Magnetism

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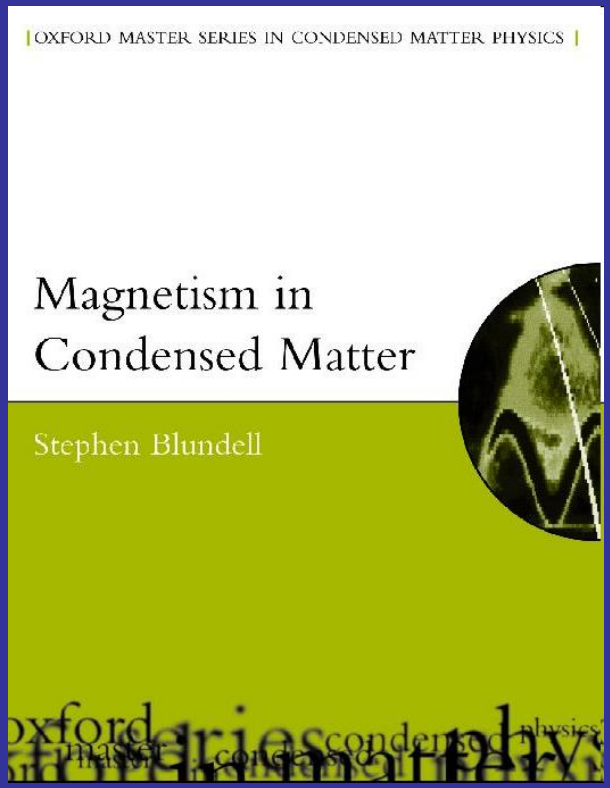
Uname: magnetism Pwd: SS19

Optical Condensed Matter Physics

Literature

Magnetism in Condensed Matter
Stephen Blundell
Oxford Master Series in Condensed matter
Oxford University press 2003
ISBN 0 19 850591 4

Powerpoint slides
Notes made during lectures



Additional literature: Kittel; Ashcroft&Mermin; your favorite solid state book

Magnetism in condensed matter

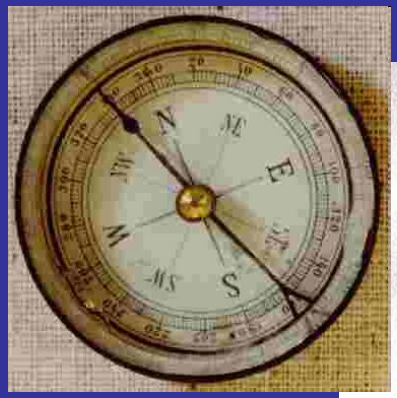
Ch. 1	Introduction
Ch. 2	Isolated moments
Ch. 3	Environments
Ch. 4	Interactions
Ch. 5	Order & magnetic structure
Ch. 6	Order & broken symmetry
Ch. 7	Magnetism in metals
Ch. 8	Competing interactions

Introduction

Today: Introduction (Ch.1; 2.1-2.5; 8.9)

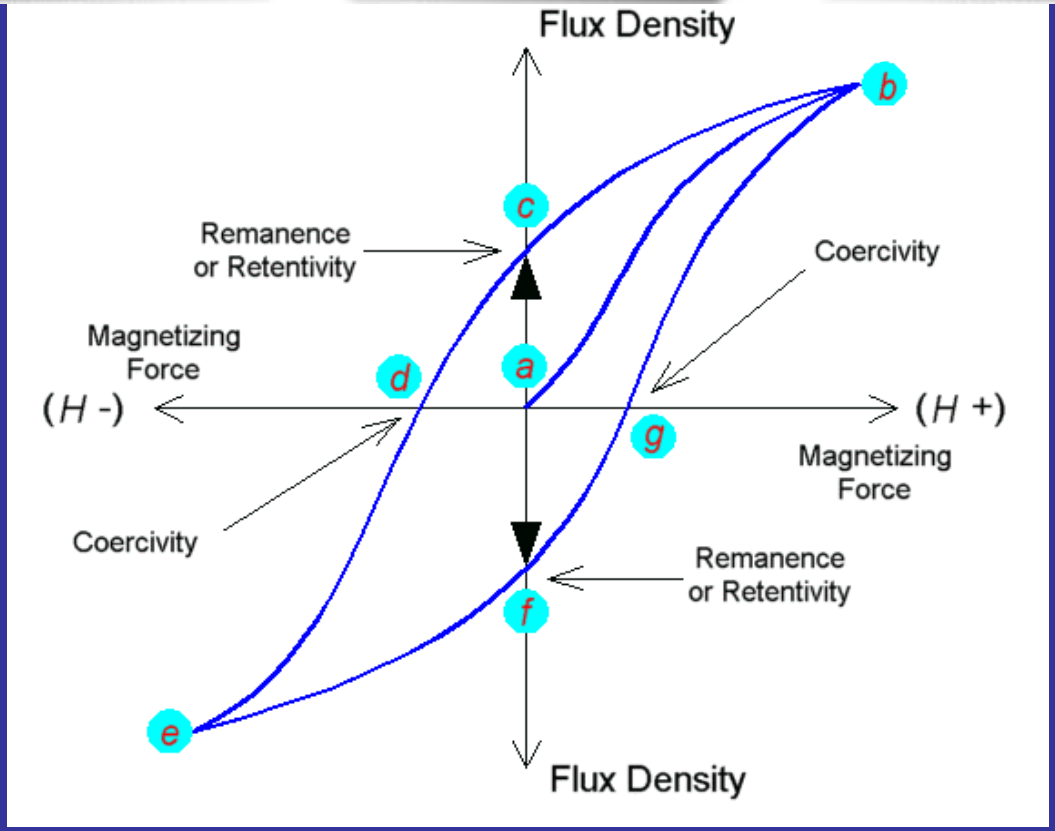
Next time: Interactions, environment (3.1, Ch.4; 7.1-7.7)

