



# Portable Muon Tracker

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## What are Muons and Why Detect Them?

- Muons are fundamental particles that are created in the upper atmosphere by cosmic-ray protons (Figure 1).
- Muons have the same charge as electrons but are roughly 200 times more massive.
- Because muons large mass, they carry high energy (average 3GeV) allowing them to travel through hundreds of meters of solid rock.
- Since muons possess this special penetrating ability, they can be tracked in order to passively interrogate objects.

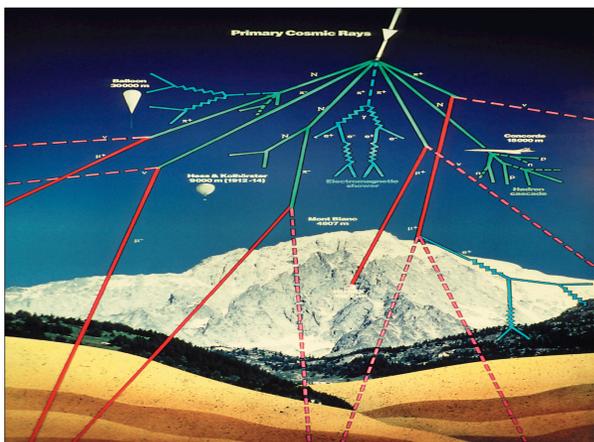


Figure 1. Cosmic Ray Shower (muons shown in red)

## Background

National Security Technologies LLC and Decision Sciences International Corporation are currently researching muon imaging techniques for national security applications, but a database of muon flux information across a large number of locations and elevations is needed.

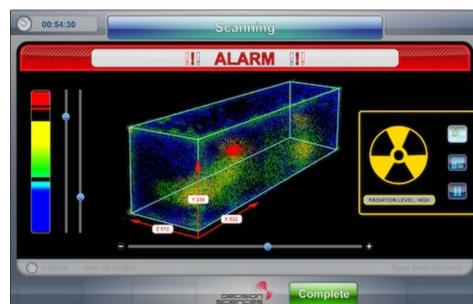


Figure 2. Decision Sciences Imaging Interface

## Detector Specifications

- Drift tube based detector design
- The ability to generate a tabulated list of particle hits in the drift tube array
- From tabulated list generate fitted trajectories of particles
- Determine if particles are muons

## Results

- Produced 2D and 3D test bed simulations to test trajectory fitting algorithms (Figure 3)
- Developed algorithm to recreate muon trajectories
- Assembled detector hardware
- Completed data acquisition software for single-channel triggering.
- Fitting algorithm implemented in the LabVIEW MathScript module

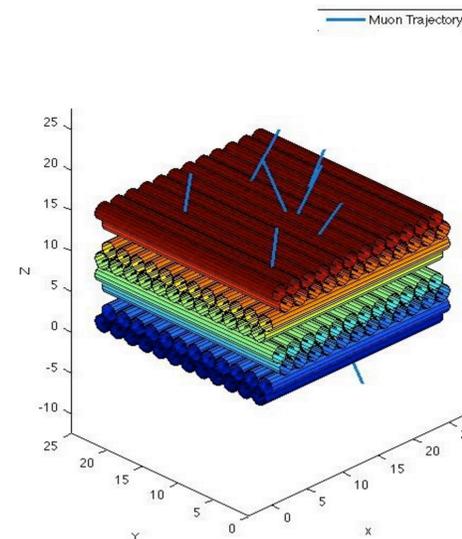


Figure 3. Three Dimensional Detector Simulation

## Conclusion

We have developed a design approach for collecting data from our array of 96 drift tube detectors in order to recreate the trajectories of impinging particles. As can be seen below, we will accomplish this task by implementing a modular design to reduce system complexity.

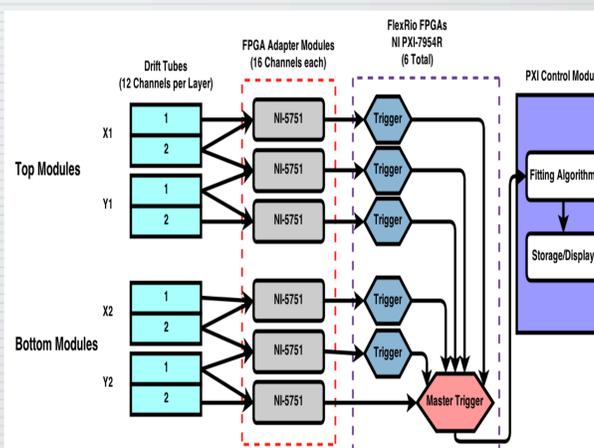


Figure 4. Detector Data Architecture

## Future Work

- Complete implementation of multi-layer triggering hierarchy
- Integrate MathScript algorithm with data collection
- We will continue this work until June 1<sup>st</sup>

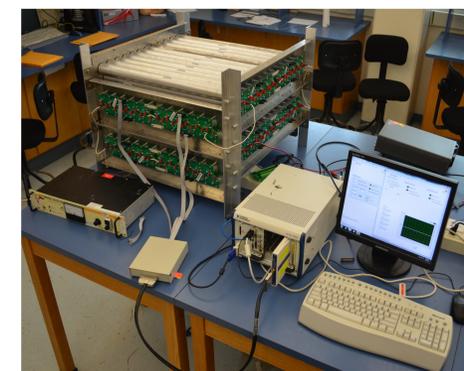


Figure 5. Muon Tracker and Acquisition Hardware



Our Design Team (left to right): William Maier, Wesley Chavez, Katherine Harriger, and Nick Kallas

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## References

Figure 1. taken from [http://www.science20.com/quantum\\_diaries\\_survivor/muon\\_tomography\\_who\\_leading\\_research](http://www.science20.com/quantum_diaries_survivor/muon_tomography_who_leading_research)  
Figure 2. courtesy of Decision Sciences International Corporation.