



# France-Berkeley Fund

Annual Report  
2023

**Berkeley**  
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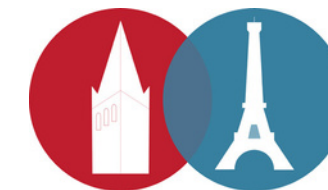
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# FROM THE DIRECTORS

The France-Berkeley Fund has had a busy and exciting year almost fully recovered from the COVID setbacks. In 2023, numerous researchers were able to make further progress on previously funded projects or start new ones. We were excited to hear of the numerous in-person FBF activities, and of the travel to both Berkeley and France that took place over the past year. Though we had successfully pivoted to virtual collaborations, we are delighted to see in-person trans-Atlantic collaborations continue. Before welcoming the new grantees, we have to announce that all of us at the FBF are very sad that our Program Manager, Laura Morello, is leaving us in early August, moving on to other exciting challenges. We have so appreciated Laura's dedication, enthusiasm, and overall quality service that have spoiled us since she joined us in January 2022. Among Laura's many accomplishments is the supervision of our wonderful French and American student assistants in the Undergraduate Research Apprenticeship Program (URAP) at UC Berkeley who conducted very informative interviews with recent FBF awardees which can be seen posted on our website. Another particularly enjoyable highlight of our working together with Laura was attending the annual FBF meeting together in Paris on June 5, where we had a lovely work lunch at the restaurant Les Belles Plantes at the Jardin des Plantes, followed that afternoon by the very productive meeting we had with our Parisian colleagues at the Ministry for Europe and Foreign Affairs. Our thanks to Eléonore Garnier, Audrène Eloit, Kristiana Stoitseva, Christophe Delacourt and Yann Le Maguet both for their rôles in organizing this meeting and for their warm reception.

Looking forward to the present academic year, we are delighted to support 21 new projects in 2023-24 thanks to the generous sponsorship of the French Ministry of Foreign Affairs, the UC Berkeley Office of the Vice Chancellor for Research, as well as the Lawrence Berkeley National Laboratory.

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Established in 1993 as a partnership with the French Ministry of Foreign Affairs, the France-Berkeley Fund (FBF) promotes and supports scholarly exchange between faculty and research scientists at the University of California and their counterparts in France.

Through its annual grant competition, the France-Berkeley Fund provides seed money for innovative, bi-national collaborations in all disciplines. The Fund's core mission is to advance research of the highest caliber, to foster interdisciplinary inquiry, to encourage new partnerships, and to promote lasting institutional and intellectual cooperation between France and the United States.

# FBF NEWS

## FBF launched a new website in September 2022!

Visit [fbf.berkeley.edu](http://fbf.berkeley.edu) to browse the new site!



This year’s cohort showcases the extraordinary diversity of interests and methods that characterizes the FBF: from projects on “Mathematical modeling for cyber-risk insurance” to “Paving the road to Jupiter’s icy moon”, “Vitamin B12 (cobalamin): New roles in the human microbiome and enzyme catalysis”, “Political lives in Socialist China: Work, Scripts and Authority”, “Literature and forms of knowledge across the long nineteenth century”, and “Strategies for perspective shift in natural languages”, to mention only a few examples. We look forward to seeing all of the new projects progress over the grant period. We wish all of our awardees the best of luck in pursuing their research goals.

We sincerely thank the many proposal reviewers at Berkeley and in France, together with our Executive Committee, who generously dedicated their time and effort to the evaluation process. We also wish to recognize our French colleagues in the consulate in San Francisco, the Washington Embassy, and the Ministries in Paris for their enthusiastic support and interest in the France-Berkeley Fund—among many others: Mireille Guyader, Counselor for Science and Technology at the French Embassy, Frédéric Jung, Consul General of France in San Francisco, Sabine de Maussion, Cultural Attachée and Director of the Villa Albertine, and Emmanuelle Pauliac-Vaujour, Attachée for Science and Technology.

