

β -Detected Nuclear Magnetic Resonance: A New Probe of Correlated Electrons

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Radioactive Ion Beams

NMR

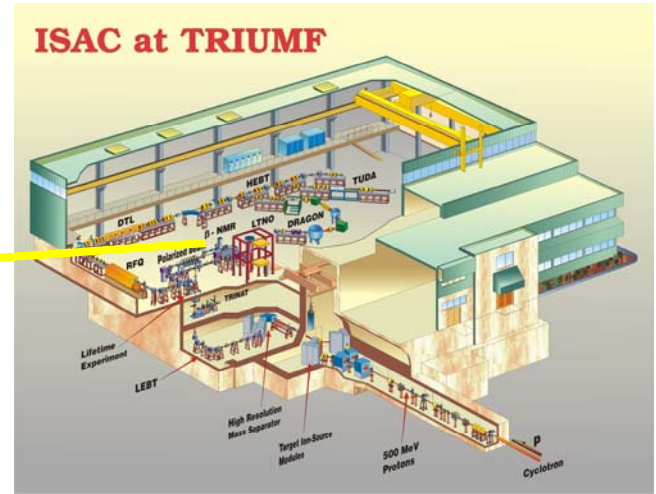
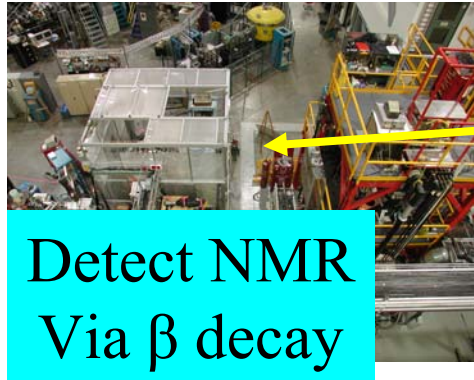
$$M = \chi H$$

$$\chi = \chi' - i\chi''$$

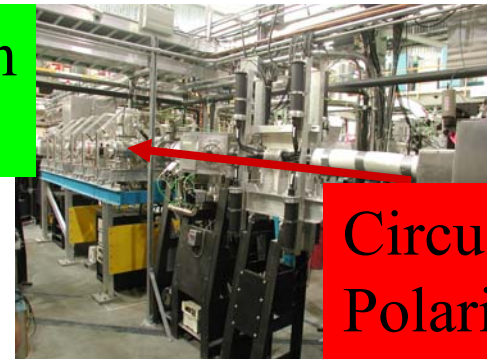
Shift: $K = A\chi'(0,0)$

Relaxation (Moriya Expression):

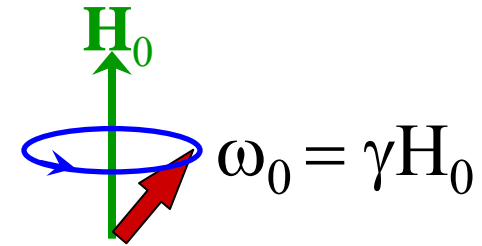
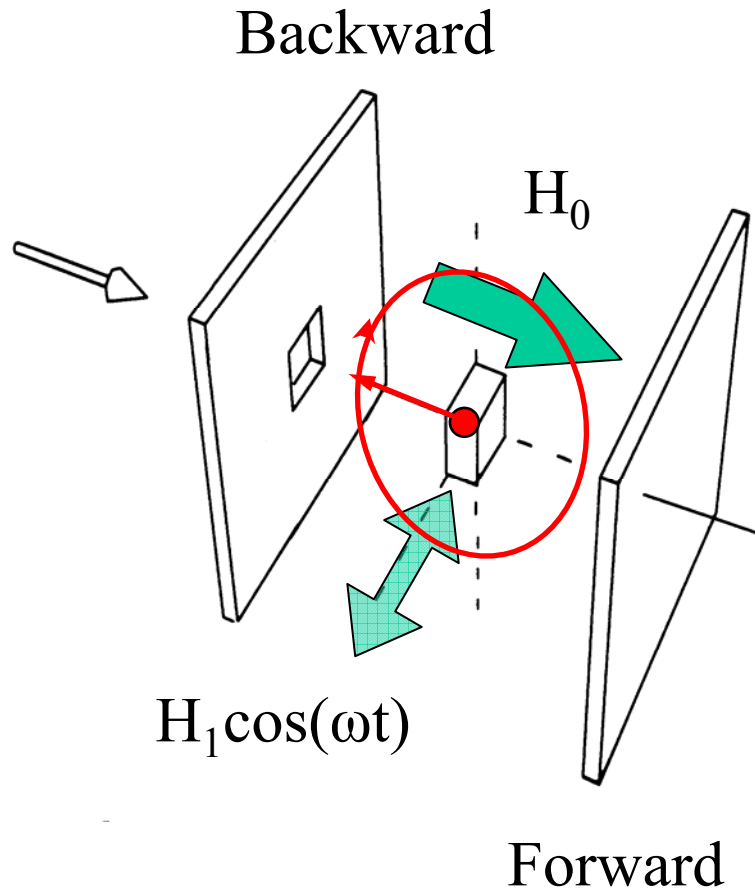
$$\frac{1}{T_1} \propto kT \sum_{\vec{q}} A^2(\vec{q}) \frac{\chi''_{\perp}(\vec{q}, \omega_0)}{\omega_0}$$



