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Webinar: Adaptive optics in astronomy and beyond - December 4, 2020

An online conference jointly organized by the Australian National University (ANU, Australia), the Université Paris Sciences et Lettres (PSL, France) and the Università di Padova (UniPadova, Italy)

Background

Adaptive optics (AO) in astronomy emerged in the early 1990s, then developed in the wake of major technological breakthroughs in three key areas: wave front sensing, high-performance real-time calculation and deformable mirrors. These advances were made possible by a close and efficient collaboration between academic institutions and industries.

ANU, PSL and UniPadova are jointly organizing an online conference/workshop to review the history of AO development as well as its latest and near future realizations, with a special emphasis of the role they have themselves played in this evolution over the last three decades.

This online conference will first focus on historical aspects of AO developments, showing how major scientific and technological locks were progressively undone, thanks to international cooperation and to academic-industrial links. It will then present some examples of today's and tomorrow's realizations in AO, both in astronomy and other areas such as medical sciences.

Speakers

Welcoming remarks and introductory words will be provided by:

- **Prof Brian P. Schmidt**, Vice-Chancellor at ANU and Nobel Prize laureate in Physics in 2011
- **Prof Alain Fuchs**, President of Université PSL
- **Prof Fabrizio Dughiero**, Vice-Rector for Innovation at University of Padova

Six leading scientist and researchers from the three institutions will then present the history of AO, recent insights from research and innovative applications of AO to other scientific fields:

- **Marie Glanc**, research engineer in charge of the biomedical activities at LESIA / Observatoire de Paris-PSL.

Photo credit: Laser beams coming out of the European Southern Observatory's Very Large Telescope, located in the Atacama Desert in Chile. © ESO/Gerhard Hüdepohl / Photo published in the National Geographic magazine n° 234, April 2019.

- **Céline d'Orgeville**, professor at the Research School of Astronomy and Astrophysics, ANU, leader of the Laser Guide Star activities at the Advanced Instrumentation and Technology Centre.
- **Roberto Ragazzoni**, Director of the Astronomical Observatory of Padova and member of the Accademia dei Lincei.
- **François Rigaut**, professor and Adaptive Optics Principal Scientist at the Advanced Instrumentation and Technology Centre, Research School of Astronomy and Astrophysics, ANU.
- **Gérard Rousset**, leader of the high angular resolution scientific team at LESIA / Observatoire de Paris-PSL.
- **Valentina Viotto**, researcher at the Italian national institute for Astrophysics (INAF), Observatory of Padova.

Closing remarks will be provided by **Claude Catala**, former President of the Observatoire de Paris-PSL and astrophysicist. Discussions will be moderated by **Damien Gratadour**, associate professor at Observatoire de Paris, PSL and Instrument Scientist at the Research School of Astronomy & Astrophysics, ANU, head of PSL's representative office to Australia.

Attendees are welcome to participate in the moderated discussions that will follow each talk. Questions can also be provided prior to the start of the conference. The conference will be fully recorded.

Date and time
The webinar will be held on Friday, **December 4, 2020**, starting **at 8:00 am Central European Time (CET) = 6:00 pm Australian Eastern Standard Time (AEST)**, and ending at 10:15am CET = 20:15 pm AEST.

Registration & more information
Registration will be free but mandatory at the following link:
https://anu.zoom.us/webinar/register/WN_9_l2EXolQQ-irhjmWCqpOQ

About ANU and ANU's Research School of Astronomy and Astrophysics
The Australian National University (ANU) is located in Australia's capital city, Canberra, and is one of the world's leading research universities and one of the most selective institutions of higher learning globally.

The ANU Research School of Astronomy and Astrophysics seeks to advance the observational and theoretical frontiers of astronomy and astrophysics. The Advanced Instrumentation and Technology at RSAA provides designs and builds astronomical instrumentation for telescopes around the world.

