

# Raphaël Berthier

PhD student at Inria Paris  
under the supervision of  
Francis Bach and Pierre Gaillard

## PhD topics ...

- stochastic optimization
- gossip algorithms (averaging algorithms in networks)

## See my talk on Friday 7, 5:30pm

- Berthier, Bach, Gaillard - *Tight Nonparametric Convergence Rates for Stochastic Gradient Descent under the Noiseless Linear Model*, 2020
- Berthier, Bach, Gaillard - *Accelerated Gossip in Networks of Given Dimension using Jacobi Polynomial Iterations*, 2019

## ... and interests related to statistical physics of machine learning

- Approximate Message Passing algorithms and proof of the state evolution equation
- multi-layer AMP
- Kac-Rice formalism
- Berthier, Montanari, Nguyen - *State Evolution for Approximate Message Passing with Non-Separable Functions*, 2017

# Hugo CUI

Currently finishing my education at ENS, Paris in physics. PhD next year w. Lenka

## What I'm interested in :

*In ML/Physics* : Like everyone I'd like to understand the influence of data structure/architecture/implicit reg..., for now I've been working on active learning.

*Outside of science*



# Stéphane d'Ascoli

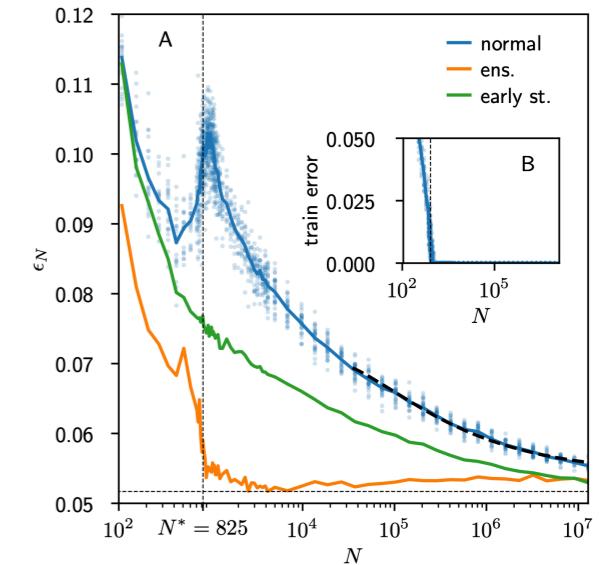
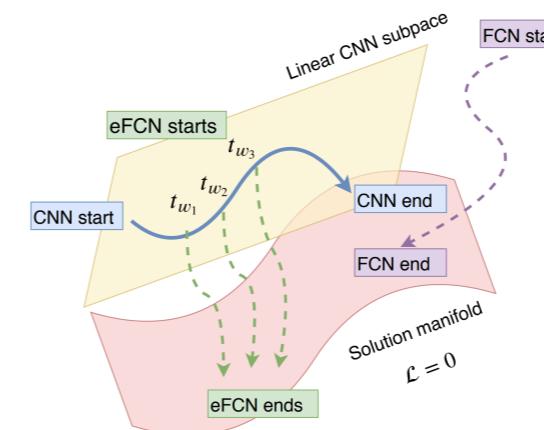
Currently : Ph.D. student, ENS Paris & FAIR Paris

Supervised by : Giulio Biroli, Lévent Sagun

Previously : Masters Degree in Theoretical Physics, ENS Paris

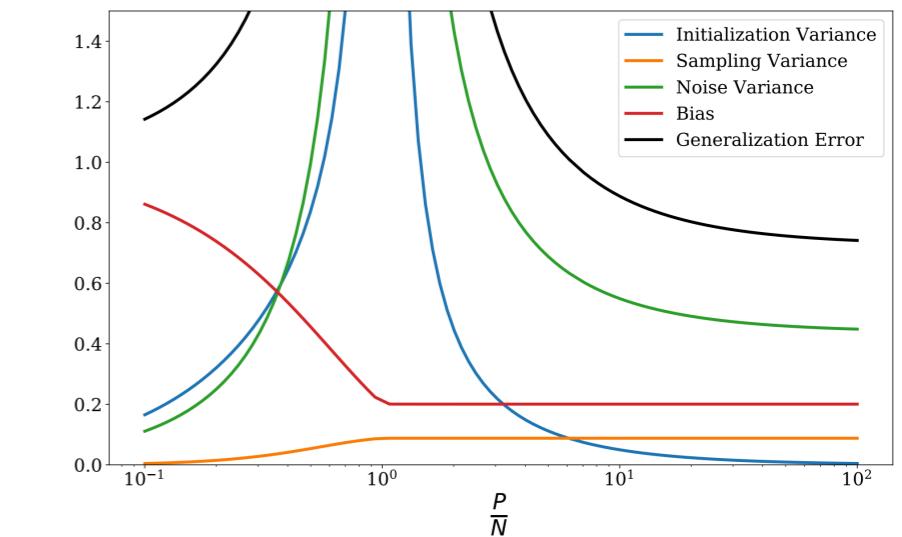
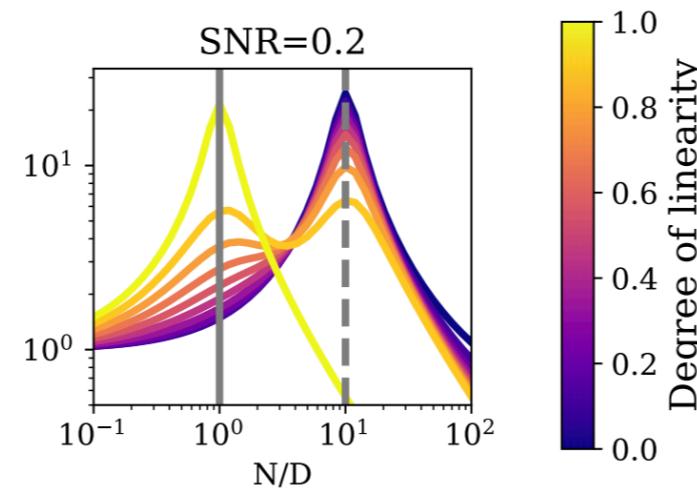
## Subjects of interest :

- Dynamics and generalisation in deep learning
- Analytically tractable models of double descent
- Lazy and rich learning regimes



## More recently :

- Role of data structure
- Graph neural networks



## Outside work :

- Sports (cycling, hiking, tennis, hit me up if you're interested !)
- Music (come and see my orchestre play near here in two weeks !)

# Lorenzo Dall'Amico

## Who...

- M.Sc in Physics of complex systems
- Ph.D at GIPSA lab with Romain Couillet and Nicolas Tremblay

## So far...

- Unified framework for spectral community detection in sparse graphs
- New spectral algorithm for dynamic community detection

## Now heading towards...

- A competing algorithm for SSL in the dense and sparse regime
- Do common algorithms (*e.g* label propagation) have a simple, physics-inspired interpretation?

# Jonathan Dong

- 3rd-year PhD student with:
  - Florent Krzakala (LPENS, Paris)
  - Sylvain Gigan (LKB, Paris)
- Next year: Postdoc with Michael Unser (EPFL, Lausanne)
- Research interests:
  - Computational imaging (phase retrieval, inverse problems)
  - Optical computing (random matrices, Random Features, Reservoir Computing)



# Jorge Fernández de Cossío Díaz

- Post-doc at ENS, with Remi Monasson & Simona Cocco.
- I am working on:
  - statistical mechanics of deep Boltzmann machines;
  - interpretable representations in restricted Boltzmann machines
  - adversarial training of restricted Boltzmann machines;
  - applications to protein sequence data
- PhD in University of Havana, Cuba, on modelling of metabolic networks in cell cultures.
- In the future, I hope to continue working on statistical physics applications in machine learning and biology.
- Looking forward to exciting discussions during this school!