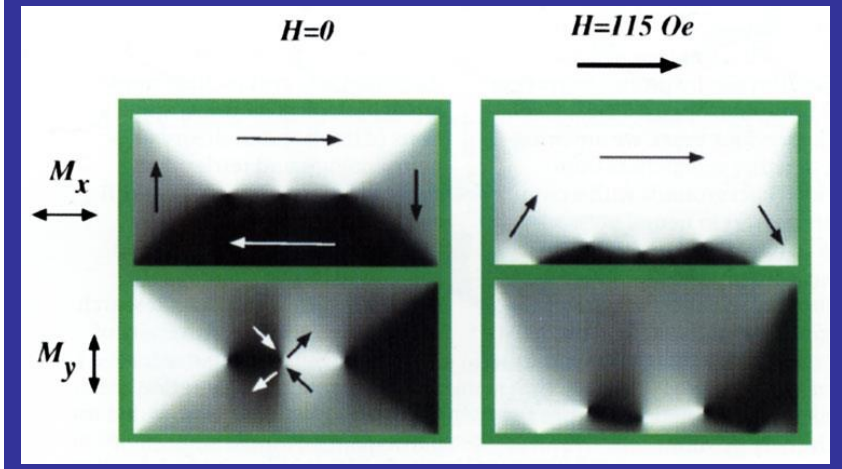
6c BC Thales, loadstone



1c AD chinese compass

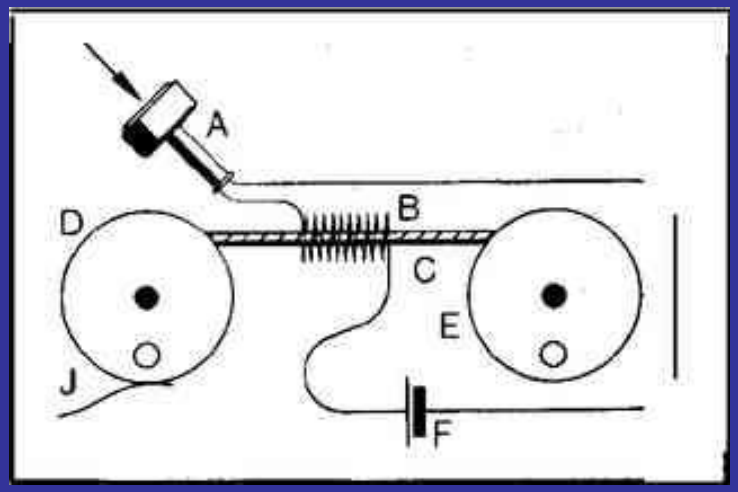
Ferromagnetic hysteresis





Domains
Anisotropy

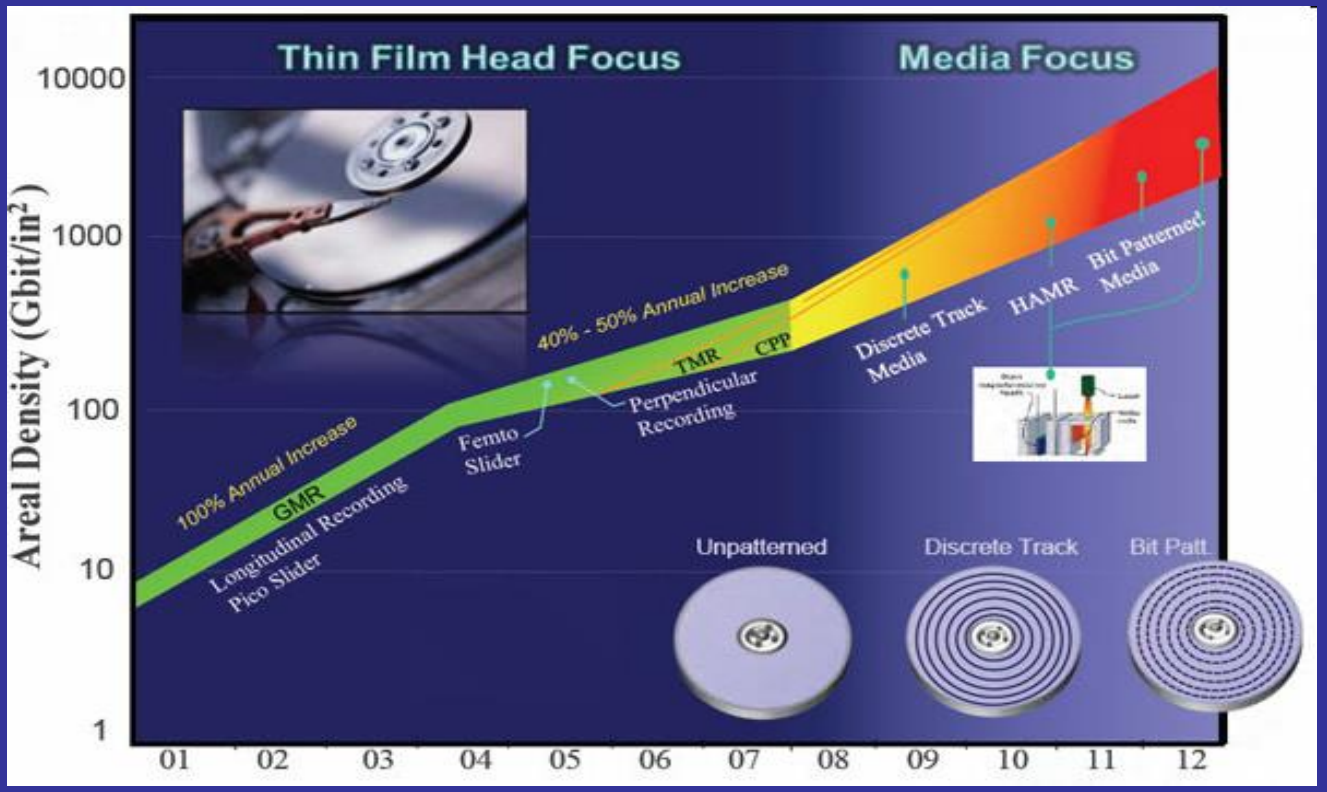
Data storage



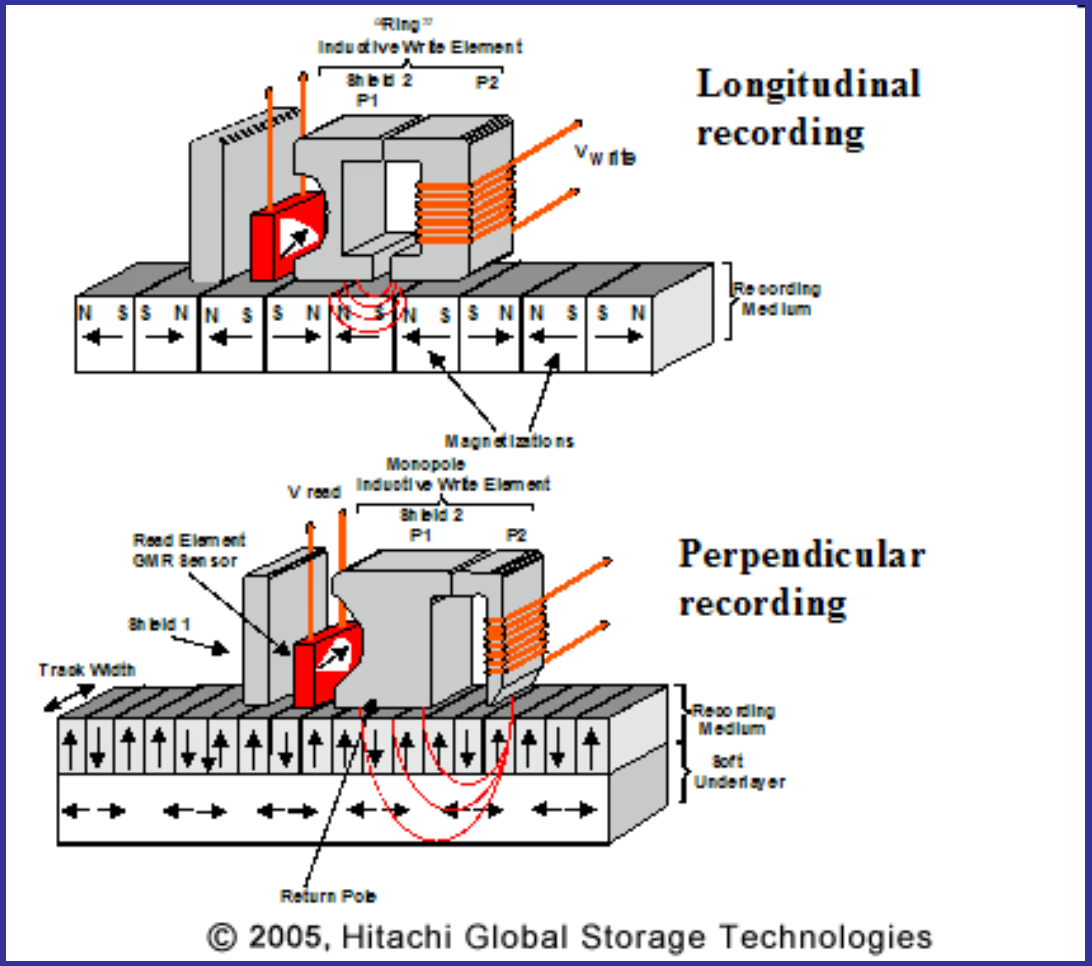
Oberlin smith 1888

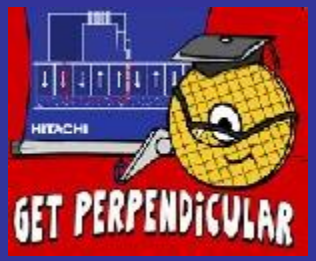
1898 Valdemar Poulsen
Telegraphone answering machine
Wire @ 250 cm/s (1 hr = 10 km)

Today:
744 Gb/inch^2 (toshiba, 2011)



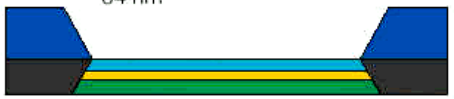
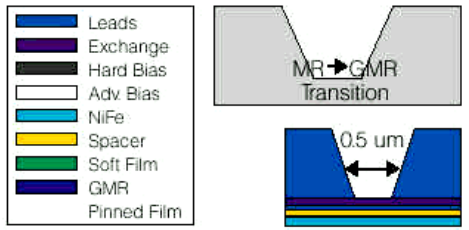
Perpendicular recording

