# Detecting the angular momentum compensation by NMR

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Ferrimagnets contains multiple types of magnetic ions; their magnetic moments align in opposite direction. In some ferrimagnets, the net angular momentum becomes zero at the angular momentum compensation temperature $T_A$. Our group demonstrated the observation of $T_A$ by using the Barnett effect [1], in which mechanical rotation magnetizes an object due to spin-rotation coupling [2,3]. We observed the Barnett effect of the rare earth iron garnet $Ho_{3-x}Dy_xFe_5O_{12}$ with air-driven rotor system, and determined $T_A$ to be 240 K in $Ho_3Fe_5O_{12}$ (HoIG). With the focus on magnetic dynamics at $T_A$, a microscopic method was required to investigate the spin dynamics at $T_A$.

Here, we propose an NMR method to explore the spin dynamics at $T_A$. In ferro(ferri)magnets, the NMR signal is enhanced via hyperfine interactions. Particularly, the NMR signal from nuclei in domain walls is strongly enhanced due to the magnetic domain wall motion (Fig. 1).

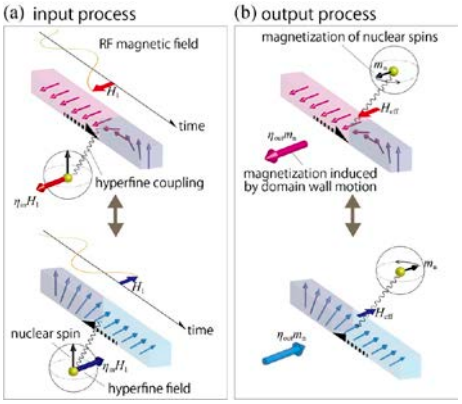


Fig. 1 Schematic illustration of enhancement of the NMR signal in a domain wall.

We show that $^{57}$Fe-NMR measurements can be used to explore domain wall dynamics near $T_A$ in HoIG. We found that the NMR signal shows a maximum at $T_A$ in the multi-domain state. This enhancement of the signal enables us to determine $T_A$ by the NMR measurement [4].

[1] S. J. Barnett, *Phys. Rev.* **6**, 239 (1915)., S. J. Barnett, *Rev. Mod. Phys*. **7**, 129 (1935).
[2] M. Imai, Y. Ogata, H. Chudo *et al*., *Applied Physics Letters* **113**, 052402 (2018).
[3] M. Imai, H. Chudo, M. Ono, *et al*., *Appl. Phys. Lett.* **114**, 162402 (2019).
[4] M. Imai, H. Chudo, *et al*., *Physical Review B* **102**, 014407 (2020).