



Delibera n. 66/2017
Verbale del Consiglio di Amministrazione n. 6/2017

Oggetto: approvazione della Convenzione tra lo “*Istituto Nazionale di Astrofisica*”, la “*Université d’Aix-Marseille*” (“AMU”), il “*Centre National de la Recherche Scientifique*” (“CNRS”), il “*Laboratoire d’Astrophysique de Marseille*” (“LAM”), lo “*European Organisation for Astronomical Research in the Southern Hemisphere*” (“ESO”) e il “*The Office National d’Etudes et de Recherches Aérospatiales*” (“ONERA”) per l’attivazione, il conferimento, il cofinanziamento e la cosupervisione di una Borsa di Studio per l’accesso e la frequenza del Corso di Dottorato di Ricerca in “*Calibration and Optimization of complex AO systems on Extremely Large Telescopes*”, che ha sede presso la “*Scuola di Dottorato*” della “*Université d’Aix-Marseille*” (“AMU”).

IL CONSIGLIO DI AMMINISTRAZIONE

- VISTA** la Legge 7 agosto 1990, numero 241, e successive modifiche ed integrazioni, che contiene “*Nuove norme in materia di procedimento amministrativo e di diritto di accesso ai documenti amministrativi*”, ed, in particolare, gli articoli 4, 5 e 6;
- VISTO** il Decreto Legislativo del 23 luglio 1999, numero 296, pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 26 agosto 1999, numero 200, che istituisce lo “*Istituto Nazionale di Astrofisica*”;
- VISTO** il Decreto Legislativo del 4 giugno 2003, numero 138, pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 19 giugno 2003, numero 140, che disciplina il “*Riordino dello Istituto Nazionale di Astrofisica*”;
- VISTA** la Legge 27 settembre 2007, numero 165, pubblicata nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 10 ottobre 2007, numero 236, che definisce i principi e i criteri direttivi della “*Delega al Governo in materia di riordino degli Enti di Ricerca*”, ed, in particolare, l’articolo 1;
- VISTO** il Decreto Legislativo 31 dicembre 2009, numero 213, pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 1° febbraio 2010, numero 25, che disciplina il “*Riordino degli Enti di Ricerca in attuazione dell’articolo 1 della Legge 27 settembre 2007, numero 165*”;



- VISTA** la Legge 30 dicembre 2010, numero 240, pubblicata nella Gazzetta Ufficiale della Repubblica Italiana del 14 gennaio 2011, numero 10, che contiene "**Norme in materia di organizzazione delle università, di personale accademico e reclutamento**" e che disciplina la "**Delega al Governo per incentivare la qualità e l'efficienza del sistema universitario**";
- VISTO** il Decreto Legislativo del 31 maggio 2011, numero 91, pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 24 giugno 2011, numero 145, che contiene le "**Disposizioni di attuazione dell'articolo 2 della Legge 31 dicembre 2009, numero 196, in materia di adeguamento ed armonizzazione dei sistemi contabili**" e che disciplina, in particolare, la "...armonizzazione dei sistemi contabili e degli schemi di bilancio delle amministrazioni pubbliche, al fine di assicurare il coordinamento della finanza pubblica attraverso una disciplina omogenea dei procedimenti di programmazione, gestione, rendicontazione e controllo...";
- VISTA** la Legge 7 agosto 2015, numero 124, con la quale sono state conferite alcune "**Deleghe al Governo in materia di riorganizzazione delle amministrazioni pubbliche**", ed, in particolare, l'articolo 13;
- VISTO** il Decreto Legislativo 25 novembre 2016, numero 218, che disciplina la "**Semplificazione delle attività degli enti pubblici di ricerca ai sensi dell'articolo 13 della legge 7 agosto 2015, numero 124**", pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 25 novembre 2016, numero 276, ed entrato in vigore il **10 dicembre 2016**;
- VISTO** lo Statuto dello "**Istituto Nazionale di Astrofisica**", adottato dal Consiglio di Amministrazione con Delibera del 7 marzo 2011, numero 14, emanato con Decreto Presidenziale del 10 marzo 2011, numero 25, ed entrato in vigore il **1° maggio 2011**;
- VISTI** in particolare, gli articoli 1, 2, 6, comma 2, lettera m), 24, comma 1, lettera a), e 27 del predetto Statuto;
- VISTO** il "**Regolamento sulla amministrazione, sulla contabilità e sulla attività contrattuale dello Istituto Nazionale di Astrofisica**", predisposto ai sensi dell'articolo 18, commi 1 e 3, del Decreto Legislativo 4 Giugno 2003, numero 138, approvato dal Consiglio di Amministrazione con Delibera del 2 dicembre 2004, numero 3, pubblicato nel Supplemento Ordinario della Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 23 dicembre 2004, numero 300;

- VISTA** la Delibera del 2 luglio 2009, numero 46, con la quale il Consiglio di Amministrazione ha modificato l'articolo 14 del predetto "**Regolamento**";
- VISTO** il "**Regolamento del personale dello Istituto Nazionale di Astrofisica**", approvato con Delibera del Consiglio di Amministrazione dell'11 maggio 2015, numero 23, pubblicato nella Gazzetta Ufficiale della Repubblica Italiana, Serie Generale, del 30 ottobre 2015, numero 253, ed entrato in vigore il **1° novembre 2015**;
- VISTO** il "**Disciplinare di organizzazione e funzionamento dello Istituto Nazionale di Astrofisica**", approvato dal Consiglio di Amministrazione con Delibera del 21 giugno 2012, numero 44, e modificato dal medesimo Organo con Delibere del 19 dicembre 2013, numero 84, del 19 febbraio 2014, numero 7, del 16 dicembre 2015, numero 28, del 21 marzo 2016, numero 16, e del 19 ottobre 2016, numero 107;
- VISTO** il Decreto del Ministro della Istruzione, della Università e della Ricerca del 14 ottobre 2015, numero 821, con il quale il Professore **Nicolò D'AMICO** è stato nominato Presidente dello "**Istituto Nazionale di Astrofisica**";
- VISTA** la Delibera del 2 agosto 2016, numero 83, con la quale il Consiglio di Amministrazione dello "**Istituto Nazionale di Astrofisica**" ha unanimemente deliberato:
- di "...nominare il Dottore **Gaetano TELESIO** quale Direttore Generale dello "**Istituto Nazionale di Astrofisica**" a far data dal **17 ottobre 2016**...";
 - che il "...predetto incarico, ai sensi dell'articolo 14, comma 1, dello Statuto dello "**Istituto Nazionale di Astrofisica**" avrà durata coincidente a quella dell'incarico del Presidente del medesimo Istituto, fatti salvi i casi di risoluzione anticipata espressamente previsti dalle disposizioni statutarie e dalla normativa vigente...";
- CONSIDERATO** pertanto, che l'incarico di Direttore Generale dello "**Istituto Nazionale di Astrofisica**" conferito al Dottore **Gaetano TELESIO** scadrà il **14 ottobre 2019**;
- VISTO** il Decreto del Presidente del 19 dicembre 2014, numero 91, con il quale il Dottore **Filippo MANNUCCI** è stato nominato Direttore dello "**Osservatorio Astrofisico di Arcetri**";
- VISTO** in particolare, l'articolo 2, comma 1, lettera a), dello Statuto, il quale prevede che lo "**Istituto Nazionale di Astrofisica**" promuove, realizza e coordina, anche nell'ambito di programmi della "**Unione Europea**" e di "**Organismi Internazionali**", attività "...di ricerca nei campi della astronomia e della astrofisica, sia





tramite la rete delle proprie Strutture di Ricerca e delle Infrastrutture Strumentali e Gestionali, sia in collaborazione con le Università e con altri soggetti pubblici e privati, nazionali, internazionali ed esteri...";

