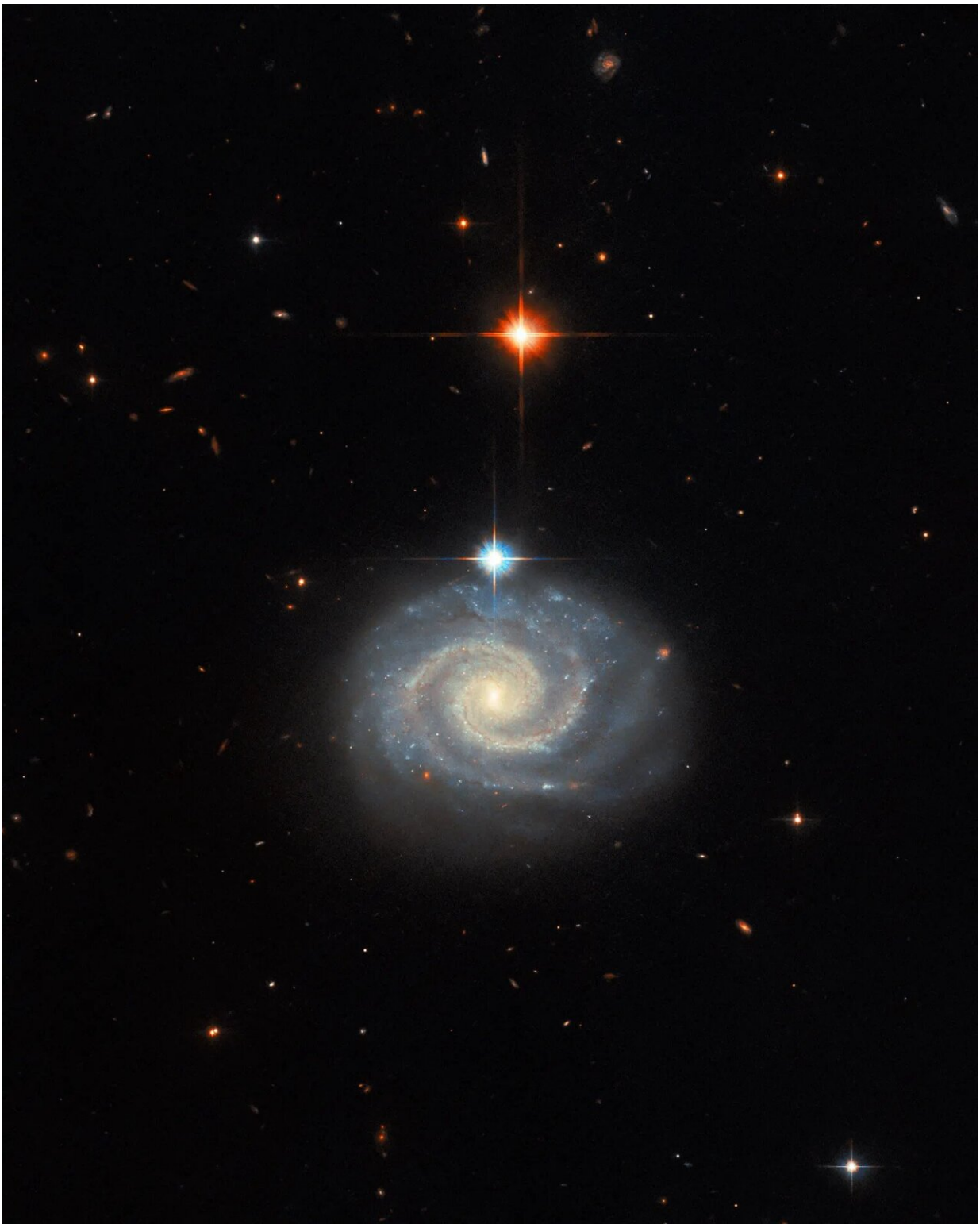
# Hubble sights a galaxy with 'forbidden' light

December 22 2023



This NASA Hubble Space Telescope image features a bright spiral galaxy known as MCG-01-24-014, which is located about 275 million light-years from Earth.

Credit: ESA/Hubble & NASA, C. Kilpatrick

This whirling image features a bright spiral galaxy known as MCG-01-24-014, which is located about 275 million light-years from Earth. In addition to being a well-defined spiral galaxy, MCG-01-24-014 has an extremely energetic core known as an active galactic nucleus (AGN) and is categorized as a Type-2 Seyfert galaxy.

Seyfert galaxies, along with quasars, host one of the most common subclasses of AGN. While the precise categorization of AGNs is nuanced, Seyfert galaxies tend to be relatively nearby and their central AGN does not outshine its host, while quasars are very distant AGNs with incredible luminosities that outshine their host galaxies.

There are further subclasses of both Seyfert galaxies and quasars. In the case of Seyfert galaxies, the predominant subcategories are Type-1 and Type-2. Astronomers distinguish them by their spectra, the pattern that results when light is split into its constituent wavelengths. The spectral lines that Type-2 Seyfert galaxies emit are associated with specific 'forbidden' emission lines. To understand why emitted light from a galaxy could be forbidden, it helps to understand why spectra exist in the first place.

Spectra look the way they do because certain atoms and molecules absorb and emit light at very specific wavelengths. The reason for this is quantum physics: electrons (the tiny particles that orbit the nuclei of atoms and molecules) can only exist at very specific energies, and therefore electrons can only lose or gain very specific amounts of energy. These very specific amounts of energy correspond to the wavelengths of light that are absorbed or emitted.

Forbidden emission lines should not exist according to certain rules of quantum physics. But quantum physics is complex, and some of the rules used to predict it were formulated under laboratory conditions here on Earth. Under those rules, this emission is 'forbidden'—so improbable that it's disregarded. But in space, in the midst of an incredibly energetic galactic core, those assumptions don't hold anymore, and the 'forbidden' light gets a chance to shine out toward us.

Provided by NASA's Goddard Space Flight Center