About PSL and the Observatoire de Paris-PSL
Université PSL is a leading French university providing research and education programs in all disciplines including sciences, humanities, management and art. PSL ranked 36th worldwide in the Academic Ranking of World Universities.

Established in 1667, Observatoire de Paris-PSL is a member institution of PSL and a renowned organization dedicated to research and education in astronomy and astrophysics.

About UniPadova and the Observatory of Padova
Founded in 1222, the University of Padova is one of Europe's oldest higher education institution and hosts today more than 65.000 students. It proposes both scientific research and teaching activities in 32 Departments, from the bachelor the Ph.D. level.

The Observatory of Padova is one of the main structures of the National Institute of Astrophysics (INAF). The main activity of the Observatory is to advance research in astronomy and astrophysics.

Program – Adaptive Optics Webinar – December 4, 2020

Timing	Sessions	Speakers
8:00 - 8:05 (CET, Europe) / 18:00 - 18:05 (AEST, Canberra)	**Welcome words**	• **Damien Gratadour,** Moderator • **Alain Fuchs**, President, Université PSL • **Brian P. Schmidt,** Vice-Chancellor, ANU • **Fabrizio Dughiero,** Vice-Rector for Innovation, University of Padova
8:05 - 8:30 (CET) / 18:05 - 18:30 (AEST)	Scene setting **Introduction to Adaptive Optics (AO)**	• **Gérard Rousset,** leader of the high angular resolution scientific team at LESIA / Observatoire de Paris-PSL.
8:30 - 8:50 (CET) / 18:30 - 18:50 (AEST)	Session 1 **Laser Guide Stars for AO: past, present and future**	• **Céline d'Orgeville**, professor at the Research School of Astronomy and Astrophysics, ANU, leader of the Laser Guide Star activities at the Advanced Instrumentation and Technology Centre.
8:50 - 9:10 (CET) / 18:50 - 19:10 (AEST)	Session 2 **The various breeds of AO for astronomy**	• **François Rigaut,** professor and Adaptive Optics Principal Scientist at the Advanced Instrumentation and Technology Centre, Research School of Astronomy and Astrophysics, ANU.
9:10 - 9:30 (CET) / 19:10 - 19:30 (AEST)	Session 3 **AO astronomical systems implementation challenges**	• **Valentina Viotto,** researcher at the Italian national institute for Astrophysics (INAF), Observatory of Padova.
9:30 - 9:50 (CET) / 19:30 - 19:50 (AEST)	Session 4 **Wave-front sensing systems: past, present, future**	• **Roberto Ragazzoni,** Director of the Astronomical Observatory of Padova and member of the Accademia dei Lincei.
9:50 - 10:10 (CET) / 19:50 - 20:10 (AEST)	Session 5 **Adaptive Optics for medical imagery**	• **Marie Glanc,** research engineer in charge of the biomedical activities at LESIA / Observatoire de Paris-PSL.
10:10 - 10:15 (CET) / 20:10 - 20:15 (AEST)	**Closing remarks**	• **Claude Catala,** former President of the Observatoire de Paris-PSL and astrophysicist.

About the speakers

Brian P. Schmidt

Professor Brian Schmidt is the Vice-Chancellor and President of the Australian National University (ANU). He is one of Australia's most eminent scientists. Winner of the 2011 Nobel Prize in Physics, alongside many other academic awards and distinctions, Professor Schmidt spent most of his academic career as an astrophysicist at the ANU Mount Stromlo Observatory and Research School of Astronomy and Astrophysics before becoming Vice-Chancellor. Professor Schmidt received undergraduate degrees in Astronomy and Physics from the University of Arizona in 1989, and completed his Astronomy Master's degree (1992) and PhD (1993) at Harvard University. Under his leadership, in 1998, the High-Z Supernova Search team made the startling discovery that the expansion rate of the Universe is accelerating. Fellow of the Australian Academy of Science, The United States Academy of Science, and the Royal Society, he was made a Companion of the Order of Australia in 2013.