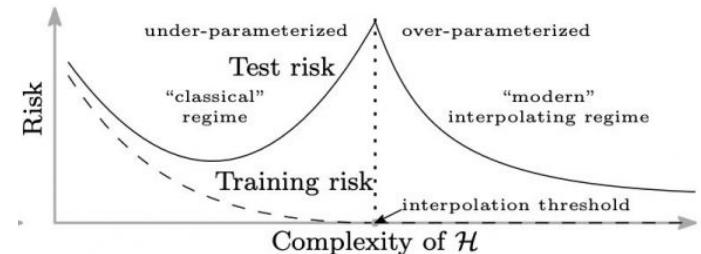
## Where I come from:

- ▷ PhD completed in 2019 – École Normale Supérieure Paris  
Advisors: Florent Krzakala & Lenka Zdeborová
- ▷ Postdoc since January 2020 - NYU / Flatiron Institute



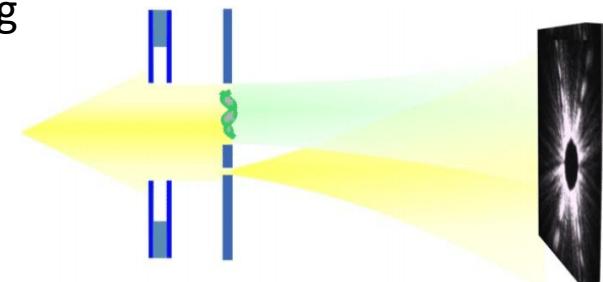
## What I am interested in:

- ▷ Theory of machine learning, statistical inference  
generalization / overparametrization,  
role of structure in signal
- ▷ Machine learning applications in science
  - ▷ Neural networks for efficient sampling of Boltzmann distributions
  - ▷ Neural network priors for diffraction imaging



## Besides Science:

- ▷ Hiking, maybe running and playing ware-wolf



# Mario Geiger

Experimental physics on neural networks



## Advisors

F. Krzakala (Physics, ENS) and M. Lelarge (Computer Science, ENS)

## Interests

Graphical models, optimization, probability, statistical physics

## Current projects

Exact asymptotics on simple machine learning models (GLM)

Get close to realistic cases - more on that later

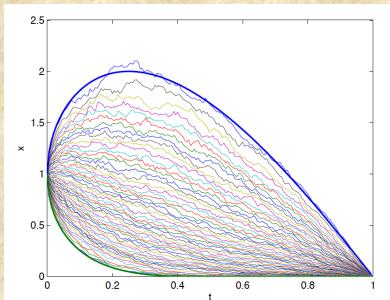
Theory : state evolution, replicas, convergence/convex analysis

Algorithms : message-passing, expectation propagation, proximal descent (ADMM)

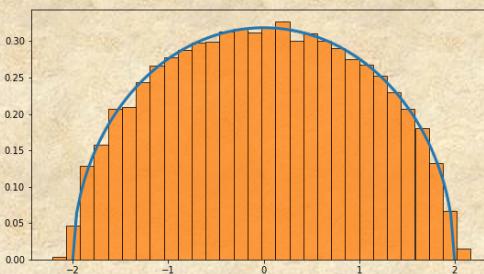
## Would like to learn more about

Neural networks, learning dynamics, approximation theory

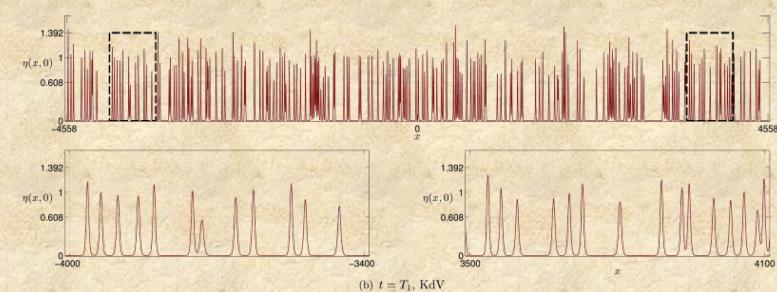
## *My background (Math):*



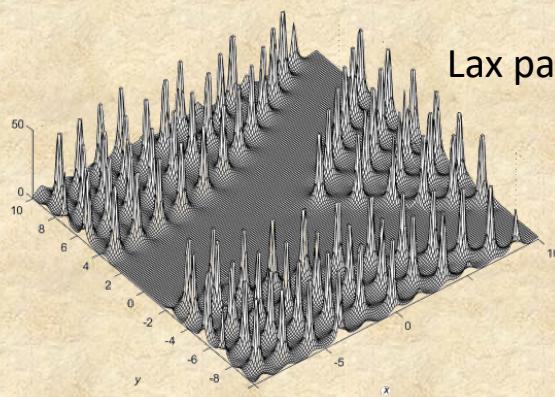
Determinantal Point  
Processes



Random Matrices



Soliton gas (integrable  
turbulence)



**Integrable Systems:**  
Lax pair, Hamiltonian,  $\tau$ -function,...  
(e.g. KdV, Painlevé)

- **Asymptotics:** critical regimes, long-time, large/small gaps, ...
- **Universality**

*More recently (ML): generalization in overparametrized models (+ optimization)*

# Grzegorz Głuch



From Poland

PhD candidate at EPFL

Advised by M. Kapralov & R. Urbanke

## Interests

- Theoretical ML: Adversarial Robustness
- Sublinear Algorithms: Clustering via spectral methods

## After hours

Biking MTB/downhill, crossfit, in general: sports

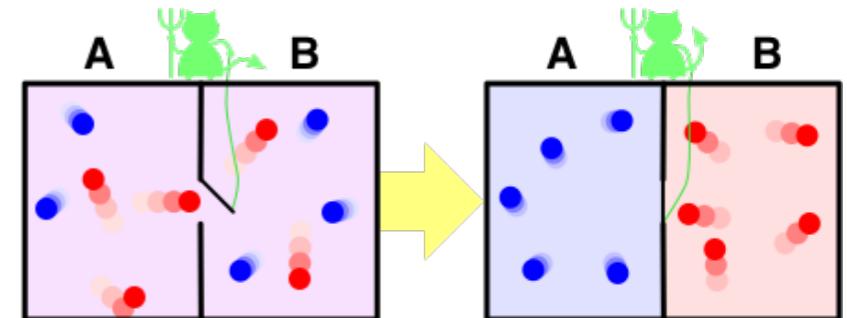
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# Sebastian Goldt

## Previously

Undergraduate in physics

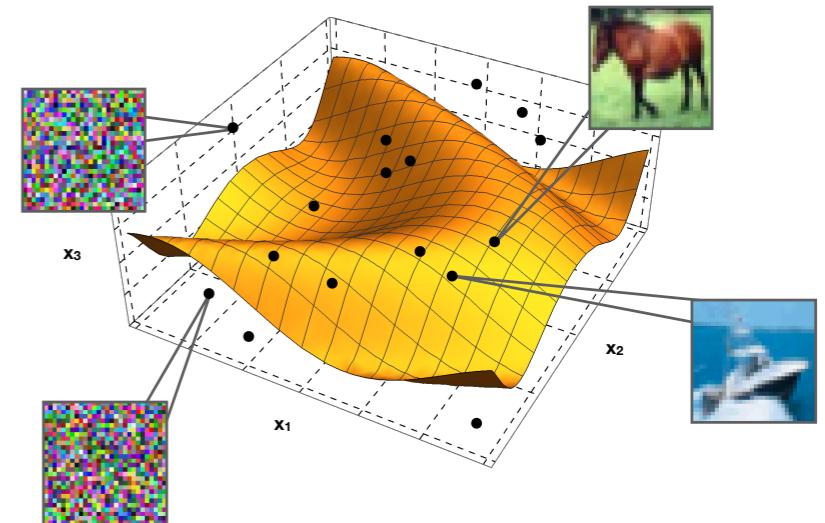
PhD in non-equilibrium statistical physics



