Sensitivity of the MicroBooNE experiment to dark trident interactions

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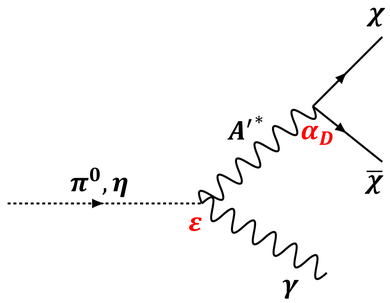
Introduction

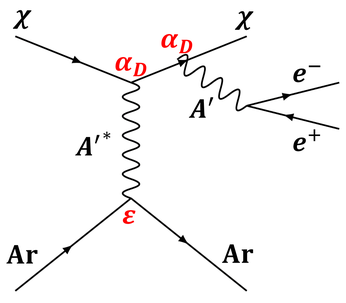
- The **dark trident** interaction [1] is a hypothetical interaction of sub-GeV dark matter (DM) with regular matter.
- The model considered includes a dark scalar (or fermion) χ which interacts with Standard Model (SM) particles though a massive dark photon A'. Four new parameters are added to the SM:

Dark photon mass: $M_{A'}$
Dark matter mass: M_{χ}

Coupling to SM: ε
Dark sector coupling: α_D



Production of DM from neutral meson decay.

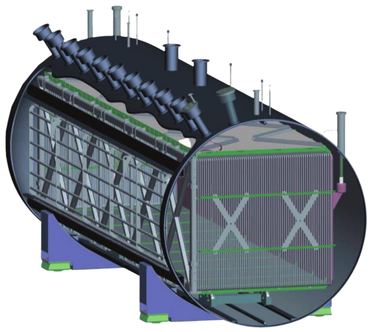


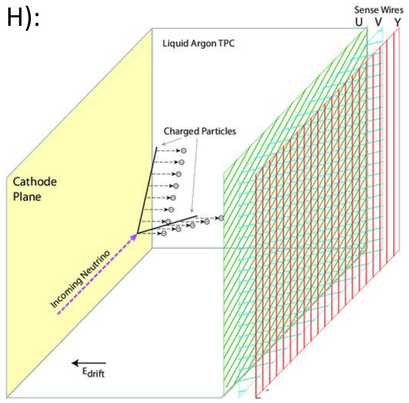
Dark trident interaction with an argon nucleus

- In this work we evaluate the sensitivity of MicroBooNE to this dark matter interaction channel [2].

MicroBooNE detector [3]

- Liquid argon time projection chamber (LArTPC) with an active mass of 85 tonnes. Rich neutrino physics program.
- Off-axis to the NuMI beam (120 GeV protons on target).
- Great capabilities for beyond the Standard Model searches.
- Dimensions of the TPC (L x W x H): 10.36 m x 2.56 m x 2.32 m

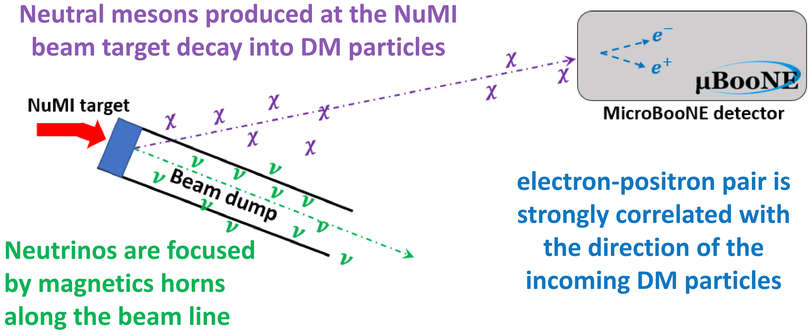




Search strategy and detection

Off-axis dark matter production at the NuMI beam:

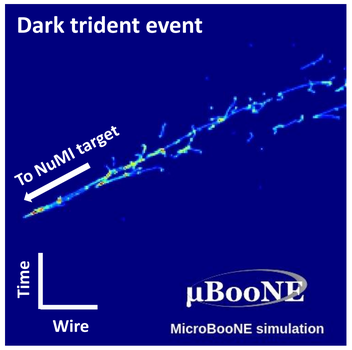
Neutral mesons produced at the NuMI beam target decay into DM particles

