help of the ICFO library. 3.- Proceed with the normalization and consolidation of the different data sources. 4.- Provide tools for extraction of this data with business intelligence.</p> <p><b>Indicadors i valors esperats:</b> Get a clear and complete picture of the different relevant indicators of the program, including student productivity.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> mitja</p> <p><b>Termini:</b> 23/5/2023</p> <p><b>Estat:</b> No iniciada</p>
1407.M.12.2021	<p><b>Expand mentoring program for career transitions</b></p> <p><b>Càrrec:</b> Coordinador del programa, Head of academic affairs</p> <p><b>Origen:</b> acreditació</p> <p><b>Estàndard:</b> Estàndard 6: Qualitat dels resultats dels programes formatius</p> <p><b>Diagnòstic:</b> Several activities are organized at ICFO aiming at providing PhD Students information on different career paths and opportunities and to maintain contact with PhD graduated through the ICFO Alumni network. However we have identified that PhD Students need more close support in their career transition and that we need more information on the PhD graduates. Specifically, PhD graduate participation in the surveys is very low, either because the University does not have up-to-date contact or because the graduates do not feel the need to answer.</p> <p><b>Implica modificació de la memòria verificada?:</b> No</p> <p><b>Objectius a assolir:</b> Expand the current mentoring program for career transitions with the aim of providing more support to PhD Students in this process and help them launch their future careers. Reinforce engagement of Alumni to ensure we get all relevant information from them when needed as well as get them involved in our mentoring program for career transitions.</p> <p><b>Accions proposades:</b> 1.- Implement a specific mentoring program that allows help researchers identify their own career goals, facilitate orientation in the scientific career and expand their professional network. 2.- Take advantage of the high degree of participation of graduate students in the ICFO-Alumni network to conduct a survey regarding the satisfaction with the PhD and employment.</p> <p><b>Indicadors i valors esperats:</b> Obtain statistically significant values that allow temporary tracking for the PhD studies and employment satisfaction.</p> <p><b>Abast:</b> Programa de doctorat en Fotònica</p> <p><b>Prioritat:</b> baixa</p> <p><b>Termini:</b> 23/5/2024</p> <p><b>Estat:</b> No iniciada</p>

1407.M.13.2021	<b>Continuous enhancement of the career and personal development opportunities</b>	
	<b>Càrrec:</b>	Head of academic affairs
	<b>Origen:</b>	acreditació
	<b>Estàndard:</b>	Estàndard 1: Qualitat del programa formatiu
	<b>Diagnòstic:</b>	We have identified two topics to pay attention: First, Research Integrity has been identified as a key issue and ICFO aim to ensure full compliance with these principles. Second, a research career path is highly demanding on a personal as well as intellectual level, increasing the PhD student stress. This situation is particularly high for foreign PhD students having to relocate and support is needed on this scope.
	<b>Implica modificació de la memòria verificada?:</b>	No
	<b>Objectius a assolir:</b>	Enhance the training and support activities offered to PhD students to address the abovementioned issues. Compile detailed information on both topics to be displayed in the intranet so that PhD Students has clear detailed information about resources offered and how to access them once at ICFO. Create clear guidelines on in which cases complementary training activities will be requested and options to undertake them.
	<b>Accions proposades:</b>	<ol style="list-style-type: none"> <li>1. Expand and update Research Integrity training.</li> <li>2. Ensure all incoming researchers has appropriate information/training on arrival and update the content of the courses.</li> <li>3. Consolidate the Resilience &amp; Well-being program.</li> </ol>
	<b>Indicadors i valors esperats:</b>	A greater satisfaction with the PhD studies, and with research in general, prior and after graduation.
	<b>Abast:</b>	Programa de doctorat en Fotònica
	<b>Prioritat:</b>	baixa
	<b>Termini:</b>	28/5/2024
	<b>Estat:</b>	En curs
	<b>Actuacions realitzades:</b>	Setting up of the Resilience & Well-being program



## Valoració global del Pla de Millora

The improvement plan of the doctoral program must be seen as a co-substantial part with the ICFO general improvement plan, formally launched in 2014 when the Institute adopted the “Charter for European Researchers” and the Code of Conduct for the Recruitment of Researchers”, starting a Human Resources strategy to improve the experience of Researchers at ICFO. In this way, ICFO obtained the “HR Excellence in Research” from the European Commission in 2015.

Aligned with this process, the improvement plan has been advancing and meeting its goals. 6 out of the 8 improvement proposals in 2017 have finalized, and two of them are ongoing. The 6 implemented proposals have substantially changed the program in the following aspects:

The improvement proposals “modification of the compulsory courses” (1041.M.1.2017) and “Courses on transversal skills at the start of the PhD studies” (1041.M.2.2017) allow a better follow-up and the PhD student greater satisfaction.

The improvement proposal “New selection process” (1041.M.3.2017) resulted in a more professional and transparent procedure that follows the highest European standards.

