

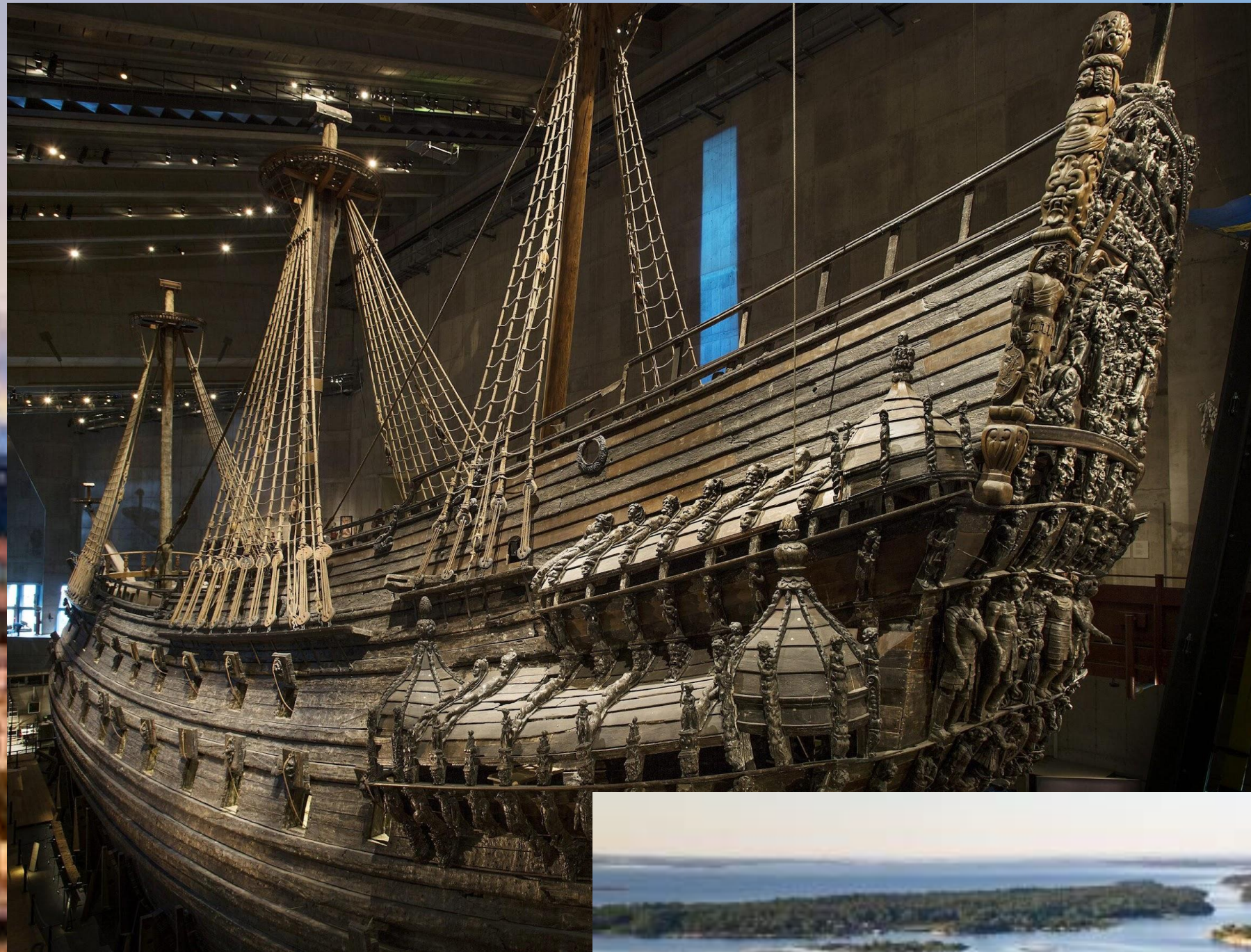
2025 WINTER SCHOOL MACHINE LEARNING & PHYSICS

13-24 JANUARY 2025

 Nordita



Welcome to Stockholm!





