Statistical analysis of radio-flaring brown dwarf population

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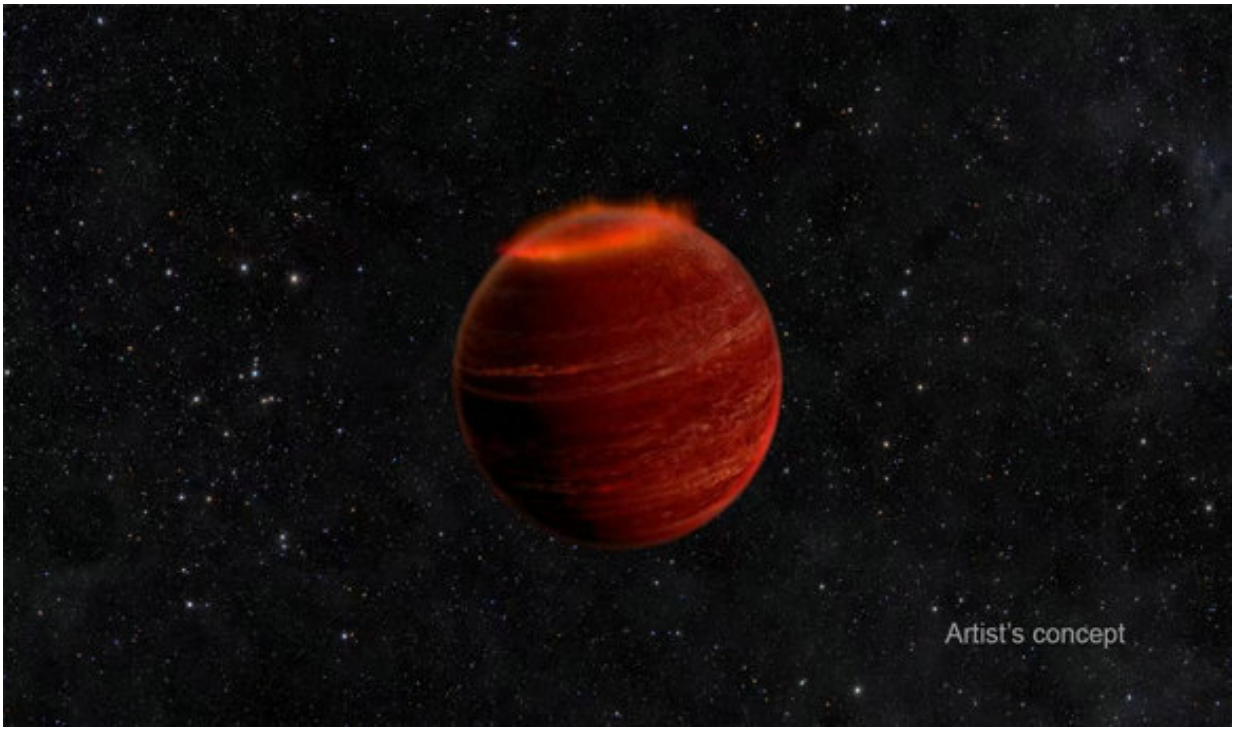

This artist's concept shows an auroral display on a brown dwarf. If you could see an aurora on a brown dwarf, it would be a million times brighter than an aurora on Earth. Credit: Chuck Carter and Gregg Hallinan/Caltech

Brown dwarfs are known as "failed stars," owing to the lack of central hydrogen burning. They bridge the gap between planets and stars. Some brown dwarfs are found to maintain kilogauss magnetic fields and

produce flaring radio emissions, similar to aurora on magnetized planets in solar system, arousing astronomers' curiosities about their field properties and dynamics.

Radio emissions from brown dwarfs reflect their magnetic activities. For solar-type stars, radio, optical and X-ray emissions are all used as magnetic indicators, while for brown dwarfs, optical and X-ray emissions decrease dramatically, and radio becomes the most efficient probe.

Dr. Tang Jing and her colleagues from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) carried out a statistical analysis of a radio-flaring brown dwarf population, which helped quantify the potential of finding such objects in FAST surveys.

This study was published in *Research in Astronomy and Astrophysics*.

The traditional way to study brown dwarfs is to select a number of them and track them for several hours to catch the possible flares, which is very expensive. Until now, the number of detected flaring brown dwarfs was fewer than 20. The so-called Commensal Radio Astronomy FAST Survey (CRAFTS) promises to increase the number by almost one order of magnitude, according to the study.

Led by Dr. Li Di, chief scientist of FAST, CRAFTS utilizes a novel and unprecedented mode to realize simultaneous data taking for pulsar and FRB search, Galactic HI mapping, and HI galaxy study. It is designed to cover 60% of the sky in drift-scan mode.

For FAST, the most significant problem in locating a point source is the confusion due to the large beam size. However, the flaring radio emission is highly circularly polarized, suffering little confusion. Circular polarization can be calculated from the orthogonally polarized

outputs, independent of system fluctuation, and is a good method to search for flares.

If some highly circularly polarized signals are found in the survey, cross-matching the archival optical/infrared counterpart can be used for identification. FAST is expected to detect flaring brown dwarfs as far as 180 pc.

Most flaring brown dwarfs are detected at high frequencies. Though some efforts have been made in low frequencies, the flaring emission at the L band has not been detected yet. FAST may fill in this gap. If successful, it also bodes well for FAST's potential to discovery exoplanets with strong magnetic fields.

More information: Jing Tang et al, The Potential of Detecting Radio-flaring Ultracool Dwarfs at L band in the FAST Drift-scan Survey, *Research in Astronomy and Astrophysics* (2022). DOI: 10.1088/1674-4527/ac66bd

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