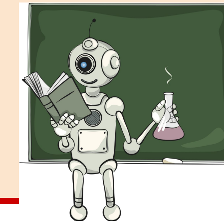
DIDACTS: Data-Intensive Discovery Accelerated by Computational Techniques for Science (didacts.org)

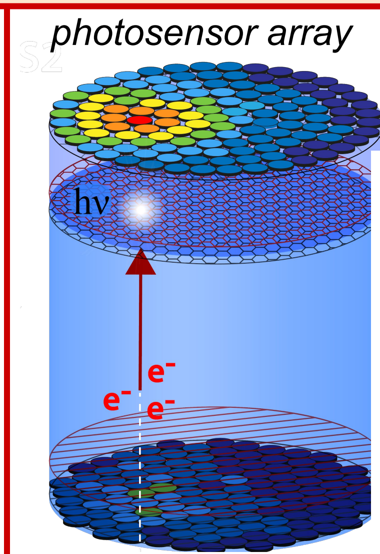


Hagit Shatkay
U. Delaware,
Computer & Info. Sciences

Waheed Bajwa
Rutgers,
ECE / Statistics

Chris Tunnell
Rice,
Physics and astro

Challenge: Physical sciences are at a tipping point as current machine learning methods do not adequately address their needs



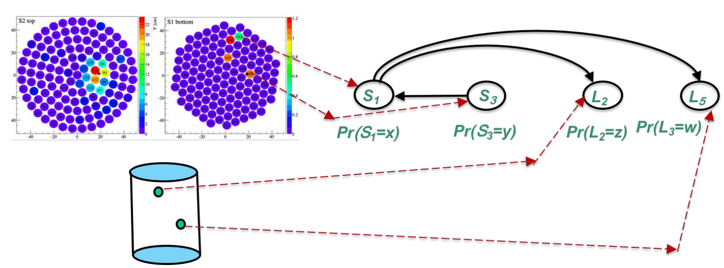
How to incorporate the physics we *know* (particle physics) into machine learning such that it can uncover the physics we *don't know* (dark matter)?

How to detect extreme rare events from the weakest phenomena in the Universe (dark matter) using sensor-based particle detectors?

Solution via Inverse Problem Formulation

- Several scientific disciplines, including particle physics, have detailed forward models for observations.
- Inverse problems based on these forward models often yield decent results.
- Many disciplines do not have access to real-world ground truth data, which forms the backbone of machine learning
- Graph-structured data, rather than Euclidean data, is often prevalent in many scientific disciplines, and can form the basis for our inverse-problem formulation.

Solution via Sparse, Constrained, Probabilistic Graphical Model of sensors,events & relations.



Nodes: Random Vars: Sensors & Tank Regions

Edges: Interdependence among Sensors/Regions/Events

Introducing Domain Knowledge via: *Priors; Distributions; Interdependency constraints*