Agencia Nacional de Investigación y Desarrollo

Ministerio de Ciencia, Tecnología, Conocimiento e Innovación

# PROPOSAL - FIFTH CALL SCIENTIFIC AND TECHNOLOGICAL MAJOR EQUIPMENT FONDEQUIP, 2024

| Proposal Title | LABORATORY FOR APPLIED AND ULTRAFAST PHOTOSCIENCES (LAUPS) |
|---|---|
| **Name and technical description of the equipment** (Describe briefly what the equipment consists of and how it is used) | Femtosecond fluorescence (HALCYONE) and Transient absorption (HELIOS-EOS) automated spectrometers, coupled to a compact high-energy amplified femtosecond laser (HYPERION with APOLLO-Y OPA).<br><br>These automated spectrometers allow measuring the light emitted or absorbed by short-lived species, generated upon photoexcitation in the femtosecond temporal scale. |
| **If you apply for an equipment platform, you must technically justify the requested configuration** | This platform allows to get laser-induced transient emission (HALCYONE Spectrometer) and absorption (HELIOS-EOS Spectrometer) measurements in the femtosecond temporal scale. The equipment has a patented automated system for aligning the excitation beam from the laser, which constitutes a unique advantage given the difficulty of the optics involved in this kind of equipment compared to other systems normally assembled by parts (home-made). The Ytterbium laser excitation source (HYPERION) coupled to an optical parametric amplifier (OPA - APOLLO-Y), allows to obtain a wide range of excitation wavelengths (258 nm - 1300 nm) and short pulses in the range of 190 to 300 fs. These characteristics allow time-resolved emission detection on the femtosecond scale. On the other hand and complementary, it also allows the absorption of transients (excited species or short-lived species) on the femtosecond time scale and in the spectral range from 270 nm to 1600 nm. |

## Instructions:

1. Answer each of the requested items in this form considering the **evaluation criteria** of the Contest Guidelines.

2. Respect the format and maximum length of each section. It is not allowed to alter the established format regarding structure, margins, spacing or font size.

# 1. Scientific and technical justification of the proposal.

## 1.1 Clarity, coherence and pertinence of the requested equipment with the research activities and/or experimental development of the research area(s) that the institutions wish to support.

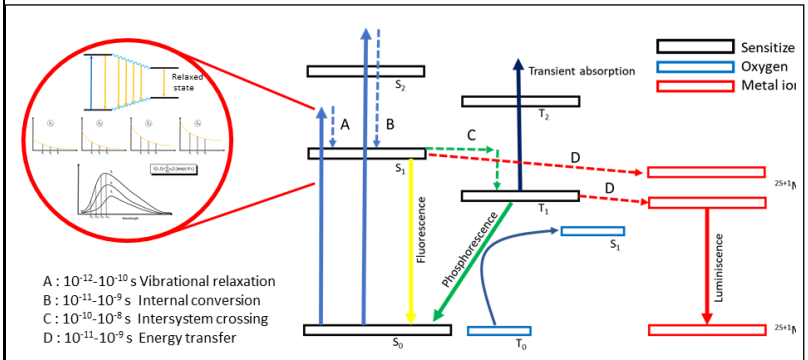
Justify the participation of the institutions conforming this application, both Principal and Associates, including a detailed description of tasks distribution and the synergies that could be achieved. Explain the link between the requested equipment and the research and/or experimental development activities undertaken by these institutions. Justify the reasons for choosing the requested equipment, clearly explaining your preference over other similar equipment, according to its characteristics and in relation to the proposed research. Address how the absence of the requested equipment currently affects the investigation.

(Maximum length 3 pages, including this one. You must use Calibri font 11 and line spacing 1.0).

LABORATORY FOR APPLIED AND ULTRAFAST PHOTOSCIENCES (LAUPS)

The main goal of this proposal is the acquisition, installation and operation of a femtosecond fluorescence and a transient absorption automated spectrometer, coupled to a compact high-energy amplified femtosecond laser. The Institutions being part of the present proposal are Universidad Andrés Bello (UNAB) as the Principal one; Universidad de Chile (UCH), Universidad de Santiago (USACH), Pontificia Universidad Católica (PUC), Universidad de Concepción (UdeC), Universidad Católica del Norte (UCN), Universidad de Talca (UTALCA) and Pontificia Universidad Católica de Valparaíso (PUCV) as the Associate ones. All of them have long-term experience and prestige at undergraduate and postgraduate level in almost all disciplinary areas. The scientific research developed by these Institutions is focused on the generation of new knowledge and advanced human resources promotion to be a remarkable contribution to our Country. In this context, they have made huge efforts to support to their academic staff doing research by providing proper laboratories, internal grants, protected research-time, and money to counterpart the equipment acquisition. The synergism or collaborative work between these Institutions has taken place through their academics, who have associated for the execution of national grants like FONDECYT, ANILLOS, FONDEQUIP among others financial support programs. Within this frame, the research team supporting this proposal has stablished a productive multi-institutional research collaboration. The team is configured by the Principal Researcher (PR), Prof. Nancy Pizarro (NP, UNAB), and the Associate Researchers (ARs), Prof. German Günther (GG, UCH), Prof. Carolina Aliaga (CA, USACH), Prof. Denis Fuentealba (DF, PUC), Prof. Nestor Novoa (NN, UdeC), Prof. Jaime Llanos (JLL, UCN), Prof. Luis Felipe Aguilar (LA, PUCV), Prof. Felipe Avila (FA, UTALCA), who have been collaborating during more than five years developing research projects (for example FONDECYT 1200903 by NP, GG, DF), manuscripts (https://doi.org/10.1007/s43630-023-00507-0; https://doi.org/10.1016/j.jphotochem.2023.115388), and also, in the organization of relevant international conferences as the XXV Inter-American Photochemical Society Meeting (2016, 170 participants), and XV Encuentro Latinoamericano de Fotoquimica y Fotobiologia (2019, 120 participants). **All the research areas developed in these Institutions by the above-mentioned researchers converge in the study of different processes involving the interaction between matter and light**. In this context, the research areas detailed for each member of the team are: “Photophysical and photochemical characterizations of pharmaceutical, organometallic or luminescent materials” by the PR (NP, UNAB); “Singlet oxygen generation by glycosensitizers” by GG (UCH); “Radicals, fluorophores, and nanoparticles” by CA (USACH); “Biosupramolecular systems and photosensitizers interactions” by DF (PUC), “Non-linear absorption and optical limiting in the near infrared” by NN (UdeC), “Luminescent materials, lanthanides and up-conversion processes” by JLL (UCN), “Mechanisms of photoinduced oxidative modifications on eye lens proteins” by FA (UTALCA) and “Fluorescence Spectroscopy and lipid bilayers” by LA (PUCV). All of them are related to photosciences and despite big

efforts have been made in order to acquire contemporary spectroscopic equipment for photophysical measurements, our limitation is still the time domain. **Many current and interesting processes that have attracted our attention occur in the ultra-fast time scale.** These processes (depicted in **Scheme 1**) include: Energy Transfer and Photosensitization for singlet oxygen generation or Antenna Effect, Electron Transfer and Electron Injection for Solar Cells, Solvation and Media Dynamics in Biosupramolecular Systems or Materials, among others. It must be remarked that all these topics are currently being studied by different research groups in Chile and in neighboring countries (i.e., Argentina, Brazil). Therefore, the acquisition of automated spectrometers for fluorescence and transient absorption coupled to a compact high-energy amplified femtosecond laser, represents a strategic opportunity to enhance the development and scientific scope of these research lines, overcoming their technical limitations, and also promote the creation of international ties and the consolidation of those already established.




