



# SwissMAP

The Mathematics of Physics  
National Centre of Competence in Research



## SwissMAP Perspectives

Issue 6 | 2021

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# The International Congress of Mathematical Physics (ICMP) 2021

SwissMAP is the main sponsor and organizer of the XX International Congress on Mathematical Physics to be held in Geneva, Switzerland from 2-7 August 2021. The ICMP, on its three year cycle, is the most important conference of the International Association of Mathematical Physics. It will be a major event, where new results and future challenges will be discussed, illustrating the richness and vitality of Mathematical Physics.

Planned in hybrid format for the first time, the ICMP 2021 is currently planned in physical presence and will also be streamed. The on-site event will comply with the Swiss Federal Office of Public Health (FOPH) Safety Rules at the time of the event.

## The ICMP will be preceded by:

- Two satellite meetings: the Summer School on Current Topics in Mathematical Physics (19-23 July, Zurich) and the conference on Topological Phases of Matter (25-28 July, Leysin).
- The ICMP Young Researchers Symposium (YRS), which will take place from 29-31 July, at the University of Geneva. The YRS aims to offer young researchers the opportunity to gain visibility, discover new perspectives and to share their knowledge in an international scientific context through four thematic sessions and mini course lectures.

## The ICMP Programme:

The list of the ICMP plenary and invited speakers include leading experts who will present the state of the art in mathematical physics through:

- 16 Plenary Sessions
- 12 Thematic Sessions
- Contributed Talks and Poster Sessions (including junior participant presentations)
- Public lecture (by Michel Mayor, 2019 Nobel Prize in Physics)
- ICMP Human Rights Session (dedicated to Equal Opportunities and the promotion of women in science, specifically women in mathematics and physics)
- Visits to CERN (possibility of virtual guided tours)



MnΦ  
ICMP|2021  
Geneva

[www.icmp2021.com](http://www.icmp2021.com)

## INTERNATIONAL CONGRESS ON MATHEMATICAL PHYSICS (ICMP)

August 2 - 7, 2021  
(CICG) Geneva

### PLENARY SPEAKERS

- Viviane Baladi (CNRS, Paris)
- Thierry Bodineau (Ecole Polytechnique)
- Wojciech De Roeck (Leuven)
- Hugo Duminil-Copin (IHES; Geneva)
- Marco Gualtieri (Toronto)
- Peter Hintz (MIT)
- Antti Kupiainen (Helsinki)
- Juan Maldacena (IAS)
- Nikita Nekrasov (Simons Center)
- Yoshiko Ogata (Tokyo)
- Nicolai Reshetikhin (UC Berkeley; Amsterdam; St. Petersburg)
- Jan-Philip Solovej (Copenhagen)
- Jeremie Szeftel (CNRS; Sorbonne)
- Thomas Vidick (Caltech)
- Feng Xu (UC Riverside)
- Horng-Tzer Yau (Harvard)

### PUBLIC LECTURE

- Michel Mayor (Geneva)

 SwissMAP  
International Congress on Mathematical Physics

 FNSNF  
Swiss National Science Foundation

### PRECEDED BY Young Researchers Symposium (YRS)

July 29 - 31, 2021  
University of Geneva

### MINI-COURSES BY

- Martin Hairer (Imperial College)
- Marcos Mariño (Geneva)
- Hugo Duminil-Copin (IHES, Geneva)

### THEMATIC SESSIONS

- Dynamical Systems
- Equilibrium Statistical Mechanics
- General Relativity
- Integrable Systems
- Many-body Quantum Systems and Condensed Matter Physics
- Nonequilibrium Statistical Mechanics
- Partial Differential Equations
- Probability & Random Structures
- Quantum Field Theory
- Quantum Information
- Quantum Mechanics & Spectral Theory
- String Theory and Quantum Gravity

# A conversation with



## Alba Grassi

### First Winner of the SwissMAP Innovator Prize

Alba completed her Master's in Physics at the ETH Zurich under the supervision of our member Matthias Gaberdiel. She was a SwissMAP member until 2015, when she completed her PhD Thesis under the supervision of Marcos Mariño at the University of Geneva.

She then did a postdoc at the ICTP in Trieste, Italy. And spent some time at the Simons Centre for Geometry and Physics in Stony Brook, New York.

At the start of 2020, Alba received a PRIMA grant and was appointed professor. And in November 2020, she rejoined SwissMAP as a member, when she took up a joint position between CERN and the University of Geneva.

Her research interests are string theory, quantum field theory and mathematical physics.

**The SwissMAP Innovator Prize was introduced in the year 2015. Its first recipients were Alba Grassi and Vincent Tassion. Now, almost 6 years later, we decided to sit down with them and catch-up.**

**- You were recipient of the first SwissMAP innovator prize in 2015. Can you tell us what your experience of being part of SwissMAP was like at the time?**

At the time, I was a PhD student and SwissMAP was in its early years. As a student, I remember being naively happy that the SNSF decided to commit and, in a sense, to recognise the importance and relevance of the research field I was working in. This gave me a positive perspective about the future of the field.

**- Can you briefly tell us about your academic path since the Innovator Prize?**

After I graduated, I first did a postdoc at the ICTP in Trieste, Italy. This was a very interesting experience. ICTP is a research centre with a strong commitment to promote science in developing countries. The combination of these two aspects makes this

place unique. So that was my first experience.

After that, I went to the Simons Centre for Geometry and Physics in Stony Brook, New York. This was also an important experience, which contributed further to my scientific development. And finally, I came back to Switzerland and joined SwissMAP once again.

**- Did you keep in touch with people from SwissMAP?**

Yes, I did keep in touch with the SwissMAP program. I had some collaborations with people from SwissMAP. This was also facilitated by the fact that my family lives in Switzerland, so I would come visit them regularly. And once you are in the area, you of course use the occasion to visit collaborators.

**- How did you find yourself being part of SwissMAP again?**

I was first awarded with an SNF PRIMA grant (with ETH Zurich) and then I was offered a joint position between the theoretical physics department of CERN, and the mathematics department of the University of Geneva.

I can now fully appreciate the extraordinary opportunities that SwissMAP provides. We can organise events, invite collaborators from all over the world, and hire new scientists in our field.

This position was created explicitly within the SwissMAP framework because it allows to bridge between these two fields and the institutions in question.

**- How is your experience of the SwissMAP program different now as a group leader?**

As a group leader, I can now fully appreciate the extraordinary opportunities that SwissMAP provides. We can organise events, invite collaborators from all over the world, and hire new scientists in our field. This is something that I can truly appreciate now, as a group leader since I can actively participate in the creation of these opportunities.

**- Can you tell us about recent collaboration opportunities within SwissMAP or perhaps possible desired future ones, particularly those within SwissMAP but with a different institutions to yours?**

This is quite a tough question, because I only started my new position in November of 2020. Usually, it takes some time to build new collaborations. Especially now that in-person meetings are not possible. So currently, I do not have any collaborations

I always found it encouraging to meet strong female scientists on my path. They make science (and academia) look like a more accessible place.

with people from other SwissMAP institutions. But I'm confident, that with a little bit of time this will be possible once again.

**- Can you briefly describe your research?**

I work on mathematical and theoretical aspects of quantum field and string theory. On one hand, my research consists in applying ideas developed in a string theory context to address and solve open problems in related fields. For example in the context of spectral theory, matrix models, Painlevé equations or black holes physics.

On the other hand, my work aims to deepen our understanding of non-perturbative aspects of quantum field theory, string theory and the corresponding notion of quantum geometry. Moreover, since string dualities play an important role in this context, part of my research is also devoted to provide rigorous tests and making some of their aspects qualitatively precise.

**- Did you always know you wanted to follow the academic path?**

No, not at all. I grew up in a small

farm up in the Swiss Alps. So growing up, I could never imagine becoming a scientist, let alone following an academic path.

**- Did your academic path change at some point in your career and how did it come about?**

No, it didn't, but you never know what the future might hold. Up to this point in my career however, my academic path has not changed. The reason is, that I decided very late what path I wanted to take.

**- What advice would you have for a young researcher wishing to take the academic path?**

I would advise choosing a subject that you really like. Something that you love. Because it's important that you feel a passion for your specific field. And after that, just be persistent. Because things can get hard, and tough. So try not to give up when you find yourself in front of a closed door, or whenever you feel that you're not good enough. This might be a very obvious thing, but it's easier said than done.

**- Who were/are your scientific role models? Can you tell us what inspired you and what you learned from them?**

This is another tough question, but let me put it this way. As I mentioned, I grew up in a farm, in a very isolated place in the Alps. We were so far



Alba Grassi (UNIGE & CERN)

away from everything that the electric grid didn't even reach our home. So I grew up without television and also we didn't have many books at home. Therefore, growing up I didn't really know much about science and as a consequence, I didn't have scientific role models.

How did I get into physics and mathematics you might ask? Well, as a kid I loved school. So I decided to go to high school. It was sometime in the middle of high school, when I began to develop a preference for math and physics. I don't know why, I guess I just found them more interesting

than the other subjects. And in addition to this, I had an amazing professor in high school. He was actually a mathematical physicist. And since I also became a mathematical physicist, you could say, he had an impact on the path I decided to follow.

I don't have just one singular, favourite moment. For me, research is more a collection of small moments that I get to enjoy on a daily basis.

I would advise choosing a subject that you really like. Something that you love. Because it's important that you feel a passion for your specific field.

So role models were not what got me into mathematics and physics. However, once I chose this path, role models have encouraged me to stay. Knowing that there have been women like Marie Curie or Emmy Noether, who really stood out and made brilliant contributions to science, it has been very important to me as a woman. But in general, already as an undergraduate student, I always found it encouraging to meet strong female scientists on my path. They make science (and academia) look like a more accessible place.

**- What has been the greatest challenge you had to face?**

I am not sure, there are always many challenges. Work-wise for example, I always found challenging to stay focused and to produce high level results while having to apply for a new job every two or three years.

**- What has been so far your favorite moment in your career?**

I don't have just one singular, favourite moment. For me, research is more a collection of small moments that I get to enjoy on a daily basis. For example, when I discuss constructively with my colleagues, or when I overcome an obstacle in my research, or when I discover something new. I enjoy all of these. There's not one favourite, but a collection of small moments that happen every day.

**Conversation with Alba Grassi**  
April 2021, Geneva

**Interviewed by Maria Kondratieva**  
On behalf of NCCR SwissMAP

# A conversation with



## Vincent Tassion

### First Winner of the SwissMAP Innovator Prize

Vincent completed his PhD thesis in 2014 under the supervision of Vincent Beffara at the ENS Lyon. He then did a postdoc at the University of Geneva under the supervision of SwissMAP member Hugo Duminil-Copin, which he completed in 2016.

