Studying the low surface brightness universe with CASTLE (the Calar Alto SchmidT-Lemaître Explorer):

Science preparation and exploitation

Name of the laboratory: Laboratoire d'Astrophysique de Marseille

Thesis advisor:
Dr Samuel Boissier, Laboratoire d'Astrophysique de Marseille, CNRS, France - HDR
Email and address: Samuel.boissier@lam.fr

Co-advisors:
Dr Simona Lombardo, Laboratoire d'Astrophysique de Marseille, CNRS, France

Other members of the thesis team :
Dr Pierre Alain Duc, Observatoire Astronomique de Strasbourg, CNRS France - HDR
Dr Emmanuel Hugot, Laboratoire d'Astrophysique de Marseille, CNRS, France – HDR
+ other associated scientists
+ engineers

Subject's title:
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Subject description:

Context

CASTLE is a 35-cm – F/2.5 robotic telescope to be installed at the Calar Alto Observatory by spring 2022. Its original design makes it suited for two cutting-edge science cases. This telescope benefits from a set of new technologies combining a freeform entrance mirror, a folded design allowing to get rid of the holding spider's obscuration and a curved convex focal CMOS 46MPix sensor suppressing flattening optics and polluting ghosts. It results in a very low diffraction effect in the image plane, as well as a high PSF stability across the wide field of view (3.6deg²).

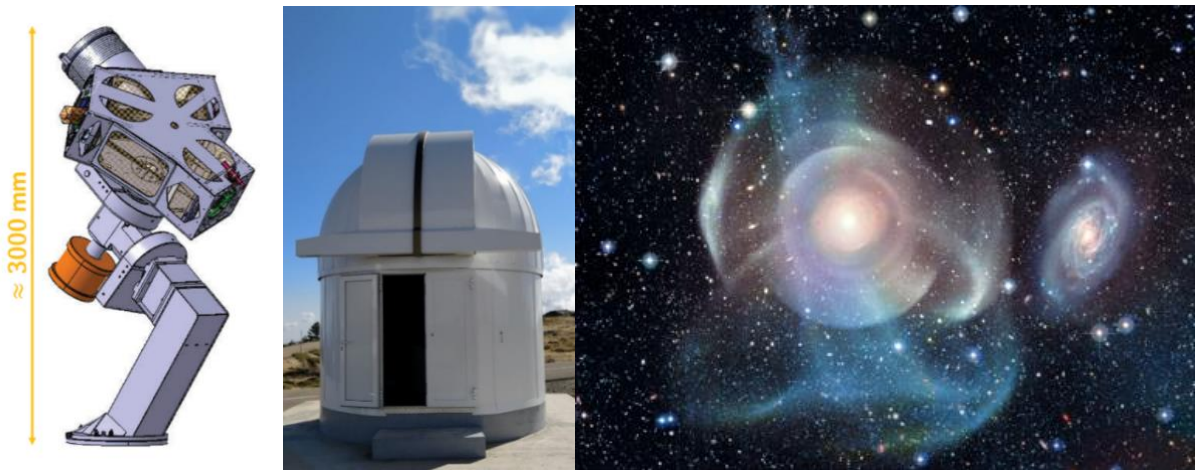

Figure 1. Left: Opto-mechanical design of the telescope: Center: CASTLE Cupola installed on the summit of Calar Alto in September 2021. Right: Example of low surface brightness features around the galaxy NGC 474.

This combination of innovations makes it a facility perfectly suited to **observe the Low Surface Brightness (LSB) Universe**. CASTLE has also been made robotic and can serve as **a transient follow-up facility** in the visible. Part of its observation time is dedicated to this science case, in an alert mode. Additionally, CASTLE will serve, once a month, as an educational tool, targeting scholars, college and grad students willing to discover or enrich their knowledge about what an observation program and a telescope operation are.

PhD workplan

The PhD work will cover several of the aspects involved in the construction of a new telescope. The student will be in charge of preparing and executing tests for a sub-module of the telescope, he/she will participate to the integration and commissioning phase on site, and be involved in the science exploitation.

Tasks to be undertaken are to develop the automatic data pre-processing which includes applying dark, bias and flat field correction. The possibilities of preparing simulations of realistic observations, starting from observations made by other surveys (e.g. CFHT), will be considered depending on the status of the project. This action will be focused on providing: (i) initial target selections, (ii) assessment of observing strategy (exposure time, dithering pattern).

Once an initial observing campaign will start, the student will be part of the science exploitation phase, for which data will be collected and analysed to better understand galaxy formation and evolution.

One of the LSB science case of CASTLE being the study of very large LSB star-forming galaxies such as Malin 1, studied in Boissier et al. 2016, Junais et al. 2000, we also propose as an initial preparatory work to analyze a few candidates of such large disks around otherwise normal galaxies, detected in the optical in the deep DES survey, identified in the context of a citizen science project in collaboration with Barry Madore (Carnegie Observatories, Pasadena).

Work Environment: The candidate will share her/his time between Marseille Strasbourg and the Institute of Astrophysics of Andalusia in Spain, and will participate to the missions at the Calar Alto Observatory during the course of her/his work.

Principally based at LAM, the candidate will be integrated in two science teams: GECO and GRD. The student will be part of the CASTLE team comprising about 10 engineers and scientists.

Timeliness: The telescope is currently under construction. The Dome has been installed in 2021, the mechanical structure is delivered in February 2022, the mirrors are already stored at LAM, and the Robotic Mounting is delivered in April 2022. The entire assembly will be done at LAM and shipped to Calar Alto in Autumn 2022, at start of the PhD. The building of the pipeline is then very timely and the student will benefit of a full experience in a small observatory to enhance her/his capacity as an astronomer to reduce her/his own data taken on sky. This crucial experience will allow the student to

diverse her/his experience after the PhD and be able to use other observatories to feed the science created during the PhD.

Co-funding: An ANR has been requested in 2022.

Bibliography:

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