**Scheme 1**

The acquisition of the requested equipment will directly impact not only on the development of the projects directed by the PR and ARs: FONDECYT 1200903 (metal carbonyl complex capacities as photo-sensitizers and antibacterial agents), FONDECYT 1240543 (polyelectrolytes for singlet oxygen photooxidations), FONDECYT 1240302 (Environmental effects on photochemical processes), FONDECYT 1210583 (Supramolecular activatable photosensitizers), FONDECYT 1220159 (Solar Spectral Conversion based on Luminescent Lanthanides), FONDECYT 1221280 (Antiglycating agents and Photosensitized mechanisms) and FONDECYT 1201680 (Photoinduced processes in metallo-supramolecular boxes). Additionally, this equipment will contribute to strengthening the Graduate and Undergraduate Programs of each participant Institution: PhD in Molecular Physical Chemistry (UNAB), PhD in Chemistry (UCH, USACH, UdeC, PUCV and PUC), M.Sc. or Bachelor in Chemistry (UNAB, PUCV, UCN, USACH, UTALCA), Bachelor in Biochemistry (UTALCA) and other programs closely related with chemistry (Physics or Materials Sciences, Biological Sciences, Pharmaceutical Sciences, etc.). To illustrate this point, here are some examples of PhD or MSc theses being currently developed and which could be improved with the requested equipment: “Experimental and Theoretical Approach to Energy Transfer Process in Rhenium (I) – Lanthanide (III) Complexes” (UNAB, ANID scholarship 21200995), the equipment will allow to measure the ultrafast energy transfer between the two metallic fragments; “Metal carbonyl complexes as singlet oxygen and carbon monoxide photoinduced releasers” (UNAB, ANID scholarship 21210727), the equipment would help to characterize the excited states that are responsible to sensitize singlet oxygen or release carbon monoxide; “Optical and Magnetic Properties of New Compounds based on Dysprosium (III)” (UCH, internal scholarship), the equipment would allow to measure the optical properties of the Dy compounds including the fast energy transfer process; Biosupramolecular Complexes of Toluidine Blue Derivatives linked to Human Serum Albumin interacting with Cucurbut[n]urils. Phototoxicity Studies in vitro Tumoral cells” (PUC, internal scholarship).

**South America and Worldwide Collaborations:** To the best of our knowledge, no other equivalent, neither similar equipment is actually operating in South or Latin America. Then, its acquisition and operation will contribute to reinforce current international collaborations and establish new ones. As can be stated from their support letters (attached to the present proposal), Latin American researchers belonging to Universidad Nacional de Río Cuarto, Universidad Nacional de La Plata and Universidad Nacional de Santiago del Estero from Argentina, as well as University of Sao Paulo from Brazil would be interested to use the equipment.

**Requested Equipment:** The femtosecond fluorescence and transient absorption automated spectrometers (HALCYONE and HELIOS-EOS), coupled to a compact high-energy amplified femtosecond laser (HYPERION with APOLLO-Y OPA) from Ultrafast Systems Company, consists of an ultrafast amplified Ytterbium laser of maximum energy pulse of 400 mJ, minimum pulse duration of 270 fs and central wavelength of 1030 nm. When is coupled to the APOLLO-Y Optical Parametric Amplifier (OPA), the femtosecond pulses can be tuned from UV to NIR wavelength range (258 nm – 1300 nm). This attachment or accessory allows to excite samples along all UV-Vis-NIR spectral range. This configuration has been optimized for working with the HALCYONE and HELIOS-EOS spectrometers. The HALCYONE is an automated femtosecond fluorescence spectrometer that upon photoexcitation allows to record spectral and kinetics data for luminescence detection range of 270 nm to 1600 nm. Coupling with an Optical Delay Line allows to perform automated alignment (time 3-5 min), avoiding this common tricky problem of optical measurements. The HELIOS-EOS is an automated femtosecond transient absorption spectrometer that allows measuring the light-absorption of short-lived species generated upon photoexcitation in the probe spectral range of 350 nm to 1700 nm and time window of 8 ns. Switching of spectral regions is fully automated, minimizing the risk of misaligning critical components. The selection of this integrated equipment is based on the following characteristics (besides spectrometers by Ultrafast Systems have a high level of automation accompanied with a broad spectral and temporal coverage, and an automated beam alignment system):

- HYPERION: Compact and simplified integration to OPA and spectrometers. Monolithic thermally stabilized body. Computer-controlled. The Ytterbium laser is less expensive than a Ti:Sapphire laser.
- APOLLO-Y OPA: Compact. It has multiple frequency conversion schemes which allows fully computer-controlled tuning of the output wavelength from 258 nm to 1300 nm. Collinear output from a single port reduces the need for external beam routing optics. The timing of the pulse output remains consistent across the whole wavelength tuning range.
- HALCYONE fluorescence spectrometer: computer-controlled tuning of the crystal angle over a specified spectral region of interest to maximize signal. The standard Time Window of 8 ns is extendable to ms time scale using a Time-Correlated Single Photon Counting integrated detector (TCSPC) for direct measurement of the sample fluorescence (IRF < 200 ps).
- HELIOS-EOS transient absorption spectrometer: Enhanced sensitivity (compatible with nJ pump energy levels). Fully Automated (patent pending) optical delay line alignment and switching between spectral ranges (350 nm to 1700 nm).

These characteristics when compared to those of femtosecond lasers offered by other Companies like Newport, Spectra-Physics or Coherent, lead us to decide on the Ultrafast Systems supplier. The main disadvantage of these other brands is that they provide the excitation source and optical parametric amplifier without the spectrometer integration and automatization. Then, the integration of the components from one or different suppliers increases the complexity and would lead to difficulties in optical alignment.

**Expected Impact:** The equipment acquisition will directly impact not only on the development of the above-mentioned projects in execution by the PR (UNAB) and ARs (UCH, PUC, USACH, UdeC, PUCV, UCN, UTALCA), but also will allow the development of the research carried out within the Country (including other external Institutions like UTFSM, UA, UCEN) to be promoted towards higher standards of quality and scientific impact. Considering that this will be a unique equipment in the region, this platform will also benefit other researchers from Chile and South America, who are willing to access to the offered services. Likewise, access to this equipment will strengthen the theoretical and practical formation of human capital at both, the undergraduate and graduate levels, because we will include topics related with the requested equipment in courses of the different Programs as can be seen in the attached support letters. Finally, the international collaboration with experts in femtosecond time-resolved spectroscopy will allow us to improve and optimize the use of the equipment for future new applications and joint research collaborations, being also possible the development of new research lines in the frontline of research.

## 1.2 Viability and maintenance of the equipment over time.

Explicitly indicate current projects or research activities, active at least until December 2026, that will be linked to, or benefit from, the requested equipment and that can assume the costs associated with its operation. Please include the completion date (day/month/year) and describe how each of the projects will use the equipment.

(Maximum length: 3 pages, including this one. You must use Calibri font 11 and line spacing 1.0). If necessary, insert rows in the table.

| | |
|---|---|
| Current Project Code | 1240543 |
| Project's Title | Desing and synthesis of polyelectrolytes for singlet molecular oxygen-mediated photooxidation with visible light, durable in the dark. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2028 |
| Main researcher and affiliation | Germán Günther – Universidad de Chile |
| Describe the intended use of the equipment in the research project. | To characterize photophysically different colloidal systems (polyelectrolytes), trying to stablish the mechanism for populating the triplet excited state able to generate singlet oxygen. |

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|---|---|
| Current Project Code | 1241928 |
| Project's Title | Heteronuclear Near Infrared Emitters Based on Imidazole Frameworks as Biocompatible Contrast Agents for Lanthanide Luminescent Thermometry |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2028 |
| Main researcher and affiliation | Pablo Fuentealba – Universidad de Chile |
| Describe the intended use of the equipment in the research project. | Characterization of the excited states and the energy transfer process (antenna effect) in the femtosecond time scale. |

| | |
|---|---|
| Current Project Code | 1240302 |
| Project's Title | Probing environmental effects on photochemical processes. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 30/03/2028 |
| Main researcher and affiliation | Carolina Aliaga Vidal – Universidad de Santiago de Chile |
| Describe the intended use of the equipment in the research project. | Photophysical and transients' characterization of chromophores in different media in the femtosecond time scale. |

| | |
|---|---|
| Current Project Code | 1240893 |
| Project's Title | Unveiling the inverted solvatochromism of organic and organometallic sensors. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 30/03/2028 |
| Main researcher and affiliation | Moisés Domínguez Caru – Universidad de Santiago de Chile |
| Describe the intended use of the equipment in the research project. | Photophysical characterization of excited states and solvatofluorochromism parameters evaluation of fluorophores, evaluating the ultrafast vibrational solvent effect. |