In 2017, he was appointed assistant professor at the ETH Zürich. He received an ERC Starting Grant in 2019, and as of April 2021, he obtained a permanent position at the ETH Zurich as associate professor.

His research interests include percolation theory, probability and mathematical physics.

**The SwissMAP Innovator Prize was introduced in the year 2015. Its first recipients were Alba Grassi and Vincent Tassion. Now, almost 6 years later, we decided to sit down with them and catch-up.**

**- You were recipient of the first SwissMAP innovator prize in 2015. Can you tell us what your experience of being part of SwissMAP was like at the time?**

I was a postdoc at the time and part of Hugo Duminil-Copin's group. Those two years were probably my most intense years, but it was a wonderful time. We had a very active group and I had a lot of time for my research. I really enjoyed those years and I think there was a particularly good energy and synergy within the group. We also had great relationships with other colleagues. But in particular, I was in close collaboration with Hugo Duminil-Copin and we did some very interesting work.

**- Can you briefly tell us about your academic path since the Innovator Prize?**

After my two years as a postdoc, I was appointed assistant professor at

the ETH in Zurich. I have been here ever since I started in January of 2017, so for four years now. And actually as of April 2021, I received a permanent position here at the ETH Zurich as associate professor.

**- Did you keep in touch with people from SwissMAP?**

Yes, and quite a lot. I still am in very close collaboration with Hugo Duminil-Copin. We discuss a lot of things. Not just our research, but also things surrounding the academic environment. For example, we coordinate the collaboration between our teams. We also organise events together. At the moment, we are preparing an online conference, and we have projects for future conferences that we would like to organise. I also have many other collaborators within SwissMAP, such as Ioan Manolescu (University of Fribourg) or Juhan Aru (EPFL). Since I am in Zurich, many of my local collaborators are also part of SwissMAP, and we have very good relationships between colleagues.

**- How did you find yourself being part of SwissMAP again?**

This was quite a natural process for

me. I moved from the University of Geneva, to the ETH Zurich, meaning I stayed in Switzerland. And I did not change my research subject. Since both institutions are part of the SwissMAP program, it was a natural choice to be part of SwissMAP once I was appointed assistant professor.

**- How is your experience of the SwissMAP program different now as a group leader?**

When you are a student, you do your own research. But when you are a group leader, you have additional tasks to handle. You have to find problems, have good organisation, and create a good dynamic within your group.

I was actually very lucky when I was young. You don't realise it at the time, because you're so focused on your research, but people do a lot of things for you. And when you start to have PhD's and postdocs, you realise how it functions. I am very grateful to the group leaders I had when I was younger, because we had a great group dynamic.

**- Can you tell us about recent collaboration opportunities within SwissMAP or perhaps possible desired future ones, particularly those within SwissMAP but with a different institutions to yours?**

I kept a strong collaboration with Hugo Duminil-Copin. There are a lot of other scientists I would like to collaborate with as well. Nevertheless, collaborations should not be forced. They should happen

naturally. And I don't bring any intentions into a new collaboration. It's a lot like meeting in real life. I don't like when things are forced and I don't want to feel the pressure that I must collaborate with someone specific on a specific subject. Generally, in my academic path, I seize the opportunities as they come. And I have found that the best opportunities come naturally, and you are able to grasp them.

naturality. And I don't bring any intentions into a new collaboration. It's a lot like meeting in real life. I don't like when things are forced and I don't want to feel the pressure that I must collaborate with someone specific on a specific subject. Generally, in my academic path, I seize the opportunities as they come. And I have found that the best opportunities come naturally, and you are able to grasp them.

Of course, there are several people I would be happy to collaborate with, and I have a lot of projects in mind. But for the moment, maintaining the collaboration I have and developing our ideas is already a good challenge.

**- Can you briefly describe your research?**

I'm working in the field of percolation theory. This theory originally stems from physics, but I'm working on the



Vincent Tassion. Shuffling Paper at the XV CLAPEM in Mérida, Mexico.

mathematics side of it. The goal of percolation is to describe how a fluid propagates in a random environment. And on the mathematics side of it, this creates a rich number of fascinating questions. Here, I would like to quote Harry Kesten, "Quite apart from the fact that percolation theory had its origin in an honest applied problem, it is a source of fascinating problems of the best kind a mathematician can wish for: problems which are easy to state with a minimum of preparation, but whose solutions are (apparently) difficult and require new methods". Since it requires new methods, it is mathematically very challenging.

And percolation is particularly relevant within SwissMAP, because it has a lot of connections with other models in physics. For example, in the study of spin systems, where percolation models can also be used to describe how information travels between spins. This is particularly pleasant, because you get to have many interactions between various fields.

**- Did you always know you wanted to follow the academic path?**

Not really. When I was young, I didn't even know I could go into mathematics. I didn't grow up in an academic environment at all. And actually even when I found out that we could study mathematics, I was not attracted by the academic path. I must say, I don't quite like the idea of big careers and high academics. My interest was only in mathematics and the possibility to do research. But step by step, I discovered an interest in the academics side as well, which came at a later stage. I have now discovered many things that I particularly like about the academic path. For example, collaborating with other researchers, or even sharing knowledge with new generations. These are dimensions I didn't think I would like so much. I thought I was a "mountain goat" who liked to stay up on his mountain. But that has changed a lot since I set on the academic path.

**- Did your academic path change at some point in your career and how did it come about?**

There was no single drastic change; things happened step by step. An important moment happened when I was a student and I met Vincent Beffara, who taught me Percolation Theory and later became my PhD adviser. Another big change was when I came to Geneva to work with Hugo Duminil-Copin. I met him during my PhD and it was a really great encounter. I remember that when I came to Geneva, I told Hugo that I would only stay for one year. Back then, I wanted to stay in France. But here I'm am,

all these years later, and I'm still in Switzerland.

**- What advice would you have for a young researcher wishing to take the academic path?**

It is actually quite difficult to give general advice, because it depends so much on the persons and their personality. Some advice might be good for one person, but not for someone else. However, two things do come to mind. The first advice I would give, is to always keep an eye on yourself. This might be completely obvious, but you cannot do good research if you are not healthy and happy. You need to keep a good balance between the things that are important for you.

In my case, for example, if I forget to go to the mountains, I get dried out and I can't do mathematics. It is sometimes tempting to say that you will work like crazy for some time, but then you forget about things that are completely essential to life. Primarily essential like, family, health, hobbies and so on. Especially nowadays, research has become so competitive, so intense, it's easy to forget about the other things that also matter. This is a crucial point.

The second advice I would give, has to do with this fact that we are in a competitive environment. It is to never forget to pay attention to the people around you - your colleagues, postdocs, students.. etc. It is better to advance together with other people, instead of fighting to make a space for yourself. Take care of your colleagues and academic friends and take an interest in them. It is always better to not be too self-centred.

That is why the group I was in during my postdoc in Geneva worked so well together. We took interest in each other and advanced together as a group. It really is an essential point nowadays.

**- Who were/are your scientific role models? Can you tell us what inspired you and what you learned from them?**

I have several role models. They are all people at very different stages in their careers, but they maintain a strong passion for mathematics. These people are driven by this passion and are truly beautiful researchers.

I have also been inspired by their generosity. They have this very strong global vision and they build an environment around it. But they build it in a way, that other people can join, especially the younger generation. They build a vision and are able to share it. I find these two strong components very inspiring. As for what I learned from them. Well, I would say, everything.

**- What has been the greatest challenge you had to face?**

The greatest challenges we face are definitely the mathematics problems we are trying to solve. But these are the best challenges and the best feeling – when you have a problem, and you want to solve it. So the biggest challenges, are the math problems that are not easy to solve. But the reward is great afterwards.

On a more personal note, one chal-

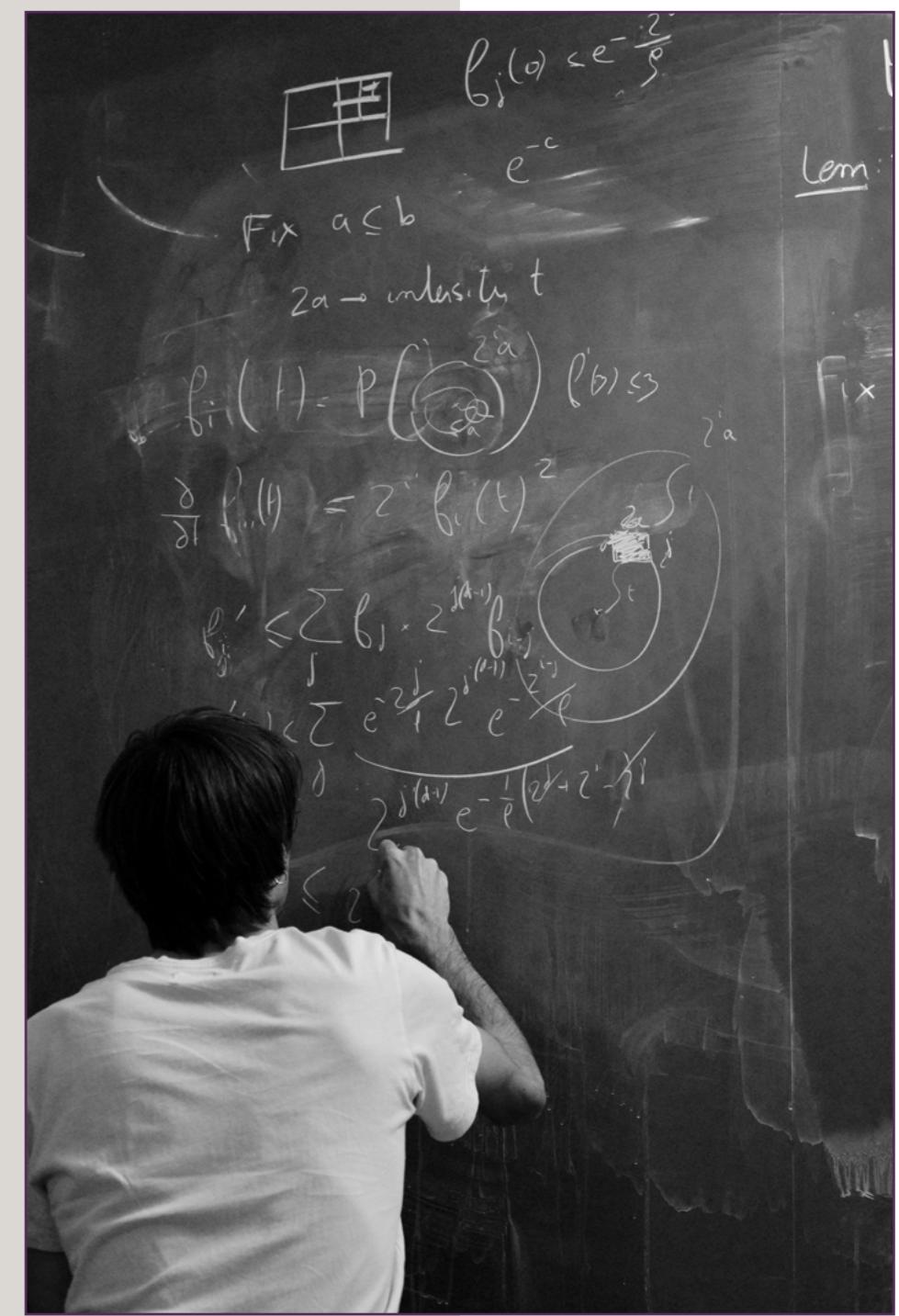
lenge for me, is to find balance in the workplace. I would like to find balance between having time for research, and being able to respond to my other obligations. Another challenge I face, is that I am a perfectionist. There is always a large amount of tasks that have to be done, and not necessarily perfectly. They just need to be accomplished. For me, this is challenging.

