DNA Breaks From Neutron Radiation

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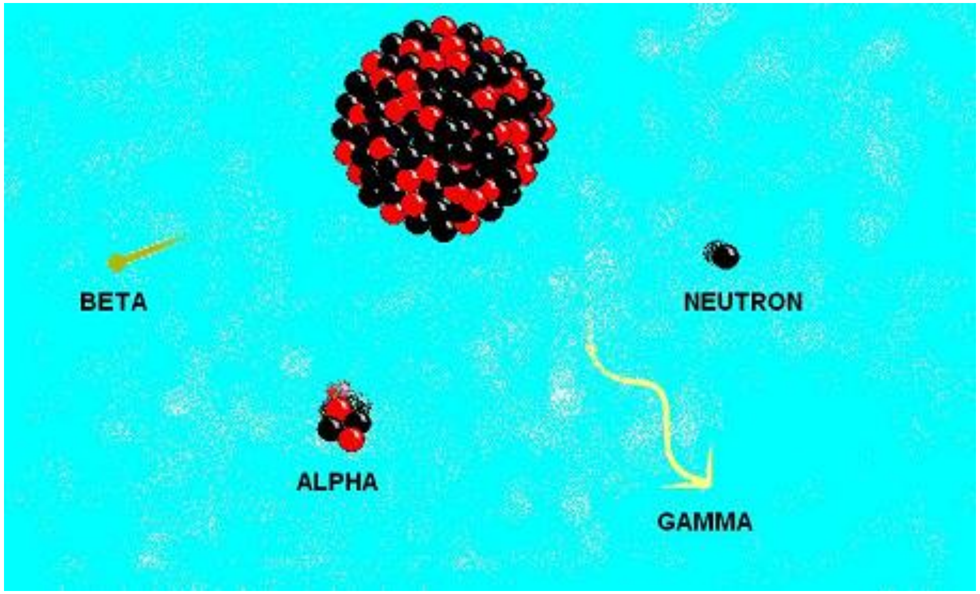
Types of Radiation

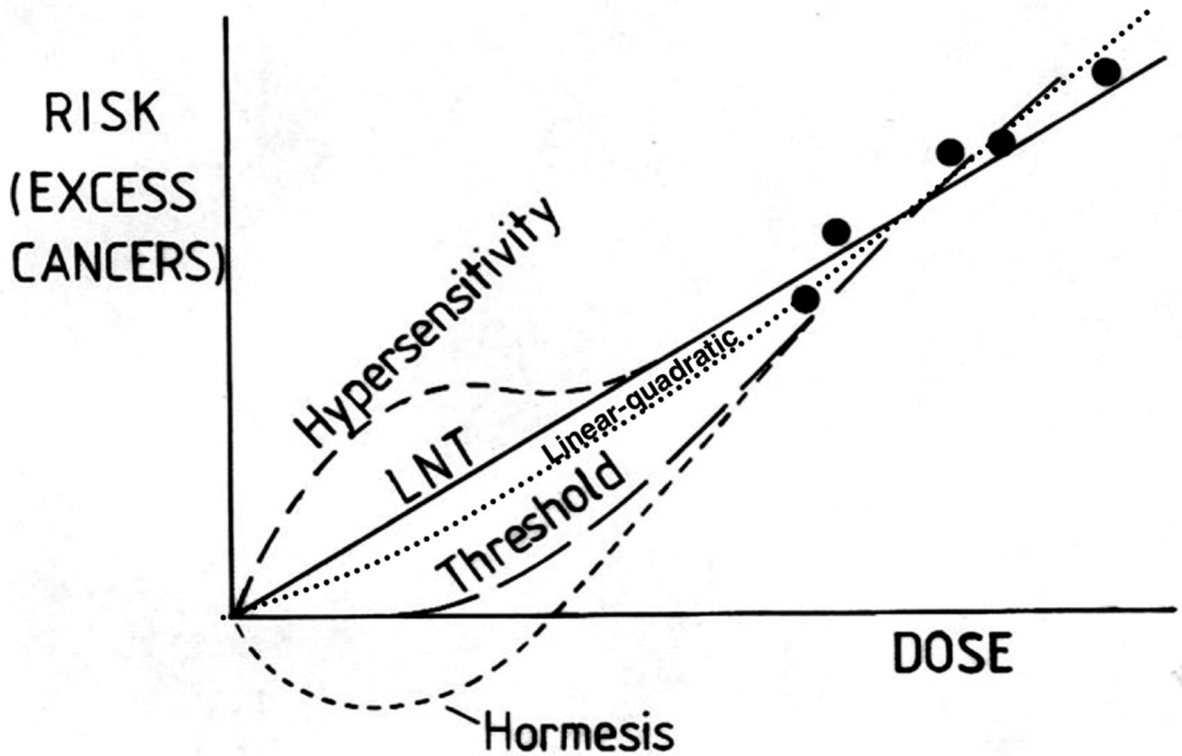
- Non-Ionizing
- Ionizing
  - Alpha
  - Beta
    - β +
    - β -
  - Gamma Rays
  - X-rays
  - Neutrons



