

Particle visualization and identification with Timepix detectors

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MoEDAL

- Experiment designed to search for highly ionizing particles, such as magnetic monopoles and massive (pseudo-) stable charged particles
- Defines over 30 scenarios that yield insight to many foundational questions: are there extra dimensions or new symmetries; what is the mechanism for the generation of mass; does magnetic charge exist; what is the nature of dark matter; how did the big-bang develop, etc.

$$\begin{aligned}\nabla \cdot \mathbf{E} &= \frac{\rho_E}{\epsilon_0} \\ \nabla \cdot \mathbf{B} &= 0 \\ \nabla \times \mathbf{E} &= -\frac{\partial \mathbf{B}}{\partial t} \\ \nabla \times \mathbf{B} &= \mu_0 \mathbf{J}_E + \frac{1}{c^2} \frac{\partial \mathbf{E}}{\partial t}\end{aligned}$$

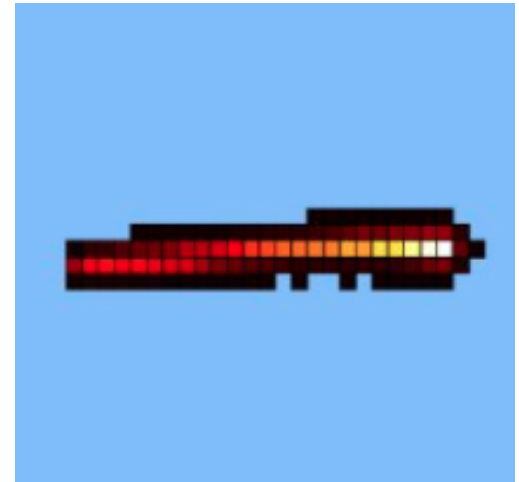
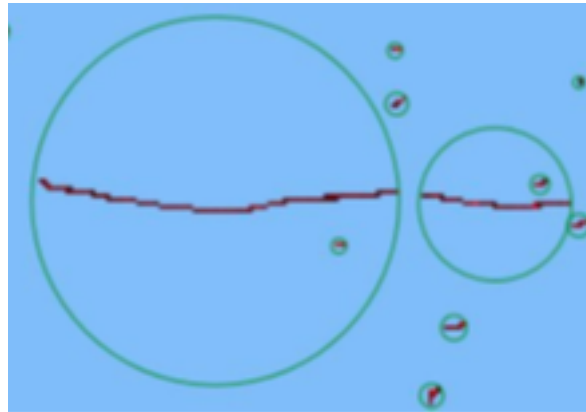
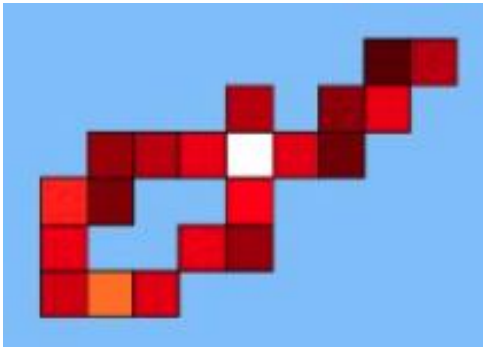
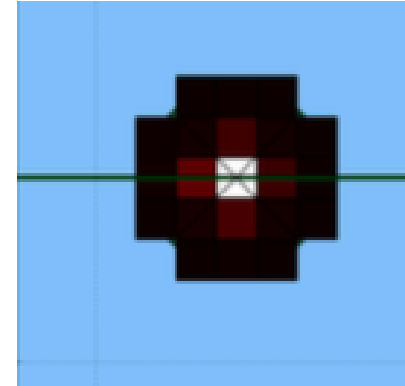
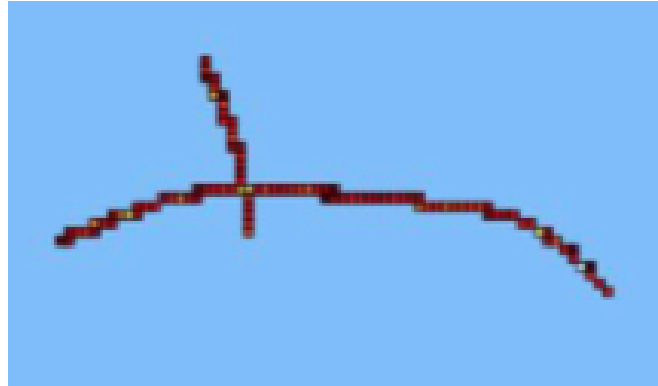
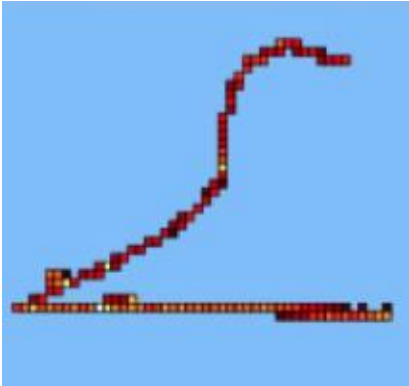


$$\begin{aligned}\nabla \cdot \mathbf{E} &= \frac{\rho_E}{\epsilon_0} \\ \nabla \cdot \mathbf{B} &= \mu_0 \rho_M \\ \nabla \times \mathbf{E} &= -\left(\frac{\partial \mathbf{B}}{\partial t} + \mu_0 \mathbf{J}_M\right) \\ \nabla \times \mathbf{B} &= \mu_0 \mathbf{J}_E + \frac{1}{c^2} \frac{\partial \mathbf{E}}{\partial t}\end{aligned}$$

