Comparative analysis of optical-physical schemes of gyroscopes based on macroscopic quantum effects of superfluid helium isotopes (^{3}He & ^{4}He)

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Measuring fluctuations in Earth's rotation rate requires a sensitive laboratory instrument. Now, two groups of researchers have exploited the peculiar quantum properties of superfluid helium to build novel gyroscopes that can sense Earth's spin. Richard E. Packard, a physicist of the University of California, Berkeley, has demonstrated a new kind of gyroscopes that can detect absolute rotation at a very sensitive level. In principle, the new device has the potential to surpass the most sensitive gyroscopes available today for high-precision measurements of rotation rates. Eric Varoquaux of the University of Paris-South in Orsay, France, and his coworkers presented their findings last year at a conference in Prague. And now my group (the first group in Russia) has started doing a research. Gathering the world experience (in patents, scientific efforts etc.), we aim to achieve the purity of our developments. A superfluid helium gyroscope takes advantage of the fact that the flow of a superfluid filling a doughnut-shaped container is quantized. In this case, the flow velocity multiplied by the length of the path along the center of the toroidal channel must be zero or a whole-number multiple of a fundamental quantity determined by Planck's constant and the mass of a helium atom.