COMMISSION H1

THE LOCAL UNIVERSE

L'UNIVERS LOCAL

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Gražina Tautvaišieně Matthias Steinmetz Wako Aoki Dante Minniti Andrea Ahumada, Jens Kauffmann, Silvia Pallegrini, Panos Patsis, Priya Shah

TRIENNIAL REPORT 2021-2024

1. Introduction

The IAU Commission H1 on "The Local Universe (L'Univers Local)" belongs to the Division H, "Interstellar Matter and Local Universe". The Commission H1 was established in mid-2015, and it was presided by Eva Grebel (Germany) and Dante Minniti (Chile) during its first and second triennial periods, respectively. IAU Commission H1 presently counts with 347 members from all over the World.

The Commission focuses on studies of the Milky Way and nearby galaxies, where stars can be resolved, to explore how galaxies in different environments and across a wide range of masses formed and evolved. We foster the organisation of meetings and workshops worldwide on the study of the Local Universe.

A range of observational and theoretical research on the stellar populations, stellar clusters and streams, dark matter of local galaxies, etc. are covered. Many recent ground-and space-based photometric, spectroscopic, and astrometric surveys contributed to the knowledge in this field.

We expect the revolutionary scientific discoveries to continue emerging from the James Webb Space Telescope (JWST), launched on December 25, 2021 by the NASA and its partners, ESA (European Space Agency) and the Canadian Space Agency. Thousands of engineers and hundreds of scientists worked to make JWST a reality, along with over 300 universities, organisations, and companies from 29 U.S. states and 14 countries.

Exciting new scientific results are coming from the ESA Gaia, NASA TESS and other space telescopes and from the ground-based surveys. ESA's Euclid space telescope, launched on July 1, 2023, is expected to shed light on the composition and evolution of the dark Universe, to detect objects fainter or cooler than those Gaia can detect and to provide complementary information in the near-infrared for stars already observed by Gaia. The Euclid Consortium consists of more than 2000 scientists from 300 institutes in 13 European countries, the US, Canada and Japan.

We also look forward to the launch of the Nancy Roman Space Telescope in 2027, with wide field near-IR imaging capabilities that would certainly impact Galactic astrophysics. The current and forthcoming facilities will deepen our understanding of the Local Universe.

2. Main contributors to the Local Universe investigations

Among the major developments on the area of Milky Way and nearby galaxies that occurred during these three last years, we can mention as examples the data releases and important publications from the following large surveys (in random order, incomplete list):

Imaging, Astrometry, and Photometry

- Dark Matter Survey (DES) optical imaging
- eROSITA satellite All-Sky Survey the first X-ray data release in January of 2024
- Gaia Data Release 3
- \bullet Galactic Legacy Infrared Midplane Survey Extraordinaire (GLIMPSE) and its extensions
 - James Webb Space telescope (JWST)
 - Optical Gravitational Lensing Experiment (OGLE)
 - Panchromatic Hubble Andromeda Treasury (PHAT)
- Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) all-sky optical imaging
 - Palomar Transient Factory (PTF) and Zwicky Transient Facility (ZTF) in the North
 - SkyMapper Southern Survey
 - Southern Photometric Local Universe Survey (S-PLUS)
 - Subaru Hyper Suprime Cam (HSC)
 - Transiting Exoplanet Survey Satellite (TESS)
 - Two Micron All-Sky Survey (2MASS)
 - VISTA near-infrared YJKs survey of the Magellanic System (VMC)
- ullet VISTA Hemisphere survey (VHS) and ESO large public survey VISIONS in the South
 - VISTA Variables in the Via Lactea (VVV) and extended (VVVX) near-IR surveys
 - Wide-field Infrared Survey Explorer (NEOWISE)

Spectroscopy

- Gaia-ESO Survey (GES) Final data release
- Galactic Archaeology with HERMES survey (GALAH) 3rd data release
- James Webb Space telescope (JWST)
- \bullet Large Sky Area Multi-Object Fibre Spectroscopic Telescope (LAMOST) data releases 5–9
 - RAdial Velocity Experiment (RAVE) Final data release
- SDSS survey 16-18th releases, including the APO Galactic Evolution Experiment (APOGEE2) near-IR survey, and the Mapping Nearby Galaxies at Apache Point Observatory survey (MaNGA)
 - Southern Stellar Stream Spectroscopy Survey (S⁵)