Alain Fuchs

Professor Alain Fuchs is the President of “Université PSL” in Paris. He studied chemistry at EPFL, Lausanne and received his PhD in physical chemistry at the “University Paris-Sud, Orsay” in 1983. After a postdoctoral stay at the University of Edinburgh, he was appointed as a research fellow at the French “Centre National de la Recherche Scientifique” (CNRS). He became Professor of chemistry at “Université Paris-Sud” in 1996 and director of the “École de Chimie-Paris”, a graduate school of chemistry and chemical engineer, in 2006. He was appointed from 2010 to 2017 as the President and CEO of CNRS. He is a fellow of the UK Royal Society of Chemistry, a member of the Academia Europea, a French knight of the Legion of Honor and a laureate of the Gold and Silver Star of the Japanese Order of the Rising Sun. His research activity is devoted to the modelling and theory of fluids confined in nanoporous materials. He is the co-author of 200+ publications with an h-index of 52.

Gérard Rousset

Gerard Rousset has been a Professor at Université de Paris (formerly Université Paris Diderot) and a Researcher at LESIA in Observatoire de Paris – PSL since 2005, after 20 years working at ONERA. His main research field is instrumentation at high angular resolution (HAR) in astronomy based on adaptive optics (AO), high contrast imaging and long baseline interferometry. In terms of instrument developments, he was one of the contributors to the first AO for infrared astronomy (COME-ON, 1986-90), the Principal Investigator (PI) of the first AO system of the VLT at ESO (NAOS, 1997-2002) and more recently co-PI of the Multi-Object AO demonstrator program (CANARY, 2008-18). He is responsible for the LESIA contributions to a number of EU research programs (OPTICON in FP7 & H2020) since 2008. During his career, he has been the supervisor of more than 30 PhD theses in the field of HAR. He was co-recipient of the Alexandre Joannidès Award from the French Science Academy in 2004. Gerard Rousset was the co-founder and the leader of Groupement d'Intérêt Scientifique PHASE in HAR instrumentation, bringing together research teams from Observatoire de Paris, CNRS, ONERA and the Universities Paris Diderot, P. & M. Curie, J. Fourier Grenoble and Aix-Marseille (2006-15). He is currently the leader of the HAR scientific team at LESIA and supervises the activities for the biomedical applications. He was also the co-founder and is now the Director of the Graduate Studies of the Engineering School (EIDD) at Université de Paris.

Céline d'Orgeville

Céline d'Orgeville is a Professor at the Australian National University (ANU) Research School of Astronomy and Astrophysics where she leads Laser Guide Star (LGS) activities undertaken at the Advanced Instrumentation and Technology Centre (AITC) on Mount Stromlo near Canberra. Céline is the LGS AO Group Manager at the Australian Astronomical Optics (AAO)-Stromlo, and the AITC Discovery Priority

Lead. She is also one of two inaugural recipients of an ANU Translational Fellowship aiming to transfer her semiconductor guidestar laser research into the commercial world. Before ANU, Céline worked at the Gemini Observatory where she led the multi-million dollar Gemini laser program, including the design, fabrication and commissioning of the Gemini North and South LGS facilities in Hawaii (1999-2006) and Chile (2007-2011). The Gemini South Multi-Conjugate AO system, GeMS, uses five sodium LGS to probe the atmospheric turbulence above the Gemini South 8-meter telescope. Céline's GeMS LGS Facility has held the record for most sodium guide stars in a LGS asterism since its commissioning in 2011. Céline was the inaugural chair of the RSAA Access and Equity Committee created in 2013. With Nobel Laureate Prof. Brian Schmidt (who became ANU's Vice-Chancellor in 2016) she co-chaired the 2014 edition of the Astronomical Society of Australia (ASA) Women in Astronomy workshop. She has been a steering committee member of the ASA Women in Astronomy (WiA) Chapter, which broadened its remit to become the Inclusion Diversity Equity in Astronomy (IDEA) Chapter in 2016. Céline is also an ANU Ally and a member of the ANU Gender Institute (GI) management committee. Céline holds a Masters degree in Optics & Photonics from Paris XI University and a Masters degree in Optical Engineering from Institut d'Optique Graduate School, Orsay (1997, France).

