


Collaboratively probing the universe

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In recent years, several new telescopes have started operation or are being constructed to explore the universe in increasing detail and depth. Together, they will provide a treasure-trove of data that promises to revolutionise our knowledge and understanding of the cosmos. In this special issue of Europhysics News we present a selection of these projects, all of which have significant European involvement.

In space, we consider three telescopes that have been launched to operate around the second Lagrange point (L2) which is about 1.5 million kilometers from Earth.

The X-ray telescope *eROSITA* onboard the Russian–German Spectrum-Roentgen-Gamma observatory was launched on 13 July 2019. It began taking data in October 2019, however, this stopped on February 26, 2022 due to the invasion of Ukraine by Russia which led to suspension of institutional cooperation. In this special issue, Thomas Reiprich (University of Bonn, Germany) and Andrea Merloni (Max Planck Institute for Extraterrestrial Physics, Garching, Germany) report exciting new findings concerning the hot universe revealed by eROSITA.

The *James Webb Space Telescope* (JWST) was launched on 25 December 2021; its first image was publicly released on 11 July 2022. In Europhysics News 53/5 (November 2022) we presented already a first tribute to this worthy successor to the Hubble mission. Since then amazing results have continued to pour in and have both enthralled the public and excited the scientific community. In this special issue Karina Caputi and Edoardo Ianni (Kapteyn Astronomical Institute of the University of Groningen, The Netherlands) discuss how JWST has challenged our understanding of galaxy formation and evolution in the early universe.

The *EUCLID telescope* was launched on 1 July 2023 and released its first images on 7 November 2023. EUCLID is a wide-angle telescope designed to probe the history of the expanding universe and the formation of cosmic structure. By measuring the redshift of galaxies out to redshift 2, it will create a superb 3-dimensional map of the universe. Koen Kuijken (Leiden Observatory of the University of Leiden, The Netherlands) reports here on the first year of EUCLID in space, which promises a wealth of new results to come.

The ground-based telescopes that we focus on are scattered over the globe: the forthcoming *Vera Rubin Observatory* (VRO) in Chile, the forthcoming *Cherenkov Telescope Array Observatory* (CTAO) with sites in both Chile and La Palma, Spain, and three operational neutrino telescopes – *IceCube* buried beneath the South Pole, *KM3NeT* at the bottom of the Mediterranean sea, and *Baikal-GVD* in Lake Baikal, Siberia.

Rosanna Coniglione & Giovanna Ferrara (Laboratori Nazionale del Sud (LNS) of INFN, Catania, Italy) describe the potential of neutrinos as cosmic messengers, complementing observations of photons and gravitational waves; Reza Ansari (CNRS, IN2P3, France) & Cyrille Doux (CNRS, France) present the Legacy Survey of Space and Time (LSST) to be done at the VRO to probe dark matter and dark energy; and Tjark Miener & Teresa Montaruli (University of Geneva, Switzerland) present the status of the CTAO gamma-ray telescopes and the science results coming out of them already.

As guest editors of this Special Issue on Probing the Universe, we are grateful to all the distinguished authors. Together, they provide an illuminating overview of the work of many thousands of theoreticians, astronomers, astrophysicists and astroparticle physicists around the world. Their work is conducted in large international scientific collaborations, in which Europe plays an important and visible role. It is a prime example of how world-wide cooperation in science yields results that no single country can achieve, and moreover generates lasting bonds between nations and cultures.

We wish you pleasant reading and trust that you will enjoy these excellent presentations by the authors. ■