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| Current Project Code | ICN17_012 |

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| Project's Title | Millennium Institute of Research in Optics (MIRO) |
| Financing Source | ANID - MILLENNIUM SCIENCE INITIATIVE PROGRAM |
| Project's end date (dd/mm/yyyy) | 01/12/2027 |
| Main researcher and affiliation | Dinesh Pratap Singh – Universidad de Santiago de Chile (USACH) |
| Describe the intended use of the equipment in the research project. | Most of the optically active materials which we synthesize, show luminescence or photoluminescence. This equipment will be much useful for the exploration of these properties of the materials in the femtosecond temporal scale. |

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|---|---|
| Current Project Code | 1231894 |
| Project's Title | Design and application of multichannel chemosensors of environmentally relevant analytes; N´N and NHC transition metal complexes as the building blocks of sensitive and selective platforms. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2027 |
| Main researcher and affiliation | Fernando Godoy – Universidad de Santiago de Chile (USACH) |
| Describe the intended use of the equipment in the research project. | The equipment will be used to characterize the chemosensors: Re(I); Fe(II) and Ru(II) functionalized complexes in order to evaluate their photophysical properties upon external stimulus. |

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|---|---|
| Current Project Code | 1231787 |
| Project's Title | Supramolecular complexes as a platform for molecular recognition and structural modification of biomolecules |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 30/03/2027 |
| Main researcher and affiliation | Luis Lemus – Universidad de Santiago |
| Describe the intended use of the equipment in the research project. | The equipment will be used to evaluate the photophysical properties of coordination compounds (Cu(I) or Fe(II) complexes) designed for low-cost energy conversion and technological applications. The Transient Absorption Spectroscopy is mandatory due to the short lifetimes involved in photoprocesses of energy conversion. The lack of such an instrument in Chile makes difficult the study of transient species as we depend on foreign research groups. |

| | |
|---|---|
| Current Project Code | 1230090 |
| Project's Title | Oligo/poly(azomethine)s and oligo/poly(heteroaryl)s with modulated processability as potential materials in the optoelectronic field. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2027 |
| Main researcher and affiliation | Claudio Terraza – Pontificia Universidad Católica de Chile (PUC) |
| Describe the intended use of the equipment in the research project. | The equipment will be used to record important photophysical properties of TADF compounds (small molecule) and new TADF polymers, evaluating their potential use in OLED devices. The results will allow modification of the proposed synthetic routes to optimize the efficiency of the devices. |

| | |
|---|---|
| Current Project Code | 1231194 |

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|---|---|
| Project's Title | Enlightening the luminescence-based sensing mechanisms of doped MOFs with single- and double-emission centers through DFT and multiconfigurational ab initio methods |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2027 |
| Main researcher and affiliation | Ximena Zarate – Universidad Autónoma de Chile (UA). |
| Describe the intended use of the equipment in the research project. | To characterize the luminescent properties, to evaluate the antenna effect and the non-radiative energy transfer in the sensitization process on materials (MOFs) doped with lanthanides. Results will be correlated with theoretical calculations. |

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|---|---|
| Current Project Code | 1241649 |
| Project's Title | Dicationic derivatives of azobenzene as photoactive surfactants for drug transport systems: study of photoreversible behavior and load capacity in molecular aggregates. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2028 |
| Main researcher and affiliation | Cristian Tirapegui – Universidad Autónoma de Chile |
| Describe the intended use of the equipment in the research project. | The equipment will be used for the study of ultrafast transients obtained from the cis- and trans-configuration isomers of the dicationic molecular switches proposed in this project. In addition, these photoswitches show aggregation phenomena and load capacity, so it will be possible to study molecular interactions of probes included in these self assemblies. |

| | |
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| Current Project Code | 11241068 |
| Project's Title | A new exploration toward dihydropyrimidine – triazole hybrid derivatives as cancer multidrug resistance reversal agents. Synthesis, characterization, and bioactivity. |
| Financing Source | ANID - FONDECYT INICIACIÓN |
| Project's end date (dd/mm/yyyy) | 31/03/2027 |
| Main researcher and affiliation | Yeray Rodríguez – Universidad Andres Bello |
| Describe the intended use of the equipment in the research project. | The equipment will be used to evaluate photophysical properties of biological probes like rhodamine 123 in cancer cells and its interactions with the dihydropyrimidine-triazole hybrid derivatives. |

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|---|---|
| Current Project Code | 1240695 |
| Project's Title | Unveiling the Potential of Sulfonamide-Quinoline Derivatives: Integration of experimental and in silico combinatorial strategies for Designing and Synthesizing Selective Innexin-2 Gap Junction Inhibitors. |
| Financing Source | ANID - FONDECYT REGULAR |
| Project's end date (dd/mm/yyyy) | 31/03/2028 |
| Main researcher and affiliation | Yorley Duarte – Universidad Andres Bello |
| Describe the intended use of the equipment in the research project. | The equipment will be used to study the optical and electronic properties of sulfonamides-quinoline derivatives. This is essential to understand how these molecules interact with Innexin-2. |

## 1.3 Justification of the need for the requested equipment in relation to the already existing equipment in the applicant's and associated institutions and/or in other entities, at a national or international level.

Justify why it is essential to purchase the new equipment. Refer to the existence of similar equipment in the Institutions included in the proposal or other entities (at a national or international level). Explain why the Institutions consider that they require this equipment, also what standards, requirements and/or capacities limits them today and what is the evolution, progress and/or improvement that the new equipment would represent.

(Maximum length: 2 pages, including this one. You must use Calibri font 11 and line spacing 1.0).
If necessary, insert rows in the table.

| Similar equipment name (Brand, Model) | Equipment location (Laboratory/Institution/Location) |
|---|---|
| FluoTime300 Lifetime Spectrometer | UNAB / Viña del Mar |
| LP980 Flash Photolysis Spectrometer | UNAB / Viña del Mar |
| FluoTime200 Lifetime Spectrometer | UCH / Santiago |
| Mini-tau Lifetime spectrometer | USACH / Santiago |
| LifeSpec II Lifetime spectrometer | PUC / Santiago |
| Horiba-Jobin-Ivon TCSPC spectrometer | UNRC / Argentina |
| Nano to millisecond laser flash photolysis spectrometer | UNBA / Argentina |
| Horiba-Jobin-Ivon TCSPC spectrometer | UNLP / Argentina |

Justify:

The acquisition of automated spectrometers for femtosecond fluorescence and for transient absorption, coupled to a compact high-energy amplified femtosecond laser is fully justified taking into account the following scientific and technological reasons:

As mentioned in section 1.2, there are several national research groups whose research involves topics related with the interaction between light and matter (photocatalysis, photosensitization, light-harvesting and solar cells, etc). More critical, **several of the research stages mentioned occur in the femtosecond time scale, among them processes like energy transfer, charge transfer, media dynamics, vibrational relaxation (Scheme 1), and all of them having a key-role to enhance or control the efficiency of the complete process**. In this context, the current equipment's available at the laboratories of the applicant research team, just permit to characterize processes in the nanosecond to millisecond time framework, while the new one will allow to get insights into the excited state dynamics prior to the population of the reactive or emissive excited state. Then, it will be a great support to fully achieve the goals stated in the national scientific projects developed around these subjects, along with others in related areas or that involving photophysical characterizations.

In addition, it should be noted that the requested equipment will not only allow to overcome the accessible time limits (lifetime in the femtosecond range), but also but will also expand the currently accessible spectral window, opening the possibility of exciting samples in a wider range of wavelengths (258 nm to 1300 nm), and additionally, improving the detection capabilities in terms of wavelength of the emitted radiation (270 nm to 1700 nm) or the transient absorption spectral range (350 nm to 1700 nm). Specifically, the capacity limits existing today for each research line of the applicant team can be described as follow:

- NP-UNAB, (collaborators GG and DF) the presence of different P,N-bidentate ligands in rhenium tricarbonyl complexes has been related with fast non-radiative deactivation of the excited states, processes that it is not possible to characterize with the current equipment. Also, it will be possible to evaluate energy transfer processes between excited states with intraligand or metal to ligand charge transfer characters or potential electronic communications between metallic centers in $Re^{I}$/M complexes.

