# Quantum Sensing: From Materials to Universe

## Topic for FY2022

- We developed quantum devices utilizing 2D materials including transition metal dichalcogenides (TMDC) and graphene: we developed TMDC devices with Bi-basd ohmic contacts which work at cryogenic temperatures, studied quantum transport through TMDC quantum dot devices, developed high-frequency measurement techniques, and realized local back gates and demonstrated the operation using graphene quantum dots.
- We have studied the response of GaAs quantum point contacts to ionizing radiation, alpha-ray source ($^{241}$Am, 5.4 MeV)
- We continued to study and develop superconducting (SC) materials/devices for potential applications high energy physics (HEP) such as dark matter detection: we made a measurement of the qualify factor of bulk resonance cavity coated with superconductor films NbTiN
- We started to explore Dirac materials for dark matter detection
- We have developed methods to use spin defect centers such as NV centers in nanodiamond and spin defects in h-BN as magnetic field sensitive quantum sensors to study magnetic quantum materials (Phys. Rev. Research, 4, L012025, 2022; Nature Materials 21, 1024, 2022)
- Press release: "The discovery of interfacial ferromagnetism in 2D antiferromagnet heterostructures" (https://www.wpi-aimr.tohoku.ac.jp/en/achievements/press/2022/20221216_001566.html) for our work published as G. Cheng et al. Nature Communications 13, 7348 (2022)