http://sabinpr2.blogspot.com/2012_05_01_archive.html

Radiation Risks

- Linear No Threshold
- Threshold



Goodhead D T Radiat Prot Dosimetry 2009;137:109-117

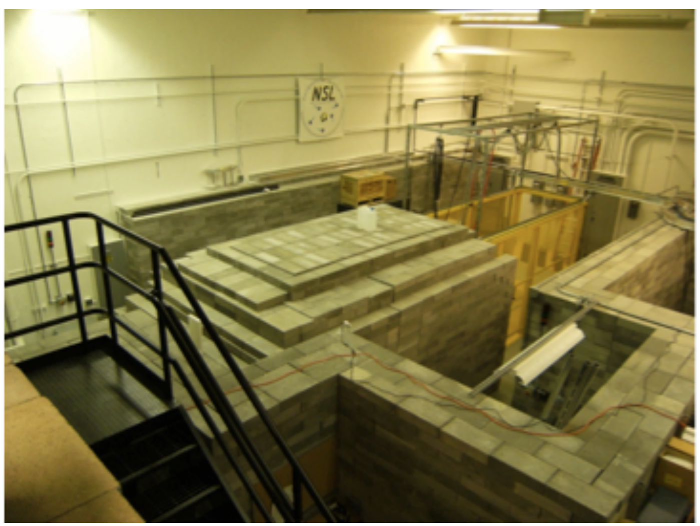
Dose

- Absorbed Dose
  - Kerma
- Dose Equivalent
  - $H \equiv QF \times D$
- Effective Dose Equivalent
- Effective Dose

Type of radiation, R	Energy range	Quality or weighting factor, w_R
Photons, electrons	All energies	1
Neutrons	<10 keV	5
	10–100 keV	10
	100 keV–2 MeV	20
	2–20 MeV	10
	>20 MeV	5
Protons	<20 MeV	5
Alpha particles, fission fragments, heavy nuclei		20

Neutron Radiation

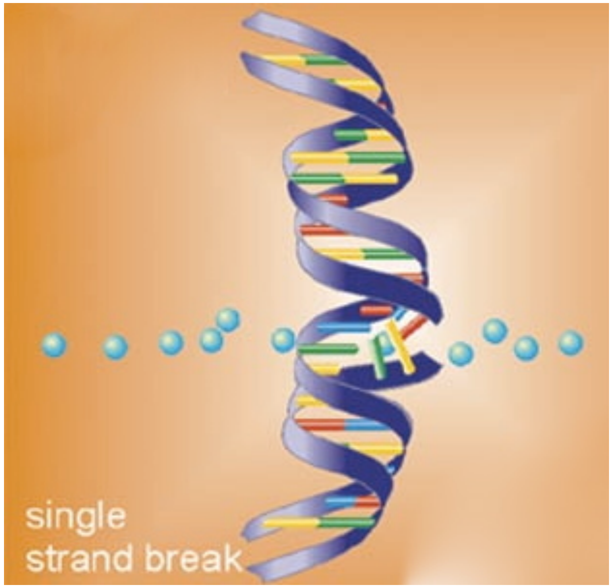
- Sources
  - Fission
  - Generators
  - Solar Flares
  - Cosmic Rays
- Interactions
  - Nuclear Accidents
  - Nuclear Terrorism
  - Space Travel