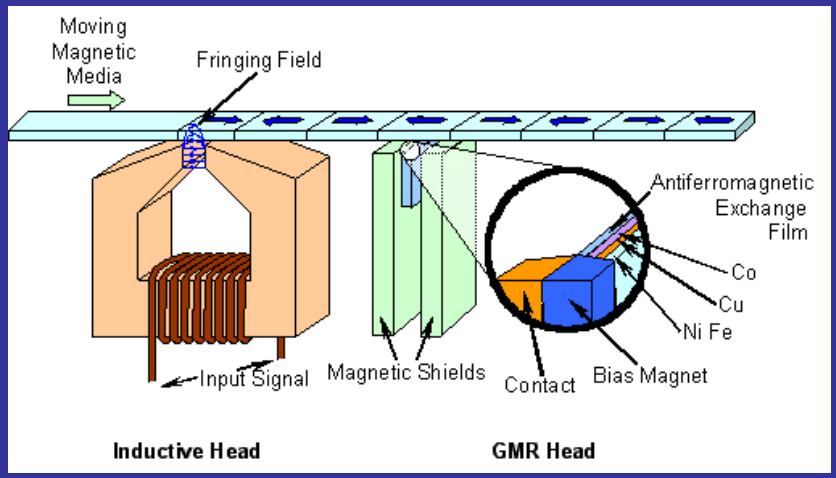


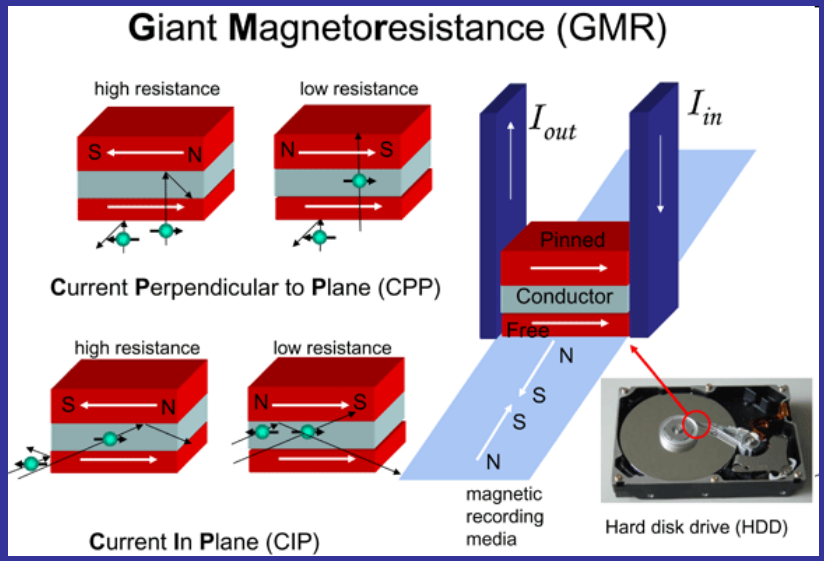


http://www.hitachigst.com/hdd/research/recording_head/pr/PerpendicularAnimation.html

