SwissMAP
The Mathematics of Physics
National Centre of Competence in Research

SwissMAP Perspectives

Final Issue 11 | 2026

Contents

A Final Word...

This final issue of SwissMAP Perspectives marks the conclusion of more than a decade of NCCR SwissMAP. We thank all those who have contributed to the programme and to this journal over the years.

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The final issue of SwissMAP Perspectives

With this final issue of SwissMAP Perspectives, we mark the conclusion of the NCCR SwissMAP after more than a decade of activity at the interface of mathematics and theoretical physics. As a Swiss National Centre of Competence in Research, SwissMAP was created to advance research in this area, foster collaboration across institutions, and build a coherent national community with a strong international dimension.

Funded by the Swiss National Science Foundation (SNSF), the NCCR SwissMAP was hosted by its leading house, the University of Geneva, and its co-leading house, ETH Zurich. The network included the University of Basel, the University of Bern, CERN, EPFL, the University of Fribourg, and the University of Zurich, mobilising a community of around 650 researchers.

The scientific strength of the consortium was reflected, among other things, in the distinction of several of its members with the Fields Medal. During the lifetime of the programme, three consortium members received the award: Alessio Figalli (ETH Zurich) in 2018, and Hugo Duminil-Copin (UNIGE) and Maryna Viazovska (EPFL) in 2022. Together with Wendelin Werner (ETH Zurich, 2006), Stanislav Smirnov (UNIGE, 2010), Artur Avila (UZH, 2014), and Martin Hairer (EPFL, 2014), this brings the total number of Fields Medallists within the SwissMAP consortium to seven. SwissMAP's international role was also illustrated by the organisation of the International Congress on Mathematical Physics (ICMP) in 2021.

That same year, the SwissMAP Research Station (SRS) was inaugurated in Les Diablerets as a joint initiative of ETH Zurich and the University of Geneva. Designed as a permanent structure, it hosts international topical conferences and targeted workshops in mathematics and theoretical physics, providing a dedicated environment for sustained scientific interaction. It will provide a lasting framework through which part of SwissMAP's scientific activity will continue beyond the NCCR phase.

The development of the next generation has also been central to SwissMAP. The long-standing Winter School in Mathematical Physics has served as a regular meeting point for the community across institutions and career stages. It will remain at the SwissMAP Research Station, while the Mathematical Physics Summer School (MAPSS), introduced after the creation of the Station, will also continue to offer Master's-level participants and beginning PhD candidates introductory lectures on different aspects of mathematical physics.

As part of this commitment, the SwissMAP Innovator Prize was established to recognise outstanding PhD students and postdoctoral researchers within the network. Awarded to 19 members over the years, the prize is revisited in this final issue through updates on some of its former recipients and the paths their research has taken. In 2024, it was replaced by the SwissMAP Junior Researcher Prize, which will continue to recognise early-career researchers in the same spirit, with the support of G-Research.

Alongside research and advanced training, outreach also formed part of SwissMAP's broader mission. Over the years, the programme supported a range of initiatives aimed at younger audiences and the wider public. Several of these structures will continue beyond the NCCR, including Genève Évasions Mathématiques (G·EM) and Mathscope in Geneva, as well as the Junior Euler Society and ETH Math Youth Academy in Zurich. Their impact is already visible, both in the number of participants reached and in the trajectories of former participants. This issue highlights two examples, one from Zurich and one from Geneva.

The conclusion of the NCCR SwissMAP therefore marks a transition rather than an end. Over the years, and thanks to the long-term support of the SNSF, the commitment of the partner institutions, and the engagement of many colleagues, SwissMAP has helped build a strong scientific community and lasting collaborations across institutions and generations. It has also created an ecosystem that supports the development of future generations at different stages, from school students encountering mathematics beyond the standard curriculum to Master's students, PhD candidates, and early-career researchers entering the field. Through the SwissMAP Research Station and the structures that will continue, this community will keep meeting, exchanging, and developing new ideas in the years to come.

Matthias Gaberdiel (ETH Zurich)
Co-Director of SwissMAP

A conversation with

Stanislav Smirnov & Matthias Gaberdiel

Stanislav Smirnov is a full professor of mathematics at the University of Geneva and director of SwissMAP. He was awarded the Fields Medal in 2010. His research focuses on the fields of complex analysis, dynamical systems and probability theory.

Matthias Gaberdiel is a full professor at ETH Zurich and co-director of SwissMAP. His work focuses on higher-spin theory and conformal field theory, mainly on the duality between higher spin theories on AdS and dual conformal field theories.

Looking back on SwissMAP

What scientific gap was SwissMAP designed to address?

Stanislav: *I wouldn't say that there was a scientific gap. Switzerland was historically already very strong in mathematical physics. As people often joke, we even chose not to hire Einstein at one of our universities, though he got the job eventually.*

The idea was that we wanted to create more interactions between all the assets we have in Switzerland and make them even better than they already were. And I believe it worked. We also wanted to make a point. Before SwissMAP, all NCCRs were in experimental science. We wanted to show that theoretical and fundamental science are also important.

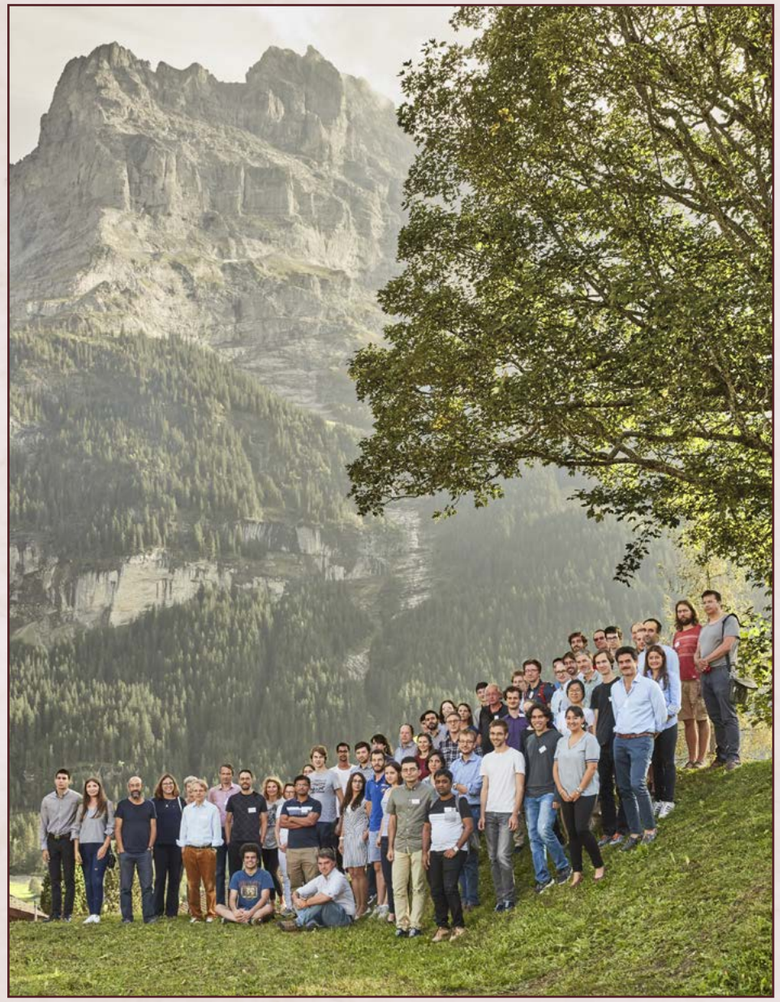
Matthias: *It is not that there weren't any interesting scientific problems. There were, and we have made progress with them. But there wasn't a specific scientific problem that drove the setup of SwissMAP. As Stas correctly says, it was more about bringing strong individual groups closer together and establishing deeper connections between Geneva, Zurich, Lausanne, Bern, CERN, etc. I believe it has worked very well and it has also strengthened the individual groups. For example, there was virtually no string theory in Lausanne before SwissMAP, and now there is a very strong group. Other fields have also been strengthened similarly.*

Why was a national, structured programme necessary at that time?

