Study probes the origin of the very high energy gamma-ray source VER J1907+062

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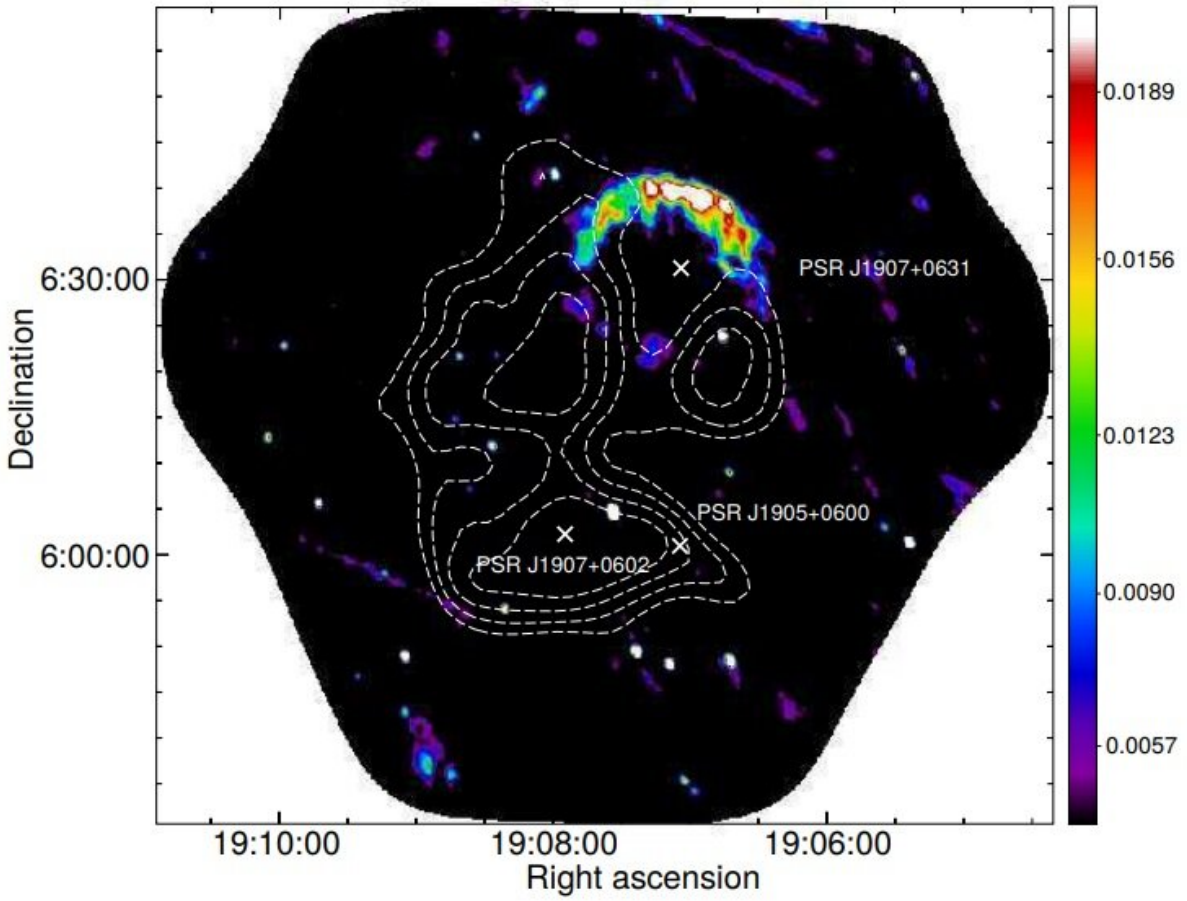

Radio continuum image at 1.5 GHz covering the whole extension of the TeV source VER J1907+062. Credit: Duvidovich et al., 2019.

A new study based on high-quality radio observations with the Karl G.

Jansky Very Large Array (VLA) has investigated the origin of a very high-energy gamma-ray source known as VER J1907+062. Results of the study, published December 27 on arXiv.org, suggest that VER J1907+062 consists of two separate gamma-ray sources.

Sources emitting gamma radiation with photon energies between 100 GeV and 100 TeV are called very high energy (VHE) gamma-ray sources. Observations show that these sources are often blazars or binary star systems containing a compact object. However, the nature of many VHE gamma-ray sources is still not well understood.

This is the case with VER J1907+062, a TeV source first identified in 2007. Previous studies have shown a strong TeV emission from this source near the location of the pulsar PSR J1907+0602, extending toward the supernova remnant SNR G40.5−0.5.

The nature of VER J1907+062 is still unknown. Based on the strong TeV emission around PSR J1907+0602, some astronomers suggest that this source could be a TeV pulsar wind nebula (PWN) powered by this pulsar. Moreover, it was also proposed that VER J1907+062 may be the superposition of two sources, either separated or interacting.

To clarify these uncertainties and to shed more light on the origin and true nature of VER J1907+062, a team of astronomers led by Laura Duvidovich of the University of Buenos Aires, Argentina, has carried out new high-quality radio observations of this source using VLA.

"In this paper, we present new high-quality radio images of a large region containing the extended TeV source VER J1907+062 at 1.5 GHz and a region toward the PSR J1907+0602 at 6 GHz, in both cases with data obtained using the VLA in its D configuration," the astronomers wrote in the paper.

The VLA observations found no nebular radio emission toward PSR J1907+0602 or the other two pulsars in the region. Moreover, the new images show no evidence of extended radio emission in coincidence with PSR J1907+0602 and also no evidence of extended nor point-like emission toward the pulsar. These results seem to disfavor the scenario suggesting that the non-thermal X-ray emission around the pulsar may be a PWN.

The research found molecular clouds in the vicinity of SNR G40.5–0.5, which match the eastern, southern and western borders of the remnant and partially overlap peaks of the TeV emission from VER J1907+062. The finding suggests an association of the studied TeV source with this SNR.

Summing up the results, the astronomers proposed two hypotheses that could explain the origin of VER J1907+062. According to them, this source could be the superposition in the line of sight of two distinct gamma-ray sources powered by different emission mechanisms and located at different distances. They find this scenario as the most plausible, but do not exclude the possibility that VER J1907+062 could be a single source whose VHE emission is produced by two particle accelerators (the pulsar and the supernova remnant) located at the same distance.

More information: Radio study of the extended TeV source VER J1907+062, arXiv:1912.13352 [astro-ph.HE] arxiv.org/abs/1912.13352