

ASASSN 14o: Artists impression of the star being ripped apart by its supermassive black hole. Credit: NASA's Goddard Space Flight Center

'Old Faithful' - An Active Galaxy

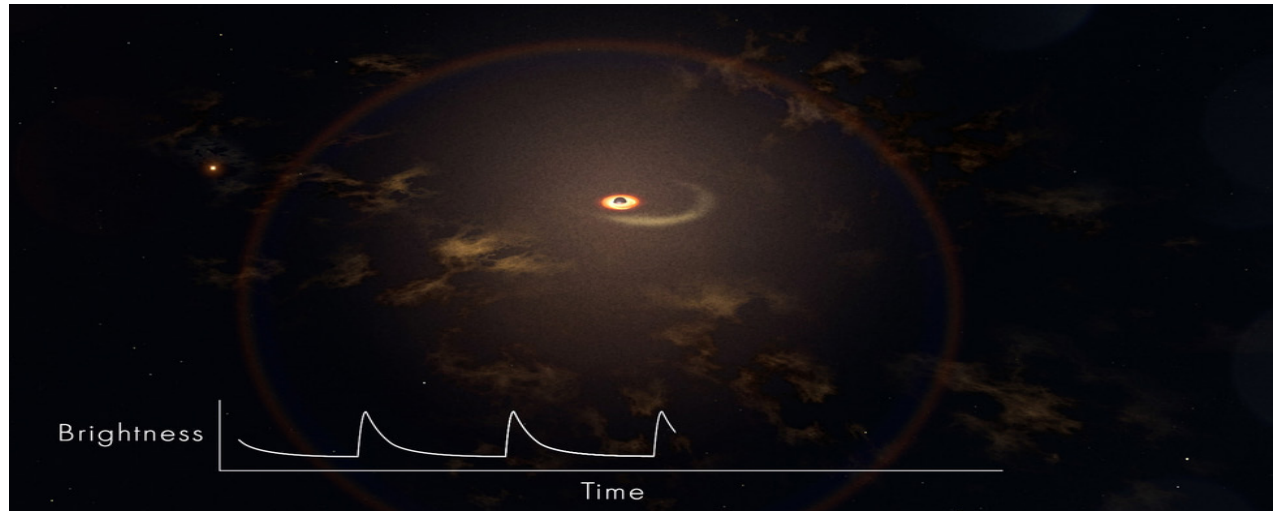
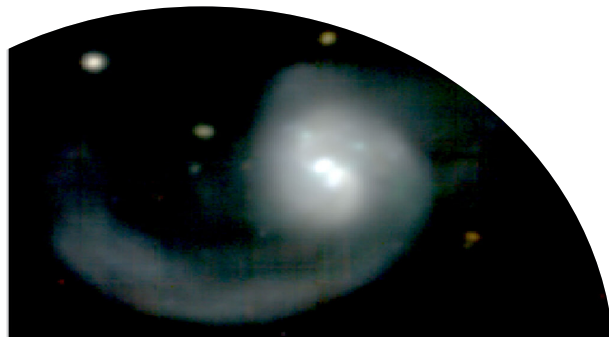
An unusual event

NASA's **Transiting Exoplanet Survey Satellite (TESS)** is an Explorer class mission designed to detect planets in our galaxy transiting their host stars, but it can also be used to investigate some of the most energetic events in the Universe.

Around 570 million light-years away in the southern constellation of Pictor, there is a galaxy called ESO 253-3 that exhibits some unusual behavior. An image of the galaxy, as taken by the **European Space Observatory's Multi Unit Spectroscopic Explorer** is shown below.

Every 114 days, a burst of bright light, known as a flare can be seen to occur within the galaxy. The flare reaches its peak brightness in about five days, and then steadily dims.

The event was discovered on November 14th, 2014, by the **All-Sky Automated Survey for Supernovae (ASAS-SN)**, where scientists first classified the object as a supernova (the explosive death of a star) and named it ASASSN-14ko.



An illustration of the black hole consuming gas from the star. The light curve produced as the gas hits the accretion disc is illustrated. Credit: NASA Goddard Space Flight Center/Chris Smith (USRA/GESTAR)

Six years later, scientists discovered that this flare event actually repeated every 114 days and that it could not possibly be a supernova. As such, on May 17th, 2020, coordinated joint observations of the galaxy were taken to try and determine the cause of the flare events.

Not a supernova!

Using measurements taken from ASAS-SN, TESS, **Swift** and other observatories, including **NASA's NuSTAR** and the **European Space Agency's XMM-Newton**, the team of scientists determined that the flare was likely caused by a partial tidal disruption event (TDE).

A TDE occurs when a star gets too close to a black hole. The gravitational force from the black hole rips the stray-

ing star apart, forming a stream of gas. Some of this gas escapes the system, some swings back onto the black hole's accretion disc, and as it strikes, creates the flare.

For ASASSN-14ko, observational evidence suggests that a giant star is orbiting a 78 million Solar mass black hole, and as it does so, it becomes partially disrupted. The orbit of the star is not circular and so each time it passes close to the black hole, the star becomes distorted, shedding mass from its outer layers but still remaining intact. Each encounter with the black hole removes an amount of material equivalent to three times the mass of Jupiter!

This process of losing mass to the black hole cannot go on forever, but until it stops, scientists will continue to observe this fascinating event!