Q 43: Laser Applications: Optical Measurement Technology

Time: Thursday 11:00–12:15 Location: P 5

Group Report Q 43.1 Thu 11:00 P 5

Novel optical beams, from accelerating wavepackets to Janus waves — •Dimitrios Papazoglou[1,2] and Stelios Tzortzakis[1,2,3] — [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, P.O. Box 1527, 71110, Heraklion, Greece — [2]Department of Material Science and Technology, University of Crete, P.O. Box 2208, 71003, Heraklion, Greece — [3]Science Program, Texas A&M University at Qatar, P.O. Box 23874, Doha, Qatar

Lately a plethora of optical beams with non-trivial amplitude and phase distributions like for example the accelerating Airy and ring-Airy beams have been introduced. These novel optical beams propagate in curved trajectories and resist to diffraction or dispersion. Therefore, they are able to self-heal and bypass obstacles, advantages that make them exiting for applications ranging from materials processing to telecommunications. Recently we have revealed that these waves are members of the broader family of Janus waves. Counterintuitively, when these Janus waves are focused, two focal regions, instead of one are formed. On the other hand, the generation and control of these wavepackets is not trivial. Their complexity challenges our current state of the art techniques for wavefront shaping, and has urged us to exploit, among others, unconventional approaches like the use of optical aberrations. The talk will focus on the exciting ongoing quest of materializing these novel optical wavepackets, and their usage to a broad range of applications ranging from tailored filaments, light bullets, multi-photon polymerization and THz generation.

Q 43.2 Thu 11:30 P 5

"Single Pixel" Imaging and its application in beam profile analysis — •Daniel Laukhardt, Till Mohr, Sébastien Blumenstein, and Wolfgang Elsässer — Technische Universität Darmstadt, Darmstadt, Germany

Nowadays it is not implicitly necessary to make use of high resolution cameras in order to get spatial resolved images. With the progress of computational capacity the application of single pixel detectors appeared more frequently in the scope of imaging. To achieve spatial resolution in this single pixel detector concept, a set of particular masks is needed which is sequentially projected onto the object, providing the spatial information. This task can be fulfilled by digital micromirror devices (DMD) which have the advantage of a high reflectivity in a broad wavelength range. Recent applications of single pixel imaging range from real time 3D imaging in the visible spectrum [1] to imaging in the terahertz spectral region [2].

In this contribution, we perform beam profile analysis using the single pixel imaging concept for a large wavelength span using a DMD and three different single pixel detectors. Thereby we are able to measure the beam profile of different light sources covering the range from the blue visible to the mid infrared spectral region.

[1] B. Sun et al., Science, Vol. 340, Issue 6134, pp. 844-847 (2013)

[2] W. L. Chan et al., Appl. Phys. Lett., Vol. 93, 121105 (2008)

Q 43.3 Thu 11:45 P 5

Miniature cavity-enhanced diamond magnetometer — •Georgios Chatzidrosos[1], Arne Wickenbrock[1], Lykourgos Bougas[1], Nathan Leefer[2], Teng Wu[1], Kasper Jensen[3], Yannick Dumeige[4], and Dmitry Budker[1,2,5,6] — [1]Johannes Gutenberg-Universität Mainz, 55128 Mainz, Germany — [2]Niels Bohr Institute, University of Copenhagen, Blegdamsvej 17, 2100 Copenhagen, Denmark — [3]CNRS, UMR 6082 FOTON, Enssat, 6 rue de Kerampont, CS 80518, 22305 Lannion cedex, France — [4]Helmholtz Institut Mainz, 55099 Mainz, Germany — [5]Department of Physics, University of California, Berkeley, CA 94720-7300, USA — [6]Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA

We present a miniaturized cavity-enhanced room-temperature magnetic field sensor based on nitrogen vacancy (NV) centers in diamond. The magnetic resonance signal is detected by probing absorption on the 1042 nm spin-singlet transition. The enhanced absorption of the infrared light gives an improved signal contrast greater than 13% at room temperature. Based on this, we demonstrate a magnetic-field sensitivity of $120\,\mathrm{pT}/\sqrt{\mathrm{Hz}}$, and a projected a photon shot-noise-limited sensitivity of $12\,\mathrm{pT}/\sqrt{\mathrm{Hz}}$ for the amount of infrared light collected, while the quantum projection-noise-limited sensitivity for our sensing volume of $\sim 390\mu\mathrm{m} \times 1200\ \mu\mathrm{m}^2$ is estimated to be $0.7\,\mathrm{pT}/\sqrt{\mathrm{Hz}}$

Q 43.4 Thu 12:00 P 5

Microwave-free magnetometry with nitrogen-vacancy centers in diamond — •Huijie Zheng[1,2], Arne Wickenbrock[1,2], Lykourgos Bougas[1,2], Nathan Leefer[1,2], Samer Afach[2], Andrey Jarmola[3], Victor. M Acosta[4], and Dmitry Budker[1,2,3,5] — [1]Johannes Gutenberg-Universitaet Mainz, 55128 Mainz, Germany — [2]Helmholtz Institut Mainz, 55128 Mainz, Germany — [3]University of California, Berkeley, CA 94720-7300, USA — [4]University of New Mexico, Center for High Technology Materials, Albuquerque, NM 87106, USA — [5]Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA

We demonstrate a method of all-optical magnetometry by using magnetic-field-dependent features in the photoluminescence of negatively charged nitrogen-vacancy centers. In particular, our method relies on the level anti-crossing (LAC) in the triplet ground state at 102.4mT without the requirement of microwaves. Firstly, we present a magnetometer with a demonstrated noise floor of $6\,\mathrm{nT}/\sqrt{\mathrm{Hz}}$. Secondly, we show how the sensitivity is improved by implementing a more dilute diamond sample with a smaller linewidth of the LAC feature in a more homogeneous background field. The technique presented here removes the microwave requirements for magnetometry with NV centers which makes the scheme potentially useful in applications where the sensor is placed close to conductive materials.