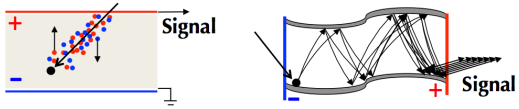
Optical Method for Detecting Alpha Particles and Neutrons

Los Alamos NATIONAL LABORATORY EST. 1943

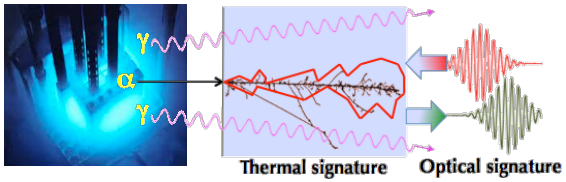
Build an all-optical particle detector to measure single energetic particles that is immune to x-rays and gammas

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 nonlinear optics, detect the refractive index change due the thermal energy deposited by particle radiation, namely alphas and neutrons

- *This is a novel type of radiation detector method that has never been tested before.*
- ***Fast particle detection method***
- ***Radiation hardened sensor***
- ***Precision dosimeter for particle radiation***
- *This study will include utilizing ^{6}Li and ^{10}B compounds directly into the active detection region.*

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

$$^{10}\mathrm{B} + n \rightarrow {}^{7}\mathrm{Li}\,(1.01\,\mathrm{MeV}) + \alpha\,(1.78\,\mathrm{MeV})$$

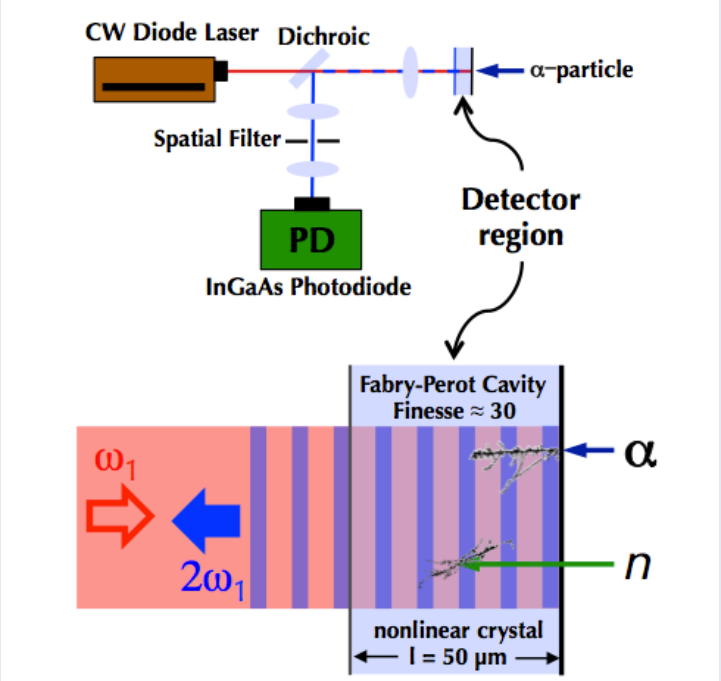
This neutron detector would be insensitive to x-rays, gamma rays, and beta particles.

DESCRIPTION

Approach

- *Apply the technique of second harmonic generation 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

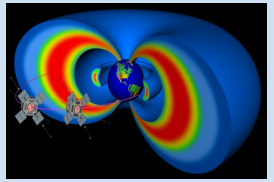
This detector technology will enable or improve

Nuclear forensics –

EM insensitive alpha and neutron particle detector

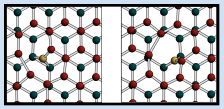
Space radiation detector –

Sensitive method for measuring energetic particles and neutrons in harsh radiation environments



Radiation damage –

Characterization of material damage and defect aggregation



PATH FORWARD

- ***Procure materials, build detector setup***
- ***Measure alphas from actinides***
- ***Measure neutrons from AmBe source***
- ***Test against EM radiation background***

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