**- What has been so far your favorite moment in your career?**

I have two moments that come to mind straight away. The first one, was when I was in Geneva with Hugo Duminil-Copin. One day, we were discussing something as we usually did every day. But this day we suddenly found a proof for something that we were not actively working on. I still remember how surprised we were and that we couldn't really believe it. I was supposed to take the train to Lyon that day, and I missed my train. I wanted to stay to check that the proof was correct and of course, to share the moment with Hugo. We were jumping in our office from happiness. I remember it so well, because of our surprise at the time, and how it was a very intense moment in our friendship and collaboration with Hugo. It is a really good memory.

The other moment that comes to mind, happened recently. There is one problem that I have been thinking about since I know percolation, since I pretty much began to do probability. I have been thinking about it for more than 10 years now. And together with my PhD student we solved this problem last year. This was also a very intense moment. At first, we didn't have the proof yet. But we knew we had the argument and that it would be solved. This was also a memorable moment in my career.

This might be completely obvious, but you cannot do good research if you are not healthy and happy. You need to keep a good balance between the things that are important for you.



Vincent Tassion (ETH Zurich)

These two moments do have something in common. They are moments when you discover something, and you discover it with someone who is able to share the intensity of the moment.

**Conversation with Vincent Tassion**  
April 2021, Zurich

**Interviewed by Maria Kondratieva**  
On behalf of NCCR SwissMAP

# Presenting: The SwissMAP Research Station

The SwissMAP Research Station is a partnership between the University of Geneva and the ETH Zurich and will ensure the long-term sustainable effects of SwissMAP.

SwissMAP is proud to announce that the SwissMAP Research Station (SRS), based in the Swiss Alps in the village of Les Diablerets, is officially opened since January as planned despite the pandemic situation. Due to the associated restrictions, the formal onsite inauguration ceremony has been postponed to the SwissMAP General Meeting in September 2021. We hope this will be possible and we look forward to welcoming the SwissMAP Community onsite and online!

Events have so far taken place either online or in hybrid format. The first events at the Research Station were the Winter School in Mathematical Physics in January and the Cohomology and moduli spaces of flat connections Workshop in February.

Some other events were postponed to a further date in 2021 or 2022; the summer and fall 2021 should be the occasion to host at least 8 of them.

In order to make it accessible to a maximum number of people, videos of most of the SRS events will be made available through the SRS website. Videos of the first two events are already online.

The Scientific Program for 2022 has now been finalized and includes seven Winter and seven Summer events touching upon a wide range of topics in mathematical physics. Some of these events are invitational only, whereas some others will be open to all. Should you be interested in attending one of them, do not hesitate to contact the organizers and/or our Science officer Elise Raphael at [contact@swissmaprs.ch](mailto:contact@swissmaprs.ch)

The call for 2023 events is open until September 30, 2021. Those interested in organizing an event for 2023 at the SwissMAP Research Station can apply by completing the proposal form available on the SwissMAP Research Station website. Evaluations of the proposals will be carried out by the Scientific Council.

Selected events can be funded by SwissMAP for up to 40 participants (accommodation, full board and conference rooms included).

## Directors:

- Anton Alekseev (UNIGE)
- Renato Renner (ETH Zurich)

## Scientific Officer:

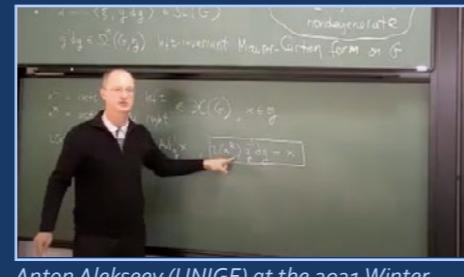
- Elise Raphael (UNIGE)

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- Matthias Gaberdiel (ETH Zurich)
- Krzysztof Gawedzki (ENS Lyon)
- Marcos Mariño (UNIGE)
- Nuriya Nurgalieva (ETH Zurich)
- Claudia Rella (UNIGE)
- Stanislav Smirnov (UNIGE)
- Chenchang Zhu (U Göttingen)



The SRS conference room in Les Diablerets



Anton Alekseev (UNIGE) at the 2021 Winter School in Mathematical Physics

Call for proposals for 2023 opened in May.



# Scientific Program 2022

## Winter School in Mathematical Physics

January 9-14

Alberto Cattaneo (Zurich)  
Giovanni Felder (ETH Zurich)  
Maria Podkopaeva (IHES)  
Thomas Strobl (Lyon 1)  
Andras Szenes (Geneva)

## From Coadjoint Orbits to Black Holes

January 16-21

Anton Alekseev (Geneva), Pranjal Nayak (Geneva)  
Julian Sonner (Geneva)

## Recent development in Link Homology

January 30 - February 4

Anna Beliakova (Zurich), Krzysztof Putyra (Zurich)  
Louis-Hadrien Robert (Luxembourg)

## Differentiable Stacks, Poisson geometry and related geometric structures

February 6-11

Henrique Bursztyn (IMPA)  
Rui Loja Fernandes (Illinois)  
Marco Gualtieri (Toronto)  
Jiang-Hua Lu (Hong-Kong)

## Workshop in Statistical Mechanics 2021

February 13-18

Stanislav Smirnov (Geneva)

## Vertex Algebras and Poisson Geometry

February 20-25

Anton Alekseev (Geneva)  
Leonid Rybnikov (NRU HSE Moscow)

## Workshop on Spin Glasses

February 27 - March 4

David Belius (Basel), Erwin Bolthausen (Zurich)  
Giuseppe Genovese (Basel)

## Workshop on Network Non-Locality

May 29 - June 3

Nicolas Brunner (Geneva), Nicolas Gisin (Geneva)  
Renato Renner (ETH Zurich)

## Helvetic Algebraic Geometry Seminar (HAGS) 2022

June 5-10

Rahul Pandharipande (ETH Zurich)  
Andras Szenes (Geneva)

## Large Charge in Les Diablerets

July 3-7

Luis Alvarez-Gaume (Simon Center for Geometry and Physics),  
Simeon Hellerman (Kavli ITPMU)  
Domenico Orlando (INFN Sezione di Torino)  
Susanne Reffert (Bern)

## Gauged maps, Vortices and their moduli

August 20-26

Nuno Romão (Augsburg)  
Eduardo González (Massachusetts)  
András Szenes (Geneva)

## Algebra, Topology and the Grothendieck-Teichmüller group

August 28 - September 2

Anton Alekseev (Geneva)  
Thomas Willwacher (ETH Zurich)

## Young Group theorists workshop

September 4-9

Donna Testerman (EPF Lausanne)  
Rebecca Waldecker (Halle-Wittenberg)

## Let's talk about outreach

September 25-30

Pierre-Alain Cherix (Geneva), Shaula Fiorelli (Geneva)  
Joana Mailler (Geneva), Elise Raphael (Geneva)

<https://swissmaprs.ch>



# SwissMAP Highlights:

# SwissMAP Collaborations

## Introduction by Elise Raphael

SwissMAP mobilises a large community of over 200 researchers from 8 different Swiss institutions. It aims at encouraging the exchange of ideas and methods and promoting collaborative research at different levels (cross-institution, cross-project and cross-field).

We asked our Science Officer Elise Raphael her thoughts on collaborations within SwissMAP, both as a mathematician and through the prism of her new position.

I think it is both a great opportunity and a huge challenge to bring together such a wide community of researchers in SwissMAP. As mentioned, collaborative research within SwissMAP can be done at different levels: between the different partner institutions, between different research groups and projects, and of course between mathematics and physics.

But what does it mean to collaborate? It is not something we can easily quantify, and ways to measure collaborations are hard to define. Joint publications, for example, only reflect a tip of the iceberg of the shapes collaborations can take.

We will explore some of them through the interviews proposed in this issue of Perspectives:

- Joint seminars between groups and institutions (see Chiara Saffirio's interview page 24)
- Integration of a new research area into SwissMAP (see Renato Renner's interview page 20)
- Dedicated events like the SwissMAP general meeting (see Fiona Seibold (ETH Zurich) and Nikita Nikolaev (UNIGE) interviews on page 32).

This issue of Perspectives is also the occasion to explore what more could be done to prompt further collaborations and to understand what might hinder them. Michele Schiavina's interview (on page 28) offers some insight on this.

In this short piece, I would like to think in terms of what is necessary for collaborations to arise. I don't think there exists a set of sufficient conditions, but still, we can try to look for it!

I believe some necessary conditions are for people to meet, be aware of what the others are doing, and make some effort to be understandable to each other.

SwissMAP provides its members with possibilities to meet regularly by organizing events such as the Annual General meeting and the Winter School in Mathematical Physics. These events are also opportunities for junior researchers to gain visibility by giving short talks and therefore to make others aware of what they are doing.

However, these are not always sufficient conditions to generate collaborations.



Elise Raphael (UNIGE)

## Mathematical Physics is a very wide field.

Some obstacles are intrinsic to the fields of research we are in: as Michele Schiavina mentions in his interview, there exist anchored bias regarding mathematicians and physicists. Many of us were educated primarily in one or the other discipline, and tend to regard the other one with circumspection.

Because the scope of research within SwissMAP is very wide, there naturally exists a gap between what each of us considers as basic no-

tions in their respective fields. Some words are part of our everyday research landscape, so much that it is almost surprising for us to see that someone in mathematical physics does not have a good grasp of it. Given the opportunity to do a 25 minutes talk, as we do for example in our Annual General Meeting, people want to present their recent results, not the background everyone knows in their field.

But whenever I hear “AdS/CFT correspondence”, my brain gives up and I skip whatever comes next. And I assume that similarly, some phys-

icists at SwissMAP stop listening whenever someone says “moduli space” or “homotopy theory”. Of course, I might be terribly wrong, and everyone but me understands all such concepts perfectly.