Li⁺ ion
beam

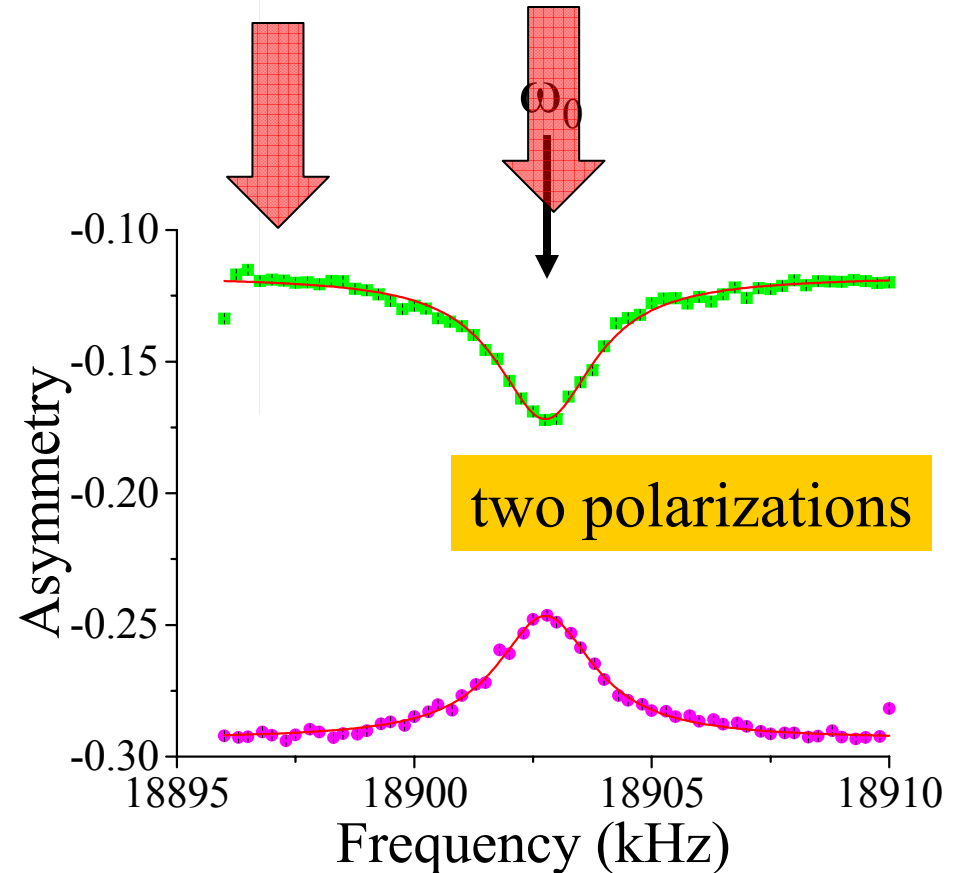


β NMR Resonance

