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Title: Optical Method for Detecting and Analyzing Energetic Particle
Radiation

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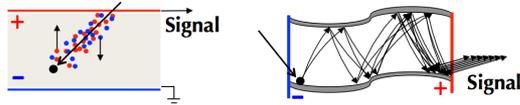
Optical Method for Detecting and Analyzing Energetic Particle Radiation

Build an ultrafast phonon detector to measure single energetic particles that is immune to x-rays and gammas

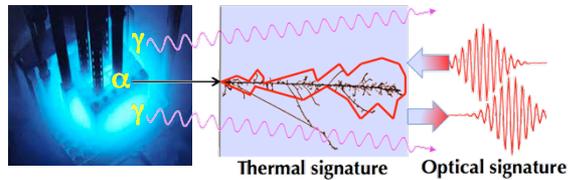


BACKGROUND & MOTIVATION

All room temperature particle detectors ultimately rely on electrons for detection.



A fast particle detector that responds to phonons would be insensitive to gamma, x-ray, and beta radiation environments.



INNOVATION

Using time resolved optical interferometry, detect the refractive index change due the thermal energy deposited by particle radiation

- This is a novel type of radiation detector method that has never been tested before.
- Fast particle detection method
- Radiation hardened sensor
- Sub-picosecond time resolution
- Precision dosimeter for particle radiation
- Future studies can involve imbedding ${}^6\text{Li}$ compounds directly into the active detection region.



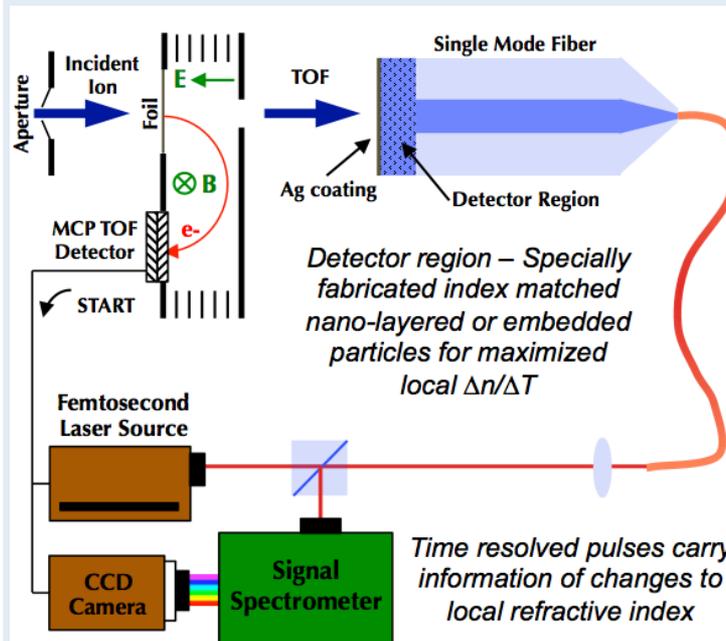
This neutron detector would be insensitive to x-rays, gamma rays, and beta particles.

DESCRIPTION

Approach

- Apply the technique of time resolved optical interferometry to detect penetrating particle radiation into matter.

Experimental Set Up



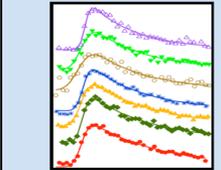
Current Technology Readiness Level (TRL) TRL 1-2

- There are no known theoretical obstacles
- Practical merits far outweigh any risk; it is also very likely others will try similar techniques in the near future

ANTICIPATED IMPACT

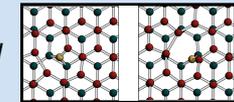
This detector technology will enable or improve

Nuclear forensics – EM insensitive alpha particle detector



Measurement of thermalization times of radiation impacts

Characterization of material damage and defect aggregation



PATH FORWARD

- Procure materials, build detector setup
- Measure ions (Au to He) with energies (15 MeV to <1 MeV)
- Characterize timing and energy resolution
- Modify detector region materials and geometries for improved sensitivity
- TRL 4 by end of ER
 - For use as ultrafast alpha detector
 - Test against EM radiation background
- Future Science
 - Neutron detector capabilities
 - Study non-equilibrium phonon events
 - Material defect analyzer capabilities

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