Curriculum Vitae et Studiorum
LAURA SCHREIBER

Personal data

Place and date of birth: Brescia, 30/04/1981
Tax code: SCHLRA81D70B157E
Contact info: lauraschr@gmail.com
INAF - Osservatorio Astronomico di Bologna,
Via Ranzani 1, I40127 Bologna
Tel. +39-051-2095704 Fax. +39-051-2095700

Experience

Apr 2013 Permanent position at the Astronomical Observatory of Bologna (INAF) as a CTER VI level (technician)

Apr 2011 INAF two years Post-doc fellowship programme 2010 assignment for the development of *'A new software package for the analysis of Adaptive Optics images with complex and variable Point Spread Function'*

Gen 2010 Two years research grant at the Astronomy Department of the Alma Mater Studiorum Bologna University on an advanced study, optimization and specification of the wavefront sensor for the multi-conjugate adaptive optics module of the E-ELT telescope

Dec 2009 Special mention national award 'Giampietro Puppi' for young researchers, II edition

Mar 2009 PhD in Astronomy, XXI ciclo, at the Astronomy Department of the Alma Mater Studiorum Bologna University after the defense of the thesis: *'MCAO for Extremely Large Telescopes: the cases of LBT and E-ELT'*

Gen 2009 One year research grant at the Astronomy Department of the Alma Mater Studiorum Bologna University on the design and analysis of a Laser Guide Stars wavefront sensor for the multi-conjugate adaptive optics module for the E-ELT telescope

Feb - June 2008 Four months grant called 'Programma Marco Polo' at the Max Plank Institut fuer Astronomie of Heidelberg (Germany), funded by the Alma Mater Studiorum Bologna University for the training of young researchers abroad

Gen 2006 Admission to the PhD course in Astronomy of the Alma Mater Studiorum Bologna University with the three years granting funded by the University

July - Sept 2005 Ten weeks Summer Studentship at the Large Binocular Telescope (LBT; Arizona-USA) with the role of technical assistant of the project director, John Hill

July 2005 Degree in Astronomy at the Astronomy Department of the Alma Mater Studiorum Bologna University with vote 110/110 magna cum laude

---

My research activity is focused on the field of astronomical instrumentation, with particular care to the development of adaptive optics systems for large diameter-class telescopes (with diameter $>$ 8m). During my scientific activity I actively participated in the construction of several instruments being involved in different stages of their realization, from the design to the last phases of integration and testing. In particular, my research activity can be summarized as follows:

- Study and numerical modeling of wavefront sensors
- Assembly, integration, alignment and testing (both in laboratory and at the telescope) of complex opto-mechanics systems
- Data analysis software development

During my career, I collaborated with recognized leading figures of this research field both in Italy and abroad. My current activity is carried out mostly in collaboration with the Astronomical Observatory of Bologna (OABo), the Astronomical Observatory of Padova (OAPd), the University of Genova (DIBRIS), the Max Plank Institut fuer Astronomie (MPIA; in Heidelberg) and the European Southern Observatory (ESO; in Garching b. Munchen).

I obtained my **Master Degree in Astronomy** at the University of Bologna on **July 14th 2005** with a thesis devoted to the opto-mechanical integration and testing of two similar wavefront sensors: the 'layer oriented' wavefront sensor for the Multi-Conjugate Adaptive Optics Demonstrator (**MAD**) for the Very Large Telescope (**VLT**), and of the mid-high wavefront sensor (**MHWS**) for **LINC-NIRVANA**, the next-generation interferometer at the Large Binocular Telescope (**LBT**) equipped with an adaptive optics system. For the thesis preparation I spent one year at the **Arcetri (FI) Observatory** under the supervision of **Roberto Ragazzoni**, acquiring **technological and programming skills** working mainly in the optical laboratory. In summer 2005 I spent **ten weeks in Arizona, at the LBT** telescope being awarded of a **summer studentship** with the role of technical assistant of the project director John Hill. During this period I was involved in the commissioning of the **active optics** system of the telescope and in the **first light** of the prime-focus camera **LBC**.

On **November 2005** I **started the PhD** in Astronomy at the University of Bologna with a **three years Postgrad fellowship** of the University, under the supervision of Bruno Marano and Emiliano Diolaiti (INAF-OABO). During the PhD I developed a code to **estimate the performance of a laser guide stars wavefront sensor**. Such a code, written in IDL, has been used for the dimensioning of critical components of a multi-conjugate adaptive optics module (**MAORY**) for the future European Extremely large Telescope (**E-ELT**). In this context I was engaged in the project 'ELT Design Study' funded by the European Community, coordinated by ESO, within the Sixth framework programme (**FP6**) in the work package devoted to the study of new concepts for laser guide stars wavefront sensing. Moreover I worked on the **integration and testing** of some components of **LINC-NIRVANA** with the instrumentation research group at the Astronomical Observatory of Bologna and in collaboration with the Max Plank Institut fuer Astronomie (**MPIA**, Heidelberg) within the '**Programma Marco Polo**' program for the training of young researchers abroad. During her PhD I attended many conferences, workshops and PhD schools presenting works and original results by posters and talks.

