

# Automatic Particle Detection in Cloud Chambers

Zachary Sussman

## Abstract

**Introduction:** A cloud chamber is a user-friendly particle detector utilized for smaller-scale research and educational purposes. One major limitation of this type of device is the lack of accessible automated programs to detect and analyze the particles. I attempted to rectify this situation by creating my own algorithms to detect and evaluate subatomic particle tracks in videos of functioning cloud chambers.

**Methods:** I constructed a 10 gallon diffusion cloud chamber and collected 5 hours of video. Using the OpenCV video-processing library for Python, I created a program that analyzed the video and generated a database of track events and properties. The program runs frame by frame, finding groups of foreground pixels, which correspond to tracks. By matching tracks in sequential frames, a database of events is built. Each type of subatomic particle leaves a different path in the chamber, so by evaluating track characteristics including aspect ratio, length, and intensity, I can identify particle type and approximate its energy.

**Results:** With just 200 lines of Python, the program processed tracks at a 90% accuracy rate, and identified beta particle energies within 0.5-1 keV and alpha particle energies within 10-20 keV.

**Conclusion:** With fairly straightforward algorithms, my program can identify particle tracks in cloud chambers with good accuracy. The automation of this cost-effective particle detector removes a barrier to more widespread use.