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GALAXY EVOLUTION WITH INFRARRED MISSIONS

Abstract: The space between stars within galaxies is filled with gas mixed with tiny dust grains. These dust grains absorb ultraviolet and optical light emitted by stars and re-emit it in the infrared. Infrared (IR) astronomy is therefore essential to uncover the obscured side of galaxy evolution. Since most IR wavelengths are absorbed by Earth's atmosphere, space-based observations are necessary to explore the full frequency range. I will focus on the contribution of IR satellites to our understanding of galaxy evolution throughout cosmic history highlighting work carried out by my group at Université Paris-Saclay. Each mission has triggered paradigm shifts. IRAS (1983) discovered ultra-luminous infrared galaxies (ULIRGs), dominated by dust-enshrouded starbursts and/or obscured active nuclei. ISO (1995) demonstrated the ubiquity of dust-obscured star formation and revealed that even at redshift $z < 1$, a large fraction of star formation is hidden at optical wavelengths. Spitzer (2003) extended ISO's studies to $z \approx 2$, enabling the discovery of a fundamental relation between the star formation rate of galaxies and their stellar mass. Herschel probed the far-IR and submillimeter regime, detecting thousands of dusty star-forming galaxies at $z > 2$. JWST (2021) is now exploring the very early universe, delivering many surprises, in particular about galaxy properties in the few hundred million years after the Big Bang. All of these missions involved a degree of international cooperation. Telescope access—and especially data—is shared worldwide. Pushing technology to its limits in such missions has major knock-on effects for industry and for big data handling techniques.

About the speaker: Catherine Cesarsky has performed research activities in several central areas of modern astrophysics, interstellar medium, high-energy astrophysics, infrared astronomy, galaxy evolution. Born in France, she holds a Physics degree from University of Buenos Aires (1965), and a PhD in Astronomy from Harvard University (1971). She then worked at the California Institute of Technology. In 1974, she moved to France and joined the Atomic Energy and Alternative Energies Commission (CEA). Catherine Cesarsky was the principal investigator for ISOCAM, the infrared camera on board the Infrared Space Observatory satellite of the European Space Agency (ESA). From 1985 to 1993, she was Head of Astrophysics at CEA, and from 1994 to 1999 she was Director of CEA basic research in physics, chemistry and earth sciences. From 1999 to 2007, she was the Director General of the European Southern Observatory . As such, she oversaw the operation of ESO's large optical telescopes at the La Silla and Paranal observatories in northern Chile, and started the construction of the Atacama Large Millimeter Array (ALMA). She launched the European Extremely Large Telescope project. From 2017 to 2021, she chaired the Council of the SKA

Organization and from 2021 to 2025 she was the first Chairperson of the Council of the Intergovernmental organization SKA Observatory. From 2006 to 2009 she was President of the International Astronomical Union. From 2009 to 2012, she was High Commissioner for Atomic Energy in France, advisor to the French government for science and energy issues. Since then, she is High level Science Advisor at CEA.

Among others, she is recipient of the 1998 COSPAR (Committee on Space Research) Space Science Award, of the Tate medal for leadership in physics from the American Institute in Physics (2020) , of the Fritz Zwicky prize of the European Astronomical Society (2024), member or foreign member of the main science Academies in France, United Kingdom (RS), Sweden (RSA), USA (NAS), Argentina (ANCEFN), and Europe, and of the Academy of Astronautics. She is Doctor Honoris Causa from the Geneva University and honorary Doctor of Science from the University of Cambridge. Catherine Cesarsky is Grand Officier de l'Ordre de la Légion d'honneur and Grand-Croix dans l'Ordre National du Mérite.