If not, though, as a first step to bridge this gap, I would like to organize workshops and seminars for PhD and postdocs where one can learn what seems trivial to the other.

At the next General Meeting, we will propose a discussion- junior researchers only! to see what we can admit to not understanding. We can then create recurrent events during which some basic notions are explained, and very naïve questions answered.

### The “But why should we care about this problem?” question

PhD students tend to be extremely specialized and not have much hindsight yet on their topics of research. Exposure to other domains is key to creating a bigger picture and perhaps new connections, and SwissMAP has an important role to play in regard to this.

I think Renato Renner (ETH Zurich) explains very well in his interview what should happen in collaborative environments: “One has to put focus on explaining to others not only how this problem even came about but also why it is interesting and relevant”. This is something that is generally missing in specialized workshops and conferences, because everyone knows the relevant background.

Organizing SwissMAP events is both an opportunity to create a solid group unity and to learn how to discuss with people a bit further from your research domain than your usual collaborators, in a safe and

kind environment. As a PhD student, I would have loved to be able (or rather to be forced) to expose my research to people who had no prior interest in it. I think it is important to learn to answer the “But why should we care about this problem?” question very early in one’s career, and be able to discuss it with others at regular intervals.

SwissMAP offers a perfect setting to do this, and it is our task to create the right events for these interactions to really bloom. Our annual general meetings are great events to meet and strengthen our group identity, and we continually look for ways to improve them and make them scientifically accessible to all our members.

We traditionally invite SwissMAP senior researchers to give colloquia talks, but it is not an easy task to address such a diverse and continually expanding audience. Why not ask them to discuss a specific problem from A to wherever it is possible to get to in the alphabet in one hour (certainly not Z), and make sure everyone feels comfortable interrupting if it doesn’t remain understandable for more than three



minutes?

Of course, to be possible, it should start with the most advanced researchers furthest from the topic at hand daring to say “I have never heard of this theorem before, can you take some time to tell us about it?”. If the people we look up to can publicly admit to not knowing stuff, it might become easier for the rest of us to do so.

I consider the problems I mention to be part more widely of our research community, and not specific to SwissMAP. But as our NCCR keeps intertwining more and more fields, projects and groups, as we bring some parts tighter and tighter, some other begin to appear loosely knitted.

The journey we have taken since the beginning of the first phase is fantastic, but we can still accomplish a lot.

The SwissMAP Research Station will, in the coming years, create more opportunities for the SwissMAP community to come together but also develop new external collaborations. We will implement some of the ideas that arise in this issue of Perspectives and make sure we provide a great environment for collaborations to be born and nurtured.

**Author:** Elise Raphael  
UNIGE, NCCR SwissMAP

# The integration of a new research area into SwissMAP

a conversation with Prof.  
Renato Renner

**Prof. Renato Renner (ETH Zurich) is a physicist,  
SwissMAP member and part of the SwissMAP  
Quantum Systems research project.**

**Can you tell us a bit about your field of research?**

Quantum information is really a lot about correlations, i.e., about how things relate to other things. For example, if I have a material, I can ask myself “how is a piece here in the material correlated with a piece there?”. The point is that by understanding how this correlation scales as you move away, you can learn a lot about the system.

This has for long been known by physicists who study different types of systems. But in quantum information, our focus is not on calculating correlations for concrete systems, but rather on actually understanding correlation as an object itself. We want to know what type of correlations there are, how they can be quantified and characterised. We provide the techniques to measure correlations in a way that makes sense.

**Do you consider mathematical physics is a field different from yours?**

It is a matter of definition. Quantum information has a strong overlap with mathematical physics, but it is not a subset of it. Quantum information includes subfields like quantum computing, which I don't think are close to mathematical physics. The mathematical physics community did not always see quantum information as a part of it. But this has changed over the years. Also, SwissMAP started without quantum information. But I am of course very happy that, when transitioning to its second phase, SwissMAP has reached out to quantum information theorists like me and welcomed us.

**Can you tell us about your collaborations within SwissMAP?**

I joined SwissMAP relatively recently (just a little bit before the pandemic started), so I should rather tell you



*Prof. Renato Renner (UNIGE)*

about my planned future collaborations. But already in the past I had very fruitful exchanges with the groups of Nicolas Brunner (UNIGE) and Nicolas Gisin (UNIGE), which are now also part of SwissMAP. SwissMAP will certainly present a good opportunity for us to intensify these contacts and start new collaborations. The nice thing with SwissMAP is that we have a consistent and long-term binding. We see each other in common workshops and conferences, which is particularly important for younger group members. For example, I got very positive feedback from the students that were in the

SwissMAP workshop in Leysin, which I co-organized with Anton Alekseev. It was really amazing for the students as they were not only able to meet for the first time some of the authors of the papers they had read, but also discuss with them in an informal setting. Such meetings can thus serve as a basis for future collaborations.

**Could you tell us about the workshop in Leysin you co-organized with Anton Alekseev? What was the aim of the workshop?**

Our workshop “Mathematical physics meets quantum information”

took place in early summer 2019. As quantum information was new to Swiss-MAP, the workshop was a great opportunity to invite scientists from both quantum information and mathematical physics to give talks and to see how they would interact. I think this worked quite well. However, I also realised that there is still a lot of work to be done in the sense of learning to speak the same language.

**And what would you say is the biggest problem in trying to understand each other?**

*It is partially a language problem, and partially a problem of thinking differently about the same objects. Quantum information is a lot about how systems can be correlated, and we thus use a rather sophisticated slang to characterise them. You could say it is similar to Eskimos who have 100 ways to talk about snow and we have 100 ways to talk about correlation and entanglement.*

*Apart from the language itself, the approaches are also conceptually different. On the quantum information side, we usually regard correlations as properties of a quantum state or, more technically speaking, a density operator. On the mathematical physics side, the focus is more strongly on observables and their correlation functions.*

the fact that they are just two-dimensional. Of course, these only become interesting when you consider correlations between them.

Mathematical physicists sometimes appear to have the view that in finite-dimensional systems everything becomes trivial and uninteresting. It is of course true that certain problems which are hard in the infinite-dimensional case become easy if you make them finite dimensional. What we do, however, is to study problems that are hard already in the finite-dimensional case.

But this variety of views and approaches is of course a great opportunity. Obviously we can learn a lot from each other.

**Did you have some problem understanding each other during this type of conference?**

*It is not only the understanding of what they are doing, but also “why they are doing one thing and not another?”.*

*Sometimes the difficulty is that in their presentations, people tend to talk directly about solving a problem instead of telling the others why this problem actually is interesting. This is of course fine in a specialised workshop. But in a more interdisciplinary*

it is necessary for the audience to appreciate what is presented.

**What would you say came out of this workshop? Particularly regarding potential problems that could interest you or results from the other side which you could use?**

*It is difficult to associate outcomes to particular workshops or events. I usually need to hear a thing more than just one time until I understand its relevance. In this sense, the workshop in Leysin, as well as the other meetings I participated in within Swiss-MAP, were all elements that certainly are influencing my current research.*

*More concretely speaking, one of the impacts that these meetings had on my research is that I moved it more into the direction where abstract quantum information theory is applied to problems in real space rather than Hilbert space. An example is the study of correlations between different regions of spacetime, separated for example by the event horizon of a black hole. We are now working on projects in this direction.*

**Do you think you expect to collaborate more within SwissMAP with some other project(s)?**

*Yes, but maybe more in the mid-term than in the short-term future. A concrete example of where quantum information meets other branches of mathematical physics is what we call the black hole information paradox. This is a really interesting subject because it is a paradox that arises if you combine ideas from quantum information with the description of black holes that comes from gravity.*

*I am pretty sure that in the mid-term future we will collaborate with various people who do research on problems related to this. But we still have a lot of homework to do, one of it learning to speak a common*

**[We think] differently about the same objects. [...] But this variety of views and approaches is a great opportunity. Obviously we can learn a lot from each other.**

language, as I indicated earlier.

**Could this be facilitated by creating workshops with them?**

*Yes, actually even before I was in SwissMAP I co-organised an event in the Kavli Institute for Theoretical Physics in Santa Barbara, whose goal was to bring together researchers working on General Relativity, Ads/CFT, and quantum information. That is something that I could imagine repeating in the future, once the situation allows it here.*

**Would being part of SwissMAP facilitate the organization of this event?**

*Yes, I hope to do it at the SwissMAP Research Station.*

**Could you consider a shared SwissMAP postdoc or PhD between different projects?**

*Definitely, particularly in the area I just mentioned, which has to do with the black hole information paradox. A collaboration with groups with more expertise on the gravity side would make a lot of sense, and I would really appreciate it.*

*Another direction where I would hope to be able to collaborate with people from SwissMAP is related to our study of relative entropies. We recently discovered that they have some properties related to Lyapunov exponents. I am sure having insights from someone who is working on Lyapunov exponents from a different angle would help us making progress.*

**Perhaps Antti Knowles (UNIGE) in random matrices...**

*Indeed, he is one of the people my group had contacts with already in the past, in fact via one of my students who was working on developing relative entropies. But this was before we were part of SwissMAP.*

*Anyway, as I indicated, I joined SwissMAP rather shortly before the pandemic. I attended one of the nice SwissMAP Annual General Meetings, but then everything moved to online operation, which makes it more difficult to establish new contacts. But I am looking forward to the time when we can meet again in person!*

The nice thing with SwissMAP is that we have a consistent and long-term binding. We see each other in common workshops and conferences, which is particularly important for younger group members.

One other big difference is that in quantum information we usually believe that the physics essence is not buried in the infinite dimensionality of systems --- we even consider qubits as interesting objects, despite

event like the workshop in Leysin, one needs to address the question of the why, i.e., why a problem is interesting and relevant. Answering this question often requires providing quite some background. But I think

**Conversation with Renato Renner**  
Spring 2021, Geneva

**Interviewed by Elise Raphael**  
UNIGE, NCCR SwissMAP

# Bringing the Swiss kinetic theory community together

## a conversation with Prof. Chiara Saffirio

Chiara Saffirio (UniBas) was a postdoc in the SwissMAP Quantum Systems project at UZH in Benjamin Schlein's Group. Since July 2019, she joined SwissMAP as a professor in the Quantum Systems project.

In this article, Chiara speaks to us about her collaborative project with Mikaela Iacobelli (ETH Zurich) which aims to group the Swiss kinetic community.

