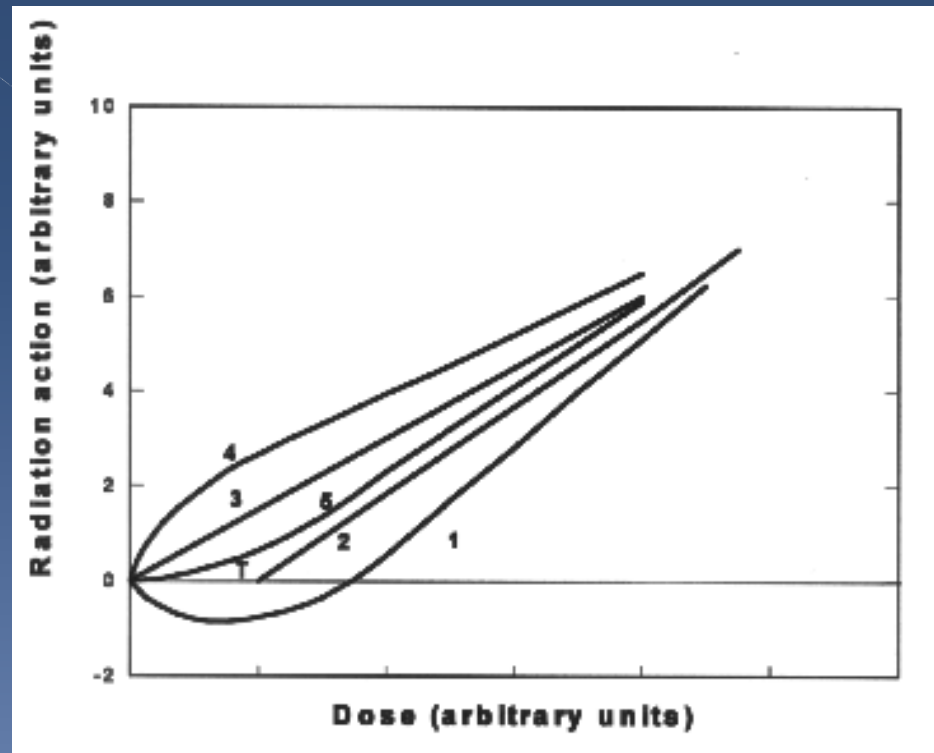


Non Linearity in Irradiated DNA and the Effect of Magnetic Field

Adriana Córdova
Advisor: Frederick D. Becchetti
University of Michigan
NSF - REU Program – Summer 2010

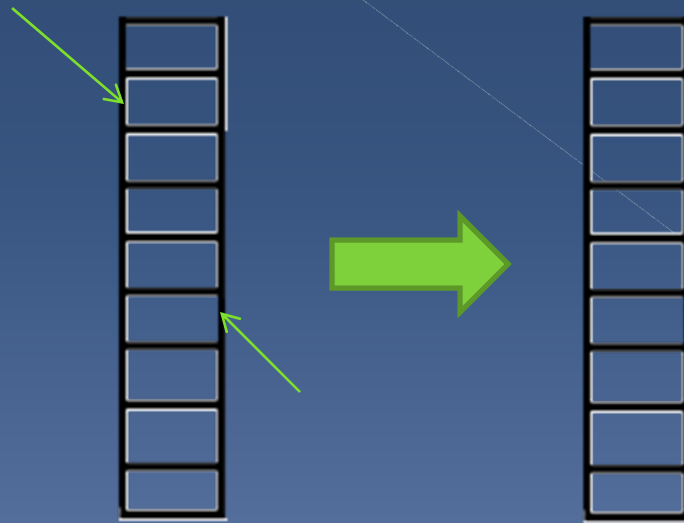
Uncertainties...

- Is the relation between radiation dose and DNA damage linear?
- What is happening at low doses?
- What if we apply a magnetic field?