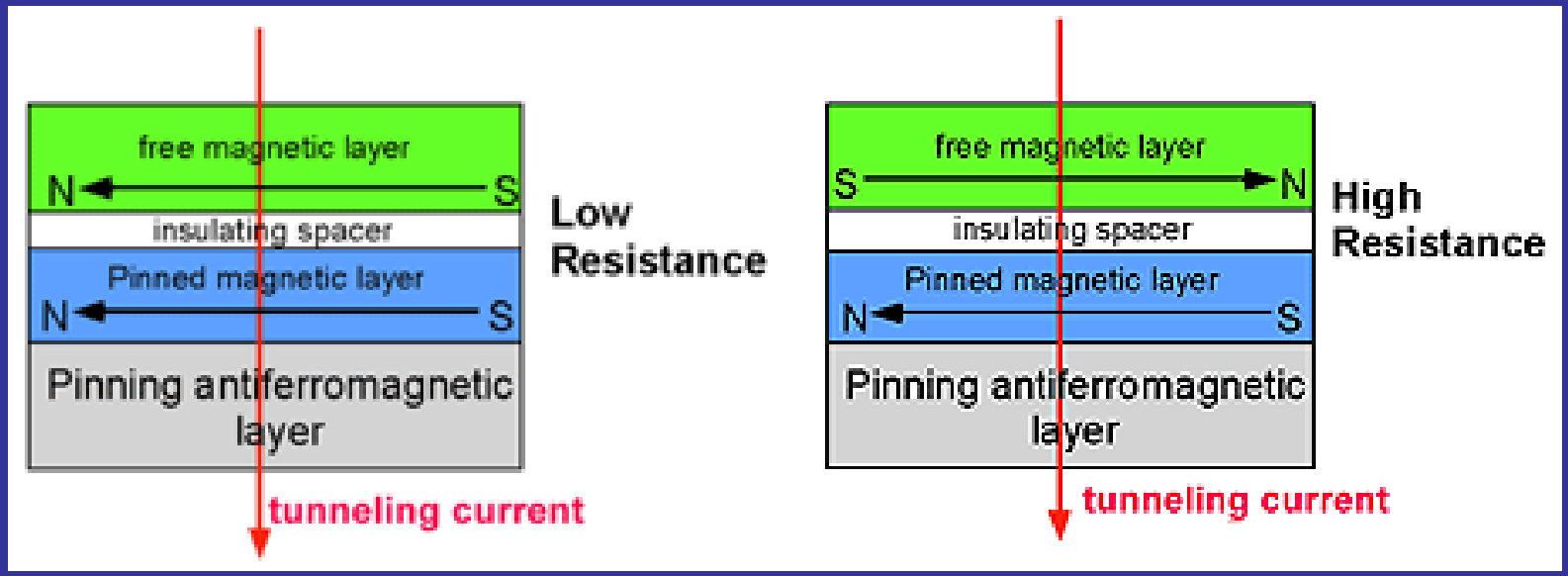
MR and GMR heads

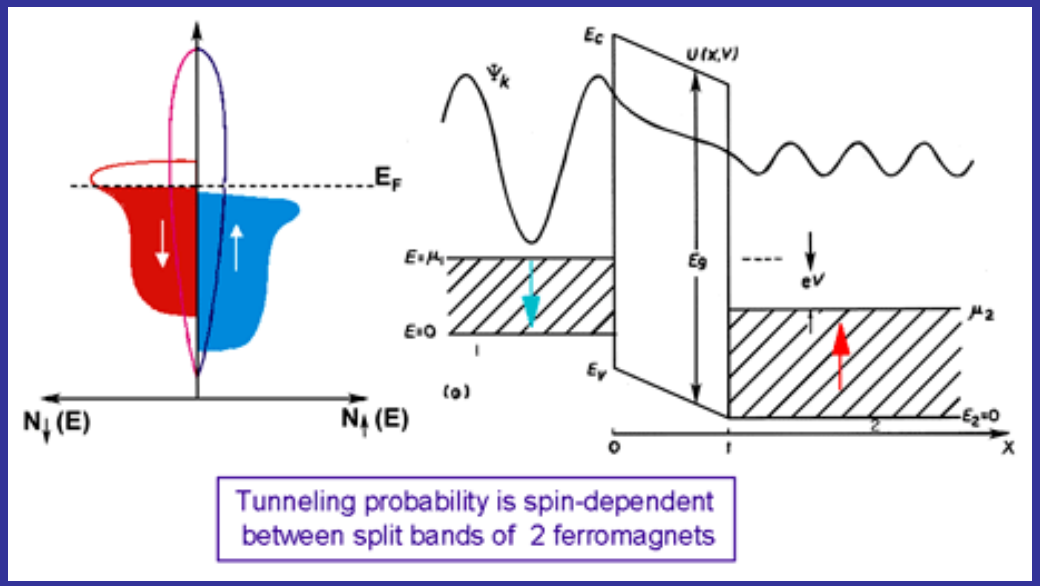
Year	Areal Density Gbits/in^2	MR Element
1991	0.132	
1992 1993	0.260 0.354	
1994	0.578	
1995	0.829 0.923	
1996 1997	1.32 1.45 2.64	
1998	3.0-5.0	
2000	10.0	



