CalVision

In particle physics, calorimetry refers to the detection of particles and measurement of their properties by the complete absorption of the particle's energy in a bulk of matter, referred to as a calorimeter**.** These calorimeters are far more sensitive than those used in conventional thermodynamic processes, as the most energetic particles in accelerators are on the order of 1 TeV, whereas 1 calorie is equivalent to about a trillion TeV. Hence, more sophisticated methods are needed to determine particle properties accurately.

CalVision is a consortium of universities and Department of Energy laboratories focused on advancing state-of-the-art calorimetric measurements for all types of particles with a higher level of precision. The program prioritizes the development of homogeneous calorimeters that maximize the use of available information.

The two key light signals of interest in the calorimeter, which we use to detect particle properties, are scintillation and Cherenkov radiation (a special type of radiation produced when a particle moves faster than the speed of light in a medium). One of the key aspects of this program involves harnessing the "dual readout" of these signals. The challenge arises because the Cherenkov light wavelength spectrum overlaps with the scintillation light spectrum, and there is a small UV window below the scintillation peak of the candidate crystal. To address this, we utilize the time difference between these two signals, which is on the order of nanoseconds (ns). It is thus important to study the properties of these crystals in detail to develop appropriate methods and algorithms for analyzing these signals.

The current phase of the program is focused on developing an electromagnetic calorimeter that maximizes information usage, making it suitable for future lepton colliders such as the Future Circular Collider (FCC-ee). As part of this initiative, CUA's high-energy physics group plans to establish a crystal testing facility to characterize candidate crystals for use in the calorimeter. This classification involves studying the transmission spectrum, linear uniformity of light yield, decay time of scintillation signals, and the X-ray excited emission spectrum of the crystals. In this talk, I will discuss the methodology for these studies, share some of the results I obtained for Bismuth Germanate (BGO) crystal samples, and explore the future scope of this work.

- Bhavya Singhal