Measurement of the Quenching Factor for Barium Fluoride Crystals

Ariel Hasse
Mentor: David Hitlin

The energy of particles can be determined by measuring the scintillation light emitted by crystals such as barium fluoride. As the particles travel through the inorganic scintillator, Birk's Law describes the amount of light emitted for a given energy lost. The ratio of dispersed energy is dependent on the mass of the particle; this is known as the quenching factor. Barium fluoride has two mechanisms of scintillation, a fast and a slow component, which are at different wavelengths, that determine how quickly photons are emitted. The ratios of energy from the fast and slow components from multiple photomultiplier tubes with varying quantum efficiency as a function of wavelength, determine the final quenching factor. We find that the quenching factors of the fast and slow components are substantially different.

We measure the response of the barium fluoride crystal fast and slow components to alpha particles of known energies coming from the decay of slight radium contamination in the crystals. Confirmation with the known values allows for analysis of energy readout from gamma, electron, and alpha particles. This data, along with the quenching factor, is valuable for many high-energy physics experiments in which inorganic scintillators are used to find the mass or energy of particles. We will also use the findings to study the physical mechanisms affecting the quenching factor.