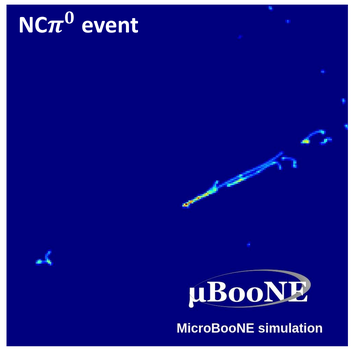


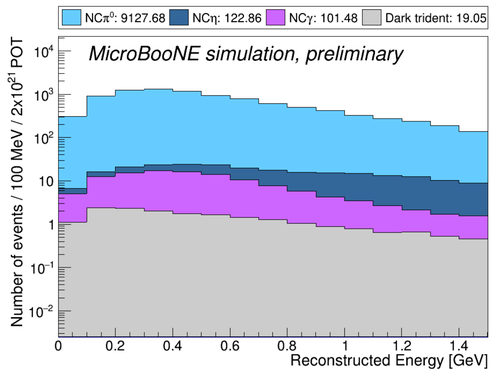
Neutrinos are focused by magnetics horns along the beam line

electron-positron pair is strongly correlated with the direction of the incoming DM particles

- Neutrino neutral current interactions with a subsequent neutral meson (π and η) or photon emission are the main background sources.
- Events registered by MicroBooNE are reconstructed. The output of the reconstruction are **high-resolution images, calorimetry information** among others.

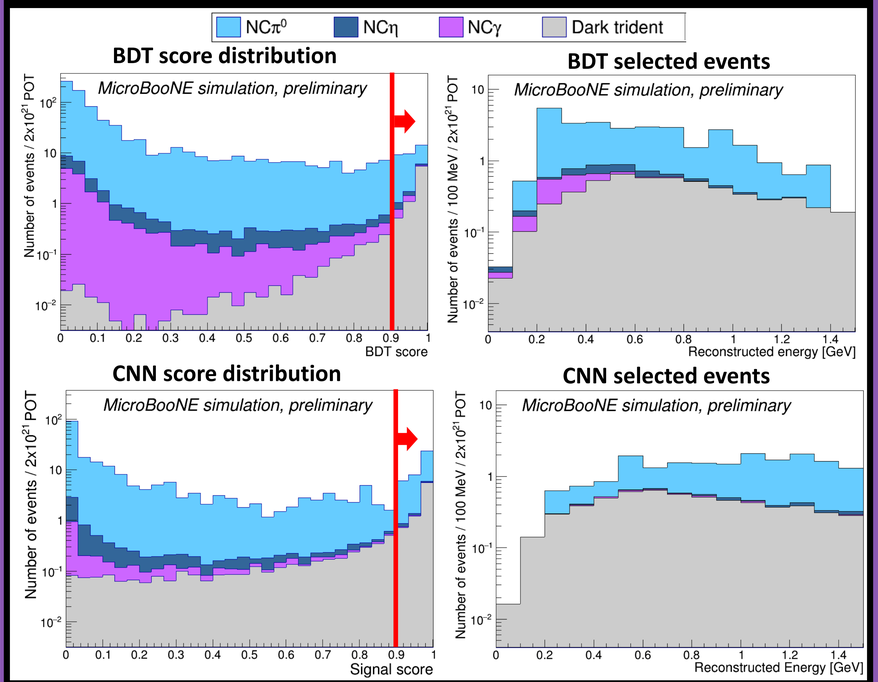






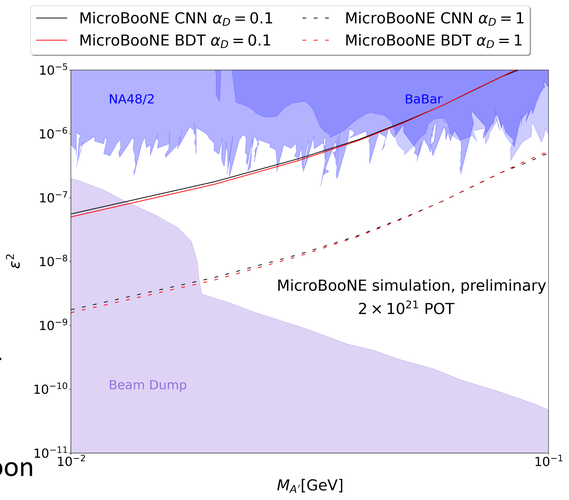
- Two parallel event selection methods were studied. One using **boosted decision trees (BDT)** and another one using a **convolutional neural network (CNN)**.

Event selection



Expected sensitivity

- Independent counting experiments for each selection method are performed to obtain expected sensitivity contours at 95% of confidence level.
- MicroBooNE has the potential to exclude unexplored parameter space.
- Full analysis coming soon stay tuned!



References

[1] André de Gouvêa, et al, JHEP 2019, 1 (2019)
[2] MICROBOONE-NOTE-1118-PUB
[3] R. Acciarri, et al (MicroBooNE collaboration), JINST 12, P02017 (2017)

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