



A team of CSH scientists works to make cryptofinances safer. © Shutterstock

## Dear friends of the Hub!

The CSH never has been as busy as it currently is. One event is chasing the next; winter, spring and summer schools are being held; countless new topics are emerging between the teams; guests are helping us to re-link with the world, and the number of things we could engage in literally seems to be exploding.

The speed at which we are regaining life after (really after?) corona is both amazingly beautiful and overwhelming. The fact that in the past months we discovered new ways and modes of how science can play a role and impact society—and that it can potentially be much more than producing papers—confronts us with new challenges. In combination with our growth in numbers in the past two years, we have to start focusing on the complexity of the CSH as an institution.

I hope we have the tools to engage in a constructive process of reflection, rethinking and eventually reinventing the procedures a bit to stay abreast of all the dynamics going on.

Stefan Thurner  
CSH President

## Curbing fraud in cryptofinance

*A start-up with CSH participation wants to make Decentralized Finance safer.*

Busy times for **Bernhard Haslhofer**. The leader of our Cryptofinance team co-founded the company IKNAIO Cryptoasset Analytics, a start-up offering support in crypto asset forensics. “Cryptocurrencies like Bitcoin are becoming increasingly popular—unfortunately also as payment for illegal purposes like ransomware attacks on companies or illegal trade,” says the scientist with entrepreneurial spirit. The resulting damage has already amounted to billions and will dramatically increase in the future.

Together with colleagues from AIT Austrian Institute of Technology, Bernhard’s team develops world-leading forensic technologies to track and trace fraudulent activities. Their findings, openly accessible for scientific purposes, will now also be available as a service for security companies or authorities. “Hopefully, this will contribute to make the handling of cryptocurrencies more secure and curb criminal activities,” Bernhard concludes.



## Ranking algorithms can reinforce inequalities

*The way people connect on Twitter or in Academia can distort and influence the visibility and ranking of minorities.*

Online social networks claim to make connections and bring people together. But the ranking and recommender algorithms that suggest whom to connect with, or who the most relevant scientists in a particular field are, can discriminate against certain groups of people in top ranks and thus exacerbate inequalities, according to a study led by our Network Inequality team.

### Algorithms amplify biases

“We know that ranking algorithms tend to increase the popularity of users who are already popular,” says CSH PostDoc and first author **Lisette Espín-Noboa**. “This can lead to a loss of opportunities for other groups. We wanted to understand when these algorithms go wrong.” The scientists investigated PageRank,

one of the main algorithms behind Google’s search engine, and Who-to-Follow, Twitter’s algorithm that suggests people one may find interesting to follow. They composed different networks with 2,000 individuals each and simulated various social mechanisms: the proportion of a minority in the network, how active users were in connecting with others or the way people connected, more specifically, if they connected with popular people, or if they chose people similar to themselves (“homophily”).

### Key social mechanism is homophily

The team showed in an earlier paper how the human tendency “like goes with like” can influence the ranking of minorities. The new study adds even more realistic social network scenarios as it not only looks at ranking algorithms, but also social recommender algorithms. The simulations are therefore closer to real conditions. According to this study, the main social mechanisms distorting the visibility of minorities in rankings are homophily and the proportion of the respective minority.

“When the majority group associated mostly with others from the majority, the minority group was underrepresented in top ranks,” explains Lisette. “Yet, minorities can overcome this underrepresentation, for instance, by strategically creating more connections to others and by being more active in the network.”

*The paper “Inequality and inequity in network-based ranking and recommendation algorithms” appeared in Scientific Reports.*

Ranking algorithms sometimes lead to disadvantages for minority groups. © Shutterstock