## Now

Post-doc with Lenka & Florent @ ENS (Paris)

- Dynamics of neural networks
- Impact of data structure on learning



## Soon

Starting a new group at SISSA (Trieste):

**“Theory of neural networks”**

We're hiring - feel free to inquire :)



# MOSHIR HARSH

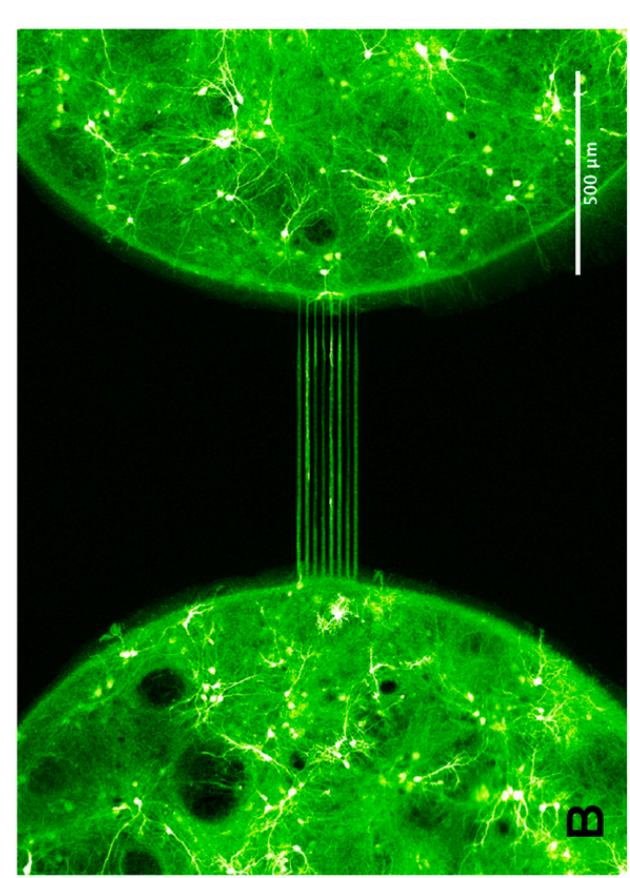
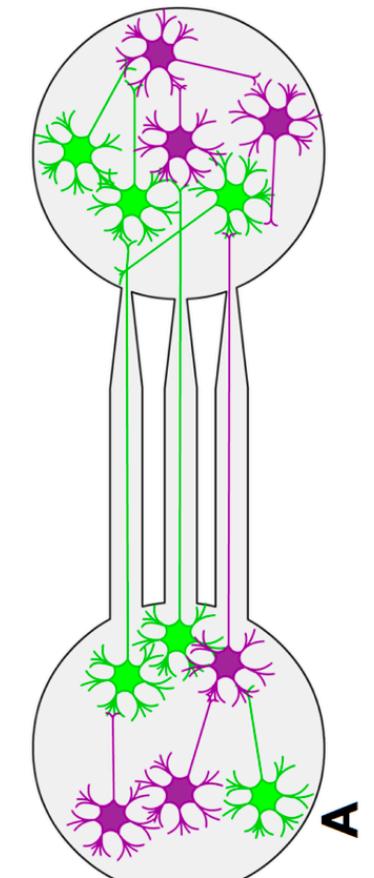
PhD student at the Institut für Theoretische Physik, Universität Göttingen

Supervisor: Prof. Peter Sollich

Past: Masters from ENS, Paris; Physics Major & Biology minor from **Indian Institute of Science**, Bangalore

## PAST PROJECTS:

- Protein complex assembly by super-resolution microscopy and stochastic modelling.
- Mechanism of bacterial ‘persistence’ by single particle fluorescence imaging.
- In-vivo “Neural Networks” and neuro-degradation simulations.

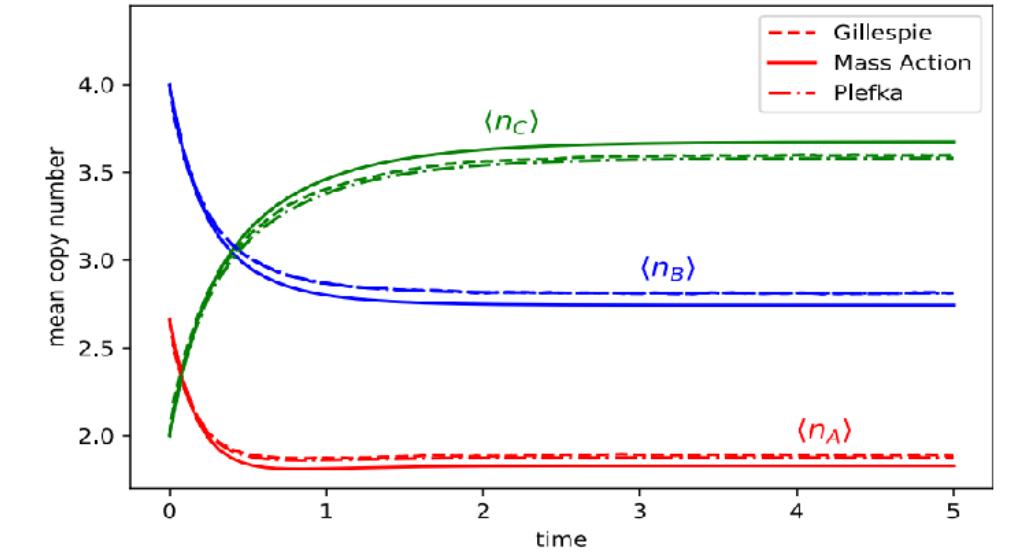


From Samuel Bottani

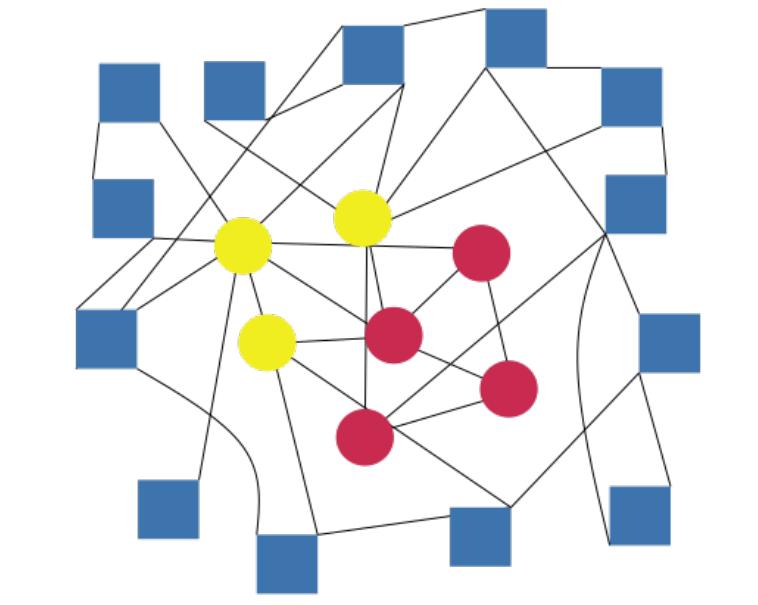


## RESEARCH INTERESTS:

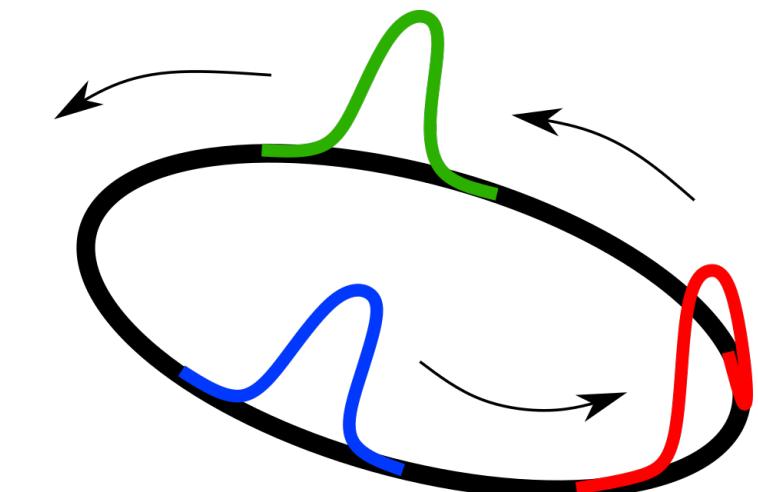
- Approximation methods for dynamics on networks with large fluctuations.
- Inference and ML methods for dynamics in biochemical networks.
- Using stat. physics to understand ML & phase transitions in learning.
- The role of symmetries in learning.
- Neural encoding in sensory space - place fields and CA!
- Glasses and dynamics on complex landscapes.
- AI for healthcare improvement and automation.



