Contribution ID: **40** Type: **YSF poster**

Using machine learning to detect antihydrogen in free fall

Monday, 30 October 2023 18:35 (20 minutes)

The properties of the hydrogen atom have played a central role in fundamental physics for the past 200 years. The CPT theorem, a cornerstone of the standard model, requires that hydrogen and antihydrogen ($\bar{H}$) have the same properties. The ALPHA antihydrogen experiment attempts to test this theory by measuring the fundamental properties of antihydrogen. We have previously measured the 1S-2S transition frequency, hyperfine structure, and other properties of the antihydrogen atom; but now sets our sights on the effect of gravity on antimatter.
To perform this measurement a completely new 3m tall apparatus (ALPHA-G) was built, to see the effects of antihydrogen in free fall, first measurements in this new machine were taken in 2022.
To detect these rare particles ALPHA makes use of several particle detector technologies, including a Silicon Vertex Detector (ALPHA-2), and a Time Projection Chamber (ALPHA-G). One of the key challenges for both detector systems is being able to distinguish between $\bar{H}$ annihilations and cosmic rays, a classification problem well suited for machine learning.
Here we present the preliminary results of this "free fall"experiment in ALPHA-G, as well as describing how machine learning is used to determine the difference between signal and background.

Brainstorming idea [title]

Is there room for machine learning to improve discoveries in dark matter that are not currently being applied?

Brainstorming idea [abstract]

The quest to unveil the elusive nature of dark matter has ignited multifaceted investigations across the realms of particle physics, astrophysics, and cosmology. Amidst this pursuit, the untapped potential of machine learning techniques remains a point of interest. During this brainstorming session we could discuss the possibility of using existing (or new) ML methods to help aid in the detection/discovery of these dark matter signals. Looking at existing dark matter experiments, as well as concept experiments, we could use machine learning to inform the creation of new, more efficient, experiments that rely on machine learning but give better chance of understanding its properties. This brainstorming session would allow everyone to contribute, whether you are a particle physicist, or astronomer, and links the discussion together with the common theme of machine learning.

Primary author: GOLINO, Lukas (Swansea University (GB))

Presenter: GOLINO, Lukas (Swansea University (GB))

Session Classification: Young Scientist Forum