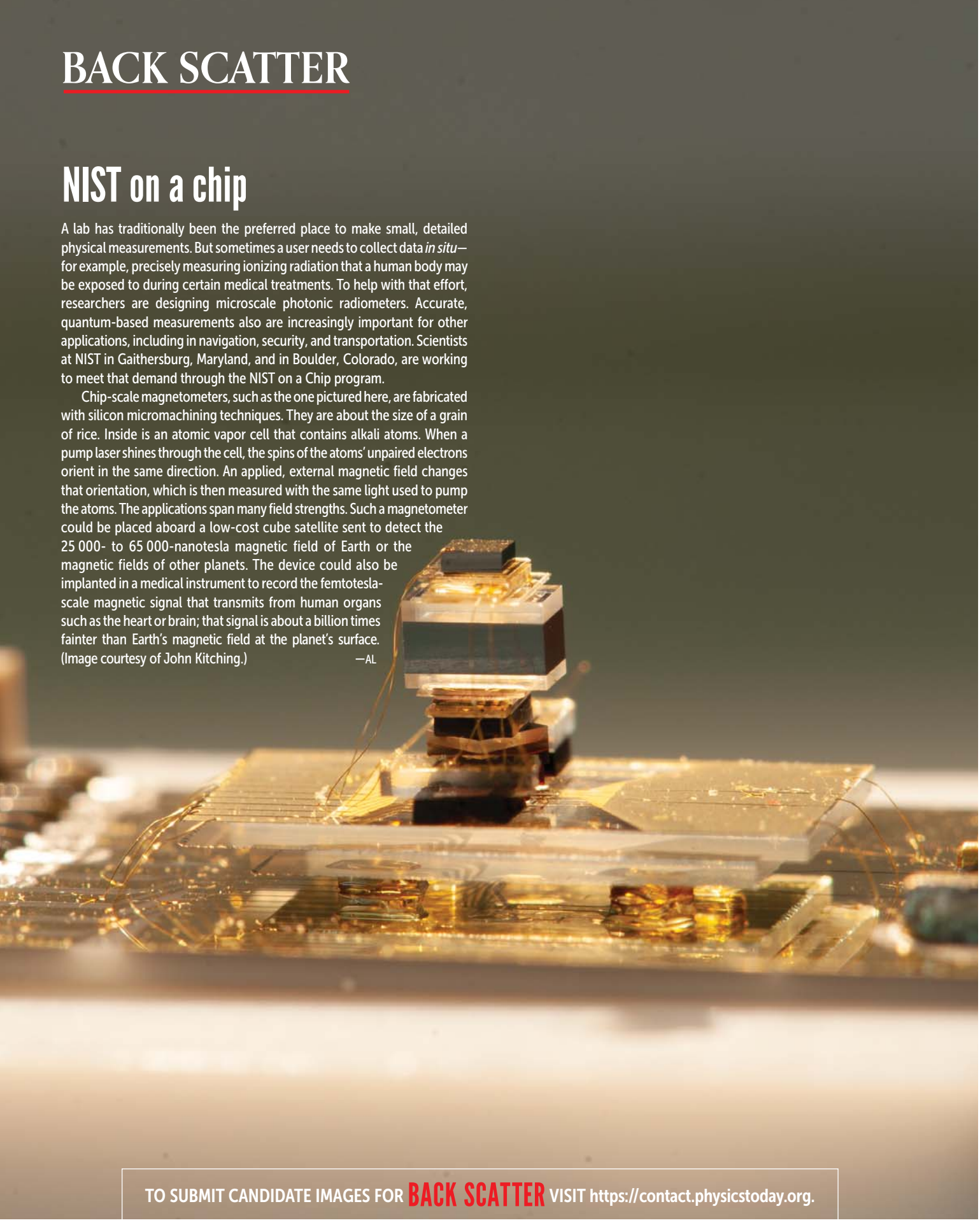
# NIST on a chip

A lab has traditionally been the preferred place to make small, detailed physical measurements. But sometimes a user needs to collect data *in situ*—for example, precisely measuring ionizing radiation that a human body may be exposed to during certain medical treatments. To help with that effort, researchers are designing microscale photonic radiometers. Accurate, quantum-based measurements also are increasingly important for other applications, including in navigation, security, and transportation. Scientists at NIST in Gaithersburg, Maryland, and in Boulder, Colorado, are working to meet that demand through the NIST on a Chip program.

Chip-scale magnetometers, such as the one pictured here, are fabricated with silicon micromachining techniques. They are about the size of a grain of rice. Inside is an atomic vapor cell that contains alkali atoms. When a pump laser shines through the cell, the spins of the atoms' unpaired electrons orient in the same direction. An applied, external magnetic field changes that orientation, which is then measured with the same light used to pump the atoms. The applications span many field strengths. Such a magnetometer could be placed aboard a low-cost cube satellite sent to detect the 25 000- to 65 000-nanotesla magnetic field of Earth or the magnetic fields of other planets. The device could also be implanted in a medical instrument to record the femtotesla-scale magnetic signal that transmits from human organs such as the heart or brain; that signal is about a billion times fainter than Earth's magnetic field at the planet's surface. (Image courtesy of John Kitching.) —AL



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