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NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE
2015 SEMINAR SERIES PRESENTS

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Professor Igor Žutić

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Teaching Nanomagnets New Tricks

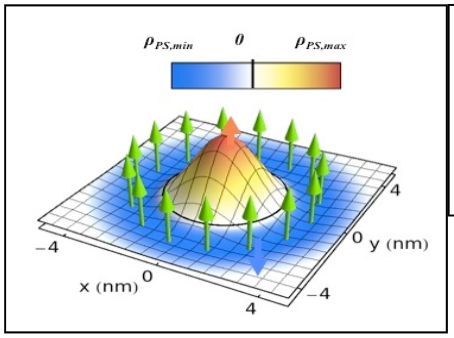

***Fig. 1 Spin corral. Colored surface: The hole-spin density**: ρ_{PS} of the pseudosinglet. Black circle indicates vanishing ρ_{PS}. Green arrows: Mn spins, placed to maximize the stability of the ferromagnetic alignment. Red and blue arrows: The more probable hole-spin projections at two positions [4].*

Semiconductor nanostructures doped with magnetic impurities provide an intriguing play-ground to control magnetic ordering. An important manifestation of such ordering is the formation of a magnetic polaron (MP). It can be viewed as a cloud of localized magnetic ion spins, aligned through an exchange interaction with a confined carrier spin and is typically considered a low-temperature phenomenon in bulk semiconductors. However, recent experimental advances in colloidal nanocrystals and epitaxially grown quantum dots (QDs) show robust signatures of MPs that can persist up to room temperature and lead to effective internal fields up to 100 tesla [1]. These nanostructures offer novel possibilities for magnetism. We suggest how magnetic ordering can be controlled even at a fixed number of carriers [2] and enhanced by heating [3]. In a closed-shell system a pseudosinglet spin configuration is responsible for magnetic ordering [4], shown in Fig. 1. Doping QDs with magnetic impurities (Mn) may open unexplored opportunities to study the nanoscale correlations [5]. Through Mn-carrier exchange interaction, molecular-like correlations can be enhanced, imprinted on Mn spins, and thus observed.

[1] R. Beaulac et al., Science **325**, 973 (2009); S. T. Ochsenbein et al., Nature Nanotech. **4**, 681 (2009); I. R. Sellers et al., Phys. Rev. B **82**, 195320 (2010).
[2] R. M. Abolfath, A. G. Petukhov, and I. Žutić, Phys. Rev. Lett. **101**, 207202 (2008).
[3] J. M. Pientka et al., Phys. Rev. B **86**, 161403(R) (2012).
[4] R. Oszwaldowski, I. Žutić, A. G. Petukhov, Phys. Rev. Lett. **106**, 177201 (2011).
[5] R. Oszwaldowski, et al., Phys. Rev. B **86** 201408 (R) (2012).

Igor Žutić received his PhD in theoretical physics from the University of Minnesota, after undergraduate studies at the University of Zagreb, Croatia. He was a postdoc at the University of Maryland and the Naval Research Lab. In 2005, he joined the State University of New York at Buffalo as an assistant professor of physics and got promoted to an associate professor in 2009 and to a full professor in 2013. His research interests are centered around spin-dependent phenomena in solid-state systems and their applications.

Wednesday, October 21, 4:00 pm
136 Jorgensen Hall

3:45 pm - Refreshments served in Jorgensen Atrium

Host:
Dr. Kirill Belashchenko
Department of Physics & Astronomy

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