Identify the boundary layer from subnetwork dynamics



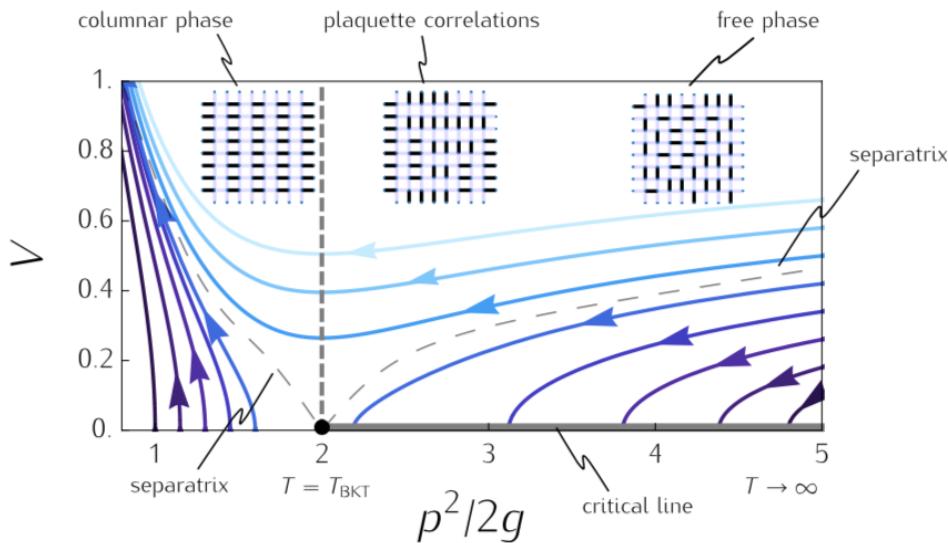
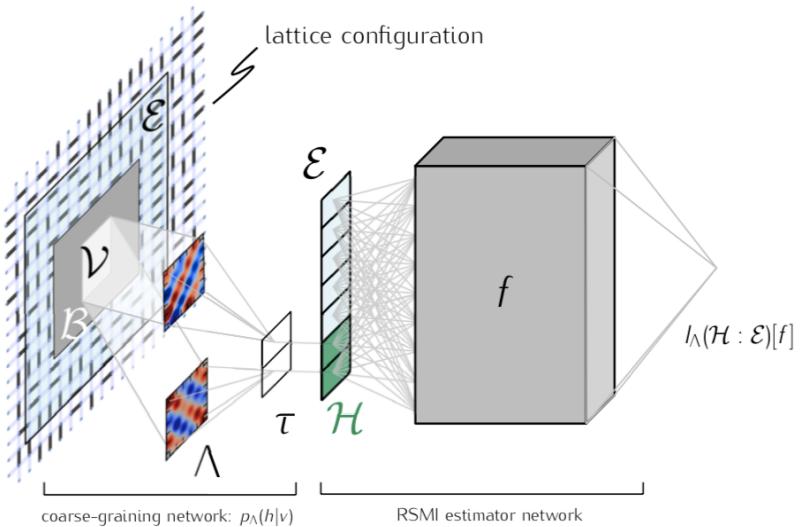
● boundary layer ● subnetwork ● bulk



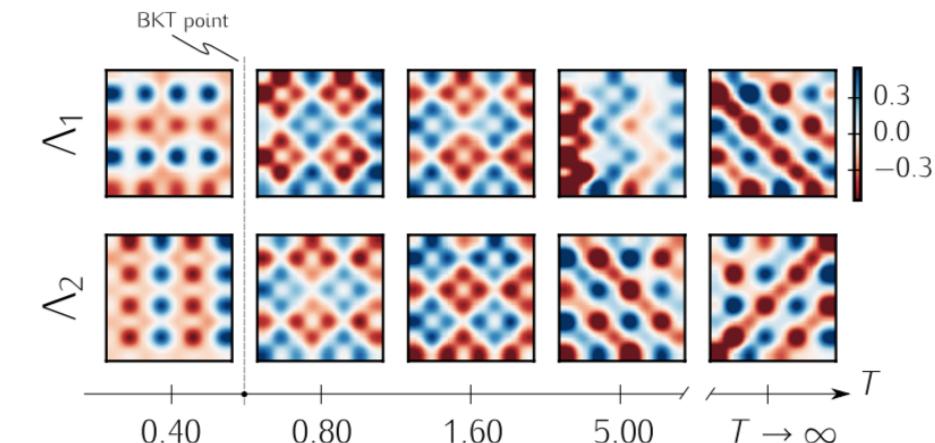
## **Vojtech Havlicek**

- ▶ My PhD was in quantum computation.
- ▶ My academic journey so far: Imperial (Theoretical Physics) → ITP ETH for 1 year → Oxford (Computer Science) → Bristol (Math) → IBM Research? (waiting for a visa decision)
- ▶ Also interested in non-quantum things. Currently working on approximation algorithms with IBM.
- ▶ Free time: boardsports, hiking, rowing, violin, programming.

# Information theoretic RG: algorithms and theory



- RG construction via efficient mutual information maximization with MINE



- Information theoretic (IB) vs. RG relevancy, symmetries in IB and RG
- Physics-inspired ML, e.g. in hyperparameter optimization

