

# Addressing the Inverse Problem: Spin Identification of Exotic Charged Particles at Future $e^+e^-$ Collider

*Tuesday, 12 May 2026 13:50 (15 minutes)*

Despite its remarkable success, the Standard Model fails to explain phenomena such as neutrino masses, dark matter, and the matter–antimatter asymmetry, motivating a wide range of Beyond the Standard Model (BSM) scenarios. A major challenge in this context is the inverse problem, where different models produce overlapping signatures; hence, identifying the underlying BSM scenario becomes difficult.

In this talk, I address this issue by investigating how the spin of exotic charged particles, and the dark matter candidates, can be determined at future colliders. Focusing on models with a stable neutral particle ( $C^0$ ) and charged partners ( $C^\pm$ ) decaying via a  $W^\pm$  boson, we study the process

$e^+e^- \rightarrow C^+C^- \rightarrow C^0C^0W^+W^-$ , considering the Inert Doublet Model and the Minimal Supersymmetric Standard Model as representative examples of scalar and fermionic charged states, respectively. Using beam polarization at a future  $e^+e^-$  collider, we demonstrate that the distributions of angular variables of the visible final-state particles provide an effective way to determine the spin of these exotic particles.

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**Session Classification:** Session 1: Collider+DM+Neutrino