- GG-UCH, (collaborators NP and DF) to have access to this equipment will allow us to excite probes at wavelengths not actually available. Additionally, it permits to monitor the vibrational and solvent relaxation processes which will permit to unveil processes taking place before the energy transfer occurring during photosensitization.
- CA-USACH, (collaborators NP) due to the current limitations, the photophysical characterization of the novel fluorophores synthesized in our laboratories at USACH is not able to be fully obtained. The time-resolved emission measurements for these solvatofluorochromic probes are asked to be carried out through overseas collaborations.
- DF-PUC, (collaborators GG and NP) Current photophysical research at PUC involving time-resolved emission are performed in the ns-μs range. Transient absorption studies are done in the same range through collaborations. Faster measurements are only available abroad during research stays. Phenomena occurring at shorter time scales are lost, no mechanistic information obtained for research involving MOF, organic photovoltaic cells and supramolecular photosensitizers.
- NN-UdeC, (new collaboration NP) This equipment will allow to work in the different research lines (Non-linear absorption and optical limiting in the near infrared, Photo-induced Electron Transfer in Ruthenium(II)/Tin(IV) Multiporphyrin Arrays or similar systems, Photo-induced Processes in Metallo-supramolecular Boxes, Photo-induced energy transfer in molecular machines based on Lanthanide(III) ions), promoting the advanced academic human resources formation.
- JLL-UCN, (new collaboration NP) The equipment will be used for time-resolved spectroscopy studies. It will allow the determination of decay curves and mechanisms of up-conversion process for applications in Luminescent down-shifting (LDS) layers and Luminescent Solar Concentrator (LSC).
- FA-UTALCA, (new collaboration NP) In order to study the molecular mechanisms of protection against oxidative stress, photosensitized processes and participation of reactive oxygen species (ROS), it is necessary to be able to measure processes in the femtosecond temporal scale.
- LA-PUCV, (new collaboration NP) The equipment will allow to characterize dynamics processes in lipid bilayers, which until now have been studied only through steady state methodologies and/or nanosecond time resolved techniques. Some examples can be get from literature: https://doi.org/10.1016/j.cplett.2004.03.012 https://doi.org/10.1016/j.jphotochem.2021.113376; https://doi.org/10.1063/5.0077910.

It is important to mention that UNAB has a PhD Program in Molecular Physical-Chemistry (http://investigacion.unab.cl/doctorados/doctorado-en-fisicoquimica-molecular/) certified for seven years by the National Accreditation Commission (CNA-Chile), whose **main research lines** are focused on **relationship between structure and properties of the matter** (Line 1), and **study of the interaction matter-radiation** (Line 2). This Academic Program has graduated more than 60 students since 2002. In this context, the requested equipment will directly contribute to the Line 2 of this Program, supporting the high-qualify human resource formation. Examples of current PhD Theses that are being developed and will be potentiated by the acquisition of the equipment are: "*Experimental and Theoretical Approach to Energy Transfer Process in Rhenium (I) – Lanthanide (III) Complexes*" (UNAB, ANID scholarship 21200995); "*Síntesis, estructura, propiedades fotofísicas y fotoquímicas de carbonilos metálicos mono y binucleares como generadores de oxígeno singlete y liberadores de monóxido de carbono en medio homogéneo y heterogéneo*" (UNAB, ANID scholarship 21210727); "*Design of Mono- and Multinuclear $d^6/d^8$ Complexes with Potential Applications in Photocatalysis: Structure, Photophysical Properties and Computational Analysis*" (UNAB, internal scholarship); "*Synthesis and Characterization of Lanthanide Complexes for Potential Photodynamic Therapy Applications*" (UNAB, internal scholarship).

**Regarding the existence of similar equipment at international level**, our closer neighbor countries with active research groups in photosciences, Argentina and Brazil, have analogous facilities with the equivalent technological problems. Then, the acquisition of this equipment will reinforce the existing international collaborations or allow to establish new ones.

# 2 Strategic contribution from the Institutions.

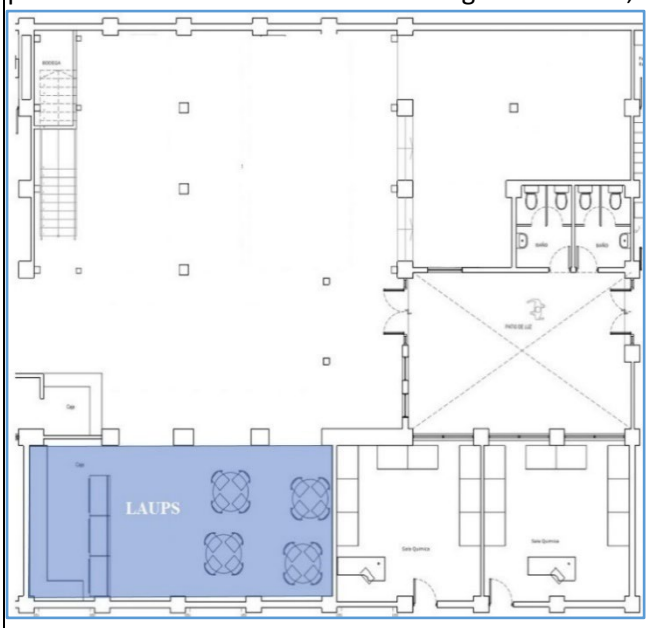
## 2.1 Model of use, association and access plan for the requested equipment.

Describe the model of use, association with other institutions and access provision to the requested equipment and how it will support intra and inter-institutional collaborative research and/or collaboration with foreign researchers.
Specify the measures that will be taken for the dissemination of the equipment. In addition, describe the model of use (professional in charge, hours of operation, among others) and provide details related to the allocation of time for external researchers to use the equipment, such as the distribution of the (at least) 30 annual business days of external access, the equipment access logistics, supplies, consumables, personnel, transfer protocols, and insurances associated with equipment to be used in the field. If, due to the nature of the equipment, external access will not be provided, it must be justified at this point. Also, for equipment that collects data in real time or performs continuous measurements, define a data management model.

(Maximum length: 2 pages, including this one. You must use Calibri font 11 and line spacing 1.0).

**Plan for Use and Access**

The automated spectrometers for femtosecond fluorescence and transient absorption, coupled to a compact high-energy amplified femtosecond laser will be located at the New Research Laboratory of UNAB (Av. República 275, Santiago), in a space (50 m2) that will be specially conditioned for their installation and operation: "Laboratory for Applied and Ultrafast PhotoSciences, LAUPS". This building will be specially dedicated as a research facility. Its entrance is totally controlled, allowing the access only to authorized persons. The central location in Santiago downtown, close to subway stations, makes it easy to reach.




LAUPS will be coordinated by the PR and operated by a specialized technician (technical operator), who will be first trained, in order to know and understand all the capacities and safety requirements of the equipment for a good operation. The Ars will conform a Scientific Committee, which will be in charge of establishing academic, scientific and administrative teaching guidelines for the operation of the equipment.
The technical operator that will be full time hired by UNAB for being in charge of the operation of the equipment, will organize the working hours of system using the LabNeetings application (https://labnettings.com/), website specially designed for requesting or scheduling shared equipment's. He or She will also give support with the measurements of each user, according to his specific necessities. All the measurements and data will have a backup in a cloud (Dropbox, OneDrive or similar), in order to permit easy access to them.
One of the main goals of LAUPS will be the contribution to the preparation and training of highly qualified human resources, through direct teaching in advanced courses and/or through direct experimental training, being an invaluable contribution to research development of the involved Institutions and the country. After the Universities will set their annual academic calendar, the laboratory will receive as

priority, the corresponding requests for measurement time for students or the requests for use in teaching subjects from the different Institutions.