# Anastasia Koloskova

PhD student at EPFL, under supervision of Martin Jaggi

Bachelor's degree from Moscow Institute of Physics and Technology

## Research interests:

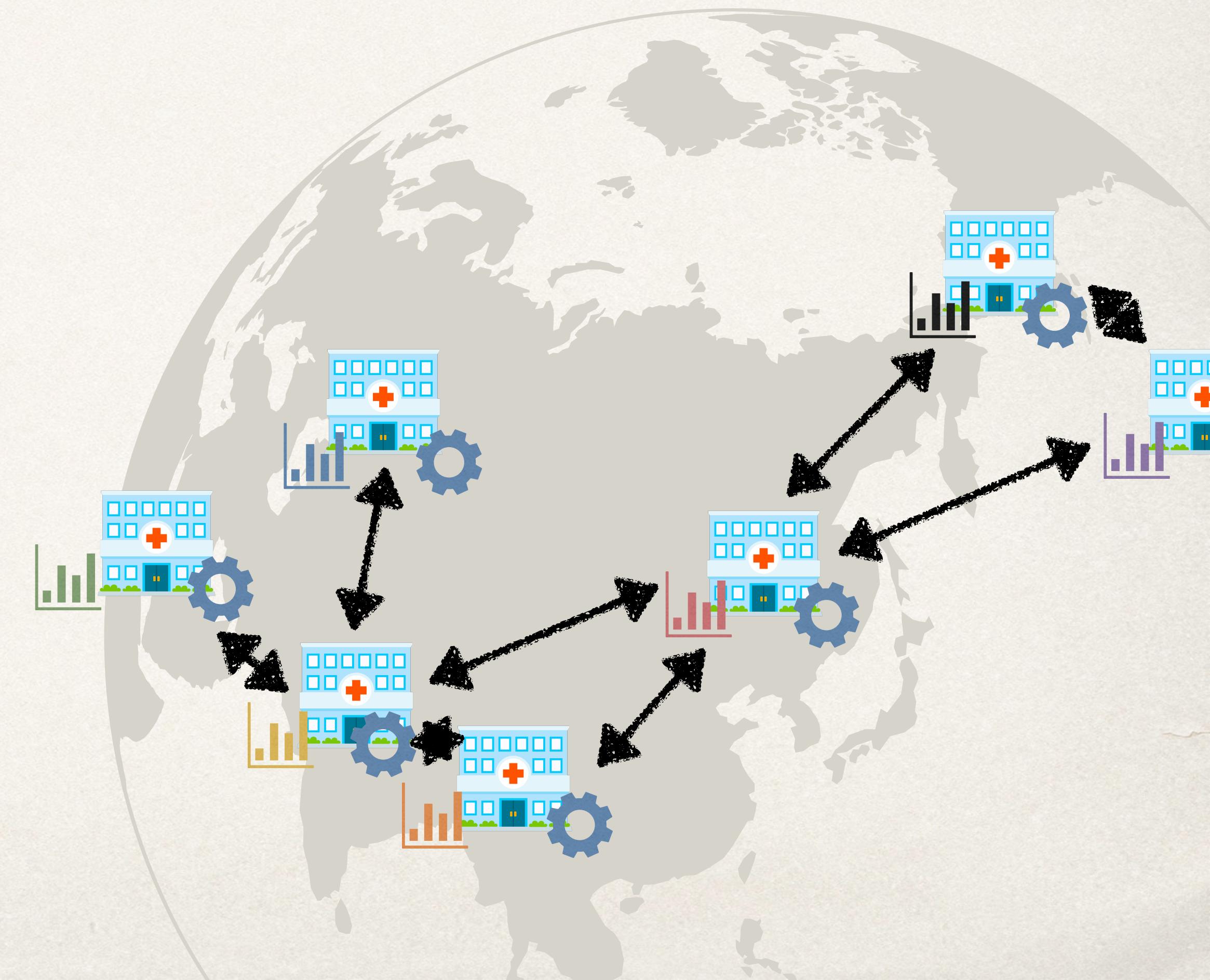
Optimization for machine learning

Distributed and decentralized optimization

Federated learning

## Other interests:

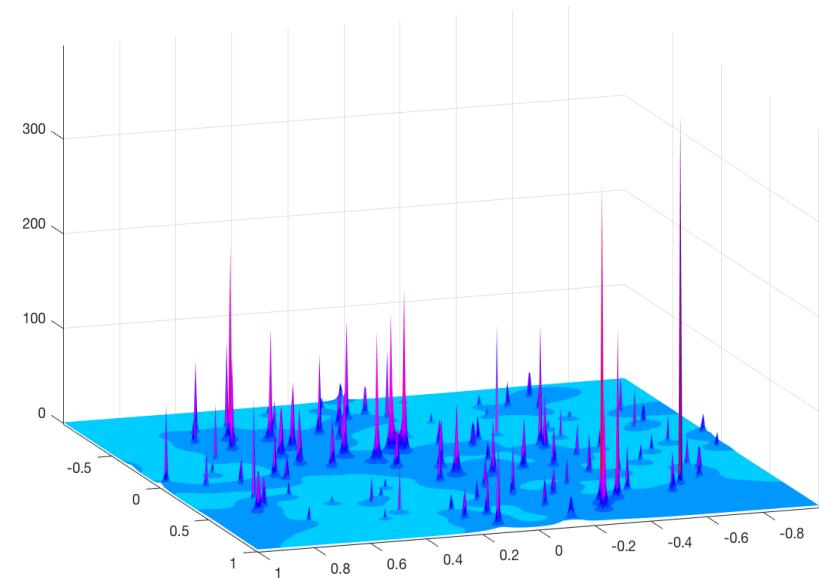
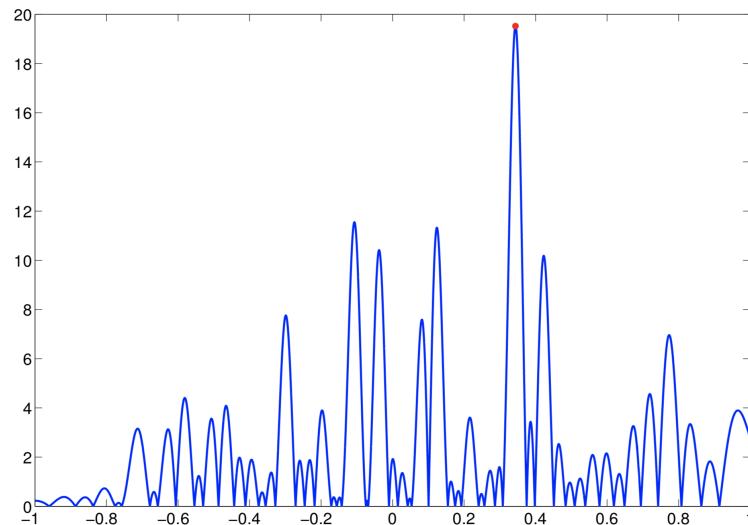
hiking, biking, bouldering, ping-pong, music, etc.



# Gaultier Lambert, University of Zürich

I study eigenvalues of random matrices and other related objects.

- Central limit theorems for linear statistics of eigenvalues (combinatorics & Stein's method)
- Characteristic polynomials of random matrices (behavior of the maximum & extreme values)



- Gaussian Multiplicative Chaos
- Free fermions & determinantal point processes

# ANTOINE MAILLARD

PHD STUDENT, ENS PARIS

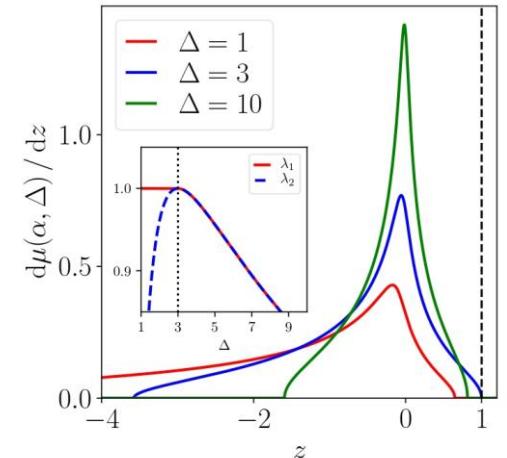
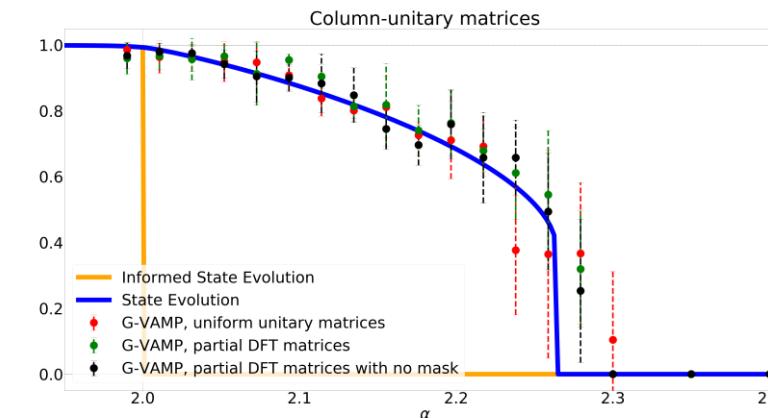
w. FLORENT KRZAKALA

Some of my work interests :

- Statistical physics / inference problems (computational gaps, message-passing...) ↑  
TAP equations of inference models, matrix factorization, committee machine, spectral methods, phase retrieval...
- Rigorous proofs of conjectures from the stat. physics literature.  
Committee machine, linear regression with correlated matrix, phase retrieval w. correlated patterns....
- Random matrix theory (large deviations, Kac-Rice formula, ...)