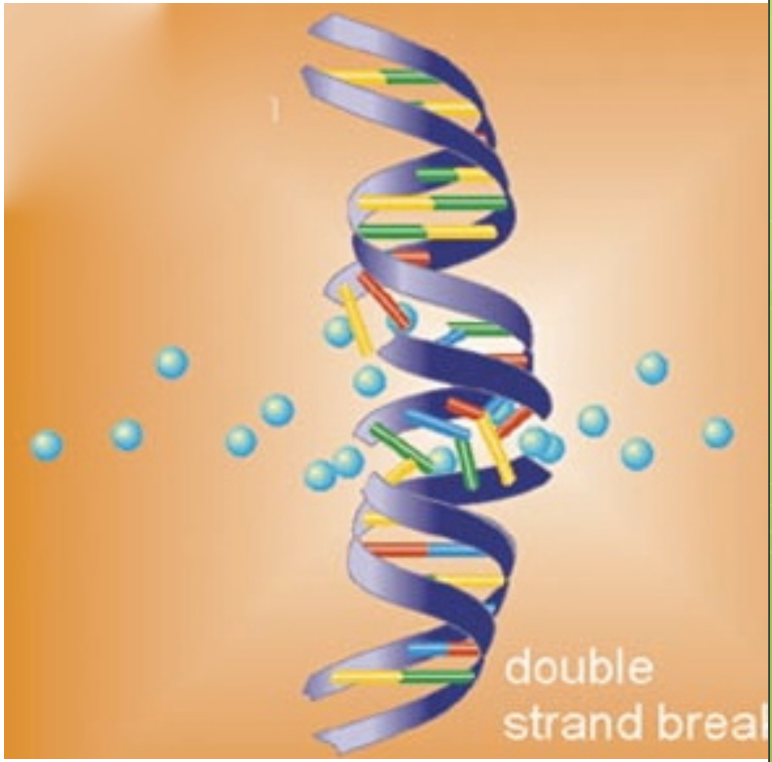


UM d-t Neutron Generator

DNA & Damages

- Plasmid DNA
- Single Strand Breaks
- Double Strand Breaks

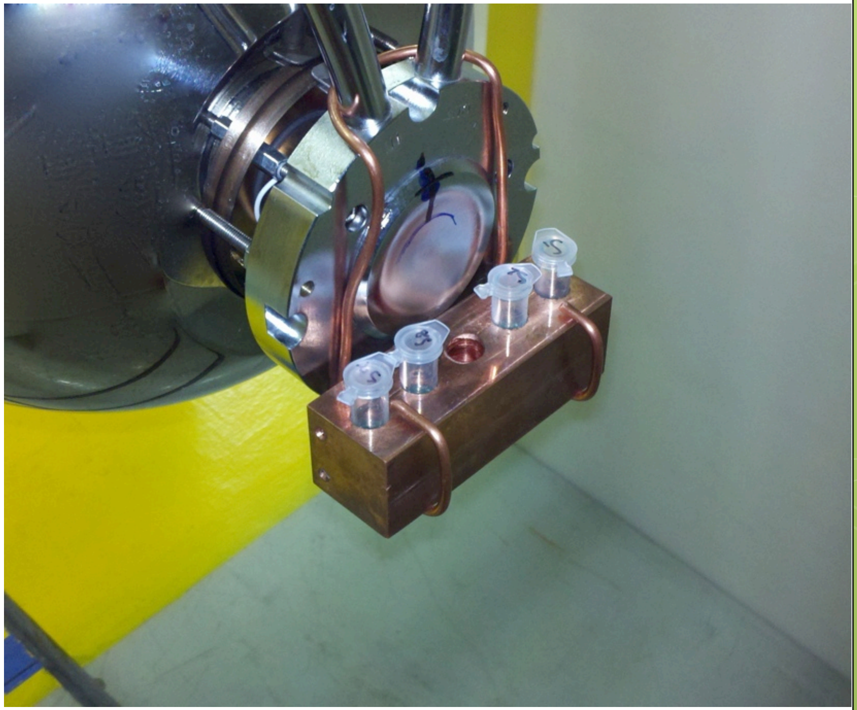




Set Up at UM Nuclear Engineering:

DNA Sample Holder

Neutron Generator



Neutron Flux

Flux Rate

$$\Phi = \frac{N}{4\pi r^2}$$

Point Source with a Shield

$$\Phi^o = \Phi e^{-\sum \sigma n t}$$

Kerma

$$K = 1.602\times 10^{-10} E\left(\frac{f_s(E)\mu_{n,\gamma}(E)}{\rho}\right)\Phi$$

$$f_s = \frac{2A}{(A+1)^2}E$$

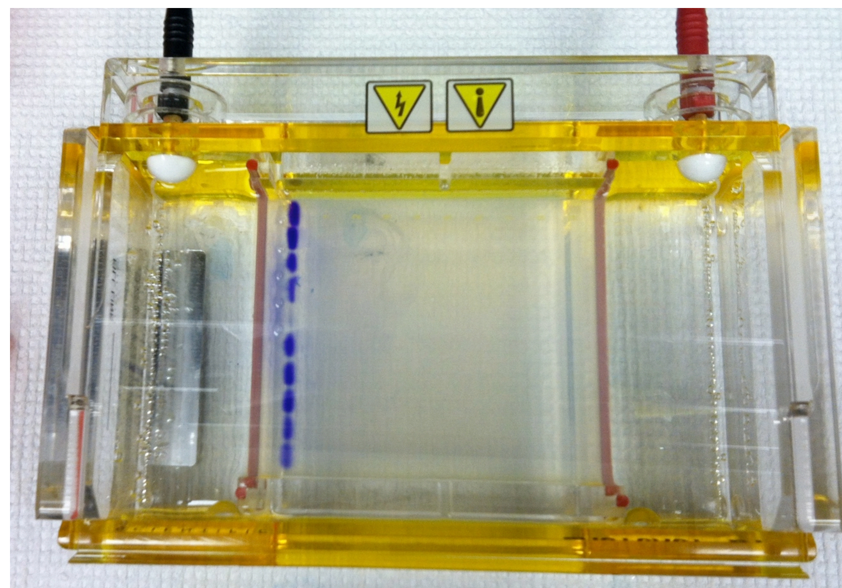
Approx. Dose

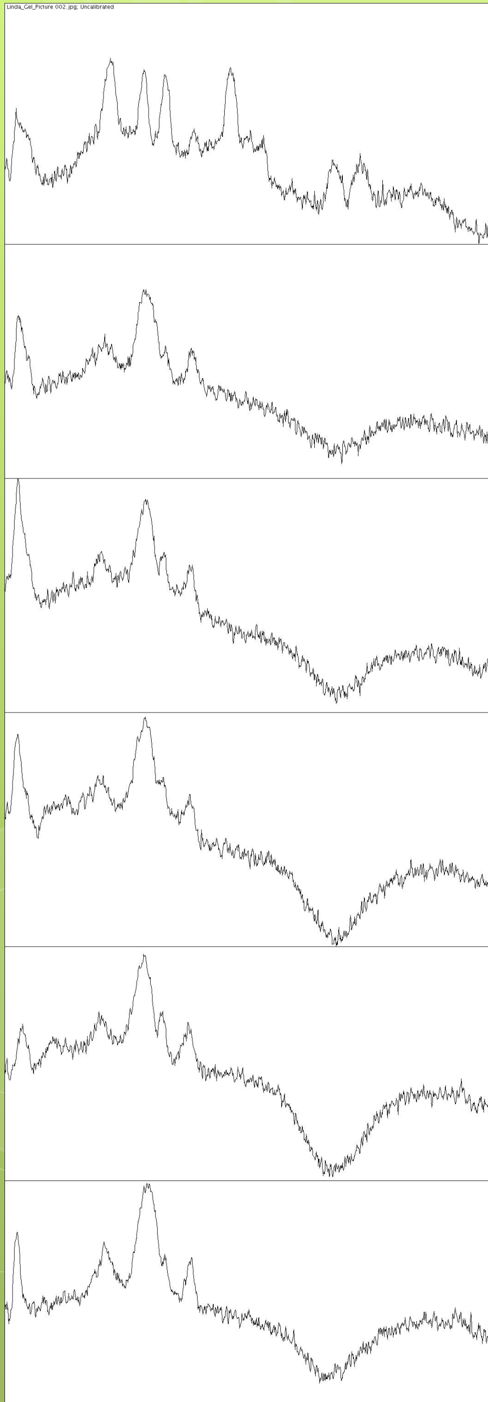
$$Time = \frac{D}{K}$$

Electrophoresis

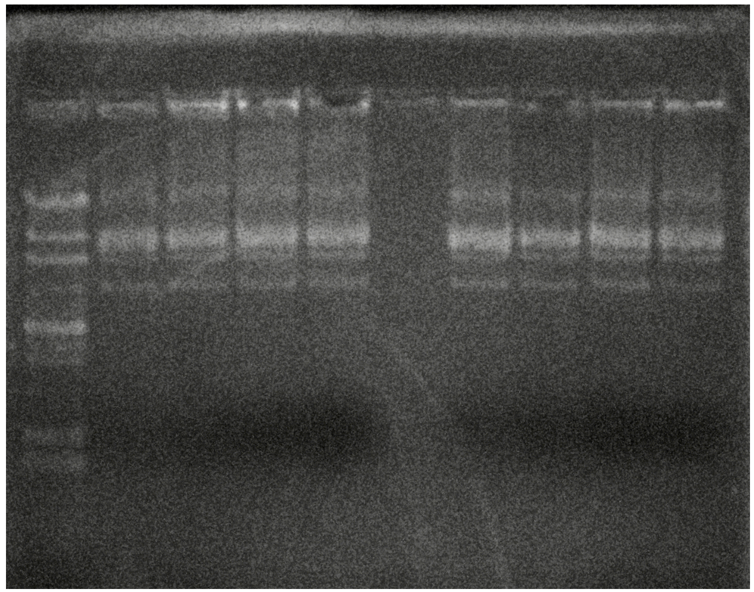
Chris Meiners Biophysics Lab

- Larger fragments travel more slowly because they experience more drag in the gel.
- More DSBs will create smaller fragments causing them to move farther in the gel.



