Optical Method for Detecting and Analyzing Energetic Particle Radiation

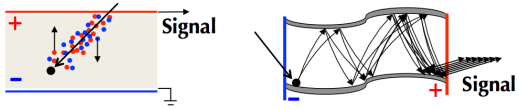
Los Alamos NATIONAL LABORATORY EST. 1943

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

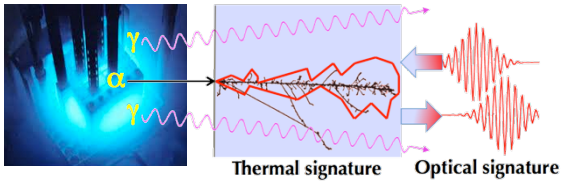
LDRD innovation for our nation

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}Li compounds directly into the active detection region.*

$$^6\mathrm{Li} + n \rightarrow t\,(2.05\,\mathrm{MeV}) + \alpha\,(2.73\,\mathrm{MeV})$$

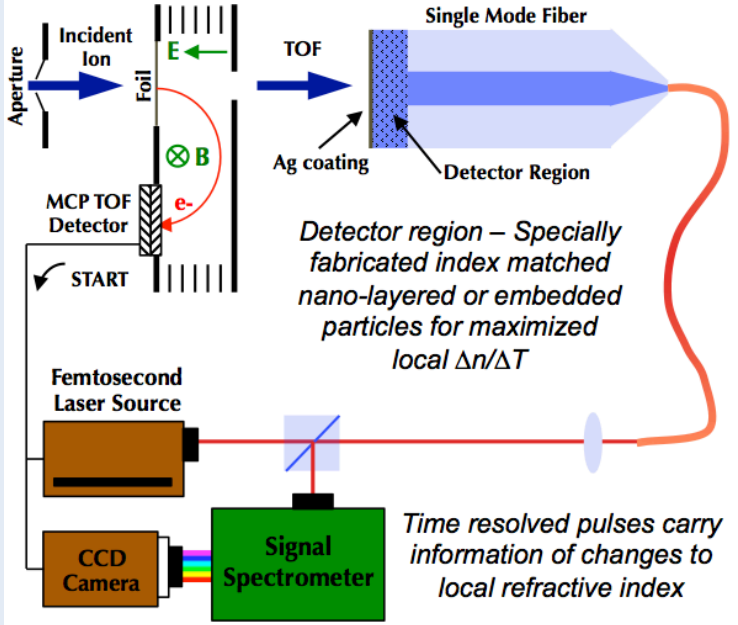
This neutron detector would be insensitive to x-rays, gamma rays, and beta particles.

DESCRIPTION

Approach

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

Experimental Set Up



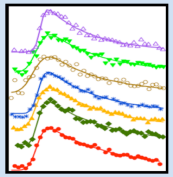
Current Technology Readiness Level (TRL) TRL 1-2

- *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

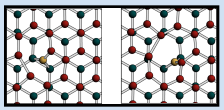
This detector technology will enable or improve

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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