Spiked matrix model with generative prior

Complexity of empirical risk of GLM:  $\lim_{n \rightarrow \infty} \frac{1}{n} \ln \mathbb{E} \text{Crit}_{n,L_1} = \frac{1 + \ln \alpha}{2} + \sup_{\nu \in \mathcal{M}_1^+(\mathbb{R})} \left[ -\frac{1}{2} \mathcal{E}_\phi(\nu) + \kappa_{\alpha,\phi}(\nu, t_\phi(\nu)) - \alpha H(\nu | \mu_G) \right].$





# Chiara Marullo

Department of Mathematics "G. Castelnuovo"  
Sapienza Università di Roma



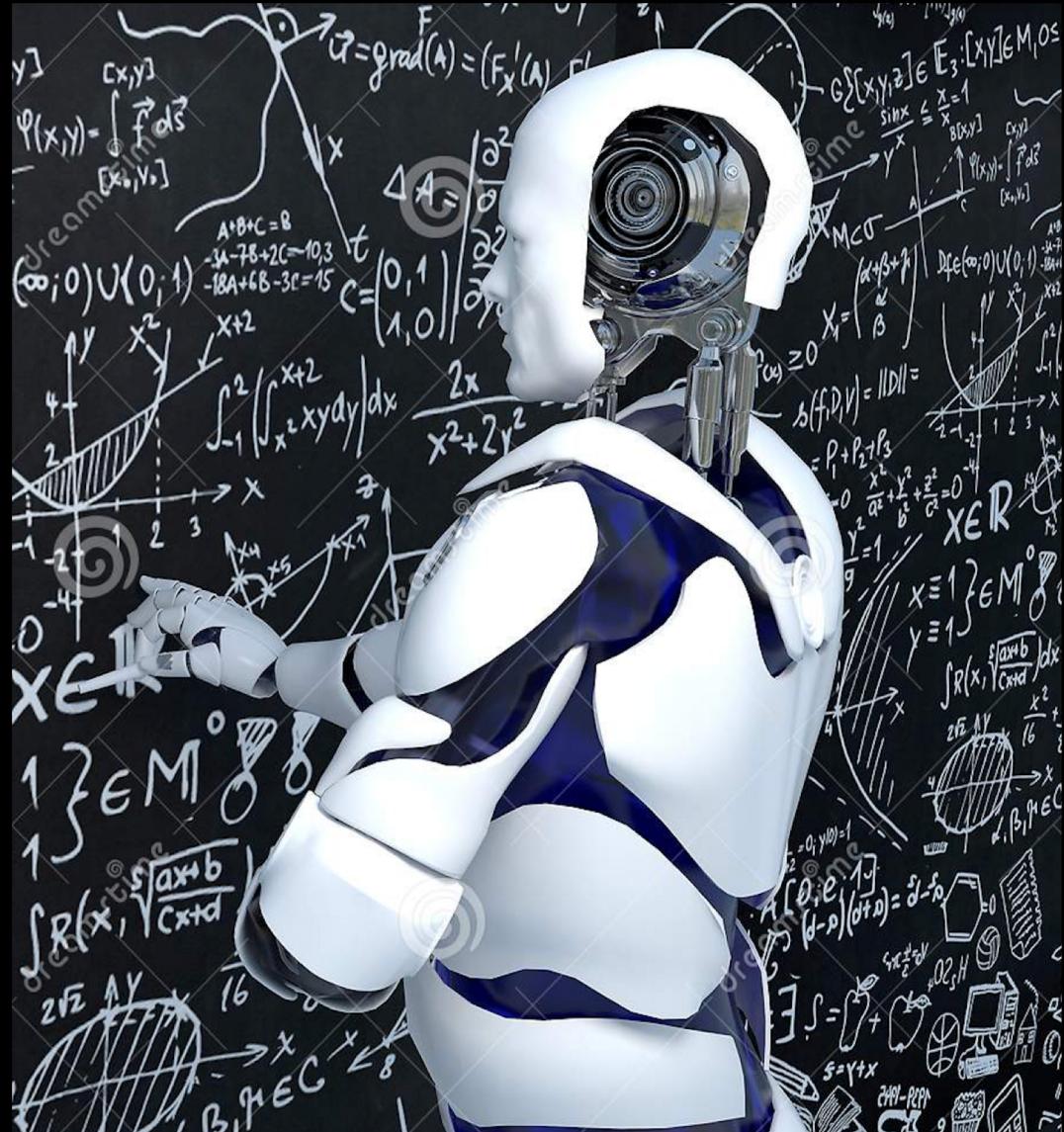
Master degree in Applied Mathematics, July 2019  
**current position:** PhD student in mathematics

My main field of research is Statistical Mechanics  
In particular, I am interested in Neural networks and Machine Learning

## This year submitted papers:

*"The relativistic Hopfield model with correlated patterns"* E. Agliari, A. Fachechi, C. Marullo  
Submitted to Journal of Mathematical Physics (2020)

*"Retrieval capabilities of neural networks with biased patterns"* E. Agliari, A. Fachechi, C. Marullo  
In preparation



