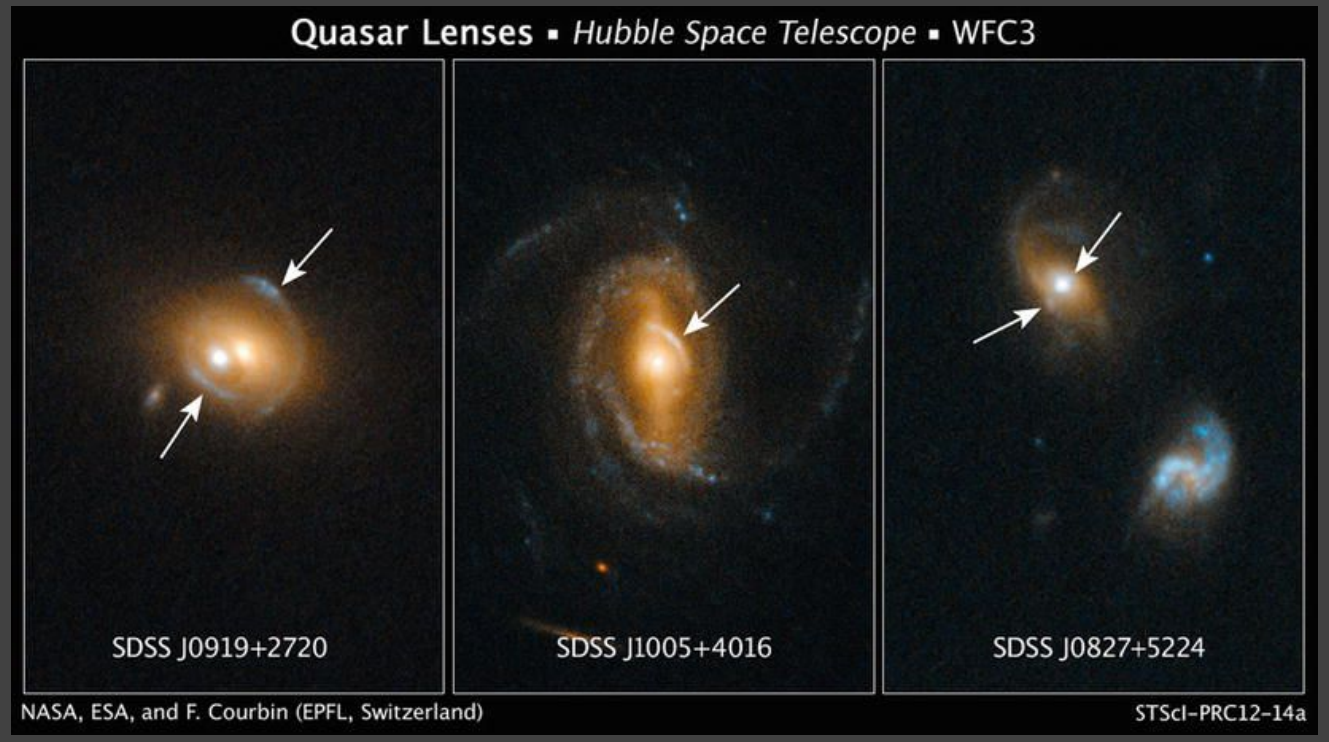

QUASARS

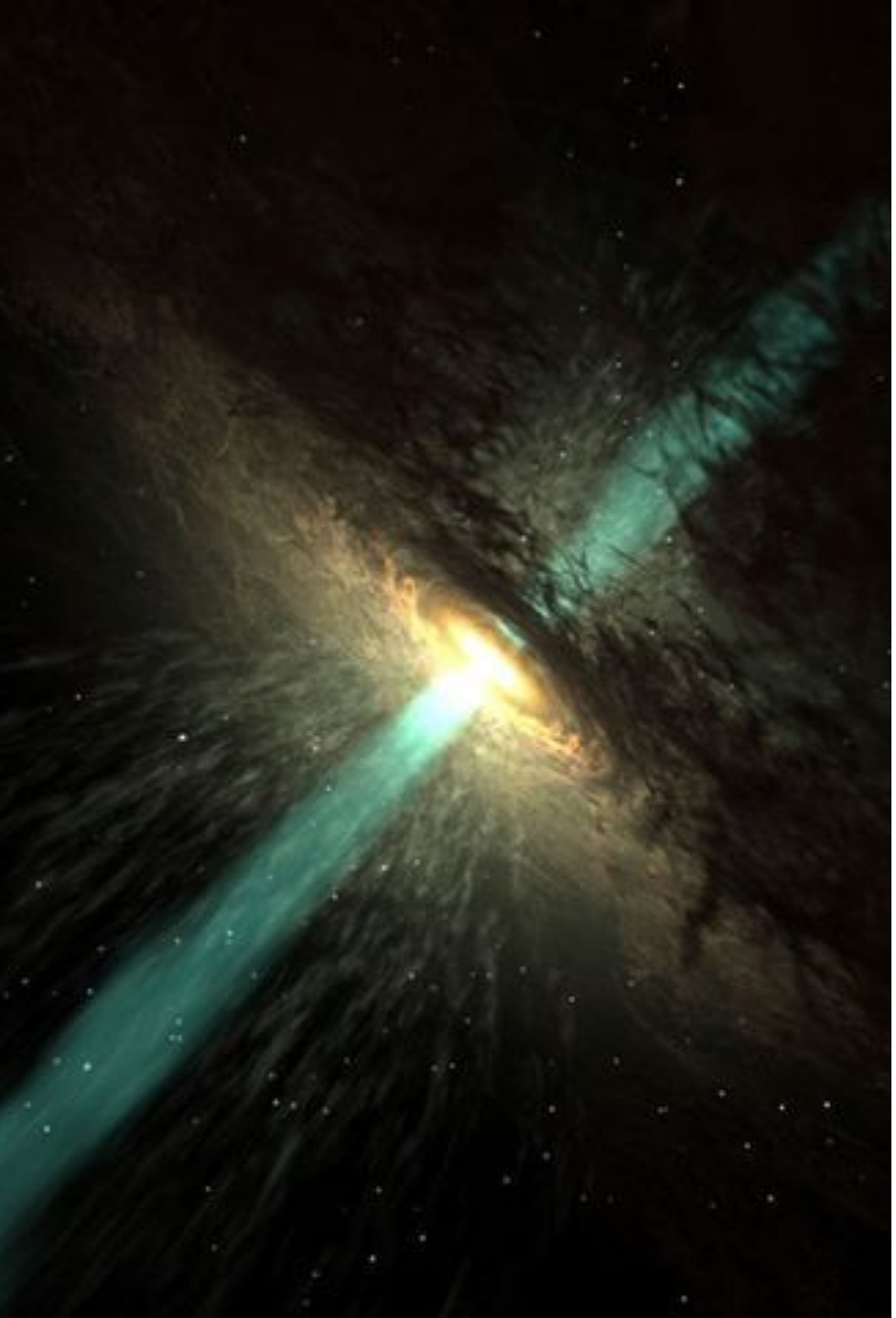
What is a Quasar?

- Quasars are a type of active galactic nucleus (AGN), which is a small region at the centre of a galaxy that emits an immense amount of energy in the form of radio, optical, X-ray, or gamma radiation or high-speed particle jets.
- Quasars are the brightest and most luminous objects in the known universe and were first identified by their major redshift which indicates they are also very old.
- The energy output of quasars is several thousand times that of our entire galaxy.

Family tree



- Quasars are part of a class of objects known as active galactic nuclei (AGN). Other classes include Seyfert galaxies and blazars. All three require supermassive black holes to power them.
- Seyfert galaxies are the lowest energy AGN, putting out only about 100 kiloelectronvolts (KeV). Blazars, like their quasar cousins, put out significantly more energy.
- Many scientists think that the three types of AGNs are the same objects, but with different perspectives. While the jets of quasars seem to stream at an angle generally in the direction of Earth, blazars may point their jets directly toward the planet. Although no jets are seen in Seyfert galaxies, scientists think this may be because we view them from the side, so all of the emission is pointed away from us and thus goes undetected.

