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A. Siebert, K. Baillié, M. Béthermin, F. Cantalloube, E. Josselin, N. Lagarde, J. Malzac, J. Richard, L. Selliez, O. Venot (eds)

THE D.I.A.N.A. PROJECT

B. Chauffeté, N. Bioud and A. Manet

Abstract. The D.I.A.N.A. (Deep-sky Imaging and Astrophotography for Nightsky Advancement) project is a collaborative association founded in August 2024. This summary report presents: the organization, the IC 1613 pilot project, the acquisition and processing methodology, the technical and scientific results, as well as the prospects and tools put in place (website, gallery, forum).

1 Background and objectives

D.I.A.N.A. brings together amateur and professional astrophotographers (more than 40 members spread across France, Switzerland, the Caribbean, and Spain). The goal is twofold: to produce aesthetic images of a quality comparable to professional images, and to exploit this data for scientific purposes (photometry, variable detection, prospecting for faint background objects).

2 Why IC 1613 ?

IC 1613 is an irregular dwarf galaxy located in the constellation Cetus, approximately 2.38 million light-years from Earth. It is part of the Local Group of galaxies, which includes our Milky Way. This galaxy is particularly interesting for several reasons :

- Scientific significance: IC 1613 played a crucial role in calibrating the period-luminosity relationship of Cepheid variables, which is essential for estimating cosmic distances.
- Unique characteristics: It has a low abundance of interstellar dust, making it an excellent target for studying stellar populations and galactic evolution.
- Observation challenge: Despite its relative proximity, IC 1613 is very faint and diffuse, making it one of the most difficult Caldwell objects to observe.
- A diverse stellar population: The galaxy contains different types of stars, including RR Lyrae variables, which are important for accurate distance measurements.
- Current research: Recent studies have focused on the history of star formation, chemical composition, and the extended structure of the galaxy.

By choosing IC 1613 as its first target, the D.I.A.N.A. project demonstrates its commitment to imaging scientifically significant and challenging objects, while producing aesthetically pleasing results.

3 Organization and implementation of the IC 1613 project

The project followed a precise schedule:

- August 2024: founding of D.I.A.N.A. and formation of the team (students and engineers).
- September 2024: target definition, testing, and launch of photo shoots.

- November 2024: first batches of images (50 hours total), preliminary analysis, and adjustments to our methods.
- December 2024: end of filming and start of processing.
- February 2025: publications and dissemination (article in *L'Astronomie*).

3.1 Roles and division of tasks

As part of the IC 1613 project, all members were mobilized for the data acquisition phase, ensuring diversity in terms of instruments, observation sites, and shooting conditions.
However, the following steps were handled by the organizing team: image pre-processing (calibration, sorting, and normalization), advanced processing (stacking, photometric balancing), and project communication (publication of results, dissemination in the journal *L'Astronomie*).

3.2 Acquisition

This project was made possible thanks to four astrophotographers who captured their data using different instruments and under various skies in France and Spain. The accumulation of these shots enabled us to obtain more than 100 hours of exposure time spread over the months of September to December last year. The final image integration took 71 hours and 18 minutes after rigorous sorting and numerous tests!

3.3 Detailed results

The final image highlights several things :

- The numerous galaxies and galaxy clusters that populate the image (Fig. 1):
  In addition to IC 1613, the final image reveals numerous galaxies in the background, ranging from faint diffuse patches to more detailed structures with well-defined cores. The low stellar density and absence of dust in the target galaxy make them easy to observe, enriching the field and highlighting the diversity of objects present in this region of the sky.

Fig. 1. Galaxy in the background of IC 1613

- Structure of stellar filaments (Fig. 2):
  Galaxies contain complex stellar structures in the form of filaments, resulting from the gravitational collapse of interstellar gas. These elongated, often dense structures serve as channels to transport gas to star-forming regions. They consist mainly of molecular clouds and young stars in formation, creating privileged pathways where matter accumulates and organizes itself under the effect of gravity.
  In irregular galaxies such as IC 1613, the absence of spiral arms and high turbulence shape disordered

networks. These filaments are formed by gravitational instabilities and gas compression, while the magnetic field influences their orientation and fragmentation.
Multi-wavelength observations and numerical simulations enable us to analyze their role in the evolution of galaxies and the dynamics of the interstellar medium.