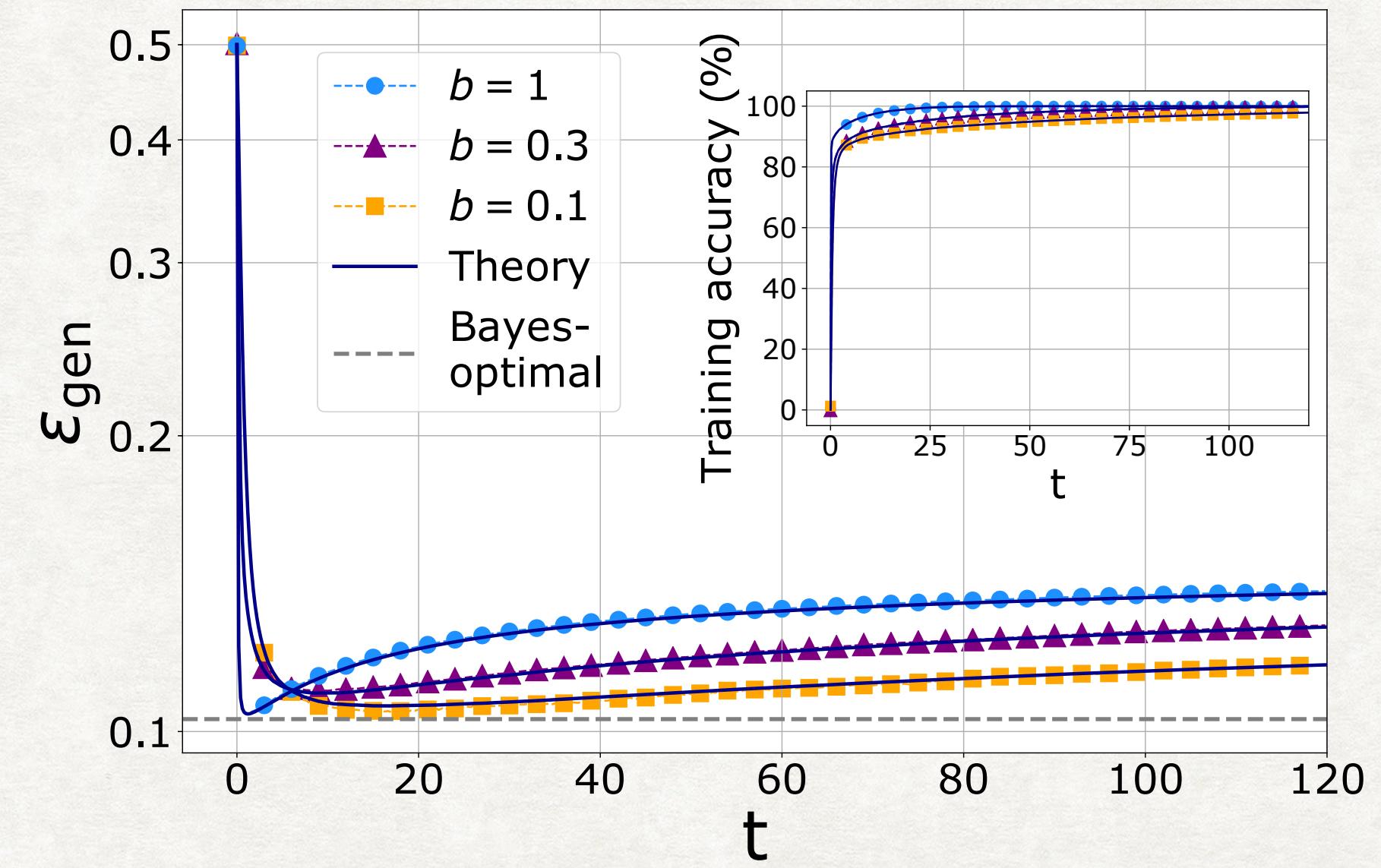


# Francesca Mignacco

Ph. D. in *Statistical physics modelling of artificial neural networks*  
under the supervision of Lenka Zdeborova & Pierfrancesco Urbani

Seminar on : *Dynamical mean-field theory for  
stochastic gradient descent*\*  
(Wed 12<sup>th</sup>)

\* FM, F. Krzakala, P. Urbani, L. Zdeborová,  
[arXiv:2006.06098](https://arxiv.org/abs/2006.06098)



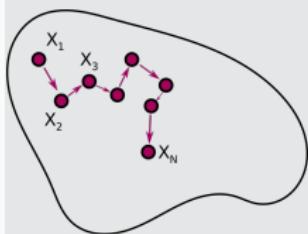
Athina Monemvassitis

LMBP / LPC (Université Clermont Auvergne, France)

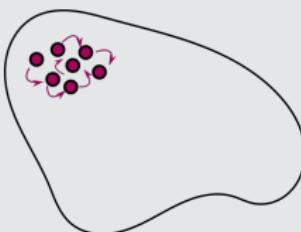
Co-advisors : Arnaud Guillin, Manon Michel, Stephane Monteil

## Exploration of energy landscapes in high-dimensions

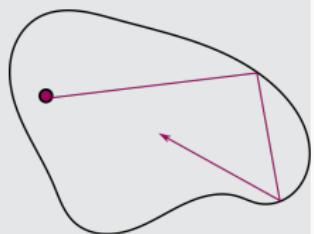
Monte Carlo



Metropolis



Irreversible (ECMC)



## Perspectives

- Application to mean-field methods in deep neural networks  
Alternative to Langevin dynamics ?
- Look at Coulomb gases
- ...

# RUBEN OHANA - PHD STUDENT

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- Supervised by F. Krzakala (LPENS), A. Rudi (DIENS - Inria), L. Daudet (LightOn)
- Two lines of work:
  - Optical Random Features (in collaboration with LightOn)
  - Theory of Random Features and Statistical learning theory
- Interested in the link between kernel methods and Neural Networks, adversarial attacks and Random Projections.



# Leonardo Petrini



Currently PhD Student @  
**Physics of Complex Systems Lab**  
Advisor: Prof. Matthieu Wyart

## Research Interests:

- Statistical Physics
- Neural Nets
- Reinforcement Learning  
(very recently)

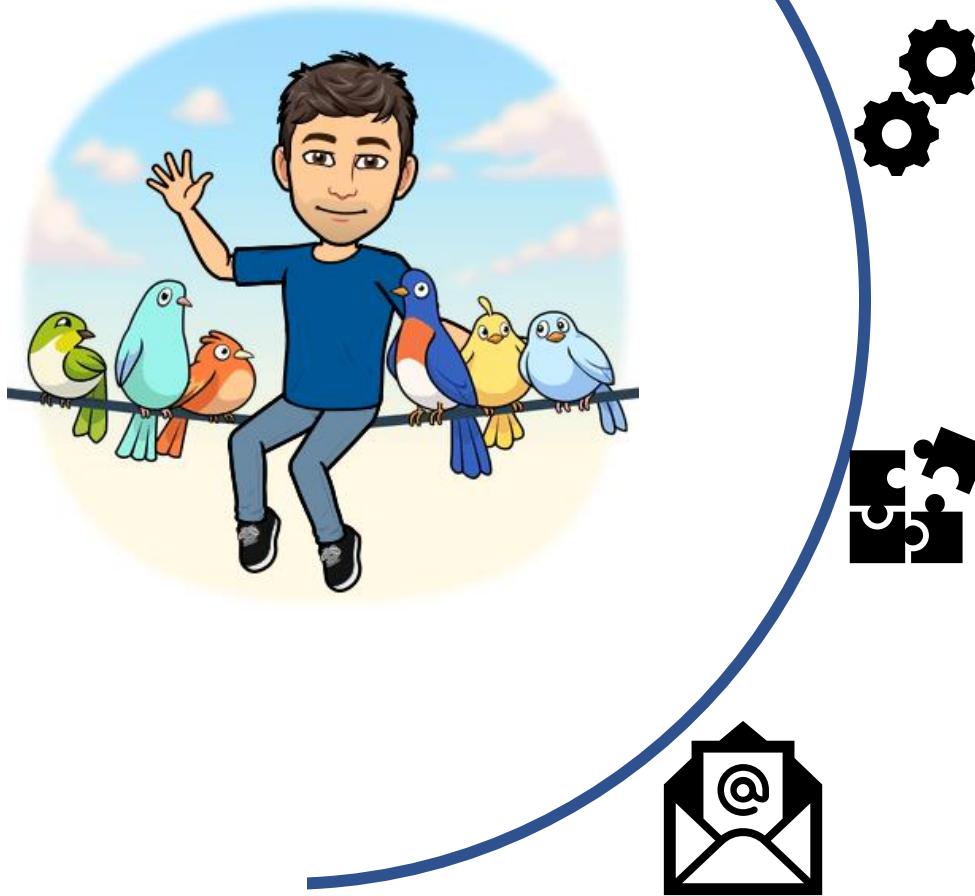


## Other interests:

- Hiking 
- Some climbing 
- Pizza 
- ...

# About me

Giovanni Piccioli



Master's student in statistical physics at Sapienza  
University of Rome

Statistical physics, inference and machine learning

Rock climbing, alpinism, hiking

[giovannipiccioli@gmail.com](mailto:giovannipiccioli@gmail.com)

# Hi everyone, I'm Mirko Pieropan

I'm a PhD candidate in Physics at [Politecnico di Torino](#), Italy

I work on **linear estimation problems** with [Andrea Pagnani](#) and [Alfredo Braunstein](#)

I hold a [M.Sc.](#) degree in Physics of Complex Systems from Politecnico di Torino and an [M2](#) degree in Physics from Université Paris Diderot (now Université de Paris)

I'm interested in **compressed sensing**, **approximate inference**, **message passing algorithms** and **neural coding**.

I'd like to work on **reinforcement learning** problems too in the future.

I'm excited to be here in Les Houches and I'm looking forward to knowing you!