**Can you briefly tell us about your research area?**

*My research area is kinetic theory. In particular I study the link between microscopic and macroscopic systems of many particles that obey classical or quantum laws of mechanics. In other words, it is about finding the way of approximating a complex system of many interacting particles through a macroscopic equation, called effective equation, that is a typical nonlinear PDE and which encodes the collective behaviour of the microscopic system.*

**SwissMAP encourages and promotes cross-project and cross-institution collaborations.**

**Can you tell us which other SwissMAP project(s) you have collaborated with or are planning to collaborate with in the near future?**

*So far collaborations have been mainly within the Quantum Systems project. However, at the moment, we have an ongoing cross-project and cross-institution collaboration with Mikaela Iacobelli (ETH Zurich) who is part of the SwissMAP Statistical Mechanics project.*

**Group identity and trust can be important factors for interdisciplinary collaborations.**

**Would you say the collaboration was facilitated or brought about through the SwissMAP network?**

*Definitely. The idea first came up during the SwissMAP Annual General Meeting last September, specifically during the SwissMAP professors meeting in which we were discussing the importance of creating collaborations.*

*The collaboration with Mikaela came quite naturally, as she is one of the few working in kinetic theory at the moment in Switzerland. Particularly as during our conversation we realized that we were both facing very similar problems. For example, if we had an invited speaker, we both found that attendance would be mainly limited to the members of our group. As the kinetic theory community in Switzerland is very small, we thought that it would make sense to collaborate and to offer our students and postdocs the possibility of increasing the interactions within their field.*

*As Basel and Zurich are relatively close, Mikaela and I decided to organize a joint seminar which would be devoted to the members of our groups. It would be an opportunity for them to present themselves and their research and get to know each other.*



*Prof. Chiara Saffirio (UniBas)*

*This is a very important part as not only will they be able to speak about what they are doing but also to learn about what their colleagues are doing in the same field in Switzerland.*

*The idea is organized around three main objectives. Firstly as previously mentioned, we want to encourage discussions and interactions in an informal atmosphere which we believe could also potentially attract master class students. So, the idea would be to also invite master class students, particularly those who could be interested in subsequently joining our groups, for example for a master thesis or PhDs.*

*Secondly, although initially we planned to start with the members of our groups presenting themselves, in the near future we would also like to invite more senior speakers from outside from time to time.*

*Finally, to provide the grounds for potential collaborations amongst young researchers through informal discussions. This is why we plan to have not just a seminar but an extended afternoon, also because we will have to travel from one city to another. We are indeed hopeful that these meetings and discussions will create the opportunity to start projects together or some scientific collaborations amongst the members of our groups. Furthermore, if it is successful this might also facilitate the exchange of personnel. For example if I have a PhD student who is motivated to pursue an academic career within the research area of kinetic theory, then it is easier if he or she already knows someone (Mikaela in this case) at another Institution or University that can offer him/her a postdoc position.*

***This is not only a cross-project but also a cross-institution collabora-***



tion, will you also be inviting other institutions to participate?

To start with, it would make sense to advertise it also within UZH as the plan is to have alternating locations, once in Basel once in Zurich. For people at the UZH it would be very easy to come if there is a topic that is of interest to them. Then, depending on the success, another natural extension could be EPFL. Perhaps an interesting point about this is that it would also be outside SwissMAP as there are groups at EPFL that are studying problems related to kinetic theory, but from the point of view of

analysis and not that much from the mathematical physics perspective. I think this could be very interesting especially for the exchange of methods to integrate them into this project.

Are you planning to invite senior women speakers regularly?

This I think is not difficult in our field because it is less male oriented being kinetic theory at the border with partial differential equations. I think having women invited speakers will come quite naturally and also by the fact that we are two women organizing. In our field, amongst the most

influential scientists there are two women, Laure Saint-Raymond and Isabelle Gallagher, so it will not be difficult for us to achieve an equal distribution.

**Will the talks be made available online?**

The idea is that as soon as it is possible, we will privilege onsite participation which makes filming slightly more complicated. For the video creation it could be an option when we have external speakers.

**Can you tell us more about your interdisciplinary collaboration(s) within SwissMAP, aims, organization, long term impact etc?**

If this project is going to be successful I think that there is also the goal of consolidating and enhancing the kinetic community in Switzerland. Gaining visibility within and outside Switzerland could also result in attracting the best students from Switzerland and abroad for PhDs or as postdocs. This would somehow also contribute to the scientific level of mathematical physics in Switzerland. In the last years kinetic theory has been a very active research area, we have Fields medalists working in this field, so I believe it is important that it is more represented in Switzerland.

**How would you plan to gain visibility outside?**

I think that by having these joint seminars and inviting external senior speakers who, when they come, see there is an active community in Switzerland, the word will start spreading that there is not just an isolated person working in Basel or in Zurich but rather a community of people interested in these topics.

**What are the potential challenges ahead and how could they be approached?**

At the moment the greatest challenge is the pandemic, this is a problem we are all facing. As I've mentioned, for this kind of event onsite attendance is crucial as it is really about creating the occasions to start collaborations and discussions, and online the interactions are less natural. Online it is great if you already know the other person, then you can have really a good scientific interaction. However, when people don't know each other, then I think personal contact is really important. I think informal time so that people can really discuss and get to know each other in a friendly relaxed atmosphere is the ideal fertile ground to start collaborations.

We are currently planning to start in September and hopefully, as it is within Switzerland, we might be able to start the seminars onsite, even if initially we have to limit attendance to our group members.

**Who else, do you or would you expect to collaborate with, within SwissMAP and why?**

I have already been collaborating with Benjamin Schlein (UZH) over the past years. One of my postdocs who will be finishing this summer will be joining his group in September, so we will be starting a project all together again within the Quantum Systems project.

Also, when I was a SwissMAP postdoc there was a similar collaboration with Gian-Michele Graf (ETH Zurich) as the one we are planning to do with Mikaela and which is actually where the idea of the kinetic theory seminars came from. I remember it was a great opportunity and a great way of knowing what the others were doing. I think it is very possible that in the future we will organize something similar again within the Quantum Systems project.

I think informal time, so that people can really discuss and get to know each other in a friendly relaxed atmosphere, is the ideal fertile ground to start collaborations.

When we come back to meeting in presence, it will also be much easier for me to meet other SwissMAP colleagues and discuss. For example, there are topics I would like to discuss with my colleagues in the Statistical Mechanics group which is the closest to my research field. I think this comes naturally when you meet people in person.

**What do you think is key to encourage collaborations?**

I would say that the first step is to get to know each other. So encouraging people to talk and through team building activities or situations that force people to meet other people from outside their groups and departments will provide the grounds. When you know someone then it is more natural to discuss science. Physicists and mathematicians like to speak about science so it is not something that has to be forced, it is about creating the right occasion, preferably in an informal setting.

**Conversation with Chiara Saffirio**  
Spring 2021, Geneva

**Interviewed by Mayra Lirot**  
NCCR SwissMAP

# Fostering connections and bridging gaps between mathematics and physics

a conversation with  
Michele Schiavina

We spoke with Michele Schiavina (ETH Zurich,  
Nicolas Beisert's & G. Felder's Group) about  
mathematical physics and bridging the gaps  
between these two fields.



Michele Schiavina (Postdoc at ETH Zurich, Nicolas Beisert's & G. Felder's Group)

You have navigated across the frontiers of mathematics and physics with a BA and MA in Physics from the University of Bologna, a PhD in Mathematics from the University of Zurich.

Then as a Postdoc and visiting scholar at the Department of Mathematics at the University of California at Berkeley and currently a Postdoc with a joint position at Physics & Math Departments at ETH Zurich.

Do you consider yourself more as a physicist or a mathematician?

This is a very good question, and also one that I wish I knew how to answer. Perhaps I should say I am in a state that is a superposition of a mathematician and a physicist: depending on the application I reveal my true nature...

Jokes aside, this is not easy to say.

I deeply enjoy both approaches to research, and sometimes you need to be able to switch between them. My deepest fear is not being either of them. Perhaps, though, that is also OK.

Maths and physics are very closely related fields. What in your opinion is the relationship between them, do they speak different languages? What are their underlying differences? Do they rely on different methods?

Simplifying, I would say that a physicist is interested in the intrinsic properties and value of specific examples, whereas a mathematician is interested in the broader picture, a general scenario.

In my opinion there are two different paradigms at play: Physical "Relevance" and Mathematical "Placement".

Can you explain a bit further...?

As a physicist I am invested in problems that have "real-world" application, or relevance. Achieving that relevance becomes the primary objective. This is especially true when there is an experimental setup that allows the process of falsification of theories, so that I can focus on developing theories and making predictions.

What I mean is that you can make all the theories that you want and be as crazy and as bold as you want as long as you have a way to test them. Falsification of theories means that if you have a theory that doesn't match your experimental observation, that theory is falsified and discarded.

This means that you can focus on relevance and forget about all the rest as long as you have a way of testing your theory.



As a mathematician, I need to establish incontrovertible relations between mathematical structures: placing a modicum of knowledge within a framework becomes the primary objective. Often this is performed by looking at what can be perceived as less physically relevant examples that might be easier to place, in order to prepare later generalisations.

However, there obviously is an area of substantial overlap, where one can navigate the dichotomy between physical relevance and mathematical placement. I call this area “mathematical physics”.

**Do you think mathematicians need different qualities than physicist and vice versa?**

I do not think that fundamentally different qualities are needed, but the

mindset might be slightly different.

**Building bridges across disciplinary boundaries is more likely to achieve in scientific terms.**

**What do you think are the requirements to successfully conduct collaborative research between these fields? How do they translate their ideas and understand each other?**

In my experience, the most success I have obtained in cross disciplinary scientific interaction has been by suspending for a moment the respective drives for physical relevance or mathematical placement. Listening to each other, learning from one's expertise, and believing that there might be something useful in what the other person has to say goes a long way in building a bridge.

**What are the common problems they encounter when working together? Where do you think they might not be communicating well?**

If I have to be honest, there is a stigma on both sides. Simplifying again, both believe that physicists produce heuristic non-rigorous results, and that mathematicians have no grasp on what is truly relevant cannot be good for scientific development, and must be actively rejected.

I think we can agree that there are challenges in physics that could very much use a mathematical breakthrough or a more general perspective. Many of the theories that are of direct physical interest at the moment are beyond experimental verification, therefore a solid mathematical foundation becomes, at least in my opinion, equally important.

At the same time there is a huge amount of mathematical work that is vaguely inspired by physics, but that has mostly lost track of its original goal and its physical relevance, so to speak. In this sense, a little more guidance on what the active research questions in physics are might help focus the research of mathematics in these areas.

**Group identity and trust can be important factors for interdisciplinary collaborations.**

**Would you say that collaborations are facilitated or brought about through the SwissMAP network and how do you think bridging the gap between the two could be further encouraged? Please share any ideas you might have.**

I would not be here if it were not for SwissMAP, and I would not have the opportunity to collaborate directly with both mathematicians and physicists. Pursuing an interdisciplinary research career would be much more

difficult.