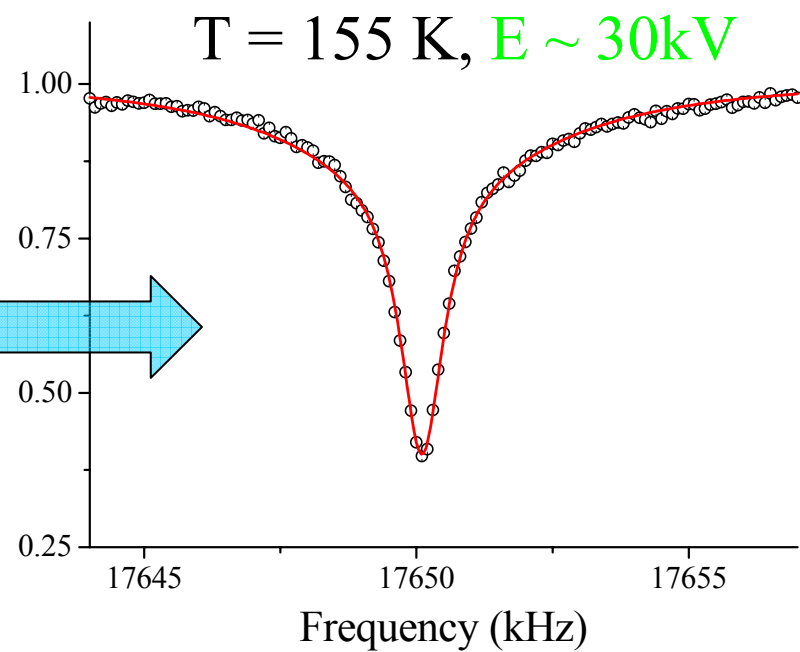
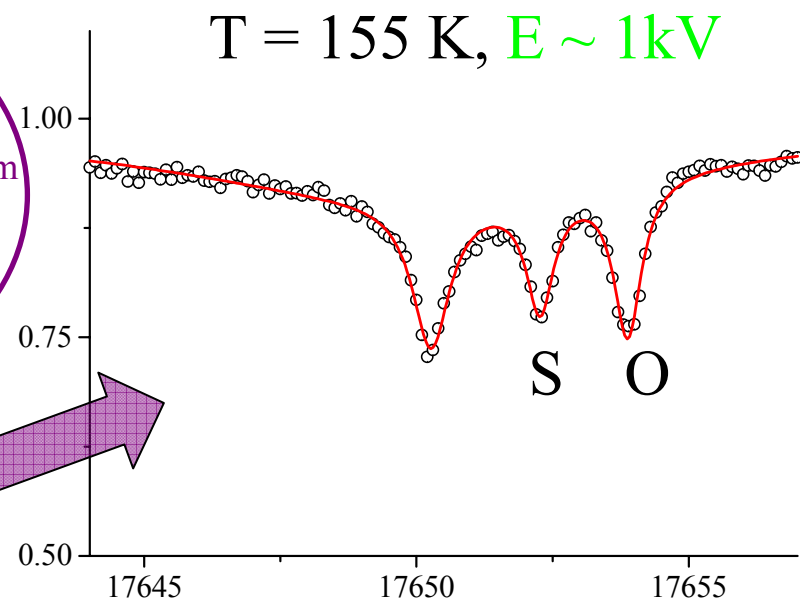
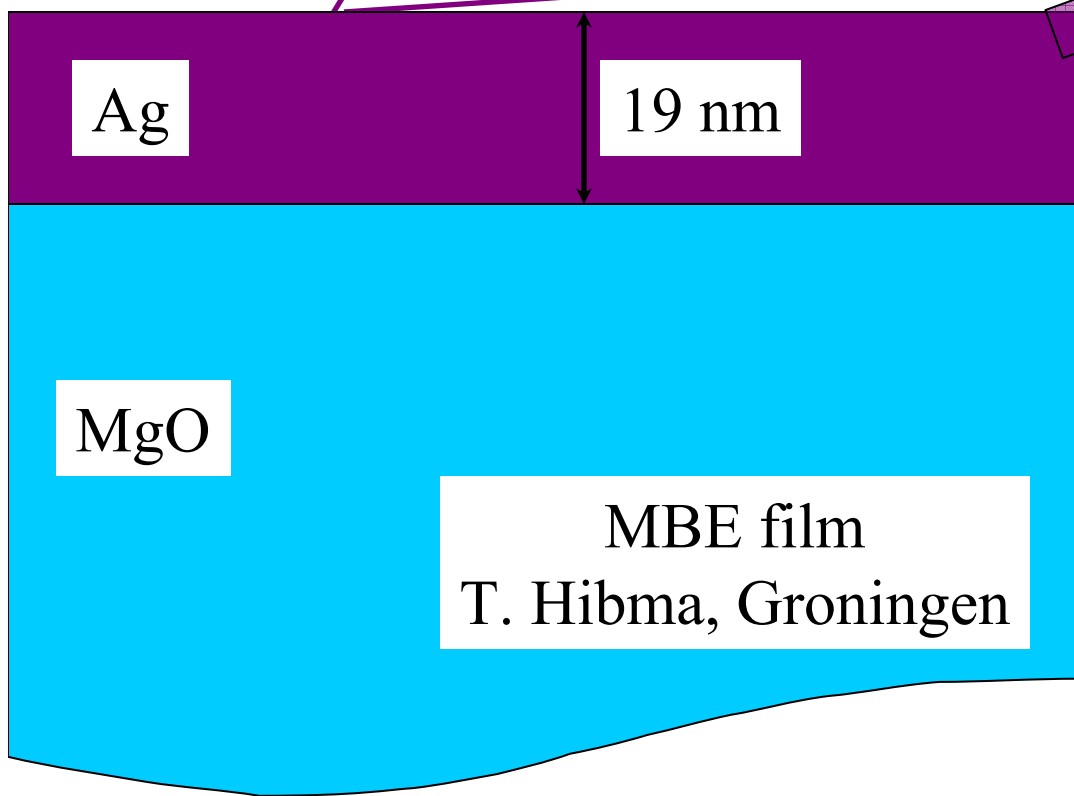
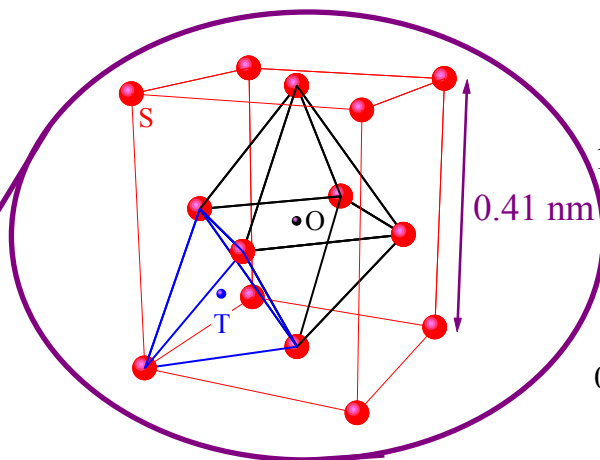
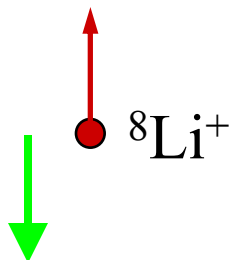