The **PhD thesis**, titled ***'MCAO for ELT class telescopes: the cases of LBT and E-ELT'*** and defended on March the 31st 2009, has been awarded with the special mention of the national award **Premio Puppi** for young researchers on December 2009.

After the completion of the PhD, I continued my research activity at the Astronomy Department of the University of Bologna working at the **phase A study of MAORY**, leaded by Emiliano Diolaiti and **successfully concluded on December 2009** with the final conceptual design review at the European Southern Observatory (**ESO**). In 2009 I also took part in the program ***'Preparing for the construction of the European Extremely Large Telescope'***, funded by the Seventh Framework Programme (**FP7**) of the European Community and coordinated by ESO for the development of a **laser guide stars wavefront sensor laboratory prototype**. Through this prototype it was also possible to verify the predictions of the simulations developed during the PhD. .

On **Genuary 2012** I started a two years INAF Post-doc fellowship for the development of *'A new software package for the analysis of Adaptive Optics images with complex and variable Point Spread Function'* at the Padova Observatory with the supervision of Laura Greggio. The subject of the fellowship research proposal was tightly related to the TECNO-

INAF project 2010 leaded by Emiliano Diolati at the Astronomical Observatory of Bologna, ensuring a natural sequel of the previous collaboration.

Since **April 2013** I have signed for a **permanent position** as a technician at **INAF - Ossevatorio Astronomico di Bologna**. The position tasks consist of design, integration, development and use of hardware and software systems for astronomical instrumentation and data analysis, with particular interest in Adaptive Optics.

Scientific Context

Over the last decades an increasing interest has been given to the realization of telescopes having large diameters. Although the astronomical advantages of such facilities are undoubtful, their efficiency is strictly connected to the capability of their adaptive optics systems to compensate the effects of the atmospheric turbulence, that would otherwise strongly limit the performance. Nevertheless, classical adaptive optics has several drawbacks like, for example, the limited number of reference stars suitable for the determination of the wavefront and the vertical extension of the turbulence. The main consequences are the reduction of sky coverage (fraction of the sky where an efficient correction can be achieved) and the small corrected field. The usage of Laser Guide Stars (LGSs) as 'mobile' reference sources partially solves only the sky coverage issue. A very promising solution is given by Multi-conjugate Adaptive Optics (MCAO, Beckers, SPIE 1114, 1989), correcting more than one turbulent layer by means of multiple deformable mirrors. Several MCAO systems are under study to improve the angular resolution of the current and of the future generation large ground-based telescopes (diameters in the 8-40 m range). Up to now, the feasibility of the MCAO techniques has been demonstrated on sky only with the Multi-conjugate Adaptive Optics Demonstrator (MAD) at the Very Large Telescope in March 2007 (Marchetti et Al, SPIE 6272, 2006).
The first MCAO system based on laser guide stars will be the Gemini MCAO System (GeMS) at Gemini-South, Chile (Neichel, SPIE 7736, 2010), and it will see its first light at the beginning of 2011.

Research activity and skills

Study of wavefront sensors
Within the phase A study of the MCAO module for the E-ELT, called MAORY (Diolaiti et al., 2010, SPIE, 7736), I worked, in collaboration with the team of the Astronomical Observatory of Bologna, leaded by Emiliano Diolaiti, on the analysis of the performance of laser guide stars wavefront sensors applied to the ELTs. The artificial reference stars present indeed several drawbacks due to their vertical extent and their finite distance from the telescope. In order to create an artificial star, a laser able to excite the sodium atoms in the mesosphere at an altitude of about 90 km is required. Since the sodium layer has a significant thickness ($\sim$ 10 km), its image looks elongated when observed at a distance $>$ 10 m from the laser launcher. Elongation significantly limits the performance of the commonly used wavefront sensor, therefore highlighting the importance of a detailed treatment of this problem for the development of the adaptive optics module for the 42m-class telescope E-ELT.

- By means of a specifically designed numerical model I completed the study of the dimensioning of some critical components of a Shack-Hartmann wavefront sensor, quantifying the performance in terms of the wavefront error in presence of elongation. The code allows to choose different kinds of input parameters: beside telescope, wavefront and atmosphere characteristics, the sodium layer properties (which appears to actually show a

significant time-variability both in thickness and distribution; Hickson et al., SPIE 7736, 2010) and the geometry of the laser launcher scheme (which affects the elongation on the wavefront sensor detector). This study allows a preliminary dimensioning of wavefront sensors based on laser and natural guide stars for MAORY, including parameters like the minimum laser power, the detector size (Schreiber et al., MNRAS 396, 1513, 2009), the maximum read-out-noise acceptable and the efficiency of different centroid algorithms, taking particular care of the variation of the sodium layer density profile.

