Contribution ID: **81** Type: **Talk (20 min + 5 min discussion)**

Understanding the magnon dynamics in LuFeO3 for magnonics applications

Thursday 5 December 2024 13:40 (25 minutes)

Magnonics is a multidisciplinary field of research focusing on the study and application of magnons in information processing and technology [1]. Magnons can carry the spin information through thermally generated spin-wave spin currents over the large distances [2]. Insulating antiferromagnets (AFMs) are promising for next-generation high-density and high-speed spintronic applications due to their negligible stray field and ultrafast spin dynamics [3]. Especially, non-collinear AFMs with high magnon velocities corresponding to terahertz frequencies are greatly appreciated [1,4]. In view of the technological prospects LuFeO3 has attracted the attention[4]. We report here the magnon dynamics based on the inelastic neutron scattering studies performed on the single crystal of LuFeO3. The measured magnon dispersion along the (011) matches well with the simulated results obtained using the Holstein-Primakoff theory for the present antiferromagnets. Our analysis including the simulated and experimental results revealed that magnon propagates into such material with supersonic velocities of more than 20kms−1. This source of short wavelength magnon carriers opens the new prospects for terahertz antiferromagnetic magnonics and logic devices at terahertz frequencies.

[1] J. R. Hortensius, et al., Nat. Phys. 17, 1001 (2021).
[2] K. Uchida, et al., Nat. Mater. 2856, 10.1038 (2010)
[3] W. Lin, et al., Nat. Phys. 18, 800 (2022)
[4] J. Xu, et al., Phys. Rev. Lett 129, 117202 (2022)

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Session Classification: Quantum Phenomena

Track Classification: Quantum Phenomena