Hybrid Magnonics

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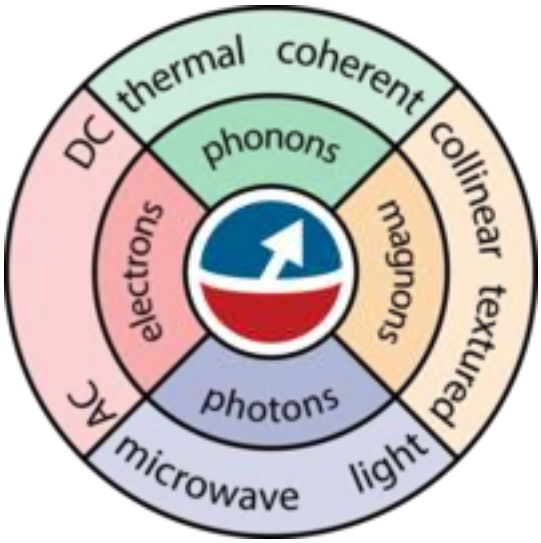

Magnons are the fundamental spin excitations of magnetically ordered materials, such as ferromagnets and antiferromagnets. Magnons combine non-linear properties with tunability and sub-micrometer wavelengths in the gigahertz-frequency regime. The field of magnonics [1] explores potential applications of magnons for information processing and communication. These applications encompass wave-based Boolean logic, neural networks, quantum technologies and miniaturized microwave components. The excitation, control, and detection of magnons is at the heart of this broad application spectrum.

In “hybrid magnonic” approaches, one goes beyond the well-established use of external magnetic fields to interact with spin excitations. Interfacing magnons with electrons, phonons & photons in hybrid architectures addresses a major challenge in the field of magnonics by providing pathways for more efficient excitation, control, and detection of magnons. I will discuss some of our results to exemplify unique features and merits of hybrid magnonics based on magnon-magnon interactions [2], spin-photon interactions [3], and spin-phonon interactions [4-6].

[1] Chumak et al., IEEE Trans. Magn. **58**, 0800172 (2022)
[2] Al-Hamdo et al., Phys. Rev. Lett. **131**, 046701 (2023)
[3] Liensberger et al., Phys. Rev. B **104**, L100415 (2021)
[4] Küß, Albrecht, and Weiler, Front. Phys. **10**, 981257 (2022)
[5] Shah et al., Adv. Electron. Mater. 2300524 (2023)
[6] Koujok et al., Appl. Phys. Lett. **123**, 132403 (2023)