But people tend to get either lazy or prioritise their career goals, and very few put the time to really reach out and explain their research topics to others across the disciplinary boundary.

**It is easier to work on a continuation of one's earlier research projects than starting new, cross-disciplinary ones, whose success is obviously**

there is a background presentation from both sides followed by brainstorming sessions. I also think it is important to make sure that speakers at interdisciplinary meetings know that their talks should be aimed at a broad audience.

**It could also be interesting to explore the possibility of a targeted prize for exceptional cross-disciplinary collaborations, not much in the sense of outreach (which is also important) but really at the level of basic collab-**

Listening to each other, learning from one's expertise, and believing that there might be something useful in what the other person has to say goes a long way in building a bridge.

more uncertain. This is naturally a big problem, especially for young scientists who are establishing their career (including myself in the lot), because it communicates the idea that it pays off more to stick to publishing in one's own narrow field instead of reaching out.

**I think that in fostering interactions between disciplines we need to take this into account and incentivise people to collaborate at a basic level. I think mathematicians need to be reminded of what is relevant and necessary from a physicist's perspective, and in exchange they can explain a few new tricks that have been developed in the pure-maths circles.**

**Please share any ideas you might have in respect to how SwissMAP could encourage this bridging.**

Concretely, I think that targeted small group workshops are a good way to bring new techniques and problems to the attention of both young and senior researchers. It could be around a topic where physicist and mathematicians are brought together and

orative work. This might incentivise young researchers to take more risks, be more open-minded towards less familiar research topics and ultimately explore new ideas.

**Conversation with Michele Schiavina**  
Spring 2021, Geneva

**Interviewed by Mayra Lirot**  
NCCR SwissMAP

# Annual General Meeting Member's Experience

## a conversation with Nikita Nikolaev and Nina Holden

The SwissMAP Annual General Meeting is a very important internal event regrouping the SwissMAP community. The programme traditionally includes the innovator Prize winners announcement, colloquium talks, several short talks by junior participants and networking activities. One of the main aims of this event is to present important trends and results to researchers working in other fields.

We have spoken to some of our members in order to understand their experience of the event and to ensure it remains an avenue to brainstorm and network as well as to encourage cross-field, cross-project and cross-institution collaborations.

In this article, Nikita Nikolaev (UNIGE) and Nina Holden (ETH Zurich) shared their experiences about the SwissMAP Annual General Meetings.

**Have you found the Annual General Meetings beneficial and if so, why?**

Nikita: Socially: yes; scientifically: no. From a socialising point of view: it's nice to catch up with friends from other universities in Switzerland who are not in my immediate research area (hence we may not see each other often or at all at other conferences). From the scientific point of view: there is very rarely ever any attempt from speakers to reach across fields and disciplines in their presentations. For the most part, geometers lecture geometers, analysts lecture analysts, physicists lecture physicists, etc. There should more presentations by junior members, and more colloquium-style presentations from senior members.

Nina: The meeting was beneficial. I work in probability theory myself, but my work has connections to other topics present at the conference. The meeting was also an opportunity to meet people closer to my own field in Geneva and at EPFL, both people I haven't met before and my collaborators at EPFL.

**What has been your favourite part of the program and why? Talks, networking, poster session... please specify.**

Nikita: Poster session is nice because you can speak with the poster presenter and get them to explain their work in a way that can be understood by someone from outside the immediate field.

Nina: Networking with other participants.

**Did you get the opportunity to meet new people, particularly from different institutions, positions and fields?**

Nikita: Yes, but there should be more encouragement or incentive to chat



Nina Holden (Postdoc at the ETH Zurich, W. Werner's Group)



Nikita Nikolaev (UNIGE Alumnus, A. Alekseev's Group)

people who are also at ETH after the meeting.

**Would you say this kind of meeting favours interactions or understanding between both fields?**

Nikita: As mentioned before, the purpose of the meetings is excellent, the implementation is not good.

Nina: Yes, I think in-person meetings with people of different backgrounds is a good way to encourage interactions between different fields.

**Do you think this event offers young researchers visibility within the community?**

Nikita: Disappointingly minimal.

Nina: Yes, young researchers were very visible at the meeting and gave many of the talks.

**Do you have any comments or suggestions?**

Nina: Some of the talks could have been even more introductory to be easier to follow for people from other fields. Otherwise, I enjoyed the possibility to meet people a bit outside my main field of research.

knew few of the other people before the meeting.

**Have you collaborated with them or kept in touch with them?**

Nikita: Collaborated no, kept in touch yes.

Nina: No collaborations except with someone I already knew before, but I have spoken a bit with some of the

Conversation with Nikita Nikolaev and Nina Holden  
Spring 2021, Geneva

Interviewed by Mayra Lirot  
NCCR SwissMAP

**Every two years the Wright Colloquium brings fascinating subjects to the broader public in order to encourage a greater understanding of science. In 2020, the 19th Wright Colloquium "The Art of Maths" (2-6 Nov 2020) was completely devoted to mathematics. Due to the unprecedented conditions caused by the pandemic, the event took an altogether very different format than in the previous years.**

**From the beginning, our members Shaula Fiorelli (SwissMAP Outreach Officer) & Elise Raphael (SwissMAP Science Officer) collaborated with the Wright Foundation and the University of Geneva at different levels and stages of the event organization. In this interview they discuss the challenges, results and success of the Wright Colloquium "The Art of Maths".**

**Was there any hesitation when the subject on maths was chosen?**

At the beginning of the discussions there was some initial internal hesitation regarding whether maths would be a subject which would generate enough interest, linked perhaps to the idea that there is a poor image of mathematics amongst the general public. The question was, for what reason should other subjects from previous years, such as gravity or gravitational waves, be more of interest to the general public than maths?

The success and results from this year's Colloquium leave no doubt about the choice of the subject and angle by which it was approached. "The Art of Maths" sparked curiosity from the beginning, starting with the image that was chosen to promote the event which broke away from other more traditional ways in which maths has been presented.

## *Challenges, results and success of The Wright Colloquium "The Art of Maths"*

### **Interview with Shaula Fiorelli & Elise Raphael**



*Shaula Fiorelli (SwissMAP Outreach Officer)*

Not only did the event succeed to attract and engage the general public with almost 400 people from different locations connected every evening, and actively participating by asking questions, but it also brought mathematics and researchers closer to the general public. Speakers

**"When I see the reaction of everybody around me when I say that I am a mathematician, either people tell me they loved maths when they were young or they say they hated maths. There is no in-between, it's either one or the other."**  
**LAURE SAINT-RAYMOND**

included ETIENNE GHYS (CNRS ENS Lyon and Académie des Sciences Paris), LAURE SAINT-RAYMOND (École normale supérieure in Lyon), MARTIN HAIRER (Imperial College London), ALAIN CONNES (Collège de France, Institut des hautes études scientifiques at the University of Paris-Saclay and Ohio State University, Columbus) and STANISLAV SMIRNOV (University of Geneva). Each of them exposed the subject under a different light.

**Can you tell us about the criteria for choosing the speakers?**

We were not directly involved in the process of choosing the speakers, but choosing the right speakers who were able to bridge their research to

the general public was an important task for the organizers. We believe the selection criteria were first, to be very well known in the field and second, to be able to speak to the general public about their research. All of the chosen speakers are outstanding internationally renowned researchers but what is also interesting about them is that they are all involved in the popularization of mathematics and reach out to different segments of the general public through different ways.

**"Obviously Jean-Pierre was a great source of influence on me when I studied in Geneva. I think I learnt a lot from him and his approach, his way of looking at mathematics and the fact that he considered it as a game and not as a science."**  
**MARTIN HAIRER**

As an example, just after receiving his Fields Medal in 2010, our Director Stanislav Smirnov, was very committed to promoting mathematics amongst secondary school children,

visiting schools and giving a series of conferences. Another different example would be Etienne Ghys who is also widely known for addressing the general public through conferences and also through the web. For example, amongst others, the online series of films "Dimension".

**You were both present every evening as the public talk's Q&A session moderators. As this year the event was online this session had a special and valuable significance as it was the only real connection between the audience and the speaker. Could you tell us about the difficulties you encountered?**

Running a virtual Q&A session is very different from a live session where people just raise their hands. It is actually a very intense job and not an easy task. It involved firstly going through and reviewing the list of questions, there was an average of around 20 questions per talk, that came in continuously throughout the talk, and at the same time remaining concentrated on the content of the talk as the chosen questions needed to be appropriate and in line with the content. The questions also had to be articulate and timekeeping reasons it was important to make sure that the

event moved forward and did not get stuck on certain questions.

Having journalists present during the discussions was very helpful. Scientists need to be directed and being asked a precise question provided a common thread and also helped to keep the answers short and understandable.

**What were your favourite moments of the conference?**

**Shaula:** Perhaps the discussion with Alain Connes after his talk "The music of shapes". Especially the way he provided simple explanations on such an incredibly broad range of subjects, with his very calm and pleasant voice.

**Elise:** Indeed, I enjoyed the debate with Alain Connes a lot! He is a very

**"The kind of maths you do at a secondary level is just the basics. You learn methods of calculating and of thinking, but you don't really grasp what it actually means. You don't grasp mathematics as a language. For me, it is an art and it should be presented that way."**  
**LAURE SAINT-RAYMOND**



*Elise Raphael (SwissMAP Science Officer)*

articulate speaker, and I found myself wanting to listen to his answers more than participating...

However, my favourite evening was Laure Saint-Raymond's talk "Disorder, chance and large numbers". I found it was a very lively talk and the debate between her and Hugo Duminil Copin (University of Geneva), was also extremely interesting. They both have a very hands-on approach. It was also the topic which made it very understandable as you can start from very concrete examples. The

discussion after the talk was also particularly interesting, when she talked about the need for creativity to be a researcher. I'm also glad she got to talk about popularization in mathematics, and how different it is from research.

**Shaula:** Another favourite moment was when the question for Martin Hairer came up about what he had been most influenced by and who had most inspired him when he studied mathematics in Geneva. Martin Hairer's provided a very touching answer in which he expressed that he had been most influenced by Jean-Pierre Eckmann (University of Geneva). What was great was that as Jean-Pierre was also there he was able to reply and they shared a special moment between advisor and his former student with the audience.

**Elise:** Yes! And also the moment Jean-Pierre presented Martin Hairer: he did not stop at the Fields Medal or other outstanding prizes but centred his presentation on Hairer's childhood. Jean-Pierre knows Martin Hairer's father, who also taught at Geneva. He showed pictures and made us laugh.