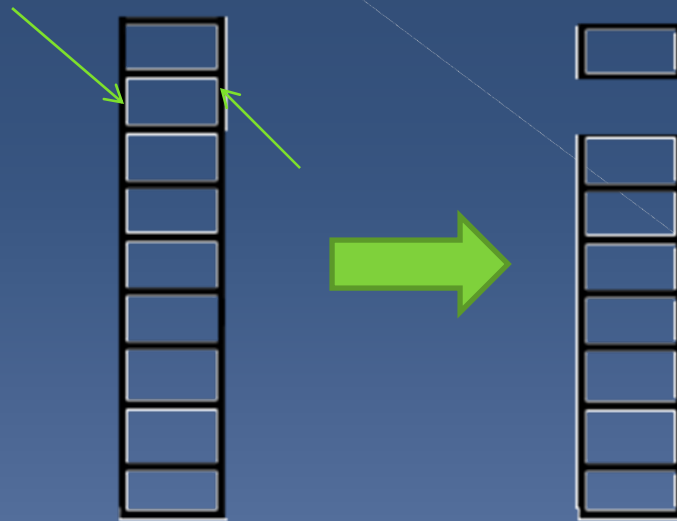
Radiation Damage in DNA

- Most Irradiation damage results in single strand breaks which DNA can repair itself.
- Double strand breaks usually can't be repaired and can lead to DNA mutations



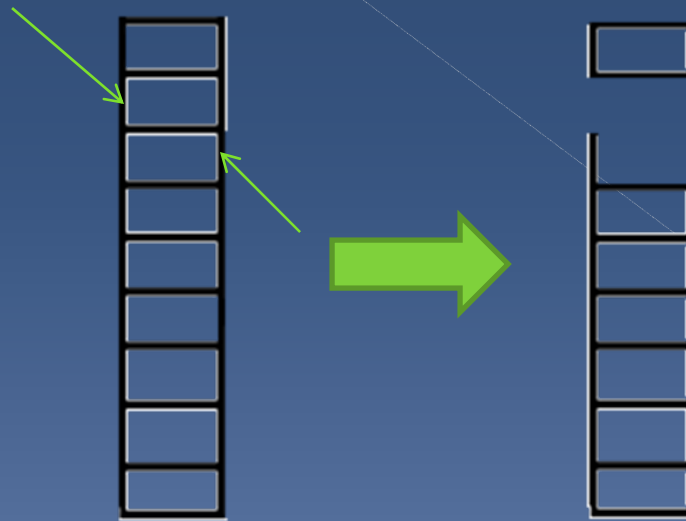
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Radiation Damage in DNA

- Most Irradiation damage results in single strand breaks which DNA can repair itself.
- Double strand breaks usually can't be repaired and can lead to DNA mutations
- The limitation of radiation therapies
 - > Secondary electron scatter and interact with healthy cells
- A magnetic field reduces the scatter
 - > Will the magnetic field cause less damage to DNA?

Problem

- Can we extrapolate yearly or lifetime radiation dose limits in humans using data from high doses?

Why Study Radiation?

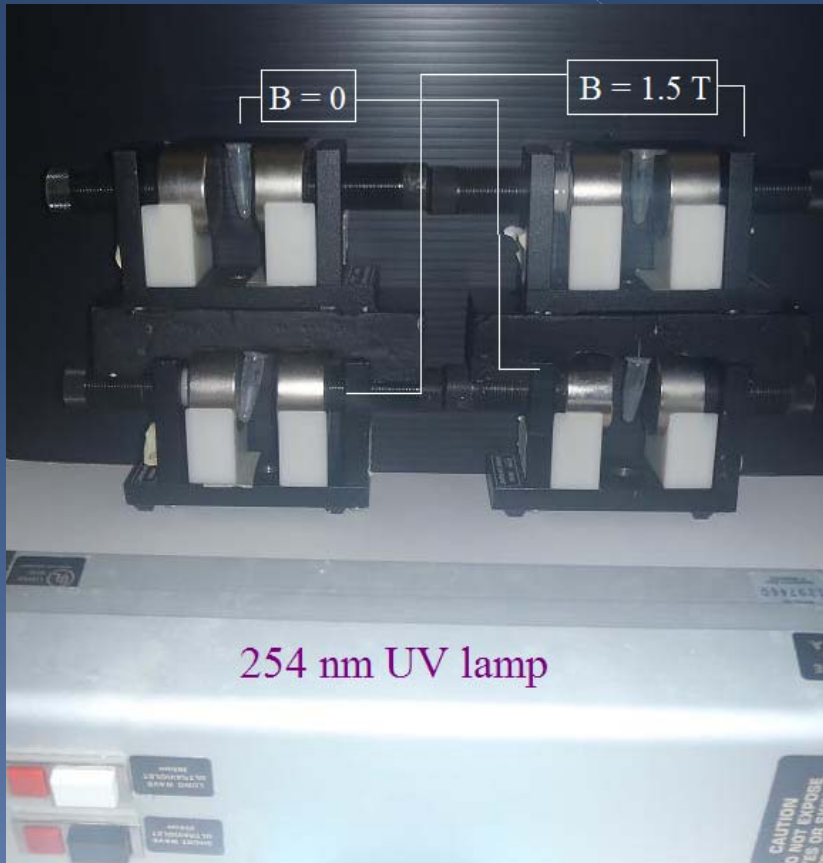
- Human exposure to radiation is a common cause for cancer (natural sources, air travel)
- Concerns for radiation and medical workers
- Long term effects of medical x-rays / CT's
- Long duration space travel
 - > elevated radiation/ cosmic rays
 - > Solar flares

