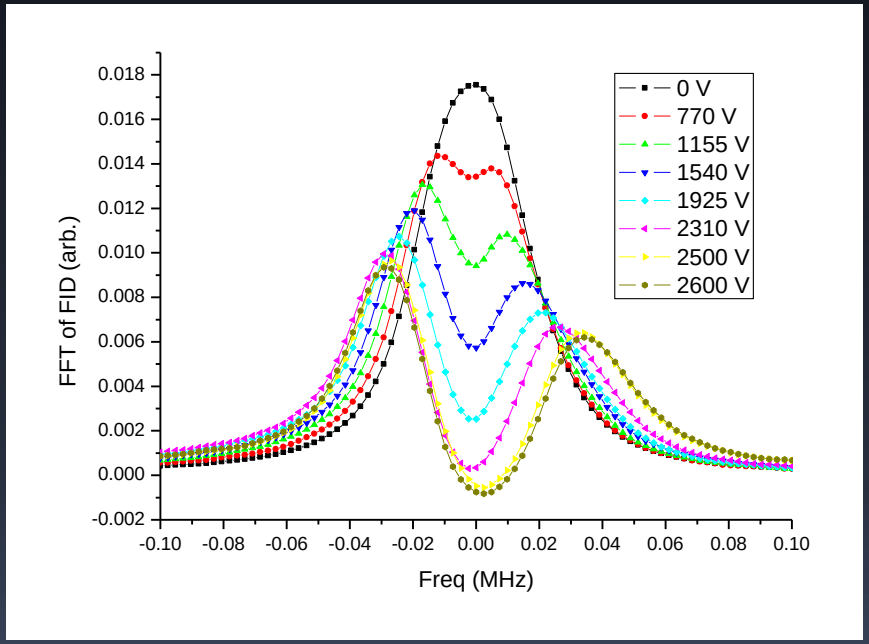
NMR in Paramagnetic MnF_2

KAIST
Kang, Byeongki

Ref.: R.G. Shulman, V. Jaccarino, Phys. Rev. **108**, 1219 (1957)

Motibation

- Dr. Song's Experiment
  - Control of hyperfine interaction with electric field
  - antiferromagnet

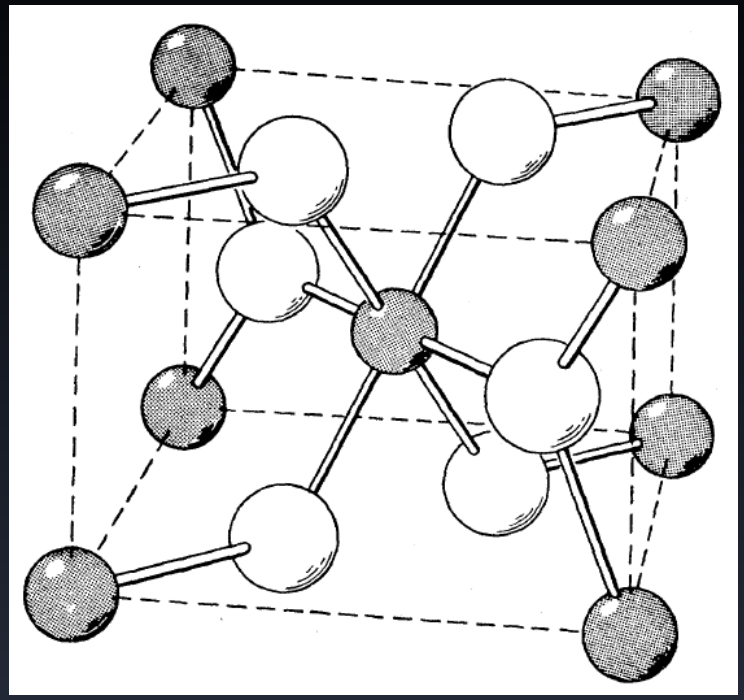


Contents

- MnF_2
- NMR in Paramagnet
- ^{19}F NMR
- Angle depended doublet
- Time relaxation
- Summary

MnF_2

- Rutile structure
  - Mn^{2+}, F^-
- Antiferromagnet
  - T_N: 68K
- ^{19}F nuclear
  - γ: 40.053MHz/T, 4.0053kHz/Oe