We are delighted to wrap up a successful 2022 year of fruitful cooperation between researchers and colleagues on both sides of the Atlantic. We very much look forward to another successful year in 2023

**Larry M. Hyman**  
**Clément Sanchez**  
Co-Directors

## FBF Information Session

FBF hosted an online information session in November 2022 to promote the Call for Projects 2023-24. The information session covered information about the history of FBF, eligibility requirements, the application process and expense allowability. The session was attended by PIs in both France and in California.

## IES & FBF Undergraduate Research Apprentice Team



FBF was delighted to have the support of the IES Undergraduate Research Apprentice Team (URAP). The URAP team composed of UC Berkeley students as well as UC Berkeley and SciencesPo dual degree students. The URAP team worked on various projects throughout the year for FBF, including the FBF interview series. FBF would like to thank Ellie Andersen, Oriane Badre, Nick Moore, Evan Breteche, Vaidehi Patel, Tiffany Von Streng, Celine Savaricas, Emma Levi, Lucia Alvarez, Hannah Chiara Boettge, Simon Pouly, Aideen Solis, Atiana Novikoff, Eva Michela Polovina, Luca Zislin and Paul Lesgourgues for their contributions to FBF this year!

## FBF launches new interview series!

FBF is thrilled to launch a new interview series, lead by the Undergraduate Research Apprentice Team (URAP). Members of the IES URAP Team interviewed FBF Principle Investigators to learn more about them and their projects. The interviews can be found on the News section of the FBF website.

### An Interview with Matthias Sprenger and Sylvain Kuppel

By: Simon Pouly

March 4, 2023

The Colorado River is one of the major rivers in the United States and Northern Mexico, going through more than seven states and is the major water supply for many communities across Southwestern America. This is what pushed both Matthias Sprenger (Research Scientist at the Earth & Environmental Area of the Lawrence Berkeley National Laboratory) and Sylvain Kuppel (Research Scientist at the French National Research Institute for Sustainable Development (IRD)) to focus on the water components of this infamous watercourse. We sat down with them to learn more about the motivations behind their project, what their research consists of, and what opportunities the France-Berkeley Fund gave them.



Can you both introduce yourselves and talk about your academic journeys that lead you to this project?

MS: I am Matthias Sprenger, a Research Scientist at the Earth & Environmental Area of the Lawrence Berkeley National Laboratory. Before coming to the national lab in 2020, I did my B.Sc., M.Sc., and PhD at three different German universities and worked as a Postdoc in Aberdeen in Scotland, Barcelona in Spain, and Raleigh in North Carolina. In Aberdeen, Sylvain and I crossed paths briefly. However, since we never worked together, the France-Berkeley Fund appeared to as a great opportunity to get a collaboration going.

SK: I am Sylvain Kuppel, a Research Scientist at the French National Research Institute for Sustainable Development (IRD), based at the Géosciences Environnement Toulouse laboratory in France. I studied engineering and plasma physics, and then I realized I was most interested in studying Earth functioning rather than "harnessing its power". So, I embarked in a PhD on the terrestrial carbon cycle, and slowly drifted towards hydrology and critical zone science during my postdoc time in Argentina, Scotland, and

France. As Matthias said, we never formally collaborated, although we knew each other's work quite well.

### An Interview with Paolo Mancosu and Marco Panza

Atiana Novikoff

May 5, 2023

The concept of infinity has many applications throughout history in the fields of mathematics, philosophy, logic, and probability. New perspectives on the concept of infinity have brought together Professor Paolo Mancosu (Professor of Philosophy at UC Berkeley) and Professor Marco Panza (Director of research at the CNRS; IHPST, CNRS and Univ. of Paris 1 Panthéon-Sorbonne and Professor at Chapman University). In this interview they discuss how they came to research this topic, what they have learned from it, and how the France-Berkeley Fund has supported them.



Can you both introduce yourselves and talk about your academic journeys that led you to this project?