Method

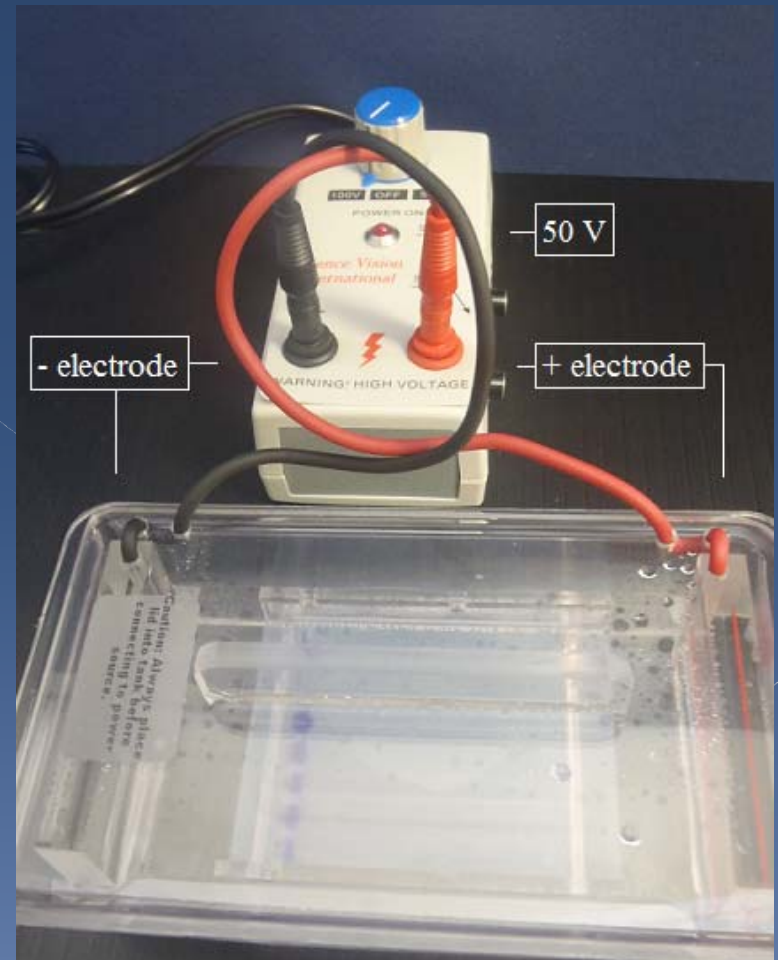
- ◉ Look at DNA mutations vs dose
 - high dose → low dose
 - › First irradiate with a 254nm UV light and in near future with fast neutrons at the Nuclear Engineering and Radiological Sciences (NERS)
- ◉ Look at high dose with and without magnetic field applied
- ◉ Analyze DNA mutations using electrophoresis

