Annual Highlights

Hiding behind a wall of dust

The hunt for distant galaxies has traditionally been based on telescopes designed to detect their starlight emitted in the UV and visible spectrum. Naturally, this light becomes progressively fainter and harder to detect as we look farther out into space.

While missions like NASA's and ESA's new flagship, the James Webb Space Telescope, are specifically built to address this technical limitation, there is another, more fundamental barrier set by Nature: Galaxies are enshrouded in large amounts of dust and gas blocking the starlight, re-emitting it as infrared light.

Using a combination of state-of-the-art observations, DAWN members revealed that this "wall of dust" in some of the most star-forming galaxies in the early Universe blocks not only starlight but also a portion of the emitted light by the dust itself. DAWN PhD student Isabella Cortzen demonstrated that this "self-absorption" caused by thick layers of dust has profound implications for the observability and the very nature of these galaxies.

The new results suggest that some early galaxies are up to ten times more efficient at converting gas to stars than previously thought, calling for a radical rethinking of their dust and gas measurements, and the evolution of the first galaxies.

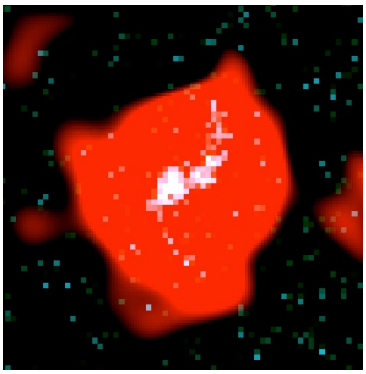
Early, mature galaxies and the dispersion of heavy elements

Heavy elements (or "metals") such as carbon and oxygen did not exist in the Universe at the time of the Big Bang. They were formed later by nuclear fusion in stars. However, it is not yet understood how these elements spread throughout the Universe — an essential process to foster life.

To understand these processes, DAWN postdoc Seiji Fujimoto and collaborators undertook, for the first time, a systematic survey of distant galaxies with the ALMA observatory. And the result was unexpected: As a by-product of dying stars, galaxies already contained a significant amount of dust and metals when the Universe was only 10% of its current age.

In particular, they found that the gaseous metal clouds are always present, far beyond the stars, sometimes even forming an ordered rotating disk. That is, the galaxies are much more "mature" than previously thought.

Supernova explosions and energetic jets and radiation from supermassive black holes are likely to be the main drivers that transport the metal gas outside of the galaxies and finally throughout the Universe.



Roughly 50,000 lightyears across, the stars (white) in this galaxy are seen enshrouded in a halo (red) of metal gas (credit: S. Fujimoto).