PM: I am Paolo Mancosu and I am a professor in the philosophy department at UC Berkeley. My areas of work are mathematical logic and the history and philosophy of logic and mathematics. Throughout my career (Milan, Stanford, Princeton, Yale, UC Berkeley), I have been engaged with the challenges that mathematical infinity poses to philosophy. This takes very different forms: can infinite objects exist? If so, how can we have access to them? How can reasoning with infinite objects be grounded in an epistemologically satisfactory way? These issues have been central to the foundations of mathematics, for instance in Bolzano, Frege, Cantor, Dedekind and Hilbert. The project itself focuses on some very recent mathematical results that justify new ways of counting the size of infinite sets.

MP: I am Marco Panza and I am a research director at the CNRS (IHPST, CNRS and Univ. of Paris 1 Panthéon-Sorbonne) and a professor at Chapman University (Orange, CA). I'm a historian and philosopher of mathematics and logic. I previously held appointments in Geneva (Philosophy), Nantes (Mathematics), Mexico City (UNAM, Mathematics), Barcelona (UPF, Humanities), University Paris Diderot (REHSEIS and Dept. of History and Philosophy of Sciences). In the first part of my career, up to my Habilitation in 2000, my research mostly focused on the history of the infinitesimal calculus in the seventeenth and the eighteenth centuries. Thus, the topic of the infinite – more specifically, the way mathematicians have managed to tame it by finite means – has always been at the center of my interests.

What made you interested in the concept of infinity as it relates to the philosophy of mathematics and probability?

# NEW COLLABORATIONS

The FBF is pleased to sponsor 21 outstanding projects in 2023-24, with awards totaling \$240,089.

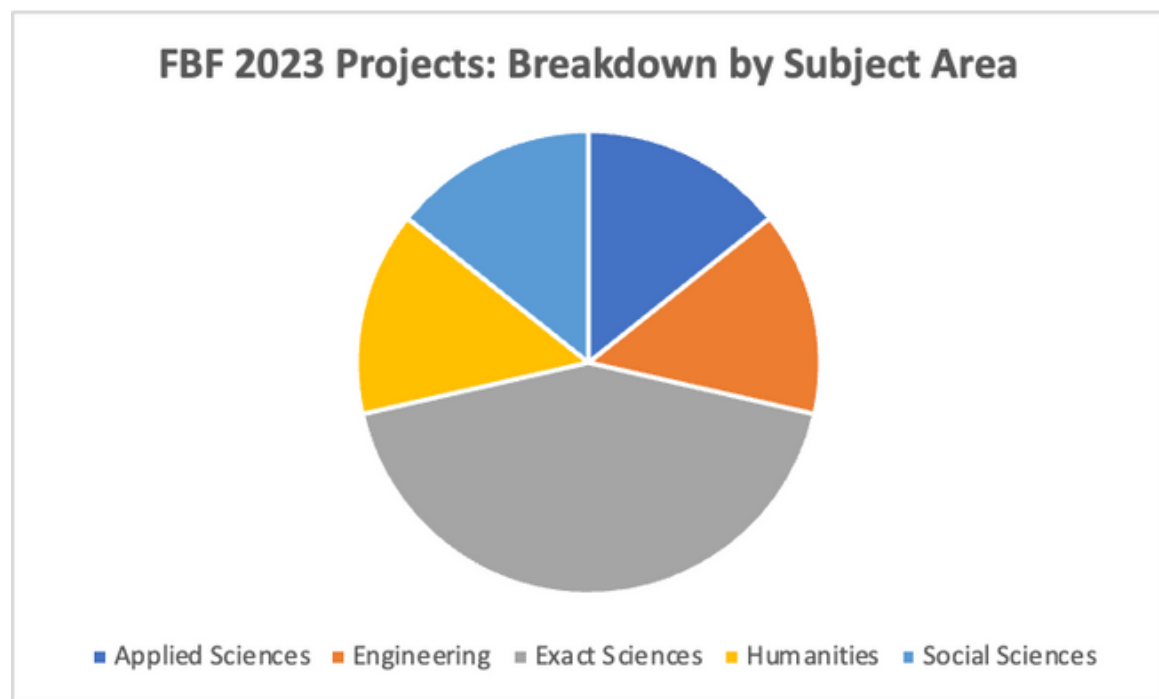
Political history  
Dark matter  
Equilibria  
Software  
Quantum chaos

