Post-doc job offer for the design & characterization of next-generation high-contrast integrated optics solutions

Observatoire de la Côte d'Azur - Laboratoire Lagrange, Nice (France)

Application deadline: September 6, 2024

The PHOTONICS project

The direct detection and spectral characterization of potentially life-harboring exoplanets remains one of the most ambitious goals of astrophysics of the century, that requires to combine high-angular resolving power with high-contrast imaging capability. Optical interferometry is a powerful observing technique for astronomy that brings out the highest angular resolution potential of any observing facility. Our project is dedicated to the development of single-mode integrated optics solutions for the design of interferometric recombiners. A unique feature of single mode photonics is that with the right interface, the same interferometric recombiner can be deployed in a wide variety of contexts, either at the focus of a single telescope or a long-baseline interferometer, either on the ground or onboard a space-borne observatory. This property of single-mode optics enables the construction of a coherent technology development plan, exploiting different photonic platforms, whose common end-goal is to overcome current observing constraints, and lead to the direct detection and characterization of habitable exoplanets.

The options we propose to explore over the course of this project will: improve the coupling efficiency required for the detection of faint features, enable the simultaneous recombination of a large number of apertures and produce rich information content, deliver enhanced high-contrast detection limits compatible with exoplanet science, integrate some much needed robustness to perturbations introduced by an ever imperfect observing environment and cover a large number of astronomical band-passes, ranging from the visible to the mid-infrared. When deployed on already existing and/or planned observing facilities, these integrated optics single-mode interferometric recombiners will open access to currently inaccessible parts of the exoplanet parameter space.

PHOTONICS is a work-package of the PEPR Origins, funded by the France 2030 plan. For more details, please visit the PEPR Origins website: https://pepr-origins.fr/projet/photonique/

Research objectives

Our group in Nice has recently demonstrated that the Silicon Nitride (SiN) photonic platform that is regularly used in the context of optical telecommunications, presents some very useful features, enabling the efficient implementation of very advanced circuitry compatible with astrophysical applications in the near-infrared. The platform was used to experimentally validate the self-calibrating properties of the kernel-nuller concept (Martinache & Ireland, A&A, 2018) for a 3-input beam (Cvetojevic et al, A&A, 2022) as well as for a 4-input beam (Chingaipe et al, SPIE, 2022). It was also used to demonstrate on-device real-time complex-amplitude control of the input beams, using thermo-optical effects (Cvetojevic et al, SPIE, 2022).
PHOTONICS gives us the opportunity to build on this previous experience: double down on some features such as the kernel-nuller architecture and the active complex amplitude control; integrating lessons learned from several earlier design shortcomings. The successful candidate will lead the design and laboratory characterization of at least two generations of integrated optics interferometric recombiners for high-contrast imaging in the near-infrared, and have a chance to bring the most promising design for further on-sky qualification at the focus of an 8-10 meter class telescope through our ongoing scientific collaborations.

Sought-out skills & expertise

A Ph.D. in astronomy, physics, or a closely related field is mandatory. We are interested in individuals with research experience in the development and the scientic exploitation of instrumentation in the field of high angular resolution astronomy that include active wavefront control either in the laboratory or at the telescope. Candidates with experience in the design/chatacterisation/handling of photonic or integrated circuits are a bonus. We operate in a highly collaborative and supportive environment: the candidate should be willing to interact with vendors, research engineers, and collaborate with or assist graduate students that will use the PHOTONICS test-bench for their own research projects.

Although this cannot be his/her primary objective, the successful candidate will also have the opportunity to get involved in the integration and the commissionning of the VLTI PI instrument suite ASGARD where some of the technology developed in the context of PHOTONICS will eventually be deployed.

The initial appointment will be for two years, with a possible one-year extension. The successful candidate will be hosted at the Lagrange Laboratory, on the Valrose campus of the Université Côte d'Azur, downtown the beautiful city of Nice, France.

Application process

Application packages should consist of:

- a CV summarizing qualifications & previous experience
- a cover/motivation letter describing your research interests
- between two and three reference letters supporting the application

and be sent to Prof. Frantz Martinache (frantz.martinache@oca.eu).

For full consideration, applications should be received before **September 6, 2024**, although applications will be reviewed up until the position is filled.

Références

- Publication: description of the kernel-nulling concept
- Publication: first successful laboratory demonstration of a 3-input kernel-nuller
- Publication: premiminary characterization of a 4-input kernel-nuller recombiner
- Video: the why and the how of kernel-nulling!