A brief pictoral introduction to the Hall effects, the generation of composite fermions, and the impact of changing magnetic field on Landau levels and extended states.

Elektromagnetische Polka[1]

"O! mickle is the powerful grace that lies
In plants, herbs, stones, and their true qualities:
For nought so vile that on the earth doth live
But to the earth some special good doth give,
Nor aught so good but strain'd from that fair use
Revolts from true birth, stumbling on abuse:
Virtue itself turns vice, being misapplied,
And vice sometime's by action dignified."[2]

I. Electromagnetic Interactions
II. Hall Effects
III. Connections

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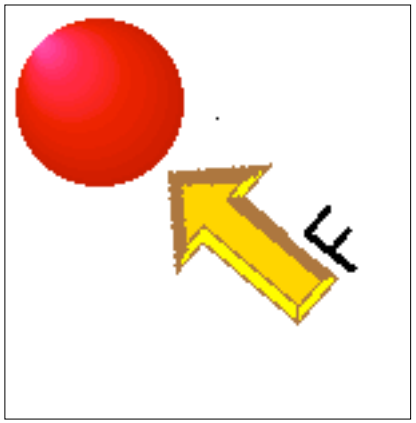
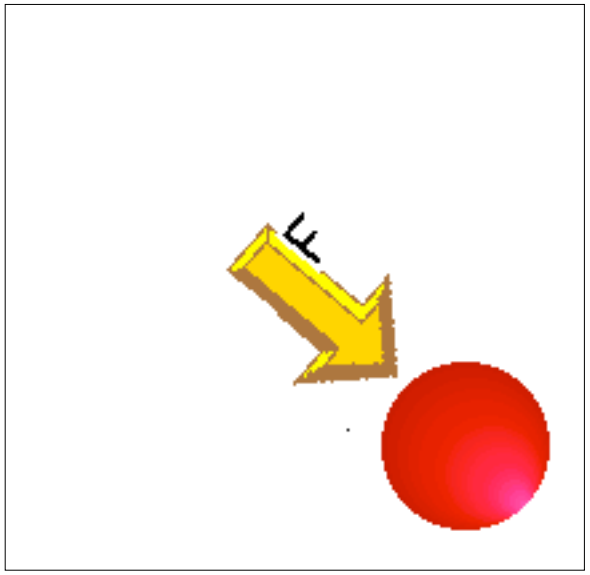
[1] from title of composition by Johann Strauss

[2] Friar Lawrence, Romeo and Juliet, William Shakespeare, II iii 15-22



Coulomb's Law

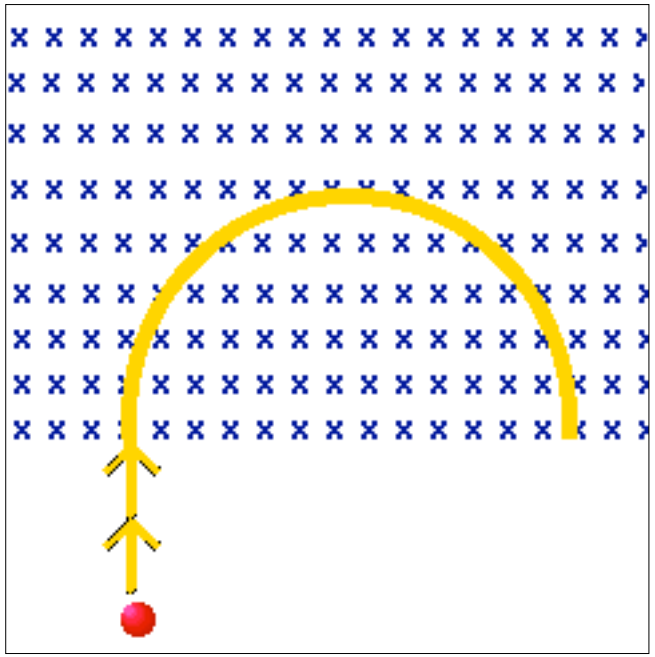
$$\mathbf{F} = \mathbf{k_e} \frac{e^2}{r^2} \hat{\mathbf{r}}$$