Stanislav: *To reinforce connections between different places, and this actually worked quite well. We interact more between different places, different universities and different scientific subjects, even physics and mathematics. And that has already improved the science we do here in Switzerland.*

But I also think it is important to improve the public perception of fundamental and theoretical science. Nowadays, the government and public opinion favour science that has immediate applications over fundamental science. But most cornerstones of modern society – from electric appliances to airplanes or mobile phones actually came out of fundamental science. We would not have these things without it — everything from electricity to semiconductors.

Matthias: *We brought scientific entities together, and that is important progress. But I also believe we have*



been very successful in our outreach activities. We have made important progress in motivating a generation of highschool students and even younger school children to go into Mathematics and Physics. I think this is one of the most important legacies of the NCCR.

Of course, we have also done very good research. After all, I am first and foremost a researcher. But I think it is very important that we have motivated the next generation to be interested in scientific problems.

Stanislav: *I think that if a person goes into practical research, it is very good to first have experience in fundamental science. Fundamental research is basically like sailing in the deep sea — you're not just going in one direction; you can go in any and all directions. It opens your mind, and when you do practical things, it allows you to explore more avenues. Louis Pasteur, for example, is mostly famous for pasteurisation, which is a very practical answer to a very practical problem. It helps us combat hunger by preserving food for longer. But Pasteur's original research in molecular asymmetry, which made him famous, was purely theoretical. He was doing this type of open research, and I think it helped him later when he went on to do practical things. I think it is very important to keep fundamental and theoretical sciences alive.*

Matthias: *Another example, since Stas mentioned Einstein earlier, is GPS. GPS is partially based on General Relativity, which was developed by Einstein in the 1910s. At that time, General Relativity did not have any practical applications, and it was unclear whether and how it would ever lead to one. Yet, 80 years down the line, General Relativity is an important ingredient for making something work that we all use every day. It is difficult to imagine life without GPS now.*

I think it is therefore important to educate young people broadly, and to encourage them to pursue directions that are not directly motivated by applications. After all, we never really know what will become important in the future, and the true revolutions have always been unexpected. For example, many of our former students and postdocs are now being hired by AI companies, and I am sure they will play an important role in developing and shaping this critical technology in the future.

What has SwissMAP enabled scientifically?

Stanislav: *Many things. It is not easy to name just one. My work touches upon several areas of SwissMAP, but the one I focus on most is statistical mechanics. And we have achieved a great deal in the last twelve years in this field. There are at least a dozen professors and several dozen students and postdocs who contribute a lot to the field. For example, conformal invariance in 2D statistical mechanics in relation to CFTs, with important contributions by people like Hugo Duminil-Copin at UNIGE, Wendelin Werner at ETHZ, and also Clément Hongler and Juhan Aru at EPFL, and many more.The interaction between people from different universities has contributed to making these groups so*

strong. We have, for example, a yearly meeting with about 30 students and postdocs, which creates a very fruitful atmosphere.

I believe that, in more or less all areas, we have achieved some spectacular things.

***Matthias:** I can also talk more about my specific area (string theory). I believe we have made a lot of progress in various directions: for example, with deriving AdS/CFT, understanding quantum chaos, the theory of resurgence and its many applications, with string theory in de Sitter backgrounds (that are closer to our real world), etc.*

I think it would be fair to say that, while there were already strong individual groups in string theory before the beginning of the NCCR, we are now one of the strongest countries in Europe in this field. For example, if you look at the speaker lists of the yearly international Strings meetings, there has been a very strong Swiss representation over the years, and it is clear that our community now has a very high international visibility.

What remains structurally missing in the math–physics ecosystem?

***Stanislav:** Well, of course, nothing is perfect, and there is always room to improve. One thing that would certainly be good is to bring experimental and theoretical physicists closer together with mathematicians. They were certainly much closer 100 years ago. I actually discovered a few years back that we already had SwissMAP in the 1930s. Throughout the years before the war, there was a series of 16 workshops here in Geneva on a wide range of topics. There was logic and the history of mathematics, but also workshops on quantum theory and electrons in metals. And this was all organised by the mathematics department. At the same seminar, we had Kolmogorov speaking about the foundations of probability and Heisenberg speaking about its applications in quantum mechanics.*

And we are losing this interconnection. It is partially understandable, as science has become so big and complicated that there are no true polymaths anymore. Today, there are several different kinds of mathematical physicists. Some do more mathematics, others more theoretical physics, and some are closer to the experimental sciences. Maybe something should be done to bring these sciences closer, but I do not know a good way to fix it. It is not easy to communicate with people from other fields.

For example, I now successfully work with several biologists and neuroscientists, but it took me quite some time to find biologists with whom I could communicate in a way that allowed us both to understand each other. And it is even partially related to SwissMAP because I bring a combination of mathematics, physics and some machine learning to the project, while they bring biology and some physics. Although it was originally considered too far from SwissMAP, we persevered, and our paper ended up on the cover of Nature.

***Matthias:** One thing that we have not managed to achieve is to set up a joint Swiss-wide Master programme in Mathematical Physics. The idea was to combine the strengths of the various groups in Switzerland to create a broad and comprehensive curriculum of basic and advanced Master courses in Mathematics and Physics. In our modern times, with Zoom and other online solutions, it should be possible to create such a structure without much additional effort. But we encountered many administrative hurdles and obstacles from the universities, and unfortunately did not succeed in the end. I hope some informal arrangements will remain possible, but it would have been better to put this into a structural form that would have guaranteed its lasting success.*

***Stanislav:** I would add to this that universities also don't seem to understand two things. The first is that, to develop a good researcher, you should start working with them from the Bachelor's level. You should even start earlier because schoolchildren don't know what a scientist does. They don't know how interesting this job is, and they don't understand that you do not have to be Einstein to make an important contribution to physics. The second thing is that it is a very competitive environment, and in order to maintain Switzerland's leadership, we need to do something infrastructural at the national level.*

Interdisciplinarity (what worked, what didn't)?

***Stanislav:** If you take subcommunities within SwissMAP, such as mathematicians or theoretical physicists, there are already several disciplines within them. And this has certainly brought people together, and good things have come out of that. Actually, my work with biologists, which I mentioned earlier, was partly initiated thanks to SwissMAP. One of the biologists came to a popular talk I gave within the framework of SwissMAP, and he realised that what I was speaking about was something he had seen in living organisms. He came to me afterwards with some questions. Since then, we have written two beautiful papers and are currently writing the third one. But, interestingly, this is something that research agencies do not like, even if they say they are in favour of interdisciplinarity — not when it doesn't fit into their boxes of classification.*

> "We have made important progress in motivating a generation of highschool students and school children to go into Mathematics and Physics. I think this is one of the most important legacies of the NCCR. "
> — Matthias

***Matthias:** Yes, unfortunately, research agencies usually preach interdisciplinarity but also want to direct research — you have to tell them in advance what precisely you're going to do. And, in a sense, this is somewhat contradictory. Because interdisciplinarity is about creating an environment where you interact with people you haven't interacted with before. But then you don't know what will and will not be relevant or important in the end. So, you need to create an environment where scientific interactions are encouraged, but you have to accept that you cannot make detailed predictions about when and how things will work out. Interdisciplinarity is therefore hard to measure — certainly just counting joint publications is doing it grave injustice. It is about creating a common community where you know people, can ask them questions informally and have a sense of what is happening in other scientific fields.*

***Stanislav:** Another advantage of having a programme like SwissMAP within an NCCR is that it is big enough to promote both things. Meaning, you have something to report to the research agency that they will like. But inside, you can also do more open-ended research. This type of research has been decreasing and worsening over the last 30 years. Maybe because it makes things easier for the agencies, or maybe for political reasons. But I believe this is a big mistake, especially for Switzerland. Switzerland was traditionally stronger in open-ended research, and it was one of the reasons why Switzerland was historically a very strong country in technology.*

***Matthias:** Absolutely. Switzerland has many resources, and one important one is human capital. We are an attractive place and we can attract very good people to come to Switzerland. But it is becoming harder to do so. Switzerland should try to continue to attract talent from abroad, educate them here, and make them like*

"Fundamental research is basically like sailing in the deep sea – you're not just going in one direction; you can go in any and all directions. It opens your mind."
— Stanislav

this country and stay — this is part of our success story. Some of my former students and postdocs who left the field have stayed in Switzerland. These are very talented people who probably would not have come to Switzerland otherwise.