off resonance $\omega < \omega_0$

on resonance $\omega \sim \omega_0$



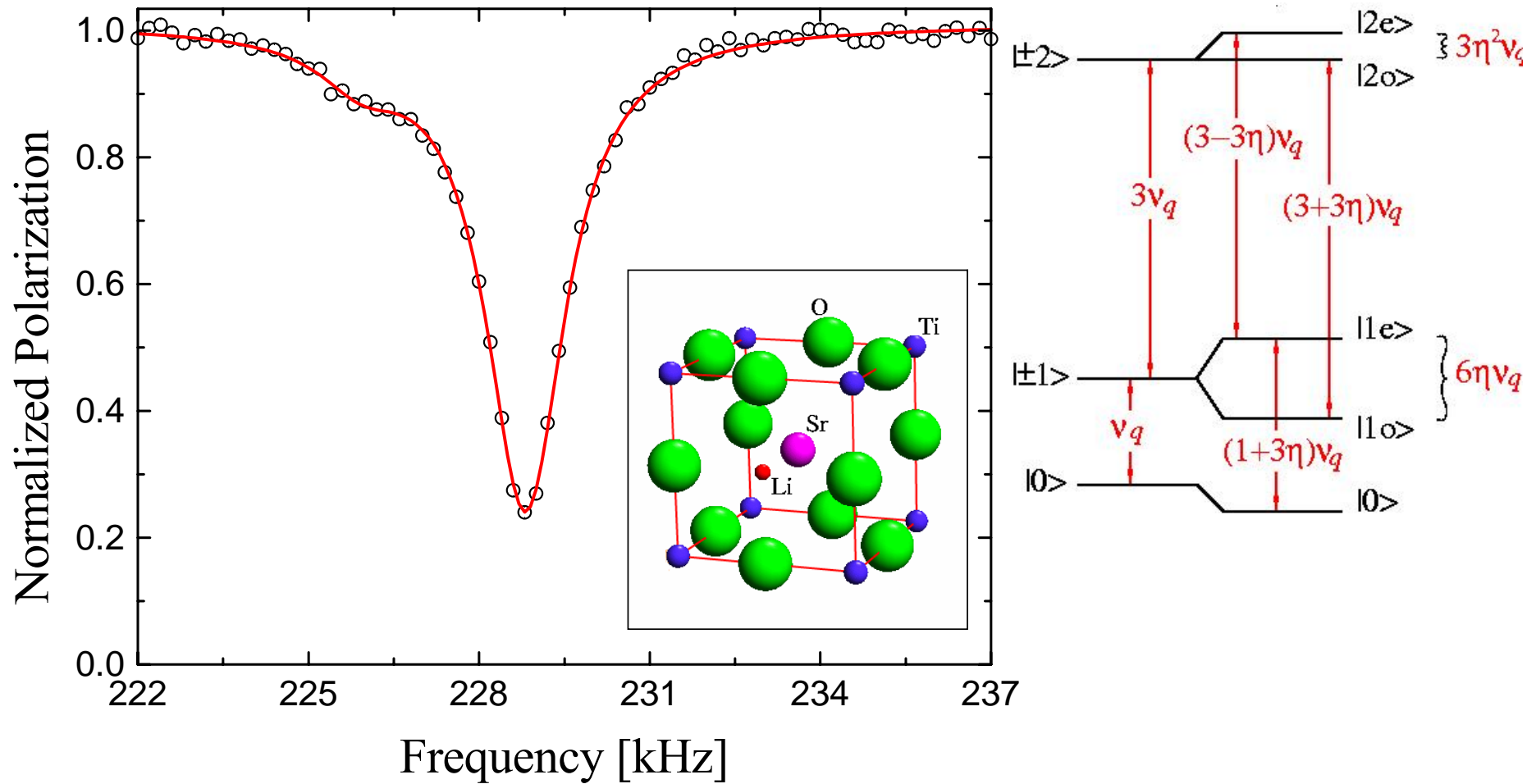
Nuclear Decay Detection:
10 orders of magnitude more
Sensitive than normal NMR