VISTO inoltre, l'articolo 2, comma 1, lettera c), del predetto Statuto, il quale dispone, a sua volta, che lo "**Istituto Nazionale di Astrofisica**" promuove, sostiene e coordina la "*...partecipazione italiana a organismi, iniziative, progetti europei o internazionali, assicurando una presenza qualificata nei campi di propria competenza...*";

VISTO altresì, l'articolo 27, comma 1, dello Statuto, il quale stabilisce che, al "*...fine di promuovere la collaborazione con le Università, gli Enti di Ricerca e gli Organismi pubblici e privati, nel reciproco interesse di sviluppare le attività di ricerca e l'alta formazione sulle materie di competenza, lo "Istituto Nazionale di Astrofisica", con atto del Presidente e previa delibera del Consiglio di Amministrazione, può stipulare "Convenzioni Generali" o "Accordi Quadro"...*";

VISTO altresì, l'articolo 28, comma 1, del "**Disciplinare di Organizzazione e Funzionamento dello Istituto Nazionale di Astrofisica**", il quale stabilisce che lo "**Istituto**" può "*...collaborare con le Università alla istituzione di Corsi di Dottorato nelle materie di competenza, anche attraverso il finanziamento di Borse di Studio per candidati italiani e stranieri...*";

CONSIDERATO che la "**Université d'Aix-Marseille**" ("**AMU**") è uno dei più importanti Istituti Universitari Pubblici della Francia e "*...vanta numerose collaborazioni con Università e Istituti di Ricerca in tutto il mondo nonché con Istituzioni pubbliche e private francesi, tra le quali il "Centre National de la Recherche Scientifique" ("CNRS") e il "Commissariat à l'énergie atomique et aux énergies alternatives" ("CEA"), con le quali ha attivato rapporti di stretta cooperazione...*";

CONSIDERATO che il "**Centre National de la Recherche Scientifique**" ("**CNRS**") è la più grande ed importante Organizzazione di Ricerca Pubblica della Francia e "*...svolge attività di ricerca di natura sia scientifica che tecnologica in diversi settori, tra i quali quelli della "fisica" e della "astrofisica"...*";

CONSIDERATO che il "**Laboratoire d'Astrophysique de Marseille**" ("**LAM**") è una importante "**Unità di Ricerca**" del "**Centro Nazionale di Ricerca Francese**" ("**CNRS-INSU**") e della "**Université d'Aix-Marseille**" ("**AMU**") ed è considerato uno dei più importanti Istituti Pubblici di Ricerca del continente europeo nel campo della "**astrofisica**", in quanto è in grado di "*...associare la ricerca*

Alles

fondamentale in “astrofisica” con la ricerca tecnologica nella strumentazione ed è uno dei pochi laboratori in Francia ad essere assolutamente qualificato per sviluppare strumentazioni per missioni spaziali...”;

CONSIDERATO che, a sua volta, lo “**European Organisation for Astronomical Research in the Southern Hemisphere**” (“**ESO**”) è la principale organizzazione intergovernativa scientifica e tecnologica nel settore della “**astronomia**” e “...sviluppa, ormai da tempo, un ambizioso programma di ricerca a livello internazionale incentrato sulla progettazione, sulla costruzione e sul funzionamento di potenti strutture di osservazione a terra per l'astronomia, svolgendo, altresì, un ruolo di primo piano nella promozione e nella organizzazione della cooperazione nella ricerca...”;

CONSIDERATO che il “**The Office National d'Etudes et de Recherches Aérospatiales**” (“**ONERA**”) è il più importante laboratorio francese di ricerca nei settori della “**aeronautica spaziale**” e della “**difesa**” e costituisce una “...organizzazione multidisciplinare con mezzi sperimentali unici in Europa nel campo della “**industria aerospaziale**” e della “**difesa**”...”;

CONSIDERATO che le predette “**Istituzioni**” hanno manifestato la volontà di sottoscrivere una apposita Convenzione per l'attivazione, il conferimento, il cofinanziamento e la cosupervisione di una Borsa di Studio per l'accesso e la frequenza del Corso di Dottorato di Ricerca in “**Calibration and Optimization of complex AO systems on Extremely Large Telescopes**”, che ha sede presso la “**Scuola di Dottorato**” della “**Université d'Aix-Marseille**” (“**AMU**”);

CONSIDERATO che lo “**Istituto Nazionale di Astrofisica**” è “...interessato allo svolgimento ed allo sviluppo delle attività di alta formazione e di ricerca nei settori disciplinari che riguardano il predetto Corso di Dottorato...”;

VISTA la nota del 18 luglio 2017, con la quale il Dottore **Filippo MANNUCCI**, nella sua qualità di Direttore dello “**Osservatorio Astrofisico di Arcetri**” dello “**Istituto Nazionale di Astrofisica**”, ha trasmesso lo “**Schema**” di “**Convenzione**” tra lo “**Istituto Nazionale di Astrofisica**”, la “**Université d'Aix-Marseille**” (“**AMU**”), il “**Centre National de la Recherche Scientifique**” (“**CNRS**”), il “**Laboratoire d'Astrophysique de Marseille**” (“**LAM**”), lo “**European Organisation for Astronomical Research in the Southern Hemisphere**” (“**ESO**”) e il “**The Office National d'Etudes et de Recherches Aérospatiales**” (“**ONERA**”), predisposto per le finalità innanzi specificate;

 