The improvement proposal “Creation of the mentor position” (1041.M.4.2017) made possible to carry out monitoring processes that would otherwise have been impossible, as coordinators of PhD programs have to deal with administrative issues and have many other functions within the university, mainly teaching, which reduces the available time to carry out the mentoring tasks. Specifically, the improvement proposal “Consolidation of mechanisms to obtain the opinion of students” (1041.M.5.2017), which implies continuous contact with all the PhD students has been made possible only by the creation of this figure.

All the above measures made possible to adjust the machinery of the PhD program in such a way that the implementation of the improvement proposal “Increase vacancies offered by the program” (1041.M.8.2017) has been performed without introducing stress to the system.

Of the two on going improving proposals, the first one, “Improve the different websites that provide information on the PhD program” (1041.M.6.2017), depended on the total remodelling of the website that the Doctoral School implemented in the fall of 2020. Once completed, the project has been resumed with medium priority. The improvement proposal “Improve the number of theses with the international mention” (1041.M.7.2017), is a slow process that we hope will show its benefits in the long term, when the effect of the covid-19 crisis and the consequent impossibility to perform stays do not disturb the situation.

The 5 proposals for improvement presented during this Accreditation process, reinforce the previous proposals.

The improvement proposal “Enhance training complements” (1407.M.9.2021) can be understood as a consequence of the revision of the training program (proposals 1041.M.1.2017 and 1041.M.2.2017) and of the selection and admission process (proposal 1041. M.3.2017). This is a proposal that has already been finalized through the submission of the Modification report, now waiting for the outcome.

The improvement proposals “Consolidate Data Management Project” (1407.M.11.2021) arise from the great improvement performed in the new website of the program (improvement proposal 1041.M.6.2017) and the new system of data collection from the Doctoral School ([process PT.03](#) to collect the satisfaction of the stakeholders), which have uncovered the lack of interconnectivity between ICFO and UPC databases. These two proposals have a relatively low priority with the objective to have them implemented having in mind the next Follow-up Process of the PhD program.

On the other hand, precisely, the improvement of the information systems of the Doctoral School suddenly made apparent the weakness of the information we have about our PhD graduates. This information should be easy to obtain through the ICFO Alumni network, initiating the improvement proposal “Expand mentoring program for career transition” 1407.M.12.202. However, this proposal goes beyond the collection of information, and aims to help our graduates going into the job market.

Finally, the most important improvement proposals we currently have are “Consolidate supervision mechanisms” (1407.M.10.2021) and “Continuous enhancement of the career and personal development opportunities” (1407.M.13.2021). The implementation started almost two years ago and are based on the figure of the mentor (1041. M.4.2017), supported by the opinion of the students (1041.M.5.2017). The aim is to improve what is essential in doctoral studies: the scientific, academic and personal relationship between a supervisor and their pupils. The key to the success of a thesis is in this relationship and we want to lay the foundations for a satisfactory relationship, both for the PhD student and the supervisor, without diminishing the scientific level of the thesis. In this sense, we have numerous success stories in the program of groups that manage to be among the best in the world, with a very high level of demand

on the PhD student work, and yet, the student enjoys the thesis, the supervisors and the doctoral program.

## 4. Evidències

En aquest apartat cal introduir les evidències que suporten l'informe d'acreditació. Aquestes evidències han d'estar disponibles i accessibles per als membres del Comitè d'Avaluació Externa (CAE).

