Daniel Yaacoub

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EDUCATION

2021 - now   **PhD candidate** at Clermont-Auvergne Université

Excitons and charges transport in natural and artificial photosynthesis : paths-space analysis and modeling of thermokinetic couplings *under the supervision of* Pr. J.-F. Cornet (Institut Pascal, Clermont-Auvergne University) *and* Pr. R. Fournier (LAPLACE, Toulouse-III University).

- Theoretical modeling of photosynthetic primary steps and thermokinetic couplings. Paths-spaces probabilistic rephrasing of models and non-linear couplings within Feynman-Kac and Branching Stochastic Processes frameworks. Monte Carlo statistical estimations and numerical simulations in complex geometries.

2020 - 2021   **M2 Fundamental physics (international theoretical physics training) [2/24, *highest honours*]** at Aix-Marseille Université

Equilibrium and Non-equilibrium statistical physics (CPT) :

- Advanced classical statistical physics / Stochastic processes and fluctuations : Path-space topological formulation of Hamiltonian chaos. Stochastic equations, fluctuations, dissipations and Markov processes.

- Advanced quantum statistical physics near equilibrium : Quantum Field Theory, Paths-integrals formulations and Renormalization methods within the framework of quantum transport (BCS superconductivity, Green-Kubo methods, Luttinger liquids).

Non-linear physics and Dynamical systems (IRPHÉ) :

Instabilities and road to chaos. Self-organization, multiscale analysis and patterns formation.

Out of equilibrium physics and Complex systems (CENTURI) :

- Complex networks and network-based dynamical processes. Physics of living systems and soft matter (Self-organized patterns and feedback models. Neural networks and learning dynamics theories. Collective behaviors and emergence of cellular/molecular motion out of equilibrium).

2019 - 2020   **M1 Fundamental physics** at Aix-Marseille Université

2018 - 2019   **L3 Fundamental physics [1/56, *highest honours*]** at Toulouse-III Université

2016 - 2018   **CUPGE - Preparatory classes** at Toulouse-III Université

DIPLOMA

2021	**M.Sc. - Fundamental physics** at Aix-Marseille Université	
	high honours	
2019	**B.Sc. - Fundamental physics** at Toulouse-III Uniiversité	
	highest honour	
2016	**Baccalaureat Sc-Physics** at Lycée Notre Dame de Sion	
	highest honour	
2016	**Musical Studies Brevet** at Conservatoire de Marseille	
	high honours	

ATTENDED SCHOOLS AND SEMINARS

2021 **TAMARYS**, national GDR annual days (Bordeaux, 3 days)

Multi-scale and multi-physics approaches to thermal transfer and non-linear coupling

2022 **ZIRCON**, annual interregional conference (Clermont-Ferrand, 3 days)

Transfer Evolution Formalism for model partitioning, coupling and feedback analysis in non-linear systems

2021/22/23 **EDSTAR** consortium annual workshop (Saint Front, 3×5 days)

Statistical approaches to transport and multi-scale/multi-physics Monte Carlo methods
under the leadership of LAPLACE and RAPSODEE.

TALKS AND ORAL COMMUNICATIONS

2024 **MCMET (ANR), anual days** (Toulouse, 3 days)

Field coupling to velocity models [20 min].

2023 **STARDIS consortium, national congress** (Toulouse, 2 days)

Monte Carlo gradient estimations in complex geometries [15 min].

2023 **FédEsol consortium, national congress** (Clermont-Ferrand, 2 days)

Thermokinetic coupling : 0d vs 3d, linear vs non-linear [15 min].

2023 **LMBP** **Phd seminar** (Clermont-Ferrand)

Paths-space physics and statistical approaches to PDEs : Feynman-Kac and Monte Carlo
[30 min] Laboratoire de MAthématiques Blaise Pascal.

2022 **TAMARYS consortium, national congress** (Lyon, 3 days)

Photogeneration, transfer and conversion of electronic energy in paths-space for solar processes inverse design. [15 min] LAPLACE, Institut Pascal, LEMTA, IES, EDStar collaboration.