We should, of course, also support Swiss-born and Swiss-raised kids, but we need to accept that everything is very international now.

***Stanislav:** There's globalisation, and not just in science but in everything. If you look at our department, we have Finns, Swedes, French, Italians, Russians... but similarly, there are Swiss people working in the US, in France... Science has become even more mixed. And we saw this in the example of the Master Classes that we organised. We were able to attract some very good Master's students from many different places, and then some of them stayed for their PhDs. So it was a great investment in attracting human capital.*

Which scientific needs make the SwissMAP Research Station a necessary permanent structure?

***Stanislav:** Well, we don't really have such a centre in Switzerland. I wouldn't count Ascona because it covers a wider scope, which makes it harder to make an impact. But centres such as ours have been established in other countries and have been very successful. There are several levels to what makes it successful. For example, I ran a conference for more than 20 years that brings together all postdocs and graduate students from Switzerland, but also nearby places like Grenoble, Lyon and Paris. And this is very good for networking and learning about new developments. Once in a while, we have a bigger conference that is more structured, and this brings foreign scientists to Switzerland and improves interaction on a more international level. The last time I attended it, the topic was mathematical biology. There were people from Korea, Israel and America. And now I will probably be starting two new projects thanks to the people I met there.*

I think there are two main reasons for such a structure. The first is for networking within Switzerland, as well as making new contacts with people from abroad.

The second is to maintain this interaction. We have become so much busier over the last 30 years because of the Internet. You would think that the Internet would free up your time because it is easier to communicate with others, but in reality it takes up a lot of your time. Before, there used to be five-week summer schools in Les Houches, a famous physics institute. Many professors and students would come for those five weeks, and I know some who would write three papers during that time. But now, there is no professor, and not even many students, who would go to a summer school for five weeks. We have to restructure this somehow. People have become too busy, and they live in these shorter time frames. We used to have the 3ème cycle, where many scientists would gather for one day in Lausanne. But now people in Lausanne have cancelled it because they were too busy. We also used to have a seminar where, once a week, all mathematicians in a certain field would meet in Bern. This seminar died out almost 20 years ago because people were too busy.

If we really want to talk in person, a week-long conference is still best adapted to modern times, and it does work. There is always time for discussions, but also outdoor activities, because in our line of work we need fresh air, which we do not get enough of in our offices.

***Matthias:** The first time I met Marcos Mariño was in 1994, when we were both PhD students attending the Summer School in Les Houches. There was already Internet back then, but it was slow and expensive, and people didn't interact much via it. But I became friends with many people in Les Houches, and these personal connections have proven very important and useful throughout my career. And the SRS, although obviously Les Diablerets has Internet now, is re-creating certain aspects of that earlier experience. It is quite remote, so you tend to stay for some time. And once you have answered your emails, etc. you go down to the bar and start chatting with people. There are also activities such as hikes that people do in small groups, and this creates important personal connections (just as it did in Les Houches back then).*

The other advantage of the SRS is that it opens up the opportunity to attract very good people from abroad to come to Switzerland. This helps our young students and researchers to be exposed to new ideas, to develop connections themselves, etc.

The meetings we have organized at the SRS have been very successful, and people have really enjoyed attending them. For example, I ran a Simons Collaboration meeting at the SRS a few years ago, and people still talk fondly about it now. At the same time, the SRS is also functioning as a center that connects the different Swiss nodes together --- many of my interactions with my Swiss colleagues have taken place in Les Diablerets.

The SRS is a very important infrastructure, and we should do whatever we can for it to continue to function successfully. I was actually astonished by how successful the SRS has become. When we started it, we aimed for six plus six events per year. But we were overwhelmed by the number of excellent proposals we received, and it is now hard to choose between them all. People clearly want to come, and the SRS is supporting activities and interactions that are not easy to reproduce in any other way. It has been a great success story that we must maintain!

Conversation with Stanislav Smirnov and Matthias Gaberdiel
Geneva/USA/Online

Interviewed by Maria Kondratieva
On behalf of NCCR SwissMAP

SwissMAP Innovator Prize

Past prize winners

Introduced in 2015, the SwissMAP Innovator Prize recognised outstanding PhD students and postdoctoral researchers within the network.

Awarded annually during the SwissMAP General Meeting, it highlighted important scientific achievements in mathematics and theoretical physics, while also reflecting SwissMAP's commitment to balanced representation among its laureates.

Over the years, the prize was awarded to 19 early-career researchers. In the pages that follow, we revisit some of the past prize winners and share where their research and careers have taken them since receiving the award.

In 2024, the initiative evolved into the SwissMAP Junior Researcher Prize, supported by G-Research and carried forward by the SwissMAP Research Station. Now awarded during the SwissMAP Winter School in Les Diablerets, with a call opening in June and closing in September, this new format ensures that the recognition of early-career excellence continues beyond the conclusion of the NCCR SwissMAP programme.

2015 Winners

Alba Grassi
(formerly a member of M. Mariño's Group at UNIGE)

Joint faculty position between the theory department at CERN and the section of Mathematics at the University of Geneva. Her research lies at the interface of mathematics and theoretical physics, with a focus on quantum field theory and string theory, and their connections to spectral theory, integrable systems, and geometry.

Vincent Tassion
(formerly a member of H. Duminil-Copin's Group at UNIGE)

Associate Professor at ETH Zürich. His research focuses on probability theory and mathematical physics, more specifically on questions related to percolation theory.

2016 Winners

Emily Clader
(formerly a member of R. Pandharipande's Group at ETH Zurich)

Associate Professor of Mathematics at San Francisco State University. Her research focus is algebraic geometry and combinatorics, especially as they relate to moduli spaces of curves.

Angnis Schmidt-May
(formerly a member of N. Beisert's Group at ETH Zurich)

Leads the Data Science section at the Uppsala Monitoring Centre, a non-profit organization coordinating the WHO Programme for International Drug Monitoring. Her team works at the intersection of research and technology, enabling the safer use of medicines and vaccines worldwide.

2017 Winners

Wei Qian
(formerly a member of W. Werner's Group at ETH Zurich)

Associate Professor at the University of Hong Kong. Her research lies in random geometry, a field of probability theory inspired by questions in statistical mechanics.

Florian Naef
(formerly a member of A. Alekseev's Group at UNIGE)

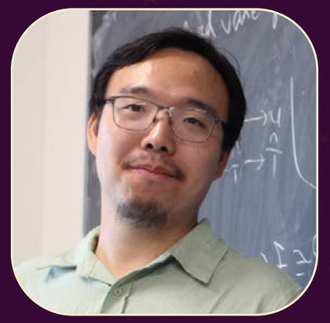
Assistant Professor at Trinity College Dublin. His research has recently shifted towards topology, while remaining much connected to the work he did with Anton, Nariya and Yusuke towards the end of his PhD.

2018 Winners

Yilin Wang
(formerly a member of W. Werner's Group at ETH Zurich)

Associate Professor of Mathematics at ETH Zurich. Her research focuses on probability theory of random curves and random surfaces, complex analysis and hyperbolic geometry.

Junliang Shen
(formerly a member of R. Pandharipande's Group at ETH Zurich)



Associate Professor in the Section of Mathematics at Yale University. His research concerns algebraic geometry and moduli spaces.