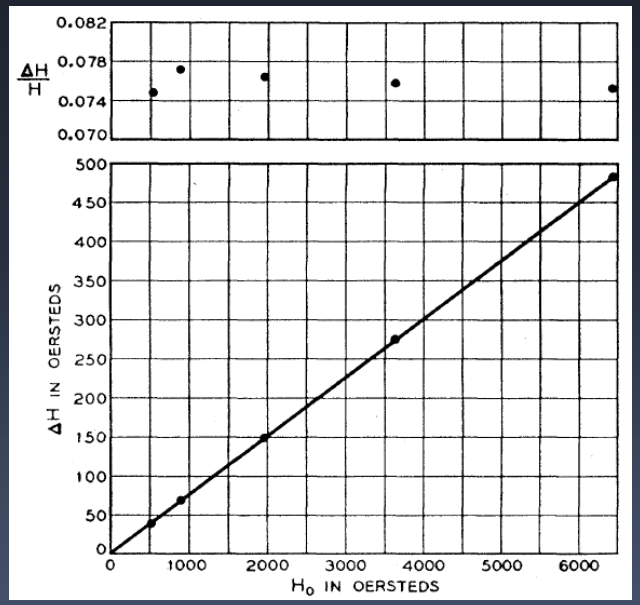


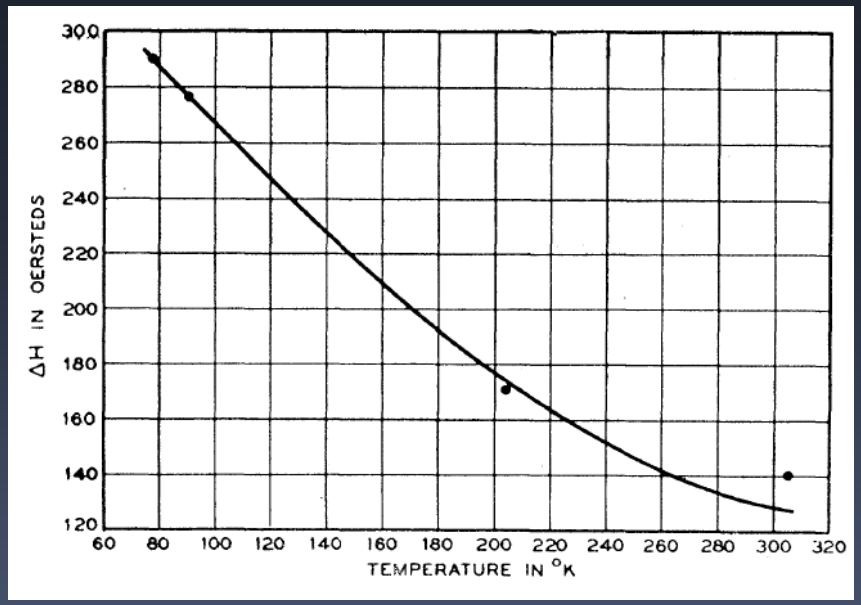
NMR in Paramagnet

- Generally unobservable
  - Line width broadening by dipole fields
  - To observe: $\exp(-\mu H/kT) \ll 1$
- Exchange narrowing
  - Exchange interaction → rapid electron motions → line width narrowing

