



## Centre de Recherche Astrophysique de Lyon UMR 5574

Postdoctoral position in Adaptive Optics at CRAL :

### Optimization of Adaptive Optics with the Fractal Iterative Method

**Location :** CRAL - Observatoire de Lyon, Saint-Genis-Laval

**Duration :** 1 year (with a possible extension)

**Starting Date :** 1 December 2017

**Deadline for application :** 8 September 2017

A postdoctoral position supported by the Labex LIO (Lyon Institute of Origins) under grant ANR-10-LABX-66 is offered at CRAL (Centre de Recherche Astrophysique de Lyon) in the field of Adaptive Optics.

#### Job Description

The European Southern Observatory (ESO) has just started to build the ELT (Extremely Large Telescope), a giant 39 m telescope. The high performances of this telescope are entirely based on adaptive optics to compensate for the effects of the atmospheric turbulence in order to form images approaching the diffraction limit.

At the size of the ELT, the adaptive optics systems are very ambitious. They require "atmospheric tomography" for the estimation of the turbulence perturbations in volume. The HARISSA team at CRAL has developed a novel inverse approach, FrIM-3D ("Fractal Iterative Method") [1], particularly powerful to perform the necessary calculations and control of these giant systems : for instance, the multi-conjugate adaptive optics of the ELT needs to solve 60000 equations with 10000 unknowns, 1000 times per second. The method, well adapted to atmospheric tomography [2], has had a direct impact on the design of the ELT laser guide stars [3]. Originally developed for the study of the method, FrIM-3D code is currently used by ESO for the simulations of the ELT, and generally gives the best performances [4].

Our aims are now to develop methods to auto-calibrate the physical modeling of the adaptive optics systems to make them adapt to changing conditions (turbulent layers, noises, variations of the geometry), and to demonstrate the effectiveness of the approaches on sky. The project has access to data from the CANARY demonstrator for the validation of multi-object adaptive optics on the 4.2 m William Herschel telescope [5], and from the AOF (Adaptive Optics Facility) on the VLT [6] (8 m telescope). The successful applicant will work in this context in collaboration with ESO team (Garching), CANARY team (Paris), and C. Béchet's team at Pontificia Universidad Catolica in Chile.

#### Requirements

Minimum qualifications include a PhD degree in astronomy, physics, applied mathematics or related fields. Skills in optics, physics, and signal processing will be useful. The position is open for 1 year from December 2017, with a possible extension. Full benefits are included. Applicants should send a resume, list of publications, statement of research interests and experience, and arrange for two letters of reference to be sent directly via e-mail to Dr. Michel Tallon (mtallon@obs.univ-lyon1.fr). The review of the applications will begin on September 9, 2017 and will continue until the position is filled.

Please contact Michel Tallon for any information (mtallon@obs.univ-lyon1.fr).

- [1] Thiébaud, E. and Tallon, M., “Fast minimum variance wavefront reconstruction for extremely large telescopes,” *J. Opt. Soc. Am. A* 27(5), 1046–1059 (2010).
- [2] Tallon, M., Tallon-Bosc, I., Béchet, C., Momey, F., Fradin, M., and Thiébaud, É., “Fractal iterative method for fast atmospheric tomography on Extremely Large Telescopes,” *SPIE* 7736, 77360X (2010).
- [3] Béchet, C., Tallon, M., Tallon-Bosc, I., Thiébaud, E., Le Louarn, M., and Clare, R. M., “Optimal reconstruction for closed loop ground layer adaptive optics with elongated spots,” *J. Opt. Soc. Am. A* 27(11), A1–A8 (2010).
- [4] Le Louarn, M., Clare, R. M., Béchet, C., and Tallon, M., “Simulations of Adaptive Optics Systems for the E-ELT,” *SPIE* 8447, 84475D (2012).
- [5] Morris, T. J., Basden, A. G., and Vidal, F, et al., “Tests of open-loop LGS tomography with CANARY,” *SPIE* 8447, 84470K (July 2012).
- [6] Kolb, J., Madec, P.-Y.; Arsenault, R., "Laboratory results of the AOF system testing" *SPIE* 9909, 99092S (2016).