

Postdoctoral Position:
Lab development of active post-processing strategies
for High Contrast Imaging with the Roman Space Telescope

Start date: As early as October 15, 2023

Contract duration: 2 years with possibility of 1 year extension

Workplace: [Laboratoire d'Astrophysique de Marseille](#) (LAM), France

Application deadline: September 15, 2023

Contact: Elodie.Choquet@lam.fr

Science Background:

The US 2020 Astrophysics Decadal Survey has identified the search for biosignatures in Earth-like exoplanets as one of the key scientific challenges for the next decade. It has recommended a large ($D \geq 6m$) UV-O-IR space telescope, the Habitable Worlds Observatory (HWO), equipped with 10^{-10} contrast imaging technologies to address this ambitious goal as mission for the 2040's. In parallel, the next NASA mission, the Roman Space Telescope (RST), scheduled for launch in 2027, will host the CGI instrument, a technology demonstrator to develop 10^{-8} contrast operations with active wavefront control (WFC) and optimized coronagraphs for the first time in space.

Active wavefront control in space also opens prospects for new observing strategies and post-processing techniques, equivalently critical to reach very high contrast limits. Yet, the baseline for CGI – and for HWO unless better methods are demonstrated – is to use conservative observing and postprocessing methods that were developed for the passive Hubble and Webb space telescopes. The 5-year ESCAPE ERC program aims at developing advanced observing strategies and post-processing techniques for active space high-contrast imagers, and to demonstrate them on sky with CGI.

Job Description:

Aim: The goal of the postdoc position is to develop observing strategies that make use of the deformable mirrors and wavefront sensor telemetry to calibrate the instrument response against non-corrected quasi-static aberrations and reach optimized postprocessed detection limits. These developments will be made primarily for the Roman Space Telescope CGI instrument, with a goal of demonstrating improved performances ahead of its launch. The longer-term goal is however to adapt them to operations with HWO and inform its design in terms of error budget.

Method and workplan: These developments will be done experimentally using the **HiCAT** high-contrast imaging testbed at the STScI R.B. Makidon Optics lab (Baltimore). HiCAT is designed to develop and test system-level strategies for high-contrast imaging with complex-aperture space telescopes such as RST and HWO. The testbed can be controlled fully remotely and routinely achieves 10^{-8} contrast levels comparable to the raw contrast limit of CGI. The successful applicant will have access to the HiCAT testbed a few times per year through dedicated runs, either on-site at STScI or remotely, and work at LAM on the data analysis and methods optimization. The postdoc will work closely with a PhD student at LAM who investigate active post-processing methods for CGI through numerical simulations (HClpy).

The expected workplan is the following:

- Benchmark the post-processed performance of a classical observing sequence with HiCAT.
- Implement an active observing sequence on HiCAT by injecting calibrated aberrations on the DMs, and optimize the calibration to maximize the post-processed performance.
- Incorporate the WFC telemetry in the post-processing to optimize the final performance.
- Refine the methods and their practical implementation for on-sky CGI observations.

Expected outcome: The outcomes expected for this work are 1/modern observing strategies and post-processing techniques for the next generation of space exoplanet imagers equipped with active WFC, 2/ lab demonstrations of their performance for RST-CGI, 3/ a roadmap for their implementation in CGI operations through the Community Participation Program (CPP).

International collaborations:

The ESCAPE team and the R&D group at LAM have a long history of collaboration with the STScI Makidon Optics Lab. Collaborations between our groups are supported by a CNRS International Research Program (PI M. Ferrari & R. Soummer). The postdoc will benefit from this collaboration and work closely with the Makidon Optics Lab team. Furthermore, LAM is a partner of the RST mission. As such, LAM has a representative in the Roman CGI CPP, allowing prospects to implement the developed observing and postprocessing methods in its operation plan, if successfully demonstrated beforehand.

Research environment:

This research will be done as part of the ESCAPE ERC consolidator program (PI: Elodie Choquet), which aims at developing advanced image processing methods for the detection of exoplanets for RST. The postdoc will evolve in a growing team working on a diversity of topics related to space coronagraphic imaging. The postdoc is expected to contribute to and benefit from the mutual interactions with the whole team. Support will be provided for computing resources, collaborative works, and participation to conferences as part of the ESCAPE project.

Candidate selection criteria:

Our team recognize the key role of diversity in our scientific community. We are committed to equal opportunity employment, and we encourage applications from members of under-represented communities. All qualified applicants will be considered regardless of gender identity, sexual orientation, cultural background, or disability status.

Applicants must have a PhD degree in Astronomy, Astrophysics, Physics, or equivalent field. Experience in the following field will be given primary consideration:

- High-contrast imaging techniques,
- Wavefront Sensing and Control,
- Coronagraph design and development,
- Excellent programming skills (Python, Git)

Application process:

Applications should include a CV, a publication list, and 2-page research statement developing the candidates research interests, past work, projects. They should be sent by email to Elodie Choquet (elodie.choquet@lam.fr) by **September 15**. Applicants should also arrange for at least two letters of recommendation to be sent by the same deadline.

Applications received after the deadline will be considered until the position is filled.