**Intra and Inter-institutional Users**

In our proposal the equipment will be available for use 200 business days per year (5 business days/week x 4 week/month x 10 month/year), which corresponds to 1600 hours (considering to leave a month off for maintenance or time schedule adjustment). The reserved time for open access of external users will be 30 business days (240 hours), which considers 15 business days for researchers or students from other regions or cities (Valparaíso, Concepción, Talca, Antofagasta). The Intra-Institutional time will be 60 business days (480 hours), which implies teaching and researching hours. Each AI and AR, will have 14 business days (112 hours) for measurements or teaching activities. Other no-Associate Institutions (external) that support this proposal (UA, International Collaborations), will have 12 business days (96 hours).

| User | Type | Hours | Percentage |
|---|---|---|---|
| UNAB (PI) | Intra-Institutional | 480 | 30.0 % |
| UCH (AI) | Inter-Institutional | 112 | 7.0 % |
| USACH (AI) | Inter-Institutional | 112 | 7.0 % |
| PUC (AI) | Inter-Institutional | 112 | 7.0 % |
| UdeC (AI) | Inter-Institutional | 112 | 7.0 % |
| PUCV (AI) | Inter-Institutional | 112 | 7.0 % |
| UCN (AI) | Inter-Institutional | 112 | 7.0 % |
| UTalca (AI) | Inter-Institutional | 112 | 7.0 % |
| UA, International | Inter-Institutional | 96 | 6.0 % |
| External (30 days open access) | Inter-Institutional | 240 | 15.0 % |
| | TOTAL | 1600 | |

**Model of Use, Procedures and Costs**

The procedure to make use of the requested equipment will consider the operation in charge of a full time Technical Operator, who will assume the following tasks:

- Scheduling through LabNettings
- Reception and registration of samples with specifications.
- Sample preparation
- Measurements and raw data record (backup in Dropbox or OneDrive)
- Billing

The Technical Operator will also be in charge of the 30 business days open access to the equipment, contacting to the interested users that must apply by the FONDEQUIP platform.

The billing and invoice emission consider two situations:

- minimal cost (1 UF/sample or experiment) for the PR and ARs, who can measure by them self or send their students for being helped by the Operator.

- external cost (2 UF/sample or experiment) for users that send their samples with specifications for measuring them. This cost includes the sample preparation in spectroscopic solvent, special cuvette with neck or flow cell, de-aeration with ultrapure gas (argon or nitrogen).

It must be remarked that all the incomes will be spent in supplies and future maintenances of the equipment, which makes its operation viable in the medium and long term.

**Dissemination of the equipment**

The use of the equipment will be promoted by different activities to be carried out in the conference room at the Research Building of UNAB (capacity for 100 persons) and Lectures at the different involved Institutions. The ultrafast time-resolved technique will be included as topic in the program of new or current curses for pre or postgrad level. The LAUPS will also have a website and social network to promote its use.

## 2.2 Consistency and justification of the resources requested from FONDEQUIP and those provided by the Beneficiary and Associated Institutions.

Justify in detail the requested resources and the specification of the pecuniary and non-pecuniary contributions to the project in each sub-item (Beneficiary and Associated Institutions).
It must be specified the plan of operation and maintenance of the requested equipment and how the Pecuniary Contribution of the institution(s) will be materialized to carry out the hiring of technicians and/or specialized professionals in charge of the equipment operation (except in cases where, due to the nature of the equipment, a person in charge is not required), and the training of personnel related to the use of the equipment. In addition, refer to the consistency of the Non-Pecuniary Contributions, considering a valuation within the term of the project and according to the date of purchase and installation of the equipment (following Section 2.5 of the Contest Guidelines). Consider the need for additional equipment or laboratories for the proper performance of the requested equipment and the existence or access to these. Regarding in-kind institutional contribution committed in human resources with a current contract in the institution, it is aimed only the responsible coordinator and researcher associate of their efforts about execution and follow-up of the project, specialized technical and/or professional personnel in charge of the manipulation and/or maintenance of the equipment. It also includes technicians, professionals, administrative personnel and the researchers in charge of the purchasing of the equipment. This budged does not include payment for potential users of the equipment once it is in operation.
In relation to the adaptation of infrastructure and/or habilitation of spaces, do not include the renovation of offices or the purchase of furniture that are not directly related to the operation of the equipment.

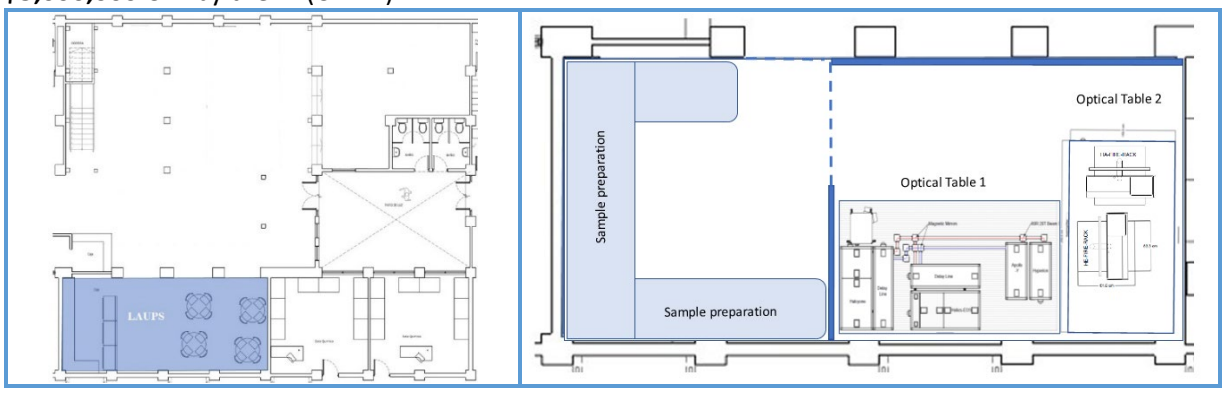
(Maximum length: 3 pages, including this one. You must use Calibri font 11 and line spacing 1.0)

**Proposal Overall Cost**

The total cost of this proposal is **$1,328,976,831** Chilean Pesos (CLP). The amount requested to FONDEQUIP is **$949,999,928** CLP, while the pecuniary contribution of UNAB is **$157,462,980** CLP and the non-pecuniary contributions of UNAB, UCH, USACH, UdeC, UCN, PUCV, UTALCA and PUC are **$221,513,923** CLP. The detailed and justified distribution of these amounts in each item is as follows:

**Equipment, Shipping and Insurance cost, IVA and Customs Expenses**
**Item A.1.** A total of **$728,869,500** CLP is requested to FONDEQUIP for covering the cost of the equipment (DAP value to Santiago from USA, quote UE23-6984).
**Item B.1.** The Transfer, Transfer Insurance, Customs Clearance Expenses and VAT (Value Added Tax or IVA 19%) are estimated to be **$158,573,338** CLP, which are requested to FONDEQUIP. This cost is estimated by customs broker (https://www.ececconi.cl/).
**Laboratory Adaption**
**Item B.2.** A total of **$39,251,090** CLP is requested to FONDEQUIP in order to contribute to the habilitation of the existing space. This amount considers the purchase and installation of an air conditioner and two dehumidifiers (please see attached quotes), in order to maintain the room temperature at 22°C with the humidity below 60% (technical requirements). In addition, it is also necessary the purchase and installation of an L-shape optical table (or two tables, (see the scheme below, right)), which is a technical requirement for optimum performance of the equipment avoiding vibrations (even small earthquakes). Estimated cost: USD$35,930.40 x $900 CLP/USD$ x 1.19 IVA + customs clearance expenses = $38,681,110 CLP (please see attached quote). A **non-pecuniary contribution** of **$10,000,000** CLP by the PI (UNAB) is estimated for adapting the existing space (see the scheme below, left). This amount considers removing the existing furniture, thermic isolation with panel or wall (in blue), air condition installation, blackout window (please see attached quote, $10.000.000). The adaptation also considers having at least 2 UPS (5 KWH and 1 hour backup for the

laser chiller and dehumidifiers), which will prevent electric failures and with enough time backup, in order to permit connecting to the emergency electric net. It is also necessary the installation of a laboratory gas pipeline to connect ultrapure gases (nitrogen, argon, oxygen), which are commonly used in photophysical measurements. The connection to the emergency electric network (industrial electric generator) and independent switchboard with 25 A three-phase current, adaptation to connections to water networks and high-impact level floor covering are considered as **non-pecuniary contribution** of **$5,000,000** CLP by the PI (UNAB).