**Shaula:** It was a special moment, it was as if he brought "a real man" to the public and not only the mathematician.

### Can you speak to us about the participants?

The Wright Colloquium has traditionally always attracted a wide spectrum of participants of all ages from the general public. Starting with its sound and light show as well as the workshops aimed at a younger public, both unfortunately postponed this year due to the pandemic. The public talks on the other hand have always brought in people who already have an interest in science.

As the format of the talks this year had to be re-adapted and moved online, the direct contact with the public was lost and it is therefore difficult to evaluate their background. However, based on the type of questions received from the public during the talks, they were mainly people who were interested in science but not necessarily mathematicians.

There was a very peculiar *ambiance* in the nearly empty conference room, particularly during the debates where the people present sat in a circle and there was an armchair with the screen showing the speaker.

Despite the void created by the absence of the clapping at the end of each talk and the valuable networking moments, the conditions this

"Thank you... The talks this year helped us to discover and link between several fields in mathematics and their exciting and promising future."

"Thank you for this week's online presentation. I probably would not have been able to go to Geneva every evening."

### Anonymous participants

year also gave way to new possibilities. Firstly, expanding the audience, participants throughout Switzerland were registered as well as participants from other European countries. Secondly, the ability to extend the life of the event as the Public Talks and the Exhibition remain online. Only nine days after the Public Talks, one of the videos approached 4'000 views! The Feedback from the public has been great. They said they loved it!

Elise was also contacted by people who said they had attended the Wright Colloquium this year after having listened to her on the RTS Radio programme "Les Dicodeurs" the week prior to the event.

**Elise:** I'm glad I got the opportunity to present the Wright Colloquium on the RTS via "Les Dicodeurs": it was a lot of fun and, I realized later, a great way to reach people that would never have been to the Colloquium otherwise. It was also very nice, albeit quite stressful, to present Alain Connes and "sit with him" for the discussion on the day of his colloquium. To prepare for it I read some of his books and articles, which is something I probably wouldn't have had the occasion or time to do otherwise.



During the debates, there was an armchair with the screen showing the speaker.

### What about the Exhibition?

When the idea of an exhibition was first discussed, there was an initial debate on whether it should be art in maths, maths in art, math that is using art, beautiful maths images...

When the name "Beautiful Maths" was decided upon, finding beautiful images was not such a difficult task as there are plenty in mathematics! More challenging was to get the researchers who provided the images to write a concise explanation that would be "almost understandable" about the image.

The feedback from the online exhibition has again been positive in spite of the loss of direct contact with visitors. Between October and November, the exhibition webpage alone had already registered over 2'000 views. A school has also expressed interest in showing the exhibition in their school.

The aim was not only to present a beautiful image with an explanation but also to fully engage the visitors and to make them participate. The challenge then became to find a question for each of the posters which would be at the same time interesting and not too easy.

For those who have not yet visited the exhibition and are curious to discover the images, the explanations and the questions, are also now available in English online through the SwissMAP website. Also for information, and for those interested in art using maths, Mathscope has contributed to the University of Geneva's Campus Junior which proposed examples of outside sculptures in Geneva and Lausanne which were inspired by geometry or mathematical forms.

Why were the videos "Scientific experiments" created?



The image that was chosen for the event broke away from other more traditional ways in which maths has been presented.

In previous years, the University of Geneva's Scienoscope team has been there to welcome the audience before they enter the Wright Colloquium Public Talks. The idea being that each one of the Scopes presents their work to the general public attending the talks. As the conditions changed this year, it was decided to create the videos "Scientific Experiments" which would provide a small preview of the Scienoscope.

Mathscope created the video: "Can sound be seen? From a physical problem to a numerical method" the subject was inspired by Alain Connes' talk entitled "The music of shapes". The video tells us a story generated by the fascination of mathematicians for a physical discovery. In 1787, Ernst Chladni, a German musician and physicist, discovered that, when he rubbed the bow of his violin on a metal plate covered with sand, each different pitch that he managed to obtain revealed a new pattern. These are called the Chladni figures.

Attempting to reproduce these figures numerically, mathematicians have built a powerful numerical method used today to model complex situations.

### Videos

The videos from the Wright Colloquium talks will remain online and continue to bring awareness of mathematics and bring people closer to the subject. The videos are available in French and English through a dedicated playlist on the SwissMAP YouTube channel.

### Beautiful Maths Exhibition

The Beautiful Maths Exhibition is currently displayed from May 16<sup>th</sup> till July 30<sup>th</sup> in the DIVE into the infinite world of FRACTALS interactive exhibition for the construction of the first 3D fractal in Switzerland.

# Events

2021-22

## Online Events of 2021:

Due to the pandemic, most events have been transferred online or postponed to a later date. SwissMAP members continue to host a number of successful regular events online.

- Sustainable HEP Workshop (28-30 June 2021, CERN)
- Global Poisson Webinar (UNIGE)
- Ergodic Theory and Dynamical Systems Seminar (UZH)
- Talks in Mathematical Physics (ETHZ)
- QFT, Strings and Beyond (ETHZ)
- [K-OS] KNOT online seminar (CNRS, UNIGE)

20 - 22 January  
**Winter School in Mathematical Physics - 2021**

📍 *Les Diablerets*

The annual Winter School was offered as an online event this year and included a mini-course by Anton Alekseev (UNIGE) and Marcos Mariño (UNIGE).

16 May - 30 July  
**Exhibitions - DIVE into the infinite world of FRACTALS**

📍 *Geneva*

Participate in building the first ever Level 3 Menger Sponge in Switzerland! The interactive exhibition on fractals is opened to the general public and classes. Each visitor can build a cube and incorporate it into the largest fractal in Switzerland.

19 - 23 July  
**Summer School on Current Topics in Mathematical Physics**

📍 *Zurich*

This event is a satellite meeting of the International Congress of Mathematical Physics (ICMP) and will take place just ahead of the Young Researchers Symposium.

26 - 30 July  
**Gauge/Gravity Duality**

📍 *Geneva*

The conference was postponed from July 2020 to the summer of 2021. The aim of this event is to explore all aspects of gauge/gravity duality, both applied and theoretical, and to generate an extensive exchange of ideas.

12 - 15 September  
**SwissMAP Annual General Meeting**

📍 *Les Diablerets*

The program will include: The SwissMAP Innovator Prize ceremony; talks by the Innovator Prize winners, colloquia covering SwissMAP research directions, and talks by junior participants.

Jan - Mar

Apr - Jun

July

Aug - Dec

2022

25 - 26 May  
**NCCR SwissMAP Site Visit**

📍 *Geneva*

The next internal SwissMAP Site visit will take place online. As usual, this event will bring together the SNSF Review Panel members and SwissMAP Steering Committee and Project and Group Leaders.

12 - 16 July  
**Higher Structures in QFT and String Theory**

📍 *A Virtual Conference for Junior Researchers*

The conference aims at bringing together young people pursuing research at the intersection of theoretical and mathematical physics.

25 - 28 July  
**Topological phases of matter**

📍 *Leysin*

The event is a satellite meeting of the International Congress of Mathematical Physics (ICMP) and will take place just ahead of the Young Researchers Symposium.

29 - 30 Jul  
**Young Researchers Symposium (YRS)**

📍 *Geneva*

The YRS - Young Researchers Symposium will precede the ICMP 2021. It will include mini-course lectures and four thematic sessions.

02 - 07 Aug  
**International Congress of Mathematical Physics (ICMP)**

📍 *Geneva*

Geneva will be hosting the XX International Congress on Mathematical Physics. This event will gather world-class experts in the field. It is a major event, where new results and future challenges will be discussed, illustrating the richness and vitality of Mathematical Physics.

7 - 10 June 2022  
**Conference in honor of J.-P. Eckmann (UniGE)**

📍 *Geneva*

The conference was postponed to June 2022. This event will bring together students and close collaborators of Jean-Pierre Eckmann on the occasion of his 50 years at the University of Geneva.

For more detailed information please visit our Website:  
[https://www.nccr-swissmap.ch/  
news-and-events/events](https://www.nccr-swissmap.ch/news-and-events/events)

# Awards



## Anton Alekseev **2020 Medal of the Erwin Schrödinger Institute for Mathematics and Physics**

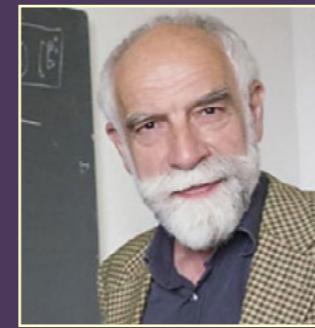
Congratulations to our deputy director Anton Alekseev (UNIGE) for receiving the Medal of the Erwin Schrödinger Institute for Mathematics and Physics for the year 2020.

He is honoured for his recent outstanding contributions to mathematics. His work unites brilliant intuition, deep knowledge, and remarkable technical skills.

## Jürg Fröhlich **International member of the National Academy of Sciences**

We are glad to announce that our member Jürg Fröhlich (ETH Zurich) has been elected as an international member of the National Academy of Sciences.

His colleagues in the United States invited him to join the fellowship in recognition of his significant contributions to science.



## Nina Holden **2021 New Frontiers in Mathematics Prize**

Congratulations to our member Nina Holden (ETH Zurich, W. Werner Group) who was awarded the 2021 Maryam Mirzakhani New Frontiers Prize.

She was awarded “for work in random geometry, particularly on Liouville Quantum Gravity as a scaling limit of random triangulations.”



## Ilya Losev **Edouard Gans 2020 Prize**

We are glad to announce that our SwissMAP Master Class in Mathematical Physics student, Ilya Losev, received the Edouard Gans 2020 Prize for his thesis: “On maximal subgroups and other aspects of branch groups” under the supervision of our director Stanislav Smirnov.

The prize is awarded by the UNIGE Faculty of Science. It rewards the best Master’s thesis in Mathematics of the year at the University of Geneva.

## Corinna Ulcigrai **Member of the Italian National Academy of Science**

Congratulations to our member Corinna Ulcigrai (UZH) who was elected as new member of the Italian National Academy of Science, the ‘Accademia Nazionale delle Scienze detta dei XL’.

Founded in 1782 it is one of the oldest Italian scientific institutions. The presentation of the new members elected in 2020 took place online in December, the assembly streamed online from the Academy home in Rome.



## Maryna Viazovska **2020 National Latsis Prize**

Congratulations to our member Maryna Viazovska (EPFL) for receiving the National Latsis Prize awarded to young researchers under the age of 40, for her ground-breaking mathematical problem solving. Maryna achieved a scientific breakthrough in solving the sphere-packing problem in 2016.

She has been a professor at the EPFL Lausanne since 2017 and is Chair of Number Theory. The prize was presented by Federal Councillor Guy Parmelin at an awards ceremony in Bern in November 2020.



