

# Sékou-Oumar Kaba

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Machine learning Ph.D. student with a physics background and data science industry experience. My interests include **AI for science**, **Geometric Deep Learning**, **Graph Representation Learning**.

## Education

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### Doctor of Philosophy in Computer Science

*McGill University*

GPA : 3.9 / 4.0

Supervisor: Prof. Siamak Ravanbakhsh

- Designing deep learning models that leverage symmetry in materials for prediction and generation.

**Montréal**

*Since 2020*

### Master of Science in Physics

*Université de Sherbrooke*

GPA : 4.1 / 4.3

Supervisor: Prof. David Sénéchal

- Conducted numerical simulations on quantum lattice models to study unconventional superconductivity.

**Sherbrooke**

*2016 - 2018*

### Bachelor of Science in Physics

*Université Laval*

**Québec**

*2013 - 2016*

## Research experience

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### Research Intern in AI for Science

*Microsoft Research Amsterdam*

Supervisor: Dr. Giulia Luise

**Amsterdam**

*2023*

### Research Intern in Machine Learning

*Mila - Quebec Artificial Intelligence Institute*

Supervisor: Prof. Yoshua Bengio

- Implemented deep learning models for material property prediction. Performed predictions on a database of existing materials to identify promising candidates for magnetic refrigeration.

**Montréal**

*2019 - 2020*

### Research Intern in Neuroscience

*CERVO Brain Research Center (Formerly CRIUSMQ)*

Supervisor: Prof. Robert Bonin

- Designed and performed optogenetics and behavioural experiments on mice to study the MrgprB4 expressing neurons suspected to play a role in chronic pain.

**Québec**

*2015*

## Industry experience

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### Scientific Developer

*OODA Technologies*

- Full-stack work on data collection, analysis, and visualization programs, with applications in geolocation and computer vision. Tested, debugged, and documented software products.

**Montréal**

*2018 - 2019*

### Data Scientist

*The Brane*

- Scraped and processed data from various scientific databases to populate knowledge graphs. Engineered ontologies for the extracted data.

**Montréal**

*2018 - 2019*

## Publications

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### Conference papers:

A. K. Mondal, S. S. Panigrahi, **S.-O. Kaba**, S. Rajeswar, S. Ravanbakhsh. *Equivariant adaptation of large pre-trained models*, Advances on Neural Information Processing Systems 36 (NeurIPS), 2023.

**S.-O. Kaba\***, A. K. Mondal\*, Y. Zhang, Y. Bengio, S. Ravanbakhsh. *Equivariance with learned canonicalization functions.*, International Conference on Machine Learning (ICML), 2023.

**S.-O. Kaba**, S. Ravanbakhsh. *Equivariant networks for crystal structures*. Advances on Neural Information Processing Systems 35 (NeurIPS), 2022.

M. Pezeshki, **S.-O. Kaba**, Y. Bengio, A. Courville, D. Precup, and G. Lajoie. *Gradient starvation: A learning proclivity in neural networks*. Advances on Neural Information Processing Systems 34 (NeurIPS), 2021.

### Workshop papers:

**S.-O. Kaba**, S. Ravanbakhsh. *Symmetry breaking and equivariant neural networks*. NeurIPS 2023 Workshop on Symmetry and Geometry in Neural Representations, 2023. (**Oral**)

**S.-O. Kaba\***, A. K. Mondal\*, Y. Zhang, Y. Bengio, S. Ravanbakhsh. *Equivariance with learned canonicalization functions*. NeurIPS 2022 Workshop on Symmetry and Geometry in Neural Representations, 2022. (**Spotlight**)

D. Levy\*, **S.-O. Kaba\***, C. Gonzales, S. Miret, S. Ravanbakhsh. *Using multiple vector channels improves E(n)-equivariant graph neural networks*. ICML Workshop on Machine Learning for Astrophysics, 2023.