Name of evidence	Site (URL)
Web of the UPC PhD School	<a href="https://doctorat.upc.edu/">https://doctorat.upc.edu/</a>
SGIQ of the PhD School.	<a href="https://doctorat.upc.edu/en/school/quality/sgiq?set_language=en">https://doctorat.upc.edu/en/school/quality/sgiq?set_language=en</a>
Website of the program at the PhD school: <ul style="list-style-type: none"> <li>Full information of the program,</li> <li>Qualitat: Verification, Follow-Up and (if available at the moment) Modification reports.</li> <li>Tesis doctorals: Doctoral theses can be found.</li> </ul>	<a href="https://doctorat.upc.edu/en/programmes/photonics">https://doctorat.upc.edu/en/programmes/photonics</a>
Website of the program at ICFO: <ul style="list-style-type: none"> <li>Brief description of the program</li> <li>Links to the PhD program and to the fellowship websites</li> </ul>	<a href="https://www.icfo.eu/lang/studies/phd-programs">https://www.icfo.eu/lang/studies/phd-programs</a>
Scholarships and available PhD positions.	<a href="http://jobs.icfo.eu">http://jobs.icfo.eu</a>
Atenea PhD	<a href="https://serveistic.upc.edu/ca/atenea-phd/">https://serveistic.upc.edu/ca/atenea-phd/</a>
PhD School indicators (you must select "photonics" in the drop-down corresponding to the program)	<a href="https://app.powerbi.com/view?r=eyJrJoiZWUxOTFkMWYtMTgwMy00Y2ViLTlhZTctY2Q0MjdjZDg0ZDNiliwidCI6Ijc4ZmMzMGMGFhLTNmMjEtNGE3ZC05ZjFhLWEzOTkzZTIyOTM0OSIsImMiOiI9">https://app.powerbi.com/view?r=eyJrJoiZWUxOTFkMWYtMTgwMy00Y2ViLTlhZTctY2Q0MjdjZDg0ZDNiliwidCI6Ijc4ZmMzMGMGFhLTNmMjEtNGE3ZC05ZjFhLWEzOTkzZTIyOTM0OSIsImMiOiI9</a>
Quadre de comandament d'indicadors per programa: Indicators of the PhD in Photonics Program (you must select "photonics" in the drop-down corresponding to the program)	<a href="https://app.powerbi.com/view?r=eyJrJoiMzBmOTA2ZjYtZmY4NS00NjFkLWFjMzEtNDhhNGRhZjhmM2I0IiwidCI6Ijc4ZmMzMGMGFhLTNmMjEtNGE3ZC05ZjFhLWEzOTkzZTIyOTM0OSIsImMiOiI9">https://app.powerbi.com/view?r=eyJrJoiMzBmOTA2ZjYtZmY4NS00NjFkLWFjMzEtNDhhNGRhZjhmM2I0IiwidCI6Ijc4ZmMzMGMGFhLTNmMjEtNGE3ZC05ZjFhLWEzOTkzZTIyOTM0OSIsImMiOiI9</a>
PhD School the surveys	<a href="https://www.upc.edu/portaldades/ca/enquestes/doctorat/enquesta-a-lestudiantat-de-doctorat/2019-20/informes-per-programa/doctorat-en-fotonica-doc000001407.pdf">https://www.upc.edu/portaldades/ca/enquestes/doctorat/enquesta-a-lestudiantat-de-doctorat/2019-20/informes-per-programa/doctorat-en-fotonica-doc000001407.pdf</a>
Website of the ICONs student association	<a href="https://icons.icfo.eu/">https://icons.icfo.eu/</a>
Plus+ ICFO's training program	<a href="https://www.icfo.eu/es/lang/studies/icfo-plus">https://www.icfo.eu/es/lang/studies/icfo-plus</a>
ICFO Alumni Network	<a href="https://www.icfo.eu/lang/about-icfo/alumni">https://www.icfo.eu/lang/about-icfo/alumni</a>
Actions with a gender perspective	<a href="https://www.icfo.eu/lang/about-icfo/gender-equality">https://www.icfo.eu/lang/about-icfo/gender-equality</a>
SPIE@ICFO Chair for Diversity in Photonic Science	<a href="https://icfo.eu/newsroom/news/article/4772">https://icfo.eu/newsroom/news/article/4772</a>
Maria Yzuel Fellowship Awards	<a href="https://www.icfo.eu/newsroom/news/4292-maria-yzuel-fellowship-awards">https://www.icfo.eu/newsroom/news/4292-maria-yzuel-fellowship-awards</a>
BIST Workshop: Supervising PhD Students	<a href="https://bist.eu/events/event/workshop-supervising-postgraduate-students/">https://bist.eu/events/event/workshop-supervising-postgraduate-students/</a>
Resilience and Well-Being program	<a href="https://www.icfo.eu/newsroom/news/4752-resilience-and-well-being-workshop">https://www.icfo.eu/newsroom/news/4752-resilience-and-well-being-workshop</a>
The Nanofabrication Laboratory (NFL), Super-Resolution Light Microscopy Laboratory, Characterization and Post-Processing Laboratory, Basic Chemistry and Biology Laboratory, Advanced Engineering Laboratory	<a href="https://www.icfo.eu/lang/research/facilities">https://www.icfo.eu/lang/research/facilities</a>
Industrial laboratories	<a href="https://www.icfo.eu/lang/industry/industrial-">https://www.icfo.eu/lang/industry/industrial-</a>

	<a href="#">collaborations</a>
ICFO Corporate Liaison Program	<a href="https://www.icfo.eu/lang/industry/corporate-liaison-program">https://www.icfo.eu/lang/industry/corporate-liaison-program</a>
CARLA project	<a href="https://carlahub.eu/">https://carlahub.eu/</a>
ICFO annual report 2019	<a href="https://www.icfo.eu/images/about/transparency/Memoria_ICFO_2019.pdf">https://www.icfo.eu/images/about/transparency/Memoria_ICFO_2019.pdf</a>
Accreditation repository: <ul style="list-style-type: none"> <li>• List of JCR papers published by EEES PhD students (grouped by years).</li> <li>• List with the thesis defence committees.</li> <li>• List with graduated PhD students' positions.</li> <li>• PhD in Photonics Policy</li> </ul>	<a href="https://icfo-my.sharepoint.com/personal/lmiralles_icfo_net/_layouts/15/onedrive.aspx?id=%2Fpersonal%2FImiralles%5Ficfo%5Fnet%2FDocuments%2FDocsAcreditaci%C3%B3DoctoratFot%C3%B2nica">https://icfo-my.sharepoint.com/personal/lmiralles_icfo_net/_layouts/15/onedrive.aspx?id=%2Fpersonal%2FImiralles%5Ficfo%5Fnet%2FDocuments%2FDocsAcreditaci%C3%B3DoctoratFot%C3%B2nica</a>