François Rigaut

Dr Francois Rigaut is a professor at the Australian National University (ANU). He is the Adaptive Optics Principal Scientist at the Advanced Instrumentation and Technology Centre (AAO Stromlo), Research School of Astronomy and Astrophysics. Dr Rigaut has over 30 years of experience and involvement in various Adaptive Optics system for astronomy, from COME-ON, the first successful AO system for astronomy (Rousset et al 1989) to, more recently, being PI of GeMS, the first and only astronomical Laser Guide Star Multi-Conjugate Adaptive Optics system (Rigaut et al 2013). As a PhD Scientist, Project Scientist, AO group head at ESO or the ANU RSAA or AO senior scientist/PI at Gemini, Dr.Rigaut was involved in many AO project and instruments: COME-ON, PUEO, NAOS, MACAO, Altair, Hokupa'a, GeMS, NGS2 and more recently AO systems for applications to Space Situational Awareness. Dr.Rigaut has also been active on the theory of AO: he proposed the concept of Ground Layer Adaptive Optics, which since then has spawned the construction of a few instruments on some of the largest ground based telescope (MMT, VLT, projects for SUBARU and for the future Giant Telescopes –EELT and GMT), and a new Fourier space based approach to estimating AO performance that has spawned a few AO analysis codes (e.g. PAOLA). He is also the author of yao, a Monte Carlo AO simulation code that is regularly used at RSAA and other laboratories in the world to estimate the performance of LGS based AO system. Dr.Rigaut

has authored over 300 papers, most of them in Adaptive Optics or astronomical instrumentation, with over 6000 citations (as per Google Scholar). He has an h-index of 41 and an i-10 index of 113. Dr Rigaut is currently the principal investigator of MAVIS, the visible multi-conjugate system for the ESO VLT, involving a consortium of institutes in Italy, France and Australia.

Valentina Viotto

Valentina Viotto is a researcher at the Italian national institute for Astrophysics (INAF), Observatory of Padova. She graduated in Astronomy at the Padova University, in 2007, and completed her PhD in the same institute in 2012, focusing in AO instrumentation, both applied to Astronomy (LINC-NIRVANA) and to Ophtalmology (a demonstrator for intra-ocular lenses characterization). As a post-doc at INAF-Observatory of Padova, she focused her research in two main fields: space missions for extra-solar planets search/characterization, and AO. Concerning space projects, she performed her duties as the system engineer for the telescope units of CHEOPS, the first S-size mission of ESA, dedicated to the characterization of already known extra-solar planets, and of PLATO, an M-size mission composed by 26 telescopes devoted to the search of new planets orbiting around bright host stars. In the AO field, she took active part in the LINC-NIRVANA instrument AIV. Dr. Viotto also focused her research on the theory of AO, working on the feasibility studies of novel concepts, like the Global Multi-Conjugated AO and the INGOT WFS, in particular writing the relative simulation codes for performance evaluation. She currently is responsible for the Adaptive Optics Module of MAVIS, the next generation MCAO module for VLT, working in the visible band. Since 2011, she has been working as an assistant professor for the course of Laboratory of astrophysics, held by Roberto Ragazzoni, for the master degree program in Astronomy, at the University of Padova. In the last two years, she took over the chair of Applied Optics for the bachelor degree in Astronomy.