- Within the Seventh Framework Programme (FP7) funded by the European Community and coordinated by ESO, I was the scientific responsible of a laser guide star wavefront sensor laboratory prototype for the E-ELT, in collaboration with Matteo Lombini and the instrumentation research group at the Astronomical Observatory of Bologna. Using this prototype we were able to compare the predictions of the numerical models previously developed (Schreiber et al., SPIE 7736, 2010).

- Alternative solutions for the problem of perspective elongation have been also investigated through the design of a new concept of wavefront sensor based on an optical design which overcomes this problem (Schreiber et al. 2008, SPIE, 7015). This project is still in progress.

Assembly, integration, alignment and testing of opto-mechanics systems
Assembly, integration and alignment phase of astronomical complex instrumentation, like for instance adaptive optics systems and sub-systems, requires laboratory experience, manual ability, high precision, but also optical knowledge and programming skills. Each opto-mechanical component have to be assembled and handed with the maximum precision, constantly verifying the fulfillment of the design specifications. During my training I had the opportunity to join in the alignment and integration phase of some components of important adaptive optics system as, for instance, the 'layer oriented' wavefront sensor for MAD (the Multi-Conjugate Adaptive Optics Demonstrator for the VLT), the two infrared test cameras for the adaptive optics commissioning of the Large Binocular Telescope (LBT), the two mid-high wavefront sensors and the post focal warm optics of LINC-NIRVANA (Schreiber et Al, SPIE 7715, 2008) and the laser guide star wavefront sensor laboratory prototype developed at the Astronomical Observatory of Bologna in the framework of FP7.
After the assembly and alignment of opto-mechanical components and of complex systems of them, it is necessary to verify the fulfillment of the performance required to reach a certain goal established by the science drivers. This phase consists on laboratory tests to measure the instrument performance recreating the same conditions as at the telescope by means of dedicated laboratory test setups. In this context I had the opportunity to join the laboratory verification of the 'layer oriented' reconstruction concept with MAD; I took part in the commissioning of LBT active optics on occasion of the first light of the LBC prime focus camera (blu channel); I verified the performance of both the mid-high layer wavefront sensors of LINC-NIRVANA as stand alone units, after the alignment of the sensors to the instrument post focal relay and also in opto-mechanical stress conditions due to the instrument tilt between 0° and 80°.

Data analysis software development
Both opto-mechanical systems verification and laboratory data analysis require a dedicated software tool. Over the last years, I acquired experience in programming with IDL modular

software packages for the laboratory data analysis. In particular I prepared and distributed to the LINC-NIRVANA team a package of procedures and functions useful for the alignment and verification of the post focal relay of the instrument. I also realized a software package for the analysis of the images taken with a laser guide star wavefront sensor laboratory prototype recently realized by the Astronomical Observatory of Bologna. Taking advantage of the gained experience, I continued my collaboration with the Bologna Astronomical Observatory taking part of the TECNO-INAF 2010 project titled 'A dedicated free software to optimize and maximize the scientific output of images from present and future adaptive optics facilities'. The goal of this present project is the development of a software package, based on Starfinder code (Diolaiti et al. 2000, A&AS 147, 335), designed and optimized for the analysis of AO images with complex and spatially variable PSF. In the same context I got a two years Post-doc INAF fellowship at the Astronomical Observatory of Padova with the scientific support of Laura Greggio and the collaboration of Emiliano Diolaiti.

Scientific/Technological projects involvement

During my career I actively participated in the projects listed below:

Multi-Conjugate Adaptive Optics Demonstrator (MAD at VLT) Role: Alignment, integration and testing of the 'Layer Oriented' concept.

LINC-NIRVANA (LBT) Role: Alignment, integration and testing of the two mid-high layer wavefront sensors; alignment and verification of the post focal relay warm optics; preparation of the software package for the alignment procedure and for the verification of the mid-high layer wavefront sensors; flexure tests.

MAORY (E-ELT) participation in the Phase A study of the instrument. Role: numerical modeling of the laser guide stars wavefront sensors; dimensioning of some critical components; research on new wavefront sensor concepts.

FP6 ELT Design Study Role: Study on conventional wavefront sensors applied to ELTs; numerical modeling of wavefront sensors.

FP7 ELT Design Study Role: Verification through a laser guide stars wavefront sensor laboratory prototype of the predictions of the simulations developed during the MAORY Phase A; Development of a software package for the prototype data reduction.