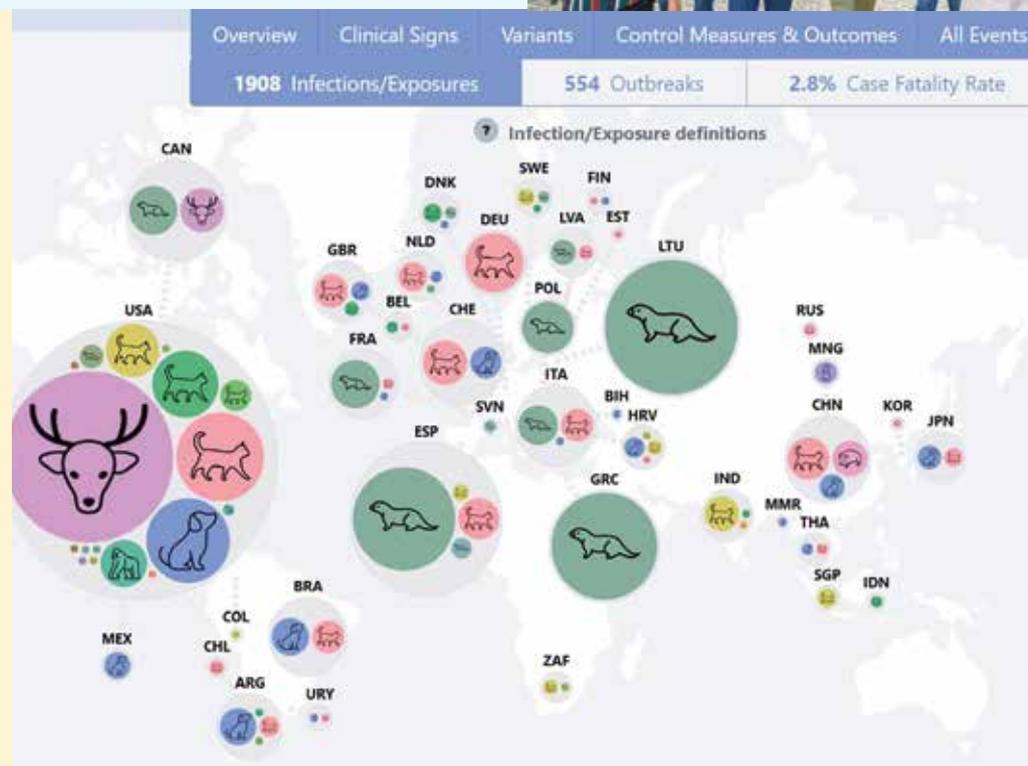
## Animals get Corona, too

*CSH scientists are collecting the documented cases of SARS-CoV-2 in animals. A dashboard shows them all.*

To tackle major threats to human health, we need an integrated view which not only takes the health of humans, but also animal and environmental health into account, CSH epidemiologist **Amélie Desvars-Larrive** is convinced—and initiated the assembling of all documented coronavirus cases in animals into one database.

For months, Amélie’s team has been meticulously extracting, combining, and structuring data on SARS-CoV-2 cases in animals—and will continue to do so—from ProMED and the World Animal Health Information System (OIE-WAHIS). Amélie also convinced the Wildlife Conservation Society to contribute information.

The dataset is publicly available for analytical purposes and can be integrated with multidisciplinary data. “We also hope to receive further data from researchers around the world,” says the expert in animal health (Amélie did exciting research on rats in the past!).



So far, almost 700 SARS-CoV-2 cases have been documented in animals. © CSH

### The SARS-ANI Vis Dashboard

To make the hard-won data easily accessible, **Liuhuaying Yang** and **Johannes Sorger** from the CSH visualization team developed a dashboard. SARS-ANI Vis shows the cases, stratified

by species and region, or by which clinical signs of disease, control measures and outcomes were documented.

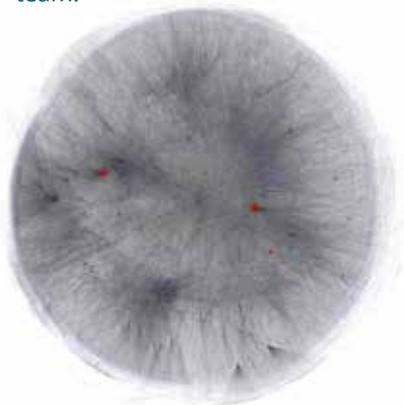
→ *The dashboard can be reached via the CSH vis page (<https://vis.csh.ac.at/sars-ani>).*



### The first complete image of an entire economy

*Hub researchers used VAT data to map the entire production network of Hungary.*

“By viewing an economy as a network of all companies and their mutual relationships, we can rethink economics,” says **Stefan Thurner**, one of the authors of a brand-new study by the CSH Economics team.



