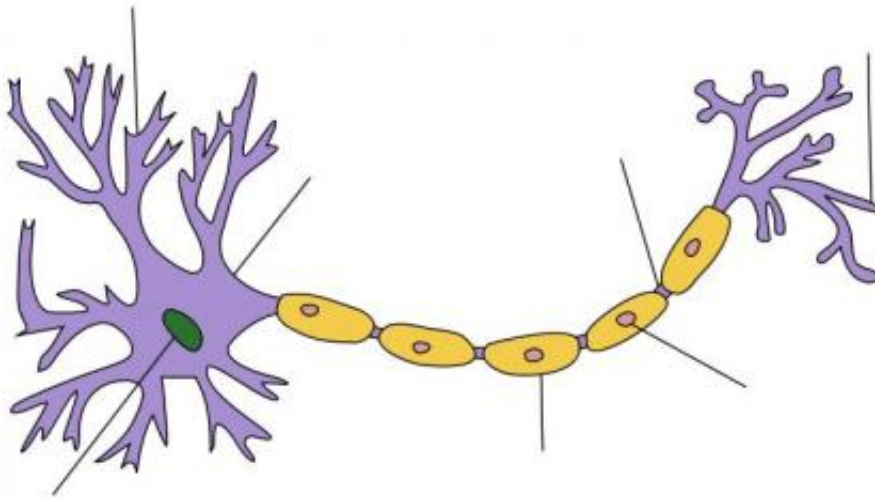


The highways of our brain

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Myelin sheath. Credit: Wikipedia.

Researchers from the Netherlands Institute for Neuroscience (NIN) used a new technique to show how electrical impulses are traveling at high speed in the brain. It appears that myelin, the sheath around neurons, creates a coaxial cable producing multiple waves of electrical potentials traveling in a more complicated manner than was envisioned earlier. These findings allow us to create better theories and tools to understand demyelinating diseases, including the most common neurological disorder, multiple sclerosis. The paper has been published in the prestigious scientific journal *Cell*.

The brain consists of around one hundred billion neurons. All these neurons have to communicate with each other. This happens by means of exchanging [electrical impulses](#) traveling at velocities of up to 360 km/h. "We know this requires the presence of [myelin](#) sheaths, consisting of multiple layers of fatty material wrapped around the nerve cell extensions. Myelin is often conceptualized as being an insulator that leads to the "jumping" of electrical potentials along the cables that we could see as the 'highways of our brain,' but the mechanisms of jumping were not understood. However, this research opens new avenues to understand the hardware of the brain in terms of it computes with rapid signal transfer," says professor Maarten Kole.

12 nanometers

Together with researchers of the Max-Planck Institute (MPI) of Experimental Medicine (Göttingen, Germany), the researchers used [electron microscopy](#) to measure the distance between the nerve cell membrane and the insulating sheath, which turned out to be 12 nanometers, approximately 10,000 times thinner than a hair. Furthermore, the scientists of the NIN used a new technique to make electricity visible and took advantage of a supercomputer to calculate the specific properties of myelin sheaths. "All the findings together showed that instead of being an insulating sheath, myelin creates an additional layer like coaxial cables producing multiple waves of electrical potentials travelling in a more complicated manner than was envisioned earlier," Kole explains. These findings open new avenues to understand the hardware of how brains are computing with rapid signal transfer.

Multiple Sclerosis

This research also will help to better understand demyelinating diseases such as multiple sclerosis (MS). In patients with MS, [myelin sheaths](#) are broken down. This leads to an increasing degree of limitations that affect

strength, balance and coordination, and thus the patient's mobility. In order to be able to cure and prevent MS, it is important to know the exact way the myelin sheath functions in order to predict what happens if it doesn't function as it should. "Our work now may provide reliable predictions of how impulses travel along the highways without myelin. This finding contributes to the understanding of the cellular changes occurring in MS," says Kole.

More information: Charles C.H. Cohen et al, Saltatory Conduction along Myelinated Axons Involves a Periaxonal Nanocircuit, *Cell* (2019). [DOI: 10.1016/j.cell.2019.11.039](https://doi.org/10.1016/j.cell.2019.11.039)

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