

# Charles Collot

*Born September 13, 1990. French nationality.*

## Current Position and research field

2022 - **Professeur Junior**, *CY Cergy Paris Université (CYU)*, France.

I am interested in qualitative properties of solutions of nonlinear evolution partial differential equations. My topics of research include:

- Dynamics near solitons, self-similar solutions and steady states.
- Singularity formation and long time behavior for quasilinear transport and nonlinear parabolic or dispersive equations.
- Certain statistical physics problems: weak wave turbulence, dynamics of infinitely many particles.

## Awards and fundings

2023- **P.I. of the ERC starting grant FloWAS "Flows, Waves, and their Asymptotic Stability"**.

2023- **Member of the ANR project BOURGEONS "Boundaries, Congestion and Vorticity in Fluids: A connection with environmental issues"**, P.I. Anne-Laure Dalibard.

2022- **P.I. of the ANR-22-CPJ2-0018-01 project Chaire professeur junior "Analyse harmonique et mécanique des fluides"**.

2022- **Co-P.I. of the CY Initiative Emergence project "CYngular Fluids and Interfaces"**, other co-P.I. Christophe Prange.

2021- **Member of the CY Initiative project CY Nonlinear Analysis**, P.I. Philippe Gravejat.

## Past positions

2020-2022 **Chargé de Recherches**, *Centre National de la Recherche Scientifique (CNRS)*, *CY Cergy Paris Université*, France.

2018-2020 **Courant Instructor**, *Courant Institute, New York University*, New York, U.S.A..

2017-2018 **Postdoctoral Associate**, *New York University in Abu Dhabi*, Abu Dhabi, U.A.E..

## Education

2014-2017 **Ph.D. with P. Raphaël "On critical and supercritical blow-up for the semi-linear heat and wave equations"**, *Université Nice Côte d'Azur*, Nice, France.

Defended on November 8, 2016,

Rapporteurs: T. Cazenave, N. Masmoudi, Jury: T. Cazenave, G. Lebeau, F. Merle, P. Raphaël, L. Vega.

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- 2011-2013 **Master's Degree "Partial Differential Equations and Numerical Calculation" with first class honors**, *École Normale Supérieure and Orsay University*, Paris.
- 2010-2011 **Bachelor's Degree**, *École Normale Supérieure*, Paris, France.
- 2008-2010 **Classe préparatoires MPSI-MP\***, *Lycée Malherbe*, Caen, France.

## Preprints and publications (24)

**Stability of homogeneous equilibria of the Hartree-Fock equation, for its equivalent formulation for random fields**, 37 pages *arXiv:2310.03442*, submitted, with E. Danesi, A.-S. de Suzzoni and C. Maleze.

**Asymptotic Stability of Solitary Waves for One Dimensional Nonlinear Schrödinger Equations**, 106 pages *arXiv:2306.03668*, submitted, with P. Germain.

**On classification of non-radiative solutions for various energy-critical wave equations**, 72 pages *arXiv:2211.16085*, to appear in *Advances in Mathematics*, with C. Kenig, T. Duyckaerts and F. Merle.

**On channels of energy for the radial linearised energy critical wave equation in the degenerate case**, *International Mathematics Research Notices*, rnac288 (2022), with C. Kenig, T. Duyckaerts and F. Merle.

**Stability and cascades for the Kolmogorov-Zakharov spectrum of wave turbulence**, 22 pages *arXiv:2208.00947*, submitted, with H. Dietert and P. Germain.

**Soliton resolution for the radial quadratic wave equation in six space dimensions**, 56 pages *arXiv:2201.01848*, to appear in *Vietnamese Journal of Mathematics*, with C. Kenig, T. Duyckaerts and F. Merle.

**Collapsing-ring blowup solutions for the Keller-Segel system in three dimensions and higher**, *Journal of Functional Analysis*, 285(7) 110065 (2023), with T.-E. Ghoul, N. Masmoudi and V. T. Nguyen.

**Stable Singularity Formation for the Inviscid Primitive Equations**, *Annales de l'Institut Henri Poincaré. Analyse Non Linéaire*, 2023, with S. Ibrahim and Q. Lin.