The entire production network of Hungary. Colors according to their systemic risk. © CSH

The scientists used a unique dataset of value-added tax (VAT) information—a general tax that is applied to all goods and services—to reconstruct the production processes and the supply relationships between companies in Hungary. By “entire production network” they literally mean all relevant firms and all supply relationships with their clients and customers.

“This unprecedented granularity allows us to quantify the systemic risk of each single company in that network. We can now determine how each enterprise was affected by supply chain disruptions,” explains co-author **Christian Diem**.

In particular, the 32 top high-risk companies, which represent 0.035 percent of the analyzed Hungarian enterprises, display an extremely high systemic risk of about 23 percent. “This means that, in the short term, about 23 percent of the national production could be adversely affected if firms cannot adjust their supply relations by finding new suppliers and customers fast enough,” Christian points out. In addition, the scientists saw that almost 75 percent of the national systemic risk is concentrated on only 100 high-risk companies.

### Rethinking economics

The new approach demonstrates that a real economy cannot be seen as collection of separate supply chains. “Economies are tightly connected networks. In the case of Hungary, we found one strongly connected component that contains 26 percent of all companies,” adds Christian. “That means only a few firms pose a substantial risk to the overall economy.”

The researchers point out that their results have several policy implications. “Using our model, government institutions could identify and monitor the weak spots of an economy: those critical companies that, in case of default, could cause system-wide damage. Once those weaknesses are known, one can consider what can and should be done to fix them. That would make the system way more resilient,” Stefan concludes.

*The study “Quantifying firm-level economic systemic risk from nation-wide supply networks” appeared in Scientific Reports.*



The CSH Winter School 2022 focused on Green Transition. © Jo Stangl

In April, our long-awaited 2nd Winter School took place in Obergurgl. Nineteen international students listened to, and discussed about Green Transition with **Sigrid Stagl**, **Georg Brasseur**, **Ilona Otto**, and **Stefan Thurner**; virtual presentations were given by **Geoffrey West** and **Stefan Rahmstorf**. “I was impressed by the wide range of perspectives on the subject that we got to know, and how economics, social and natural sciences approach the topic differently,” said one of the participants, Moritz Laber. “For me, a major take-away from this multidisciplinary discourse was that there is no silver bullet for such a complex problem. Any solution will have different effects on climate, people and the economy, which might enhance or reduce each other.”

In January, we launched the **Complex Systems Journalist in Residence (COSY JiR)** program. It offers science journalists an up to three-month fellowship at the CSH. Our first JiR is science journalist, book editor and editorial consultant **W. Wayt Gibbs** from Kirkland, Washington; he will be arriving in mid-May. **Aleszu Bajak**, senior science and investigative data reporter at USA TODAY, will be following in mid-June. We are very much looking forward to their visits.

In July, 36 international PhD students will participate in the **Complexity-GAINS International Summer School 2022** at the Hub to learn about “Disintegration of societies: Quantitative modeling of complex socio-behavioral systems.” Of course, there will not only be science all over the place, but also a lot of social and cultural activities in one of the most beautiful

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cities in the world! The program is a partnership with the Santa Fe Institute, the Max Planck Institute for Mathematics in the Sciences/Hamburg University of Technology (DE), the International Center for Theoretical Physics (IT), and the IAS/University of Amsterdam (NL).

The current **Art at the Hub** exhibition features photographs from the Austrian and South Tyrolean photographers **Peter Hassmann** and **Georg Hofer**.



© Peter Hassmann

# UPCOMING

The CSH is taking part in the "Long Night of Research" 2022.



Updates and further information  
→ [www.csh.ac.at/events](http://www.csh.ac.at/events)

## CSH contributes to the "Lange Nacht der Forschung"

May 20, 2022 | 17:00–23:00

The Long Night of Research, an Austrian-wide annual event, presents scientific methods and findings to the public. CSH scientists will present their ideas and approaches to manage a Green Transition at CAPE 10 in Vienna's Tenth District.

## CSH External Faculty Meeting 2022

May 30, 2022–May 31, 2022

The motto of this year's get-together of our international friends is "Restart."

