4CF15-2015-000007

Abstract for an Invited Paper
for the 4CF15 Meeting of
the American Physical Society

Simple generation and measurement of twisted light with orbital angular momentum

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We normally think of light as traveling straight between points in space, but beams of light can rotate as they travel. In the simplest rotating beams, individual light particles (photons) spin as they travel and this "spin angular momentum" has been well understood for about 100 years. But less than 25 years ago, the "orbital angular momentum" form of rotation was discovered that leads to "twisted light" with a helical phase. Twisted light has many exciting applications, including controlling tiny micromachines, measuring star rotation, enabling super-high-resolution imaging, and allowing communication with theoretically-unlimited bandwidth. Conventional methods for generating and measuring twisted light involved either expensive and fixed-wavelength optics or computer-controlled electro-optics such as a spatial light modulator. In this talk, I will review the applications of twisted light, and also discuss our research into very simple methods for generating and measuring light's OAM. Using off-the-shelf optical components such as lenses and optical fiber, we demonstrate 1.) tunable generation of twisted light with OAM up to $\pm.8\hbar$ per photon, and 2.) quantitative OAM measurement. These simple and inexpensive methods of manipulating light's OAM should reduce the barrier to using twisted light in new technologies.