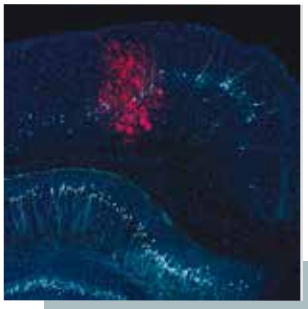
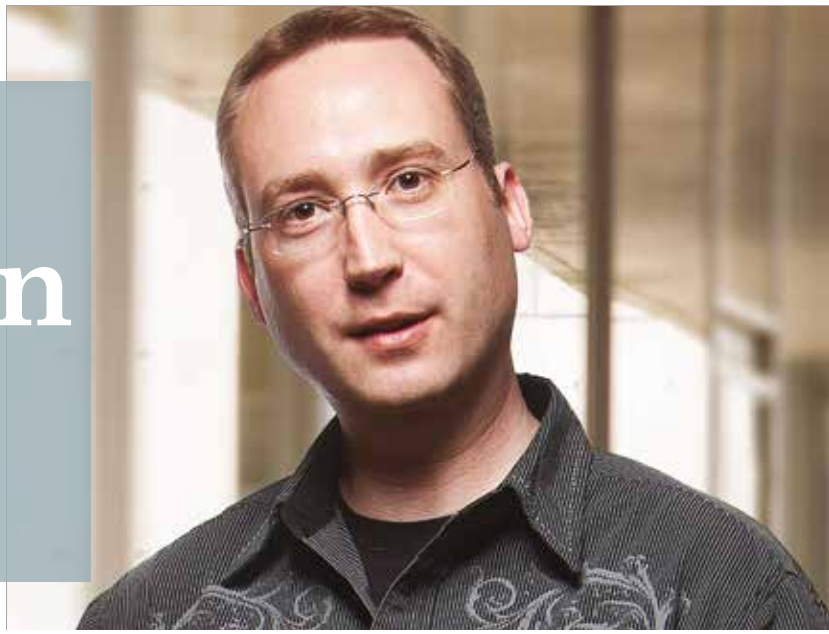


salk
Where cures begin.



Axel Nimmerjahn

Assistant Professor
Waitt Advanced Biophotonics Center

The Problem

The human central nervous system (CNS), which includes the brain and spinal cord, consists of an incredibly diverse set of cells, and each cell type carries out highly specialized functions in cellular networks of dazzling complexity. While much research has focused on understanding the circuits formed by neurons, brain cells called glia are equally pervasive and account for roughly an equal number of cells in the human brain. Glial cells were long believed to play a merely passive, supportive role in the CNS. However, it is becoming increasingly clear that glia make crucial contributions to CNS formation, operation and adaptation. Additionally, glial cells are involved in practically all CNS injuries and diseases, including viral and bacterial infections, Alzheimer's and Parkinson's diseases, cancer and stroke. This makes glia promising targets for future therapeutic interventions.

The Approach

Axel Nimmerjahn has spearheaded the development of new microscopy techniques to visualize the dynamics of glial cells and their functional cellular interactions in the living brain. Additionally, he has created new tools for cell type-specific staining and genetic manipulation and for analysis of large-scale imaging data. This has allowed him to address long-standing questions regarding the role of glial cells in the intact healthy or diseased brain. Resolving these fundamental questions has broad implications for our understanding of brain function and the treatment of neuroinflammation and neurological disorders. Nimmerjahn has recently expanded his studies to the spinal cord and related maladies.

He continues to push the boundaries of microscopy. In collaboration with other engineering experts, he has worked to shrink the size of microscopes to make them wearable. His tiny microscopes are less than 0.2 cubic inch in size, weigh less than two grams and have allowed him to reveal how cellular brain activity relates to animal behavior.

The Innovations and Discoveries

- Nimmerjahn discovered that microglia, the brain's resident immune cells, continuously survey the cellular environment with their fine branches. He showed that through this behavior, microglia provide the first line of defense against tissue injury and infection.
- Nimmerjahn's lab used cutting-edge microscopy approaches to visualize the blood-brain barrier (BBB) breakdown after stroke. His team found that stepwise impairment of different cellular mechanisms accounts for the BBB deficits in stroke. The findings could lead to new ways to treat the disease.
- Nimmerjahn uncovered that astroglia, a major regulatory cell type in the brain, show large-scale activity that potentially initiates macroscopic changes in brain dynamics. He also showed how general anesthesia disrupts this waking state activity.

For more information, please visit:
http://www.salk.edu/faculty/nimmerjahn.html

Biophotonics, Cancer, Neurobiology, Neurological Disease, Stroke