

Prize Talk

PV VIII Tue 14:50 RW 1

Complex scattering systems: from non-Hermitian topology to neuromorphic computing — ●CLARA WANJURA — Max Planck Institute for the Science of Light, Staudtstraße 2, 91058 Erlangen — Laureate of the Gustav-Hertz-Prize 2026

Recent experimental advances allow us to realise complex optical systems that can be explored for quantum science and technological applications, ranging from sensors based on optomechanical systems harnessing the interaction between light and mechanical vibrations to analogue computing systems based on nanophotonics. In my talk, I will discuss two different kinds of complex scattering systems enabled by these advances.

In the first part, I will discuss a notion of topology only arising in systems exhibiting gain and loss and how these systems can be harnessed to devise quantum devices such as quantum-limited directional amplifiers and sensors, e.g., based on cavity optomechanics. Specifically, we

have shown that this notion of non-Hermitian topology corresponds one-to-one with the phenomenon of directional amplification, which is highly sought-after for applications including quantum information processing. Non-Hermitian topology is also a resource for sensing as we recently demonstrated in an optomechanical system.

In the second part, I will discuss our work on neuromorphic computing systems based on optical scattering. Neuromorphic computing is born out of the demand for more energy-efficient hardware for machine learning and artificial intelligence. As such, neuromorphic computing aims to replace or complement our digital hardware with analogue physical neural networks. In particular, I will show how one can perform fully non-linear neuromorphic computing with a purely linear scattering system. This approach greatly simplifies the experimental requirements on neuromorphic hardware platforms and can be widely applied in existing state-of-the-art scalable platforms, such as optics, microwave and electrical circuits.