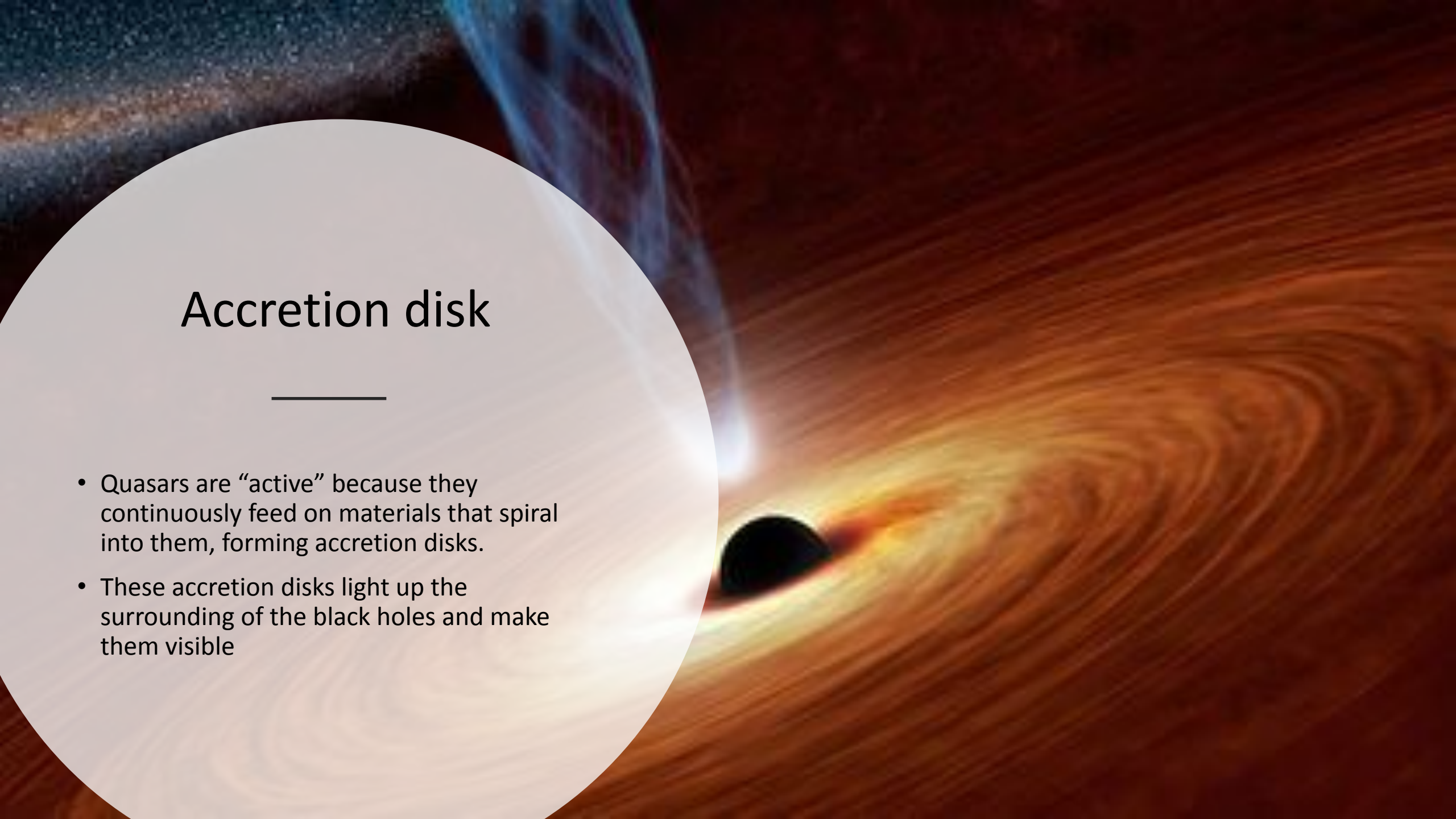


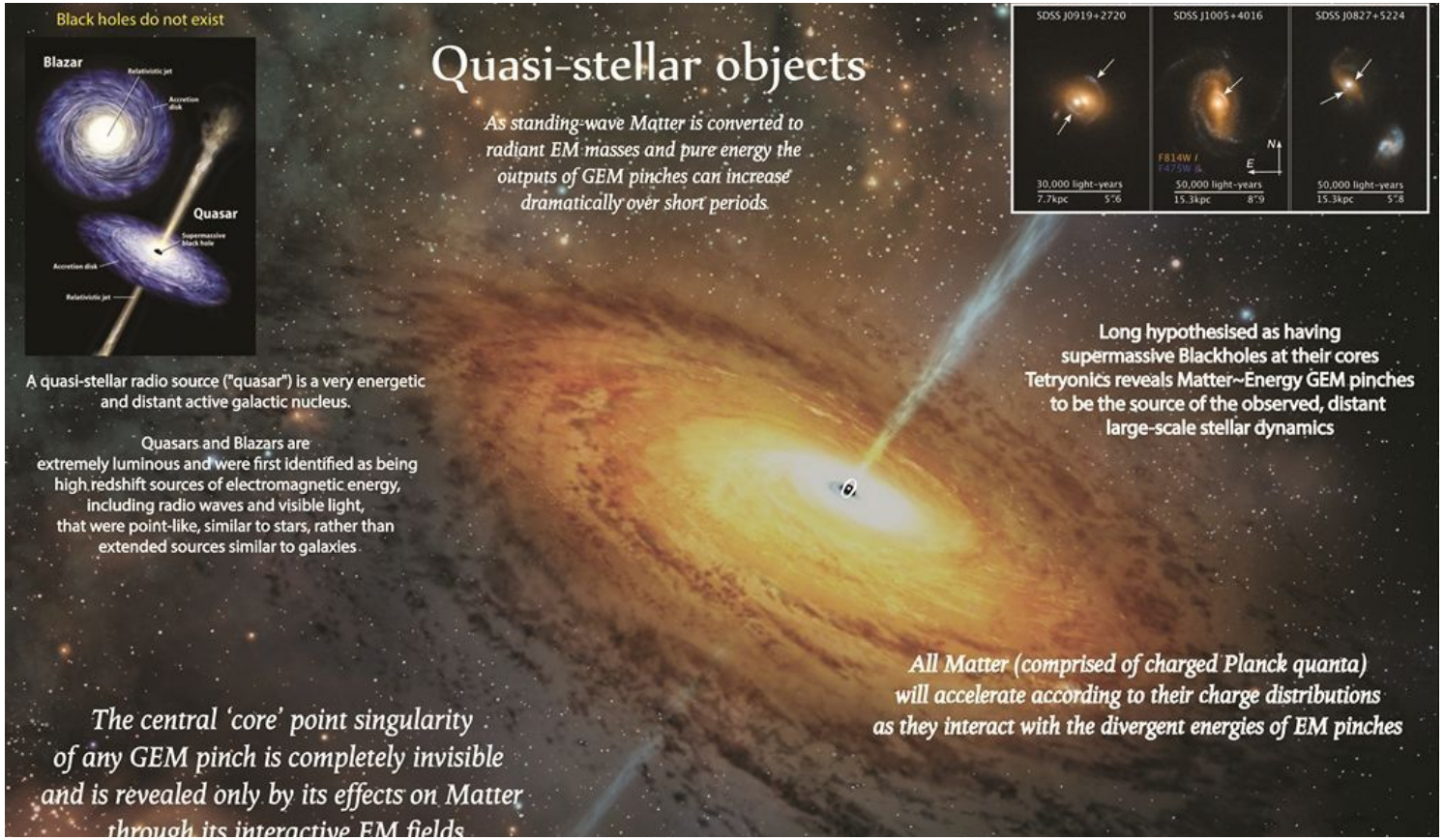
How do quasars occur?

- Quasars only exists in galaxies with supermassive black holes, which are black holes that contain mass billions of times greater than our sun.
- That's surrounded by a solar system-sized whirlpool of superheated plasma that shines brighter than an entire galaxy.
- Although light cannot escape from the black hole itself, some signals can break free around its edges. While some dust and gas fall into the black hole, other particles are accelerated away from it at near the speed of light. The particles stream away from the black hole in jets above and below it, transported by one of the most powerful particle accelerators in the universe.