## CSH Public Panel:

### "Managing a dramatically changing world—What science can contribute"

May 30, 2022 | 16:30–18:00

Society, democracy, and humanity as a whole are facing tremendous challenges. More and more, crises seem to be accumulating all at the same time. The CSH panel, consisting of Helga Nowotny, Henriette Spyra, J. Doyne Farmer, Simon DeDeo and Peter Klimek, will discuss what levels of collaboration are needed to manage big transitions without risking social disruption. Registration via our webpage!

## CSH Workshop: "Stochastic dynamics for complex systems"

June 01, 2022–June 03, 2022

Organized by Christian Kühn et al., this workshop intends to foster the interplay between different approaches in stochastic methods and to explore new, unifying directions to tackle challenges in complex systems.

## CSH Talk by Marc Wiedermann: "Big Data and Citizen Science in the fight against COVID-19—The Corona Data Donation Project"

June 03, 2022 | 15:00–16:00

Marc Wiedermann from the Robert Koch Institute highlights one of the largest citizen science projects worldwide: The Corona Data Donation Project uses personalized physiological sensor data from over 100,000 people, collected via fitness trackers and smart watches and donated to science to be used in a privacy-preserving way.

## CSH Workshop: "Decentralized Finance: Hype or Disruption?"

June 13, 2022

Organized by Bernhard Haslhofer and his Cryptofinance team, the meeting aims to have an interdisciplinary group of researchers with a shared interest in crypto assets and DeFi discuss opportunities and risks associated with DeFi, and to identify possible future partnerships.

## CSH Workshop: "Move or Perish—Scientific trajectories, inclusion, and inequality, and their consequences for transformative science"

June 15, 2022–June 16, 2022

CSH's Fariba Karimi and Márcia Ferreira invite participants to discuss gendered and underrepresented career trajectories and typical, or atypical mobility patterns across a variety of dimensions. The workshop also addresses how advances in bibliometric databases, additional data sources and complex system approaches might assist decision-makers in promoting a more inclusive science.

# PUBLICATIONS

This is a selection of publications affiliated to the Hub. Find more at  
→ [www.csh.ac.at/publications](http://www.csh.ac.at/publications)

C. Diem, A. Borsos, T. Reisch, J. Kertész, S. Thurner  
→ Quantifying firm-level economic systemic risk from nation-wide supply networks, *Scientific Reports* 12 (7719) (2022)

R. Crescenzi, A. Dyèvre, F. Neffke  
→ Innovation catalysts: How multinationals reshape the global geography of innovation, *Economic Geography* (2022) 1–29

K. Ledebur, M. Kaleta, et al.  
→ Meteorological factors and non-pharmaceutical interventions explain local differences in the spread of SARS-CoV-2 in Austria, *PLoS Computational Biology* 18 (4) (2022) e1009973

L. Espín-Noboa, C. Wagner, M. Strohmaier, F. Karimi  
→ Inequality and inequity in network-based ranking and recommendation algorithms, *Scientific Reports* 12 (2022) 2012

T. M. Pham, R. Hanel, J. Korbel, S. Thurner  
→ Empirical social triad statistics can be explained with dyadic homophylic interactions, *PNAS* 119 (6) (2022) e2121103119

J. Lasser, J. Sorger, L. Richter, S. Thurner, P. Klimek  
→ Assessing the impact of SARS-CoV-2 prevention measures in Austrian schools using agent-based simulations and cluster tracing data, *Nature Communications* 13 (554) (2022)

J. Wachs, M. Nitecki, W. Schueller, A. Polleres  
→ The geography of Open Source Software: Evidence from GitHub, *Technological Forecasting and Social Change* 176 (2021) 121478

F. Dablander, A. Pichler, A. Cika, A. Bacilieri  
→ Anticipating critical transitions in psychological systems using early warning signals: Theoretical and practical considerations, *Psychological Methods* (2022)

N. Savela, D. Garcia, M. Pellert, A. Oksanen  
→ Emotional talk about robotic technologies on Reddit: Sentiment analysis of life domains, motives, and temporal themes, *New Media & Society* (2021)

J. Lasser, J. Zuber, J. Sorger, et al.  
→ Agent-based simulations for protecting nursing homes with prevention and vaccination strategies, *J. R. Soc. Interface* 18 (185) (2021)

A. Desvars-Larrive  
→ To beat Omicron, Delta and bird flu, Europe must pull together, *Nature* 600 (386) (2021)



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