**Derivation of the kinetic wave equation for quadratic dispersive problems in the inhomogeneous setting**, 72 pages *arXiv:2107.11819*, submitted, with I. Ampatzoglou and P. Germain.

**Derivation of the homogeneous kinetic wave equation: longer time scales**, 52 pages *arXiv:2007.03508*, submitted, with P. Germain.

**Stability of Steady States for Hartree and Schrodinger Equations for Infinitely Many Particles**, *Annales Henri Lebesgue*, 5, 429-490 (2022), with A.-S. de Suzonni.

**On the derivation of the homogeneous kinetic wave equation**, *To appear in Communications on pure and applied mathematics*, with P. Germain.

**Spectral analysis for singularity formation of the two dimensional Keller-Segel system**, *Annals of PDEs*, 8(1), 5 (2022), with T.-E. Ghoul, N. Masmoudi and V.-T. Nguyen.

**Refined description and stability for singular solutions of the 2D Keller-Segel system**, *Communications on pure and applied mathematics*, 75(7), 1419-1516 (2022), with T.-E. Ghoul, N. Masmoudi and V.-T. Nguyen.

**Singularities and unsteady separation for the inviscid two-dimensional Prandtl system**, *Archive for Rational Mechanics and Analysis*, 240(3), 1349-1430 (2021), with T.-E. Ghoul and N. Masmoudi.

**Stability of equilibria for a Hartree equation for random fields**, *Journal de Mathématiques Pures et Appliquées*, 137, 70-100 (2020), with A.-S. de Suzzoni.

**On singularity formation for the two dimensional unsteady Prandtl system around the axis**, *Journal of the European Mathematical Society*, 24(11), 3703-3800 (2022), with T.-E. Ghoul, S. Ibrahim and N. Masmoudi.

**Singularity formation for Burgers equation with transversal viscosity**, *Annales Scientifiques de l'École Normale Supérieure*, 55(4), 1047-1133 (2022), with T.-E. Ghoul and N. Masmoudi.

**Strongly anisotropic type II blow up at an isolated point**, *Journal of the American Mathematical Society*, 33(2), 527-607 (2020), with F. Merle and P. Raphaël.

**On the stability of type I blow up for the energy super critical heat equation**, *Memoirs of the American Mathematical Society*, 260(1255), (2019), with P. Raphaël and J. Szeftel.

**Dynamics near the ground state for the energy critical nonlinear heat equation in large dimensions**, *Communications in Mathematical Physics*, 352(1), 215-285 (2017), with F. Merle and P. Raphaël.

**Stability of ODE blow-up for the energy critical semilinear heat equation**, *Comptes Rendus Mathématique*, 355(1), 65-79 (2017), with F. Merle and P. Raphaël.

**Non radial type II blow up for the energy supercritical semilinear heat equation**, *Analysis & PDE*, 10(1), 127-252 (2017).

**Type II blow up manifolds for a supercritical semi-linear wave equation**, *Memoirs of the American Mathematical Society*, 252(1205) (2018).

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## Proceedings and reviews (3)

**Self-similarity in the singularity formation for the Prandtl equations and related problems**, *Seminaire Laurent Schwartz - EDP et applications*, 1-16 (2019).

**Un resultat de diffusion pour l'équation de Hartree autour de solutions non localisees**, *Seminaire Laurent Schwartz - EDP et applications*, 1-12 (2018), with A.-S. De Suzzoni.

**On blow-up and dynamics near ground states for some semi-linear equations**, *Seminaire Laurent Schwartz - EDP et applications*, 1-12 (2016).

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## Supervision

2023- **Ph.D. of K. Zhang**, one year exchange co-supervision with L. Ma, UST Beijing.

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- 2022- **Ph.D. of C. Maleze**, *co-supervision with A.-S. de Suzzoni*, École Polytechnique and CY Cergy Paris University.
- 2022- **Internships of Master students**, *2 supervisions*, CYU.