1957: founded in
Copenhagen

2007: move to
Stockholm

2021: new
building



The Wallenberg Initiative on Networks and Quantum Information (WINQ)

Quantum Physics: Fabio Costa, Robert Jonsson, Andrea Maiani, Sreenath Manikandan, Jason Pye, Sofia Qvarfort, Jing Yang, Roope Kristian Uola



Networks and Complex Systems: Soon Hoe Lim, Henri Riihimäki, Hanlin Sun, Niccolò Zagli, Matthew de Courcy-Ireland



PIs: Prof. John Wettlaufer (Yale, Nordita) and Prof. Frank Wilczek (MIT, ASU, SU)



The Organizers



Robert Jonsson, Andrea Maiani, Soon Hoe Lim, Jason Pye, Jing Yang

The Events Team



Anastasios Mentesidis, Olga Lekka

School web page: <https://indico.fysik.su.se/event/8856/>

Schedule

Date	9.15-10.45	11.15-12.45	14.45-16.15	16.45-18.15	Evening
13 Jan (Mon)	Bruno Loureiro	Bruno Loureiro	Arno Solin	Welcome Fika (16.15, Floor 6)	
14 Jan (Tue)	Bruno Loureiro	Bruno Loureiro	Arno Solin	Discussion	
15 Jan (Wed)	Arno Solin	Arno Solin	Niels Bohr Colloquium by Bernhard Mehlig (3-4pm, venue TBD)	Discussion	School Dinner (6.30pm, <i>Hermans</i>)
16 Jan (Thu)	Florian Marquardt	Florian Marquardt	Social Poster Session (3-6pm, Floor 6)	Social Poster Session (3-6pm, Floor 6)	
17 Jan (Fri)	Florian Marquardt	Florian Marquardt	Discussion		
Weekend					
20 Jan (Mon)	Ricardo Vinuesa	Ricardo Vinuesa	Evert van Nieuwenburg	Discussion	
21 Jan (Tue)	Evert van Nieuwenburg	Evert van Nieuwenburg	Riddhi Gupta	Discussion	
22 Jan (Wed)	Riddhi Gupta	Connor van Rossum	Michael Spannowsky	Discussion	
23 Jan (Thu)	Anna Dawid	Anna Dawid	Ricardo Vinuesa	Discussion	
24 Jan (Fri)	Anna Dawid	Michael Spannowsky	Michael Spannowsky	Discussion	Farewell party

Niels Bohr Colloquium

15 Jan (Wed), 3-4pm, venue TBD



Bernhard Mehlig
(U of Gothenburg)

