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The localization of a repeating Fast Radio Burst

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Fast Radio Bursts (FRBs) are transient sources that emit a single radio pulse with a duration of only a few milliseconds. They were firstly discovered ten years ago, and nowadays we have detected tens of these events. However, their physical origin remains unclear, and a number of scenarios even larger than the number of known FRBs has been proposed during these years.

The detection of multiple bursts in FRB 121102 excluded all the cataclysmic scenarios, at least for this particular FRB. The presence of these repeating bursts allowed us to perform a precise localization of the source with the Karl G. Jansky Very Large Array (VLA) and the European VLBI Network (EVN). Optical observations with Keck, Gemini and HST unveiled the host to be a low-metallicity star-forming dwarf galaxy located at a redshift of 0.193. The EVN results showed that the bursts are co-located (within a projected separation of < 40 pc) to a compact and persistent radio source with a size of 0.7 pc and located within a star-forming region.

This environment resembles the ones where superluminous supernovae or long-duration gamma-ray bursts are produced. Although the nature of this persistent source and the origin of the bursts remain unknown, the scenarios considering a neutron star/magnetar energizing a young superluminous supernova, or a system with a pulsar/magnetar in the vicinity of a massive black hole are the most plausible ones to date.

More recent observations have shown that the bursts from FRB 121102 are almost 100% linearly polarized at an unexpectedly high and variable Faraday rotation measure, that had been observed to date only in vicinities of massive/supermassive black holes. The bursts are thus likely produced from a neutron star in such environment, although the system can still be explained by a young neutron star embedded in a highly magnetized pulsar wind nebula or supernova remnant.