TECNO-INAF 2010 with the Project titled 'Exploiting the adaptive power: a dedicated free software to optimize and maximize the scientific output of images from present and future adaptive optics facilities'. Role: development of a software package based on Starfinder code designed and optimized for the analysis of AO images with complex and spatially variable PSF

Contracts

01/01/2006 - 31/12/2008 PhD fellowship at the Bologna University

01/01/2009 - 31/12/2009 PostGrad fellowship at the Bologna University with the title: 'Design and analysis of a Laser Guide Stars wavefront Sensor for the multi-conjugate adaptive optics module for the E-ELT telescope'

01/01/2010 - 31/12/2011 PostDoc fellowship at the Bologna University with the title: 'Advanced study, optimization and specification of the wavefront sensor for the multi-conjugate adaptive optics module of the E-ELT telescope'

01/01/2012 - 01/04/2013 PostDoc fellowship at the INAF - Osservatorio Astronomico di Padova with the title: 'A new software package for the analysis of Adaptive Optics images with complex and variable Point Spread Functions'

09/04/2013 - ... Permanent Position as a technician at the INAF - Osservatorio Astronomico di Bologna

Didactics

As doctoral student, in **AA 2007-10** I trained graduate students in the course of **Astronomical Optics** (teacher B. Marano) in the Astronomy degree course of the University of Bologna. Into this course, I held recitations and laboratory training. I also held a tutorial for the usage of Zemax, a ray tracing software widely used for optical design.

During the **AA 2009-2010** I gave support to the Optics Lab practice in the same course mentioned above.

On December 3rd **2008**, I held a lesson titled ***'Adaptive Optics in the ELT epoch'*** within the 4th edition of the PhD school in Astronomy lessons of the year 2008.

In **AA2010-11** I had a grant by the University as **tutor** in the Optics Lab associated with the **Astronomical Optics** course.

Conferences and workshops

26 - 31 May 2013:	*'AO4ELT3'* Firenze, Italia
25 Feb - 1^{st} Mar 2013:	*'Shaping E-ELT Science and Instrumentation'* Garching bei Munchen, Germany
4-5 December 2012:	*'Real Time Control for Adaptive Optics Workshop 2012'* Garching bei Munchen, Germany
1-6 July 2012:	*'Come massimizzare il ritorno scientifico di LBT'* Amsterdam, Netherlands
26-27 October 2011*:	*'Come massimizzare il ritorno scientifico di LBT'* Osservatorio Astronomico di Padova, Italy
25 - 30 September 2011:	*'AO4ELT2'* Victoria, Canada
20 May 2011:	*'AO @ LBT'* Arcetri, Firenze, Italy
27 June - 2 July 2010:	*'Astronomical Telescopes and Instrumentation 2010'* San Diego, California, USA
22 - 26 June 2009:	*'AO4ELT'* Paris, France
23 - 28 May 2008*:	*'Astronomical Telescopes and Instrumentation 2008'* Marseille, France
12 - 13 Dec 2007*:	*'LGS for ELT'* ESO, Garching bei Munchen, Germany
17 - 20 Apr 2007:	*LI Congresso Nazionale della Società Astronomica Italiana* Firenze, Italy
27 Nov - 1 Dec 2006:	*'European Extremely Large Telescope'* Marseille, France
27 Nov - 1 Dic 2006:	*'AO at the LBT: Upgrades and Their Science Drivers'* Firenze, Italy
30 - 31 Oct 2006:	*'Astronomical Telescopes and Instrumentation 2006'* Orlando, Florida, USA
14 - 15 May 2005:	*'RTN-AO ELT'* ONERA, Chatillon Cedex, Paris, France

* Participation as a speaker

Courses and schools of astrophysics

Oct - Nov 2010: Course on PLC programming
duration: 60 hours

Aug 2007: *8th Summer school in Adaptive Optics 2007*
Univesity of California Santa Cruz
Santa Cruz, California, USA

May 2007: National school of astrophysics
'Pulsar and compact objects - Science with ALMA'
Cagliari

Oct 2006: National school of astrophysics
'Galaxies Clusters -Astrophysical Plasma'
SISSA, Trieste

May 2006: National school of astrophysics
'Galactic dynamic - Active Galactic Nuclei'
Bertinoro, Forlì

It is noteworthy that the technological research activity usually produces a reduced amount of publications in the usual international astrophysical journals. In particular:
It is internationally recognized that the SPIE conferences represent the most challenging benchmark for new instrumental proposals, which are reviewed in that context by a wide community of experts. **SPIE** papers are thus considered the most appropriate - and de facto peer reviewed - presentations of new techniques in astronomy.

Refereed publications

1. W. Gässler, C. Arcidiacono, S. Egner, T.M. Herbst, D. Andersen, H.Baumeister, P. Bizenberger, H. Boehnhardt, F. Briegel, M. Kürster, W. Laun, L. Mohr, B. Grimm, H.-W. Rix, R.-R. Rohloff, R. Soci, C. Storz, W. Xu, R. Ragazzoni, P. Salinari, E. Diolaiti, J. Farinato, M. Carbillet, **L. Schreiber**, et Al, *"LINC-NIRVANA: MCAO toward Extremely Large Telescopes"*, C.R. Physique 6, 1129-1138, 2005
   DOI: 10.1016/j.crhy.2005.11.005

2. **L. Schreiber**, I. Foppiani, C. Robert, J-M Conan, E. Diolaiti, M. Lombini, *"Laser Guide Stars for Extremely Large Telescopes: Efficency of centroid algorithms in Shak-Hartmann Wavefront Sensor"*, MNRAS 396, 1513-1521, 2009
   DOI: 10.1111/j.1365-2966.2009.14797.x