Project #1 goals

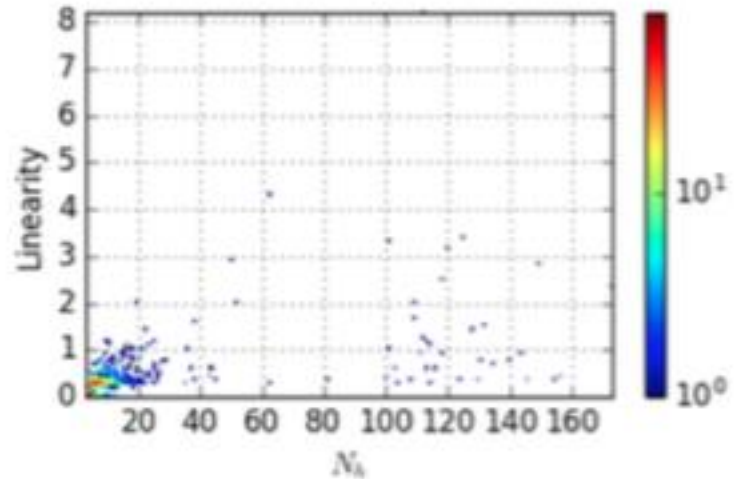
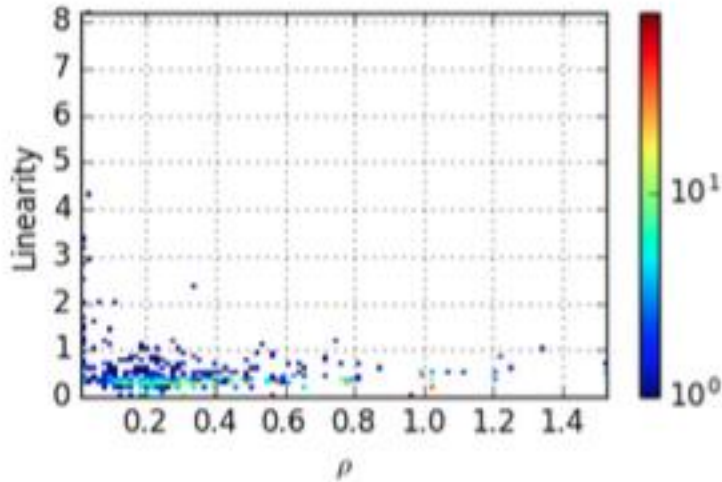
- To use information from Timepix detectors to analyze patterns of charge. This will aid in the identification of different particle species.
- This also involves using SQUID-based magnetometers to detect monopoles

Examples of clusters



Cluster properties

- Linearity, radius, density, inner pixel fraction, etc.



Selection cuts

```
for i in range(len(cluster_density_u)):
    if cluster_size[i] > 40:
        if cluster_density_u[i] > 0.25:
            if cluster_innerfrac > 0:
                slugs += 1
            else:
                loopers += 1
        else:
            if cluster_radius_u[i] > 45:
                SWpbranch += 1
            else:
                if cluster_density_u[i] > 1.0:
                    boxy += 1
                elif cluster_linearity[i] > 2:
                    crossovers += 1
```

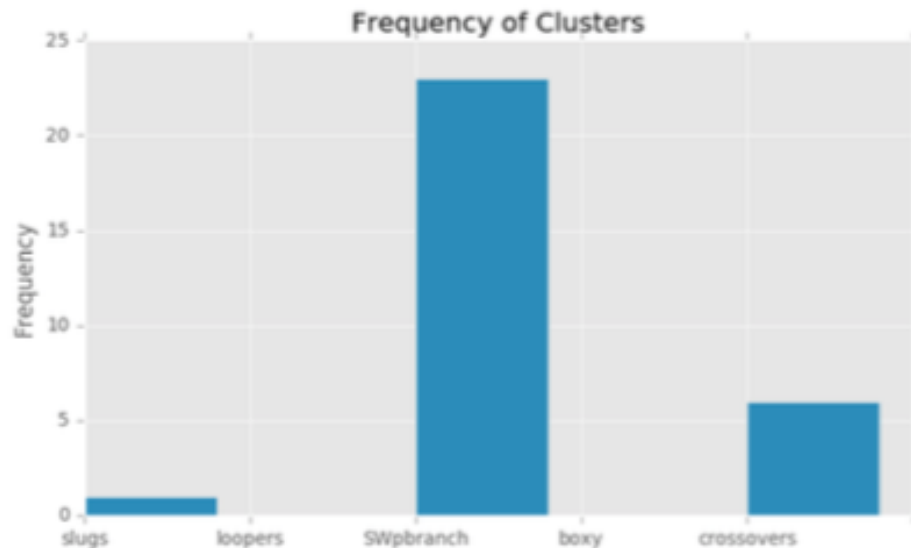


Figure 10: Graph showing classified clusters.

My goals

- Hope to:
 - know how to make more than graphs in python
 - Make useful modifications to existing classification code and to think of other cluster properties that can be used to make selection cuts
 - Find magnetic charge

Trips!

