# C18 - Mathematical Physics

**Annual Report to the Council & Committee Chairs (Fall 2021)**

Bruno Nachtergaele, Chair

## 1 Conferences

The main periodic IUPAP sponsored event associated with the Commission on Mathematical Physics is the triennial International Congress on Mathematical Physics (ICMP). The organizers of ICMP 2021, however, did not apply for financial support from IUPAP for this conference. They were confident that they had secured sufficient financial resources locally in Switzerland. The ICMP 2021 took place in Geneva, August 2-7, and was as usual preceded by a very well-attended Young Researchers Symposium (see https://www.icmp2021.com). Both events were organized in a successful hybrid format with about equal numbers of in-person and remote participants.

C18 received two conference applications this year, which is two more than last year (the covid-19 pandemic is the most likely explanation of the latter). They both received a strong recommendation for funding by C18, which we have transmitted to Associate Secretary General Nemutudi.

## 2 Young Scientist Prizes

The Young Scientist Prizes in Mathematical Physics recognize exceptional achievements in mathematical physics by scientists at relatively early stages of their careers. It is awarded triennially to at most three young scientists satisfying the following criteria:

- The recipients of the awards in a given year should have a maximum of 8 years of research experience (excluding career interruptions) following their PhD on January 1 of that year (in this case that is 2021).
- The recipients should have performed original work of outstanding scientific quality in mathematical physics.
- Preference may be given to young mathematical physicists from developing countries.

Instead of awarding one prize every year, C18 has elected to recognize three researchers with a IUPAP Young Scientist Prize (YSP) once every three years in sync with the schedule of the ICMP conferences. This allows us to publicly announce the winners during a prize ceremony held in conjunction with the opening of the ICMP conference. We believe that this schedule has helped raise the profile of the prizes and offers a great opportunity to advertise IUPAP's role in the international community.

Nominations for YSP include a brief description of the achievements of the candidate that support the nomination, a CV, and a list of publications (or current links to that information online). For this round we received 16 nominations. The pool of candidates was exceptionally strong.

A subcommittee of C18 consisting of Jan de Gier (Melbourne), Rajesh Gopakumar (ICTS-TIFR Bengaluru, secretary C18) Alain Joye (Grenoble, vice-chair C18), Bruno Nachtergaele (UC Davis, chair), German Sierra ( UAM-CSIC, Madrid), reviewed applications and solicited input for outside experts. They proposed the selection of Stefanos Aretakis, Chiara Saffirio, and Vincent Tassion to the full committee for their approval, which was unanimous.

A brief biography for each of the winners and the citation for their award is included in the appendix.

# 3 Commission Membership

In response to the IUPAP leadership's decision to postpone the General Assembly to Fall 2021 and their request to continue their duties for a year, all current C18 members and officers have agreed to continue in their current roles until December 31, 2021.

New and continuing members as well as a slate of officers have been nominated for consideration by the Council & Committee Chairs and confirmation by the General Assembly in Fall 2021. We paid particular attention to achieve a broad representation of mathematical physicists from all over the world. Since Western Europe dominates the field numerically, this is not automatic.

# 4 Appendix. Citations and Short Bios of the 2021 IUPAP Young Scientist Prizes in Mathematical Physics

## 4.1 Stefanos Aretakis

Citation: Stefanos Aretakis is awarded the 2021 IUPAP Young Scientist Prize in Mathematical Physics for his influential contributions to the understanding of the dynamics and instability mechanisms of black holes as well as conservation laws in general relativity, with a recognized potential for experimental applications.

Stefanos Aretakis was born in Athens, Greece, in 1987. He studied mathematics at the University of Patras in his hometown in Greece and obtained his M.Sc. (2008) and Ph.D. (2012) in Mathematics from Cambridge University under the supervision of Professor Mihalis Dafermos. He was a Veblen Research Instructor at Princeton University and the Institute of Advanced Study from 2012 to 2015. In 2016 he was an Assistant Professor at Princeton University and since 2017 he has been an Assistant Professor at the University of Toronto.

He pioneered the dynamical study of extremal black and found that scalar perturbations give rise to a non-trivial hair along the event horizon. The existence of this hair is responsible for the unbounded growth of higher order transversal derivatives along the extremal horizon, a result which is now known as the *Aretakis instability*. This instability has been further studied and extended to other fields such as electromagnetic and gravitational perturbations on various backgrounds. In collaboration with Angelopoulos and Gajic, they rigorously proved that the horizon hair can be measured by observers along null infinity meaning that this hair could potentially serve as an observational signature of extremal black holes.

In joint work with Czimek and Rodnianski, he introduced the characteristic gluing problem for the Einstein vacuum equations and showed that the only obstructions to gluing stem from conservation laws of the linearized equations.

## 4.2 Chiara Saffirio

Citation: Chiara Saffirio is awarded the 2021 IUPAP Young Scientist Prize in Mathematical Physics for her important contributions towards the mathematical understanding of the dynamics of classical and quantum many-body systems, leading to rigorous derivations of effective evolution equations.

Chiara Saffirio received her PhD degree in Mathematics in 2012 at the University of Rome, La Sapienza. Then she worked as postdoctoral researcher in the Hausdorff Center for Mathematics at the University of Bonn and as an SNF Ambizione fellow at the University of Zurich. In 2019 she was appointed SNF Eccellenza Assistant Professor at the University of Basel.

Chiara's research focuses on the derivation of effective evolution equations emerging from classical and quantum many-body systems, such as Boltzmann, Hartree-Fock and Vlasov equations, describing the dynamics of classical and quantum gases or plasmas.

## 4.3 Vincent Tassion

Citation: Vincent Tassion is awarded the 2021 IUPAP Young Scientist Prize in Mathematical Physics for his key contributions to the understanding of the stochastic properties of representations of classical lattice spin models via probabilistic methods, and his analysis of the sharp phase transition of the Potts model.

Born in the village of Beaufort in the French Alps, Vincent Tassion studied mostly in Lyon, where he received his PhD from the ENS Lyon in 2014, advised by Vincent Beffara. After a postdoc in Geneva in the group of Hugo Duminil-Copin, he started to work at ETH Zurich in 2017, first as an assistant professor, then as an associate professor.