Electron in a Magnetic Field

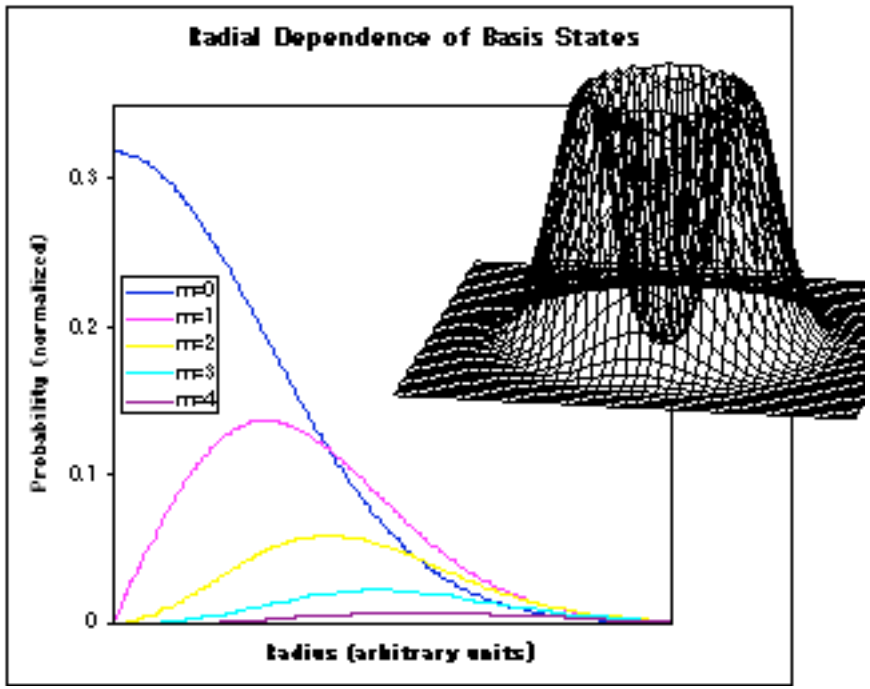
Classical

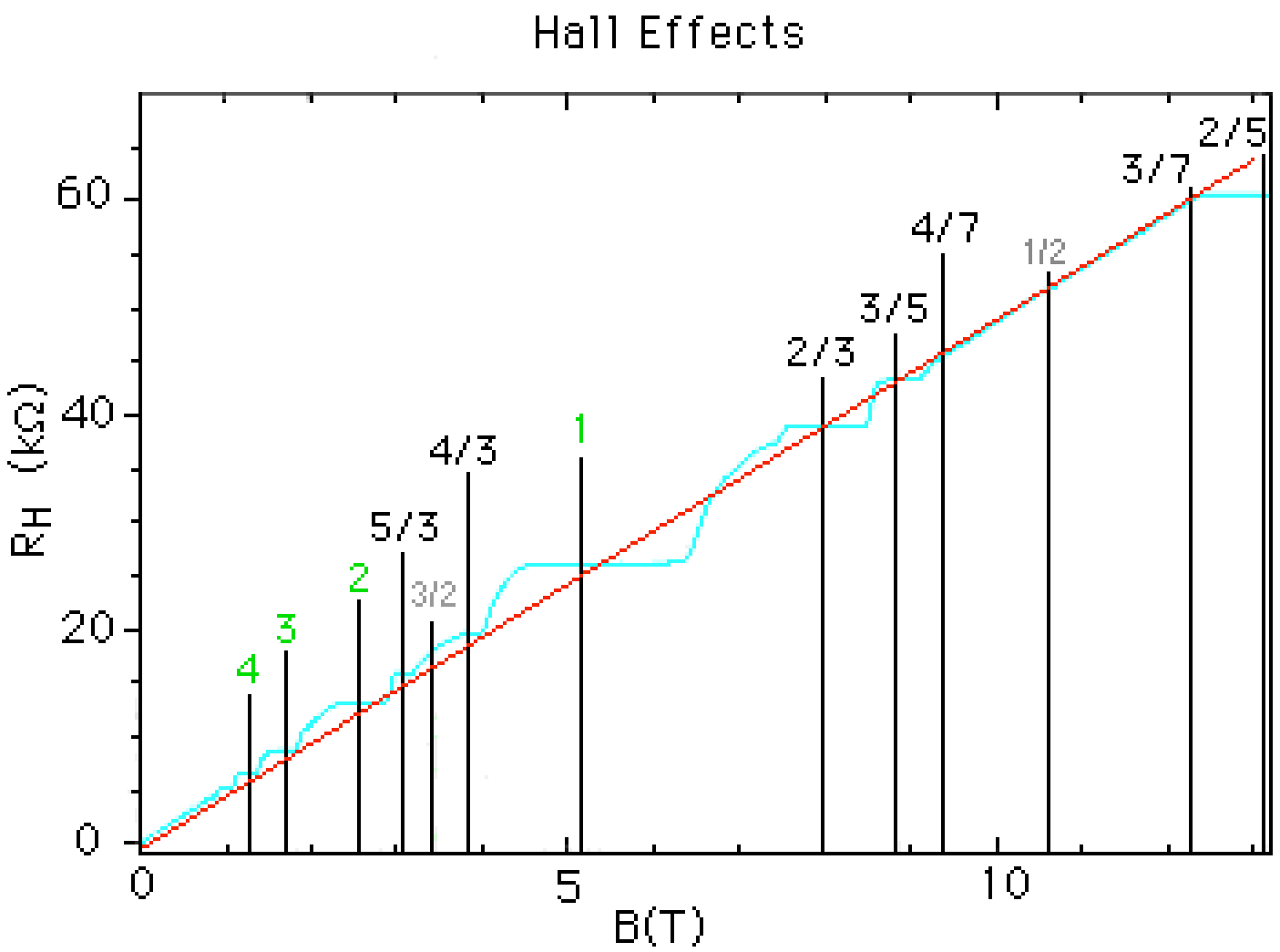
$$\mathbf{F} = -e\mathbf{v} \times \mathbf{B}$$



