Curriculum vitae – Jérôme Kasparian

Born 11/04/1973 - Paris

Citizenship : French

Address : UNIGE - ISE, Bd Carl-Vogt 66, 1211 Genève 4, jerome.kasparian@unige.ch

ResearsherID: K-4700-2013 ; ORCID ID: 0000-0003-2398-3882

Education

2005	**Habilitation**, University Lyon 1 (France)
1997	**PhD** in Physics, Université Lyon 1 (France)
1995	Magistère *Sciences de la Matière*, École Normale Supérieure de Lyon
1994	DEA (**Master**) *Chemistry of atmospheric pollution and physics of the environnement*, Université Joseph Fourier Grenoble 1

Employment

Oct. 2013 –	Associate Professor, University of Geneva. Leader of the Nonlinearity and Climate Group at Group of Applied Physics and Institute for Environmental Sciences
2007 – 2013	Researcher at University of Geneva, GAP - Biophotonics
2000 – 2007	**Researcher at** CNRS, Laboratory for ionic and Molecular Spectroscopy (LASIM, Lyon, France), in charge of the *Téramobile* project
1999-2000	**Post-doc,** Institute for optics and Quantum Electronics, F. Schiller University, Jena, Germany, in charge of the *Téramobile* project
1999	**Post-doc**, Laboratory for structural electronic microscope, Institute for Structural Biology Jean-Pierre Ebel (CEA/CNRS), Grenoble, France
1997-1999	**Scientific animator,** Radio Pluriel - Fréquence Écoles, Lyon-St Priest, France
1994-1997	**Assistant** at LASIM « *Spectroscopie linéaire et non-linéaire d'aérosols atmosphériques* », University Lyon 1

Responsibilities

- Leader of the French-German-Swiss project *Teramobile* (2000 – 2012)
- Member of the Pedagogic innovation commission, University of Geneva (2016 –)
- Co-president of the Equality commission of the Faculty of Science; member of the University Equality Commission, University of Geneva (2020 –)
- Member of the Open Science working group, Swiss Academies of Arts and Sciences, 2019 – See factsheet, doi: 10.5281/zenodo.3248929

Approved research projects

- French National Research Agency, « Teramobile », (2006-2008)
- FNS project « From non-linear optics to oceanic rogue waves », project 200021_155970 (2015-2018)
- FNS project « Nonlinearity in optics and natural systems », project number 200020_175697 (2018-2022)
- University of Sydney – University of Geneva Partnership Collaboration Awards "Wind waves steepening in coastal areas" (2018-2020)
- H2020 FET-OPEN "Laser lightning rod" (2017-2021)

Supervision of junior researchers

- (Co)-supervision of **15 PhD students**: Didier Mondelain, Guillaume Méjean, Rami Salamé, Roland Ackermann, Pierre Béjot, Stefano Henin, Nicolas Berti, Elise Schubert, Jean-Gabriel Brisset, Debbie Eeltink, Alexis Gomel, Ariadna Fossas-Tenas, Liliane Nguyen, Thomas Produit, Charline Ragon
- (Co)-supervision **of 12 master students**: Guillaume Méjean, Rami Salamé, Pierre Béjot, Pierre Joly, Pierre-Marie Gassin, François Pommel, Nadège Marchando, Lorena de la Cruz, Romain Gaillard, Joan Rey, Caroline Steinfeld, Isabel Valdez

Teaching activities (current)

- General physics for first-year medical students (700 students)
- Non-linearity in physics (Master of Physics & Master in Environmental Sciences, University of Geneva)

Panels and expertise

- 2005-2007: Member of the hiring commission, physics department, University Lyon 1
- Referee for various reviews (typically 25/year) : Physical Review Letters, Scientific Reports, Optics Express,…
- Referee for funding agencies : NSF (USA), ANR (France), DFAE (Switzerland)

Conference organisation

Conference co-chair of the *Conference on laser, weather, and Climate* (WMO, Geneva, www.laserweatherandclimate.org, 2011 2013, and 2015)

Conference co-chair of the International Conference on Filamentation (COFIL, 2018)

Prizes and awards

Prize La Recherche 2005, section Environnement

Prize Aimé Cotton 2008, French Physical Society

Medal of the French Ministry for Youth and Sports, 2011

Main recent scientific accomplishments

My main scientific accomplishments in the last years cover three main domains, linked by the approach as nonlinear systems with formal analogies between them, allowing to transfer knowledge and techniques from one to another.

Laser filamentation and atmospheric applications

I have long been interested in high-power, ultrashort laser filamentation, both on the fundamental point of view and for atmospheric applications. On the fundamental point of view, I recently focused on statistical aspects of filamentation, as well as its analogies with other natural systems. In particular, I investigated the formation and evolution along the propagation, of the number and relative position of filaments. I showed that **the filament patterns** are not random, but **display a local quasi-honneycomb order.** The high-intensity filaments are connected by medium-intensity “strings” and display a characteristic distance in the millimeter-range between filaments.