PUBLICATIONS AS A CO-AUTHOR

2022 **Advection, diffusion and linear transport in a single path-sampling Monte-Carlo algorithm : getting insensitive to geometrical refinement**

L. Ibarrart, S. Blanco, C. Caliot, J. Dauchet,*[...]*, D. Yaacoub, 2022, hal-03818899v2, [2023].

2022 **Coupling radiative, conductive and convective heat-transfers in a single Monte Carlo algorithm: a general theoretical framework for linear situations**

J.-M. Tregan, J.-L. Amestoy, M. Bati, S. Blanco,*[...]*,D. Yaacoub, 2022, hal-03819157, **Plos One**, [2023].

TEACHING ACTIVITIES [130H]

2021-2024 **INP teaching assistant** at SIGMA engineering school, Clermont-Ferrand

Out-of-equilibrium phenomena and balances (Bachelor last year level [L3]) [**42h**, *tutorials*]
Mass/heat transfer and chemical reactions. Energy/matter balances toward processes dimensionalization.

2022-2024 **INP teaching assistant** at SIGMA engineering school, Clermont-Ferrand

Equilibrium thermodynamics and balances (Bachelor last year level [L3]) [**28h**, *tutorials*]
Principles and applications of equilibrium-state thermodynamics. Matter and energy balances.

2022-2024 **UCA teaching assistant** for Life Sciences bachelor, Clermont-Ferrand

Radioactivity (Bachelor first year level [L1]) [**24h**, *lectures/tutorials*]
Introduction to radioactivity basics for Life Sciences first year students. Principles and exponential law.

2022-2024   **UCA teaching assistant** for Life Sciences bachelor, Clermont-Ferrand

Electrostatics (Bachelor first year level [L1]) [**36h**, *tutorials*]
Dipolar momentum, polarization of molecules. Dipolar electric field. Screening effect.

RESEARCH EXPERIENCES

2021   **M2 Research internship (5 months)** at LIPHY, Grenoble

Stationary states and correlations in active matter models *under the supervision of Dr. V. Lecomte*

In the framework of active interacting overdamped particles subject to a noisy self-propulsion velocity, a generic procedure allowing us to compute analytically the perturbative expansion of the probability distribution in a limit of weak activity (*i.e.* weak temporal correlations of the noise) is build. Motivated by the concordance between our results and the pre-existing ones derived by paths integrals methods, we develop a controlled extension of the weak activity regime based on Pade-Borel-Laplace resummation procedure for divergent series, in view of reaching the strong activity limit and understanding the expected undergoing phase transition. In the weak activity regime, we attend to construct a well controlled procedure to the case of a 2d active Ornstein-Uhlenbeck process.The ensuring analytical results allow us to predict new phenomena due to the existing non-local correction of the stationary probability in the presence of activity : [1] a trapping effect, [2] a ratchet effect and [3] a rotational effect. The laters are cross-checked with stochastic numerical simulations. See report here.

2021   **M2 Research project** at CPT, Marseille

Microcanonical Monte Carlo simulation of a glass forming binary mixture to characterise the geometry of energy surfaces *[Pr. M. Pettini]*

2020   **M1 Research internship (2 months)** at IRPHÉ, Marseille

Mixed convective/diffusive layers in spherical shells configurations *[Dr. M. Le Bars]*

2019   **L3 Research internship (2 months)** at LAPLACE, Toulouse

Microwave electromechanical conversion *[Pr. O. Pascal]*

COLLECTIVE RESPONSIBILITIES AND SEMINARS ORGANIZATION

- GePEB - Institut Pascal PhD's representative.
- Creation and organization of GePEB PhD's seminars.

LANGUAGES

Programming Languages

Mathematica, LaTeX, Python, C++

Languages

Native tongue	French
B2	English

ASSOCIATIVE COMMITMENTS, INTERESTS AND HOBBIES

- Organ player at Clermont-Ferrand's Cathedral.
  Member of "*Association des amis des orgues de Notre Dame de Clermont*"
- Organ player at Marseille.
  Member of "*Association des amis des orgues de Ste Marguerite*"
- Improvisation and interpretation (pipe organ, piano).
- Epistemology, phenomenology, poetry.