DUST IN THE WIND

A JWST SURVEY OF NEARBY SUPERMASSIVE BLACK HOLES

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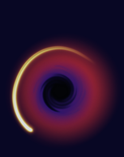
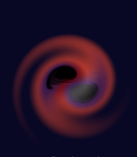
1. SUPERMASSIVE BLACK HOLES

Supermassive black holes, with masses that can be billions of times that of our Sun, inhabit the centres of every massive galaxy in the nearby Universe. They grow by:



feeding on available gas or dust (accretion)



or by combining with other black holes (mergers)

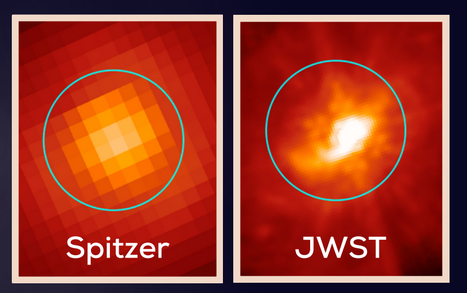
When actively accreting, we refer to them as Active Galactic Nuclei (AGN). The process by which a black hole transfers a part of its enormous energy back to its host galaxy is called AGN feedback. This leads to the black hole launching very fast flows of matter, powerful enough to alter the nature of the host galaxy.

2. WHY DUST MATTERS

Most of the dust in AGN sits in a light-year sized torus that ultimately fuels accretion. Because it obscures optical light, we have never been able to observe its behaviour near the black hole in detail before, for example with Hubble.

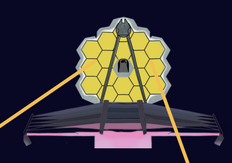
Dust in space is also intimately connected with gas, and its behaviour is a lot easier to understand. It is how heavy elements (such as carbon) are stored in interstellar space. Using dust as a tracer provides insights into the processes of obscuration, accretion, and feedback in AGN.

3. BLACK HOLES THROUGH THE EYE OF JWST



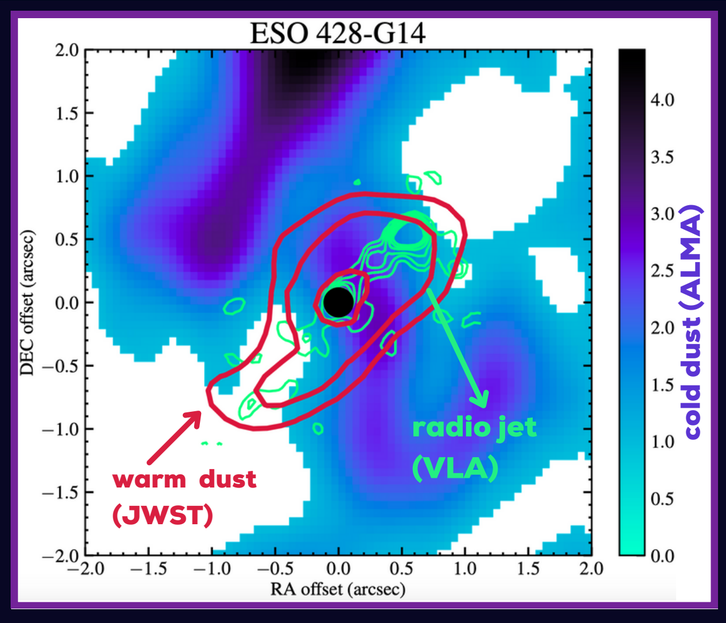
The superior resolution of JWST *(right)* far supersedes previous infrared telescopes *(left)* and reveals hidden dusty details with unparalleled clarity.

JWST's infrared vision allows us to look through the dusty torus and see the hidden core. At the same time, JWST's sharp eye allows us for the first time to resolve the detailed structure of this dust itself.



Our full study is one of the first JWST programmes led by UK astronomers. Supported by STFC funds, our images reveal a treasure trove of structures in these galaxies: spiral-laden discs bursting with star-formation, hidden clusters of stars, flows of gas and dust, and bright spears of nuclear light. Each galaxy is unique and has its own story to tell.

4. DUST FOUND BEYOND THE TORUS



Zooming into the heart of a nearby obscured supermassive black hole called ESO 428-G14, we reveal the launching sites of feedback. The cold gas imaged by ALMA feeds the active black hole as it flows down to the accretion disc. The warm dust, revealed for the first time with JWST, cuts through this cold gas. It lines up with the extended superfast outflows seen in the radio ("jets").

Our findings provide the first evidence with JWST that warm dust is being heated by the AGN and potentially swept out by its energetic outflows, leading to a dusty wind. We demonstrate that the dust can escape the influence of the black hole and carry mass and energy into the galaxy.

JWST: *James Webb Space Telescope* ***ALMA:*** *Atacama Large Millimeter Array* ***VLA:*** *Very Large Array*