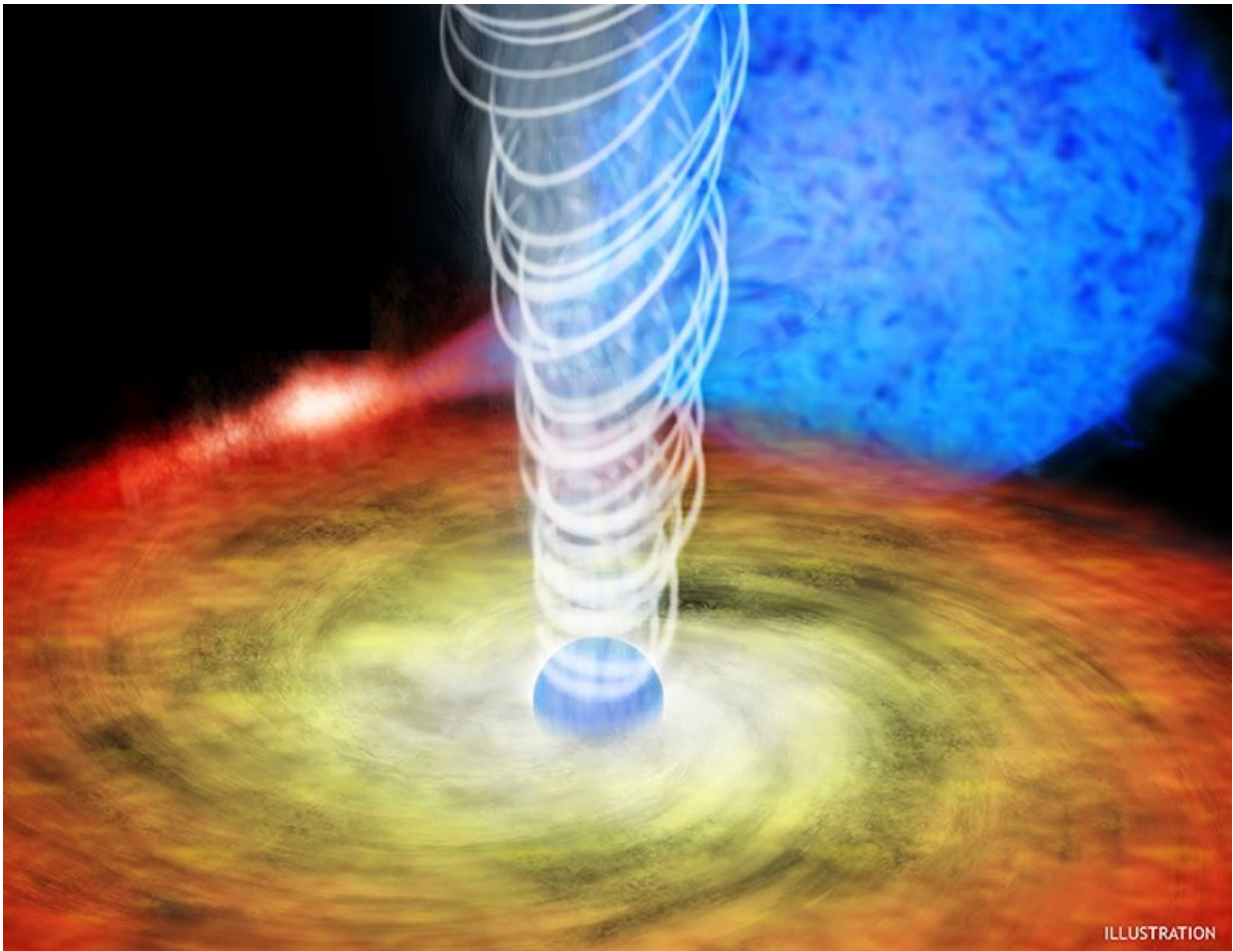


Neutron star with strong magnetic field may still launch jets

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Artist's impression of the launching of a jet by a neutron star. Gas, stripped from the normal star in the background, first spirals towards the neutron star before being expelled in a powerful stream of plasma. Credit: NASA/CXC/M.Weiss

An international team of astronomers led by the University of Amsterdam (The Netherlands) suspects that neutron stars with a strong magnetic field can still launch so-called jets. Since the 1980s, it was thought that strong magnetic fields inhibit the formation of these plasma streams. But observations with more advanced telescopes indicate jet-like radiation. The astronomers publish their findings in two articles in the *Monthly Notices of the Royal Astronomical Society*.

Jets are energy rich plasma streams that are blown out of black holes or [neutron stars](#) at high speed. Jets have been known for decades, but so far no jets have been observed at [neutron](#) stars with a strong magnetic field. The prevailing assumption was that strong magnetic fields prevent the formation of jets. Since the eighties, astronomers hardly actively looked for jets at neutron stars with a strong magnetic field.

Data crunching

In 2013, astronomer Nathalie Degenaar (University of Amsterdam, the Netherlands) decided that it was time to observe a few neutron stars with improved telescopes. She asked and got observing time with the Very Large Array (VLA), a radio telescope with 27 dishes in the state of New Mexico (USA). On June 6, 2013 and June 16, 2013, the VLA focused on the binary systems Her X-1 and GX 1+4 for a few dozens of minutes. Both systems consist of a neutron star with a very strong magnetic field and a normal star that orbits around it. Material flows from the normal star to the neutron star. The radio observations were intended to test whether these systems, with such a strong magnetic field, indeed do not launch a jet.

The observational data was stored for some time until the PhD student Jakob van den Eijnden (University of Amsterdam) crunched it in the summer of 2017. Van den Eijnden says, "Analyzing this type of data from 27 telescopes together is complicated, so in June, I went to Perth in

Australia to learn from an expert how to do it."

The analysis showed that both neutron stars emit radio-radiation and that the intensity of that radiation is comparable to that of jets. The researchers do not claim that there are real jets, because for that claim additional measurements are needed. "However, we can now rule out a number of processes," says Van den Eijnden. "There is no so-called stellar wind. Her X-1 has no winds and the wind in GX 1+4 is not strong enough."

It also seems, at least for Her X-1, that the radiation is not the result of shocks that emerge because gas of the donor star contacts the neutron star's magnetic field.

And, again for Her X-1, there doesn't seem to be a so-called propeller. Van den Eijnden says, "That's the case when the magnetic [field](#) is so strong that all the gas is blown away. You can compare it with a wet umbrella that rotates very fast so the drops fly away."

The researchers have now applied for further observation time. They want to have a better look at Her X-1 and GX 1+4 to finally decide that they're launching jets. And they want to observe other similar neutron [stars](#) with [strong magnetic fields](#) to check if the observations are unique or just very common.

More information: Discovery of radio emission from the symbiotic X-ray binary system GX 1+4. arxiv.org/abs/1711.01958

Radio emission from the X-ray pulsar Her X-1: a jet launched by a strong magnetic field neutron star? arxiv.org/abs/1711.01971

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