**Installation and Commissioning**

**Item B.3.** A total of **$12.110.000** CLP is requested to FONDEQUIP in order to purchase the initial supplies for the starting-up of the equipment ($2,400,000 for spectroscopic solvents, $1,700,000 for quartz cuvettes and $4,500,000 for Fluorescence Flow Through Cell with peristaltic pump, $1,860,000 for ultrapure gases: argon, nitrogen and oxygen), and $150.000 for the acrylic or metal plate of the project. This amount also considers the purchase process expenses (wire transfer cost of $1,500,000 CLP). It must be remarked that, once the equipment will be in use, all the incomes will be spent in supplies and future maintenances of the equipment, which makes its operation viable in the medium and long term.

**Equipment Maintenance, Warranties, and Insurance**

**Item B.4.** A total of **$11,196,000** CLP is requested to FONDEQUIP in order to cover the first maintenance visit including the airfare tickets (at the end of year 2). Estimated cost based on quote No. UE23-6984 ($ 8,400,000 CLP x 1.19 (IVA) plus air ticket $1,200,000 CLP). A **pecuniary contribution** of **$64,666,980** CLP is considered by UNAB in order to cover the additional 12-month warranty extension (Warranty Gold for each component), because the first year is included in quote UE23-6984. The total cost is estimated as USD$60,380.00 x $900 CLP/USD$ = $54,342,000 CLP plus VAT ($10,324,980 CLP). In addition, a **pecuniary contribution** of **$11,196,000** CLP by UNAB is considered in order to cover a second maintenance visit including the airfare tickets (at the end of year 4). Estimated cost based on quote No. UE23-6984 ($ 8,400,000 CLP x 1.19 (IVA) plus air ticket $1,200,000 CLP). The existing insurance of the facilities (Aon, Commercial Risk Solutions) is considered as **non-pecuniary contribution** of **$2,160,000** CLP by the PI (UNAB). In addition, the increase of the institutional insurance policy for contingencies affecting the equipment is also considered as **non-pecuniary contribution** by UNAB (0.179% of the equipment value/year x 3.5 years = **$ 5,444,155** CLP).

**Training, Operational Cost and Administrative Expenses**

**Item C.1.** A **non-pecuniary contribution** of **$20,676,000** by UNAB is considered for carrying out a four days theorical and experimental workshop for the training of the 26 students or academics, potential users of the equipment (3 students x 7 associated institution + 5 students or academics from UNAB). The estimation considers the use of the conference room, technological support and typical fee of international short-courses that include practical add-on (like PicoQuant, $700 EUR/person, https://www.picoquant.com/events/details/fluorescence-course#description ). It is expected that the

travel expenses of students from Institutions out of Santiago will be covered by the associated projects which supports and are linked to this proposal.

**Item C.2.** A **pecuniary contribution** of **$81,600,000** CLP ($1,700,000 CLP/month x 48 months) by the PI (UNAB) is considered in order to hire a technical operator or specialized professional (professional title of Chemist, Ph.D., postdoctoral level or similar), who will be selected by a committee conformed for the applicant research team and other invited academics. The technical operator will be hired from the beginning of the proposal adjudication, in order to help with all the administrative work and starting with his(her) training. A **non-pecuniary contribution** of **$10,080,000** CLP by UNAB is attributed to the electrical consume due to the 24 hours continuous operation of the air condition and the 2 UPS (laser chiller and dehumidifiers). In addition, the cost of the existing space located in Santiago downtown (50 $m^2$) is estimated to be **$88,413,768** CLP (1.0 UF / ($m^2$ x month) x 50 $m^2$ x 48 months = 2,400 UF x $36,839.07 CLP / UF). It is also considered as **non-pecuniary** contribution, the special cleaning service of the laboratory by professional staff with current contract in the principal institution (**$2,640,000 CLP**). A **non-pecuniary contribution** of **$16,200,000** CLP by UNAB is considered due to the time assessment of the main researcher who will participate directly during the second time of execution of the project (training task, teaching special courses, diffusion activities, full professor salary of $4,500,000 x 24 months x 15% = $ 16,200,000 CLP). The estimation considers the salary of a full professor with current contract at the institution (full professor salary estimated from website of Universidad de Chile, Facultad de Ciencias Químicas y Farmacéuticas: http://web.uchile.cl/transparencia/p0421vwxyz.html). A **non-pecuniary contribution** of **$4,800,000** CLP by UNAB is attributed to the administrative executive with a current contract in the institution, who will be in charge of all billing internal processes and project accountability during the second time of execution of the project. Finally, a **non-pecuniary contribution** of **$10,800,000** CLP by the 7 Associated Institutions is considerer due to the use of complementary infrastructure that will be necessary for the better performance of the requested equipment ($50,000 x 24 months = $1,200,000 x 6 = $7,200,000 CLP + USACH will contribute with additional infrastructure (space and equipment) in order to prepare samples previously to perform measurements at the requested equipment, $150,000.00 CLP/month x 24 months = $3,600,000).

**Item C.3.** A **non-pecuniary contribution** of **$9,600,000** CLP by UNAB is attributed to the administrative executive with a current contract in the institution, who will be in charge of all purchase processes and project accountability of the first step of the execution of the project ($2,000,000 x 24 months x 20% = $9,600,000). In addition, a **non-pecuniary contribution** of **$14,100,000** CLP by the Associate Institutions (UCH, USACH, UdeC, UCN, PUCV, UTALCA and PUC) is considered due to the time assessment of the associate researchers who will participate directly in the first step of execution of the project (purchase process, hire of the technical operator, installation and start-up, training, 6 associate researchers x $3,000,000 x 24 month x 2.5% = $10,800,000, associate professor salary estimated from website of Universidad de Chile, Facultad de Ciencias Químicas y Farmacéuticas: http://web.uchile.cl/transparencia/p0421vwxyz.html; USACH has the special situation that Dra. Carolina Aliaga is a full professor with a long experience in photophysical experiments, then her contribution will be $3,300,000 during the first 24 months). Also, a **non-pecuniary contribution** of **$21,600,000** CLP by UNAB is considered due to the time assessment of the main researcher who will in charge directly during the first time of execution of the project (purchase process, hire of the technical operator, Installation and start-up, training, full professor x $4,500,000 x 24 month x 20% = $ 21,600,000).

**Summary of Pecuniary and Non-pecuniary Contributions**

In summary, UNAB will provide with **$157,462,980** CLP as **pecuniary contribution** and **$196,613,923** as **non-pecuniary support**, while the Associate Institution (UCH, USACH, UdeC, UCN, PUCV, UTALCA and PUC) will contribute with **$24,900,000** CLP as **non-pecuniary** funds.

## 2.3 Technical feasibility of the installation and start-up process of the requested equipment

Describe the important aspects - administrative, technical and financial - to carry out and ensure the installation and start-up process of the requested equipment and the forecast of the associated risks and/or challenges.