## Organization

- 2020- **Co-organizer of the AGM Colloquium and the Analysis and PDEs seminar**, CYU, Cergy-Pontoise.
- 2024 **"Nonlinear Partial Differential Equations" workshop**, NCTS, Taipei, with Van Tien Nguyen.
- 2024 **"(In)-stability Phenomena in Fluids" summer school**, CYU, Cergy-Pontoise, with Christophe Prange.
- 2023 **"Advances in Nonlinear Analysis and Nonlinear Waves" conference, in honor of Frank Merle**, IHES and CYU, co-organizer.
- 2022 **CY Days in Nonlinear Analysis conference**, CYU, Neuville-sur-Oise, co-organizer.
- 2021 **Boundary layer day workshop**, CYU, Cergy-Pontoise, with C. Prange.
- 2014-2016 **Co-organizer of a J.A. Dieudonné Laboratory's PDE seminar, Co-organizer of the Ph.D. students' workshop, co-organizer of the Ph.D. students' seminar on PDEs and numerical analysis**, Université Nice Côte d'Azur, Nice.

## Expertise

- 2023- **Member of AGM department's council**, CYU, Cergy-Pontoise.
- 2022- **Member of the Scientific Comitee of Labex MME**, Ile-de-France.
- 2022- **Reviewer for several national research agencies**, worldwide.
- 2017- **Reviewer for journals for 40+ articles**, including Ann. Maths, JAMS, Inventiones Math., JEMS, CPAM....
- 2020-2023 **Member of AGM laboratory's council**, CYU, Cergy-Pontoise.
- 2022 **Member of hiring comitee for assistant professor position, member of hiring comitee for postdoc position**, CYU, Cergy-Pontoise.
- 2014-2016 **Member of the PhD school council, member of L.J.A.D laboratory's council**, Université Nice Côte d'Azur, Nice.

## Talks given at conferences and seminars

- 2024: Oxford analysis seminar (Jan. Oxford)
- 2023: LJLL seminar (Mar. Paris), ENS-Jussieu seminar (Mar. Paris), Warwick Analysis seminar (Mar. Warwick), Equilibria in dispersive and fluid PDEs conference (Apr. La Rochelle), NTU Analysis seminar (Apr. Taiwan), Ondes non-linéaires workshop (May Paris), International Conference on Structural Nonlinear Dynamics and Diagnosis (May Marrakech), Mathematical justification of the kinetic and fluid equations of plasmas and self-gravitating system (Jul. CIRM), Site Center seminar (Sept. NYUAD), Rencontre AGM-IDS (Sept. CYU), Korean AIST (Nov. online), Conference in Honor of Carlos Kenig (Dec. Monash University), Guest lecture CY IAS (Dec. CYU)
- 2022: SITE online conference: Long Time Behavior and Singularity Formation

in PDEs-Part IV (Jan., Abu Dhabi, online), KIT workshop on wave phenomena (Feb., Karlsruhe, online), Calderon-Zygmund seminar (The Univ. of Chicago), Analysis Seminar (Brown Univ.), Syngflow ANR project meeting (Apr., Univ. Bordeaux), L.J.A.D. Analysis seminar (June, Nice), Nonlinear Waves and Dispersive Equations (June, Oberwolfach), Bath analysis seminar (Oct., Bath), Cambridge analysis seminar (Oct., Cambridge), Journée d'analyse des Hauts-de-France (Nov., Lille), National Taiwan University analysis seminar (Dec., Taipei, online).

2021: Joint meeting of the A.M.S (Jan., Washington, online), Lisbon WADE (Jan., online), Long Time Behavior and Singularity Formation in PDEs - Part II (Jan., Abu Dhabi, online), Spectral problems in Mathematical Physics seminar (Apr., Paris, online), Open PDE seminar (Apr., worldwide online), I.H.E.S Large-scale limits of interacting particle systems workshop (Oct., Paris), BIRS workshop Singularity Formation in Nonlinear PDEs (Oct., Banff online), I.C.E.R.M. Generic Behavior of Dispersive Solutions and Wave Turbulence workshop (Oct., Brown), London PDE seminar (Oct., online), Cambridge kinetic reading group (Nov., online), NYUAD seminar (Nov., Abu Dhabi),