### Journal articles:

**S.-O. Kaba**, B. Groleau-Paré, M.-A. Gauthier, A.-M. S. Tremblay, S. Verret, and C. Gauvin-Ndiaye. *Prediction of large magnetic moment materials with graph neural networks and random forests*. Phys. Rev. Mater., 7:044407, 2023.

**S.-O. Kaba** and D. Sénéchal. *Group-theoretical classification of superconducting states of strontium ruthenate*. Phys. Rev. B, 100:214507, 2019.

### Presentations:

*Equivariant networks for crystal structures*. Learning on Graphs Conference, Montréal, Canada, 2022.

*Superconductivity in strontium ruthenate with quantum cluster methods*. Canadian Graduate Quantum Conference, Vancouver, Canada, 2018. (**Best presentation award**)

### Invited talks and panels:

*Valoriser les communautés noires en IA*. IVADO, Canada, 2022.

*Zoom sur la recherche en physique de la matière condensée*. SAPHARI Symposium, Montréal, Canada, 2019.

## Summer schools

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- CIFAR Deep Learning and Reinforcement Learning Summer School, Canada 2022
- International Physics School on Quantum Materials, Sherbrooke, Canada 2017

## Awards and achievements

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### Scholarships:

FRQNT Doctoral Training Scholarship (25 000\$) 2023 - 2025

DeepMind PhD Scholarship (13 600\$) 2021 - 2024

IVADO PhD Excellence Scholarship (25 000\$) 2021 - 2024

DeepMind Masters Scholarship (12 000\$) 2020 - 2021

### Awards:

Laureate of the Acfas science popularization contest 2018

## Grants

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- Samsung SAIT Call for Projects, Pls : Siamak Ravanbakhsh and Yoshua Bengio (60 000\$) 2022

## Technical skills

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**Programming:** Python, Java, JavaScript      **Environment:** Mac OS, Linux, Windows

**Technologies:** Pytorch, Git, L<sup>A</sup>T<sub>E</sub>X, Docker, MongoDB, ArangoDB, React, Spring, Flask

## Other experience

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### Academic.....

#### Reviewer

- Advances on Neural Information Processing Systems (NeurIPS)
- Science Advances
- Nature Machine Intelligence
- NeurIPS Workshop on Symmetry and Geometry in Neural Representations (NeurReps)
- ICML Workshop on Topology, Algebra and Geometry in Machine Learning (TAG-ML)
- NeurIPS Workshop on AI for Accelerated Materials Design (AI4Mat)

#### Reading Group Organizer

Co-organized the [Geometric Deep Learning Reading Group](#) at Mila

**Montréal**

*Since 2023*

#### Workshop Organizer

Co-organized the Quantum and AI Day at Mila

**Montréal**

*2023*

### Teaching.....

#### Teaching Assistant

*Université de Sherbrooke*

Course: Statistical Mechanics I

- Prepared and taught weekly tutorial sessions using an active learning approach

**Sherbrooke**

*2017*

#### Science Instructor

*Cégep de Sainte-Foy*

**Québec**

*2013 - 2015*

### Outreach.....

#### Science Communication Consultant

*Acfas*

**Montréal**

*Since 2019*

#### Radio Host

*CISM (Montréal) and CFAK (Sherbrooke)*

- Co-hosted the weekly radio show *Aujourd'hui, c'est déjà demain*, aired on two radio stations and as a podcast.

**Montréal**

*2018*

#### Science Popularizer

*Boîte à science*

**Québec**

*2014*

### Community service.....

#### Laboratory Representative

*Mila - Quebec Artificial Intelligence Institute*

**Montréal**

*2020 - 2022*

#### Student Mentor

*Projet SEUR*

**Montréal**

*2019 - 2021*

#### Vice President External

*Regroupement étudiant des chercheurs en sciences de l'Université de Sherbrooke*

**Sherbrooke**

*2017 - 2018*

#### Vice President Academic

*Association des étudiants de physique de l'Université Laval*

**Québec**

*2015 - 2016*