Título: VERY-HIGH-ENERGY GAMMA-RAY OBSERVATIONS OF PULSAR WIND NEBULAE AND CATACLYSMIC VARIABLE STARS WITH MAGIC AND DEVELOPMENT OF TRIGGER SYSTEMS FOR IACTS

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Fecha de lectura: 02/07/2015

Programa de doctorado: Física

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> 2015lopezvery-.pdf

Localización: BIBLIOTECA DE COMUNICACIÓN Y HEMEROTECA GENERAL UAB

Resumen: The history of astronomy is as ancient as the reach of our written records. All the human civilizations have been interested in the study and interpretation of the night sky and its objects and phenomena. These observations were performed with the naked eye until the beginning of the 17th century, when Galileo Galilei started to use an instrument recently developed called telescope. Since then, the range of accessible wavelengths has been increasing, with a burst in the 20th century with the developing of instruments to observe them: antennas (radio and submillimeter), telescopes (optical, IR) and satellites (UV, X-rays and soft gamma rays). The last wavelength range accessed was the Very-High-Energy (VHE) gamma rays. At this range fluxes are so low that it is not possible to use space-based instruments with typical collection areas of O(1) m2. We must resort to the imaging atmospheric Cherenkov technique, which is based on the detection of the flashes of Cherenkov light that VHE gamma rays produce when they interact with the Earth¿s atmosphere. The field is very young, with the first source discovered in 1989 by the pioneering Whipple telescope. It is very dynamic with more than 150 sources detected to date, most of them by MAGIC, HESS and VERITAS, that make up the current generation of

instruments. Finally, the field is also very promising, with the preparation of a next generation of imaging atmospheric Cherenkov telescopes: CTA, that is expected to start full operation in 2020.

The work presented in this thesis comprises my efforts to take the ground-based gamma-ray astronomy one step forward. Part I of the thesis is an introduction to the non-thermal universe, the imaging atmospheric Cherenkov technique and the Imaging Atmospheric Cherenkov Telescopes (IACTs) MAGIC and CTA. Part II deals with several ways to reduce the trigger threshold of IACTs. This includes the simulation, characterization and test of an analog trigger especially designed to achieve the lowest possible energy threshold with the LSTs of CTA. Together with this work, the trigger of the MAGIC telescopes was improved. We have simulated, tested and commissioned a new concept of stereoscopic trigger. This new system, that uses the information of the position of the showers on each of the MAGIC cameras, is dubbed ¿Topo-trigger¿.

The scientific fraction of the thesis deals with galactic sources observed with the MAGIC telescopes. In Part III, I talk about the analysis of the VHE gamma-ray emission of Pulsar Wind Nebulae (PWNe): the discovery of VHE gamma-ray emission from the puzzling PWN 3C 58, the likely remnant of the SN 1181 AD and the weakest PWN detected at VHE to date; the characterization of the VHE tail of the Crab nebula by observing it at the highest zenith angles; and the search for an additional inverse Compton component during the Crab nebula flares reported by Fermi-LAT in the synchrotron regime. Part IV is concerned with searches for VHE gamma-ray emission of cataclysmic variable stars. I studied, on a multiwavelength context, the VHE gamma-ray nature of the previously claimed pulsed gamma-ray emission of the cataclysmic variable AE Aqr. I also performed observations of novae and a dwarf nova to pinpoint the acceleration mechanisms taking place in this kind of objects and to discover a putative hadronic component of the soft gamma-ray emission.

A conclusion chapter summarizes all the work performed and lists prospects related with the topics treated in this thesis.