2019 Winners

Nina Holden

(formerly a member of W. Werner's Group at ETH Zurich)

Professor of Mathematics at the Courant Institute, New York University. Her research is in probability theory and mathematical physics.

2020 Winners

Fiona Seibold

(formerly a member of N. Beisert's Group at ETH Zurich)

SNSF Ambizione Fellow at EPFL. Her research focuses on integrable models, string theory, and the holographic correspondence.

2021 Winners

Arthur Jacot

(formerly a member of C. Hongler's Group at EPFL)

Assistant Professor at the Courant Institute of the New York University. His research focuses on Theory of Deep Learning, trying to prove Deep Neural Networks' ability to find the simplest programs that fit the data.

2022 Winners

Barbara Dembin

(formerly a member of V. Tassion's Group at ETH Zurich)

CNRS researcher at the Université de Strasbourg. Her research focuses on percolation and first-passage percolation models.

2023 Winners

Adrián Sánchez Garrido

(formerly a member of J. Sonner's Group at UNIGE)

Completing a postdoctoral position at the University of Southampton and will move in October to the Vrije Universiteit Brussel (VUB) for a further postdoctoral appointment. His research focuses on the quantum properties of gravity in the context of gauge/gravity duality, with particular emphasis on low-dimensional models, quantum chaos, Krylov complexity, and conformal field theory.

Olga Trapeznikova

(formerly a member of A. Szenes' Group at UNIGE)

Postdoctoral researcher in the Hausel group at the Institute of Science and Technology Austria (ISTA), funded by an FWF ESPRIT grant. Her research focuses on the enumerative geometry of moduli spaces.

Lorenz Eberhardt

(formerly a member of M. Gaberdiel's Group at ETH Zurich)

Assistant Professor at the University of Amsterdam. His research focuses on string theory and mathematical physics.

Pierrick Bousseau

(formerly a member of R. Pandharipande's Group at ETH Zurich)

Associate Professor at the Mathematical Institute at the University of Oxford. His research focuses on algebraic geometry, with particular emphasis on enumerative geometry.

Maria Yakerson

(formerly a member of R. Pandharipande's Group at ETH Zurich)

CNRS researcher at Sorbonne University. Her research combines algebraic geometry and homotopy theory, with further interests in algebraic K-theory and motivic cohomology of singular schemes.

Tomas Reis

(formerly a member of M. Mariño's Group at UNIGE)

Research Fellow at the CERN Theory Department (TH). His research focuses on resurgence, non-perturbative effects and integrable quantum field theory, and more recently on problems in low dimensional holography and conformal field theory.

Dmitrii Krachun

(formerly a member of S. Smirnov's Group at UNIGE)

Instructor of Mathematics at Princeton University. His research spans probability, statistical mechanics, theoretical computer science and, more recently, cryptography.

Conversation with past SwissMAP Innovator Prize winners
Online

Contacted by Mayra Lirot
NCCR SwissMAP

Looking back at the Winter School

A conversation with

Anton Alekseev

Anton Alekseev is a professor of mathematics at the University of Geneva. Since 2014, he has been the Deputy Director of SwissMAP funded by the Swiss National Science Foundation and Co-Director of the SwissMAP Research Station (SRS) since 2021.

His research interests include Symplectic geometry, Moment theory and Mathematical physics. In this interview we discuss the Winter School which is now anchored within the permanent structure of the SwissMAP Research Station.

The Winter School predates the NCCR SwissMAP. What was its original purpose, and how has its role evolved over time within the SwissMAP community?

The purpose of the Winter School is to bring together young researchers and leading experts in mathematics-related fields. Over the years, the format has varied somewhat. At different times there were four mini-courses, sometimes even five, whereas today there are usually three. At the Winter School, one can learn a little bit about a topic. The mini-course serves as an introduction. We ask lecturers to make the beginning of their courses accessible, although of course this works better in some cases than in others. And then towards the end of the mini-course, the material usually progresses more steeply towards the frontline of research.

The goal is for participants to understand the basics of a field, to see how it connects to their own interests, and ultimately to become aware of current research questions. This broadens the horizons of both participants and organizers. There are also senior researchers who attend regularly because they are interested in discovering the topics of the next edition. And these vary from year to year. Typically, there are two topics that are more mathematical and one that is closer to physics, but its always between mathematics and physics.

Another important purpose is to create opportunities for young researchers to meet one another and to interact with leading figures in their fields. Senior researchers also benefit by connecting with younger generations. In that sense, the original purpose has remained largely unchanged. What changed with SwissMAP is that the Winter School acquired a broader audience. In the beginning it was more restricted to Geneva and Zurich because few people knew about it. With SwissMAP it became more widely known within Switzerland but also abroad because of increased visibility. Today we have many international participants, and some return several years in a row. The Winter School has become an international event while maintaining a strong anchor in Switzerland.

The goal is for participants to understand the basics of a field, to see how it connects to their own interests, and ultimately to become aware of current research questions.

What advantages does the SwissMAP Research Station provide for this type of scientific event, compared to a university-based setting?

The answer is quite straightforward. In fact, the origins of the Research Station itself lie in the tradition of organizing scientific events away from the university environment. Already in the 1980s, Michel Kervaire, the famous Geneva mathematician, began organizing out-of-town events. Initially these were private initiatives, but they were later taken over by more formal structures, first the Troisième Cycle Romand, then the Department of Mathematics, and eventually SwissMAP.

The reason is that people are away from their usual environment, they spend much more time together. There are lectures and tutorials, of course, but participants also share meals, go hiking, and spend informal time together. Sometimes they simply get to know one another, and sometimes they discuss mathematics and physics.

This creates five days of continuous interaction, which is far more efficient than a standard event. The chances are much higher of discovering common interests and beginning new collaborations together. Sometimes these collaborations are not even directly related to the topic of the school. The topics of the school give you a framework of course, but sometimes collaborations emerge from entirely different discussions. The Winter School is a very efficient way of initiating scientific collaborations.

The Winter School at Les Diablerets in 2022. Credit: Julien Gaspoz Photographe

Over the years, have you observed concrete examples of collaborations or research directions that emerged from interactions at the Winter School?

It is difficult to provide statistics, but I can certainly think of individual examples. One of my recent PhD students, who defended his thesis last year, Valerian Montessuit, attended a Winter School with me. His thesis eventually focused on the topic of one of the mini-courses we attended together. That is probably the most recent example that comes to mind.

More generally, it is difficult to trace outcomes systematically because there are always many participants intensely interacting throughout the week. We never really kept a record of what collaborations emerged afterwards. And it would be difficult to do so. I remember one Winter School where there were two mini-courses devoted to the same topic, one in physics and the other one in mathematics. I cannot say whether specific research outcomes resulted directly from it, but I personally continued following that topic afterwards. Although I don't write papers in the area, I gained an understanding of it, which has been very valuable. I imagine that many participants have had similar experiences.

In the absence of the NCCR framework and the Annual General Meeting, what structural role does the Winter School now play in maintaining scientific coherence within the SwissMAP network?

That remains to be seen, but ideally the Winter School will continue to play a central role. Today the Winter School has considerable visibility and is specifically targeted towards young researchers. Together with the MAPSS Summer School, which is aimed more at Master's students and beginning PhD students, the Winter School provides a natural platform for young researchers working in

The Winter School at Les Diablerets in 2020. Credit: Julien Gaspoz Photographe

mathematics, physics and mathematical physics to meet one another. We hope it will continue fulfilling this role in the future. Its status as a highly visible event also increases its ability to attract a broad audience.

The partnership with G-Research has supported the continuation of the Winter School in recent years. How do you see the role of external partnerships in sustaining initiatives of this kind?

Of course, people sometimes have doubts about public-private collaborations, especially in a university context. But we know there are many successful international examples of this type. The most obvious example is the Simons Foundation in the United States, which supports mathematics and theoretical physics through grants, events, and has a big research institute in Stony Brook.