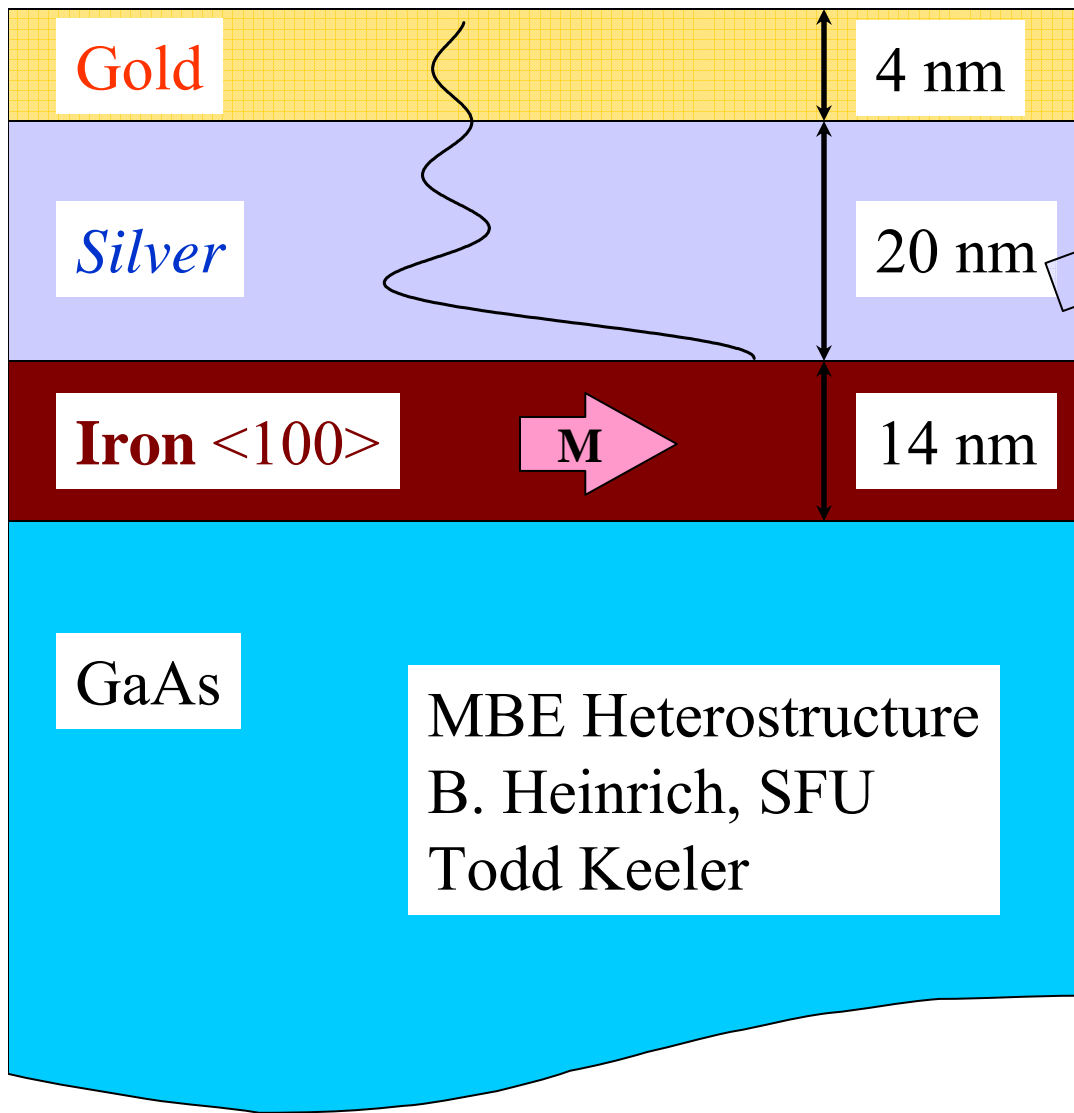
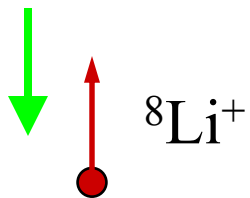
NMR in nanostructures!