From a statistical point of view, these patterns undergo a **phase transition comparable with percolation**. With increasing incident intensity, a phase transition similar to a gas-to-liquid transition occurs [2], which corresponds to a spreading of the local order in the filament patterns. Furthermore, these patterns exhibit self-similarity over at least 3 scales, allowing to perform numerical simulations at a coarser scale, resulting in a more than 100-fold acceleration. Surprisingly, this behavior is generic to many systems, being for example observed in the self-patterning of peatlands. **This universality is at the root of the pattern stability**, as it stems from only a few ingredients, namely the combination of a local attraction and a longer-distance repulsion.

Furthermore, I recently showed that filaments can not only survive their interaction with obscurants or turbulence, but **can even be initiated by turbulence** [3] seeding spatial transverse modulational instability, which locally triggers the subsequent self-focusing and the corresponding filament onset.

Atmospheric applications of filamentation, the investigation of which have been launched by the Teramobile project [1] which I have coordinated, include remote sensing, condensation triggering in sub-saturated atmospheres and high-voltage discharge control. In particular, I recently focused on remote **spark suppression by diffuse unloading** of high-voltages, as well as on **multi-pulse, multi-wavelength approaches** to optimize discharge guiding and triggering.

Water wave dynamics

At first order, water waves on deep water are described by the same nonlinear Schrödinger equation as laser filaments. I therefore developed analogues between the two approaches, experimentally, numerically as well as theoretically. My personal contribution to the field is the **consideration of wind forcing and its spectral effects**, regarding the dispersion relationship [4], the spectral mean as well as the spectral unbalance, whether transient or permanent. I therefore showed that **wind directly induces an upshift of the wave spectrum**, although at high speed it also indirectly induces a downshift by initiating wave breaking, which effectively damps the waves as viscosity does.

Furthermore, extending the work to intermediate and shallow waters, I showed that by manipulating group-velocity dispersion and nonlinearity with an uneven bottom allows to **"freeze" breathers** at their focus, ending in a stable pattern. This finding opens the way to active wave manipulation and design in the future.

Climate modelling

As a member of the University of Geneva Institute for Environmental Sciences, I am involved in climate change studies. In particular, I work on the spatial description (or "velocity") of climate change. This approach allowed me to compare velocities of the central trends and extremes of temperature distributions over Europe, showing that both evolve at the same pace, i.e., the **temperature distribution function shifts as a whole** with very little deformation except in regions where de-icing occurs [5].

I furthermore developed a **new approach relying on the continuity of the velocity field,** allowing for a well-behaved velocity map as well as the possibility to estimate the local stability of trajectories to better identify "sinks" or "wells", i.e., regions where previously unobserved conditions emerge, or where climate zones disappear without being able to shift, due e.g. to coastlines or to mountainous regions. Such information is critical to assess the ability of species, biota or even human activities to mitigate climate change by migrating spatially.

On the modelling side, I evaluate the ability of **simplified "multi-column" models**, where horizontal advection and diffusion are not explicitly resolved, to provide useful information at the local scale. In spite of some limitations, such computationally-efficient approach allows to adequately describe lake surface temperature maps and thermocline depths, and is under evaluation for forecasting flash floods in alpine regions or frost on hilly vineyards. I also investigate the occurrence of **alternative stable states in climate simulations**, with a particular interest on simplified models ("aquaplanet") and **paleoclimates**.

5 recent representative publications

1. **J. Kasparian**, M. Rodriguez, G. Méjean, J. Yu, E. Salmon, H. Wille, R. Bourayou, S. Frey, Y.-B. André, A. Mysyrowicz, R. Sauerbrey, J.-P. Wolf, et L. Wöste, *White-Light Filaments for Atmospheric Analysis.* Science. **301**, 61-64 (2003)
2. D. Mongin, E. Schubert, N. Berti, **J. Kasparian**, and J.-P. Wolf, *Gas-solid phase transition in laser multiple filamentation*. Phys. Rev. Lett. **118**, 133902 (2017)
3. D. Eeltink, A. Lemoine, H. Branger, O. Kimmoun, C. Kharif, J. D. Carter, A. Chabchoub, M. Brunetti, and **J. Kasparian**, *Spectral up- and downshifting of Akhmediev breathers under wind forcing* Physics of Fluids **29**, 107103 (2017)
4. A. Armaroli, D. Eeltink, M. Brunetti, and **J. Kasparian**, *Viscous damping of gravity-capillary waves: Dispersion relations and nonlinear corrections* Physical Review Fluids **3**, (2018).
5. J. Rey, G. Rohat, M. Perroud, S. Goyette, **J. Kasparian**, *Shifting velocity of temperature extremes under climate change*, Environmental Research Letters **15**, 034027 (2020)