- CONSIDERATO** altresì, che, con la medesima nota, il Dottore **Filippo MANNUCCI** ha fatto presente che la adesione alla predetta **“Convenzione”** consente *“...di formare giovani ricercatori in settori critici per le attività dell'ente e di rafforzare la collaborazione con importanti istituti europei...”*;
- VISTO** lo **“Schema”** di **“Convenzione”**;
- CONSIDERATO** in particolare, che l'articolo 2 dello **“Schema”** di **“Convenzione”** prevede che *“...il titolare della Borsa di Studio svolge la propria attività di ricerca sotto il controllo e la responsabilità di tre cosupervisorì così individuati:*
- Dottore **Thierry FUSCO**, per la **“Université d'Aix-Marseille”** (**“AMU”**), il **“Centre National de la Recherche Scientifique”** (**“CNRS”**), il **“Laboratoire d'Astrophysique de Marseille”** (**“LAM”**) e il **“The Office National d'Etudes et de Recherches Aérospatiales”** (**“ONERA”**);
 - Dottore **Sylvain OBERTI**, per lo **“European Organisation for Astronomical Research in the Southern Hemisphere”** (**“ESO”**);
 - Dottore **Simone ESPOSITO**, per lo **“Istituto Nazionale di Astrofisica”**...”;
- VISTO** l'articolo 5 dello **“Schema”** di **“Convenzione”**, il quale prevede che *“...il conferimento della Borsa di Studio oggetto della Convenzione non dà luogo a rapporti di lavoro con gli Enti finanziatori, ma esclusivamente con la **“Université d'Aix-Marseille”** (**“AMU”**), che è sede del Corso di Dottorato...”*;
- CONSIDERATO** altresì, che secondo quanto previsto dallo stesso articolo 5 del predetto **“Schema”**:
- lo **“Istituto Nazionale di Astrofisica”** si *“...impegna a versare alla **“Université d'Aix-Marseille”** (**“AMU”**) un importo pari ad € 35.000,00 (trentacinquemila/00) per l'attivazione, il conferimento, il cofinanziamento, nella misura di un terzo del suo costo complessivo, e la cosupervisione di una Borsa di Studio per l'accesso e la frequenza del Corso di Dottorato di Ricerca in **“Calibration and Optimization of complex AO systems on Extremely Large Telescopes”**, secondo le seguenti modalità:*
 - € 11.666, alla data di sottoscrizione della Convenzione;
 - € 11.667, entro il 15 novembre 2017;
 - € 11.667, entro il 15 novembre 2018...”
 - la **“Convenzione”** ha *“...la durata di tre anni, a decorrere dall'Anno Accademico di attivazione del Corso di Dottorato...”*;

- ACQUISITO** il parere favorevole alla approvazione ed alla sottoscrizione della **"Convenzione"** tra lo **"Istituto Nazionale di Astrofisica"**, la **"Université d'Aix-Marseille"** (**"AMU"**), il **"Centre National de la Recherche Scientifique"** (**"CNRS"**), il **"Laboratoire d'Astrophysique de Marseille"** (**"LAM"**), lo **"European Organisation for Astronomical Research in the Southern Hemisphere"** (**"ESO"**) e il **"The Office National d'Etudes et de Recherches Aérospatiales"** (**"ONERA"**) per l'attivazione, il conferimento, il cofinanziamento e la cosupervisione di una Borsa di Studio per l'accesso e la frequenza del Corso di Dottorato di Ricerca in **"Calibration and Optimization of complex AO systems on Extremely Large Telescopes"**, che ha sede presso la **"Scuola di Dottorato"** della **"Université d'Aix-Marseille"** (**"AMU"**), espresso, nell'ambito delle rispettive competenze, sia dal Direttore Scientifico che dal Direttore Generale;
- VISTA** la Delibera del 21 dicembre 2016, numero 126, con la quale il Consiglio di Amministrazione ha approvato il Bilancio Annuale di Previsione dello **"Istituto Nazionale di Astrofisica"** per l'Esercizio Finanziario 2017;
- VISTO** il Bilancio Annuale di Previsione per l'Esercizio Finanziario 2017;
- ACCERTATA** la disponibilità finanziaria sui pertinenti capitoli di spesa del predetto Bilancio;
- ATTESA** pertanto, la necessità di provvedere,

DELIBERA

alla unanimità dei presenti

Articolo 1. Di approvare lo **"Schema"** della **"Convenzione"** tra lo **"Istituto Nazionale di Astrofisica"**, la **"Université d'Aix-Marseille"** (**"AMU"**), il **"Centre National de la Recherche Scientifique"** (**"CNRS"**), il **"Laboratoire d'Astrophysique de Marseille"** (**"LAM"**), lo **"European Organisation for Astronomical Research in the Southern Hemisphere"** (**"ESO"**) e il **"The Office National d'Etudes et de Recherches Aérospatiales"** (**"ONERA"**) per l'attivazione, il conferimento, il cofinanziamento e la cosupervisione di una Borsa di Studio per l'accesso e la frequenza del Corso di Dottorato di Ricerca in **"Calibration and Optimization of complex AO systems on Extremely Large Telescopes"**, che ha sede presso la **"Scuola di Dottorato"** della **"Université d'Aix-Marseille"** (**"AMU"**), nel testo che si allega alla presente Delibera per formarne parte integrante (Allegato numero 1).

Articolo 2. Di autorizzare la sottoscrizione della Convenzione tra lo **"Istituto Nazionale di Astrofisica"**, la **"Université d'Aix-Marseille"** (**"AMU"**), il **"Centre**






National de la Recherche Scientifique ("CNRS"), il "**Laboratoire d'Astrophysique de Marseille**" ("LAM"), lo "**European Organisation for Astronomical Research in the Southern Hemisphere**" ("ESO") e il "**The Office National d'Etudes et de Recherches Aéropatiales**" ("ONERA") per le finalità specificate in premessa e nell'articolo 1 della presente Delibera.

Articolo 3. Di autorizzare il Dottore **Filippo MANNUCCI**, nella sua qualità di Direttore dello "**Osservatorio Astrofisico di Arcetri**", a sottoscrivere la Convenzione richiamata nei primi due articoli della presente Delibera.

Articolo 4. La copertura finanziaria per il cofinanziamento, nella misura di un terzo del suo costo complessivo, della Borsa di Studio per l'accesso e la frequenza del Corso di Dottorato di Ricerca in "**Calibration and Optimization of complex AO systems on Extremely Large Telescopes**", che ha sede presso la "**Scuola di Dottorato**" della "**Université d'Aix-Marseille**" ("AMU"), verrà assicurata:

- per un importo pari ad Euro **23.333,00** (ventitremilatrecentotrentatre/00), mediante prelievo dai fondi iscritti nella "**Funzione Obiettivo**" 1.05.03.31.01 "**GMT WFS (Referente Simone ESPOSITO)**", "**Capitolo**" 1.04.02.03.003 "**Dottorati di ricerca**", del "**Centro di Responsabilità Amministrativa**" 1.07 "**Osservatorio Astrofisico di Arcetri**" del Bilancio Annuale di Previsione dello "**Istituto Nazionale di Astrofisica**" per l'Esercizio Finanziario 2017;
- per un importo pari ad Euro **11.667,00** (undicimilaseicentosessatasette/00), mediante prelievo dai fondi che verranno iscritti nella "**Funzione Obiettivo**" 1.05.03.31.01 "**GMT WFS (Referente Simone ESPOSITO)**", "**Capitolo**" 1.04.02.03.003 "**Dottorati di ricerca**", del "**Centro di Responsabilità Amministrativa**" 1.07 "**Osservatorio Astrofisico di Arcetri**" del Bilancio Annuale di Previsione dello "**Istituto Nazionale di Astrofisica**" per l'Esercizio Finanziario 2018.