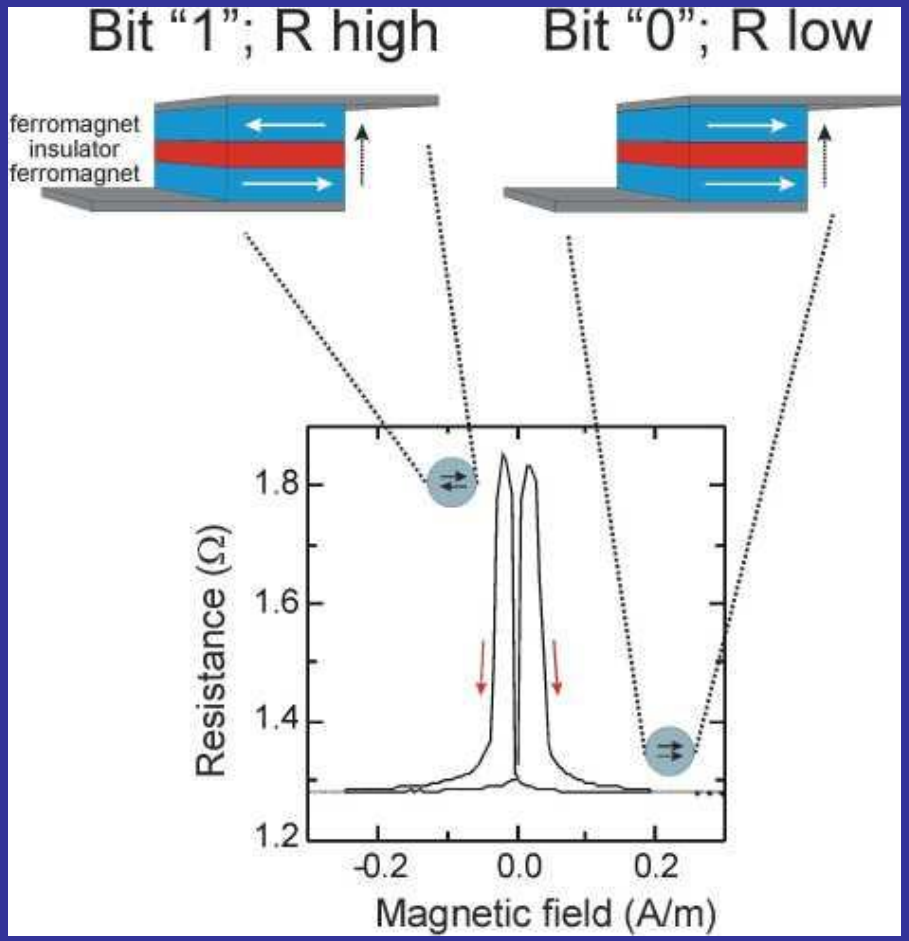


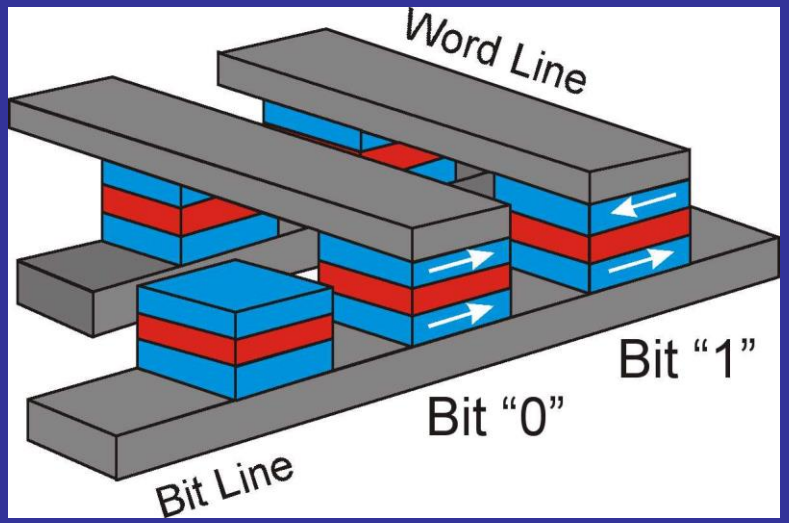
Tunneling magnetoresistance





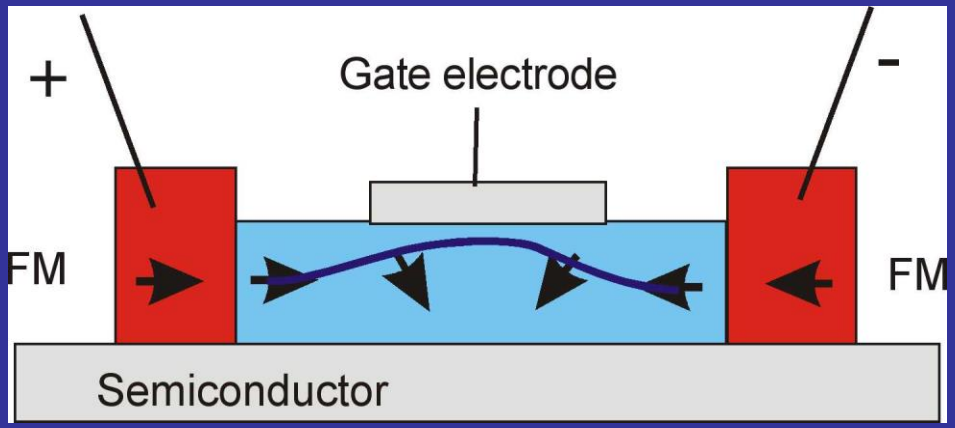
MRAM

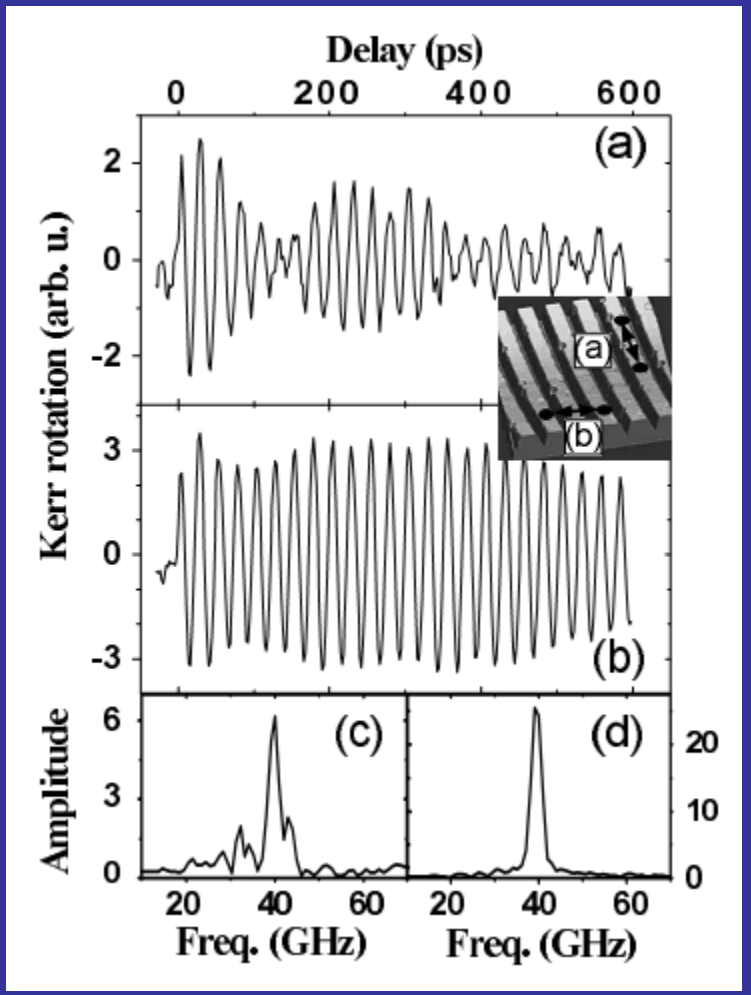

Bit “1”; R high
Bit “0”; R low
ferromagnet
insulator
ferromagnet
Resistance (Ω)
1.8
1.6
1.4
1.2
-0.2
0.0
0.2
Magnetic field (A/m)