Experimental Setup

Irradiation Chamber



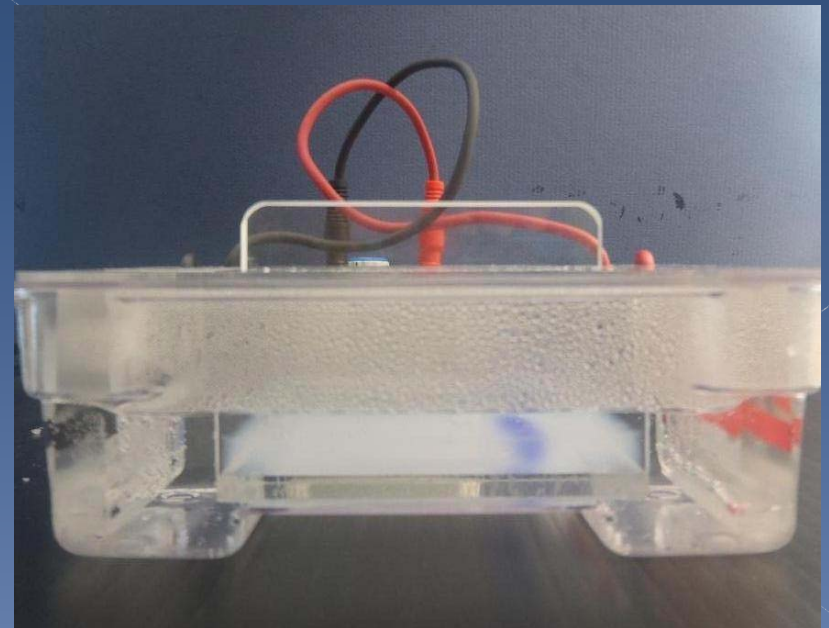
Electrophoresis Equipment



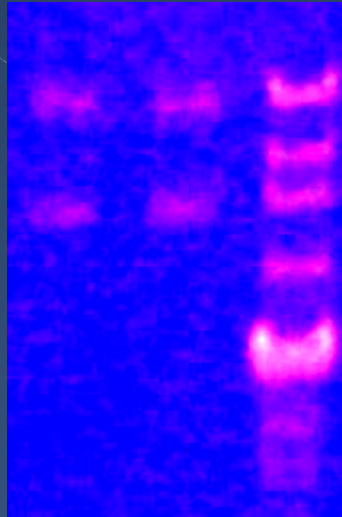
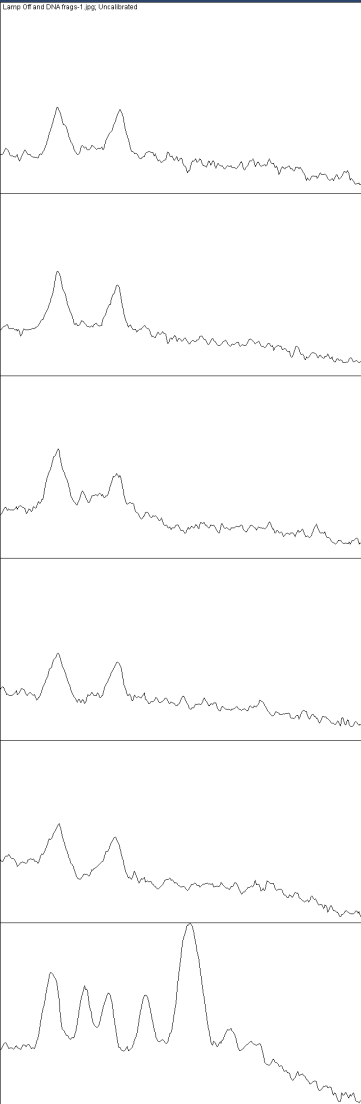
DNA migrates from negative to positive electrode

Electrophoresis

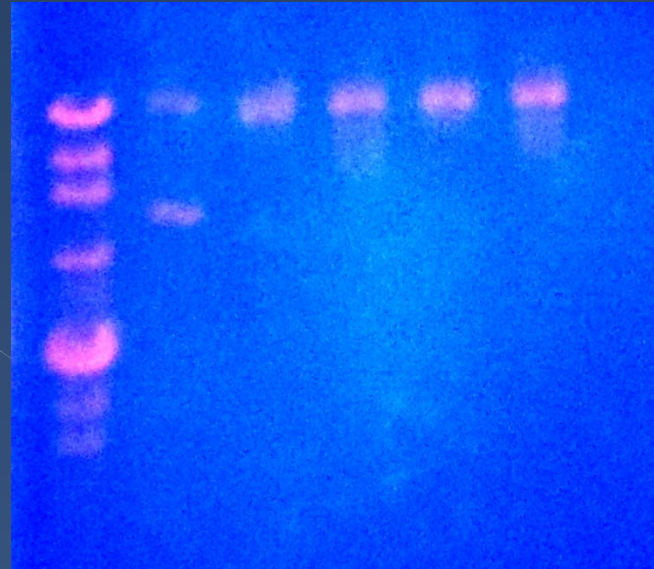
- Electrophoresis is the motion of dispersed particles relative to a fluid under the influence of a uniform electric field
- Restriction enzymes cuts the DNA in fragments
- Longer molecules or fragments migrate more slowly because they experience more drag within the gel