Roma, 25 luglio 2017

Il Segretario

Il Presidente

S.Sarra



ONERA

THE FRENCH AEROSPACE LAB

Aix*Marseille
université



**AGREEMENT OF RESEARCH COLLABORATION
AND CO-SUPERVISED PHD THESIS**

Between :

THE NATIONAL CENTER OF THE SCIENTIFIC RESEARCH,

Public establishment of a scientific and technological nature, having its registered office at 3 rue Michel-angel 75794 Paris Cedex 16 France, Represented by its President Mr Alain FUCHS, and by delegation, by Mr Younis Hermes, Regional Delegate for the district Provence and Corsica,

Hereinafter referred to as “CNRS”

The CNRS having given mandate retroactively to Aix Marseille University on January 1st, 2012 for the signature of the present agreement.

And

AIX MARSEILLE UNIVERSITY

Public establishment of a scientific, cultural and professional nature

SIRET : 130 015 332 00013/ Code APE : 8542Z Higher Education

Located 58 boulevard Charles Livon, Jardin du Pharo, 13284 Marseille Cedex 7 - France

Represented by its President, Professor Yvon BERLAND

Hereinafter referred to as « AMU »

Both AMU and the CNRS hereinafter referred to as the “ESTABLISHMENTS”,

Acting on their behalf and on behalf of their laboratory Laboratoire d’Astrophysique de Marseille (LAM UMR 7326) directed by Mr Jean-Gabriel CUBY,

Hereinafter referred to as « LAM »

And :

THE EUROPEAN ORGANIZATION FOR ASTRONOMICAL RESEARCH IN THE SOUTHERN HEMISPHERE

Intergovernmental Astronomy Organization

Located Karl-Schwarzschild-Strasse 2 - 85748 Garching bei München - GERMANY

Represented by

duly delegated by

Hereinafter referred to as « ESO »

And :

THE ISTITUTO NAZIONALE DI ASTROFISICA

Italian Public Institution

Located Viale del Parco Mellini 84 - 00136 Rome, ITALY

Represented by Dr. Filippo Mannucci

duly delegated by the President Prof. Niccolò D'Amico.....

Hereinafter referred to as « INAF »

And :

THE OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES

Etablissement Public à caractère Industriel et Commercial,

Located : Palaiseau Center – Chemin de la Hunière - BP 80100 – 91123 PALAISEAU Cedex – France

Represented by

duly delegated by

Hereinafter referred to as « ONERA »

Collectively hereinafter referred to as the "PARTY (sg) / PARTIES (pl)";

Whereas :

1/ LAM is one of the most important public research institutes in Europe in the area of astrophysics. It associates fundamental research in astrophysics with technological research in instrumentation. It is one of the few laboratories in France to be qualified to develop instrumentation for space missions. The Laboratoire d'Astrophysique de Marseille (LAM) is a joint research unit (UMR7326) of the French National Research Center (CNRS-INSU) and the Université d'Aix-Marseille (AMU). The LAM undertakes research in astrophysics, with about 55 researchers, 90 engineers, technicians and administrative staff, and 55 doctoral and post-doctoral researchers. LAM building is located on the Technopole of Chateau Gombert campus.

2/ ESO is the pre-eminent intergovernmental science and technology organization in astronomy. It carries out an ambitious program focused on the design, construction and operation of powerful

ground-based observing facilities for astronomy to enable important scientific discoveries. ESO also plays a leading role in promoting and organizing cooperation in astronomical research.

3/ INAF is the most important Italian institution conducting scientific research in astronomy and astrophysics. Research performed by the scientific staff of the Institute ranges from the study of the planets and minor bodies of the Solar system up to the large-scale structure of the Universe and groups and clusters of galaxies on cosmological scales. In parallel INAF conducts forefront works in instrumentation developments for most of today's major Astronomical projects like SKA, E-ELT, CTA and so on.

4/ ONERA is the French aeronautics, space and defense research lab. A multi-disciplinary organization with experimental means unique in Europe, ONERA brings expertise to government programs, both institutional and industrial. Research at ONERA meets the major challenges of the aerospace and defense industries. It is the only organization in France gathering all the knowledge and skills in these areas.

5/ In order to determine the most relevant operating conditions for complex AO systems, ESO, INAF and ONERA wish to work in collaboration with the LAM.

The Parties agree as follows :

Article 1 : Purpose

The present agreement (hereinafter referred to as "the Agreement") determines the arrangements for the partnership between ESO, INAF, ONERA and the ESTABLISHMENTS regarding a jointly-directed Ph.D. thesis.

The Parties collaborate through the below mentioned entities :

- ESTABLISHMENTS : LAM
- ESO :
- INAF: OSSERVATORIO ASTROFISICO DI ARCETRI
- ONERA :

in order to allow Mr. Cedric Taïssir HERITIER-SALAMA (hereinafter referred to as the «**PhD Student** ») to prepare a Ph.D. thesis on the entitled subject :

“Calibration and Optimization of complex AO systems on Extremely Large Telescopes”
(hereinafter referred to as the “**Project**”)

A detailed schedule of the Project is provided in the scientific and technical Appendix attached hereto (annex 1).

Article 2 : Scientific management and Co-supervisors of the Ph.D. thesis

- Dr Thierry FUSCO for the ESTABLISHMENTS and for ONERA

- Sylvain OBERTI for ESO
- Dr Simone ESPOSITO for INAF

Hereinafter referred to as the “**co-supervisors**”.

The PhD student performs his research work under the control and responsibility of these 3 co-supervisors.

The co-supervisors undertake to exercise fully and in collaboration the function of thesis co-supervisors of the doctoral student and to respect the guidelines for PhD theses of their institutions.

Article 3 : Proportions of period in each institutions

The preparation of the thesis can be done by alternating periods in each partner institution.

The distribution of these periods will be set by the PhD student in accordance with all advisors, depending on scientific needs and material necessities of the thesis work.

The PhD student will undertake research in a proportion of :

- 34 % for the LAM:/ ESTABLISHMENTS and for ONERA
- 33 % for ESO
- 33 % for INAF

During the periods spent at the each institution he PhD student is required to :

- Observe all of the local applicable rules, regulations and circulars, in particular those relating to safety;
- Refrain from any conduct that will adversely reflect on the local institution and not engage in activities that are incompatible with its aims and objectives ;

Article 4 : Registration and oral examination

The PhD student will register yearly at AMU within the Doctoral School “.....” (ED.....) in order to obtain the degree of PhD in

The PhD student will have to renew his registration every academic year with AMU.

This Agreement is null and void if the PhD student does not renew his administrative registration at AMU. .

The oral examination as well as its recording will take place at AMU.

The examining committee will be composed in accordance with the rules of AMU as well as the recording of the thesis.

Article 5: Financial issues

As PhD student's employer, AMU shall pay the 3-year salary of the PhD student.