2020: CAMS Colloquium at University of Southern California (Jan., Los Angeles), Paris 13 Analysis Seminar (Mar., Villetaneuse), Institut Mathématiques de Bordeaux analysis seminar (Apr., Bordeaux), Shanghai Tech PDE Seminar (Apr., Shanghai), Long Time Behavior and Singularity Formation in PDEs conference (May, Abu Dhabi), NCTS PDE and Analysis Seminar (Jun., Taipei), Princeton Analysis Seminar (Sep., Princeton), Lyon Analysis Seminar (Nov., Lyon)

2019: New York University in Abu Dhabi (Jan., U.A.E.), University of Sharjah (Jan., U.A.E), Fluid dynamics seminar (Feb. Princeton), Columbia (Apr., New York), Waves Cote d'Azur conference (Jun., Nice), Advances in Dispersive Equations workshop (Jul., Banff, Canada), minicourse given at USTC (Aug., Hefei, China), University of Maryland (Oct., Washington), Effective Equations in Quantum Physics session of AMS joint meeting (Gainesville, Florida), Brown University (Nov., Providence), University of British Columbia (Dec., Canada)

2018: Conference in honor of Lin and Shatah (Jan., Abu Dhabi), University of Victoria (Jan., Victoria), Courant Institute (Feb., New York), Journées Jeunes EDPistes (Mar., Nancy), Université libre de Bruxelles (Jun., Bruxelles), Conférence Jeunes Chercheurs en EDP dispersives (Jun., Paris), Nonlinear Waves Conference (Jul., Karlsruhe), Courant Instructors day (Oct., New York), Cergy-Pontoise university seminar (Nov., Paris), Courant Institute (Dec., Paris).

2017: Journées jeunes EDPistes (Mar., Autrans), Lille university (May), Paris Dauphine university (May), Strasbourg university (Jun.), Nonlinear Waves and Dispersive Equations (Jun., Oberwolfach), Analyse asymptotique des équations d'évolution (Jul., C.I.R.M, Marseille), Nonlinear equations and singularity formation (Oct., Pauli Institute, Vienne), analysis seminar (Nov., American University of Sharjah).

2016: Ph.D. students seminar (Jan., Nice), Imperial college (Fev., London), Ph.D. students in sciences day (May, Nice), Laurent Schwartz seminar at IHES (May, Paris), Orsay University (Oct., Paris), Ph.D. students seminar (Oct., Rennes), Second Workshop on Evolution Equations (Dec., Valdivia, Chile).

2015: Ph.D. students seminar (May, Nice), Ph.D. students workshop (June, Nice), Ph.D. students seminar (Oct., Berkeley).

2014: workshop of the analysis team of Nice (Sep., Lecco), analysis team seminar (Nov., Nice).

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## Long term stays

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Summer 2023: Mini-course at Chinese Academy of Science, Beijing  
Spring 2023: Invited for three weeks at National Taiwan University.  
Winter 2022: one month at Courant Institute and The University of Chicago, New York and Chicago.  
Summer 2019: Mini-course at University of Science and Technology of China, Hefei.  
Spring 2019: Invited researcher for two months at IHÉS, Bures-sur-Yvettes.  
Winter 2019: Invited researcher for one month at NYUAD, Abu Dhabi.  
Spring 2018: Invited researcher for three months at IHÉS, Bures-sur-Yvettes.  
Winter 2018: One month at Courant Institute, New York.  
Fall 2015: Program associate for "New Challenges in PDE" at MSRI, Berkeley.

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## Spoken languages

**French and English (fluent), Spanish (intermediate).**

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## Teaching

- 2022-2024 **Dynamics of parabolic equations**, *CY Cergy Paris Université.*
- 2022-2024 **Python programming**, *CY Cergy Paris Université.*
- 2022-2023 **Fourier Analysis**, *CY Cergy Paris Université.*
- 2021-2022 **Introduction to mathematical modelling**, *CY Cergy Paris Université.*
- 2019-2020 **Linear Algebra Instructor**, *New York University.*
- 2018-2019 **Analysis Instructor**, *New York University.*
- 2018-2019 **Calculus I Instructor**, *New York University.*
- 2016-2017 **Tutorial in mathematics for economy (first year BA), tutorial in statistics for economy (first year BA)**, *Université Nice Côte d'Azur.*
- 2014-2016 **Course in mathematics for biology (first year BA), tutorial in discrete mathematics (first year BA)**, *Université Nice Côte d'Azur.*