Divorce  
Jupiter  
Migration  
Deconvolution  
Electron transfer

Genre  
Microbiota

Statistical mechanics  
Theory  
Game  
Cardiac arrhythmia

Cyber-risk management  
Organic scintillators  
DNA-origami



### Smart cell-mimetic microbots for cargo delivery

Grigory Tikhomirov, UC Berkeley  
Laura Alvarez, University of Bordeaux

The goal of this proposal is to develop intelligent microbots that can transport and deliver molecular cargo. To this end, we will engineer motile cell-mimetic architectures using giant lipid membranes with responsive DNA-origami channels. The final assembly will be able to explore the space and release the specific cargo under external stimuli.

### Mathematical modeling for cyber-risk insurance

Thibaut Mastrolia, UC Berkeley  
Caroline Hillairet, ENSAE

Cyber risk is a major concern for public entities and private companies, and constitutes a systemic threat to the resilience of the financial and economic world. 1% of the world's GDP, or \$1,000 billion, goes up every year because of cyber-crime. The objective of this project is to contribute to a better knowledge of cyber risk and to propose solutions for better insurability of this risk, while proposing innovative contributions in terms of mathematical modeling. We propose to design a new regulatory policy to provide a framework for protection against cyber-attacks and limit risks and financial losses.

### Optimized organic scintillators for neutron detection

Thibault Laplace, UC Berkeley  
Guillaume Bertrand, CEA Saclay

Organic scintillators are materials that convert the energy deposited by radiation into UV/visible light. Their low cost and ability to detect both neutrons and gamma rays make them attractive for a variety of applications in basic science, homeland security and defense as well as in the nuclear industry. The development of innovative materials and their characterization require unique skill sets in material science, chemistry, photonics, nuclear physics and electronics, which can lead to challenges in advancing new materials for applications. This partnership aims to accelerate the use of new scintillating materials in applications and provide feedback for advancing development of future organic materials.

### Sex-specific computational models for studying hormonal differences in cardiac electrophysiology

Eleonora Grandi, UC Davis  
Jason Bayer, University of Bordeaux

This project aims to develop computational models that can specifically study differences in cardiac electrophysiology (the electrical activity in the heart) between males and females. Importantly, we will take into account the effects of sex hormones, which can have a significant impact on heart cells and tissue function. By combining the complementary expertise of our groups, we will develop multiscale sex-specific models to gain a better understanding of how heart rhythm disturbances differ between men and women, and potentially lead to more effective treatments.

### **Machine learning methods for Agent-based Dynamic Network Equilibrium**

**Alex Skabardonis**, UC Berkeley

**Mostafa Ameli**, Université Gustave Eiffel

This project aims to co-develop dedicated learning-based algorithms to alleviate the uncertainty of dynamic network equilibrium (DNE). To that end, we will investigate adapted clustering methods to distinguish the different areas of a large-scale traffic network based on the suppletive features and sensitivity to the demand level. We will apply advanced machine learning methods, such as deep neural networks, to capture the evolution of the DNE solution space with respect to the correlations of origins-destinations demand and the network supply. These developments will be based on the mathematical foundation of the DNE problem, precisely fixed-point and mean fields games theories. The simulations will be carried out in large-scale city test cases, e.g., Lyon and San Francisco, by open-source agent-based traffic simulators.