The PhD student will be financed through ESO, INAF and ONERA contributions for the duration of his PhD thesis as follows :

5.1 ESO undertakes to pay a total amount of 35000€ (thirty five thousand hundred Euros) over the three year project to AMU after having received justification supporting documents and provided that the employment contract of the PhD Student has been performed until its expiry date.

The said supporting documents are the PhD's employment contract and its salaries slips.

The total amount can include any additional expenses other than the salary of the PhD student, especially travel expenses or functioning costs.

This amount shall be paid by ESO as follows :

To the Accounting officer of Aix-Marseille University
Bank Code : 10071
Branch Code : 13000
Account n° 0000 1020067
bank ID : 80
SWIFT Code : TRPUFRP1
IBAN Code : FR76 10071130000000102006780

Upon presentation of one invoice on the following dates :

- Euros 11666, exclusive of taxes, on the signature date of this Agreement.
- Euros 11667, exclusive of taxes, on November 15th, 2017
- Euros.11667, exclusive of taxes, on November 15th, 2018

Invoices shall be sent to ESO, to the attention of M.....

In case of an early termination of the employment contract of the PhD student for whatever reason, the payment by ESO to AMU will be suspended until a solution has been found out, which may include the reimbursement of the overpaid amounts from AMU to ESO.

5.2 Identically, INAF undertakes to pay a total amount of 35000€ (thirty five thousand hundred Euros) over the three year project to AMU after having received justification supporting documents and provided that the employment contract of the PhD Student has been performed until its expiry date.

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The said supporting documents are the PhD's employment contract and its salaries slips.

The total amount can include any additional expenses other than the salary of the PhD student, especially travel expenses or functioning costs.

This amount shall be paid by INAF as follows :

To the Accounting officer of Aix-Marseille University
Bank Code : 10071
Branch Code : 13000
Account n° 0000 1020067
bank ID : 80
SWIFT Code : TRPUFRP1
IBAN Code : FR76 10071130000000102006780

Upon presentation of one invoice on the following dates :

- Euros 11666, exclusive of taxes, on the signature date of this Agreement.
- Euros 11667, exclusive of taxes, on November 15th, 2017
- Euros.11667, exclusive of taxes, on November 15th, 2018

Invoices shall be sent to INAF, to the attention of Mrs. Mimma Lauria

In case of an early termination of the employment contract of the PhD student for whatever reason, the payment by INAF to AMU will be suspended until a solution has been found out, which may include the reimbursement of the overpaid amounts from AMU to INAF.

5.3 Identically, ONERA undertakes to pay a total amount of 35000€ (thirty five thousand hundred Euros) over the three year project to AMU after having received justification supporting documents and provided that the employment contract of the PhD Student has been performed until its expiry date.

The said supporting documents are the PhD's employment contract and its salaries slips.

The total amount can include any additional expenses other than the salary of the PhD student, especially travel expenses or functioning costs.

This amount shall be paid by ONERA as follows :

To the Accounting officer of Aix-Marseille University
Bank Code : 10071
Branch Code : 13000
Account n° 0000 1020067
bank ID : 80
SWIFT Code : TRPUFRP1
IBAN Code : FR76 10071130000000102006780

Upon presentation of one invoice on the following dates :

- Euros 11666, exclusive of taxes, on the signature date of this Agreement.

- Euros 11667, exclusive of taxes, on November 15th, 2017

- Euros.11667, exclusive of taxes, on November 15th, 2018

Invoices shall be sent to ESO, to the attention of M.....

In case of an early termination of the employment contract of the PhD student for whatever reason, the payment by ONERA to AMU will be suspended until a solution has been found out, which may include the reimbursement of the overpaid amounts from AMU to ONERA.

Article 6: Insurance and assistance

6.1.The University of enrolment informs the PhD student that he must subscribe to the organization of his choice for personal liability insurance for damage he may cause to people or property during its exchange period as well as repatriation insurance.

6.2. Pursuant to the Study, the employees of either PARTY, who shall continue to be paid by their employer, may be called upon to work in the other PARTY's premises.

Said staff shall then comply with the internal regulations of the host establishment and with the technical instructions concerning the materials.

Nevertheless, as regards the staff whom it pays, each PARTY shall continue to be responsible for all the employer's social security contributions and tax obligations, and shall exercise, vis-à-vis the staff, all administrative management responsibilities (grading, promotion, discipline, etc.,).

The host institution provides relevant information for the employer in order to fulfil such responsibilities.

The PARTIES shall provide cover for their respective employees as regards work injuries and occupational diseases without prejudice to any and all actions against liable third parties.

6.3.The materials and equipment provided by one PARTY to the other, or financed by this PARTY pursuant to a specific Agreement, shall remain the property of said PARTY.

Consequently, each PARTY shall be liable for the damage to the materials, facilities and machinery which it owns, including the materials entrusted to the other PARTY and the materials being tested, during the conducting of the Study, even if the other PARTY is responsible for the damage, with the exception of gross or intentional negligence by the latter.

Article 7 : Confidentiality - Publications

7.1 Confidentiality

Confidential Information means any and all information and/or data in any form and of any nature whatsoever – including, but not limited to, all written or printed documents, samples, models, and/or information whether or not patentable - disclosed by a PARTY to one or more other PARTY(IES) under this Agreement, provided that the disclosing PARTY has clearly and unambiguously specified their confidential nature, or, if disclosed orally or visually, that the disclosing PARTY verbally announced their confidential nature upon disclosure and confirmed this nature in writing within thirty (30) days.

To the extent that it is authorized to do so, each PARTY shall provide the other PARTIES with its Confidential Information to the extent that it considers it necessary for pursuing the objectives described in the collaboration.

No provision of this Agreement shall be construed as requiring a PARTY to disclose its Confidential Information to another PARTY.

A PARTY which receives Confidential Information (the "**Receiving PARTY**") from another Party (the "**Disclosing PARTY**") undertakes that, throughout the duration of the Agreement and for the five (5) years following its termination or expiration, such Confidential Information :

-will be protected, kept strictly confidential, and be treated with the same degree of care and protection that it provides for its own confidential information of equal importance, which in any case shall not be less than a strict duty of care;

-will be disclosed internally only to those of its employees and students on a need to know basis or to its subcontractors in charge of executing part of its share of the collaboration only if such disclosure is strictly necessary for the execution of the subcontracted part of the collaboration and subject to the subcontractors or students being bound by confidentiality obligations at least as stringent as those set out herein;

- will be used by the said members of its personnel or subcontractors only for the purposes set out in the Agreement;

-will not be used, in whole or in part, for any purpose other than the execution or the collaboration, without the prior written consent of the Disclosing PARTY;

-will not be disclosed, directly or indirectly, or be susceptible to being disclosed to any third parties or persons other than those specified in the second hyphenated item above;

-will not be copied, reproduced or duplicated in whole or in part unless such copies, reproductions or duplicates have been specifically authorized in writing by the Disclosing PARTY.

