

Blazars: Staring down the throats of galactic monsters.

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Introduction

- Blazars are among the brightest, most energetic and bizarre objects in the universe!
- They are a type of **quasar**, and are not fully understood.

What are quasars?

- **Quasars** are extremely energetic and violent regions formed in the nuclei of most, if not all **active galaxies**.
- They are the result of material spiraling into a **supermassive black hole**, as seen in the illustration below.
- This material forms an **accretion disc**, and emits massive amounts of **electromagnetic radiation** across the whole spectrum.
- Huge amounts of material fall into the **black hole**, which emits two powerful **relativistic jets** out into space.

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Accretion Disc

The material spiraling into the **black hole** forms a spinning **accretion disc**. The friction of the material generates extreme heat and energy, and produces a broad range of electromagnetic **radiation**. The accretion disc is surrounded by a large donut shape of dust and gas called the **torus**.

Supermassive black hole

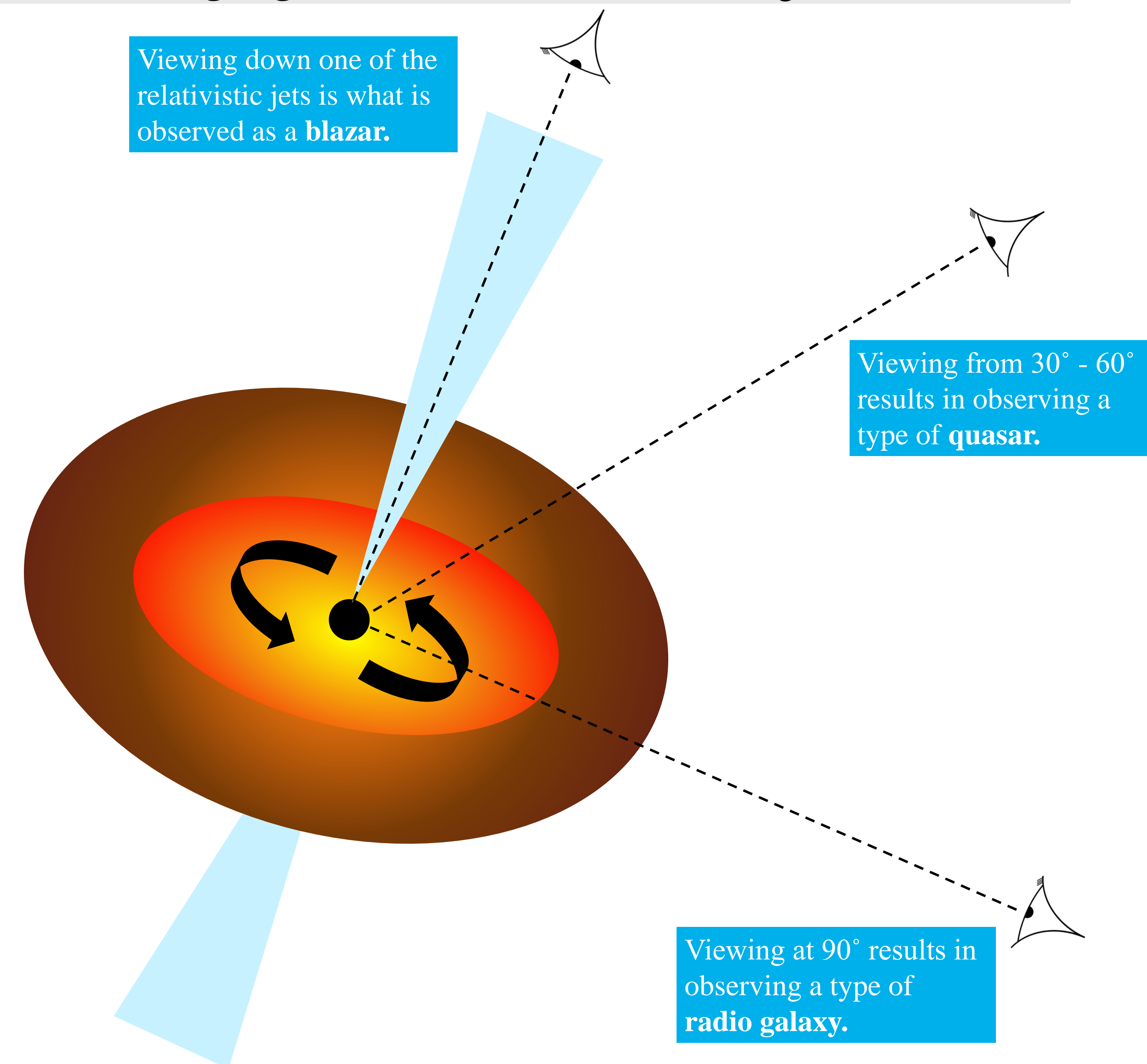
The **supermassive black hole** is the engine that drives the **active galactic nuclei**, pulling in surrounding material from stars as well as interstellar gas and dust. A supermassive black hole has a mass of 1 million – 10 billion **solar masses**.

Relativistic Jets

Along the axis of rotation of the **black hole**, a fraction of the accreted **particles** are accelerated to **relativistic speeds**, and are propelled away in tremendously powerful jets. These particles are some of the fastest known particles in the universe, and can travel hundreds of thousands of lightyears away.

Classification

Blazars and quasars as well as radio galaxies, are all types of **active galaxies**, and have subsequent sub-classes. They are essentially different manifestations of active galaxies. What distinguishes them, is the **viewing angle** from Earth, as seen in the diagram below.