NMR in Paramagnet

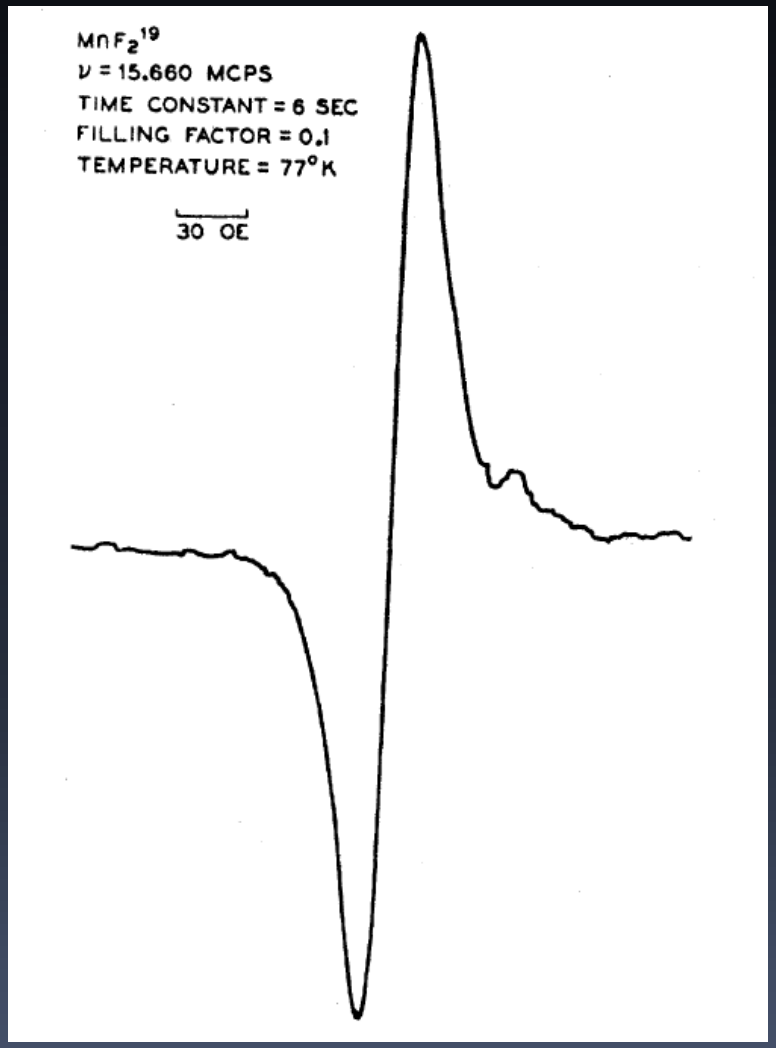
- Resonance shift ΔH by time-averaged field
  - Magnitude : $\mu(\mu H_0/kT)(1/a^3)$
  - Proportional to H_0, $1/T$