Word Line
Bit “1”
Bit “0”
Bit Line

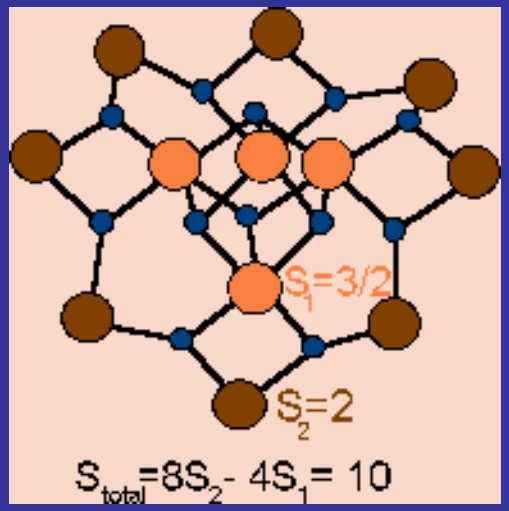
Spintronics

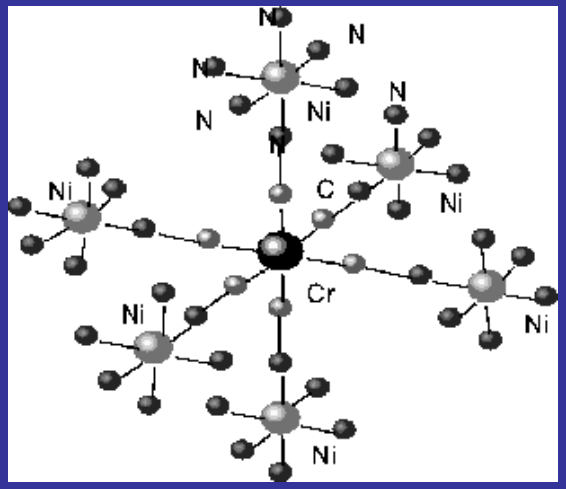
Spin dependent transport

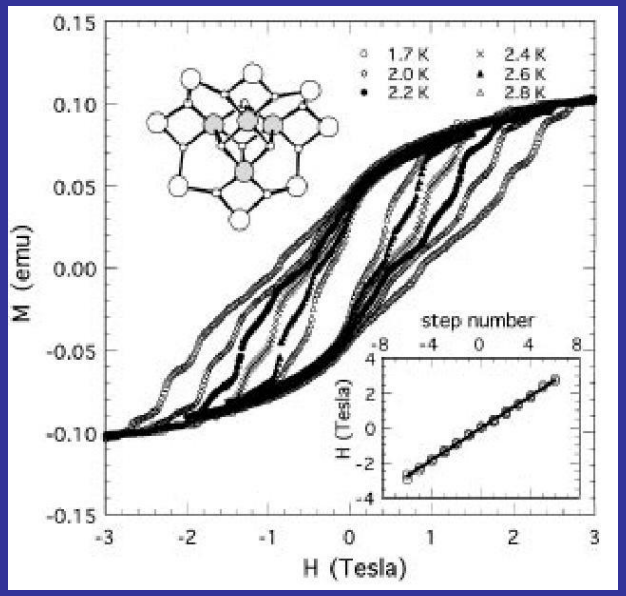


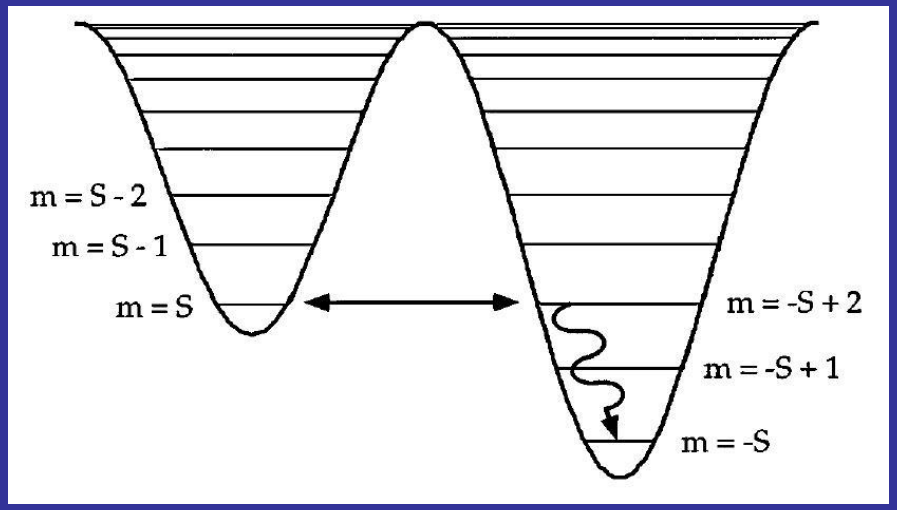


Molecular nanomagnets



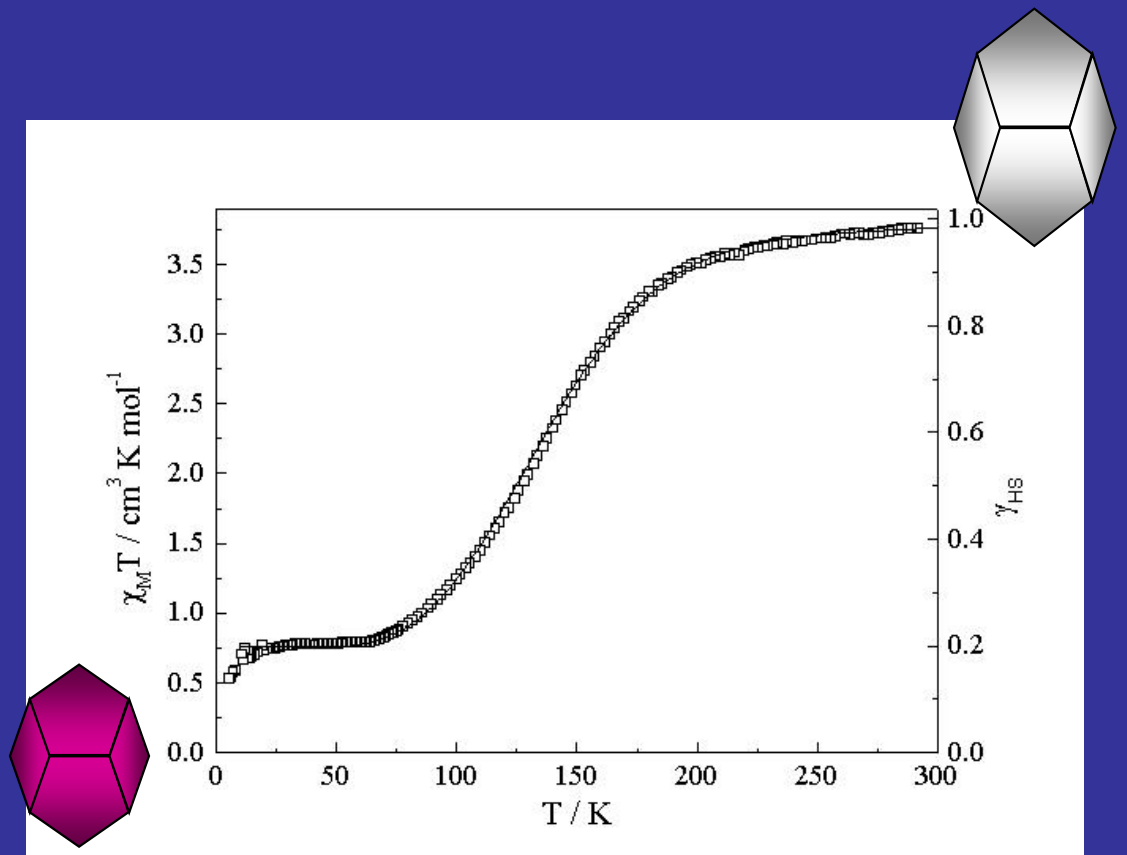






Molecular magnets: spin state switching

