Persistent radio source QRS121102 investigated in detail

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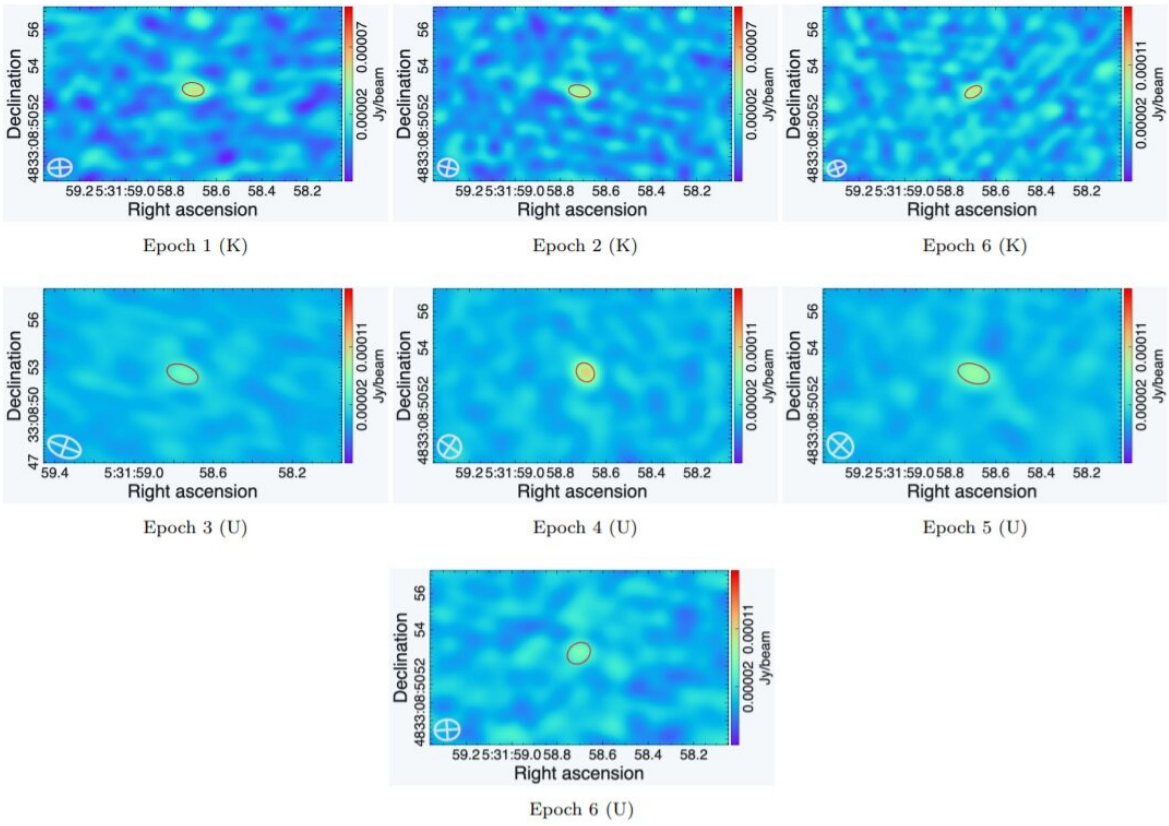

VLA images (in J2000 coordinates) of QRS121102 in seven epochs, with band indicated in parentheses. Credit: Ge Chen et al., 2022.

Astronomers from the California Institute of Technology (Caltech) have investigated a persistent radio source known as QRS121102 that is

associated with the fast radio burst FRB 121102. Results of the study, published January 4 on arXiv.org, shed more light on the origin of this source and could help us better understand the nature of fast radio bursts.

Fast radio bursts (FRBs) are intense bursts of radio emission lasting milliseconds and showcasing characteristic dispersion sweep of radio pulsars. The physical nature of these bursts is yet unknown, and astronomers consider a variety of explanations ranging from synchrotron maser emission from young magnetars in supernova remnants to cosmic string cusps.

FRB 121102 is the first repeating fast radio burst detected and one of the most extensively studied FRB sources. It exhibits complex burst morphology, sub-burst downward frequency drifts, and also complex pulse phenomenology. FRB 121102 is also one of only two FRBs reported to be spatially associated with persistent radio emission of unknown origin.

A team of astronomers led by Caltech's Ge Chen took a closer look at this persistent radio source. For this purpose, they observed QRS121102 with the G. Jansky Very Large Array (VLA) and the Low-Resolution Imaging Spectrometer (LRIS) at the Keck Observatory.

"In this work, we investigated the origin of the persistent radio source, QRS121102, associated with FRB 121102. We present new VLA monitoring data (12 to 26 GHz) and new spectra from Keck/LRIS," the researchers wrote in the paper.

The observations allowed the team to estimate the physical size of QRS121102. It was found that the emission radius is most likely between 0.1 and 1 light year. Such a relatively small size suggests a few compact radio source candidates, for instance, active galactic nuclei

(AGN), pulsar wind nebulae (PWNe), very young supernova remnants (SNRs) and gamma-ray burst (GRB) afterglows.

Given that QRS121102 may be an AGN, the astronomers constrained the mass of the potential black hole. They found that this mass would be lower than 100,000 solar masses, which does not support the AGN scenario as this source is too faint in the X-ray for its calculated low black hole mass and bright radio emission.

The radio luminosity of QRS121102, from 400 MHz to 10 GHz, was measured to be approximately 20 billion TW/Hz. Therefore, according to the researchers, this source is too luminous to be an SNR. It was added that QRS121102 is also too bright to be a long-duration GRB (LGRB) radio afterglow.

Summing up the results, the researchers noted that it is too early to draw final conclusions regarding the true origin of QRS121102 and further observations are required in order to get more insights into the nature of this source.

"We urge continued broadband radio monitoring of QRS121102 to search for long-term evolution, and the detailed evaluation of potential analogs that may provide greater insight into the nature of this remarkable, mysterious class of object," the authors of the paper concluded.

More information: A comprehensive observational study of the FRB 121102 persistent radio source, arXiv:2201.00999 [astro-ph.HE] arxiv.org/abs/2201.00999