3. C. Robert, J-M Conan, D. Gratadour, **L. Schreiber** and T. Fusco, *"Tomographic wavefront error using multi-LGS constellation sensed with Shack-Hartmann wavefront sensors"*, JOSA 27, 11, A201-A2015, 2010
   DOI: 10.1364/JOSAA.27.00A201

4. I. Foppiani, J. M. Hill, M. Lombini, G. Bregoli, G. Cosentino, E. Diolaiti, T. M. Herbst, G. Innocenti, D. Meschke, D. L. Miller, R. Rohloff, **L. Schreiber**, *"An instrument for commissioning the active and adaptive optics of modern telescopes: the Infrared Test Camera for the Large Binocular Telescope"*, Experimental Astronomy, (in press)
   DOI: 10.1007/s10686-011-9229-2

5. X. Zhang, W. Gaessler, A. R. Conrad, T. Bertram, C. Arcidiacono, T. M. Herbst, M. Kuerster, P. Bizenberger, D. Meschke, H-W. Rix, C. Rao, L. Mohr, F. Briegel, F. Kittmann, J. Berwein, J. Trowitzsch, **L. Schreiber**, R. Ragazzoni, and E. Diolaiti, *"First laboratory results with the LINC-NIRVANA high layer wavefront sensor"*,Opt. Express 19, 16087-16095, 2011
   DOI: http://dx.doi.org/10.1364/OE.19.016087

6. X. Zhang,C. Arcidiacono, A. R. Conrad, T. M. Herbst, W. Gaessler, T. Bertram, R. Ragazzoni, **L. Schreiber**, E. Diolaiti, M. Kuerster, P. Bizenberger, D. Meschke, H-W. Rix, C. Rao, L. Mohr, F. Briegel, F. Kittmann, J. Berwein and J. Trowitzsch, *"Calibrating the interaction matrix for the LINC-NIRVANA high layer wavefront sensor"*, Opt. Express 20 Issue 7, 8078-8092, 2012
   DOI: http://dx.doi.org/10.1364/OE.20.008078

7. R. Hofferbert et Al, *"LINC-NIRVANA for the large binocular telescope: setting up the world's largest near infrared binoculars for astronomy"*, Optical Engineering 52(8), 081602-1/081602-14, 2013

SPIE publications

8. J. Farinato, R. Ragazzoni, C. Arcidiacono, G. Gentile, E. Diolaiti, I. Foppiani, M. Lombini, **L. Schreiber**, et Al,*"The MCAO wavefront sensing system of LINC-NIRVANA: status report"*, Adaptive Optics Systems II, SPIE Proc, 6272, 2006
DOI: 10.1117/12.673083

9. M. Lombini, I. Foppiani, E. Diolaiti, J. Farinato, R. Ragazzoni, G. Bregoli, C. Ciattaglia, G. Cosentino, G. Innocenti, **L. Schreiber** et Al, *"Integration, testing and laboratory characterization of the mid-high layer wavefront sensor for LINC-NIRVANA"*, Adaptive Optics Systems II, SPIE Proc., 6272, 2006
DOI: 10.1117/12.671600

10. **L. Schreiber**, M. Lombini, I. Foppiani, E. Diolaiti et Al, *"An optical solution to the LGS spot elongation problem"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.789390

11. **L. Schreiber**, M. Lombini, I. Foppiani et Al, *"Integration of the Mid-High Wavefront Sensor to the Linc-Nirvana post-focal relay"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.789486

12. E. Diolaiti, J-M. Conan, I. Foppiani, M. Lombini, C. Petit, C. Robert, **L. Schreiber**, et Al, *" A preliminary overview of the multiconjugate adaptive optics module for the E-ELT"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.789604

13. C. Arcidiacono, M. Lombini, R. Ragazzoni, J. Farinato, E. Diolaiti, A. Baruffolo, P. Bagnara, G. Gentile, **L. Schreiber** et Al, *"Layer oriented wavefront sensor for MAD on sky operations"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.791780

14. J. Farinato, R. Ragazzoni, C. Arcidiacono, G. Gentile, A. Brunelli, V. Viotto, E. Diolaiti, I. Foppiani, M. Lombini, **L. Schreiber**, et Al, *"The multiple field-of-view layer-oriented wavefront sensing system of LINC-NIRVANA: two arcminutes of corrected fi eld using solely natural guide stars"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.790401

15. M. Lombini, I. Foppiani, **L. Schreiber**, E. Diolaiti, *"Preliminary design of the post focal relay of the MCAO module for the E-ELT"*, Adaptive Optics Systems II, SPIE Proc., 7015, 2008
DOI: 10.1117/12.788921

16. M. Lombini, G. Bregoli, G. Cosentino, I. Foppiani, **L. Schreiber**, E. Diolaiti, *"Prototype of a laser guide stars wavefront sensor for E-ELT: design and integration"* Adaptive