### **Coherent structures in 2D active and inertial turbulence**

**Edgar Knobloch**, UC Berkeley

**Alexandros Alexakis**, École normale supérieure de Paris (Ulm)

Turbulence is a classical problem of major importance in many fields from weather forecasting to engineering, and similarly complex flows, called “active turbulence”, are found in biological systems such as bacterial suspensions. While a key characteristic of turbulence is its disorder and the presence of structures of many different sizes, distinct long-lived coherent structures can emerge which play an important role in shaping its properties. Here, we propose to employ a combination of numerical simulation and theory to improve our understanding of coherent structures in turbulence generated by instabilities in thin layers like the Earth's atmosphere, focusing on mechanisms whereby intermediate-scale vortices may suppress the formation of destructive large scale vortex structures.

### **New approaches to many-body quantum dynamics: From complexity to holography and hydrodynamics**

**Ehud Altman**, UC Berkeley

**Xiangyu Cao**, Ecole Normale Supérieure Paris

The complex dynamics and chaos in many-body quantum systems pose basic questions in physics with important implications ranging from transport in quantum materials to understanding quantum black holes. We propose to further develop a notion of complexity pioneered by the PIs to capture collective coherent effects in the chaotic dynamics, focusing on connections with the theory of gravity. We will also utilize the notion to develop computational schemes that capture nonlinear hydrodynamic effects. The project aims to foster lasting exchange between theorists from UC Berkeley and the Paris area.

### **Cosmic Gold Rush: OCA-Berkeley Collaborative Innovations in Multimessenger Astrophysics**

**Joshua Bloom**, UC Berkeley

**Sarah Antier**, Université Côte d'Azur

The first detections of gravitational-wave events has revealed a universe teeming with the violent mergers of compact objects, like neutron stars and black holes. Yet while much of the streaming gravitational-wave data is public, just how to make sense of it all and just how to optimally follow-up events with ground-based observatories remains an unsolved intellectual and technical challenge. We propose a collaboration, bringing together two of the leading “multimessenger” teams in the world, focused on building and deploying the cutting-edge technologies needed to maximize the scientific returns from a new worldwide gravitational wave observing campaign, due to start this summer. This grant will not only support a project that has significant French and American overlap, but also supports connections between the gravitational-wave and astrophysics community, which will significantly benefit both communities.

### **Paving the Road to Jupiter's Icy Moons**

**Andrew Poppe**, UC Berkeley

**Quentin Nénon**, CNRS

At the three icy moons orbiting around the giant planet Jupiter, we will combine numerical models developed by U.C. Berkeley with in-situ measurements analyzed by IRAP to study the interaction between the moons and their space environments. This effort will not only advance our fundamental understanding of the physics at work, but will also be critical for the detection and characterization of the subsurface oceans which may sustain life. Immediate scientific results will be generated, and this project will be the seed of a long-term relationship beneficial for American and European space missions planned in the next decade.

### **Discovering Axions with Astrophysical Polarization**

**Benjamin Safdi**, UC Berkeley

**Francesca Calore**, Centre National de la Recherche Scientifique

One of the most outstanding problems in science today is to understand the microscopic nature of dark matter. One of the best candidates for dark matter at present is a hypothetical particle of nature called the axion, which can also explain a mystery behind how neutrons behave in electric fields. Axions are predicted to be weakly interacting, making them hard to observe directly in the laboratory, but using the extreme environments found in astrophysical environments there is a chance we may observe the indirect effects of axions on the propagation of ordinary light in the near future with the current and next generations of precision, space-based X-ray and gamma-ray telescopes. In this project we will study how axions may induce unique polarization signatures in galactic and extragalactic astrophysical sources, and we will use the results of these calculations, in conjunction with a class of cutting-edge instruments that will for the first time measure polarization at X-ray energies and above, to push closer to discovering or ruling out axions as real particles of nature.

### **Towards Local, Distribution-Free and Efficient Guarantees in Aggregation and Statistical Learning**

**Nikita Zhivotovskiy**, UC Berkeley  
**Jaouad Mourtada**, CREST, ENSAE, Paris

The objective of this project is to explore information-theoretic methods for analyzing localized complexity measures in Statistical Machine Learning. The focus on local rather than global complexity measures aims to provide a more precise and optimal description of non-sequential learning problems. The refinement brought by local bounds not only offers improved sub-optimal guarantees but also allows for a finer and more accurate comparison of existing methods in Machine Learning.