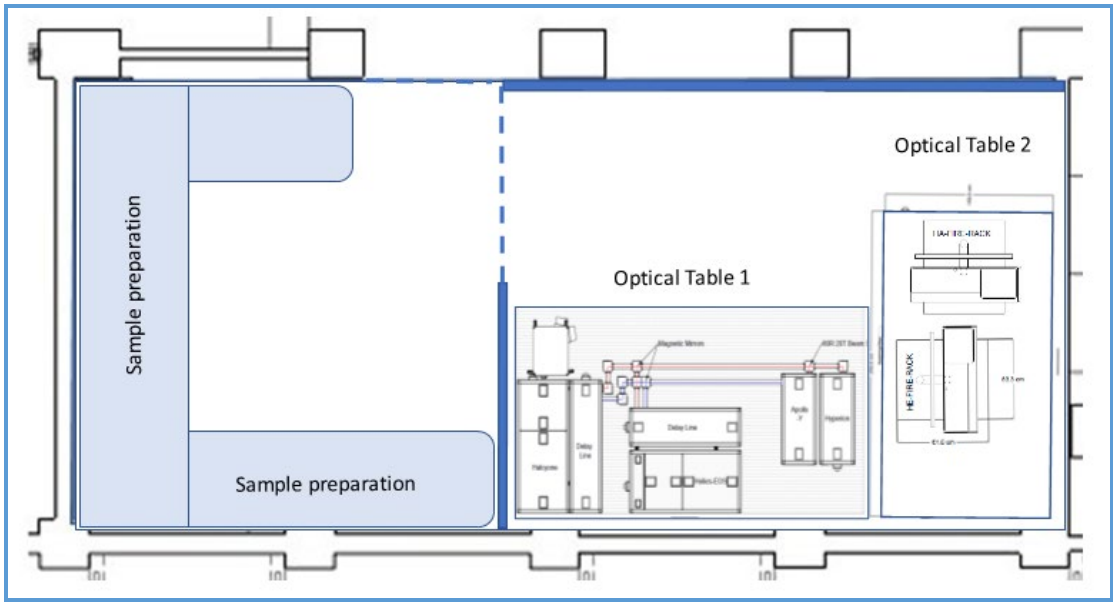
(Maximum length: 2 pages, including this one. You must use Calibri font 11 and line spacing 1.0)

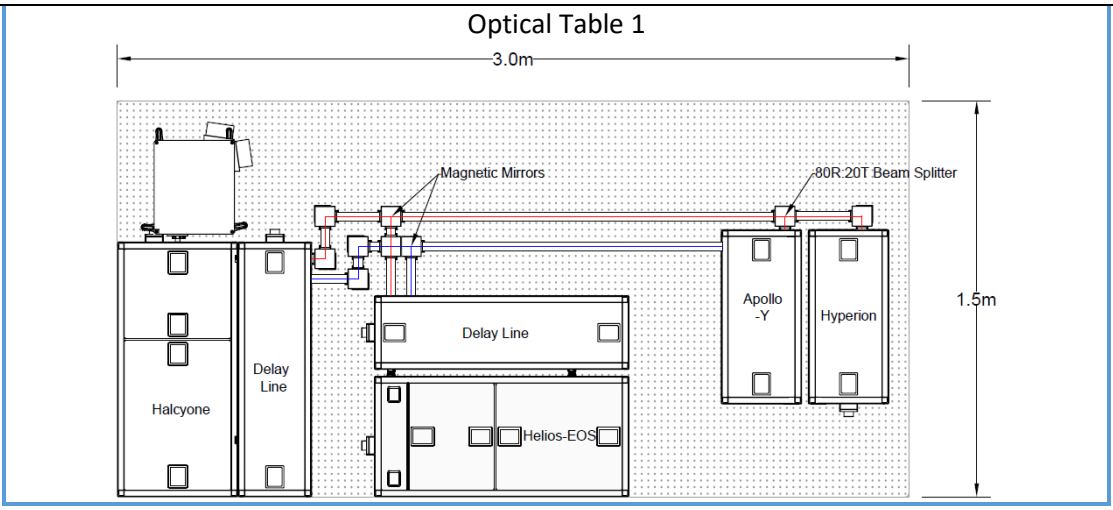
**Transfer**:

First to all, the shipping cost of US$9,500.00 included in quotation No. UE23-6984 considers the DAP Incoterm (Delivery At Place), this means that the cost of insurance and freight of the equipment will be covered in order to safely reach the destiny. The equipment will be packed in at least five appropriate crates: 1 crate @ 71"x42"x38" (~780 lbs) HS code 9027304080; 1 crate @ 71"x42"x38" (~760 each) HS code 9027304080; 1 crate @ 41"x29"x26" (~250 lbs) HS code 9027304080; 1 crate @ 28"x19"x21" (~93 lbs) HS code 9027508060; 1 crate @ 30"x29"x42" (~210 lbs) HS code 9027508060.

**Installation**:

The installation of the equipment considers a first step of the adequacy of the existing space in order to have an appropriate laboratory which fulfils the requirements for the correct operation of the complete system. As depicted in the following scheme (top figure), an isolate space will be conditioned with two optical tables which provide vibration isolation for the optical components and laser system, avoiding optical misalignment. The Optical Table 1 which will support the main components of the equipment (bottom figure), is recommended to have rigid legs and to size 3 m by 1.5 m.






As the temperature of the room should be between 18-25°C, with less than ±1°C of fluctuation in 2 hours (ideal temperature is 22°C), the adequacy of the laboratory considers the installation of an appropriate air condition system. In addition, as the humidity must be less than 60%, two dehumidifiers are considered for the laboratory.

The electrical requirements considers that the complete system needs at least two sockets with 15A of max current. It is expected to have at least 2 UPS (5 KWH and 1 hour backup for the laser chiller and dehumidifiers), which will prevent electric failures and with enough time backup, in order to permit connecting to the emergency electric net.

**Start-up process**:

The installation and commissioning of the equipment will be performed by the Ultrafast Systems personnel. This includes all the calibration processes and verification of performance specifications. It is also considerer the training of customer's technical operator and academic (Responsible Coordinator) by the Ultrafast Systems personnel to ensure their ability to independently use the equipment. It will be conducting test experiments with the samples provided by Ultrafast Systems or the customer.

In addition, a final important aspect that will ensure the technical feasibility of the proposal is the long experience in time-resolved techniques of the Responsible Coordinator as can be seen in her curriculum (https://www.scopus.com/authid/detail.uri?authorId=56193145500).

# 3 Expected results of the Proposal.

Describe the expected results from the use of the requested equipment in each of the sub-criteria defined, considering the indicators committed in this application.

## 3.1 Knowledge that will be generated from the use of the requested equipment.

Describe, in particular, new lines of research, national collaborations and scientific publications resulting from the use of the equipment (consider the committed outcome indicators).
(Maximum length for this chart is 2 pages, including this one. You must use Calibri font 11 and line spacing 1.0).
If necessary, insert rows in the table or adjust columns.

| Current situation | Situation considering the equipment |
|---|---|
| The current equipment's available at the laboratories of the applicant research team, just permit to characterize processes in the nanosecond to millisecond time framework. | It will be possible to characterize research stages that occur in the femtosecond time scale like energy transfer process, charge transfer, media dynamic, vibrational relaxation, and this new knowledge will be applied to enhance or control the efficiency of the complete process. |
| It is not possible to get insights into the excited state dynamics prior to the population of the reactive or emissive excited state. | It will be a great support to fully achieve the complete photophysical characterizations of different systems and compounds, because this new information will allow to stablish and control the evolution of the excited states and their main deactivation channels. |
| Currently, time-resolved photophysical research at UCH is performed using a FluoTime 200 with several excitation wavelengths and in the ns-ms range. Transient absorption studies are done in a homemade equipment in the ms range or in the ns-ms range through collaborations. Processes with shorter times are omitted, and no mechanistic information can be obtained about vibrational or solvent relaxation. Infrared emission of singlet oxygen is restricted to only two excitation wavelengths. In addition, the photophysical properties characterization of lanthanide complexes, is performed through international collaboration. | To have access to the requested equipment will allow to perform experiments to a time range never before accessible for all investigators which deals with short lived excited states in our community. Besides an important increase of available excitation wavelengths, not accessible today. It will be possible to characterize and evaluate the efficiency of the energy transfer in the photosensitization process for lanthanide complexes. |
| Nowadays, the photophysical characterization of the novel fluorophores synthesized in our laboratories at USACH are not able to be fully obtained. The time-resolved emission measurements for these solvatofluorochromic probes are asked to be carried out through overseas collaborations. | The fs and ps range scale for the lifetime measurements in a wide range of excitation wavelengths performed in a variety of solvents and microheterogeneous media will be possible to be measured with the asked equipment. In this way, a more dynamic discussion of the results will allow the design of improved fluorescent probes as media sensors. |