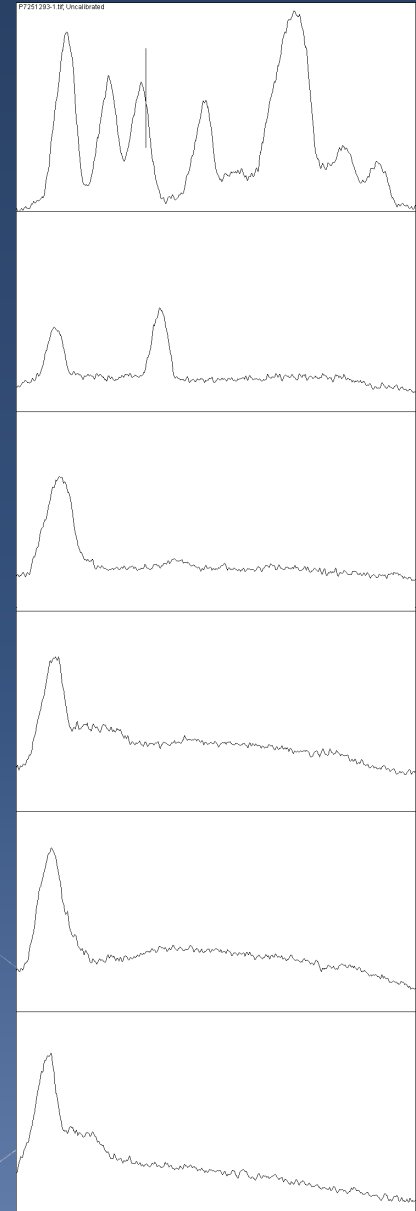
Gel Scans/Image Analysis



Above – control samples with DNA fragment, base pairs(bp)
Left – intensity peaks



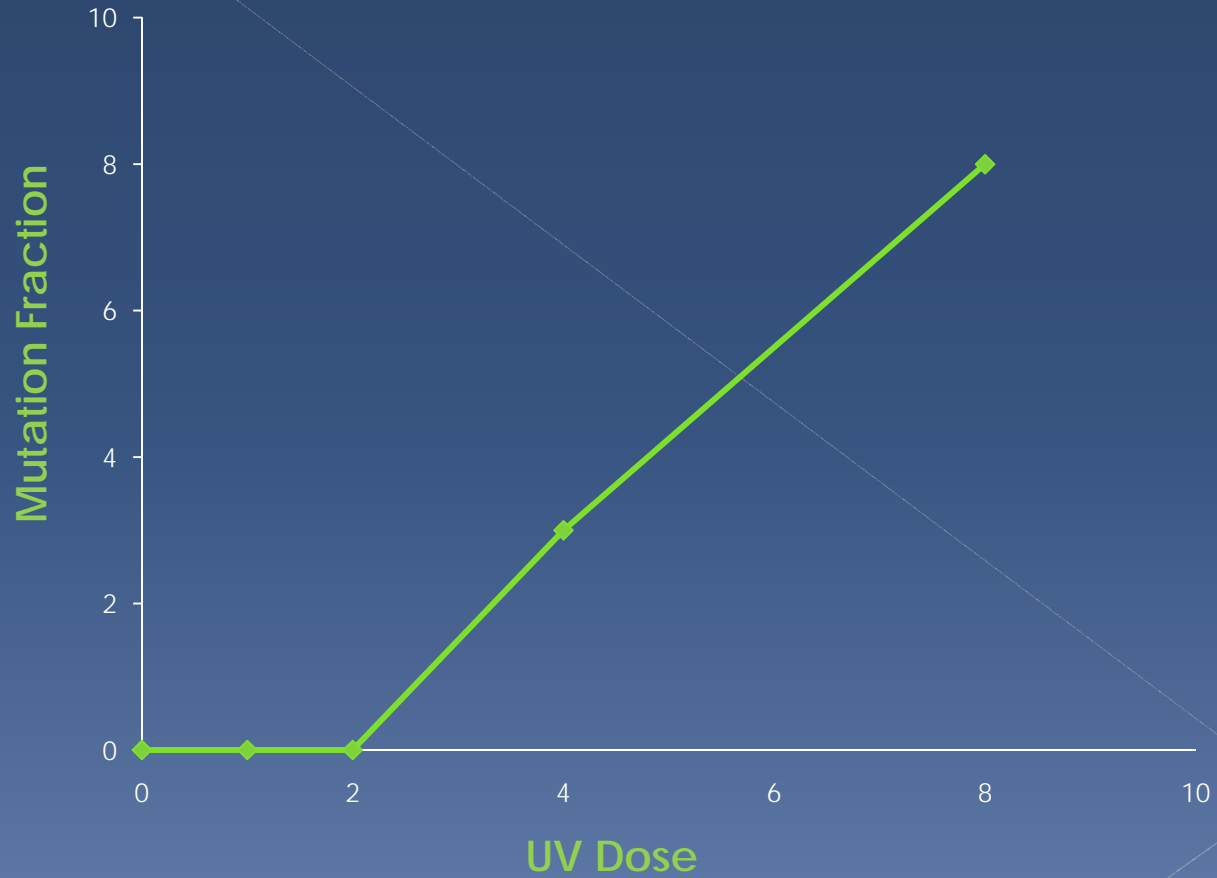
Above – mutated DNA (4 hour radiation)
Right – intensity peaks