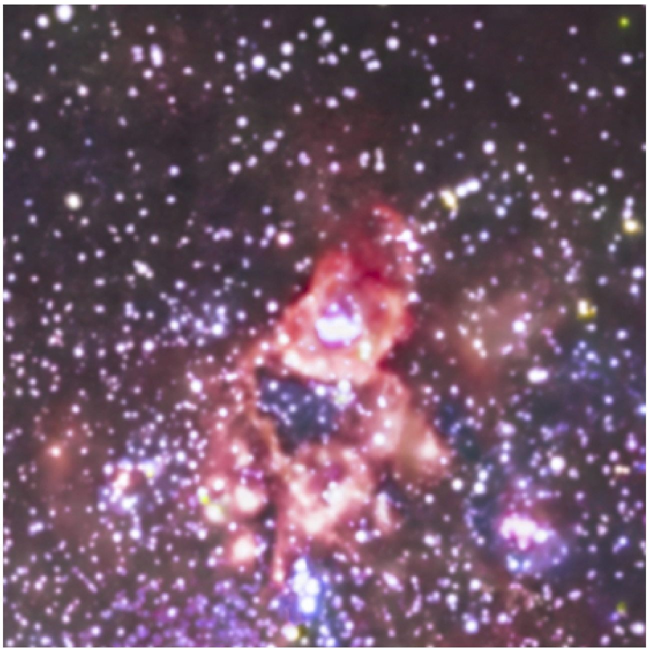

Fig. 2. Structure of the stellar filaments of IC 1613

- The extension of Hα and OIII zones (Fig. 3):
  The image highlights strong H-α emission, particularly in the intense red area at the top right of the galaxy. The more subtle OIII regions are clearly visible, including a bright bubble at the top left, illustrating the complexity of the ionized gas and the mechanisms at work in IC 1613.

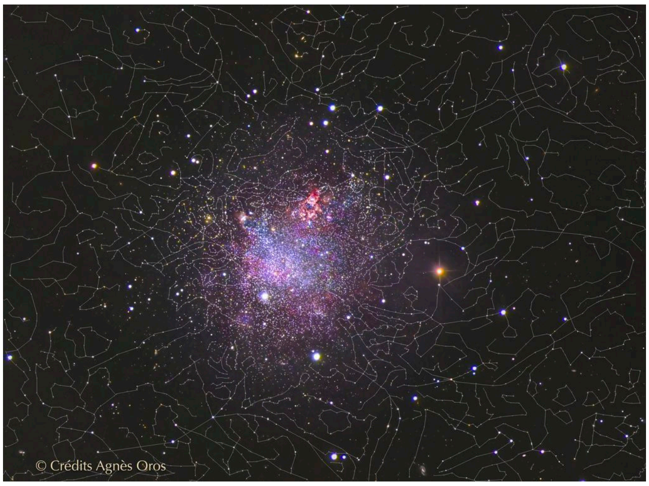

Fig. 3. Details of Hα zones

4 Website creation

The website `diana-project.fr` is the central tool of the project. It brings together all the practical information about the targets and how to participate, offers an image gallery enriched with an anonymous awards system, and provides a support forum complemented by a space for members to sell items to each other. It also features a data repository with tracking of cumulative exposure hours, as well as an FAQ and documentation for newcomers.

5 Conclusion

The D.I.A.N.A. project has demonstrated the relevance and strength of a collaborative organization in astrophotography. By combining the involvement of numerous members in data acquisition with the rigor of the organizers in the processing and dissemination phases, the team has been able to produce results that are both aesthetically pleasing and scientifically useful. The study of the IC 1613 galaxy perfectly illustrates this potential, revealing the richness of its ionized structures and the diversity of objects visible in its environment. Beyond this initial success, D.I.A.N.A. has established itself as a model association, bringing together enthusiasts and researchers around common goals. Thanks to its centralized website, digital tools, and dynamism, the project is paving the way for new collaborations, an expansion of its community, and a growing contribution to astronomical research.

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