Optics Systems II, SPIE Proc., 7736, 2010
DOI: 10.1117/12.857975

17. **L. Schreiber**, M. Lombini, E. Diolaiti, I. Foppiani, G. Cosentino, G. Bregoli, C. Robert, J-M Conan, E. Marchetti, *"Prototype of a laser guide stars wavefront sensor for E-ELT: test results"*, Adaptive Optics Systems II, SPIE Proc., 7736, 2010
DOI: 10.1117/12.857975

18. E. Diolaiti, J-M. Conan, I. Foppiani, E. Marchetti, A. Baruffolo, M. Bellazzini, P. Ciliegi, M. Lombini, C. Petit, C. Robert, **L. Schreiber**, G. Cosentino, V. Biliotti, G. Bregoli, T. Fusco, N. Hubin, S. C. Meimon, J-F. Sauvage, *"Conceptual design of the multi-conjugate adaptive optics module for the European Extremely Large Telescope"*, Adaptive Optics Systems II, 7736, SPIE Proc., 2010
DOI: 10.1117/12.857634

19. I. Foppiani, E. Diolaiti, M. Lombini, A. Baruffolo, V. Biliotti, G. Bregoli, G. Cosentino, B. Delabre, N. Hubin, E. Marchetti,**L. Schreiber**, *"System overview of the multiconjugated adaptive optics RelaY for the E-ELT"*, Adaptive Optics Systems II, SPIE Proc., 7736, 2010
DOI: 10.1117/12.858128

20. V. Viotto, R. Ragazzoni, C. Arcidiacono, M. Bergomi, A. Brunelli, M. Dima, J. Farinato, G. Gentile, D. Magrin, G. Cosentino, E. Diolaiti, I. Foppiani, M. Lombini, **L. Schreiber**, T. Bertram, P. Bizenberger, F. De Bonis, W. Gässler, T. M. Herbst, M. Kuerster, L. Mohr, R-R. Rohloff, *"A very wide-field wavefront sensor for a very narrow-field interferometer"*, Adaptive Optical and Infrared Interferometry II, SPIE Proc., 7734, 2010
DOI: 10.1117/12.857353

21. P. Ciliegi, A. La Camera, S. Antoniucci, G. Desidera, M. Bertero, P. Boccacci, M. Carbillet, E. Diolaiti, I. Foppiani, M. Lombini, D. Lorenzetti, B. Nisini, **L. Schreiber**, *"Analysis of LBT LINC-NIRVANA simulated images with the software package AIRY-LN"*, Optical and Infrared Interferometry II, SPIE Proc., 7734, 2010
DOI: 10.1117/12.856951

22. T. Bertram, C. Arcidiacono, J. Berwein, P. Bizenberger, F. Briegel, E. Diolaiti, J. Farinato, W. Gässler, T. M. Herbst, R. Hofferbert, F. Kittmann, M. Kürster, R. Ragazzoni, **L. Schreiber**, J. Trowitzsch and V. Viotto, *"The MCAO systems within LINC-NIRVANA: control aspects beyond wavefront correction"*, Adaptive Optics Systems II, SPIE Proc., 7736, 2010
DOI: 10.1117/12.857097

23. E. Diolaiti, **L. Schreiber**, I. Foppiani, M. Lombini, *"Dual-channel multiple natural guide star wavefront sensor for the E-ELT multi-conjugate adaptive optics module"*, Adaptive Optics Systems III, SPIE Proc., vol 8447., 2012
DOI: 10.1117/12.927091

24. M. Lombini, I. Foppiani, **L. Schreiber**, E. Diolaiti, G. Bregoli, G. Cosentino, *"Design of the multiple Laser Guide Stars wavefront sensor prototype for the EELT"* Adaptive

Optics Systems III, SPIE Proc., vol 8447., 2012
DOI: 10.1117/12.926122

25. **L. Schreiber**, E. Diolaiti, A. Sollima, C. Arcidiacono, M. Bellazzini, P. Ciliegi, R. Falomo, I. Foppiani, L. Greggio, B. Lanzoni, M. Lombini, P. Montegriffo, E. Dalessandro, D. Massari, *"Developing a new software package for PSF estimation and fitting of Adaptive Optics images"*, Adaptive Optics Systems III, SPIE Proc., vol 8447., 2012
DOI: 10.1117/12.926900

26. X. Zhang, A. R. Conrad, D. Meschke, T. Bertran, T. M. Herbst, C. Arcidiacono, P. Bizenberger, W. Gaessler, **L. Schreiber**, R. Ragazzoni, M. Kuerster, F. De Bonis, L. Mohr, J. Farinato, E. Diolaiti, H.-W. Rix, C. Rao; F. Briegel, F. Kittmann, J. Berwein, J. Trowitzsch, M. Brangier, *"The LINC-NIRVANA high layer wavefront sensor laboratory experiment: Progress report"*, Adaptive Optics Systems III, SPIE Proc., vol 8447., 2012
DOI: 10.1117/12.926304