The collaboration with G-Research is obviously not on the same scale, but it follows a similar idea. G-Research operates in a field that relies heavily on human intelligence, and it believes in investing in fundamental research such as the SwissMAP Research Station and the Innovator Prize. I see this as a win–win situation. I do not think these collaborations are driven by commercial interests. Rather, they create connections with talented, curious, and highly trained people. Many young researchers remain in academia, but many others eventually move into industry. It is beneficial when they can find careers that make use of their intellectual abilities, and companies such as G-Research provide excellent opportunities for that.

For all these reasons, I regard this partnership as extremely positive. I also think the SwissMAP Research Station should remain open to similar collaborations in the future whenever the opportunity arises.

Now that the Winter School is anchored within the permanent structure of the SwissMAP Research Station, how do you see its scientific mission evolving in the coming years?

In many ways, the scientific mission remains essentially the same as it was before SwissMAP and should remain the same after SwissMAP. The Winter School continues to bring together a broad audience of young researchers and leading experts working in sub-fields between mathematics and physics. It allows scientific enthusiasm to be passed from one generation to the next, introduces young researchers to new fields, and helps them broaden their horizons. It also creates opportunities for participants from different institutions to meet their peers and potentially forming future collaborations.

At the same time, there may be new possibilities. SwissMAP has created a large and active scientific community, and it is conceivable that this community could influence the future direction of the Winter School.

Until now, decisions have largely been made by a relatively stable organizing committee. But this committee has stayed pretty much the same over the years. Now we have a much wider community that was formed during the SwissMAP years, and I would not exclude the possibility that this community may eventually contribute more actively to determining future themes and priorities. If that happens, the range of topics covered at the Winter School could become even more diverse and more reflective of the community as a whole. There may be opportunities to develop new mechanisms for identifying exciting emerging areas of research and to broaden the spectrum of topics represented. That is one possible way of capitalising on the experience and legacy of SwissMAP.


Anton Alekseev at the SwissMAP General Meeting in 2021. Credit: Julien Gaspoz Photographe

When people are away from their usual environment, they spend much more time together. The Winter School is a very efficient way of initiating scientific collaborations.

Conversation with Anton Alekseev
Geneva/Online

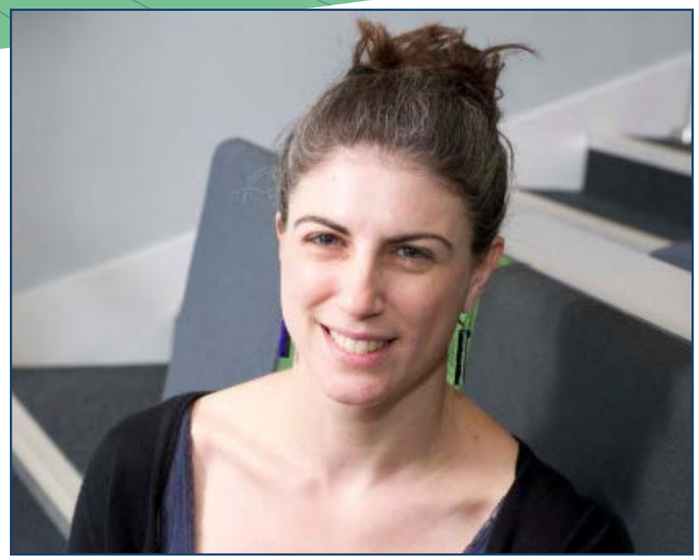
Interviewed by Maria Kondratieva
On behalf of NCCR SwissMAP

MAPSS

The Mathematical Physics Summer School for Master's students is organized by SwissMAP and offers introductory lectures to different aspects of mathematical physics.

We spoke with MAPSS co-organizer Elise Raphael about how the programme came to be and what the future holds. We also invited three former participants to reflect on their experience of the programme and the role it has played in their academic paths.

Elise Raphael



Elise Raphael (UNIGE) is the Science Officer of SwissMAP and the SwissMAP Research Station and co-organiser of the Mathematical Physics Summer School (MAPSS). She holds a PhD in mathematics and now combines her role supporting the research community with a strong commitment to mathematics outreach and communication.

How did MAPSS come to life? As SwissMAP reaches the end of its 12-year programme, what legacy do you hope it will carry forward, for the field and for the community?

Over the twelve years of SwissMAP, we developed several programmes for master's students, such as the three editions of the Master Classes: in Planar Statistical Physics (2015–2016), in Geometry, Topology and Physics (2016–2017) and more broadly in Mathematical Physics (2019–2020). These were very successful: several international students who took part in the master classes developed collaborations with researchers from the NCCR network. It also provided local students with courses by exceptional visitors and a glimpse into research-level topics at the interface of mathematics and physics.

As SwissMAP was coming to an end, we wanted to find a way to preserve that experience. Our tentative to develop a permanent Master's programme in mathematical physics in collaboration with another Swiss institution was not successful, and we turned to a summer school format: MAPSS was born. Every summer, for ten days at the SwissMAP Research Station, it offers students a unique environment for discovery and exchange in a compact format designed to foster scientific interaction.

I hope this is one of the legacies MAPSS will carry forward: keeping a space open for young students to discover the mathematical physics community, especially in Switzerland, and to start building connections that last well beyond the school itself. One of the strengths of SwissMAP has always been the sense of community it fostered, and I hope MAPSS helps keep that spirit alive.

What is the "SwissMAP signature" of MAPSS? In what way is it different from a more standard summer school in mathematical physics?

Is there such a thing as a standard summer school in mathematical physics? The location in the middle of the Alps, at the SRS, is definitely a signature of MAPSS. I believe it's important to host such a school in a place that welcomes research conferences, to show students that research is also about collaborating in this kind of magical setting. The format is the same as our other conferences or schools, meaning most afternoons are free until 4pm to give people time to discuss, work or get outside. One specificity of this school is our will to mix students coming from both physics and mathematics backgrounds and in priority from the different Swiss institutions. Since Switzerland doesn't have that many, it enables local students to meet their peers and the lecturers in an informal atmosphere.

But of course, if I had to choose one thing, it might be the fast becoming traditional excursion to Via ferrata des dames Anglaises... Some students will definitely agree.

Beyond content, what outcomes matter most to you for participants, stronger foundations, confidence, a shift in direction, a network, and how is the school designed to foster those?

I'm not sure the courses we provide are designed to strengthen foundations. It's more about discovering a research domain and sparking curiosity: what kind of objects are we working with? What kind of questions are people in this field interested in at the moment? Master's students may not have a clear direction in mind yet, so it's more about showing them what's out there, as well as showcasing problems under different lights, since we have both mathematicians and physicists teaching. A network, though, that's definitely something I'd like to give participants an opportunity to create. Ten days in the mountains living and working together tends to create proximity, and I think it's great to see some participants keeping in touch.

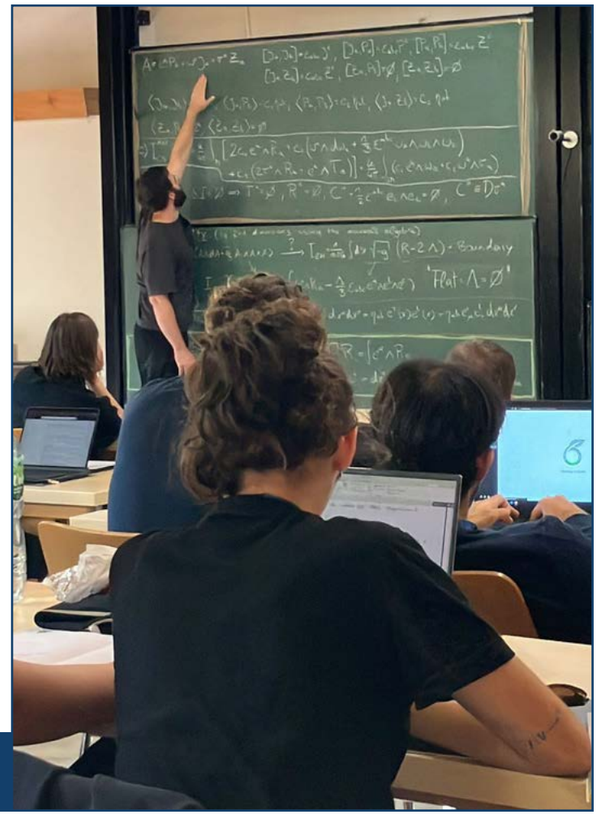
How do you choose the mini-courses and topics each year?