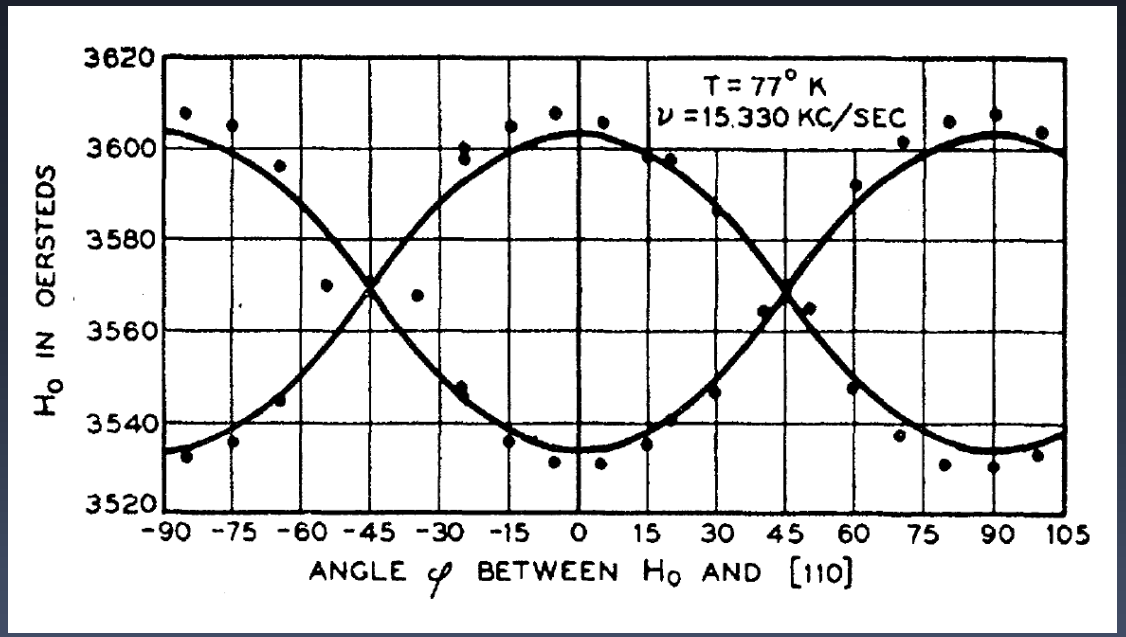
^{19}F NMR Signal

- cw-NMR signal
- H_0 ~ 3620 Oe
- f = 15.660MHz
- 77K



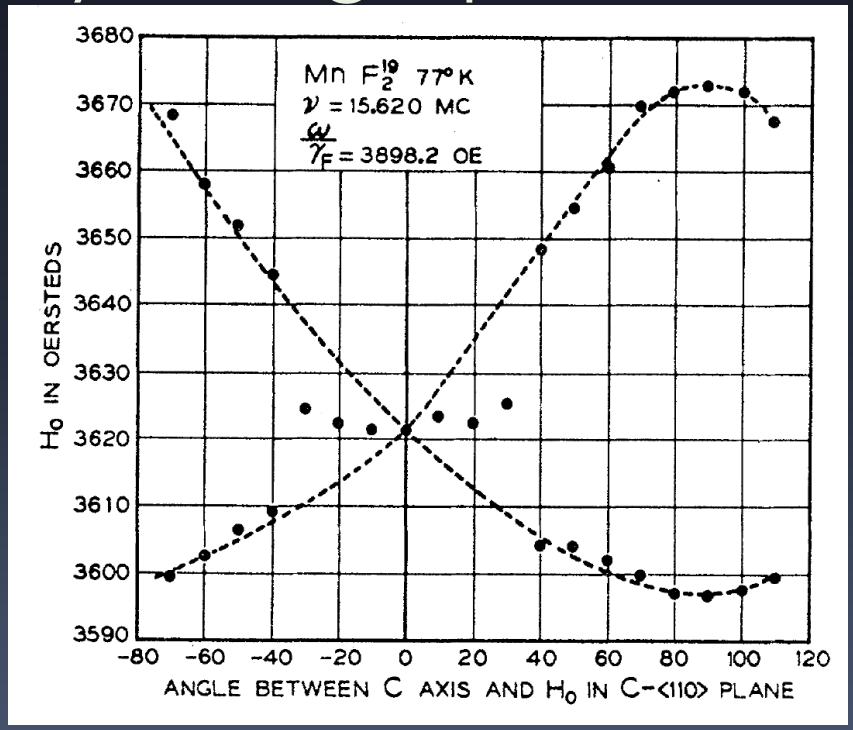
Angle dependence

- H_0 in ab plane
- Φ : angle b/w H_0&[110]
- Doublet : crystallographic 2 kinds of F ion
- ΔH ~262Oe



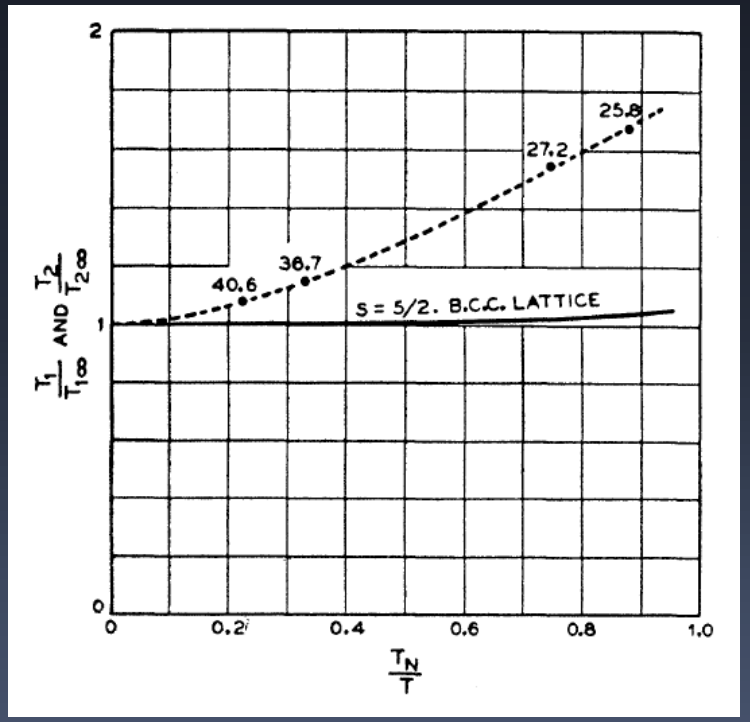
Angle dependence

- H_0 in (110) plane
- Φ : angle b/w H_0&[001]
- Doublet : crystallographic 2 kinds of F ion



Relaxation time

- Relaxation time
  - Decrease with temperature increase
- Line width increase 25 to 42 Oe
  - 103 kHz to 160 kHz



Summary

- Exchange narrowing
- Time-average shift by dipole sum, diamagnetism
- Angle depended doublet signal
- From relaxation, line width increases with temperature increases