All confidential Information and reproductions thereof disclosed by a PARTY to another shall remain the property of the Disclosing PARTY, subject to third parties' rights, and shall be returned to the Disclosing PARTY immediately upon its request.

The Receiving PARTY shall not have any obligation and shall not be subject to any restriction with regard to Confidential Information in respect of which it can provide proof that:

- it was in the public domain prior to being disclosed or entered into the public domain thereafter, but in the latter case in the absence of any fault which can be attributed to the Receiving PARTY;
- the Receiving PARTY had **prior** knowledge thereof, such knowledge being demonstrated by relevant documentary evidence from its records;

- it was received from a third party legally authorized to disclose it without restrictions or violation of the provisions herein;
- it was published without contravening the provisions herein;
- its use or disclosure was authorized in writing by the Disclosing PARTY;
- it is the result of developments undertaken by the Receiving PARTY by members of its personnel having had no access to such information;
- its disclosure has been required by the application of a legal or regulatory provision or within a judicial, administrative or arbitration procedure. In such a case, the disclosure of Confidential Information must be limited to what is strictly necessary. The Receiving PARTY undertakes to immediately inform the Disclosing PARTY prior to any such disclosure in order that the Disclosing PARTY may take appropriate measures with a view to preserving the confidential character of the Confidential Information.

The PARTIES expressly agree that the disclosure of Confidential Information to each other under the Agreement shall not in any circumstances be construed as an express or implied grant to the Receiving PARTY of any right (by virtue of a license or by any other means) in the content, inventions or discoveries to which this Confidential Information relates. This also applies to copyright and other rights attached to literary or artistic intellectual property, trademarks and trade secrets.

7.2 Publications – communications

Subject to the terms as follows, each draft communication or publication project by a PARTY pertaining to technical or scientific information relating to the tasks and results of the collaboration (including the filing of a patent application) shall be subject to the other PARTIES' prior written approval during the duration of the Agreement and the eighteen (18) months if the subject of the communication or publication contains Confidential Information not developed by the PARTY proposing the communication or publication.

The PARTIES shall make their decision known within a maximum period of two (2) months from the date on which the approval request has been notified.

A PARTY shall be deemed to have approved the communication / publication if it does not respond within this period.

Any PARTY not providing approval shall specify which Confidential Information was not developed by the PARTY proposing the communication or publication so that the Confidential Information might be removed. In the case of JOINT FOREGROUND contained in a proposed communication or publication, the Co-owning PARTIES shall have two (2) months to determine whether patent protection might be pursued and to implement any agreed strategy after which the PARTY proposing the communication or publication shall be free to publicly disclose.

These publications and communications shall mention the contribution made by each of the PARTIES in the framework of the collaboration.

The provisions of this article 7.2 shall not prevent:

- the performance of the obligation imposed on each person participating in the collaboration to produce a report to the entity to which he/she belongs; the dissemination of Confidential Information arising from this obligation shall be limited to only those of the entity's authorities which have a need to know and subject to abiding to the confidentiality obligations herein; or

- the examination for thesis of researchers participating in the collaboration; such examination, organized in compliance with university regulation, shall ensure the respect of the confidentiality obligations herein, most notably, each member of the examining board can be bound by a confidentiality agreement; or
- the filing by a PARTY of a patent application which solely ensues from its own BACKGROUND and/or FOREGROUND
- the publication by a PARTY of its own BACKGROUND and/or FOREGROUND.

Article 8 : Results and intellectual property

8.1 BACKGROUND

8.1.1 OWNERSHIP OF BACKGROUND

BACKGROUND means any and all information as well as knowledge of a technical and/or scientific nature [including, but not limited to, know-how, manufacturing and /or trade secrets, data, data bases, software (in source code and object code versions), files, plans, diagrams, drawings, formulas and/or any other type of information, in any form whatsoever, whether or not patentable and/or patented], and all intellectual property rights resulting therefrom, necessary for the execution of the collaboration and owned by a PARTY or in its possession prior to the EFFECTIVE DATE (ARTICLE 9), and in respect of which the said PARTY has the unencumbered right to grant licenses or rights of use without having to seek the prior consent of a third party.

Each PARTY retains full ownership of its BACKGROUND.

Each PARTY is the owner of any change or/and improvement of its BACKGROUND developed in the framework of this contract, no matter the inventor or author.

BACKGROUND of all PARTIES is listed in Annex 2.

8.1.2 USE OF BACKGROUND

- By the holding PARTIES

Subject to the terms of article 8.1.1, each PARTY shall remain free to use, exploit - and/or have exploited - and dispose of its own BACKGROUND.

- By the non-holding PARTIES, to execute the collaboration

In order to execute the collaboration and solely for that purpose, each PARTY may use on a royalty free basis the BACKGROUND of another PARTY. This BACKGROUND shall be provided, upon request, by the holding PARTY to the requesting PARTY and shall be treated as Confidential Information.

8.2 FOREGROUND

8.2.1 - OWNERSHIP OF FOREGROUND :

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FOREGROUND means any and all information as well as knowledge of a technical and/or scientific nature [including, but not limited to, know-how, manufacturing and /or trade secrets, data, data bases, software (in source code and object code versions), files, plans, diagrams, drawings, formulas and/or any other type of information, in any form whatsoever, whether or not patentable and/or patented], and all intellectual property rights resulting therefrom, generated by one or more PARTY(IES) - or their subcontractors –under the collaboration.

NEW PATENT means any patent application and patent ensuing therefrom, stemming from the FOREGROUND.

- FOREGROUND owned by a single PARTY

FOREGROUND shall be the property of the PARTY which generated it alone, and any eventual NEW PATENTS ensuing therefrom shall be filed at the said PARTY'S own initiative, solely in its name and at its own expense.

Notwithstanding anything contained in this Agreement, no PARTY is obligated to pay any patent expenses.

- JOINT FOREGROUND

Where FOREGROUND is jointly generated by the PARTIES (to the extent that none of the said PARTIES could reasonably claim full ownership of this FOREGROUND), such FOREGROUND (hereinafter "**JOINT FOREGROUND**") shall be co-owned Joint in proportion to their intellectual, human, material and financial contributions (hereinafter the "**Co-owning PARTIES**").

Where JOINT FOREGROUND consists in a NEW PATENT, the PARTIES concerned shall enter into a co-ownership agreement which shall be signed as soon as necessary and in any event prior to any industrial and/or commercial exploitation.

The PARTIES shall decide whether it shall be the subject of patent application(s) filed in their joint names, and shall appoint among themselves the PARTY responsible for filing and maintenance procedures, as well as commercialization. The PARTIES will agree on the revenue sharing based on the joint ownership agreement.

If one of the PARTY renounces the filing, procedure for delivery or maintenance of one or more NEW PATENTS in co-ownership in France or in foreign countries, it shall give the other Co-owning PARTIES timely notice of its decision so that they may pursue such filing, procedure for delivery or maintenance.