Looking down the barrel

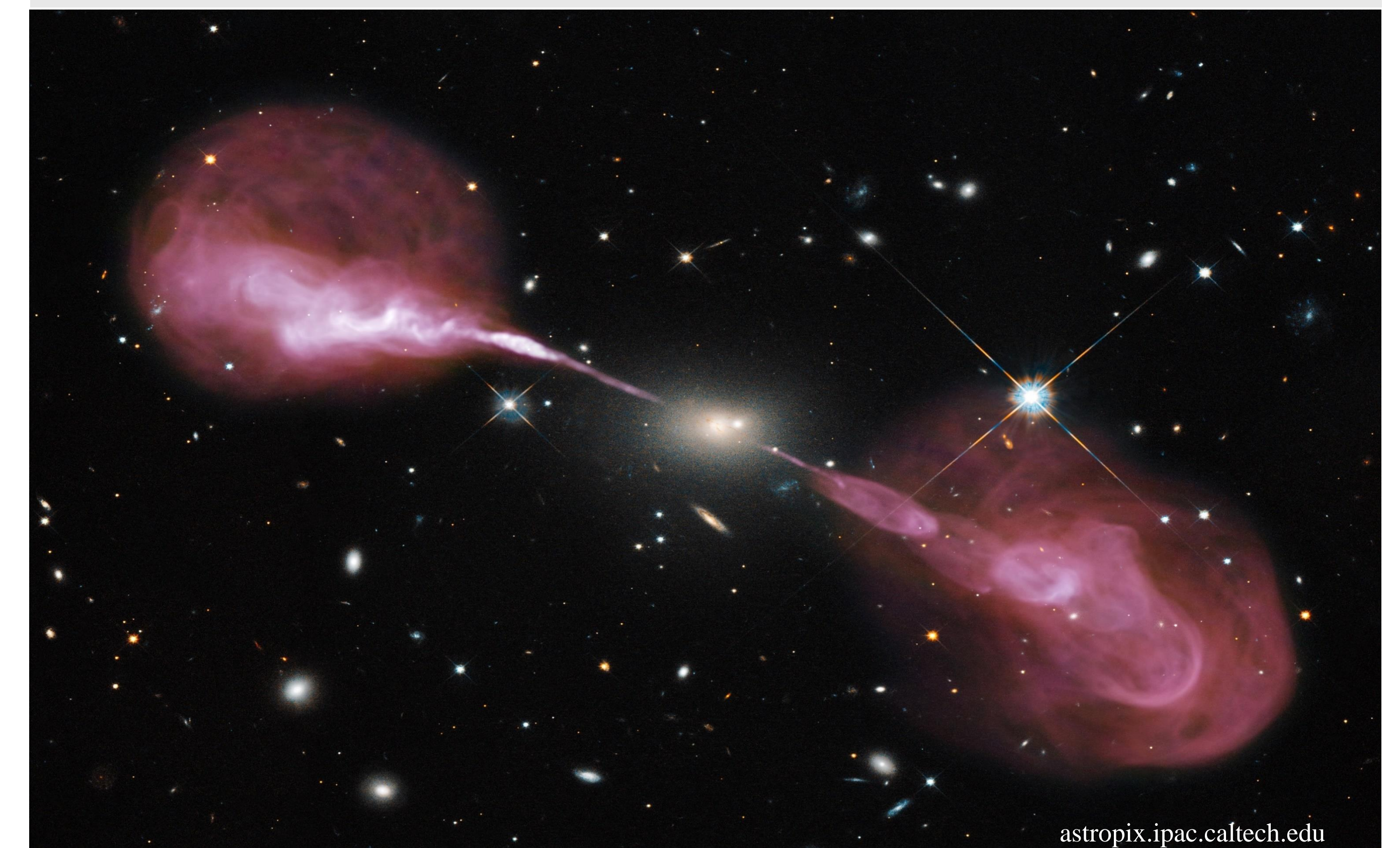
When **blazars** are observed, we are looking down one of the powerful **relativistic jets**. They appear as super bright variable objects, due to the charged particles travelling towards us at near the speed of light, emitting **synchrotron radiation** from moving through strong **magnetic fields** in the jet.

The amplification of brightness due to the close angle of observation and relativistic speeds, is known as **relativistic beaming**. Unlike other **active galactic nuclei**, blazars produce a **flat spectrum** with no emission or absorption lines – which is unusual for active galaxies. This makes it difficult to determine their velocities or distance.

The unique orientation of blazars give astrophysicists an opportunity to research their **emissions**, and an insight into the workings of the **black holes** at the heart of the galaxies. This could lead to discovering more about how energy is removed from the black hole, and how the **relativistic jets** are created and accelerated.

What we don't know

- Below is a **multi-wavelength** image of the **radio galaxy** Hercules A, taken by the Hubble Space Telescope and the VLA (Very Large Array).
- Clearly shown is the **relativistic jets** radiating from the **active galactic nuclei**, forming huge **radio lobes** due to interactions with the interstellar medium.
- Astrophysicists are working to understand how the **relativistic jets** are formed, how they create such extreme **broad spectrum radiation**, and how they propagate over such vast distances.
- It is currently unknown as to why most galaxies, including the **Milky Way**, appear to have dormant black holes that appear not to accrete great quantities of material.



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Current work

- Current low frequency radio astronomy offers significant information on sources exhibiting **flat radio spectrums** and **high intensity**, such as **blazars**. However, current surveys lack sufficient sensitivity and therefore miss a substantial portion of these objects.
- **ICRAR** (International Centre for Radio Astronomy Research) has recently used the **MWA** (Murchison Widefield Array) to conduct a new all sky survey called **GLEAM**, that will provide further insights into these sources, and discover **new blazars**.

Summary

- Blazars are fascinating and powerful objects, which still hold a lot of mystery – making them exciting for astronomers!
- For further information, check out; imagine.gsfc.nasa.gov/science/objects/active_galaxies2.html.