Conference Proceedings

27. I. Foppiani, E. Diolaiti, M. Lombini, A. Baruffolo, V. Biliotti, G. Bregoli, G. Cosentino, B. Delabre, E. Marchetti, **L. Schreiber**, J-M Conan, S. D'Odorico and N. Hubin, *"MCAO for the E-ELT: preliminary design overview of the MAORY module"*, AO4ELT, Paris , 2009
DOI: 10.1051/ao4elt/201002013

28. M. Lombini, **L. Schreiber**, I. Foppiani, G. Bregoli, G. Cosentino, E. Diolaiti, J-M Conan, and E. Marchetti, *"A prototype of the Laser Guide Stars wavefront sensor for the E-ELT multi-conjugate adaptive optics module"* AO4ELT, Paris, 2009
DOI: 10.1051/ao4elt/201005020

29. E. Diolaiti, J.-M. Conan, I. Foppiani, M. Lombini, E. Marchetti, C. Petit, C. Robert, **L. Schreiber**, et Al, *"Towards the phase A review of MAORY, the multi-conjugate adaptive optics module for the E-ELT"*, AO4ELT, Paris, 2009
DOI: 10.1051/ao4elt/201002007

30. E. Diolaiti, J-M Conan, I. Foppiani, E. Marchetti, A. Baruffolo, M. Bellazzini, G. Bregoli, C. R. Butler, P. Ciliegi, G. Cosentino, B. Delabre, M. Lombini, C. Petit, C. Robert, P. Rossettini, **L. Schreiber**, R. Tomelleri, V. Biliotti, S. D'Odorico, T. Fusco, N. Hubin, S. Meimon, *"The multi-conjugate adaptive optics module for the E-ELT"*, SF2A-2010, p63, 2010
link: http://sf2a.cesr.fr/2010/2010sf2a.conf..0063D.pdf

31. **L. Schreiber**, E. Diolaiti, M. Bellazzini, P. Ciliegi, I. Foppiani, L. Greggio, B. Lanzoni, M. Lombini,*"Handling a highly structured and spatially variable Point Spread Function in AO images"*, AO4ELT2, Victoria (Canada), 2012

32. E. Diolaiti, I. Foppiani, J.-M. Conan, R. C. Butler, R. I. Davies, A. Baruffolo, M. Bellazzini, G. Bregoli, P. Ciliegi, G. Cosentino, B. Delabre, T. Fusco, N. Hubin, M. Lombini, E. Marchetti, C. Petit, C. Robert, **L. Schreiber**,*"E-ELT Multi-Conjugate*

Adaptive Optics module", AO4ELT2, Victoria (Canada), 2012

33. X. Zhang, C. Arcidiacono, T. Bertram, T. M. Herbst, A. R. Conrad, W. Gaessler, **L. Schreiber**, P. Bizenberger, D. Meschke, M. Kuerster, J. Berwein, F. De Bonis, R. Ragazzoni, H.-W. Rix, C. Rao, L. Mohr, F. Briegel, F. Kittmann, J. Trowitzsch, J. Farinato, and E. Diolaiti,*"Natural Guide Star Acquisition for LINC-NIRVANA's MCAO systems"*, AO4ELT2, Victoria (Canada), 2012

34. P. Ciliegi, E. Diolaiti, A. Baruffolo, M. Bellazzini, G. Bregoli, C.R. Butler, J.M. Conan, G. Cosentino, I. Foppiani, M. Lombini, E. Marchetti, C. Petit, C. Robert, **L. Schreiber**, V. Biliotti, S.D'Odorico, T. Fusco, and N. Hubin, *"E-ELT Multi-Conjugate Adaptive Optics module: image quality performance"*, Mem. S.A.It, Vol. 83, 1151, 2012 Bibliographic Code: 2012MmSAI..83.1151C

Technical reports

A **design review** is a milestone within a product development process whereby a design is evaluated against its requirements in order to verify the outcomes of previous activities and identify issues before committing to further work. By definition, a review must include persons who are external and independent to the design team, often members of similar projects.

Technical reports submitted and approved as *'design review'*

1. I. Foppiani, E. Diolaiti, P. Ciliegi, M. Bellazzini, J-M. Conan, C. Petit, **L. Schreiber**, C. Robert, F. Assémat, E. Marchetti, M. Lombini, A. Baruffolo, L. Busoni, S. Esposito, *"MAORY System overview and design trade-off"*, E-TRE-INA-528-0004 Issue 1, 03/10/2008, phase 1 review

2. **L. Schreiber**, M. Lombini, *"MAORY Key component specifications and procurement assessment"*, E-SPE-INA-528-0017 Issue 1, 09/11/2009, final review

3. **L. Schreiber**, M. Lombini, E. Diolaiti, *"MAORY Risk assessment"*, E-TRE-INA-528-0002 Issue 2, 09/11/2009, final review