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

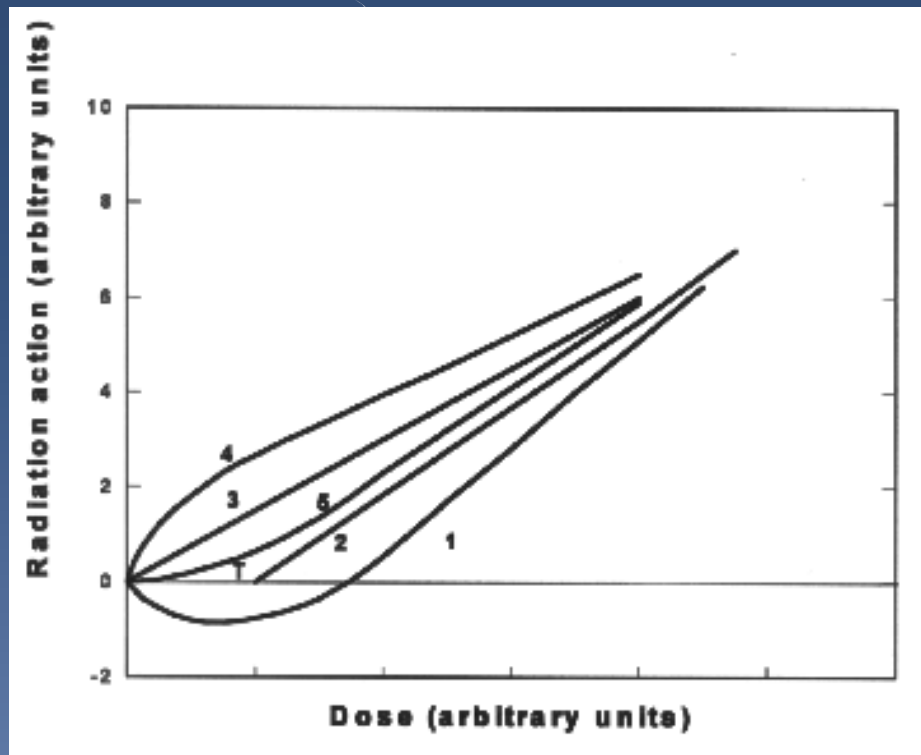
Results

Relation between dose and damage



Conclusion

- The relation between dose and DNA damage seems to be consistent with a threshold effect



Conclusion

- The relation between dose and DNA damage seems to be consistent with a threshold effect
- A linear extrapolation of high dose data to low dose will over estimate the radiation damage if there is a threshold as indicated by the UV data
- The radiation causes smears at the DNA bands
- The results in these experiments are reproducible
- Research must continue in order to get a concrete conclusion
- More time is required to analyze the magnetic field effect

Future Research*

- Irradiation of DNA samples using a d+t [deuterium (^2H) - tritium (^3H)] 14.5 MeV neutron generator at NERS



*Awaiting approval by UM Radiation Control

Special thanks to:

- ◉ Ramon Torres
- ◉ Mitaire Ojaruega
- ◉ Michael Hartman
 - ◉ Dave Burke
 - ◉ Chris Meiners
- ◉ Gursharan Singh Sandhu
- ◉ Prof. Liu and the UM REU staff for this wonderful experience

Thanks for your attention

- Questions???



- I hope to continue my studies in Medical Physics