

## Post-doctoral position at Observatoire de Paris

Meudon, the 29th of April 2013

**Laboratory:**

LESIA

Pôle Haute Résolution Angulaire en Astrophysique

**Title:**

Turbulence profile and tomographic reconstructor parameters identification for wide field Adaptive Optics. Validation with the on-sky demonstrator CANARY.

**Research subject:**

The European Southern Observatory (ESO) is currently planning the construction of the European Extremely Large Telescope (E-ELT) for a first light for early 2020s. The instrumentation plan foresees at least three instruments equipped with wide-field adaptive optics (AO), all using laser guide stars for wave-front sensing and using tomographic techniques for estimating the turbulent volume and compensating the wave-front. For all these techniques, the knowledge of the turbulence profile ( $C_n^2(h)$ ) along the line of sight is essential.

The on-sky demonstrator, CANARY, has been developed by Durham University and Paris Observatory (in collaboration with ATC, ING, LAM, Institut d'Optique and ONERA). CANARY is installed on the William Herschel Telescope (WHT), of 4m20 diameter, on the Canaries Islands, and has already demonstrated on-sky since 2010 the feasibility of the wide-field multi-object AO concept called MOAO. The CANARY program will take place until 2016 and foresees a series of system upgrades to reach a fully realistic simulation of the E-ELT MOAO setup. CANARY also allows one to explore the calibration strategies of wide-field AO, and in particular the identification of the turbulence profile which is done using the measurements of the instrument wave front sensors (WFS), not less than 8 (4 LGS, 4 NGS)! Processing the angular correlation of wave front measurements allows one to retrieve not only the turbulence profile but also some system parameters required for building the tomographic model of the instrument. The goal of this in situ analysis is an on-line profile estimation, exactly as seen by the instrument.

The goal of this post-doctoral position is to go thoroughly into the work already started in order to increase the reliability of the joint estimation of profile and instrumental parameters, and evaluate the uncertainties on the estimates and the impact on the tomographic reconstruction. We propose to study and compare the different techniques that exploit correlation maps of the WFS measurements, and create innovative methods. The particular case of the LGS will need to be taken into account. Those studies will take advantage of the experience gained with CANARY using the Learn & Apply technique during the 3 years of use of CANARY on-sky.

On the other hand, some profilometers (SLODAR, generalized SCIDAR...) may be set up on site. These systems will be installed close to the telescope and will retrieve profiles with a

given resolution and timing, in parallel to the instrument. Their data could be combined with instrument correlation maps to improve the identification.

Those methods require a heavy data processing. The LESIA has acquired some expertise in the use of GPU (Graphic Processing Units) that bring a substantial gain in processing speed. This will be applied to the on-line estimation of the tomographic reconstructor.

### **Expectations:**

The skills required for this work are primarily knowledge in adaptive optics, atmospheric turbulence, and an understanding of the wave-front sensing techniques.

A good experience in programming and data processing is necessary, using a high level language such as yorick, python, matlab, idl... A knowledge of C or C++ is a plus.

The candidate will participate to observing campaigns with the CANARY team at WHT and will carry out some part of the processing and the analysis of the tomographic data.

The candidate will work in the adaptive optics team at LESIA, in Meudon.

The position is proposed for a period of 2 years.

The candidate shall be available at the latest beginning of 2014.

The remuneration is according to the CNRS rules.

### **Required diploma:**

PhD in astronomical instrumentation at the date of the contract signature

### **Contacts:**

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### **Application:**

Interested candidates should send a "curriculum vitae", publication list and a brief statement of their research demonstrating the relevance of their skills for the proposed position.

Letters of reference are welcome and should be provided separately.

Please send your application until the **30<sup>th</sup> of September 2013**

- in electronic form to the two above-given email addresses

- or by mail to the address:

To the attention of Dr. E. Gendron and Pr. G. Rousset

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