INVITATION

Department of Condensed Matter Physics

Is pleased to invite you to the lecture

Mueller matrix ellipsometry and vortex beam spectroscopy of antiferromagnetic, altermagnetic, and chiral materials empowered by synchrotron radiation

by

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Time: **11:00**

Venue: **Lecture room F1, Building 6, Faculty of Science, Kotlářská 2, Brno**

Circularly polarized light with spin angular momentum is one of the most valuable probes of magnetism. Combination of linearly, circularly, and elliptically polarized light is in the foundation of the Mueller matrix ellipsometry technique that is known to be very practical for studies of magnetic and chiral materials. Recently we demonstrated that light beams with orbital angular momentum (OAM), or vortex beams, can also couple to magnetism exhibiting dichroisms in a magnetized medium. Terahertz (THz) and far-IR vortex beams with various combinations of the orbital angular momentum l=±1, ±2, ±3, and ±4 and spin angular momentum σ = ±1, or conventional circular polarization, were used for studies of the magnon spectra at the antiferromagnetic resonance conditions in a number of $TbFe_3(BO_3)_4$, Ni_3TeO_6, $NiCo_2TeO_6$,, and *h*-$Lu_{0.6}Sc_{0.4}FeO_3$ single crystals. Coherent synchrotron radiation at the MET beamline at NSLS-II enabled studies of relatively small single crystals and the chiral effects at the optical phonons. In all studied materials we observed strong vortex beam dichroism for the magnon doublet, which is split in an external magnetic field. The absorption conditions at the magnon frequencies depend on the total angular momentum of light j that is determined by the combination of the spin and orbital angular momenta: j=σ+l. Applications of the Mueller matrix ellipsometry, vortex beam spectroscopy, and the combination of the both will be presented in this talk. Our results demonstrate the high potential of the vortex beams with OAM as a new spectroscopic probe of magnetism in matter. In addition to the results for

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magnetic and chiral materials, we will also present our recent experiments with vortex beam spectroscopy of the Landau level resonances and the MIRO effect in 2DEG semiconductor heterostructures in high magnetic field. Strong dichroism was observed for rotational vortex fields and much weaker dichroism was detected for irrotational vortex beams. We found that the absorption selection rules for the Landau levels resonances depend on the sign of *l* and the mutual direction of the light propagation and the external magnetic field.

Various parts of this work was performed in collaboration with V. Martinez[1], P. Marsik [2], L. Bugnon[2], C. Bernhard[2], V. Kiryukhin[3], T. Priessnitz,[4] A. Boris[4], J. Smet[4], G. L. Carr[5], and S.-W. Cheong[3]
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https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.126.157401
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