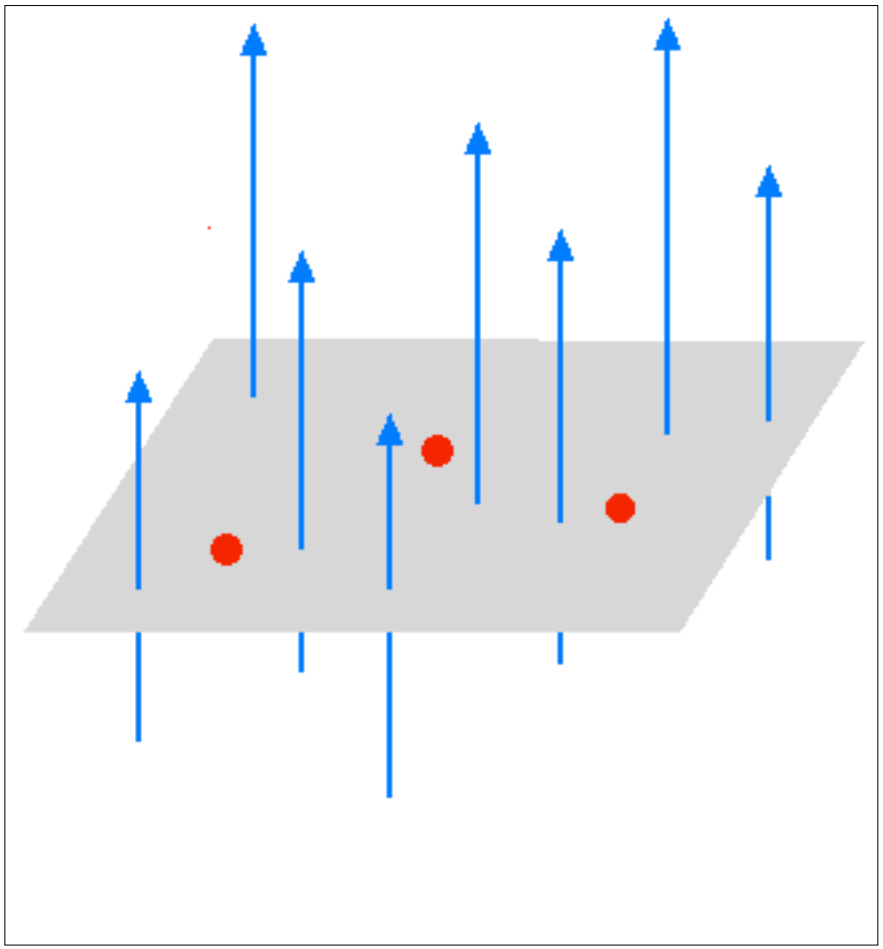
Quantum Mechanical

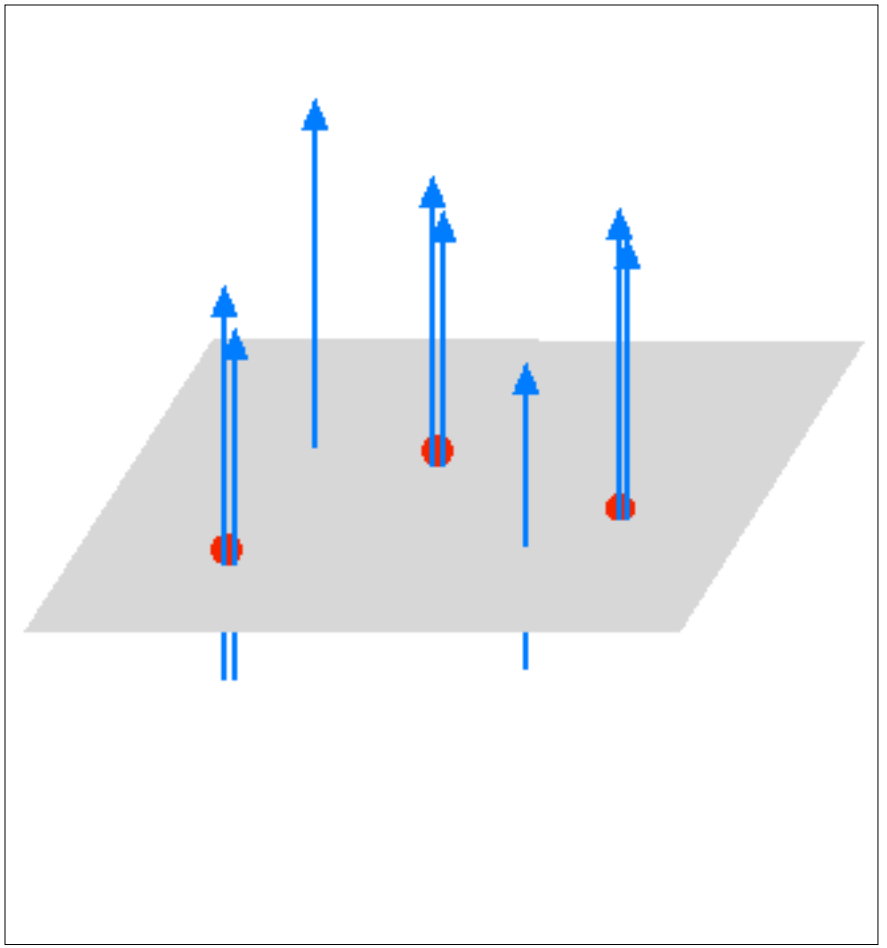
$$H = \frac{1}{2}\left[\sigma \cdot \left(\mathbf{p} + \frac{e}{c}\mathbf{A}\right)\right]^2$$




Hall Effects
RH (kΩ)
B(T)
0
20
40
60
0
5
10
4
3
2
5/3
3/2
4/3
1
2/3
3/5
4/7
1/2
3/7
2/5

