



Neuron

Axon

Laser

HOT STUFF The laser zaps the axon with quadrillions of pulses of light per second, creating a spot on the cell that is as hot as the sun. (The beam's tight focus and short duration prevent heat from building up in surrounding cells.) The axon evaporates off [inset] as a plasma of electrons and ions, leaving behind scant debris.

NURSE, PASS THE FEMTOLASER

THOUGH HE'S PERFORMED more than 8,000 brain surgeries in his 30-year career, Michael Apuzzo hates using a scalpel, a tool he considers woefully outdated. "Whenever I go in to do a surgery with a scalpel in my hand," says Apuzzo, a professor of neurological surgery at the University of Southern California, "I feel like I should be wearing a powdered wig."

Soon Apuzzo may be able to swap his 18th-century cutting tool for a laser. Femtosecond lasers, the fastest in the world, are capable of producing energy pulses that last a millionth of a billionth of a second and can be focused into beams less than one hundredth the diameter of a human hair. This makes them ideal for operating on subcellular structures—such as the axon, the long tail by which a neuron sends information to its neighbors—that are far too small for even the finest robotic surgical hands to handle.

Biologist Yishi Jin of the University of California at Santa Barbara and mechanical engineer Adela Ben-Yakar of the University of Texas led a team that used the femtolaser to sever the axons that control muscles in nematode worms. The worms immediately lost the ability to wiggle backward, although they regenerated about half their axons, and some worms regained full movement within 24 hours. The ability to operate on individual brain cells without killing them in the process could allow scientists to study how the cells regenerate and might lead to better treatments for neurodegenerative diseases such as Alzheimer's and Parkinson's. Someday, doctors could even use the laser to slice out damaged axons and replace them with new ones. With far-off applications such as these, the femtolaser has the potential to take neurosurgery way beyond the limits of its powder-wigged origins.—ANDREW ROSENBLUM