Future observational projects

- Maunakea Spectroscopic Explorer (MSE), operations of the 10.25 m telescope nominally starting in 2027
- $\bullet\,$ 4-metre Multi-Object Spectroscopic Telescope (4MOST) first sky-light observed in 2023

- Multi-Object Optical and Near-infrared Spectrograph (MOONS) for ESO's Very Large Telescope (VLT) is under construction, papers published in The Messenger
- Subaru Prime Focus Spectrograph (PFS), operations on the 8.2 m telescope to be started in 2024
- Vera Rubin Observatory, formerly known as the Large Synoptic Survey Telescope (LSST), the data preview (DP0) released in 2022, the DP1 is expected in 2025
- \bullet William Herschel Telescope Enhanced Area Velocity Explorer (WEAVE), science observations started in 2022

3. Science meetings 2021-2024

The Commission web page was regularly updated by a list of selected conferences, workshops, summer schools, and other meetings related to the thematic of Commission H1. Due to the Covid-19 pandemic the number of face-to-face meetings was smaller, some were organised virtually or in a hybrid format. However, still 80 meetings have been highlighted.

During the past three years the organising committee members contributed to the organisation of symposia and dedicated sessions at scientific conferences. They also attended various international meetings and workshops worldwide, representing the IAU and giving invited/contributed talks and posters. The H1 OC member Dante Minniti served in the SOC for the IAU Symposium 377 on "Early Disk Galaxy Formation: From JWST to the Milky Way", that was held in Kuala Lumpur, Malaysia, from 6 to 10 of February, 2023. This meeting was very successful, where some of the first scientific JWST results were presented and future developments were discussed. Panos Patsis has organised the workshop "Spirals and Bars in galaxies", which was held at the Academy of Athens on October 14th 2022 (http://astro.academyofathens.gr/events.html). Priya Shah was a keynote speaker in the 6th Middle-East and Africa Regional IAU Meeting (MEARIM VI), Cairo, Egypt on February 13-16, 2023. Panos Patsis was a SOC member for the conference "Galactic bars: driving and decoding galaxy evolution", held in Granada, Spain from 3-7 July 2023 (http://www.galacticbars2023.com/). Gražina Tautvaišienė was organising the IAU Division H Days during the IAU XXXI General Assembly in Busan (South Korea) and during the IAU XXXII General Assembly in Cape Town (South Africa). Gražina Tautvaišienė is the SOC member of the IAU Symposium 395 "Stellar populations in the Milky Way and beyond" to be held in Paraty, Brasil, from 17 to 22 November, 2024.

4. Commission H1 The Local Universe Seminars

Under influence of Covid-19 pandemic, in December of 2021 the commission has launched the seminar series, which were held via Zoom approximately once per month and covered both hot topics and long-term work. By March 2024, 20 seminars were held by senior and young researchers from eight countries, 40% of whom were females.

The seminars are recorded and listed for asynchronous viewing on the new dedicated IAU Commission H1 "The Local Universe" Seminars YouTube Channel:

https://www.youtube.com/channel/UCyH2KzKFVPmABOIJfgBtJ5g

The channel has 131 subscribers. By March 31, 2024, 19 seminar presentations have been posted and viewed 2220 times.

Potential speakers of the seminars can fill the online application form on the Commission's webpage.

Seminar talks during the reporting period:

- December 15, 2021, Keynote talk by Sergio Martin-Alvarez (University Cambridge) "Dwarf galaxy formation beyond supernovae: magnetism, radiationandcosmic rays".
- December 15, 2021, Highlight talk by Kung-Yi Su (Columbia University) "WhichAGN Jets Quench Star Formation in Massive Galaxies?"
- February 3, 2022: Keynote talk by Khyati Malhan (Humboldt Postdoc fellowat MPIA, Heidelberg, Germany) "The Global Dynamical Atlas of Milky Way mergersusing ESA/Gaia dataset".
- February 3, 2022, Highlight talk by Grazina Tautvaisiene (Vilnius University, Lithuania) "Gaia-ESO Survey: Detailed elemental abundances in red giants of the peculiar globular cluster NGC 1851".
- March 2, 2022, Keynote talk by Ricardo Schiavon (Liverpool John Moores University) "The inner halo of the Milky Way". Confer ences and other meeti
- April 6, 2022, Keynote talk by Lorenzo Spina (INAF- Astronomical Observatory of Padua, Italy), "Strong chemical tagging: possibility or mirage?".
- May 24, 2022, Keynote talk by Q. Daniel Wang (University of Massachusetts, USA), "X-ray galactic ecosystem of nearby galaxies".
- June 6, 2022, Keynote talk by Priya Shah (Maulana Azad National Urdu University, India) "Machine learning for membership determination in open clusters".
- September 15, Keynote talk by Lorenzo Spina (INAF- Astronomical Observatory of Padua, Italy), "Planet engulfment events in Sun-like stars".
- October 19, 2022, Keynote talk by Thavisha Dharmawardena (Max Planck Institute for Astronomy, Germany), "The 3D structure of Star Formation Regions in the era of Gaia DR3".
- November 24, 2022, Keynote talk by Angela Bragaglia (INAF-OAS Bologna), "NGC 6388: combining high-resolution spectroscopy and Gaia".
- December 14, 2022, Keynote talk by Donatella Romano (INAF–Istituto Nazionale di Astrofisica, Italy), "The evolution of CNO elements in galaxies".
- February 15, 2023, Keynote talk by Saroon Sasi (University of Andres Bello, Chile), "Shape of the Outer Stellar Warp of the Large Magellanic Cloud Disk".
- March 22, 2023, Keynote talk by Elisa Rita Garro (University of Andres Bello, Chile), "Gaia-IGRINS synergy: Orbits of newly identified Milky Way star clusters".
- April 19, 2023, Keynote talk by Javier Roman (Kapteyn Astronomical Institute, University of Groningen, Germany), "A potential nuclear star cluster in formation".
- May 23, 2023, Keynote talk by Cecilia Mateu (Universidad de la República, Uruguay), "The current inventory of Milky Way stellar streams".
- September 20, 2023, Keynote talk by David Benisty (University of Cambridge, United Kingdom), "Constraining Dark Energy from Local Group dynamics".
- October 18, 2023, Keynote talk by Michael Schulreich (Center for Astronomy and Astrophysics, Technische Universität Berlin, Germany), "The supernova link between the Local Bubble and deep-sea radioisotopes".
- February 7, 2024, Keynote talk by Claire Murray (Space Telescope Science Institute, USA), "A Galactic Eclipse: The Small Magellanic Cloud is forming stars in two superimposed systems".
- March 6, 2024, Keynote talk by Keith Hawkis (University of Texas at Austin, USA), "Chemical Cartography in the Galactic Disk".

5. Science outreach

• The Galaxy Zoo initiative for the citizen science promotion

We would like to highlight the Galaxy Zoo project, which began in 2007 as a collaboration between astronomers and citizen scientists, led by researchers from the University of Oxford, Johns Hopkins University, and elsewhere for analysing of images from the Sloan Digital Sky Survey (SDSS), has expanded over the years to include additional surveys, such as the Galaxy Zoo: Hubble project, which focuses on classifying galaxies observed by the Hubble Space Telescope. There have also been spin-off projects, such as Galaxy Zoo Quench, which investigates the process of galaxy quenching. Galaxy Zoo has been highly successful in harnessing the power of citizen science to tackle complex astronomical problems. It has engaged hundreds of thousands of volunteers worldwide, making significant contributions to our understanding of galaxy evolution and morphology.

6. Final Remarks

The field of galactic astronomy is dynamic, with new discoveries and advancements occurring regularly as theoretical and observational techniques improve and new data become available. Current and forthcoming facilities as well as theoretical studies will yield a deeper understanding of our Local Universe.

The Commission Organising Committee is deeply upset for the continuing totally unacceptable and unjustified military invasion to Ukraine by the Russian Federation, for the military actions in the Gaza strip and other hot spots, which are damaging scientific work and collaboration. Along with all IAU, we expresses our heartfelt condolences to colleagues who have suffered loss in disasters including the devastating earthquake in Turkey and Syria.

The Commission H1 The Local Universe (L'Univers Local) looks forward to new astronomical discoveries and peace during the upcoming term 2024-2027.

Gražina Tautvaišieně President of the Commission