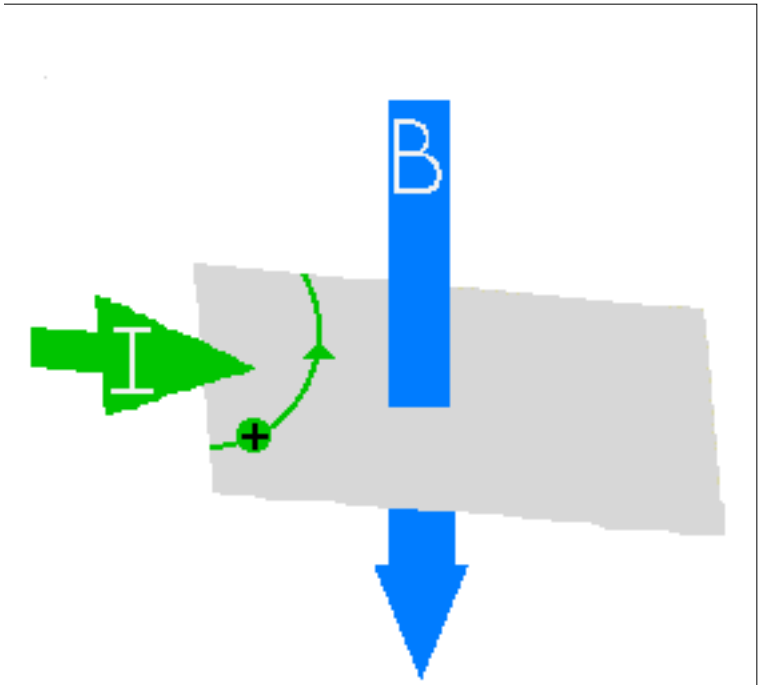
Formation of Composite Fermions

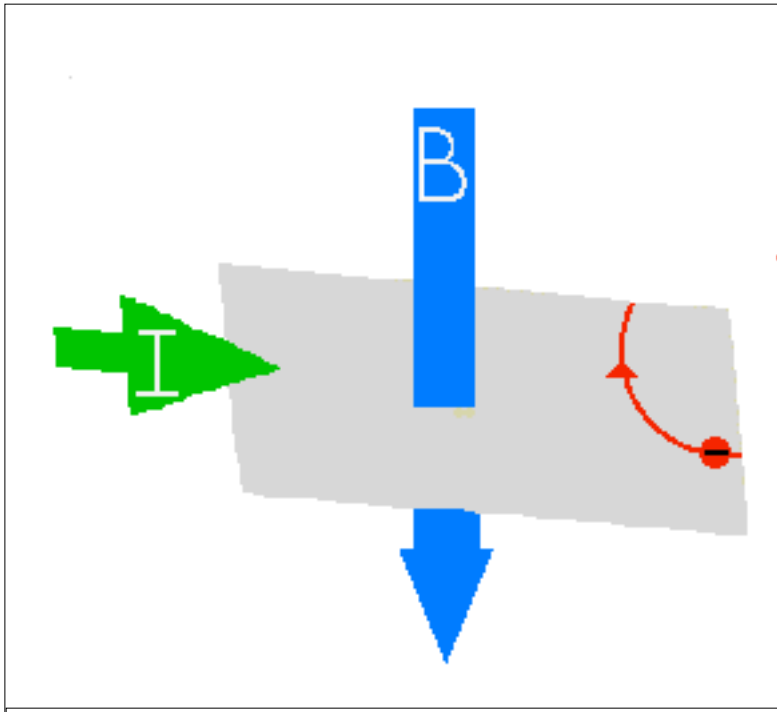