### **A new twist on electron transfer with bilayer graphene**

**David Limmer**, UC Berkeley  
**Guillaume Jeanmairat**, Sorbonne Université, Paris

We will understand how novel two-dimension materials can be used to drive faster and more efficient chemistry by means of molecular simulation. Using state of the art computational techniques we will deduce the mechanism of recently observed on atomically thin sheets of carbon, twisted at a so-called magic angle.

### **Unbinned Deconvolution for Particle/Nuclear Physics**

**Benjamin Nachman**, Lawrence-Berkeley National Laboratory  
**Anja Butter**, LPNHE

Deconvolution is the technique of removing distortions from a detector and is an essential step to cross section measurements in particle/nuclear physics. Principal Investigators (PIs) A. Butter (LPNHE) and B. Nachman (LBNL) have proposed new deconvolution methods based on machine learning that allow for a new paradigm of measurements that unlike all existing measurements, do not require discretization. Butter's approaches are based on deep generative models that learn posterior distributions while Nachman's approaches are based on deep discriminative models that approximate likelihood ratios. The goal of this proposal is to forge a collaboration between groups to develop a new method that makes the best of both generative and discriminative models for the optimal deconvolution method.

### **Theoretical Challenges for the Electron-Ion Collider**

**Feng Yuan**, Lawrence-Berkeley National Laboratory  
**Edmond Iancu**, Université Paris-Saclay, CNRS, CEA

We plan to systematically investigate the gluon tomography at the future EIC, one of the major scientific programs. The goal is to build a solid theoretical foundation to apply various processes for this purpose. These efforts will be important to fully explore the discovery potential and make the EIC physics program even more compelling, and to help ensure that the EIC program stays with time.

### **Literature and forms of knowledge across the long nineteenth century**

**Ian Duncan**, UC Berkeley  
**Christine Reynier**, Université Paul-Valéry Montpellier3

Exploration of relation of literary genres (fiction, poetry, etc.) to scientific, philosophical and other knowledge-bearing discourses in the period of formation of academic curricula and professions, c.1800-1920; study of literary genres as themselves knowledge-generating; study of the role of form in the production and circulation of knowledge.

### **Digital Methods for the Study of Migration in the Aegean Region, 1821-1945**

**Christine Philiou**, UC Berkeley  
**Andreas Guidi**, Institut national des langues et civilisations orientales (INALCO)

With this project we aim to develop a common methodology for digital visualizations for a range of datasets/studies that are already underway, conducted by the two coordinators as well as 4 doctoral students and 1 postdoctoral scholar. All of these studies focus on cases of geographic mobility of individuals and groups in the Aegean region during the transition from the Ottoman to post-Ottoman regimes there, in the 19th and 20th centuries. The goal of this quantitative and digital approach is to enable a sharper analysis of the pattern and exigencies of human migration as sovereignty in the region was reorganized from that of a confessionally and ethnically diverse empire to supposedly discrete and homogeneous nation-states and colonial territories.



### **Strategies for perspective shift in natural languages**

**Amy Rose Deal**, UC Berkeley  
**Marta Abrusan**, Ecole Normale Supérieure

The ability to shift perspective and see the world from the point of view of someone else is a fundamental human capacity. Natural languages employ various devices to signal a shift in perspective, yet the nature and variety of these mechanisms is not yet understood. Our project will contribute to resolving this important problem by comparing various understudied languages and uncovering laws and regularities in how human languages represent perspective.

### **Decentralizing Divorces**

**Federico Echenique**, UC Berkeley  
**Matias Nunez**, Ecole Polytechnique and CNRS

This project focuses on the development of practical applications of mechanism design, a branch of economics concerned with developing well-functioning institutions that ensure efficient and fair outcomes. In particular, we will focus on legal settings where two persons need to reach an agreement while their preferences are misaligned. Examples are dissolution of partnerships, allocation of rights and duties among conflicting agents, and divorces. While a judge, legal experts and lengthy bargaining procedures are often needed in practice, we plan to develop economic tools to appraise reasonable compromises, reducing both cost and time.