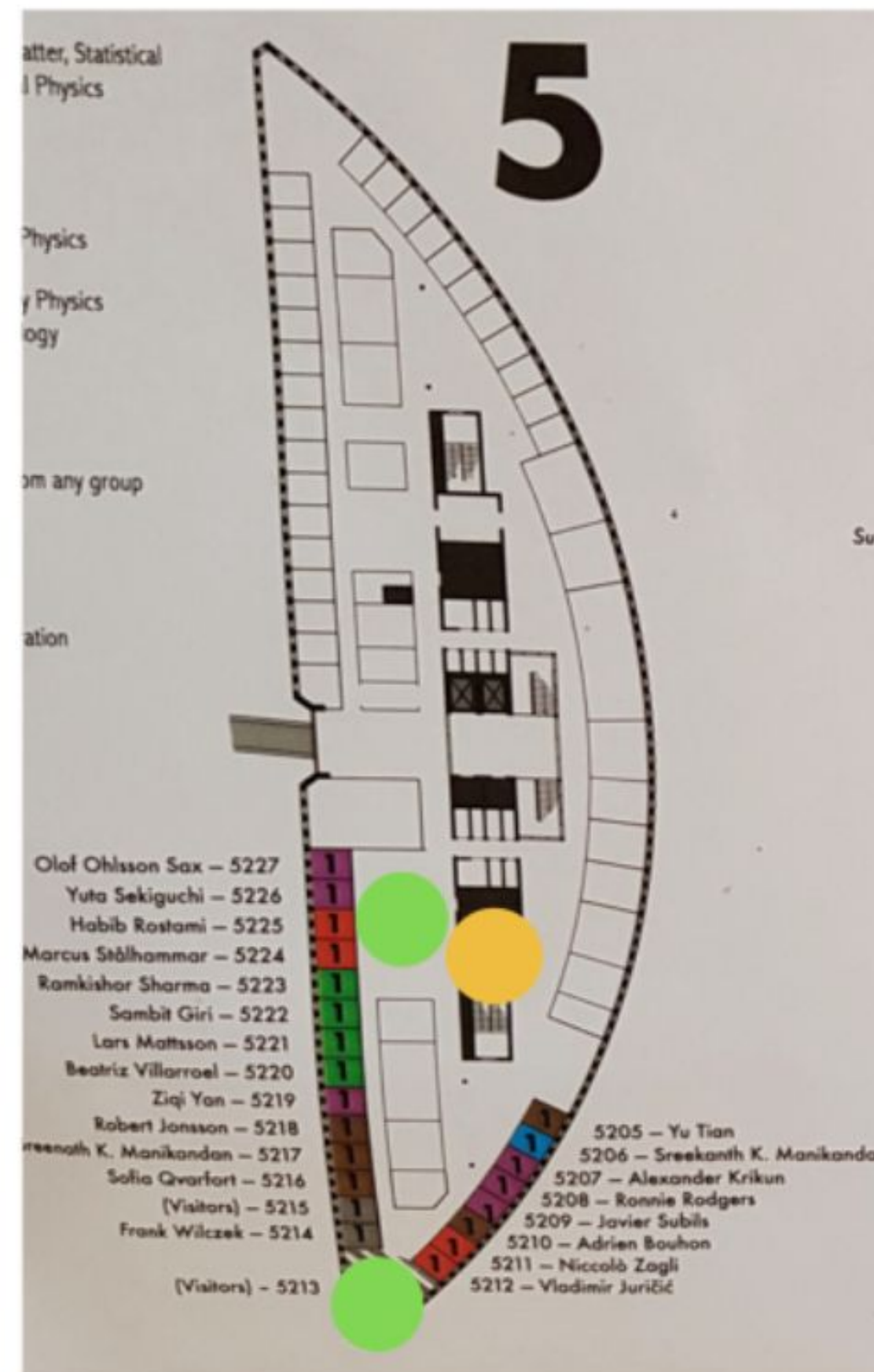
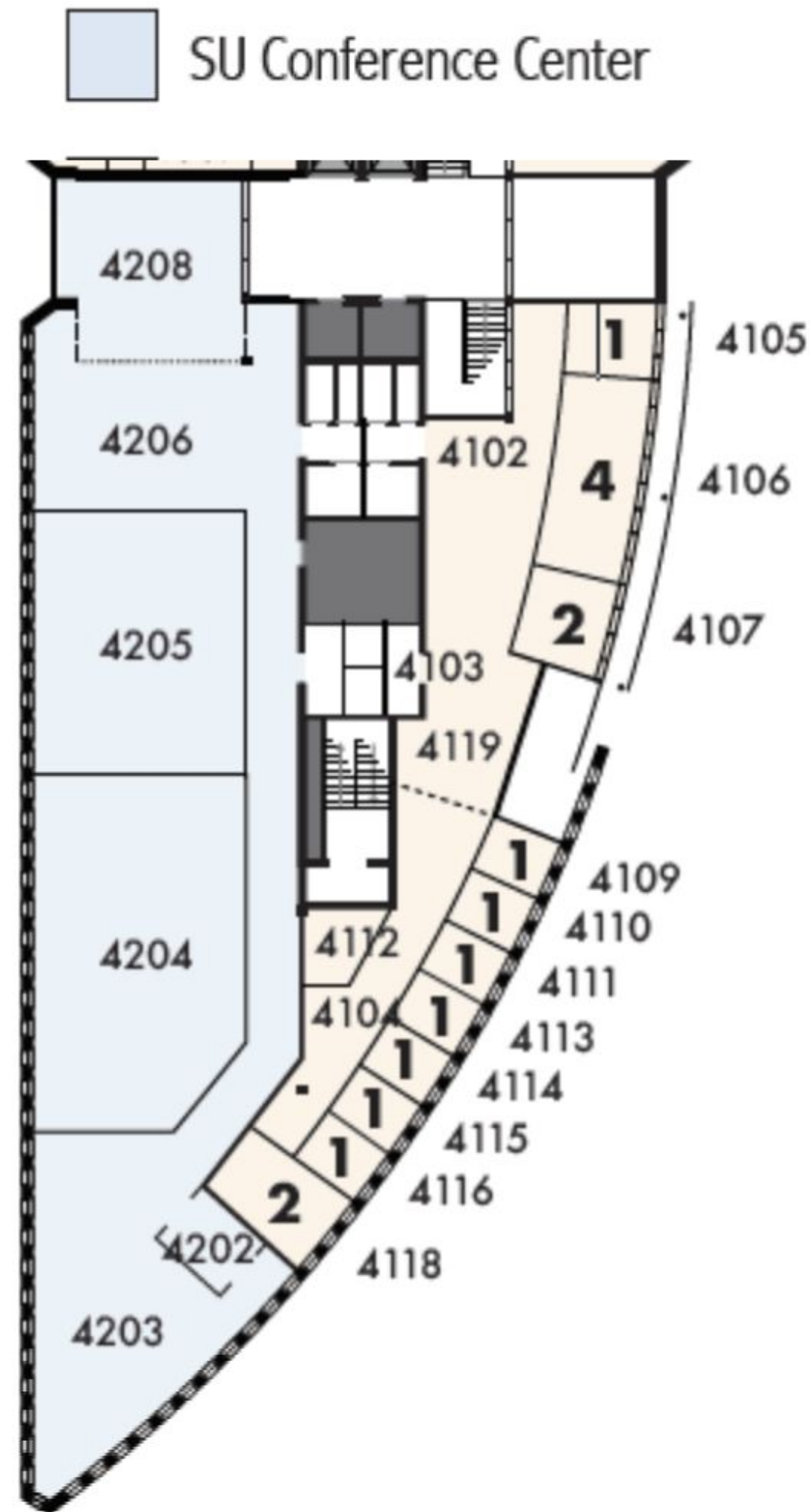
Multiplicative amplification in deep neural networks

After giving an introduction to deep learning, I will discuss how deep networks learn. This can be analysed and understood, in part, using concepts from dynamical-systems theory [1]. For deep neural networks, the maximal finite-time Lyapunov exponent forms geometrical structures in input space, akin to coherent structures in dynamical systems such as turbulent flow. Ridges of large positive exponents divide input space into different regions that the network associates with different classes in a classification task. The ridges visualise the geometry that deep networks construct in input space, and help to quantify how the learning depends on the network depth and width [2].

[1] Bernhard Mehlig, [Machine Learning with neural networks](#), Cambridge University Press (2021)

[2] Storm, Linander, Bec, Gustavsson & Mehlig, [Finite-time Lyapunov exponents of deep neural networks](#), Phys. Rev. Lett. 132 (2024) 057301

Practical Information



- Workspaces:** Use the open desks throughout floor 6 and floor 5 (east wing).
- Coffee:** Help yourself to free coffee in Nordita's kitchens on floor 5 and floor 6.



Food

Albano restaurant

Proviant

Coffice



Lockers