A Co-owning PARTY shall be deemed to have renounced the filing, procedure for delivery or maintenance of a NEW PATENT if it fails to respond within sixty (60) days from its receipt from the other Co-owning PARTY (IES) of a registered letter with acknowledgement of receipt requesting it to make known its decision in that regard, subject to any extension of time agreed between the Co-owning PARTIES concerned.

Each PARTY undertakes to pay any remuneration which might be due to its inventors.

8.2.2 USE OF FOREGROUND

By the holding PARTIES

Each PARTY shall be free to use, exploit - and/or have exploited - and dispose of the FOREGROUND it solely owns.

The PARTIES undertake to put in place all appropriate measures, including but not limited to with regard to their employees and/or eventual subcontractors, enabling them to grant other PARTIES use and exploitation rights on their FOREGROUND and JOINT FOREGROUND, under the conditions set out hereunder.

By the Co-owning PARTIES of JOINT FOREGROUND

Co-owning PARTIES of JOINT FOREGROUND and/or of NEW PATENTS in co-ownership shall state the terms under which their exploitation shall be carried out either in a commercialization agreement or, where NEW PATENTS are concerned, in the co-ownership agreement mentioned in article 8.2.1.

The PARTIES agree that any direct and/or indirect exploitation by a Co-owning PARTY of JOINT FOREGROUND and/or of NEW PATENTS in co-ownership shall entail an equitable financial compensation to the other Co-owning PARTIES under the conditions and terms defined in the co-ownership agreement.

By the non-holding PARTIES, to execute the collaboration

The terms of article 8.1.2 shall apply *mutatis mutandis* to FOREGROUND necessary to execute the collaboration.

By the non-holding PARTIES, for exploitation purposes

Each PARTY which owns or co-owns FOREGROUND undertakes, for the duration of the collaboration and the period of eighteen (18) months which follows its expiration, to grant another PARTY, upon their request, a non-exclusive license to exploit its FOREGROUND which is necessary to exploit the requesting PARTY's own FOREGROUND, under preferential conditions – i.e. terms more favorable than those which would be granted to a third party for the application sector considered. No PARTY is obligated to pay patent expenses pertaining to FOREGROUND, including any NEW PATENT.

The commercial conditions and the terms of the license shall be negotiated prior to any commercial and/or industrial exploitation and shall be the subject of a separate license agreement between the PARTIES concerned.

At the expiry of the said period of eighteen (18) months, the above undertaking shall cease and a PARTY owning or co-owning FOREGROUND shall regain its freedom to exploit that FOREGROUND which has not been licensed under this article, and/or to have it exploited under an exclusive license.

It is understood that the exploitation licenses granted hereunder shall be non-transferable and shall not include the right to grant sub licenses, unless otherwise previously authorized in writing by the owning or Co-owning PARTY.

However, PARTIES which cannot directly exercise a commercial activity by reason of their status or their mission may benefit, upon request, from the right to sublicense the rights granted hereunder, subject to informing the PARTY owning or co-owning the FOREGROUND of the object of the sublicense and the identity of the third party sublicensed and subject to reasonable commercial terms negotiated in accordance with this article.

By the non-holding PARTIES, for own internal research purposes

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Upon request made at the latest eighteen (18) months after the expiry of the collaboration, each PARTY shall be free to use FOREGROUND of another PARTY on a royalty free basis for its own internal research needs, which shall not include direct or indirect use for commercial purposes.

This FOREGROUND shall be provided by the owning PARTY to the requesting PARTY and shall be treated as Confidential Information by the requesting PARTY.

Article 9 : Term

This agreement shall enter into force retroactively on November 15th, 2016 (the "EFFECTIVE DATE") and will remain valid until November 14th, 2019.

Any modification of this Agreement is subject to the prior written consent of all PARTIES by way of an additional agreement.

This Agreement may be terminated by either PARTY in the event of the other PARTY'S breach of one or several of the obligations set forth in its various clauses.

Termination shall only become effective three months subsequent to the sending, by the aggrieved PARTY, of a registered letter with acknowledgment of receipt setting forth the reasons for the complaint, unless during this period, the defaulting PARTY were to have complied with its obligations, or were to present proof of an obstacle representing a case of force majeure.

The exercising of this right of termination shall not discharge the defaulting PARTY from having to comply with its contractual obligations until the effective termination date, subject to any loss suffered by the aggrieved PARTY as a result of the early termination of the Agreement.

Articles 7, 8, and 10 shall survive its termination, however caused.

Article 10 : Consultation, Arbitration and Dispute Settlement

In case of the termination of the present Agreement by one of the co-supervisors, the former would have to send a written notification to his home institution and doctoral school.

The home institution will then officially inform the partner institutions of this notification.

The PARTIES will try hard to solve amicably any dispute which can arise between them concerning the interpretation, the execution or the termination of the Agreement.

In the event of any dispute arising out of, or in connection with, this Agreement, the PARTIES agree to submit the matter to the settlement proceedings under the Rules of Arbitration of the International Chamber of Commerce in Paris, by one or more arbitrators appointed in accordance with Rules of Arbitration.

The Agreement shall be governed by and interpreted in accordance with French Law, without reference to international conflict rules, and the arbitration proceedings shall be carried out in English. The procedure shall take place in PARIS, unless otherwise agreed by the PARTIES.

Article 11 : Entirety and scope of the Agreement

This Agreement, together with its Appendices, sets forth the entirety of the PARTIES' obligations.

No clause appearing in the documents sent or provided by the PARTIES may be included herein, unless otherwise agreed by the PARTIES in writing.

Article 12 : Invalidity of a clause

Should one or several provisions of this Agreement be held to be invalid, or found to be so in application of a treaty, legislation or regulations, or even subsequent to a final decision from International Chamber of Commerce , the other provisions shall retain all their effect and scope. In this case, the PARTIES shall immediately make the required changes, whilst complying, insofar as possible, with their intention when this Agreement was signed.

LIST OF ANNEXES

Are annexed to the AGREEMENT the following documents:

- Annex 1: Details of the Scientific Cooperation
- Annex 2: BACKGROUND Information

IN WITNESS WHEREOF, the Parties have executed this AGREEMENT in four (4) original copies.

For the ESTABLISHMENTS

Yvon BERLAND
President of AMU
[Signature]

For ESO

Name of the representative
Quality
[Signature]

For INAF

Filippo Mannucci
Director of INAF Arcetri
[Signature]

For ONERA

Name of the representative
Quality
[Signature]

Visa

AMU Doctoral School Director

.....

Visa
AMU Co-supervisor of thesis

Visa
Partner University Co-supervisor of thesis

Annex 1

Scope of the Research

PhD Project : "Calibration and Optimization of complex AO systems on Extremely Large Telescopes"

**PhD position in adaptive optics for astronomical ground-based telescope
Calibration and optimisation of complex AO system on Extremely Large Telescope**

PhD supervisors: T. Fusco (ONERA/LAM) / S. Esposito (INAF)

PhD co-supervisors: S. Oberti (ESO) – B. Neichel (LAM)

Context

Today's Astronomy observations rely on state-of-the-art instrumentation and facilities. The gain in higher sensitivity, better image quality, and wider field of view allows scientists to make breakthrough in their research field. Astronomy is a science where the observations of extremely distant objects are the single source of information. Therefore, larger aperture telescopes and higher angular resolution play a crucial role.

