17 Dec **Friday** **12:00 – 12:45** **Chair: ARIANDO**

Search for Axion-Like Dark Matter with Quantum Sensors

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Professor PENG Xinhua is a professor in the Department of Modern Physics at University of Science and Technology of China, China. She received her Ph.D. in atomic and molecular physics from Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, in July 2003. After that, she arrived at the University of Dortmund, Germany, as an Alexander von Humboldt Fellow. She joined in University of Science and Technology of China as a Professor in 2008. She was awarded National Science Fund for Distinguished Young Scholars. Her main research interests include quantum information processing using magnetic resonance technology, nuclear magnetic resonance spectroscopy, quantum sensing and fundamental physics. She authored more than 100 papers in reputed journals.

Abstract:

Ultralight axion-like particles (ALPs) are well-motivated dark matter candidates introduced by theories beyond the standard model. However, the constraints on the existence of ALPs through existing laboratory experiments are hindered by their current sensitivities, which are usually weaker than astrophysical limits. In this talk, I will introduce our recently developed quantum sensors to search for ALPs in the mass range that spans about two decades from 8.3 feV to 744 feV [1,2,3]. Our sensor makes use of hyperpolarized long-lived nuclear spins [4] as a pre-amplifier that effectively enhances coherently oscillating axion-like dark-matter field by a factor of >100. Using spin-based amplifiers, we achieve an ultrahigh magnetic sensitivity of 18 fT/Hz$^{1/2}$, which is significantly better than state-of-the-art nuclear-spin magnetometers. Our experiment constrains the parameter space describing the coupling of ALPs to nucleons over our mass range, improving over previous laboratory limits by at least five orders of magnitude. Our measurements also constrain the ALP-nucleon quadratic interaction and dark photon-nucleon interaction with new limits beyond the astrophysical ones.

References

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