It's still a work in progress. We want to have young speakers, mostly post-doctoral students, who will be able to stay for most of the school in order to discuss with the participants as much as possible and create a real connection. Since the idea of the school is to propose introductions to different areas of mathematical physics, we try not to have courses that depend on each other, but sometimes some courses do provide a bit of background for other ones.

We discussed the idea of thematic years, but in the end decided it should remain an introduction to a rather vast array of topics. We also played a bit with the length of the courses and the school, and so far settled on the current format of ten days. We welcome feedback from all the students attending and try to get the perfect formula! This year, one of the topics was suggested by a former participant and Nikita Nikolaev (one of our co-organisers) rose to the occasion.

How do you see MAPSS evolving in the coming years?

I'm hoping that former students spread the word about MAPSS. I'd like to have a regular basis of students from Swiss Institutions: MAPSS should be known by students (either from older students talking about it or professors mentioning it) as a classic option for students in physics or mathematics to discover mathematical physics, or to meet with kindred spirits. As for any of our initiatives, it would be lovely to have some former participants coming back in a few years as lecturers!



Conversation with Elise Raphael
UNIGE, SwissMAP, SRS

Ophélie Rivière

Ophélie Rivière is currently pursuing a PhD in Mathematics at UCL. Her research lies at the interface of mathematics and physics, focusing on crystals and quasi-crystals with defects using tools from microlocal analysis and spectral theory. She is co-supervised by Jeffrey Galkowski and Leonid Parnovski.

What made you decide to come to MAPSS?

I attended MAPSS during the first year of my Master's in physics at ETH Zurich, at a point when I had already decided to pursue a PhD in mathematical physics. While my background was primarily in physics, I had taken courses in functional analysis and differential geometry to pivot toward a more mathematical path.

MAPSS felt like a great opportunity to deepen my mathematical perspective, meet people with similar interests, and seek advice from others who had navigated a similar transition. As I was preparing for a PhD, participating in a summer school also provided an early experience of the academic environment and community.

Did MAPSS broaden your research horizon, or confirm that you're on the right track? What's the clearest example?

MAPSS significantly broadened my perspective. In particular, I was introduced to areas such as symplectic geometry and gained a clearer view of the range of directions within mathematical physics.

Which lecture or topic challenged you the most (in a good way), and what do you want to understand better now?

I was especially intrigued by a lecture on resurgence given by Nikita Nikolaev. The topic was technically challenging but presented in an accessible way, and I later attended a mini-course he gave at the Winter School in mathematical physics.

What part of the school was most valuable for you, mini courses, problem sessions, or informal discussions, and why?

I found value in all aspects of the Summer School. Given the variety of topics and the limited time, it is difficult to engage deeply with every course. I found it most effective to be curious about all the mini-courses, focus more closely on selected problem sheets, and, most importantly, take the time to discuss mathematics, physics, and more with other participants and speakers.

These informal discussions were particularly valuable. They strengthened my understanding of the lectures and were highly motivating. On a more personal note, during the week at MAPSS, I formed a close friendship that has continued since.

Is there anything you think you did or will do differently because of MAPSS and where do you think it could show up (thesis, PhD work, reading group, collaboration)?

MAPSS consolidated my engagement with the mathematical physics community and provided a valuable first experience of a collaborative and friendly academic environment.

Tom Folgmann

Tom Folgmann is currently studying Mathematical Physics at Julius-Maximilians-Universität Würzburg and will begin his Master's thesis later this year. He expects to complete his degree in 2027 and plans to pursue a PhD in mathematical physics, with Switzerland among the options he is considering.

What made you decide to come to MAPSS?

Alright, that is a good question. And a very personal one. I was fairly new

in my master's program, and was just discovering the mathematics of differential geometry - before I had studied physics, so it was a very exciting time for me. I decided that I wanted to talk to different people in the field, and since I've had a special connection to Switzerland ever since I was a child, I thought that I should connect the two and come to MAPSS. In fact, my first attempt in coming to SwissMAP was for the 2024 Winter School in mathematical physics, but back then I had missed the deadline by a few days - so I made sure it would not happen with MAPSS25 again!

Did MAPSS broaden your research horizon, or confirm that you're on the right track? What's the clearest example?

Absolutely. A very reassuring thing for me to see was that so many interesting people were working actively in mathematical physics and were equally excited about it as me! You know, during your first years as a bachelor student you probably met a lot of people with a lot of different interests, with many of whom you might not feel much connection. But when I arrived at MAPSS, suddenly in one place so many different and yet similar people were available to talk to, and I could really feel that I was in the right place. I think that is the clearest example for me, that this was the right path.

Which lecture or topic challenged you the most (in a good way), and what do you want to understand better now?

Well, the most challenging for me was the change between a physics-oriented and a more mathematics-oriented way of thinking itself. But by summer when MAPSS started, I was already well prepared in different aspects of geometry, so most of the courses were managable for me to follow. For instance I remember Anton's talk on characteristic classes, since many techniques he introduced are now also part of my daily toolbox. A very surprising connection was introduced to me in Elise's talk - the multiple zeta values - which I had never heard of before in this context.

What part of the school was most valuable for you, mini courses, problem sessions, or informal discussions, and why?

For sure the informal parts of it. The value of all discussions one realizes only later, when suddenly you can pay a visit to new friends in Zurich because of them - no, but seriously, I think that these events are there for the people and the connections you can make with them. And the hikes of course, I mean, the research station is surrounded by beautiful and versatile nature, so you should definitely explore it - after class of course! :)

Is there anything you think you did or will do differently because of MAPSS and where do you think it could show up(thesis, PhD work, reading group, collaboration)?

MAPSS was the first research event I attended outside of my university. Ever since, I have been looking for these events and am planning to attend more in the future. In fact, the next event I attended was again a SwissMAP event - the 2026 Winter School in mathematical physics. But that of course is a whole different story! So to answer your question, I think that it has already shaped my research and personal life in a very positive way, and I am sure that it will continue to do so in the future.

Andrea Lanteri

Andrea Lanteri is currently completing a Master's degree in Physics at EPFL, which he expects to finish in July 2026. He intends to pursue doctoral studies in theoretical physics, possibly specialising in condensed matter physics, and hopes to remain in Switzerland for his PhD.

What made you decide to come to MAPSS?

I decided to come to the school because my Master's was taking a more computational and applied turn, but I was still deeply interested in formal mathematical physics. Therefore, I saw MAPSS as the perfect opportunity to devote time and attention to a part of physics I find extremely captivating, while also spending some time in the beautiful Swiss Alps. Once the courses were fully announced I was even more intrigued by the topics, whether they were entirely new concepts or subjects I had already encountered but could now explore more deeply.
The other main factor in my decision was the desire to meet new people from different countries but who share the common passion for mathematics and physics.

Did MAPSS broaden your research horizon, or confirm that you're on the right track? What's the clearest example?

Both the courses and the exchange with the other students made me realise once again that I crave a more formal and analytical approach to physics. In particular, the excellent course on Large N Matrices sparked my interest in Random Matrix Theory and made it clear to me that I would like to focus more heavily on Statistical Physics moving forward.

Which lecture or topic challenged you the most (in a good way), and what do you want to understand better now?