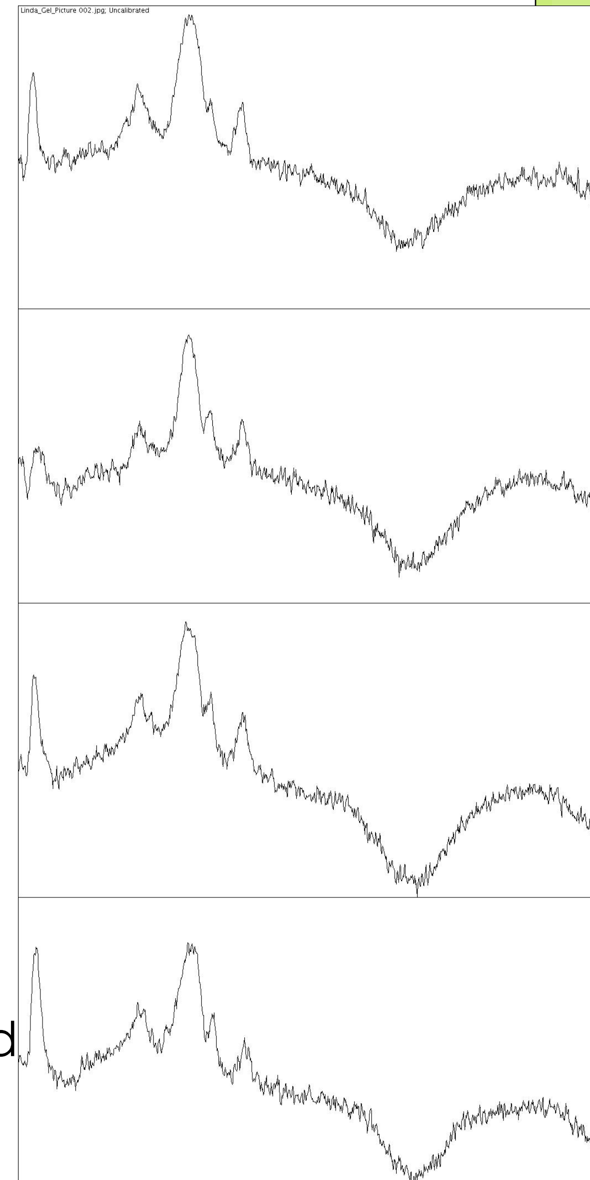


Gel Scans



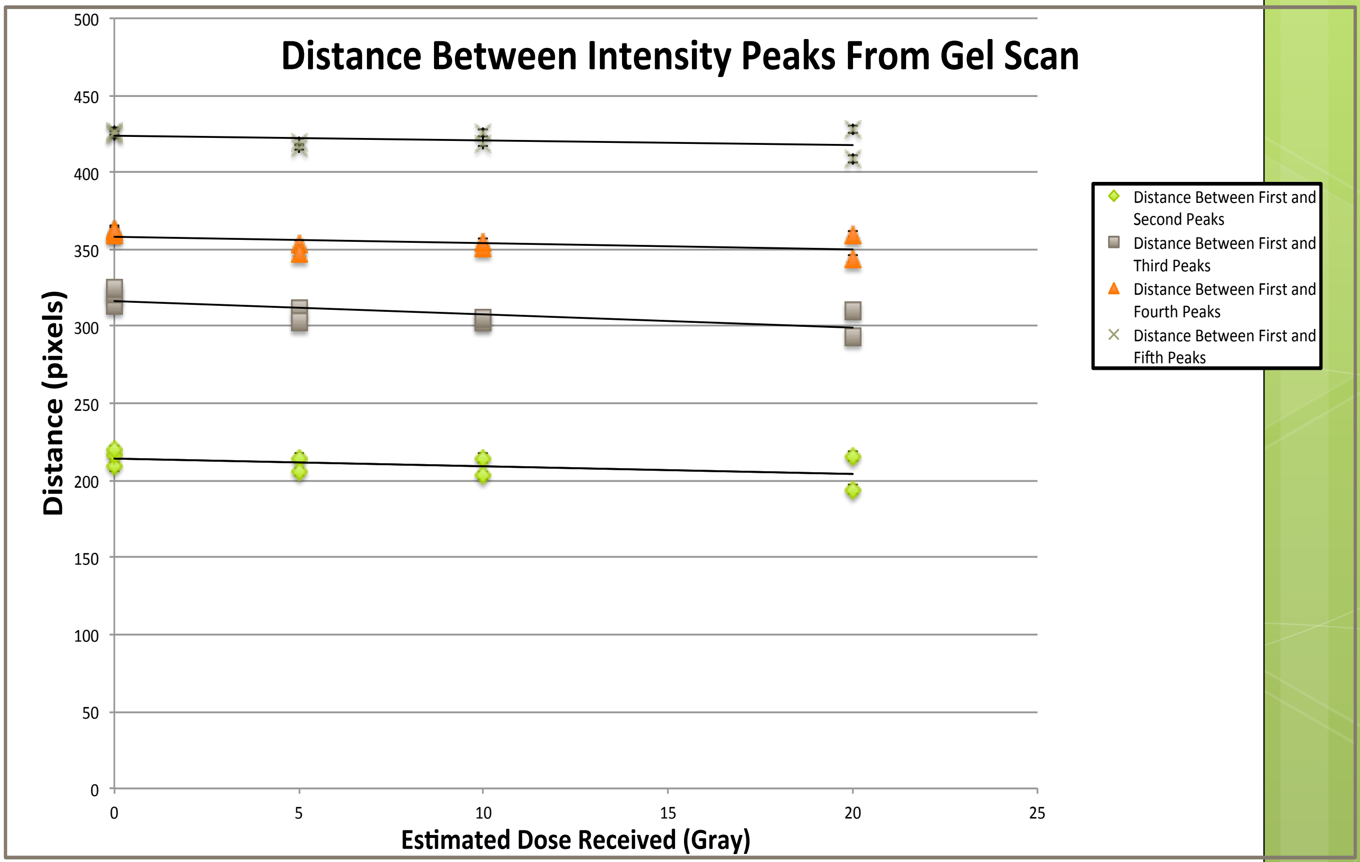
Above: scan of stained gel
Left & Right: intensity peaks

Gels and samples were prepared in lab, photographed and analyzed using NIH ImageJ



Conclusions

- Threshold effect?
- Not a point source?



What's next?

- Retesting with new block placement
- New cylindrical block
- Dose estimates from neutron activation
- Human heart cells
- γH2AX analysis

Thanks to:

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