# Maria Refinetti



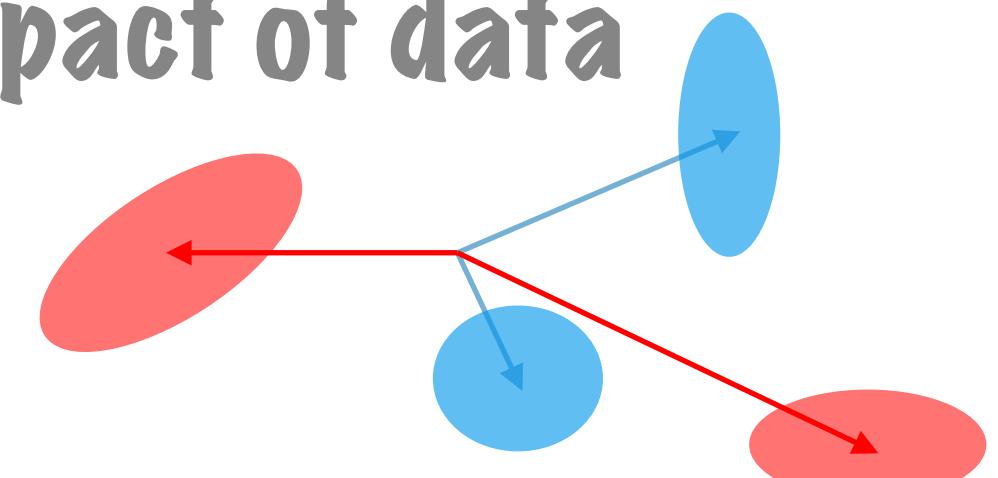
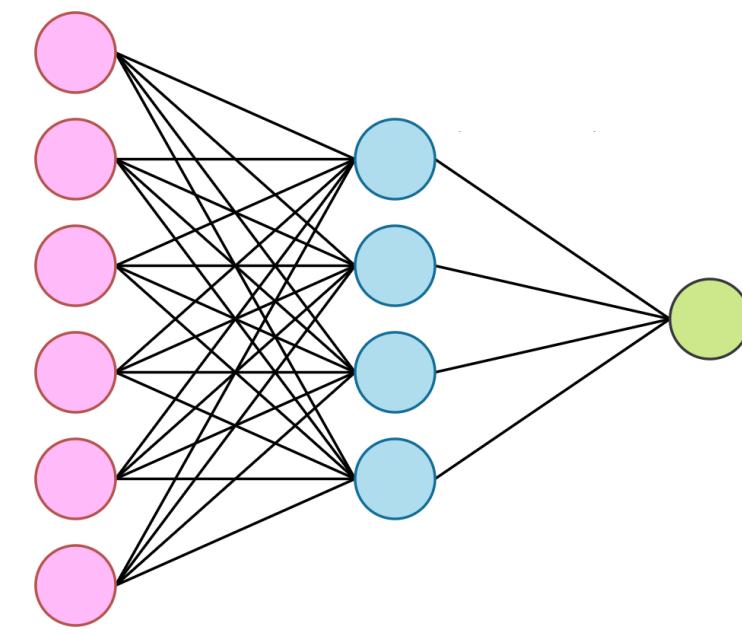
► 2019 - Master: EPFL High Energy Physics



► 2019 - PhD ENS Paris with F. Krzakala

→ Double Trouble in Double Descent (arXiv: 2003.01054)  
Rethinking the Bias Variance trade-off Using Random Features

→ Learning from a Gaussian Mixture Models and the impact of data structure



# Stefano Sarao Mannelli

For the next 3 months: PhD student at IPhT CEA Saclay  
with Lenka Zdeborovà

Physicist by training: master in the Physics of Complex  
Systems (Trieste, Torino, Paris)

Soon: postdoc at University of Oxford with Andrew Saxe

I like:

disordered systems in particular dynamical aspects

running, bike riding, ~~rock climbing~~.

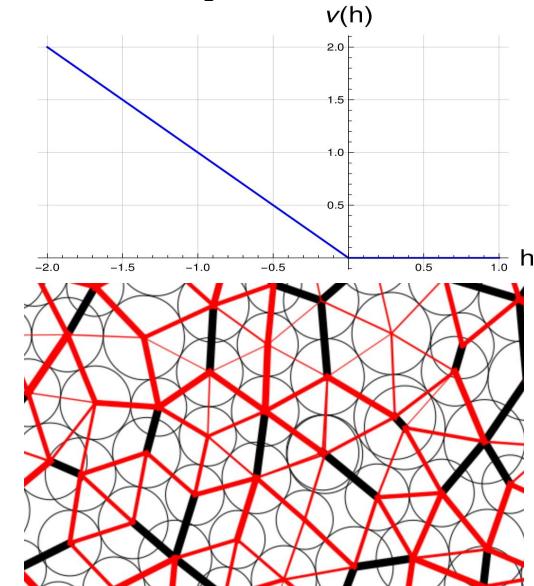


# Antonio Sclocchi

PhD student @ LPTMS, Orsay (Université Paris-Saclay) supervised by Silvio Franz  
and Pierfrancesco Urbani

## Topics:

- Perceptron model with linear hinge loss (theory and simulations)
- Soft spheres with linear repulsive potential
- Jamming criticality

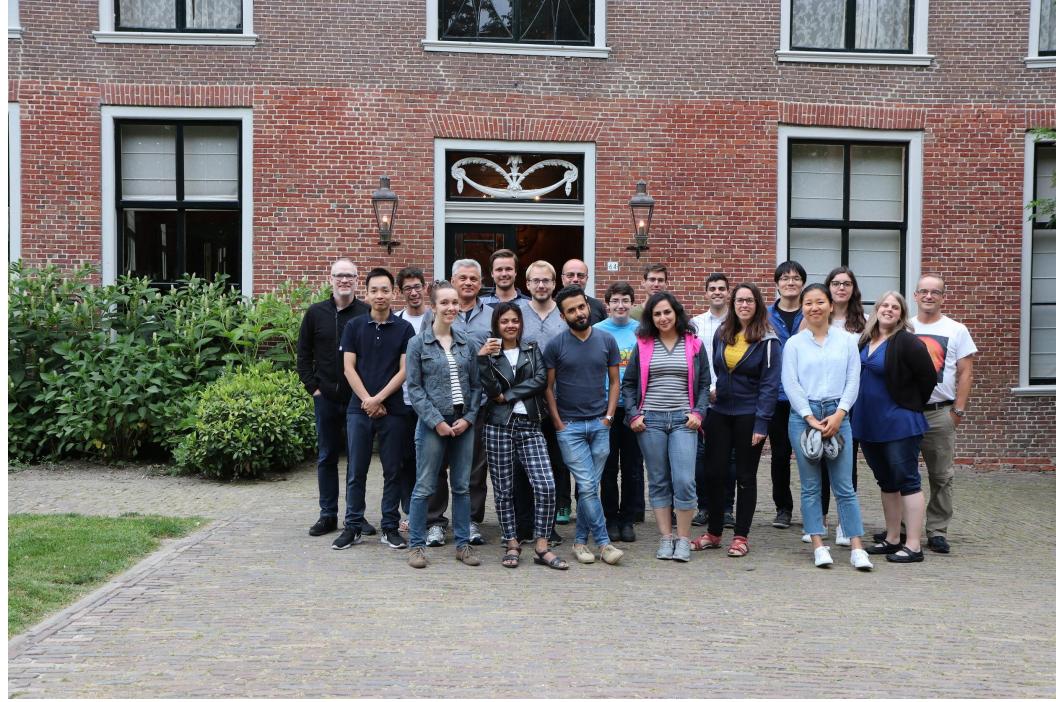


**Next:** from January 2021, post-doc with Matthieu Wyart @EPFL, Lausanne, studying learning in neural networks.



Michiel Straat

PhD student in the *Intelligent Systems* group  
University of Groningen



Group picture *Intelligent Systems*

## Interests

- Learning dynamics of machine learning algorithms, phase transitions
  - Neural networks, Learning Vector Quantization (model scenarios, student-teacher settings)
- Learning in the presence of concept drift, non-stationary situations.
- Predictive maintenance, automated control



# Tiffany Vlaar

- Partitioned Integrators for Thermodynamic Parameterization of Neural Networks
- Constraint-Based Regularization of Neural Networks

Joint work with:

**Benedict Leimkuhler**, Charlie Matthews, Timothée Pouchon, Amos Storkey