The course on Conformal Field Theory was definitely the most challenging for me. I had already been introduced to the field but at MAPSS I had the opportunity to explore two dimensional CFT. I believe the course was a good starting point, but I aspire to gain a much deeper understanding of the topic as it is crucial to properly describe some phenomena in Condensed Matter and Statistical Physics.

What part of the school was most valuable for you, mini courses, problem sessions, or informal discussions, and why?

The mini-courses were incredibly valuable, both for the immediate learning experience and for planting the seeds of new concepts that I plan to cultivate further.
However, I would say that what I treasured the most were the informal discussions with the other students. I loved the exchange of perspectives brought by our different backgrounds and I was deeply inspired by the passion and knowledge of everyone in their field of expertise.

Is there anything you think you did or will do differently because of MAPSS and where do you think it could show up (thesis, PhD work, reading group, collaboration)?

Firstly, the course on Large N Matrices has inspired me to steer my Master's degree in a more statistical physics-oriented direction.
Secondly, what I felt at the school was a sense of community among people who share a common passion and, despite the different cultural and academic backgrounds, speak the common language of mathematical and theoretical physics. I have realised that I want to be fully part of this community, which is why I also attended the Winter School and I am now more convinced than ever to pursue a PhD in theoretical physics.

Conversation with Ophélie Rivière, Tom Folgmann and Andrea Lanteri
Online

Twelve Years of **Educational Impact**

Over the years, SwissMAP supported numerous outreach initiatives such as the Junior Euler Society (JES) at UZH and ATHENA at UNIGE, which offer motivated high-school students early exposure to university-level mathematics.

In this final issue of Perspectives, we return to these programmes through the experiences of former participants and reflect on the role they played in shaping their academic paths.

Ekin Arikoek

Ekin Arikoek participated in the ATHENA programme at UNIGE and is currently a PhD student in mathematics at the University of Geneva in Stanislav Smirnov's Group. His work focuses on low-dimensional statistical mechanics models and their large-scale properties. Prior to this, he earned his Bachelor's and Master's degrees at the University of Geneva, specialising in mathematical physics.

When you first joined the programme, what attracted you to it? What were you expecting at the time?

I did not think much about it at first. I was in 2nd year of high school, and a friend of mine wanted me to enrol with him, which I did without thinking too much about it. I enjoyed it a lot, so I ended up enrolling again the two following years.

Was there a particular moment when mathematics "clicked" differently for you?

I don't think there was a particular moment when mathematics "clicked". Already as a child, I enjoyed solving enigmas, building things with legos and playing boardgames. To me, doing mathematics just felt like another game to enjoy. I guess I never really stopped seeing it that way!

Did the programme change the way you saw yourself in mathematics, for example in terms of confidence or ambition?

It was more of a humbling experience to me. Mathematics in high school wasn't very challenging to me and at the time it made me feel overconfident about my capacities. The Athena program gave me the opportunity to meet many people that were way better than me at maths, and to have an overview of the numerous things I still had to learn.

What specific skills, habits, or ways of thinking from the programme are still with you today?

In high school, I was used to study only on the day preceding an exam. As my grades were quite good in most classes, I got used to not really invest myself. It is not the smartest idea to do so at university. Things such as doing the exercises regularly are a crucial part of the learning process. The program gave me the chance to assimilate it a bit earlier.

Looking back now, how do you see the role that this early exposure played in your academic path?

It made me familiar with the academic world, which in turn probably influenced me in my decision of doing a PhD.

What would you say to a student today who is hesitating about joining such a programme?

As you are not a university student yet, you are freed of any stress related to passing the class you take. The only thing that matters to you is to enjoy some cool Mathematics or Physics that you may not have the chance to learn otherwise!

What difference does it make when students meet mathematics beyond the standard school curriculum?

Mathematics taught in the curriculum can feel a bit boring or repetitive. Studying mathematics outside that context allows to explore more exotic and interesting concepts.

Aisha Azhgaliyeva

Aisha Azhgaliyeva took part in the Junior Euler Society (JES) at UZH while still in high school and is now pursuing a Bachelor's degree in Mathematics at ETH Zurich.

When you first joined the programme, what attracted you to it? What were you expecting at the time?

When I first joined the programme I was motivated by the enthusiasm, charisma and knowledge of my first teacher in JES, Tatiana Samrowski. Also a crucial part was the environment created and cultivated by all the people at JES. I quickly realised that I want to be there and learn from them.

Was there a particular moment when mathematics "clicked" differently for you?

Perhaps I haven't reached that "click" and I wouldn't say it's attainable. Every time I think I grasp some field, I soon see that there's so much more depth.

Did the programme change the way you saw yourself in mathematics, for example in terms of confidence or ambition?

JES definitely gave me the courage to approach problems even if it seems daunting and difficult.

What specific skills, habits, or ways of thinking from the programme are still with you today?

One of the habits that JES taught me is breaking down a task into smaller and more manageable subtasks, divide and conquer to say, while still keeping track of the overall picture and goal. This has proven to be quite useful in any situation also outside of mathematics!

Looking back now, how do you see the role that this early exposure played in your academic path?

I would say that JES very heavily shaped my academic path. Before joining, I wasn't sure what I wanted to do when I got older but rather quickly I figured that solving problems is what I wanted to do every day. Even though I find other fields extremely interesting, I know that even after a hard day of thinking on a problem, I will still want to continue the next day.

What would you say to a student today who is hesitating about joining such a programme?

I'd say: "GO FOR IT!" You won't just learn new things but also meet kids your age who share many of the same interest as you. I'm still good friends with many of the people I met during my time at JES.

What difference does it make when students meet mathematics beyond the standard school curriculum?

It changes the way you approach a problem. Mathematics stops being a list of formulas but becomes a way of perceiving the world through structure and logic. You learn to not be afraid of difficult problem and dare to attempt them.

Conversation with Ekin Arikoek and Aisha Azhgaliyeva

Awards & Grants

Nicolas Gisin

Honorary doctorate

Congratulations to Nicolas Gisin, of the University of Geneva and Constructor University, who was awarded the honorary degree of Doctor of the University of York on 21 July 2025.

Géraldine Haack

Sandoz FPFS award

Géraldine Haack (UNIGE) has been awarded the 2025 "Monique de Meuron - FPFS pour la relève universitaire" prize from the Fondation philanthropique famille Sandoz.
The distinction supports her project on «Non-equilibrium quantum systems, from foundations to quantum technologies».

Martin Hairer

American Academy of Arts and Sciences

Martin Hairer (EPFL) has been elected as an International Honorary Member of the American Academy of Arts and Sciences. His research focuses on the study of stochastic partial differential equations (SPDEs).

Clément Hongler

2026 Frontiers of Science Award

Clément Hongler (EPFL) together with his co-authors Arthur Jacot and Franck Gabriel, has received a 2026 Frontiers of Science Award from the International Congress of Basic Science for their contributions to theoretical computer science. The award recognizes the paper *Neural Tangent Kernel: Convergence and Generalization in Neural Networks.*

Mikaela Iacobelli

Bartolozzi Prize 2025

Mikaela Iacobelli (ETH Zurich) has been awarded the 2025 Giuseppe Bartolozzi Prize by the Italian Mathematical Union.
The prize was awarded unanimously in recognition of her original and influential contributions to kinetic theory and related fields.
The Bartolozzi Prize is a biennial distinction awarded every two years by the Italian Mathematical Union to outstanding young mathematicians.

Chiara Saffirio

New roles in scientific and editorial governance

Chiara Saffirio (UniBas) takes on new roles in scientific and editorial governance.
As of February 2026, Chiara Saffirio has been appointed delegate of the Swiss Physical Society for *Annales Henri Poincaré* and joins the executive committee of the Association Publication de l'Institut Henri Poincaré.

SwissMAP Junior Researcher Prize

SwissMAP and G-Research invite nominations and applications for the SwissMAP Junior Researcher Prize 2026.

