The foam optimizer is a simulation program which can be used to determine the optimal geometric foam parameters for neutron detection. The type of foam will determine how the optimizer operates

Two types of foams will be considered: Lithium impregnated foam and B4C coated RVC foam. Lithium impregnated foams are made of 2 constituents: Struts and Pores. The struts are plastic with a given weight percent LiF. Struts vary in diameter 1 standard deviation about an average value. The pores are composed of an ionization gas and vary 1 standard deviation about an average value. When optimizing lithium impregnated foam, strut diameter will be optimized. RVC foam consists of 3 constituents: Struts, Layers, and Pores. The struts are carbon and equilateral triangular in shape, with a height which varies 1 standard deviation about an average value. The layers are composed of neutron reactive material, and coat the outer face of the strut with a thickness which varies 1 standard deviation about an average value. The pores are composed of an ionization gas, and vary 1 standard deviation about an average value. Strut and pore averages are determined by pore density. Five different pore densities are available: 5, 10, 20, 45, and 80 PPI. When optimizing RVC foam, the B4C layer thickness will be optimized for a given pore density.

The optimization will be accomplished by iteration over the given dimension from a minimum value to a maximum value at a specified step-size. The optimization parameter will be the intrinsic neutron detection efficiency. Intrinsic neutron detection efficiency will be determined by Monte Carlo simulation.

The Monte Carlo simulation will use a specified number of histories to find an average rate of neutron detection. A neutron is detected if a neutron interaction occurs & the reaction products deposit more energy in the ionization material than the lower level discriminator setting. Neutron transport is conducted through a path of foam to determine if an interaction occurs. The foam path is the 1-D list of path-lengths for each material in the foam material. Each neutron history will use a dynamically generated path which is created 1 step at a time until a neutron interaction occurs or the neutron escapes. A neutron interaction will occur if a randomly generated interaction distance is less than the current path-length in a neutron reactive material. After a neutron interaction occurs, reaction products will be generated (alpha + triton for Li-Imp, alpha + Li for RVC). The emission direction will be randomly selected for the alpha particle, and the other reaction product will be emitted in the opposite direction. Energy lost in the remaining material will be calculated (based on ionization data) until each reaction product reaches the surface of a new material. Using the residual energy method, energy deposition in the ionization material will be tabulated.

The energy deposition for each neutron history will be stored. A data processor will be capable of outputting data. Histogram data for the energy deposition can be used to develop a pulse height spectrum (PHS) for a particular geometric configuration. A comparison of the optimization parameter and optimized parameter should be available. An optimal value for the optimization parameter and respective optimized parameter should be found. Statistical information for the neutron path should be available and include: the average number of struts in the sample and a distribution of path-lengths for struts, pores, and layers (if applicable). All output should be in the form of .csv files which can be easily plotted using other software.

* Foam Optimizer
* Foam
* Li-Imp Foam
* RVC Foam
* Strut Pore
* Material
* Layer
* Shape
* Neutron
* Alpha
* Triton
* Lithium Ion
* Path
* History
* Data
* Data Processor
* Pulse Height Spectrum
* Optimization Curve
* Path Statistics

**Classes**

Foam

Variables

Name: Str

Strut: Path Element

Pore: Path Element

Layer: Path Element

Methods

Path Element

Variables

Name: Str

Avg: Float

SD: Float

Material: Material

Methods

Generate New Element

Material

Variables

Name: Str

Ionization: List

Residual Energy: List

MFP: Float

Methods

Particle

Variables

Name: Str

Path: List

Foam: Foam

Methods

Get Current Material

Neutron

Variables

Location: Float

Methods

Interaction Test

Generate Reaction Products

Escaped

Reaction Product

Variables

Source: Str

Energy: Float

Name: Str

Omega: Float

Phi: Float

Methods

Calculate First Path Length

Find Residual Energy

Find Lead-In

Add Ionization

Report Ionization

History

Variables

Iteration #: Int

RN Vector: List

Neutron

Reaction Product (x2)

Foam

LLD: Float

Escape Flag

Ionization: Float

Methods

Receive Foam Parameters

Receive MC Parameters

Generate Neutron

Send Result

Escape Flag

Variables

Flag: Boolean

Reason: String

Methods

Escaped

Below LLD

Interaction

RNG

Variables

Seed: Int

a: Int

m: Int

Methods

Generate New Random Number

Generate Random Number Vector

Run Manager

Variables

# Nodes: Int

# Hist: Int

Foam Parameters: List

RNG

Ionization Energies: List

# Undetected: List

Methods

Compile Results

Broadcast RNG

Broadcast Stride

Collect Results

Set Foam Parameters

Broadcast Foam Parameters