G.D. Morris, PRL (2004)

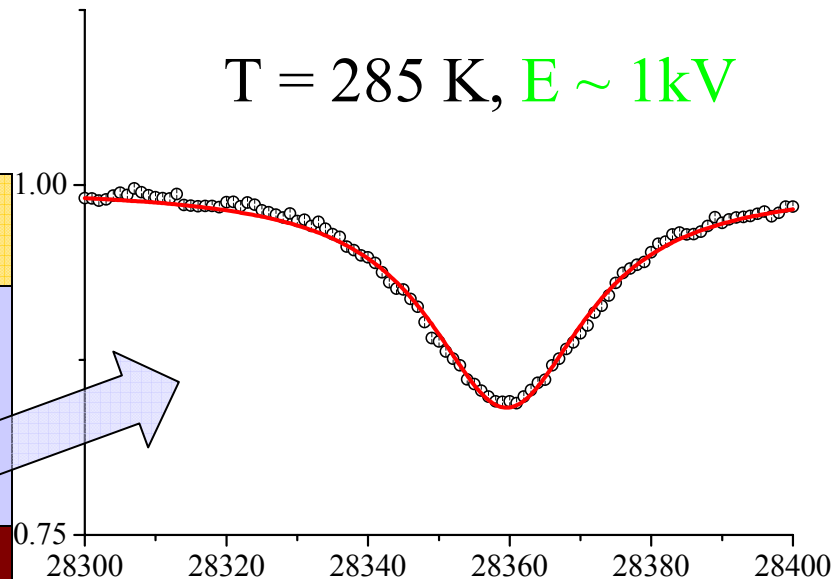
β -detected ZF-NQR SrTiO_3 in ZF at T=300K



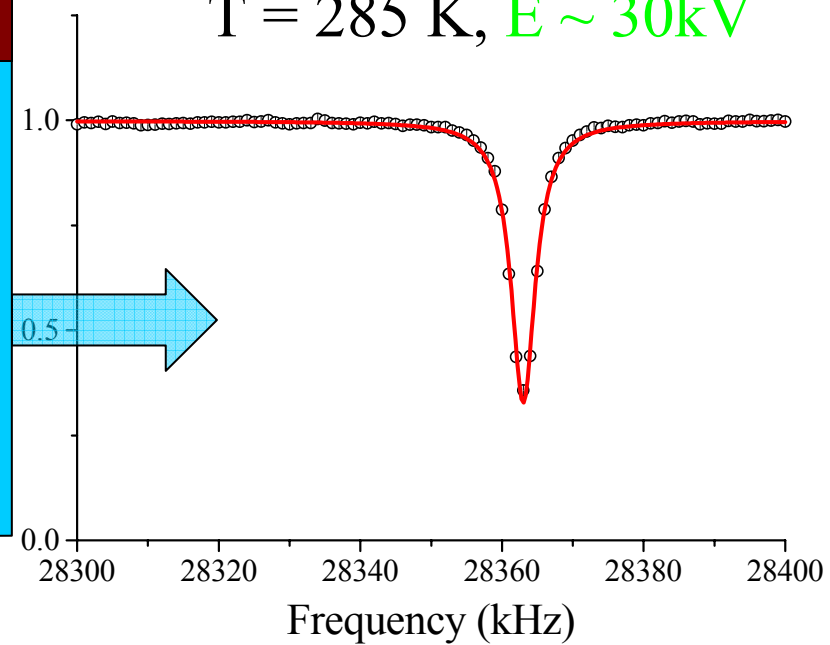
Z. Salman et al. PRB 70, 104404 (2004)



$T = 285 \text{ K}, E \sim 1 \text{ kV}$



$T = 285 \text{ K}, E \sim 30 \text{ kV}$



Summary

βNMR:

NMR of implanted radioactive ions in situations where conventional NMR is undetectable

Low energy beams: allows electrostatic deceleration – depth resolution

βNMR Facility at TRIUMF/ISAC:

High field spectrometer working, scientific programme starting
Low field spectrometer being commissioned

bnmr.triumf.ca