Roberto Ragazzoni

Roberto Ragazzoni is from 2018 Director of the Astronomical Observatory of Padova, belonging to the INAF (Istituto Nazionale di Astrofisica) and member of the Accademia dei Lincei, in Rome. He graduated in 1990 in Astronomy and got an Astronomer researcher position in 1992 in Padova and a full professorship in Astronomy as of 2001 at the Astrophysical Observatory of Arcetri in Florence . He has been Research Scholar in 1995 in Tucson, Arizona, at Steward Observatory, Visiting Researcher in San Diego at UCSD in 2000 and Humboldt Scientist, as winner of the Wolfgang Paul Prize at the MPIA in Heidelberg in 2002-2005. He has been active in optical instrumentation and in particular in wide field and adaptive optics instruments. PI of the AO module for the TNG telescope he adopted for that instrument a pyramid WFS, that he invented in 1995. He collaborated to the development of MAD, the WAC onboard ROSETTA, LBC, CHEOPS and PLATO among other projects, often with novel approaches and design. In particular he developed the so-called layer oriented AO system, that have been implemented in MAD an LINC-NIRVANA. He is now working on extending the pyramid concept to Laser Guide Stars with an "ingot-like" WFS and to a whole sky large aperture telescope.

Marie Glanc

Marie Glanc graduated from the Institut d'Optique Graduate School in 1998 and has obtained a PhD in « optics and photonics » in 2002. She holds a CNRS permanent position at LESIA / Observatoire de Paris-PSL as a research engineer since 2006. In charge of the biomedical activities at LESIA, she has been working on translating astronomical high resolution imaging techniques and other top biological imaging techniques to perform in vivo high resolution imaging of tissues (retina, rat cerebellum and cortex). She has been the first in Europe to obtain high resolution AO-assisted images of the living human retina (2001).

More recently, she has been working on the development of a 3D micrometric-scale imager, coupling AO and full-field OCT, or toward implementing AO in a two-photon microscope.

Claude Catala

Doctor in astrophysics, astronomer, polytechnicien (class of 1977), Claude Catala was President of the Paris Observatory from 2011 to 2020. Previously, from 2005 to 2011, he was scientific advisor on astronomy issues at the Ministry of National Education, Higher Education and Research. Claude Catala has been working since 1993 on major international projects in astronomy in space and on the ground. In particular, he took part in the CoRoT mission on the search for exoplanets and the study of the internal structure of stars, and was scientific leader of ESA's PLATO space mission from 2007 to 2012. Deputy Director of the Toulouse Astrophysics Laboratory at the Observatoire Midi-Pyrénées (OMP) from 1999 to 2001, he also chaired the national stellar physics programme at Institut National des Sciences de l'Univers (INSU) of CNRS between 1999 and 2003. Claude Catala has contributed to 177 articles published in international journals. He was awarded the Deslandres Prize in 2008 and the SF2A Prize in 1990 for his research.

Damien Gratadour

Damien holds a PhD in Observational Astronomy from Université Paris-Diderot (2005). He was an Adaptive Optics (AO) fellow, responsible for the last stages of commissioning of the Altair AO system on the Gemini North Telescope in Hawaii (2006) ; and an Instrument Scientist (2007-2008), for GeMS, the Gemini MCAO System, a facility featuring 5 laser guide stars. Since 2008, as Associate Professor at Observatoire de Paris - PSL, Damien has been leading an original research program on high performance numerical techniques for astronomy including modeling, signal processing and instrumentation for large

telescopes. He has been the P.I. of large multi-M€ programs in this field, at the national level as well as internationally. In order to build a full fledged international hub focused on real-time control systems for astronomical instrumentation, Damien has relocated to Australia in 2019, as an instrument scientist at the Australian National University, with the goal of enabling a long term collaboration including several Australian partners and several large Observatories. He has also been appointed as director of the permanent representation office of the PSL University at the ANU, in close collaboration with the Embassy of France, with the goal to foster a number of projects already under way in a variety of disciplinary fields, including astronomy, physics, chemistry, biology, mathematics and social science, both at the ANU and at other Australian higher education institutions.