# SwissMAP Awards

## Fiona Seibold and Pierrick Bousseau **SwissMAP Innovator Prize 2020**

Congratulations to our members Fiona Seibold and Pierrick Bousseau who have been awarded the 2020 SwissMAP Innovator Prize!

The SwissMAP Innovator Prize is awarded once a year to PhD students or Postdocs for important scientific achievements in the NCCR SwissMAP research areas.



## Nikita Nikolaev **SwissMAP PhD & Postdoc Video Competition**

Congratulations to Nikita Nikolaev (UNIGE – A. Alekseev’s Group) who is this year’s winner of the SwissMAP PhD & Postdoc Video Competition for his video: “How do you solve a really hard problem? With Perturbation Theory!”

The SwissMAP PhDs & Postdoc Video Competition aims to answer to non-specialist audiences, the question which is often asked “So, what’s your PhD or research about?”



# Grants

## Johannes Alt

### Marie Skłodowska-Curie Actions (MSCA)

Johannes Alt's (UNIGE, A. Knowles Group), project RanMatRanGraCircEl, was among the six UNIGE projects selected for European funding under the Marie Skłodowska-Curie Actions (MSCA).



The IFs are individual scholarships at postdoc level for experienced researchers who wish to develop their career prospects with research experience abroad.



## Juhan Aru

### SNSF Eccellenza Grant

The Swiss National Science Foundation has awarded our member Juhan Aru (EPFL) an Eccellenza Grant. His research lies mainly in probability theory, in the domain of random planar geometry.

The Swiss National Foundation's Eccellenza Professorial Fellowships and SNSF Eccellenza Grants are given each year to "highly qualified young researchers who aspire to a permanent professorship."

## Alba Grassi

### SNSF PRIMA grant

Congratulations to our member Alba Grassi (UNIGE & CERN) for receiving a PRIMA grant. Securing an SNSF PRIMA grant is an important step on the road to a professorship. The career development of our member Alba Grassi is testimony to this: she has been appointed professor.



"I found it very motivating and encouraging to see that there is a concrete willingness to support ideas and projects conceived by women."



## Nikolai Leopold

### Marie Skłodowska-Curie Individual Fellowship

Congratulations to our postdoc member Nikolai Leopold (University of Basel, C. Saffirio's Group) who has been awarded the Marie Skłodowska-Curie Individual Fellowship under Horizon 2020.

The Marie Skłodowska-Curie actions support researchers at all stages of their careers, regardless of age and nationality.

# New Members



Alba Grassi  
UNIGE & CERN



We would like to welcome Prof. Alba Grassi (UNIGE & CERN) as SwissMAP member. She will be joining our String Theory, Field Theory and Geometry, Topology and Physics research projects.

Alba was already a SwissMAP member until 2015, when she completed her PhD Thesis under the supervision of Marcos Mariño at UNIGE. Prior to that, she completed her Master's in Physics at ETH Zurich under the supervision of our member Matthias Gaberdiel.

She received a PRIMA grant and was appointed professor in early 2020. In November of the same year, she took up a joint position between CERN and the University of Geneva. Her research interests are string theory, quantum field theory, mathematical physics.

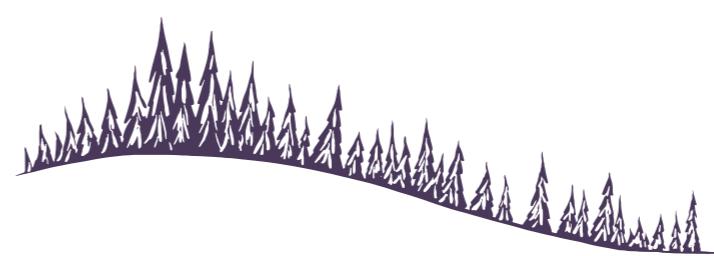
Beatriz Navarro  
UNIGE



We would like to welcome Beatriz Navarro (UNIGE) as our new SwissMAP Science Writer. Beatriz worked on the SwissMAP Annual Report.

Beatriz started her PhD in Toronto, during which she also taught mathematics in different capacities: as a teaching assistant, lecturer and course coordinator. During this time, she actively participated in teaching innovation. She has also worked training teaching assistants on topics related to providing formative feedback and teaching mathematical writing.

She received the SwissMAP Equal Opportunities Mobility Grant in 2018 and won 2<sup>nd</sup> prize of the SwissMAP PhD & Postdoc Video Competition 2020 for her video: Random Walks.



# Puzzle Corner

## 1. A little game among students

Olga, Lucia and Vladimir are facing a board on which they can read these five numbers:

4 – 11 – 15 – 18 – 25

This inspires Olga to play a little game. She chooses two numbers and calculates the difference and the sum. She writes these two new numbers on two pieces of paper and gives the one with the difference to Vladimir and the one with the sum to Lucy. Then she mischievously asks, “What are the two numbers I chose?”

“I can’t say” Vladimir quickly replies.

“Neither can I!” replies Lucy, “But since Vladimir can’t answer, I found your two numbers, dear Olga!”

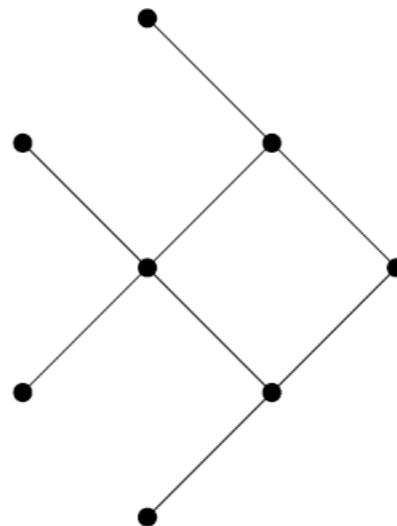
What numbers did Olga choose?

## 2. Arithmetic progressions

Is it possible to split the set of nonnegative integers into a disjoint union of at least two but finitely many arithmetic progressions with pairwise distinct differences?

## 3. A swimming fish

Turn the fish to swim left by moving only 3 sticks.



## 4. Mathematical gibberish

If STCDIKJTUACBMNEGFIHITUACBMN EGFRSACB LMUVFGIKJTUU-WVACBEGFBC means “Mathematics are beautiful”, which mathematical quote by Guillermo Moreno is hidden behind the following sentence?

STPQUWVOQPRSGH, STACB NOEGFMN, LMLMIKJWX EGFBC NOWXO-QPNOKL YAZBC RSIKJEGFIHITU STNOOQPIKJTUCDACP.

# Answers

## 1. A little game among students

Olga chose the numbers 11 and 18.

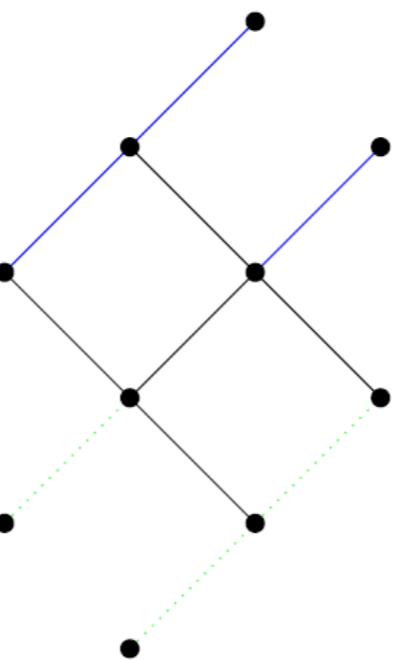
Let's calculate all the differences and sums of two numbers.

	11		15		18		25	
	-	+	-	+	-	+	-	+
4	7	15	11	19	14	22	21	29
11			4	26	7	29	14	36
15					3	33	10	40
18							7	43

Vladimir cannot guess what the original numbers are, because he has only received the difference between them, i.e. 7. 7 is the difference not only between 11 and 18, but also between 11 and 4 and between 25 and 18.

Lucy, on the other hand, received the sum of these numbers, i.e. 29. But 29 is the sum of 4 and 25 as well as 11 and 18. So she cannot determine which numbers Olga has chosen. But she learns from Vladimir that he too cannot give the two initial numbers. This allows her to deduce that Olga did not choose 25 and 4, which would have allowed Vladimir to find the two numbers, and that the two selected numbers are 18 and 11.

## 3. A swimming fish



## 2. Arithmetic progressions

*Solution.* No. Suppose such arithmetic progressions  $P_1, \dots, P_s$  exist. Let  $a_i$  and  $d_i$  denote the initial term and difference of  $P_i$ . Then

$$\sum_{m \in P_i} x^m = x^{a_i} + x^{a_i+d_i} + x^{a_i+2d_i} + \dots = x^{a_i}(1 + x^{d_i} + x^{2d_i} + \dots) = \frac{x^{a_i}}{1 - x^{d_i}}.$$

The assumption implies that if we add these sums for  $i = 1, \dots, s$ , we obtain the formal power series

$$1 + x + x^2 + \dots = \frac{1}{1 - x}.$$

Therefore

$$\frac{x^{a_1}}{1 - x^{d_1}} + \dots + \frac{x^{a_s}}{1 - x^{d_s}} = \frac{1}{1 - x}. \quad (1)$$

Without loss of generality  $d_s = \max(d_1, \dots, d_s)$ . Let  $\xi$  be a primitive  $d_s$ -th root of unity. Then  $\xi$  is not a  $d_i$ -th root of unity for any  $i \neq s$ . Let  $x \rightarrow \xi$  in (1) to obtain a contradiction.

## 4. Mathematical gibberish

Let us have a look at the example sentence. In red appear the letters that are actually important.

STCDIKJTUACBMNEGFI TUACBMN EGFRSACB LMUWVFGIKJTUU-  
WVACBEGFBC

We first notice that the order of the words is maintained, but each word is written backwards. If we flip them, we can see that each vowel is preceded by the two letters coming directly after it in the alphabet, while each consonant only has its immediate successor placed in front of it.

BCASRFGE

In order to fully decode the proverb, one should then start from the very first letter of the first word and if it's a vowel, erase the two letters after it, if it's a consonant erase just one. Keep going this way through each word, then flip them and you should be able to read:  
“Groups, as men, will be known by their actions.”

### Puzzle contributors:

- No 1, 4: MathsScope & RTSdécouverte | Monthly maths problem | [https://scienroscope.unige.ch/mathsscope/](https://scienoscope.unige.ch/mathsscope/)
- No 2, 3: ETH Math Youth Academy | <https://people.math.ethz.ch/~kslavov/>

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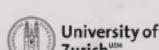
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Cover photo: Maria Kondratieva, *Les Diablerets*



Leading House



Co-leading House



SWISS NATIONAL SCIENCE FOUNDATION

The National Centres of Competence in Research (NCCR) are a research instrument of the Swiss National Science Foundation.