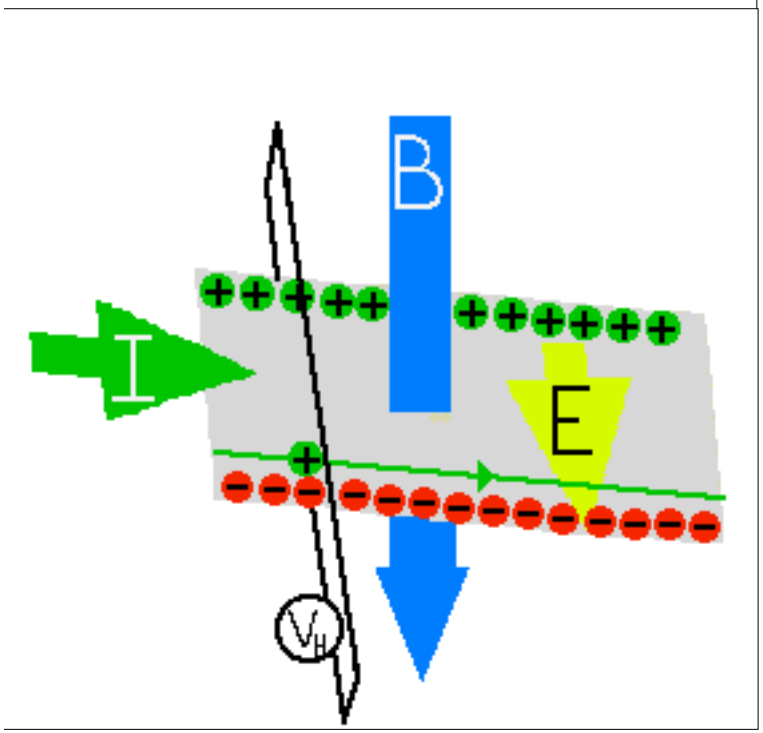
HALL EFFECT

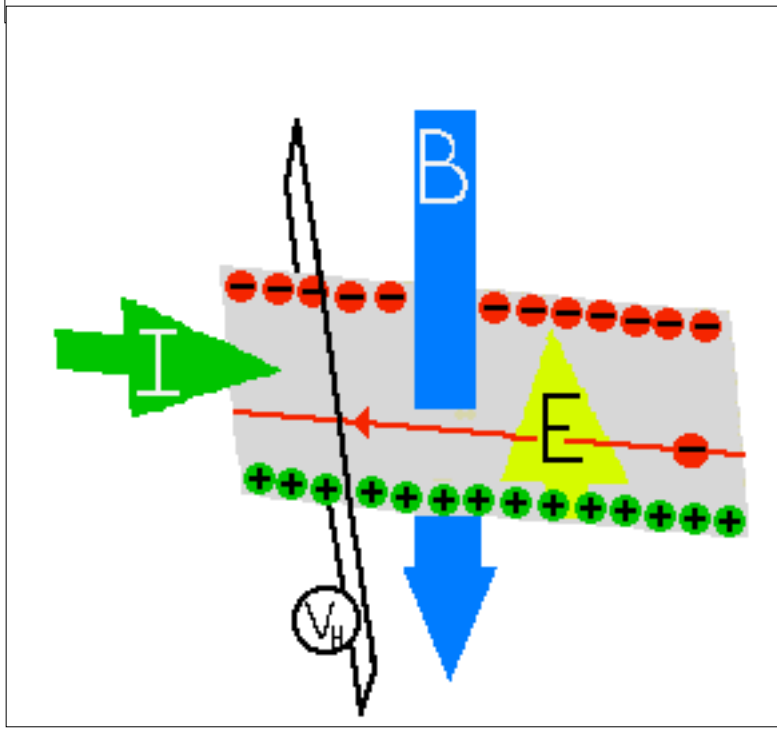
