Contribution ID: **180** Type: **Oral**

Search for Dark Matter spectral lines around the Galactic Centre with CTAO LST-1

Wednesday 27 August 2025 14:40 (20 minutes)

Dark Matter (DM) remains one of the most profound mysteries in modern physics. Among the many proposed candidates, Weakly Interacting Massive Particles (WIMPs) stand out due to their strong theoretical motivation and testable implications. A definitive detection of monoenergetic gamma-ray lines from WIMP annihilation would provide a direct probe of electroweak-scale interactions, offering a complementary approach to collider and direct detection experiments.

At very high energies (VHE), WIMP annihilation is expected to yield gamma rays alongside other Standard Model particles. The Galactic Center (GC), owing to its proximity and high expected DM density, is a prime target for such searches. Imaging Atmospheric Cherenkov Telescopes (IACTs) have set stringent limits on DM properties in the GC region, with the MAGIC telescopes providing the strongest constraints in the 20–100 TeV range through Large Zenith Angle (LZA) observations. However, the limited field of view (FoV) of MAGIC ($<3.5^\circ$) has restricted detailed studies of the broader GC environment, where DM density enhancements are anticipated.

The first Large-Sized Telescope (LST-1) of the Cherenkov Telescope Array Observatory (CTAO), located at the Roque de Los Muchachos Observatory in La Palma, Spain—near the MAGIC site—has been observing the GC since 2021. With its wider FoV of 4.5°, LST-1 offers new opportunities for extended searches. Although the GC transits at low elevation, necessitating LZA observations ($ZA > 58^\circ$), such conditions enhance sensitivity to gamma rays up to and beyond 100 TeV.

In this work, we present the first WIMP gamma-ray line search with LST-1. We detail the characterization of LST-1's instrument response functions under LZA conditions, along with a comprehensive background rejection strategy for monoscopic observations. Using advanced statistical methods and spectral line search techniques applied to simulated data, we demonstrate significant improvements in sensitivity and methodology. These results highlight LST-1's growing potential in the indirect search for DM at the GC.

Collaboration you are representing

CTAO, LST-1

Authors: Dr ABE, Shotaro (ICRR, UTokyo); INADA, Tomohiro (Kyushu University)

Co-authors: Mr ABHISHEK, Abhishek (University of Siena & INFN Pisa); VERNA, Gaia (University of Siena & INFN Pisa); Prof. TESHIMA, Masahiro (Max Planck Institute for Physics); Prof. DORO, Michele (University of Padova); VENTURA, Sofia (University of Siena & INFN Pisa)

Presenter: INADA, Tomohiro (Kyushu University)

Session Classification: Dark Matter and Its Detection

Track Classification: Dark Matter and Its Detection