UNIVERSITY OF LEICESTER

The astrophysics of the most luminous active galaxies of all time

• The NASA WISE mission discovered thousands of the most luminous galaxies in history: HotDOGs. • Supermassive blackholes in HotDOGs are extremely powerful, and reveal galaxies around. • What triggers HotDOGs, and the effects of their feedback works is important for the evolution of galaxies.	**Level**	PhD
	First Supervisor	Prof. Andrew Blain
	Second Supervisor	Prof. Nial Tanvir
	Application Closing Date	17th January 2027
	PhD Start date	27th September 2027

Project Details:

The WISE infrared sky survey catalogued over five hundred million objects (Wright et al. 2010), including the most luminous galaxies that have ever existed (Eisenhardt et al. 2012). Dubbed "HotDOGs", because their interstellar dust is heated to much greater temperatures than in ordinary galaxies, and they are "Dust-Obscured Galaxies", following the class of galaxies discovered and highlighted by the Spitzer Space Telescope (Tsai et al. 2013).

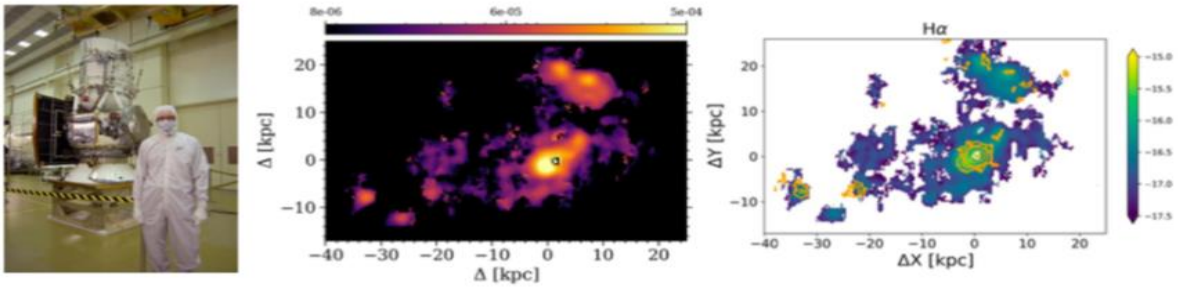
The conditions in the luminous centres of HotDOGs have been probed using the most powerful telescopes, including Keck, ALMA, Hubble, JWST and ESO's VLT (Diaz-Santos et al. 2018; Vayner et al. 2026). The effort to take images and spectra to reveal the details of the processes of accretion within are still underway, and we hope to continue to provide more insight into how blackholes grow and influence their surroundings in more ordinary galaxies too.

We strongly suspect that these most-luminous galaxies, powered by the accretion of matter onto supermassive blackholes in the centres of merging galaxies signpost the densest and most active regions in the Universe at "cosmic noon", the epoch when galaxy formation was at its height (Bridge et al. 2013; Jones et al. 2017). As such, they can potentially help us to understand the growth of cosmic structure and tensions in current values of cosmological parameters.

The growth of cosmic structure is an important way to confront models of galaxy evolution driven by dark matter. Looking at the rarest and most unusual galaxies can often provide strong tests of the models that can have difficulties reproducing the correct number of remarkable objects like the HotDOGs, and how their population evolves with time.

During a PhD, you'll work with data on understanding what's going on within HotDOGs, and on how they are influenced by and can influence their surroundings, by using multiwavelegth data, from new radio telescopes, ALMA, JWST and instruments like MUSE and MOONS at ESO's VLT. Alongside you will get the chance to develop new models, and test appropriate models that already exist.

Images



Caption: WISE before launch, and ALMA and JWST images of the most luminous galaxy in the Universe, W2246-05 (Diaz-Santos et al. 2018; Vayner et al. 2026). These show both line and continuum emission from stars, the interstellar medium and the central supermassive blackhole. The galaxy is engaged in a dramatic multi-object merger and contains gas outflowing at over 5000 km/s (Vayner et al. 2026).

Further Reading:

- Bridge et al. (2013) The Astrophysical Journal, Volume 769, Issue 2, article id. 91, 7
- Diaz-Santos et al. (2018) Science, Volume 362, Issue 6418, pp. 1034-1036
- Eisenhardt et al. (2012) The Astrophysical Journal, Volume 755, Issue 2, article id. 173, 11
- Jones et al. (2017) Monthly Notices of the Royal Astronomical Society, Volume 469, Issue 4, pp. 4565-4577
- Tsai et al. (2018) The Astrophysical Journal, Volume 868, Issue 1, article id. 15, 9
- Vayner et al. (2026) arXiv:2510.09870
- Wright et al. (2010) The Astronomical Journal, Volume 140, Issue 6, pp. 1868-1881

Further Details:

- **Proposed Funding Source:** STFC
- **Proposed Start Date:** 27th September 2027 for 3.5 years.
- **Closing Date:** 23:59 Sunday 17th January 2027.
- **Eligibility:** UK/EU/International; fee waivers will be available for small number of international students; otherwise international applicants must show that they can cover the fee difference between UK/International costs (~£16k/year).
- **Entry requirements:** Applicants are required to hold/or expect to obtain a UK Bachelor Degree 2:1 or better in a relevant subject. The University of Leicester English language requirements apply where applicable.
- **Application enquiries to pgradmissions@le.ac.uk**

Further information on how to apply and funding can be found here