4. I. Foppiani, **L. Schreiber**, E. Diolaiti, *"MAORY System overview and design trade-off"*, E-TRE-INA-528-0004 Issue 2, 09/11/2009 , final review

5. J-M. Conan, T. Fusco, C. Petit, C. Robert, **L. Schreiber**, I. Foppiani, S. Meimon, J-F Sauvage, E. Diolaiti, *"MAORY Adaptive optics system analysis and performance"*, E-TRE-INA-528-0007 Issue 1, 03/10/2008, phase 1 review

6. J-M. Conan, T. Fusco, C. Petit, C. Robert, **L. Schreiber**, I. Foppiani, S. Meimon, J-F Sauvage, E. Diolaiti, *"MAORY Adaptive optics system analysis and performance"*, E-TRE-INA-528-0007 Issue2, 09/11/2009, final review

7. I. Foppiani, G. Cosentino, **L. Schreiber**, E. Diolaiti, *"MAORY Thermal analysis and cryogenic design"*, E-TRE-INA-528-0012 Issue 1, 09/11/2009, final review

8. I. Foppiani, M. Lombini, E. Diolaiti, G. Bregoli, G. Cosentino, **L. Schreiber**,*"MAORY Breadboard and prototype test reports"*, E-TRE-INA-528-0013 Issue 1, 09/11/2009, final review

9. I. Foppiani, E. Diolaiti, P. Ciliegi, M. Bellazzini, J-M. Conan, C. Petit , **L. Schreiber**, C. Robert, F. Assémat, E. Marchetti, M. Lombini, A. Baruffolo, S. Meimon, G. Cosentino, V. Biliotti, *"MAORY Phase A study Status at mid-term progress meeting"*, E-TRE-INA-528-0021 Issue 1, 13/07/2009, mid-term review

10. M. Lombini, G. Cosentino, E. Diolaiti, I. Foppiani, R. Tomelleri, P Rossettini, G. Bregoli, T. Herbst, R Rohloff, G. Innocenti, D. Meschke, **L. Schreiber**, *"AO Test Camera Design Review: Optical and Mechanical design, optics integration and alignment"*, 609g002 Issue b, 21/08/2008, final review

Other technical reports

11. C. Arcidiacono,M. Lombini, **L. Schreiber**, J. Farinato, R. Ragazzoni,E. Diolaiti, *"Layer Oriented WFS Preliminary Acceptance 1 in Arcetri"*, OWL-TRE-INA-60000-0173-PAE1-MADLOWFS-ARCETRI, 04/07/2005

12. **L. Schreiber**, I. Foppiani, M. Lombini, E. Diolaiti, *"Centroid algorithms performance with elongated LGS spots"*, ELT-TRE-INA-09400-0006, 04/02/2008

13. J-M. Conan, T. Fusco, C. Petit, C. Robert, L. Schreiber, I. Foppiani, S. Meimon, J-F. Sauvage, E. Diolaiti, *"MAORY Final report of the MCAO system analysis"*, EFP7-TRE-ONE-09500-0002 Issue 1, 5/02/2010

14. **L. Schreiber**, G. Bregoli, G. Cosentino, E. Diolaiti, I. Foppiani, M. Lombini, C. Robert, *"MAORY Test report of the LGS WFS prototype"*, E-FP7-TRE-INA-09500-0004 Issue 1, 16/06/2010

15. M. Lombini, I. Foppiani, E. Diolaiti, G. Bregoli, G. Cosentino, J.-M. Conan, **L. Schreiber**, *"Design Report of the LGS WFS Prototype"*, E-ELT Prep WP9-D31 Issue 1, 19/12/2008

16. I. Foppiani, **L. Schreiber**, E. Diolaiti E., J-M. Conan, *"MAORY Advanced straw-man design of the MCAO module"*, EFP7-TRE-INA-09500-0003 Issue 1, 16/02/2010

17. **L. Schreiber**, M. Lombini, I. Foppiani, E. Diolaiti, F. De Bonis, *"LINC-NIRVANA Mid High layer Wavefront Sensor Hardware Manual"*, LN-INAFB-MAN-AO-001, 28/01/2011

18. **L. Schreiber**, E. Diolaiti, M. Lombini, *"Mid High layer Wavefront Sensor AIT Plan"*, LN-INAFB-TN-AIT-002, 23/03/2011

19. **L. Schreiber**, E. Diolaiti, P. Bizenberger, D. Meschke, F. De Bonis, M. Lombini, *"Mid High layer Wavefront Sensor Flexure Test"*, LN-INAFB-TN-AIT-006, 23/03/2011

20. **L. Schreiber**, M. Lombini, I. Foppiani, E. Diolaiti, F. De Bonis, D. Meschke, *"Mid High layer Wavefront Sensor Verification & Acceptance Report"*, LN-INAFB-VER-AO-001, 23/03/2011

21. **L. Schreiber**, P. Bizenberger, *"LINC-NIRVANA FP20 optics Verification & Acceptance Report"*, LN-MPIA-VER-OPT-003, 26/06/2009

Date Signature