SEARCHING FOR GALACTIC BARS THROUGH COSMIC TIME

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Figure 1. The NGC 1365 galaxy with a central stellar bar. **Credit:** ESO/IDA/Danish 1.5 m/ R. Gendler, J-E. Ovaldsen, C. Thöne, and C. Feron.

AN INTRODUCTION TO GALAXIES

Galaxies are some of the most magnificent objects to observe in the Universe. They emit light through the electromagnetic spectrum and can live in small or extremely large-density regions. Galaxy shapes range from ellipticals made of a smooth distribution of stars, to discs, which commonly show a spiral pattern.

The disc galaxy stabilises by forming a stellar bar at its centre. This feature drives internal evolution by redistributing gas and dark matter.

BAR EVOLUTION

It is thought that in the early Universe, galaxies were closer together, so they frequently merged. Merging events meant that discs were unsettled and could not form a bar.

Over 10 billion years, the galaxies stabilise due to Hubble expansion. The literature shows that the fraction of bars in disc galaxies is higher in the local Universe.

We want to understand how quickly these bars formed after the big bang. If there is a high population of bars, then slow internal evolution begins earlier than we once thought.

OBSERVING GALAXIES WITH THE JAMES WEBB SPACE TELESCOPE (JWST)

To measure the bar fraction looking back over 10 billion years, we take a limited sample of 4,000 galaxies in the near-infrared waveband from JWST.

The reddest filter images show the clearest bars as old red stars populate them.

The sample ranges from redshift 1 to 3.

We remove edge-on galaxies and perfectly circular galaxies.

We visually inspected 600 JWST imaged galaxies and classified them as barred, candidate bar and non-barred.

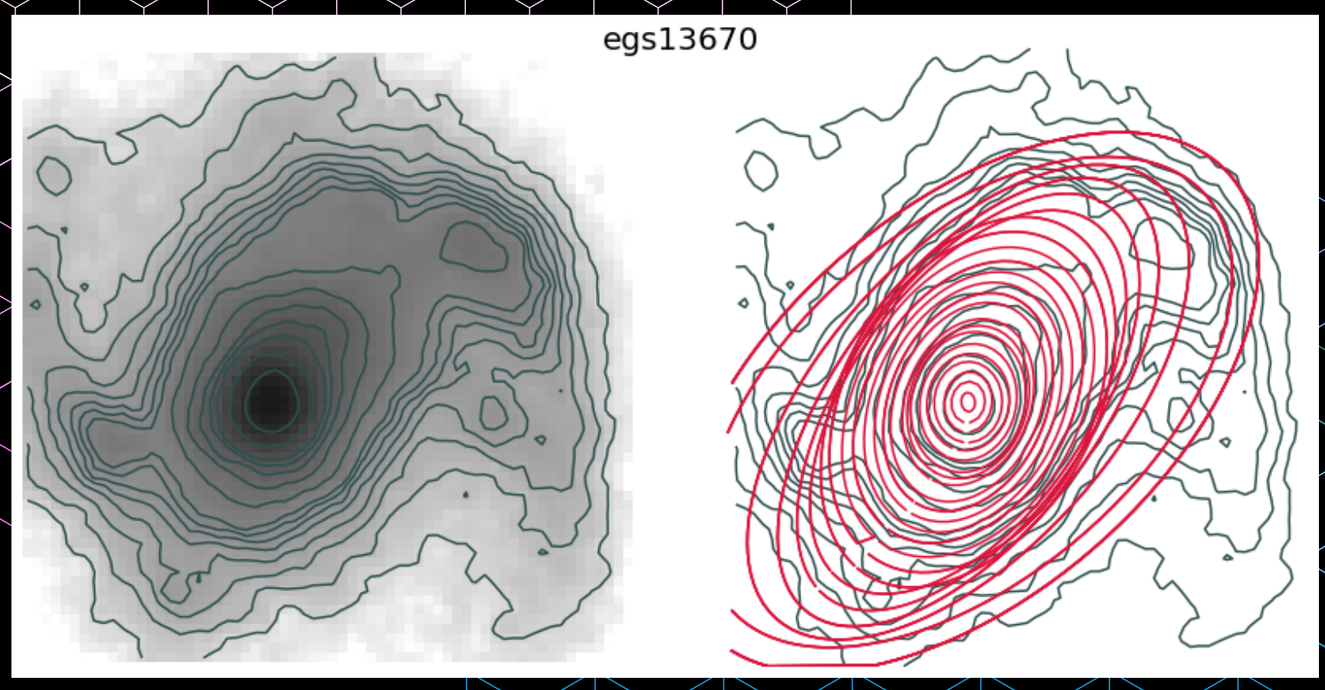

Figure 2. A JWST image of the galaxy egs13670. Left: brightness contours (isophotes). Right: Isophote contours in grey, elliptical isophotes in red.

RESULTS

We have made one of the first feature classifications of high redshift disc galaxies.

Literature finds that the immediate Universe bar fraction is ~ 70%.

For the distant Universe (redshift 1 to 3), the bar fraction decreased to ~ 10%.

This result agrees with predictions from simulations.

Typically, smaller blue disc galaxies are missed by JWST.

NEXT STEP

Having found an exciting and impactful result, we aim to consolidate these results by increasing our sample by a factor of three.

We will then measure this sample's bar length to understand these galaxies' evolutionary stages.

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