Toward these objectives, one of the key technological breakthroughs done in the past decades was the introduction of Adaptive Optics [AO] for astronomical observations.

At the cross of optics, electronics, atmospheric science, control theory, computer science and mathematics, AO is a technique that aims at compensating quickly-varying optical aberrations to restore the ultimate angular resolution limit of an optical system. It uses a combination of wave-front sensors [WFSs], to analyze the light wave aberrations, and deformable mirrors [DMs] to compensate them.

For astronomical telescopes, AO allows to overcome the natural "seeing" frontier: the blurring of images imposed by atmospheric turbulence and limiting the angular resolution of ground-based telescope to that achievable by a 10 to 50cm telescope, an order of magnitude below the diffraction limit of large 8-m class telescopes which are the current standard.

Within a decade, the world will see a new generation of telescopes with diameter up to 39m, called the Extremely Large Telescopes [ELTs]. These giants will address fundamental astrophysical science cases as for instance the direct imaging and characterization of exo-worlds or the study of bulk and evolution of the first galaxies. The scientific potential of these giants relies on challenging new AO concepts, integrated inside the telescope itself, and providing high-resolution images to all the instrumentation downstream.

These new instrumental developments impose a complete rethink of the AO concept: towards eXtreme AO [XAO] to improve dynamics, or towards wide field AO [WFAO] to increase the science field of view.

Moreover WFAO generally uses several laser guide stars [LGSs] for sensing in order to improve sky coverage and avoid relying on the presence of bright natural guide stars.

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The colossal size of the ELTs and the complexity of the scientific instruments compel us on a complete rethinking, in order to improve the overall performance, but more specifically the sensitivity and the robustness of the AO systems, and thus to maximize the astrophysical returns of AO assisted instruments. In particular, the combination of new and complex AO concepts with completely revolutionary, but partially unknown, telescopes leads to a complete set of new problems especially concerning the AO calibration and optimization. On top of the main AO loop, driving the DM optical shape based on the WFS measurement, an AO system relies on a large number of calibrations and look-up tables that may not be perfectly tuned, or may evolve dynamically with the telescope environment. If those calibrations are not perfectly tuned, the AO system may not be responding as expected, and the resulting AO performance will be affected.

Future ELTs, and the E-ELT in particular, provide a new and constraining environment for AO calibrations, with no direct access to the AO Deformable Mirror, and a very tight constraint on telescope access during daytime. In this context, accelerating the calibration procedures, or performing it on sky, if possible during the AO correction itself by identifying key parameters to be adjusted in theoretical models becomes a must. The goal of this PhD is to address these innovative solutions for accurate calibrations and optimization procedures, in the context of the future ELTs AO-systems.

PhD work

The PhD work will be developed along two main calibration challenges:

- ☐ AO system alignment identification and interaction matrix calibration,
- ☐ Non-common path aberrations calibrations,

Interaction matrix calibration: The WFS to DM registration is characterized by a matrix that defines how each DM actuator is seen by all the WFS subapertures. This matrix is usually calibrated on a regular basis for an AO system, and then used during operations. However, in the case of the E-ELT, no optical sources will be available to calibrate this fundamental matrix, which will have to be measured, identified and monitored indirectly during operations. It is particularly fundamental for the E-ELT case, where the adaptive mirrors are located in the telescope itself and therefore constantly move with respect to the adaptive optics sensors located after the telescope focal plane. If this calibration drifts during observations, the AO correction will be affected, resulting in degraded performance.

Non-Common Path aberrations: All the differential aberrations lying in the WFS and science optical path should be accurately calibrated, as the AO system is blind to them. Those optical aberrations are generally measured with an external calibration light source. Offsets are then applied to the WFS measurements to drive the AO correction toward the optimal performance. In the case of the E-ELT instruments, the situation will be completely new, with no external source available, and moving elements in the system. New methods for on-sky calibrations, monitoring and compensation of these aberrations are to be developed. In both cases, first strategies have been developed and are currently tested / validated on current 8m telescope facilities. Among others, the Adaptive Optics Facility (AOF) at the VLT 8m telescope will deploy on-sky identification of critical calibration parameters. This system will be in commissioning and tests during 2016/2017, and the PhD candidate will benefit from a privileged access to the results provided by the AOF. New methods developed during the PhD may also be tested in real conditions on this platform. The methods developed and validated on the AOF, and other available systems, will have to be extended and generalized for the scale of the E-ELT accounting for post-focal WFS specificities such as non-linearity.

PhD environment

The project will be done in close collaboration between the European Southern Observatory [ESO], the Arcetri Observatory (INAF), the Laboratoire d'Astrophysique de Marseille (INSU-CNRS) and ONERA. These 4 institutes gather all the background, the competences, the tools and the experimental devices to conduct such a challenging research program. In particular, the institutes can provide a privileged access to world-class AO instrumentation both on VLT (AOF-MUSE, SPHERE) and LBT (Lucifer). Both AOF and Lucifer will implement some future E-ELT features and thus the successful candidate will have access to results from these instruments to feed his/her thoughts and potentially to tests some innovative ideas he/she may have.

Requirements

Qualifications: We are looking for a candidate with an MSc or PhD degree in Physics, Astronomy, Optics, Computer Science, Mathematics, or the equivalent, with a strong interest for astronomical instrumentation. Experience with signal processing is advantageous. The successful candidate will have to spend part of his/her PhD time in each partner institute (Munich, Florence and Marseille). The final repartition and the exact context will be decided in close interaction with all the project participants and will depend on the exact work to be done as well as the candidate personal constraints. In any case, a strong motivation for mobility, excellent communication skills and aptitude for working in a multi-laboratory team are required.

Language Skills: Excellent command of the English language. A good knowledge of French and /or Italian language should be a plus.

Applicants should send a single PDF file containing a CV, education transcript, and a short statement of research interests to Thierry.fusco@lam.fr and esposito@arcetri.astro.it. Must be provided the names of two referees to whom references will be asked.

Annex 2

Background

ESTABLISHMENTS

No Background

ESO

INAF

The National Institute of Astrophysics INAF has a long tradition in design and development of Adaptive Optics Systems for Astronomy. Currently INAF is leading several key projects in this field for 8m class telescopes and ELTs. In particular Arcetri is leading the design and realization of the AO module for the VLT UT4 telescope ERIS instrument and the AO system upgrade of the LBT telescope dedicated to Shark VIS and NIR instrument. Furthermore Arcetri is involved in the development of the MCAO system for the E-ELT MAORY and of the NGS AO system of the GMT telescope. In both cases (8m and ELTs) the AO calibration is a mandatory part of Arcetri activities providing a very relevant environment for the considered PhD thesis.

ONERA