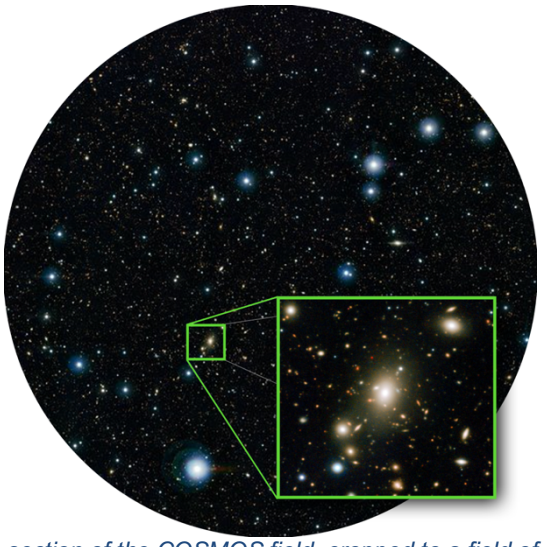
2.1.1a Annual Highlights

COSMOS2020: A panchromatic view of the Universe through cosmic time

Covering a full two square degrees area on the sky — nine times as large as the disk of the full Moon — the Cosmic Evolution Survey (COSMOS) has become a cornerstone of extragalactic astronomy. Starting as a Hubble Space Telescope Treasury project and later followed up with observations from telescopes around the world and across the entire electromagnetic spectrum, COSMOS is designed to probe the formation and evolution of galaxies through cosmic time.



A section of the COSMOS field, cropped to a field of view equal to the size of the full Moon. The zoom-in contains around 1,000 galaxies. Credit: ESO, UltraVISTA team, TERAPIX, CNRS, INSU, & CASU.

A major milestone was reached last year with the "COSMOS2020" catalog (Weaver et al. 2022). With the data gathered throughout the seven years since the preceding data release, the catalog contains galaxies more than twice as faint as previously. Thus, COSMOS2020 presented the detection of more than one million galaxies.

The power of COSMOS2020 lies in its use of bleeding-edge galaxy model-fitting techniques. With accurate measurements of the light emitted from radio waves, to infrared, and all the way to X-rays, the catalog not only shows a coherent history of the evolution of galaxies through 97% of cosmic time; it also provides a firm basis for follow-up observations with the James Webb Space Telescope, in particular spectroscopy.

The ancestor of a supermassive black hole

Arguably, the most enigmatic entity in astrophysics is a black hole; a clot of gravity so immense that nothing may escape. How the most massive of these behemoths can build up billions of Solar masses already in the early Universe is a bit of a mystery. Theories predict that supermassive black holes undergo an early phase of rapid growth, with a highly star-forming galaxy evolving first to a dust-obscured, compact object and then transitioning to an unobscured luminous quasar.

Both dusty starbursts and luminous quasars are extremely rare in this epoch. It was therefore a breakthrough when Fujimoto et al. (2022) discovered a galaxy with physical properties lying in-between these rare objects, thereby providing an important avenue toward understanding the birth of supermassive black holes.

Interestingly, the galaxy was found in archival observations from the Hubble Space Telescope. Other authors had noticed the source but thought it was a dwarf star in our own galaxy. This shows how big discoveries may sometimes be hidden just in front of us.