Deadline for nominations & applications: September 15th, 2026

2025 Winners

We are delighted to announce the awardees of the second edition of the SwissMAP Junior Researcher Prize, recognizing important scientific achievements in Mathematics and Theoretical Physics.
This prize, supported by G-Research, highlights groundbreaking contributions from early-career researchers in Switzerland.

Alessandro Giacchetto
ETH Zurich

Manuel Loparco
EPFL

Alessandro Giacchetto:
Alessandro is an algebraic geometer whose work lies at the intersection of enumerative geometry and mathematical physics. He studies recursive structures that govern the geometry of moduli spaces, with particular focus on cohomological field theories and their connections to integrable systems, topological recursion, and large-genus asymptotics. After completing his PhD at the Max Planck Institute for Mathematics in Bonn, he has held research positions at Paris–Saclay and ETH Zurich.

Manuel Loparco: Manuel studies the formalism that lies at the foundation of statistical physics, particle physics and cosmology: Quantum Field Theory (QFT). His PhD thesis was focused on QFT in the context of cosmology, studying how simple consistency conditions constrain the space of possible QFTs in an expanding universe. During the end of his PhD, he shifted his focus towards strongly coupled QFTs. Many phenomena of nature are described by strongly coupled QFTs, from phase transitions to the inner workings of a proton. His current research goal is to develop new methods to formulate predictions in these settings, where full theoretical control is still lacking. He has defended his PhD in theoretical physics at EPFL under the supervision of Joao Penedones, and is now a postdoc at Università di Torino.

Puzzle Corner

1. Swap in the orchard

At the swap point in an orchard, you can:

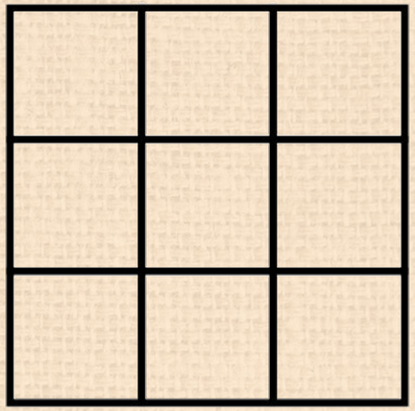
- swap one orange for two pears,
- swap one apple and one pear for one orange,
- swap one orange and one pear for one apple.

To mark the festival, there is a special offer at the swap point: for every swap, you receive a sweet as a gift.

Paul has 30 apples, 30 pears and 30 oranges.
What is the maximum number of sweets he can receive?

2. Divisibility of numbers in a table

Fill in the cells of a 3×3 grid with different natural numbers less than 20 so that, in every pair of cells sharing a side, one number is dividable by the other.

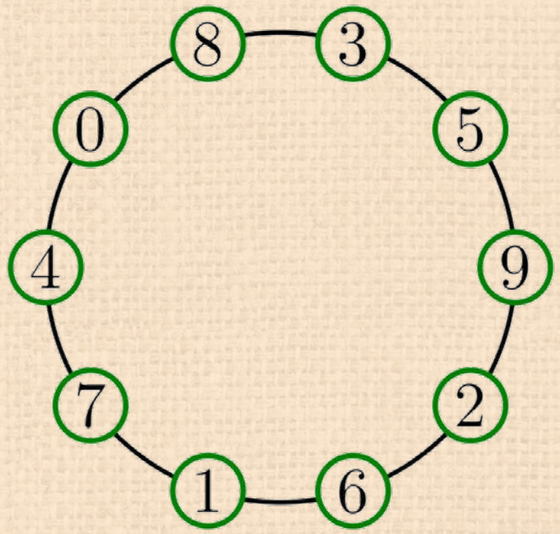


3. At least one 1

How many natural numbers less than 1000 contain at least one 1 in their representation?

4. Neighbouring sums

When the digits 0 to 9 are arranged in a circle, a number is called a "neighbouring sum" if it is the sum of two adjacent digits. For example, this arrangement has five different neighbouring sums: 4, 7, 8, 11 and 14.



What is the minimum number of different adjacent sums if each digit from 0 to 9 is to be used exactly once in the arrangement?

5. The largest product

We use each of the digits 1, 2, 3, …, 9 exactly once to form two numbers (e.g. 8362 and 79154).

Which two numbers formed in this way have the largest product?

Answers

1. Swap in the orchard

Solution: 208 sweets

We'll try to express the price of the fruit in terms of sweets:

- Pear + FRUIT = sweet + FRUIT, so a pear is worth one sweet.
- Orange = sweet + 2 pears, so an orange seems to yield 3 sweets.
- And an apple is equivalent to an orange.

With these exchange rates, the price of the pieces of fruit in terms of sweets does not change. In the final exchange, Paul gets fruit for at least 2 sweets, so more than 30+30×3+30×3−2 = 208 sweets.

How do you get 208 sweets? Here's one way:
Swap everything for oranges: Paul then has 30 sweets and 60 oranges
Get rid of the oranges: 2 × O --> O + 2B --> A + B --> O.
This reduces the number of oranges Paul has by 1, and he gets 3 sweets for every orange.
Paul repeats this process 59 times and then has 30 + 3 × 59 = 207 sweets.
The final swap is O --> 2B, so Paul has 208 sweets and 2 pears.

2. Divisibility of numbers in a table

There are many solutions.

Idea: Put 1 in the centre, the smallest numbers around it, and the products of the adjacent squares in the corners.

10	2	8
5	1	4
15	3	12

3. At least one 1

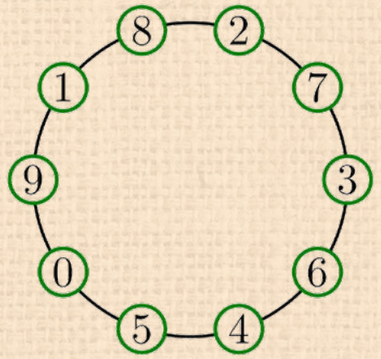
271 numbers.

Imagine that EVERY number consists of three digits, e.g. 57 = 057 and 4 = 004.

Let's first work out how many numbers do not contain a ONE. In the first place, we can put any of the 9 digits – 0, 2, 3, 4, 5, 6, 7, 8, 9. The same applies to the second and third places, so there are a total of 9 × 9 × 9 = 729 numbers that do not contain a 1. The remaining 1000 – 729 = 271 numbers contain at least one 1 in their representation.

4. Neighbouring sums

The minimum number of adjacent sums is 3.
The following arrangement yields only 3 adjacent sums – 5, 9 and 10:



Why can't there be fewer?
Let's consider the number 0. It has two different neighbouring numbers, so there are at least two sums of neighbouring numbers that are less than 10.
Let's consider the number 9. It has two neighbouring numbers, and at least one of them is not zero, so there is at least one sum of neighbouring numbers that is greater than or equal to 10.

5. The largest product

9642 and 87531.

It is difficult to find a "good" justification. As a solution, we place a zero in front of both numbers (e.g. 0.8362 and 0.79154). This is equivalent to dividing the result by 109, and the property of "being the largest" is retained. It is now clear that we want to find the largest tenths, hundredths, etc.

A. The digits must be arranged in descending order; otherwise, we can increase the product.
B. A larger digit should never be assigned a lower place value in one decimal number than the place value assigned to a smaller digit in the other decimal number (e.g. 0.98 . . . and 0.7 . . . , since the tenth 7 is smaller than the hundredth 8). If the numbers are swapped, the product becomes larger.
C. The digits are then arranged as follows: tenths 9 and 8, hundredths 7 and 6, and so on. If the sum of the digits is fixed, the product is greatest when the digits are closest together, i.e. 9642 and 87531.

Puzzles contributed by:
Dmitrij Nikolenkov (ETH Zurich) | TagesAnzeiger's - Hier trainieren Sie Ihr Hirn | https://www.tagesanzeiger.ch/ (Folgen 401, 404, 405 des Zahlendrehers)

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