Accretion disk

- Quasars are “active” because they continuously feed on materials that spiral into them, forming accretion disks.
- These accretion disks light up the surrounding of the black holes and make them visible



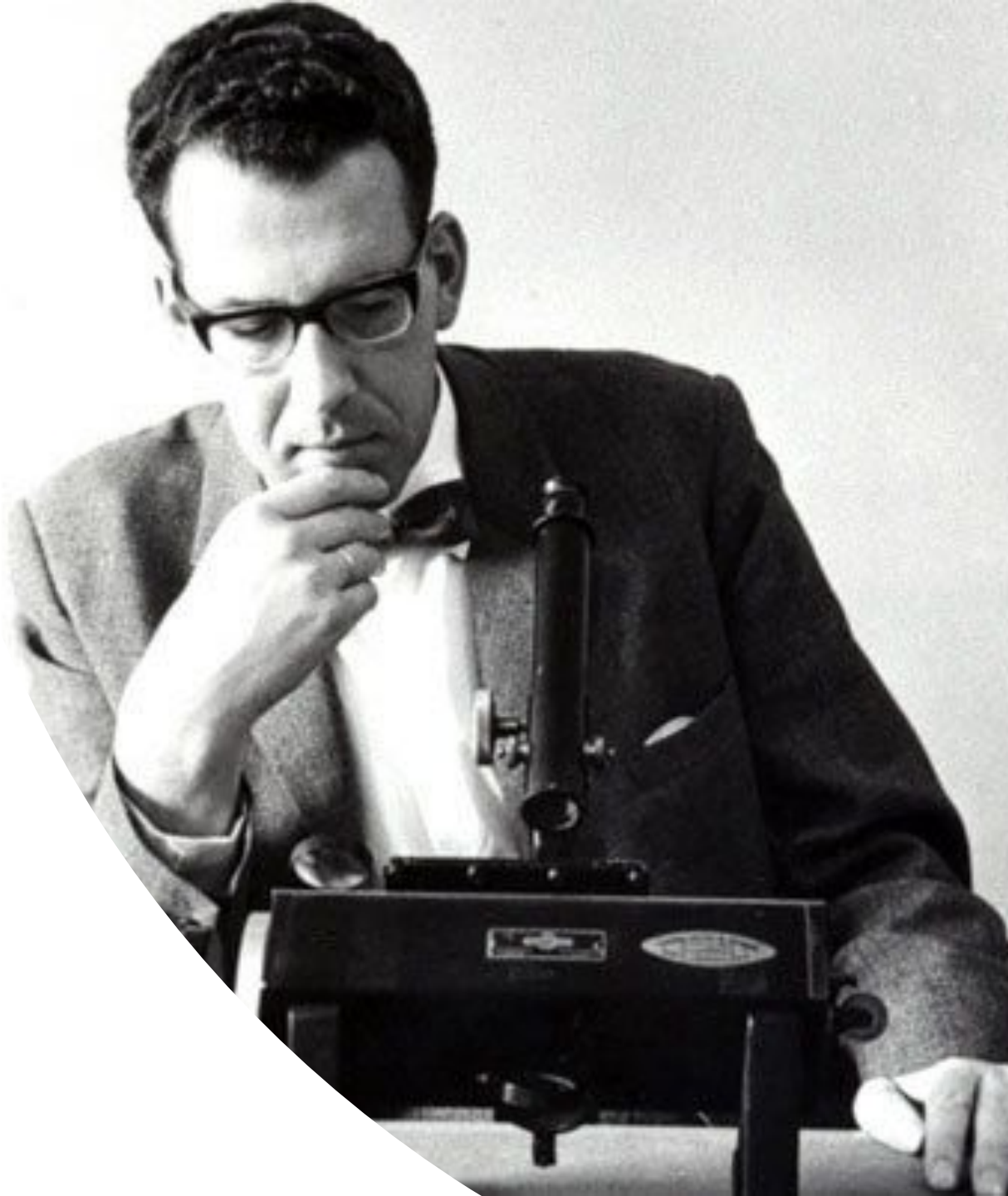


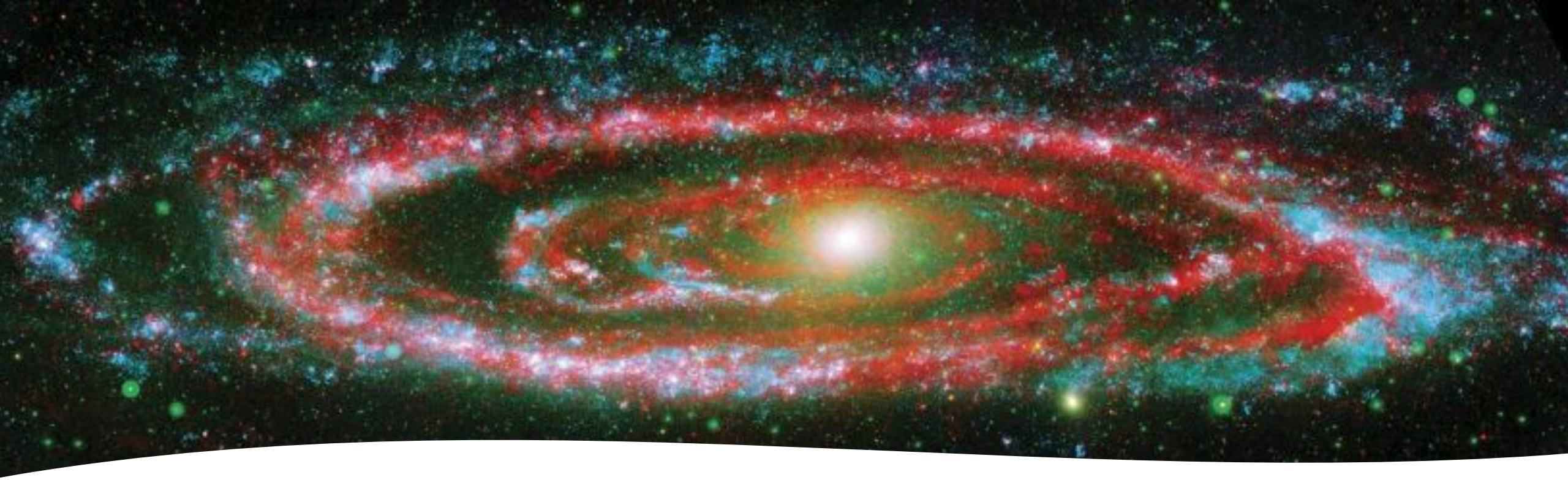
The Different types of quasars

- Quasi-Stellar Objects (QSO) is class of objects beyond our Milky Way Galaxy that have a star like visual appearance except that the optical spectrum has a large redshift.
- Quasars (quasi-stellar radio sources) are strong radio sources that are star like.
- A QSO may have a strong radio source or may not have a strong radio source.
- **Radio-loud quasars** are quasars with powerful jets that are strong sources of radio-wavelength emission. These make up about 10% of the overall quasar population.
- **Radio-quiet quasars** are those quasars lacking powerful jets, with relatively weaker radio emission than the radio-loud population. The majority of quasars (about 90%) are radio-quiet.

The Discovery of the Quasar.

- The discovery of Quasars in 1963 provided a final piece of evidence that undermined the Stead state theory and supported the Big Bang.
- Maarten Schmidt, a Caltech astronomer working at Mt. Palomar Observatory, was credited with discovering the most distant object observed to date—so bright that it was mistaken for a star; but it was a billion light years away.
- In 1963 Maarten Schmidt was studying radio Source 3C 273.
- It was unusual because the radio signals appeared to be coming from a star. At first the spectrum of the star was puzzling. Schmidt could not figure out what elements produced the bright spectral lines. Then he realized that the unfamiliar lines were simply the bright emission lines from hydrogen gas that had been shifted to different wavelengths.
- According to Hubble's law. An object with that red shift must be located billions of light-years away. It must be brighter than a million galaxies to appear as bright as a star at that great distance.
- 3C 273 came to be known as a quasar, short for quasi-stellar radio source, since it looks like a star, but cannot possibly be one since it is so bright. If quasars are only found at great distances, they could very well be young galaxies, since we are seeing them much earlier in the history of the universe. (Light from an object a billion light years away takes a billion years to reach us.)





Why is it important

- The steady state theory was first disproved when quasars were discovered in the 60s.
- Because they are billions of light years away, we are effectively viewing what the universe was like billions of years ago. This means that because the structure of these quasars is very different to the structure of the universe today, it indicates that the steady state theory cannot be correct because the universe has changed.