Gamma-Ray and AntiMatter Survey (GRAMS) for antimatter detection

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1. Introduction

GRAMS (Gamma-Ray and AntiMatter Survey) is a proposed balloon/satellite mission that will be the first to target both MeV gamma-ray observations and antimatter-based indirect dark matter searches with a LArTPC (Liquid Argon Time Projection Chamber) detector. We are currently building and testing a prototype detector, MiniGRAMS, that will be employed for the first balloon flight proposed in the mid-2020s.

2. Potential dark matter signatures in the recent experiments

**Fermi Gamma-ray Excess**

- It is hard to identify whether the signals we detect come from dark matter or background/uncertainty
- we need some new methods/approaches for these potential DM signatures

**AMS-02 Antiproton Excess**

3. Low energy antiparticles for background-free dark matter search

**Primary Flux**

**Cosmic Ray Interaction**

4. GRAMS Detection concept

Time of Flight (TOF) is constructed of plastic scintillators that can measure the velocity of incoming antiparticles. LArTPC acts as both detector and stopping material. To collect and reconstruct produced particles’ track, we could separate different incoming particles.

5. $d$ and $^3He$ Identification Techniques

- Time of Flight targeting on low energy incoming particles (~250MeV/n)
- Normal particles could not produce annihilation product, making secondary profile unique

6. Preliminary GRAMS Antihelium-3 Sensitivity

**Preliminary result**

N. Saffold, et al, 2021

**AMS-02 Antihelium-3 Flux**

**Preliminary model**

**GRAMS Could Extensively Explore DM Parameter Space**

7. References

[4] GRAMS Web: https://grams.sites.neostestinal.edu/