[Fe(1,2-bis(tetrazol-1-yl)propane)$_3$](ClO$_4$)$_2$

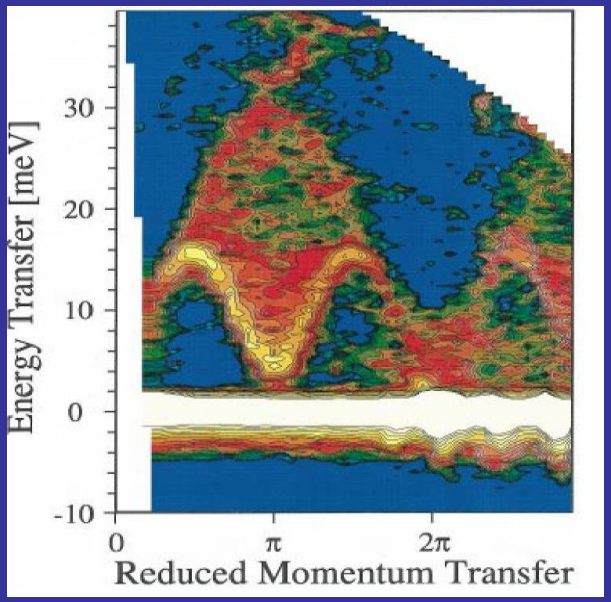


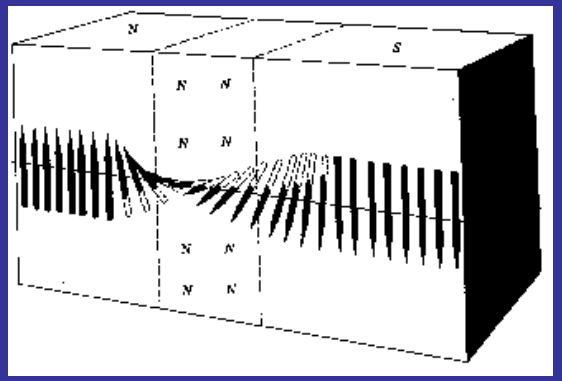
100 K, Fe(II) LS: Fe–N = 2.038(4) Å Fe–Fe = 7.273(2) Å

200 K, Fe(II) HS: Fe–N = 2.164(4) Å Fe–Fe = 7.422(2) Å

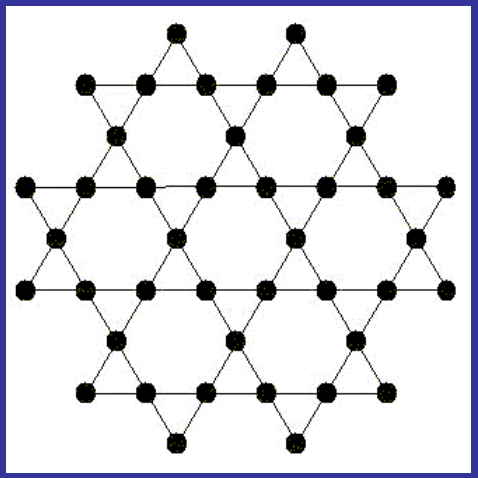
Frustration and quantum magnetism

Spin liquids and Spin ice





Geometric frustration



Kagome lattice