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Universal Magnetism Across Structurally Distinct Families of Iron-Pnictide Superconductors

Prof. Omar Chmaissem

Department of Physics, Northern Illinois University USA

Magnetism and unconventional superconductivity coexist and compete throughout the iron-pnictide phase space, making magnetic order a sensitive probe of the electronic interactions responsible for Cooper pairing. This talk presents a cross-family neutron and x-ray diffraction study, supported by muon spin resonance and magnetic susceptibility, spanning three structurally distinct systems: hole-doped $(Ca,Sr,Ba)_{1-x}Na_xFe_2As_2$ (122), phosphorus-substituted $LaFeAs_{1-x}P_xO$ (1111), and its terbium analog $TbFeAs_{1-x}P_xO$. In the hole-doped 122 sub-family, we fully map the conditions governing the tetragonal C_4^C phase, yielding a universal scaling relation for an iron-pnictide sub-family, predicting onset temperature and doping level independent of the alkaline-earth ion. Extending this analysis to $LaFeAs_{1-x}P_xO$, we identify two further phases, C_4^{ab} and C_4^C, previously reported only in the 1144 and 122 structures respectively, showing these phases are intrinsic to the Fe-As electronic system rather than structural artifacts. $TbFeAs_{1-x}P_xO$, by contrast, shows no detectable Fe-site order within the accessible doping range. Diffuse scattering in $Ba_{1-x}Na_xFe_2As_2$ single crystals further reveals *c*-axis in-plane two-dimensional sodium ordering with no correlations along the *c*-axis. Together, these results point to a shared magnetic phase diagram underlying diverse iron-pnictide compounds

Location: seminar room IWC PAN, al. Prymasa Tysiąclecia 98, Warsaw
and online via Zoom, to get the Zoom link ask dyrekcja@unipress.waw.pl