begin



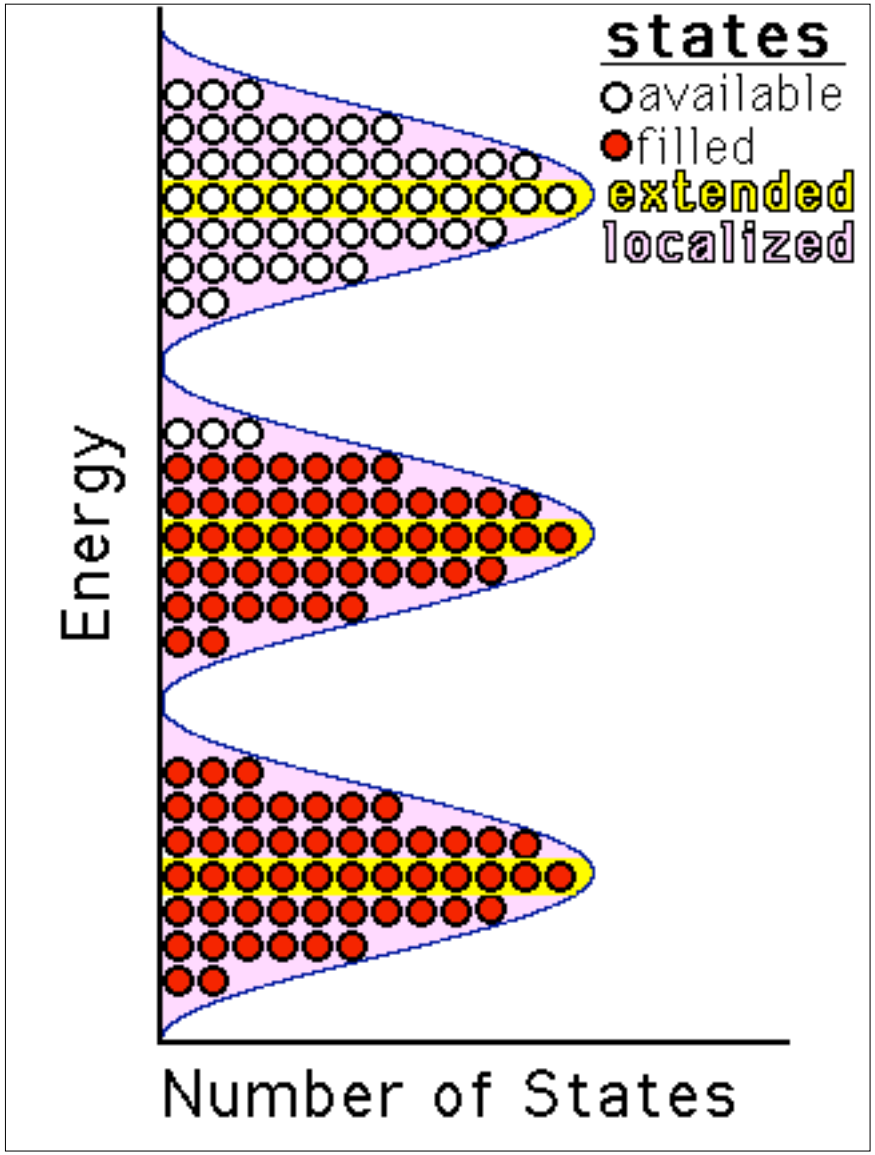


end





Magnetic Field



Stronger Magnetic Field