

Continued gamma-ray observations with H.E.S.S. – Letter of Interest

Michael Backes^{1,2,*}, Markus Boettcher², Andrew Chen^{3,*}, Garret Cotter^{4,*}, Isak D. Davids¹,
Hambeleleni Davids¹, Tim L. Holch⁵, Eli Kasai¹, Nukri Komin^{3,*}, Jonathan Mackey⁶,
Mathieu de Naurois⁷, Jimmy Shapopi¹, Kleopas Shiningayamwe¹, Riaan Steenkamp¹,
Brian van Soelen^{7,*}, Christo Venter², Tiziana Venturi⁸

¹ *School of Science, University of Namibia, Namibia*

² *Centre for Space Research, North-West University, South Africa*

³ *Wits Centre for Astrophysics, University of the Witwatersrand, South Africa*

⁴ *Department of Physics, University of Oxford, UK*

⁵ *Deutsches Elektronen-Synchrotron (DESY), D-15738 Zeuthen, Germany*

⁶ *Laboratoire Leprince-Ringuet, CNRS, Institut Polytechnique de Paris, F-91128 Palaiseau, France*

⁷ *Dublin Institute for Advanced Studies, 31 Fitzwilliam Place, Dublin 2, Ireland*

⁷ *Department of Physics, University of the Free State, South Africa*

⁸ *INAF, Istituto di Radioastronomia, Bologna, Italy*

Working group: Astrophysics and Cosmology

Subgroup: High-energy Astrophysics and Astro-particle Physics

* mbackes@unam.na, andrew.chen@wits.ac.za, garret.cotter@physics.ox.ac.uk,
nukri.komin@wits.ac.za, ansoelenb@ufs.ac.za

Abstract

The High Energy Stereoscopic System (H.E.S.S.) is an array of 5 Imaging Atmospheric Cherenkov telescopes (IACTs), located near Windhoek, Namibia, sensitive to very-high-energy (VHE) gamma rays with energies above ~ 100 GeV. It is the World's largest and most sensitive ground-based gamma-ray telescope system and scientifically hugely successful in many different fields of high-energy astrophysics, including time-domain and multi-messenger astronomy. A successor, the Cherenkov Telescope Array (CTA), is being constructed in Chile and La Palma but the World's largest IACT will remain unrivalled in the foreseeable future. This, together with H.E.S.S.'s capabilities for and the importance of time-domain astronomy as well as the favourable aspect of time-zone difference, being able to observe 8 hours ahead of CTA south in Chile, makes it most desirable to keep H.E.S.S. in operation even after the CTA becomes operational.

Introduction

Cherenkov Telescopes detect very-high-energy (VHE) gamma rays indirectly by detecting faint light flashes (Cherenkov radiation) produced by high-energy particles, cosmic rays or photons – messengers of the most enigmatic events in the Universe. The H.E.S.S. telescopes [1] are situated in Namibia and represent the world-leading instrument in its field. Currently, it is the only such facility operating in the Southern hemisphere. Plans for a successor to H.E.S.S. called the Cherenkov Telescope Array [2] are advanced and the project recently entered construction phase in Chile and La Palma. This southern CTA array is planned to comprise of tens of Cherenkov Telescopes (CTs) of 3 different sizes. However, H.E.S.S. will still host the largest single dish CT, even with the full CTA in operation.

Science scope

The last few years saw the birth of true multi-messenger astrophysics with many breakthrough discoveries to which H.E.S.S. has made important contributions, like the first joint detection of gravitational waves and multi-wavelength (gamma-ray through radio) emission from a binary neutron-star merger and an associated short gamma-ray burst (GW 170817 / GRB 170817A) [3, 4], and the first association of a gamma-ray bright blazar, TXS 0506+056, as the likely source of very-high-energy neutrinos detected by IceCube (IceCube-EHE-170922A) [5, 6]. Further, the first detection of very-high-energy gamma rays from gamma-ray bursts and their afterglows (GRB 180720B, GRB 190829A) [7, 8] and from a recurrent Nova (RS Ophiuchi) [9, 10] by H.E.S.S. highlighted not just the potential of the telescopes more than 15 years after their inauguration, but also the importance of time-domain astronomy and the ability to react quickly to external triggers. This will become even more important in the future: With the advent of further gravitational wave detectors, detection rates will increase and localization will significantly improve. Furthermore, the ongoing construction of the next-generation neutrino observatory KM3NeT in the Mediterranean Sea will take neutrino astronomy to the next level. In addition, unbiased monitoring of rapidly variable sources like blazars will reveal deeper insights into their powering and emission processes. Besides contemporaneous visible light monitoring, also the planned monitoring program [11] of the Africa Millimetre Telescope (AMT) [12] will greatly enhance the scientific potential of such observations. Altogether, H.E.S.S. is ideally positioned to make leading contributions to further breakthroughs in multi-messenger and time-domain astronomy expected in the coming years.

Current situation

H.E.S.S. was the only major international ground-based astronomy facility which continued operating uninterrupted throughout the COVID-19 pandemic and, in 2020, thanks to recent upgrades leading to more stable operations, achieved its highest data-taking efficiency ever. Current plans foresee H.E.S.S. operations at least until September 2024. This Letter of Interest advocates for continued operations of H.E.S.S. beyond 2024.

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