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STUDYING MICROQUASARS AT HIGH-ENERGIES

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RESUMEN

El estudio de la radiación gamma en fuentes galácticas ha experimentado un progreso radical durante los últimos años gracias a los resultados obtenidos por los telescopios Cherenkov y los aportes de misiones como Fermi. Entre tales fuentes, los sistemas binarios que se han detectado a energías mayores que ∼100 GeV albergan potentes aceleradores de partículas inmersos en regiones donde pueden operar múltiples procesos no térmicos de emisión y donde la propagación de los fotones energéticos da lugar al desarrollo de cascadas electromagnéticas. A su vez, desde un punto de vista hidrodinámico, también muestran un comportamiento fascinante, y cuya descripción aún no hemos alcanzado. Este tipo de ambiente, con condiciones regularmente variables, provee un excelente laboratorio de comparación para el desarrollo de modelos teóricos. Como último resultado de la combinación entre la acreción y la eyección de materia sobre un objeto compacto, los microcuasares, binarias de rayos X con radio jets, se manifiestan a lo largo de todo el espectro electromagnético. Esta charla presenta una breve puesta al día sobre nuestro conocimiento de estos sistemas, con énfasis en su emisión a muy altas energías.

ABSTRACT

The study of galactic gamma-ray sources has experienced an outstanding advance during the last years thanks to the results obtained by the atmospheric Cherenkov telescopes and satellites such as Fermi. Between those sources, the binary systems that have been detected at energies greater than ∼100 GeV, host powerful particle accelerators embedded into environments where multiple non-thermal emitting processes take place and where the propagation of high-energy photons trigger the development of electromagnetic cascades. The hydrodynamical description of the plasmas and flows within these systems also involves a complex, fascinating behavior which we have yet to fully understand. Moreover, the varying, but regularly repeating conditions make of them an excellent constraining laboratory for theoretical models concerning all these issues. The microquasars, X-ray binaries with radio jets, manifest all along the electromagnetic spectrum as the last result of the combined matter accretion and ejection by a compact object. Here I present a brief update on our knowledge about them, with focus on their high-energy emission.

Key Words: gamma-ray: observations — gamma-ray: theory — ISM: jets and outflows — stars: binaries

1. INTRODUCTION

Gamma-ray astronomy, embracing the photons with energies above ∼500 keV (the rest energy of an electron), has undergone an enormous progress during the last years. Successful observations in the MeV (10^6 eV), GeV (10^9 eV) and TeV (10^{12} eV) energy regions have been made recurring to different techniques. Satellites cover the energies below 100 GeV, the high-energy (HE) band, whereas at higher energies (very high: VHE, up to ∼100 TeV) the γ-rays start particle showers in the atmosphere. Those showers can be reconstructed thanks to the Cherenkov light emitted in the atmosphere by the yielded particles which move faster than light in the air.

The detections made by the Fermi-LAT (Large Area Telescope, 100 MeV to 100 GeV) during 11 months of operation form a First Catalog with 1451 sources above 4.1σ significance threshold (Abdo et al. 2010). Along with Fermi, INTEGRAL and AGILE are called to be the improved new generation of satellites after the revolutionary Compton Gamma-Ray Observatory (1991–2000, see e.g. Aharonian 2004). The ground-based detectors, with MAGIC and HESS as the most sounding present instruments, provide a lower number of detected sources in the TeV regime, i.e. 61 galactic sources by the end of 2010[3]. This is not surprising given the difficulties inherent to the technique, but the flux sensitivities and angular resolution need to be improved significantly in order to increase the ratio of identified-to-unidentified sources. There is a confidence that

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[3]See `http://www.mppmu.mpg.de/~rwagner/sources/` for an updated map of the sky at this energy range.