### **Political Lives in Socialist China: Work, Scripts, and Authority**

**Puck Engman**, UC Berkeley  
**Isabelle Thireau**, EHESS, CNRS

"Political Lives in Socialist China" is a collaborative effort to establish the study of Chinese socialism on a new footing. In the proposed project, collaboration will be formalized through an interdisciplinary conference bringing together both senior and junior scholars from North America, France, and China to present original research on the theme of political lives. Understood capaciously, this theme will let us retain the sophisticated understanding of Chinese society and governance that has emerged in recent scholarship while giving due weight to the political dimension of Chinese socialism.

### **The Political activities of overseas Chinese students: A network**

**Thomas Gold**, UC Berkeley  
**Jerome Doyon**, Sciences Po

We aim to develop a research network that will serve as a basis for a long-term enquiry into the evolution of the political activities of overseas Chinese students in the western world. This includes an analysis of the strategies developed by the Chinese party-state to monitor, control, repress, and sometimes mobilize Chinese students abroad and how these strategies are implemented in practice. It also includes the study of the forms of political actions that take place outside the structures led by the Chinese party-state, and that sometimes contest its authority.

### **Vitamin B12 (cobalamin): New roles in the human microbiome and enzyme catalysis**

**Michi Taga**, UC Berkeley  
**Olivier Berteau**, Université Paris-Saclay

The recently discovered "B12-dependent radical-SAM enzyme family", numbering over 200,000, catalyzes challenging biochemical transformations in major biological pathways that impact human and environmental health such as antibiotic biosynthesis, microbial methane production and others. To date, studies have investigated these enzymes only with the commercially available vitamin B12 cofactor, and have not explored their activity with other B12-like cofactors known as cobamides that are very abundant in natural environments such as the microbiome. This proposal combines the expertise of Dr. Olivier Berteau (Université Paris-Saclay, INRAE) in discovering unique biochemical transformations catalyzed by B12-dependent radical-SAM enzymes, with the expertise of Dr. Michi Taga (Berkeley) in synthesizing and characterizing the functions of natural cobamides that are not commercially available, in order to make breakthrough discovery into the chemical and biological functions of this emerging enzyme family and vitamin B12, in the context of the human microbiome.



## SUPPORT OUR WORK

"The project has deepened our working relationship and also enhanced or established relationships for all who have participated in it. We are certain that these connections will bear fruit in other contexts in the years ahead."

**- TODD HICKEY (Classics, UC Berkeley) and  
JEAN-LUC FOURNET (Collège de France /  
EPHE)**

"The France-Berkeley Fund has been fantastic support for the initiation of this research trajectory. Without it, this project could not have proceeded in this collaborative fashion. It has advanced the research career of a Berkeley junior faculty member, provided valuable training for a Berkeley PhD, and led to an academic research position for a recent French PhD. These collaborative relationships will be sustained into the future."

**- NICHOLAS SWANSON-HYSELL (Earth & Planetary Sciences,  
UC Berkeley) and YVES GODDÉRIS (Observatoire Midi-  
Pyrénées, CNRS / Université Toulouse)**

"This has been an invaluable experience for the junior researchers involved and it has directly facilitated the establishment of larger-reach projects between Lyon and Berkeley."

**- MARY FIRESTONE (Environmental Science, Policy & Management, UC Berkeley) and GRAEME  
NICOL (Laboratoire Ampère, Université de Lyon)**

### ACKNOWLEDGEMENTS

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The France-Berkeley Fund is committed to advancing innovative research and international exchange across the humanities and sciences. Help amplify our work by making a gift to our grant fund. Gifts to the FBF help sustain cutting-edge collaborations that bring together faculty, researchers, and junior scholars from UC Berkeley and institutions throughout France.

To learn more and make a gift, visit  
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