

MACE captures high energy gamma-ray signal from the deep Universe

MACE (Major Atmospheric Cherenkov Experiment) has detected strong gamma-ray signal from a distant galaxy OP 313 on January 26, 2025. These very high energy gamma rays carry a large amount of energy in the range from tens of billion electron-Volt to a few trillion electron-Volt. Such energetic radiation is expected to originate from a plasma jet oriented along the Earth and powered by a super massive black hole of mass of the order of billion times the mass of Sun situated at the center of galaxy. These photons have traveled for more than eight billion years to reach the Earth and detected by MACE on January 26, 2025. Developed by Bhabha Atomic Research Centre of DAE, the MACE was commissioned at Hanle, Ladakh in September, 2021, and was officially inaugurated by the Chairman, Atomic Energy Commission on October 4, 2024. It is well equipped to detect such photons. The measurement of these photons with MACE, plays a pivotal role in not only probing the mechanisms of high energy emission in the vicinity of black holes but also the mysteries of the formation and evolution of massive galaxies during the early phase of the Universe. The estimated age of the Universe is close to 14 billion years. The MACE observations also push the boundary of visible gamma-ray Universe, enhancing the so called cosmic gamma-ray horizon beyond redshift $z > 1$.

Located at a cosmological redshift of $z=0.997$ (~8 billion light years), OP 313 (also called as B2 1308+326), is the farthest known very high energy gamma-ray source belonging to the family of jetted active galactic nuclei. The MACE telescope monitored this source in March 2023 but no significant detection of the very high energy emission was found. This null detection with MACE was used to place stringent constraints on the gamma ray flux emitted by the source. The first very high energy gamma-ray emission from this source was discovered by the prototype Large Size Telescope (LST-1) located on the Canary Island of La Palma, Spain, in December 2023. Following a recent alert from the NASA's Fermi satellite regarding sudden enhancement in the emission level of OP 313, MACE was pointed to monitor the source activity on January 26, 2025. Preliminary analysis of MACE-data revealed presence of strong gamma-ray signal from the direction of OP 313. This was promptly communicated to the international community through the Astronomer's Telegram on January 30, 2025. MACE detection of OP 313 was cited by the "Special Astrophysical Observatory of the Russian Academy of Science" and "The Ice Cube Collaboration" in their Telegrams on the optical observations and neutrino search from this source.

MACE observations of OP 313 in a unique time window are complemented by the observations with other leading gamma-ray telescopes like MAGIC (La Palma, Spain) and VERITAS (Arizona, USA). Located 4.3 km above sea level at Hanle, MACE is the highest gamma-ray telescope in the world and is the only state-of-the-art national facility for carrying out front line research in the fields of very high energy gamma-ray astronomy and astroparticle physics. It is also an important player for various ongoing multi-messenger astronomy programs.



The MACE telescope at Hanle, Ladakh