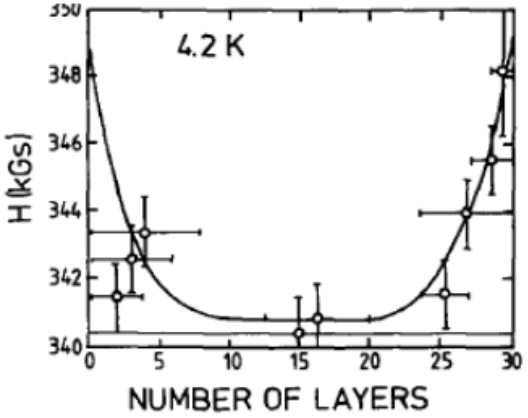
Variation of magnetic moment with environment

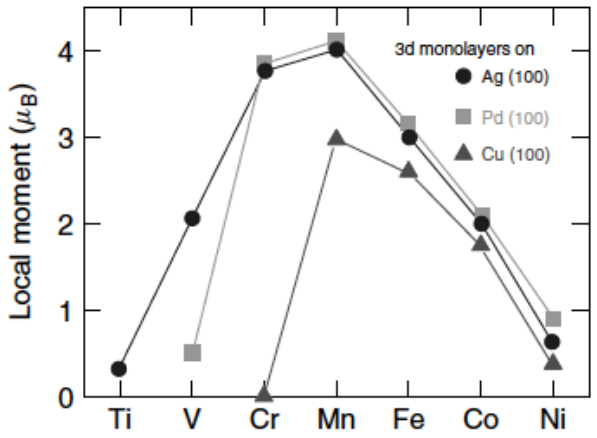
In atoms or Ions: Hund'rules determine S and L
In matter: strong modifications due to crystal field ;

Large changes may occur for 3d ions:

- **orbital moment is quenched (partially or totally)**
- **if crystal field is large possibility of low spin state**
- **in 3d metals: magnetic moment is not an integer (itinerant magnetism).**
- **its value depends on the local density of states**
- **near surfaces or in alloys possibility of charge transfer ➔ modification in the band filling**



Magnetic moment of Fe in a 30 layers film



Magnetic moments for itinerant systems strongly depend on their environment and interactions:

Magnetic moment of Fe determined by atomic rules:

$m_0 = g_J \mu_B J$, $m_{eff} = g_J \mu_B (J(J+1))^{1/2}$

Fe^{3+}: $3d^5$ L=0, S=5/2, J=5/2, g_J= 2 , $m_0 = 5\mu_B$, $m_{eff} = 5.9$

Fe^{2+}: $3d^6$, L=2, S=2, J=4, g_J=3/2 , $m_0 = 6\mu B$, $m_{eff} = 6.7$

Fe-compounds:

- FeO (Fe^{2+}): $m_{eff} = 5.33$ → partial quenching of orbital moment (if total quenching, spin only magnetism → m_{eff} = 4.9) (AF)
- γFe_2O_3 (Fe^{3+}): $m_0 = 5\ \mu_B$ (ferrimagnetic)
- α-Fe (metal): m_0=2.2 μ_B (ferromagnet)
- YFe_2 (metal): m_0=1.45 μ_B (ferromagnet)
- YFe_2Si_2 : Fe is non-magnetic (enhanced paramagnet)
- FeS_2 : diamagnetic
- Fe surface: m_0=2.8 μ_B