

## MP 710 – Lecture 4 9/18/2018



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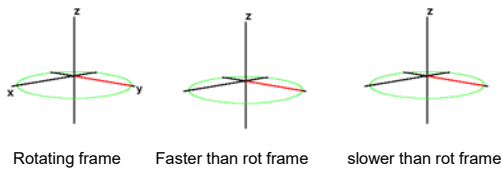


### Youtube movies

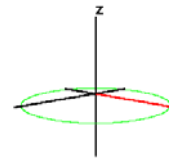
- **Precession**

- **Precession 1min45s**
  - <https://www.youtube.com/watch?v=3WnFYBngbLU>
- **Protons as Vectors 6min45s**
  - <https://www.youtube.com/watch?v=XCnMwz6Z1g>

### Rotating frame of reference



### Spin packet



### Youtube movies

- **Redding**

- **T1 relaxation**
  - <https://www.youtube.com/watch?v=Z7HfnNAz-UIM&list=PL40F1EE0DF59D777A&index=5>
- **T2 relaxation**
  - [https://www.youtube.com/watch?v=LvyADhrpc\\_s&index=6&list=PL40F1EE0DF59D777A](https://www.youtube.com/watch?v=LvyADhrpc_s&index=6&list=PL40F1EE0DF59D777A)

### Youtube movies

- **Redding**

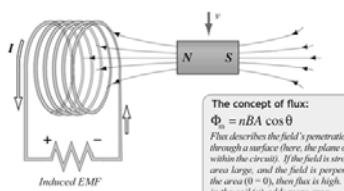
- **90 deg pulse and T1 relaxation – 15 s**
  - <https://www.youtube.com/watch?v=Kp67iqQIH4&index=1&list=PL40F1EE0DF59D777A>
- **T2 dephasing – 12s**
  - [https://www.youtube.com/watch?v=GDEIT6Tz7\\_Q&list=PL40F1EE0DF59D777A&index=4](https://www.youtube.com/watch?v=GDEIT6Tz7_Q&list=PL40F1EE0DF59D777A&index=4)
- **T2 dephasing – top view 13s**
  - <https://www.youtube.com/watch?v=7oZMA0OuK4&list=PL40F1EE0DF59D777A&index=3>
- **180 deg pulse – 8s**
  - <https://www.youtube.com/watch?v=Z7HfnNAz-UIM&list=PL40F1EE0DF59D777A&index=5>

Physics • ELECTROMAGNETIC INDUCTION • XVIII • Faraday's and Lenz's Laws (379) ©

### Faraday's Law

$$\mathcal{E} = - \frac{\Delta \Phi_m}{\Delta t}$$

$\mathcal{E}$  = induced emf  
 $\frac{\Delta \Phi_m}{\Delta t}$  = rate of change of magnetic flux through the circuit



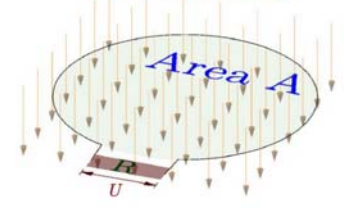
The concept of flux:  
 $\Phi_m = nBA \cos \theta$   
 Flux describes the field's penetration (or flow) through a surface (here, the plane of the loops within the circuit). If the field is strong and the area large, and the field is perpendicular to the area ( $\theta = 0$ ), then flux is high. Each turn in the coil ( $n$ ) adds more area.

Induced EMF

From <http://www.cobblearning.net/physicslaw777ap/2014/03/04/induced-emf-and-faradays-law/>

### Faraday law of induction

Magnetic Field Change  $\frac{dB}{dt}$

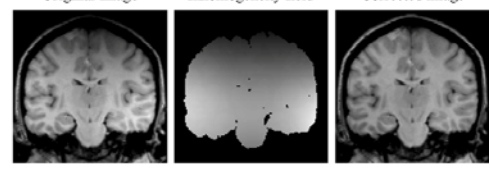


Area A

From <http://math-science.net/?q=node/158>

### MRI Image Intensity Correction

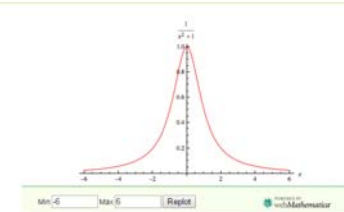
Original image    Inhomogeneity field    Corrected image



From <http://www.drcmr.dk/bloch>

### Lorentzian aka Cauchy Distribution

Lorentzian Function



The Lorentzian function is the singly peaked function given by:

$$L(x) = \frac{1}{\pi} \frac{\Gamma}{(x - x_0)^2 + \left(\frac{\Gamma}{2}\right)^2}$$

From <http://mathworld.wolfram.com/LorentzianFunction.html>

### Youtube movies

- **Spin echo**
  - Spin echo 1 – 31 s  
<https://www.youtube.com/watch?v=yKmEhCPV4Cg>
  - Bloch Simulator – 1min 45 s  
<https://www.youtube.com/watch?v=FyIH2TQvI>
  - Another simulator: [www.bigs.de](http://www.bigs.de)  
<https://www.youtube.com/watch?v=nSrvhRuKFas>

<http://www.drcmr.dk/bloch>