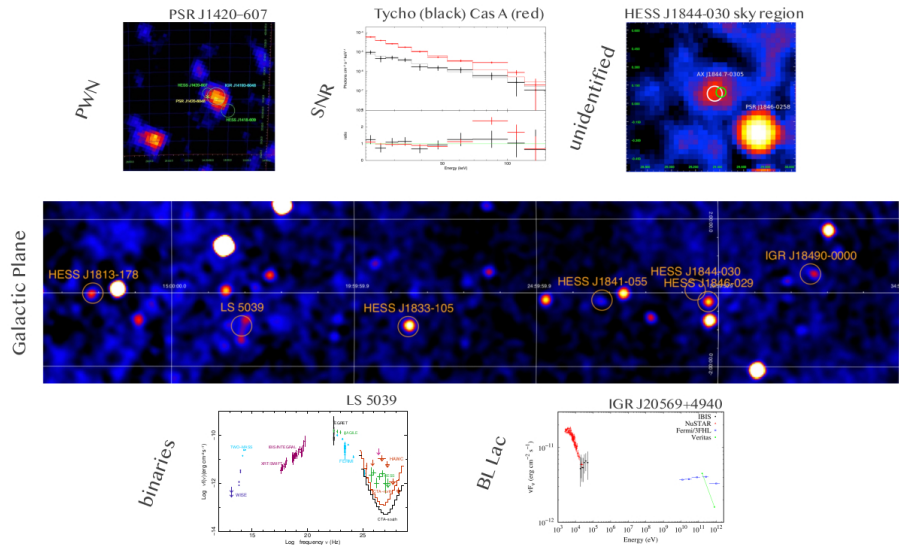


INTEGRAL PICTURE OF THE MONTH

JUNE 2021



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THE INTEGRAL VIEW OF TEV SOURCES

There is a significant correlation between INTEGRAL-detected hard X-ray (or soft gamma-ray) sources and TeV sources. By comparing the INTEGRAL/IBIS 1000 orbit catalogue (Bird et al. 2016, ApJS 223, 15) with the online TeV source list, it has been shown that 39 objects (about 20% of the very-high energy gamma-ray catalogue) have emission in both the soft gamma-ray and TeV wavelength bands. This provides an indication of the usefulness of combining information at these frequencies and preparing a legacy program for future very-high energy observations (such as with the Cherenkov Telescope Array, CTA).

The central panel of the image shows the Galactic Plane as observed by INTEGRAL/IBIS at 20-100 keV, with TeV sources superimposed. The objects found by the cross-correlation analysis belong to various classes, both galactic and extra-galactic, but also contains unclassified sources.

In the galactic realm, compact objects, such as binary systems, pulsars, as well as extended objects, like Supernova Remnants (SNR) and Pulsar Wind Nebulae (PWN), have been found to emit in both wavelength bands. In the bottom-left panel of the image the Spectral Energy Distribution (SED) of the gamma-ray binary system LS 5039 is shown, which is constructed using non-simultaneous data. The sensitivities expected from the Southern (black line) and Northern (orange line) CTA observatories in a 50-hour observation (from <https://www.cta-observatory.org/science/cta-performance/>) show how future CTA observations will help to discriminate between models proposed to reproduce the observed data.

In the top-left panel of the image, a 20-100 keV IBIS/ISGRI image of a complex region known as the "Kookaburra" is shown. In this region, the High Energy Stereoscopic System (H.E.S.S.) telescope detected two distinct TeV sources, one coincident with a PWN surrounding the pulsar PSR J1420-607, the other coincident with the "Rabbit" nebula. INTEGRAL detected IGR J14193-6048 in between these two TeV objects, although its position is shifted towards PSR J1420-607. Analysis of low energy X-ray data from the Chandra X-ray observatory suggests that the most likely identification for the INTEGRAL source is indeed PSR J1420-6048, the pulsar that powers one of the two H.E.S.S. sources.

The top central panel of the image, shows the unfolded IBIS/ISGRI spectra as well as the data-to-model ratio of two SNRs, i.e., Tycho (black) and Cas A (red), between 20 and 150 keV. It is evident that a simple power law fits well the spectrum of Tycho but it is not sufficient to describe that of Cas A. For the latter, an excess around 70-90 keV is clearly detected; this excess can be attributed to the presence of Titanium-44 decay lines.

In the extra-galactic case, active galaxies of various flavours have been found such as types of Blazars (both of the BL Lac and FSRQ classes) as well as radio galaxies. The bottom-right panel of the image shows the SED of the blazar candidate IGR J20569+4940, recently classified as a high peaked BL Lac object.

Finally, the identification of objects that are still lacking a definite counterpart at TeV energies can benefit from information at soft gamma-ray energies. The top-right panel of the image shows the sky region surrounding HESS J1844-030 as seen by IBIS/ISGRI. HESS J1844-030 is still an unidentified object; it has, however, been largely covered by INTEGRAL observations, which have revealed only one persistent source, AX J1844.7-0305, spatially associated with the TeV object.

Credits:

- "INTEGRAL View of TeV Sources: A Legacy for the CTA Project", A. Malizia, M. Focchi, L. Natalucci, V. Sguera, J.B. Stephen, L. Bassani, A. Bazzano, P. Ubertini, E. Pian, A.J. Bird, 2021, in: Special Issue "High-Energy Gamma-Ray Astronomy: Results on Fundamental Questions after 30 Years of Ground-Based Observations", Universe 7(5), 135 <https://www.mdpi.com/2218-1997/7/5/135>

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