| Current situation | Situation considering the equipment |
|---|---|
| Current photophysical research at PUC involving time-resolved emission are performed in the ns-μs range. Transient absorption studies are done in the same range through collaborations. Ultrafast measurements are only available abroad during research stays. Phenomena occurring at shorter time scales are lost, no mechanistic information obtained for research involving MOF, organic photovoltaic cells and supramolecular photosensitizers. | The equipment will give access to researchers from PUC to time-resolved absorption and emission measurements in the fs-ps range locally (close to the San Joaquin Campus – PUC). This time resolution will allow obtaining mechanistic information from inorganic complexes (MOF, organic photovoltaic cells) and supramolecular photosensitizers such as ultrafast deactivation processes in the excited state, excited state photoreactions and energy transfer processes, which can help to modulate or improve the efficiency of these systems. |
| Some of the research lines at UdeC (Non-linear absorption and optical limiting in the near infrared, Photo-induced Electron Transfer in Ruthenium(II)/Tin(IV) Multiporphyrin Arrays or similar systems, Photo-induced Processes in Metallo-supramolecular Boxes, Photo-induced energy transfer in molecular machines based on Lanthanide(III) ions) are limited by the time domain of the existing equipment. | The equipment will allow to perform experiments to a time range that will give new information about the fast processes having place upon excitation like in the photoinduced intramolecular electron transfer process between two metallic centers or in the photoinduced energy transfer or photosensitization of lanthanides. This new knowledge will allow to take control or modulate the deactivation pathways that these systems undergo upon excitation. |
| Current fluorescent lifetime measurements of probes located in different membranes are in the ns range, allowing us partially study and understand the effect of membrane properties, like fluidity among others in probe behavior and biological processes, at UTALCA. | Studies in the ps range will increase the knowledge on the behavior of membrane fluorescent dyes inside lipidic domains helping the understanding of domains dynamics and their relationship with specific biological processes, for example photosynthetic light-harvesting pigments which are able to transfer its energy in the range time of 10 ps. |
| The time-resolved photophysical measurements related with the research lines at UCN are mainly developed in collaboration with international researchers (Universidad de la Laguna, Tenerife, España) due to the lack of equipment that allows the characterization of fast photoinduced processes that our systems undergo upon excitation. | To have access to the requested equipment will allow to perform experiments in Chile, getting new knowledge about the fast photoinduced processes having place in systems like luminescent down-shifting (LDS) layers and luminescent Solar Concentrator (LSC) based on lanthanide complexes. The equipment will also allow the training of our students (academic human resources) in novel photophysical techniques, generating young researchers with new knowledge. |
| The research lines like fluorescence spectroscopy of lipids or photoelectrochemical at PUCV do not have equipment that allows to perform time-resolved photophysical experiments, which would permit to complement characterization of lipid interactions in membranes, luminescent quantum dots or semiconductors for solar energy conversion. | The equipment will allow to get information about the fast processes having place upon light absorption of quantum dots or semiconductors with potential applications in solar energy conversion. In addition, it will also permit to measure the fast dynamic process of chromophores included in membranes for studies like protein-probe interactions. |

## 3.2 Support for the education and training of undergraduate and graduate students.

This section must be certified by a letter from a pertinent authority, such as the head of the degree program, or the Dean, among others (consider the committed outcome indicators).

(Maximum length for this chart is 2 pages, including this one. You must use Calibri font 11 and line spacing 1.0).
If necessary, insert rows in the table or adjust columns.

| Current situation | Situation considering the equipment |
|---|---|
| The undergraduate students of Chemistry Degree Program and the postgraduate students of the Molecular Physical Chemistry PhD Program (research Line 2, interaction matter-radiation) at UNAB do not have access to ultrafast time-resolved techniques. | It will be possible to train students in ultrafast photophysical characterizations in order to capacitate or encourage them to the develop of new research areas. (Support letters from PhD program and Chemistry Degree Program of UNAB). It is expected to have at least two thesis per year related with the use of the equipment. The ultrafast spectroscopy is planning to be included as a part of the course “Fotofisica y Fotoquímica Aplicada”. |
| The students of undergraduate Chemistry and PhD in Chemistry programs at UCH that require information on the photophysical behaviors of different substrates do not have received training in this kind of spectroscopy measurements. | It will be possible to provide training to undergrad or grad students that will be developing thesis related to the active current research lines funded by Fondecyt (or similar grants), supporting also the generation of multidisciplinary research. (Please see support letters from Undergrad and PhD program of UCH). |
| Currently at PUC, there are several students from Chemistry and also from Pharmacy undergraduate degrees that are developing their thesis in the laboratories of prof. Schott, Angel and Fuentealba. Additionally, chemistry postgraduate studies from the Ph.D. in program are currently being developed by several students. All of them do not have access to fast time resolved techniques and are mainly involved in synthesis and standard absorption/emission characterizations. Time-resolved techniques are discussed theoretically in postgraduate courses. | The equipment will allow several undergraduate and postgraduate students (Chemistry, Pharmacy and Ph.D. in Chemistry) to access ultrafast techniques that are not available in Chile nor in the region. With this technique the students will be able to study ultrafast relaxation and deactivation processes. The students will have a hands-on experience with techniques only discussed theoretically in their courses. The current courses that will be related to the equipment are advanced inorganic chemistry, advanced physical chemistry and advanced photophysics and photochemistry. (Support letter from undergraduate and PhD programs of PUC). |
| USACH as Secondary Institution, has access to basic equipment for photophysical characterization, but the undergraduate and postgraduate students do not have access to ultrafast time resolved techniques. | This equipment will represent an unique system in Chile that would make possible the characterization of photophysical properties of molecules and materials that up to know is not possible to tackle, representing a great contribution to our undergraduate and postgraduate students in chemistry, biology and biochemistry, helping them to complete their scientific training, to increase quality in their thesis and consequent publications in the area of photochemistry and photobiology research development. (Support letters from Undergrad and PhD programs of USACH). |

| Current situation | Situation considering the equipment |
|---|---|
| Undergraduate and PhD Programs at the UdeC do not have access to photophysical characterization or ultrafast time resolved techniques, measurements have to be performed through collaborations outside the country. | Students will be able to measure and be trained in advanced photophysical techniques increasing their knowledge and making possible the development of new research lines. It will also allow the training of international students interested in the photocatalysis or photoinduced energy transfer fields. (Support letters from Undergrad and PhD programs of UdeC). |
| UCN as Associate Institution, has access to basic equipment for photophysical characterization, but the undergraduate and postgraduate students do not have access to time-resolved techniques. | The equipment will allow several undergraduate and postgraduate students (Chemistry, M.Sc. in Chemistry) to access to ultrafast photophysical measurements that are not available in Chile nor in the region. With this technique the students will be able to study ultrafast relaxation and deactivation processes upon excitation. (Support letters from Undergrad and M.Sc. programs of UCN). |
| PUCV as Associate Institution does not have equipment that allows to perform time-resolved photophysical experiments. | The equipment will allow provide training to students of careers or frontier programs in Chemistry, supporting the generation of multidisciplinary research. (Support letters from Undergrad and PhD programs of PUCV). |
| UTALCA as Associate Institution, has access to basic equipment for photophysical characterization (UV-Vis spectrometer and fluorimeter), but the undergraduate and postgraduate students do not have access to time-resolved techniques. | In a multidisciplinary context, students from careers like Biochemistry will be trained in order to collaborate with projects which are linked or support this proposal having the possibility of developing new multidisciplinary research lines (Support letter from Undergrad program of UTALCA). |
| PhD Programs of other Institution that do not have access to photophysical characterization or ultrafast time resolved techniques. | It will be possible to provide training to students of other Institution (UA, through the FONDECYT REGULAR projects or similar currently in execution, and which are willing to participate as external usuaries), increasing the national collaborations or the develop of new research lines. The participation of external students will be ensured taking into account the 30 days of the equipment open access and the 20 days consider for external institutions. |
| PhD Programs at the Institutions of International Collaborators that do not have access to photophysical characterization or ultrafast time resolved techniques. | It will be possible to receive and provide training to students of international Institution, increasing the international collaborations or the develop of new research lines (please see the international support letters). It is also considered to offer co-directed thesis in topics related to the requested equipment. |