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Born 12/5/1995  
Nationality : french

## Isabelle Eisenmann

Laboratoire de Physique de l'Ecole Normale Supérieure (LPENS)

### EDUCATION

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PhD candidate, Physics, LPENS (Paris, France) oct 2020 – present

#### **Collective behavior in the phototactic micro-algae *Chlamydomonas reinhardtii***

Team Multiscale physics of living systems. Expected date of completion : December 2023.

Director : Raphaël Jeanneret, [raphael.jeanneret@phys.ens.fr](mailto:raphael.jeanneret@phys.ens.fr)

Co-director : Nicolas Desprat, [nicolas.desprat@phys.ens.fr](mailto:nicolas.desprat@phys.ens.fr)

M.Sc, Institut Pierre-Gilles de Gennes (Paris, France) 2019-2020

Research master in biophysics. First short intership at PCC with Pascal Silberzan and Mathilde Lacroix, on chiral edge currents in nematic cell monolayers. 6 months internship at LPENS with Raphaël Jeanneret, on the influence of viscosity on the structure of algal cell suspensions.

M.Sc and B.Sc, Ecole Centrale Paris (now Centrale-Supélec) 2014-2018

Engineering M.Sc and B.Sc after the french competitive entrance exam. Specialization in physics and biotechnologies. Gap year : internship at Air Liquide R&D, then musical and educational project abroad.

B.Sc, Université Paris XI (Orsay, France) 2014 -2015

Licence in fundamental physics (acquired during the 1<sup>st</sup> year at Ecole Centrale Paris)

### RESEARCH – WORK IN PROGRESS

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Collective photoprotection through light-induced phase separation in a phototactic micro-algae (with A.Lhomme, A.Lahlou, S.Bujaldon, B.Bailleul, N.Desprat, R.Jeanneret)

Excess of light can be hazardous for photosynthetic organisms. When intensity is too high, the motile micro-algae *Chlamydomonas reinhardtii* reorients itself to swim away from the incident light. We discovered that a suspension of such migrating cells can be unstable, whereby small spatial fluctuations in cell density can quickly trigger the phase separation of the system and the formation of a dynamic branching patterns. This new kind of instability can be understood from the strong coupling between cell density and light fields through both negative phototaxis and light absorption by the individual cells. Our model captures the destabilization of the system for critical control parameters and finely reproduces experimental data. On the physiological side, algae inside dense areas are protected from the light stress, showing that on short timescales, phototaxis efficiently contributes to photoprotection through non-trivial reponses at the population level.

Droplet and waving instability in an active fluid jet (with R.Jeanneret, N.Desprat and E.Lauga)

Over the past few years, many groups have predicted instabilities in suspensions of aligned micro-swimmers. We are currently testing it experimentally thanks to the fine control of

phototactic micro-algae by light. We show the two kind of instabilities that were predicted : the breaking of a dense cell jet into drops and its buckling into waves. Those patterns arise from hydrodynamic interactions between individual micro-swimmers, as shown by numerical simulations.

Phototaxis and photosynthesis (with R.Jeanneret, N.Desprat, B.Bailleul)

Phototaxis in *Chlamydomonas reinhardtii* is poorly understood, yet it allows those motile photosynthetic cells to navigate a highly variable light environment. We are currently exploring the interplay between phototaxis and other biological functions such as photosynthesis.

Fluorescence to measure light intensity, Lahlou et al, accepted in Nature Methods (July 2023)

Lahlou et al report two protocols for quantitative measurement of light intensity - required in many fields of biology, chemistry, engineering, and physics - which exploit fluorescence to enable the retrieval of the light intensity even in the depth of samples, with spatial distribution information, over wide ranges of wavelengths and intensities, and in a quick, inexpensive, and simple manner. As an application, we used one of those protocols to quantitatively characterize the spatial distribution of light in one of our phototaxis setup.

CONFERENCES AND PRESENTATIONS

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- 2021 LPENS biophysics axis seminar (Paris, France) : oral presentation
- 2022 IBPC team seminar (Paris, France) : oral presentation
- LPM team seminar, CEA (Grenoble, France) : oral presentation
- PSL Soft and Living Matter Days (Paris, France) : oral presentation
- Congrès de la SFP (Lyon, France) : oral presentation
- PHYMOT annual meeting (Paris, France) : oral presentation
- 2023 Active Matter in Complex Environments (Aspen Center of Physics, USA) : poster
- LPENS PhD and Post-doc seminar (Paris, France) : oral presentation
- GDR Approches quantitatives du vivant (Oléron, France) : oral presentation

SCHOLARSHIPS

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- 2020-2023 EDPIF (Ile-de-France physics doctoral school)
- Full PhD funding for 3 years obtained through a competition

TEACHING EXPERIENCE

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- 2020-2023 Mathematics (teaching + tutorials) – L1 Sciences Biomédicales, Université Paris Cité
- 2020-2023 Mechanics (tutorials) – PASS minor Biology/Physics/Chemistry, Université Paris Cité

MISCELLANEOUS

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The K-Brass Band. Musical and educational project between january and july 2017 for the children of the NGOs Gawad Kalinga (Philippines), Aldeas Infantiles, Sonidos de la Tierra (Paraguay) and the

Centre Betania (Madagascar). I was playing tenor saxophone and in charge of part of the global project's progress (12 musicians and a reporter, total budget of 100k€).

Onbios. Design, production and diffusion of an open-source 3D printed spectroscopy instrument in collaboration with a biology laboratory (LGPM, Centrale-Supélec). End-to-end technical development, partnerships with teacher associations and school networks, development of teaching material, sales. This project was part of an entrepreneurship program during and after my M.Sc at Ecole Centrale Paris (2018-2019).

#### PERSONAL INFORMATIONS

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I also enjoy playing piano, reading and climbing in my free time.